FEBRUARY 1987

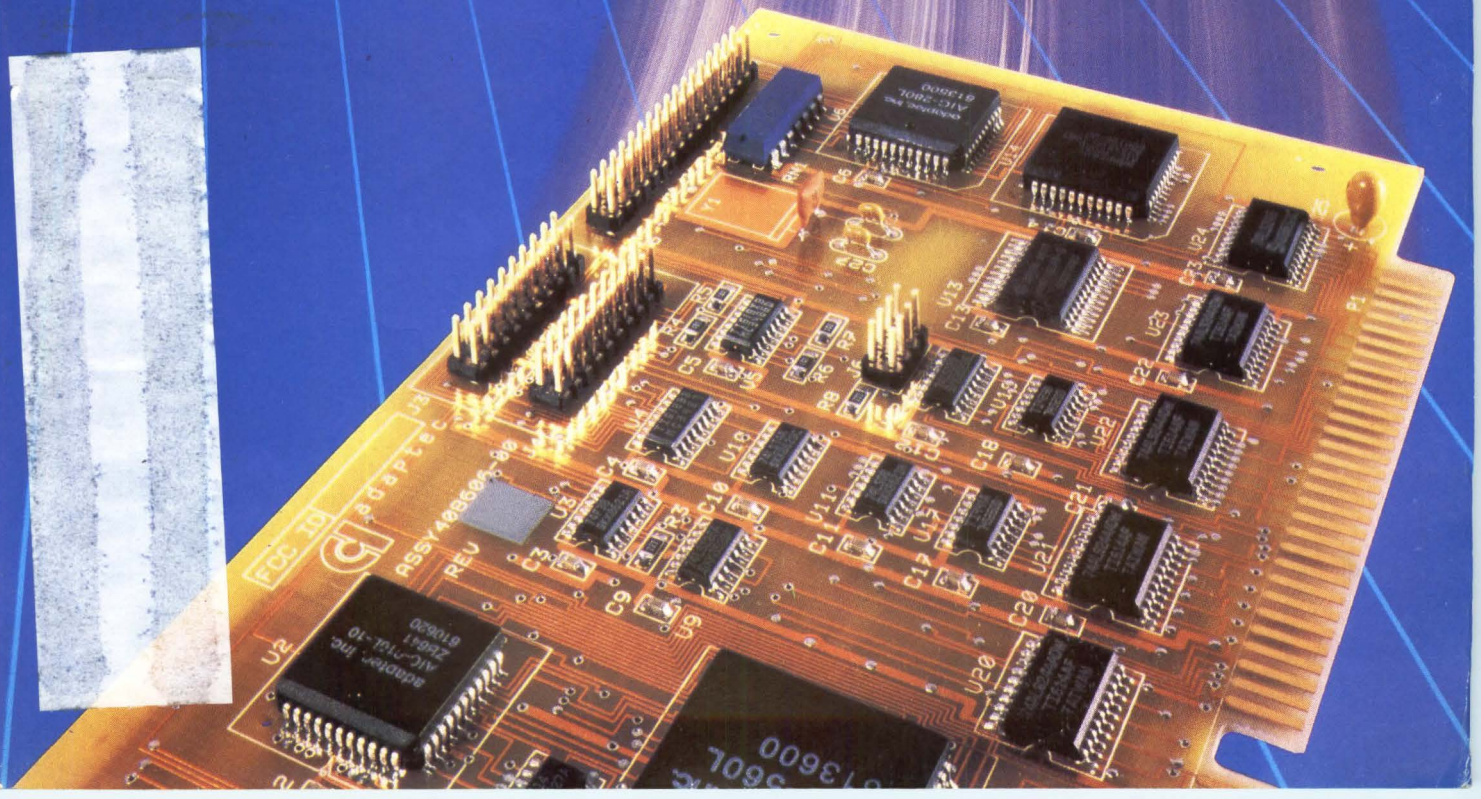
Mini-MicroSystems

THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

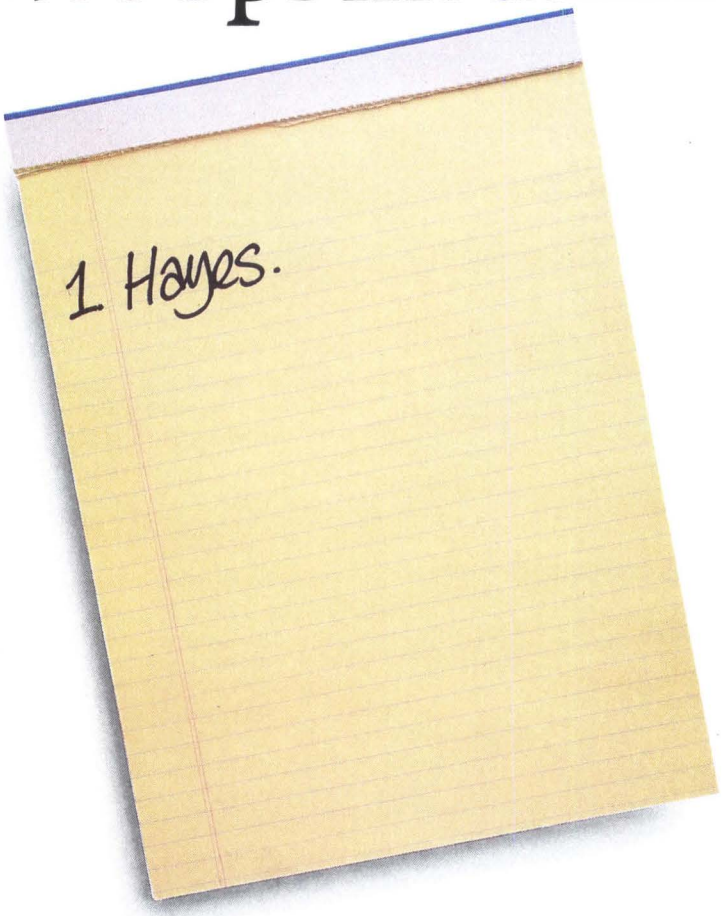
A CAHNERS PUBLICATION

SPECIAL REPORT: SCSI
PRODUCT FOCUS: HP AI workstation
PRODUCT TABLE: ¼-inch tape drives

Adaptec advances RLL encoding, doubles PC/AT drive capacity



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



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

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

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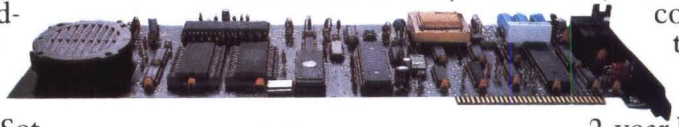
4. The technology of the Smartmodem 2400 allows you to transfer volumes of files with confidence across the city or across the ocean using Bell and CCITT standards.



5. The new Smartmodem 2400B™—a plug-in board for the IBM PC and compatibles—allows synchronous and asynchronous communication through the same Com port.

6. You will also get the Hayes standard 2-year limited warranty and the opportunity to extend the warranty to 4 years.

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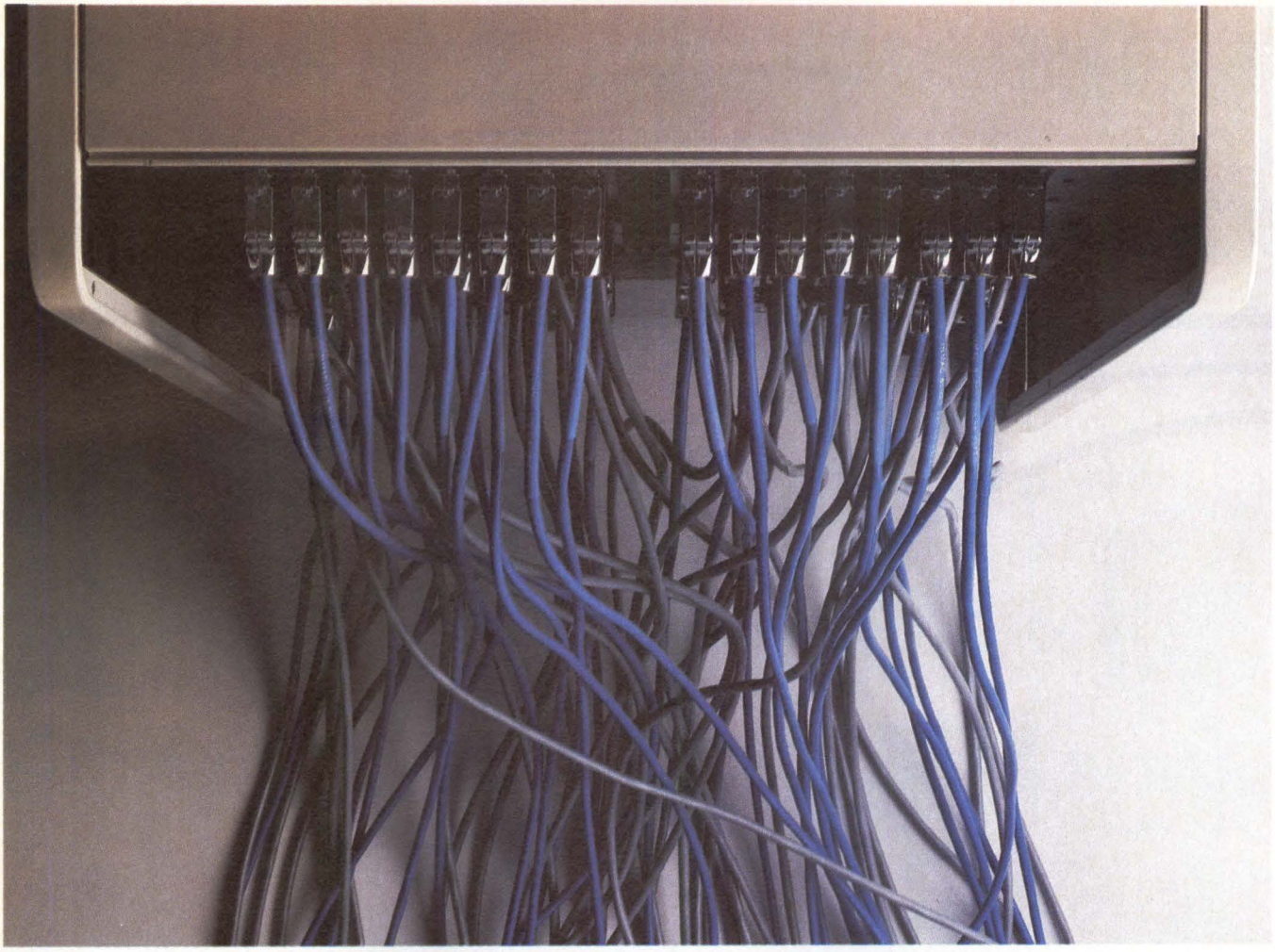
CIRCLE NO. 1 ON INQUIRY CARD



How many more reasons do you need to Unplug your computer?

Until now, connecting 128 terminals to your computer meant one thing. A myriad of cards taking up precious space on the backplane. And accomplishing nothing but communications. All of which could frustrate almost any self-respecting system designer into hanging up his calculator.

Well, at Systech, we understand the serial communications problems of a multi-user system. So we developed The Unplug™ asynchronous distributed multiplexer that can be used with any Multibus,® VMEbus or Multibus® II system.

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You see, what we did was move part of the computer's operating system—the part devoted to managing traffic to and from the terminals—out of the computer and into The Unplug. Giving the host computer the freedom to concentrate on more important tasks.

We know it sounds simple. And the truth is, it is. In fact, you might wonder why no one thought of it before. Then again, no one else has our commitment to make your job easier. And a lot more gratifying.

Just give us a call at Systech to hook up with The Unplug. Then you can start figuring out what you want to add on next.

Instead of trying to figure out how to untangle all those wires.

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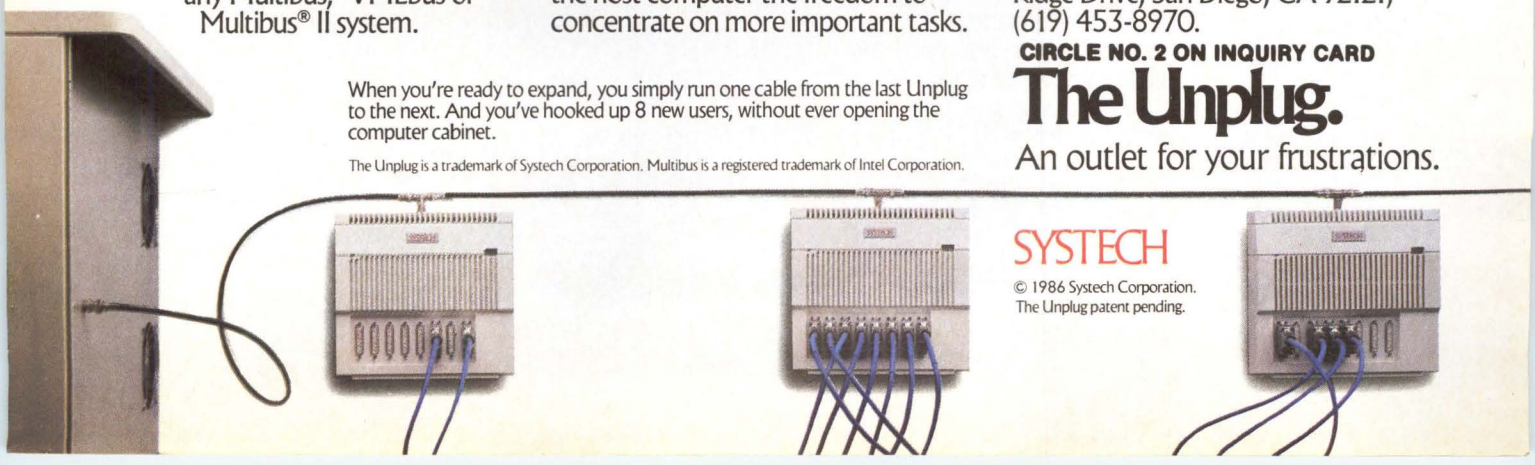
CIRCLE NO. 2 ON INQUIRY CARD

When you're ready to expand, you simply run one cable from the last Unplug to the next. And you've hooked up 8 new users, without ever opening the computer cabinet.

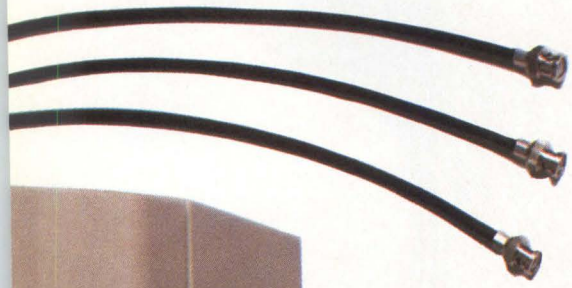
The Unplug.

An outlet for your frustrations.



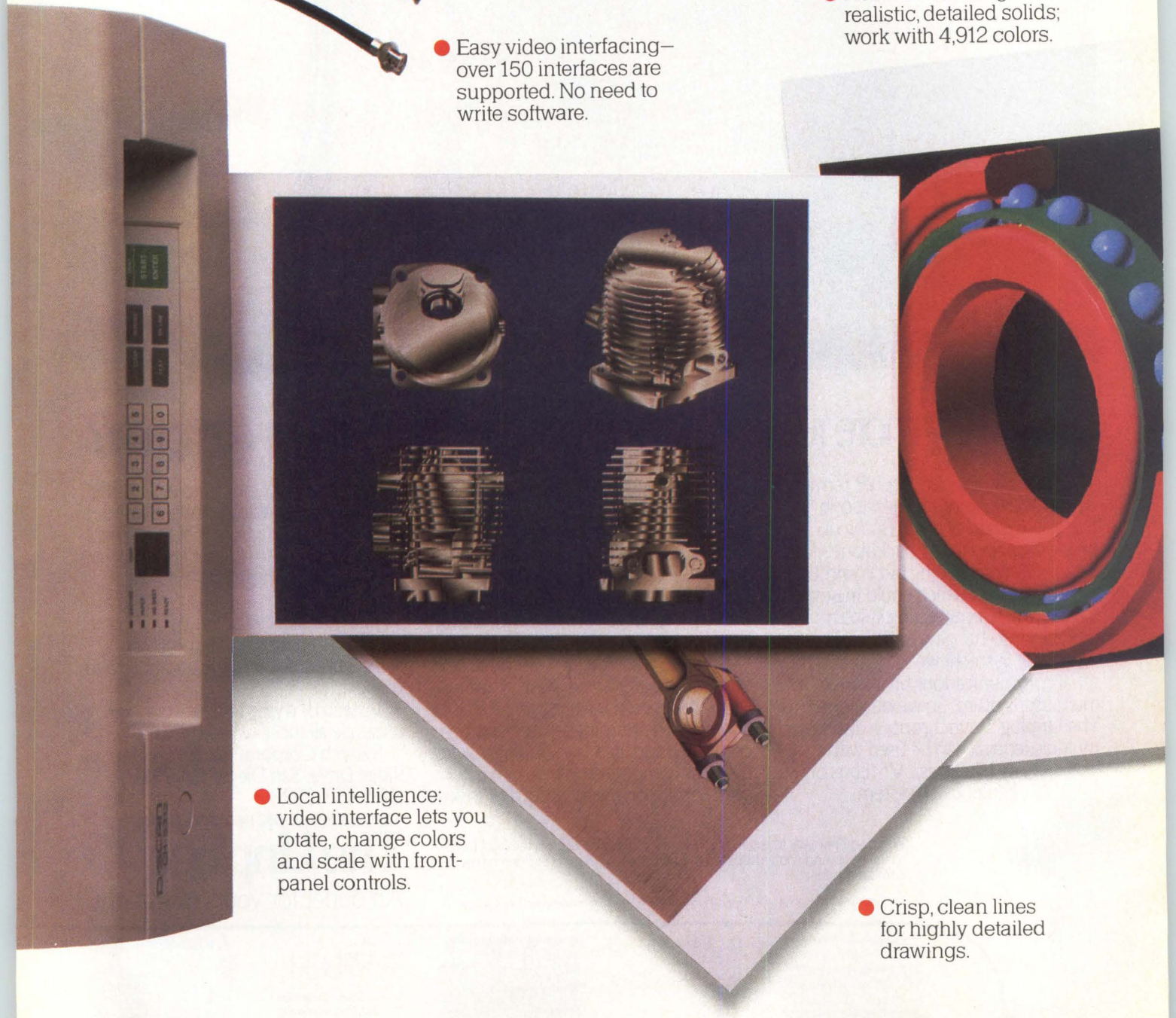
SYSTECH

- Both parallel and RS-232 interfaces are supported by a wide selection of software.



- Easy video interfacing—over 150 interfaces are supported. No need to write software.

- Accurate shading for realistic, detailed solids; work with 4,912 colors.



- Local intelligence: video interface lets you rotate, change colors and scale with front-panel controls.

- Crisp, clean lines for highly detailed drawings.

No Other Color Hardcopier Can Make These Points.

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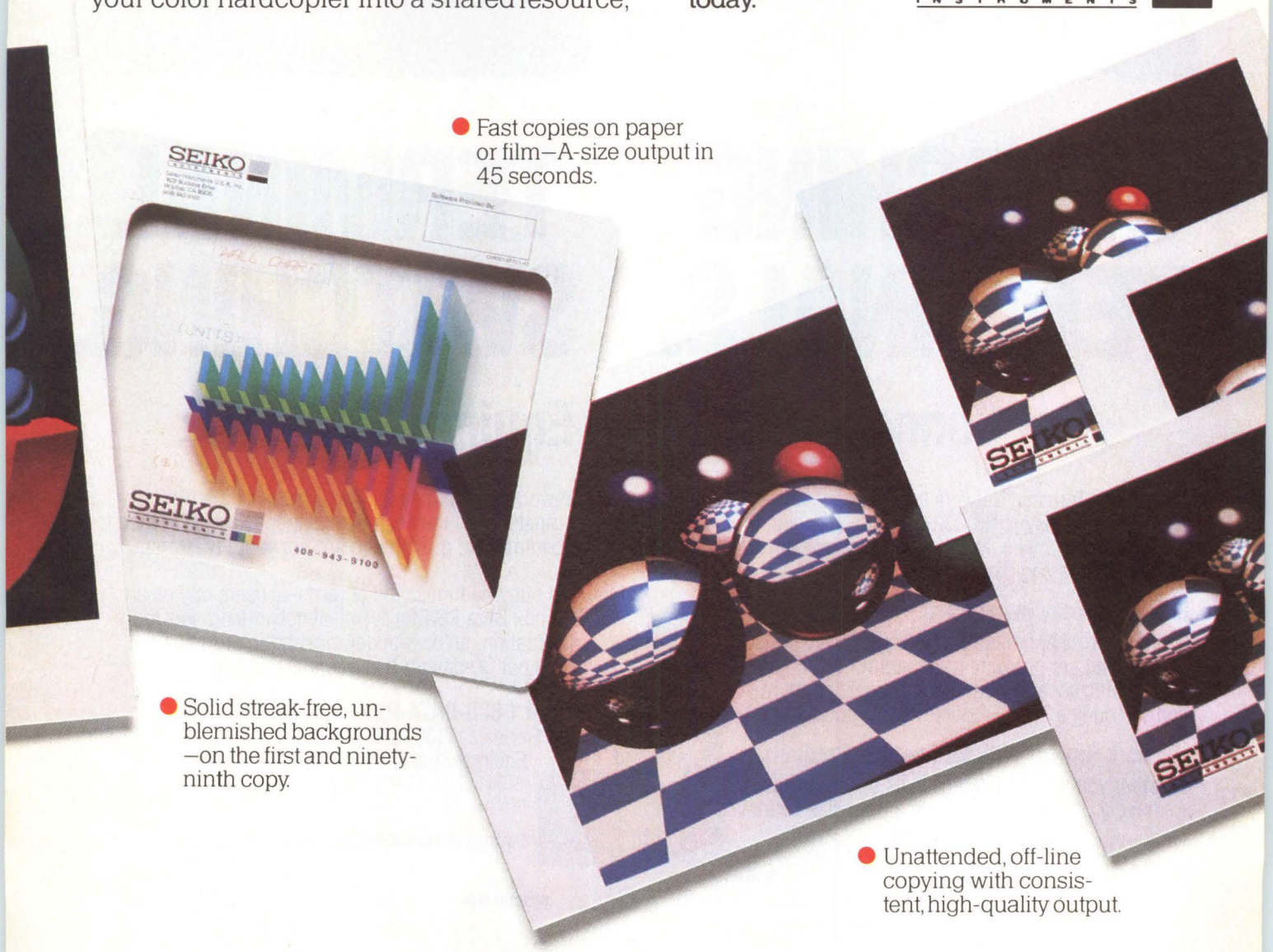

- Fast copies on paper or film—A-size output in 45 seconds.
- Solid streak-free, unblemished backgrounds—on the first and ninety-ninth copy.
- Unattended, off-line copying with consistent, high-quality output.

CIRCLE NO. 3 ON INQUIRY CARD

Visuals courtesy of Ramtek Corporation, Matra Datavision, Computer Design Equipment Incorporated.

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CIRCLE NO. 4 ON INQUIRY CARD

Mini-Micro Systems

A CAHNERS PUBLICATION

VOL. XX NO. 2
FEBRUARY 1987

EXCLUSIVE

INTERPRETER

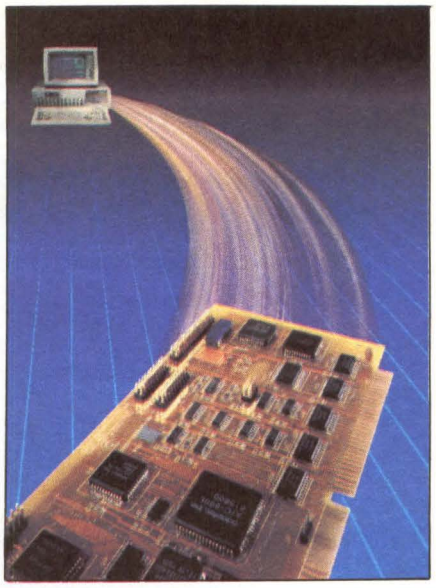
FEATURES

*DEC DIRECTIONS

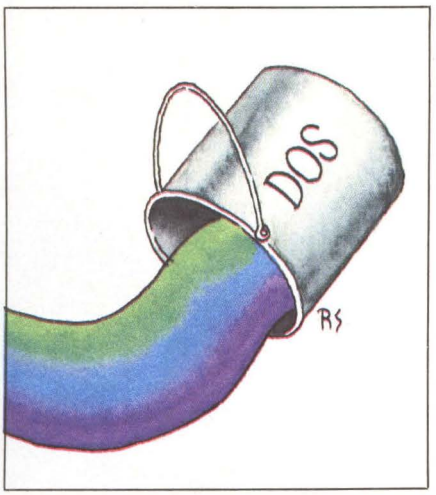
(Section begins opposite Page 108)

*Appearing in issues of subscribers who have DEC computers

DEPARTMENTS



p. 23 . . Adaptec wrings more performance out of 2,7 RLL. Courtesy of Adaptec Inc.



p. 81 . . . . . Mixing DOS and UNIX

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Truth: Now there is a solution to your backup, archiving, data interchange, logging and software distribution problems: The competitively priced EXB-8200.

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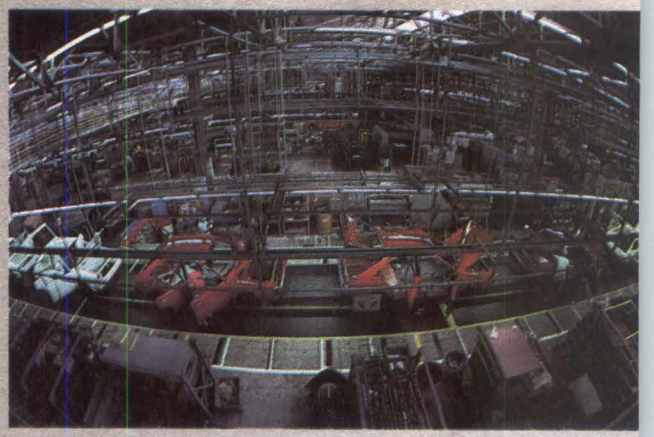
Digital has it now.



"As the world's largest privately-owned software company, Cincom develops software for Digital and IBM systems in national and international markets," states Stanley J. Sewall, vice president of R&D. "For the past four years, we've been designing all our business solutions on Digital equipment. Digital's total systems approach – the interactiveness of its hardware and software – gives us tremendous business leverage."

One significant advantage has been a dramatic drop in Cincom's software development costs. "Until we started using Digital," says Mr. Sewall, "the expense

"Computing systems so cost-effective, Cincom uses them to develop its software products – even those for the IBM market."

of developing each line of code had soared. As a conservative estimate, now we have cut our costs in half." Mr. Sewall is equally impressed with the time savings and productivity gains Cincom has made. "With Digital systems, our software development cycle is four times faster than before. As a result, we're beating our competitors to market with our products. And that's the kind of edge everyone can appreciate."

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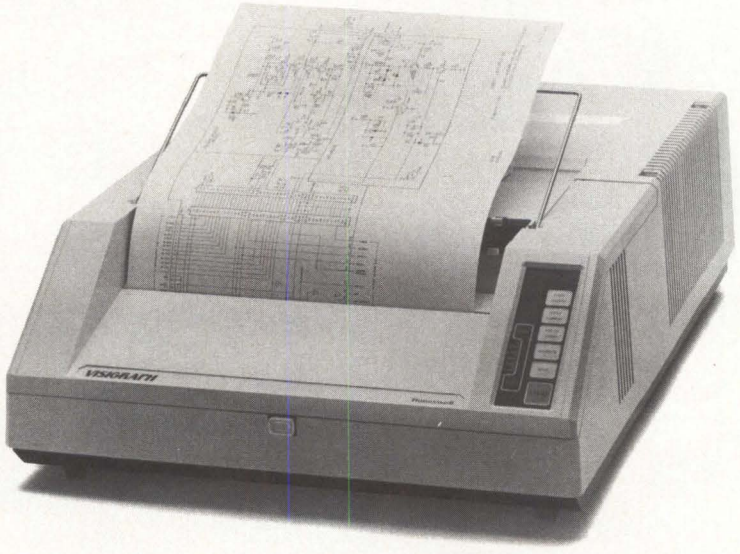

Together, we can find the answers.

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CIRCLE NO. 8 ON INQUIRY CARD

BREAKPOINTS

PRODUCTS ARE HOT BUT HAVE NOWHERE TO TROT

Computer vendors may presently be hot on microcomputer systems that incorporate Intel Corp.'s 80386 chip, but for the most part 386 computers still remain powerful machines in search of a market. For example, Compaq Computer Corp., Houston, sold just over 10,000 Deskpro 386 computers last year. Some analysts expect sales to triple by the end of this year. Jeff Stives, the company's director of corporate relations, admits that many buyers are actually corporate tire kickers who want to test 386 machines but not necessarily to use them in everyday applications. Stives said that systems based on the 80286 chip account for about half of Compaq's total annual sales. In fact, sales of 286-type machines are doing so well the company expects to expand its offerings in that area sometime later this month.—*Tim Scannell*

WANG SHOWCASES NEW PRESIDENT, HARDWARE, SOFTWARE

At an extravaganza at corporate headquarters in Lowell, Mass., Wang Laboratories Inc. introduced five add-ons to the high end of its venerable VS minicomputer line and Version 2.0 of its 2-year-old Professional Application Creation Environment (PACE) software. But more important, the troubled mini-giant showcased its new president, Frederick A. Wang. The son of founder An Wang promised to cut expenses by $50 million by July and return the company to profitability. The hardware, the VS 7000 Series, comprises five machines ranging from the 7110 ($90,000 with 4M bytes of memory) to the 7310 ($280,000, 16M bytes). Wang positions the VS 7000 against IBM Corp.'s 9370 and Digital Equipment Corp.'s VAX 8300/8500/8550.—*Jim Donohue*

INSIGHT SUPPLIES LASERCONTROL FOR IMAGEN'S DDL

Insight Development Corp., Moraga, Calif., announced this month that is has received a contract from Imagen Corp., Santa Clara, Calif., to develop and supply a version of its LaserControl software adapted to Imagen's DDL, a high-performance document-description language. LaserControl will act as a bridge between existing IBM Corp. PC or compatible software application packages and printers supporting DDL. Under the agreement, Imagen will sell or license a private-label version of LaserControl to owners of their laser printing systems. It will be available this spring.
— *Megan Nields*

LOTUS LAWSUIT BREAKS NEW COPYRIGHT GROUND

If a software package has the "look and feel" of another package, it violates copyright protection, claims a suit filed in U.S. District Court in Boston by Lotus Development Corp., Cambridge, Mass. The $10 million suit charges Mosaic Software Inc. of Cambridge and Paperback Software Inter-

national of Berkeley, Calif., with selling look-alikes of Lotus 1-2-3 that are too look-alike. For example, Lotus says that 160 of the 180 spreadsheet commands of 1-2-3 "are not only duplicated by name in the Mosaic copies, but are duplicated in the same organization and sequence." Copyright protection of a program's "look and feel"—essentially, how it appears on a screen—would break new ground for the courts. Last year, federal courts in Philadelphia and San Francisco expanded copyright laws to cover the "overall appearance, structure and sequence" of computer programs.—*Jim Donohue*

INTEL SPEEDS UP 80386, UNVEILS NUMERIC COPROCESSOR

Intel Corp., Santa Clara, Calif., has wound the clock a little tighter on its 80386 processor, getting the 32-bit chip's speed up to 20 MHz from 16 MHz. Production quantities of the faster version, along with a true 32-bit companion numerical coprocessor—the 80387—should be available after Feb. 16. Two other 80386 peripheral chips to control cache and direct memory access are expected later this year.—*Mike Seither*

INTERPHASE VMEBUS SCSI ADAPTER EXCEEDS 30M BYTES/SEC.

This month, Interphase Corp., Dallas, begins shipping the V/SCSI 4210, a VMEbus-based host adapter card with two small computer systems interface (SCSI) ports. Using the company's proprietary BUSpacket Interface technology, the board can transfer data across the VMEbus at speeds in excess of 30M bytes per second. The V/SCSI 4210 costs $1,750 in OEM quantities.—*Dave Simpson*

MAKING A PLUG FOR IBM COMPATIBILITY

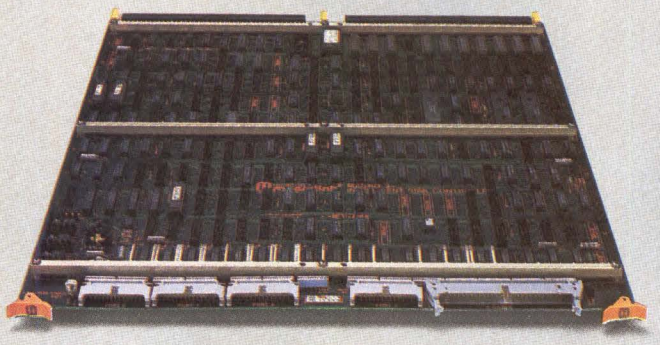
Look for increased activity in the Digital Equipment Corp. add-in peripherals market, particularly as it relates to distributed processing and the use of IBM Corp. PC compatibles within the VAX environment. At the recent DEXPO show in New York, Virtual Microsystems Inc. of Berkeley, Calif., demonstrated a board that plugs into a MicroVAX to port MS-DOS facilities into the VAX environment. Once installed, the product allows the VAX to interact transparently with an IBM PC/AT to run such PC applications software as Lotus Development Corp.'s 1-2-3 and even tap into an IBM PC local area network. The board, with software, costs $4,000, or $7,000 with an expansion box that allows PC board use and LAN attachment.—*Tim Scannell*

AT-STYLE UNIX WORKSTATION RUNS AT 5 MIPS

Look for shipments this quarter of a UNIX workstation based on the IBM Corp. PC/AT that chugs along at 5 MIPS. The Series 300 Personal Mainframe from Opus Systems, Cupertino, Calif., uses Fairchild Semiconductor Corp.'s 32-bit Clipper chip mounted on an AT-compatible board. The

PERKIN-ELMER USERS:

FAST



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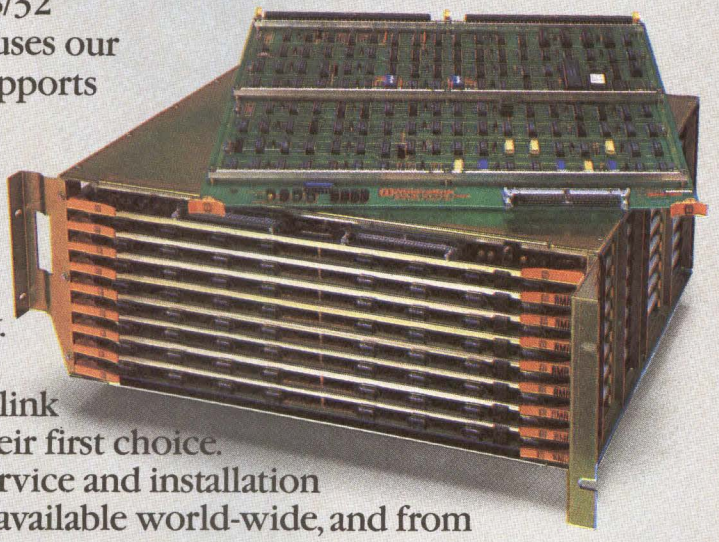

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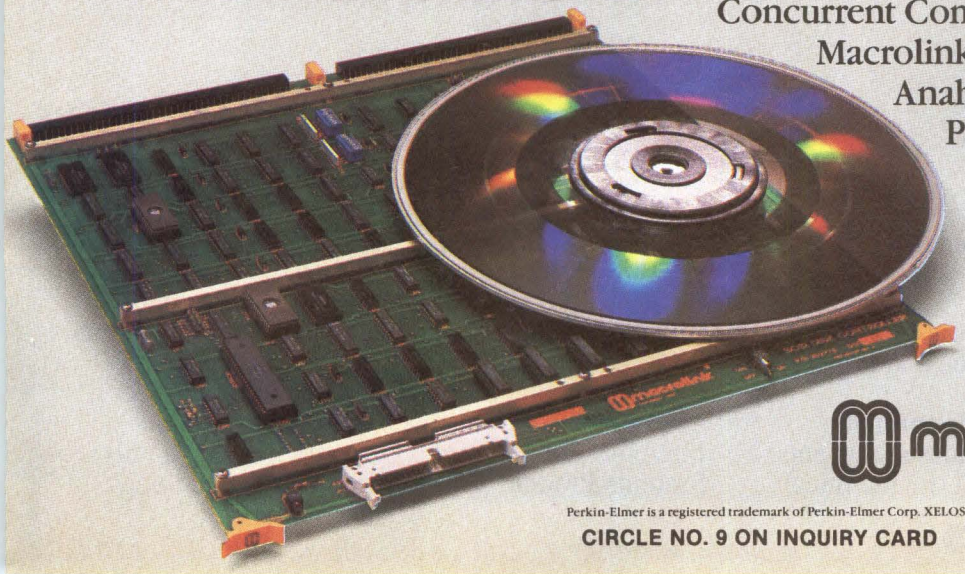

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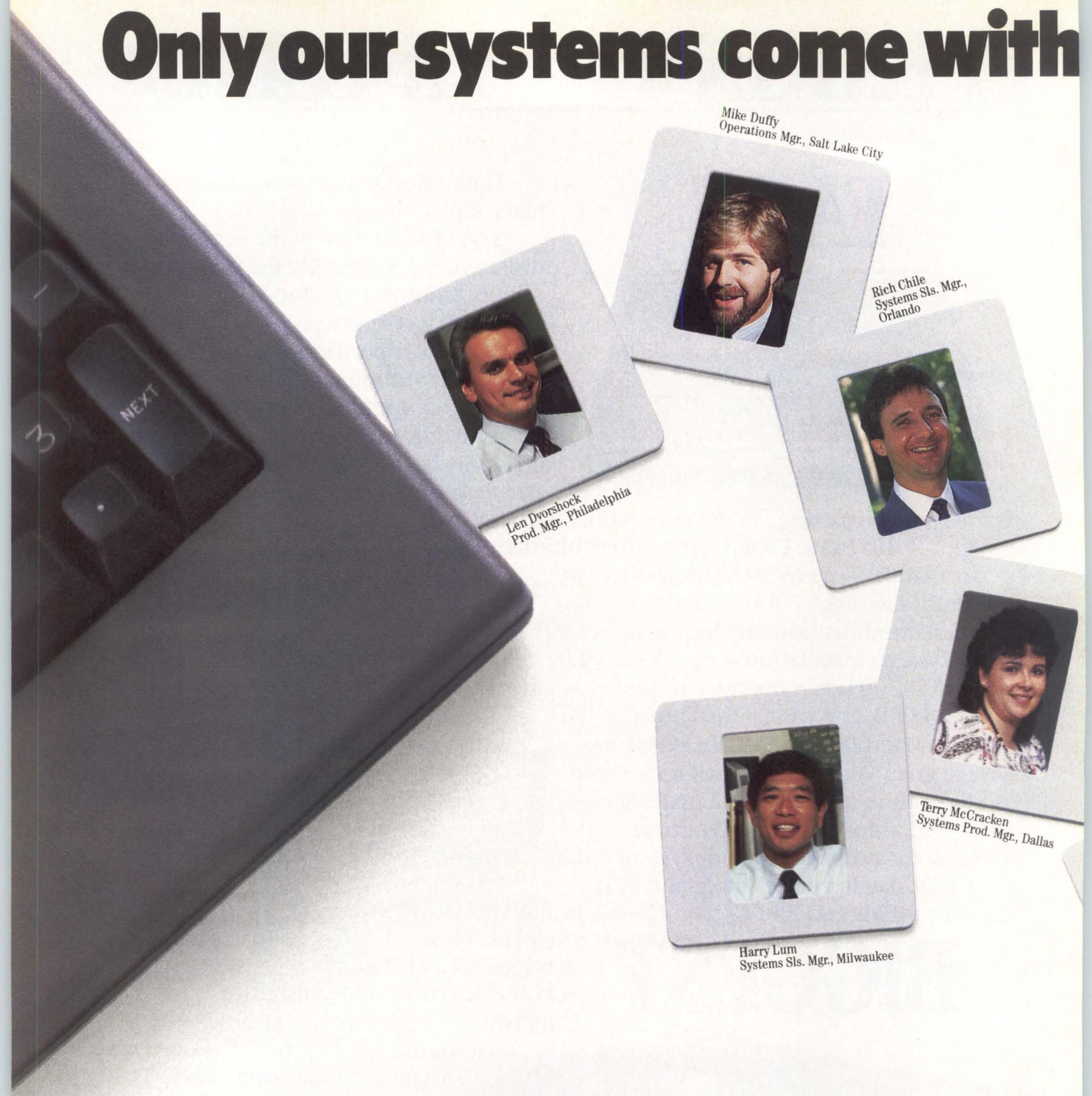

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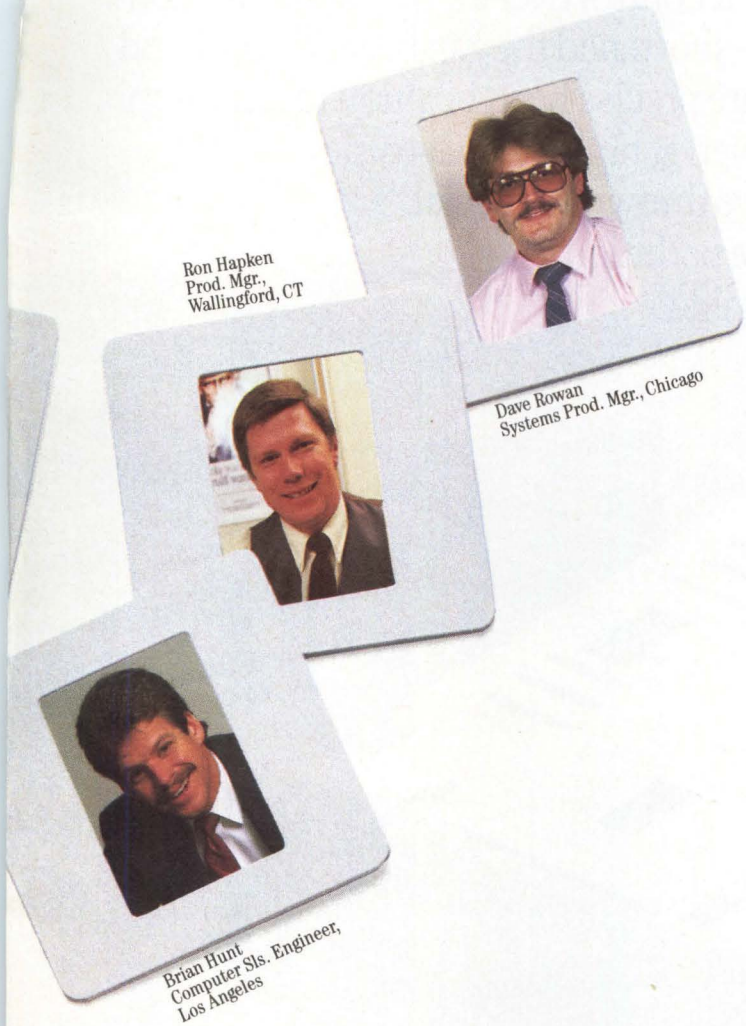

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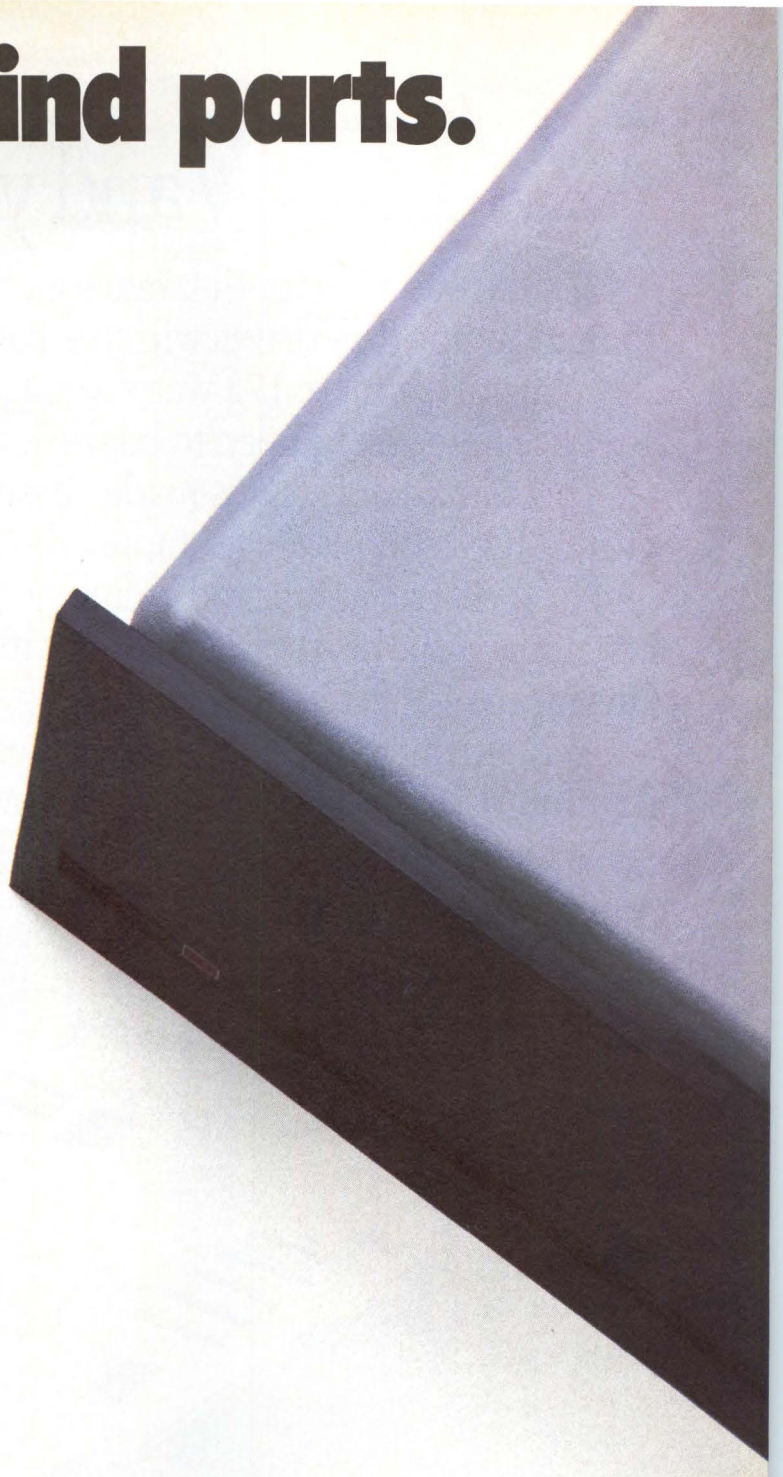

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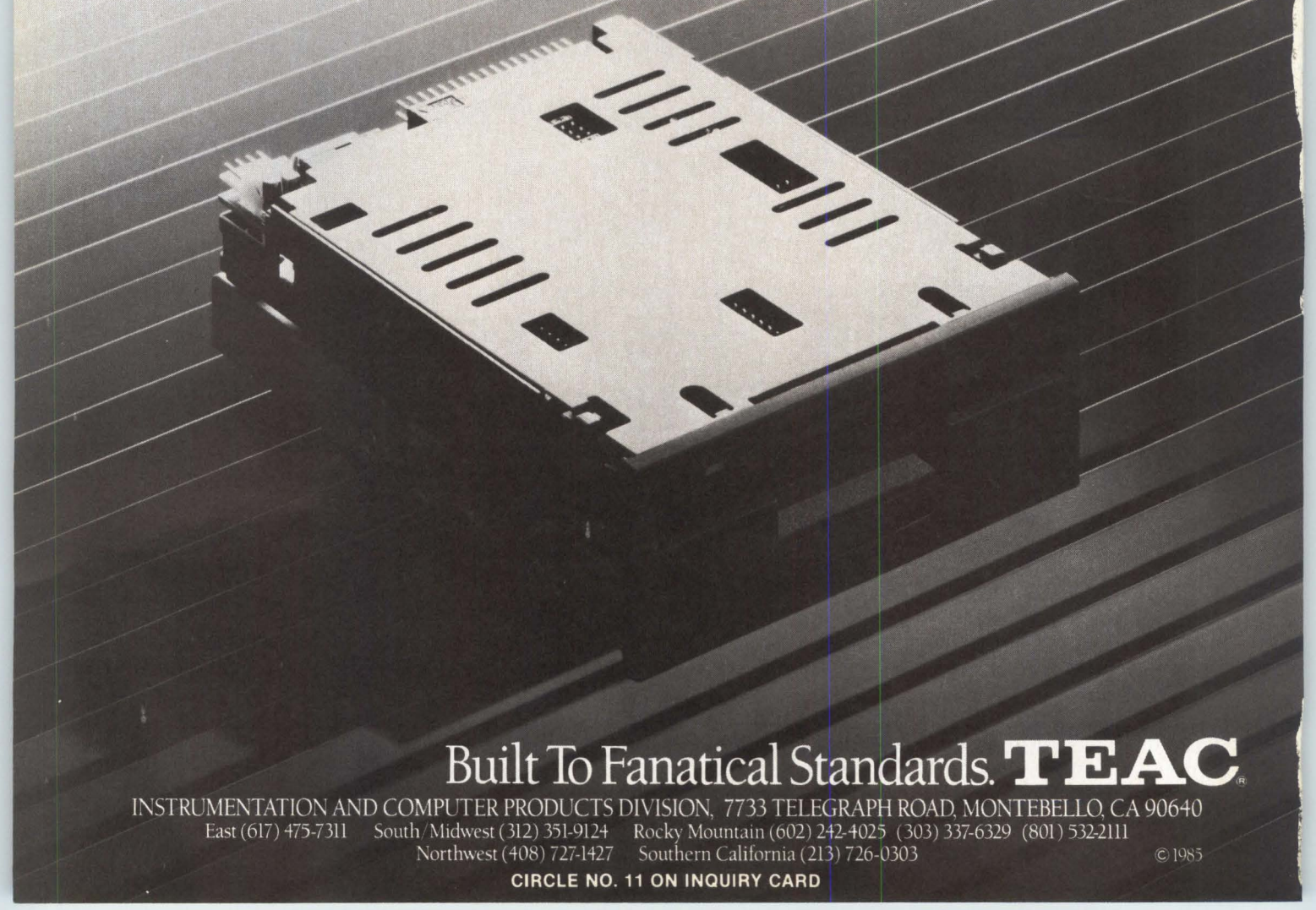

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CIRCLE NO. 11 ON INQUIRY CARD

systems, beginning at about $3,000 in OEM quantities, run AT&T Co.'s System V Release 3 of UNIX while allowing concurrent access to DOS operations. Opus claims that its new systems will allow file access via Sun Microsystems Inc.'s Network File System and AT&T's Remote File Sharing software.—*Mike Seither*

PLENTY OF LIFE IN LOTUS AFTERMARKET

With more than 450 independent software developers and about 1,000 products already in existence, is there room for growth in the Lotus Development Corp. 1-2-3 and Symphony aftermarket? Lotus' vice president of R&D, Ed Belove, thinks so. At a recent showing of new add-on products using the Lotus Developer Tools, which were introduced last April, Lotus took time to mention the coming of two aftermarket products of its own: Speedup, which will make 1-2-3 run faster by performing selective recalculation; and Learn, a macro program that permits users to save and execute keystrokes and commands automatically. Prices are not yet available, but both products will debut later this year.—*Tim Scannell*

SEIKO TO SHOW DIGITIZERS AT GRAPHICS SHOW

Seiko Instruments U.S.A. Inc., Milpitas, Calif., will use the National Computer Graphics Association show in Philadelphia, March 22-26, to show off its new line of high-resolution digitizing tablets. The Screenplay family features resolutions of 1,000 lines per inch and will position Seiko against Hitachi America Ltd. and CalComp for a piece of the high-end digitizer market. Seiko is unveiling four desktop tablets and four floor-mounted digitizers ranging in size from 8 inches by 12 inches to 42 inches by 60 inches, as well as a number of pens and cursors. Base prices begin at $495 and rise to $5,695.—*Mike Seither*

ANSI COMMITTEE READIES STANDARDS FOR OPTICAL-MEMORY CARDS

Proposed standards for the physical structures of optical memory cards are expected from ANSI Committee X3B10 by early summer, according to committee chairman Bob Callen of Drexler Technology Corp., Mountain View, Calif. These devices, about the size of credit cards, have an optical strip that can hold about 2M bytes of data. Right now, they're used primarily for identification (for example, of holders of medical insurance). But in the future, system integrators will use them to mail programs and other computer data, saving on telephone charges. The committee, which

includes representatives of Blue Cross and AT&T Co., hopes to standardize the card size, including thickness, and has begun work on track and sector characteristics. —*Jim Donohue*

OPTICAL-STORAGE DEVICES SLOW IN ARRIVING; STANDARDS AREN'T

Although the optical-storage industry is not shipping large quantities of disk drives, it is working on standards proposals. Laser Magnetic Storage International, Alcatel Thomson Gigadisc Inc., Philips Information Systems Inc. and Sony Corp. have developed a standards proposal for full data-interchange capability for 130-mm optical-recording products. The proposal suggests using a sampled-servo format that will be workable on read-only, write-once and erasable optical medium. The format, which allows 300M bytes of storage, uses a 4/15 modulation code and error detection. The proposal must be ratified by ANSI committee X3B11, subcommittee LD-1. Ratification may entail a long pull, because it may run counter to what several companies, including Cherokee Data Systems Inc. and Laserdrive Ltd., plan to propose.—*Carl Warren*

DUAL CPU BOARD BUILT FOR 25-MHZ MULTIPROCESSING

Dual Systems Corp., Berkeley, Calif., claims it is the first company to ship a CPU board in a standard VMEbus format that is loaded with the 25-MHz version of Motorola Inc.'s 68020 processor and 4M bytes of dual-ported memory. The VMPU-4M features onboard floating-point and memory-managment functions. Dual is positioning the board for use in single- and multiprocessor systems. For multiprocessing, the unit features a board-to-board "mailbox" that allows CPUs to interrupt each other and share the bus. It is initially priced at $12,000.—*Mike Seither*

NEW UTILITY SQUEEZES MORE INFORMATION OUT OF EXISTING DATABASE

Users of Scientific Marketing Inc.'s sales-event processor, MarketFAX, will be able to use its collected data more efficiently, according to national marketing director Ronald Mock. The Costa Mesa, Calif., company is making a $695 add-on package called Analyzer that will allow users to extract every bit of information from the unstructured base of information created under MarketFAX.—*Carl Warren*

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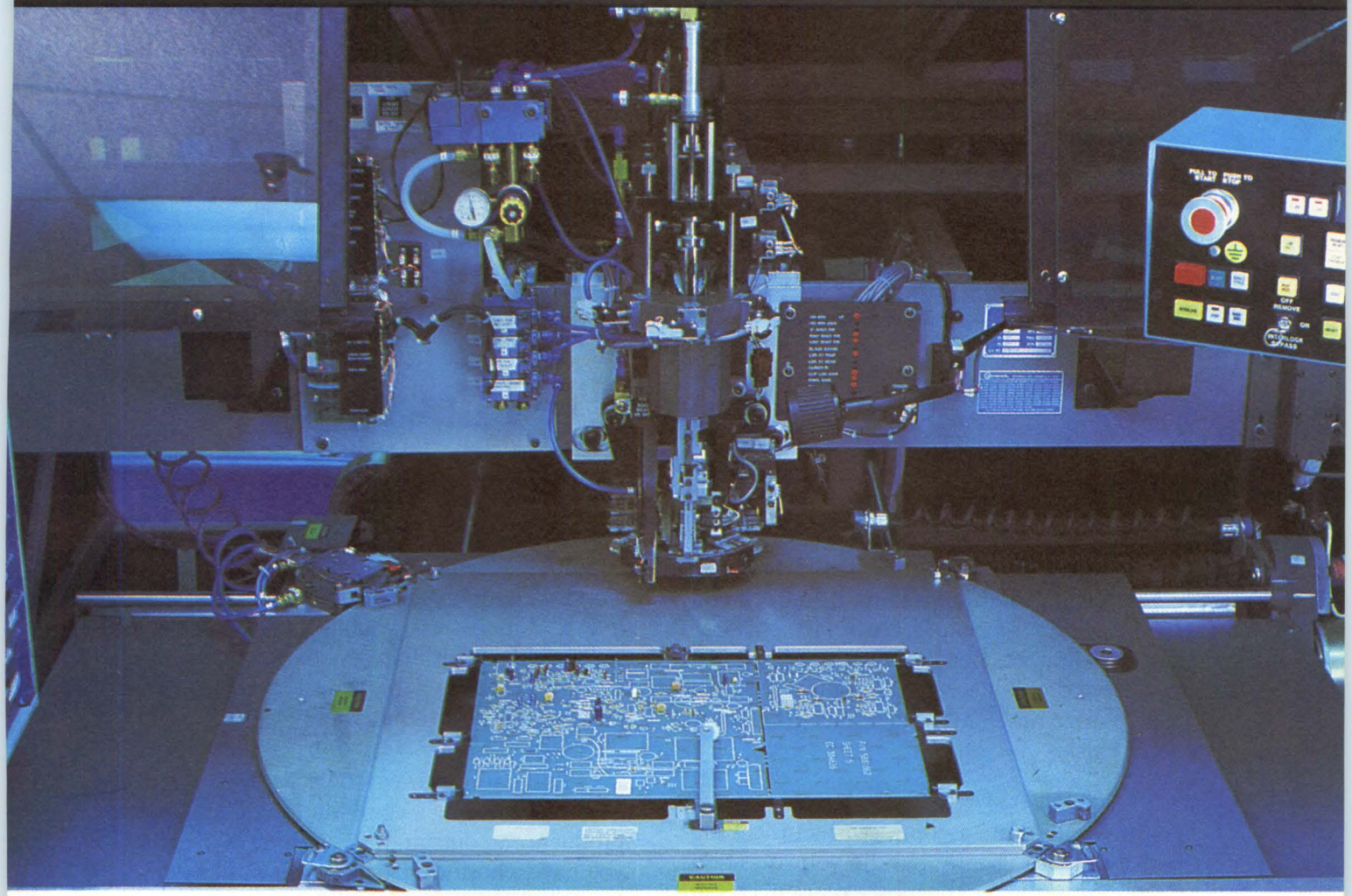

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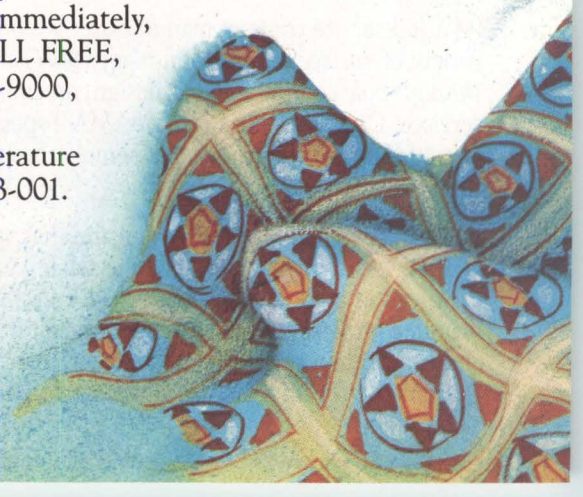

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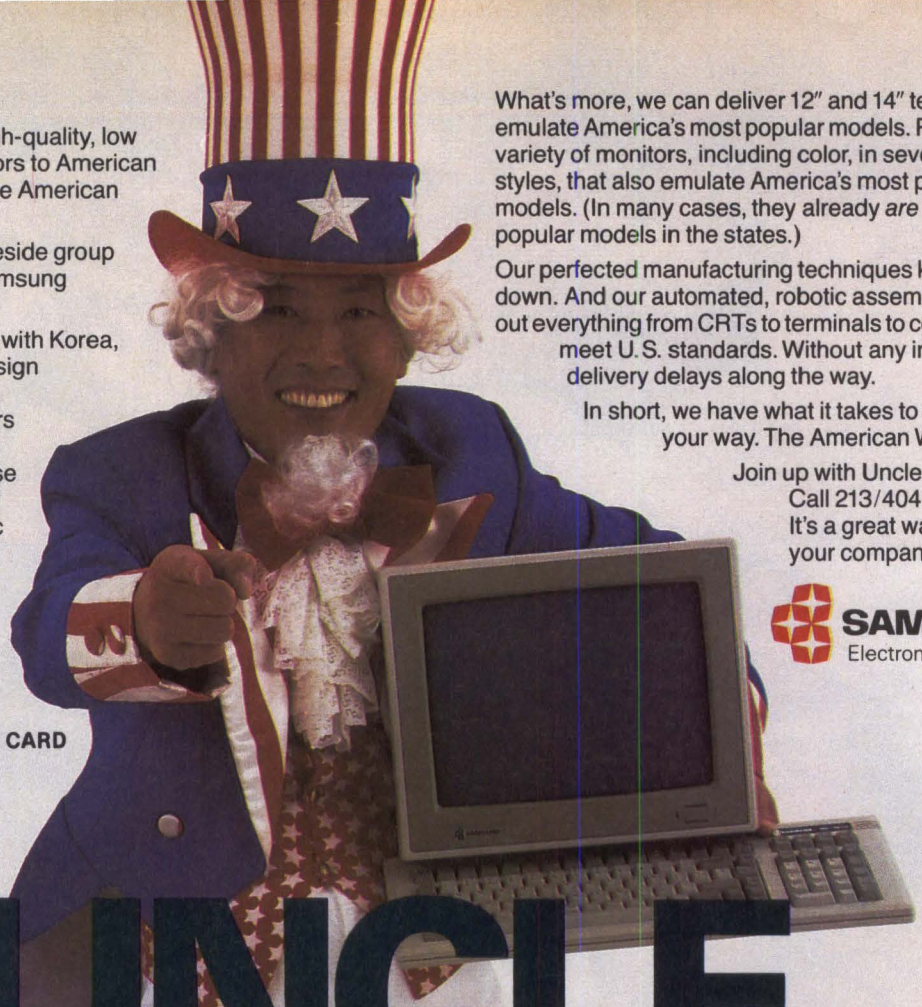

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EXCLUSIVE

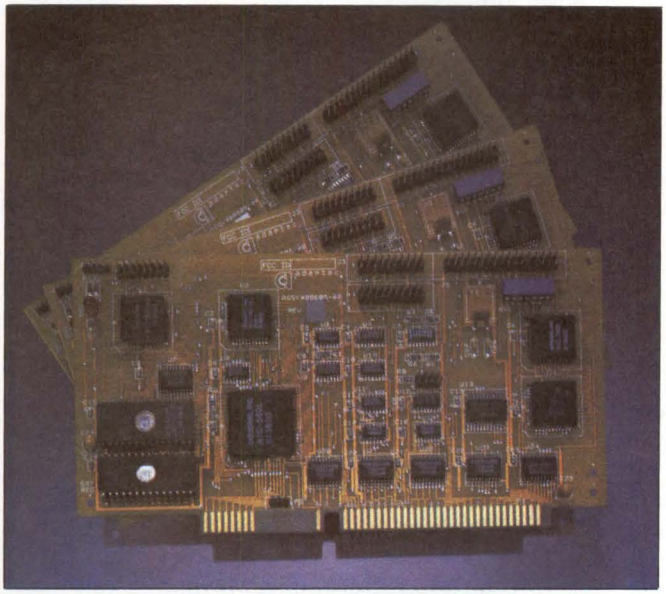
Adaptec advances RLL encoding, doubles PC/AT drive capacity

Mike Seither, Senior Editor

The 2,7 run-length limited (RLL) encoding scheme, a data-packing method that adds substantial capacity to disk drives, is just beginning to attract serious attention from systems integrators who want to wrestle more power out of personal computers.

Developed several years ago by IBM Corp. for use in the mainframe world, the 2,7 RLL technique most recently has been used to extend the life of rigid disk drives that use the ST506/412 interface. Controller and drive manufacturers who have decided to support 2,7 RLL have been able to boost capacity on ST506/412 drives by 50 percent, while pushing the data-transfer rate from 5M bits per second (bps) to 7.5M bps.

Now, Adaptec Inc. is wringing even more performance out of 2,7 RLL. In the last few weeks the Milpitas, Calif., company has shipped OEMs sample controllers for the IBM PC/AT and compatibles that use what Adaptec is calling advanced run-length limited, or ARLL, encoding. This encryption method is being used on one of three PC/AT controllers—collectively called the ACB-2300 line—that Adaptec is introducing this month. The ACB-238X accelerates the typical RLL data-transfer rate by a third to 10M bps. At the same time, it provides 50 percent more capacity than RLL, Adaptec claims.



Adaptec's ACB-2380, *the star of its new line of IBM PC/AT controllers, uses ARLL coding to double capacity on qualified ST/412 rigid disk drives.*

A reprieve for ST506/412

Some ST506/412 drives are now using modified frequency modulation (MFM) to encode data on PCs and PC/XTs at 17 sectors per track. By switching to RLL, a 10M-byte MFM drive, with modifications to the read/write channel, can store 15M bytes at 26 sectors per track. Adaptec says that by implementing ARLL on the same kind of drive, it becomes a 20M-byte mass-storage device with 34 sectors per track. (Codes such as 2,7 RLL increase efficiency by making the flux-changes-per-inch, or FCI, rate smaller than the bits-per-inch, or BPI, rate. Thus, two flux changes yield three bits written. As a result, drives that can manage 12,000 FCI store 18,000 BPI.)

"People have been predicting the demise of the ST412 for some time," says industry observer I. Dal Allan of ENDL Consulting, Saratoga, Calif. "But something always comes along to extend its life. This [ARLL] could be another lifesaver. The challenge will be for drive manufacturers to meet the performance margins Adaptec is establishing."

Adaptec expects production quantities of its ARLL controller, the ACB-238X, to be available in May. OEM pricing in quantities of 1,000 will be $180 and $150, depending on which of two versions is purchased. The company also plans volume shipments to begin about that time for the two other new PC/AT controllers in the ACB-2300 line. The ACB-237X, priced at $155 and $125 for 1,000-unit lots, is a standard RLL device with a 7.5M bps data-transfer rate. Adaptec says the third drive, the ACB-232X, will support all enhanced small device interface (ESDI) drives, moving data at 10M bps. It will be priced at $170 and $140 in OEM quantities.

All the drives in the ACB-2300 line come in two versions. The lower priced version supports a pair of Winchesters; the higher priced version supports the pair of Winchesters and two flexible disk drives. Adaptec claims that all the controllers—ARLL, RLL and ESDI—are hardware- and software-compatible with the PC/AT and operate at a 1-to-1

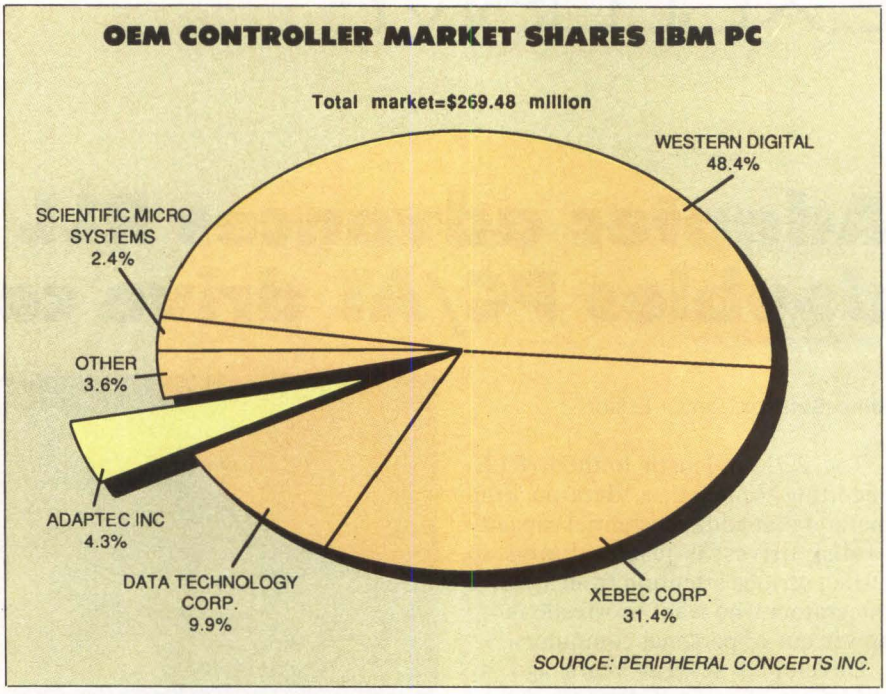
interleave ratio. The necessary logical transformations the controller performs—for instance, making the 34 sectors per track of ARLL look like the 17 a PC/AT expects—are transparent to the application.

Extends the concept

Adaptec is no newcomer to run-length limited controllers. In fact, the company is regarded as something of a pioneer in the technology, though, as Allan notes, "Adaptec never promoted it much for PCs," mainly because so few drives would support it. Adaptec first implemented RLL as a component to increase performance on its ACB-4000 series of small computer system interface (SCSI) controllers more than two years ago. It wasn't until last year, when volume shipments of its ACB-2070A began, that Adaptec brought RLL to users of PC/XTs. But only with the company's latest product line has Adaptec begun to make its move into the market for PC/AT-class machines.

Adaptec's strategy with the ACB-2300 line is to open up higher performance thresholds for the PC/AT in all segments of the market. When IBM introduced the PC/AT in 1984, part of Big Blue's game plan was to position the machine for use as a server. But by establishing 20M bytes as the standard for AT mass storage, IBM didn't give the machine enough horsepower to do that job, says Jeff Miller, Adaptec's vice president of marketing. At that time, he says, ST506/412 devices were the only drives available for the PC/AT; there were no ESDI drives, nor was there RLL. Meanwhile, computer manufacturers increased the power of PC/AT-type machines by cranking up the clock from 6 MHz to 8 MHz to 10 MHz and beyond.

"Most people have been using ATs as upgraded XTs," Miller says. "The host speed has increased to collect data faster, but the drive and controller have stayed fixed. What we're trying to do [with the ACB-2300 line] is complete the legacy that IBM orginally set down for the AT." Industry analysts say that as the AT overcomes obstacles, like the ST506/412 I/O bottleneck of 5M bps, the machine will become more popular as an engine for specific applications.



The broad reach Adaptec is taking with its complete line of PC/AT controllers is being matched piecemeal in the market by a number of other vendors.

For example, Maynard Electronics, Casselberry, Fla., recently announced its enhanced run-length limited, or ERLL, encoding scheme that nearly doubles capacity for ST506/412 drives for the IBM PC and PC/XT. An AT version is planned for introduction soon. Maynard claims that its ERLL controllers achieve data transfer rates of 9M bps. Sectors per track have been increased from 17 to 33. Maynard, however, has not sold its controllers on an OEM basis, but instead matches them to specific drives and sells the works as a subsystem. At press time Maynard had announced neither pricing nor which drives ERLL will work with.

Meanwhile, at least two other major manufacturers are offering PC/AT controllers that either take advantage of ESDI drives or support RLL.

Western Digital Corp., Irvine, Calif., has begun ramping up production of its WD1003 series of 2,7 RLL controllers that work in conjunction with Seagate Technology's 32M-byte ST238 Winchester. The boards come in full- and half-slot models and can operate either a pair of Winchesters or two Winchesters and two flexible disk drives. The controllers feature 56-bit error correcting code and data rates up to 7.5M bps.

The OMTI division of Scientific Micro Systems Inc., Mountain, View, Calif., is also set to produce volume quantities of 2,7 RLL and ESDI controllers for the PC/AT. Both were introduced at Comdex/Fall. OMTI's 8620, an enhanced version of a controller that has been shipping since last year, supports a pair of flexible disk drives and two Winchesters that use either ST412 or ESDI interfaces. The OMTI 8627 is generally the same as the 8620, except that it adds 2,7 RLL capability.

OMTI says its RLL controllers support drives from a number of manufacturers, including La Pine Technology, Microscience International Corp., Miniscribe Corp., Peripheral Technology Inc. and Priam Corp.

That list of manufacturers tends to demonstrate the support that RLL has had among drive manufacturers. But how quickly they will embrace Adaptec's ARLL is still to be seen. Admits Adaptec's Miller: "We're

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CIRCLE NO. 15 ON INQUIRY CARD

RLL: Shrinking windows to stretch capacity

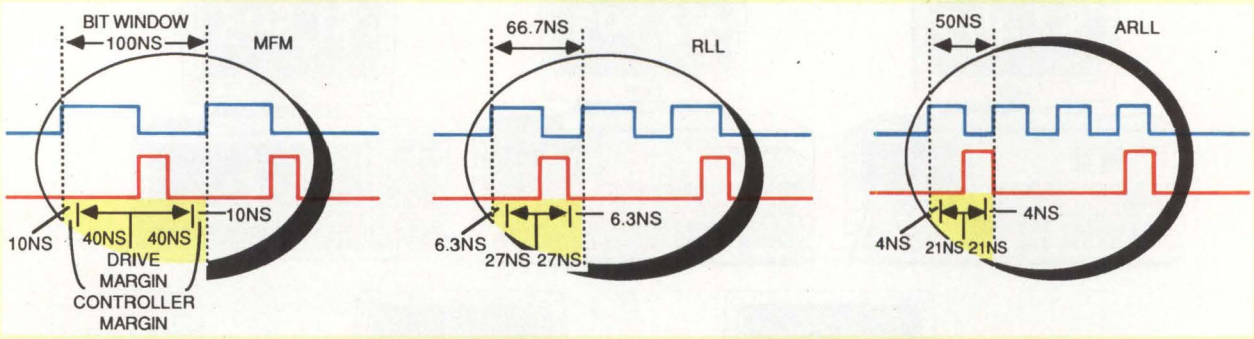
Controller manufacturers are squeezing more information out of Winchester disk drives for IBM Corp. PCs by using run-length limited (RLL) encoding schemes that have proved themselves in the mainframe world.

In the encryption methods illustrated here, the blue lines represent the controller's data clock. The red lines represent analog signals, or magnetic flux reversals, that the controller recognizes as one bits from the drive.

As vendors move from modified frequency modulation (MFM) to RLL, for example, the data transfer rate increases while the recording density of the drives remains the same, resulting in a 50 percent increase in capacity.

As that happens, however, the bit window—that slice of time needed to recognize a data bit—shrinks drastically. Going from MFM to RLL, the bit window is cut by a third from 100 nsec to 66.7 nsec.

The challenge for both drive and controller vendors is to reduce margins as much as possible in order to identify data accurately at these higher frequencies.



Requirements	MFM	2,7 RLL	ARLL
Data transfer (M bps)	5	7.5	10
Data clock (MHz)	10	15	20
Data bit window (nsec)	100	66.7	50
Drive margin (nsec)	±40	±27	±21
Read/write channel (MHz)	2.5-5.0	1.875-5.0	2.5-6.67

SOURCE: ADAPTEC INC.

about where we were three years ago with RLL." In other words, there is still a lot of missionary work to do to convince drive manufacturers that they should improve their drives to handle the tight margins that ARLL requires (see "RLL: Shrinking windows to stretch capacity," above). Changes in the read/write channel, head design and flying height, as well as media, can be expected.

At least two manufacturers think they now are technically prepared to support ARLL. One, La Pine, plans to announce a 40M-byte, 3½-inch Winchester during the first quarter this year. The other, Microscience, has tried ARLL on its 40M-byte, 5¼-inch half-height Winchester. Engineering doesn't seem to be the problem at this point, says marketing vice president Ron Schlitkus in Mountain View, Calif.

"We want to be sure," he says, "that there is a market for an 80M-byte half-height, before we put it into manufacturing." □

FACT FILE

Adaptec Inc.
580 Cottonwood Drive
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(408) 432-8600
Circle 473

*Three series of ACB-2300 disk drive controllers for the IBM Corp. PC/AT and compatibles.

*Controllers for drives with ST/412 interface use 2,7 RLL or ARLL coding. ESDI controller features 1-to-1 interleave.

*ACB-2380 with ARLL increases capacity of qualified Winchester disk drives by 100 percent.

*All ACB-2300 controllers are available in either rigid or rigid/flexible disk drive versions.

LOCAL AREA NETWORKS

By creating competition, Starlan lowers network prices

James F. Donohue
Managing Editor

All right, system integrators: multiple choice. Starlan is the ultimate cheap way to network office microcomputers? Or Starlan is just another silly local area network standard, and who needs more of them?

What's your answer? Correct. Go to the head of the class. That's right, no matter which answer you picked, some knowledgeable people think you're right.

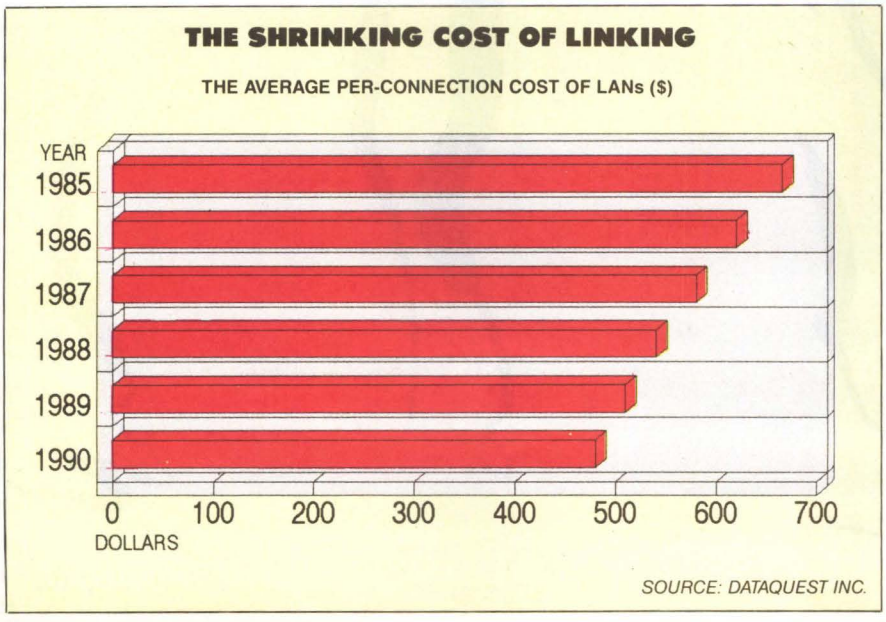
Starlan proponents tout it as the end of the search for an inexpensive office network. It's "the ultimate dirt LAN," in the words of Gabe D'Annunzio, vice president for marketing services at network vendor Micom-Interlan Corp., Boxborough, Mass. By "dirt," he means dirt cheap.

Lined up against him are people like William N. Carrico, president of Bridge Communications Inc., Mountain View, Calif., another network vendor. "We don't think the world needs yet another networking scheme," he says. "We have no current plans whatsoever to support Starlan."

In the middle are consultants like David Rubin of Arthur D. Little Inc., Cambridge, Mass. "AT&T has a product that has cost advantages and is good enough for many applications," he says. "It's a reasonable plan."

Whether Starlan is the ultimate anything, what it has created, of course, is the system integrator's ultimate dream: hot and heavy competition. The presence of Starlan already has put prices of many office networks into a steep dive, and the vendors say, "You ain't seen nothin' yet." Some predict the cost of a Starlan network will drop to $100 per connection before the end of 1987. (Connections are via plug-in cards.)

Vendors of competing classes of products—mainly Ethernet and IBM Corp.'s Token-Ring Network—vow to keep up. "You'd have a hard time convincing me that we cannot continue to bring the cost [of Ethernet connection] down just as fast as they can bring the Starlan cost down," says Carrico. An Ethernet connection, like the EtherLink network card from 3Com Corp., Mountain View, Calif., goes for about $600.



Starlan, star bright

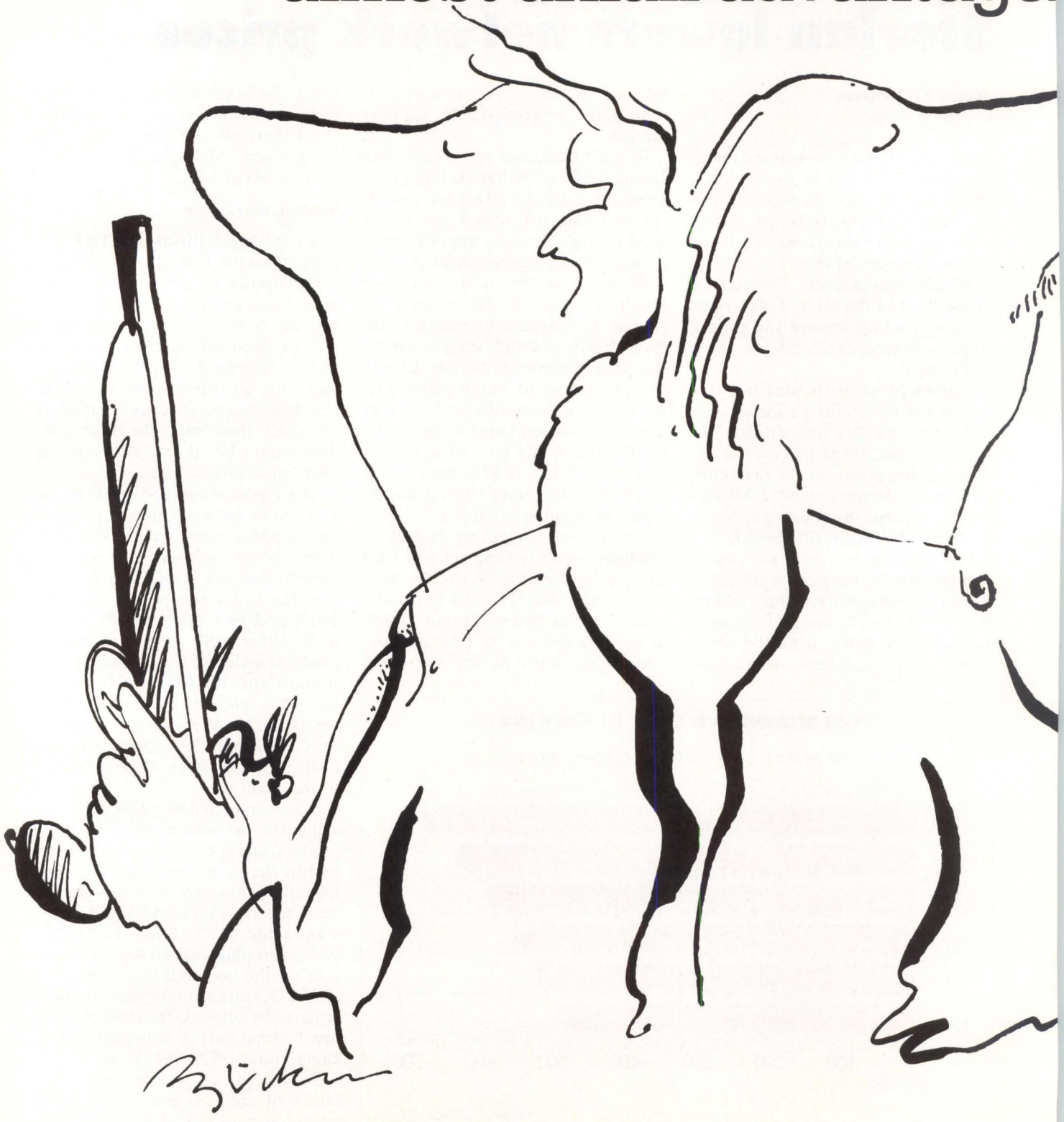
Starlan began life as an AT&T Co. product name. But when AT&T was slow coming to market, the name passed into computer parlance as the generic name of IEEE committee 802.3's specification for a 1M-bit-per-second, baseband, Ethernet-like LAN that runs on twisted-pair wires, like telephone wires. (Because Starlan is an AT&T trademark, the other vendors describe their products as "Starlan-like.")

AT&T posted a price of $600 for its Starlan connection. Quickly, competing vendors came to market with lower price tags. Micom-Interlan brought out one (with fewer features than the AT&T version) for less than $400, and that price rapidly fell to $325. Other early vendors of Starlan products included AST Research Inc., Irvine, Calif., Fox Research Inc., Dayton, Ohio; Hewlett-Packard Co.'s Information Networks Group, Cupertino, Calif.; Retix Corp., Santa Monica, Calif.; and Western Digital Corp., Irvine, Calif.

Prices came to depend on what you wanted to do with a particular Starlan product, and they varied widely, even within the same company. Western Digital, for example, sells two plug-in Starlan cards ($199 and $275) and a standalone $495 "hub." For $199, you get to plug your computer into a port on the hub, and that's about it. For $275, you can make your computer part of a network: for example, you can become part of a 10-port "daisy chain" hung off the $495 hub.

Starlan joined a wild and feisty bunch of products and standards already vying to link office microcom-

HP Precision Architecture gives almost unfair advantage.



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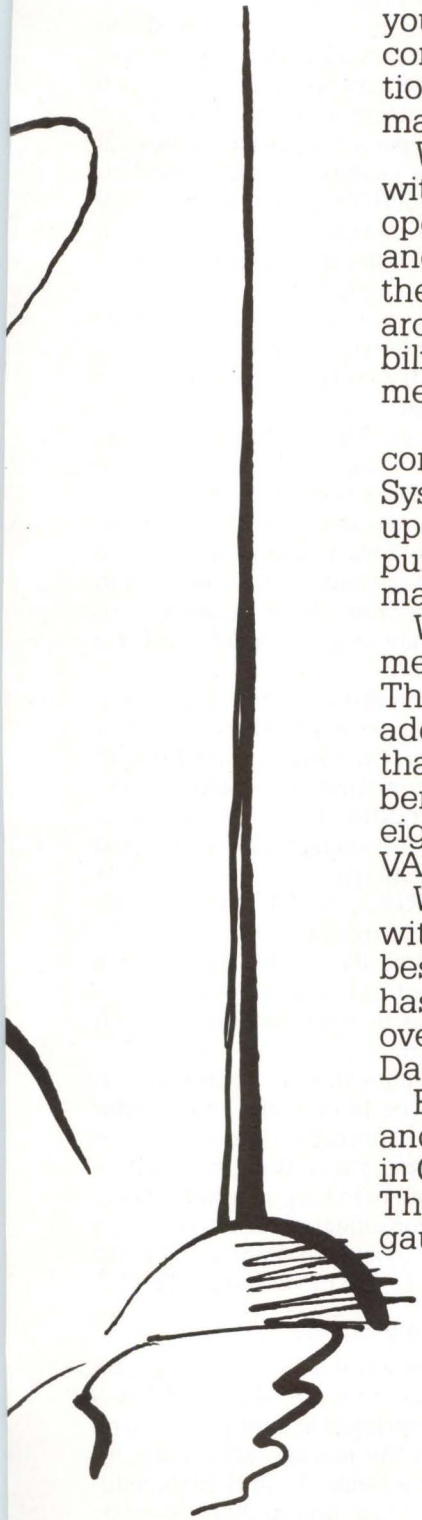

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puters. This bunch, which embraces even that old war horse, the RS232 standard, is led by Token-Ring Network and includes thin-wire Ethernet, sometimes called Cheapernet.

Token-Ring Network is considered the most powerful and most expensive of the networks, at about $1,000 per connection. It runs at 4M bits per second (bps). Cheapernet is a coaxial cable (for example, IEEE's specification RG-59/U) that sells for about 20 cents a foot, compared to about $1 a foot for the so-called wide-wire coaxial (for example, RG-11/U). But cabling runs can be only about half as far for thin-wire as for wide-wire, so you face the costs of putting repeaters on the line.

It's clear: There's a bit of a standards war going on. But unlike a lot of the standards wars that have torn at the computer industry over the years this one does not appear to be a matter of life and death for the system integrator. Your choice is among a lot of adequate products, all of which are inexpensive.

But keep this in mind: At one level, your choice is mainly between wires: twisted-pair telephone wires (Starlan and Token-Ring) or coaxial cable (Ethernet). But on another level, your choice is between three very big and very competitive companies: IBM (Token-Ring), AT&T (Starlan) and Digital Equipment Corp. (Ethernet). Consultants like A.D. Little's Rubin say your choice is probably best made according to which of those worlds you live in.

Rubin adds that the competition is likely to be bloody and that vendor failure, especially among smaller companies, is something system integrators ought to keep in mind. "There will be consolidation," he says. "The biggies will start to dominate. I mean the AT&Ts, the IBMs and the DECs."

Business picks up

For Starlan, business started a bit slowly, but it built briskly. AT&T says that last spring, when the product first came on the market, shipments totaled 50 a week. By mid-1986, shipments were running at 200 a week; by fall, at 500 a week. Besides using its own sales force, AT&T has signed on

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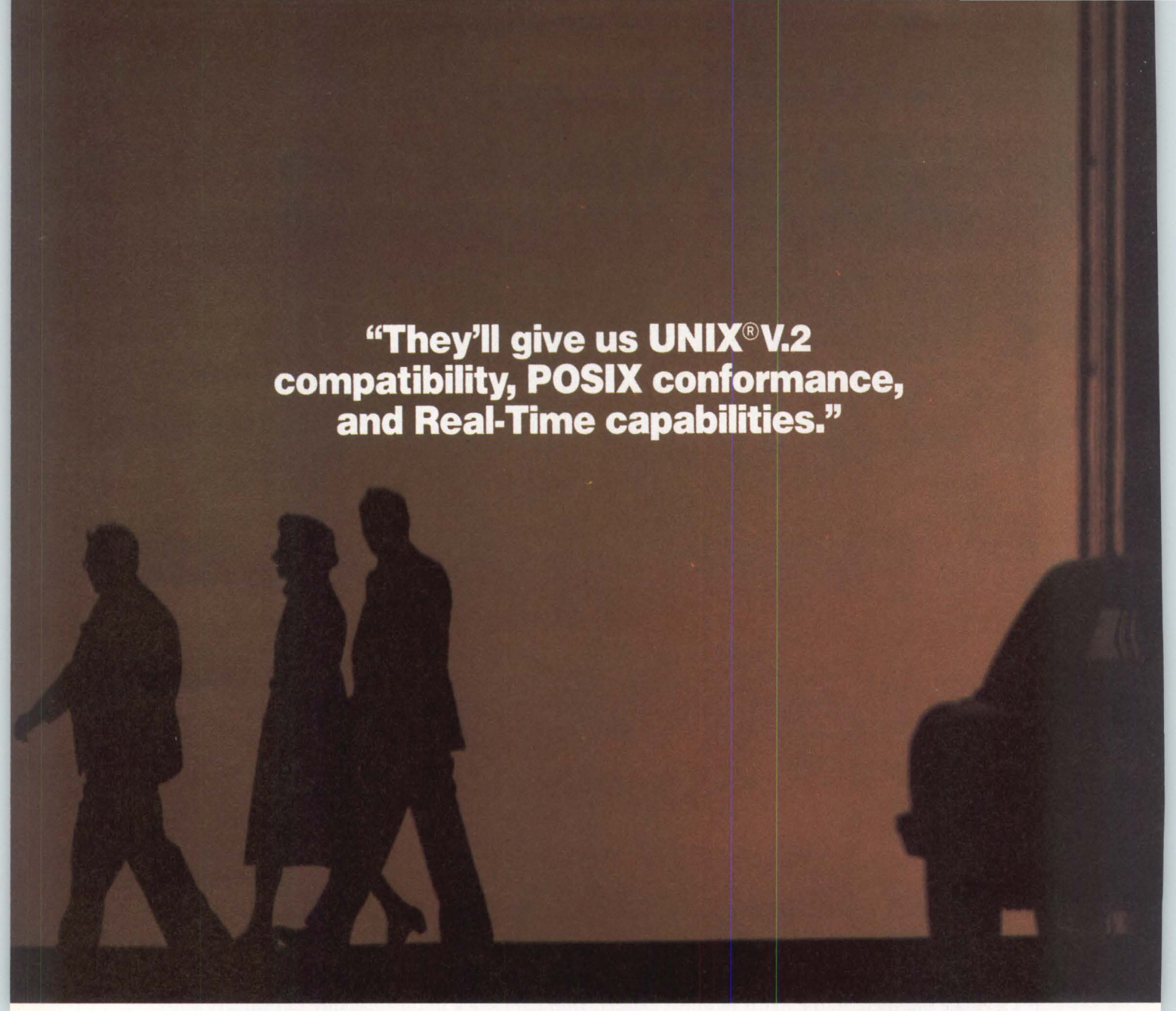

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CIRCLE NO. 19 ON INQUIRY CARD

Starlan and Token-Ring fight for market share

An interview with David Rubin, senior communications consultant, Arthur D. Little Inc., Cambridge, Mass.

MMS: What's your forecast for market share for the various office-networking products for 1987?

Rubin: The aggregate for Starlan and [IBM Corp.'s] Token-Ring [Network] will be about 40 percent market share, split pretty evenly. At one time, we thought that Starlan would have an edge, but we don't any more. Thin-wire Ethernet will have a 10 to 15 percent market share. The rest of the market will go to the proprietary vendors, like 3M [3M/Interactive Systems, Ann Arbor, Mich.] and Novell [Novell Inc., Orem, Utah]. There are also arrangements for modified RS232 connections that can hook computers into file servers and allow you to exchange files. One of the vendors of that product is EasyNet [EasyNet Systems Inc., Mississauga, Ontario].

MMS: How do you rate Starlan?

Rubin: It's a product that has cost advantages and is good enough for many applications. It's a lower cost system than Token-Ring, and it's modular. The architecture is one which you can use to link up personal computers over a large enterprise in building-block fashion. It's a reasonable plan.

MMS: And Token-Ring?

Rubin: It has a higher ultimate performance, compared to Starlan. Token-Ring can be used for better connectivity to IBM mainframes. You can hang a 3174 controller off a Token-Ring and attach 3270 terminals to that and access the mainframe. There's the trade-off with Starlan: cost vs. greater speed and connectivity to IBM.

MMS: And Ethernet?

Rubin: It probably is a better mechanism for handling large file transfers between minicomputers. So, the Token-Ring system might be more for a PC network, and Ethernet would be better for a mix of PCs and minis. That's Ethernet's advantage. It also turns out that DEC [Digital Equipment Corp., which endorses and uses Ethernet] has been doing very well, and Ethernet has a growing constituency.

Novell Inc., Orem, Utah, and Xerox Corp., Stamford, Conn., to hawk its Starlan as value-added resellers.

Novell, recognizing the difference in price and performance among the Starlan products, looked into selling both AT&T's and Micom-Interlan's versions in something called a Starter kit. The two products are most cost effective when they work together, says Novell vice president Craig Burton, "The AT&T card is suited for the [network] server, the Micom card for the workstation. Micom's card is lousy for a server, and AT&T's is overkill in the workstation."

Software support for Starlan is coming on. Among the early players were Novell with its NetWare operating system and Ashton-Tate, Torrance, Calif., which made its dBASE III Plus and dBASE III Plus LAN pack available for Starlan.

Curiously, AT&T has become a factor—a negative factor—in the Starlan scene. Knowledgeable people say two competing factions in AT&T confused the company's early marketing strategy. One faction wanted Starlan to go directly against hated IBM and bump off Token-Ring. But another faction had a longer range view: for them, Starlan was the first step toward a grander, worldwide integrated services digital network (ISDN).

As the dust settled, industry players concluded that the people with the long-range view had won out. AT&T doesn't care about bashing IBM as

System integrators struggle with a tough decision

System integrators split almost evenly when asked in a *Mini-Micro Systems* survey if they backed Starlan, IBM Corp.'s Token-Ring Network or Ethernet.

Ethernet drew praise for being easier to hook into and for having a better reliability record. Token-Ring was the choice at IBM installations, especially where there were mainframes.

System integrators backing Starlan seemed the most worried about their choice. One was concerned about the fact that the telephone wires in his building that would be used to make the network were owned by AT&T, not by the user.

Jack Benson, research associate with Generic Research Associates, Williamston, Mich., typifies how many system integrators are struggling with the imponderables of Starlan.

"I have to admit a bias toward AT&T [Co.]," he says. But he notes that the quality of telephone service can vary. "Phone service in general seems to have deteriorated [after the breakup of AT&T], especially in non-AT&T lines," he says.

On the other hand, there are obvious cost advantages to Starlan. "A hospital I have been working with to set up a lab information system would benefit from a Starlan set up because the facility already has enough telephone lines available for much of the needed network."

This is a small hosptial (350 beds), and the cost of the network will be a major factor in its eventual decision on which network to install.

"I guess, overall, the final purchase depends on the individual needs, cost, service and which fits the situation best," Benson says.

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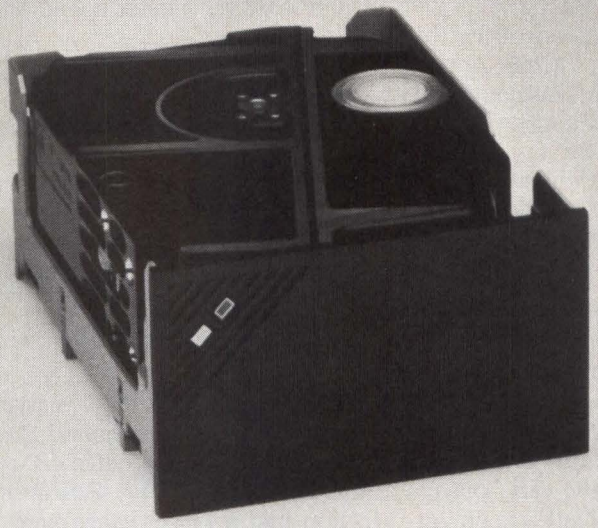

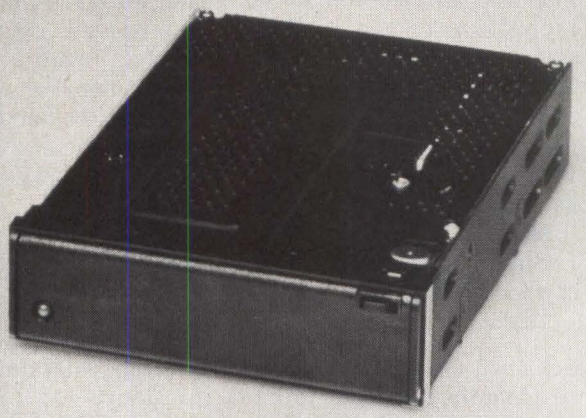

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much as it cares about those long-range, global goals. "They're just going to use Starlan as a part of their own total system business," says Ray Noorda, president of Novell.

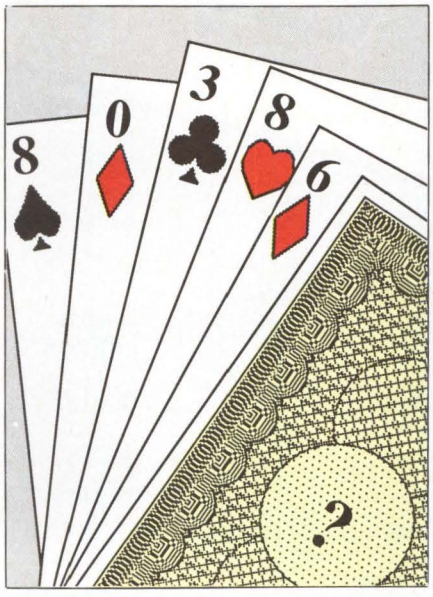
AT&T, say Noorda and many others, wants Starlan to link workstations and desktop computers into clusters and the clusters into departmental groups. The next step, according to this scenario, will be to integrate the various departmental networks into a single network by connecting Starlan to AT&T's Information Systems Network (ISN), a powerful packet-switched LAN. ISN supports IBM's Systems Network Architecture (SNA) for connection to IBM mainframe environments and the faster "established" Ethernet (10M bps over coaxial cable) for access to DEC machines and to most of the rest of the world. When ISDN standards are established, Starlan will be part of it.

If that happens, says Noorda, AT&T's Starlan may simply disappear. "It will just get buried someplace. The price will be bundled [into the price of the larger network]." As an AT&T Starlan vendor, however, Noorda has a different agenda. "Our hope is that we can help make AT&T's Starlan a more recognized standard product in the market," he says. □

MICROCOMPUTERS

386 add-ons: a pat hand or house of cards

Tim Scannell, Senior Editor



While next-generation personal computers, built around Intel Corp.'s 80386 chip, are barely out of the starting gate, software and board manufacturers are already jockeying for lead positions on the systems track.

Unfortunately, although the vendors are many, the rules in this contest—which are the standards codified by such companies as IBM Corp.—have yet to be set. As a result, many vendors that adhere to a particular design philosophy may find themselves out of the running when the dust finally settles.

"The demand for the 386 is phenomenal," says Jeff Stives, director of corporate relations for Compaq Computer Corp. in Houston, which introduced one of the first 386-based systems. "But, you will see some problems, especially with plug-in boards that make a system a 386." In most areas, "it's just not do-able."

Despite Stives' reservations, however, many companies are doing it. Witness the number of add-in products displayed at Comdex/Fall in Las Vegas. In fact, shipments of Intel's 80386, the silicon heart and soul of a plug-in conversion board, are expected to shoot from about 100,000 in 1986 to 1 million in 1987, according to Intel's projections.

Among those manufacturers that have unveiled plug-in 386 products

for the IBM PC/AT and compatibles are:

- Applied Reasoning Corp., Cambridge. Mass., which has announced an add-in board called the PC Elevator that can reportedly turn any PC into an 80386 workstation by boosting the clock speed to 12 MHz and offering a 32-bit bus;
- Orchid Technology Inc., Fremont, Calif., which has introduced its Jet 386 accelerator card that plugs into a PC/AT, boosting performance by three times;
- Seattle Telecom & Data Corp. of Redmond, Wash., which introduced the STD-386 at Comdex/Fall (The company made a name for itself a year or two ago by manufacturing accelerator boards for IBM's PC/XT and compatibles that pushed clock speeds to the then-remarkable rate of 12 MHz.);
- Cheetah International Inc., Longview, Texas, which has a low-cost 386 converter, the Adapter/386, that, at $495, is priced about one-fourth as much as other 386 add-in devices. (However, the board's performance is limited by the PC's 16-bit architecture, and even with the addition of a second zero-wait-state board results in only a 10 percent increase in speed—to approximately 9 MHz.)
- Chip-maker Intel, which has gotten into the add-in act by introducing the Inboard 386/AT from its Personal Computer Enhancement Operation based in Hillsboro, Ore. It reportedly offers multitasking and double the performance for about $2,000.

However, even though the level of 386 product activity is high, particularly on the hardware side, the market remains pretty much stalled until IBM unveils its 386 entry. And that probably will not occur until sometime late this year, observes Bonnie Digrius, an analyst with INPUT, a market research company in Mountain View, Calif.

Who's buying the machines?

Doubt over exactly how IBM will structure its 386 offensive is keeping a lot of large corporate computer users away from the current crop of 386 machines and add-ins, says Compaq's Stives. According to data collected from the reply cards sent in by a small percentage of the Compaq Deskpro 386's more than 10,000 users, most are employed by small- to mid-size corporations of 1,000 employees or less and with multiple sites. In fact, 80 percent of the users who returned cards indicated they worked for mid-size companies.

Stives noted that nearly all the Fortune 1000 companies that purchased the firm's 386 machine—including a large number of financial institutions—have bought one or two units for evaluation. This indicates these firms are willing to look but are hesitant to accept 386 technology at this point—especially before IBM states its position on the matter. When IBM does finally launch an expected 386 salvo, it may do the most harm to vendors who have rushed into the market shouting "more performance and higher speeds" without thinking about the compatibility problems should IBM decide to use a proprie-

tary 386 chip design.

Right now, all signs point to IBM taking a less traveled road in its 386 chip structure. For example, IBM owns 20 percent of Intel and could easily adopt any architecture Intel develops without expending much of its own research and development dollars. Yet, Big Blue late last year entered into a five-year agreement with Intel to produce application-specific integrated circuits (ASICs) that could presumably lead to highly customized PCs. Clone manufacturers would have a tough time duplicating proprietary IBM PC technology, because it would be spread horizontally, rather than vertically within a market.

Cashing in the custom chips

The capability for IBM to become semiconductor snobs by incorporating cutomized 386 chips has not escaped the attention and efforts of at least one of the more successful board manufacturers. Late last year, AST Research Inc., of Irvine, Calif., made its move from add-in to systems manufacturer by announcing a series of computer systems. Based on Intel's 80286 chip architecture, the computers can be upgraded to a 386-type machine.

Unlike a PC/AT, which has I/O slots that are compatible with the standard operating bus of the IBM PC, AST's Premium/286 machines offer so-called FASTslots that increase computing speed by going directly into the 286 bus and extracting the address or timing signals.

Besides allowing for a more natural boost in system speed, AST's FASTslot architecture also permits upgrading to any type of 386 or Motorola Inc.'s MC68000 product without using jumpers, and without sacrificing 80286 software compatibility because the 286 signals are simulated in the bus, explains Jerry Bowers, an AST spokesman who demonstrated the system at a New York press conference.

Although the Premium/286's 10-MHz computing speed is not as fast as that claimed by some board manufacturers, AST's co-founder and executive vice president Thomas Yuen maintains that the 386 race will ultimately not go to the swiftest. "Having the fastest engine is not the solution," he says. "But, offering an upgrade to the IBM 386, if and when it comes, potentially is." □

QUALITY ASSURANCE

SCSI test gear's here, but drive analysis still at issue

Mike Seither, Senior Editor

One of the more spirited debates involving disk drives that use the small computer systems interface (SCSI) is how to test them adequately.

On one side of the table sit the drive manufacturers. Many of them contend that the built-in intelligence of SCSI provides the necessary means for customers to tell whether the complete system—head-disk assembly and on-board controller—functions properly. Probing individual subassemblies, say these manufacturers, may yield an erroneous picture of a drive's overall performance.

On the other side are test-equipment manufacturers. They claim that the sophisticated electronics of SCSI hampers the ability of customers to see what is actually going on inside the drive. These vendors, working through an ANSI committee, are lobbying for a method to test SCSI drives. They want accessible test points so that their equipment can measure crucial signals.

Caught in the middle are system integrators. In the best of all worlds they would prefer to avoid the cost of incoming inspection. But, in reality, drives often fail to perform when they arrive at the receiving dock. Some system integrators report disk-drive failure rates as high as 20 percent. From their point of view, testing is still a necessary evil. But given the

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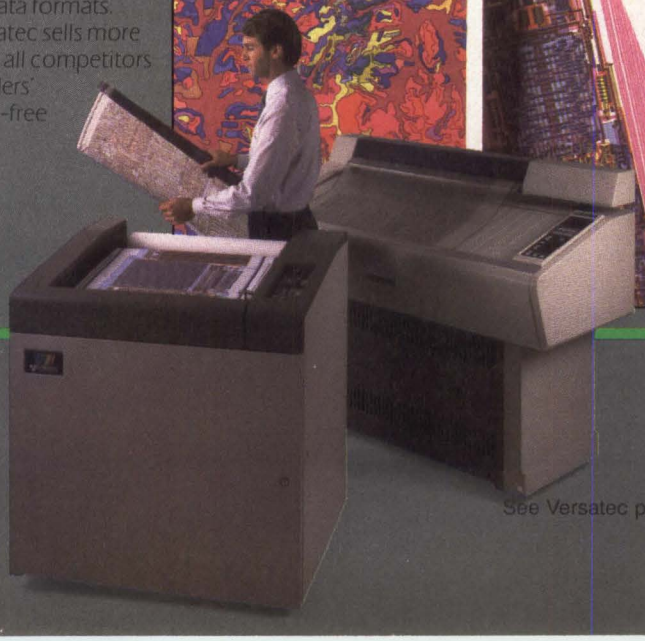

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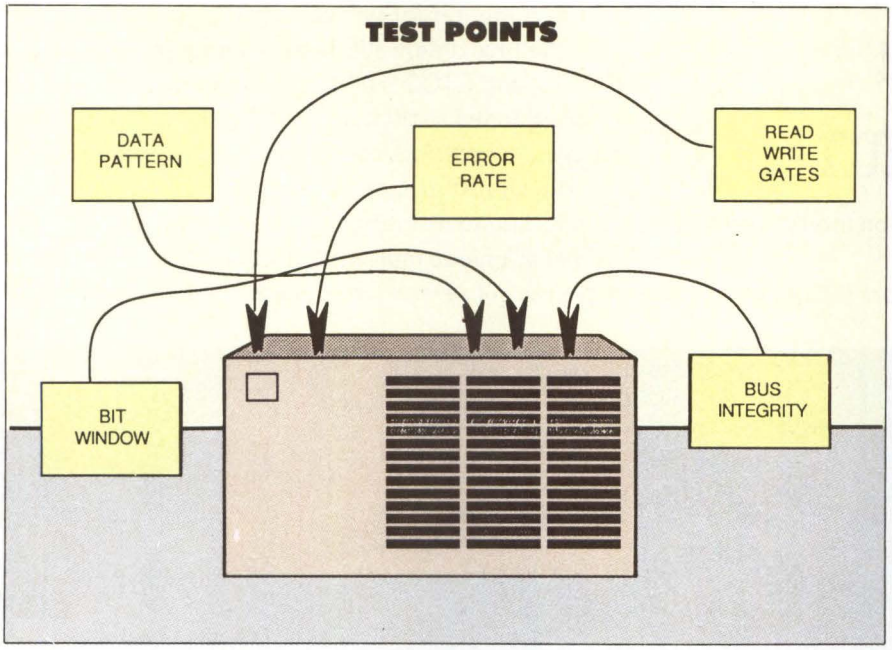

sluggish pace of the standards process, it's unlikely that the ANSI effort will soon yield a set of common SCSI test points that all parties can agree on.

Close your eyes and ship

Meanwhile, an interim solution has begun to appear. Test equipment is becoming available to bypass SCSI in order to examine some of the inner workings of rigid disk drives. At least two California test-equipment vendors—Flexstar Corp. of Milpitas and Wilson Laboratories Inc. of Orange—claim they are now shipping gear that allows system integrators to scrutinize raw analog signals from a drive's head-disk assembly. Other companies plan to follow suit. The KJ Instruments division of Applied Data Communication, Tustin, Calif., expects to introduce similar gear before April. And Applied Circuit Technology, Anaheim, Calif., is working on product definitions for SCSI drive testers.

Flexstar's FS6500, priced at $8,995, uses a probe to connect to the output of the head's read/write amplifier. The FS6500, driven by an IBM Corp. PC, monitors early and late phases of data pulses, as well as bus timing, to ensure compliance with SCSI specifications. Custom modules allow the FS6500 to connect to analog signals for specific drives. The SCSI common command set, as well as user-defined commands, resides in a library file on the PC.

Wilson's MSX 500, priced at $7,995, provides several interface-level tests to measure drive parameters such as long-term error rates, data-pattern sensitivity and bus integrity. Wilson has just added a feature called "advanced read margining" that allows examination of the bit window through the drive's read channel.

System integrators should welcome these product developments. Many have been clamoring for some way to get a closer look at SCSI drives they buy, but the means haven't been there. By contrast, drives with the popular ST506/412 interface have a standard plug to check the read, write and data-recovery functions.

"The bottom line is, you close your eyes and ship," confesses the quality-control manager for one system integrator. "There's no equipment in place to quantitatively test the SCSI drives we use."

Without analog testers, system integrators by and large have been able to look only at decoded data that's come out the back of the SCSI interface. Present test equipment has allowed for little more than exercising the drive's ability to read and write, monitoring activity on the bus and making

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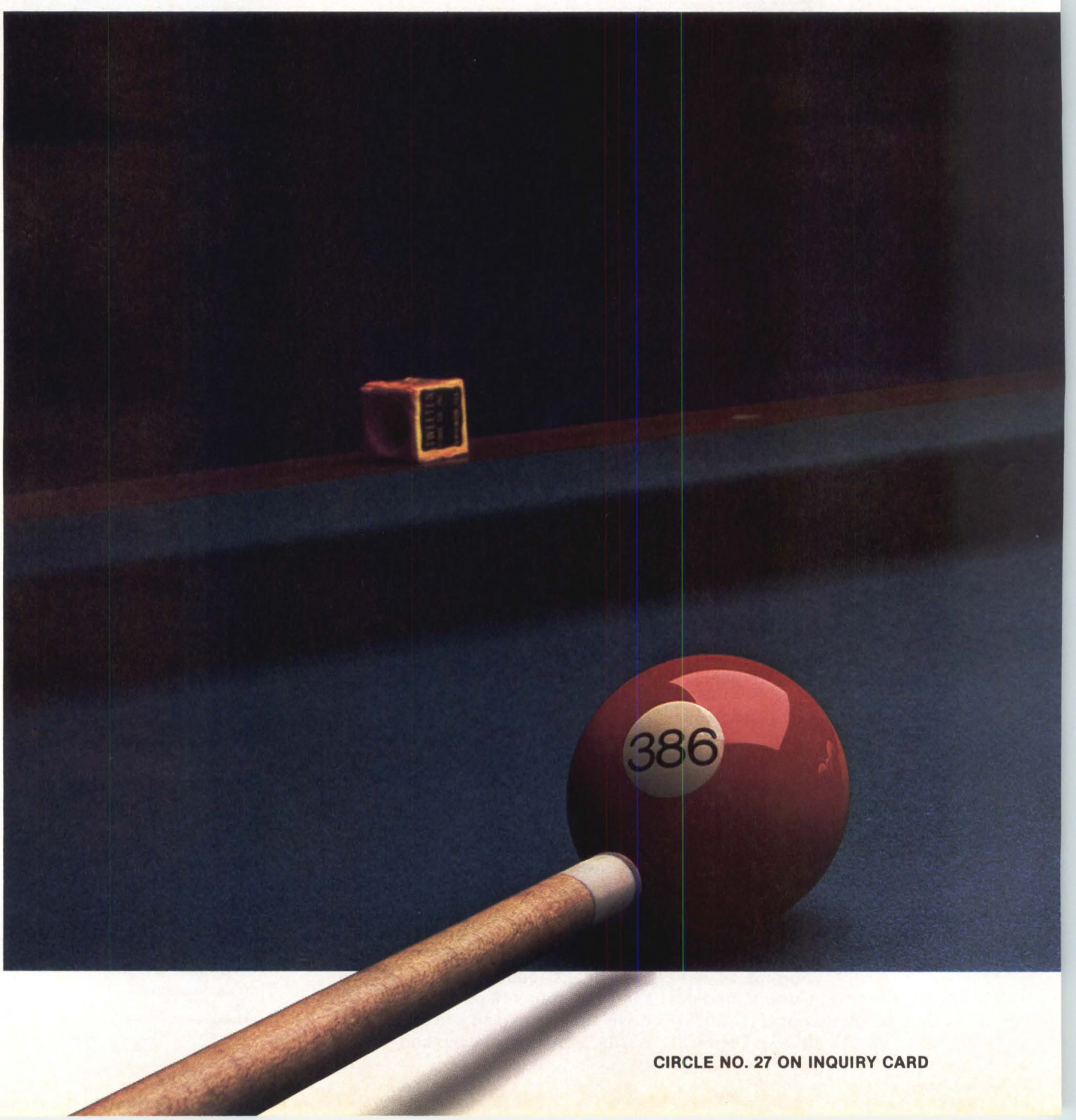

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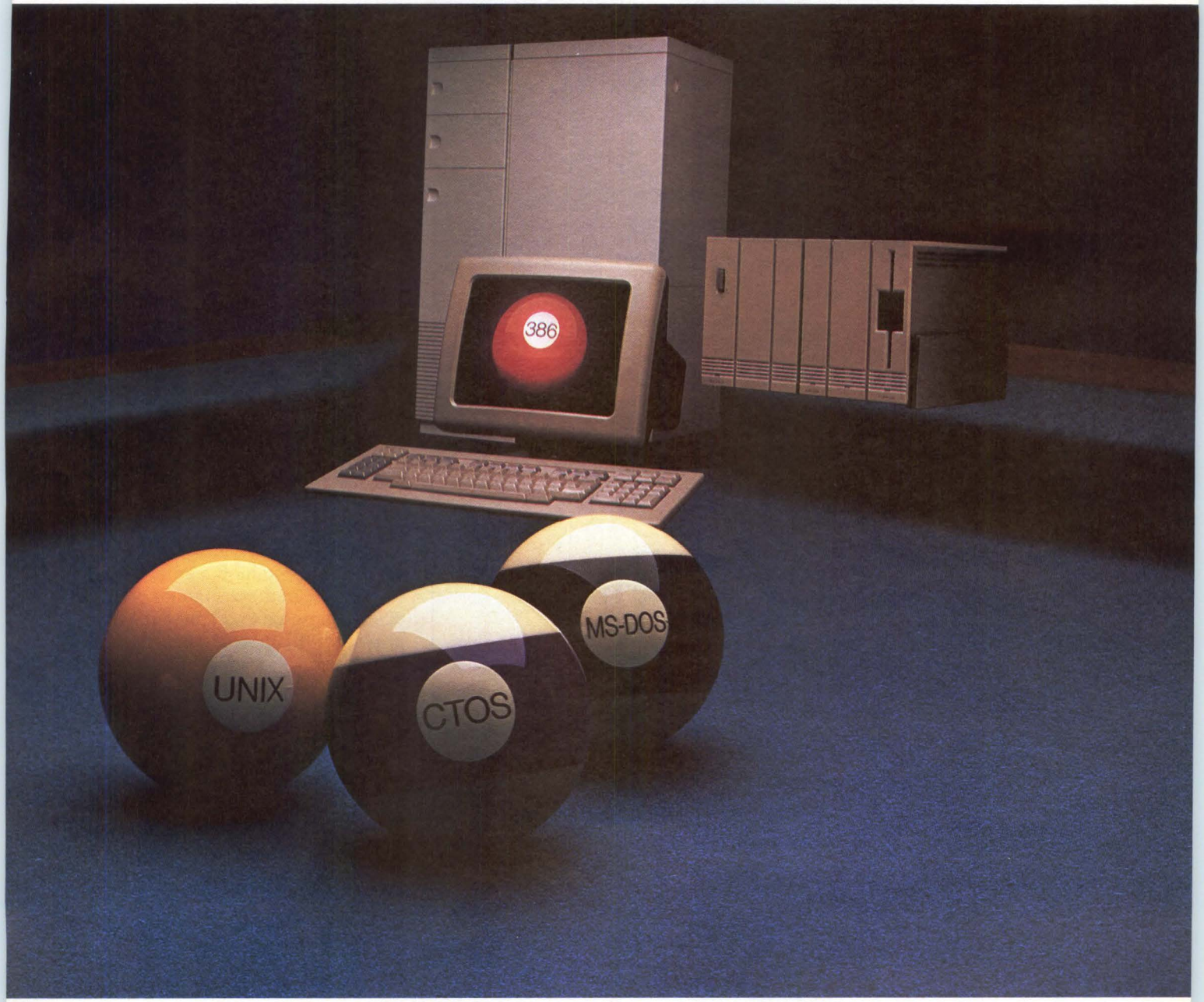

Convergent

sure that the SCSI commands execute.

What's going on here?

Critics point out that the signals that originate on the media have been buffered by a maze of controller electronics before they reach the end of the SCSI interface. Media flaws and marginal read/write heads, for example, can be hidden by intelligent SCSI features such as error-correcting codes. So-called "soft errors" that occur only periodically can remain undocumented because of SCSI's ability to perform multiple retries to recover data.

Altos Computer Systems, San Jose, Calif., recently was qualifying a SCSI drive that broke down during such a soft-error situation, according to Stan Salot, who heads the company's quality-assurance program. "It went into nothing but retries. From a technical point of view, I didn't know what was going on," says Salot. "That tells me you could have a powerful CPU, but with a SCSI drive that spends a lot of time on retries, you can wind up with a system that has less than adequate performance."

Although SCSI can cover up imperfections, it "is not well-equipped to display its weaknesses," declares Frank Meijers, president of Luctor Corp., a Phoenix, Ariz., test-equipment vendor. Meijers is chairman of the ANSI X3B7.1 media and disk drive test methods subcommittee, which is at work trying to standardize test points for intelligent interfaces. The X3B7.1 group is seeking status as a full ANSI committee to pursue that goal.

So far, more than two dozen such test points for SCSI have been proposed. Most observers seem to believe that number will be boiled down to fewer than 10. Critical signals include those coming from the read and write gates. Other requirements for analog testing would allow access to bit and servo clocks to measure signal cycles. According to Meijers, drives should also provide the means, through pins and special test signals, to erase complete tracks or sectors so that data can be rewritten easily a number of times to check for media integrity.

Indeed, a common sore point with system integrators has to do with the defect map that most manufacturers provide with drives. This map lists "hard errors," or areas on the media that are consistently bad and which the drive cannot read to. But often this critical road map is full of wrong-way signs. Meijer says that the number of invalid flaw maps provided by drive vendors is "shocking," ranging from the ommission of serious defects to "long lists of false errors."

George Robinson, president of Flexstar, notes that a major problem exists just in trying to correlate results among different vendors' test equipment. Media defects that one tester ignores another may pick up. That leads to finger pointing among all parties and does nothing to identify the problem, he adds.

What do system integrators want?

Listen to Salot of Altos. "I want to be able to understand window margins and error rates and know that I have a real drive, not a sophisticated controller masking a sloppy drive."

However, most drive manufacturers disagree. Industry leaders such as Seagate Technology, Scotts Valley, Calif., sell SCSI drives based on an overall error rate performance. "We don't plan to sell drives based on window margins," says Mike Robinson, Seagate's manager of controller development. "We guarantee that the entire system has adequate margins—that includes read channel, data separator, heads and media. If you can show that the system has sufficient margins to meet its error rate over its life, that's all you need to guarantee."

As for standardized test points, Robinson says Seagate does not support that approach, adding that the company has its own way of performing necessary measurements tests during the manufacturing process. Robinson would not elaborate on the process.

Other drive manufacturers take a similar stand. John Klonick, strategic planner at Maxtor Corp., San Jose, Calif., says Maxtor is not interested in making the boards in its drives look like everyone else's. As for the inability to perform tests, he adds, "That's one of the prices you pay for an intelligent interface." Klonick adds that Maxtor's SCSI drives do have test points, though not readily accessible, which the company will help customers find and use.

Conner Peripherals of San Jose, which recently began making 3½-inch SCSI drives, has designed a special maintenance port into its drives to help identify problems during the manufacturing process. The port bypasses the SCSI interface to monitor things like the read channel, soft-error rate, window margins and the spindle motor's rotational speed. According to marketing vice president Scott Holt, Conner considers the port a sales tool that lets OEMs do source inspection at the factory. However, the port is not designed for incoming inspection at a customer's site.

Holt readily admits that drive vendors like SCSI "because it covers up a lot of sins." But, like Seagate's Robinson, he says the important thing is that a drive formats within its rated capacity. "A drive that has 50 errors is not necessarily better than a drive that has one," he says. "As long as there is no difference in performance, error rates should not be an issue."

Bill Zeissner, an engineering consultant from Fountain Valley, Calif., who specializes in SCSI peripherals, believes that drive vendors are justified in taking that stand, as long as their manufacturing process stays in control. But he adds that it is wrong for a disk to have a lot of defects. "It's indicative of poor quality," says Zeissner. "If I were a customer, I'd demand to look beyond the interface."

What vendors do to make test points accessible on SCSI drives may ultimately depend on the amount of noise system integrators make. If the present tools don't get the testing job done to their satisfaction, the noise level is likely to get higher. □

FACTORY AUTOMATION

Is MAP GM's revenge on us for not buying its cars?

And nine other questions about Manufacturing Automation Protocols.

James F. Donohue
Managing Editor

1. Is MAP GM's revenge?

No, it only seems that way. Certainly, resolute support from General Motors Corp. got MAP started, and its cutbacks in MAP-product purchases in 1986 caused pain to vendors. But the automaker is only one of many hands propelling the standard forward. Many system integrators are pushing, too. They consider MAP nothing but good news.

2. Good news? MAP's a confused mess that's making everybody's life hell.

Hang in there. This, too, will pass. MAP is a set of protocols for a broadband communications network to *integrate* a factory. By definition, it will generate new business for system integrators. That MAP often appears confused only makes your services more valuable. Says a vendor of MAP products, "I firmly believe that any factory communications scheme is so complex that it requires the expertise of people with specialized training, like the system integrator."

3. Will the MAP issue ever be settled?

Fortunately for the system integrator, no: not even if MAP standards are adopted uniformly in the United States. Remember that MAP is a subset of the developing Open Systems Interconnection (OSI) protocols of the International Standards Organization. Because of that, a lot of support for MAP comes from Europe, where OSI standards are in vogue. But, notes system integrator Bernard J.L. Pech of Integrated Automation, Alameda, Calif., "Europeans always want something slightly incompatible with what's developed in the United States so that Americans can't sell their products over there." As your companies and your clients plunge into world markets, you can bet that your MAP interconnect business will grow.

4. People tell me MAP is a boondoggle that will never result in usable products.

They're wrong. "MAP's a done deal," say people like Howard W. Johnson, marketing manager for computer maker Sequoia Systems Inc., Marlborough, Mass. What gives MAP

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its strength is not GM but the fact that it's part of an emerging international standard. "It's a one-way street that we're going down, in standards," says Johnson. "We're on that highway, and there's no turning back."

5. Aren't there contrary opinions?

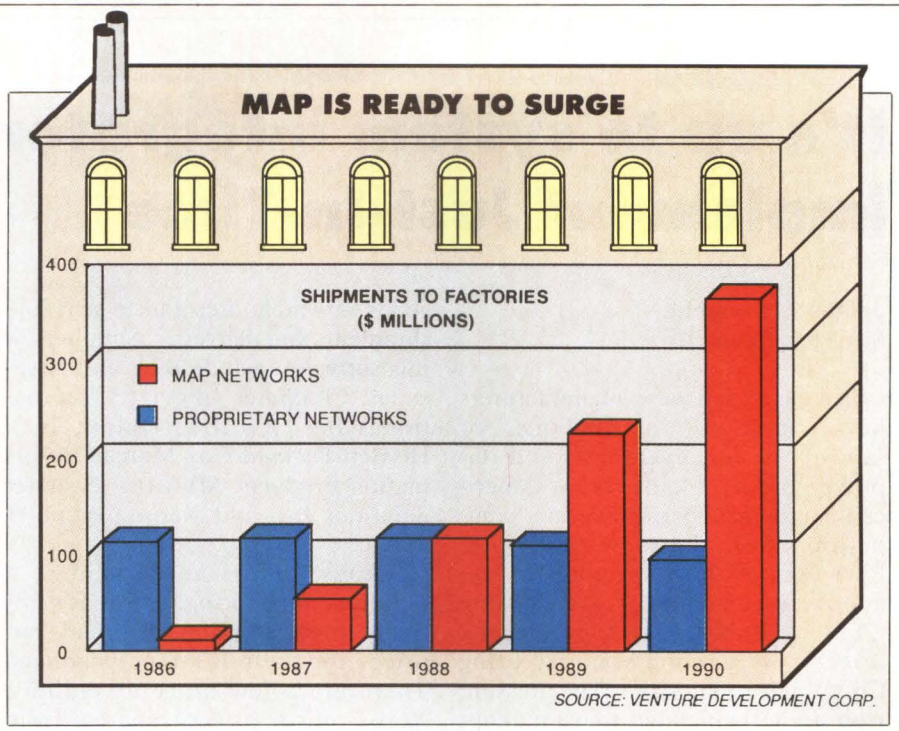
Oh, yes. Many manufacturers of MAP-compatible products are very nervous about the investment they've made: $20 million or more in start-up costs alone, according to system integrators. "I am very concerned about the investment our company has put into MAP," says Albert D. Bender, president of FiberCom Inc., Roanoke, Va., who builds fiber-optic networks. "I have a certain amount of second thoughts about whether we ought to be doing it at all. I wonder if it ever will be viable as a business." At recent trade shows, Bender says, he's finding "very modest interest in MAP." Ethernet is what people are most interested in, he says.

6. Can I expect some of these manufacturers to get fed up and drop out of the MAP business?

Yes. There will be a shakeout of vendors. And it's a good idea to look into your suppliers' commitment to MAP before you commit to them. The advent of MAP Version 3 will be traumatic to many manufacturers who have sunk millions of dollars into Version 2 products and have not yet realized an acceptable return on their investment. Some big players are quietly telling customers they will not make Version 3 products when that standard is published. They either will wait to get their money out of Version 2 before they move to Version 3, or they will cut their losses and quit the MAP arena entirely.

7. When will we see Version 3 products?

MAP is peculiar: It's driven by a trade show, Detroit's annual Autofact conclave in November. There's been talk about Version 3 products appearing at 1987 Autofact, but you can dismiss that. There may be specifications for Version 3 and even some prototypes, but you won't see anything that actually works in a factory until 1988 Autofact at the earliest. Richard L. Stuckey of consultant Arthur Andersen & Co., Chicago, says not to expect Version 3 products until the first quarter of 1989.



8. That's great. What do I do in the meantime?

It depends. If your company wants to integrate its factory today, don't wait around for Version 3. Version 2.1 and 2.2 have a lot of good features, and migration from Version 2 to Version 3 may not be as difficult as many people think. Says Integrated Automation's Pech, "The migration from one version to another is not going to be that big of a deal." And MAP is not the only game in town, nor will it ever be. "It's just a protocol," says Sequoia's Johnson. Alternatives abound. There's transmission control protocol/internet protocol (TCP/IP) running on Ethernet, an arrangement many system integrators say is a smart step toward MAP because of TCP/IP's accommodation of OSI. There are good proprietary networks available, and there are MiniMAP products, which skip some MAP protocols to run faster and at lower cost. Many vendors, like Digital Equipment Corp., have announced support for MAP, meaning they will offer gateways/bridges from their proprietary networks (like DECnet) to MAP, according to Dr. Henrik A. Schutz of General Electric Co. Schutz, senior product planner at GE's Automation Controls Department, Charlottesville, Va., concedes, "There is always some performance penalty in going across a bridge or though a gateway, but often it is not very great—a third of a second or so."

9. How do I prepare my factory for MAP?

Very carefully. Shutz says, "Companies should consider a pilot implementation of MAP right now so that their staffs can take the six to 12 months needed to learn how to use the network and to get used to the idea of using communications as an integration mechanism, rather than just some oddity." Cost of a good pilot network? "About $60,000," Schutz says.

10. Where do I get more information about MAP?

A good place to start is at the MAP Users Group of the Society of Manufacturing Engineers, One SME Drive, P.O. Box 930, Dearborn, Mich. 48121. You can get copies of the current MAP standards from a number of organizations, including the American National Standards Institute Inc., 1430 Broadway, New York, N.Y. 10018 and the IEEE Standards Office, 345 East 47th St., New York, N.Y. 10017. □

INTEGRATION STRATEGIES

It's up to system integrators to implement Just-In-Time

James F. Donohue
Managing Editor

For years, Japanese manufacturers have employed Just-In-Time, or *kanban*, to cut inventories and improve product quality. Now, American companies, beleaguered by competition from Japanese and other low-cost, offshore producers, are adopting concepts of just-in-time (JIT). As Robert Davis, purchasing director at Carwood Manufacturing Co., Winder, Ga., says, "The pressure from imports dictated that we adopt the JIT concept."

If you're not already involved in planning and implementing JIT, you soon will be. It's another of those regimens that requires patching together disparate hardware and software—the territory of the systems integrator.

There's no such thing as off-the-shelf JIT software. But some available manufacturing systems have elements of JIT in them: primarily software to manage inventories, to keep track of goods in warehouses and to schedule shipments and deliveries. Suppliers of this software include Biles and Associates, Computer Associates International Inc., Creative Output Inc., Hewlett-Packard Co., Marcam Information Products, MSA Inc., Scanner Solutions Inc. and Xerox Computer Services.

Because JIT is an element in a bigger manufacturing system, it's difficult to get suppliers to break out prices for their JIT-type products. There are a few brave exceptions. Xerox posts prices ranging from $25,000 to $40,000 for a variety of JIT programs (for example, query and report generator, data dictionary); Scanner Solutions charges $25,000 for an inventory tracking system; and Creative Output sells OPT (optimized production technology) minicomputer software for $250,000 to $365,000, depending on what's being done.

Novel sales tool

Creative Output has a unique approach to selling OPT. Company president Eliyahu M. Goldratt wrote a novel, *The Goal: Excellence in Manufacturing* (North River Press Inc., Croton-on-Hudson, N.Y., $12.95). In it, long-suffering plant manager Alex Rogo uses the techniques and disciplines of OPT to save not only his job but also—yes, indeed—his marriage. The book has attracted a cult following: 50,000 copies have been sold or distributed.

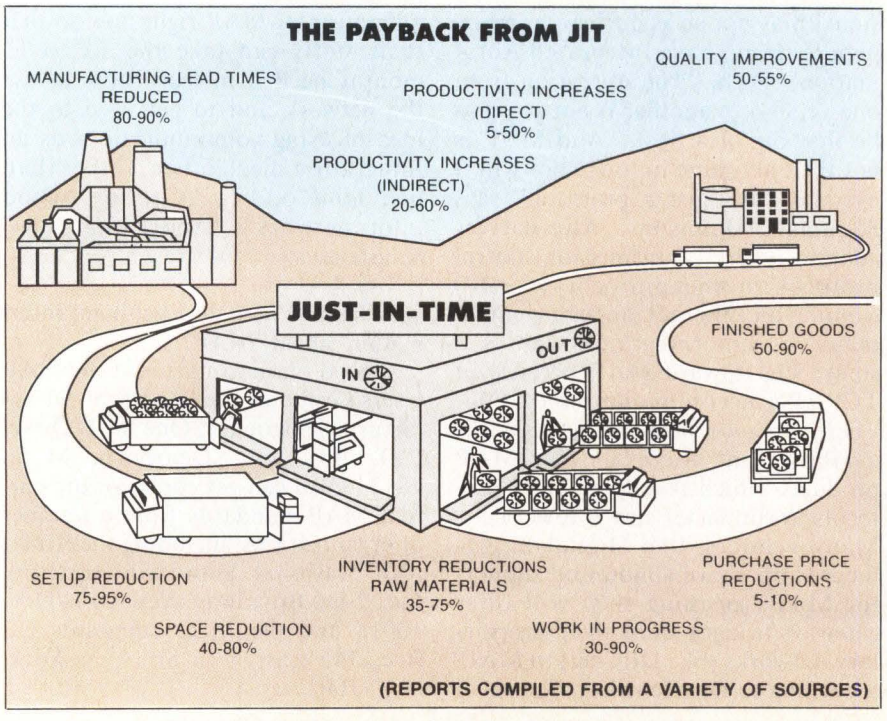
In figuring out how to get into JIT, consultants can be helpful. People in the field cite Coopers & Lybrand, Oliver Wight Companies Inc. and Rath & Strong. Some of the suppliers can be helpful, too. Xerox offers a free monthly newsletter, *Tip of the Month*. To get it, send your business card to Pat Gale, Xerox, Los Angeles.

But, what is JIT? It's not hardware. It's not software. It's not even a system. It's a concept of manufacturing. The following is a primer.

As its name indicates, JIT means that the material to make a product arrives at the production line just as it's needed. The goal is to eliminate the 30 percent (estimated by A.T. Kearney Inc., Chicago consultants) of the total production cost that American manufacturers spend on functions like warehousing and inventory maintenance.

Many American manufacturers at first misconstrued JIT as a way to shove inventory costs back on their suppliers. That callous and brutal approach got a cold shoulder from most suppliers. Soon, the early practitioners wised up. "It can't be a one-way street," says Jim DeToge, manager of contract purchases at Hyster Co., Portland, Ore., maker of tractors and forklifts. "A good system has to benefit both parties."

Properly understood, JIT is a manufacturing concept that views anything not directly adding value to the product as a waste that ought to be eliminated. "This deceptively simple approach means using the absolute minimum amount of equipment, labor, materials, space and time necessary to add measurable value to the product," explains John F. Proud, manager of JIT manufacturing for



JIT starter kit

Companies mentioned in this article that provide JIT-related products and services:

Biles & Associates
Suite 500
6161 Savoy Drive
Houston, Texas 77036
(713) 789-8880

Computer Associates International Inc.
711 Stewart Ave.
Garden City, N.Y. 11530
(516) 227-3300

Coopers & Lybrand
(New England office)
1 Post Office Square
Boston, Mass. 02109
(617) 574-5000

Creative Output Inc.
60 Commerce Park
Milford, Conn. 06460
(203) 877-5671

Hewlett-Packard Co.
Manufacturing Systems Group
11000 Wolfe Road
Cupertino, Calif. 95014
(408) 257-7000

Marcam Information Products
19 Crawford St.
Needham, Mass. 02192
(617) 449-5510

MSA Inc.
3445 Peachtree Road N.E.
Atlanta, Ga. 30326
(404) 239-2000

Rath & Strong
21 Worthen Road
Lexington, Mass. 02173
(617) 861-1700

Scanner Solutions Inc.
Suite 340
Corporate Plaza 1
Dayton, Ohio 45401
(513) 254-4388

Oliver Wight Companies Inc.
85 Allen Martin Drive
Essex Junction, Vt. 05452
(802) 878-8161

Xerox Computer Services
5310 Beethoven St.
Los Angeles, Calif. 90066
(213) 306-4000

Xerox Computer Services.

JIT attacks the problem of bloated inventories by trying to make products in small lots. "The idea is to make a little of everything every day. If you sell it daily, build it daily," explains Bill Wheeler of Coopers & Lybrand.

On-time delivery is essential in successful JIT environments, and too-often too-late suppliers often lose customers. When companies adopt JIT, more often than not their stable of supplier companies gets trimmed drastically. Turtle Wax Inc., Chicago, for example, cut the number of its suppliers from 350 to 200 in three years.

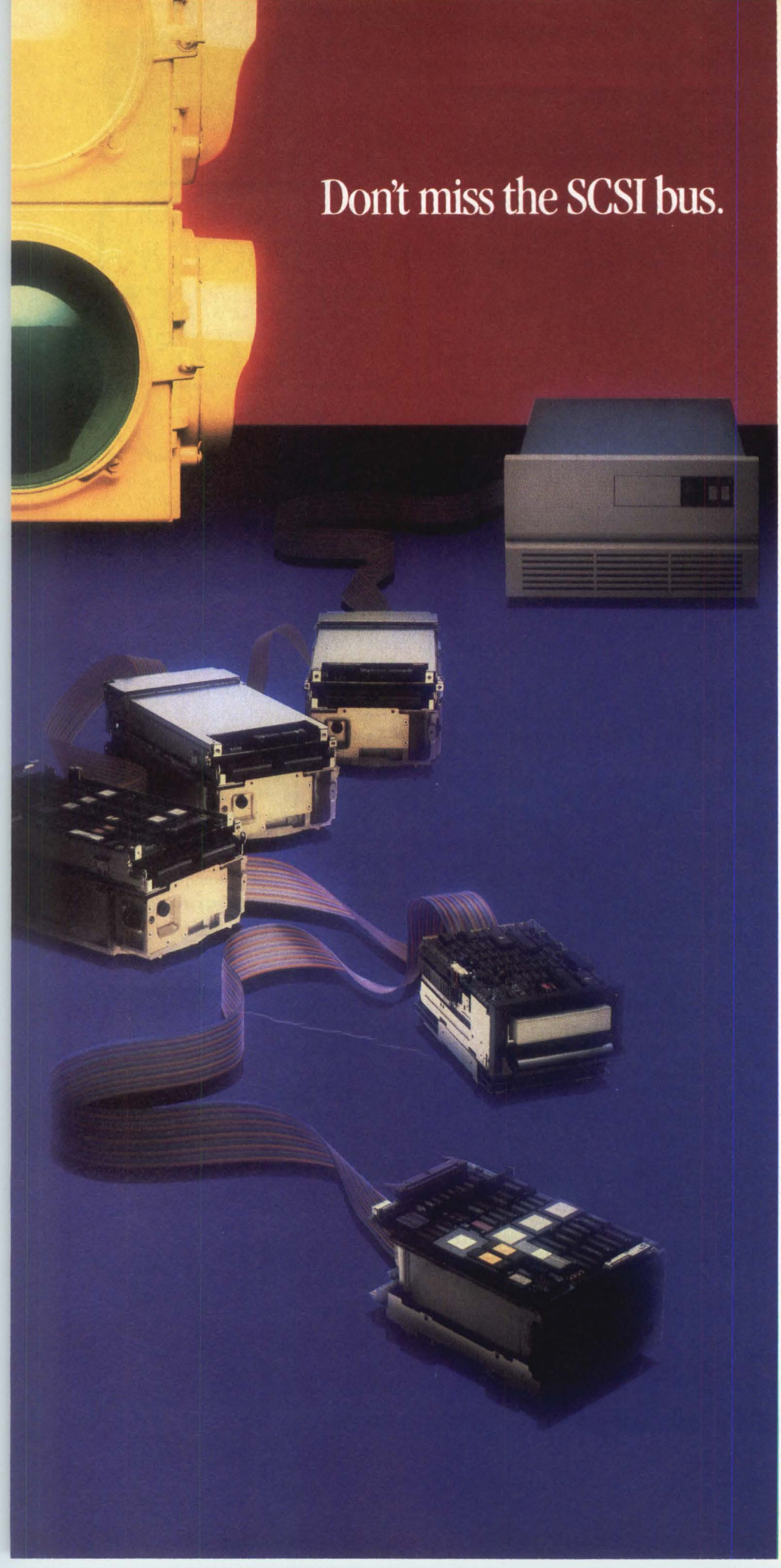
On-time delivery is helped greatly by computerized tracking and scheduling systems, and many aspects of JIT are so complex and so interrelated that they can be managed only on a computer. But many others are no more than the application of common sense. For example, to attack high transportation costs, many companies are shifting to suppliers closer to home. Packard Electric Co., Warren, Mich., established "core suppliers," all of which are within 15 miles of the plant. That cut not only transportation costs but also, by shortening supply lines, permitted Packard to trim inventories and to cut inventory costs by $1.2 million.

Other companies, simply by relocating machinery in the plant to speed up the flow of material, scored major JIT-related successes. Omark Industries Inc., at its saw-chain manufacturing plant in Guelph, Ontario, moved metal-forming machines to cut flow distance from 2,620 feet to 173 feet. That helped cut throughput time for the chain to three days, from 21 days.

Improving quality is a key goal of JIT. Material arriving just in time to a production line had better be of satisfactory quality. A few defective parts will shut down the line because there is little or no backup inventory.

Quality improvement is another job done without much help from computers. Many companies simply become teachers to their suppliers. Black & Decker Corp., Towson, Md., teaches concepts of statistical analysis to workers at its suppliers so they can track the performance of their machinery. Cummins Engine Co. Inc., Columbus, Ind., quantifies acceptable levels for quality. If a supplier falls below that, Cummins sends in teaching teams comprising representatives from engineering, manufacturing, purchasing, quality control and sales to fix what's wrong.

But, ultimately, it's computers that make JIT work, just as it was computers that drove the first modern manufacturing control system, materials requirements planning (MRP). Some practitioners believe it was MRP, which has been around for 20 years or so, that set the stage for JIT. "MRP got people to rely on computers as opposed to their own noodles," says Wheeler of Coopers & Lybrand. □



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SCSI EXTENDS BEYOND DATA STORAGE DEVICES

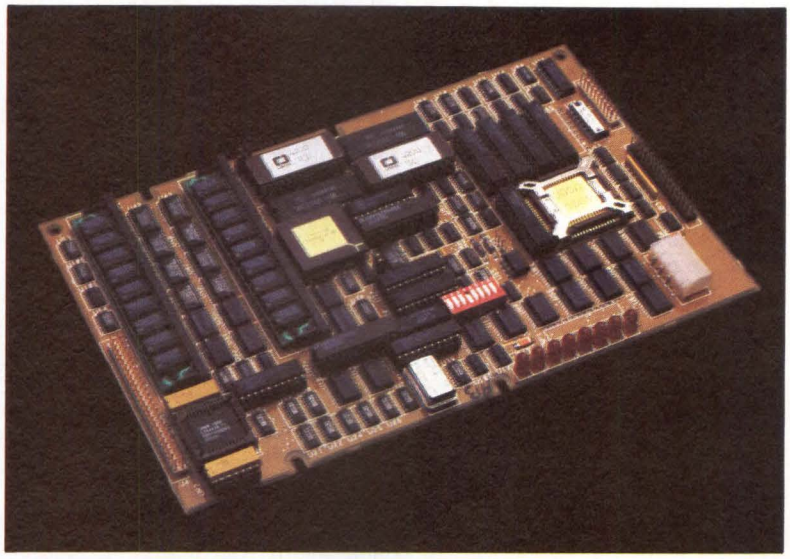
Primarily thought of as a disk drive interface, SCSI can also serve as an ideal interconnect bus for attaching a variety of peripherals, including tape drives, scanners and printers

Carl Warren, Senior Editor

In the past two years, the small computer systems interface (SCSI) has grown from an obscure interconnect proposal supported by only a few companies to possibly the most important peripheral-interconnect structure in the industry. It is surpassed in usefulness only by the ubiquitous RS232C serial device interface. But, unlike RS232C, SCSI is a broad interface that allows system integrators to match a wide range of peripheral devices with host architectures.

Although SCSI was originally intended as an interconnect bus for storage devices, the definition of the SCSI standard (ANSI X3.131-1986) has been extended to manage devices other than disk drives, including tape drives, scanners and printers. In fact, some companies are using SCSI for host-to-host communications or in limited-distance networks.

Because of the growing trend toward SCSI-compatible devices, particularly those that adhere to the newly defined common command set (CCS) subdefinition of SCSI, system integrators need no longer search hard for SCSI vendors. Now they seek answers to system-level questions involving performance and compatibility of non-storage SCSI products.



Using a 2-MIPS RISC processor *and a Motorola MC68000 microprocessor, U.S. Design's 4200 Access Accelerator controller couples as many as four ESDI Winchester disk drives to the device-independent SCSI bus.*

SCSI optimizes drive performance

SCSI is a local I/O bus that achieves data rates as high as 4M bytes per second, depending on the circuit implementation. The purpose of SCSI is to provide host computers with device independence within a certain class of peripheral devices. To that end, SCSI employs logical, rather than physical, addressing for all data blocks.

Disk drive manufacturers and system integrators are adopting SCSI for two key reasons. First, it provides a flexible and relatively low-cost method of connecting a drive to virtually any host backplane. Second, SCSI can be embedded in the disk drive. Embedding SCSI involves relocating the drive controller electronics—which usually reside on the host backplane—to a drive-resident board.

But there are performance questions that still bother system integrators. In particular, how fast will a SCSI drive respond when a command is issued? This concern generally centers on command latencies associated with SCSI.

Hewlett Packard Co.'s disk-memory division (Boise, Idaho) is especially concerned about the use of SCSI in high-performance applications. Dave McIntyre, HP's R&D project manager, contends that channel utilization is an important factor in system performance. He acknowledges that there are bus bandwidth limitations inherent in any system, but believes that they are largely a factor of the architecture chosen by the system integrator. To achieve the highest level of performance—especially in multidrive, multiuser systems—McIntyre recommends that system integrators and OEMs minimize seek latencies and/or make data available via either caching or special memory buffers. "You want to get off the SCSI bus as quickly as

possible to avoid clogging up the bandwidth and losing the effectiveness of the system."

Most SCSI disk drives currently operate at 1.2M bytes per second, or approximately 10 MHz. This rate is due in large part to the perceived limitations of low-level buses, such as that used in the IBM Corp. PC and PC/XT, and the lack of line drivers and receivers that are capable of managing faster transfer speeds.

Most SCSI disk drives currently operate at 1.2M bytes per second, or approximately 10 MHz.

William Horton, director of development systems for Adaptec Corp., believes that there is a great deal of confusion in how a SCSI bus can be set up and managed for performance. He suspects that many developers still fear the process of integrating a SCSI bus, and that all developers are cost conscious. "Most designs are single ended—a single line—and are typically asynchronous. It's easy and cheaper to implement. But you do give up having higher performance in the system," says Horton.

Single-ended implementations of SCSI use a logical signal with a single electrical line. As such, no ground line exists for signal and noise isolation. Single-ended SCSI configurations usually are limited to asynchronous data transfers of 1.2M bytes per second over a maximum distance of 6 meters.

Differential SCSI implementations, on the other hand, can manage signals over 25 meters with synchronous data transfer rates as fast as 4M bytes per second. The differential method of implementing SCSI involves a single logical bus signal with two electrical lines 180 degrees out of phase. This method increases the signal-to-noise ratio, which translates into better noise immunity.

SCSI will eventually exceed 4M bytes per second. Most speed improvements will come formally via the SCSI-II definition, which is currently in ANSI committee. SCSI-II takes into consideration the faster data transfer requirements of other peripheral devices.

However, system integrators have been unjustifiably concerned that SCSI disk drives might be limited to 1.2M bytes per second. Consequently, many have been eyeing the enhanced small device interface (ESDI) as a good substitute where speed counts. ESDI is a device-level interface that provides direct device-to-host connection, which is incorrectly perceived as offering faster transfer rates than those of SCSI. In fact, the rates are similar.

Where to get the SCSI spec

To get the small computer systems interface (SCSI) specification, for $20, write to the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018. Be sure to reference the SCSI ANSI X3.131-1986 spec.

Dr. Gunther Haass, executive director of engineering for Siemens AG, Munich, maintains that performance is not to be confused with transfer rate when comparing ESDI and SCSI. "You can realize a 10M-bit-per-second transfer rate with both, but SCSI has a greater overhead due to command latency," he says. Nevertheless, other analysts believe that data transfer rates will be the point of contention because ESDI may reach 4M bytes per second long before SCSI does.

Siemens has to date delivered more than 2,000 310M-byte, 5¼-inch MegaFile Winchester disk drives with ESDI interfaces. The company recently introduced two drives with SCSI interfaces that conform to CCS specifications and employ full arbitration and a 1-to-1 interleave. They are the models 2200 and 2300 with 207M bytes and 310M bytes, unformatted, respectively.

Combining SCSI and ESDI

U.S. Design Corp. combines the best of both worlds with its 4200 Access Accelerator controller, which attaches as many as four ESDI disk drives to the SCSI bus. The 4200 will eventually use differential SCSI to sustain 4M-byte-per-second transfer rates. The controller uses a 2 million instructions per second (MIPS) reduced instruction set computer (RISC) processor and a Motorola Inc. MC68000 to handle a 2M-byte cache in which data blocks are made available for rapid read or write. "The idea is to provide integrators with a module that creates a very smart subsystem using an internal bus for high-speed transfer, but an open-system bus—SCSI—for matching up to the outside world," says Jeff Lessner, manager of advanced product marketing.

NCL America Computer Products Inc.'s approach involves less onboard intelligence, but nevertheless solves the problem of device performance and host independence. The model 3016 SCSI host adapter connects a drive with an embedded SCSI controller—or a hybrid ESDI/SCSI controller—to the host system. The NCL adapter uses all the advanced SCSI features, such as disconnect/reconnect and transparent copy, to allow integrators to create sophisticated multifunction systems.

Although most of the controller emphasis is on rotating memory, tape drive manufacturers also regard SCSI as an ideal interconnect solution (MMS Fall Peripherals Handbook, November 14, 1986, Page 11). SCSI provides independence from the idiosyncrasies of particular devices. Therefore, for example, slow tape speeds can be increased to match the needs of the system.

For instance, using SCSI in streaming-tape applications allows system integrators to estab-

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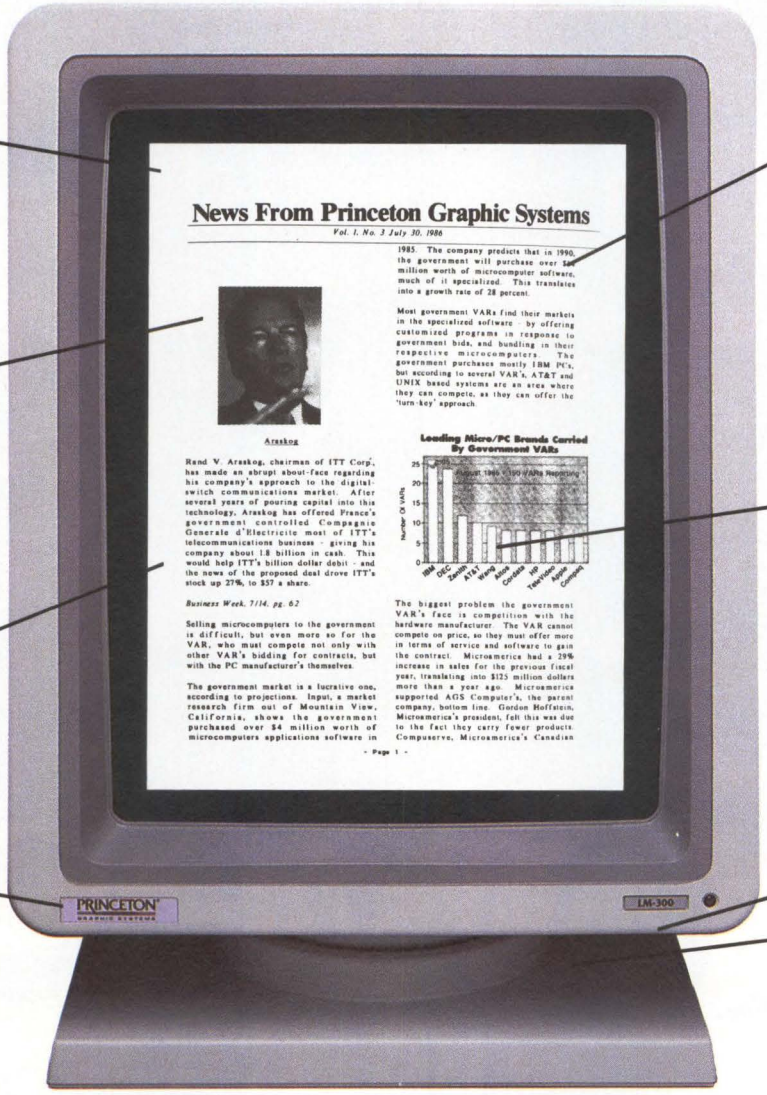

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lish shared buffers or caches that eliminate tape stopping and repositioning. The SCSI bus controls the buffer or cache, allowing data to continually move from the disk storage device to the tape storage device without interruption.

One major advantage of SCSI is the availability of powerful commands that allow system integrators to take advantage of built-in capabilities such as automatic copying from disk to tape. However, one of the most misunderstood of SCSI's built-in functions is the COPY command.

Most operating systems already include some form of copy function for transferring data, usually from one form of rotating memory to another. However, the SCSI COPY command is much richer and more powerful. It allows copying to a variety of devices, which might include another disk drive, a tape drive, a printer or even a network. The device is transparent to the operation and, by virtue of being a logical unit on the SCSI bus, can readily accept the data. Another advantage of the SCSI COPY command is that, unlike similar commands in operating systems, it can be executed in the background (e.g., running solely on the SCSI bus).

Because SCSI is a block-oriented interface with a rich command set, it speaks to other peripheral manufacturers. For example, some scanner manufacturers consider the SCSI bus a legitimate replacement for slower or more costly interfaces, such as 8-bit bidirectional parallel ports or video interfaces.

For example, DEST Corp. offers a series of scanners that use the SCSI interface. DEST's $1,995 PC-Scan, with a resolution of 300 dots per inch, can scan a page of text in 25 seconds. To make the scanner fully functional, users need to purchase the $595 Text Pac optical character recognition (OCR) software. "Computer users are anxious to convert paper-based information into an electronic form," says DEST's president Richard Amen. However, Amen and others agree that having the scanning and software technology is only part of the answer. Being able to quickly transfer the data to the host system has an equally high priority, notes Robert Hsieh, vice president and general manager of Microtek Lab Inc., which manufactures the MS-300 digital scanner.

Microtek currently provides a direct-memory access (DMA) interface that enables the MS-300 to scan a graphic image page in only 9.9 seconds. Although Hsieh insists that Microtek is successful with its fast DMA interface—

Although most of the emphasis is on rotating memory, tape drive manufacturers also regard SCSI as an ideal interconnect solution.

Embedded SCSI saves bucks in single-drive configurations

I. Dal Allan, ENDL Consulting

Typically, disk drives of the standard ST506 type combine a drive with interface electronics and a separate controller. Therefore, three cost items are involved: the drive, the interface and the controller. By embedding SCSI on the disk drive, the drive becomes virtually a standalone unit, requiring only an adapter to connect it to the host system. Consequently, for a single price, system integrators can buy a drive that will work on an IBM Corp. PC or a Digital Equipment Corp. VAX; the only element that changes is the host adapter.

The differences among various SCSI implementations are based on many factors, but the most dominant one tends to be cost. Embedding intelligence on the drive is attractive because it reduces the need for other pieces of hardware, such as a discrete controller and cables. The cost advantage of embedding SCSI can represent a factor as great as four when compared to other approaches.

Although system integrators can achieve some cost benefits for end users by employing embedded SCSI for single-drive systems, that might not be the case if more than one SCSI device is hung on the system. For example, a multiuser system that consists of several disk drives and tape drives is too expensive if a single-threaded embedded SCSI controller is integrated into each drive. For multiple-disk configurations, system integrators are better off using a multithreaded controller that can manage multiple devices. Iomega Corp. has recognized this factor with its Beta20 5¼-inch disk drive, which comes configured as a master drive with embedded SCSI. Additional drives—which do not have embedded SCSI controllers—are dubbed slaves because they connect off the master drive.

But cost is only one factor, and performance may be the key concern. For example, if an embedded SCSI disk drive uses a single microprocessor to manage both the disk drive and the SCSI interface, performance bottlenecks may occur. Specifically, there will be periods during which the drive isn't available to respond to the interface because the microprocessor is managing seek and servo control. Thus, the optimum approach may be a dual microprocessor design. Again, it is a matter of matching the design to the application requirement.

I. Dal Allan is founder of ENDL Consulting, Saratoga, Calif., an independent organization specializing in marketing and engineering consultation on interface issues and systems architecture.

recently becoming the supplier to AST Research Inc.—he recognizes that a SCSI approach is required for matching up to advanced systems. "As long as you're supporting a single-system architecture, you can get away with special proprietary interfaces, but if you want to attach to other systems you have to choose something like SCSI. We think we will be able to use SCSI without losing performance because we can dictate the size of the blocks being transferred."

Neither of the existing specifications for SCSI or TIFF make provisions for handling color.

DEST is taking an active role in helping the ANSI X3T9 committee define how SCSI should work with scanners. "The SCSI specification has been primarily developed by disk drive and controller manufacturers. We wanted to have some input because we feel we have some sense of how a device like a scanner should work in the total system environment," says Richard Matthews, DEST's vice president of engineering. DEST is responsible for the Revision A level of the SCSI document for scanners, which adds scanning commands to SCSI.

Like storage devices, SCSI-equipped scanners can take advantage of the COPY command. Provisions have also been made to control contrast, image composition, bits per pixel, halftone patterns and compression types, including those compatible with CCITT facsimile Groups III and IV. Yet to be added are definitions for the tagged image file format (TIFF), which is being proposed by DEST, Aldus Corp. and Microsoft Corp. to ensure that scanned data files (regardless of scanner manufacturer) can be interchanged in applications like desktop publishing.

Because scanned data has to be treated in a special manner, manufacturers like DEST and Microtek have borrowed from facsimile transfer methods to maximize functionality. The result is the TIFF recommendation. Richard Schoenhair, DEST's manager of application software development, and one of the developers of the TIFF definition, says that although the CCITT compression formats used for facsimile are usable for scanners, they are limited as to how much description can be put in the format. "TIFF lets us wrap additional control and information about the data around a CCITT compressed file," says Schoenhair.

Specifically, detail about gray scale—and eventually color such as that provided in the Howtek Inc. $5,995 Scanmaster—can be added to the data file. Currently, the Howtek scanner uses the GPIB (general purpose interface bus) interface. Like the DEST and Microtek scanners, the Howtek unit uses charge-coupled device (CCD) technology, but adds three red-green-blue fluorescent bulbs, handles 256 levels

Software puts SCSI to the test

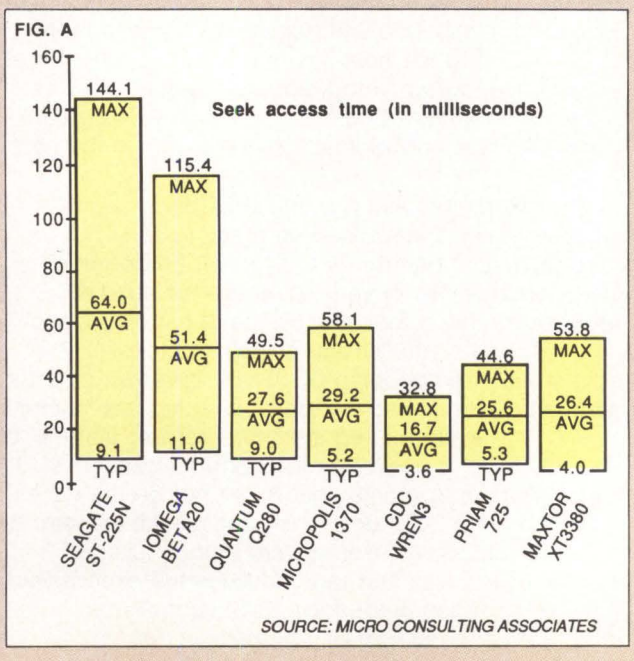
Andy Hospodor, Micro Consulting Associates

Although adding intelligence to a disk drive by way of an interface such as the small computer systems interface (SCSI) assists integrators in the task of linking drives to systems, it does complicate the drive evaluation process.

To assist system integrators, Micro Consulting Associates has developed the SCSI benchmark testing suite to measure performance of SCSI disk drives. The $1,000 benchmark program works with an IBM Corp. PC and any host adapter and SCSI drive. The test yields information about the drive, including bytes per block (typically 512) and number of cylinders, as well as performance factors such as access times, throughput rates and target overhead. The test platform used to derive the performance data in the accompanying figures consisted of an IBM PC/AT operating at 8 MHz, with 640K bytes of memory and a Western Digital Corp. Master Link SCSI host bus adapter. The PCs and drives were set up in single-initiator/single-target configurations.

The program measures access times for data located on the first two cylinders of the drive, then for random data located anywhere on the drive, and then alternates between the first two and last two cylinders of the drives (Fig. A). The time required for the SCSI benchmark program to assemble

FIG. A



SOURCE: MICRO CONSULTING ASSOCIATES

of gray scale (which translates into shades) per color and can transfer data at 200K bytes per second. Neither of the existing specifications for SCSI or TIFF make provisions for handling color. However, some observers think that the Howtek scanner may become the pacing product for extending both specifications to encompass color.

Will printers use SCSI?

Because so many peripheral manufacturers are boarding the SCSI bus, it is natural to assume that printer manufacturers are sure to follow. Surprisingly, however, Hewlett-Packard —the leader in laser printer technology—has elected to ignore SCSI for its printer line, at least for the time being. "We examined SCSI and found it lacking," says Douglas Carnahan, general manager of HP's Boise printer division.

Rather than latch on to SCSI to overcome the slow speeds associated with RS232C and 8-bit parallel interfaces, HP uses the RS722 video interface to speed transfer. This approach takes up a slot in the PC backplane and is costly (about $2,500 for the two-board set).

Future Domain Corp. is one company that already provides SCSI functionality to printers with its TMC-820 host adapter. Company officials say the price is under $500 in OEM quantities. The TMC-820 can handle tape drives, Winchester disk drives, optical drives and laser printers, and supports data transfers in bandwidths up to 32 MHz (4M bytes per second).

Some observers feel that one of the problems with putting SCSI on printers is the lack of standards for printers. "There is some justification for that claim," says Jeffrey Fleming, product marketing manager for Printronix Inc., a manufacturer of dot-matrix printers. However, he maintains that there is always a need for printer manufacturers to add value in the form of extra features, which is made possible by SCSI. NEC Information Systems Inc.'s product line manager, John McIntyre, agrees and adds that SCSI allows printer manufacturers to provide a rich set of printing commands but stay transparent to the rest of the system.

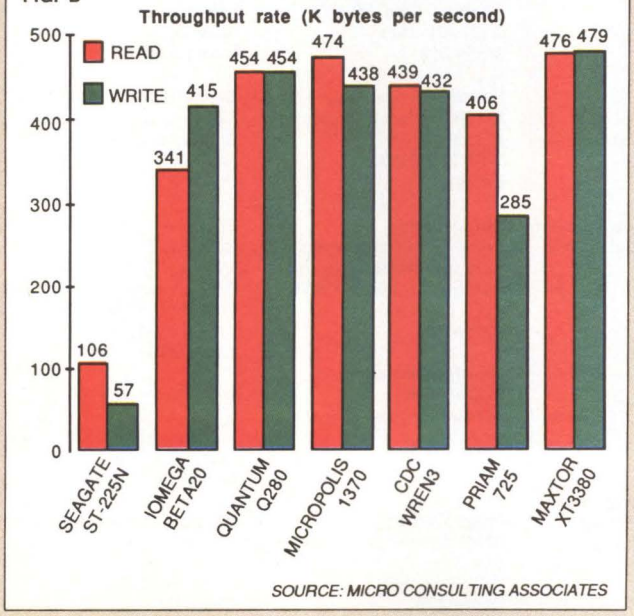
All SCSIs aren't SCSI

The idea behind establishing a standard is usually to create an environment where devices from a large number of vendors can work together. That is indeed the goal of SCSI; but like RS232C, SCSI often falls short. Like most standards, SCSI can be implemented in a variety of ways while still complying with the basic definition. On the positive side, this compliance enables system integrators to add value and differentiate their products. On the negative side, it can cause problems.

Some observers feel that one of the problems with putting SCSI on printers is the lack of standards for printers.

commands and to report status to the screen is automatically subtracted before the access times are reported. Bear in mind, however, that each drive's apparent access times can be improved from a system standpoint by optimizing integration of the overall architecture.

FIG. B



SOURCE: MICRO CONSULTING ASSOCIATES

The program also tests throughput rates (Fig. B). Throughput is a measure of how quickly the drive can continuously read or write data. Of course, each drive should ideally be rated on actual applications. In addition, newer model drives may offer faster throughput rates due to improved actuators.

In addition to access times and throughput rates, the program also measures target overhead. This measurement detects how much time the drive spends in decoding the command sent from the benchmark program.

In testing disk drives, system integrators must be aware of a variety of overheads, such as those imposed by the operating systems, the buffers and the caches. When testing throughput, they must take into consideration the general parametrics of the drive, such as average access time, seek time and track-to-track access time. And, of course, performance data depends on how efficiently system integrators implement the SCSI device channel.

Andy Hospodor is director of engineering for Micro Consulting Associates, Santa Clara, Calif., a company specializing in assembly language programming and test evaluation software.

tive side, system integrators don't always have plug-and-play SCSI compatibility.

Apple Computer Inc.'s Macintosh Plus, for example, has a SCSI-like port to increase the flexibility and extensibility of the system. However, most integrators have found that the Apple implementation isn't exactly SCSI.

The only impediment to the universal use of SCSI is lack of knowledge.

Thus, developers using the Macintosh Plus don't necessarily have full SCSI compatibility. But I. Dal Allan, president of ENDL Consulting, Saratoga, Calif., points out that Apple's approach is typical. "Apple, like most companies, took a vendor-unique approach to the integration of SCSI—theirs was a little more unique than others. SCSI merely provides a common approach to the interconnection of diverse devices," Allan explains.

One company that takes advantage of Apple's MacBus version of SCSI is National Instruments with its LabVIEW software-development environment. For $1,500 to $2,000, depending on board choices and options, developers can obtain a SCSI-to-IEEE-488 GPIB that allows the Macintosh to talk to the IBM PC as an instrument. Developers can then use the LabVIEW software to create a host of applications.

"We use the Macintosh because it provides the necessary bit-mapped display for creating our various control panels," explains James Truchard, president of National Instruments. He says that the LabVIEW software, which is used to create test diagrams and to control the bus, can be viewed as a software extension of GPIB and SCSI.

SCSI's 4M bytes per second transfer rate in the synchronous mode and its implementation with a 50-pin flat cable triggers the interest—albeit slight—in using it to create limited-area networks. How limited? SCSI restricts the distance for asynchronous transmissions to 6 meters and synchronous to 25 meters. According to Tom Gardener, one of the developers of SCSI and currently president of The System Surety Consulting company in Los Altos Hills, Calif., running 50-pin cable around a building is foolhardy at best and is subject to ruin by noise, at any rate.

But at least one company is betting on SCSI-based host-to host connections for transferring files between dissimilar systems. Dayna Communications Inc. has developed a $595 package called FT100 that allows users to transfer files between a Macintosh and a PC over the SCSI bus.

The primary purpose of SCSI is to extend open-system architectures by expanding the "openness" to peripheral subsystems. "We've spent a great deal of time making SCSI a flexible, usable tool," says ENDL's Allan, who is also vice-chairman of the ANSI X3T9.3 committee and a member of the SCSI advisory board, "The only impediment we have to its universal use is lack of knowledge." □

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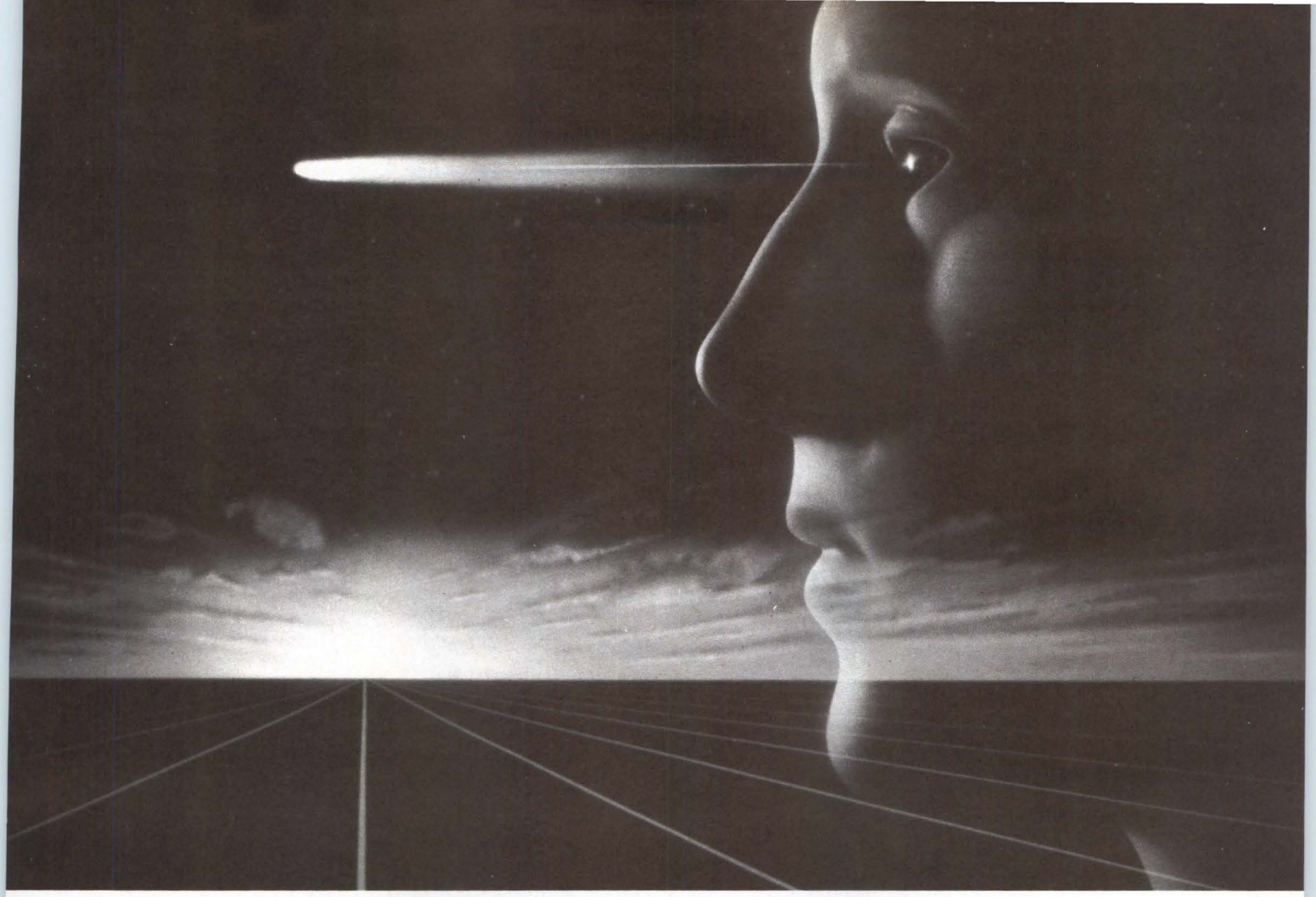

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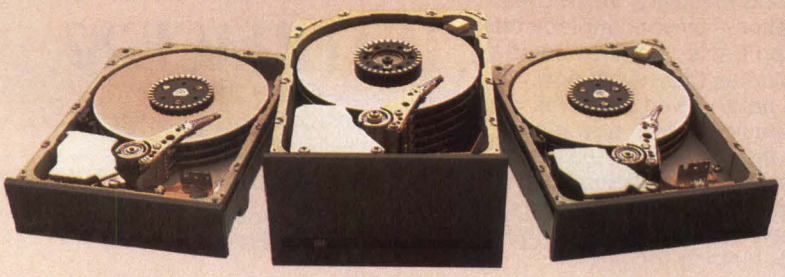

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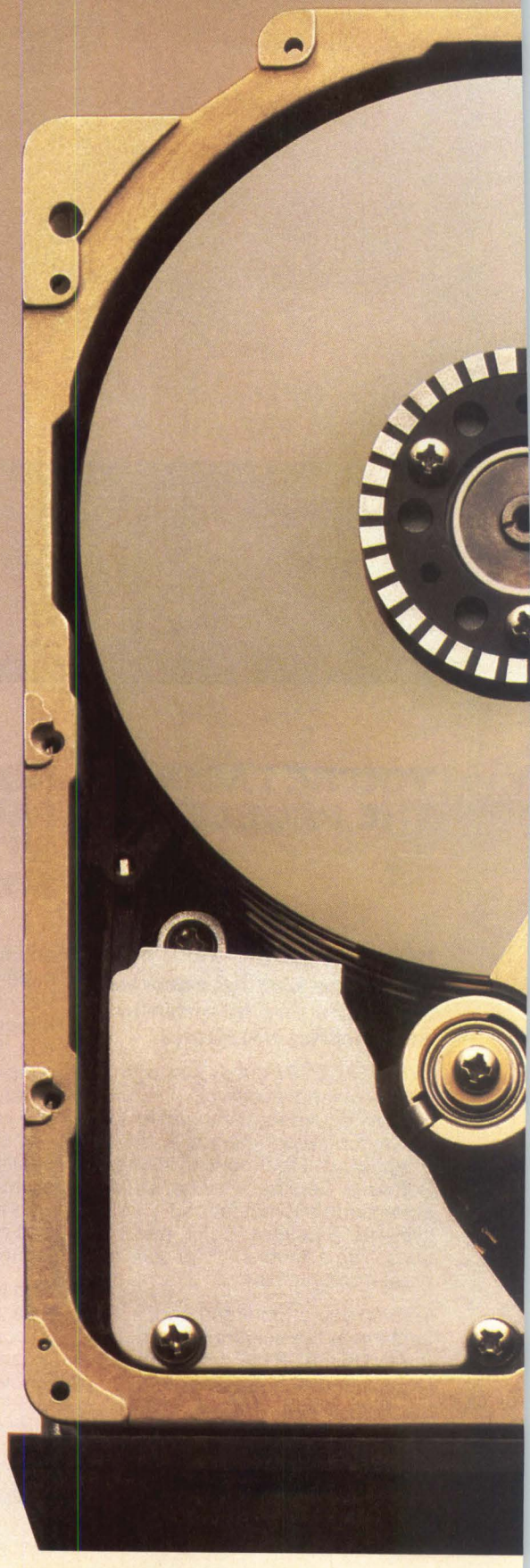
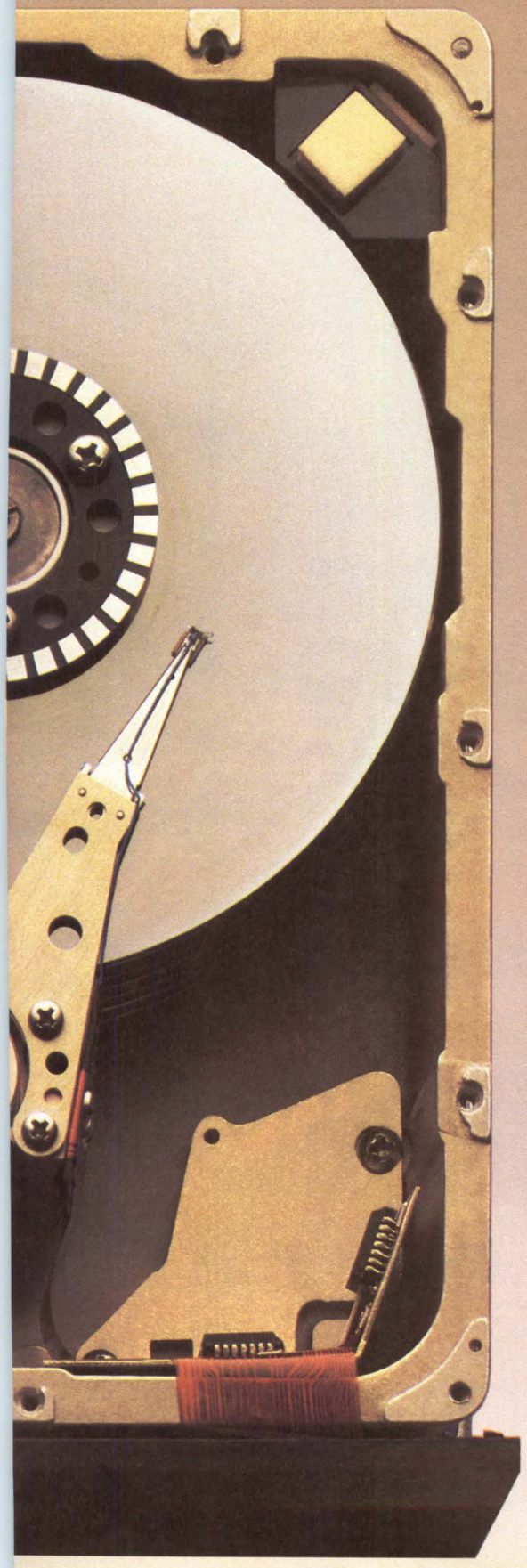


e two sides, too.



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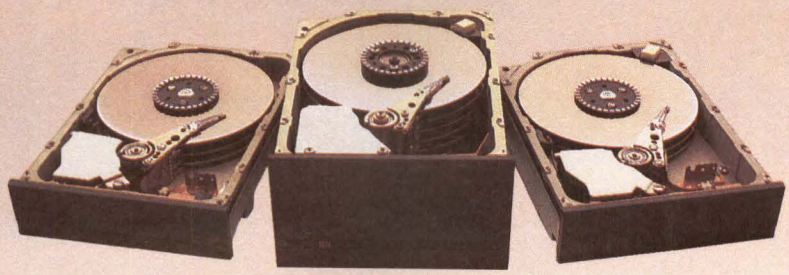

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ADVANCED CONTROLLERS MAXIMIZE BUS BANDWIDTH

Both Multibus II and VMEbus 32-bit protocols have distinct advantages when applied to wide-bandwidth multiprocessor systems, but the associated controllers are more crucial in optimizing performance

Tom Thawley and E.E. Godsey
Interphase Corp.

Users and system integrators demanding higher performance from their computer systems are turning to high-bandwidth, nonproprietary 32-bit buses, such as VMEbus and Multibus II. Multiple rigid disk controllers, high-speed Ethernet interconnects and multiprocessing schemes are all fueling this trend. But coming as close as possible to bus bandwidths of 40M bytes per second depends on choosing disk, tape and network controllers that make the most of the available bandwidth.

For example, the increased availability and lower cost of high-data-rate rigid disk drives are important factors driving the need for improved bus performance. SMD (storage module device)-E drives now run at 3M bytes per second, and ESDI (enhanced small device interface) drives will soon attain that rate. Synchronous SCSI (small computer systems interface) devices can run at 4M bytes per second; IPI (intelligent peripheral interface) Level 2 drives will soon operate at 10M bytes per second.

To effectively decouple the system bus from the peripheral, and not degrade system performance, a controller must be able to transfer data across the bus much faster than it transfers it to or from the peripheral. As high-performance peripherals become more common, controllers will begin pushing against the capability limits of the system bus.

The trend toward solving throughput problems by employing multiple processors is also increasing system bus utilization. Passing intermediate results from processor to processor across the system bus tends to load up the bus, requiring better use of bus bandwidth.

Multibus II's and VMEbus' high-bandwidth, 32-bit data paths will play major roles in the next generation of microcomputer systems. Each bus has distinct advantages for system integrators (MMS, August 1985, Page 77; September 1985, Page 129). But regardless of the bus specified, system integrators must configure controllers and peripherals to maximize bus throughput and eliminate bottlenecks.

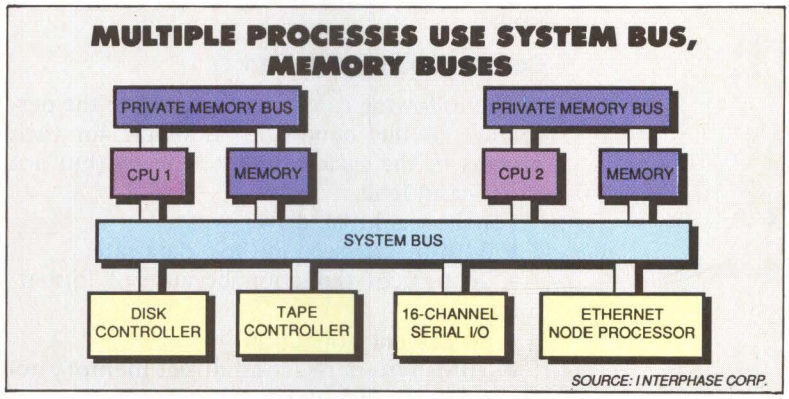

Fig. 1. Based on a high-performance *system bus, a typical multiprocessor system includes a rigid disk controller, half-inch tape-drive controller, 16-channel serial I/O card and Ethernet node processor. Two dual-ported memories handle interprocessor communication.*

Saturation calls for hard choices

Typically, high-performance systems are limited by one resource: bus bandwidth. It is easy to add more memory, disk drives, processors and communications lines. But once the main system bus becomes saturated with these devices, system integrators are confronted with several hard choices.

For starters, they can upgrade to a higher performance bus that offers increased bandwidth. This bus, however, will not solve the problem if the controllers cannot take advantage of the increased bandwidth. Alternatively, they can redesign the hardware so that multiple buses share data traffic, or redesign the software so that less data is passed across the system bus. Finally, they can upgrade to higher performance controllers that more effectively utilize bus bandwidth.

Consider the bus-bandwidth utilization problems system integrators can encounter with a typical multiprocessor system. Except for the system processors, which access memory over private memory buses, the rigid disk controller, half-inch-tape-drive controller, 16-channel serial I/O card and the Ethernet node

processor all hang off the common system bus (Fig. 1). The dual-ported memories, attached to both the private buses and the system bus, handle interprocessor communications.

Dividing the amount of data transferred across the bus per second by the maximum data-transfer rate and multiplying by 100 calculates the percentage of available bus bandwidth utilized by each process in the system. For example, if the rigid disk controller spends 120 msec out of each second moving data across the bus it is using 12 percent of the available bus bandwidth. For maximum usefulness the analysis should be made for average, heavy and absolute worst case loading conditions.

Calculate bandwidth load

The following calculations illustrate the percentage of bus bandwidth available for each process in the system under a heavy (but not worst case) load.

For the rigid disk drive:

- 24M-bit-per-second (bps) data rate
- 20 percent reduction because of formatting
- 50 percent utilization
- 10M-byte-per-second direct memory access (DMA) controller
- (24M bps)×0.80×0.50÷(8 bits per byte)=1.2M bytes per second
- (1.2M bytes per second)÷(10M bytes per second)(100)=12 percent of bandwidth used.

For the half-inch tape drive:

- 6,250 bits per inch (bpi) running at 100 inches per second (ips)
- Effective throughput of 100 percent on long records when tape is streaming
- 10M-byte-per-second DMA controller
- 1 byte for each transfer on the nine-track tape (8 bits wide with a parity bit)
- (6,250 bpi)×(100 ips)×1.0×(1 byte transferred per bit)=625K bytes per second
- (0.625M bytes per second)÷(10M bytes per second)(100)=6.2 percent of bandwidth used.

For the 16-channel serial I/O card:

- 16 full-duplex channels at 9,600 baud
- 50 percent effective utilization
- Programmed I/O, including interrupt response time, limits effective data rate to 200K bytes per second.
- For ASCII coded data, 10 serial bits for every 8-bit byte (10 bits per byte)
- (16 channels)×2×(9,600 baud)×0.50÷(10 bits per byte)=15.4K bytes per second
- (15.4K bytes per second)÷(200K bytes per second)(100)=7.7 percent of bandwidth used.

For the single-channel Ethernet card:

- 10M bps
- 25 percent effective throughput
- 1M-byte-per-second programmed I/O
- (10M bps)×0.25×(8 bits per byte)=312.5K bytes per second
- (0.3125M bytes per second)÷(1M bytes per second)(100)=31.2 percent of bandwidth used.

For interprocessor communications:

- 100K bytes per second
- 100 percent duty cycle
- 1M-byte-per-second DMA (large-scale integration DMA controllers)
- (100K bytes per second)×1.0=100K bytes per second
- (0.100M bytes per second)÷(1M byte per second)(100)=10 percent of bandwidth used.

The bandwidth diagram in Fig. 2 shows the percentage of available bandwidth each process uses. The five processes require over two-thirds (67.1 percent) of the available bus bandwidth. And this figure does not include miscellaneous bus traffic, such as command processing, bus traffic caused by exceptional loading on any of the channels or error processing.

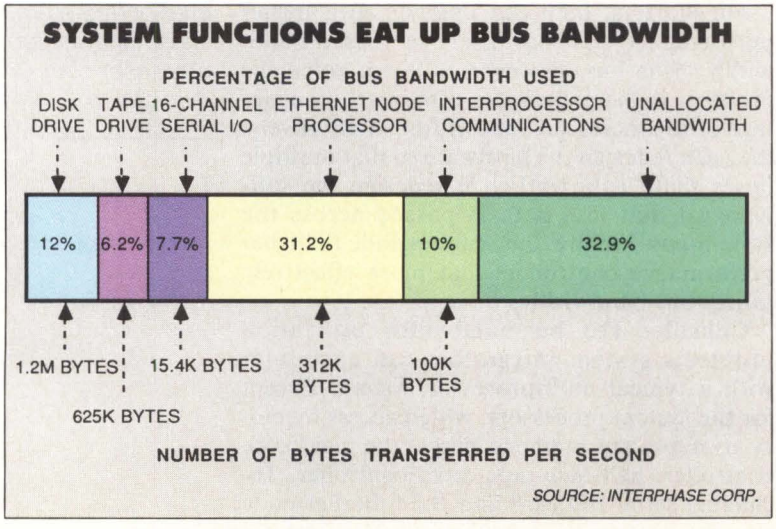

Fig. 2. Five processes *on the multiprocessor system use over two-thirds of the available bus bandwidth. A 25 percent to 30 percent increase in bus loading could saturate the bus.*

Headed for saturation

The calculations are disturbing because they demonstrate that a 25 percent to 30 percent increase in bus loading could use up the available bus bandwidth. In a multiuser workstation environment this might only cause slower response. In a real-time system, however, total disaster might result if the controlled process gets out of control.

Because it offers no room for expansion, system integrators should avoid loading a system this heavily. Thus, two or three additional processors could not be added to boost system-processing capability. And, three or four additional disk controllers could not be used to implement a disk-striping scheme, in which a file is allocated over several disks to speed up transfers to and from disk. In short, no unallo-

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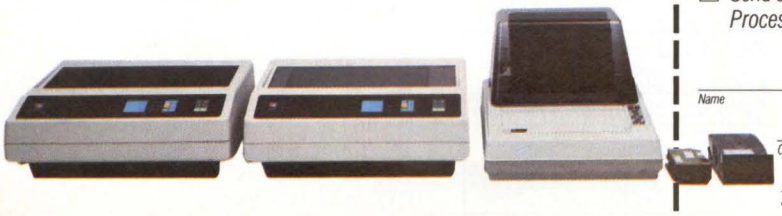

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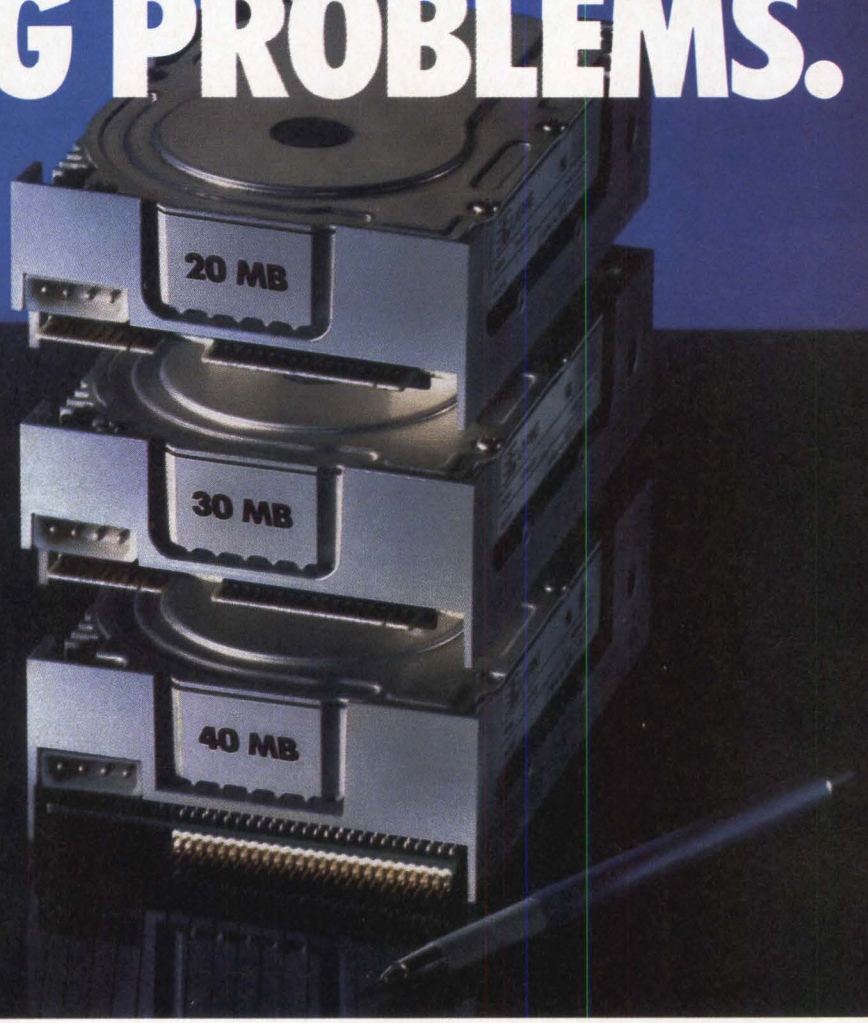

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cated bus bandwidth is available to accommodate additional processes on the bus.

Avoid these heavily loaded systems because response times tend to degrade seriously as bus utilization exceeds 50 percent. If a process must wait for bus access, total response time will be longer than if the process were able to use the bus immediately. In a heavily loaded system, lower priority processes will experience a degradation of response time long before the bus is actually saturated.

Fortunately, advanced controllers can minimize use of available bus bandwidth and free up bandwidth for expansion of system capabilities. As it uses more than 30 percent of the bus bandwidth, the Ethernet node processor in the example is an obvious candidate for replacement. Replacing it, for example, with a node processor providing an on-board MC68020 microprocessor and Interphase's 30M-byte-per-second proprietary BUSpacket interface.

As an intelligent Ethernet node processor it can implement the higher layers of the communications protocol, which would tend to reduce the amount of bus traffic. But the greatest improvement would be achieved by the BUSpacket interface, which moves data very fast across the bus via DMA.

Redoing the previous bandwidth calculations with such a node processor produces the following results—and a significant improvement in bus-bandwidth utilization:

- One Ethernet channel at 10M bps
- 25 percent effective throughput
- 30M-byte-per-second DMA
- (10M bps)×0.25÷(8 bits per byte)= 312.5K bytes per second
- (0.3125M bytes per second)÷(30M bytes per second)(100)=1.0 percent of bandwidth used.

This example also demonstrates the importance of using disk controllers that conserve bus bandwidth when implementing disk-striping schemes across several high-speed disks. In this regard, four 10M-byte-per-second controllers would saturate the system bus, attempting more than 103 percent utilization.

With a high-performance 30M-byte-per-second SMD controller, such as Interphase's V/SMD 4200 Cheetah (or an ESDI controller, such as the V/ESDI 4201 Panther), the system could easily handle four to eight disk controllers, as demonstrated by the following calculations for the V/SMD 4200 Cheetah:

- 24M-bps rigid disk data rate
- 20 percent reduction in effective data rate from formatting
- 50 percent utilization
- 30M-byte-per-second DMA controller
- (24M bps)×0.8×0.5÷(8 bits per byte)= 1.2M bytes per second
- (1.2M bytes per second)÷(30M bytes per second)(100)=4.0 percent of bandwidth used.

Thus, four of these controllers could implement disk striping and utilize only 16 percent of the available bus bandwidth. Further reductions in bus bandwidth could be achieved by substituting a high-performance half-inch-tape controller, such as Interphase's V/Tape 3209:

- 6,250 bpi running at 100 ips
- 100 percent throughput when tape is streaming
- 25M-byte-per-second DMA controller
- (6,250 bpi)×(100 ips)×1.0×(1 byte per transfer)=625K bytes per second
- (0.625M bytes per second)÷(25M bytes per second)(100)=2.5 percent of bandwidth used.

Bandwidth saved

As the diagram in Fig. 3 illustrates, substituting high-performance controllers in the example system produces a significant improvement in bandwidth utilization: Unallocated bus bandwidth increases to 62.8 percent from 32.9 percent (Fig. 2), even with the additional controllers needed to support disk striping.

With high-performance controllers the five processes supported on the bus now use only a little more than one-third of the available bus bandwidth. This leaves almost two-thirds of the bus bandwidth unallocated to accommodate future expansion.

Increasing from four to eight the number of disk controllers used to support disk striping would still leave almost one-half of the bus bandwidth available. In a system this lightly loaded significant increases in bus loading would not noticeably degrade system response

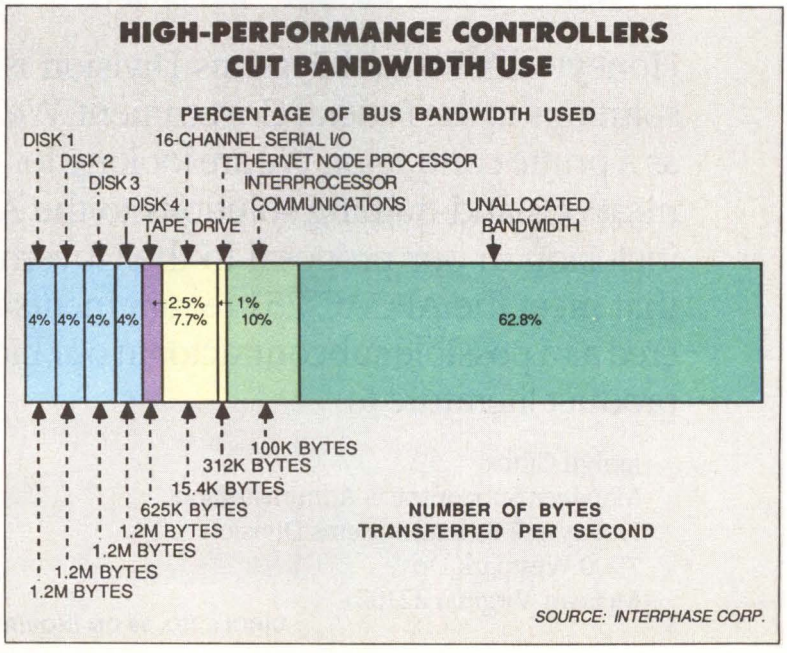

Fig. 3. High-performance controllers *in the multiprocessor system use only one-third of the bus bandwidth, leaving almost two-thirds free for future system expansion.*

Companies mentioned in this article

Central Data Corp.
1602 Newton Drive
Champaign, Ill. 61821
(217) 359-8010
Circle 301

Ciprico Inc.
2955 Xenium Lane
Plymouth, Minn. 55441
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Circle 302

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(714) 662-5600
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Interphase Corp.
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Dallas, Texas 75229
(214) 350-9000
Circle 305

Xylogics Inc.
144 Middlesex Turnpike
Burlington, Mass. 01803
(617) 272-8140
Circle 306

time, even on the lowest priority processes.

Although these calculations are based on products from Interphase, similar calculations can be applied to high-performance controllers from other major independent manufacturers. These include Central Data Corp., Ciprico Inc., Dual Systems Corp., Emulex Corp. and Xylogics Inc.

High-data-rate peripherals, multiprocessor configurations, Ethernet interconnects and disk-striping techniques continue to make increasing demands on high-bandwidth system buses. The important question for system integrators is not which high-performance bus to select but how to effectively utilize the bandwith of the bus selected. □

Tom Thawley is executive vice-president of Interphase Corp., Dallas. Before joining Interphase in 1977 he was manager of hardware development for Danray Inc. and design engineer with Teleswitcher Corp. **Ernest E. Godsey** is product marketing manager at Interphase. Previously, he was manager, design engineering, vertical products for Harris Corp.

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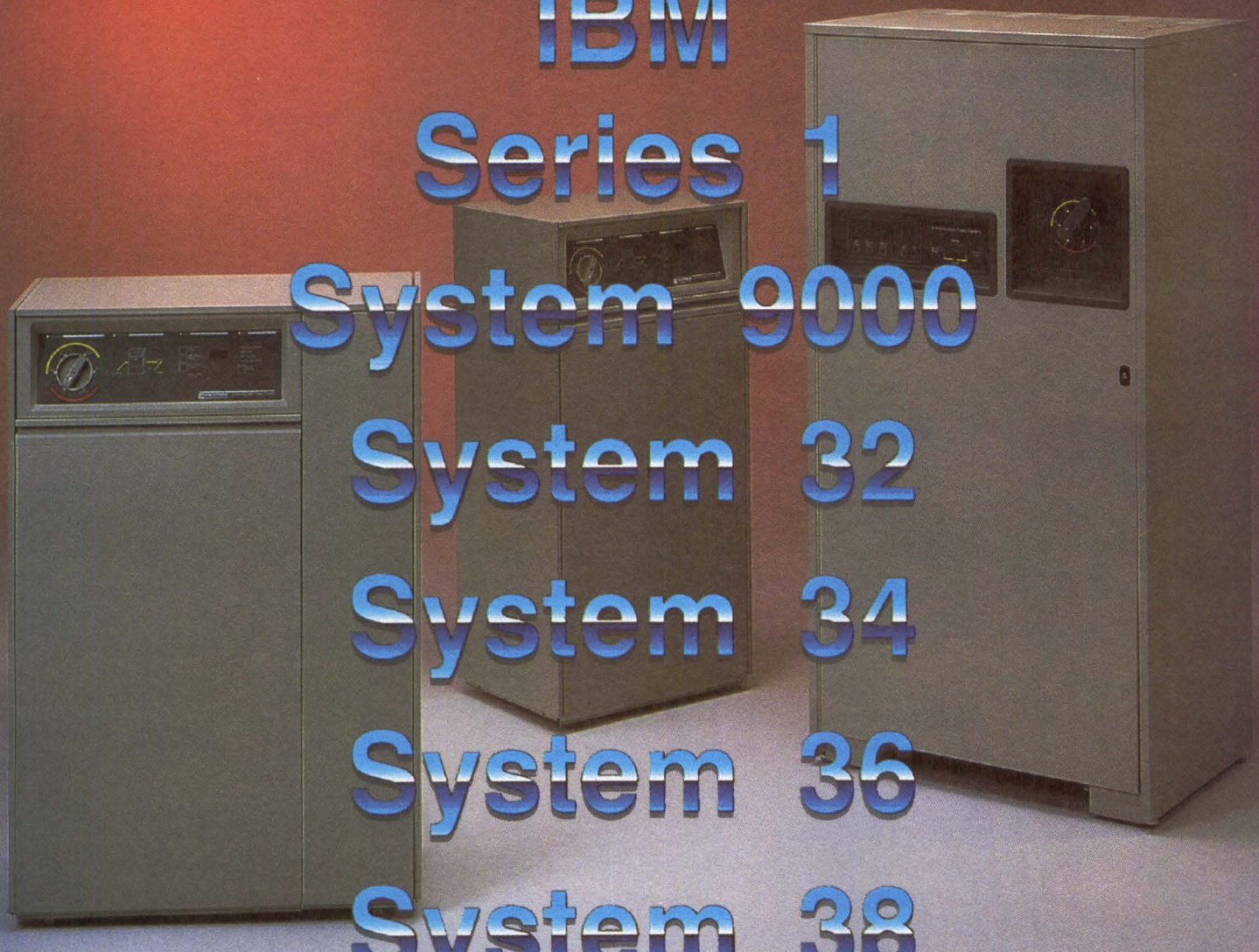

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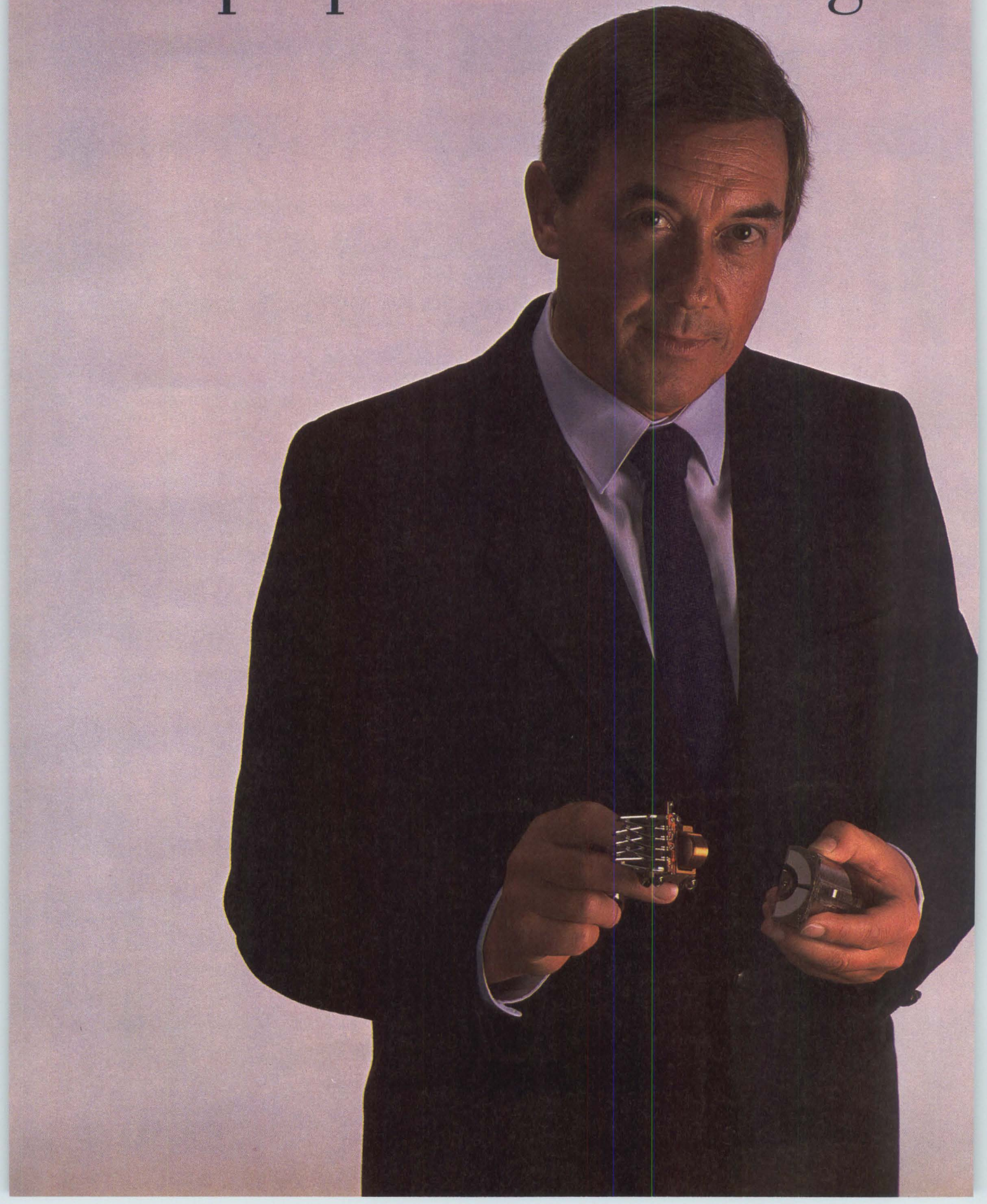

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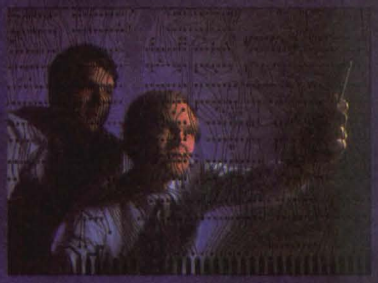

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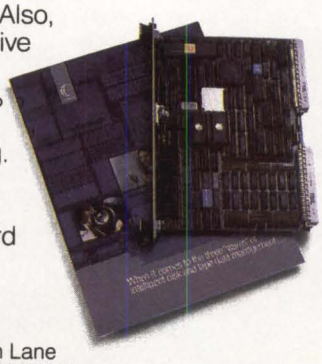

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¼-INCH TAPE CARTRIDGE DRIVES AND SUBSYSTEMS

Company / Model	Operating mode	Storage capacity (M bytes)	Number of tracks	Recording density (bpi)	Tape speed (ips)	Data transfer rate (K bytes/sec.)	Interfaces	Recording format	Dimensions (H×W×D/inches)	Price $ (quantity)
3M CO. (DATA RECORDING DIV.)										**Circle 342**
Building 225-5N-04, 3M Center, St. Paul, MN 55144, (612) 733-7297										
HCD-134	start/stop, streaming	134 (formatted)	32	10,000	120	70	SCSI		3.25×5.75×8 (internal)	1,195(Q1); 910(Q100)
MCD-403	start/stop, streaming	40 (formatted)	24	10,000	60	21.2	SCSI, QIC-36E		1.625×4×6 (internal)	240(Q500)
MCD-405	start/stop, streaming	40 (formatted)	24	10,000	60	21.2	SCSI, QIC-36E		1.625×5.75×6 (internal)	240(Q500)
ACCESS INFORMATION CONCEPTS INC.										**Circle 343**
1372 Broadway, 17th floor, New York, NY 10018, (212) 221-8764										
PBS-60E/Q44	start/stop, streaming	30-60 formatted	9	10,000	90	62.5	QIC-44	QIC-24	2.25×6×13.38 (standalone)	1,545(Q1)
PBS-60E/Q36	start/stop, streaming	30-60 (formatted)	9	10,000	90	62.5	QIC-36	QIC-24	2.25×6×13.38 (standalone)	1,245(Q1)
TVK-60I/Q36	start/stop, streaming	30-60 (formatted)	9	10,000	90	62.5	QIC-36	QIC-24	1.63×5.75×8.5 (internal)	795(Q1)
ALGO INC.										**Circle 344**
9198-C Red Branch Rd., Columbia, MD 21045, (301) 730-7442										
1200 (subsystem)	start/stop	5.3 (formatted)	4	1600	30	2.4	RS232C, IEEE 488	PE	5×7×14 (standalone)	2,585(Q1); 1,938(Q500)
1600 (subsystem)	start/stop	20 (formatted)	4	6400	30	2.4	RS232C, IEEE 488	MFM	5×7×14 (standalone)	2,995(Q1); 2,246(Q500)
ALLOY COMPUTER PRODUCTS INC.										**Circle 345**
100 Pennsylvania Ave., Framingham, MA 01701, (617) 875-6100										
APT-60	streaming	60 (formatted)	12	6400	39, 78	250	SA450, SA475	MFM	3.25×6.9×5.75 (internal)	
FT-60 (subsystem)	streaming	60 (formatted)	12		39, 78	30	IBM PC/XT	MFM	5.25×8.75×15.25 (standalone)	995(Q1)
PC-QICTAPE (subsystem)	streaming	59 (formatted)	9	10,000	90	33	IBM PC/XT	QIC-24	5×8.5×16 (standalone)	2,295(Q1)
ANALOG & DIGITAL PERIPHERALS INC. (ADPI)										**Circle 346**
815 Diana Dr., Troy, OH 45373, (513) 339-2241										
DC300	start/stop	18 (unformatted)	4	6400	30	6	TTL, CMOS	PE	8×7×8 (internal)	985(Q1)
Feedback 340/344	start/stop	4/18 (unformatted)	4	1600/ 6400	30	6/24	RS232C, RS422		8×8×13 (standalone)	2,195/ 2,250(Q100)
ANRITSU AMERICA INC.										**Circle 347**
15 Thornton Rd., Oakland, NJ 07436, (201) 337-1111										
DMT730JG	start/stop	40 (unformatted)	8	7700	30	250	GP-IB		4.6×9×14.4 (standalone)	
DMT730JP	start/stop	40 (unformatted)	8	7700	30	28.9	Pertec		4.6×8.7×9.3 (standalone)	
DMT730KP	streaming	40 (unformatted)	8	7700	90	86.7	Pertec		4.6×8.7×9.3 (standalone)	
ARCHIVE CORP.										**Circle 348**
1650 Sunflower Ave., Costa Mesta, CA 92626, (714) 641-0279										
3240/3540	streaming	61.5 (unformatted) 40 (formatted)	20	10,000	25/50	31.25/ 62.5	std. flexible disk	QIC-40	1.625×4×5.75 (internal)	590(Q1); 388(Q500)
Scorpion	streaming	64.8 (unformatted) 60 (formatted)	9	8000	90	90	QIC-02, QIC-36, SCSI	QIC-24	3.38×5.87×8.2 (internal)	1,120(Q1); 880(Q500)
Super Scorpion	streaming	135 (unformatted) 125 (formatted)	15	10,000	72, 90	90	QIC-02, QIC-36	QIC-120	3.38×5.87×8.2 (internal)	1,400(Q1); 1,000(Q500)
BRAEMAR CORP.										**Circle 349**
11400 Rupp Dr., Burnsville, MN 55337, (612) 890-5135										
QicBac 350	streaming	60 (unformatted)	24	10,000	75, 90	94	QIC-103, IBM bus, SCSI	QIC-100	1.625×4×5.75 (internal)	525(Q1); 320(Q500)
QicBac 525	streaming	60 (unformatted)	24	10,000	75, 90	94	QIC-103, IBM bus, SCSI	QIC-100	1.625×5.74×6 (internal)	525(Q1); 320(Q500)
CIPHER DATA PRODUCTS										**Circle 350**
10101 Old Grove Rd., San Diego, CA 92131, (619) 578-9100										
525 FloppyTape	streaming	32 (unformatted)	6	6400	78	62.5	SA450, SA850		3.25×5.75×8 (internal)	

¼-INCH TAPE CARTRIDGE DRIVES AND SUBSYSTEMS

Company / Model	Operating mode	Storage capacity (M bytes)	Number of tracks	Recording density (bpi)	Tape speed (ips)	Data transfer rate (K bytes/sec.)	Interfaces	Recording format	Dimensions (H×W×D/inches)	Price $ (quantity)
540	streaming	60 (unformatted)	9	10,000	90	87	QIC-02, QIC-36, SCSI	QIC-02, QIC-24	3.25×5.75×8 (internal)	
5210 FloppyTape (subsystem)	streaming	32 (unformatted)	6	6400	78	62.5	SA450, SA850		5.6×8.1×17.5 (standalone)	
CMS										**Circle 351**
3080 Airway, Costa Mesa, CA 92626, (714) 549-9111										
T-120	start/stop	20 (formatted)	4	10,000	90	90	controller card	QIC-02	1.5×5.5×7.75 (standalone)	1,095(Q1); 425(Q500)
T-160	start/stop	60 (formatted)	9	10,000	90	90	controller card	QIC-02	1.5×5.5×7.75 (internal) 5.25×8.65×12.38 (standalone)	1,495-1,595(Q1); 610-625(Q500)
CONTROL DATA CORP.										**Circle 352**
8100 34th Ave. South, P.O. Box O, Minneapolis, MN 55440, (800) 828-8001										
9219X Sentinel	streaming	70 (unformatted)	11	8000	55	55	BUDI		4.6×8.5×14.06 (internal)	1,600(Q1); 1,040(Q500)
DATA TRACK USA										**Circle 353**
9451 Sohap Lane, Columbia, MD 21045, (301) 992-9143										
1600/1600F	start/stop	5 (formatted)	4	1600	30, 90	2.4	RS232C	ANSI	5.5×7.25×14 (standalone)	2,100(Q1); 1,800(Q500)
1700/1700F	start/stop	20 (formatted)	4	6400	30, 90	2.4	RS232C	MFM	5.5×7.25×14	2,495(Q1); 1,995(Q500)
EMULEX CORP.										**Circle 354**
3545 Harbor Blvd., Costa Mesa, CA 92626, (714) 662-5600										
ED1 (subsystem)	streaming	70 (formatted)	11	8000	55	70	Q-bus, UNIbus		5.5×8.25×19.5 (standalone)	2,795(Q1)
ED2 (subsystem)	streaming	60 (formatted)	9	8000	90	90	IBM PC/AT/XT, Q-bus, UNIbus, SCSI	QIC-36	5.25×19×22 (standalone)	2,750-9,435(Q1)
ER3 (subsystem)	streaming	60 (formatted)	9	8000	90	90	SCSI	QIC-36	5.2×19×23.4 (rackmount)	3,220-15,425(Q1)
EVEREX SYSTEMS INC.										**Circle 355**
48431 Milmont Dr., Fremont, CA 94538, (415) 498-1111										
Excel-Stream 20 (subsystem)	start/stop, streaming	20.7 (formatted)	4	8000	90	86.3	QIC-02	QIC-24	3.1×7.5×12.1 (standalone)	550-615(Q1)
Excel-Stream 60 (subsystem)	start/stop, streaming	60 (formatted)	9	8000	90	86.3	QIC-36	QIC-24	5.1×7×15 (standalone)	735-825(Q1)
Excel-Stream 60-8 (subsystem)	start/stop, streaming	60 (formatted)	9	8000	90	86.3	QIC-36	QIC-24	4.9×8.6×11.8 (standalone)	675(Q1)
GENISCO MEMORY PRODUCTS CORP.										**Circle 356**
10874 Hope St., Cypress, CA 90630, (714) 220-0720										
ECR-30	start/stop	20.3 (unformatted)	4	6400	30, 90	24, 48		MFM	6.9×8.5×8.5 (internal)	4,500(Q1)
ECR-31	start/stop	20.3 (unformatted)	4	6400	30, 90	24, 48		MFM	7.3×6×16 (standalone)	9,500(Q1)
ECR-32	start/stop	20.3 (unformatted)	4	6400	30, 90	24, 48		ANSI	7.3×6×21.5 (standalone)	12,600(Q1)
GENOA SYSTEMS CORP.										**Circle 357**
73 E. Trimble Rd., San Jose, CA 95131, (408) 945-9720										
3120T	start/stop, streaming	20 (formatted)	4	10,000	90	86.7	QIC-02	QIC-24	(standalone)	1,095(Q1); 565(Q500)
3220T	start/stop, streaming	20 (formatted)	4	10,000	90	86.7	QIC-02	QIC-24	(standalone)	1,295(Q1); 645(Q500)
3260	start/stop, streaming	60 (formatted)	9	10,000	90	86.7	QIC-02	QIC-24	(standalone)	1,995(Q1); 995(Q500)
HEWLETT-PACKARD CO. (GREELEY DIV.)										**Circle 358**
700 71st Ave., Greeley, CO 80634, (303) 350-4000										
9142A (subsystem)	streaming	135.4 (unformatted)	16	9600	62.5, 90	33.3	HP-IB	PCT	5.2×12.8×11.2 (standalone)	1,990(Q1)
9144A (subsystem)	start/stop streaming	up to 67.1 (formatted)	16	10,000	60, 90	30	HP-IB	MFM	5.2×12.8×11.2 (standalone)	3,500(Q1)
IRWIN MAGNETIC SYSTEMS INC.										**Circle 359**
2101 Commonwealth Blvd., Ann Arbor, MI 48105, (313) 996-3300										
120D	streaming	20 (formatted)	14	6400	39	31.2	flexible disk controller	MFM	1.68×5.8×8.2 (internal)	850(Q1)
145AT	streaming	40 (formatted)	20	10,000	50	62.5	flexible disk controller	MFM	1.68×5.87×8.2 (internal)	995(Q1)

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*InfoWorld, July 16, 1986

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CIRCLE NO. 43 ON INQUIRY CARD

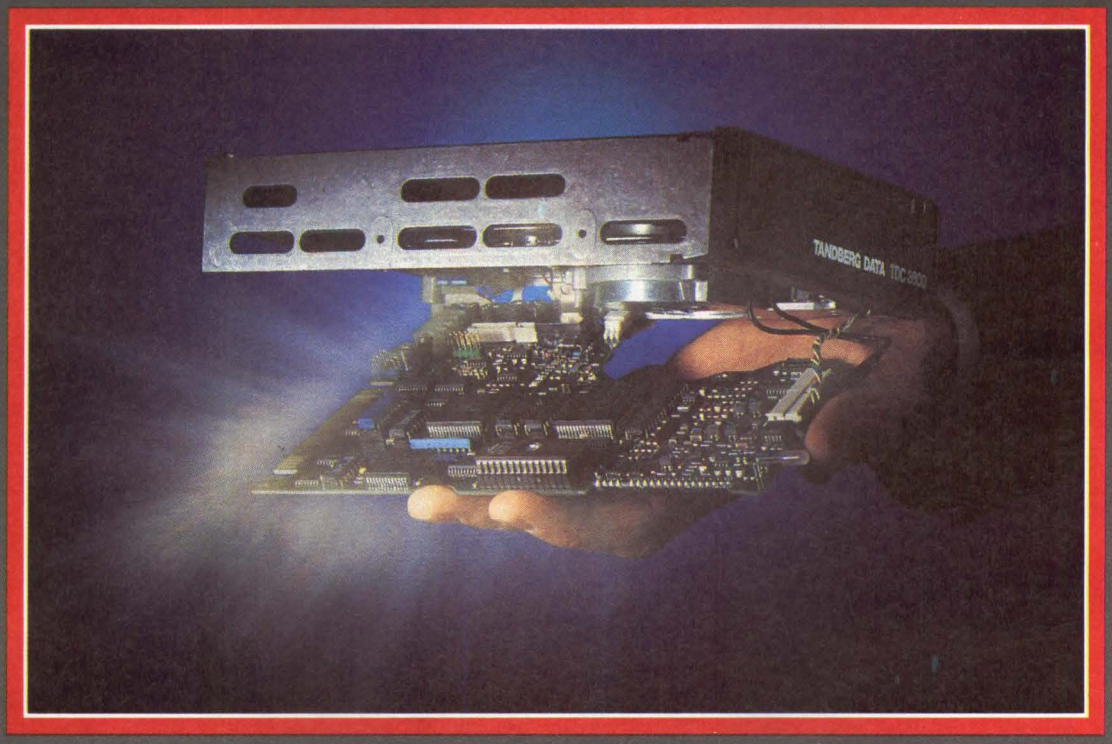
¼-INCH TAPE CARTRIDGE DRIVES AND SUBSYSTEMS

Company / Model	Operating mode	Storage capacity (M bytes)	Number of tracks	Recording density (bpi)	Tape speed (ips)	Data transfer rate (K bytes/sec.)	Interfaces	Recording format	Dimensions (H×W×D/inches)	Price $ (quantity)
245	streaming	40 (formatted)	20	10,000	50	62.5	flexible disk controller	MFM	1.68×4.96×5.95 (standalone)	995(Q1)
KENNEDY CO.										**Circle 360**
1600 Shamrock Ave., Monrovia, CA 91016, (818) 357-8831										
6500	streaming	60 (unformatted)	9	10,000	90	90	QIC-02, SCSI	QIC-11, QIC-24	1.625×5.75×8 (internal)	
6550	streaming	120 (unformatted)	15	12,500	72	90	QIC-02, SCSI	QIC-11, QIC-24	3.25×5.75×8 (internal)	
6600 (subsystem)	streaming	60 or 120 (unformatted)	9, 15	10,000, 12,500	72, 90	90	IBM PC	QIC-11, QIC-24	3.25×5.75×8 (internal)	
NORTH ATLANTIC INDUSTRIES INC.										**Circle 361**
60 Plant Ave., Hauppauge, NY 11788, (516) 582-6060										
RoadRunner I	streaming	60 (formatted)	9	8000	90	90	QIC-02, QIC-36	QIC-24	1.625×5.75×8 (internal)	800-995(Q1); 545-680(Q500)
RoadRunner II	streaming	120 (formatted)	15	12,500	72	90	QIC-02	QIC-120	1.625×5.75×8 (internal)	1,215(Q1); 835(Q500)
RoadRunner III	streaming	120 (formatted)	15	12,500	72	90	SCSI	QIC-120	1.625×5.75×8	1,260(Q1); 880(Q500)
NORTHERN TELECOM INC.										**Circle 362**
100 Phoenix Dr., Ann Arbor, MI 48104, (313) 973-4000										
Flashback 6109-90	streaming	81 (unformatted)	9	10,000	90	90	QIC-02, QIC-36	QIC-24	5.75×7.75×3.9 (internal)	810(Q1); 545(Q500)
Flashback 6112-90	streaming	108 (unformatted)	12	10,000	90	90	QIC-02, QIC-36	QIC-24	5.75×7.75×3.9 (internal)	929(Q1); 625(Q500)
PEREX LTD.										**Circle 363**
Arkwright Rd., Reading, Berkshire, RG2 OEA, England, (0) 734-751054										
HD6400	start/stop	17.5 (unformatted)	4	6400	30	24	TTL	MFM	(internal)	780(Q1)
QicBack (subsystem)	streaming	60 (unformatted)	9	8000	90	90	IBM PC/AT/XT	QIC-24	3×7×13 (standalone)	1,800(Q1)
Peristream	streaming	60 (unformatted)	9	8000	90	90	QIC-02, QIC-36, SCSI	QIC-24	1.6×5.75×8 (internal)	350-700(Q1)
PRIME COMPUTER INC.										**Circle 364**
Prime Park, Natick, MA 01760, (617) 655-8000										
4581	start/stop	15 (formatted)	4	6400	30, 90	24	Prime 50 Series except 2250	Prime	(internal)	7,000(Q1)
4585 (subsystem)	streaming	60 (formatted)	9	10,000	90	90	QIC-02	QIC-24	7×3.88×15.6 (standalone)	4,990(Q1)
4651-2250	start/stop	15 (formatted)	4	6400	30, 90	24	Prime 2250		(internal)	4,500(Q1)
QUADRAM CORP.										**Circle 365**
One Quad Way, Norcross, GA 30093-2919, (404) 923-6666										
QuadTape 60MB	streaming	60 (formatted)	9	8000	90	90	IBM PC/AT/XT	QIC-36	1.625×5.75×8 (internal)	1,695(Q1)
SIEMENS INFORMATION SYSTEMS INC. (MEMORY PRODUCTS DIV.)										**Circle 366**
5655 Lindero Canyon Rd., Suite 325, Westlake Village, CA 91362, (818) 706-8872										
3309	streaming	60 (formatted)	9	8000	90	90	QIC-02, QIC-44, SCSI	QIC-24	1.69×5.88×8.45 (internal)	550(Q1); 370(Q500)
3315	streaming	125 (formatted)	15	10,000	72	90	QIC-02, QIC-44, SCSI	QIC-120	1.69×5.88×8.45 (internal)	895(Q1); 595(Q500)
SYSGEN INC.										**Circle 367**
47853 Warm Springs Blvd., Fremont, CA 94539, (415) 490-6770										
Flat Pak 20/60	streaming	60 (formatted)	9	8000	90	90	QIC-36	QIC-24	2×12×14.2 (standalone)	2,095(Q1) (20M-byte rigid disk storage)
Smart QIC-File	streaming	60 (formatted)	9	8000	90	90	QIC-36	QIC-24	2×6×10 (standalone)	1,495(Q1)
TALLGRASS TECHNOLOGIES CORP.										**Circle 368**
11100 West 82nd St., Overland Park, KS 66214, (913) 492-6002										
TG-1020i (subsystem)	start/stop, streaming	20 (formatted)	12	10,000	75	93.75	QIC-103	QIC-100	1.63×5.75×8.38 (internal)	995(Q1)
TG-2025e (subsystem)	start/stop, streaming	20 (formatted)	12	10,000	75	93.75	QIC-103	QIC-100	4×7.1×14.95 (standalone)	2,295(Q1) (includes 25M-byte rigid disk drive)
TG-6180 (subsystem)	start/stop, streaming	60 (formatted)	11	9600	75	60	QIC-103	QIC-100	5.3×10×16.4 (standalone)	7,495(Q1) (includes 80M-byte rigid disk drive)

¼-INCH TAPE CARTRIDGE DRIVES AND SUBSYSTEMS

Company / Model	Operating mode	Storage capacity (M bytes)	Number of tracks	Recording density (bpi)	Tape speed (ips)	Data transfer rate (K bytes/sec.)	Interfaces	Recording format	Dimensions (H×W×D/inches)	Price $ (quantity)
TECHTRAN INC.										Circle 369
200 Commerce Dr., Rochester, NY 14623, (716) 334-9640										
817	start/stop	145K (unformatted)	1	1600	20	1.2	RS232C	proprietary	5×7.25×11 (standalone)	1,260(Q1); 945(Q100)
818	start/stop	145K (unformatted)	1	1600	20	1.2	RS232C	proprietary	5×7.25×11 (standalone)	1,610(Q1); 1,205(Q100)
TECMAR INC.										Circle 370
6225 Cochran Rd., Solon, OH 44139, (216) 349-0600										
QIC60 AT	streaming	60 (formatted)	9		90	90	adapter card		1.6×5.8×8 (internal)	1,695(Q1)
QIC60 H	streaming	60 (formatted)	9		90	90	adapter card		7×3.8×15.6 (standalone)	2,144(Q1)
WANGTEK INC.										Circle 371
41 Moreland Rd., Simi Valley, CA 93065, (805) 583-5255										
5000E	streaming	60 (formatted)	9	8000	90	90	IBM PC, QIC-02, QIC-36, SCSI	QIC-24	1.625×5.75×8.5 (internal)	
5125E	streaming	125 (formatted)	15	10,000	72, 90	90	IBM PC, QIC-02, QIC-36, SCSI	QIC-24, QIC-120	1.625×5.75×8.5 (internal)	555(OEM)
FAD 5000	streaming	26, 52 (formatted)	6, 12	6400	39, 78	31.25, 62.5	SA475	IBM DS/DD flexible disk	1.625×5.75×8.5 (internal/ standalone)	

THE PROOF:



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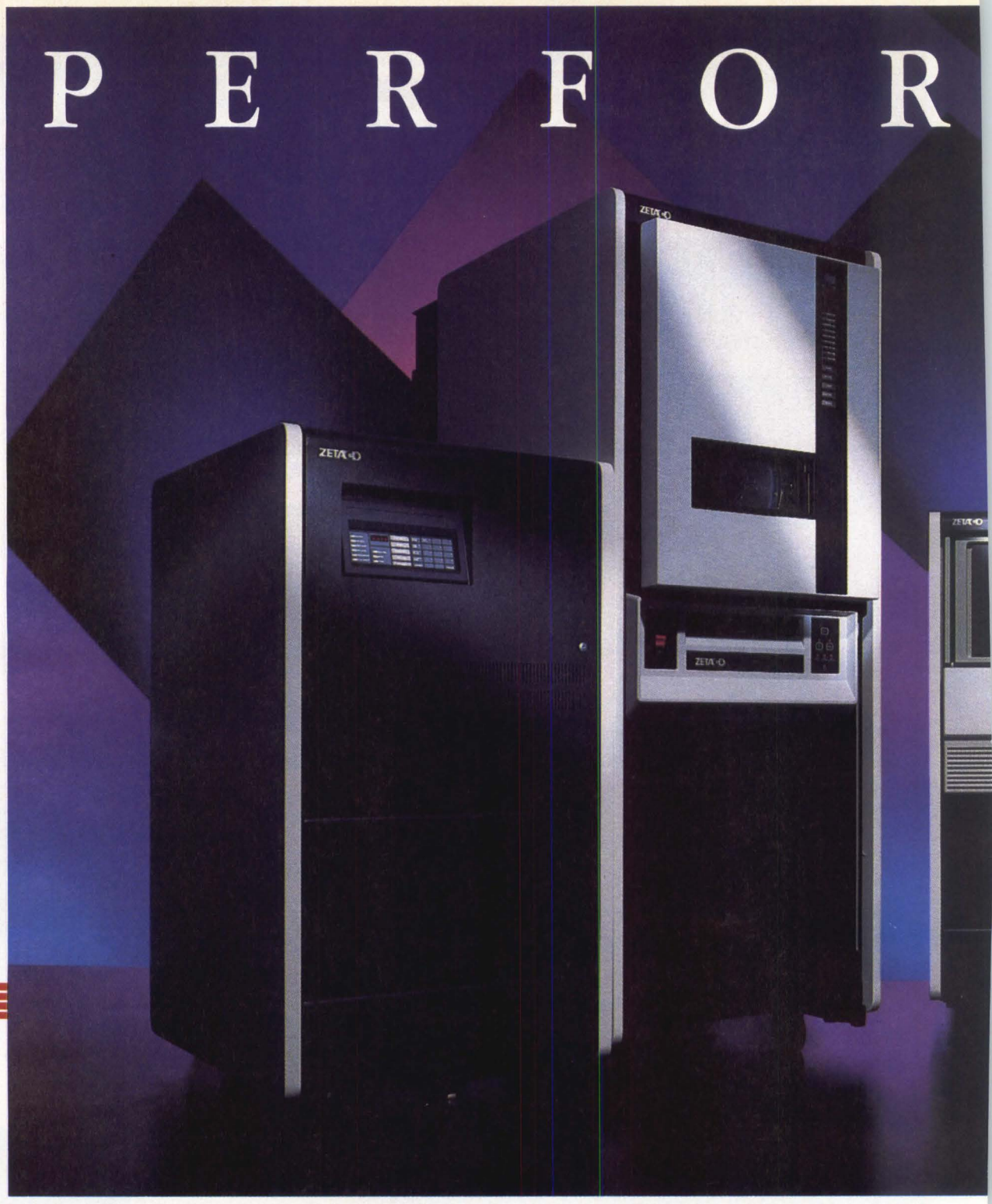
Anderson & Lembke Oslo

CIRCLE NO. 251 ON INQUIRY CARD



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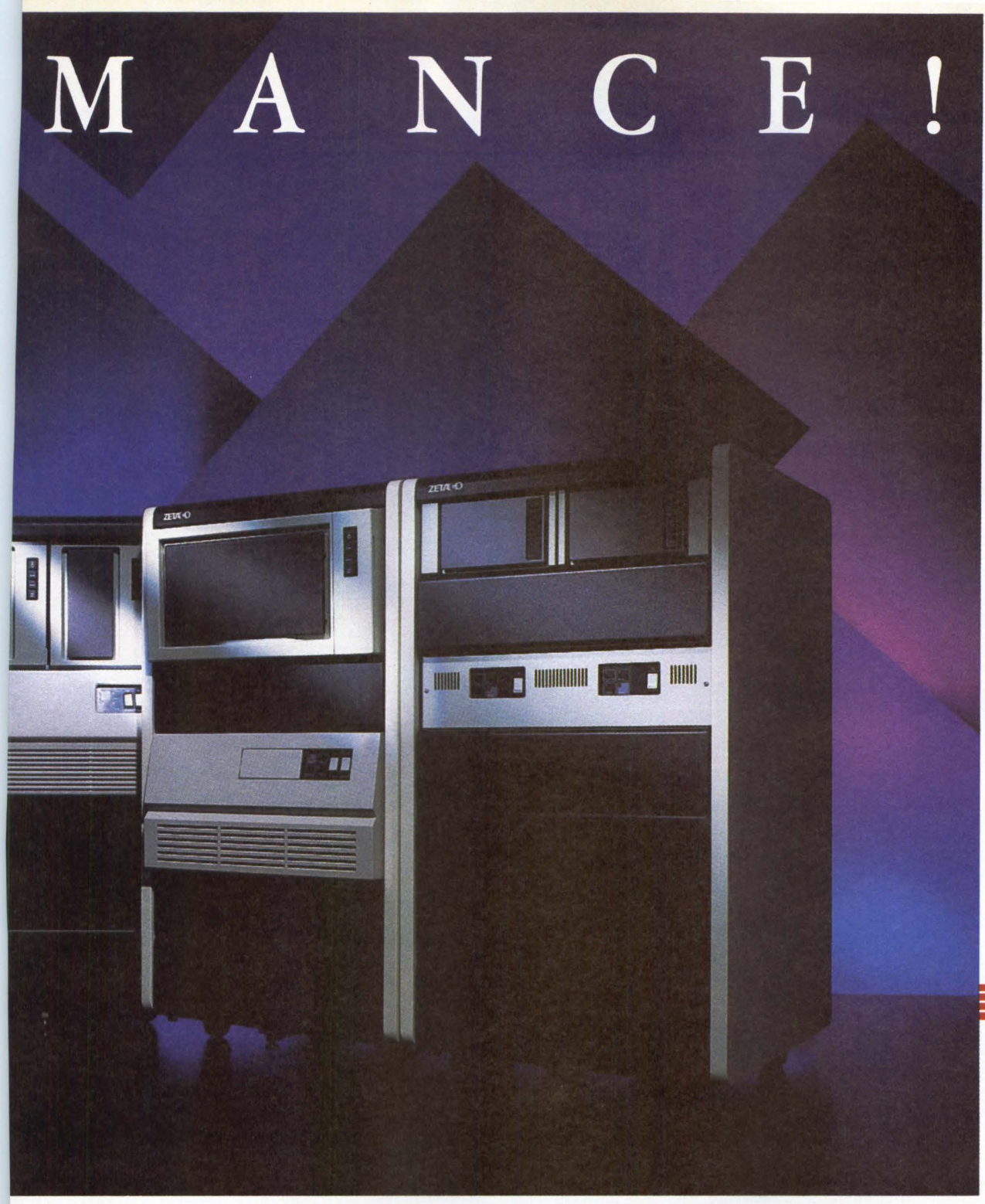

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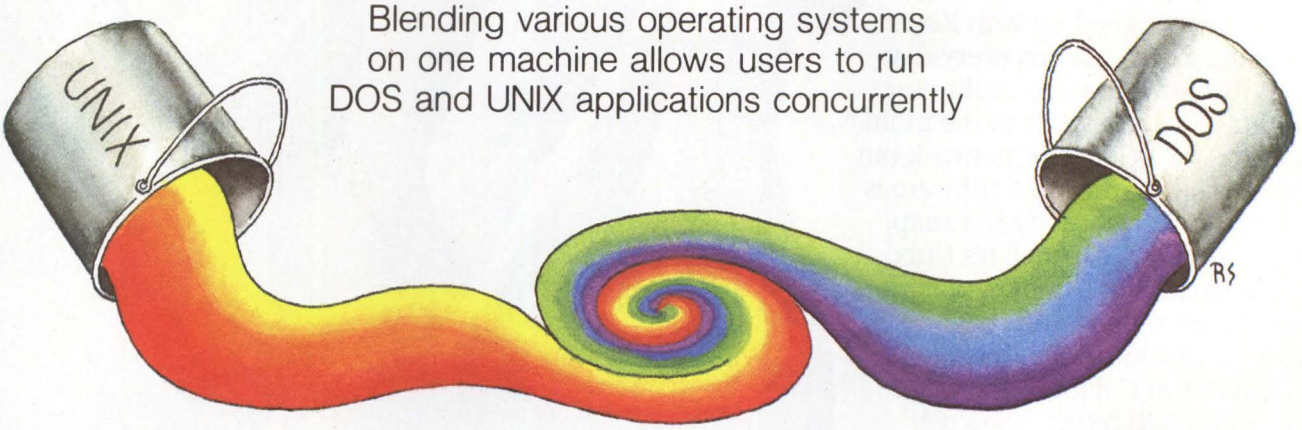
DOS-UNIX ADDS NEW MIX TO OS MARKET

Blending various operating systems on one machine allows users to run DOS and UNIX applications concurrently



Courtesy of Rob Saunders

Tim Scannell, Senior Editor

It is a little difficult to believe that when PC-DOS and MS-DOS were first unveiled about six years ago they would be destined for anything less than first place in the business microcomputer marketplace.

After all, since its debut with the IBM Corp. PC, DOS has been enhanced through various upgrades to take advantage of more powerful systems, to handle more and faster peripherals, and to accommodate commands and support that are normally found on more advanced operating systems like UNIX. Along the way, it achieved the status of an operating system standard for IBM-compatible microcomputers and is presently implemented on more than a third of the approximately 8 million personal computers installed in the United States, according to some estimates.

Why, then, would anyone think of removing DOS from the microcomputer driver's seat and replacing it with a new system leader?

The basic reason might be called "The Wall." While DOS, with its emphasis on maintaining a balance between ease-of-use and power, has managed to keep up with the pace set by new and emerging technologies, it is presently being stretched to its theoretical limits. As it is asked to address larger amounts of memory and storage, especially with systems that go beyond the IBM PC/AT and border on minicomputer capabilities, users and developers realize that DOS may have seen its day as king of the operating system hill.

Oddly enough, the operating system that is being groomed to take its place is UNIX, a system that has not exactly taken the microcomputer world by storm but offers an architecture more suitable for powerful multiuser and multitasking environments. A handful of software vendors have already shown and will soon release UNIX-based operating environments that run MS-DOS and its applications as tasks under a multiuser, multitasking umbrella.

Combine the best of both

In operation, most of these UNIX umbrella environments work much like tight-fitting gloves, covering the entire operation of a personal computer and its applications with no regard as to where a software package's roots lie. MS-DOS and its applications—as well as other operating systems—run as tasks under UNIX, allowing a user to seamlessly execute either DOS or UNIX applications. Applications can be initiated from either a DOS or a UNIX prompt and run concurrently with virtually no degradation in performance.

"By having a UNIX environment and a PC environment, users can accumulate data in both areas and have the option not only to run the applications of one or the other but to exchange data," says Richard Levandov, vice president of strategic operations for Phoenix Technologies Ltd., one of the handful of companies offering a UNIX-based integrator.

Phoenix first announced its DOS-UNIX in-

We Started A Revolution At Comdex

Pens raised, they stormed the Kowin booth.

Barely a month after we introduced our turnkey multi-user system at November's Comdex, 15 VARs had signed up with Kowin. More join forces with us every day.

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"It's the best Unix front end I've ever seen. Definitely a market-opener. I'll be selling it against LAN's."
Chris Loper
Pacific Computer Products

"Expandability at low cost is a big benefit, particularly for 3- or 4-user startup installations. Kowin provides multi-user in a non-intimidating environment."
Jack Brannon
Eastern Micro

"Ease of expandability is a big benefit. Plus, small businesses who have PC's like the fact that the PC's can be tied into the Kowin system easily."
James Whigham
Gulf Business Machines

"I had the Kowin specs reviewed by a University computer science department and a large bank's DP department. Both said nobody can do what Kowin does for anywhere near the price."
Ron Prazmark
Buffalo Office Systems

"The bundled solution is exactly what the market is looking for. Kowin has good ergonomic design, including the telephone."
Dick Buckley
Professional Automation

"A well-designed system with attractive price margins. The PC tie-in is a selling point. Plus: better price/performance, and more workstations for less money."

Lewis Creque
Link Computers

"The Kowin Office is what I've been looking for for five years. Its three 68000 microprocessors give it a throughput equivalent to the NCR Tower 32 but with a PC-level per-user price. Furthermore, you never see the UNIX behind it."

Bob Denning
Century Digital Corp

"This is the first UNIX system that makes sense for the small businessman who cares more about the solution than the technology."

Dave Whitesel
The Phoenix Group

"I sold a Kowin system before I'd even signed up. And I've already gotten three referral calls. It's great when a system sells itself like that."

Jim Milburn
Simple Solutions

"The most unique machine since the introduction of the PC."

Paul Schubert
Schubert Corporation

"The only other systems that come close to Kowin on price aren't close on performance because they're not true UNIX multi-user systems."

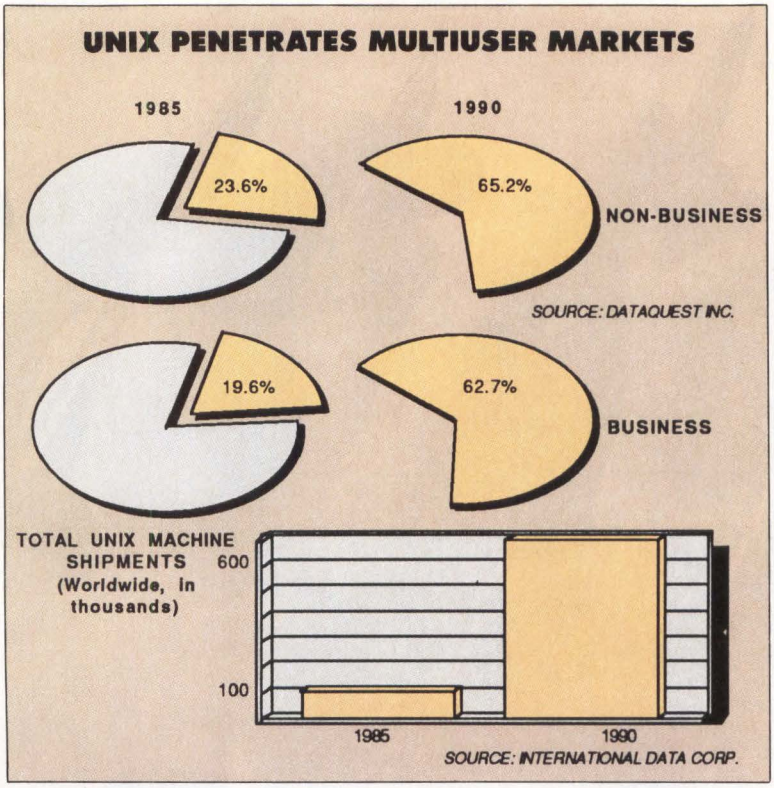
Clint Rickards
North American
Professional Technologies

"Kowin is an integrated approach to office automation. Should be easy to sell."

Don Brautigan
Office World

"A complete desktop package—everything the user needs is there: the ability for multi-user and file sharing using UNIX, and connecting to PC's and MacIntoshes."

Charlie English
Computer Galaxy



UNIX's share of the multiuser, *non-business market is expected to grow from 23.6 percent in 1985 to over 65 percent in 1990. Its penetration into the business applications market will jump from 19.6 percent to over 62 percent during the same period.*

tegrator, called VP/ix, last July and demonstrated its capabilities at the Fall Comdex show in Las Vegas by having it run on a single personal computer system that was juggling no less than three operating environments: XENIX, a version of UNIX supported by Microsoft Corp.; MS-DOS; and Microsoft's Windows, a graphics operating environment. The Phoenix product, which requires a minimum of 2M bytes of RAM, and another called Merge 386 from Locus Computing Corp., were showcased at Intel Corp.'s booth. Both are designed to operate with Intel's 80386 chip.

Merge 386 and its sister product, Merge 286, allow simultaneous running of DOS and UNIX on a personal computer. Displays attached to a minicomputer exploit the resulting operating environment through Locus' PC-Interface.

Despite the showmanship at Comdex, the success of VP/ix, Merge 386, and future similar products depends on three major factors. One is the development and growth of the 80386 systems market which, although it shows great promise, is just now emerging in the form of actual products. Another factor, though looming in the distance, is IBM. The company has expressed interest in the 386 and is rumored to be planning to introduce a system based on this chip and/or one of the company's own mainframe operating systems sometime this year.

"There's a possibility that IBM will announce a proprietary operating system, say a unique VM (virtual machine) that acts as a kind of hyper-visor," says Bonnie Digrius, director of software market analysis for INPUT, a research company based in Mountain View, Calif. "With that, you could run MS-DOS, or another type of operating system, depending on the applications that are available."

Whatever IBM unveils, it will most likely differ, at least slightly, from what is presently available in the market and not exactly follow the designs that are now being adopted by many software and hardware developers. This difference may throw a curve into what appears to be a fairly straightforward market.

"A lot of projections are going to hinge on how quickly the 386 marketplace takes off," states Phoenix's Levandov. "If it stalls, for whatever reason, then that will impact the number of OEMs that push VP/ix in the marketplace."

Fortunately, system and software developers are not waiting for IBM to "drop a shoe," Levandov notes. In fact, industry analysts are already bullish on the UNIX personal computer market which, they say, will benefit dramatically from a collaboration with MS-DOS.

Phoenix hooks up with Microsoft

Late last year, Phoenix and Microsoft signed licensing agreements that pull together the engineering and support facilities of both organizations to officially make MS-DOS an integral offering of VP/ix and assure that both environments don't develop and operate "out of sync," observes strategist Levandov. As part of the agreement, Phoenix will:

- Develop its VP/ix virtual personal computer environment for Microsoft's XENIX System V/386 multiuser operating system
- License MS-DOS 3.2 from Microsoft and offer it to VP/ix OEM customers
- Develop certified device drivers for peripheral manufacturers who want to support Microsoft's Windows interface
- Along with Microsoft, make certification testing available to all Windows device-driver developers on an exclusive basis.

While Microsoft works with Phoenix to develop a DOS-UNIX integrator for XENIX, Interactive Systems Corp. in Santa Monica, Calif., is working with Phoenix to develop a VP/ix for other derivatives of AT&T Co.'s UNIX operating system. Specifically, Interactive is focusing on a version of VP/ix for UNIX System V, Release 3.0. However, at press time, Interactive had not entered an agreement with Microsoft to license MS-DOS and was not authorized to offer it in its VP/ix product.

From a strategic standpoint, the Phoenix-Microsoft licensing arrangement puts the considerable force of Microsoft, which has worked

closely with IBM to make MS-DOS microcomputing the success that it is today, behind the whole UNIX environmental movement—an important factor should IBM throw down the gauntlet with a proprietary operating system.

"The fact that operating system vendors like Microsoft are providing tools up front to third-party software vendors is very encouraging," remarks INPUT's Digrius. "As a result, there will be products available when it comes time to market this new operating system [VP/ix]."

Finally, the third glitch that may stall the development and marketability of DOS-UNIX environment integrators are problems that are just now surfacing in early versions of Intel's 80386 chip. Some vendors claim the chip's virtual 8086 and protected modes do not support the simultaneous operation of more than one operating system, meaning that it will run UNIX or DOS, but not both at the same time.

According to some reports, the solution is either to remask the 80386—which is highly unlikely—or to correct the problems in a new version of the 32-bit chip, unofficially named the 80486. However, companies like Locus have pointed out that Intel has mapped the chip's problem areas and they can be worked around without interfering with the 80386's multiuser, multitasking capabilities. Besides, says Michael Smith, Locus' director of sales, the momentum generated for 386-type technology is too great to allow a few initial, and surmountable, problems to stand in the way.

"Based on what's available on the market today, and the demands for the capability of the 386, I have a hard time trying to justify why it would not take off," says Smith.

Both camps benefit

Although there is debate over which camp is pushing hardest for operating-environment integration—the MS-DOS forces or the UNIX contingent—both types of users have much to gain from a cooperative effort.

On the MS-DOS side, users can take advantage of the multitasking and multiuser capabilities of UNIX-based applications that have more support for networks and communications than do MS-DOS packages. UNIX also offers DOS users the ability to run multiple DOS sessions "without having to stick everything into 640K bytes," points out Smith. "You can do multiple DOS applications and never even look at UNIX."

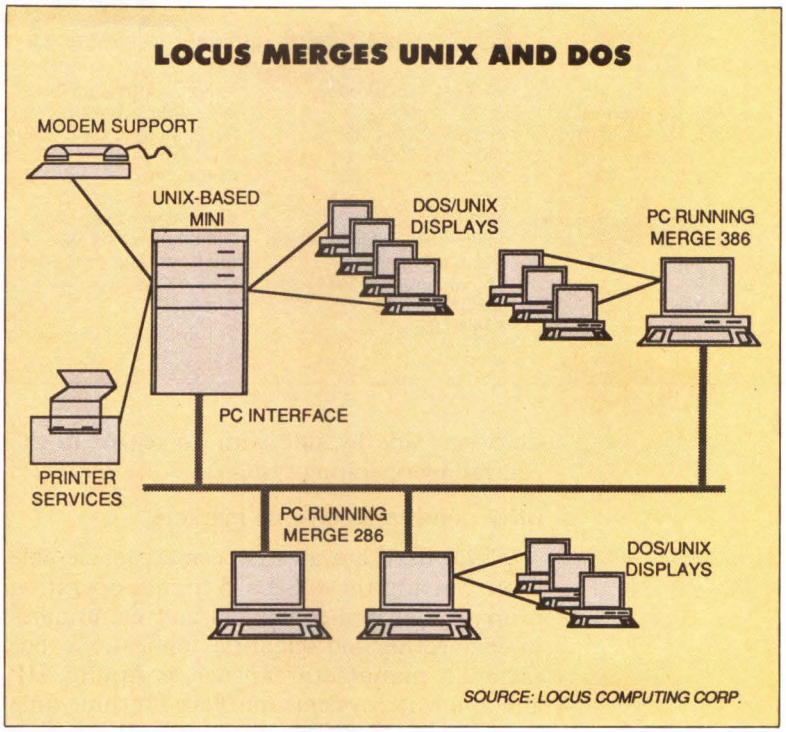
On the other hand, Smith adds, UNIX people are pushing hard "because they want to be able to add 15,000 applications and 15 million people that know how to use their operating system from day one."

The concept of UNIX and DOS working hand in hand to provide application solutions is not a new one. In 1984, for example, Locus announced its PC Interface, tied DOS and UNIX together in a fully transparent distributed-processing network, although not on the same individual system. A year later, the company unveiled Simultask, which did allow DOS and UNIX to share space on the Intel 80286 microprocessor. Both products were provided exclusively for AT&T.

Phoenix has also introduced plug-in boards that provide multioperating systems capabilities for Motorola Inc. MC68000-based workstations.

The company adopted this strategy in its first wave of DOS-UNIX integrators for Apollo Computer Inc. and Hewlett-Packard Co. minicomputers. The card was designed to completely map the file system and I/O trappings of DOS into the UNIX file system, allowing both to share functions at these levels of operation, "so the demands an MS-DOS application places on hardware would be emulated in UNIX," Phoenix's Levandov states.

Products that allow UNIX to handle MS-DOS applications are also available. However, most function mainly as gateways and do not actually allow the interaction of different operating systems. For example, Uniform Software Systems Inc. offers software that allows DOS programs to run in UNIX windows, and Network Innovations Corp. has programs that allow access to DOS from UNIX. However, none of these products establishes a seamless environment, where DOS and UNIX applica-



Merge 286 and Merge 386 software, *from Locus Computing, enables users to run DOS and UNIX concurrently on a PC. Locus' PC-Interface enables displays attached to minicomputers to take advantage of the hybrid operating system environment.*

Companies mentioned in this article

Apollo Computer Inc.
330 Billerica Road
Chelmsford, Mass. 01824
(617) 256-6600
Circle 332

AT&T Information Systems
1776 On The Green
Morristown, N.J. 07960
(201) 898-3278
Circle 333

Hewlett-Packard Co.
8020 Foothills
Roseville, Calif. 95678
(408) 257-7000
Circle 334

IBM Corp.
Information Systems Group
900 King St.
Rye Brook, N.Y. 10573
(919) 934-4488
Circle 335

Interactive System Corp.
2401 Colorado Ave.
Santa Monica, Calif. 90404
(213) 453-8649
Circle 336

Locus Computing Corp.
3330 Ocean Park Blvd.
Santa Monica, Calif. 90405
(213) 452-2435
Circle 337

Microsoft Corp.
16011 N.E. 36th Way
Redmond, Wash. 98073
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Circle 338

Network Innovations Corp.
20863 Stevens Creek Blvd.
Cupertino, Calif. 95014
(408) 257-1630
Circle 339

Phoenix Technologies Ltd.
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Norwood, Mass. 02062
(617) 769-7020
Circle 340

Uniform Software Systems Inc.
Suite 514
224 Santa Monica Blvd.
Santa Monica, Calif. 90401
(213) 395-9674
Circle 341

tions run side by side with no regard to the controlling operating system.

UNIX penetrates diverse markets

UNIX itself has always been a considerable force outside the MS-DOS arena, operating primarily on minicomputers and mainframes in engineering and scientific applications. For instance, manufacturers such as Apollo, HP and Sun Microsystems Inc. have for some time offered UNIX on workstations positioned in the $8,000-to-$10,000 price range. By working with companies like Phoenix and Locus, these companies have also been able to offer the ability to run DOS applications under each system's UNIX shell.

UNIX is presently being used in some single-user microcomputer applications on systems like AT&T's 7300, but the number of units shipped is low. UNIX does, however, have a heavy penetration in multiuser microcomputer applications, accounting for 23.6 percent of the non-business systems shipped in 1985. The percentage of shipments is expected to increase to 65.2 in 1990, according to market researcher Dataquest Inc., San Jose, Calif. On the business side, the figures are roughly similar, going from 19.6 percent in 1985 to an expected 62.7 percent in 1990.

Industry analysts are already bullish on the UNIX personal computer market which, they say, will benefit dramatically from a collaboration with MS-DOS.

Even though the market for DOS-UNIX environments and shared operating systems is, at this point, just a gleam in the eye of software and systems developers, there seems to be no lack of OEM manufacturers who want to at least look into this new technology.

Locus' Smith declined to say exactly how many OEMs were signed up to incorporate the company's environmental integrators into their 386 product designs, but he did say that several were already on board. Locus also plans to unveil a product sometime in the second quarter of this year, called LX Windows, that will allow Massachusetts Institute of Technology's X Windows package to operate on UNIX System V to coordinate activities under its operating systems' umbrella.

Levandov readily admits Phoenix has already recruited about 12 manufacturers for VP/ix on the UNIX side, and about the same number for 68000-based machines running DOS under UNIX. Furthermore, he expects to have as many as 18 OEMs signed up for VP/ix by mid-year.

"Whether OEMs announce a 386 product or not has nothing to do with the pace of the development that's going on," claims Levandov. "A lot of our early clients for VP/ix are buying it just to get the source code and product with absolutely no idea as to when they will announce a product."

While it is still too early to gauge microcomputer users' reaction to multiple-operating systems environments—largely because it is a technology that is just beginning to penetrate the personal computer marketplace—users on the UNIX side are looking forward to exploring a new technological frontier.

For example, although Alan Nemeth, president of USENIX, a UNIX user group based in El Cerrito, Calif., declines to offer any official opinion on the integration of operating systems, he does say the group is always open to new ideas and options.

"The thing that I don't want the association cast in the light of doing is blessing or cursing some new direction in the industry, because we probably have people who represent both factions," says Nemeth.

In the end, it will be the users who either give a thumbs up or thumbs down to UNIX umbrellas and seamless operating environments, observes INPUT's Digrius. "The ability to link applications is very good for certain businesses and certain people," she says, "but, it may not be the overall standard of the marketplace. Users want solutions...and they don't care if it runs on CP/M or UNIX." □

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

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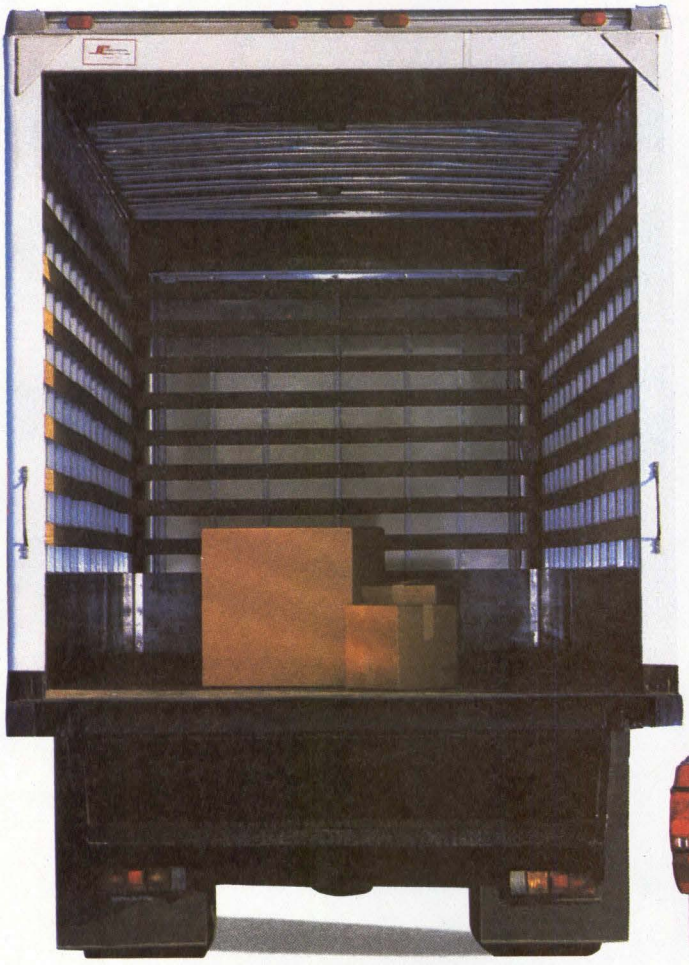

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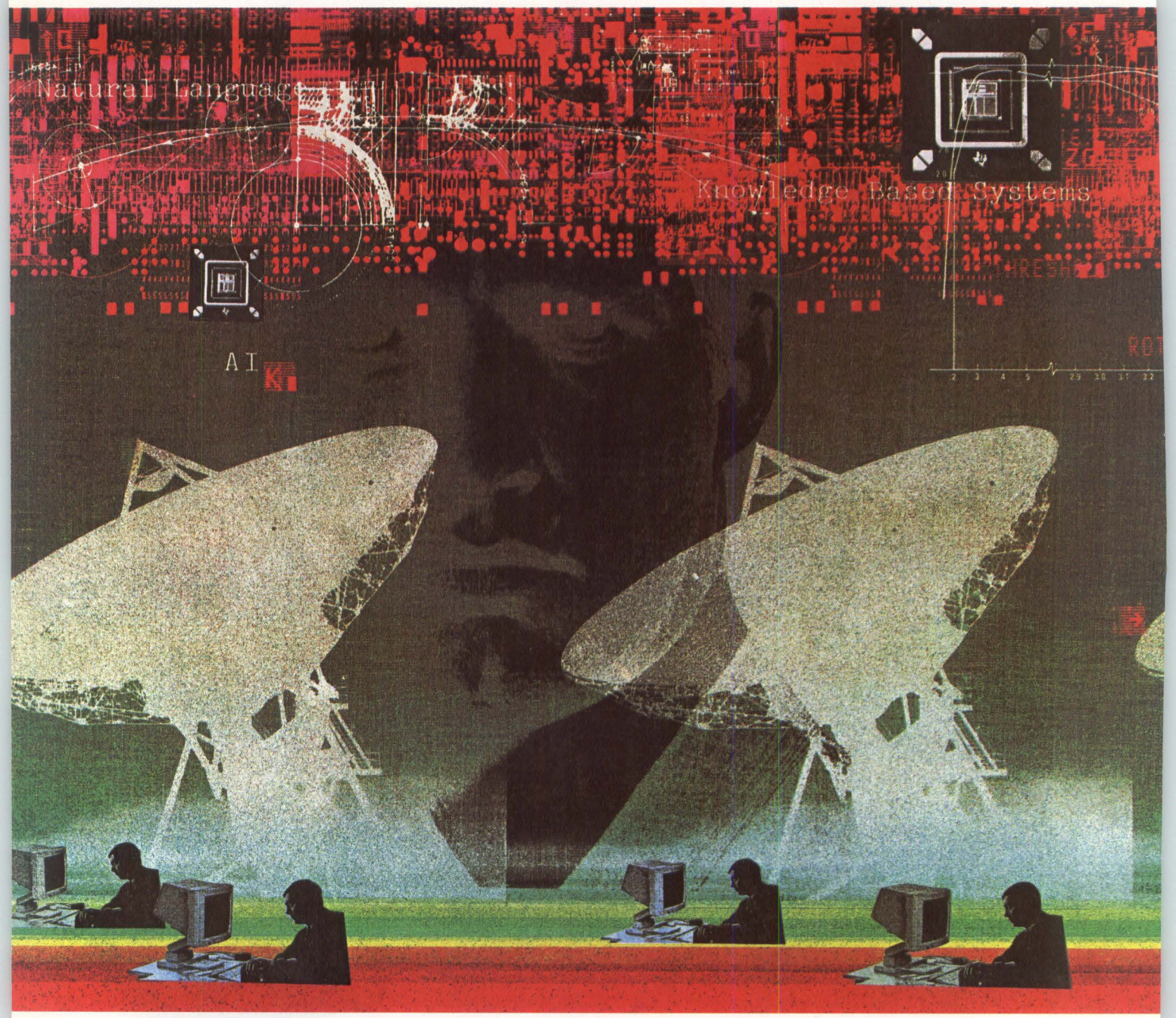

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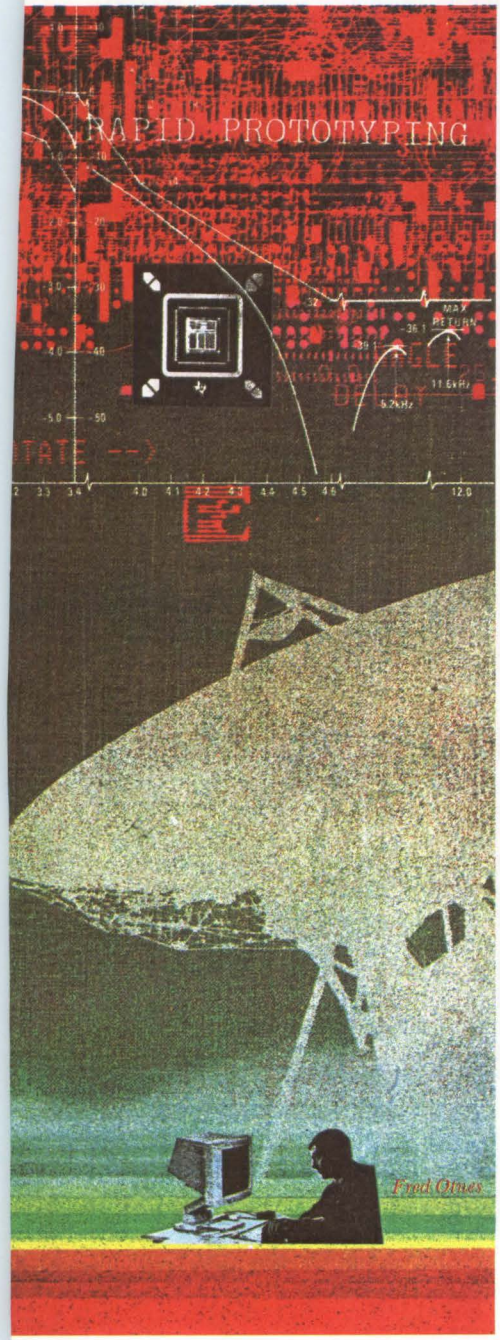

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Dr. Roger C. Schank, Professor of Computer Science and Psychology, Yale University, and Chairman of Cognitive Systems, Inc. Pioneer in development of computer models of memory and learning.

Dr. Herbert Schorr, Group Director of Products and Technology, IBM. Responsible for the introduction of new, advanced technology and applications.

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WORKSTATION UNITES AI, NUMBER CRUNCHING

System integrators and software developers can balance AI and conventional computing with a workstation that provides development capabilities for C, Pascal, FORTRAN and UNIX similar to those for LISP and Prolog

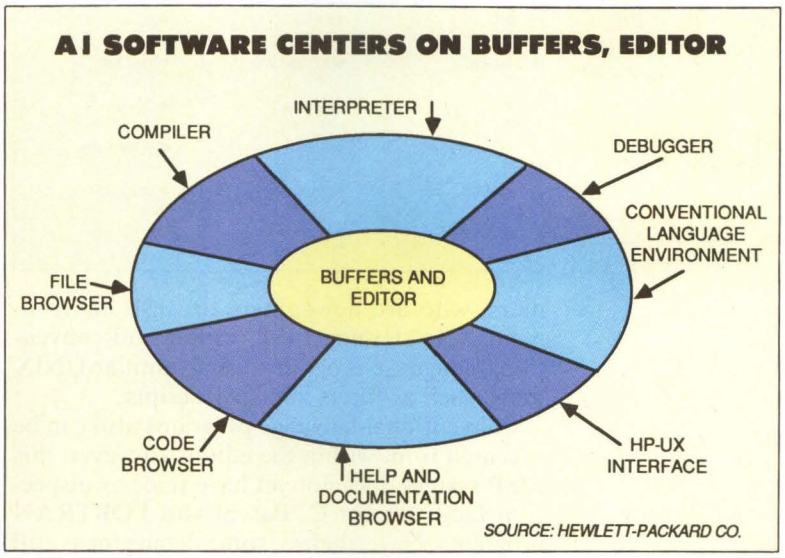
Steve Schink, Hewlett-Packard Co.

Over the next five years, system integrators and software developers will combine the number-crunching benefits of traditional computing with the symbolic-processing advantages of AI to obtain maximum leverage from old and new technologies.

Commercial and industrial companies rely on numerically oriented database, networking, computational, simulation, graphics and control programs. On the other hand, AI techniques can encapsulate in computer-readable form people's expertise in various commercial and industrial processes and operations. This encoded expertise can be used to improve existing numerically oriented applications.

Unfortunately, there aren't sufficient resources available to allow most system integrators to develop applications quickly enough to satisfy demand. It often takes too long for developers with AI expertise to get up to speed in the design and use of conventional programs, and developers used to traditional programming languages may suddenly be swamped by AI tools and environments. Furthermore, the AI effort is often prohibitively costly, in terms of training, investment in special-purpose hardware and support for different kinds of computers and operating systems.

For Hewlett-Packard Co., one solution is an AI workstation based on a conventional processor, which offers a balance of AI technology with conventional computing. The AI workstation is currently an HP 9000 Series 300 computer, based on the Motorola Inc. MC68000 series microprocessor. The workstation tightly integrates an AI development environment, Common LISP (the de facto LISP standard), Prolog and object-oriented programming, with HP-UX running C, Pascal and FORTRAN. HP-UX is HP's implementation of AT&T Co.'s UNIX System V. Prices range from $21,000 for a bundled monochrome system to $30,000 for a high-end color configuration. Prices do not include disks.



The software for HP's *AI workstation development environment centers on buffers and a smart, full-screen editor. The software provides integrated access to LISP and Prolog interpreters, compilers, debuggers, HP-UX, tools for code written in conventional languages and a series of menu-based browsers.*

The AI workstation contains the expected LISP features, such as windowing and the ability to edit, compile, debug and execute LISP and Prolog programs, without leaving the AI environment editor (see "What to expect from a LISP environment," Page 95). In addition, programmers and applications can call C, Pascal and FORTRAN routines and invoke UNIX commands and functions.

This AI system differs from most LISP systems in that it provides many of the same tightly integrated development capabilities for C, Pascal, FORTRAN and UNIX as it does for LISP and Prolog. As a result, programmers can incrementally and interactively develop, edit, compile, test and execute C, Pascal and FORTRAN routines from the LISP editor. The editor can catch compilation errors made in these conventional languages. Then, without leaving the editor, programmers can correct the errors and execute the program.

This means that LISP programmers do not have to spend a lot of effort learning UNIX in order to develop UNIX-based programs or subroutines. At the same time, UNIX program-

A series of predefined templates *are included with HP's AI workstation. The templates contain the generic portions of various constructs in LISP, C, Pascal and FORTRAN. Users fill in the specific variables, expressions or statements applicable to a particular program.*

TEMPLATES SIMPLIFY PROGRAMMING

C	Pascal	FORTRAN
•block comment	•block comment	•arithmetic if
•case	•case	•block comment
•conditional	•comment	•block if
•do while	•for	•comment
•for	•function	•do
•function	•header	•do while
•header	•if	•else if
•if	•if else	•goto
•if else	•procedure	•header
•main	•program	•logical if
•switch	•repeat	•parameter
•while	•while	•program
	•with	

mers, who are newcomers to LISP environments, can develop LISP, Prolog and conventional-language programs using familiar UNIX tools, such as filters and shell scripts.

Conventional-language programs also can be executed from within the editor. However, this LISP system does not yet have trace or inspection facilities for C, Pascal and FORTRAN programs. Nevertheless, some debugging is still facilitated because the non-LISP object-code files are linked to the LISP system. This lets developers interactively call functions in C, FORTRAN or Pascal and immediately see the results and determine the function's behavior. System developers need not engage in the usual time-consuming technique of writing, compiling, and recompiling supplemental test programs. All this significantly speeds the edit-compile-debug cycle.

Loads of modes

Key to the integrated symbolic and computational capabilities of the AI workstation is the human interface called Nmode. Nmode is an extensible user environment built on top of the underlying HP-UX operating system.

At the heart of Nmode are buffers, which are workspaces in the computer managed by Nmode, and a smart full-screen editor that is derived from Emacs (a commonly used full-screen editor) yet contains some HP extensions. The editor provides access to LISP and Prolog interpreters, compilers, and debuggers; conventional languages; HP-UX library routines and utilities; local area networking; text and code buffers; and a variety of browsers such as those for files, directories and on-line documentation. Browsers are mouse- and menu-based facilities that allow different features of the system to be presented in a uniform manner for ease of learning and use.

Two major reasons account for the tight integration of these tools. For one, the LISP language and environment run as a task under HP-UX. For another, the user environment has multiple modes that work together—hence the name Nmode.

The modes describe a style and a mechanism for performing certain activities, such as editing mode and browsing mode. Furthermore, the AI workstation supports LISP, text, HP-UX, C, Pascal, FORTRAN and two Prolog editing modes.

System facilities, such as buffers, directories, files and documentation are always associated with some mode. For example, a buffer has an editing mode.

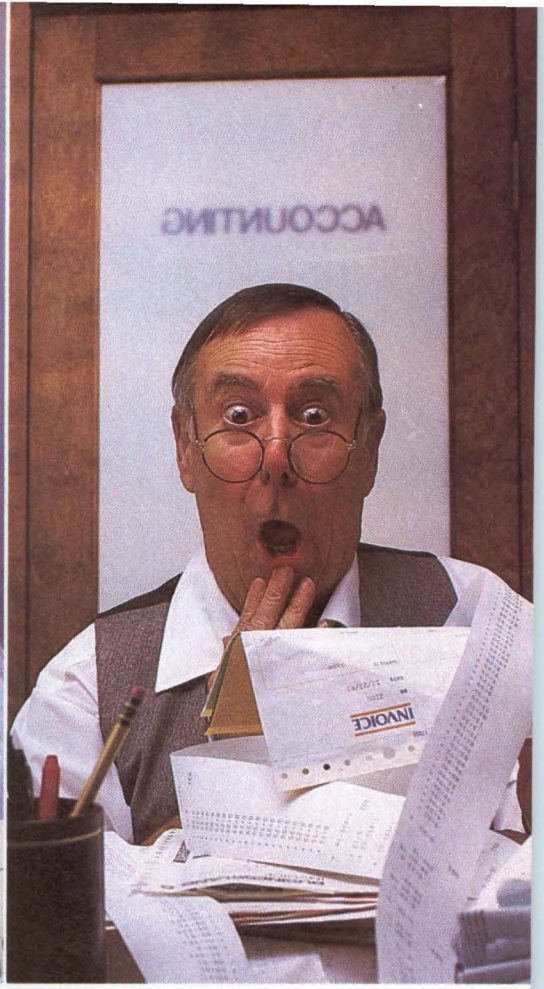
A system mode consists of one major mode and possibly some minor modes. The major mode provides most of the available commands, while a minor mode provides a limited set of special commands generally suited to a particular type of facility. For example, the Emacs mode supports many commands for manipulating text. Adding HP-UX, C or text as minor modes provides additional commands specialized for working with HP-UX, C or word processing.

The smart Nmode editor changes its behavior and available commands to correspond to the mode in which the user is working. So, in LISP mode, the editor knows the syntax of LISP functions and forms and can therefore match parentheses and evaluate LISP expressions. In text mode, the editor commands know about paragraphs and sentences.

System developers writing in LISP, but desiring a routine in a conventional language or in Prolog, can work in the Nmode editor's Emacs major mode and switch between LISP's and the other language's minor modes. The interfaces between the languages increase productivity through reuse of existing code, ability to program in a familiar language, and via integration techniques that support faster conventional-code development.

Developers can explicitly invoke a minor mode in an editing buffer. Alternatively, Nmode can recognize file suffixes, such as ".c" for C-language files and ".p" for Pascal files, and automatically invoke the appropriate minor mode.

Each of the conventional programming languages has its own editing mode, with extensions suited for code development. These extensions are language and format sensitivity,



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compiler-error-index access and templates.

With the language- and format-sensitivity extension, given one end of a block of code, the language minor-mode editor can determine the other end. A block of code is "begin . . . end" in Pascal and "{ . . . }" in C. The automated matching of one end with the other gives the developer a quick way to check the program structure. The language editor also indents and formats the source code for easy reading.

Under the second extension, each editing mode provides access to the appropriate HP-UX compiler. Any compilation errors detected are placed in a compilation-error index with direct links back to the source code that caused them. When developers browse and point at the errors in the error-index file, they are automatically taken to the line of source code that corresponds to each error.

With the templates extension, each language minor mode provides a set of predefined templates for the various constructs in that language. The templates contain the generic portion of a construct, which need not be retyped. They also contain placeholders in upper-case letters. Users replace these placeholders with variables, expressions, statements or other templates, depending on what they want the program to do. For example, a Pascal IF template looks like this:

```
if EXPR then
begin
   STMT;
end;
```

Users invoke the supplied templates with a command, followed by the name of the template. They can customize the existing templates for a particular formatting style, or they can define their own templates.

Take advantage of UNIX

From the editor, users can communicate directly with HP-UX, using HP-UX as a program development aid for development in any language. They can use Nmode's editing features to manipulate HP-UX commands and responses. They also can use HP-UX tools to manipulate Nmode's data.

The HP-UX access facility provides two methods to communicate with the underlying HP-UX operating system. With one, a special shell buffer provides an Nmode buffer that emulates an HP-UX shell, thus supporting easy, interactive HP-UX access. With the other

What to expect from a LISP environment

Several LISP mode features of the Hewlett-Packard Co. artificial intelligence workstation—many of which are typical of most LISP environments—aid in the editing, debugging and execution of LISP programs. For example, the LISP editor supports auto-indenting, parenthesis matching and LISP form manipulation and evaluation. The system provides direct access from the editor to the LISP compiler, interpreter, debugging tools and execution capabilities. In addition, the non-LISP function-calling mechanism, in conjunction with predefined LISP functions, allows programmers and applications to call HP UNIX (HP-UX) library or system functions from LISP; programmers do not have to define the access functions.

Rapid development is further facilitated by the interaction of an interpreter and compiler. This eliminates the need for a long compile-and-link process to fix small problems while debugging code.

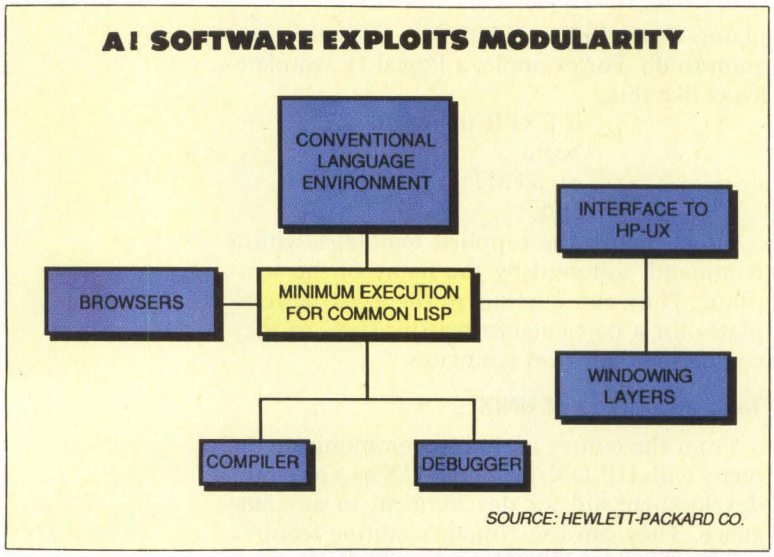
The AI workstation uses a preprocessor in front of both the interpreter and compiler. The preprocessor translates LISP into an intermediate representation instead of into assembly or machine code. The intermediate language is then either executed interpretively or compiled.

Use of the preprocessor ensures that interpreted and compiled code behave the same so that a mixture of compiled and interpreted code can be executed with no exceptions or special cases. This is necessary in instances where the timing of certain things, such as the expansion of macros, affects the apparent semantics of code.

Also, the use of a preprocessor, combined with an optimizing compiler, improves application performance by allowing software developers to take advantage of different code optimization levels defined in Common LISP. The lowest level optimization uses unmodified source code with maximum error checking. The highest optimization level replaces source code with the most efficient in-line code and reduces error checking.

The preprocessor optimizes the code, depending on the programmer-defined level of optimization. This impacts performance because, for some kinds of code, the difference between unoptimized and fully optimized may be of a factor ranging from 20 to 40.

If an error occurs during LISP execution, a full range of debugging tools is available. These include a break loop, which is an interactive environment for inspection of the system; an execution monitor, which allows developers to interactively trace or step through a LISP form until a specified breakpoint in its execution; an execution stack analyzer to view and modify the system's current state; and a data-structure inspector to view complex data structures.



The development environment *for HP's AI workstation comprises a large set of tools and a large amount of code, much of which is not needed or desired in a delivery system.*

method, the system supports execution of HP-UX commands, or command sequences, from anywhere in Nmode.

From LISP, system developers can choose to use either the Bourne shell or the C shell. The integrated HP-UX facility provides developers with access to UNIX utilities such as pipes and filters, the UNIX source-code control package and the ability to create shell scripts for execution. With the system-shell support, they can also take advantage of UNIX's I/O redirection capabilities. A typical scenario is for a programmer to take an entire buffer or a portion of a buffer and pipe it through any UNIX filter. The output can appear in the same buffer or be redirected to a different buffer or to a particular printer.

These facilities allow programmers to leverage existing HP-UX tools or develop new Nmode tools that use features from the underlying operating system. Once an application is developed using the AI workstation facilities, it can become an integral part of the environment.

Extensions to Common LISP on the AI workstation support a style of software development known as object-oriented programming.

Object-oriented programming

Extensions to Common LISP on the AI workstation support a style of software development known as object-oriented programming. Object-oriented programming reduces the complexity and size of application programs. It decreases program development time and program errors, promotes code reusability and makes programs more maintainable and easier to understand. The major drawback with object-oriented programming for most people is their unfamiliarity with the techniques.

Object-oriented programming is used often in human interfaces, graphics programs and editors, partly because there is usually a direct correspondence between a software object and a physical object or visual image. In object-oriented programming, an object is an entity containing some data and some procedures that can operate on that data. The procedures that perform similar operations in different objects are given common names called "methods." Telling an object the name of a method to be executed is called "sending a message" to that object. With message sending, in contrast to calling procedures, one object does not need to know the internal structure of another object. Since each object knows how to manipulate its own data, even dissimilar objects can be controlled by similar commands.

For example, in a graphics program, a figure object could represent a figure displayed on a screen. This object would be made up of data (such as the color and coordinates of the figure) and the operations that can be performed on that data (such as rotating or scaling). Additional figure objects, such as circles, squares and triangles, are easily created. Since they are all figure objects, they all respond to the same messages, such as rotate. Because the operations are part of the object, the figure knows which algorithm to use to rotate itself.

Several different objects may be able to share similar properties. For example, in a traffic simulation, cars, trucks and buses—which may be different objects—all share common operations such as driving, braking and accelerating. (Such common subsets of commands are called protocols.) Since each object has its own description of what it means to drive, the programmer can send the "drive" message to any of these objects and get reasonable behavior without having to know the implementation.

The concepts of the specification of a protocol and of a uniform interface for different objects are powerful aids in managing complexity, especially when large programs are being created by teams of programmers. And, because objects are really separate entities with their own encapsulated operations, it is possible to add to or change one object's operations without affecting any other object or procedure.

Object-oriented programming also makes it easy to create new objects by using existing code and writing relatively little new code. In a computer it is easy to say, "make another object like this object but with these few differences." This means, "create a new object with most of the old procedures and only a few new ones." The new object includes, or "inherits,"

the variables, characteristics and procedures of the existing object. Programmers need only write new code to implement new or variant features.

For a programmer, this technique means less code to write. The code can be understood and tested generically rather than being special-cased. For the user, object-oriented software can be friendlier and easier to learn because there is less to be learned.

Delivers applications

When an application is completed, it needs to be made available to end users. The application end-users can also be Nmode users. However, they need the option of running their application without having to know or care about LISP or Nmode. Consequently, AI system developers must package their applications into a file that can be loaded and executed with a simple command and runs on hardware scaled to the users' budget.

On the hardware side, this may mean modular workstations, such as the HP 9000 Series 300. It allows application designers to pick and choose components to tune the hardware to their application needs.

The AI workstation software also is modular and customizable. However, the development environment need not be present at all to deliver an application. System developers can eliminate some or all development components and deliver the application with nothing but LISP and the component needed for a particular application. From the user's view, this means less software and disk space, less need for real memory and swapping space and, as a result, lower prices.

All in all, a combination of features that support facilities familiar to developers who may be new to AI, and that also support modular systems that can provide cost-effective delivery vehicles for users, should hasten the spread of commercial AI applications. □

Steve Schink is an artificial intelligence project manager at Hewlett-Packard Co.'s System Division, Fort Collins, Colo.

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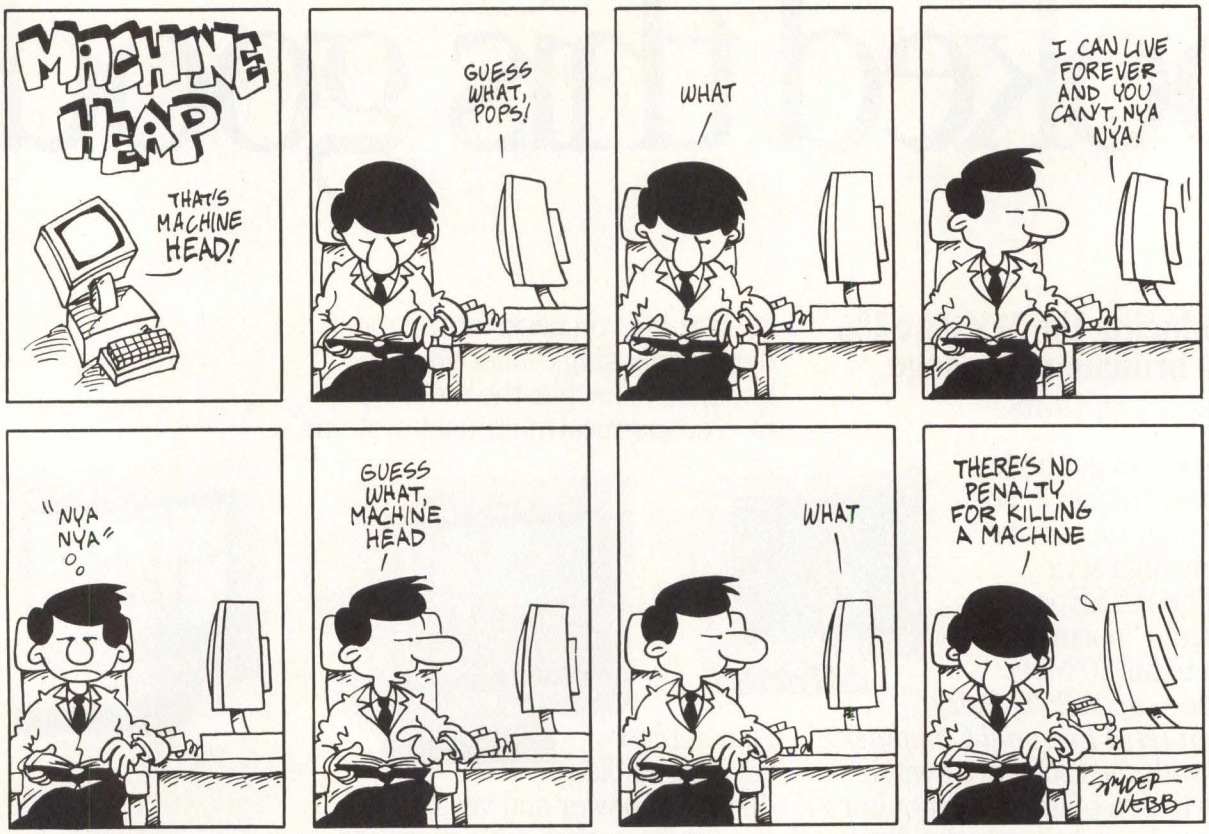

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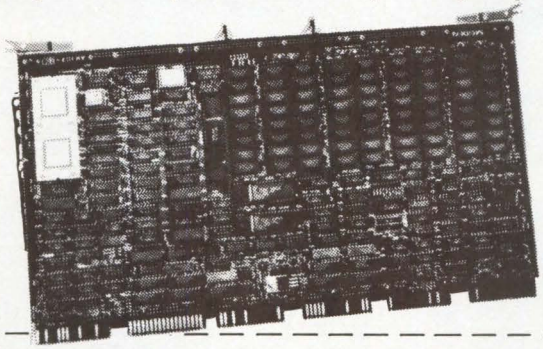

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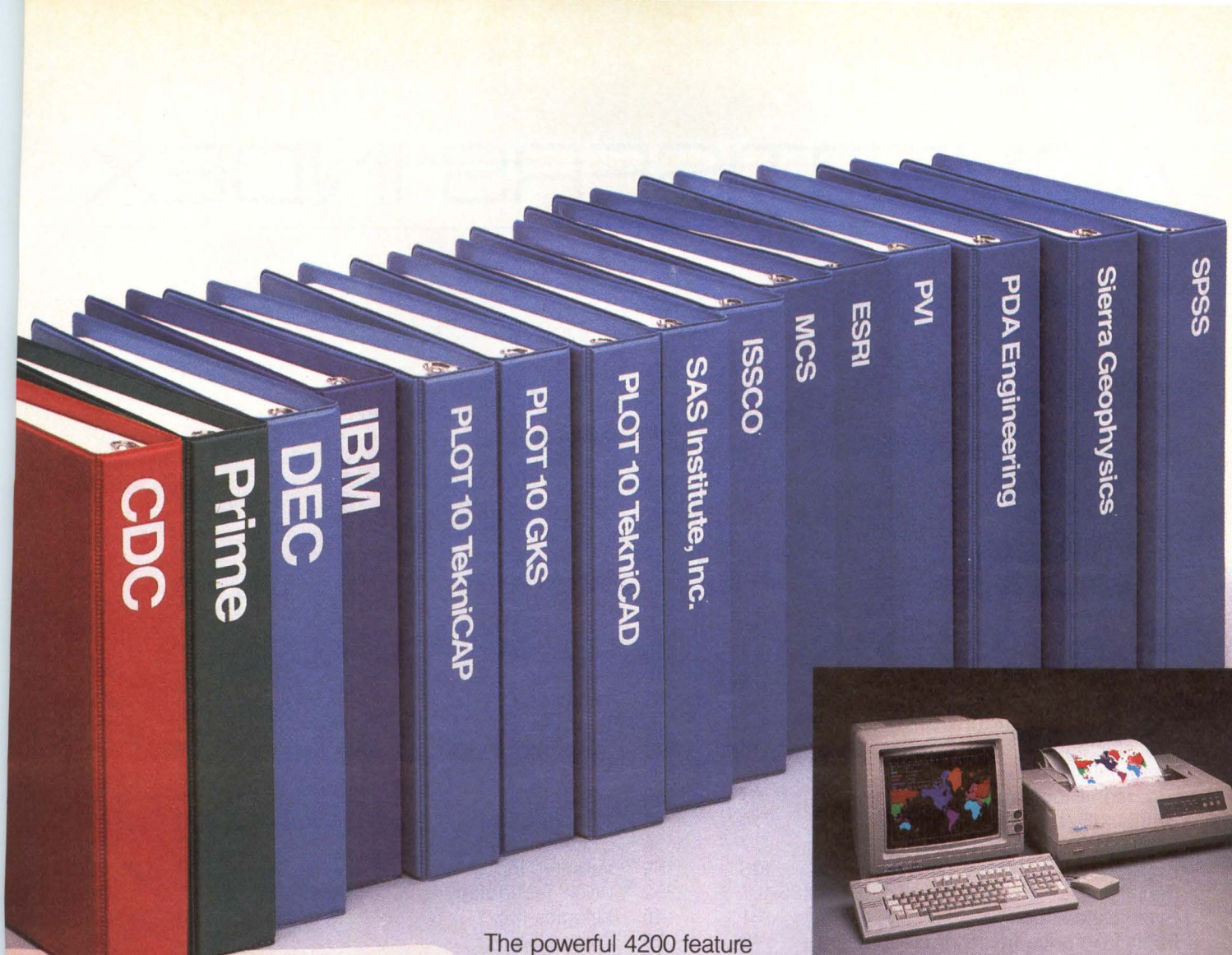

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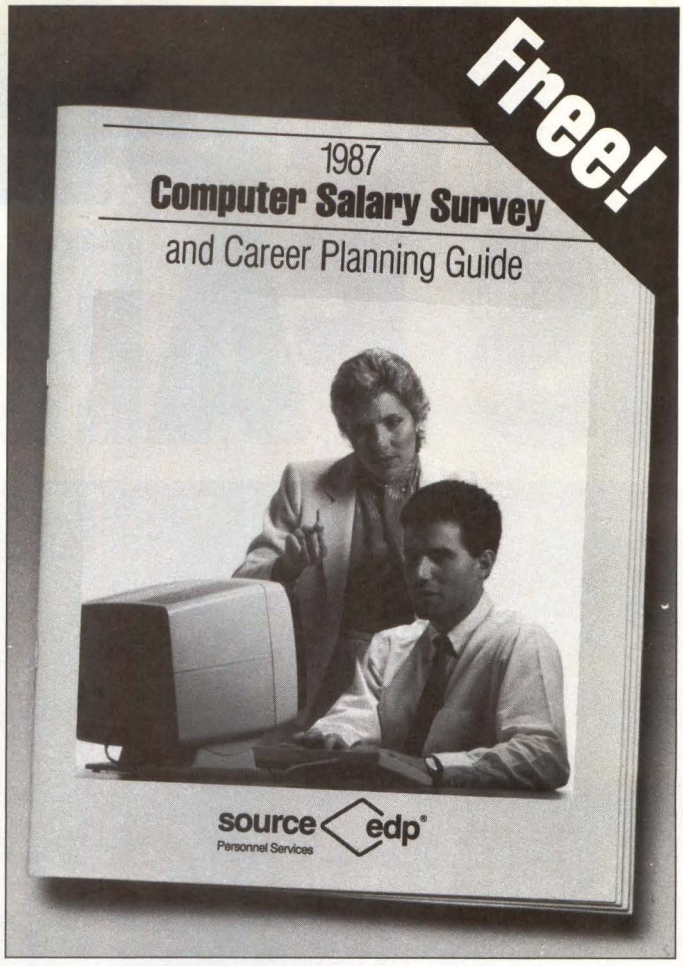

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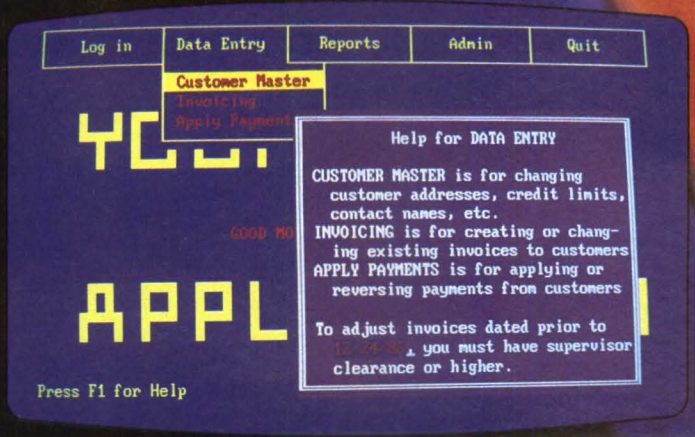

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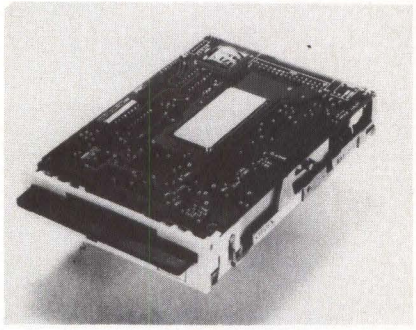

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- 20-msec access time
- 25,000 MBTF

Targeting OEMs, the 5¼-inch rigid disk 1330 Series PowerDrives are IBM PC-, PC/XT- and PC/AT-compatible and store 44M, 53M or 71M bytes. Average access time is 30 msec and MTBF is 25,000 hours. An ST505/ST412 interface is provided. $995 to $1,595. **Micropolis Corp.,** 21123 Nordhoff St., Chatsworth, Calif. 91311, (818) 709-3300.

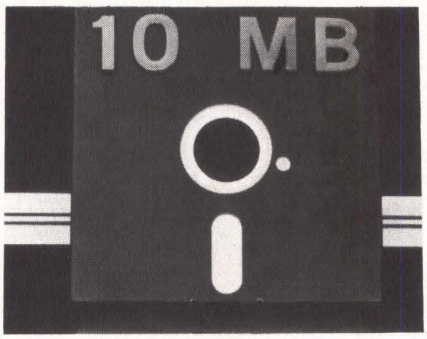
Circle 373

Rigid disk cards plug into IBM PC/XT

- 28-msec access time
- 35M, 45M bytes
- Device driver

The R-Card 35 and R-Card 45 internal rigid disk cards plug into a single expansion slot on an IBM PC/XT or compatible. The drives furnish storage capacities of 35M bytes and 45M bytes, respectively. Average access time is 28 msec. Features include a full device driver and installer software. $1,295, R-Card 35; $1,495 R-Card 45. **Rodime Inc.,** Peripheral Systems Division, Suite 214, Chagrin Blvd., Pepper Pike, Ohio 44122, (216) 765-8414.

Circle 374



Flexible drive stores 10.9M bytes

- 5¼-inch unit
- 480 tpi
- 1.6M bps

A 5¼-inch flexible disk drive, the KT-510 achieves storage capacities of 10.9M bytes, formatted, and 13M bytes, unformatted. Data transfer rate is 1.6M bps, track density is 480 tpi. Features include servo head positioning, SCSI interface and IBM PC, PC/XT and PC/AT compatibility. A built-in controller supplies diagnostic capabilities and error correction control. $400 in OEM quantities. **Konica Technology Inc.,** 777 N. Pastoria Ave., Sunnyvale, Calif. 94086-2918, (408) 773-9551.

Circle 375

Rigid disk drive stores 50M bytes

- 3½-inch unit
- 50M-byte capacity
- 29-msec access time

Targeting OEMs, the CP340 is a 50M-byte, 3½-inch Winchester disk drive. It provides a 29-msec average seek time, a rotary voice-coil actuator, embedded servo and an integrated controller with SCSI. The device is geared toward 32-bit computers. $750, OEM quantities. **Conner Peripherals Inc.,** 2221 Old Oakland Road, San Jose, Calif. 95131, (408) 433-3340.

Circle 376

Tape system suits DEC, DG, Multibus

- 6,250 bpi
- 1.25M bytes per second
- 256K-byte buffer

The model TFS 2925 GCR streaming tape system suits DEC, DG and Multibus computers. The device furnishes a 256K-byte cache buffer with a programmable transfer rate of up to 1.25M bytes per second. It is offered with a choice of controllers. Recording density is 6,250 bpi. $18,000. **Aviv Corp.,** 26 Cummings Park, Woburn, Mass. 01801, (617) 933-1165.

Circle 377

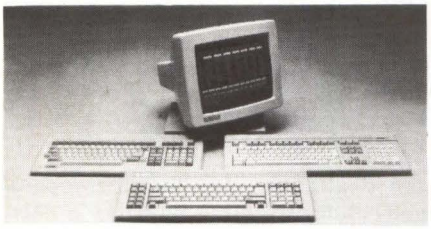
Storage system holds 130M bytes

- 5¼-inch units
- IBM PC/AT compatible
- 20-msec access time

The ID130 internal disk add-in kit and the ED130 desktop storage system give 130M-byte storage capacity to the IBM PC/AT and compatibles. The units consist of a 5¼-inch Winchester disk drive, software and interface cables. Average access time is 20 msec. $3,598, ID130; $3,898, ED130. **Priam Corp.,** Systems Division, 20 W. Montague Expressway, San Jose, Calif. 95134-2085, (408) 946-4600.

Circle 378

TERMINALS



Terminal supports ASCII, ANSI

- Three ports
- 14-inch screen
- 80, 132 columns

The MC3 terminal provides ASCII, ANSII and PC emulations as well as concurrent communications with multiple host computers. It has a Centronics port and two RS232C ports that can be configured independently. Transmission rates of up to 38.4K bytes are supported without handshaking. The 14-inch screen displays 44 lines and 80 or 132 columns. Features include 32 programmable function keys and eight programmable cursor keys. As many as 64 characters can be stored in each key and can be programmed in setup or by escape sequence. $399. **Link Technologies Inc.,** 47339 Warm Springs Blvd., Fremont, Calif. 94539, (415) 651-8000.

Circle 379

Terminals offer 3270 compatibility

- Three configurations
- 24 function keys
- 2K bytes of memory

Available in three configurations, the 3270-compatible ATL family is plug-compatible with the IBM 3179, 3180 model 1 and 3194 terminals, respectively. All units supply 2K bytes memory, 24 programmable function keys and a 14-inch screen. The model ATL-179 offers two- and four-color support and base-mode highlighting; the ATL-180 features dynamic focus, light-pen support and a screen-print printer port. The ATL-191 furnishes a programmable screen saver. $1,895, ATL-179; $1,695, ATL-180; $1,149, ATL-191. **BeeHive International Inc.,** 4910 Amelia Earhart Drive, Salt Lake City, Utah 84116, (801) 355-6000.

Circle 380

Industrial terminals emulate DEC, Hazeltine

- RS232C port
- 12-inch screens
- 28-key keypad

Supplying 12-inch color or amber screens respectively, the models 4850 and 4860 are ruggedized industrial terminals. The units include a 28-key sealed keypad and programmed functions such as vertical and horizontal bar graphs, various character sizes and process-control graphics. An RS232C port is standard. Both units emulate DEC VT100, VT200 and Hazeltine 1500 devices. $1,795, model 4860; $2,750, model 4850. **Xycom Inc.,** 750 N. Maple Road, Saline, Mich. 48176, (313) 429-4971.

Circle 381

ASCII terminal offers 400 scan lines

- 10-by-16 character cell
- 14-inch screen
- 26 lines by 132 columns

The model 5500 ASCII terminal offers 400 scan lines at 25 kHz to produce a 10-by-16 letter-quality character cell in normal operation. Features include a 14-inch screen, 16 function keys and two pages of 26 lines by 132 columns of standard memory. Multihost windowing enables users to set up or store displays on two separate windows using data being received from one or more hosts via two on-line ports. $495. **Falco Data Products Inc.,** 1294 Hammerwood Ave., Sunnyvale, Calif. 94089, (408) 745-7123.

Circle 382

Monitor suits CAD/CAM

- 14-inch screen
- Green or amber
- Dual frequency

A 14-inch monochrome monitor, the MM-14222 targets CAD/CAM applications. Horizontal scanning rate is 15.75 kHz for Compaq computers and 18.43 kHz for IBM and compatibles. The unit offers resolutions of 800 by 350 dpi and 640 by 200 dpi. It provides a green or amber display. $249, green; $269, amber. **Tatung Co. of America Inc.,** 2850 El Presidio St., Long Beach, Calif. 90810, (213) 637-2105.

Circle 383

Terminal displays 3,696 characters

- 14-inch screen
- 24 or 28 lines
- 80 or 132 characters

An ASCII terminal, the IBM 3162 offers 24 or 28 lines with 80 or 132 cpl on a 14-inch screen; providing a display of up to 3,696 characters. The unit features programmable function keys, extended menu setup, split screens and smooth scrolling in two speeds. Optional cartridges allow for emulation of the ADDS, DEC, Hazeltine, TeleVideo and Wyse terminals. $645. **IBM Corp.,** Information Systems Group, 900 King St., Rye Brook, N.Y. 10573, (914) 934-4488.

Circle 384

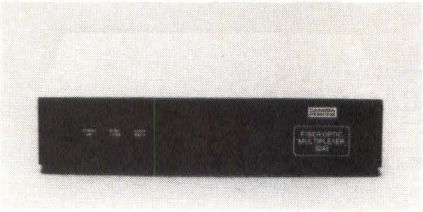
Terminal furnishes DEC compatibility

- 22 function keys
- 24 lines
- 80 or 132 columns

The ADDS 3220 is compatible with the DEC VT220, VT100, VT52 and with the ANSI X3.64 command set. The unit supplies 22 non-volatile function keys, a bidirectional printer port and smooth-scroll speed. Refresh rate is 70 Hz and screen size is 14 inches. The display is 24 lines by 80 or 132 columns. Six function keys are programmable. $695. **Applied Digital Data Systems Inc.,** 100 Marcus Blvd., Hauppauge, N.Y. 11788, (516) 231-5400.

Circle 385

DATACOMM

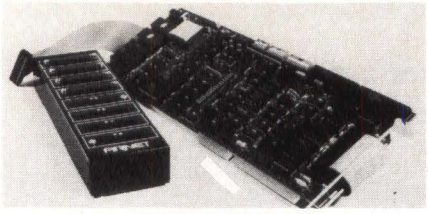


Multiplexer employs fiber optics

- 1.544M bps
- T1 interface
- Eight channels

Targeting system integrators and OEMs, the model 3248 is an eight-channel, fiber-optic multiplexer. The unit is available with a T1 or V.35 interface. It provides a 1.544M-bps data stream and local/remote loopback tests. Applications include remote graphic or CAD/CAM terminal links. A long distance option is offered. $3,000 to $4,500. **Canoga-Perkins,** 6635 Independence Ave., Canoga Park, Calif. 91303-2999, (818) 887-1897.

Circle 386



Communications board suits 386 systems

- 80186 processor
- Four or eight ports
- 64K bytes of RAM

The Smartport communications board utilizes an 80186 processor and 64K bytes of dual-ported RAM to drive terminals, printers and other peripherals. It adds four or eight RS232C ports to multiuser IBM PC/AT or 386 systems. The unit works with UNIX, XENIX and other multiuser operating systems. $895, Smart-4; $1,295, Smart-8. **Arnet Corp.,** 476 Woodycrest Ave., Nashville, Tenn. 37210, (615) 254-0646.

Circle 387

Multiplexer offers DEC compatibility

- 50 to 38.4K baud
- 16 channels
- Block mode DMA

A dual-height, 16-channel asynchronous multiplexer, the WQDHV is compatible with two DEC DHV11 multiplexers. The device supplies 16 baud rates ranging from 50 to 38.4K. Programmable line parameters include character length, parity and stop-bits. $1,375. **Webster Computer Corp.,** 1037 N. Fair Oaks Ave., Sunnyvale, Calif. 94089-2183, (408) 745-0660.

Circle 388

Communication board suits industrial OEMs

- Two serial ports
- One parallel port
- IBM compatible

Targeting industrial OEMs, the FE5500 communication board plugs into the IBM PC and PC/AT. It features two serial ports and a Centronics-compatible printer port. When the unit is connected to an intelligent I/O controller in the RS422 or RS449 mode, it acts as a communications interface to local instumentation such as A/D and D/A controllers. $345. **Faraday Electronics,** 749 N. Mary Ave., Sunnyvale, Calif. 94086, (408) 749-1900.

Circle 389

Modem runs at 9,600 bps

- Trellis-coded
- Error control
- 1,100 cps

The Courier HST modem provides 9,600-bps data communication. It uses 32-state trellis-coded modulation. A proprietary error- and flow-control protocol allows transmission of up to 1,100 cps. The device is compatible with 1,200- and 2,400-bps modems and most communications software. $995. **USRobotics Inc.,** 8100 N. McCormick Blvd., Skokie, Ill. 60076, (312) 982-5010.

Circle 390

Software comprises eight utilities

HOT, a microcomputer utility, enables users to create customized menus and locate any file in any drive. The software comprises eight utilities, including a pop-up text editor, a file finder and an MS-DOS-like command line. It requires an IBM PC, PC/XT, PC/AT or compatible with 256K bytes of memory and MS-DOS 2.0. Commands such as Backup and Restore are eliminated. $75. **Executive Systems Inc.,** Suite 305, 15300 Ventura Blvd., Sherman Oaks, Calif. 91403, (818) 990-3457.

Circle 391

Software suits DEC VAXes

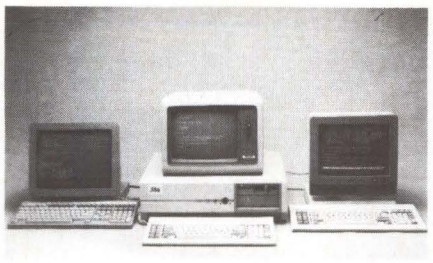
Targeting system integrators, VENIX E-NET 205 allows IBM PC/XTs, PC/ATs and compatibles running the VENIX System V operating system to be linked to DEC VAX computers. The software utilizes Exelan's Intelligent Ethernet Controller to provide TCP/IP protocol services to the host system. This capability increases networking throughput by downloading CPU-intensive functions to the controller, freeing the CPU for application processing. $595. **VenturCom Inc.,** 215 First St., Cambridge, Mass. 02142, (617) 661-1230.

Circle 392

Communications software emulates IBM SNADS

Access/SNADs is a portable version of IBM's SNA Distribution Service (SNADS)—an architecture for asynchronous or delayed program-to-program communication. The software, written in C, is provided on a UNIX System V base. It integrates into computer, gateway and workstation products. A SNADS test application and a UNIX mail-system gateway application are included. The package connects IBM and non-IBM systems with IBM's electronic mail system. $400 per node. **Communications Solutions Inc.,** 992 S. Saratoga-Sunnyvale Road, San Jose, Calif. 95129, (408) 725-1568.

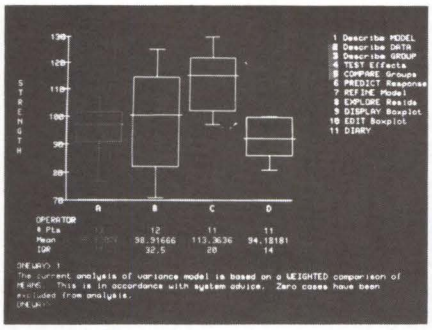
Circle 393



Software suits 386 systems

Merge 386 allows an Intel 80386-based system to simultaneously and transparently execute MS-DOS and UNIX operating systems. The software provides password security and file protection. Record-level access is furnished to the same files by both operating systems. $300 and higher. **Locus Computing Corp.,** 3330 Ocean Park Blvd., Santa Monica, Calif. 90405, (213) 452-2435.

Circle 394



Software addresses data analysis

RS/Explore and RS/Discover, multiuser software systems for data analysis and data management, run on DEC's MicroVAX II and VAX Station. The products supply graphics, modeling and report functions for scientists and engineers. Features include box, contour and 3-D plots. RS/Explore supplies computer-aided interpretation and statistical analysis in research, development and manufacturing environments. RS/Discover is for the creation and analysis of designed experiments. $9,000 to $103,000, RS/Explore; $44,000 to $138,000, RS/Discover. **BBN Software Products Corp.,** 10 Fawcett St., Cambridge, Mass. 02238, (617) 864-1780.

Circle 395

Spreadsheet boasts Lotus compatibility

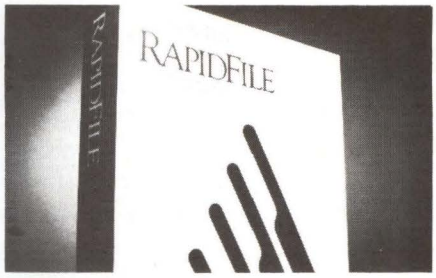
The Words and Figures software package combines a Lotus 1-2-3-compatible spreadsheet with a word processor for simultaneous display. It reads and writes .WKS files directly. Spreadsheets of 9,999 rows by 256 columns can be created. The 8027 and 8087 math coprocessors are supported. $195. **Lifetree Software Inc.,** 411 Pacific St., Monterey, Calif. 93940, (408) 373-4718.

Circle 396

Graphics packages run on IBM PC/XT, /AT

Versions 5.0 of the Mirage and Autumn graphics software packages are compatible with the IBM PC/XT, PC/AT and compatibles. A 98-color palette is supplied. Colors can be automatically or manually mixed from a range of 360 million values. The packages control text weight, shape and fill. $895, Mirage; $595, Autumn. **Zenographics Inc.,** Suite 250, 19752 MacArthur Blvd., Irvine, Calif. 92715, (714) 851-6352.

Circle 397

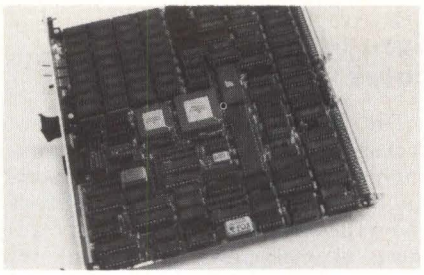


Software manages IBM PC and compatibles

A file manager for the IBM PC and compatibles, RapidFile manages data, creates reports and writes form letters. Through support of virtual memory, the product combines the speed of a RAM-based program with the capacity of a disk-based program. It requires 256K bytes of RAM and supports monochrome or color monitors. The software is compatible with 3Com 3+, PC-Net and Novell Netware/86 networks. $395. **Ashton-Tate,** 20101 Hamilton Ave., Torrance, Calif. 90502-1319, (213) 329-8000.

Circle 398

SUBASSEMBLIES

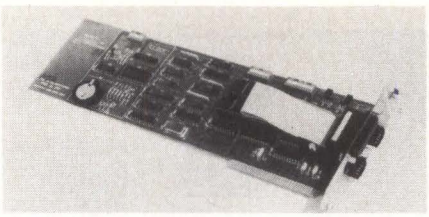


SBC packs 1M byte of DRAM

- MC68020 processor
- Dual-ported memory
- VMEbus address

A single-board computer, the DVME-134 is based on the MC68020 microprocessor and the MC68881 floating-point processor. The unit provides 1M byte of dual-ported DRAM with zero-wait states and supports 32-bit VMEbus address and data transfers. It contains one asynchronous, serial, full-duplex channel. $2,872. **DY-4 Systems Inc.,** Suite 202, 1475 S. Bascom Ave., Campbell, Calif. 95008, (408) 377-9822.

Circle 399

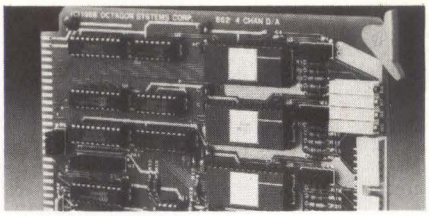


Board connects devices to IBM PC, XT, AT

- Two RS232C ports
- XENIX-compatible
- Optional parallel port

The Twinport serial port board connects terminals, printers and other peripherals to the IBM PC, PC/XT, PC/AT and compatibles via two RS232C ports. It works with XENIX, BOS, Pick and Theos multiuser operating systems. Features include an optional parallel port. $269. **Arnet Corp.,** 476 Woodycrest Ave., Nashville, Tenn. 37210, (615) 254-0646.

Circle 400



D/A card supports STDbus

- 12-bit resolution
- Four D/A converters
- I/O addressing

An analog I/O card for the STDbus, the 862 four-channel D/A unit features 12-bit resolution and accommodates both 8-bit and 10-bit I/O addressing standards. The unit has four 12-bit D/A converters that provide independently programmed output channels. Converter inputs are software-driven via double buffered storage registers. $425. **Octagon Systems Corp.,** 6510 W. 91st Ave., Westminster, Colo. 80030, (303) 426-8540.

Circle 401

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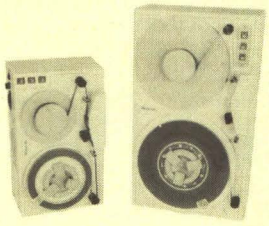

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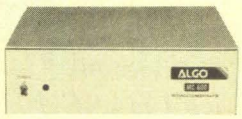

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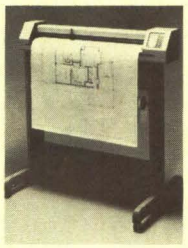

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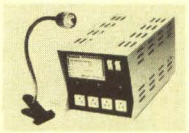

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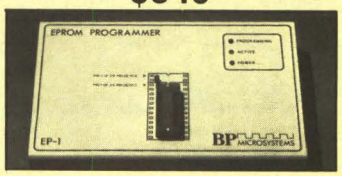

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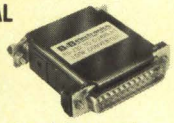

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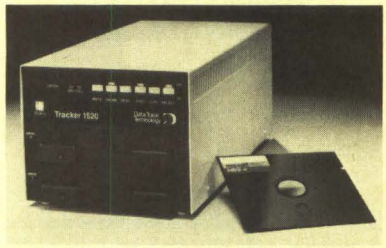

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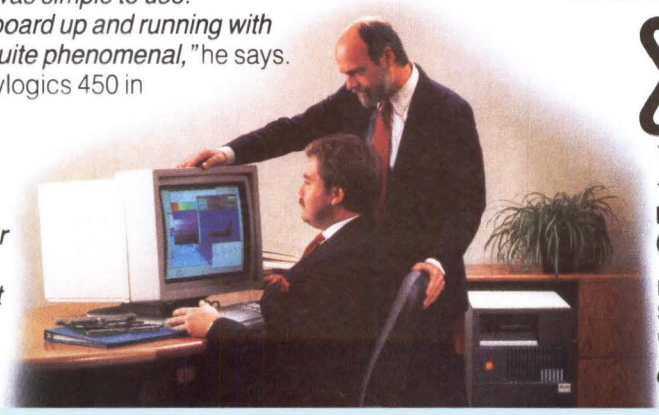

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Kevin Gonor, Xylogics and Jon Garman, Sun Microsystems, with Sun-3/160 C Color Workstation

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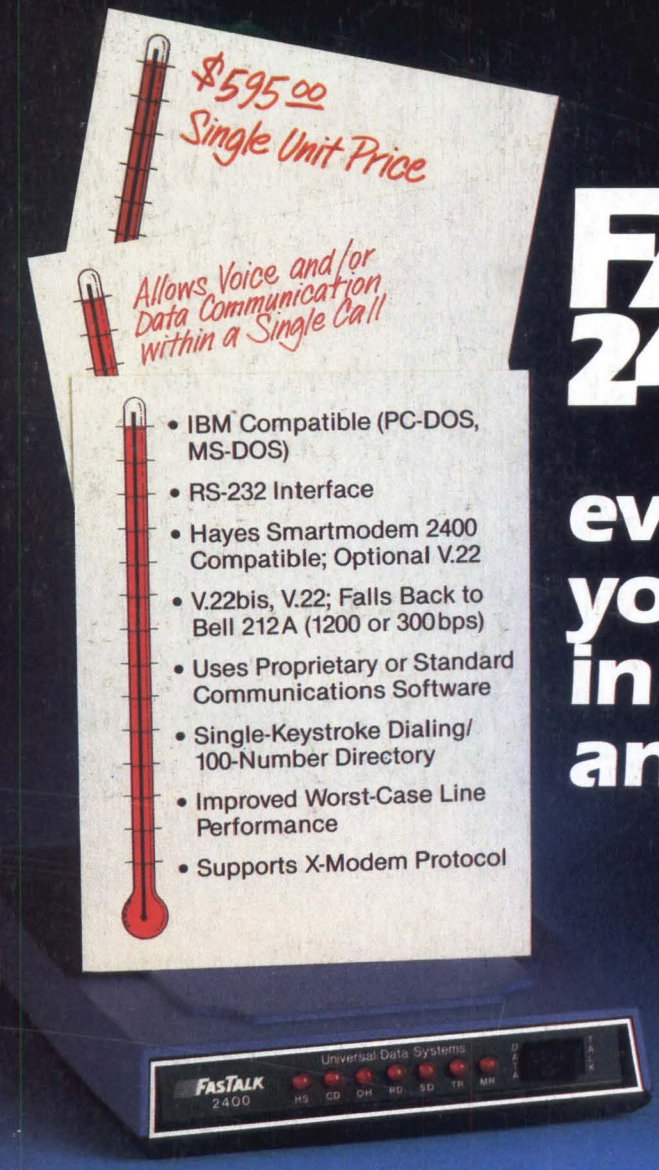

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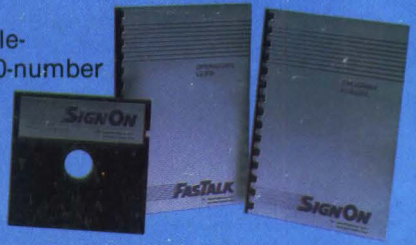

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