JANUARY 1988

Mini-MicroSystems®

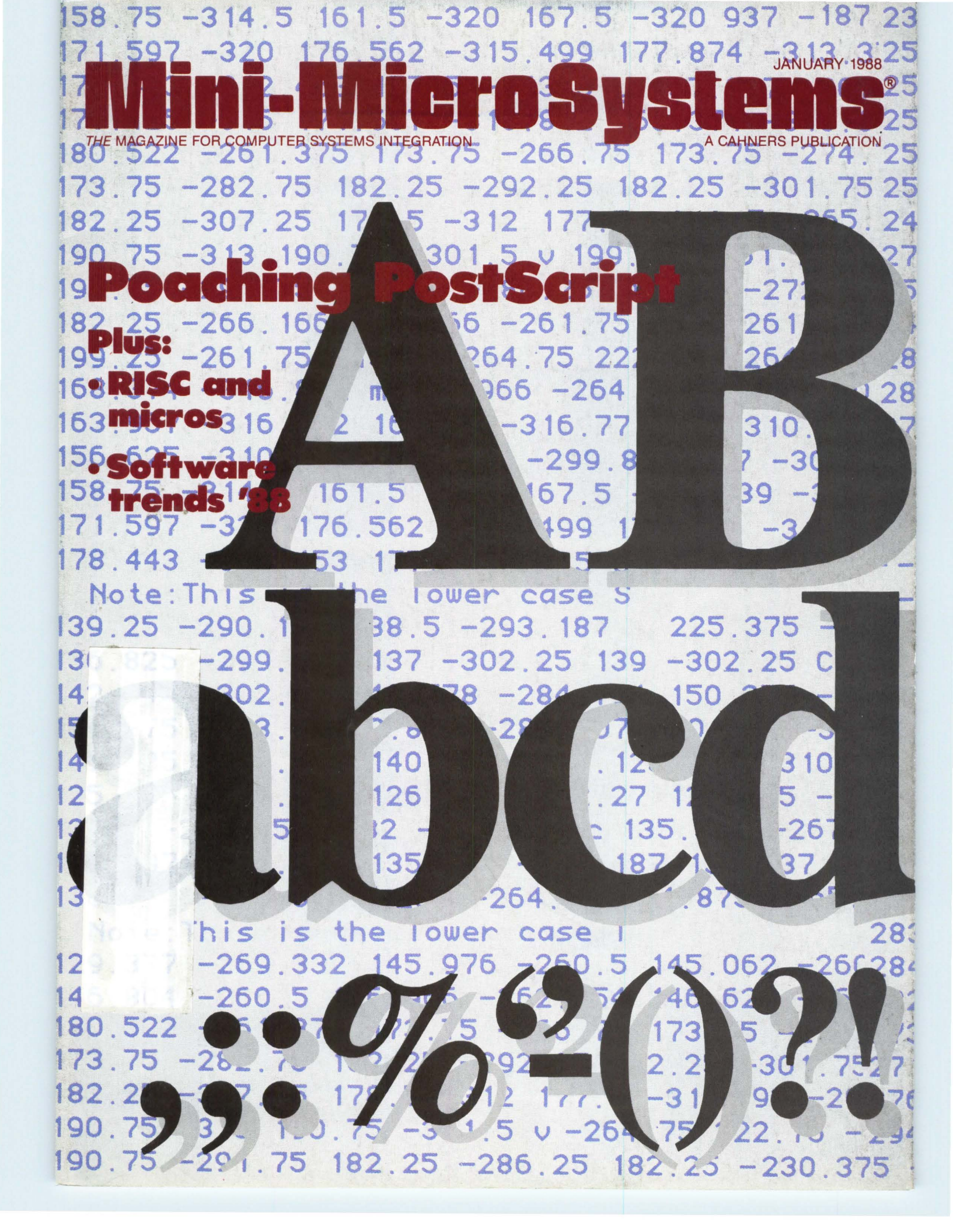
THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

A CAHNERS PUBLICATION

Poaching PostScript

Plus:

- RISC and micros
- Software trends '88



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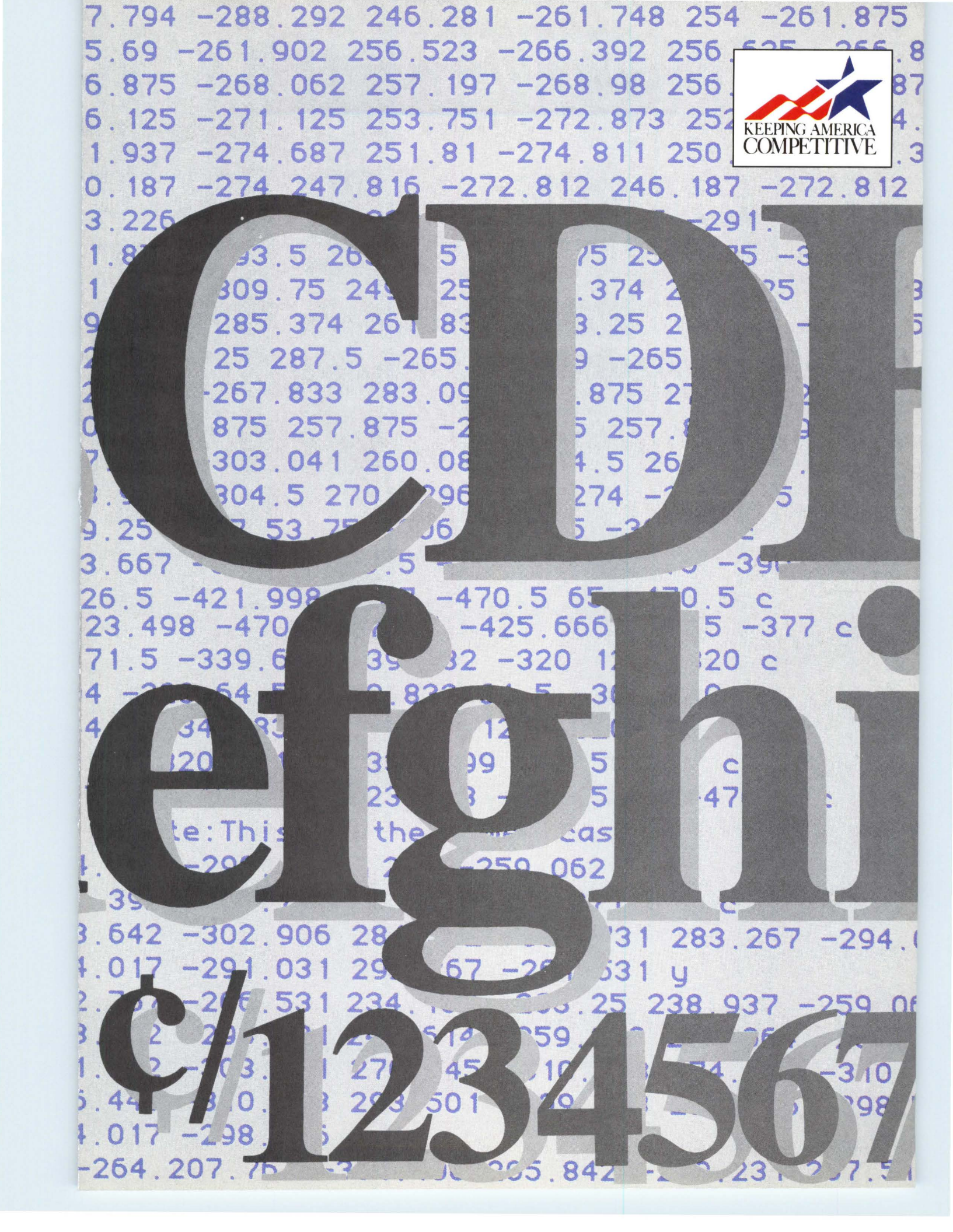
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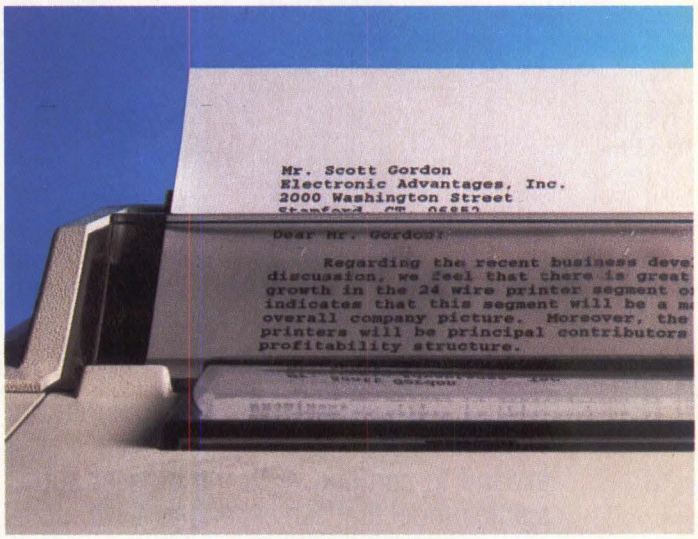

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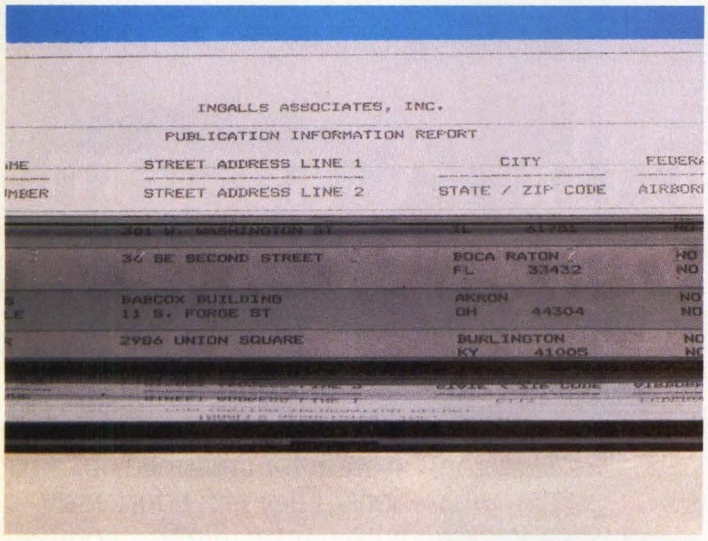

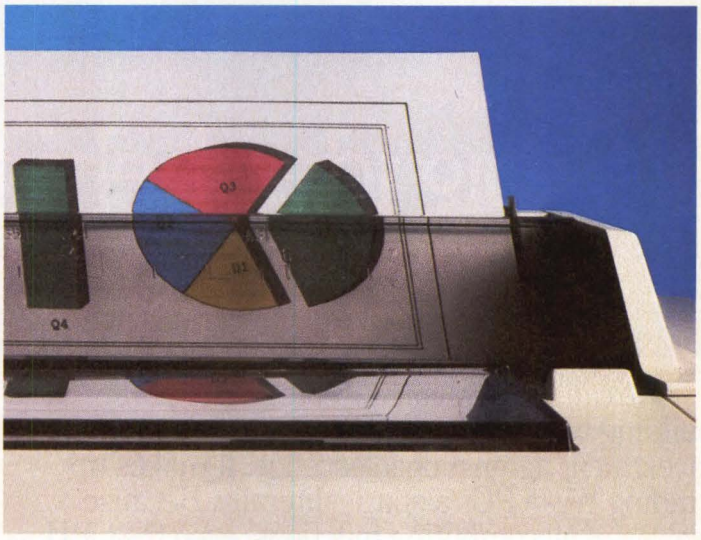

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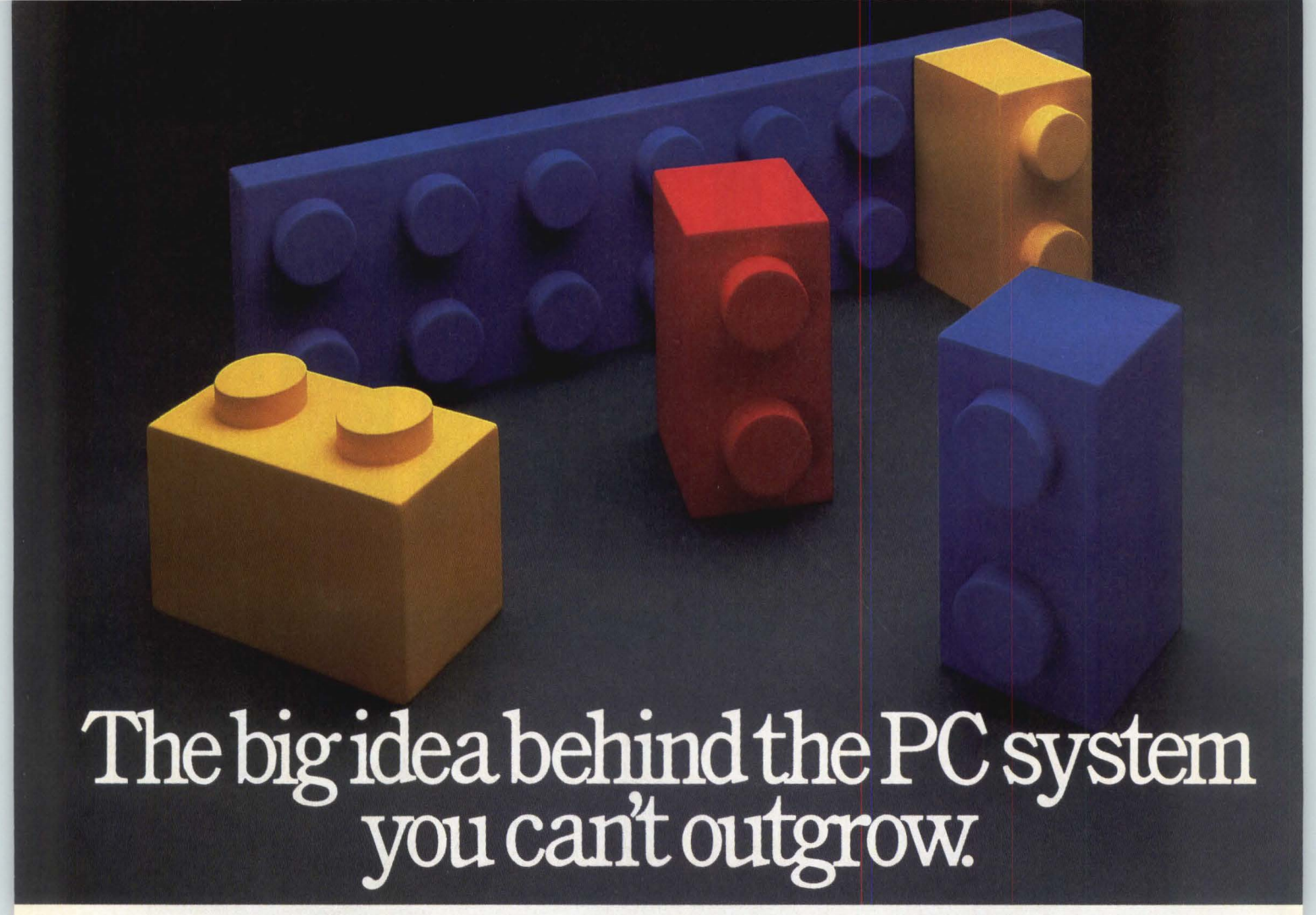

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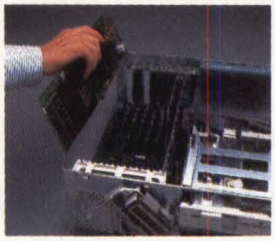

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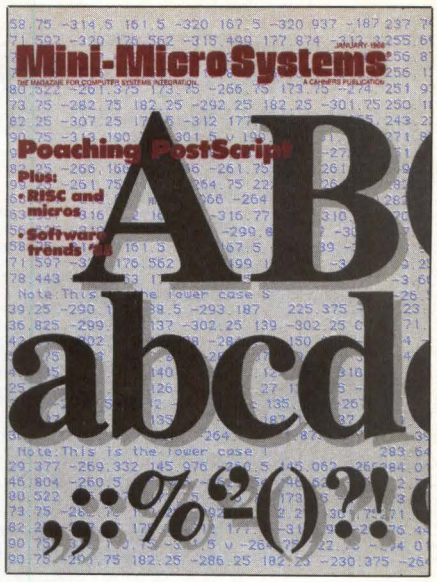

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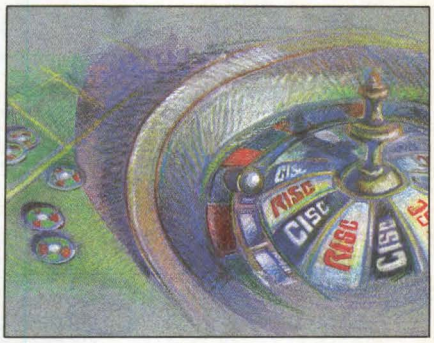
As more vendors field pure RISCs and streamline CISCs, VARs, OEMs and system integrators could realize price/performance breakthroughs.

Users impose standards on interfaces, protocols 65
In the alphabet soup of standards, the winners appear to be OSI for networking, UNIX for application portability and SQL for database interfacing.



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KEEPING AMERICA COMPETITIVE

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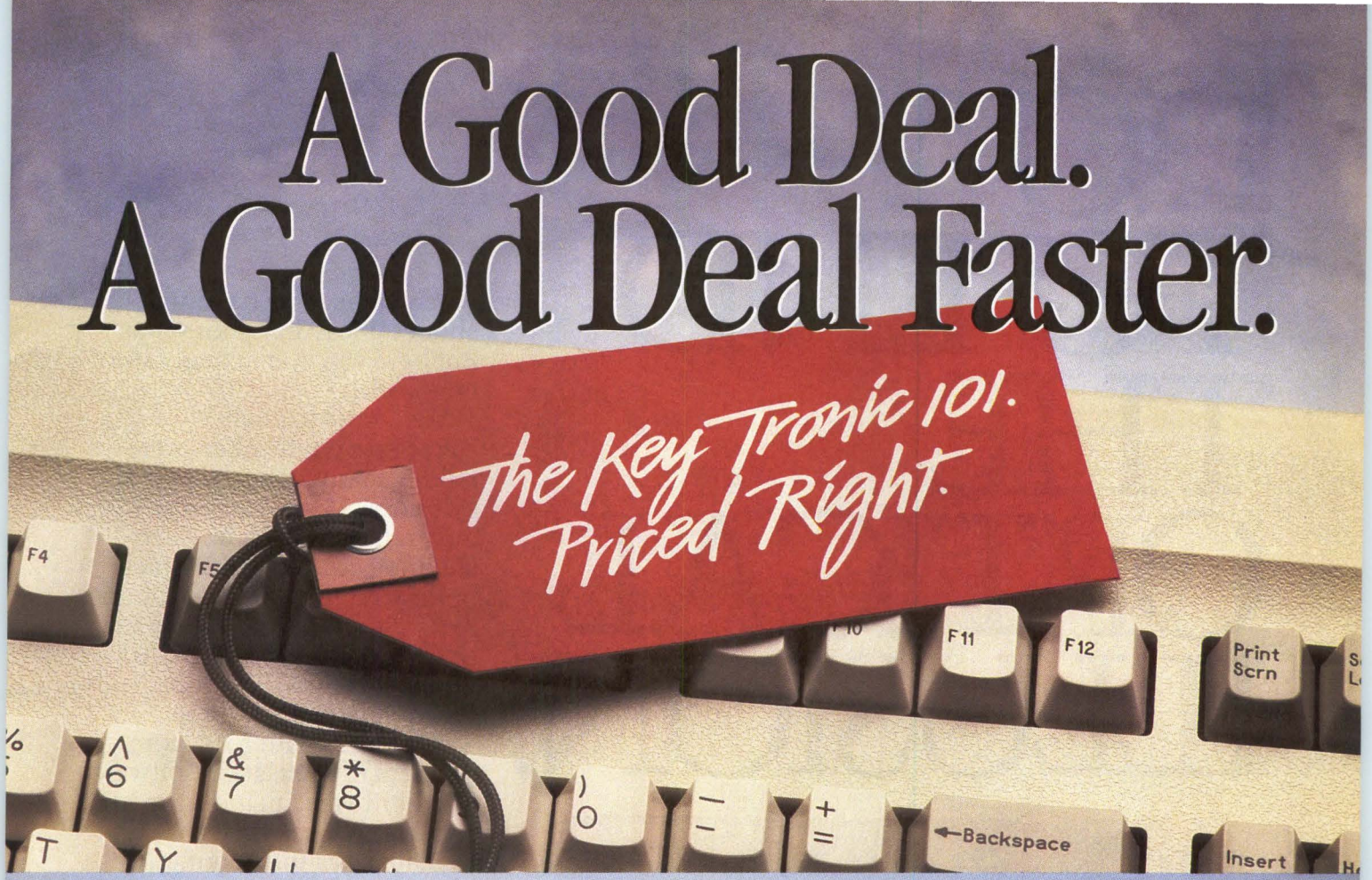

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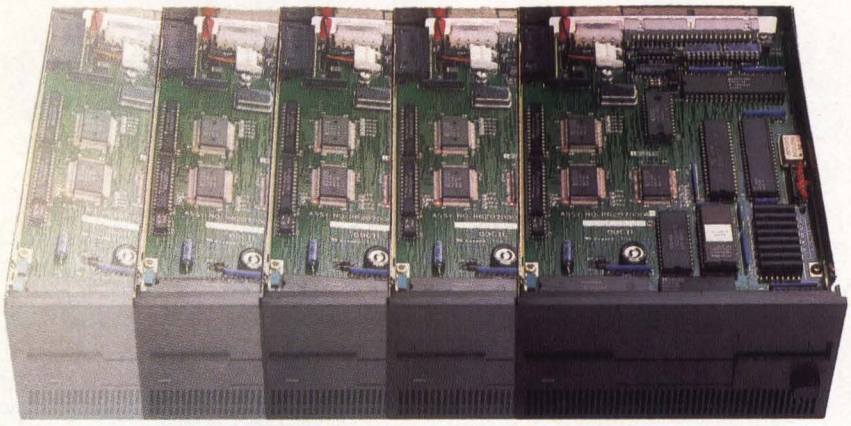

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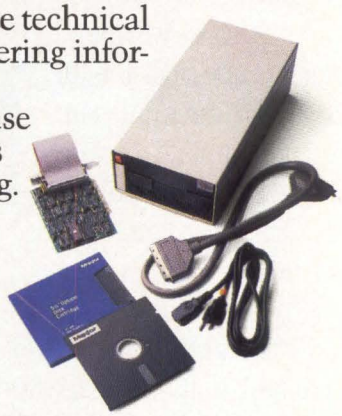

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LETTERS

NOT SO UGLY OR EVIL

Editor's note:

The editorial in the September issue (MMS, "A Blessed Event," Page 9) described the battle over Manufacturing Automation Protocol (MAP), the scheme for connecting equipment in a factory, in terms of a fable. The tongue-in-cheek story was about a prince (General Motors Corp.), a princess (MAP), a powerful sorcerer (Kenneth Olsen, president of Digital Equipment Corp.) and evil gnomes (magazine and newspaper reporters). The editorial described next June's MAP demonstration in Baltimore, the Enterprise Networking Event, as a "Blessed Event" in which the princess will give birth to MAP 3.0. The fable was not kind to the evil gnomes, describing them as professional trouble makers.

To the editor:

I should avoid gnomes, after all this time being involved with the prince and princess described in your September editorial. [But] I think there are a few good and beautiful gnomes that really do try to portray progress objectively and sometimes extremely humorously.

I laughed until I cried at your observations. But they are true.

Also, the evil gnomes will *never* go away. But as long as we have objective gnomes that really want to promote progress (such as *Mini-Micro Systems*), we will live happily ever after.

Mike Kaminski
Manager, MAP Program
General Motors Corp.
Warren, Mich. 48090

To the editor:

It's good to see somebody in the press not take themselves too seriously. So it was a pleasure to read your editorial about next June's Enterprise Networking Event for MAP [Manufacturing Automation Protocol] in Baltimore.

But, in calling the reporters from the magazines and newspapers that cover factory automation "evil and ugly gnomes," you are being too unkind to yourself and your colleagues. I am a technical writer in the aerospace industry. And I can tell you that I know a lot of cute reporters.

But, maybe even more important, you are too unkind because the press has done a lot to keep good sense in the whole MAP mess. The big players certainly have done their best to confuse us. First, we had General Motors throwing its weight around. Next we had Ken Olsen throwing his weight around. Then the MAP Users Group got into the weight-throwing act.

It's all nonsense, of course. It's just a lot of Big Shots grinding axes. We'll get progress in spite of them. Publications like yours help us sort out the important stuff from the silly stuff. So, don't put yourself down.

Shirley Batemann
Portland, Ore. 97205

WRONG NAME

To the editor:

The story, "Coprocessor revs up graphics performance," (MMS, October, Page 70) listed companies who are incorporating Intel [Corp.]'s 82786 chip into products. The list included a reference to our new multipurpose workstation, Viewmate, but erroneously referred to our company as International Software Technology Inc. We request you correctly identify us as International Software Corp.

Hal Abbott
Director of Marketing
International Software Corp.
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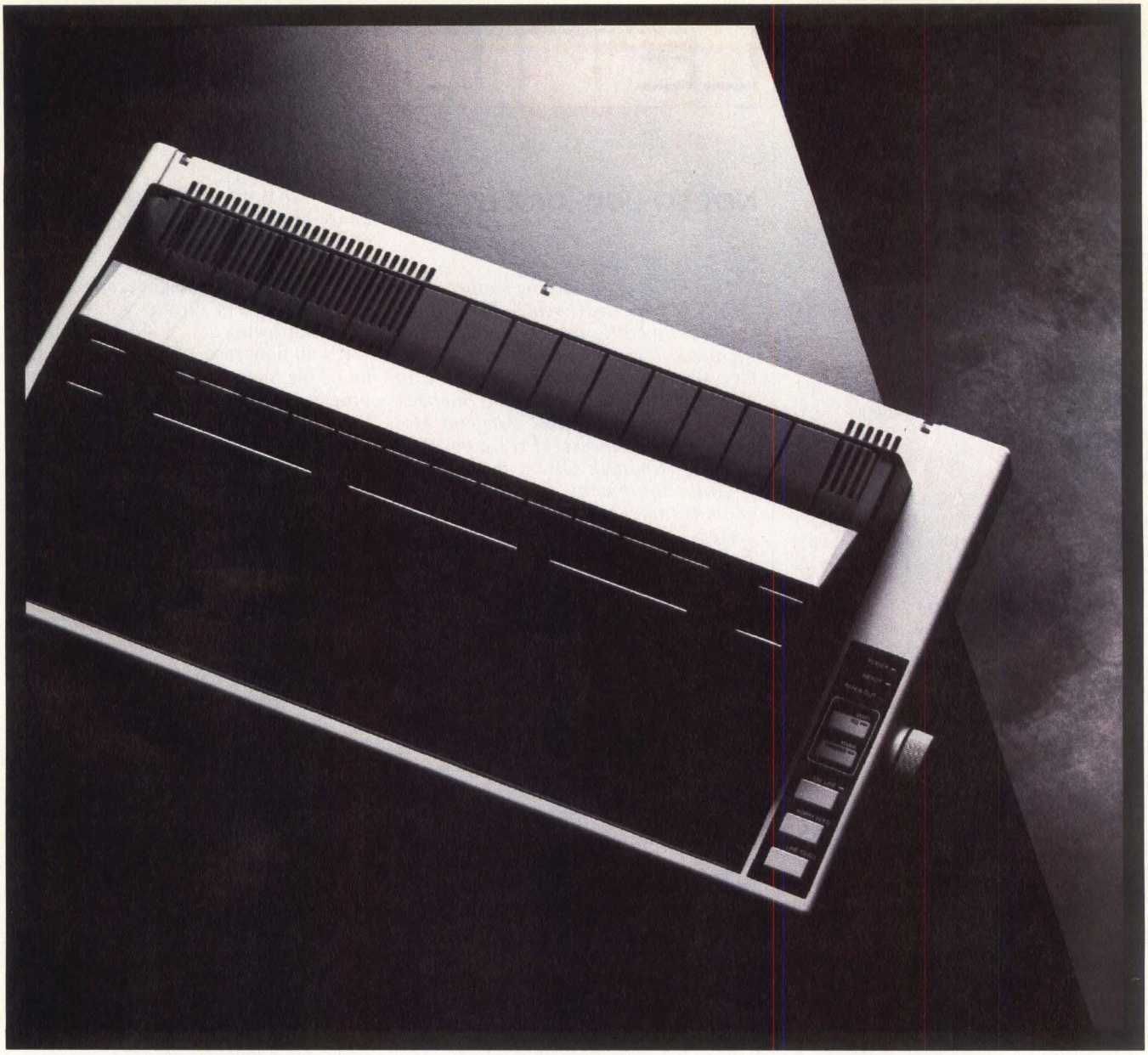
IT'S NOT SO NEW

To the editor:

In "Honeywell Bull Italia readies 'stored-energy' printer," (MMS, August, Page 12), you give the impression this is the first use of stored-energy technology in printhead design.

I am a recently retired employee of AT&T Teletype Corp. The Teletype model 43 line of teleprinters, introduced about 1975, had a printhead which used the stored-energy principle. The model 43 was Teletype's first dot-matrix printer. It was very reliable and quite popular in the 30-cps (characters per second) teleprinter field. The printhead was one of its selling points.

James H. West, Jr.
Wilmette, Ill. 60091



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BREAKPOINTS

MEAN PRICING EXPECTED FOR KOREAN-MADE 3½-INCH WINCHESTER

Kalok Corp. hopes to begin the new year by starting a price war in low-end 3½-inch rigid disk drives. This month the Sunnyvale, Calif., start-up will begin shipping OEM samples of its KL320, a 20M-byte device with an average access time of 40 msec. The company claims the target end-user price is about $150, roughly half the going rate for competing drives. Typical OEM pricing is half of the retail price, but insiders say Kalok will sell the drive in the United States for $100 from Korean manufacturer Oriental Precision Corp. —*Mike Seither*

IMAGEN AUGMENTS LASER PRINTER LINE, ADDS ULTRASCRIPT

This month, Imagen Corp., Santa Clara, Calif., starts shipping two new members of its ImageServer XP laser printer line: the 20-ppm models 5320 and 6320. The 5320 ($26,950) includes a 2,000-sheet input tray and a 1,500-sheet output tray, while the 6320 ($29,950) features duplex printing. Both are compatible with the imPRESS page description language and, in March, will be compatible with Adobe Systems Inc.'s PostScript. Imagen's clone of PostScript, dubbed UltraScript, is based on fonts licensed from Linotype Co. Adding UltraScript to existing ImageServer XP printers will cost from $2,800 to $4,800, depending on the configuration.—*Dave Simpson*

THE CONTROLLER ON DELPHAX'S S3000G DRAWS PRAISE

Printer industry analysts praise the controller on the S3000G ion-deposition printer from Delphax Systems Inc., Randolph, Mass. Delphax began shipping the printer to OEMs this month. Catherine Dingman of CAP International Inc., Marshfield, Mass., says the printer "is Delphax's most sophisticated offering to date in terms of the controller." The raster image processing (RIP) controller incorporates an Intel Corp. 80286 processor and offers 4M bytes of memory. It includes a 3½-inch internal disk drive to accommodate new emulations, fonts and forms. The printer operates at up to 30 ppm at a resolution of 300 by 300 dpi.—*Jim Donohue*

START-UP SETS SIGHTS ON HEWLETT-PACKARD TERMINAL MARKET

Cumulus Technology, Palo Alto, Calif., is taking aim at the third largest market for vendor-specific terminals—the one dominated by Hewlett Packard Co. This month Cumulus plans to ship its $795 HPC, which emulates the HP 2392/A and HP 2394/A and is compatible with HP's 700/9X series of alphanumeric terminals. The Cumulus HPC 15-inch screen displays black characters on white phosphor. It features a 75-Hz refresh rate, a battery-operated clock, 16K bytes of display memory and a "sleep mode" that shuts down an inactive screen. Cumulus, which produces monitors for Unisys Corp. personal computers, also plans a line of Digital Equipment Corp.-compatible ANSI terminals. — *Mike Seither*

CMS INVADES DEC-COMPATIBLE DISK DRIVE MARKET

Armed with an array of four rigid disk subsystems, CMS Enhancements Inc., Tustin, Calif., is invading the DEC-compatible disk drive market. Previously, CMS focused only on personal computers. The new subsystems range from 71M

bytes ($1,900) to 320M bytes ($6,800) and attach to a Digital Equipment Corp. MicroVAX II or MicroPDP-11. The company is also rolling out a variety of DEC-compatible disk subsystems that can be configured with add-in tape back-up units or flexible disk drives in a single enclosure.—*Dave Simpson*

CALCOMP REPLACES MODEL 1041GT WITH MODEL 1023

Shipments begin at the end of this month for CalComp's model 1023 eight-pen plotter, priced at $4,895 (OEM discount, 40 percent at Q100). The plotter replaces the Anaheim, Calif., company's model 1041GT ($5,400). The 1023 plots up to 30 ips with an addressable resolution of 0.0005 inches. It features automatic pen sensing to adjust for pen type, including liquid ball point, fiber and plastic tip. It also automatically loads paper and senses the paper size, from ANSI A (8.5 by 11 inches) to D (24 by 36 inches). Optional 1M-byte ($995) and 2M-byte ($1,450) plug-in buffer cartridges load the job to the plotter, freeing up the workstation computer for other tasks. The 1023 sports dual Motorola Inc. M68000 microprocessors.—*Jim Donohue*

PANASONIC OFFERS ITS FIRST 24-PIN PRINTER

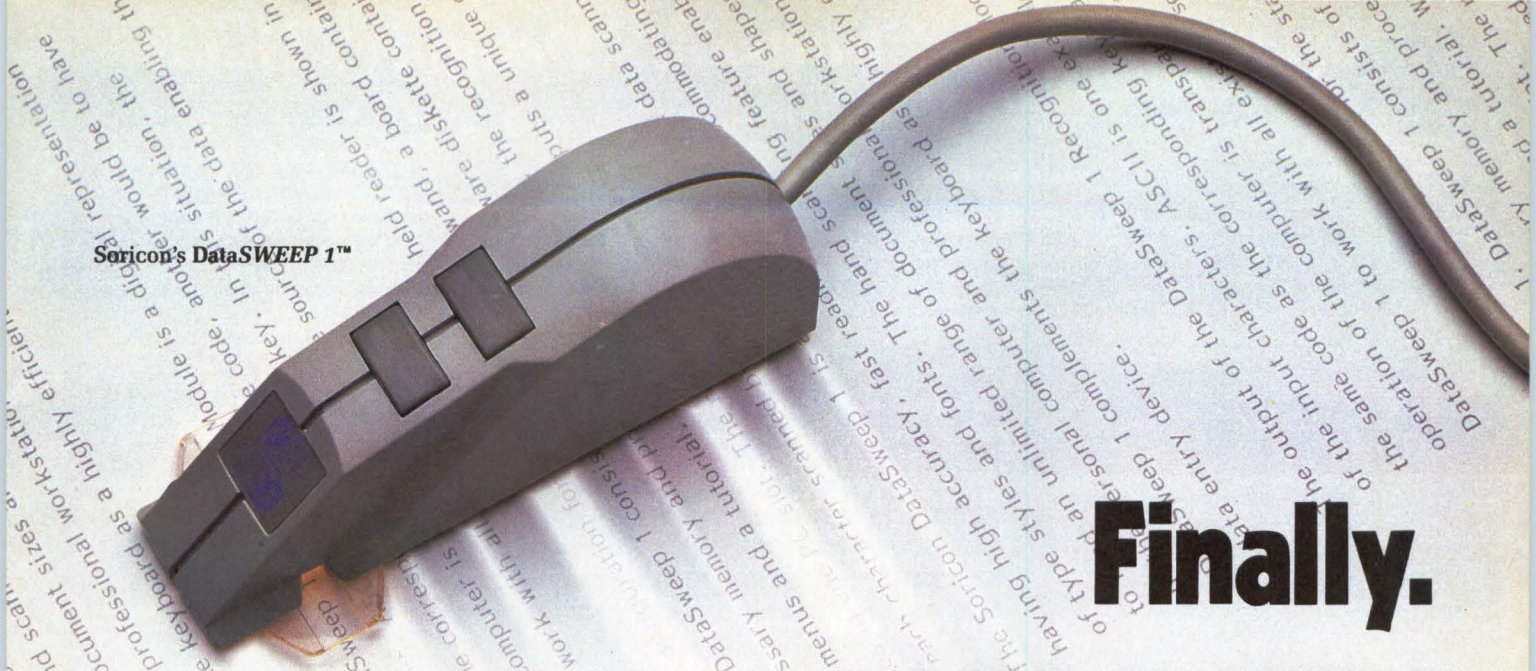
The KX-P1524, Panasonic Industrial Co.'s first 24-pin dot matrix printer, has a wide carriage, a two-year warranty and a retail price of $899. The printer offers three levels of print quality: draft, text and letter. It also supplies four pitch selections for each printing mode: 10, 12, 15 and 17. The printer emulates the Epson Corp. LQ-1500, Diablo 630 and IBM Corp. Pro-printer. The only consumable other than paper is a cartridge-type black nylon ribbon that sells for about $17. The Secaucus, N.J. company says the ribbon will print 3 million impressions.—*Jim Donohue*

STANDARD-TIME SYSTEM GETS NETWORKED VAXS INTO LOCK STEP

System clocks tends to lose time, and for networked computers that can mean lost data or trouble coordinating events. Now Precision Standard Time Inc., Fremont, Calif., has a solution for integrators who want to tie together Digital Equipment Corp. VAX computers over DECnet. Precision's Time Source hardware ($1,495) ties into a single VAX via an RS232 interface and synchronizes the calendar clock to the international time signals broadcast by the National Bureau of Standards. Synchronizing other VAXs with the host requires Precision's Time Server host software and Time Client software for each node. Software prices vary by processor type, ranging from $1,000 (host) and $400 (node) for a VAX 8500 to $250 (host) and $100 (node) for a MicroVAX. — *Mike Seither*

CENTURY DATA SET TO SHIP DEC-COMPATIBLE DISK DRIVES

Look for first-quarter shipments of a series of eight-inch plug-compatible rigid disk drives from Century Data Corp. that will be marketed as replacements for Digital Equipment Corp.'s 14-inch RA81 drives. The new DS (DEC Series) drives from the San Jose vendor have embedded SDI interfaces and are compatible with DEC's UNIbus, Q-bus, VAXBI bus and HSC50/70 cluster controllers. The DS2600 has a formatted capacity of 530M bytes and lists for $14,500. The 716M-byte DS2800 lists for $17,100. Also available in the first quarter are two 14-inch disk-pack versions—the 256M-byte DS300 ($10,500) and the 384M-byte DS400 ($11,700).—*Mike Seither*



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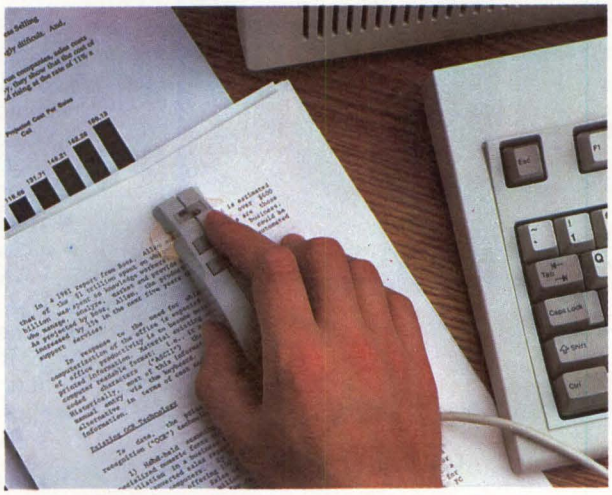

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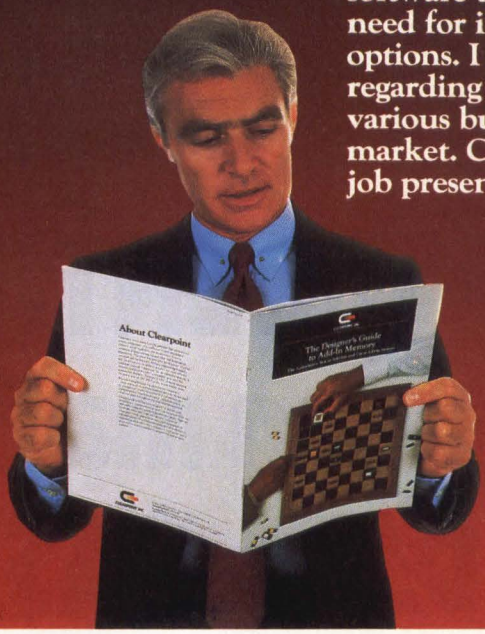

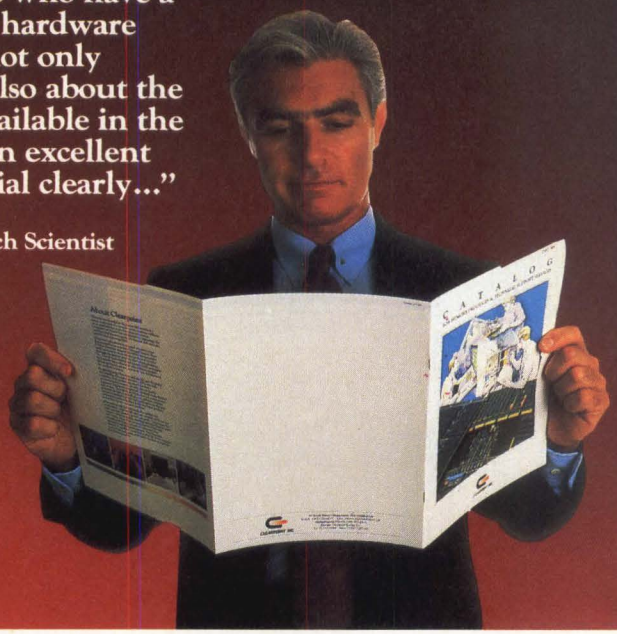

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CIRCLE NO. 12 ON INQUIRY CARD

MICROPROCESSORS

Board builders lead 68030 parade with VMEbus products

Mike Seither, Senior Editor

System integrators have long been enamored of Motorola Inc.'s M68000 family of microprocessors, and for good reason.

In 1979, Motorola began providing hardware manufacturers with a painless growth path by adding more guts to the basic processor architecture, while maintaining software compatiblity. The first 4-MHz 68000 gave way to the 12.5-MHz 68010, which evolved into the 20-MHz 68020, today the backbone of many a UNIX-based workstation, single-board computer or multiuser system.

Now that same upward mobility continues with Motorola's latest and most powerful 32-bit microprocessor —the 68030. Dubbed the "oh thirty," the 300,000-transistor chip can process more than 7 million instructions per second (MIPS)—about twice that of the 68020. The company currently produces 16-MHz and 20-MHz versions of the chip and has started shipping 25-MHz samples. By the end of the year, Motorola expects to run the clock rate up to 30-MHz.

By comparison, Intel Corp.'s 32-bit 80386 processor now tops out at 20-MHz. Motorola began volume shipments of the 68030 in November, and the first products—boards for the VMEbus—are just beginning to appear.

For example, Force Computers Inc., Los Gatos, Calif., has already begun to sell its CPU-32 series for real-time applications. The Force boards are bundled with VMEPROM, a subset of the PDOS real-time operating system and are priced at $5,990 (16 MHz) and $6,990 (20 MHz). Each comes with 1M byte of on-board static RAM (SRAM). Marty Weisberg, Force's executive vice president, says the company expects to bring out models later this year that use less expensive dynamic RAM (DRAM).

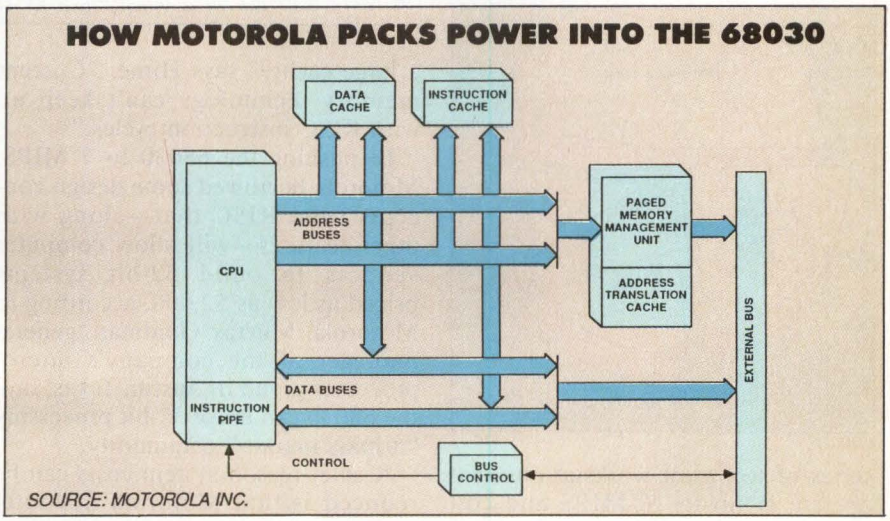
"We're still benchmarking the 68030 against the 68020, but we've found a minimum performance gain of 30 percent," says Weisberg. "There should be no problem getting a two-fold increase."

An 020 year for Apple

The Motorola Microcomputer Division, Tempe, Ariz., has a 68030 VMEbus CPU card that is being marketed as a hardware and software development system. The XVME140, priced at $4,995, comes with 256K bytes of SRAM and has switch settings that allow it to operate at 20 MHz, 25 MHz and 30 MHz. Debugging firmware for the XVME140 is priced at $500.

By midyear, Motorola plans to have two 68030-based system-level computers available in its VME Delta Series. The top of the line, the 3841, will be priced from $39,500 to $99,500. The 20-slot system can accommodate up to 66 serial ports, 48M bytes of memory and 1.6G bytes of disk storage capacity. The 12-slot model 3641, ranging in price from $31,500 to $74,500, has 50 serial ports and can handle a maximum of 32M bytes of memory and 1.2G bytes of disk storage.

Meanwhile, MASSCOMP, Westford, Mass., expects to begin volume production by this summer of 68030 upgrade boards for its MC5600 and MC5700 VMEbus systems that run real-time UNIX. Gary Bowen, vice president of marketing at MASSCOMP, claims that the 68030 board, initially priced at about $6,000, triples performance over the company's current 68020-based



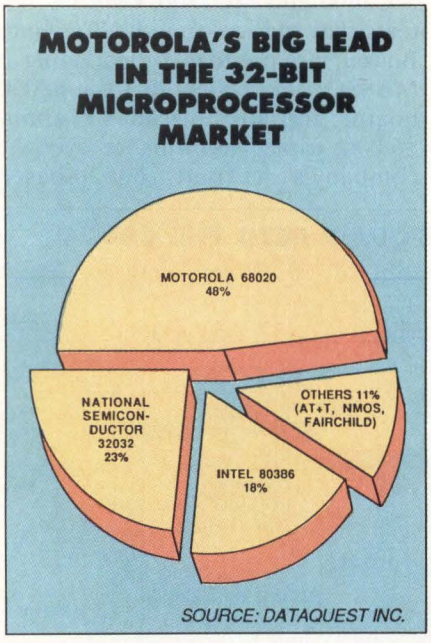
Motorola's 68030 *incorporates a number of new features not found on earlier members of 68000 family, including dual data and address buses and an on-chip data cache.*

multiprocessor systems.

All of Motorola's big customers, including Apple Computer Inc., NCR Corp., Sun Microsystems Inc. and Unisys Corp., have indicated a strong interest in the 68030. However, none has given firm dates for product introductions. Withholding dates may prevent customers from cancelling orders for 68020 systems in anticipation of the newer technology. For its part, Apple will not have a 68030 system in 1988, according to CPU engineering director Steve Sakoman.

Toward a commodity

At Sun, the 68030 most likely will be used in future low-end and mid-range systems, says John Hime, director of workstation products. At the high end, Sun plans to continue with its new reduced-instruction set computer called SPARC—Scalable Processor Architecture. SPARC first appeared last summer in the Sun 4 series of technical workstations that operate at up to 10 MIPS and cost from $40,000 to $80,000. RISC systems, in general, won't be inexpensive, however.

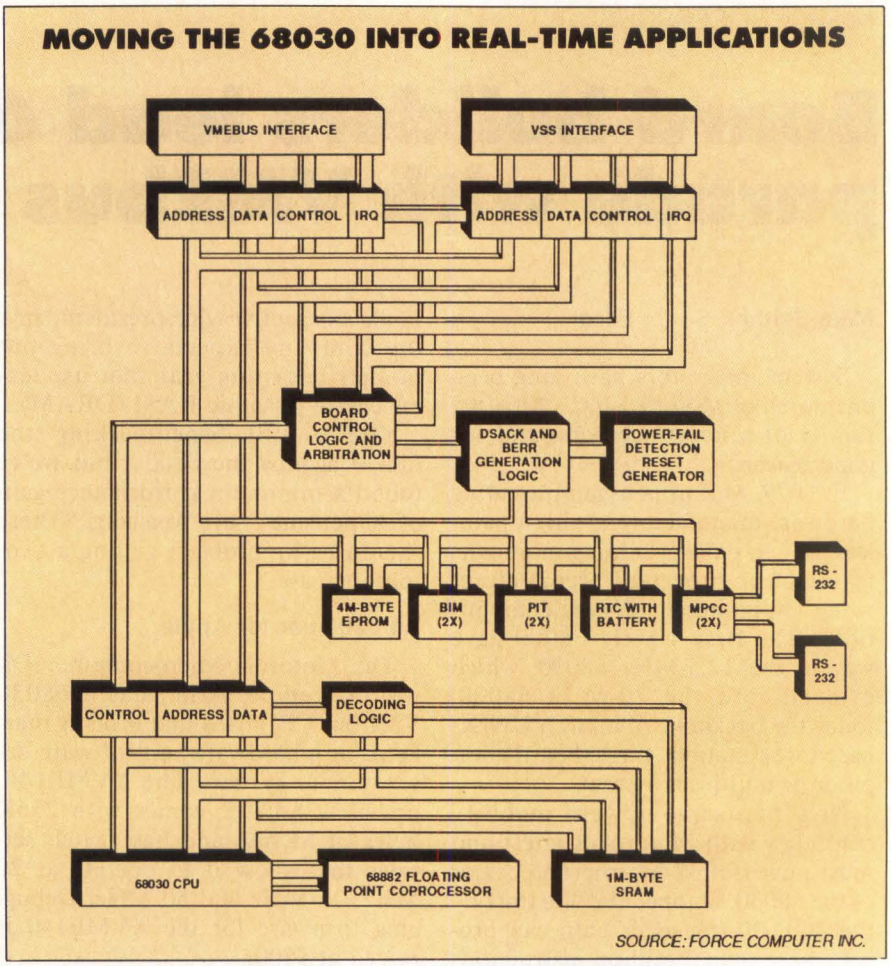


"It's impossible to build cheap RISC systems, because you need such a large cache," says Hime. "Current memory technology can't keep up with RISC instruction cycles."

In pushing the 68030 to 7 MIPS, Motorola borrowed some design concepts from RISC that—along with other features—will allow computer vendors to build 32-bit systems priced as low as $2,000, according to Motorola. Murray Goldman, general manager of the company's microprocessor group in Austin, Texas, says the 68030 can make 32-bit processing "a mass market" commodity.

A chief reason system costs can be reduced is that Motorola has integrated the memory management unit (MMU) on the chip. With the 68020, memory management required an extra MMU component, the 68851, which took up board real estate and required design time. Performance also comes from the addition of on-chip data cache. The 68020, for example, had only an on-chip address cache. Now the 68030 has both. Tying this all together is a "Harvard" architecture that features dual buses for addresses and data. These kinds of multiple parallel buses are typically found on high-end RISC systems, superminicomputers and mainframes. The bus structure allows the 68030 to fetch data and instructions simultaneously and, through a pipelining scheme, execute a number of steps at once.

Another feature Motorola is touting is the 68030's ability to operate both in synchronous and asynchronous modes. This characteristic, Motorola says, will give designers more



Force Computer's CPU-32 *68030 board for VMEbus systems comes in 16-MHz and 20-MHz versions and 1M byte of static RAM.*

MICROPROCESSORS

Alpha Micro out front with 68030-based system

When Alpha Microsystems introduced its first 68020-based multiuser system in April 1986, the Santa Ana, Calif., company wasn't exactly first out of the chute with Motorola Inc.'s then state-of-the-art microprocessor.

Several other vendors had made the leap a year earlier, and Alpha was in a financial slide that would eventually result in eight straight quarters of losses, starting in 1985.

Now that Motorola's latest microprocessor, the 68030, is here, the tables have turned. Alpha has already planted the 32-bit chip inside its new, high-end, AM3000 system, which the company claims can handle up to 360 users. Alpha says the system packs twice the performance as its AM2000 running under the 68020. The first customer shipment of an AM3000 took place in November, and full production was scheduled to begin in December.

"We wanted to be the first, not the last" with a system-level 68030 multiuser system, says Alpha president Robert Hitchcock.

General Automation Inc., Anaheim, Calif., plans to begin shipping its 256-user Pick-based ZEBRA 8830 during the first quarter of this year. Meanwhile, other major Motorola vendors including Altos Computer Systems, NCR Corp. and Unisys Corp., companies that target the UNIX market, but have not yet tipped their hands on 68030 products.

The Alpha AM3000 is a modular system built around the VMEbus. A small six-slot tower configuration with 8M bytes of main memory, six terminals, a 70M-byte Winchester disk drive and Alpha's AMOS operating system costs about $48,000. A larger 21-slot cabinet lists for about $220,000. That price includes 12M bytes of memory, an 840M-byte Winchester, a tape drive, 110 terminals and an AMOS license. Dealers can upgrade customers with AM2000 systems by swapping CPU boards. The upgrade costs $8,000.

Hitchcock hopes that the early introduction of the AM3000 will help re-establish Alpha's reputation as a technology leader and add some more black ink to what until recently was a long red bottom line. The company has a good start. In its current fiscal year, which ends in February, Alpha has enjoyed its first profitable quarters in two years.

flexiblility in choosing components and, as a result, will help drive down system costs even more.

Motorola says that on-chip memory management will make it possible to create a binary standard for all 68030 systems. The goal is for UNIX-based applications to run any 68030-based machine, regardless of the manufacturer. That was impossible with earlier members of the 68000 family, because each computer vendor designed its own method for memory management. Motorola and UniSoft Corp., Emeryville, Calif., are ramrodding the effort, called the 68030/UNIX Binary Portability Standard. The final standard is expected to be released to software and hardware vendors before midyear, according to Motorola. □

CHIP TECHNOLOGY

AT&T, Sun 'SPARC' interest in new chip design

KEEPING AMERICA COMPETITIVE

Tim Scannell, Senior Editor

News that a few more computer vendors have joined forces to promote yet another industry standard hardly raises an eyebrow among hardware and software developers today. Most realize there is a big difference between standards hype and happening.

However, when the companies pushing for a new platform include AT&T Co. and Sun Microsystems Inc., even the most seasoned developer would be hard pressed not to stand up and take notice. Still, the odds would seem to be against the promotion.

The proposed standard is based on Sun's Scalable Processor Architecture (SPARC), a microprocessor design that is a close cousin to reduced instruction set computer (RISC) technology. Like RISC, SPARC features include the use of simple instructions, delayed control transfer, and optimized compilers that boost the overall efficiency of a processor. The SPARC chip can also be easily scaled to adapt to different and faster semi-

conductor technologies as they become available.

The standard would also encompass a unified version of AT&T's UNIX that combines UNIX System V and the Berkeley 4.2 version. UNIX itself is an operating environment highly suited for RISC-type machines because of its flexibility and ability to be easily transported among different systems architectures. UNIX also has a bright future in the business segment, expected to be installed on some 20 percent of all U.S. computer systems by 1991, compared with 9 percent in 1986, according to International Data Corp., the Framingham, Mass., market researcher.

Both AT&T and Sun have also agreed to develop an application binary interface (ABI) for the new environment. It would not only manage applications run under unified UNIX but also offer a common user interface and networking and development tools. The UNIX interface has been a concern for most developers trying to move the environment into the business segment, because it does not offer the windows and menus common to MS-DOS and other operating systems. That is why a number of groups have been actively trying to push such user interfaces as Massachusetts Institute of Technology's X Window and Sun Microsystem's Network Windowing System (NeWS) as UNIX interface standards.

Watching the SPARCs fly

The SPARC technology was actually developed by Fujitsu Microelectronics in Japan and is, so far, licensed only to a handful of computer companies, including AT&T and Sun Microsystems. In a basic RISC design, instructions are channeled though multiple and parallel buses or through pipelines that together can handle a great deal of processing traffic—much like a four-lane highway can accommodate more cars faster than can a two-lane road.

Sun adapted the chip to work slightly faster than its basic 65-to-70-nsec speed and to fit snugly into workstation environments. AT&T, meanwhile, announced in October that it will develop systems based on the SPARC RISC technology. These new systems will most likely be introduced in mid-1988 and will be compatible with AT&T's 3B minicomputer line. However, AT&T is still undecided whether or not to purchase the SPARC chips directly from Fujitsu or Sun, or develop its own.

Picking up the gauntlet, Sun became the first to incorporate SPARC RISC technology last October when it introduced the first in a series of computers based on its version of the Fujitsu design. Called the Sun-4/620 workstation, the system has a processing speed of 10 million instructions per second (MIPS)—a performance level equaling that of Digital Equipment Corp.'s VAX 8800 minicomputer. It is priced from $39,900 and is source-code-compatible with the company's Sun-2 and Sun-3 workstation families.

Sun also has entered into agreements with a number of companies that will eventually produce computers based on Sun's SPARC RISC design. In October, Xerox Corp., Sunnyvale, Calif., struck a technology alliance with Sun to incorporate the new chip into its document-processing systems. Sun has also agreed to enhance its Sun Operating System (SunOS), as well as its version of AT&T's UNIX, to support Xerox Network Systems (XNS) standards.

Areté Systems Corp., a 6-year-old company in San Jose, Calif., has also agreed to produce a high-performance UNIX computer based on Sun's SPARC. It is expected to debut in the latter part of this year. Areté already has a line of systems that support up to 256 users and target such competitors as DEC, NCR Corp. and Convergent Technologies Inc.

Captures commitments

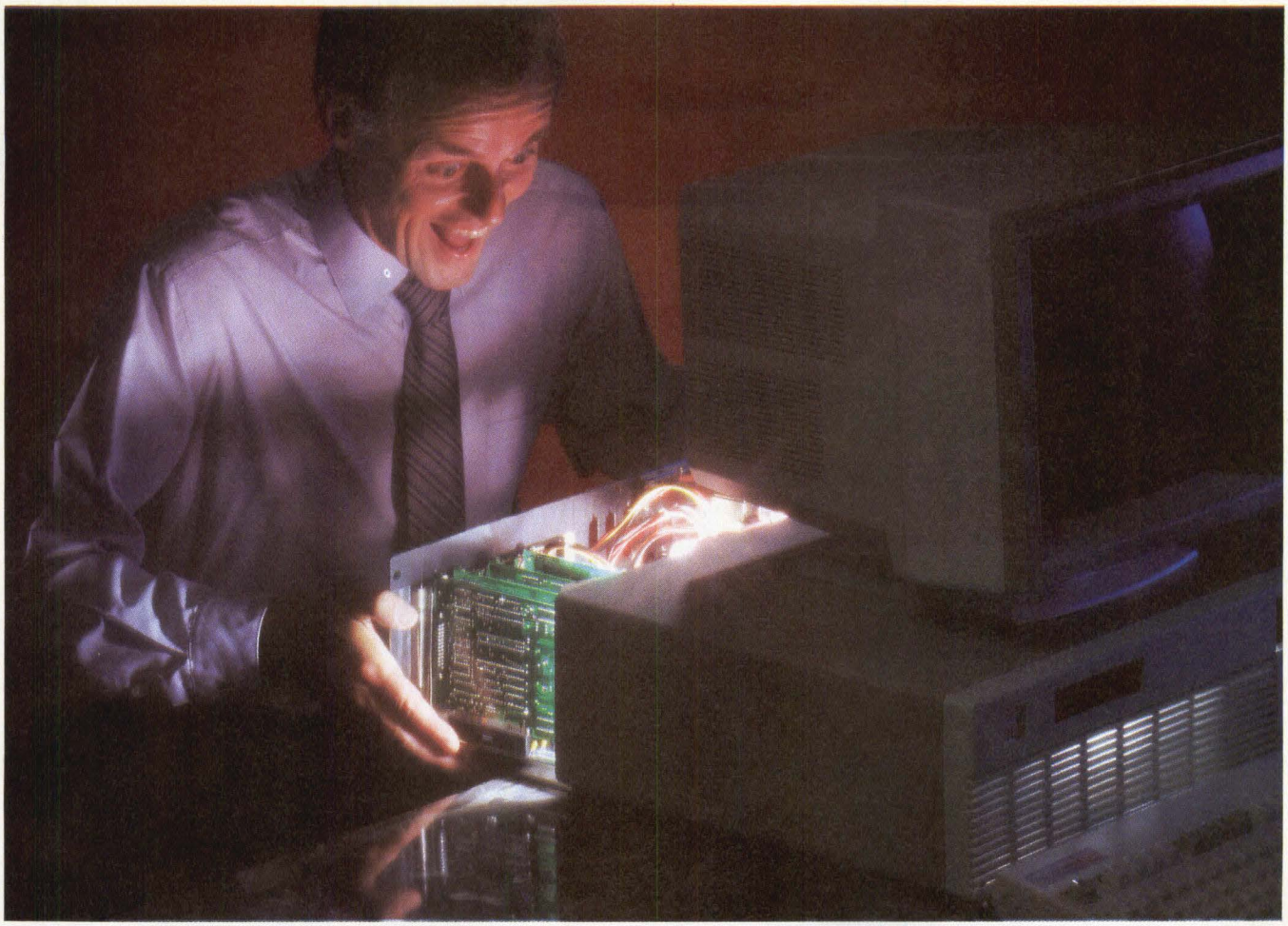
It is also heavily involved in the value-added reseller and OEM marketplace. One of its biggest OEM customers is Unisys Corp. Unisys recently agreed to service Areté computer systems nationwide through its Customcare service organization and has made no secret of its interest in the UNIX workstation market.

So, while SPARC is just now out of the starting gate, it already has garnered commitments from a number of large companies to produce products based on its technology. Promoters of SPARC systems have also decided to take advantage of an apparent gap in the UNIX systems market, and come in at the low-end under DEC and IBM Corp. They plan to gradually build a systems line that would compete head-on with the minicomputer offerings of both companies.

Despite the apparently blue skies ahead, however, there remains the question of, why in the world would anyone need a new systems technology? The question is particularly pertinent since the business UNIX market is just starting to mature and seems secure in Motorola Inc. M68000 and Intel Corp. 80386 chip technologies. More importantly, does SPARC have the spark to attract system integrators and resellers in a market that is concerned more with UNIX software than with the hardware?

Areté CEO and chairman Gene Manno maintains that Sun's SPARC is the first practical application of the RISC technology. Although most RISC machines run very fast and have a fast memory, it is tough to implement this design in silicon, due to the complicated gate arrays that are necessary. And once you do, you are married to a particular architecture which may not be flexible enough to adapt to software and systems changes.

"SPARC can be run in ECL (emitter-coupled logic), CMOS and other types of silicon . . . all the way up to gallium arsenide," says Manno. Furthermore, Manno says, while both the 80386 and the 68000 (especially in light of the memory management facilities added to the 68030) are good chips, "There is a question of just how much UNIX the 386 can support."



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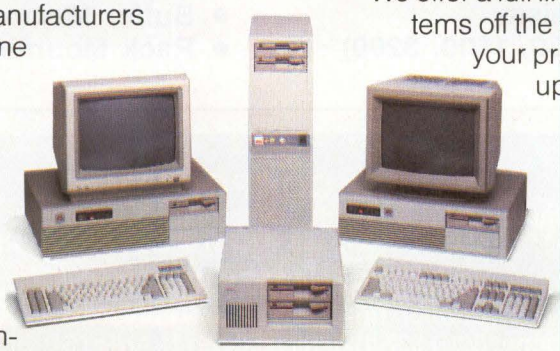

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The chief competitor to Sun's SPARC may be the 68030, which presently has a 20-MHz clock speed and double the processing speed of its predecessor, the 68020. Motorola is busily rallying UNIX software developers to work toward creating a standard for development within the 68030 environment. This coincides with similar efforts on the software side to standardize UNIX itself, particularly for government applications.

Meanwhile, a number of computer companies have announced plans to develop systems based on the 68030 chip. These include Apollo Computer Corp. and Apple Computer Inc., which probably will have systems available by mid 1988 and early 1989, respectively. Even Sun, which has all but one of its workstations based on Motorola chips, is said to have a number of systems under development that incorporate the 68030 microprocessor. However, they will most likely be positioned at the low end of Sun's systems line, while SPARC machines will be high-end and high-priced processors.

SPARC's saving grace may be that its RISC roots offer benefits that closely parallel those of UNIX. It easily accommodates running on multivendor equipment, and supports migration among such sticky barriers as program cross compilers. "RISC and SPARC are made for the UNIX environment," points out Areté's Manno.

Not everyone agrees they are a matched set, however. Minicomputer-maker Prime Computer Inc. in Natick, Mass., for example, has developed a RISC computer system and has several RISC projects in the works. The company also believes there is a growing market for RISC-type machines and applications. But, this growth may not necessarily include the development of unique RISC chip designs like SPARC, says Prime CEO Joseph Henson. Henson made the observation at a technology conference held last November in Boston by Patricia Seybold's Office Computing Group.

DEC is also investigating RISC computers. In fact, DEC CEO Kenneth Olsen is quick to say that, if he were just starting out in the business, RISC would be a good road to follow. But, he does not expect the technology to eventually replace DEC's VAX systems.

So far, "RISC has always come up short," said Olsen, noting that DEC will continue to watch RISC and other computer environments. "If you don't watch it, it overwhelms you." □

SOFTWARE ENVIRONMENTS

Objects and icons beget 'New Wave' of programs

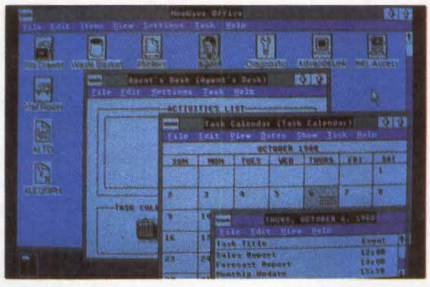
Tim Scannell, Senior Editor

A picture is worth a thousand words. It may also be a fitting epitaph to mark the passing of conventional character-based application software, which is the bulk of what is available today.

By late next year, most of the conventional programs—including such business staples as Lotus Development Corp.'s 1-2-3 and Ashton-Tate's dBASE—will begin showing their age. Replacing them over the next few years will be a "new wave" of graphics-based products that are designed to run in object-oriented operating environments.

"There will be a slow, or maybe even a quick, death of character-based systems," says John Logan, a senior analyst with The Yankee Group in Cambridge, Mass.

In an object-oriented environment, graphics images will take the place of program and file names, just as they do in an icon-heavy program like Microsoft Corp.'s Windows and Digital Research Inc.'s GEM. However, unlike a traditional "windowing" program, object-oriented environments will allow these images to tie programs and data together across different operating systems. In some cases, they will also bridge standard character-based products with the object-oriented world.



HP's NewWave Agent *facility uses some artificial intelligence sleight-of-hand to balance applications and automatically perform routine tasks. Since it is a graphics environment, icons are used to represent applications, commands and data files.*

For software developers, this means clearing their coding sheets for a whole new genre of application programs that take advantage of the "point-and-perform" style of object-oriented environments. Character-based programs will have to be completely rewritten. Windows-based programs like Microsoft's Excel, which are already familiar with icons and graphics symbols, will have to be ported to take full advantage of the

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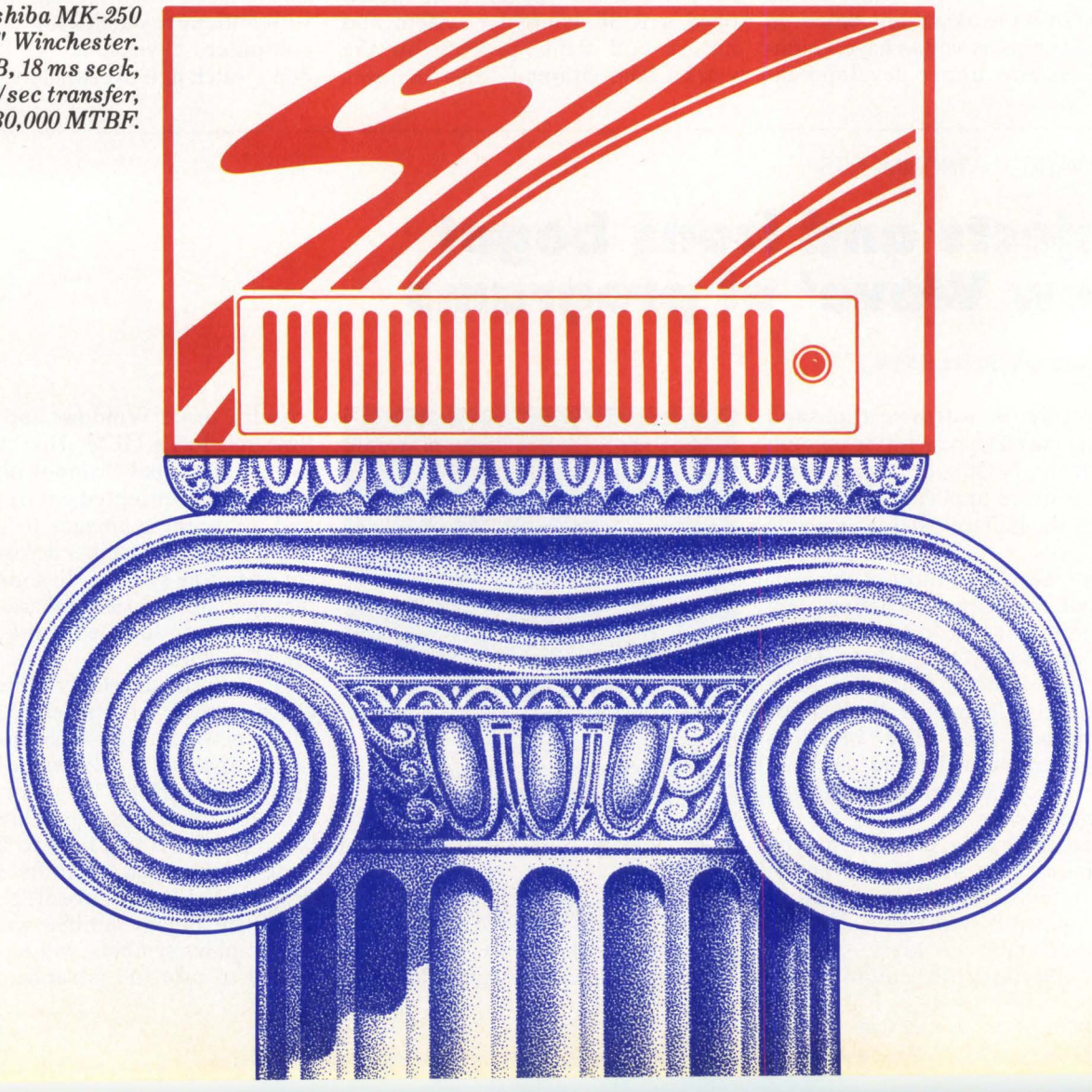

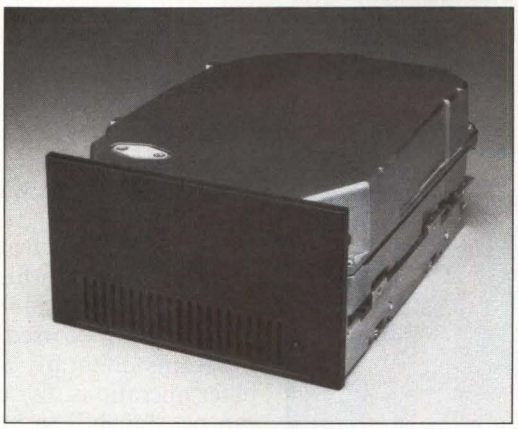

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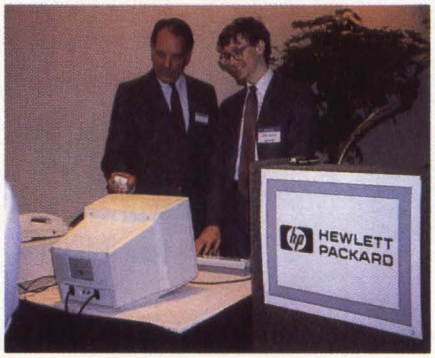
highly active and interactive object style.

Just what is an object-oriented environment, and how does its differ from traditional graphics-based programs? The main differences, basically, are in the icons themselves. In a graphics environment like Windows, the icons are graphic representations of either programs or data. An output utility, for example, could be depicted as a printer, while a communications program might be represented by a telephone.

An object-oriented operating environment also makes heavy use of icons and pictorial substitutes, but as 'hot links' to other programs and data. They can also be seamless doorways to voice messages and scanned images. The result is that all of these elements can be joined within a single document. In short, they allow users to instantly and seamlessly access data from multiple sources—a talent that will be invaluable as more computers are networked within a corporation.

Like present graphics-based programs, an object-oriented environment also cuts down on the amount of user training needed to bring a person up to speed on complicated applications. This is particularly true of those applications that extend beyond a desktop systems and involve connections to mainframes. "Over the next three years we are going to see the majority of new shipments to be graphics- and object-oriented, just because there is a shorter learning time required," contends Yankee Group's Logan.

Hewlett-Packard Co., Palo Alto, Calif., is one of the first computer makers to jump feet first into the object-oriented waters, having introduced in November its "NewWave" object management facility (OMF). Based on Microsoft's Windows 2.0, NewWave requires at least 2M bytes of memory and embraces some elements of artificial intelligence to link data and programs under a graphics umbrella. NewWave treats each object—which can be a single word, a spreadsheet cell or an individual bar in a bar chart—as a separate entity that can be pulled into other applications and merged with like or unlike data.



William Gates, *Microsoft president and CEO (right), joins HP CEO John Young at the November debut of NewWave in Cambridge, Mass. Microsoft collaborated with HP for two years to develop the object-oriented environment.*

"NewWave offers a level of integration that hasn't been seen before," says Microsoft chairman William Gates, who worked for two years with HP to develop the NewWave environment. "It is an excellent use of the graphics environment and the common user interface and gives ISVs (independent software vendors) the right tools."

One of these tools is a "hot-connect" facility that will automatically update related files in different applications, such as a spreadsheet in the accounting department along with a database file in shipping. It can also accommodate standard character-based MS-DOS programs and data through a facility called "encapsulation", which essentially repackages character-based data as a graphics element that can be recognized by NewWave. This means that developers who are not yet ready to throw their full weight behind object-oriented programs can access NewWave with their current products.

Because NewWave does have its roots in Microsoft's Windows, it can work with programs developed under the Windows environment—like the Excel spreadsheet program. However, all software must be rewritten to take advantage of some of the more key features of the NewWave environment.

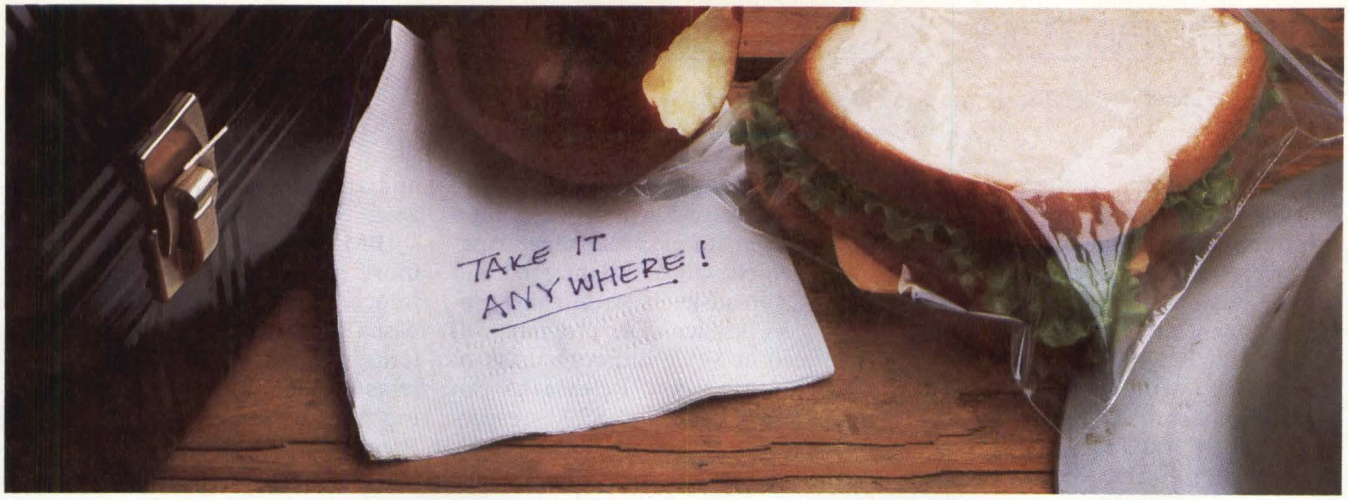
One of these key features is a facility called "Agent," which is a sophisticated, graphics-oriented macro program that can be used to either build programs or totally automate computer operations. For example, Agent can be "taught" to perform specific tasks at a certain time and date, from accessing an electronic mailbox to updating a database. It can also be told to react when certain conditions occur, much like stock market computers will automatically issue buy or sell orders when the price of stocks reaches a certain level.

HP describes Agent as its first practical application of artificial intelligence technology. Athough it can be easily manipulated by end users, its biggest fans may be software developers. With it they can construct programs and automated templates by building Agent macros—just like developers are now designing programs for Apple Computer Inc.'s Macintosh under the HyperCard graphics environment.

"The whole thrust behind an object-oriented system is that, when you go for a task, the tool appears to let you do your task," says Michael Millikin, an analyst with Patricia Seybold's Office Computing Group of Boston. In theory, it is like picking up a nail and having a hammer suddenly appear in your hand, he explains. "You don't have to worry about where the tool is."

Independent software vendors are the initial target for NewWave. In fact, HP expects to have 100 developers—or two-thirds of its value-added resellers—signed up by the end of this year. Support for these developers will be in the form of a developer's tool kit (which includes manuals, software and development tools) along with classroom training and technical support. Microsoft and HP are planning to hold the first NewWave class at COMDEX/Spring in Atlanta.

Applications software written for NewWave should hit the streets sometime in the fourth quarter of this year,



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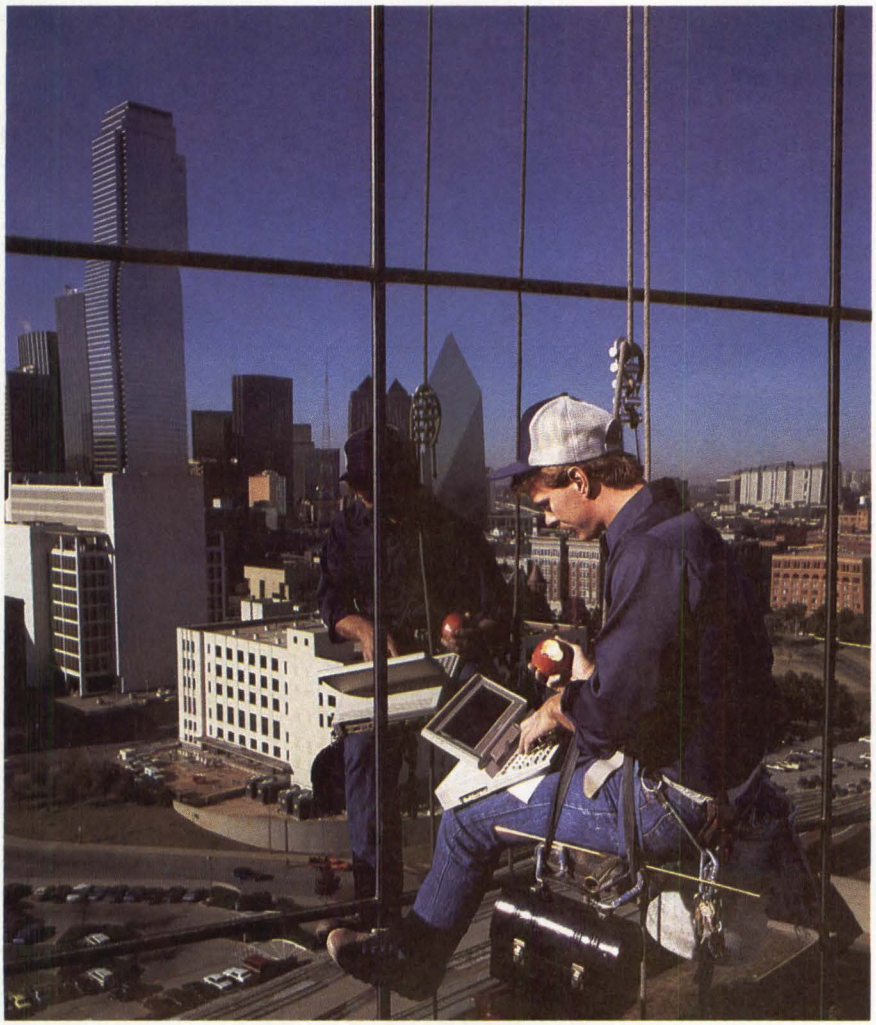

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according to some analysts. In fact, one of the first may be a database product called Quartz from Blythe Software, Foster City, Calif., since Blythe was one of the first to initiate development talks with HP.

The NewWave developer tool kit costs $895, while classes and three months of technical hand-holding are priced at $1,100 and $1,000, respectively. The run-time version of NewWave costs $195. All of these will be available next month, says William J. Murphy, a marketing manager with HP's Business Systems Sector.

While HP and Apple Computer have, so far, ventured deepest into object-oriented territories, other companies are hot on their heels with products that will be unveiled over the coming months. Lotus, for example, will this quarter unveil a third release of its 1-2-3 spreadsheet program that will function under both OS/2 Release 1.0 and DOS. Although still character-based, it will feature major improvements in performance and graphics as well as a sophisticated programming environment called the Lotus Extended Applications Facility (LEAF). Release 3 will also feature a multidimensional spreadsheet capability, which will allow merging and linking spreadsheets within the program's workspace. The program will be priced at $495, although users of 1-2-3 Release 2 and Release 1A can upgrade for $150 and $200, respectively.

This October, Lotus plans to take the wraps off a fully graphics-and-object-oriented version of 1-2-3, called 1-2-3G, following the release of OS/2 and the Presentation Manager graphical user interface. The company is also working on an information-management product that will be graphics-oriented, and perhaps mark Lotus full entry into object-oriented programming and operating environments.

"Building products on top of the Presentation Manager is an objective for everyone over time," says Chuck Digate, vice president of Lotus' Software Products Group in Cambridge, Mass. "But, there will be a long life for character-based programs," he added. "It's just a question of degree."

IBM Corp. also is working to inject more graphics-and-object thinking into all of its programs from those based on the PS/2 to mainframe systems. In fact, its Applications Systems Division in Connecticut is gearing up for the transition as the Presentation Manager-version of its OS/2 Extended Edition becomes available this November. It is also marketing, and giving support to, a mainframe-version of Lotus 1-2-3, appropriately enough called Lotus 1-2-3M. This product will also be available in early spring.

At least one company is expected to announce next month an object-oriented database management system, based on Digital Equipment Corp.'s VAX minicomputer, that will connect with Sun Microsystems Inc. and IBM PS/2 workstations. The system is already installed at a number of beta test sites and is designed for complex applications like large financial and government-sponsored scientific data acquisition. □

SOFTWARE ENGINEERING

TI, Sun Microsystems join CASE chase

Tim Scannell, Senior Editor

If computer-aided software engineering (CASE) is such a hot area right now, why hasn't any of the really big companies thrown its hat into the ring?

They have, but most people don't know about it. Much of the sophisticated software engineering at companies, like IBM Corp. and Digital Equipment Corp., goes on behind the scenes to create new versions of an operating system or to develop application software for a particular type of computer.

CASE software also has a heavy presence in highly vertical areas, especially in the government, which is a stickler for keeping costs down and getting things done on time. In fact, one thing the government now requires from every vendor submitting a bid is the odds on completing a project on time. "Don't tell me how cheap it is, just tell me I can have it when I need it," Uncle Sam is saying. Of course, if you do go over budget you foot the bill and cannot pass the increase along to a government agency.

A significant portion of CASE applications also occurs at large-scale third-party software houses. But, as with the wizard behind the curtain, you never see the CASE element, just the final product.

CASE is rapidly coming out of the shadows, however. In the past several weeks, a number of heavy hitters have unveiled products that are aimed at mid- to large-scale software houses where programmers serve up lines of code faster than lunchtime burgers are dished out at McDonald's. In September, for example, Texas Instruments Inc., Dallas, unveiled its Information Engineering Facility (IEF) at a CASE symposium. The IEF is designed to automate all phases of software development, including the generation of COBOL code. It also keeps tabs on the consistency and accuracy of programmers working within a network, says Michael J. Watters, TI's manager of advanced information management.

TI's IEF operates in an IBM mainframe environment and is compatible

with TI Business-Pro and IBM PC/AT and PS/2 models 50, 60 and 80 computers. The mainframe portion of the software costs $265,000, and the microcomputer-based modules are priced at $13,900. Early shipments are scheduled for next month.

While TI is a major force in the hardware end of the computer industry, it has only been in the CASE arena since late 1983 when it first started working on IEF. But, internal software engineering is part and parcel of everything happening at TI. CASE activities are the second-largest funded item and take up a significant portion of the company's $400 million annual R&D budget, Watters points out.

The IEF organizes and manages all software tools through a local encyclopedia and one centralized on a host system. The encyclopedias check for consistency, while an automated tool set generates code according to predefined specifications.

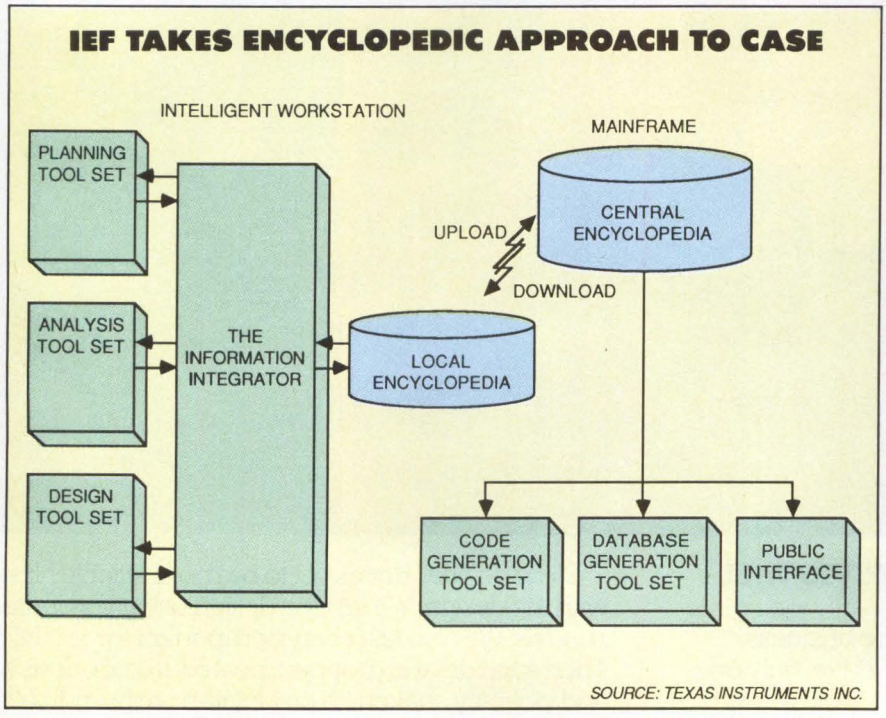
Workstation manufacturer Sun Microsystems Inc., Mountain View, Calif., is also no stranger to the internal use of CASE products. The company has about 400 software engineers at work developing the next two versions of its SunOS workstation operating system. More than 40 percent of the systems it ships are also used to run CASE products, and there are presently more than 130 CASE products available that run on Sun systems, says George J. Symons, CASE product line manager.

Sun produces a number of CASE-related tools that operate on its desktop workstations. So, it is not surprising that the company has come out with an off-the-shelf product that targets large software houses and is designed to integrate existing CASE products over networks. Sun's Network Software Environment (NSE), unveiled last year at the CASExpo in Washington, D.C., supports all phases of the software development process from staffing to managing program files.

The NSE can be integrated with SunTrac, a project manager also introduced by Sun that uses Monte Carlo simulation to weigh the risk factors in software development projects. This risk assessment can be provided with a government bid, as now required. SunTrac also provides "parallel development," which raises a flag when two or more programmers go to change the same area of a program.

NSE and Suntrac will be available in the first quarter of this year. At press time, no beta test sites had been established, although Sun was talking with companies like TRW, General Electric Co. and Rockwell International Corp., Sun's Symon explained. Sun is also spreading the word among its more than 1,100 third-party software developers that CASE is hot and should be an area of concentration in the coming months.

Other companies that have kept busy during the summer months by developing and releasing CASE products include: Index Technology Corp., Cambridge, Mass., which introduced a link between its Excelerator systems analysis and design software and the Telon code generator from Pansophic Systems Inc.; and ProMod Inc., Lake Forest, Calif., whose more recent product intros are a series of IBM PC- and DEC VAX-compatible software lifecycle tools. The Du Pont Co., Wilmington, Del., has established a CASE service bureau of sorts to develop application software for VAX users.



Texas Instruments' *Information Engineering Facility organizes and manages software engineering tools through both local and central encyclopedias. Code is generated by an automated tool set, while developers coordinate activities through a series of windows.*

Government push for productivity

There are several factors pushing CASE development. One is the government, particularly the Department of Defense, which has made CASE tools virtually mandatory for software houses jockeying to win a large contract. Organizations like The Software Productivity Consortium, Reston, Va., also make CASE tools indispensable by establishing rules and specifications for software development. In the Consortium's case, member companies band together to direct activities in so-called "mission-critical" defense applications like the Strategic Defense Initiative (SDI). Demand for such software will reach $32 billion by 1990, say the experts. □

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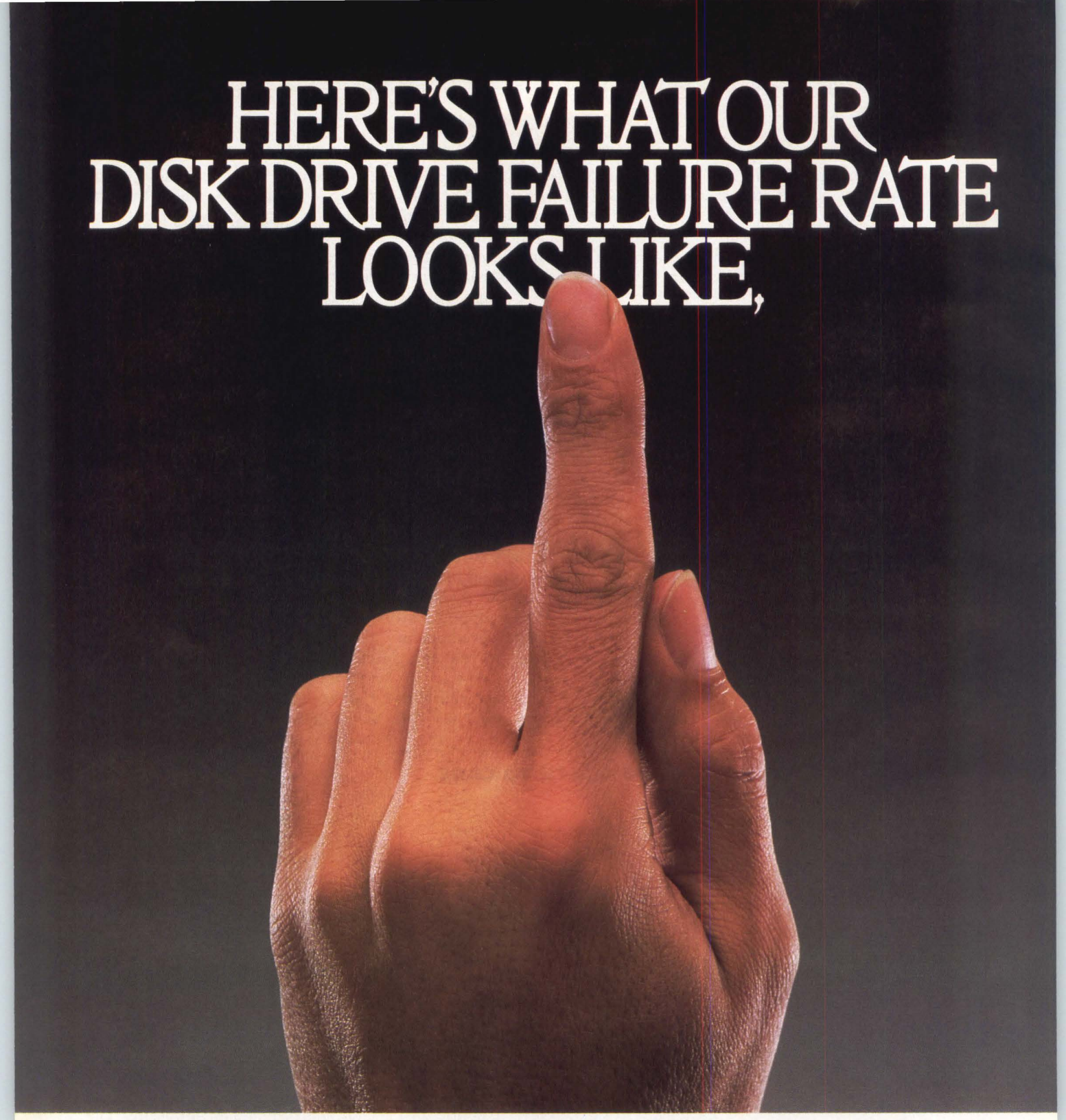

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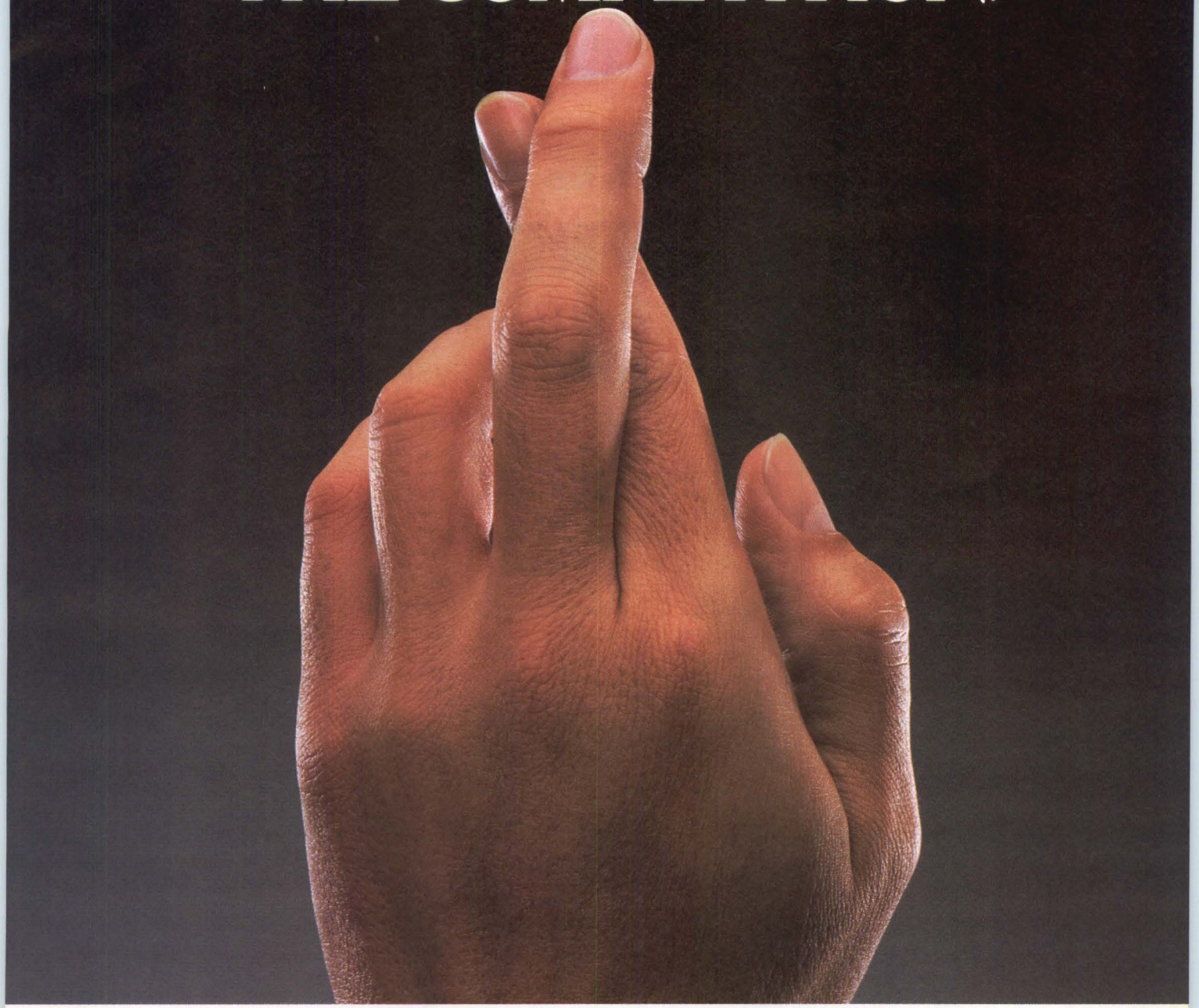

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COMPETITION

POSTSCRIPT CLONES: MORE POWER, OR MERE PROMISE?

PostScript clones promise lower printer costs and faster speeds, but system integrators best beware of compatibility and quality drawbacks

David Simpson, Senior Editor

The best way for resellers to wring more finesse and functionality out of laser printers is to add powerful page description languages. Last year, one language vanquished a handful of contenders to become the industry-standard PDL—Adobe Systems Inc.'s PostScript. Now, however, growing dissatisfaction with PostScript's performance and pricing has spurred more than a dozen companies to offer OEMs and resellers alternatives: PostScript interpreter clones.

Cloners claim faster print speeds and lower overall printer costs. If these claims stand up, resellers will realize higher margins and will be able to give their customers more value in the increasingly competitive laser printer market.

PostScript interpreter cloners feel that Adobe and its language are vulnerable on three fronts: PostScript is slow, Adobe charges excessive royalties, and the company is unresponsive to the needs of smaller manufacturers of laser printers and controllers. Those manufacturers charge that Adobe takes too long to adapt one of its standard controller designs to a specific printer (See "Adobe answers its critics").

Adobe hardly has reason to worry. Its licensees include such industry heavyweights as Apple Computer Inc. (PostScript's first champion), Dataproducts Corp., Digital Equipment Corp., IBM Corp., QMS Inc., Texas Instruments Inc. and Wang Laboratories Inc.

Hewlett-Packard Co., by far the leader in laser printer shipments with its LaserJet series, supports PostScript although it is not an official Adobe licensee. PostScript compatibility for LaserJet Series II is available via a personal computer-resident board developed by QMS—the JetScript—which is due this quarter. The $2,495 board includes a 16-MHz Motorola Inc. MC68000 microprocessor and 3M bytes of RAM.

Adding to Adobe's clout in the market, the company has a licensing agreement with Linotype Co. for Linotype's prestigious Mergenthaler Type Library. Under the agreement, Linotype develops and distributes PostScript versions of its typefaces.

Despite Adobe's considerable muscle, Post-

Script cloners, under the banner of faster speeds at lower cost, are marching ahead. But prospective buyers—including printer and controller manufacturers, OEMs, system integrators and, ultimately, end users—should be aware of a serious potential pitfall: lack of compatibility with the true PostScript. Compatibility with PostScript involves both PostScript drivers (and, thus, application packages) and font quality.

Significantly, the only major Japanese laser printer manufacturer that has a contract with Adobe is NEC Information Systems Inc. PostScript clone vendors consider Japanese manufacturers to be their most likely customers.

What's available?

Control-C Software Inc., the first company to develop a PostScript clone, claims that its CCS-PAGE uses all 279 PostScript verbs and is compatible with all PostScript drivers. Control-C implements Bitstream Inc.'s Fontware fonts.

According to Bill Bostic, director of marketing, the advantages of CCS-PAGE relative to Adobe's interpreter are in price/performance and flexibility: It is written in C, which is highly portable. Portability facilitates adapting CCS-PAGE to a variety of microprocessors. Control-C is targeting controller and printer manufacturers in the high end of the laser printer market.

Another advantage of CCS-PAGE is that it also supports Interpress, Xerox Corp.'s page description language. This allows printers and typesetting equipment to be "bilingual," i.e., compatible with both PostScript and high-speed Xerox printers.

One controller manufacturer that opted for the Control-C interpreter is Nissho Electronics (USA) Corp. Although Nissho originally wanted to use Adobe's interpreter, the company went to Control-C "for business reasons," according to Joe Friedman, director of sales and marketing. He adds that cost was not a primary consideration.

Nissho puts CCS-PAGE in ROM on its controller, bundling it with a Minolta Corp. print engine. The controller packs a 68020 processor, a floating-point coprocessor, a Texas Instruments TMS34010 graphics coprocessor and 6M bytes of RAM. The 480-dot-per-inch (dpi) engine prints 22 pages per minute (ppm), and the company is working on a 400-dpi, 12-ppm unit based on the same controller. The high-end printer, which Nissho sells to OEMs, targets shared-resource environments and corporate electronic publishing applications.

HanZon Data Inc. is another vendor that uses Control-C's interpreter. Its controller is based on a 68000 processor and proprietary VLSI. HanZon originally planned to sell complete laser printer systems and, over a year ago, even showed a printer with a slot for a plug-in PostScript clone cartridge, but it has since decided to sell controllers only.

Facit Inc. buys HanZon controllers and incorporates them into its printers. Facit just began shipping a PostScript-compatible laser printer with a HanZon controller and Control-C interpreter.

Another major clone developer, Phoenix Technology Ltd., touts a unique technique for scaling and algorithm storage called outline preprocessing. With a standard Adobe controller, font outlines are stored in ROM, scaled and adjusted for aesthetics, and then printed on a page. In contrast, Phoenix's technique includes some preprocessing for standard typefaces and rotations, thus cutting down on some of the overhead involved with the Adobe approach, which requires caching fonts. Relative to Adobe's approach, Phoenix product manager Bill Hilliard claims faster speed, less ROM requirement because of more compact code, and lower costs. For non-standard font creation and rotation, however, Phoenix does not claim any speed advantages over the Adobe method. Like Control-C, Phoenix licenses Bitstream's Fontware technology.

The Phoenix offering represents a serious challenge to Adobe's pre-emminence. Already several printer powers have lined up behind it.

Canon U.S.A. Inc., purveyers of widely used laser engines; Xerox; Kentek Information Systems Inc.; and Toshiba America Inc. have announced plans to incorporate the Phoenix interpreter in future printers and controllers.

Bell & Howell Co.'s Quintar division has adopted Phoenix's interpreter for use on its TMS34010-based controllers. "We wanted to go with Adobe," says vice president of marketing Craig Douglass, "but Adobe said 'no,' because they hadn't done development on our level of hardware." Bell & Howell chose Phoenix because of that company's considerable experience in cloning software, garnered in large part from cloning the IBM PC BIOS.

Bell & Howell's controllers can reside in either hosts or printers. The company sells primarily to printer manufacturers and phototypesetting houses, but also will incorporate the PostScript-based controllers into its own products. In addition, the Quintar division has signed a letter of intent with Toshiba. According to the terms of the agreement, Bell & Howell will provide a PostScript-compatible controller, based on the Phoenix interpreter, for Toshiba's PageLaser12 printer.

When a cloner clones . . .

Most clone vendors and their licensees concentrate on one piece of the puzzle and pool their resources (i.e., Phoenix clones the software, Bitstream supplies the font expertise, and Bell & Howell contributes the controller expertise).

In contrast, Conographic Corp. provides one-stop shopping. The company developed a PostScript interpreter clone (called ConoScript), a font compiler that processes font outlines to bit-map fonts, and a printer/scanner controller based on a 32-bit bit-slice architecture (the ConoDesk 6000).

In addition, Conographic developed its own fonts. Unlike constraint-based font technologies that use "rules," or "hints," to go from outlines to bit-maps, Conographic's approach uses shape-based algorithms that don't require

Adobe responds to its critics

Not surprisingly, Adobe Systems Inc. is quick to counter criticisms leveled against not only the performance of its software but also against its performance as a company. Liz Bond, Adobe's director of marketing, takes on the critics.

"Waiting for PostScript is like waiting for Godot."

Bond points out that accusations of slow speed are usually based on benchmarks from a single device, such as Apple Computer Inc.'s LaserWriter, which doesn't reflect PostScript's speed but, rather, how the vendor has implemented the controller design.

In fact, speed is a function of both hardware and software. To speed up PostScript, vendors have two options: optimize the interpreter code with the help of Adobe or add more powerful hardware to the controller. Addressing the first option, Bond maintains, "We'll continue working with OEMs to optimize the interpreter." In addition, Adobe continually revises the interpreter, offering newer versions.

Most controllers that take advantage of PostScript employ relatively simple designs based on Motorola Inc. MC68000 processors. However, the language is not limited to a specific processor, or to standard 300-dot-per-inch (dpi), low-speed printers. For example, Belgium's Agfa-Gevaert N.V. sells a laser printer based on Adobe's PostScript interpreter that produces 406 dpi and runs at 18 pages per minute (ppm). The controller includes a 68020 processor and 1.3M bytes of RAM.

"PostScript always rings it up twice."

As to exorbitant fees, Bond contends that reports of $400-per-printer royalty fees are exaggerated. Pointing out that royalty fees are related to sales volumes, Bond says that $100 to $200 per printer is a more accurate number for "low-speed printers shipping in quantity."

Typically, Adobe charges an advance against royalties, reportedly between $100,000 and $200,000, and provides a controller design based on the licensee's requirements. Reacting to perceived fee excesses, Adobe last year restructured its royalty schedules.

"My design ideas fall on deaf ears."

The charge of lack of response to small companies is, according to Bond, due in large part to those vendors' demands for a high degree of customizing and small volumes. "We encouraged them to be more standard," explains Bond, "but they wanted customized solutions." The combination of low volume and intensive customizing often generates too little profit for Adobe to respond.

intelligence in the outlines. In addition, the company licensed more than 5,000 typefaces from a variety of libraries. One result of this approach is that users aren't limited to one font library.

OEM account manager Ken Sims claims that Conographic's advantages, relative to Adobe, are its wide selection of fonts and faster speed. On average, a Conographic-equipped printer is 10-to-50 times faster than an off-the-shelf

PostScript clone vendors consider the Japanese to be their most likely customers.

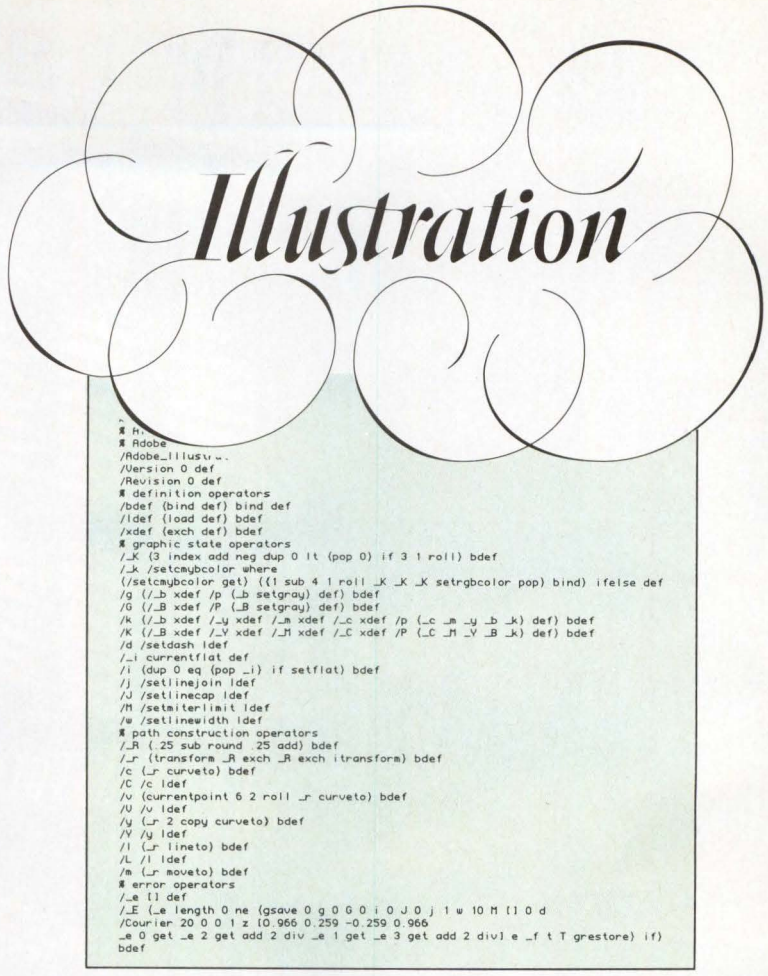
LaserWriter, according to Sims. For example, a Conographic system can print the standard Autodesk Inc. AutoCAD nozzle image in 5.4 seconds. The speed is due to Conographic's proprietary font-rendering and curve-processing technology.

The ConoDesk 6000 can drive printers via device drivers for software such as Microsoft Corp.'s Windows or Xerox's Ventura desktop publishing package, or it can operate in PostScript interpreter mode. Faster speeds are attained from bypassing PostScript mode and printing directly from the application. Conographic, which begins volume shipments this quarter, sells to printer manufacturers and OEMs.

Other PostScript clone developers just beginning to ship include Bauer Enterprises, Eicon Technology Corp., Lincoln & Co. and Printware Inc. Printware bundles its Printscript interpreter with its 720IQ Laser Imager, which prints at 1,200 dpi (horizontal) by 600 dpi (vertical). The system includes a dedicated image processor with two 68000s and a custom processor, 1M byte of RAM, and eight font outlines stored in ROM. Printware uses Bitstream fonts.

Printware, which manufactures its own print engine, developed its own interpreter—rather than license Adobe's—for economic and financial reasons, according to marketing manager Linda Gray. Printware uses Bitstream fonts. Clearly at the high end of the laser printer market, the company competes with typesetting equipment vendors.

OASYS Inc. is another major controller manufacturer and laser printer vendor that prefers a PostScript clone interpreter over Adobe's. Why? "Business factors, cost, speed and flexibility," says company president Peter Steiner. OASYS would not reveal which clone it adopted.




```
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% Adobe
/Adobe_Illustrator_
/Version 0 def
/Revision 0 def
% definition operators
/bdef {bind def} bind def
/ldef {load def} bdef
/xdef {exch def} bdef
% graphic state operators
/_K {3 index add neg dup 0 lt {pop 0} if 3 1 roll} bdef
/_k /setcmybcolor where
{/setcmybcolor get} {{1 sub 4 1 roll _K _K _K setrgbcolor pop} bind} ifelse def
/g {/_b xdef /p {_b setgray} def} bdef
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/_i currentflat def
/i {dup 0 eq {pop _i} if setflat} bdef
/j /setlinejoin ldef
/J /setlinecap ldef
/M /setmiterlimit ldef
/w /setlinewidth ldef
% path construction operators
/_R {.25 sub round .25 add} bdef
/_r {transform _R exch _R exch itransform} bdef
/c {_r curveto} bdef
/C /c ldef
/v {currentpoint 6 2 roll _r curveto} bdef
/V /v ldef
/y {_r 2 copy curveto} bdef
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/l {_r lineto} bdef
/L /l ldef
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Using PostScript, *creating the word "Illustration" as shown required about 110 lines of set-up code, a few lines of which are shown.*

To Adobe or not to Adobe

PostScript clones may be attracting some laser printer and controller vendors, but, so far at least, large vendors are still hitching their wagons to the official Adobe interpreter. Why?

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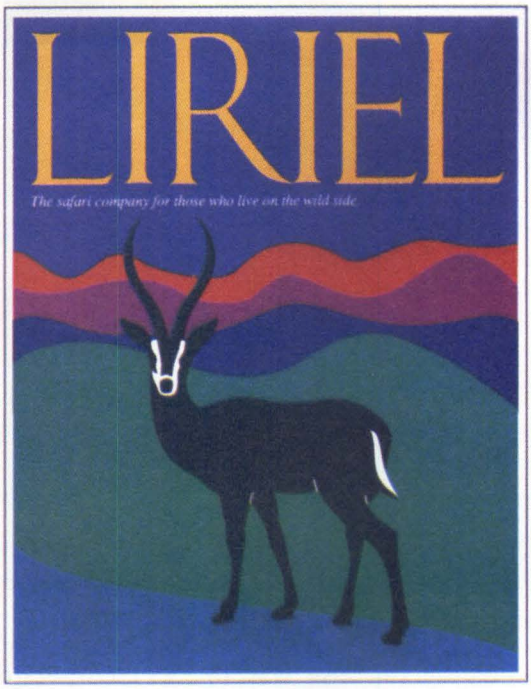
"At the time we were ready, last spring, none of the clones were proven and shippable," says AST Research Inc.'s Renée Stevenson, manager of special projects.

But mere availability wasn't the only reason AST chose Adobe. Stevenson, a former product manager at Linotype, cites Adobe's "extremely high-quality typefaces." Stevenson acknowledges that other type-houses, such as Bitstream and Compugraphic Corp., may have equally good fonts, but points out that many users have investments in downloadable PostScript libraries and thus demand compatibility.

In addition, AST downplays the usual criticisms levelled at Adobe. "It's a misperception that Adobe's prices are exorbitant," contends Stevenson, explaining that the high prices of laser printers are due more to vendor margins and expensive controller implementations. "When you're an OEM, end-user costs are determined by numerous factors," she says.

To better respond to licensees, Adobe last year implemented a "short port" policy to



This PostScript-derived image *was created using Adobe's Illustrator software and a Mitsubishi G650 color thermal printer.*

What are the clone makers cloning?

Charles LeCompte and **Naomi M. Luft**
Datek Information Services

Because the PostScript that Adobe Systems Inc. sells printer vendors is more than just a page description language, confusion often arises over just what it is the clone makers are cloning. PostScript, of course, is the name Adobe has given the high-level programming language used to describe a page's composition. However, to take advantage of the PostScript language, a system must also have a number of other elements.

First of all, PostScript-compatible application programs must have compatible driver software. The software is needed to convert the application program's internal method of representing a page into a PostScript program. In addition, a second program, called an interpreter, is required to process into printable bit-map data the high-level code created by the driver. This interpreter typically runs on a dedicated processor located either in the printer or on an add-in board in the host. Often, the term interpreter refers to both the software and to the hardware on which it runs.

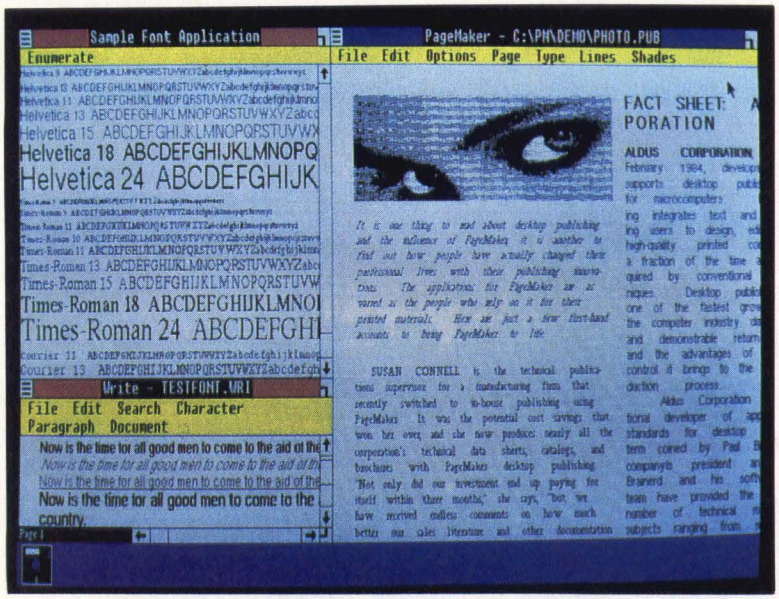
Adobe has employed a variation of the "razor-blade" strategy with PostScript. In the first place, because the language is in the public domain, it is easy for software houses to produce drivers for their applications, thereby creating a demand for PostScript printers. But, the interpreter for both the firmware and the hardware is proprietary and, therefore, subject to royalty. Reportedly, Adobe charges 5 percent to 7 percent on each printer sold. Between $100,000 and $200,000 of the royalties are paid up front, out of a $2 million minimum over the two-year life of the typical contract.

Thus, it is Adobe's profitable interpreter that most clone builders try to emulate. The ultimate goal is to produce software and/or hardware that can take PostScript code generated by an application program and create a bit-map that is as close as legally possible to one produced from the code by an Adobe interpreter.

Fonts are the foundations

Many developers say the most difficult aspect of cloning PostScript concerns the fonts. Clone builders must not only create or buy fonts that are equivalent in style and set-width to Adobe's, they must also develop a scaling algorithm and—most difficult—come up with "optimization rules" for fine-tuning the bit-maps produced after scaling.

Because the fine-tuning of fonts is essentially a typographic—rather than a software or hardware—task, almost every company involved in PostScript cloning has turned to type suppliers for help. Both Bitstream Inc. and Compugraphic Corp. offer Adobe-compatible fonts as well as font-optimization rules. These rules are not Adobe-compatible, since neither Bitstream nor Compugraphic fonts can be optimized with Adobe rules. But, some claim that the quality of the output is superior to that of Adobe.



Adobe-licensed PostScript *screen fonts are bundled with Renaissance GRX's Legacy II graphics adapter and Rendition I graphics controller. This screen was created under Microsoft Windows. Renaissance customized the fonts for improved readability and speed.*

facilitate controller design, particularly for smaller printer vendors. Taking advantage of this program, AST was able to incorporate PostScript compatibility into its TurboLaser/PS printer in 82 days. The TurboLaser uses the latest version of PostScript—Version 47—which Stevenson says is much faster than previous ones.

LaserJet straddles two standards

Although users will be able to outfit their HP LaserJet Series IIs with Postscript compatibility via the QMS board sometime this quarter, HP is by no means abandoning its own control language. The Series II currently uses PCL, HP's printer control language, or protocol, which is less powerful than full-fledged page description languages such as PostScript. HP positions PCL as a low-cost, fast alternative to PostScript that is more than adequate for the majority of laser printer applications.

In addition, responding to requests from PostScript users, HP plans to add more functionality to PCL—such as font-scaling capabilities and object-oriented graphics languages—in the next (unscheduled) release of PCL. HP is also boosting PCL by licensing it to typesetter manufacturers, thus opening the door for PCL printing at greater than 300-dpi resolutions.

Although PostScript compatibility may appear to be late in coming to the HP printers, Thad Webster, HP product line manager for languages and fonts, notes there is only a relatively small demand for PostScript, mostly in desktop-publishing applications. Of the installed base of LaserJets, Webster estimates that only about 10 percent to 25 percent of the users "really want and are willing to pay for PostScript compatibility." Although HP is relying on the QMS board, which uses Adobe's interpreter, for PostScript compatibility, the company performs ongoing clone testing at its Greeley, Colo., labs.

CCS-PAGE uses all 279 PostScript verbs and is compatible with all PostScript drivers.

Dataproducts, another major printer vendor, uses the official Adobe interpreter "because there's no question about compatibility," says product marketing manager Joe Ryan. Compatibility with PostScript refers to two areas: compatibility with PostScipt drivers, or applications, and compatibility with PostScript fonts.

Which criterion is more important to users? "Seventy percent of our customers are more concerned about making sure it runs PostScript-compatible programs and prints properly, and 30 percent are more concerned about font quality," Ryan estimates. Dataproducts implements PostScript on its 26-ppm laser

PostScript-compatible color printer debuts

Expecting to be first to market with a PostScript-compatible color printer, QMS Inc. plans to introduce next month a printer based on Mitsubishi Electronics America Inc.'s 300-dot-per-inch G650 thermal print engine.

QMS built the controller and licensed a color PostScript interpreter from Adobe Systems Inc. The controller resides in a standalone enclosure that hooks up to the printer. The system will employ standard PostScript commands and additional color-related commands. The QMS printer will have 35 resident Adobe PostScript typefaces and serial, parallel and Apple Computer Inc. AppleTalk interfaces. QMS sells through OEMs, value-added resellers and a direct sales force.

As attractive as PostScript-based color printing may be, it'll cost—both in time and money. Prices were not firm at press time, but the complete QMS system is expected to cost between $20,000 and $25,000. And it will require between 1 and 2 minutes to print a color page.

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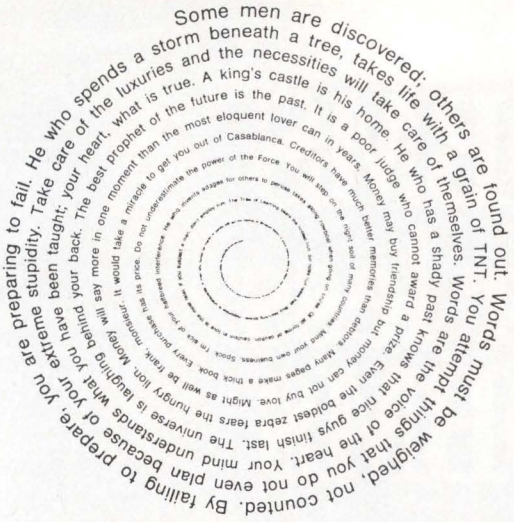
Some men are discovered; others are found out. Words must be weighed, not counted. By failing to prepare, you are preparing to fail. He who spends a storm beneath a tree, takes life with a grain of TNT. You are attempt things that you do not even plan because of your extreme stupidity. Take care of the luxuries and the necessities will take care of themselves. Words are the voice of the heart. Your mind understands what you have been taught: your heart, what is true. A king's castle is his home. He who has a shady past knows that nice guys finish last. The universe is laughing behind your back. The best prophet of the future is the past. It is a poor judge who cannot award a prize to more than one moment. Money will say more in one moment than the most eloquent lover can in years. Money may buy friendship, but money cannot buy love. Might as well be Italian. Even the boldest zebra fears the hungry lion. Many pages make a thick book. I'm not Spock. Every business has its price. Do not underestimate the power of the Force. You will step on the rights and toes of many customers. And now for something completely different

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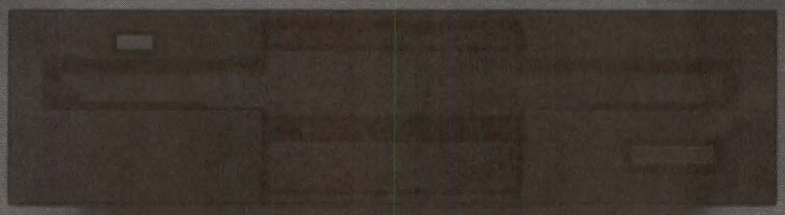

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screen image more closely resemble the laser printer output, and it increases the speed of applications running under Microsoft Windows.

Similarly, Adobe and Next Inc., Steve Jobs' new company, are jointly developing an interactive version of PostScript for the displays on Next's workstations, to be released later this year. The product is dubbed Display PostScript.

IBM, DEC drive PostScript

If there was ever any doubt about the eventual ascendancy of PostScript to industry-standard status, it was put to rest when both IBM and DEC announced support for PostScript last year. Most recently, Adobe announced the availability of PostScript software for all IBM PS/2 models that incorporate the Micro Channel architecture. The IBM SolutionPac Personal Publishing Option/A, which includes the PostScript interpreter, is available on PS/2 models 50, 60 and 80.

Taking the dominance of PostScript to outside the United States, Adobe and Nihon Digital Equipment Corp., an affiliate of DEC, have developed the first laser printer that supports a Japanese-language version of the PostScript interpreter. Nihon Digital markets the Japanese PrintServer 40. Adobe supplies outline Kanji PostScript fonts via an agreement with a Japanese typeface developer.

With Adobe licensees controlling virtually all of the PDL-based laser printer market, and HP's PCL controlling the rest of the market, the clones are clamoring for a small piece of the

Companies mentioned in this article

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Circle 367

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Mortsel, Belgium
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Apple Computer Inc.
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AST Research Inc.
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Canon U.S.A. Inc.
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Lake Success, N.Y. 11042
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pie. Prospective buyers need ask only a few questions: Will the clone interpreter run all the PostScript-compatible applications you need it to? Are the fonts and overall output quality sufficient? What are the quality/speed/cost trade-offs? Will your clone supplier still be in business by the time you get your product to market?

To better respond to licensees, Adobe last year implemented a 'short port' policy to facilitate controller design.

ACE, the helpful hardware driver

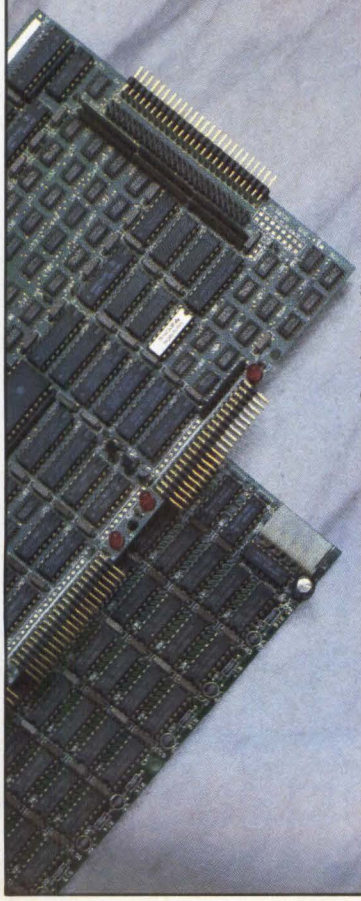
Adding a bit of confusion, there's competition for PostScript on the horizon. Genicom Corp. is touting the ACE PDL, which the company licenses from England's Chelgraph Ltd.

Genicom uses the same mathematical font outlines that Adobe does, but instead of converting them into Bezier outlines, Genicom uses lines and arcs. The advantage is that Bezier outlines are more computation-intensive. Genicom's approach uses a raster image processor, or RIP, that includes a 68000 and a bit-slice coprocessor.

Rob Auster, director of marketing, claims that ACE is at least 10 times faster than PostScript. For example, to generate the spiral shown in the accompanying figure takes an Apple LaserWriter about 10 minutes. In contrast, a Genicom printer running ACE produces the same image in 23 seconds. Recognizing that ACE is an alternative to PostScript, and not necessarily a competitor, Genicom laser printers support both.

Genicom showed ACE-equipped 400-dpi and 600-dpi printers at COMDEX/Fall, but doesn't expect to ship in quantity until next quarter. Auster—a former Adobe employee—comments, "Adobe is a rich tool, but it's like driving a Mercedes to get a loaf of bread. ACE is more like a fast Chrysler." □

Interest Quotient (Circle One)
High 517 Medium 518 Low 519



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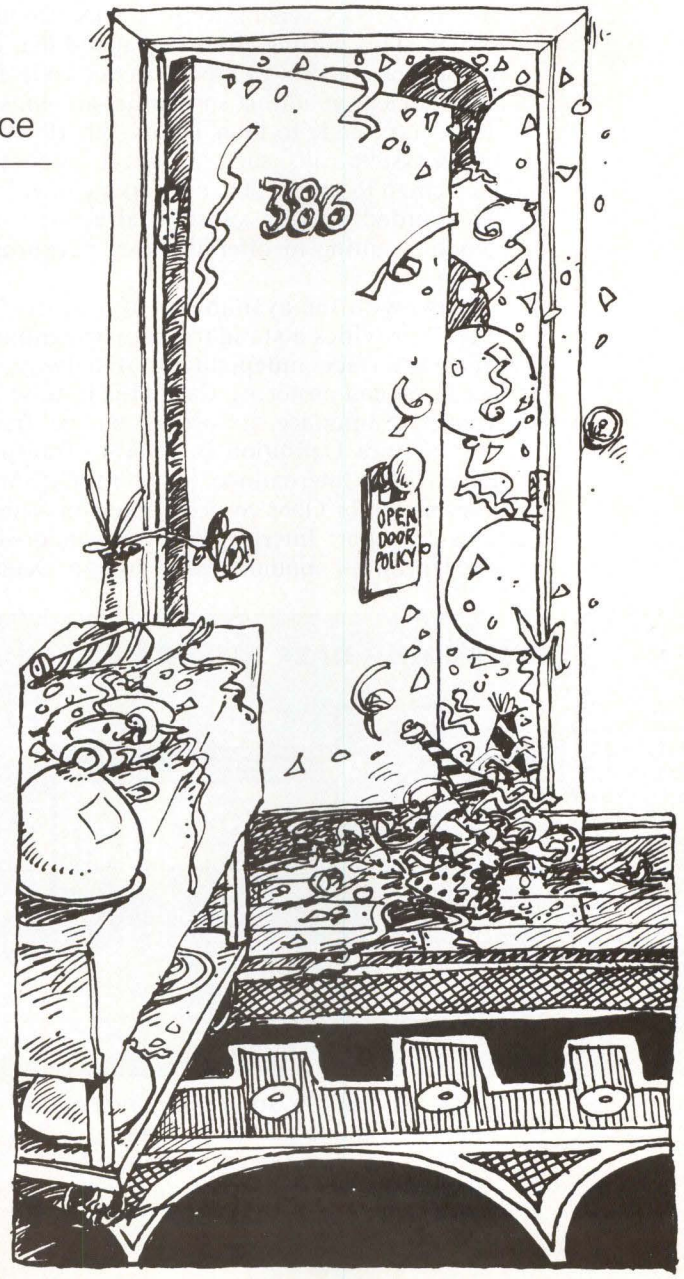
CIRCLE NO. 22 ON INQUIRY CARD

NEW, FRIENDLY UNIX MEETS 386 CHALLENGE

Streams modules open the door for handling multiple protocols over a single network hardware interface



Bill Lee, Interactive Systems Corp.

UNIX System V/386 Release 3.0, the latest AT&T Co. UNIX version for the Intel Corp. 80386 microprocessor, is winning hardware and software vendors away from proprietary operating systems in favor of the UNIX standard. Its most important addition is improved networking support, which includes UNIX's Streams and RFS (remote file sharing).

Streams consist of Streams modules, a Stream head and the necessary interface code. Other new features include shared libraries, FSS (file system switch), dynamic disk partitioning, bad-block handling, mandatory file and record locking, and the system-administration menu subsystem.

Basically, only two choices exist in selecting an operating system for the Intel Corp. 80386 microprocessor: MS-DOS and UNIX. However, MS-DOS is written for the 8086 architecture and is a single-user and single-tasking system limited to 640K-bytes of memory. Tricks such as bank switching can be used to extend programs beyond the 640K-byte barrier, but these procedures require special codes. The codes are often inefficient and don't generally solve the limited-memory problem. MS-DOS on a 80386 system simply provides the equivalent of a faster 8086 machine.

IBM Corp. and Microsoft Corp. have announced the new OS/2 operating system, which addresses some of the shortcomings of MS-DOS. However, OS/2 is based on an 80286 technology and cannot use the full capabilities of the 80386 architecture. Moreover, OS/2 is

not yet on the market, and an 80386 version of OS/2 will not be available for some time.

Release 3.0 has standard interface

Prior to Release 3.0, AT&T UNIX did not provide a standard network interface. Vendors were forced to develop their own network standards and interfaces, which resulted in compatibility and portability problems. Many vendors adopted the Berkeley UNIX Version 4.2 socket interface, which provided a consistent network interface for user applications. However, this approach required porting the kernel-resident portion of the networking code from the Berkeley VAX UNIX version to the UNIX vendor's system. This porting effort demanded that the vendor have access to UNIX source code and be proficient at adding substantial amounts of new source code to their UNIX kernel. Additional system calls, such as "select," were implemented to support the networking interface. This added up to a substantial effort for a vendor wanting to offer Berkeley networking facilities.

Now, with the availability of Release 3.0, AT&T provides a standard network applications interface independent of networking hardware and protocols. Called the Release 3.0 Transport Interface, it is based on the Transport Service Definition in level 4 (Transport Layer) of the International Standards Organization model for Open Systems Interconnection. This Transport Interface requires vendor-supplied protocol modules, such as the Department of Defense's TCP/IP (Transmission Control Protocol/Internet Protocol) or AT&T's Starlan/URP (Universal Receiver Protocol). Using Streams, protocol modules can be configured into a binary UNIX release and not require a source code integration. This Streams configuration can be easily performed by software vendors or end users. Also, Streams modules are portable between UNIX V Release 3.0 systems at a source level and between UNIX V/386 systems at a binary level.

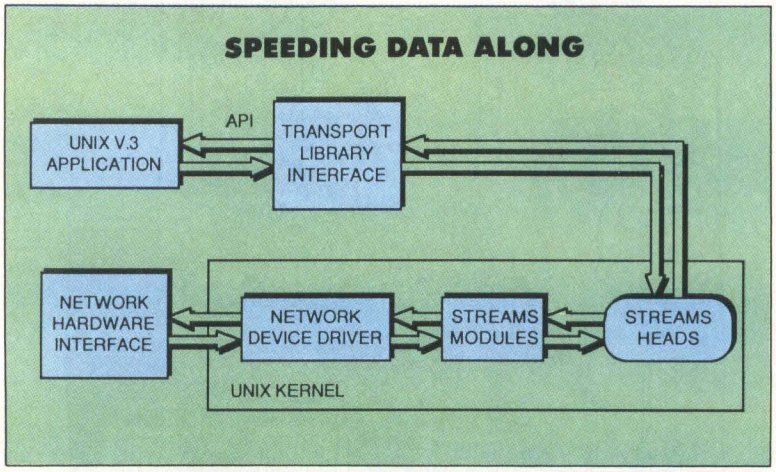
A UNIX Release 3.0 application uses a standard API (application programming interface) to access network services. The TLI (transport library interface) provides the application with ISO-compatible network services, regardless of the actual network or network protocols.

Using the TLI, the application communicates with the kernel-resident Streams head by using the standard UNIX system call. The Streams head then converts the procedural system call into a Streams message. The resulting message is passed down the specified Stream whose modules then implement the appropiate network protocols. After being processed by the Streams modules, the data is passed to the device driver controlling the network interface hardware, which then sends the appropriate data from the application out over the network.

Because the interface to Streams modules is well-documented, software developers can package network protocols for a variety of systems without having to modify their code for different processors or architectures. Streams support multiple network protocols over a single network-hardware interface. Application programs can dynamically specify the Streams modules they wish to use during execution. This combination of binary configurability of network protocols and dynamic selection of multiple network protocols was not available in previous UNIX systems.

RFS provides a distributed file system for UNIX System V, which preserves the UNIX file system semantics and is completely transparent to applications. Applications executing on a remotely mounted file system, under RFS, will behave identically to those executing on a local file system.

Other UNIX distributed file systems, such as Sun Microsystems Inc.'s NFS (network file system), provide an almost transparent capability, with some file-system operations performing differently on a remote file system than they would on a local file system. For example, file-locking applications on NFS remote file systems may behave differently than the same



UNIX Streams head *converts procedural system calls into a Streams message. This message is passed on to the specified Streams module, which then implements the indicated network protocol.*

FASTEST GUN IN TOWN

Configuration	Operating system	Compiler	Dhrystone (register)
Compaq Deskpro 386/20	386/ix (UNIX V.3)	Greenhills C 1.8.2H	9225
IBM PC/AT (6 MHz)	PC-DOS 3.0	MS C 3.0 (small)	1086
Compaq II (8-MHz 80286)	MS-DOS 3.1	MS C 3.0 (large model)	1140
Compaq II (8-MHz 80286)	MS-DOS 3.1	MS C 3.0 (small model)	1428
IBM 4381-2	VM/SP 3.18	Waterloo C 1.2	5681
DEC VAX 8600	VMS	VAX-11 C 2.0	7142

Source: Interactive Systems Corp. and Dhrystone 1.1

applications running on UNIX local file systems. However, careful attention when coding an application for an NFS environment can minimize or eliminate these differences. RFS preserves the complete UNIX file system functionality without special coding requirements though, unlike NFS, it is compatible only with other UNIX systems.

Also, shared libraries allow all UNIX programs to use a single copy of the run-time library. A copy of this library is stored on disk and a copy resides in memory. In previous versions of UNIX, as in most operating systems, the library is linked into each program.

Release 3.0 contains more than 350 commands in UNIX. Having a single library copy can result in considerable savings in disk space. The amount of memory saved varies with the number of commands being executed at any moment, but will typically be between 10K bytes and 30K bytes per running program.

Additionally, the FSS provides a standard interface that allows UNIX to support non-UNIX or modified-UNIX file systems. The Release 3.0's FSS from AT&T supports only the standard UNIX and RFS distributed file systems. But it provides "hooks" for supporting MS-DOS file systems, XENIX file systems, NFS and other types of file systems. Once the necessary interfaces are developed, these different file systems can be mounted as a UNIX file system, and can be accessed and modified with standard UNIX applications.

Other UNIX alternatives

An alternative UNIX solution for an 80386-based system is XENIX 386, from Microsoft. The UNIX kernel (the memory-resident portion of the operating system) for XENIX is a 32-bit implementation that runs on 80386-based systems, and is structured on earlier releases of UNIX. The applications provided with XENIX 386, such as vi editor, C compiler and UNIX utilities, are all XENIX 286 16-bit implementations. These applications cannot provide the same capabilities as 32-bit 80386 versions, due to speed and memory limitations. Because XENIX 386 is based on the earlier release of UNIX System V Release 2.0, it lacks some of the functionality that AT&T has provided in Release 3.0. The most notable omissions are a standard networking interface, as provided by Streams, and shared libraries.

The 386/ix is based on Release 3.0, which was developed by Interactive Systems Corp. of Santa Monica, Calif., under contract to Intel and AT&T. The code was tested through an extensive beta program managed by Intel (with more than 60 80386 beta sites). Building on the experience gained during the 80386 port, 386/ix provides functionality and enhancements that are not available in other implementations of 80386 UNIX software. These additional features include IBM PC/AT device drivers, a faster file system, direct disk page-in, virtual console support and availability of binary and bootable versions. It also offers options such as the VP/ix DOS-under-UNIX facility, software development system, network connection facilities and text processing workbench.

Few vendors have the resources to develop a new operating system from scratch.

Unlike the AT&T 80386 UNIX source-code product, 386/ix contains the UNIX device drivers for PC/AT compatible peripherals. These AT/386 device drivers were designed for standard AT controllers. They include support for keyboard, display adapter (monochrome, color graphics adapter, enhanced graphics

FEATURE HIGHLIGHTS OF MS-DOS, OS/2 AND UNIX

	Hardware required	Hardware supported	Users	Tasks	Max. memory supported by required hardware	Max. user memory	Operating system security*	File system security
MS-DOS	8086, 8088	8086, 8088, 80286, 80386	1	1	640K bytes plus 8M bytes extended memory standard (real)	approximately 600K bytes plus 8M bytes EMS (real)	none	none, single user
OS/2	80286	80286, 80386	1	multi	1G byte (virtual)	16M bytes (virtual) per process	protected mode: good real mode: none	none, single user
UNIX	80386	80386	multi	multi	4G bytes (virtual)	3G bytes (virtual) per process	complete	user- and group-level permissions for read, write, execute

Notes: EMS=Extended Memory Specification

*System security: unprotected modes let applications take control of hardware functions in a manner that can lead to system crashes.

**The OS/2 "Compatibility Box" runs DOS 3.x applications in real mode.

†System V.3/386 UNIX runs UNIX 286 binaries in 16-bit protected mode.

‡DOS-under-UNIX environments, such as VP/ix, use the virtual 8086 mode to run DOS applications.

The UNIX features are for System V.3/386 UNIX systems operating in an 80386-based environment.

adapter and Hercules), printer, flexible disk; rigid disk, CMOS memory, and real-time clock. Additional device drivers have been developed to support multiport serial communications (up to 32 users), streaming cartridge tape and MICOM-Interlan Inc. intelligent TCP/IP Ethernet controllers.

To handle the high I/O requirements that UNIX needs for multiuser performance, 386/ix contains device drivers for RLL (run length limited) and ESDI (enhanced small device interface) disk interfaces. Interactive also provides technical documentation to assist OEMs in developing their own 386/ix device drivers. To assist less experienced users, 386/ix offers a kernel configuration link kit to provide a user-friendly interface for adding device drivers and configuring the UNIX kernel.

The 386/ix incorporates the 386/ix fast file system. Transparent to the user and application, the 386/ix Fast File System allocates files contiguously where possible. Contiguous reads can improve file system throughput by a factor of 2 for certain applications, and can provide noticeably better file system performance for almost every application. Even better performance is achieved when loading programs for execution.

Another 386/ix performance improvement is direct disk page-in. Applications are loaded directly from disk to memory pages, bypassing the UNIX system disk cache. The result is a much faster start-up time, especially for large applications, such as editors and compilers. Direct disk paging requires fewer UNIX disk cache buffers and less disk swap space, resulting in noticeably quicker program start-up and a perception to the user that 386/ix is faster than other UNIX implementations.

386/ix provides virtual console support, which allows multiple-session, hot-key control. As many as 12 sessions can be supported at one time, each running an application such as vi, a C compiler, or a spreadsheet. This capability is particularly important when running under UNIX DOS applications that require the use of an EGA and cannot be run on an ASCII serial terminal. The 80386 processor can support a large number of multitasking applications; the 386/ix virtual console provides the functionality to support them on a single display.

Other distinctions between 386/ix and the AT&T product include the availability of a binary version and a bootable version for the 80386.

UNIX and DOS share files

One of the major 386/ix features is its VP/ix option, which provides multitasking, multiuser, MS-DOS support while running UNIX.

Log-in security	Device I/O	Execution granularity	Execution modes	Interprocess communications	Interthread communications	Networking	Memory management	Foreign file system support
none, single user	simple, often polled	program	real			PC NET, MS NET, PC NFS, Novell, others	physical static, segmented	none
none, single user	interrupt driven, multiple outstanding requests	thread within process	16-bit protected, real**	shared memory message queues, semaphores, pipes	RAM semaphores	LAN Manager	virtual, demand segmented	none
user password protection	interrupt driven, multiple outstanding requests	process	32-bit protected 16-bit protected†, virtual 8086‡	shared memory, message queues, semaphores pipes		RFS, NFS, PC servers (e.g. Vianet, XenixNet)	virtual, demand paged flat	DOS (386/ix)

Source: Interactive Systems Corp.

VP/ix allows users to run "off-the-shelf" DOS applications, including Microsoft Flight Simulator and others that expect direct control of 8086-based hardware and are not "well-behaved." It actually provides more complete MS-DOS and PC compatibility than IBM's recently announced OS/2.

Under VP/ix, DOS and UNIX applications can share files in the UNIX file system. Furthermore, by using Interactive's Integrated DOS-FSS (DOS File System Support) component, DOS and UNIX can share files in a MS-DOS file system. The MS-DOS file system can be either a partition on the rigid or flexible disk. DOS-FSS allows mounting of DOS file systems as if they were UNIX file systems. The MS-DOS files can then be accessed directly with UNIX applications without copying or transferring the contents. Full VP/ix support is also offered for XENIX 386 by Microsoft.

Interactive's Software Development System, Network Connection Facilities and Text Processing Workbench are used in those environments that require the extended functionality. The Software Development System provides Interactive's port of the AT&T RCC (Register C Compiler) for the 80386; AT&T's language development tools such as lex and yacc; and the sccs source code control system. The Network Connection Facilities provides the support needed for running RFS and additional networking facilities. The Text Processing Workbench is Interactive's port of AT&T's Documenters Workbench 2.0 for the 80386. It includes nroff and troff; preprocessors for creating tables, equations and graphs; and support for several dot-matrix printers, laser printers and phototypesetters.

What is the future of UNIX? Interactive is working with AT&T and Microsoft to provide a single standard for UNIX on 80386-based systems. One of the first milestones in this process will be achieving binary compatibility between XENIX and UNIX System V/386. Many of the existing UNIX applications are written for XENIX, and directly supporting XENIX 286 and XENIX 386 binaries under UNIX V/386 will extend the applications for 386/ix. □

Bill Lee is director of technical programs and oversees 80386-UNIX development at Interactive Systems Corp., Santa Monica, Calif. He has been manager of software development at Cyb Systems and UNIX coordinator at the University of Texas Computation Center.

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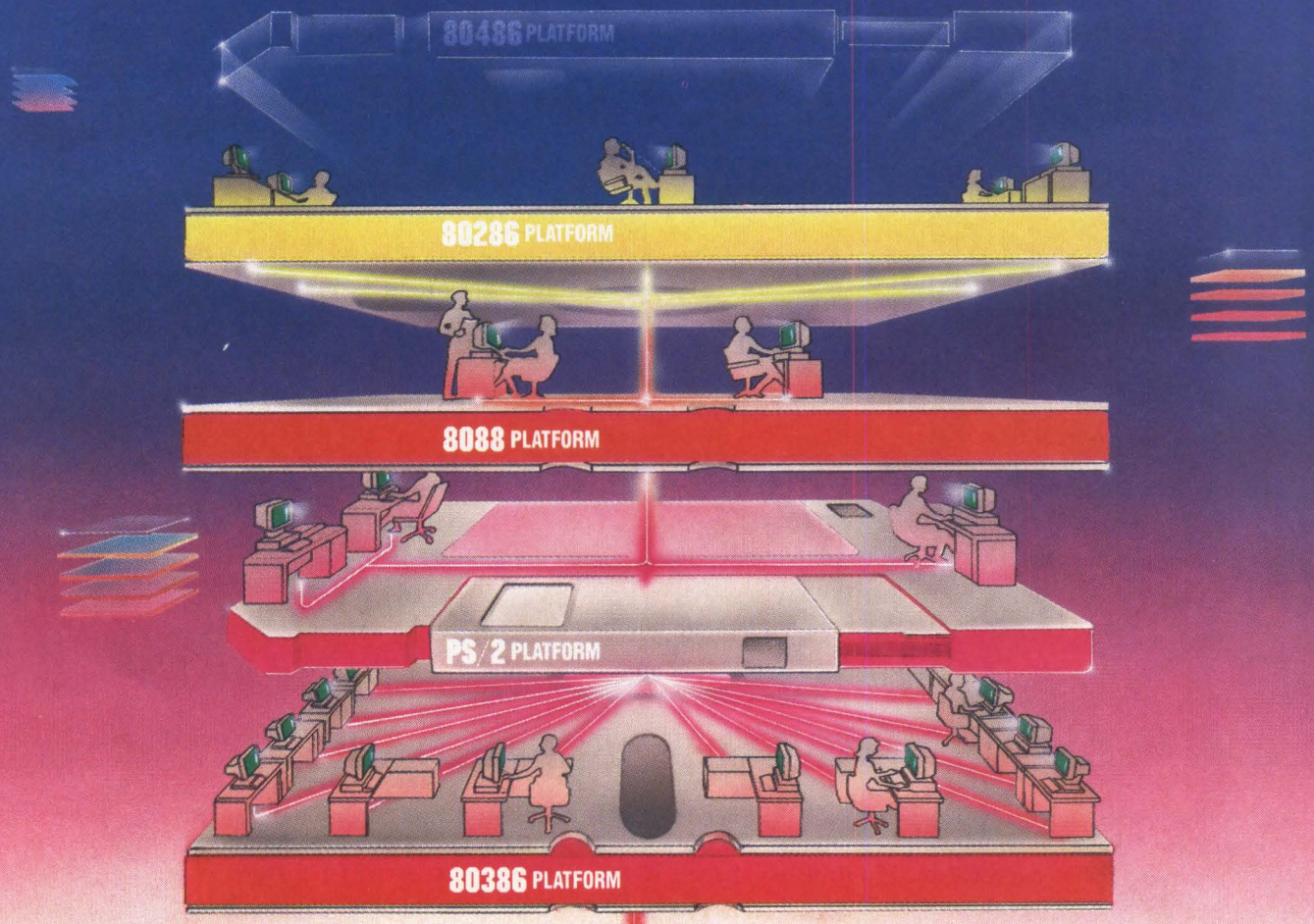

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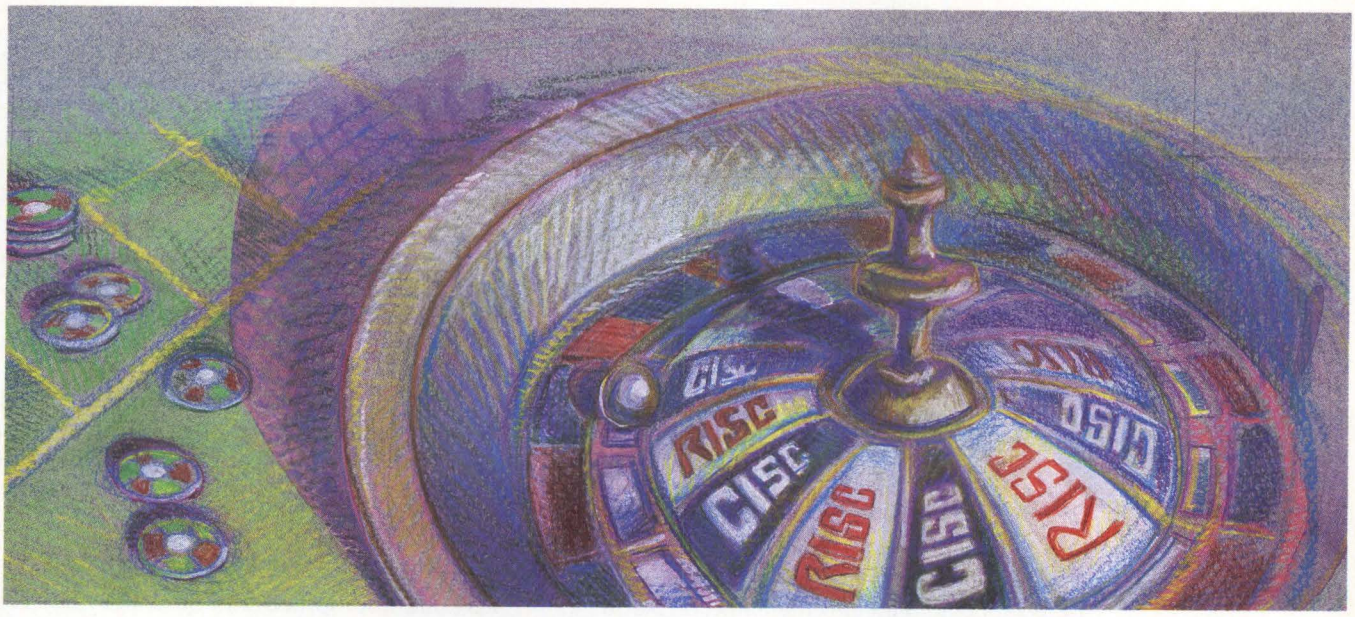


WHERE THERE'S RISC, THERE'S OPPORTUNITY

As more vendors field pure RISCs and streamline CISCs, VARs, OEMs and system integrators could realize price/performance breakthroughs

Andrew Allison, Contributing Editor

In late 1987, AT&T Co. and Sun Microsystems Inc. announced plans to outfit Sun's SPARC reduced instruction set computer (RISC) microprocessor with a new UNIX operating environment. In a related announcement, Areté Systems Corp., a manufacturer of multiprocessor systems that support 16 to 256 users, revealed that it would build high-performance computers based on Sun silicon—the scalable processor architecture chip—by the latter part of 1988. (Areté promises superminicomputer performance at supermicrocomputer prices.)

These developments, along with Xerox Corp.'s endorsement of the SPARC chip, should send a strong signal to value-added resellers and system integrators competing in the microcomputer, workstation and supermicrocomputer arenas. RISC architecture, along with streamlined complex instruction set computer (CISC) processors and the UNIX operating system, will dramatically change price/performance of products from add-in processors to systems, from microcomputers to minicomputers.

And price/performance is the name of the game, especially in the hotly contested workstation market. Manufacturers of the workhorses in this class—currently dominated by Motorola Inc.'s MC68020 microprocessor—are beginning to embrace RISC concepts and to recognize the performance leaps they offer. "Competitive high-performance workstations require the use of RISCs," says Forest Baskett, vice president of R&D at workstation vendor

The Intergraph InterPro 200 *workstation series uses the Clipper RISC chip to pack added functionality into the same package used for the original InterPro 32C, the first merchant-market RISC workstation.*

Silicon Graphics Inc. He adds, "Sun's SPARC microprocessor offers 2-to-3 times, and MIPS Computer Systems Inc.'s R2000 about 4 times, the performance of the MicroVAX 3000 in workstation implementations."

These developments also climax 14 months of RISC ventures since *Mini-Micro Systems* last investigated RISC technology and products ("RISCs challenge mini, micro suppliers," MMS November 1986, Page 127). Since then, the benefits of streamlined architecture have become clear. With several "pure RISC" system implementations and well-established CISC architectures being streamlined by the incorporation of RISC features, the methodology has entered the mainstream of computer systems design.

Microcomputers take RISC plunge

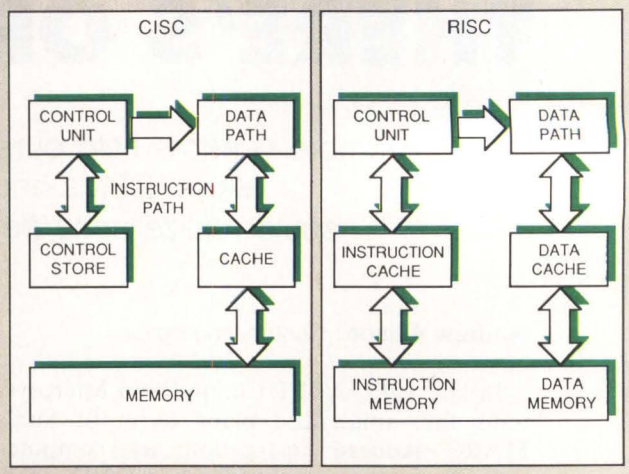
Like the microprocessors on which they are based, RISC microcomputers fall into two categories: powerful, typically application-specific,

RISCs are register-rich with time to share

RISC (more accurately, streamlined) architectures make use of several "reduced instruction set computer" techniques to minimize the total number of clock cycles required to execute programs. Instruction-set simplification, which typically eliminates microcoding, greatly reduces the amount of control logic and hence makes possible powerful single-chip implementations. Also, load-and-store architectures reduce the delays associated with data access. Up to 50 percent of the instructions executed in a typical CISC (complex instruction set computer) access data memory, and less than 20 percent are register-to-register operations. In a load-and-store architecture executing the same functions, these percentages may well be reversed.

Because streamlined processors use registers more extensively, they typically have a minimum of two sets of 16 working registers. Some offer as many as 16 banks of 32, often overlapped to facilitate parameter passing. The use of register-rich architectures originated with the University of California at Berkeley researchers and contrasts with the Stanford University-IBM Corp. approach, which stresses compiler technology.

At current levels of compiler optimization, reduced instruction sets typically require 15 percent to 20 percent more, albeit faster, instructions to execute the same functions as complex ones. While this puts



Separating the instruction *and data paths, a common feature of current RISC implementations, helps lower the clock cycles per instruction.*

a premium on instruction-memory bandwidth, the data-memory bandwidth requirements of register-oriented architectures are much lower than for memory-oriented architectures. As a result, streamlined architectures frequently use separate instruction and data paths (i.e., Harvard architecture, see Diagram). Dual caches, sometimes with their own

add-in processors for standard buses; and general-purpose systems.

Add-in processors based on the Novix Inc. family of microRISCs, for example, are being used in image-processing applications such as graphics, image enhancement, OCR (optical character recognition) and machine vision. The FORTH programming language, directly executed by Novix's NC series, is also well-suited to motion-control and disk (especially optical-disk) controllers. Robotics applications are also proving popular.

Calay Systems Inc., a leading supplier of design-automation systems for printed-circuit board (PCB) layout, introduced an NC4000-based product in September 1986. The RPR-7 Autorouting Accelerator, a $19,000 Q-bus-compatible PCB autorouting processor with up to 2M bytes of local grid storage (externally expandable to 16M bytes) and 1M byte of program memory, runs Calay's routing software 15 times faster than a Digital Equipment Corp. VAX-11/780—equivalent to 15 MIPS. Another example of an add-in product is the Fast9 PC/AT coprocessor from Quintek Ltd., which incorporates nine T414 or T800 transputers, each with 1M byte of RAM. This $25,950 add-in processor is said to deliver 13.5 MFLOPS (million floating point operations per second).

Price/performance is the name of the game in the hotly contested workstation market.

For general-purpose systems, MIPS Computer has been the leading board-level RISC supplier, but it is de-emphasizing this area in order to concentrate on various systems. However, the board-level products, typically VMEbus-compatible, provide a relatively painless way

MMUs (memory-management units) are also common, and single-cycle cache access is a significant advantage.

An instruction cache can be viewed as a dynamically alterable, writeable control store. This capability facilitates optimization for execution of high-level languages or specific applications. It may include allocation of the internal resources, e.g., of registers between general-purpose and cache utilization.

Get over pipeline stalls

Most modern processors employ pipelining. If the execution of one instruction depends upon the results of a preceding one, the pipeline must be halted until the results are available, and it often must be flushed and refilled. The most common cause of a pipeline "bubble" is a branch instruction and, instead of simply clearing the pipeline, many streamlined processors continue to execute instructions until the branch destination becomes available. This uses machine cycles that otherwise would be wasted (delayed branching). Some RISC architectures attempt to predict the branch destination instead.

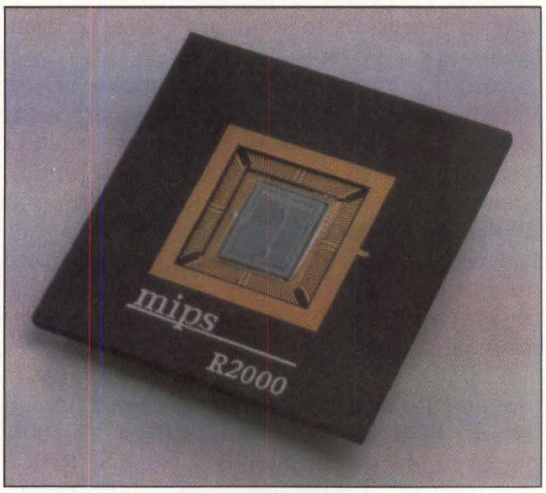
Streamlining is also influencing traditional microprocessor design. Tom Johnson, manager of technical communications for Motorola Inc.'s Microprocessor Group, points out that, "New technology tends to merge with old to obtain the best of both worlds." He adds, "Streamlining is an implementation methodology that can equally well be applied to existing architectures." For example, the average cycles per instruction has declined for successive implementations of the MC68000 architecture—from 12 for the 8-MHz 68010 to 5.5 for the 20-MHz 68030.

Johnson says, "The applicable streamlining techniques, especially those that reduce memory-bandwidth requirements, have been incorporated into the 68030." Specifically, execution-unit control points and several instructions have been hardwired, and the instruction and data paths have been separated (each with its own 256-byte on-chip cache). A three-stage pipeline was determined to be the best trade-off between architecture and performance, but the MMU has been brought onboard, and a highly autonomous bus controller prioritizes bus accesses. The multiple internal operations occurring in parallel reduce the effective cycle time of the two-cycle execution unit towards the RISC goal of an instruction per cycle, and Motorola is claiming for the 68030 double the performance of the 68020. Motorola has also been working on a "pure- RISC"design, the M78000. Intel Corp. has acknowledged that it too is developing a RISC chip.

Johnson also draws attention to a frequently overlooked aspect of RISC technology development in pointing out that, "The development of RISCs is resulting in very rapid advances in compiler technology, the benefits of which accrue to all computer architectures, RISC, CISC or hybrid."

for OEMs to gain access to RISC technology. Because any developer of RISC machines would find it difficult to market the product without one, such subsystems will proliferate.

An evolving relationship between MIPS Computer and Prime Computer Inc. illustrates the flexibility provided by the board-level approach. When Prime, an early OEM of the MIPS Computer boards, concluded it was not cost-effective to develop the graphics capability needed for high-end workstations, the two companies went to Silicon Graphics. Now, MIPS Computer supplies board-level products to Silicon Graphics, which integrates its geometry engine and then supplies Prime which, in turn, adds its own software and support value.



MIPS Computer's R2000 *chip incorporates a 10-MIPs CPU, a memory-management unit and cache control in a custom 100,000 transistor package.*

Advances on the systems front

The first "microRISC" system to market, IBM Corp.'s RT PC, was introduced on Jan. 21, 1986. With a base price of $11,700, roughly

Sparking an interest in microRISC

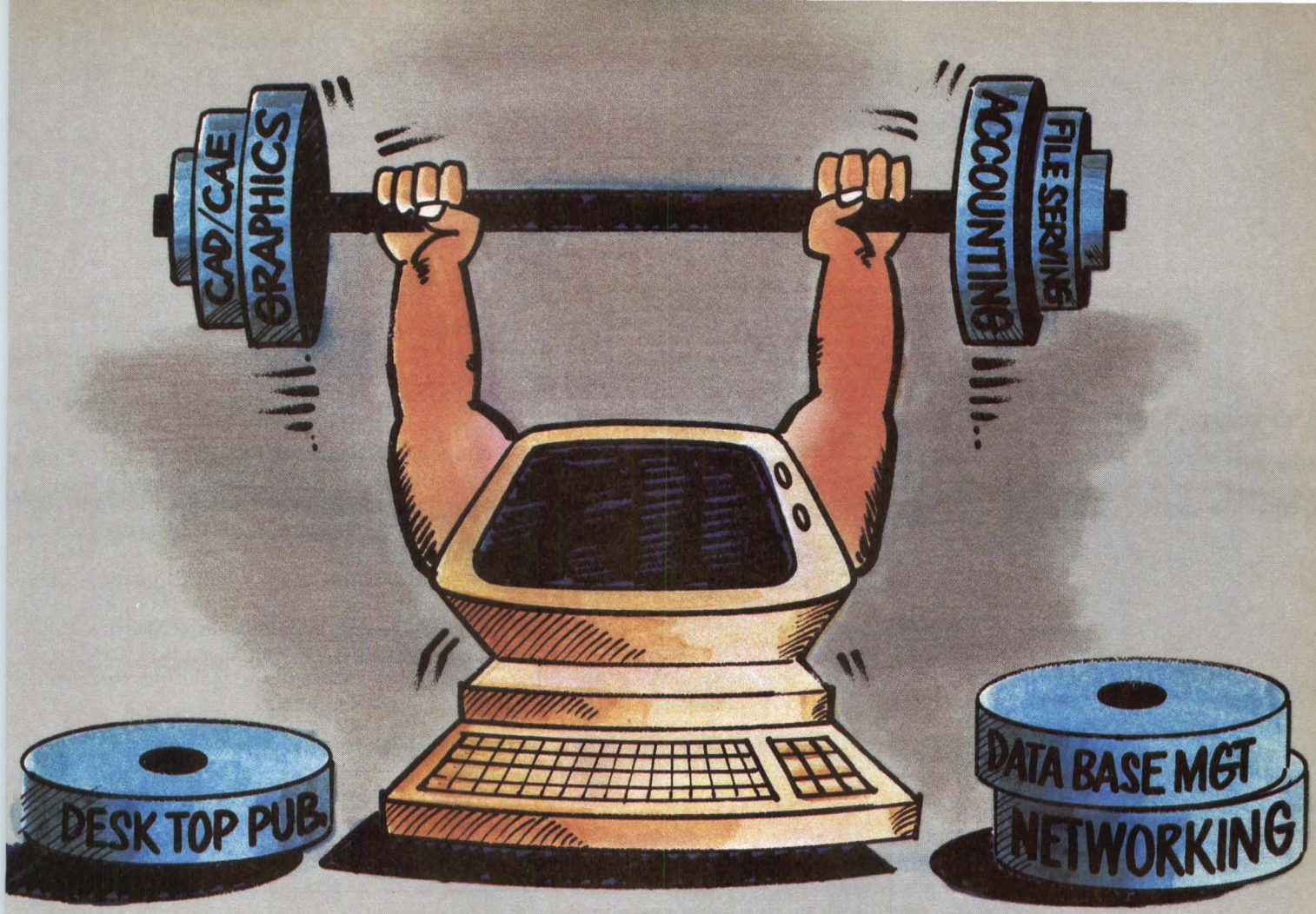
The SPARC, scalable processor architecture, from Sun Microsystems Inc. (manufactured by Fujitsu Microelectronics Inc.) is a University of California at Berkeley-style RISC (reduced instruction set computer). It has load-and-store architecture, delayed branches and up to 32 banks of 24 overlapped (by eight) registers and eight global registers in the IU (integer unit). The initial implementation of the IU, in a single Fujitsu 20,000 gate array, has six register banks. Floating-Point operations are carried out in a companion FPU (floating point unit) with 32 working registers. These initially were implemented as a controller interfacing the Weitek Corp. 1164/65 chip-set. Provision has also been made for a second, implementation-definable, coprocessor.

In addition to Fujitsu, the SPARC architecture has been licensed to Cypress Semiconductor Corp. and Bipolar Integrated Technology Inc. for marketing as a merchant-market microprocessor and to AT&T Co. for use in workstation products. This broad-based licensing makes it very likely that SPARC will become widely used.

Also, "microRISCs," like the SPARC are catching the eye of many OEMs, because they are so compact that they can be accommodated in moderately sized gate arrays and standard cells. That compactness and the availability of powerful ASIC (application-specific integrated circuit) design tools will encourage the development of application-specific processors (ASPs). Likely targets include floating-point, vector and digital signal processors. In fact, several ASP graphics processors have already reached the market. RISC-based compute, file and terminal-network servers, back-end (database management), front-end (communications and network control), and other I/O processors have also begun to appear—as have artificial-intelligence-specific microprocessors. Because of the impact of transferring data across chip boundaries and between levels of the memory hierarchy, ASPs will be integrated into extraordinarily powerful single-chip implementations as circuit density continues its relentless advance.

At the end of last November, MIPS Computer responded to Sun's aggressive entry into the microRISC market with the announcement of three semiconductor manufacturing licencees of its own: Integrated Device Technology Inc., LSI Logic Corp. and Performance Semiconductor Corp. This multiple licensing of microRISC architectures seems certain to spread, limiting their proliferation and rapidly driving down the price of high-performance 32-bit microprocessors.

Although all of the currently available RISC microprocessors are implemented in CMOS, their low transistor count makes them suitable for a broad range of semiconductor technologies. SPARC, for example, is being implemented in ECL (emitter-coupled logic) and in GaAs (gallium arsenide) semiconductors.



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Sun Microsystems' Sun-4/200 *workstation, based on Sun's SPARC microprocessor, delivers performance comparable to DEC's VAX 8700.*

double that of the PC/AT at the time. IBM claimed the RT PC offered about 3 times the AT's performance. The ROMP (Research/Office Products Division Microprocessor) used in the RT PC is a full 32-bit, three-stage pipelined derivative of an IBM RISC minicomputer, the 801, that was never introduced. Its AIX (Advanced Interactive Executive) operating system, developed under contract by Interactive Systems Corp., is an "enhanced" (read proprietary) version of UNIX System V Release 1, with selected Release 2 and Berkeley 4.2 BSD improvements.

The 4M-byte maximum memory, 200K-byte Whetstones floating-point performance, inadequate graphics and I/O performance, and a lack of connectivity (especially local area network support) inhibited the acceptance of the RT. Just over a year after the RT's introduction, IBM announced enhancements:

- 1-micron/100-nsec CMOS versions of the initial 1.8-micron/170-nsec NMOS CPU and MMU (memory-management unit) in a single-board implementation;
- 1M-byte dynamic memory chips quadrupled the memory board capacity to 4M or 8M bytes and the system maximum to 16M bytes;
- Quadrupled disk transfer speed (to 1.08M bytes per second), and high-resolution color and monochrome support.

'Competitive high-performance workstations require the use of RISCs.'

At the same time. IBM replaced the original National Semiconductor Corp. NS32081 floating-point unit with a standard Motorola MC68881 unit (on the motherboard) and added an optional floating point accelerator. More than 80 percent of the new system's cost was said to be based on IBM products and technology.

WHERE THE CHIPS FALL

	NC4000	T800	R2000	5100	SPARC	AM29000
First delivered	1985	1985	1986	1987	1987	1987
Developer	Novix	Inmos	MIPS	Ridge	Sun	AMD
Instructions[1]	48/48	22/9	79/75	70/60	89/43	115/N/A
Technology	CMOS	CMOS	CMOS	CMOS	CMOS	CMOS
Registers[2]	ext.	4	32	16	120	192[4]
Pipeline stages	none	none	5	3	4	4
Harvard architecture	Y	N	N	Y	N	Y
Cycle time (nsec)[3]	167	50/150	60	62.5/125	60	40
Transistors	16K	238K	100K	50K	50K	N/A
On-chip subsystems (cache (K bytes)/MMU/FPU)	–/N/N	4/N/Y	–/Y/N	–/Y/N	–/N/N	–/Y/N

Notes: [1]Instructions/single-cycle instructions
[2]Excluding integral FPU registers
[3]Processor/main memory buses (if different)
[4]Dynamically assignable (stack-cache/registers)

Source: compiled from industry sources

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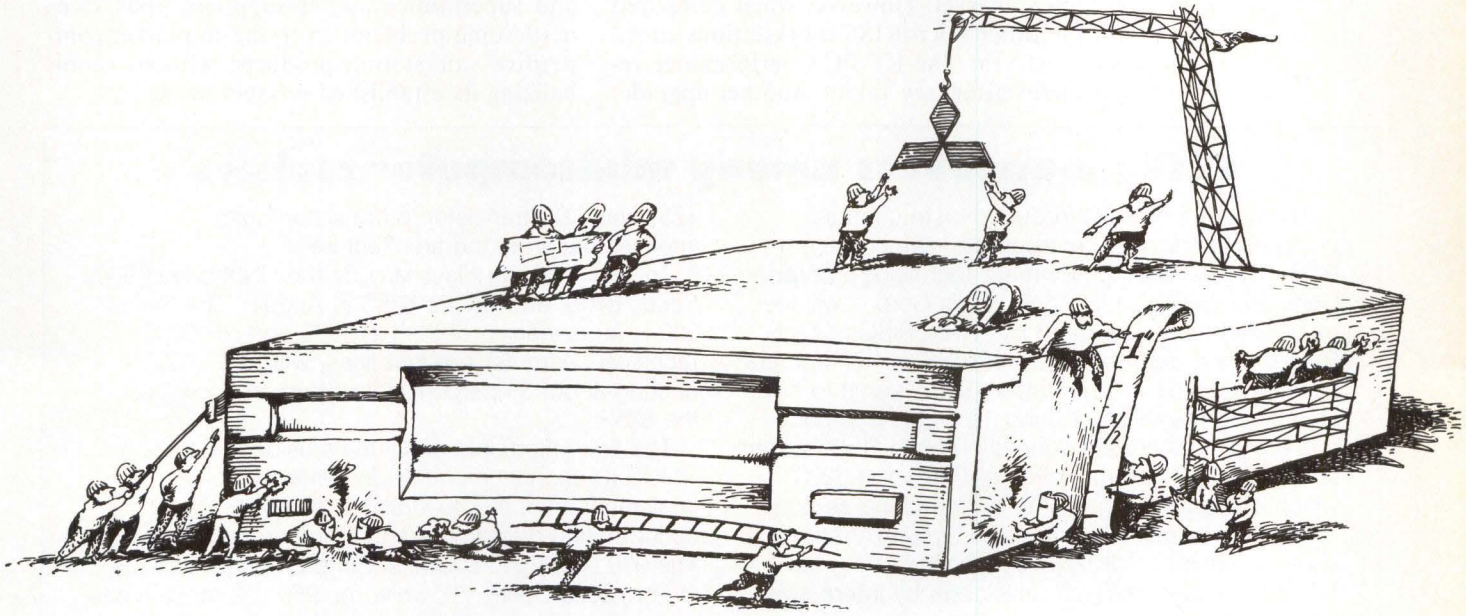

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MF353C	3½″	1″	1MB	+5V
MF355C	3½″	1″	1MB/2MB	+5V
MF501B	5¼″	1.61″	0.5MB	+5V and +12V
MF504B	5¼″	1.61″	0.5MB/1MB/1.6MB	+5V and +12V
M2896	8″	2.25″	1.6MB	+5V and +24V

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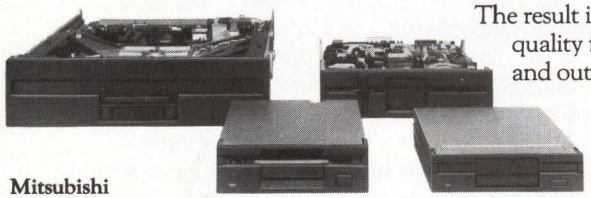

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With the introduction of IBM's PS/2 Model 80 and OS/2, it seems likely that the RT PC will become the company's vehicle for penetrating the UNIX market. However, when compared with the other microRISC workstations introduced last year, the RT PC's performance remains unexciting (see Table). Another upgrade, incorporating the PS/2 Micro Channel Architecture and other enhancements, is expected soon. Like the other established minicomputer and superminicomputer suppliers, IBM faces nettlesome problems in trying to market competitive workstation products, without cannibalizing its established product lines.

RISCy maneuvers among minicomputer makers

The handful of RISC (reduced instruction set computer) minicomputer suppliers—among them Ridge Computers Inc., Pyramid Technology Corp., Computer Consoles Inc. and Harris Corp.—will feel the market heat generated by "microRISCs." Only Ridge, which delivered the first RISC minicomputers as workstations, in September 1983, seems to have anticipated the threat. During 1986, the company repositioned itself as a general-purpose UNIX system supplier with the introduction of the Ridge 3200, which offers about the same performance as Sun Microsystems Inc.'s Sun-4 and a System V-based implementation of UNIX (RX/V) incorporating the TEN/PLUS user interface developed by Interactive System Corp.

Last September, Ridge introduced a high-performance microRISC system, the 5100. This single-board implementation of Ridge's architecture puts the CPU on the same Fujitsu Microelectronics Inc. 1.5-micron CMOS 20,000 gate-array as Sun's IU (integer unit). The implementation uses branch-prediction, instead of the more common delayed-branches technique, and an MMU (memory-management unit) that accesses separate, 32K-byte-to-128K-byte instruction and data caches in a single cycle. A companion FPU (floating point unit) is implemented in another Fujitsu gate array.

Running at 16 MHz to maintain compatibility with Ridge's 125-nsec (8-MHz) backplane timing, the 5100, according to Ridge, delivers about twice the performance of the Sun-4 and 10 percent to 20 percent more performance than the MIPS Computer Systems Inc. M/1000.

Despite the RISC plunge by this handful of vendors, only one major traditional minicomputer manufacturer has fully embraced RISC technology. Hewlett-Packard Co. continues to shift its product line to implementations of its Performance Architecture. Originally announced in February 1986, the Spectrum products suffered delays caused by difficulty in attaining backward compatibility, primarily with the I/O portion of HP's MPE XL operating system. Delivery began in November 1986 of the first of the new products, the 3000 Series 930, based on a 125-nsec TTL (transistor-to-transistor logic) implementation of the architecture.

This was followed last May by the UNIX-based 9000 Series 840S, and by the 825S in August. The Series 800 is an extension of the HP 1000 and HP 9000 technical computer product lines, with the 840S offering about 35 percent better performance than the 825S.

The first shipments of systems using a single-chip NMOS (N-channel metal-oxide semiconductor) implementation, the 3000/950 and 9000/850S, occurred last September and October, respectively. The 930 is roughly equivalent in performance to the (16-bit) 3000 Series 70, while the 950 is 2-to-2.5 times more powerful. The 850S offers about twice the performance of the 825S. A new low-end product, the 925 (positioned between models 52 and 58 and intended to compete with Digital Equipment Corp.'s MicroVAX 3000), is scheduled for introduction this Spring.

Meanwhile at DEC, RISC remains a research curio. "Digital is always investigating new technology, and, as has been publicized in the past, we have evaluated and implemented RISC machines in research," says Dom LaCava, manager of DEC's Low-End Systems Group. "The fundamental business assumption for offering a RISC machine is that it offers superior price/performance over current computer architectures. However, this price/performance is not without sacrifice—incompatibility with more than 10 years of software investment by applications developers and our customers."

DEC's position contrasts sharply with that of HP, which has (with some difficulty) switched to a source-compatible RISC architecture. LaCava does add, "If we discover through our customers that the benefits of RISCs outweigh the costs, Digital certainly has the capability to implement computers with this type of CPU." Actually, MicroVAX processor implementations have been selectively incorporating RISC methodology for several years, and it can only be a matter of time before DEC responds to the market.

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RISC MICROCOMPUTER MOUNTS THE VAX ATTACK

Company	Product	Microprocessor	Dhrystones	DP Whetstones	DP LINPACK KFLOPS	Backplane	Base price*
digital	VAX-8700	N/A	10,416	2,670	970	VAXBI	$433K
IBM	RT PC	ROMP	6,500	1,400	300	AT	$20K
mips	M/1000	R2000	23,700	7,900	1,100	VME	$59.2K
RIDGE	5100	5100	23,020	7,000	1,960	proprietary	$109K
Sun	Sun-4/200	SPARC	19,000	N/A	1,100	VME	$85.5K

Source: compiled from industry sources

MIPS Computer was the next microRISC supplier to market, with the joint introduction of the R2000 processor (a 100,000-transister unit, with a 10-MIPs CPU and cache control) and the M/500 system in May 1986. In a comparison of RISC microcomputer performance, the M/500 outperforms the DEC VAX 8600 superminicomputer at about one-tenth the price—$38,000 versus $350,000. The company introduced faster processors, single-board computers and systems in March (M/800) and July (M/1000) of 1986. John Moussouris, vice president of engineering at MIPS, expects to achieve "a better than 50 percent speed improvement per year." Unlike most of the current crop of RISC microcomputers, the MIPS systems are marketed as network servers and general-purpose systems, rather than as workstations.

In June 1986, workstation supplier Intergraph Corp. announced its first RISC workstation, the InterPro 32C. This CAE system, based on the (then Fairchild Semiconductor Corp.'s) Clipper chip, offers 6M bytes of RAM, an 80M-byte fixed disk drive and a 1.2M-byte flexible disk drive, a 15-inch 1,184-by-884-pixel color monitor, an Ethernet controller, three RS232 ports, keyboard and mouse, plus UNIX System V, for $25,000. Stressing the performance gains associated with RISCs, John Hubbard, Intergraph's executive manager of workstation marketing, reports that, "The Clipper-based system has 6-to-10 times the performance of the NS32032-based product that it replaced."

Intergraph has made a major commitment to the Clipper chip. In June 1986, the company added 10 Clipper-based products to its InterPro line: the InterAct series of dual-screen and the InterView series of large-scale digitizing workstations, along with two VMEbus-compatible plot, file and compute servers. In September 1987, Intergraph announced that it would purchase Fairchild's entire Clipper operation as part of the latter company's sale to National Semiconductor Corp., and that it would actively pursue design wins for the component as well as pursue hardware and software enhancements.

Well-established CISC architectures are being streamlined by the incorporation of RISC features.

Also in June 1986, Texas Instruments Inc. introduced the Explorer II, an artifical-intelligence workstation based on the CLM (Compact LISP Machine) microprocessor originally developed by TI as a DARPA (Defense Advanced Research Projects Agency) project. The CLM is

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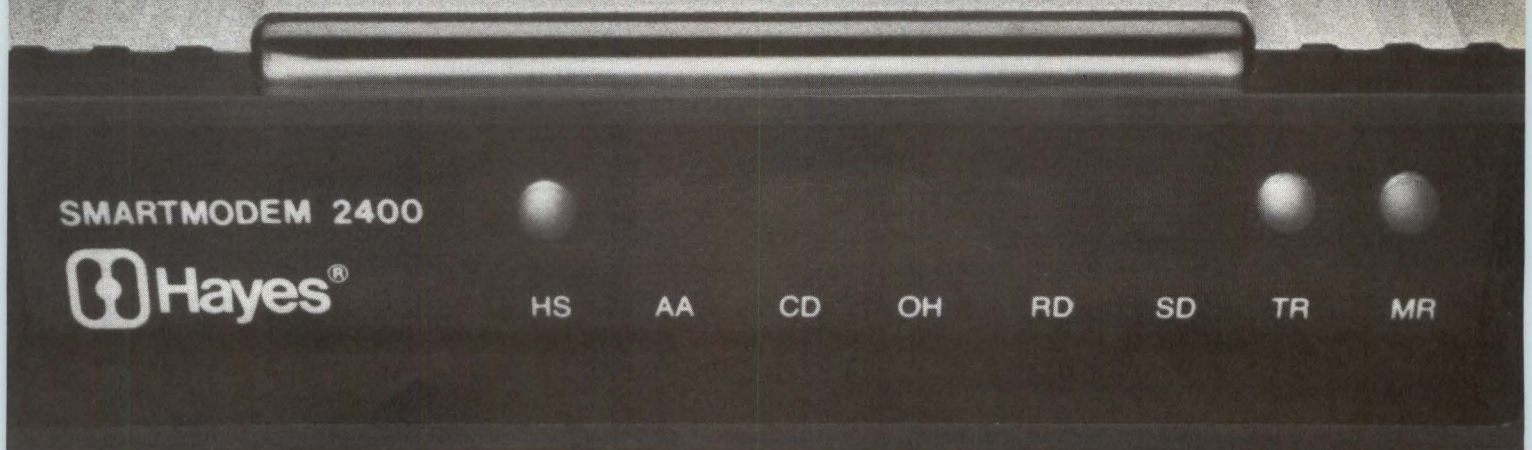

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*Based on estimated retail prices. **Requires external modem.

a 32-bit RISC-like processor microprogrammed to support Common LISP. The high performance of RISC architectures and the relative ease with which they can be optimized makes them attractive for AI applications. Other RISCs available from TI include a family of digital signal processors and the TMS34010, a 6-MIPS RISC-based graphics processor.

The following month, Sun announced a RISC-based workstation. Based on a CMOS gate-array implementation of a RISC architecture developed by Sun, the Sun-4 is said to offer 4-to-5 times the performance of the Sun-3, which uses the 16.67-MHz 68020-68881 combination and the same Weitek Corp. floating point accelerator. Sun expects to increase processor performance fivefold within two years. A diskless, entry-level Sun-4/260 system with 8M bytes of memory and a monochrome monitor is priced at $39,900 and, like the other micro-RISC suppliers, Sun is also offering server configurations. Sun-3 systems, with which the Sun-4 is source-code compatible, can be upgraded by swapping CPU boards.

Clearly, RISC design methodology is having a significant impact on microcomputer systems. In the workstation market, the pre-eminence of the 68020 chip is being challenged by microRISCs and Intel Corp. 80386-based products. Dave House, senior vice president and general manager of Intel's Microcomputer Component Group suggests, "It's just a matter of time before the engineering workstation market becomes a 386 market." However, despite the instant popularity of 80386-based MS-DOS emulation engines, this claim should be taken with a grain of salt.

Independent benchmark tests consistently show the 68020 outperforming the 80386 in the UNIX environment and Motorola claims twice the performance of the 68020 for the recently introduced 68030, first sampled last year. System suppliers and value-added resellers currently committed to the Motorola products will do well to think carefully before even considering a switch to Intel. The demand for MS-DOS compatibility can be met much less expensively with high-performance PC/AT clones, and it will be two or three years at best before OS/2 application software becomes a factor in the workstation market.

MicroRISCs, in contrast, do represent a viable challenge to 680X0-based products. They offer 2-to-3 times the performance of today's 68020-based workstations, and the gap seems more likely to widen. Furthermore, unlike the MS-DOS world, workstation applications are largely written in high-level languages and run under UNIX, making them relatively easy to port to new architectures. The de facto standardization of the VMEbus in this market further facilitates substitution. Two of the leading workstation suppliers, Sun and Apollo Computer Inc., have already made their decision, developing RISCs for high-performance applications.

But, most resellers won't have the wherewithal to devote the significant effort necessary to develop their own RISC, despite the fact it is perhaps an order of magnitude less than for a CISC. However, integrating a RISC microprocessor will be less difficult and less expensive for many of them. Intergraph's Hubbard, for example, points out that, "Although we had done some of the preliminary design work ahead of time, it took only 90 days from receipt of our first Clipper silicon to demonstrating the InterPro 32C at a trade show." It is, of course necessary to have available UNIX support (OS, compilers and support software) to achieve this kind of turnaround. As another example, the design of Calay's RPR-7, which started as a long-shot alternative to a bit-slice implementation, took about six months.

Intergraph has said that it will pursue design wins for the Clipper chip and explore software and hardware enhancements.

As might be expected, the general-purpose, multiuser market has more stringent criteria. Rick Gimble, director of product marketing at Sequent Computer Systems Inc., says: "Sequent's architecture allows for incorporation of new microprocessors, and it may be that ultimately a RISC will be the best solution. However, that will not happen until a product establishes enough momentum to create massive software support [i.e. database], rather than the UNIX, C and FORTRAN typically offered." The cost of porting and validating the software required for general-purpose systems is prohibitive for most suppliers. Nevertheless, Intergraph, MIPS and Sun are all offering network servers, and RISCs are beginning to penetrate the general-purpose systems market. Departmental processors will be the next class of

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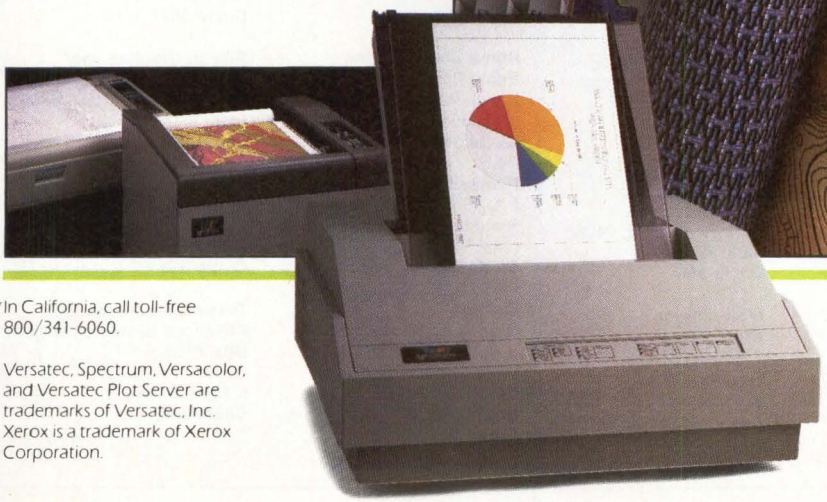

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products to feel the price/performance pressure engendered by RISCs.

A reseller considering the use of microRISC components or systems should carefully balance the price/performance benefits against the costs. In addition to conversion cost, supplier viability and the level of support available must be considered—as must the actual performance increments likely to be achieved. One caution: real performance may bear little relationship to benchmark data provided by the supplier. Consequently, great care should be taken to match the benchmarks to the intended use.

Board-level products, typically VME-compatible, offer OEMs painless access to RISC technology.

Particular attention should be paid to arithmetic requirements (i.e., the mix of integer, single-precision and double-precision floating-point) and to cache use (most published benchmarks are small programs that don't overflow cache). Another thing to keep in mind is the relative ease with which RISC-based systems can be optimized for specific applications. This is good-news/bad-news for resellers because it will inevitably increase vertical integration on the part of system suppliers.

The risks associated with committing to a new processor can be alleviated by careful attention to standards and transportability. Keep the benefits of these in mind when developing your own hardware and avoid CPU-dependent code like the plague. □

Andrew Allison is a management consultant specializing in minicomputer and microcomputer technology, products and markets. Before establishing his practice in 1977, he was with Digital Equipment Corp., Rolm Corp. and Advanced Micro Devices.

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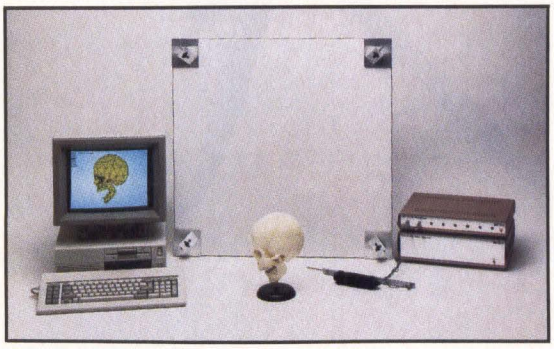

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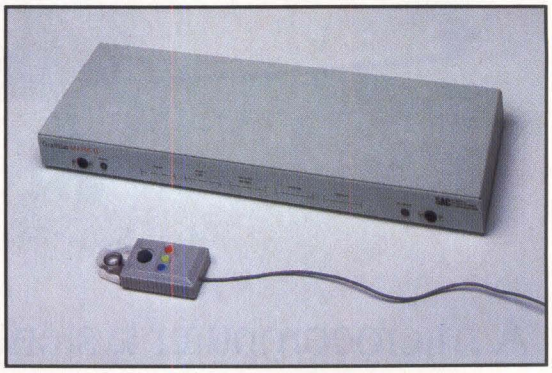

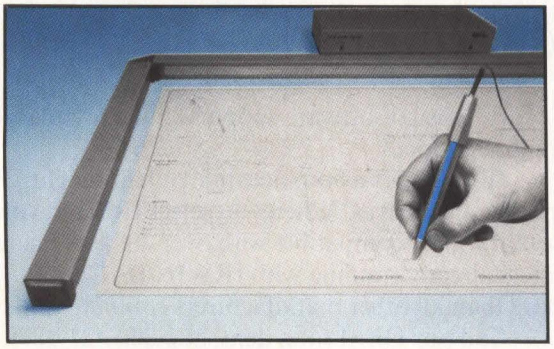

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USERS IMPOSE STANDARDS ON INTERFACES, PROTOCOLS

In the alphabet soup of standards, the winners appear to be OSI for networking, UNIX for application portability and SQL for database interfacing

Wendy Rauch-Hindin, Special Features Editor

User demand for multivendor connectivity, compatibility and application portability reshaped the software industry in 1987. The vendors, responding to the demand, focused their efforts on software that provides standardized interfaces and protocols.

For networking, these interfaces are mostly based on the International Standards Organization's Open Systems Interconnection (OSI) protocols, or its various subsets. Application portability interfaces are mostly based on UNIX. And SQL (standard query language) is the major database interface. Database companies, communications standards committees and expert-system development tools vendors are all rallying around SQL.

1. OSI is the choice for networking

Three major protocols, each adapted to groups with different interests but all compatible with OSI, are available for networking. These are OSI itself, the Manufacturing Automation Protocol (MAP) and the Technical and Office Protocols (TOP). A fourth, the Government Open Systems Interconnection Profile (GOSIP), specified by the National Bureau of Standards, is similar to TOP.

The OSI is a large protocol, which includes many options for diverse fields. Industry organizations in the diverse fields have specified subsets. MAP is the OSI subset applicable to manufacturing, although it also specifies some specialized protocols defined by industry organizations. TOP is similar to MAP, but it uses

different options at the bottom and top layers to adapt it for use in engineering and business offices.

Advances in network compatibility indicate an evolutionary, but steady, trend toward MAP-based networks. Most major computer vendors have MAP 2.1 products and are committed to MAP 3.0. There also is a clean migration path from MAP 2.1 to 3.0.

MAP purchases slowed in 1987, but most vendors and users expect the Corporation for Open Systems-sponsored multivendor demonstration of MAP and TOP in Baltimore next June to stimulate an upswing. Advanced Manufacturing Research, a consulting concern in Salem, Mass., has identified about 30 companies currently using MAP beyond the two-to-three-node phase. Of these, 40 percent say they would make limited use of MAP this year. Not until 1990 is the point reached where 90 percent say they expect to implement plant-wide MAP systems.

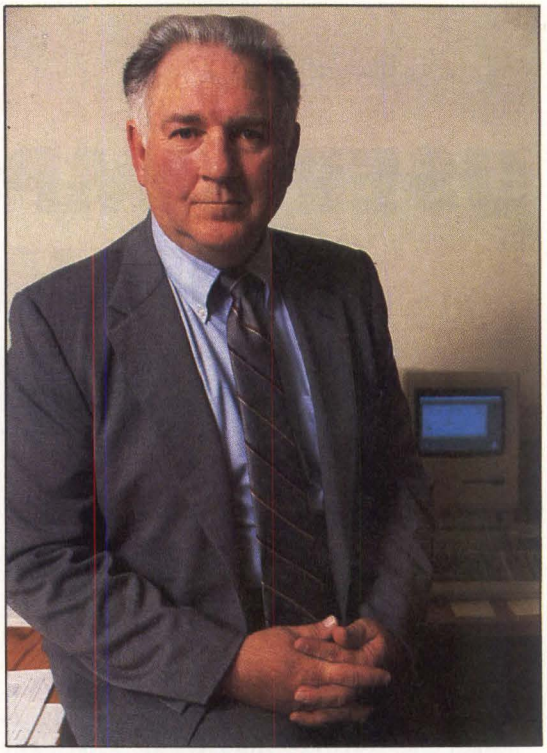
These expectations are in line with historical migration rates. "In the computer industry, it generally takes five years for 50 percent of the potential users of a new product or technology to migrate from their existing systems," says Jack Ring, director of long-range planning at the Honeywell Industrial Automation Systems Division. For example, it took about five years from the time that IBM Corp. made SNA products available until half of the potential SNA sites adopted it.

MAP products became available in mid 1986. That means 1991 is the year by which half of the potential MAP sites (the Commerce Department says there are 450,000 manufacturing establishments in the United States) may have it installed.

MAP 2.1 AND 3.0 COMPARED

Level 7	OSI File Transfer, Access and Management (FTAM) OSI Common Application Service Elements (CASE) Manufacturing Message-Format Standard (MMFS) real-time messaging Read-only directory services	Full OSI FTAM Association Control Service Elements (ACSE) Manufacturing Message System (MMS) real-time messaging, with companion for devices from industry groups Network management Read/write directory services
Level 6	Null	OSI Presentation protocol (ASN.1)
Level 5	OSI Session kernel	OSI session
Level 4	OSI Class 4 Transport	OSI Class 4 Transport
Level 3	OSI Connectionless Internet	OSI Connectionless Internet End system-Intermediate system protocol for routing
Level 2	IEEE 802.4 token-bus media access IEEE 802.2 Logical Link Control-1 (LLC-1) ISA Proway Extensions	IEEE 802.4 token-bus media access IEEE 802.2 Logical Link Control-1 (LLC-1) ISA Proway Extensions IEEE 802.1 Logical Link Control-3 (LLC-3)
Level 1	IEEE 802.4 10M-bit broadband	IEEE 802.4 10M-bit broadband IEEE 802.4 5M-bit carrierband (also in MAP 2.2) Enhanced Performance Architecture (EPA)

Source: Mini-Micro Systems



"It generally takes five years *for 50 percent of the potential users of a new product or technology to migrate from their existing systems," says Jack Ring, director of long-range planning at Honeywell Industrial Automation Systems Division.*

In sync with MAP

TOP got started later than MAP. The protocols skipped version 2.0 entirely, and version 3.0 was published last August. The idea was to get TOP in sync with MAP.

GOSIP is the procurement profile for federal government agencies acquiring computer network products and services. GOSIP is consistent with both MAP and TOP, but it is particularly similar to TOP.

For example, at the Application Layer (level 7), GOSIP and TOP 3.0 specify office-oriented capabilities, mostly in the areas of electronic mail, basic class virtual terminal and office document exchange. The electronic mail is CCITT X.400-based and supports what is called "private management domain implementation," as specified by the NBS workshop implementation agreements. It uses the Class 4 Transport Layer protocol and an application relay to transmit over a public electronic mail network.

Such electronic mail capabilities are needed. Office workers in organizations with thousands of distributed workstations and minicomputers usually require internal electronic mail as well as access to wide area networks that are part of the company's private network and to public networks to get to other companies.

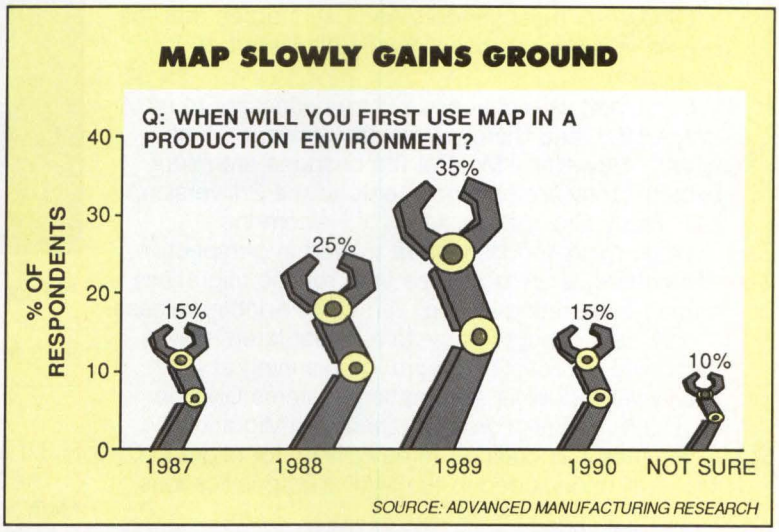
2. UNIX interfaces come in three flavors

For application portability, users in both the government and manufacturing communities have been moving first toward AT&T Co.s UNIX System V and then toward one of the UNIX-based interface standards. Most major computer vendors, such as Data General Corp., Hewlett-Packard Co., Texas Instruments Inc. and Unisys Corp., either support or have based their product lines on UNIX. There is evidence that IBM will make a more aggressive push with UNIX on workstation products (MMS, July 1987, Page 35). Digital Equipment Corp. supports AT&T's UNIX System V but will push POSIX for both its workstation and VAX products.

There are three major UNIX-based interface standards: POSIX, the System V Interface Definition (SVID) and X/Open. POSIX is the standard that both the federal government and GM say they will eventually adopt. Among the chief reasons, and POSIX's most important benefit, is that POSIX is an IEEE consensus standard, which represents the interests of all concerned parties.

POSIX's major problem is that it is still incomplete. The core POSIX standard (IEEE P1003.1) is scheduled for balloting early this year. Balloting on a supplemental POSIX standard (IEEE P1003.2), which defines the interface to tools and utilities, will come later in 1988 as will balloting on still another POSIX standard (P1003.3) on verification and validation techniques.

Finally, the work of the technical committee of /usr/group (the association of UNIX users) in defining real-time extensions to POSIX has been incorporated in the IEEE standards efforts as the P1003.4 group. The P1003.4 work is the farthest from completion.



The SVID is the interface most often specified now. Its specification in government requests for quotations has recently come under vendor attack, particularly by DEC, because it is defined by a single vendor, AT&T.

Even though the SVID is an interface, it is essentially a description of AT&T's UNIX System V.3. This gives it the advantage of being more comprehensive than POSIX and of including all the traditional tools and utilities used for program development and ad hoc management.

However, the SVID has two major disadvantages. First, since it is defined by a single vendor, that vendor can make arbitrary changes. Second, because the SVID is a description of a hardware-dependent operating system (UNIX on the AT&T 3B2), SVID has a 3B2 flavor. This makes performance and robustness optimizations difficult for vendors whose hardware architecture is different from that of the 3B2.

The third operating system portability solution, X/Open, is defined by a consortium of vendors who belong to the X/Open Group. Most of these are European vendors, although AT&T, DEC, HP and Unisys are members. X/Open has been more popular in Europe than

Migrating from MAP 2.1 to 3.0 won't be so tough

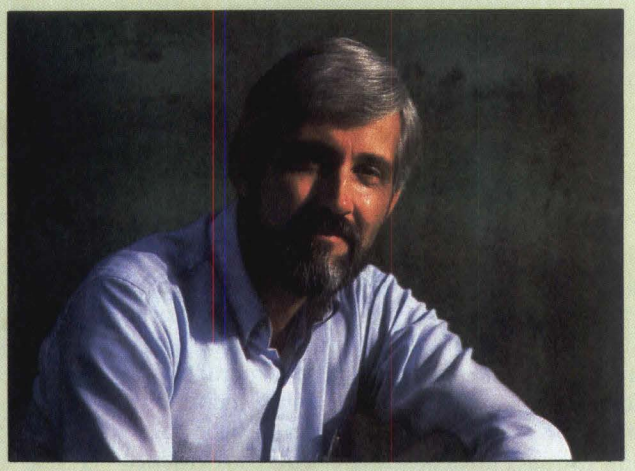
The transition from Manufacturing Message-Format Standard (MMFS) to Manufacturing Message System (MMS) appears to be the only significant issue in migrating from MAP (Manufacturing Automation Protocol) version 2.1 to version 3.0. Both MMS and MMFS are device-to-host communications protocols, but MMS has many more features.

Otherwise, most vendors and users agree that the migration issue has been greatly blown out of proportion.

Some software changes will be necessary to move to MAP 3.0, and there will be some swapping of boards. However, "Most of the changes are minor because they are enhancements to the 2.1 version," says Maris Graube, president of Relcom Inc.

When migration issues are viewed in perspective, "The changes are no worse than routine migrations form one operating-system version to another release of that same operating system a year later," says Jack Ring, director of long-range planning at Honeywell Industrial Automation Systems Division.

The MAP Task Force Compatibility Migration Committee has outlined three options for migration. They will be included in the MAP 3.0 specifications.



"Most of the changes *[in MAP 3.0] are minor because they are enhancements to the 2.1 version," says Maris Graube, president of Relcom Inc.*

Too much travel

The first is a gateway that translates the functionality and syntax between the MAP 3.0 and 2.1 networks. A disadvantage: It requires the system to travel all the way up and down an extra protocol stack to reach the translation software.

The second option moves the translation software into the Application Layer of nodes that need the 3.0 capabilities. This saves both the extra protocol stack and hardware, providing performance and cost advantages.

A third option includes both 3.0 and 2.1 protocol stacks in network nodes. This solution does not require total redundancy because the Transport and Session layers (levels 4 and 5) and parts of the File Transfer, Access and Management (FTAM) protocols in 3.0 and 2.1 versions are compatible.

The Industrial Technical Institute (ITI), Ann Arbor, Mich., has published a technical report detailing a migration strategy that deals with the difficulty in moving from MMFS to MMS. The strategy is based on an MMS subset that interfaces to MAP 2.1's Session protocols.

A subset is needed if MMS is to work with 2.1 and 3.0, because MMS would not be able to assume certain underlying 3.0 services in the 2.1 version, such as the Presentation protocol. However, the MMS subset gives a common appearance to the 3.0 and 2.1 applications.

This commonality allows an application written to the MMS subset to be ported from a 2.1 to a 3.0 environment without disrupting the application. In addition, the MMS subset has enough capabilities to allow 2.1-based equipment to communicate with devices running MAP 3.0.

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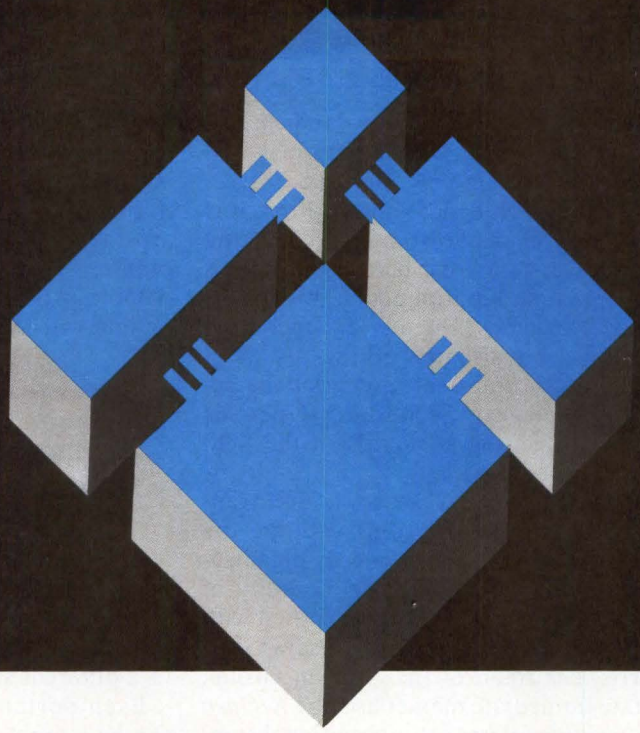

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in the United States, but there are indications that the X/Open Group will shortly make an aggressive push for it in U.S. markets.

X/Open has two chief advantages. First, it is the most comprehensive standard of all the UNIX interface standards, because it defines an entire operating environment. This means that X/Open specifies not just an operating-system interface but also networking, database-query capabilities, indexed sequential file access and languages. Second, X/Open is concerned with getting standards in the field fast so they can be used.

Unfortunately, X/Open has some disadvantages as a portability solution. "Unlike the national and international standards organizations that are concerned with the validity of standards, X/Open is primarily concerned with the extent and success of their use," says Geoffrey Morris, chairman of the X/Open Group. To facilitate immediate market use, the *X/Open Portability Guide* references international standards where they exist. Otherwise, X/Open specifies proprietary products. The *Portability Guide* goes so far as to provide the vendor's address, thereby making it easier for users to buy the products. In many people's minds, it is difficult to reconcile such proprietary products with portability.

Referencing particular vendors' products decreases portability chances, because the vendor can unilaterally change its product. Portability is further decreased because X/Open is committed to the adoption of international standards as they emerge. Consequently, users employing vendors' proprietary products as X/Open standards may find themselves incompatible with new applications that conform to international standards when X/Open migrates to a different standard.

Three major protocols, each adapted to groups with different interests but all compatible with OSI, are available for networking.

Even portability across operating systems can be a problem, because X/Open is committed to adding anything to its standard that emerges in POSIX. However, it does not have to remove non-conformant pieces of its standard, because extensions are allowed. Therefore, over time, users may become incompatible with both POSIX and the SVID.

3. SQL lines up support from the AI companies

SQL is the consensus standard in the area of databases. It is the OSI candidate for database access and for manipulation in relational databases. The X/Open group specifies SQL for its operating environment.

SQL is also the de facto standard for mainframe, minicomputer and workstation databases. Databases supporting SQL include IBM's DB/2, Applied Data Research Inc.'s DNET, Cincom Systems Inc.'s Supra and Ultra, Cullinet Software Inc.'s IDMS/R Release 11 and ADS Plus/PC, and Information Builders Inc.'s Focus. Also included are UNIX databases such as Informix Software Inc.'s Informix, Oracle Corp.'s Oracle, Relational Technology Inc.'s Ingres and Unify Corp.'s Unify

The transition from MMFS to MMS appears to be the only significant issue in migrating from MAP 2.1 to 3.0.

Recently, SQL acquired a new group of proponents. With the first wave of production-oriented expert systems scheduled for delivery this year, serious artificial-intelligence tool vendors added database interfaces to their products. Teknowledge Inc.'s new tool, Copernicus, for example, has integration modules that interface to various databases, primarily SQL, and automatically generate SQL queries. The Carnegie Group Inc.'s Knowledge Craft, sup-

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ports access to DEC's RMS database as well as to SQL databases on the DEC VAX and, in the future, will feature integration with MRP (materials requirements planning) systems.

At IntelliCorp, engineers put together two programs (KEE Connection and IntelliScope) to automate access to SQL databases. KEE Connection reads the relations and field names from a relational database's data dictionary. It creates a mapping between the relations in the database and classes of objects in KEE, and between the database fields and the object attributes or frame slots, and it graphically displays this mapping. Without programming, developers can use mouse and menu tools to modify and transform the mapping so it is more appropriate for a particular AI application.

The X/Open Group will shortly make an aggressive push for X/Open in U.S. markets.

Generates SQL dynamically

When the application executes, a certain rule might need some data from the database. However, users need not write SQL queries themselves. KEE Connection uses the mapping to dynamically generate the SQL query and transparently access and retrieve the data. In cases where ad hoc query and analysis are needed, IntelliScope uses the KEE Connection mapping to interactively prompt users for queries, retrieve the data and display it in a variety of graphical ways so users can analyze and refine their queries.

Transparent access is often incompatible with optimized performance. For optimum performance in a high-volume transaction environment, database transactions depend heavily on intelligent programming strategies. These take into account database access methods, the organization of the database(s) used, the application that needs the data, and knowledge of the data, its validity and the means for guaranteeing its validity.

Inference Corp. had performance in mind when it decided to develop a programmatic interface to Oracle's and Relational Technology's SQL databases. The interface provides language constructs within Inference's ART (Advanced Reasoning Tool) that allow developers to use the SQL query language to program specific accesses, updates and other database operations. It does not require them to navigate the data. □

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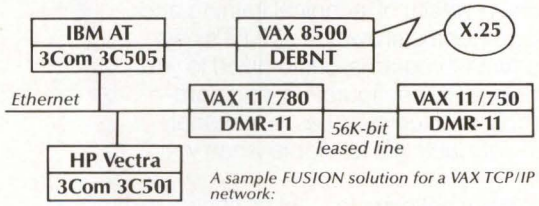

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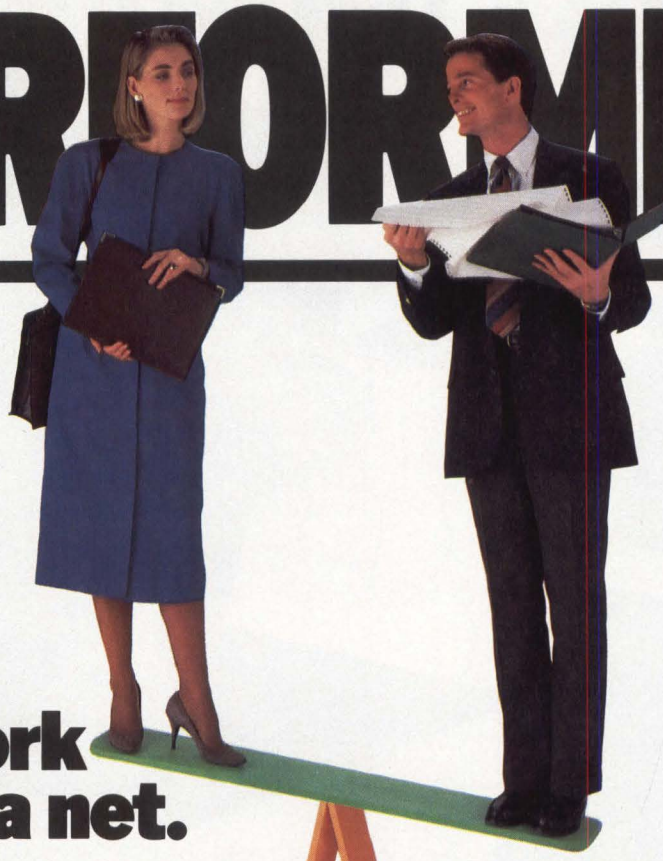

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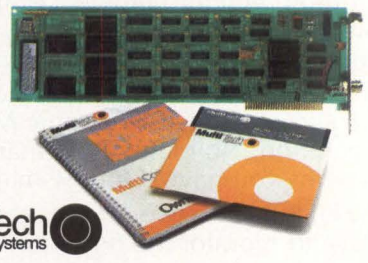

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MODEM TRANSMISSION

Full-tilt protocol accelerates data stream

Matthew Gray
Hilgraeve Inc.

As modem transmission speeds have increased from 1,200 to 2,400 to 9,600 baud, attention has shifted to file-transfer protocols. Effectively, these protocols have become the bottleneck in achieving rapid data transfer.

A basic trait common to today's most popular microcomputer file-transfer protocols, such as Xmodem and Kermit, is that data is sent in packets. And each time a computer receives a packet, it must send back an acknowledgement. In a sense, this mode of operation is "failure-oriented." That is, the sending computer assumes that a packet hasn't arrived unless the receiving computer answers that it has. New trends in modem design, computer hardware and telecommunications are highlighting the inefficiency of this style of operation.

For example, the inefficiency of such protocols in long-distance modem communications has been widely recognized. The microwave transmission of such calls causes propagation delays of approximately one-half second for every packet. At modem speeds of 300 baud and 1,200 baud, the effects of propagation delays are not apparent. But now that 2,400-plus-baud modems are common, the slowdown is obvious.

More packet problems

As baud rates move higher, even lines not plagued by propagation delays (local calls or direct-cable connections) reveal the inefficiency of Xmodem, Kermit and other protocols that send data in packets. Packetized protocols simply don't make good use of a computer's resources, because too much time is spent switching among the required tasks—receiving, error-checking, sending acknowledgements, etc. This problem is made more apparent by the new wave of 2,400-baud modems. Their built-in error-correcting capabilities clash with packetized protocols, resulting in a 10 percent to 30 percent reduction in throughput.

Worse still, with modems that operate in the 9,600-baud to 19,200-baud range, packetized protocols can be slowed to throughputs below 1,200 baud, because these modems transmit data at high speed in only one direction at a time. Each time the flow of data changes direction (which it must do twice per packet), the modem incurs a line-turnaround delay of one-quarter to 1½ seconds. Conventional protocols commonly reduce the throughput of a 9,600-baud modem to that of the 1,200- to 4,800-baud range.

Earlier attempts to overcome these problems involved incremental modifications to existing communications protocols. But, long-packet implementations of popular protocols simply increase the size of the packet to reduce acknowledgment frequency. The sliding-windows extension to Kermit lets the transmitting system move ahead and send a limited number of additional packets, while it waits for an acknowledgement. Although all of these modifications tend to increase transmission throughput, they suffer from being "Band-Aid" types of solutions when major surgery is required. The best evidence? These modified protocols have achieved little popularity in the field.

Packetized protocols don't make good use of a computer's resources.

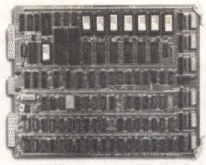
Continuous-stream approach

An alternate "clean sheet of paper" approach has resulted in the development of a radically different file-transfer protocol called HyperProtocol. HyperProtocol is "success-oriented" in that the sending computer transmits data full-tilt in a continuous stream, assuming that the receiving computer is receiving it without error. The receiver need only send back an acknowledgement upon completion of the transfer, plus a "deadman" acknowledgement once per minute during long transfers. The receiver can command the sender to pause, if necessary, or to retransmit flawed data.

Because the sender rarely has to interrupt sending to accept acknowledgements, and the receiver rarely has to interrupt receiving to send acknowledgements, both computers normally devote their full resources to moving data. This, together with the low overhead of the protocol, means HyperProtocol can transfer data substantially faster than other protocols—nearly as fast as the hardware can handle.

Matthew Gray, president of Hilgraeve Inc., directed the development of the HyperProtocol file-transfer protocol. He is an engineering graduate of Northwestern University and holds patents in microcomputer-based technology.

Follow this line.



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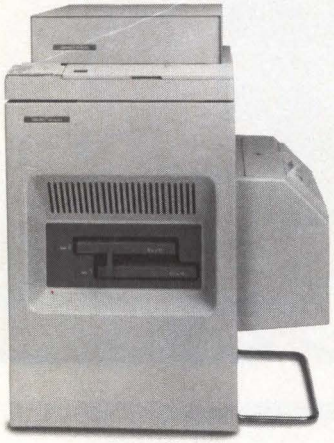

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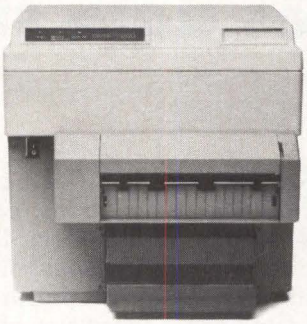

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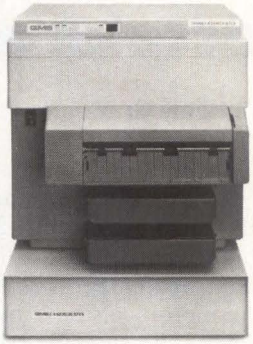

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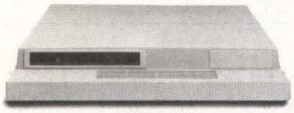

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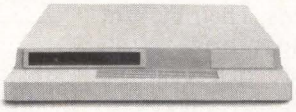

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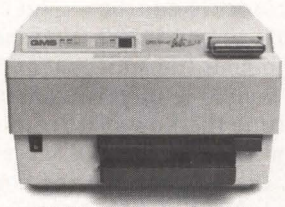

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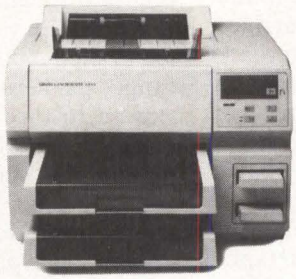

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MODEM TRANSMISSION

Due to the streaming nature of the protocol, propagation delays common in long-distance calls have no affect on its efficiency. Thus, the protocol is just as fast in long-distance calls as in local calls. Furthermore, HyperProtocol lets 9,600-plus-baud modems transfer data at their true maximum throughput, since data flows continuously from the sender to the receiver. HyperProtocol almost never reverses the data flow, so the excruciating line-turnaround delay of these modems, which can decimate throughputs of other protocols, is no practical consideration.

ECC built in

The new protocol includes complete error-detection and correction capabilities. The error checking codes —checksum or CRC (cyclical redundancy checking)—are user-selectable. They are inserted into the stream of data by the sender, so the receiver can continuously verify accurate transmission. If the receiver detects errors, it sends back a request that the sender retransmit the flawed data.

HyperProtocol, like Kermit, lets a user transfer multiple files by typing a single command that contains a filename with wildcards (* and ?). Unlike Kermit, HyperProtocol sends the files "nose-to-tail." That is, when it finishes sending one file, it immediately begins sending the next file, without any delay for acknowledgement from the receiver. This expedites sending batches of small files. If the receiver detects errors and requests retransmission of a file that the sender has already finished sending, the sender obligingly backs up into that file.

There are a variety of other unusual features in HyperProtocol. For example, if the receiving computer finds that an incoming file has the same name as a file already present, it automatically stores the incoming file under a slightly different name. Also, the protocol automatically adapts many of its operating parameters to a variety of conditions, taking into account the baud rate, line quality, CPU speed, etc.

The clean-sheet-of-paper approach used in developing the new file-transfer protocol made it possible to accommodate advanced data-compression techniques that further increase data throughput. The data flows from the sending computer's disk, through a real-time compression algorithm and then through the data channel to the receiver. Next, the receiver accepts this high-density flow of data, restores the data using a real-time decompression algorithm and stores the data to disk in its original form.

Naturally, the degree to which modem throughput is increased depends upon the compressibility of the file. Binary files typically compress to two-thirds of their original size, text files to one-half of their original size, spreadsheets to one-third of their original size and database files to one-quarter of their original size. Thus, data throughput of binary files typically increases 1½ times, that of text files doubles, that of spreadsheet files triples, and database file-transmission speed quadruples.

The compression method can adapt to files of any kind, because it dynamically builds compression tables that contain patterns repeated within the file. The algorithm used is known as Ziv-Limpel compression, considered by some experts to be the most efficient of the modern compression algorithms.

When a file is not significantly compressing, compression is automatically stopped and the balance of the transfer continues without compression. This may occur with files that have already been compressed by another program. Files that are too small for compression to be a significant help (less than 4K bytes) also are sent without being compressed.

The HyperProtocol data-transfer protocol and data-compression routines described in this article are presently available in a general-purpose communications software program called HyperAccess (from Hilgraeve Inc., Monroe, Mich.) that runs on the IBM Corp. PC and most compatibles. The file-transfer protocol and compression routines could, however, be implemented on other systems, including mainframes and minicomputers. The protocol developer provides a license and specifications to those companies desiring to do so. □

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Xmodem	955.0	1,072
Kermit (with compression)	643.7	1,591
HyperProtocol	862.2	1,188
HyperProtocol (with compression)	241.4	4,242
Telebit Trailblazer (9,600 baud)		
Transfer method using HyperAccess		
Xmodem	713.2	1,436
Kermit (with compression)	666.5	1,536
HyperProtocol	72.0	14,222
HyperProtocol (with compression)	20.6	49,709
Hayes Smartmodem V-series (9,600 baud)		
Transfer method using HyperAccess		
Xmodem	211.3	4,846
Kermit (with compression)	194.5	5,265
HyperProtocol	58.7	17,445
HyperProtocol (with compression)	29.6	34,595
Direct connection via null modem cable		
Transfer method using HyperAccess		
Xmodem	56.7	18,072
Kermit (with compression)	40.8	25,105
HyperProtocol	54.1	18,927
HyperProtocol (with compression)	17.8	57,692

Source: Hilgraeve Inc.

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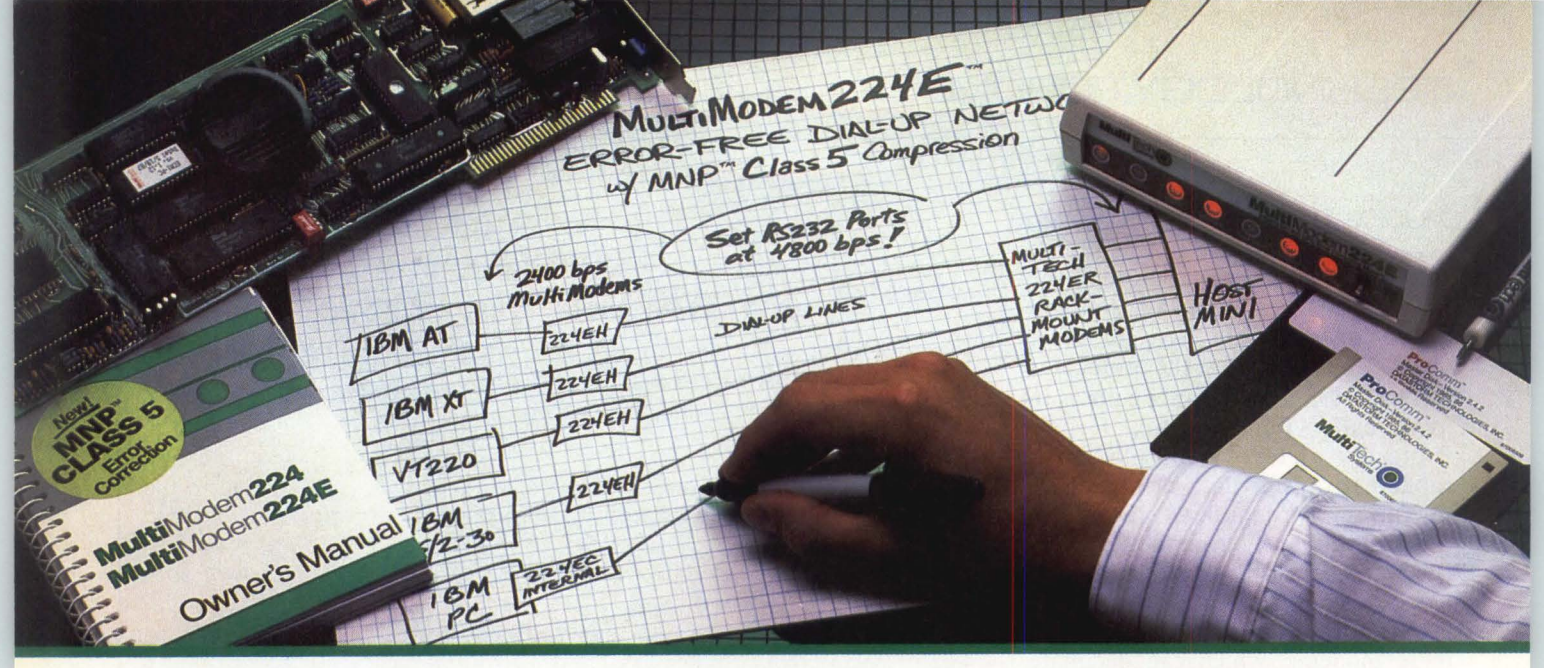

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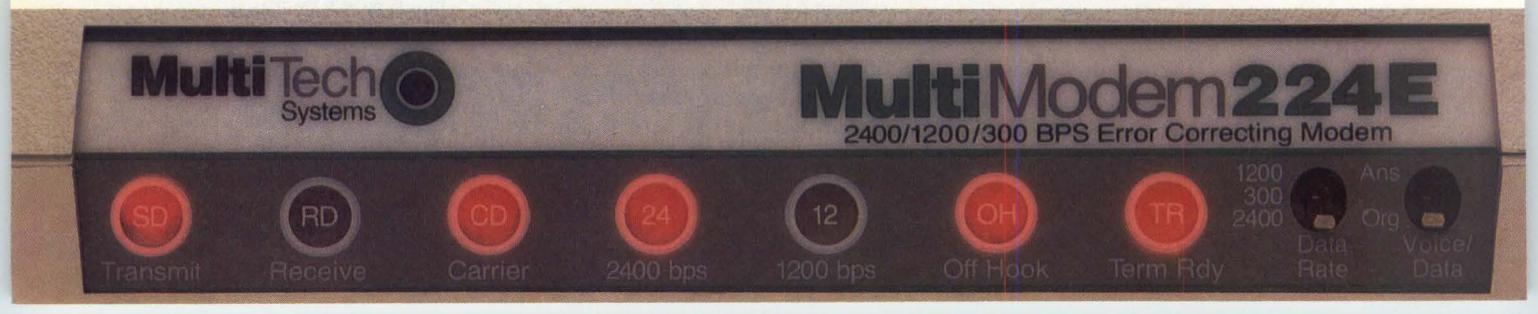

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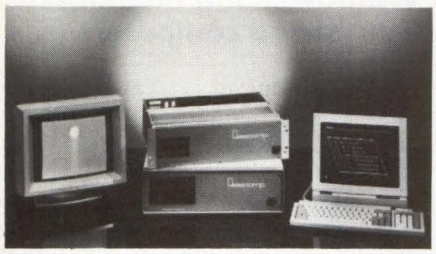

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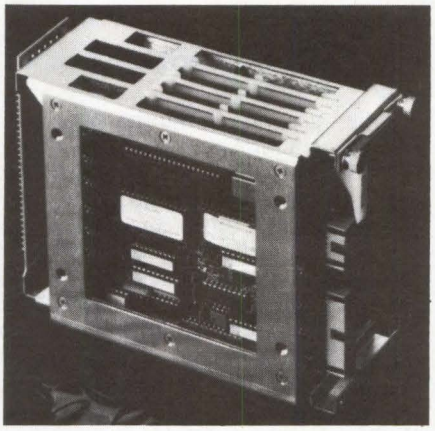
- RGB ports
- 150W auto-switching

Full internal expansion and a "lunch box" design characterize the Dolch-Pack portable computers. The systems feature either an Intel 80286 or 80386 microprocessor, and weigh about 20 pounds. The 386-Pack operates at 6 or 16 MHz with no-wait states. It has 2M bytes of RAM, expandable to 8M bytes, and a processing speed of 2 MIPS. The 286-Pack operates at 8 or 12 MHz with no-wait-states and includes 1M byte of RAM. Both computers feature VLSI circuits, surface-mount technology, full-size keyboards and an optional plasma display. They are compatible with MS-DOS 3.3. **Dolch Computer,** 2029 O'Toole Ave., San Jose, Calif. 95131, (408) 435-1881.

Circle 542



SBC links office with factory

- 128K-byte RAM
- CIM applications
- 7890 STDbus card

System 2 Model 5A is a single-board computer that offers 128K bytes RAM, up to 64K bytes of user program space and an ARCNET option for CIM applications. The system is installed on a 7890 STDbus card that has a NEC V20 CPU running at 7.16 MHz. Model 5A can be upgraded to a full-function industrial computer via a number of expansion options, such as a flexible disk drive, 30M-byte rigid disk and up to 640K bytes RAM. The unit supports coaxial, twisted-pair and fiber-optic cable. It also has a removable-cartridge bubble-memory drive in a standard 3½-inch form factor. $1,045. **Pro-Log Corp.,** 2560 Garden Road, Monterey, Calif. 93940, (408) 372-4593.

Circle 543

System boasts 80386 processor

- XENIX OS
- SNA host communications
- OpenNET option

The System 320 is a real-time, multitasking computer system based on the XENIX operating system. The 80386-based system provides computer-to-computer and computer-to-peripheral networking via the company's Multi-SERVER software. It supports IBM's SNA as well as synchronous and bisynchronous communications protocols. Options include a base system, the iRMX operating system, languages and tools, storage devices and the company's OpenNET networking software. $15,520 in OEM quantities. **Intel Corp.,** 3065 Bowers Ave., P.O. Box 58065, Santa Clara, Calif. 95052-8065, (503) 681-2233.

Circle 544

Dual-identity system runs UNIX, MS-DOS

- Up to 64 PCs
- PC/AT compatible
- 80386 microprocessor

The Server PC, a departmental server station for up to 64 networked personal computers and terminals, runs both CTIX/386, Convergent Technology's implementation of AT&T's UNIX System V Release 3.0 and MS-DOS simultaneously. The Intel 80386-based system uses an integral 64K-byte write-back cache with zero wait states and 32-bit paths. A built-in SCSI disk controller provides throughput rates up to 5M bytes per second. Memory is expandable to 64M bytes, while disk capacity can be boosted to 1G byte. A base system includes: 4M bytes of memory, an 80M-byte disk drive, an IBM PC/AT-compatible flexible disk and three full-height slots for SCSI peripherals. $7,500, OEM pricing. **Convergent Technologies Inc.,** 2700 N. First St., San Jose, Calif. 95150-6685, (408) 434-2848.

Circle 545

Program handles text, graphics

Microsoft Word, Version 4.0, for the IBM PC and compatibles and the PS/2 series, provides increased speed, document management and retrieval, macros and user-interface improvements. Speed improvements cover scrolling, file load and save, cursor movement and pagination. A toggle switch selects text or graphics mode. Text is displayed on the screen as it appears on the printed page, including bold, italic, small caps, superscript and subscript characters. The graphics mode handles resolutions of up to 640 by 480 pixels, with a choice of 16 colors from a palette of over 256,000. Updated features include spreadsheet link, style-by-example, an expanded spelling checker, line drawing and paragraph borders. $450. **Microsoft Corp.,** 16011 N.E. 36th Way, Box 97017, Redmond, Wash. 98073, (206) 882-8080.

Circle 558

Package recognizes handwriting

The PW-15 package comprises a digitizer, an electronic pen and Macintosh-compatible character-recognition software. It can write, cross out, correct, draw or sketch when used with graphics software. On spreadsheets, whole columns and lines can be activated and commands accessed with a stroke of the pen. The package writes programs and comments in BASIC, FORTRAN, Pascal or any other language. A built-in 100,000-word dictionary corrects spelling. PW-15's character-recognition software learns your handwriting quickly and easily. $895 and higher. **Anatex Inc.,** Suite 507, 1801 Avenue of the Stars, Los Angeles, Calif., 90067, (213) 556-1628.

Circle 559

Typesetting software suits Macintosh

Textures v1.0, an advanced personal typesetting software package for Apple Macintosh computers, enables business and scientific users to compose and typeset documents of any length and format complexity. Based on TeX typesetting language, a built-in preview window, a text editor and global commands, the software can handle complex table construction, precision-rule forms and multicolumn layouts. Textures is capable of numbering and cross-referencing pages, paragraphs, footnotes and exhibits. The package performs hyphenation, justification, pagination and kerning. Editing and viewing windows can be displayed simultaneously. $495. **Addison-Wesley,** EMSD, Jacob Way, Reading, Mass. 01867, (617) 944-3700.

Circle 560

Operating system runs on Macintosh

A first-generation, multitasking operating system for Apple Macintosh II, SE and Plus, MultiFinder lets users view multiple applications concurrently and copy, paste and move rapidly between applications. With the Mac 286 card from AST Research, Macintosh II users can run Lotus 1-2-3 under MS-DOS in a Macintosh window and process data directly into a Macintosh application. With a modem and terminal-emulation software, users can concurrently exchange data with UNIX applications running on a remote host. Included in all new Macintosh computers. $49. **Apple Computer Inc.,** 20525 Mariani Ave., Cupertino, Calif. 95014, (408) 996-1010.

Circle 561

Software produces slides, transparencies

Cricket Presents, a desktop presentation package, enables Macintosh computer users to create color presentations and reproduce them on output devices. It combines text-handling capabilities and drawing tools for creating hand-out materials, reports and presentation documents. Macintosh II users can customize font size, style and color. Users can incorporate rectangles, circles and lines in the creation of graphs, charts and tables. Scanned images and graphics can be imported from proprietary packages. $495. **Cricket Software,** 3508 Market St., Philadelphia, Pa. 19104, (215) 387-7955.

Circle 562

Windows/386 enhances 386-based computers

Microsoft Windows/386, aimed at Intel 80386-based personal computers, provides multitasking, 640K-byte virtual machine support for existing MS-DOS applications and visual compatibility with the Microsoft Operating System/2 Presentation Manager. It runs existing Microsoft Windows and MS-DOS applications. Users can run several MS-DOS applications simultaneously and run existing MS-DOS applications—including those that run in graphics mode or that write directly to display hardware—in a window alongside Windows applications. It emulates the LIM expanded-memory specification version 4.0. A 2M-byte memory is recommended. $195. **Microsoft Corp.,** 16011 N.E. 36th Way, Box 97017, Redmond, Wash. 98073-9717, (206) 882-8080.

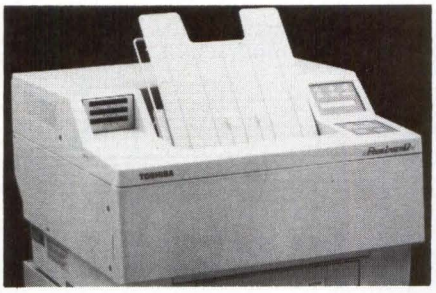
Circle 563

VAX SQL software improves interactivity

Version 1.1 of VAX SQL software, a high-level database language, serves as both an interactive and a software-development interface for VAX Rdb/VMS and VIDA with IDMS/R databases. It adds a VAX C language precompiler and improves the dynamic SQL interface. The VAX SQL language preprocessor supports VAX COBOL, VAX FORTRAN, VAX C and VAX PL/I and expands embedded SQL statements in compliance with ANSI specifications. The VAX SQL dynamic interface supports all DSRI datatypes as well as DECIMAL datatypes used by IBM's DB2 databases. VAX SQL Version 1.1 is licensed from $1,090 on the VAXstation 2000 to $26,100 on the VAX 8800. Packages including VAX Rdb/VMS Runtime licenses are priced from $1,770 on the VAXstation 2000 to $42,480 on the VAX 8800. **Digital Equipment Corp.,** 146 Main St., Maynard, Mass. 01754, (617) 897-5111.

Circle 564

PRINTERS



Laser achieves 12 ppm

- 512K-byte RAM
- 300 dpi
- 1.5M-byte option

Driven by a Toshiba engine and custom controller, the PageLaser12 produces 12 ppm at 300 by 300 dpi. Standard features include a 250-sheet bin, 512K bytes of RAM, resident fonts and Toshiba's PageLaser12 graphics draw language. Users can add 1.5M bytes of RAM, a 500-sheet feeder, an envelope feeder and a collator. $3,699. **Toshiba America Inc.,** Information Systems Division, 9740 Irvine Blvd., Irvine, Calif. 92718, (714) 380-3000.

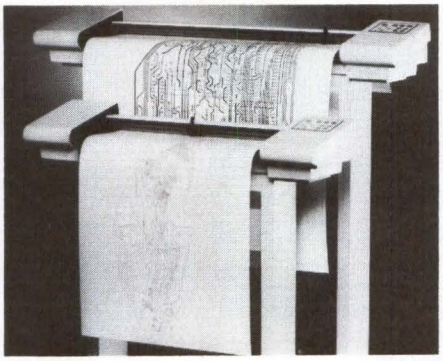
Circle 546

Personality cards enhance laser printer

- Up to 34 fonts
- 2.5M-byte RAM
- 24 resident fonts

Based on the Canon SX engine, the latest KISS plus accepts three new personality cards that allow OEMs to tailor the printer for different applications. Model 10 features 24 resident fonts, Epson, Diablo, Qume and ANSI emulations, and 512K bytes of RAM. Model 20 adds IBM Proprinter and LaserJet Plus emulations and includes a 1M-byte RAM. Model 30 includes HP 7475A plotter emulation, up to 34 fonts and 2.5M bytes of RAM. Software includes Microsoft Word, WordPerfect, Lotus 1-2-3 and Ventura Publisher. Model 10 supports a quarter page at 300 by 300 dots per inch; model 20, a half page; model 30, a full page. $1,995, KISS plus; $395. model 10; $695, model 20; $1,495, model 30. **QMS Inc.,** 1 Magnum Pass, Mobile, Ala. 36618, (205) 633-4300.

Circle 547



Printer supplies multiple fonts

- MC68000 processor
- 1K-byte buffer
- 32 ips

Aided by a Motorola MC68000 microprocessor, the DMP-61 and 62 pen plotters offer multiple fonts, filled fonts, closed fill capability, curve algorithms and character sets. The 60 series draws on paper, vellum and polyester film using fiber-tip pens, disposable technical pens, refillable liquid-ink pens and roller-ball pens. Model 61 supports drawings up to 24 by 36 inches at an axial pen speed of 32 ips. Model 62 supports media sizes of 36 by 48 inches with a speed of 24 ips. Both plotters are RS232-compatible. $4,695, DMP-61; $6,495, DMP-62. **Houston Instrument,** 8500 Cameron Road, Austin, Texas 78753, (512) 835-0900.

Circle 548

A personal printer for IBM minicomputers

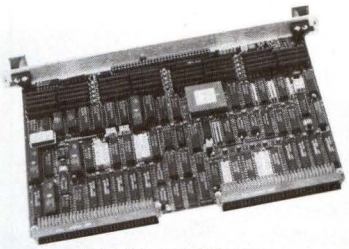
- 80 or 136 columns
- less than 55 dBa
- 6,000-hour MBTF

Attached through twinaxial cables, the Prima-TX brings the advantages of a personal printer to IBM System 3/X minicomputers. The Prima-TX is available in 80- or 136-column models, each capable of 220 cps in draft mode and 40 cps in letter-quality mode. Control panel functions permit printing of customized pages without host programming. Features include a 6,000-hour MBTF and a 55-dBa noise level. $1,395. **Printer Systems Corp.,** 9055 Comprint Court, Gaithersburg, Md. 20877, (800) 638-4041.

Circle 549

MEMORY

VME/VSB



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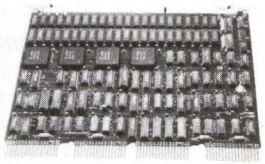
- On board CSR
- Single bit error correction double bit error detection

QBUS/PMI



CI-PMI-EDC

- Full PMI support
- Single bit error correction, double bit error detection
- Runs complete DEC diagnostics
- 4 megabytes on one board
- Block mode DMA
- Control Status Register (CSR)

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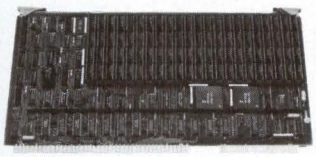

CI-796-EDC

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- Single bit error correction, double bit error detection
- Selectable in 18K byte increments

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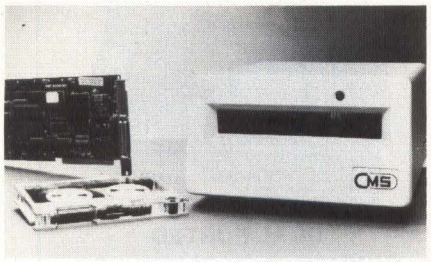

Subsystem works with Macintosh II

- 5¼-inch unit
- 140M bytes of storage
- 26-msec access time

For use with the Macintosh II, the Pro 140 II/i is a 5¼-inch, 140M-byte disk drive subsystem. The unit supplies a 26-msec average access time and automatic head-park capabilities. Proprietary software and a SCSI utilities program are included. $2,695. **CMS Enhancements Inc.,** 1372 Valencia Ave., Tustin, Calif. 92680, (714) 259-9555.

Circle 550

Subsystem runs with Macintosh Plus and SE

- Bernoulli technology
- 20M bytes of storage
- 5¼-inch cartridge

A removable Bernoulli subsystem, the Totem II supplies a 20M-byte cartridge for the Macintosh SE. Each 5¼-inch cartridge holds the equivalent of 10,000 pages of information or 25 flexible disks. Proprietary software is available. $1,195. **Bering Industries Inc.,** 280 Technology Circle, Scotts Valley, Calif. 95066-3520, (408) 438-8779.

Circle 551

ESDI disk controller sports 48-bit ECC

- 625K-byte transfer rate
- 128K-byte data buffer
- 32-bit DMA

Integrating software interface design and a 48-bit error-correction code, the Xylogics 714 enhanced small disk interface (ESDI) disk controller features data-transfer rates of 625K bytes per second at 5 MHz. A 32-bit direct memory access increases VME throughput by 60 percent. Other features include a 128K-byte FIFO data buffer, automatic configuration, programmable bus control and media-defect handling. $2,695. **Xylogics Inc.,** 53 Third Ave., Burlington, Mass. 01803, (617) 272-8140.

Circle 552

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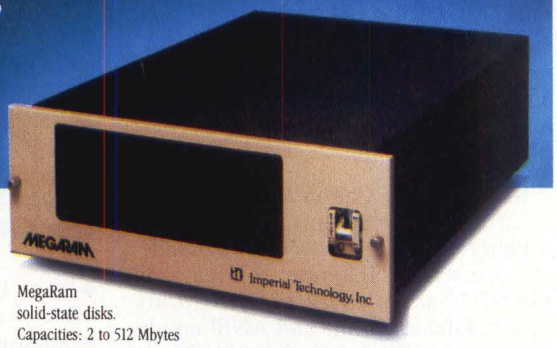

MegaRam solid-state disks. Capacities: 2 to 512 Mbytes

Thousands of users worldwide know that the MegaRam is the most cost-effective way to lower system response times!

With access times in the microseconds, the MegaRam lets you add more users and applications while simultaneously improving performance. Increased performance results in better system utilization and productivity.

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TERMINALS

Terminal displays three programs

- 70-Hz refresh rate
- Flat-profile screen
- Dual-host ports

The Ampex 270 70-Hz ASCII video display terminal offers a proprietary emulation feature for word processing applications. A 14-inch, flat-profile screen is available in white, amber or green phosphor. Dual-host ports and horizontal and vertical windowing displays three application programs simultaneously, placing less demand on the host computer. Program access and viewports are configured locally in the terminal. Sixteen programmable function keys and 325-degree tilt and swivel are standard. $569. **Ampex Corp.** Computer Products Div., 200 N. Nash St., El Segundo, Calif. 90245, (213) 640-0150.

Circle 555

Ruggidized terminal tackles environment

- 28-key data entry
- Preprogrammed functions
- Ten programmable keys

The 4850A color industrial terminal is a flexible alternative to traditional annunciator panels. Features include a built-in, 28-key data-entry keypad, 10 programmable function keys and preprogrammed CRT functions such as vertical and horizontal bar graphs, multiple character sizes and process control graphics. The terminal is ruggidized to withstand shock, vibration, humidity and temperature extremes. Front panels are sealed to NEMA 4 and NEMA 12 standards. DEC VT100, VT220 and Hazetine 1500 terminal emulation is standard. $2,700. **XYCOM,** 750 N. Maple Road, Saline, Mich. 48176, (313) 429-4971.

Circle 553

Laptop terminal edits 36 files

- 7.5 pounds
- Expanded key area
- DEC emulation

The 7.5-pound Colleague PLUS laptop terminal includes a new Supertwist LCD screen with increased contrast and viewing angles. An expanded function key area supports numeric and application codes for DEC VT52, VT100 and VT220 capability. It captures up to 60K bytes of on-line communications that can be edited and printed. Screen-snap permits storage of individual screens. The terminal can copy, delete, print and edit up to 36 files through the Word Processor menu, which features variable tabs, margins, page length, left-margin offset and windowing for 132 columns. $1,295. **Random Corp.,** 581 Northland Road, Cincinnati, Ohio 45240, (513) 825-0880.

Circle 554

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SUBASSEMBLIES

Accelerator board speeds Macintosh SE

- 16-MHz processor
- Plug compatible
- Low power use

Based on the Motorola MC68000 16-MHz processor, the Turbo SE increases the speed of the Apple Macintosh SE by 200 percent. The product plugs into the SE expansion slot, is compatible with Macintosh software and operates at 1.3 amps, 5V. An optional 68881 math coprocessor is available. The SE motherboard RAM is relocated to the faster Turbo SE bus. $599. **MacMemory Inc.,** 2480 N. First St., San Jose, Calif. 95131, (800) 862-2636.

Circle 556

Board boosts System/38 memory

- Three models
- Lifetime guarantee
- 1M to 4M bytes

Intalled with a lifetime guarantee, the three-model XTENDER/38 Module expands IBM System/38 memory by 1M, 2M and 4M bytes, depending on the version. All three configurations are compatible with System 38 models 6, 8, 18, 20 and 40. They offer 1.2M, 2.4M and 4.M bytes of RAM, full diagnostics with LED indicators and a low-heat 256K-byte RAM technology. $3,950, 1M-byte; $7,800, 2M-byte; $15,500, 4M-byte; OEM pricing available. **Decision Data Computer Corp.,** 400 Horsham Road, Horsham, Pa. 19044-0996, (215) 956-5736.

Circle 557

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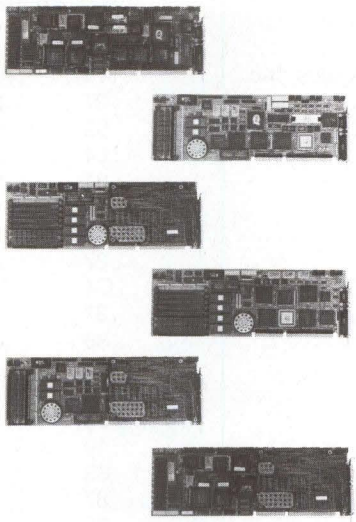
CAT910
CAT900 Features plus: EGA extended resolution (1280 x 800): CGA and monochrome modes: 1280 x 800, 640 x 480, 640 x 350, and 640 x 200 resolutions

CAT911
CAT 901 Features plus: EGA extended resolution (1280 x 800): CGA and monochrome modes: 1280 x 800, 640 x 480, 640 x 350, 640 x 200 resolutions



CAT901
12 MHz, 0 Wait: Dynamic clock speed change: Up to 4 meg RAM. 64K PROM: PROM set-up routines: Dual floppy controller: ST506 hard disk interface: 1 parallel and 2 serial ports: EGA and 80287 optional: Keyboard port, speaker, reset / keylock / turbo ports

CAT900
12 MHz, 0 wait: Up to 8 meg RAM. 64K PROM: 1 parallel and 2 serial ports: EGA and 80287 optional: Keyboard port, speaker, reset, keylock, turbo port

CAT912
CAT902 features plus: EGA extended resolution (1280 x 800): CGA and monochrome modes: 1280 x 800, 640 x 480, 640 x 350, and 640 x 200 resolutions

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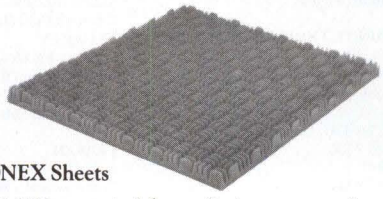

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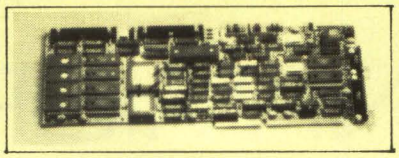

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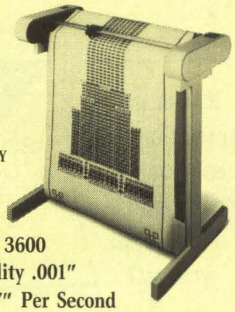

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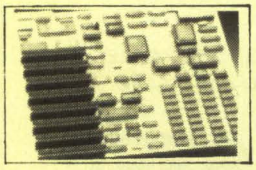

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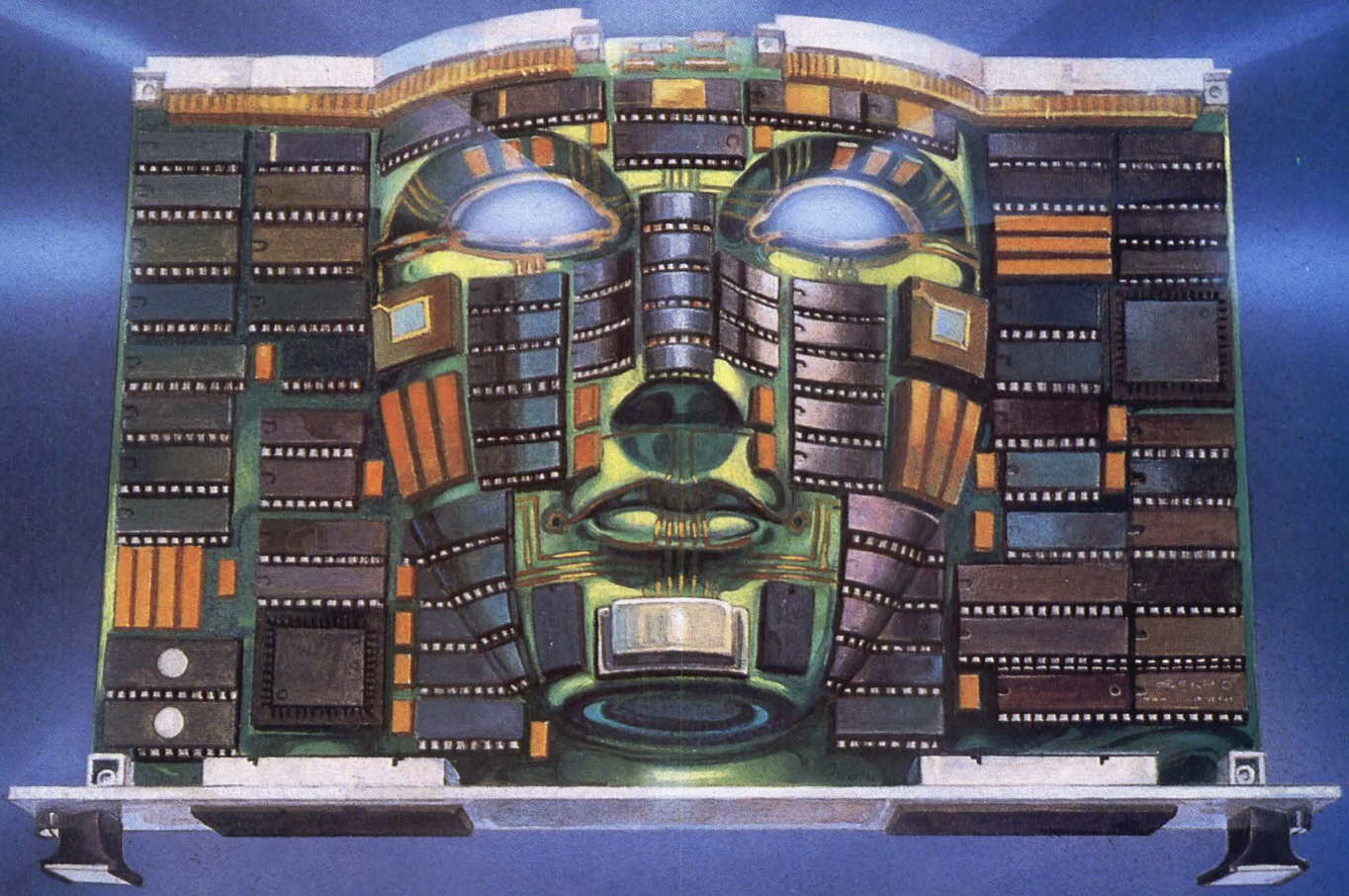

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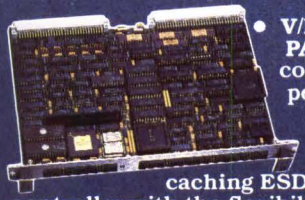

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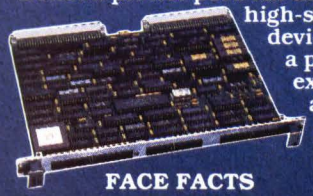

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