DECEMBER 1986

Mini-MicroSystems

THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

A CAHNERS PUBLICATION

Philips, Control Data team up to market half-height CDROM drive

SPECIAL REPORTS:

- **Optical disk software**
- **Computer architecture**
- **Parallel processing**
- **Human interface technology**

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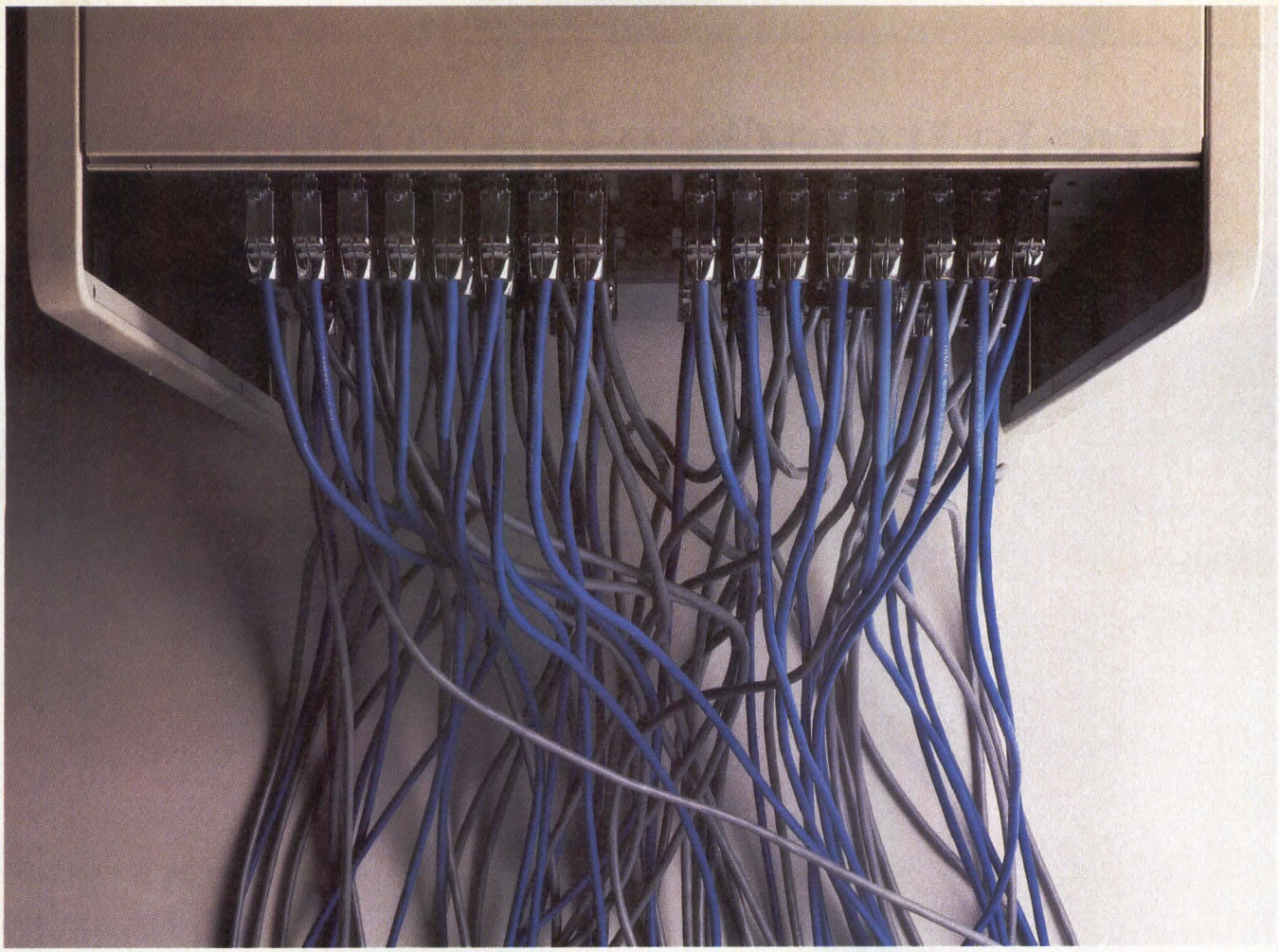
CIRCLE NO. 1 ON INQUIRY CARD



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.

The Unplug can take those 128 connections off the back of the computer and turn them into just one. And presto, you've got all the expansion slots you need for more important things. Like disks. Streaming tapes. More CPU power. A synchronous communications processor. And your imagination.

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.

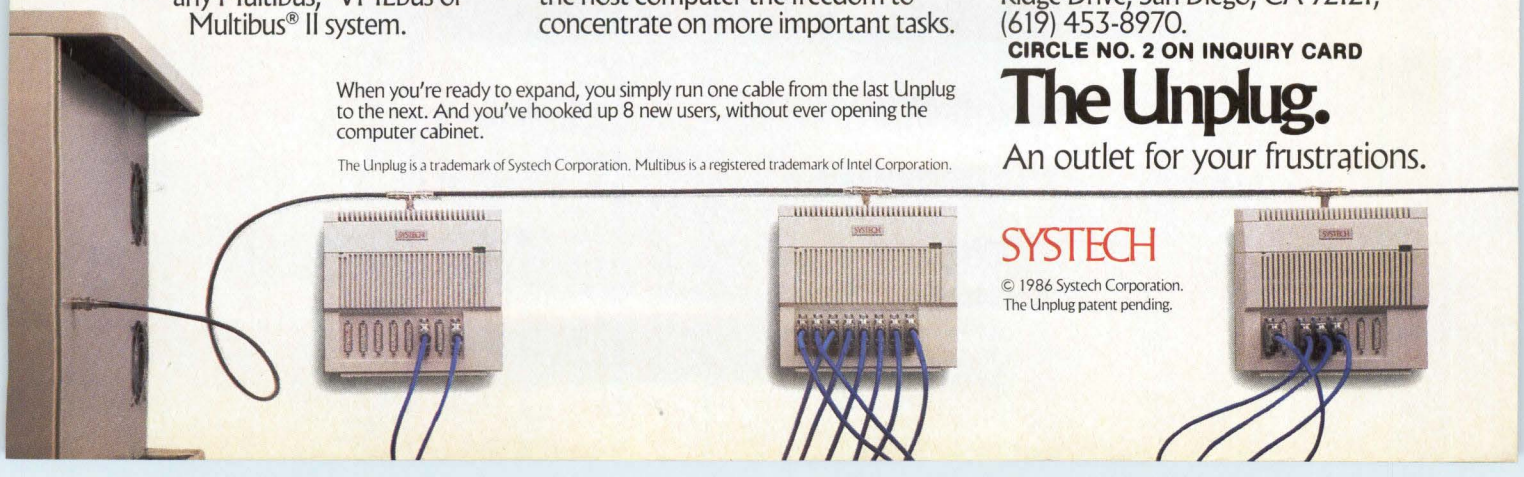
Systech Corporation, 6465 Nancy Ridge Drive, San Diego, CA 92121, (619) 453-8970.

CIRCLE NO. 2 ON INQUIRY CARD

The Unplug.

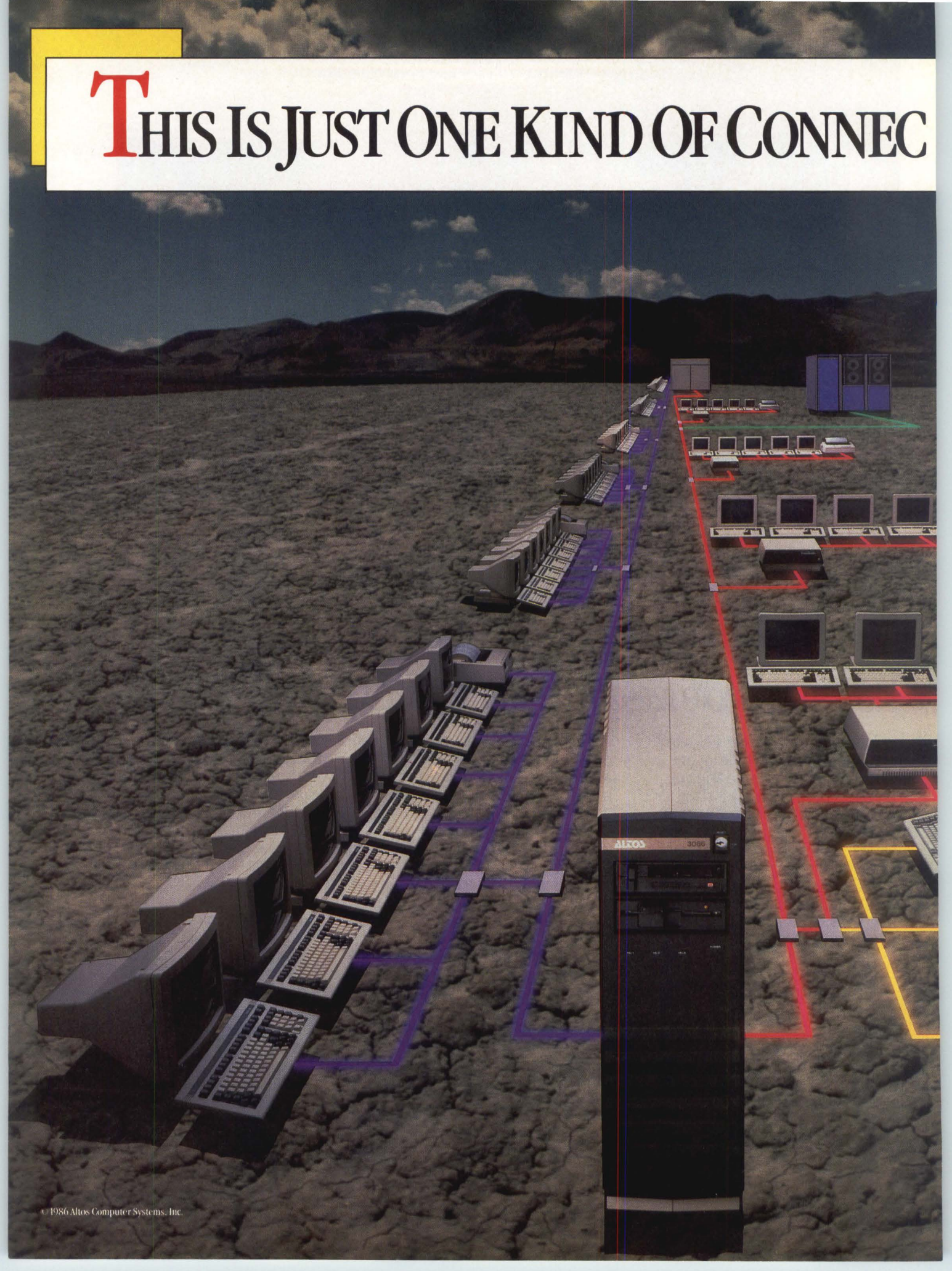
An outlet for your frustrations.

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.

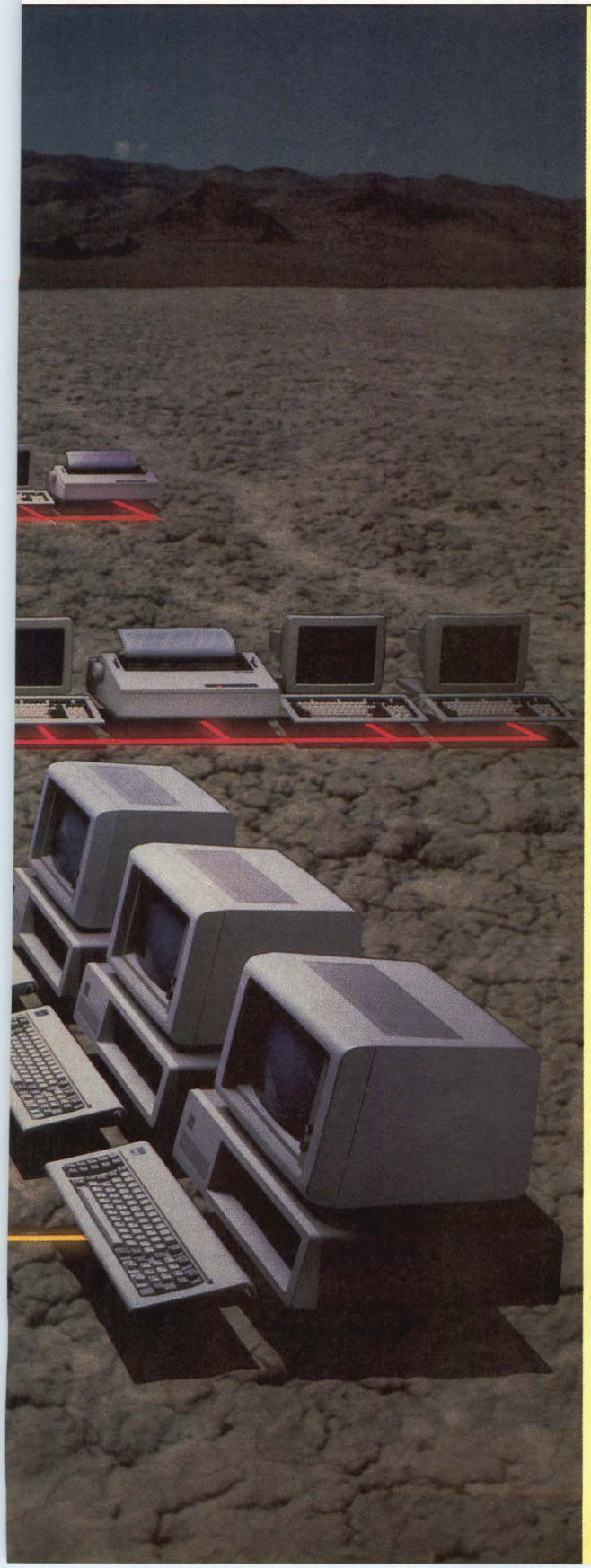


SYSTECH

THIS IS JUST ONE KIND OF CONNEC



TIVITY THAT ALTOS OFFERS OEMs.



The kind that lets one microsystem support up to 128 standard RS 232 devices on a single-cable network that spans almost two miles.

This kind of connectivity is important when you have clients who demand sophisticated, low-cost communications capabilities. But another kind of "connectivity" can be even more important to your success and profitability: the business partnership you form with your computer manufacturer.

PARTNERSHIP

At Altos, that partnership starts with a special OEM engineering team. We offer hardware and software customization services, and a commitment to manufacturing flexibility, to qualified OEMs.

BUILT FOR SPEED

In addition to high-speed processors (12.5 MHz Intel 80286 and 16.7 MHz Motorola 68020) and the latest Winchester disks, Altos machines have an architecture featuring separate processors for serial I/O and disk I/O, letting you take full advantage of the raw speed of the basic technology.

Test your software on Altos. We'll let your results speak for us.

BUILT FOR CHOICE

Intel or Motorola, Xenix, UNIX, or PICK: the choice is yours.

MODULARITY, EXPANDABILITY

Our systems are modular. The CPU, disk drives, tape drives, serial I/O board, RAM memory, and various custom boards are all field replaceable/field upgradeable.

REMOTE DIAGNOSTICS

Altos is the only supermicro with board-level remote diagnostics that run on the primary serial I/O board; they can be used even if large parts of the system are down.

UNINTERRUPTABLE POWER SUPPLY

We offer an uninterruptable power supply to our OEM clients that allows them to maximize system availability, avoid two-vendor problems, and keep their maintenance costs low.

NO DIRECT SALES COMPETITION

Altos has no direct sales force to compete with you, and doesn't need one. When you succeed, we succeed. And we've been profitable every quarter of our existence.

CONNECTIVITY

In the OEM market, Altos means connectivity.

Our sophisticated communications support — with government requirements like DDN, and a comprehensive suite of local and remote network communications products including Ethernet, SNA, 3270/3780 BSC and X.25 — are sufficient for connectivity in even the most demanding communications environments.

And the partnership we offer OEMs — with our OEM engineering team and manufacturing flexibility — gives them the business "connectivity" they require to succeed.

To find out more about how Altos connectivity can help your business, call Rick Davis, vice president of OEM sales, at 1-800-ALTOS U.S.

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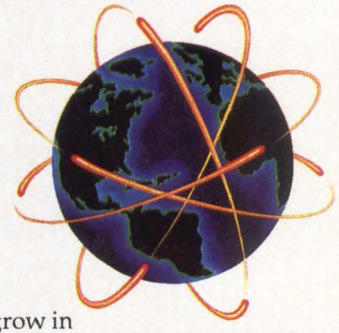

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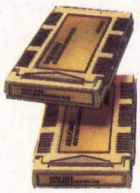

When it comes to X.25 network OEMs and system integrators, MICOM doesn't have its head in the clouds. Our 2.5-to-1 price/performance edge will give your network no-nonsense advantages your customers will appreciate.

As packet switching networks grow in number, so does the number of X.25 access equipment vendors. But only one has enough X.25 experience and manufacturing capacity to provide a full line of components at reasonable prices. That's MICOM, the largest volume datacomm manufacturer in the X.25 access equipment market.

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MICOM. We have all the products, prices, performance, and people necessary to change your current X.25 vendor into an ex-25 vendor.

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Mini-Micro Systems

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VOL. XIX NO. 15
DECEMBER 1986

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*DEC DIRECTIONS

*Appearing in issues of subscribers who have DEC computers

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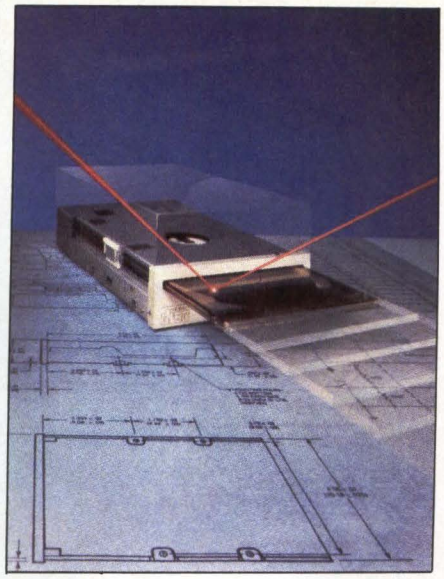
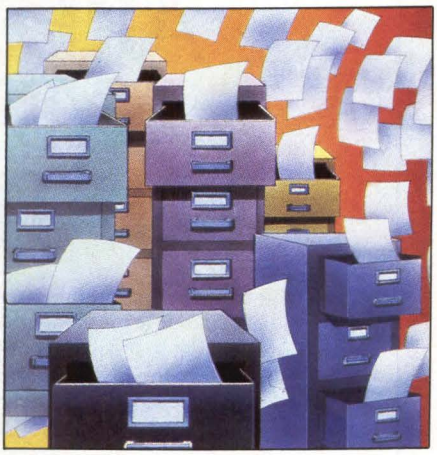


p. 15 . A new team. Art design by Marken Communications. Photography by C&I Photography Courtesy of Laser Magnetic Storage International.



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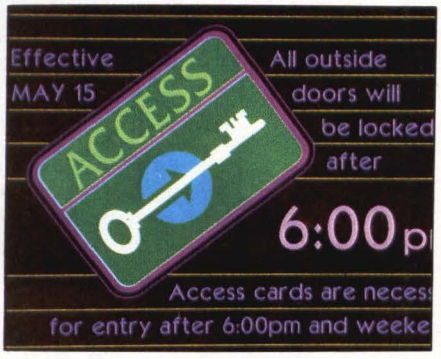

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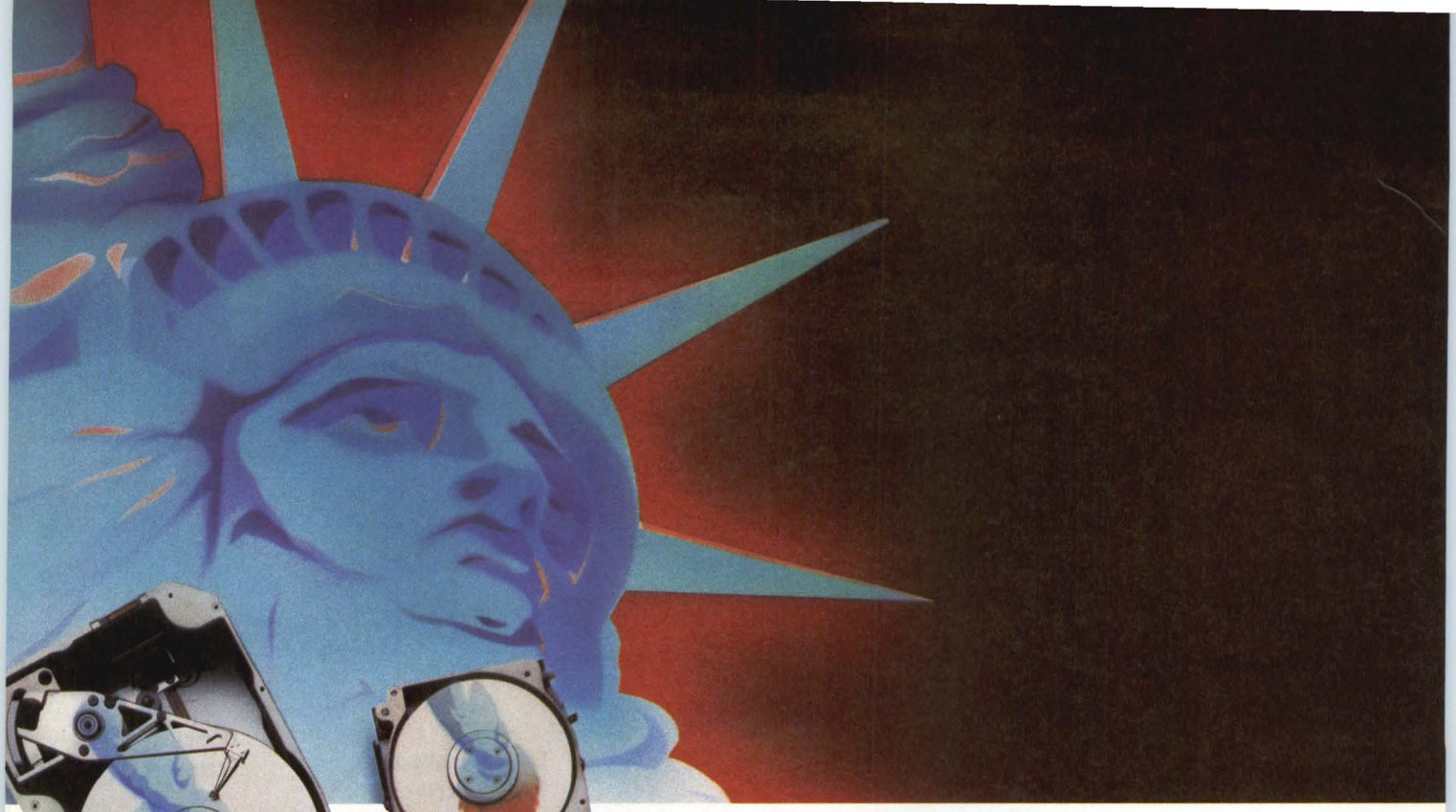

Newbury brings its European winners to America!

Newbury Data is giving American OEMs and distributors their fast, their compact, their efficient, their reliable, their proven world-class disk drives.

Newbury Data now brings two high-capacity disk drive series to this side of the Atlantic—the 65 MB to 380 MB 5.25" and 50 MB 3.5" Winchesters—both proven leaders throughout Europe. Newbury's world-class design, manufacturing and support capabilities are giving Americans a new freedom and opportunity to gain from competitive advantages that have long been recognized by Europe's leading advanced system developers. But then, this is the kind of total advantage you should expect from the company that is the leading independent peripherals manufacturer in Europe.

Newbury Data's proven 5.25" Winchesters are in a world-class of their own. *This family of 5.25" disk drives delivers users a range of unformatted storage capacities from 65 to 380 MB. The 1000 (65, 85, 105, 140 MB) and 2000 (190 MB) series offer ST-506/412 interfaces and the 4000 (175, 380 MB) series offers an ESDI interface. Data access times have been reduced a full 15 percent, to as low as 25 ms.*

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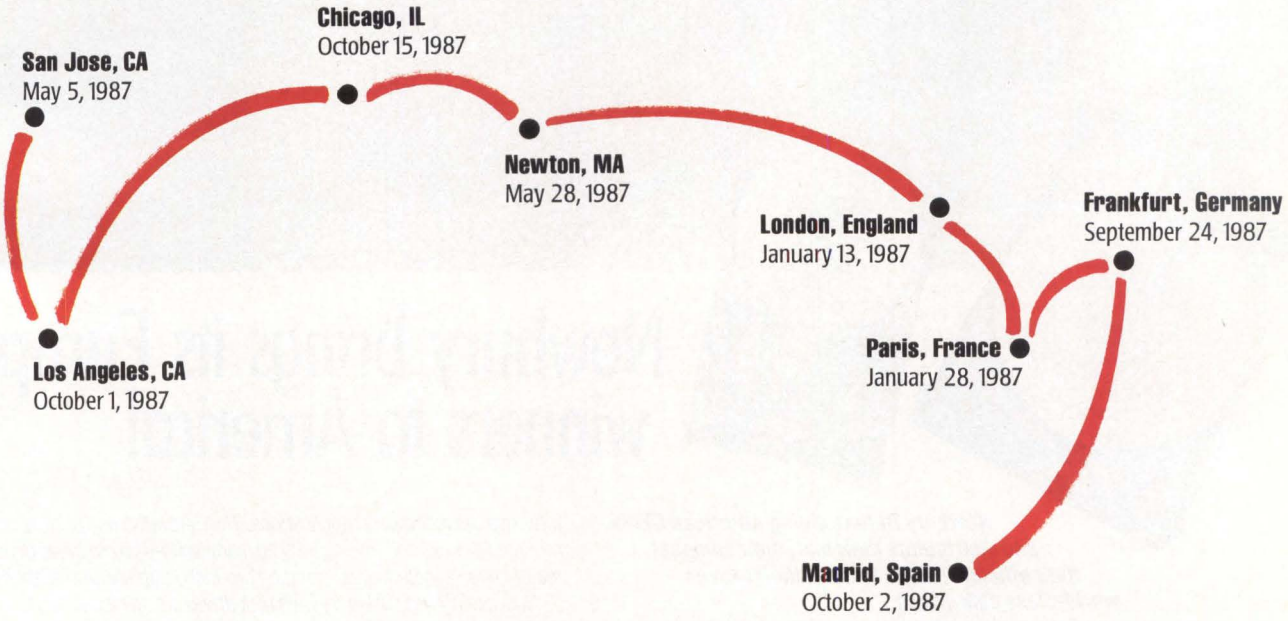

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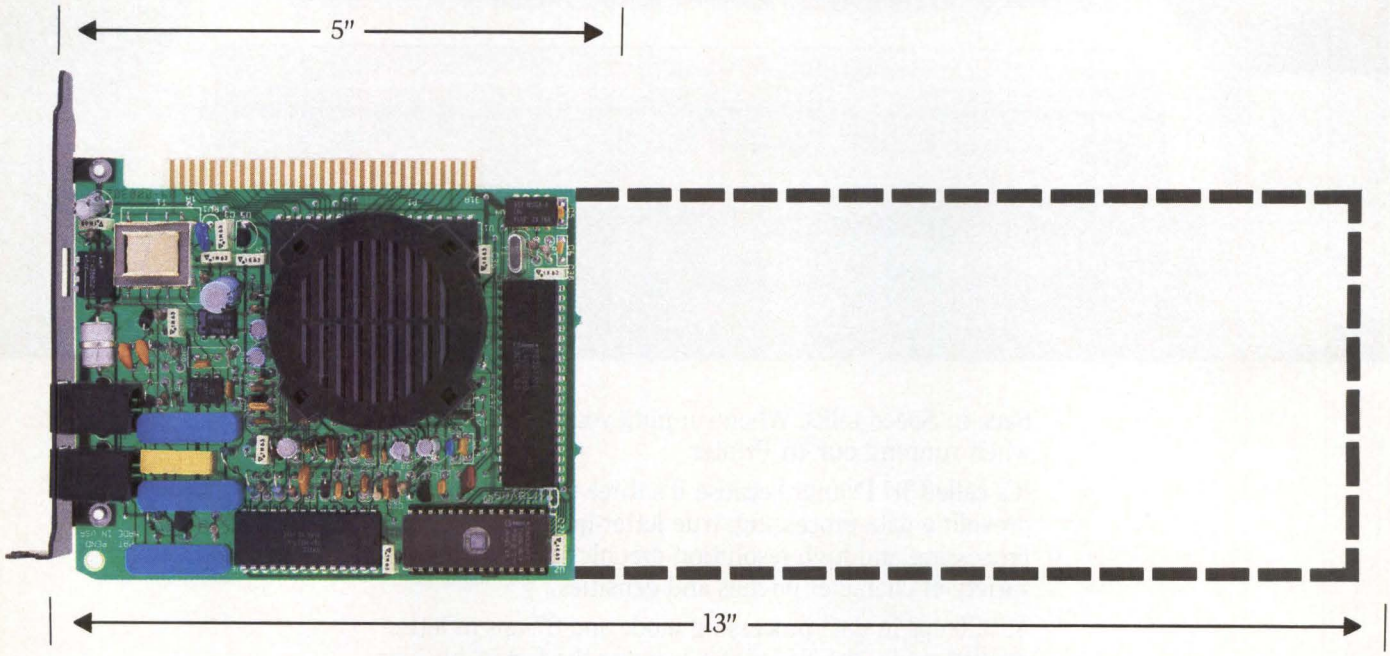
At each location admission is by invitation only, so ask your current hardware or software manufacturer for a PC Reseller invitation or contact us at one of the following locations: B. J. Johnson & Associates, Inc., 3151 Airway Avenue C-2, Costa Mesa, CA 92626, Telephone: (714) 957-0171, Telex: 5101002189 BJ JOHN (or) C. J. Nicholl & Associates, Ltd., 37 Brompton Road, London SW3 1DE ENGLAND, Telephone: 01-581 2326/9, Telex: 888068 CJNAD G.

The largest selling 1200 bps modem just got smaller.



The new Hayes Smartmodem 1200B™

Now you can get a lot more out of your PC, by putting a little more in. Our new Hayes Smartmodem 1200B includes the same quality and advanced features that have made it the leading 1200 bps modem. Now, advances in Hayes technology allow us to make it available in a size that fits either full slots or a "single" half slot.

That's important news if you have an IBM,® AT&T,® Compaq,® Tandy® or other compatible computer with half slots. It means with a Smartmodem 1200B, you can free up one of your full slots for an additional function, such as color graphics, more memory or networking. Or, if you prefer, you can continue to use the new Smartmodem 1200B in one of the full slots. Hayes makes it easy and versatile to fit your needs.

There are many good reasons for choosing Hayes. Our new space-saving Smartmodem 1200B is one of them. Hayes Smartcom II,® the industry's best selling communications software, is another.

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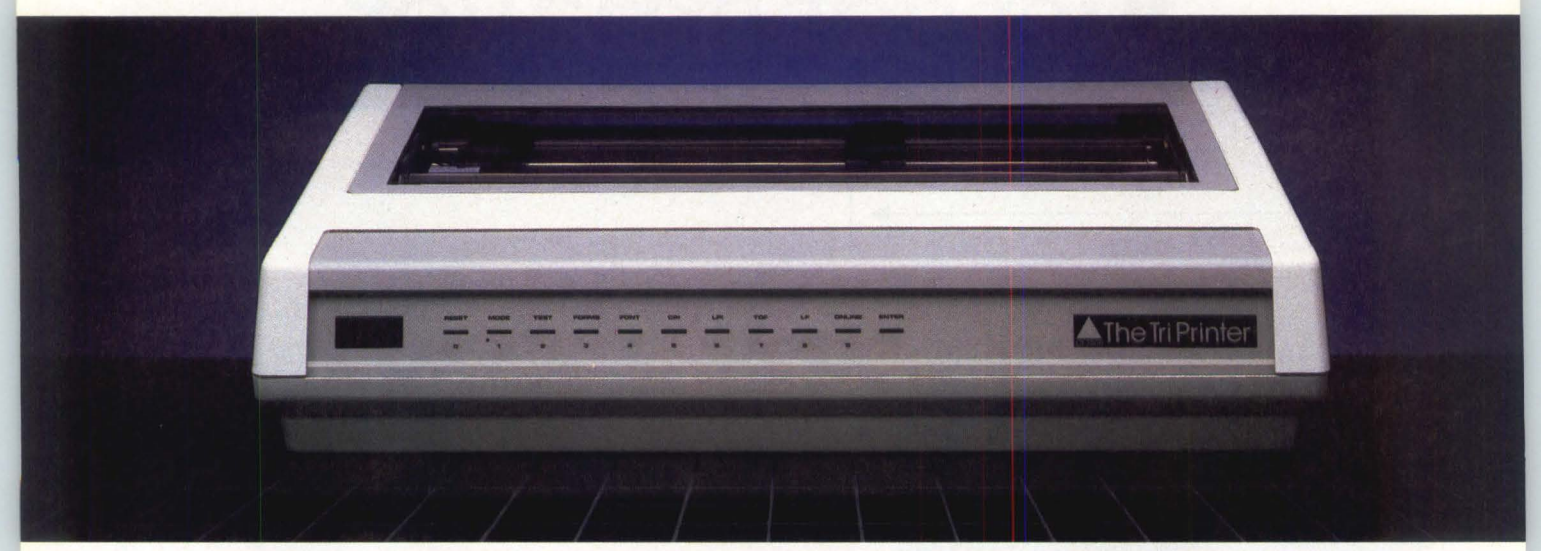

Face it. Speed talks. When running your business. And when running our Tri Printer.

It's called Tri Printer because it's three printers in one: providing data processing, true letter-quality word processing and high resolution graphics capabilities. All at a variety of character pitches and densities.

At 350 cps in data processing mode and 87 cps in letter quality mode, the Tri Printer is by far the fastest business printer in its class. Meaning that business conducted in the fast lane is finally supported by an equally fast printer.

In addition to its sheer speed, the Tri Printer's design surpasses the performance of printers that IBM, Apple and DEC make for their own computers. Improvements in important areas, like paper handling, font selection and quick-shift mode selection. And reliability.

Neither are there compatibility problems with your software. Because the Tri Printer emulates such popular printers as the Epson FX-100, IBM Graphics Printer, DEC LA210 and the Apple Imagewriter. Accomplished literally within seconds by merely changing personality cartridges.

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For more information on the Tri Printer, contact your distributor or CIE Terminals at 2505 McCabe Way, Irvine, CA 92714-6297; telephone (714) 660-1421 or (800) 624-2516.

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CIRCLE NO. 8 ON INQUIRY CARD

BREAKPOINTS

ALLOY REVEALS FIVE-USER SYSTEM, READIES '386 COPROCESSOR

A five-user computer system can be built with the Plus4 add-on subsystem from Alloy Computer Products Inc., Framingham, Mass., that will furnish eight times the speed of a typical LAN at a 30 percent cost savings, says the company. Users add a rigid-disk-equipped personal computer and four terminals to the four Alloy PC-Slave/16 processor boards (each with 1M-byte memory) and 40M-byte tape backup. Alloy's NTNX multiuser software runs under MS-DOS and has file- and record-locking under Novell's Netware. Look for a version of NTNX supporting IBM's Token-Ring Network and System/36 minicomputers and mainframes by the first quarter of 1987. Scheduled for release by midyear, Alloy's 80386-based coprocessor board will support six terminals with a version of the company's RTNX multiuser software.—*Jesse Victor*

PYRAMID'S RISC-BASED MINIS CRUNCH ALONG AT 7 TO 13 MIPS

Pyramid Technology Corp., Mountain View, Calif., has doubled the power of its reduced instruction set computer (RISC) architecture and packaged it as the new Series 9800 line of 32-bit superminicomputers. The 9810, a $199,950 single-CPU system, is rated at 7 MIPS; the $299,950 two-CPU 9820, about 13 MIPS. Existing Pyramid customers can upgrade their current systems by replacing CPUs. The Series 9000 can handle up to 128M bytes of main memory and upwards of 15G bytes of mass storage. The 9810 and 9820 use Pyramid's proprietary OSX operating system, a dual port of the Berkeley UNIX Version 4.2 and AT&T Co. System V UNIX operating systems. The Series 9800 will be shipped first quarter of 1987. —*Mike Seither*

SOLIDS-MODEL EXCHANGE SPECIFICATIONS EXPECTED IN APRIL

The National Bureau of Standards says the anxiously awaited Version 4 of the International Graphics Exchange Standard (IGES) will be published in April. The specification permits the exchange of graphics data for CAD among different-brand computers. Version 4 will permit exchange of solids-model data for the first time. The first three versions of IGES were limited to transfer of 3-D wire-frame models only. Next April will also be the target month for publication of Version 1 of the successor to IGES—Product Data Exchange Specification (PDES). However, the Bureau says not to expect products incorporating PDES, a far more complete data-exchange format than IGES, until 1988 at the earliest.—*Jim Donohue*

MAXTOR OFFERS OEMS SAMPLES OF WRITE-ONCE OPTICAL DRIVE

Evaluation units of an 800M-byte WORM optical-disk drive have emerged from Maxtor Corp.'s San Jose, Calif., facilities. The RXT800, developed

with Ricoh Co. Ltd. of Tokyo, represents the first foray into the optical arena by Maxtor. The 5¼-inch RXT-800S, with an embedded SCSI controller, uses the same command set as Maxtor's XT-3000 Winchesters. According to the company, its SCSI mass-storage devices will be interchangeable. The optical drive uses a $75 removable cartridge with 400M bytes on each side. Production is set for February. Volume OEM price: $1,300.
—*Mike Seither*

EMULEX EXPANDS COMMUNICATIONS AND STORAGE OPTIONS

At DEXPO/East in New York this month, Emulex Corp., Costa Mesa, Calif., is expected to show three products aimed at the DEC-compatible communications and disk-storage markets. The first, the NET41 switching option for the firm's CS41 asynchronous multiplexer will allow up to 143 terminals to access any of six multiple-host VAXes. The second, a microprocessor-based SMD/SMD-E disk controller for Digital Equipment Corp.'s LSI-11 systems provides a data and communications path between a host and peripherals, as well as the interface for the transparent implementation of DEC's Mass Storage Control Protocol (MSCP). Finally, Emulex will unwrap the EMR, a removable SCSI disk drive subsystem geared for high-security applications.—*Tim Scannell*

PERSYST SET TO SHIP DGIS VIDEO CONTROLLERS FOR PC

Look for a family of personal computer video controllers sometime in February from the Persyst division of Emulex Corp., Costa Mesa, Calif. The controllers, intended for high-resolution monitors, use the Texas Instruments Inc. 34010 dedicated graphics processor. Persyst's three Intelligent Graphics Controllers will be among the first products to implement the Direct Graphics Interface Specification (DGIS), a software interface between graphics boards and DOS applications. The IGC boards, which can display 16 of 256 colors, range in resolution from 640 by 480 to 1,280 by 1,024. All feature a dual bus to sense 8-bit or 16-bit operation. Prices: $1,499 to $2,499—*Mike Seither*

EXCINIS CHALLENGES AIM BENCHMARKS WITH NEW UNIX TESTS

Beginning next month, EXcinis Inc., San Francisco, Calif., will provide the UNIX Benchmark Information Service, based on the UniProbe suite of benchmarks. Billed as an alternative to Aim Technology's industry-standard benchmark, the UniProbe suite tests various implementations of UNIX and the hardware they run on at three levels: component, subsystem and system. UniProbe also includes tools that enable system designers and integrators to create their own benchmarks. The suite costs $7,950; a subscription to the Benchmark Information Service, $12,000 ($16,000 after Jan. 1). Subscriptions include access to EXcinis' laboratories.
—*Dave Simpson*

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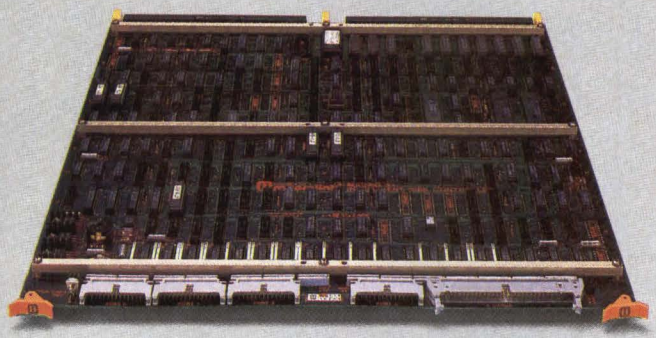

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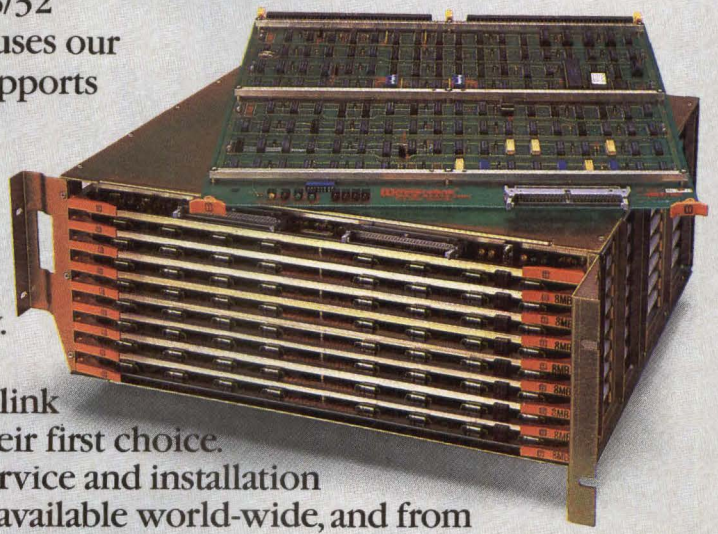

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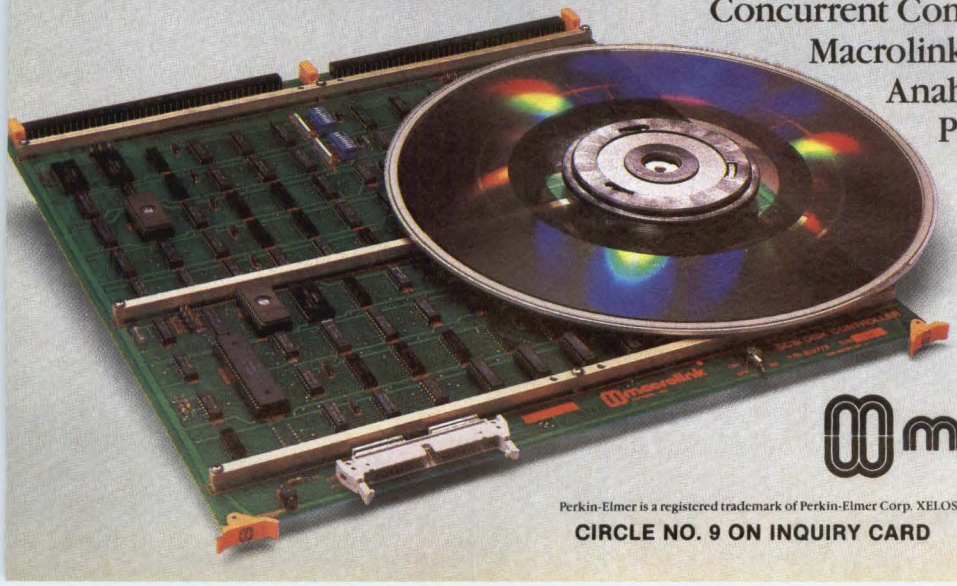

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CIRCLE NO. 10 ON INQUIRY CARD

Philips, Control Data team up to market half-height CDROM drive

Mike Seither
Associate Western Editor

Besides a money-making market and some semblance of standards, what do system integrators expect from compact disk ROM (CDROM) drives? The folks at Laser Magnetic Storage International Co. believe they know.

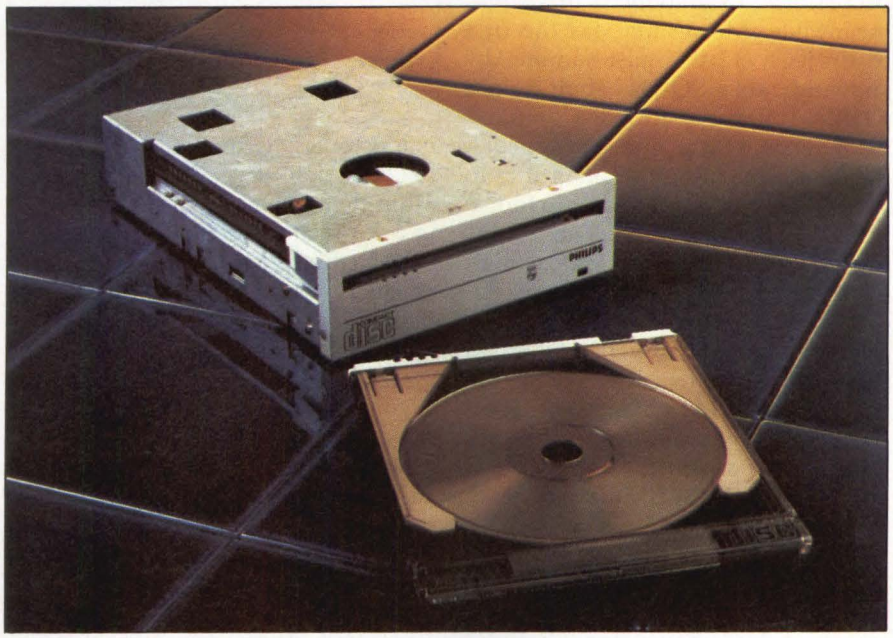
LMS, a new joint marketing venture between N.V. Philips of Eindhoven, The Netherlands, and Control Data Corp. of Minneapolis produced its answer last month at Comdex/Fall in Las Vegas. There, the company first showed analysts and selected OEMs the new LMS half-height, 5¼-inch CM200 series of CDROM drives.

LMS officials say that evaluation units of the drives will be available in the first quarter of 1987. Full production is slated for midyear.

To date, most CDROM vendors have produced either full-height, 5¼-inch drives; standalone units; or both. Philips' only previous CDROM offerings have been two standalone drives —the CM100 family. One features a small computer systems interface (SCSI), while the other ties into the IBM Corp. PC and compatibles through a full-slot plug-in controller card. But now, Philips, through its marketing effort with Control Data, has joined an industrywide move toward downsizing.

(This is not the first joint venture between Philips and Control Data. The two companies got together a few years ago to form Optical Storage International, a Santa Clara, Calif., outfit that manufacturers 12-inch write once ready many (WORM) optical drives. Laser Magnetics has since absorbed OSI.)

"Everyone is talking about half-height CDROM," says Bob Katzive, an analyst with Disk/Trend Inc., a Los Altos, Calif., research concern that tracks the mass-storage market. "Most vendors will be playing the same game at the same time."



One Laser Magnetic *half-height CDROM drive comes with a proprietary interface; the other with SCSI. Both read digital and audio disks.*

LMS is bringing to market two half-height versions, both compatible with Philips' CM100 line. The CM201 uses the same interface to connect to the PC bus. However, the new pared-down controller occupies a half slot. OEM pricing for CM201 production models will be about $320, says Robert Moes, LMS vice president of CDROM marketing operations in New York. The other LMS half-height drive, the CM210, uses the SCSI, and will be priced at $440 in OEM quantities. A new CM153 half-card controller will cost about $70.

The Japanese wave

Both LMS drives have a formatted capacity of approximately 600M bytes. By comparison, most Japanese CDROM drives are 540M bytes. The difference in capacity has to do with how much recording time a manufacturer chooses to use on a disk. LMS has chosen to implement the part of the so-called CDROM "Yellow Book" specification that calls for 70 minutes. Japanese vendors use 60 minutes. The Yellow Book, an extension of the compact audio disk standard developed by Philips and Sony Corp. describes the physical format for CDROMs.

"It's a little more challenging to make a 70-minute disk because you are on the outer fringes of the disk where tolerances are more critical," says Moes. "Ultimately everyone will do it."

The average access time for the LMS devices is 500 msec. That's about where most CDROM drive manufacturers stand, give or take 100 msec, industry observers note. The major difference between the two

LMS drives is in data-transfer rates. The SCSI version operates at 500K bytes a second. The proprietary LMS interface controller card handles data at 176.4K bytes a second.

LMS and a handful of Japanese companies are vying for shares of the CDROM market. They include Sony, Hitachi Ltd. and Matsushita Electric Industrial Co. Industry analysts expect Hitachi to announce a drive, but, meanwhile, Matsushita was the first to tip its hand this past summer by showing its SQ-D1 half-height CDROM at the National Computer Conference. Matsushita is now pedalling that drive in sample quantities to U.S. OEMs through Panasonic Industrial Co., Secaucus, N.J. The SQ-D1 ties into the PC bus with Matsushita's own plug-in controller board.

Sony, meanwhile, also demonstrated its line of half-height CDROM drives for customers at Comdex/Fall. The CDU 400, like competing models from LMS and Matsushita, uses an add-in PC controller. Sony's CDU 450 features the SCSI interface.

Line up for standards

All these manufacturers are complying with the physical-format standard laid down for CDROM drives by Philips and Sony. For the moment no one company seems to be plowing new ground. "The technology is far enough along for them to be pretty much equal players," says Disk/Trend's Katzive.

These drives use a laser beam about 1 micron wide to pick up data replicated from a master onto the surface of standard 120 mm plastic disks. The data is encoded as a series of pits and flat areas. A photodiode distinguishes reflected light and makes sense of the encoded data.

The key to the latest generation of CDROM drives, most vendors say, is packaging standards. The missionary work for the technology has already taken place, they contend. What's needed now is a way for system integrators to push CDROM into new markets.

The argument goes as follows. First, the CDROM drive has to be small enough to be integrated into a personal computer and still leave room on the front panel for other mass-storage peripherals—tape, flexible and rigid disk drives. At a minimum that means a half-height device in a 5¼-inch form factor.

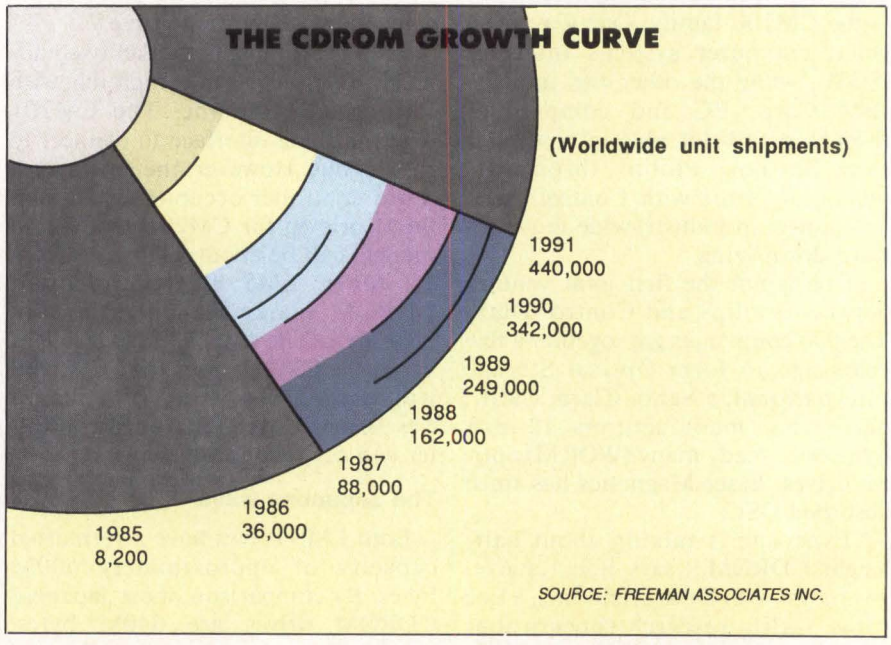
Laser Magnetic's *CDROM caddy features a protective cartridge that is removable once the disk is in the drive. A sleeve holds the disk in place, allowing the drive to be mounted either vertically or horizontally.*

"The first generation of CDROM products has accounted for little more than market development," says Aad Proeme, a business manager for Philips' peripheral-storage product group. "What we've seen lately is a demand for integrating CDROM into small systems. The problem is, there are no full-height spaces available."

Second, says Proeme, OEMs need more flexibility for integrating the CDROM drives into systems. First-generation CDROM devices, like CD audio-disk drives, have accepted unprotected disks only in a horizontal tray. OEMs who need to integrate drives vertically have been unable to do so with CDROM. The reason? The disk was not held firmly enough in place to prevent variations in focus between the disk and the read system.

LMS believes it has a solution to the problem. Its disk is fitted with a plastic frame around most of the its circumference and resides within a protective sleeve, or cartridge. The user loads the disk by inserting this entire caddy into the drive. The drive latches onto the frame holding the disk, and the protective cartridge is removed from the drive. The frame provides enough stability for the disk to be mounted either vertically or horizontally. To unload, the user reinserts the cartridge, which locks onto the framed disk and removes the caddy (see photo).

In an effort to create a standard, LMS is making the cartridge design available, free of charge, to all ven-



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dors. "It's to our benefit to let others use it," admits Moes. "What we want is a worldwide standard."

Most industry observers tend to agree. Lee Elizer, an analyst with Freeman Associates Inc., the Santa Barbara, Calif., market research outfit, says that acceptance of the cartridge would go a long way toward promoting data interchange among different vendors' drives. "It wouldn't make sense for them to fight over a design at this point, especially before they get so committed to a proprietary design that's it's too late to turn back."

"It's kind of hard to argue against," says analyst Katzive, adding that there may be another benefit in favor of standardizing. "It may get some differentiation in the mind of users that CDROM is different from CD audio and create less of an expectation for bargain-basement prices."

Sony is also working on a caddy design. But given the cooperation between Philips and Sony in the past on CD audio and CDROM standards, some industry watchers wouldn't be surprised if the two vendors put their heads together on a single design. Officials from Sony and Philips declined to comment on whether the two companies are working on a common CDROM caddy design.

How quickly system integrators will rush toward the new half-height CDROM drives is still speculative. Market reseachers believe as many as 30,000 CDROM drives will be in circulation by year-end. Next year, according to Freeman Associates, that number could triple. By 1990, Disk/Trend believes it's possible that there could be a market for as many as 600,000 drives.

Some analysts believe that 1986 has been a watershed year for CDROM. The most important development was publication of the High Sierra Group's logical-file format structure for CDROM drives. The specification has been submitted to the National Bureau of Standards for approval, as well as to the European Manufacturers Association. As proposed, it would allow CDROM applications to read data from a CDROM system regardless of the hardware or operating system in use.

To help spur development, Microsoft Corp., Redmond, Wash., recently announced extensions to its MS-DOS operating system that will support CDROM drives. The extensions allow MS-DOS to read data from any CDROM drive formatted according to the High Sierra proposal.

However, the ultimate push for the CDROM market will have to come from publishers, whose databases, parts catalogs, service manuals, encyclopedias, telephone directories—you name it—will finally wind up on CDROM disks. Until the publishers are convinced that CDROM is viable, there will be little drive makers can do except keep up the missionary work. □

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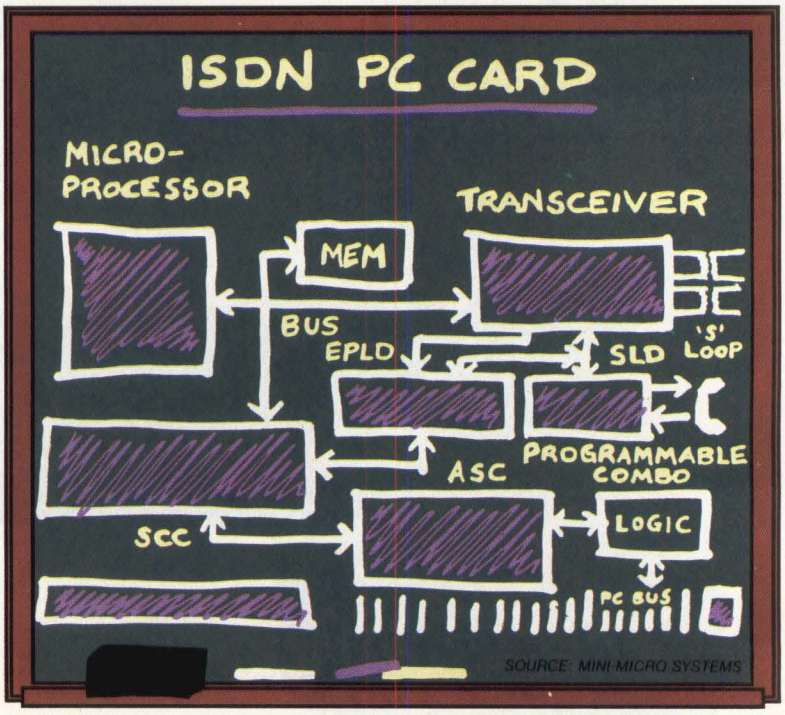
Intel chalks up first ISDN chip for integrators

Tim Scannell
Senior Editor

The push toward developing a standardized, public, high-speed voice-and-data network was given added impetus recently when AT&T Information Systems announced its plans to work with Intel Corp. to develop a marketable product. However, it still may be some time before integrated services digital network (ISDN) technology makes the jump from the testing lab to the real world.

That, at least, is the opinion of most communications industry analysts and those directly involved with ISDN, which is designed to provide end-to-end digital connections via the standard telephone network. In fact,



it may not be until the beginning of the next century before ISDN—often referred to as the "ideal, sometime, dream network," or "innovations subscribers don't need"—is universally available throughout the United States, points out Jean Buffham, an analyst with International Resource Development Inc., Norwalk, Conn.

"ISDN development is an evolutionary process that began in the mid-1960s and will go into the 21st century, before it is completed," she says.

Problems impeding ISDN development include a lack of industrywide development standards and a resistance among regional Bell operating companies (RBOCs) to go along with anything that might be sanctioned by AT&T, particularly in view of the boundaries set on operations by divestiture. As a result, a number of RBOCs have decided to ignore AT&T and work with such independent firms as Siemens Communication Systems and Ericsson Inc. to piece together regional ISDN-type networks.

'There's no central authority anymore," observes Buffham, "just a fuzziness over who will do what and when."

Big system on campus

For instance, Southern Bell Telephone, based in Atlanta, is lining up customers for an ISDN system it expects to be available sometime in 1988. In Pittsburgh, Carnegie-Mellon University and Bell of Pennsylvania have jointly begun testing a Metropolitan Campus Network (MCN). It offers basic no-frills voice-over-data communications at the same speeds standard-setters AT&T and the CCITT have proposed for ISDN networks. The test presently involves several hundred students and teachers and may eventually be expanded to include some 6,000 users at CMU.

The benefits offered by an all-digital voice-and-data system almost make it worthwhile to put the system's cart before the standards' horse. First of all, there is cost savings. Right now, if companies want to install systems that can handle voice, data and even graphics, it means replacing or supplementing existing telephone wiring with a local area or fiber-optic network. With ISDN, however, current PBX (private branch exchange) and Centrex systems can handle individual wire and data traffic, operating much like a personal telephone exchange. Voice and data would simultaneously travel over the same twisted-pair wiring already in place.

An all-digital system would also make possible simultaneous two-way communications. People could thus use telephone systems for everything from energy control and automation to automatic call screening, videotex and slow-motion video transmission. While digital systems would not make voice traffic move any faster, they would provide clearer communications, because digital signals are less susceptible to noise than are analog signals. "ISDN will not create new applications, but will enhance those available and make them more efficient," says Bradley O'Brien, president of the Perspective Telecommunications Group, a research company in Franklin, N.J.

Despite the critics, ISDN is slowly making the transition from drawing board to actual product. For example, AT&T has just completed testing an ISDN-like system that reportedly achieves high-speed transmission via wideband packet-switching technology.

Intel takes on lab work

More recently, Intel unveiled an ISDN transceiver and programmable chip, called the 29C53, that can be adapted by systems builders to construct ISDN telephones and systems. The chips, designed to fit into a plug-in ISDN card, evolved from five years and approximately $10 million in R&D efforts. In fact, AT&T has announced that it is working with Intel to develop a product around the chip set and may have a prototype available sometime next year.

Since ISDN systems would operate at an average 64K bits per second (bps) per channel, they are not seen as a competitor to LANs, which can function at speeds up to 10M bps and faster. In fact, ISDNs will more than likely work in unison with installed LANs. The technology is expected, however, to have a tremendous impact on a large portion of the low-end modem market, since the installed base of modems in business presently functions at 1.2K and 2.4K bps, points out Bruce LeBoss, strategic communications manager for Intel in Chandler, Ariz.

For example, an ISDN can typically transmit a four-page, 16K-bit document in about 1 second; a 1.2K-bps modem requires at least 13 seconds per page. Clearly, modems are "choking the productivity available from computer technology," LeBoss maintains.

The results of a survey conducted by the Newton-Evans Research Co. of Ellicott City, Md., show that users are quickly moving toward devices that offer faster transmission speeds. In the survey, a majority of 132 telecommunications executives indicated that within the next year or so they would more than double the number of high-speed (56K-bps) modems presently installed. The survey also points to microwave and broadband communications as alternatives to slower speed communications devices.

Integrators must stand and wait

Despite ISDN enthusiasm at such companies as AT&T and Intel, and the development of such products as Intel's 29C53 transceiver chip, many systems integrators are reluctant to pursue ISDN until a single technical strategy surfaces as a de facto standard.

At this point, it would seem that AT&T is the overwhelming frontrunner simply because of the investment the company has in the telephone system in particular and ISDN in general. However, AT&T has only just started to test ISDN in the field. In fact, it is planning to set up a test system in Phoenix, Ariz., next March along with Intel and Mountain Bell of Phoenix. The results will not be available until sometime in 1988, says Jim Day, executive director of systems engineering and management with AT&T Information Systems in Morristown, N.J.

In addition, although the CCITT has defined some ISDN standards in its 1984 *Redbook,* they "have a lot of holes and are in need of some work," observes George Gawrys, supervisor of the ISDN planning group at AT&T Bell Laboratories in Holmdel, N.J. ANSI, the standard-setting body within the United States, has a com-

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mittee working on ISDN but is not expected to make any determinations until after AT&T's tests are completed in 1988.

What are telecommunication users or system integrators supposed to do in the meantime? According to IRD's Buffham they should continue testing and developing systems that presently mimic ISDN structures, while keeping a close watch on the movements of such potential trend-setters as AT&T and Intel. "If they don't, others will be so far ahead in development by 1988 that they'd just be out of the market." □

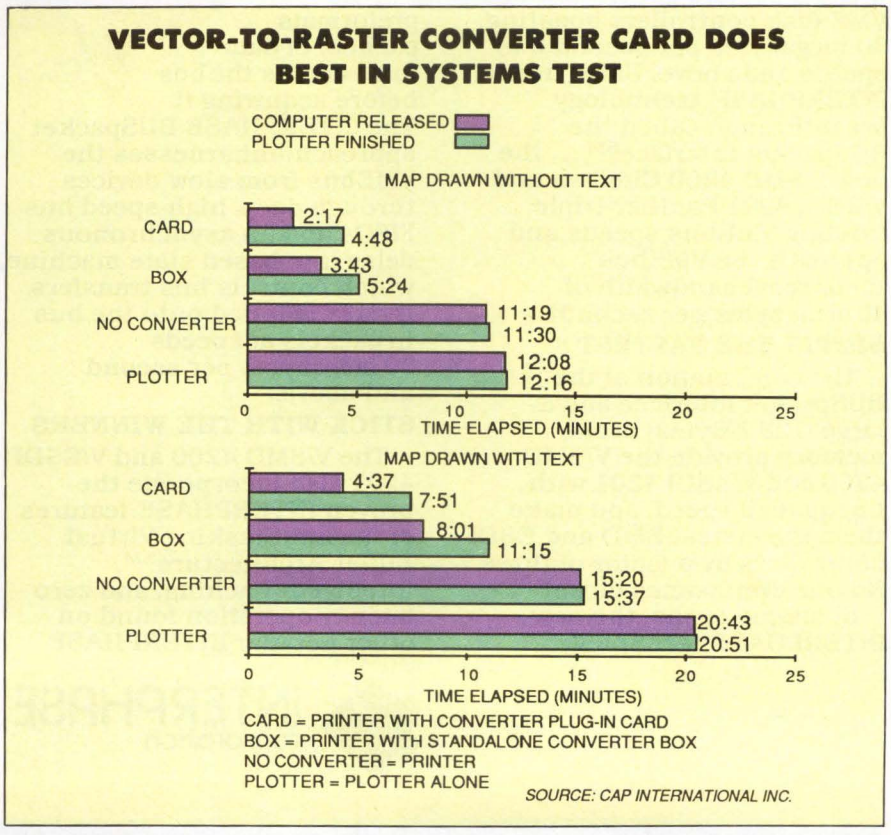
Printers beat out plotters in CAD-application tests

Rick Dalrymple
Contributing Editor

Low-cost vector-to-raster converters coming on the market are easing the processing bottleneck that made dot-matrix printers slower than plotters. In fact, recent test conducted by system integrator Secad Inc., Miami, Fla., shows that printers equipped with vector-to-raster converters perform four times faster than plotters driven by the same microcomputer. In addition, the microcomputers are tied up for less time sending data to the printers.

As a result, dot-matrix printers with vector-to-raster converters are challenging plotters as hard-copy devices of choice for microprocessor-based computer aided design systems.

All CAD software has at least one plotter driver, and most have more than one. Plotters are vector (point-to-point) devices. Users who want to print CAD graphics on dot-matrix



Running an election-analysis *mapping program on an IBM Corp. PC/AT, a dot-matrix printer system equipped with a vector-to-raster converter card (CARD) performed best in a test, especially klobbering a plotter system.*

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INTERPRETER

printers (which are raster devices) must convert the vector commands in the software to raster commands. If that's done in software on the computer, the conversion ties up the microcomputer and bogs down the system.

But the new converters—plug-in boards or standalone boxes—do the conversion instead of the host computer, speeding up the process.

Integrator runs tests

Secad, which designs CAD systems for microcomputers, tested the claims of vector-to-raster converter makers. Because Secad president Dave Smalley is a partner in an election-return consultancy, the test happened to be about producing election-analysis maps. Secad had written the mapping program.

Using a Japan Digital Laboratory (JDL), West Lake Village, Calif., 750e 24-wire serial printer and a Houston Instrument, Austin, Texas, DMP 41 pen plotter, Secad set up four configurations. The results of the tests, which were run on an IBM Corp. PC/AT, are shown in the bar chart.

In its four configurations Secad:

1. Put a vector-to-raster converter plug-in board in the PC/AT. The $595 board, from Eotron Corp., Dayton, Ohio, is sold in the United States by Alps America, San Jose, Calif. This configuration is labeled "Card" on the bar chart.
2. Attached the printer to a standalone converter box, the JDL Graphics Language Processor. This is labeled "Box" on the chart.
3. Connected the printer directly to the microprocessor (no converter). It's "No converter" on the chart.
4. Connected the plotter to the microprocessor: "Plotter" on the chart.

Secad tested maps drawn with and without text on C-size paper (11 by 17 inches).

The Miami system integrator kept two sets of time: One (represented by the colored bars) measures the elapsed time from when the output device began to draw a map to the time it was ready to accept another drawing. The second set of time (the white bars) measures the time the PC/AT was tied up sending data to

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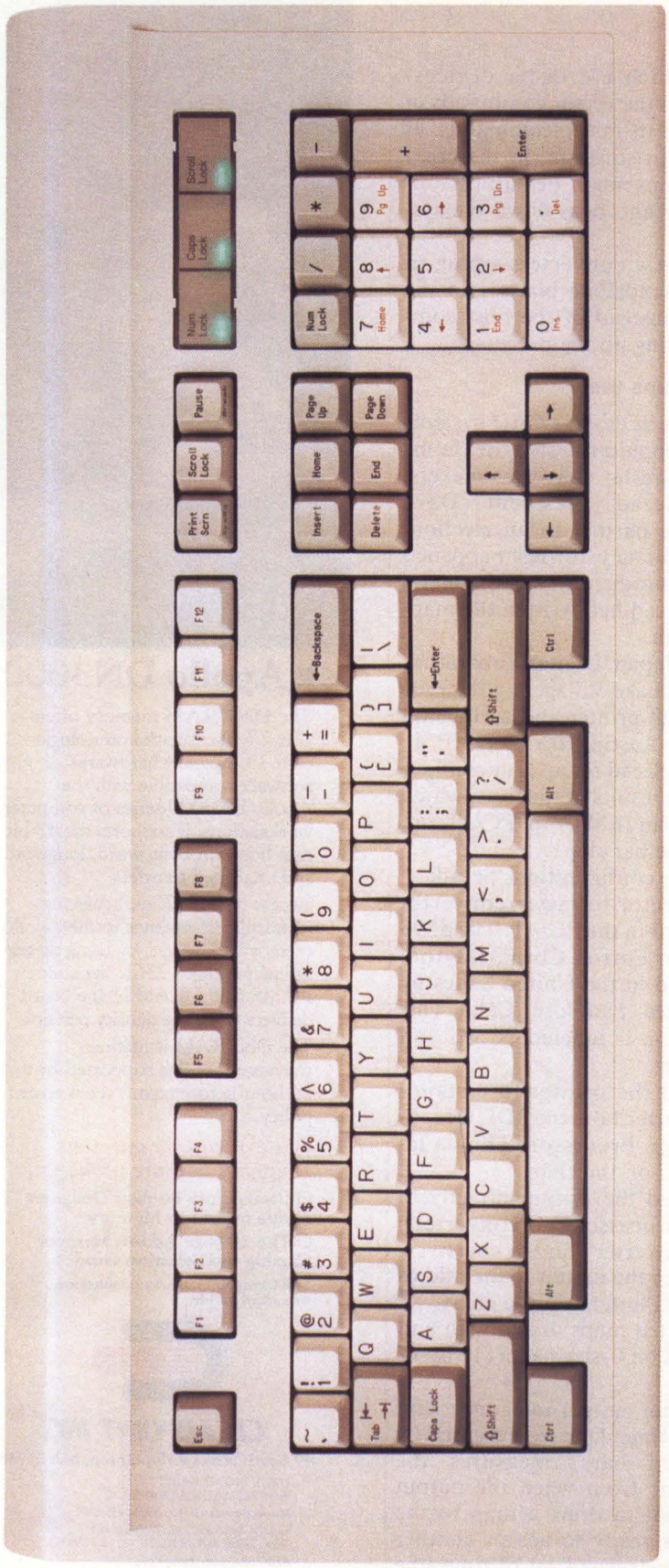

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the output device.

In all the tests, the configuration with the Eotron board won, clobbering especially the printer configuration without a converter and the plotter configuration. But it also did well against the standalone converter box from JDL.

The plug-in cards connect one printer to one microcomputer. The more expensive standalone boxes like those from JDL and from AMF Logic Science Inc., Houston, are designed to permit several computers to share one printer. For example, AMF's Turbograph 300 Series II ($2,995) converter allows up to seven computers to share one printer.

The JDL boxes come in two versions: one with 1.5M bytes of buffer memory ($1,290) and the other with 3M bytes ($1,690).

Vector-to-raster converters have been around for some time, but only as parts of expensive larger systems: for making color slides, for computer modeling. Among the companies that have joined Eotron/Alps in selling the converter plug-in cards by themselves is Advanced Matrix Technology Inc., Newbury Park, Calif. On the other hand, AST Research Inc., Irvine, Calif.; and LaserMaster Corp., Minnetonka, Minn., sell converter cards but only as elements in their printer products.

CAP International Inc., a printer-market analyst, believes that the Eotron/Alps card, at less than $600, sets a new, affordable price/performance level for vector-to-raster converters. CAP believes the affordability of the converters will boost printer sales by making printers attractive "all-in-one" printer-plotter hard-copy devices for microcomputer-based CAD systems.

Users get not only a faster drawing system but also a versatile printer for memos, reports and spreadsheets. □

Rick Dalrymple is editor of *Printout*, a monthly newsletter published by CAP International Inc., Marshfield, Mass., a consultant specializing in the printer industry.

Wire dot-matrix printers seek new applications

Carl Warren, Western Editor

Overshadowed by low-cost laser technology, wire dot-matrix printers are being forced into new roles—and possibly lower sales—but are still prominent in the application matrix.

With price tags ranging from $299 to $1,849, wire dot-matrix printers serve as workhorses in such applications as data-logging, general-purpose graphics and in-house near letter quality correspondence. But low-cost (under $5,000) noiseless laser printers have been usurping many of the applications that matrix printer manufacturers have considered their private—some industry watchers would say glutted—domain.

Despite surging laser-printer sales, wire dot-matrix printer manufacturers are still gearing up with a host of new products to match application needs in hopes of maintaining market share. For example, Epson America Inc., Torrance, Calif., recently unveiled the LQ-2500. This $1,595 printer offers four-color printing, a speed of 324 characters per second (cps) in draft mode and a 24-wire printhead, positioning it in the upper level of the wire printer categories.

But other factors make the LQ-2500 attractive as well. Specifically, to compete with laser printers, Epson's resident fonts—courier, prestige, sans serif, roman and script—add another level of selectability and flexibility for the user. To compete in the emerging forms-on-demand market, the printer contains an 8K-byte, built-in buffer to serve as a print buffer or a forms cache.

Rather than drop a new product on a market that industry watcher CAP International, Marshfield, Mass., says is flat at about 3.5 million units this year and last, C. Itoh Digital Products Inc., Torrance, Calif., elected to trade on its installed base. Specifically, $49.95 turns the existing ProWriter C-310/C-315 EP into a C-310 XP, which is switch-selectable between Epson and IBM Corp. escape codes. The upgrade makes the printer usable with virtually all the software on the market. "And we didn't have to retool the entire printer design to do it," says C. Itoh vice president Robert Cowan.

Prints big spreadsheets

One factor helping wire dot-matrix printer sales is the inability of laser printers to handle 17-inch-wide paper for large spreadsheets. A laser printer, for example, can print up to 136 columns, but only in a compressed font on legal-size paper. However, a full-size, 19-inch wire dot-matrix printer carriage can handle as many as 272 columns in compressed mode. And the OSP 3 from Newbury Data Inc., Hermosa Beach, Calif., uses an 18-wire printhead to print as many as 272 characters across an 8½-by-11-inch page.

But some end users are not too impressed. "Spreadsheets are about the only compelling reason to buy a wire dot-matrix printer today," says Jonathan L. Yarmis, personal computer analyst for General Instrument Corp., Clifton, N.J. He expects even that to change as more software and font libraries for laser printers become widely available.

"Wire dot-matrix printer manufacturers haven't really felt the pinch yet," says John Boldt, associate director of electronic printing for market researcher Nielson Dataquest Inc., San Jose, Calif. He sees some growth in sales of wire dot-matrix printers but suggests that the application role of the printers will change. "The laser printer has really impacted the fully formed character daisywheel business—sales are indeed down here—but only when multiple part forms aren't used." Boldt adds that the jury is still out on whether multiple originals can replace multiple-part-form documents.

Although some printer manufacturers are still betting that the demand for wire dot-matrix printers will outpace laser printer demand, Boldt predicts only a 10 percent growth for unit shipments in 1986. He adds, "Our April numbers seem to confirm that percent of growth (see chart), and it could slip some." By one estimate, Canon U.S.A. Inc. has shipped 622,000 laser engines (the heart of most laser printers) since 1985.

Growth projections of 10 percent or less would not be alarming in many businesses. But wire dot-matrix printer makers, especially those with marketing and business plans predicated on growth rates of 25 to 35 percent—rates not unusual 12 months ago—are rethinking strategies.

To counter the shifting market forces and the growing competition from laser printers, heretofore industry leader Epson and others seem to be hurried into making new product announcements that otherwise would have been held until Comdex/Fall 1986, or even until next year.

Epson product manager, Dennis J. Cox, says that just isn't so: "We just experienced one of our best quarters and are predicting an even better one this quarter." When asked about record sales, Cox responded that, as a private company, Epson didn't need to reveal them, and wouldn't. Dataquest's Boldt doesn't discount the Epson claim, but he is not ready to chalk up high numbers for the ensuing quarter either. Interestingly, Epson isn't planning to get "zapped" by lasers. The company is preparing a series of laser printers for 1987.

Ignore the indicators

Epson may be planning a laser printer contingent of its own, but other manufacturers are apparently ignoring the indicators. For example, Seikosha Co. Ltd., Cupertino, Calif., is bracketing the wire dot-matrix printer market at the low and high ends. Their $299 model SP-1000I operates from 20 to 100 cps. Although Seikosha is positioning this printer at the low-end home/hobby user, its price tag makes it acceptable in data-logging applications as well.

In the mid-range is the $995 Seikosha MP-1300 with a carriage that accommodates 17-inch-wide paper. The $1,849 BP-5420AI, on the other hand, prints as fast as 104 cps in correspondence mode, with an eight-pin printhead, and 420 cps in draft mode.

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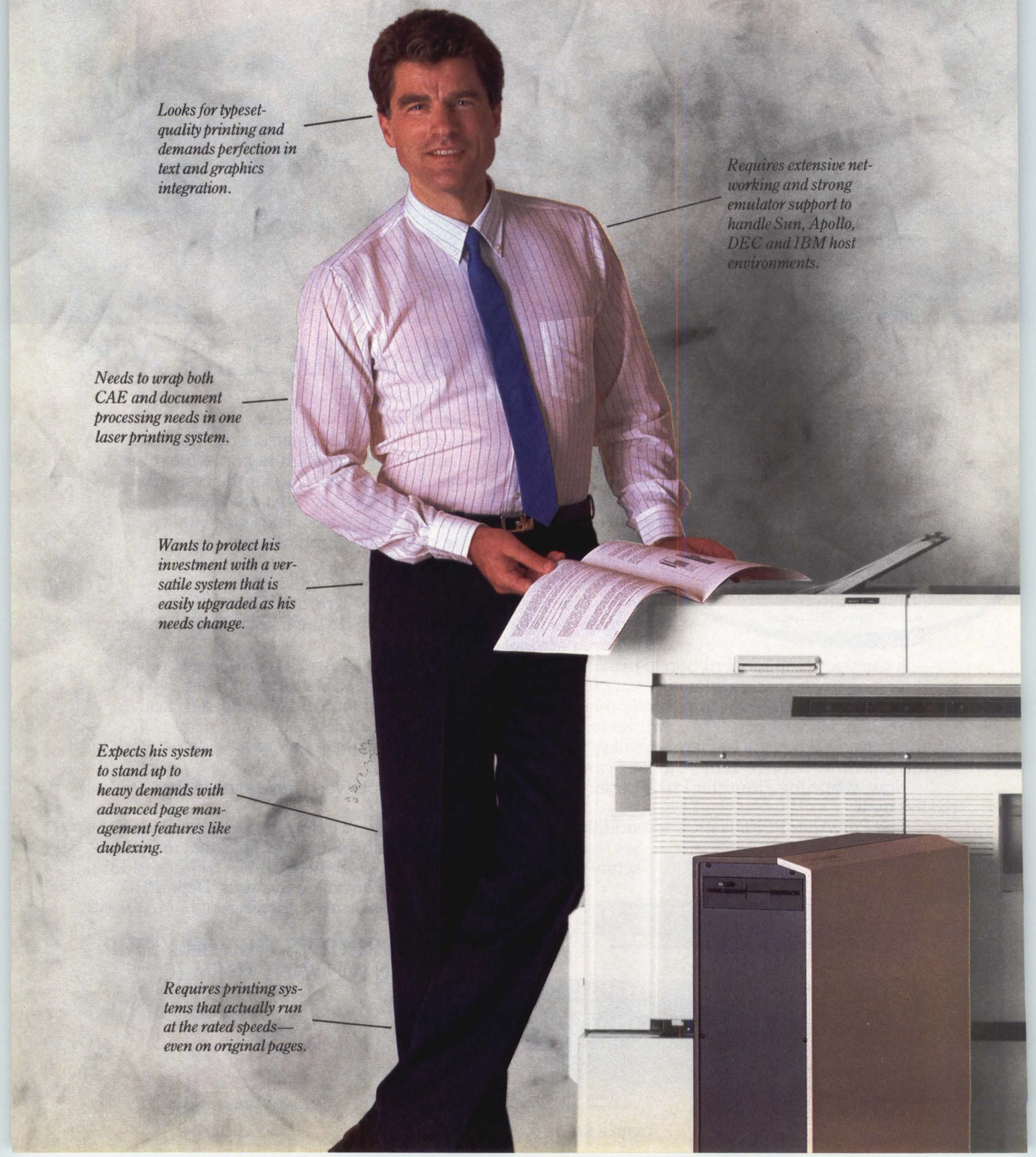
CIRCLE NO. 19 ON INQUIRY CARD

The Thinking



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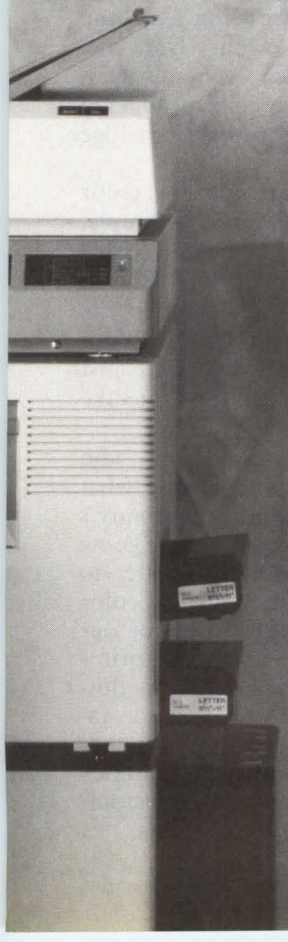

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CIRCLE NO. 20 ON INQUIRY CARD

INTERPRETER

Printronix Inc., Irvine, Calif., is offering the mid-range model P1013, priced at $795. The price tag is commensurate with the speed: 134 lines per minute (about 220 to 230 cps) in draft mode. Plug-in cartridges let the printer emulate the Epson LQ-1500 or, for letter quality requirements, a Diablo Systems Inc. 630 daisywheel —a tack that seems to indicate that Printronix is trying to position itself in the two-year-old emulation market that is shifting more to laser printers.

Competing with Epson and its LQ-2500 is Toshiba America Inc., Tustin, Calif. The full-size carriage model P351C, priced at $1,749, uses a 24-pin printhead. Toshiba, which also sells a laser printer, hopes to give users a low-cost alternative to laser printers by including Qume Corp.'s Sprint II daisywheel and IBM Color Printer emulation.

Color capability, once thought to be a major attraction, "isn't all that big a come-on," says a BusinessLand store manager in Los Angeles. Apparently, manufacturers agree. "We found color wasn't as desirable as everyone once thought," says J.M. Armstrong, managing director for Newbury Data Recording Ltd., the English parent of Newbury Data Inc. "As a consequence, we made it an option and built the color-producing mechanics into our ribbon cartridge —a $5 upgrade."

Other vendors are making color available as an option. For example, Seikosha charges $155 for a color upgrade kit for the MP-300; Epson asks for $99.95 to add color to the LQ-2500. However, Epson's Cox concedes that software vendors are just now creating applications that take advantage of color.

General Instrument's Yarmis, who is responsible for determining what printers best serve the company's needs, isn't convinced users are going to buy a wire dot-matrix printer to handle correspondence and color graphics chores. "Almost all of our new printer purchases are laser printers," he says. "We are relegating dot-matrix printers to garbage work: labels, spreadsheets and material that can be in draft quality." Graphics presentations for prospective customers are done by graphic artists. □

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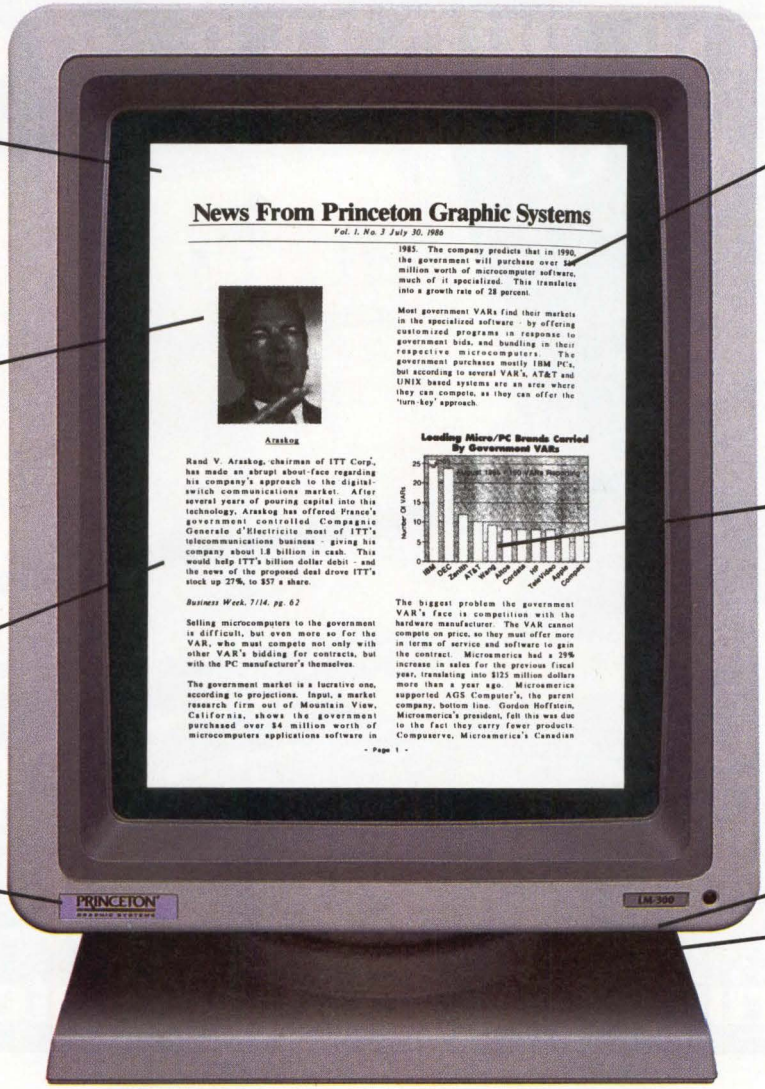

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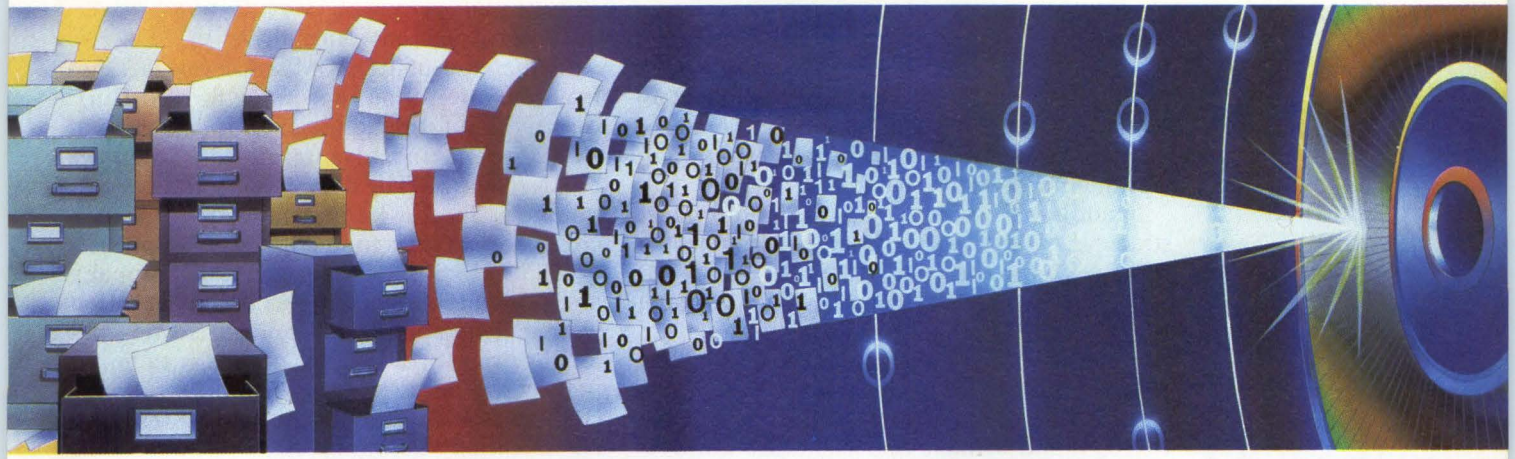
Plot sample produced on the 850 EWS printer/plotter with AutoCAD software.



Courtesy: C. Itoh Electronics Inc.

SOFTWARE TOOLS, UTILITIES DRIVE OPTICAL DISKS

Retrieval packages and specialized device drivers help system integrators link optical-storage devices to host systems and add value to information

Carl Warren, Western Editor

Storing gigabytes of information on plastic-like platters, optical technology promises to open up new opportunities for system integrators. However, exploiting these opportunities requires complex software.

Specifically, integration of an optical disk drive begins with the device driver and migrates upward to text-retrieval software and complex work-flow-management software tightly matched to the hardware.

Adding an optical drive, whether compact disk ROM (CDROM), write-once or—eventually—erasable isn't as easy as tucking an interface card into a convenient open slot on the backplane bus and turning it on. Optical drives, like most peripherals, require a device driver that matches the drive to the operating system, as well as a hardware controller, particularly when used with an intelligent interface, such as small computer systems interface (the SCSI).

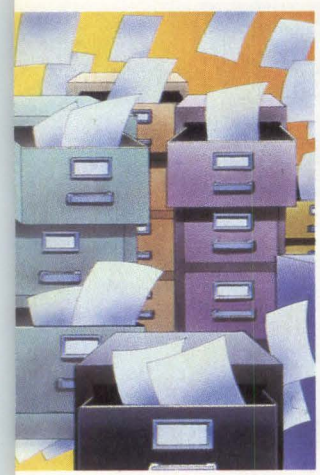
To this end, system integrators have been tailoring various operating systems to add the necessary device-driver features. Fortunately, not all this work has gone unnoticed. For example, Microsoft Corp. provides a software tool kit for system integrators to link CDROM to Microsoft's MS-DOS. According to Thomas Lopez, vice president of Microsoft's CDROM division, the product is just an underlying tool. "This is just a transfer product. It allows the data on the CDROM to be used on the computer. The real work is getting the data on the CD in the first place as enhanced information."

Turns to SCSI

But CDROM isn't the only optical-storage technology that is benefitting from device-driver innovation. Although Microsoft has been vocal in not supporting write-once optical technology, other companies aren't as reluctant. For example, Laserdrive Ltd., a manufacturer of 5¼-inch, write-once drives, takes a generic-SCSI device driver approach: "We've developed a generic driver that matches to MS-DOS or PC-DOS, UNIX or whatever operating system and always works the same way," says Chris Williams, manager of Laserdrive's software development.

Rather than reinventing the software wheel as new capacities and bells and whistles are added to the hardware, Laserdrive takes advantage of the capabilities of SCSI. "That's the idea behind SCSI," says Williams, "to minimize the impact on the system and lessen the

System integrators have been tailoring various operating systems to add the necessary device-driver features.



integration time. We essentially took SCSI at its word and developed a truly portable device driver as a result." Other optical disk manufacturers taking similar approaches in the use of SCSI include Optical Storage International, Optimem and Optotech Inc.

In addition, Laserdrive has changed product strategy. A year ago the company planned to make a $200 write once, read many (WORM) drive for low-cost systems. Now its model LD-33, scheduled for mid-1987 evaluation shipments, is aimed at the VAX and supermicrocomputer world.

Another company expecting to mine the CDROM and writable-optical-storage worlds is Storage Dimensions. Its $99 SpeedStor software utility allows system integrators to divide high-capacity disk drives up into logical segments of any size by modifying the sector and cluster size.

Managing hooks

Although the company currently markets SpeedStor as a magnetic-disk utility, "it does have hooks for managing devices with 20,000 tracks per inch," says vice president of engineering David Williams. "We see optical coming and the need to have the ability to weld it into a system, with the proper software." However, company president David Eeg adds, "Management of the storage system is really application-dependent. The size of the working file is the determinant of whether or not you mess with the size of track sectors or cluster tables."

Eeg and Williams are careful to point out that managing an optical disk isn't trivial. "There are problems with the use of special encoding; we already address that on magnetic disks with run-length limited codes. We jump from 17 sectors on a typical Winchester to 26 [on an optical drive] and that changes the overall operational characteristics of the system," says Williams.

Of course, overall system architecture is of key importance to system integrators. Specifically, how does one put the data onto, or retrieve it from, an optical drive.

In the case of CDROM, retrieval packages facilitate integration. According to Fred Durr, director of information science development at AIRS Inc., taking advantage of a CDROM is relatively easy. "The data is static and is never updated. So you know where it is and can create access tables to find it," which is precisely what AIRS does for users. The company assists clients in matching CDROM operation with specific applications and in creating tailored retrieval packages that have customized indexes and location tables. As such, software companies such as AIRS are finding that they are essentially becoming electronic-publishing consultants.

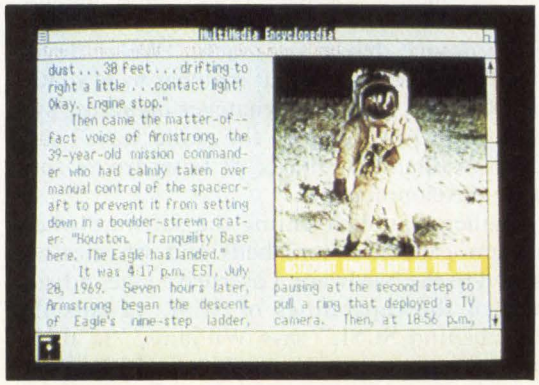
Similarly, Silver Platter Information Inc., a data preparation and optical-publishing company, develops customized retrieval packages for read-only media. But with the emergence of write-once and, eventually, erasable optical storage, most software vendors are betting on product plans that will work across a range of optical product types.

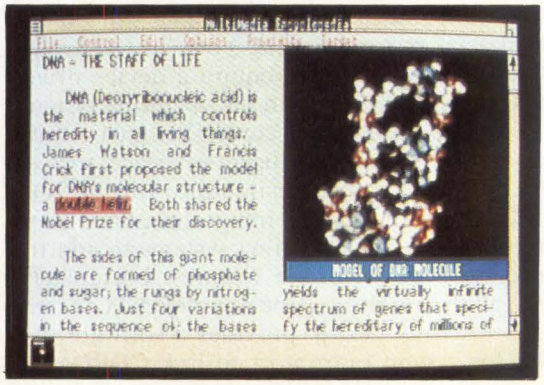
One company that offers an off-the-shelf data-retrieval and file-management package is Franklin Telecommunications. Franklin bundles its Archive Management System (AMS) software with 200M-byte Optotech drives. The bundled system, the FLD 200, carries a suggested retail price of $5,995, including a controller card that plugs into a personal computer slot. It's aimed at the end-user market.

An alternative to B-trees

Sophisticated access methods form the basis of retrieval software. The most popular is the B-tree method, which requires a series of requests to locate data. For example, finding dappled gray horses in a CDROM encyclopedia requires the user to enter: horse, dappled and gray as a series of separate entries. With each entry, the search is refined and eventually the data is located.

C. Wayne Ratliff, creator of Ashton-Tate's dBASE II and III, suggests an alternative method, claiming that the index-description access





Microsoft's "electronic encyclopedia" *optical-disk concept combines text and graphics along with "hot key" access to additional subject matter—as identified by the color-coded words in the text.*

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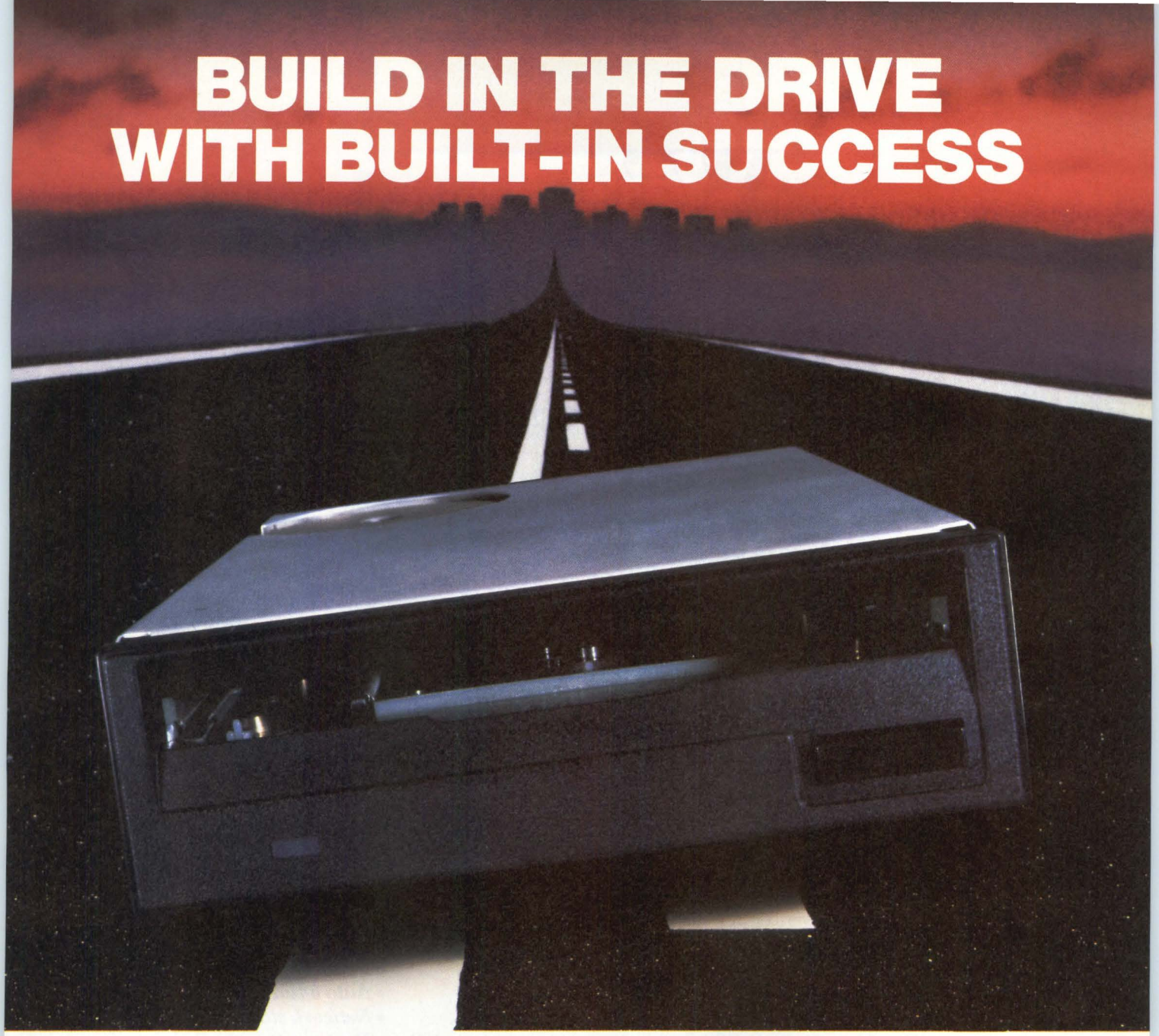

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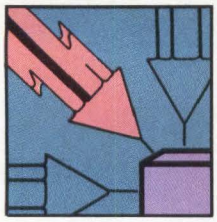

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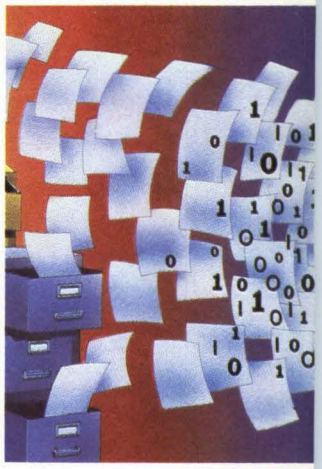
CIRCLE NO. 25 ON INQUIRY CARD

method (IDAM) is the ideal approach. IDAM is an access method that uses hashing tables to encode the data, which allows faster access speeds compared to other methods. "The search process is speeded up because all the data is coded as a minimal series of bit patterns. The requested information is converted the same way and either a yea or nay is given as to whether the information exists or not," explains Ratliff.

Alan Bartholomew, president of Trio Systems and developer of the $395 C-Index utility package—a set of C language utilities used to create databases—explains that, with IDAM, "Essentially, you are continually reducing the granularity of the data until it matches a specific bit pattern." Although IDAM promises a two- to ten-fold increase in access speed, to date none of the optical disk manufacturers have implemented it, primarily because it's a relatively new concept and there aren't any off-the-shelf IDAM packages available.

Once IDAM is part of retrieval systems, however, users will be able to make lengthy verbal queries such as, "Find all the pictures of men on the moon." Essentially, this is the method Microsoft plans to implement in its "electronic encyclopedia" concept, which combines alphanumeric data with complex graphics. "That's the nice thing about IDAM," says Bartholomew, "the locator can be anything, because everything is reduced to a bit pattern." Bartholomew expects that the Microsoft system will be a combination IDAM and B-tree, indexed sequential access method (ISAM) files.



Value added to the data

"Creating device drivers and developing index methods is only part of the electronic publishing problem," says Microsoft's Lopez. He contends that this is a new form of optical-disk publishing that requires the skills of a variety of disciplines. "Optical storage is making information dynamic—and that requires a great deal of skill." Key to this new type of publishing is the integration of high-density graphics and text.

PictureWare Inc., for example, developer of the $945 Picture Power package—which allows capturing pictures from video, scanners, or computer-generated graphics as well as adding continuous tone—expects to see its product being used to develop large optical-disk libraries of sophisticated images. "With a library of computer graphics, video images or whatever to choose from, users will be able to make their information resources much more meaningful," says Peter Kendall, vice president of marketing for PictureWare.

Similarly, Three D Graphics president Elmer

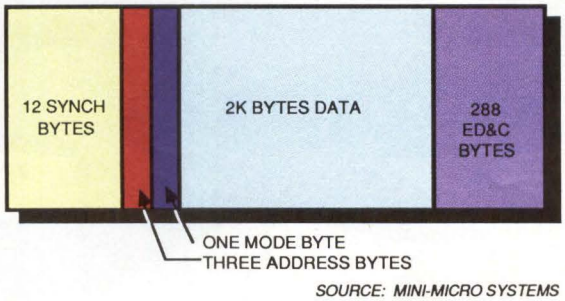
Physical and logical formats determine efficiency

The method of arranging the data elements—bits—on the disk is critical for achieving the best possible use of a storage device. As with all data-storage devices, data is written one bit at a time on an optical disk. This bit-pattern builds up bytes of information—representing characters such as the letter S, which has the binary form: 01010011. On an optical drive, the "ones" are represented as pits or bumps, depending on the technology employed.

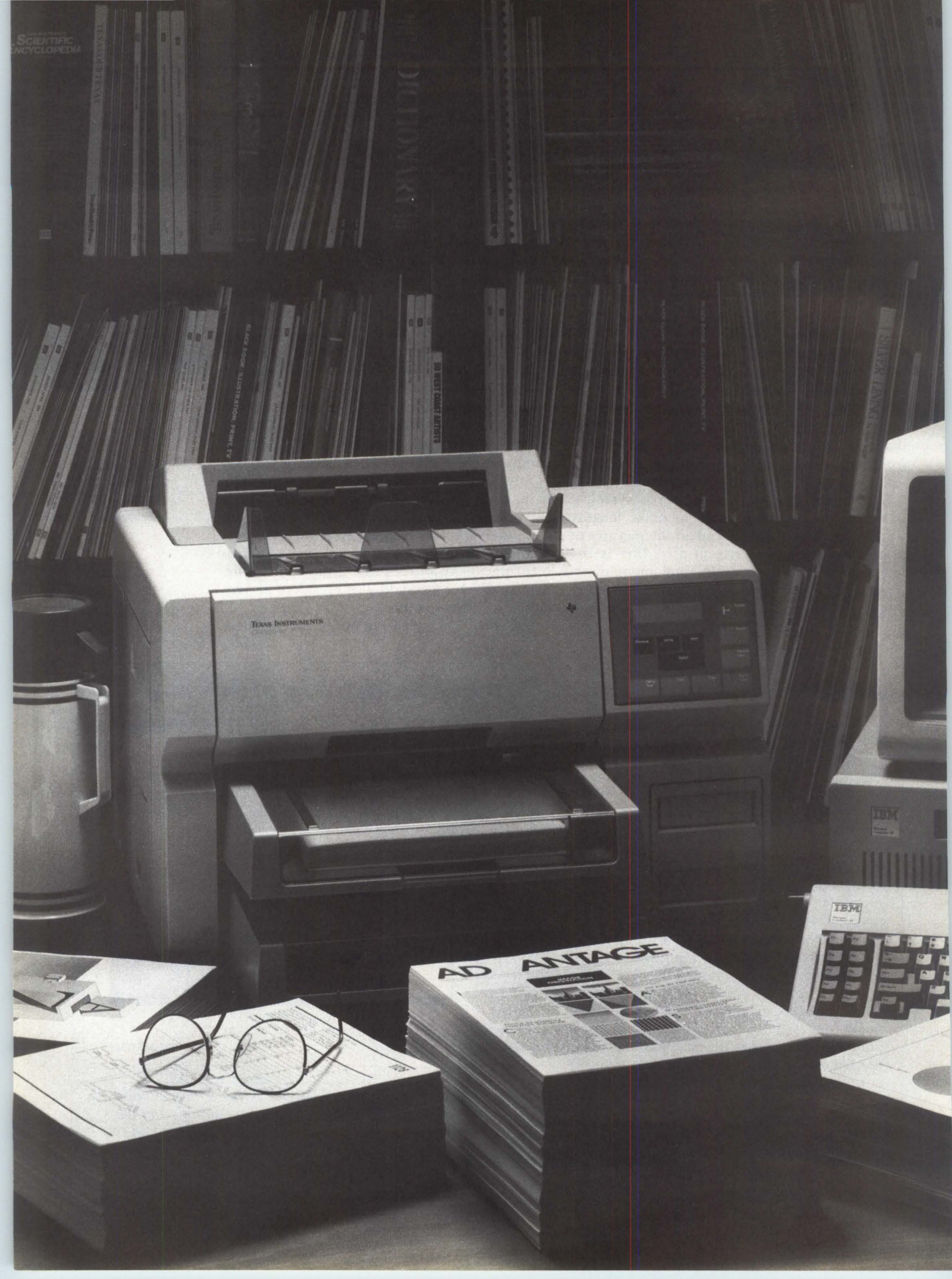
But putting individual bits and bytes onto the media is only part of the problem. The data elements must be arranged in some manner as to form an information packet that takes advantage of the specific characteristics of the device. This arrangement is known as the physical format, and it is established at the time the media is certified, or formatted. One example of a physical format provides header information, synchronization bytes, an address mark (which denotes physically where the data is on the platter) and the data bytes followed by error-detection and correction byte fields (see figure).

The logical format, on the other hand, is an agreement among vendors on how the data elements will be arranged within the physical format. Currently, compact disk ROM (CDROM) vendors are betting on the High Sierra logical file format now under consideration by the ANSI X3B11 committee.

Write-once optical drive vendors aren't faring as well as their CDROM counterparts because the LD-1 subcommittee on write-once and erasable optical drive logical file interchange formats is currently inactive. The logical format is of critical importance, because it is the determining factor of whether products from various vendors can be interchanged.



This example of a CDROM *physical format uses spiral-track recording with the data arranged in packets consisting of 12 synchronization bytes, three address bytes, a mode byte and 2K bytes of data, followed by 288 bytes of error-detection and correction.*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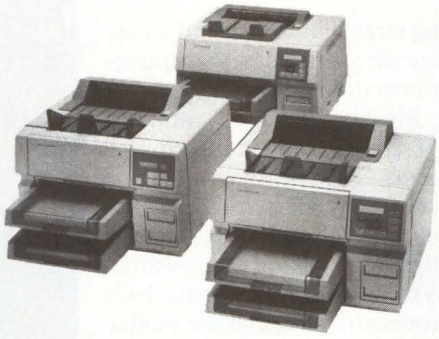
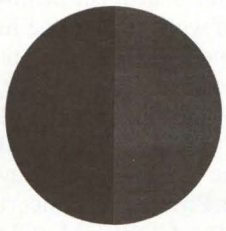
TI's new OmniLaser™ page printer can turn your PC into a desktop publishing system.



Combined with the right software, you can now have a publishing house right on your desktop.

TI's OmniLaser with any IBM®-compatible, Apple® or virtually any PC, and the right software, can help you reduce costly typesetting, outside design work and printing. The quality of your business communications will be greatly enhanced and more eye appealing, lending more credibility to your message. At 300 dots per inch resolution, the difference between laser printing and daisy wheel or dot matrix is more than mere improvement. It's light-years ahead.

The OmniLaser Series 2000 family from Texas Instruments is available in three desktop models designed to address workstation and shared-resource environment needs (8 or 15 pages per minute depending on model). Both the 2108 and 2115 feature the PostScript™ page description language which allows full integration of text, graphics and scanned images on a single page. And the Model 2015 was designed to handle text and business graphics in a shared-resource environment. All three OmniLasers, with their standard interfaces and emulators, allow you to take full advantage of your present business computer applications as well. And they'll give you unparalleled resolution in both text and graphics. Blacks are black, whites are white, and you control the shades of gray.



Ours Theirs

The OmniLaser uses the direct positive-imaging exposure process as opposed to the reverse-imaging exposure process used by many other laser printers. The difference, as shown above, is obvious.

The second generation can do more, but costs less.

Overall, TI's second generation laser printers offer up to 10 times the duty cycle, 15 times the machine life and five times the paper capacity offered on their first generation counterparts. These advances, coupled with lower maintenance costs and user-replaceable consumables, significantly reduce the costs of ownership. In fact, at pennies per page, the OmniLaser's per page cost is among the lowest in the industry.

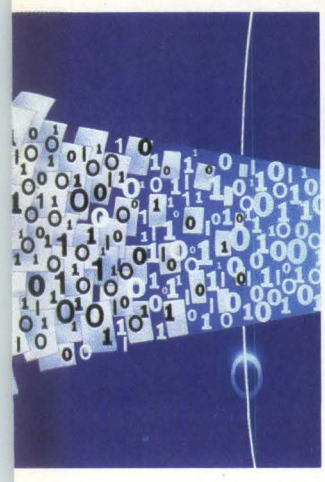
TI OmniLasers and the power of PostScript.

PostScript is a description language that can drive OmniLaser Models 2108 and 2115 printers to their full capabilities. Whether you're composing newsletters, product data bulletins, ad proofs, business presentations, technical manuals, or any type of document, you'll find that with the power of PostScript, the only limit to what you can do is your own imagination.

OmniLasers. They bring power, flexibility and affordability to the world of desktop publishing.

Turn your desktop into a publishing house. For more information on the new OmniLaser 2000 Series page printers from Texas Instruments, call toll-free **1-800-527-3500.**

TEXAS INSTRUMENTS



Easton expects that as writable optical storage becomes available, users of the company's $449 3-D Perspective package will be creating in-house libraries of 3-D views of technical and marketing information.

And Media Cybernetics offers tool kits ranging from the $300 Halo graphics-development package to the $2,000 Image-Pro 1000 for capturing images and enhancing them to assist integrators in adding value to optical subsystems. In short, vendors agree that the best optical disk systems combine graphics with a powerful underpinning of retrieval and device software.

Makes information interactive

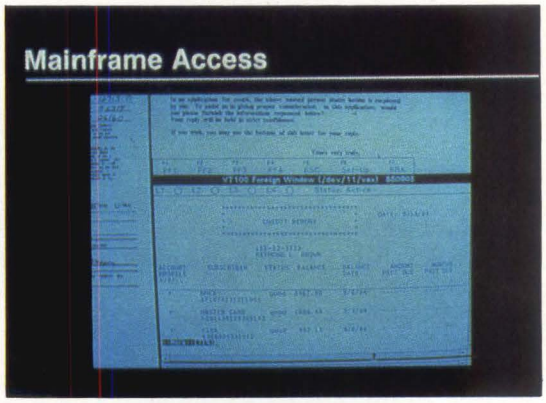
Besides providing large amounts of information, optical storage also provides the opportunity to make information more interactive. Indeed, that's the idea behind the "compact disk-interactive" (CD-I) approach developed by Microware Systems Corp., Philips Information Systems Inc. and Sony Corp. of America. The CD-I methodology combines CDROM media and an intelligent box using Microware's OS/9 operating system and a Motorola Inc. MC68000 microprocessor. Although the media is standard, the information is multimode (e.g., data, audio, and video are part of the retrievable data).

Detractors of the CD-I approach warn people not to get their hopes up. Microware president Ken Kaplan isn't holding out near-term promises either: "There is a lot of work to be done in the definition of the file standards and development of special integrated circuits for data, video and audio compression," he says. CD-I disk drives probably won't be available until late 1987, but by then the media form may change. The reason is that Philips, in concert with Sony, is developing the CDPROM (CD programmable ROM), a write-once version of the compact disk that will be easy to replicate in mass quantities.

Although most of the work in optical technology appears to be for small systems, in reality most of the advances have occurred at the high end. These optical systems are aimed at Fortune 1000 companies.

Specifically, companies like C. Itoh Electronics Inc. and FileNet Corp. have created workflow-management systems that use optical storage devices as the primary data-storage elements. "The file sizes are in the 2K- to 3K-byte range and larger—it depends on the complexity of the images," says David Seigle, vice president of marketing for FileNet.

Unlike most optical systems, which cost under a few thousand dollars, the systems offered by C. Itoh and FileNet are expensive—costing as much as $500,000.

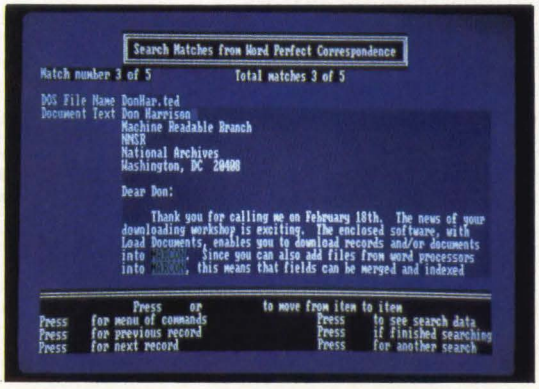


The major gain *in using an optical-disk-based information-management system is putting a document in electronic form for instant retrieval. For example, this document, which began as a piece of paper, was entered into the FileNet system via an optical scanner and stored on an optical disk. The document is available to any workstation on the FileNet local network.*

C. Itoh's Laser Optical filing system costs $125,000. The system consists of a document scanner, high-resolution CRT and an Hitachi America Ltd. 12-inch, 2G-byte write-once optical drive. The Laser Optical filing system suits medium-size companies caught in the crunch of storage cost per square foot. The goal isn't necessarily to share the data among several users but, rather, to eliminate file cabinets.

Similarly, start-up Tecex Inc. offers a $21,000 subsystem using Alcatel Thomson Gigadisc Inc.'s 2G-byte, 12-inch Gigadisk, which includes the SCSI interface and host adapter for a Digital Equipment Corp. VAX. The subsystem also includes software drivers that allow use of the full operating system commands without modification. However, application software is the user's responsibility.

Another company with a unique twist to optical-disk subsystems is Aquidneck Data Corp. Its Optical Archiving Subsystem (OAS) 100, designed to replace half-inch, Pertec Peripherals Corp. tape drives, is an emulation



Incorporating an easy-to-use *interface, the AIRS full-text retrieval system locates information on an optical disk by indexing each word in the database, allowing explicit retrieval.*

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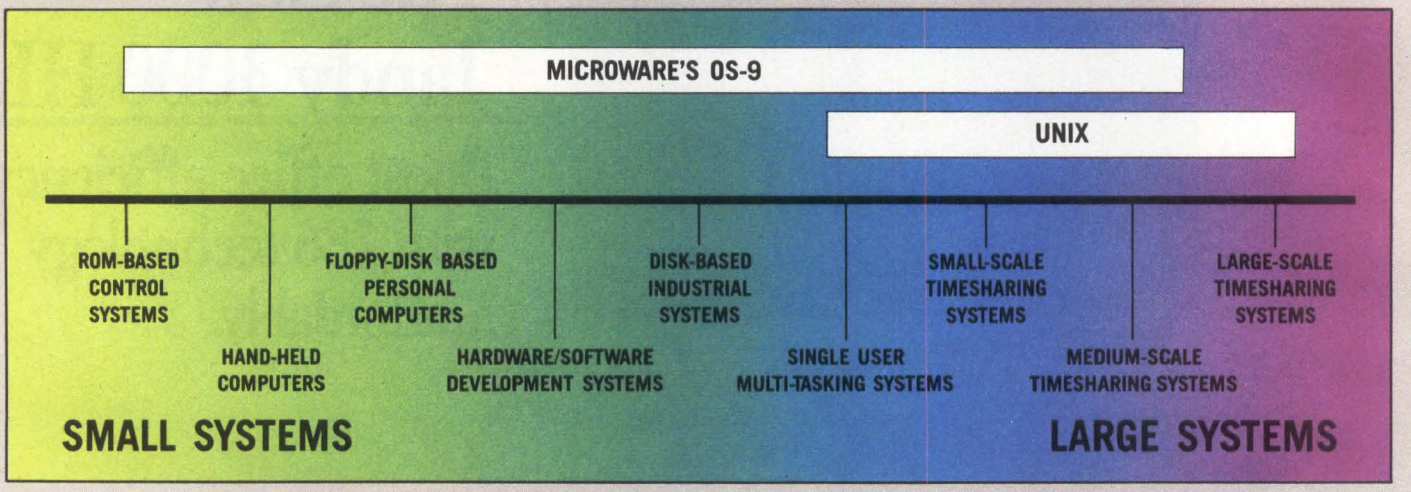
CIRCLE NO. 27 ON INQUIRY CARD

Only Microware's OS-9 Operating System Covers the Entire 68000 Spectrum



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

OS-9 is versatile, inexpensive, and delivers outstanding performance on any size system. The OS-9 executive is much smaller and far more efficient than Unix because it's written in fast, compact assembly language, making it ideal for critical real-time applications. OS-9 can run on a broad range of 8 to 32 bit systems based on the 68000 or 6809 family MPUs from ROM-based industrial controllers up to large multiuser systems.

OS-9'S OUTSTANDING C COMPILER IS YOUR BRIDGE TO UNIX

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

SUPPORT FOR MODULAR SOFTWARE — AN OS-9 EXCLUSIVE

Comprehensive support for modular software puts OS-9 a generation ahead of other operating systems. It multiplies programmer productivity and memory efficiency. Application software can be built from individually testable software modules including standard "library" modules. The modular structure lets you customize and reconfigure OS-9 for specific hardware easily and quickly.

A SYSTEM WITH A PROVEN TRACK RECORD

Once an underground classic, OS-9 is now a solid hit. Since 1980 OS-9 has been ported to over a hundred 6809 and 68000 systems under license to some of the biggest names in the business. OS-9 has been imbedded in numerous consumer, industrial, and OEM products, and is supported by many independent software suppliers.

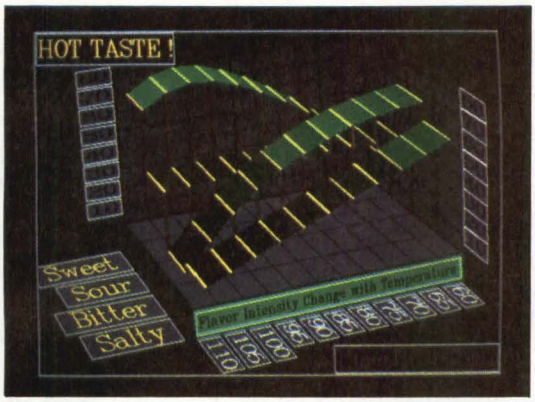
Key OS-9 Features At A Glance

- Compact (16K) ROMable executive written in assembly language
- User "shell" and complete utility set written in C
- C-source code level compatibility with Unix
- Full Multitasking/multiuser capabilities
- Modular design - extremely easy to adapt, modify, or expand
- Unix-type tree structured file system
- Rugged "crash-proof" file structure with record locking
- Works well with floppy disk or ROM-based systems
- Uses hardware or software memory management
- High performance C, Pascal, Basic and Cobol compilers

microware®
OS-9™

MICROWARE SYSTEMS CORPORATION
1866 NW 114th Street
Des Moines, Iowa 50322
Phone 515-224-1929
Telex 910-520-2535

Microware Japan, Ltd
41-19 Honcho 4 Chome Funabashi City
Chiba 273, Japan
Phone 0474-22-1747
Telex 298-3472



Because optical technology *permits storage of massive amounts of information—including video images, computer-generated graphics and half-tones—companies such as Three D Graphics are speculating that users will want enhanced images, such as the 3-D shot shown above, to give greater depth to the information.*

box based on an MC68010 microprocessor with full file-management in firmware. System integrators can plug the box into the Pertec port on the host system and attach any optical drive to the OAS 100 via a SCSI interface. No changes are required to the host operating system. The OAS 100 box costs $15,000 in small OEM quantities. With a 2G-byte, 12-inch write-once optical drive, cabling and a terminal, the system costs $39,500.

FileNet offers a complete network-based work-flow-management system. "The optical storage is the anchor end," says marketing vice president Seigle, "not the solution." He contends that the solution is the overall system, which aims at production-office environments, characterized by multiple workstations performing repetitive tasks.

The FileNet system is essentially a localized network that links to the company network via a gateway. The system includes digital scanners for images and character recognition, high-speed printers and workstations, and the optical filing system in a multiplatter automated jukebox configuration.

Rather than generate multiple pieces of paper that are continually handed down the production line, the FileNet system eliminates all but the original document. Once scanned into the system, the document goes into an electronic file folder in much the same manner as with the C. Itoh system. But the document is instantly sharable among all the attached workstations and can be updated as would be done in a bank, credit card company or insurance company.

Achieving this management of the work flow

Companies mentioned in this article

AIRS Inc.
335 Paint Branch Drive
College Park, Md. 20742
(301) 454-2022
Circle 301

Alcatel Thomson Gigadisc Inc.
16 Depot St.
Franklin, Mass. 02038
(617) 528-8890
Circle 302

Aquidneck Data Corp.
170 Enterprise Center
Middletown, R.I. 02840
(401) 847-7260
Circle 303

C. Itoh Electronics Inc.
19300 S. Hamilton
Torrance, Calif. 90248
(213) 306-6700
Circle 304

Cygnet Systems Inc.
601 W. California Ave.
Sunnyvale, Calif. 94086
(408) 773-0770
Circle 305

FileNet Corp.
3530 Hyland Ave.
Costa Mesa, Calif. 92626
(714) 966-2344
Circle 306

Franklin Telecommunications
31320 Via Colinas, #114
Westlake Village, Calif. 91362
(818) 706-1186
Circle 307

Hitachi America Ltd.
950 Elm Ave.
San Bruno, Calif. 94066
(415) 872-1902
Circle 308

Laserdrive Ltd.
1101 Space Park Drive
Santa Clara, Calif. 95054
(408) 970-3600
Circle 309

Microsoft Corp.
16011 N.E. 36th Way
P.O. Box 97017
Redmond, Wash. 98073-9717
(206) 882-8080
Circle 310

Microware Systems Corp.
1866 N.W. 114th St.
Des Moines, Iowa 50322
(515) 224-1929
Circle 311

Optical Storage International
3333 Scott Blvd.
P.O. Box 58063
Santa Clara, Calif. 95052
(408) 496-3236
Circle 312

Optimem
435 Oakmead Parkway
Sunnyvale, Calif. 94086
(408) 737-7373
Circle 313

Optotech Inc.
770 Wooten Road
Colorado Springs, Colo. 80915
(303) 570-7500
Circle 314

Philips Information Systems Inc.
15301 Dallas Parkway
Dallas, Texas 75248
(214) 980-2000
Circle 315

PictureWare Inc.
111 N. Presidential Blvd.
Bala Cynwyd, Pa. 19004
(215) 667-0880
Circle 316

Silver Platter Information Inc.
37 Walnut St.
Wellesley Hills, Mass. 02181
(617) 239-0306
Circle 317

Sony Corp. of America
1 Sony Drive
Park Ridge, N.J. 07656
(201) 930-6585
Circle 318

Storage Dimensions
Suite 114127
Capri Drive
Los Gatos, Calif. 95030
(408) 370-3304
Circle 319

Tecex Inc.
1061 S. Melrose Ave.
Placentia, Calif. 92670
(714) 632-6672
Circle 320

Trio Systems
Suite 289
2210 Wilshire Blvd.
Monica, Calif. 90403
(213) 394-0796
Circle 321

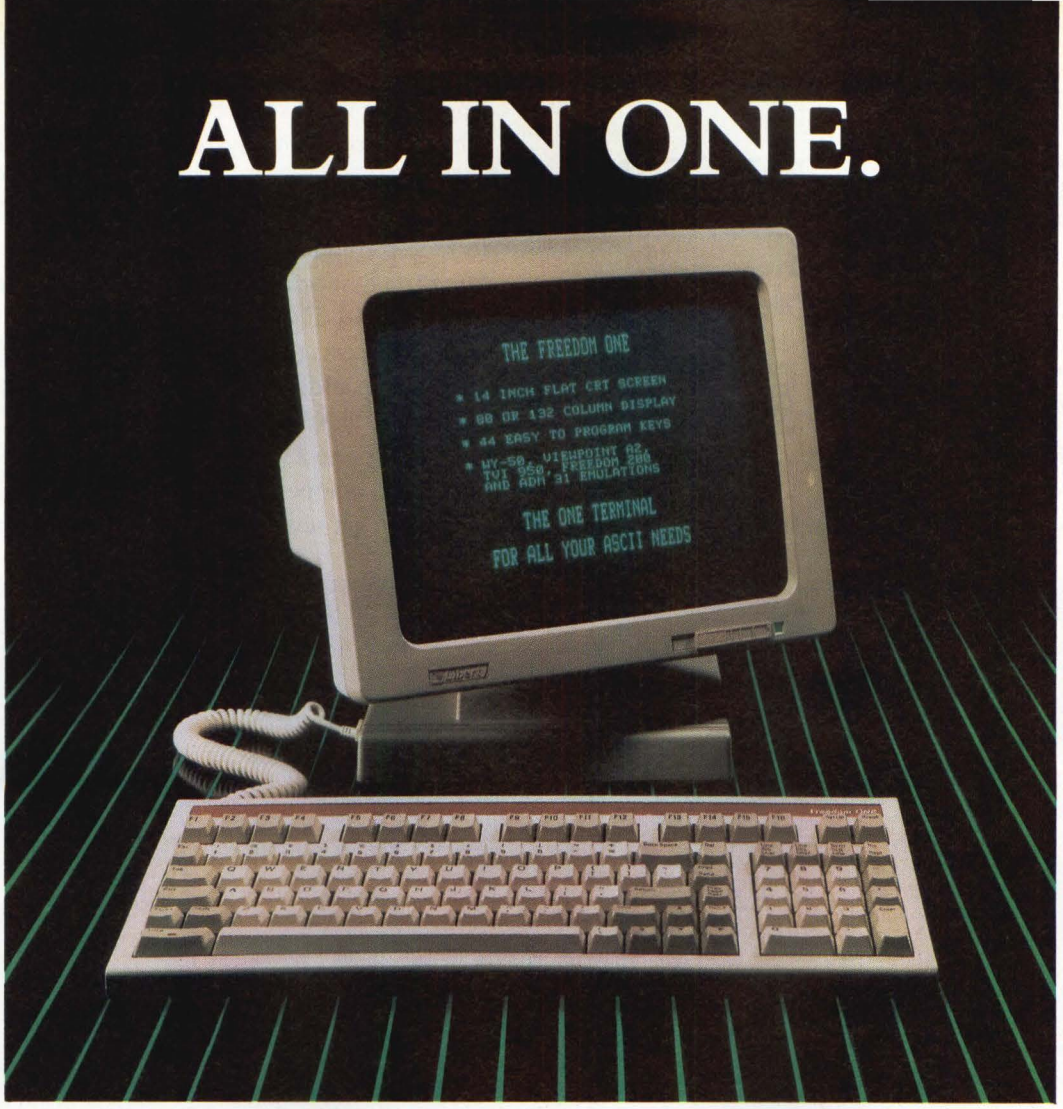
and of electronic documents requires complex software: specifically, a combination of device drivers, controlling software for the jukebox, and work-flow-management software for the documents.

Another company targeting complete optical solutions for OEMs and system integrators is Cygnet Systems Inc., until recently known only as a supplier of optical-disk jukeboxes. However, the company's new Series 2000 Smart Jukebox bundles file-server software, optical drives from a choice of manufacturers, 68020-based file-server engine and UNIX System V. The Series 2000 also includes network communications services.

Unfortunately, tightly integrated software such as that found on the C. Itoh, Cygnet or FileNet systems, isn't readily available with smaller systems. Other problems with 5¼-inch optical drives include high defect counts on the media, which require expensive error-correction codes in the controller. It takes a great deal more than just tacking a scanner and an optical drive onto a personal computer. The work is really done in the software, and that takes time and dollars, both of which are in short supply in the low-end market. □

Interest Quotient (Circle One)
High 483 Medium 484 Low 485

ALL IN ONE.



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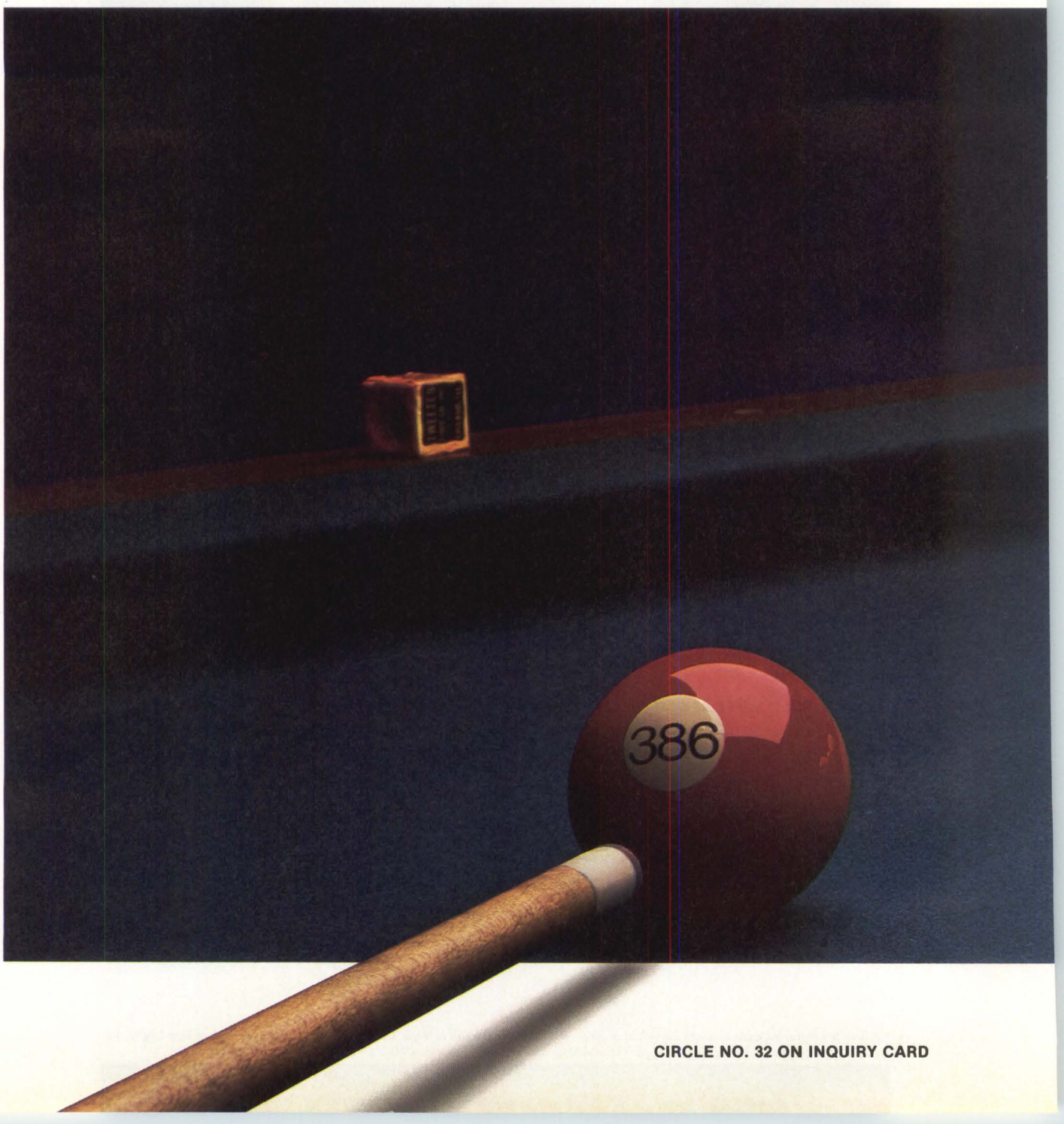

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For example, they can run Lotus 1-2-3,* WordStar* or dBase* III at the same time they're working on the NGEN® word processor, graphics or Multiplan.*

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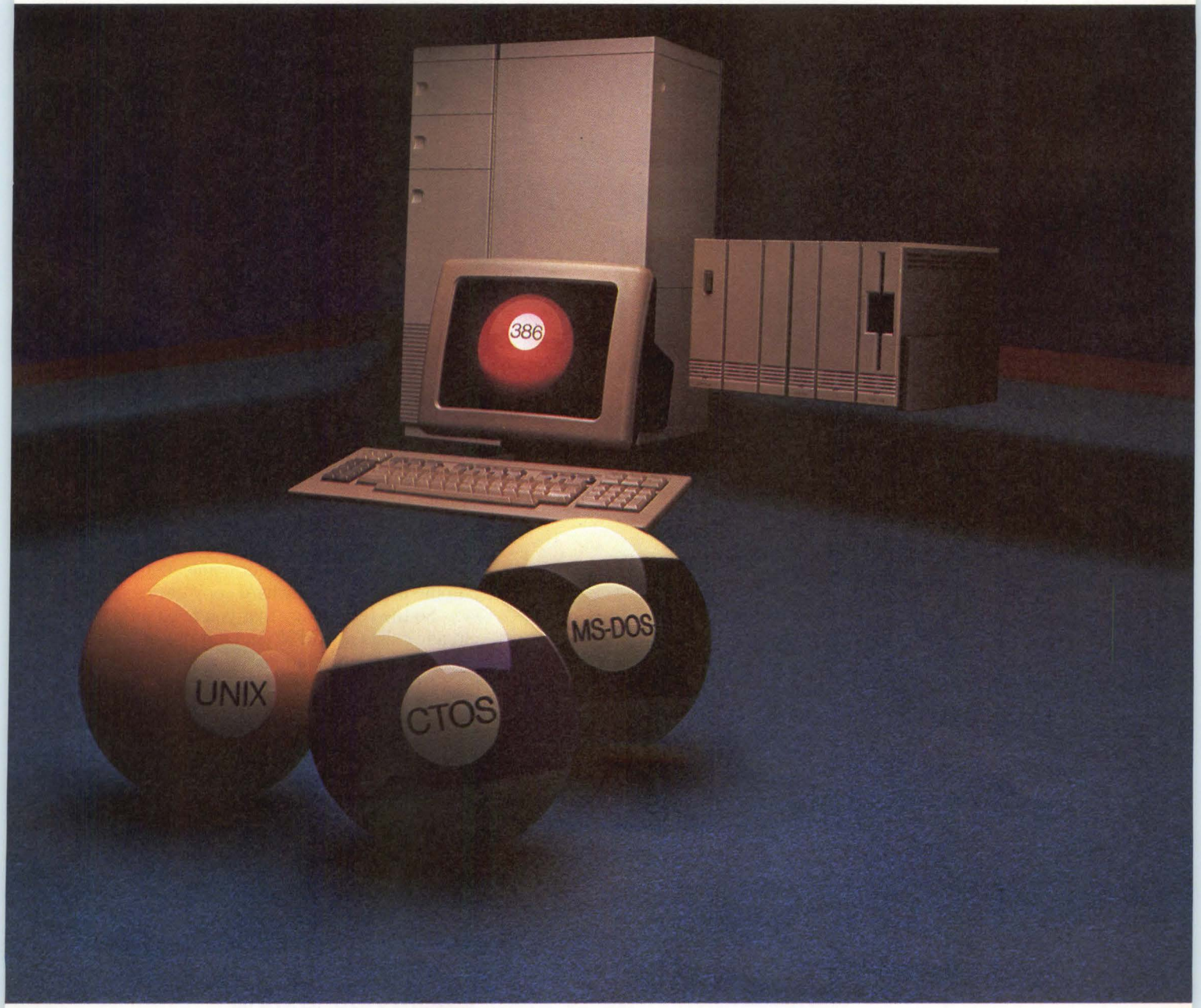

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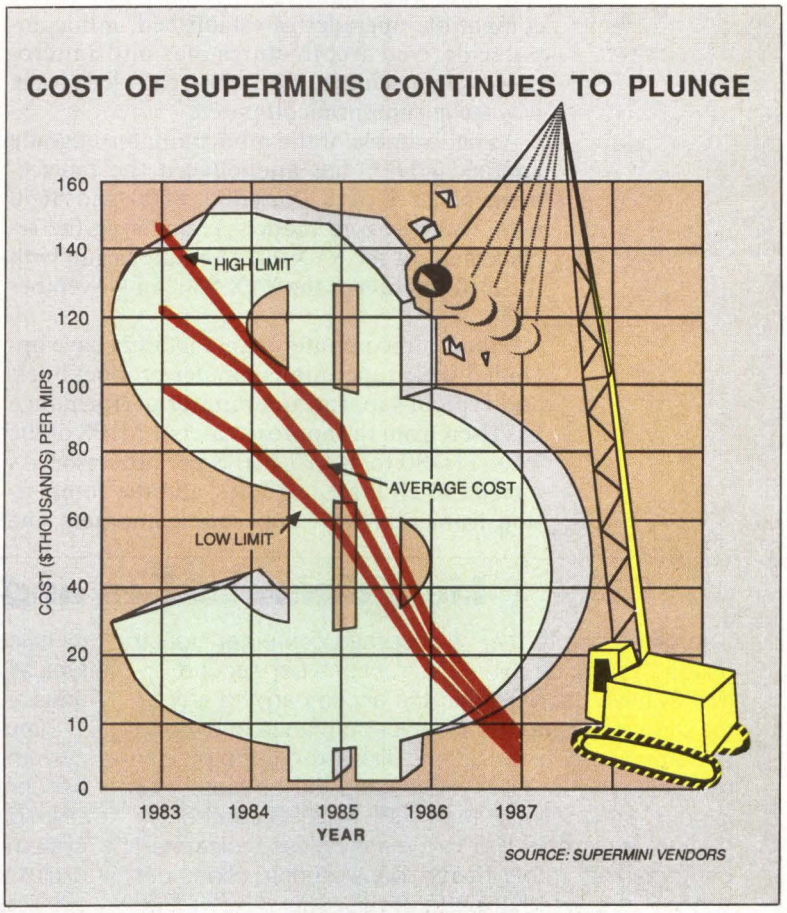
Andrew Allison, Contributing Editor

The-slow-but-steady standardization of operating systems and languages is blurring the distinction between 32-bit minicomputers and microcomputers. Uniprocessor 32-bit microcomputers are becoming the mainstay of high-performance desktop workstations. Superminicomputers with 32-bit processors are proliferating in network-server and departmental-computer applications.

In satisfying the demands of these applications, OEMs, system integrators and value-added resellers face a plethora of increasingly powerful machines. And reduced instruction set computers (RISCs) and application-specific processors are fueling a surge in superminicomputer performance.

This fast pace of technological change is restructuring the superminicomputer market with resulting confusion and concern among resellers and their customers. This problem has undoubtedly contributed to the slackening of demand for superminicomputers during the past two years.

There are, at present, three broad categories of superminicomputer. The first includes systems derived from traditional minicomputers. The second encompasses multimicrocomputers based on 20 or more merchant-market 32-bit microprocessors. The third category, "new wave" superminicomputers utilizing RISC microprocessors, is just emerging and is destined to become a major force in the marketplace.



Upgrades of superminis *via new technology and increased competition have kept the machines' average cost per MIPS on a downward course.*

Superminis bolster capabilities

All of the commercially available superminicomputers have conventional, von Neumann, architectures. More specialized multiprocessor configurations may include fault-tolerant, parallel and massively parallel systems.

A little history helps put the current state of superminicomputer development in perspective. At the end of 1983, all of the participants in the market were longtime minicomputer suppliers offering second- or third-generation superminicomputer products. Complete entry-level systems, comprising an operating system, 2M to 4M bytes of memory, rigid disk storage and backup plus an eight-line communications controller, were available from several vendors at a cost of less than $100,000 per million of instructions per second (MIPS). The average

cost of such systems was around $120,000 per MIPS.

In September 1983, IBM Corp. introduced the 4361 superminicomputer—which offered Digital Equipment Corp. VAX-11/780 performance at a lower cost—and an equally competitive high-end product, the 4381. The pricing of these machines—less than half the cost of previous 4300 models—provided the impetus for a dramatic, across-the-board improvement in the superminicomputer price/performance ratio. (IBM's recently introduced 9370 family of machines provide a comparable price/performance improvement.)

By 1986, superminicomputer evolution had split into two main paths. One path was of compatible upgrades of established, minicomputer-derived architectures plus multimicroprocessor machines. The other path led to the new wave superminicomputers.

As an example of the minicomputer-upgrade approach, DEC has annnounced the replacement of its VAX 8200, 8300, 8600 and 8650 with VAXBI-based models, completing the replacement of the VAX-11/7XX line begun with the introduction of the VAX 8600 in November 1984.

Other minicomputer manufacturers have upgraded their superminicomputer product lines, and typical superminicomputer performance has risen from the approximately 1 MIPS of the VAX-11/780 to 4- to 7-MIPS per processor. As a result of all these upgrades, and the competition from new wave superminicomputers, the average entry-level price of a 1-MIPS class superminicomputer had fallen to around $20,000 by mid-1986.

Minicomputer-derived superminicomputers, like most computers designed during the '60s and '70s (and all of the 32-bit microprocessors currently in volume production), are microprogrammed computers with complex instruction sets heavily influenced by their minicomputer forebears. Low-end products typically make use of metallic-oxide-semiconductor, VLSI semiconductor components; the mid-range systems, application-specific transistor to transistor logic (TTL) bit-slices and/or gate arrays.

High-end products utilize emitter-coupled logic (ECL). Operating systems, like the architectures themselves, are proprietary, although the influence of UNIX is being felt, and most vendors now support it.

New wave superminis make splash

The first of the new wave superminicomputers, based on RISCs, were produced by Ridge Computers Inc. and Pyramid Technology Corp. in the second half of 1983. Two more RISCs, from Celerity Computing Inc. and Computer Consoles Inc. (the latter later remarketed by both Harris Computer Systems and Sperry Corp.), followed in 1984.

Hewlett-Packard Co., a long-established minicomputer supplier, announced its first 32-bit superminicomputer product in February (MMS, March, Page 29). HP Precision Architecture machines, also known by the code name

Lies, damned lies and benchmarks

In deference to their widespread computer-industry usage, figures on million instructions per second (MIPS) have been used in the accompanying article for superminicomputer price/performance and performance categorizations. However, if the precise mix of instructions being executed for the benchmark is not clearly defined, the "MIP" of MIPS can be thought of as standing for "meaningless indicators of performance" rather than millions of instructions per second. A somewhat better measure is the Whetstone benchmark, which measures performance for a defined scientific/engineering application-oriented instruction mix.

Another FORTRAN-based benchmark, the LINPACK suite developed at Argonne National Laboratories (Argonne, Ill.) is gaining in popularity. Used to compare a system's ability to solve dense systems of linear equations, it is more applicable to minisupercomputers and supercomputers than superminicomputers. Furthermore, because neither of these benchmarks exercises I/O functions, they do not provide much guidance as to a superminicomputer's actual performance in real-world multiuser and/or commercial applications, which typically run at about half the speed of scientific ones.

Simulated loading, often used to compare multiuser systems, provides plenty of room for creative benchmarking. For example, although the typical UNIX-based system spends about half its time on system-control functions, many benchmarks focus exclusively on user activity. Worse yet, many simulated-loading benchmarks downplay I/O, the major determinant of real-world response time in all but the most lightly loaded multiuser systems.

Thus, the problem with benchmarks is that a computer's real-world performance may be startlingly different from what they predict. Prospective purchasers of superminicomputer systems should therefore seek out benchmarks that match their operating environments as closely as possible and view any measure of simulated performance with skepticism. It's also a good idea to find out who actually ran the benchmark tests, who paid for their development and execution and to ponder the implications of that information.

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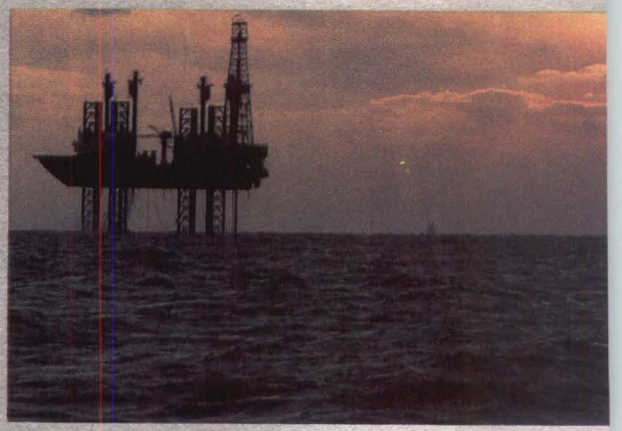

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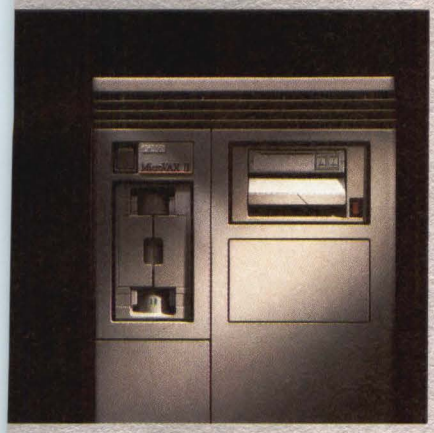

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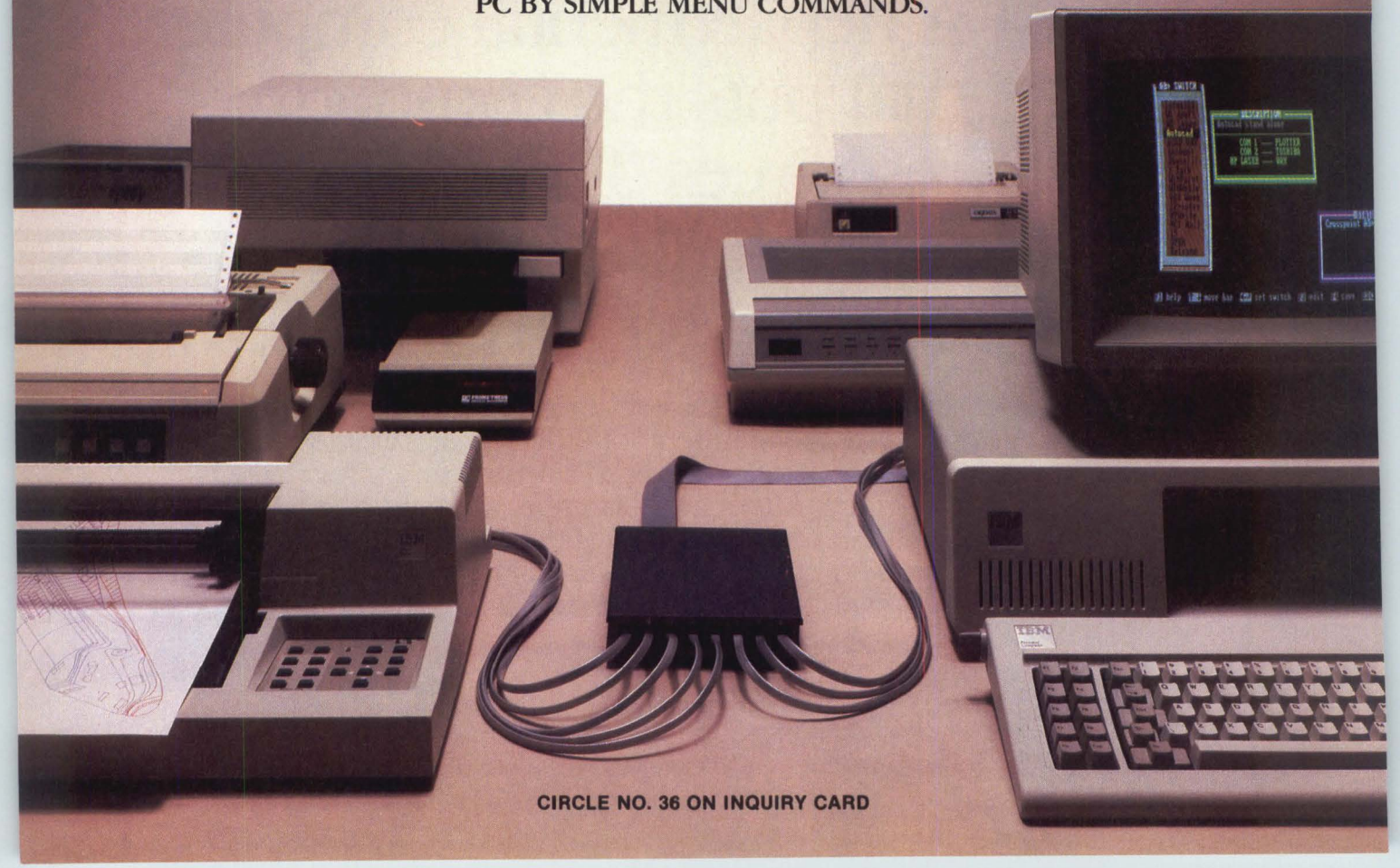

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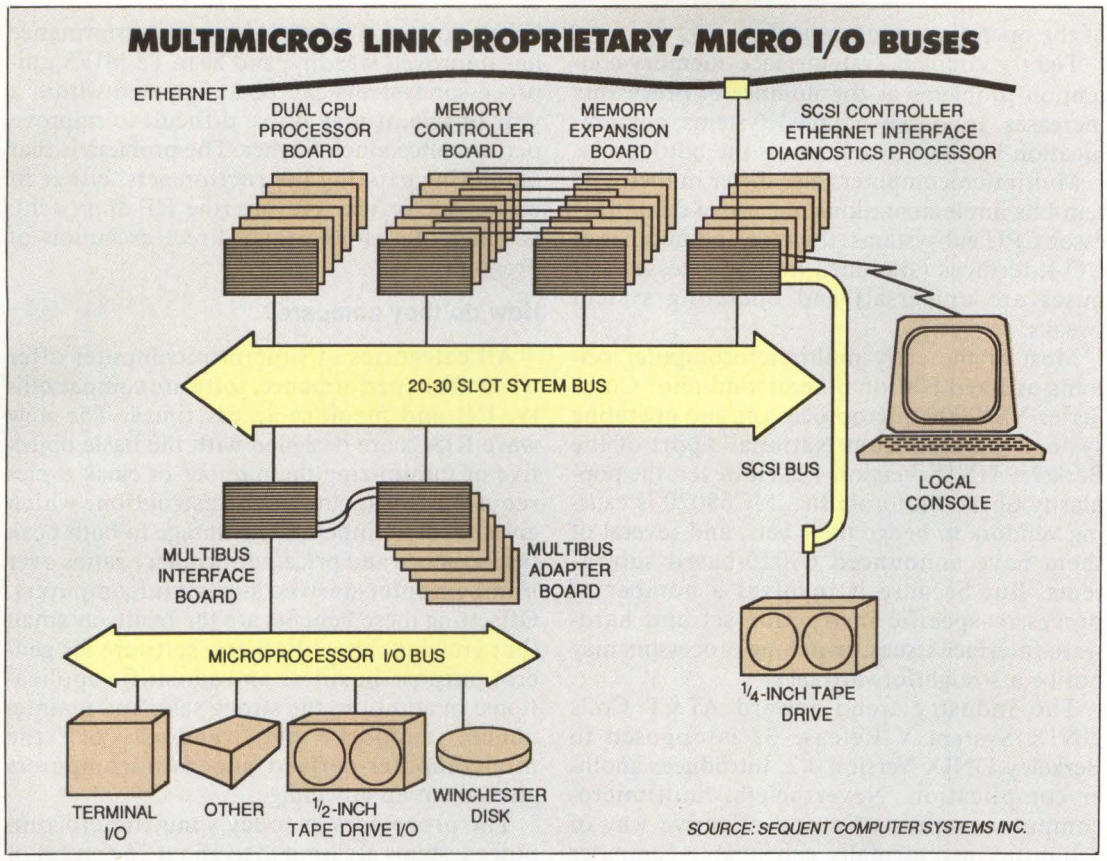


Multimicrocomputer superminis *connect 20 to 30 processors, I/O and memory subsystems via proprietary system backplane buses, but utilize standard microprocessor buses, such as Multibus and VMEbus, for I/O.*

"Spectrum," are based on a completely new, scalable RISC architecture designed to capture HP's pre-existing software base for its other Series 3000 computers while providing a springboard for new hardware and software developments.

The medium-scale and large-scale integration TTL-based HP 3000 Series 930 RISC runs at 4.5 MIPS. The 6.7-MIPS Series 950 is based on single-chip N-channel metal oxide semiconductor (NMOS) technology. Both are now scheduled for delivery in mid to late 1987. The Series 840, a superminicomputer compatible with HP's Model 9000 scientific computers, is scheduled for delivery this month.

Unlike their minicomputer-derived cousins, new wave superminicomputers, except for the HP Series 930 and 950, employ UNIX-based operating systems. The spread of UNIX has dramatically lowered the software barrier traditionally faced by new architectures, enabling the computers to incorporate developments not readily accessible to minicomputer-derived and microprocessor-based systems.

As a result, these new systems offer attractive price/performance characteristics. One feature common to both minicomputer-derived and new wave superminicomputers is their wide memory and I/O bandwidths, using dedicated memory buses and data channels. The use of high-performance floating-point hardware speeds complex calculations. Tightly coupled dual-processor implementations are becoming common in both groups, and clustering (loosely coupling 16 to 20 systems) is offered by many superminicomputer suppliers.

Multimicros upgrade to supermini class

Although one- to four-processor, 32-bit microcomputers are clearly destined to dominate desktop workstations, the rapid increase in typical superminicomputer performance from approximately 1 MIPS to 4-to-7 MIPS excludes these machines from the superminicomputer category. However, multimicrocomputer implementations supporting 20 or more processor, memory or I/O subsystems via proprietary backplane buses offer superminicomputer-class performance. To speed integration, they typically supply standard system buses, such as Multibus and VMEbus, for attaching I/O devices.

Because they all use merchant-market microprocessors and the UNIX operating system, multimicrocomputers must be differentiated from each other primarily on the basis of system topography. Tightly coupled configurations predominate, in which each processor shares global memory and the operating environment, including operating-system and application programs. In loosely coupled systems, each processor has its own memory and a copy

of the operating environment.

Tightly coupled systems face memory-contention problems as the number of processors increases. In loosely coupled systems, communication between processors is the bottleneck.

Multimicrocomputers also differ in their system-bus implementations, the use of dual-processor CPU subsystems, the type and number of I/O interfaces (standard microprocessor I/O buses are universal) and operating system tweaks.

Most of the early multimicrocomputer systems utilized National Semiconductor Corp. Series NS32000 microprocessors and operating systems derived from National's port of the Berkeley UNIX Version 4.2. However, the popularity of the Motorola Inc. MC68020 is causing vendors to hedge their bets, and several of them have announced 68020-based subsystems. But because it involves a number of processor-specific instruction-set and hardware-interface issues, switching processors may not be a straightforward task.

Minicomputer-derived and new wave *superminis employ intelligent mass-storage, terminal-controller and other subsystems, high-performance system buses and dual CPUs.*

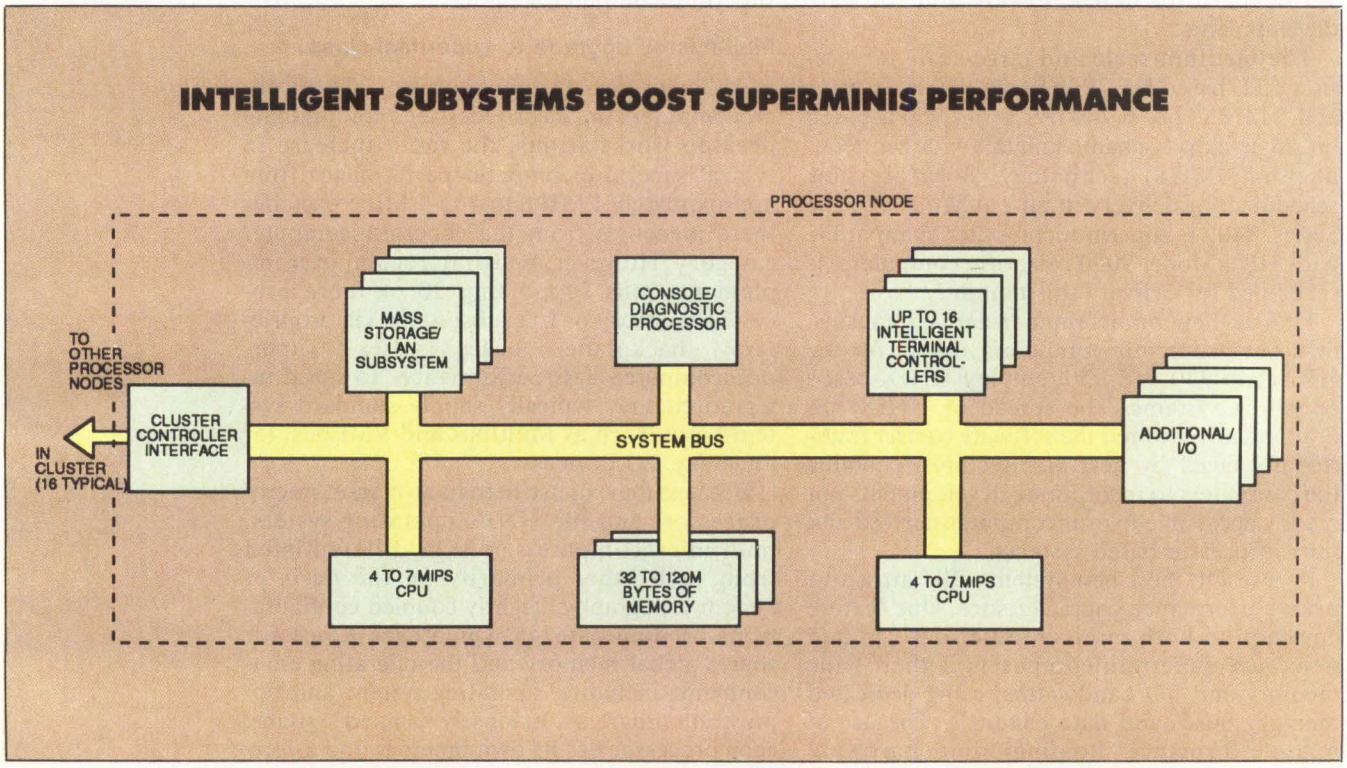
The industry trend toward AT&T Co.'s UNIX System V Release 3, as opposed to Berkeley UNIX Version 4.2, introduces another complication. Nevertheless, multimicrocomputers represent a cost-effective way of acquiring incrementally expandable computer capability that can reach superminicomputer levels.

Long-established, minicomputer-derived superminicomputers suffer from the constraint of maintaining compatibility with their established software bases. Although performance has improved steadily, and 8- to 12-MIPS uniprocessor systems can be anticipated within a year or two, it may prove difficult to improve performance much further. The problem is that emulating existing instruction sets, either in microcode or via software (the HP approach), is inherently slower than direct execution of programs.

How do they compare?

All categories of superminicomputer offer tradeoffs in performance, software compatibility, I/O and memory-access times. The new wave RISCs are designed with the basic objective of minimizing the number of clock cycles required to execute each instruction, which gives them an inherent advantage in both peak performance and price/performance ratios over minicomputer-derived superminicomputers. Offsetting these benefits are the relatively small (but growing) base of generic software for general-purpose business and scientific applications. In addition, the strong sales and maintenance support by vendors of the minicomputer-derived superminicomputers gives them an advantage.

The processors in today's multimicrocomputer systems are limited to about 25 percent of the MIPS rating of the processors in new wave and minicomputer-derived superminicomputers. As a result, they are competitive only in those multitasking applications for which the individual tasks can be handled by 1-MIPS



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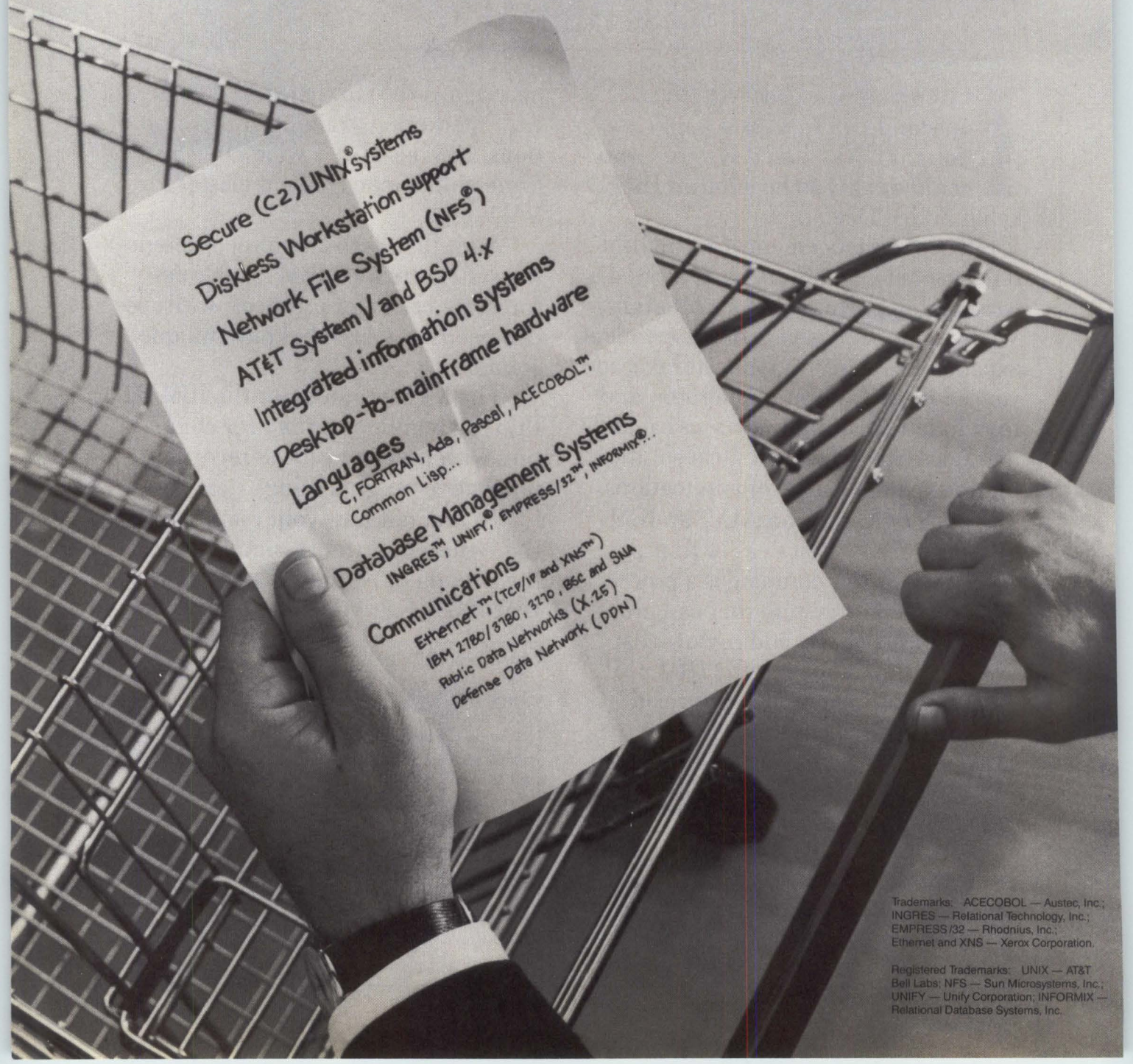

microprocessors. Despite steady increases in clock speeds, the established 32-bit microprocessors suffer from the same software-compatibility and technological constraints as minicomputer-derived superminicomputers.

For all superminicomputers, system performance is ultimately limited by effective system-bus bandwidth. Bus bandwidth is in turn limited by electrical loading on the bus produced by the number of occupied backplane slots as well as bus contention. This gives the more powerful processors an advantage in high-performance applications. The inescapable bus overhead, which increases with the number of processors, must also be taken into account in multiprocessor operation.

I/O subsystem throughput is critical in determining system response time—the primary factor by which users rate the performance of multiuser systems. Minicomputer-derived and new wave superminicomputers typically offer more memory and I/O capability per backplane slot than multimicrocomputers plus 10M- to 20M-byte-per-second I/O channels.

Multimicrocomputers, however, offer lower entry-level-system costs as well as incremental-expansion capability. The latter is constrained, though, by the need for additional memory and I/O subsystems to go along with additional processors. And the use of standard microprocessor I/O buses limits these systems' throughput to the 1M- to 2M-byte-per-second range.

Multimicro future appears cloudy

The rapid development of multiprocessor and parallel-processing technology provides a way to upgrade the performance of minicomputer-derived superminicomputers and new wave superminicomputers. New wave superminicomputers, however, can be expected to continue to offer better price/performance characteristics (and, for RISC-based implementations, higher peak performance) than minicomputer-derived products.

The future of multimicrocomputers is more cloudy. As long as they are based on the currently available complex instruction set microprocessors, their performance will be constrained by the performance of individual processors and backplane slot limitations. Product differentiation will also remain a problem. Nevertheless, multimicrocomputers have the most to gain from the use of the newly emerging RISC microprocessors, and multimicrocomputer configurations utilizing them

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Circle 357

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Prime Park
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Blue Bell, Pa. 19424
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Wang Laboratories Inc.
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San Diego, Calif. 92126
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(716) 482-5000
Circle 363

Hewlett-Packard Co.
Computer Systems Div.
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Cupertino, Calif. 95014
(408) 725-8111
Circle 364

Pyramid Technology Corp.
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Mountain View, Calif. 94039
(415) 965-7200
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Ridge Computers Inc.
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Santa Clara, Calif. 95054
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Multimicroprocessor-based

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will begin to reach superminicomputer (4 to 7 MIPS per processor) performance in 1987.

Although parallel processing is receiving a great deal of attention, the term is frequently misunderstood and misapplied to conventional multiprocessor systems. True parallel-processing systems employ several processors operating simultaneously on the same task. Only when a single instruction acts simultaneously on multiple arithmetic logic units (ALUs) or when a single task is broken into multiple instruction streams executing simultaneously in multiple ALUs is operation truly parallel.

Currently available parallel-processing systems are focused on the same, computation-intensive applications as the minisupercomputer. Derivatives of widely used operating systems and high-level programming languages capable of supporting true parallel processing have begun to appear. But it is likely to be several years before such software becomes widely used in non-specialized, general-purpose computer applications.

Parallel processing notwithstanding, in the short- to mid-term, the proliferation of application-specific processors (ASPs) is likely to have more of an impact on superminicomputers. The familiar add-on array processors, front-end communications processors and back-end database/file-management coprocessors are being augmented by intelligent mass storage, graphics and other specialized, intelligent subsystems. High-performance system buses and dual CPUs, frequently as part of a superminicomputer cluster, also boost performance.

One likely result of the spread of application-specific processors is the balkanization of operating-system functions, as I/O handling moves out to its own dedicated processors. Another result is the decreased need for a general-purpose CPU—a trend that will encourage operating-system and/or language-specific implementations.

Narrow the gap

Thus, the combination of high-performance, application-specific microprocessors and parallel processing will narrow, and probably eliminate, the gap between superminicomputer and minisupercomputer performance.

Because in many real-world applications, users find only marginal differences between superminicomputers, intensifying competition among vendors suggests that the recent rapid decline in cost per function will continue and that a supplier shakeout can be anticipated. Nevertheless, the stage is set for the emergence of some major new players in the superminicomputer market.

The well-established superminicomputer vendors will, of course, capitalize upon their software and market strengths to fend off the upstarts, but the price/performance advantages of the latter's products will prove attractive.

This restructuring of the superminicomputer market will provide additional opportunities for resellers to take advantage of fast moving technology and product developments. □

Andrew Allison is a management consultant specializing in minicomputer and microcomputer technologies, products and markets. He has worked at Digital Equipment Corp. and Rolm Corp. and as a microprocessor marketing manager at Advanced Micro Devices Inc.

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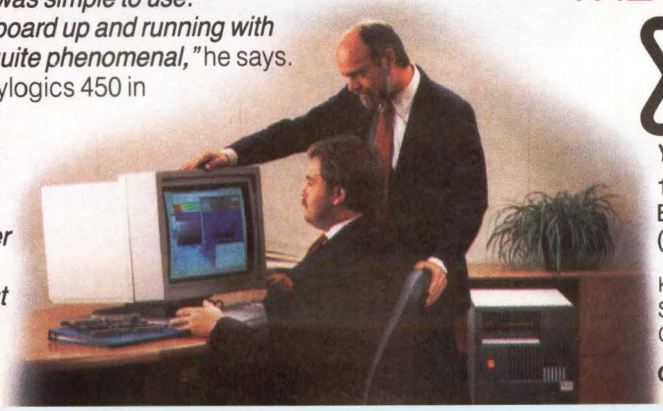

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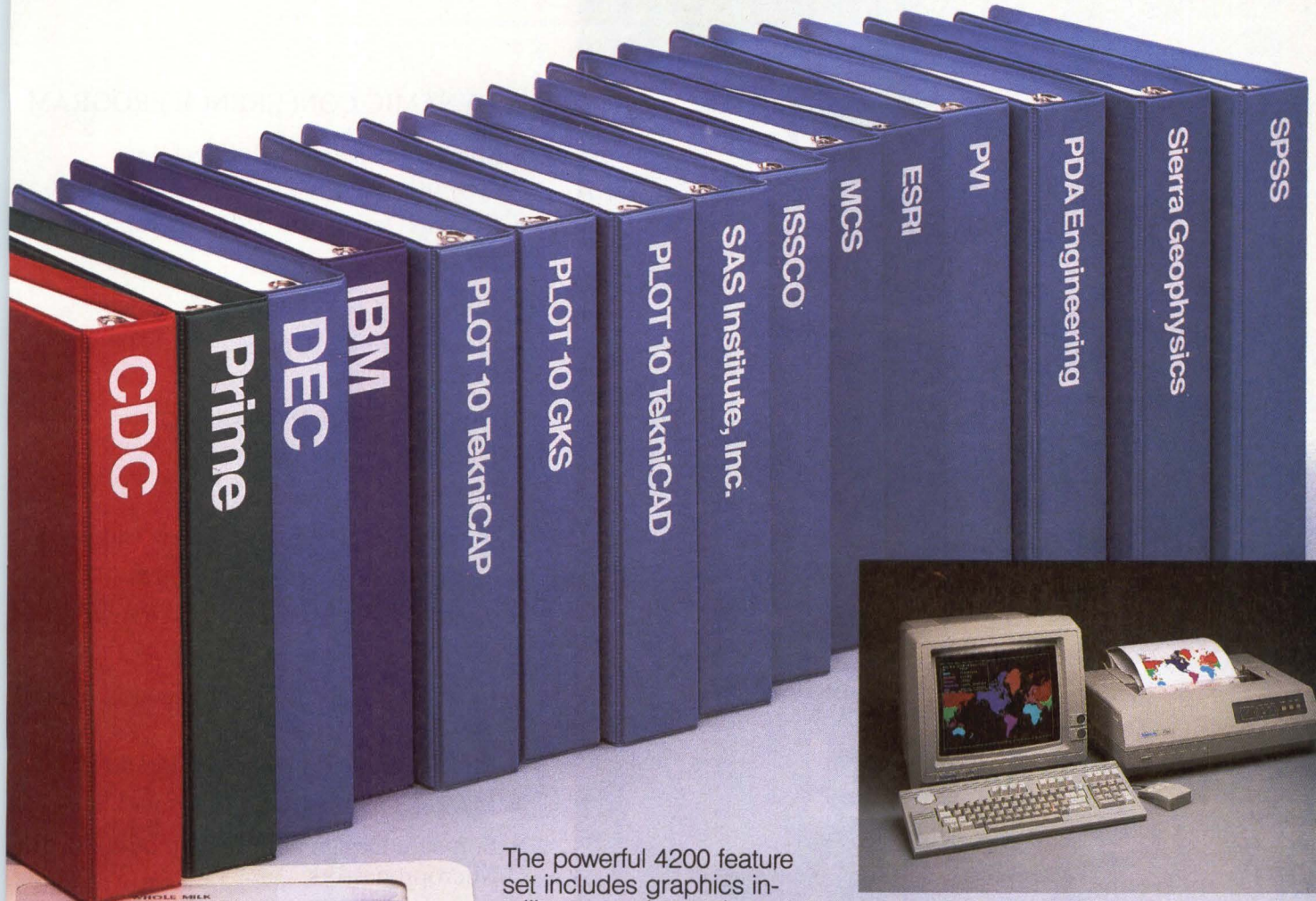

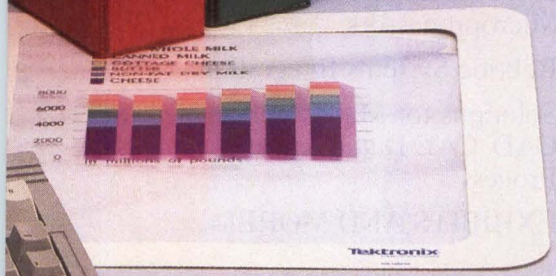

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PARALLEL PROCESSING ATTACKS REAL-TIME WORLD

Careful matching of applications to architectures holds the key to realizing parallel processing's potential for faster execution, higher throughput

J. Virgil Hornstein
Concurrent Computer Corp.

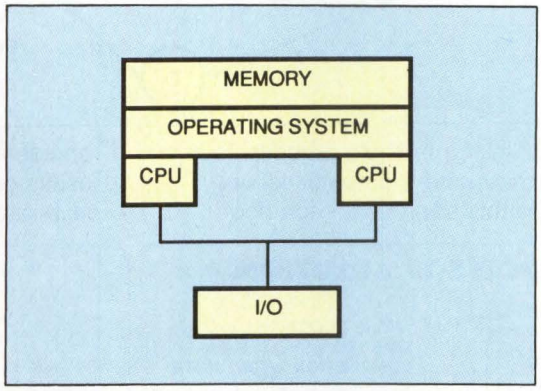
Higher throughput, faster execution and relatively simple system growth paths are the obvious benefits of parallel systems. By carefully mating application with architecture, system integrators can capitalize on the inherent parallelism of many applications to increase both speed and throughput. And, although compilers for producing parallelism at the instruction level are still in development, data-flow-programming and accessible operating systems can simplify the software task and avoid application recoding.

Real-time applications involve heavy I/O and varying, intensive, demand for compute power. For example, signal processing requires enormous vector computation capability, simulation entails a complex combination of I/O and computation, and transaction processing necessitates fast response and machine backup.

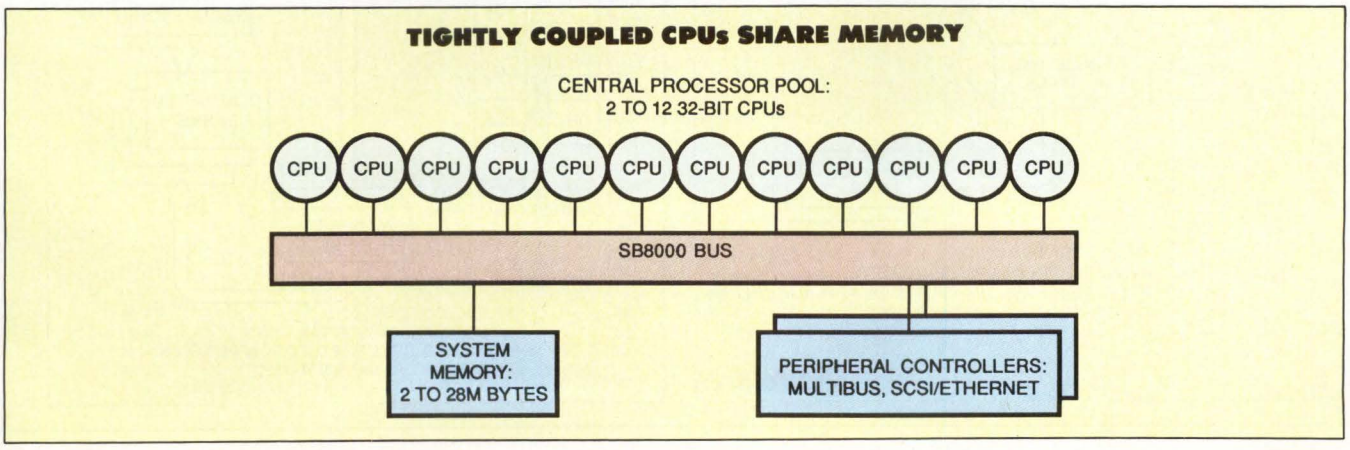
Three roads to parallelism

Three real-time application environments lend themselves easily to machines with multiple processors. There is some debate whether all three qualify as true parallel processing, and indeed some specific applications within them might be better called multiprocessing. But, still, regardless of definitions, the following parallel processing benefits are rewarding for system integrators:

- Simultaneous execution of several unrelated tasks as, for example, in program development with interactive terminal users operating independently at the same time. For applications with multiple unrelated tasks, response time can be dramatically improved by dividing processor resources and load between I/O intensive and compute intensive tasks. This implementation pursues parallelism to the task



Tightly coupled, homogeneous *architectures contain identical processors that share a common operating system and memory (left). One such system is the Balance 8000 from Sequent (below).*

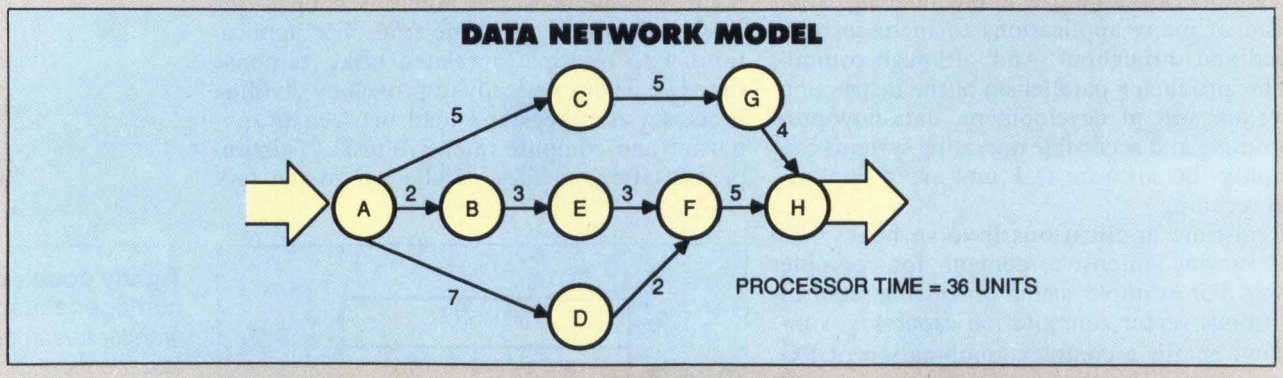


level by coupling a central processor through shared memory to multiple computers, each handling several databases and terminal-originated transactions.

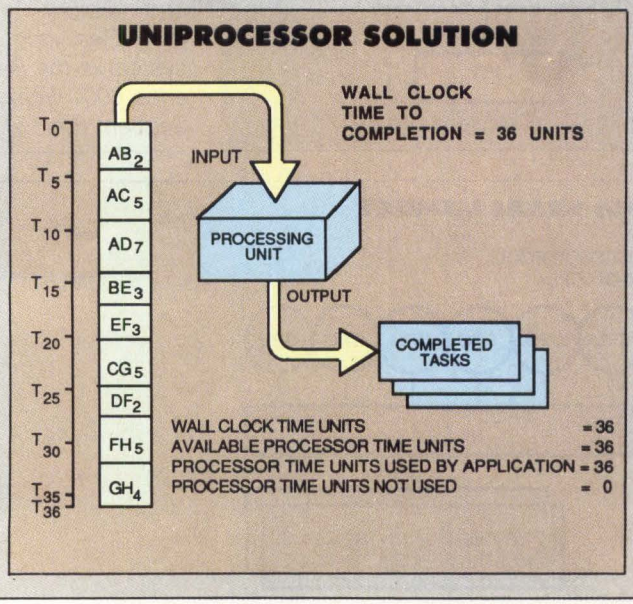
- Development and execution of interdependent tasks, which typifies most real-time applications in which a number of tasks perform functions related to the overall completion of an application. To execute interdependent tasks, a parallel system can optimize both price and performance by having several processors perform, with a host monitoring and displaying results. In this application, parallel implementation can achieve orders-of-magnitude faster execution time (depending on the number of processors) than uniprocessor implementations.
- Simultaneous execution of multiple copies of the same task, each performing the same set of calculations on different input data, such as records in large databases. This application, typically performed solely on a large processor, provides particularly easy entry into the world of parallel implementation. The database—i.e., the work—can be segmented and fed to N-number of processors, increasing system throughput on the order of the number of processors. Unfortunately, this type of application also provides a rich source of confusion, at least as far as terms are concerned, in that it closely resembles multiprocessing, where parallelism is not exploited at all. Perhaps it would best be characterized as a "halfway house," somewhere between true parallelism and "mere" multiprocessing.

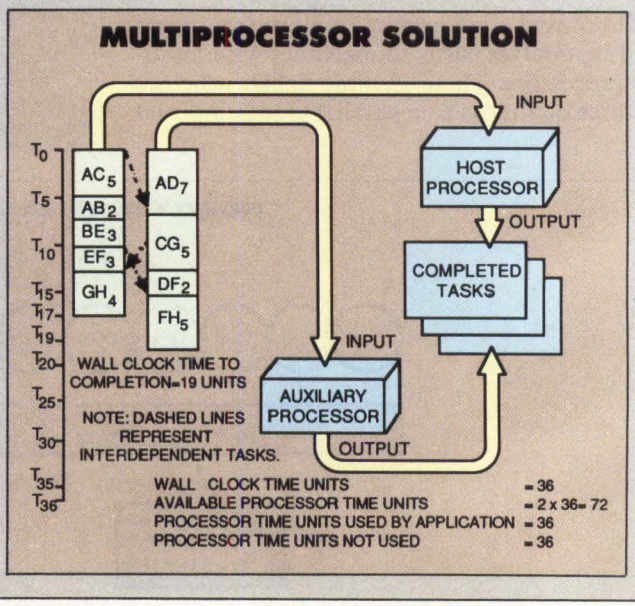
Successful parallel processing is directly related to the mode of multiprocessor coordination, which is a reflection of basic parallel architectural type. Consider a task sequence and its execution in uniprocessor, multiprocessor and parallel modes (see "Parallelism as a network," below). In parallelism, execu-

Parallelism



One technique of linking multiple processors in a single machine is to assume a data-networking operation (above). In this approach, each node represents the elements of solution data—i.e., the results of tasks—(A, B, C, etc., in the diagram), while each path (A to B, A to C, etc.) is a processing task.





tion time is improved and absolute compute power is increased largely as a function of system organization and processor coordination and synchronization.

Synchronization—how closely processors coordinate concurrent problems and interact for solutions—is affected by the type of processor organization. Two types are the most important for parallel applications.

The first, single instruction multiple data (SIMD) stream processors, are attractive for operations with inherent parallel possibilities, such as array processing for high-speed vector computation. SIMD machines have several processors performing the same operation (simultaneously) on different data. Thus, N processors can multiply N numbers (in the case of vector computation) to dramatically increase computation speed. Many machines of this type exist, including the Control Data Corp. 6600, IBM Corp. 360/11 and the Cray Corp. Cray I in the larger systems. In addition, a new class of machines, supercomputer-like minicomputers, has recently appeared to broaden the spectrum of SIMD devices. Convex Computer Corp., for example, offers a supermini-computer processor that provides high-speed vector and scalar processing based on reduced instruction set computer (RISC) architecture.

Multiple instruction multiple data (MIMD) stream systems are the second major type of processor organization. These have multiple processors running independently and working on different data, that is, each processor executes a different program or portion of a program. MIMD machines include the FX/8 from Alliant Computer System Corp., the 3200 MPS series from Concurrent Computer Corp. and the Balance 8000 from Sequent Computer Systems Corp. These machines provide flexibility in meeting application requirements but are more difficult to synchronize than are SIMD

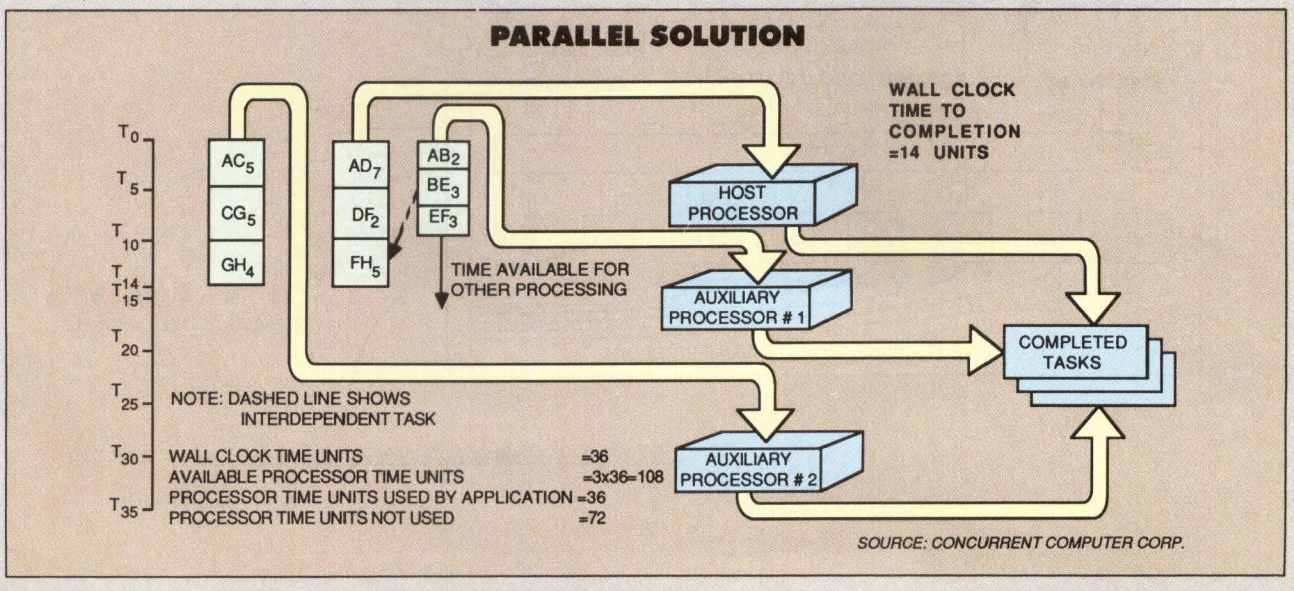
as a network

Task AB uses results A as its input and produces result B as its output. Result B is then used as input to task BE, which produces output F, and so on throughout the model until the final output, H, is produced. The numbers shown on each of the tasks represent units of execution time. Execution can proceed only in the directions indicated by the arrows. A completely processed task must entirely enter a node before the node can be exited by any path. This is known as data dependence.

The uniprocessor solution (bottom left) is the most time-consuming. At time zero, AB is arbitrarily chosen as first task, followed by AC and AD. BE and EF are chosen to be executed next, respectively, because task EF requires the solution data from task BE. Task CG is arbitrarily chosen as the next task to be executed, followed by task DF. Task FH can now be entered into the queue and executed, because solution data F is available to tasks DF and EF. Task GH is the final task to be executed. Solution data H is complete.

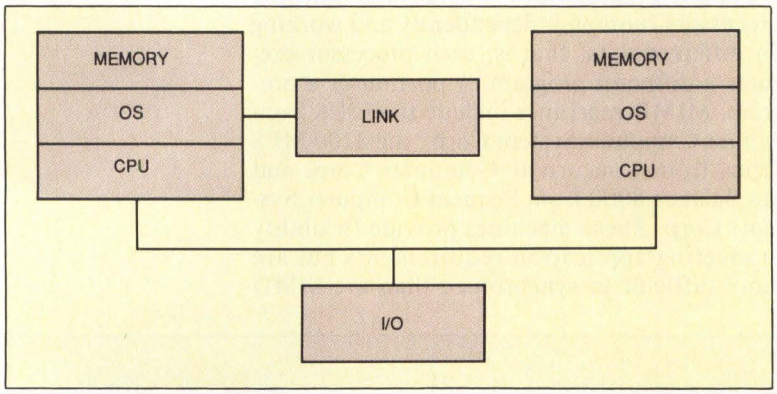
In the multiprocessor solution (bottom center), implemented with two processors, the actual time to data H availability is 19 units, thus decreasing execution time nearly 50 percent while doubling available processing power.

In the parallel solution (bottom right) natural parallelism is exploited to run tasks in three streams, reducing actual execution time from 36 to 14 while at the same time providing capability for 72 time units of additional work beyond the uniprocessor solution.



machines. Synchronization is largely a function of the way multiprocessor systems are "coupled," that is, how the processors are linked with memory—loosely or tightly.

In tightly coupled systems all processors access the same physical memory, called global memory, which allows them to operate on data in main memory for other processors. In loosely coupled systems, each processor typically accesses only its own local memory and must communicate with other processors over a link, which means increased delay and overhead.

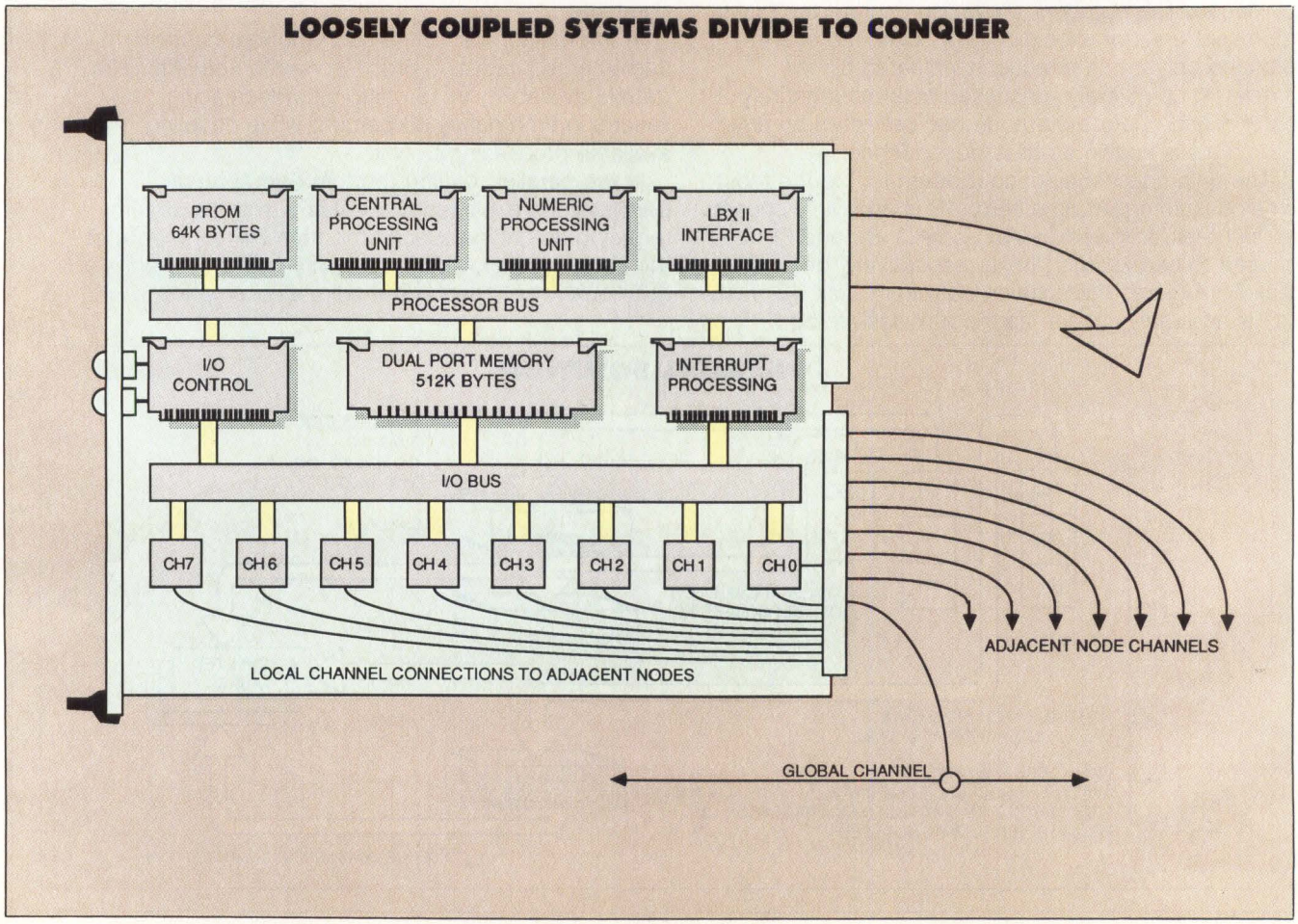


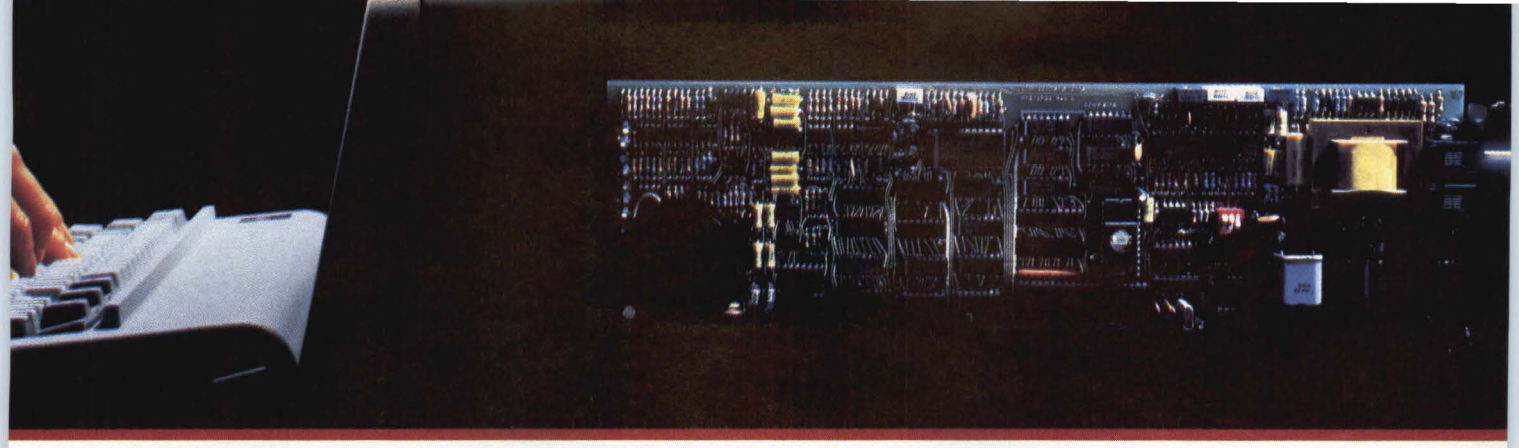
Loosely coupled architectures *contain self-sufficent processors (above). Diagrammed below is the loosely coupled iPSC from Intel.*

The processor-to-memory relationship affects throughput and influences operating system design as well as determines the efficiency of interprocessor communication. In a loosely coupled system all processors must have a copy of the operating system; in tightly coupled configurations only one copy is shared. This reduces system memory requirements. Tightly coupled systems include Alliant's FX/8, the Multimax from Encore Computer Corp., the Concurrent 3200 MPS and the Sequent Balance 8000.

The Flex/32, from Flexible Computer Corp., is an example of a multiprocessor system using both tightly coupled and loosely coupled techniques with modified UNIX and proprietary operating systems. Essentially, the Flex/32 is a packaged group of standalone processors, each with its own memory and I/O but with access to optional common memory for communication.

Systems are also characterized as being either symmetric or asymmetric. Symmetric systems, such as Sequent's in which all processors are identical and equal (homogeneous), theoretically can provide high throughput because each unit can execute all code: the operating system,





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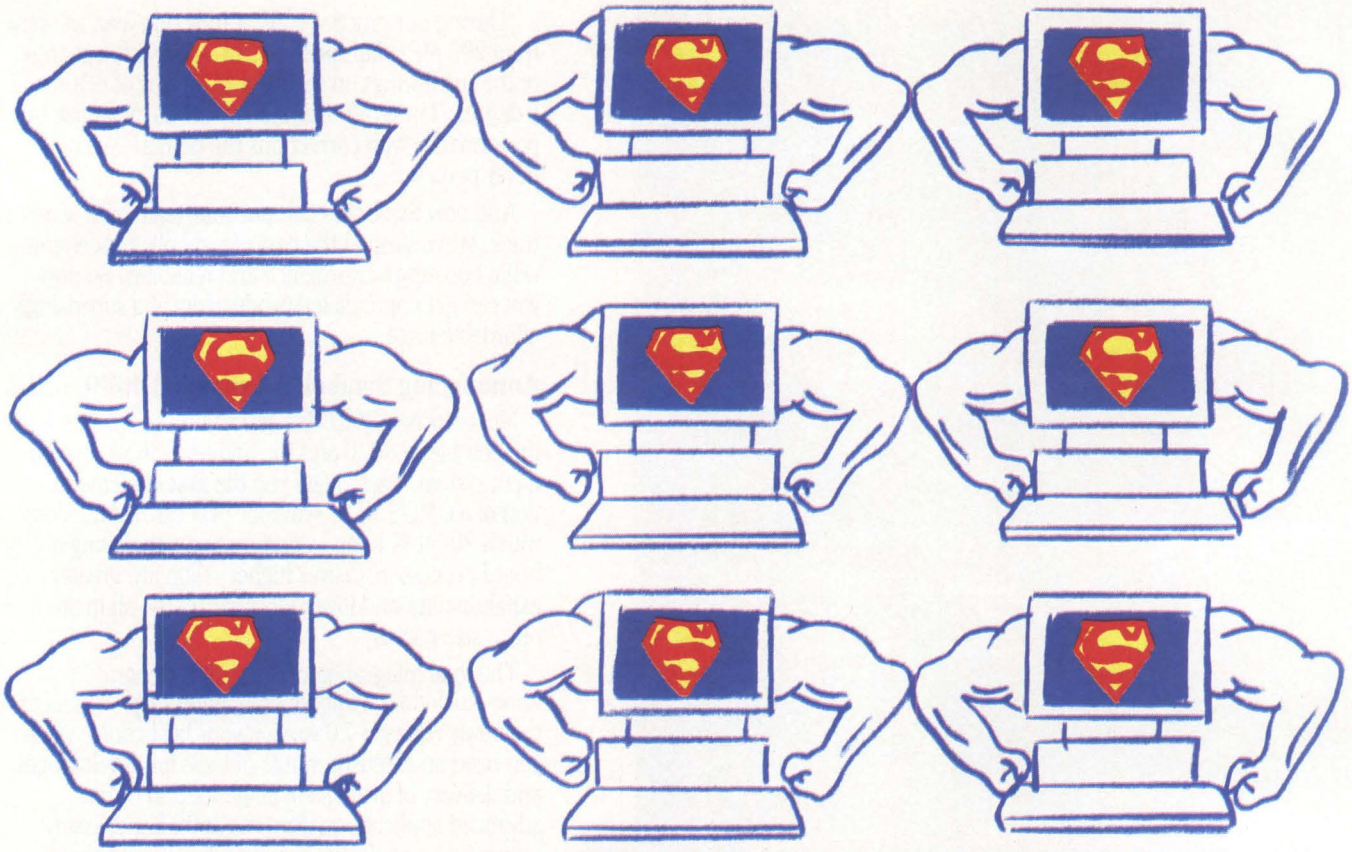

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I/O and computation. Asymmetric systems, such as Concurrent's, in which one processor handles system functions while other units perform as application processors, theoretically provide a high degree of coordination. Because such systems are heterogeneous, they can both specialize by function and yet also allow for easy expansion through the addition of identical auxiliary processing units, much the same as symmetric systems.

Architectural type defines interprocessor communication techniques, which can be over networks, through shared memory, on interprocessor buses or via bus-multiplexed memory. In loosely coupled systems, such as those based on the Intel Scientific Computers' cube networks and interprocessor buses, each processor has its own local memory for a high degree of transparency.

Tightly coupled systems, such as Alliant's, use bus-multiplexed memory plugged into high-speed buses accessible to all processors that can read or write any part of global memory through bus logic. Similarly, most tightly coupled systems also utilize shared memory in which processors communicate directly through common memory, which is the fastest means of intertask communications.

Cache cuts contention

Memory contention is addressed by various cache memory schemes. Cache memory is simply local high-speed memory used to reduce frequency of access to global memory. Cache memory was developed to avoid the cost of adding high-speed global memory. As processors got faster, they outdistanced inexpensive, slower memory. Adding cache as a buffer between CPU and main memory considerably increases system performance by handling as much as 90 percent of the memory requests on the spot.

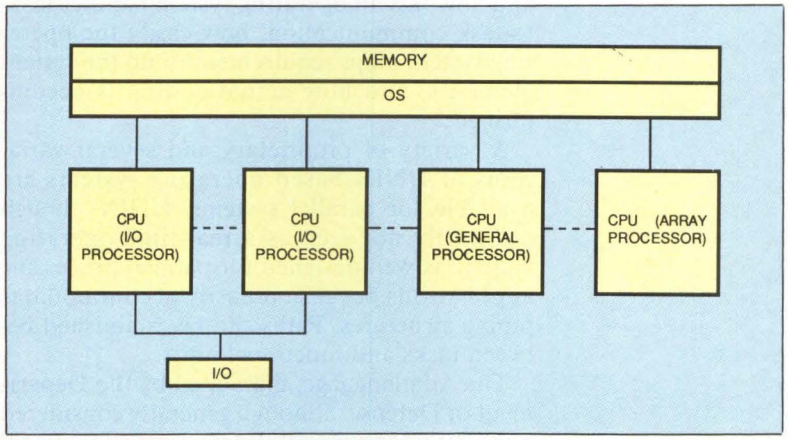
Bus bandwidth, cache type and fetch method are central to overall system performance. In Concurrent's 3260 MPS, for example, the central processor contains an 8K-byte, four-way, set-associative cache and all other processors contain 4K-byte, direct-mapped cache and use the quadword identification capability of system global memory to maintain high throughput. When a processor performs a memory fetch, the information is returned if it is in cache; if not, a cache miss occurs. The miss causes a request to global memory, which responds with an overall memory system throughput of 40M bytes per second. Four full words are placed in the appropriate cache. The next word requested by a processor is now likely to be in cache memory, so that the global memory need not respond.

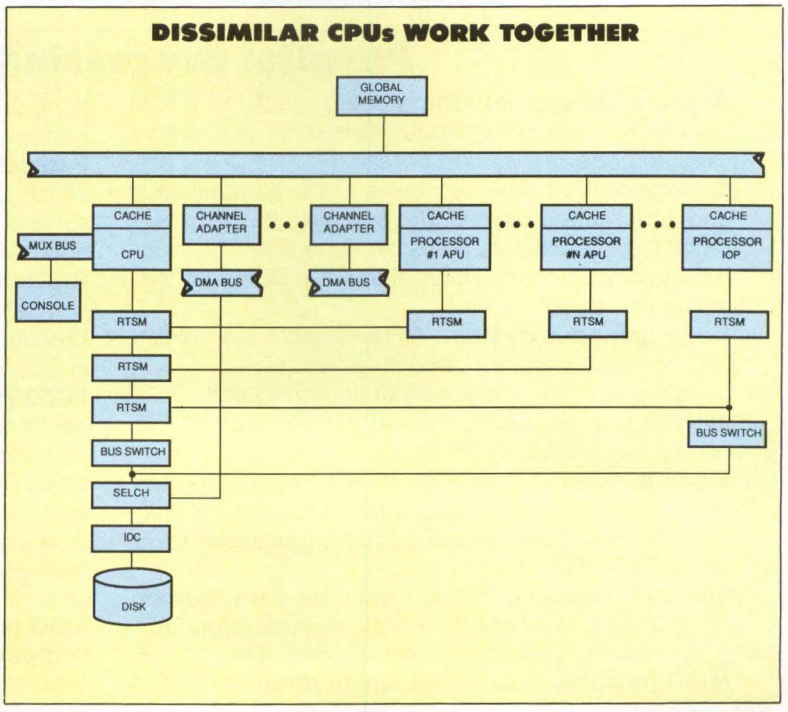
Thus, quadword fetch allows the processor to have a high cache-hit rate, which significantly increases system throughput by decreasing bus and memory cycles. Sequent uses "write-through" caches, in which every memory register actually generates a full write cycle to memory. According to Sequent, this eliminates stale data in the cache without significant traffic increases. Traffic is handled by a high-bandwidth (13.3M bytes per second) bus that allows for overlapping operations.

System type influences load balancing, which in turn is a reflection of basic architecture. Real-time applications typically benefit from both dynamic and static load balancing.

In dynamic load balancing, the operating system decides where to run a process, selecting any idle processor or bumping a program of lower priority. Dynamic load balancing, which requires some operating system overhead but which provides better multiprocessor utilization, is found typically in tightly coupled systems such as those of Encore, Concurrent and Sequent.

Tightly coupled, heterogeneous *architectures contain dissimilar processors sharing common memory (top). The Concurrent 3260 MPS system is one such machine (bottom).*





Because real-time applications typically involve both types of load parameters, system architectures are perhaps better described in terms of coupling and transparency. In loosely coupled systems, such as those which make use of the hypercube design that came out of California Institute of Technology, processes must be statically allocated, because they cannot move from processor to processor. In tightly coupled transparent systems such as Sequent's, which are homogeneous multiprocessing systems presenting themselves to the programmer as single processors, any idle processor is given work and there is some provision for dedicating a processor to specific tasks. Concurrent provides both dynamic and static load balancing by allowing auxiliary processing units to function as dedicated machines.

Adapt software to architecture

With these architectural considerations in mind, system integrators must look at how well and how fast an operating system handles task-to-task communication, how easily the operating system maps requirements onto the system elements, and how actual coding is accomplished.

A variety of proprietary and several variations of UNIX-based operating systems are available for parallel systems. UNIX, though ordinarily not seen as a real-time operating system, is well-designed for parallel-processing applications because it easily accommodates piping structures. Paths can be established between tasks and functional units.

The Ada language, mandated by the Department of Defense, although generally considered a multitasking parallel-processing language, holds the promise of eventually supporting implementations designed explicitly for parallel applications. Currently, however, software methodologies for application-program development are just being developed in such complex application environments as simulation. Meanwhile, system integrators can use data-flow programming analysis to begin decomposing their existing software offerings before mapping requirements over a potential system.

Decomposition is simply the dismantling of an application in terms of functions, tasks and data to determine inherent parallelisms. The degree to which an application is decomposed and structured for processing is termed granularity.

Large-grain parallel processing typically involves dividing the processing into functions and tasks; medium grain involves further destructuring of tasks; and fine-grain programming takes parallel procedures to the instruction level. While there is some controversy over what level of decomposition constitutes what degree of granularity, the fact is that large- and medium-grain solutions are being mounted now, while fine-grain systems exploiting parallelism await development of better, perhaps silicon-based, compilers.

Fundamentally, there are two ways to attack an application:

- **Procedure driven,** where the programmer writes the code to accomplish some task. In other words, the programmer creates a new program that exploits parallelism.
- **Data flow,** where the programmer analyzes the flow of data through the system, how individual data packets move, what their sequential dependence is, and so on. In other words, the

Parallel processing glossary

Asymmetric system: One processor acts as a host, performing system functions, while other processors execute code by function or task.
Decomposition: The degree to which an application and its tasks are divided into subtasks between processors for simultaneous excecution.
Fine grain: Decomposition of the application at the instruction level.
Heterogeneous system: All processors are identical and equal and perform the same functions.
Large grain: Decomposition of an application, function or task into logical and functional units that can be computed concurrently.
Medium grain: Decomposition of an application to allow concurrent execution of sequential operations; typically of related but independent processes, such as FORTRAN DO loops.
MIMD (multiple instruction multiple data) stream: An architecture in which several processors perform different operations on several different data streams.
MISD (multiple instruction single data) stream: A computer architecture in which several processors perform various operations on the same data.
Parallel processing: A computing technique in which two or more interconnected processors simultaneously perform different parts of an application.
RISC (reduced instruction set computer): An *SISD* computer designed to increase performance and cut execution time by reducing the number of instructions.
SIMD (single instruction multiple data) stream: A computer architecture in which a single set of operations is performed on a number of different types of data. Most commonly, this is an array processor with several processing elements governed by a single control unit with limited memory-to-processor communication for high efficiency in repetitive calculations.
SISD (single instruction single data) stream computer: A serial processor that executes sequential instructions.

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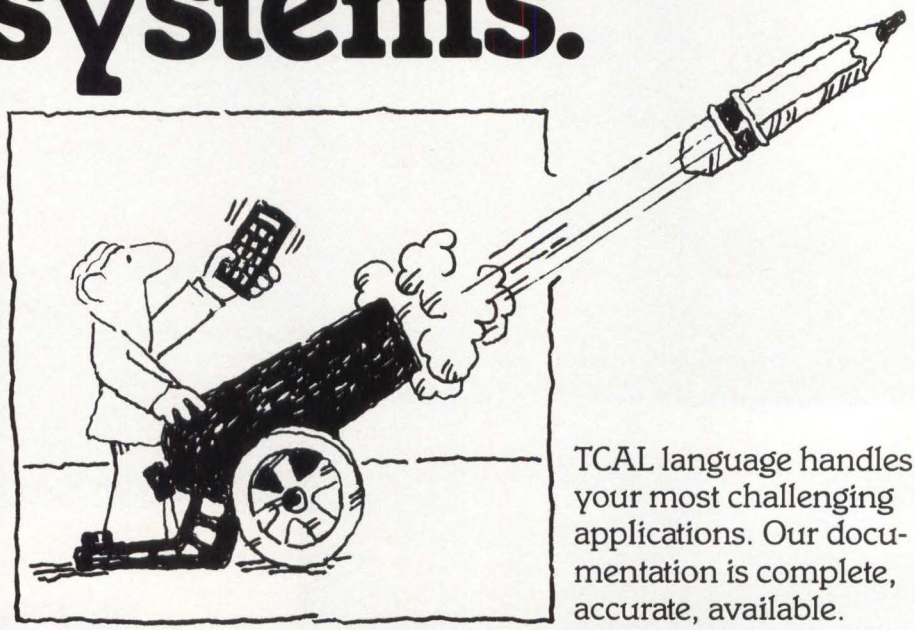

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Arete	Series 1000 (1100, 1200)	MC68000, MC68020	2, 4	UNIX System V (ARIX)
Concurrent	3200 MPS series	3250XP (proprietary), 3280XP (proprietary)	10	OS/32 (proprietary)
Convex	RISC			UNIX 4.2
Elxsi	6400	64-bit ECL gate arrays	12	UNIX System V.2, UNIX 4.2, EMBOS
Encore	Multimax	NS32032	20	UNIX System V, UNIX 4.2 (UMAX V, UMAX 4.2)
EnMasse	E/CS	MC68000, MC68010, MC68020	28(4 FPS, 24 APS)	UNIX System V (E/OS)
Flexible	Flex/32	NS32032 or MC68020	20 per cabinet	UNIX System V, MMOS (proprietary)
Intel	iPSC	80286	128	XENIX
Masscomp	MC500 series	MC68000, MC68010, MC68020	4	UNIX System V, UNIX 4.2 (RTU)
Sequent	Balance 8000, 21000	NS32032	12, 30	UNIX System V, UNIX 4.2 (DYNIX)

programmer looks at what may be an existing application, sees what tasks may be executed in parallel (effectively performs some decomposition) and writes or re-writes the code.

Either way, those parts of the application that do not share dependencies—that is, do not rely on the same data—are the most likely candidates for parallel processing. After the application has been subdivided in this fashion, a data-recombination method must be worked out to provide a complete solution. Thus, in defining data flow, structure, dependencies and recombination method, the programmer has also defined an application that makes use of large-grain parallelism.

If the application is new, data-flow analysis can provide readily discernible parallel paths so that jobs and tasks can be allocated to various processing units. For existing programs, decomposition may be harder. Start by performing data-flow analysis and then mapping the problem functionally over a set of processors. This will give some estimate of required system size and provide a starting point for decomposing the problem into a manageable number of processes.

Typically, real-time applications have inherently parallel paths whose execution can be best accomplished through a hybrid system with multiprocessing and array-processing capability. For example, the developer might exploit parallel processing for multiuser, multiprogramming applications requiring fast response and array processing for number crunching.

Functional allocation, or a one-to-one mapping of function to processor, clarifies the processing requirements. System integrators also must consider traffic sharing—diverting the main job stream into smaller streams for separate processors. In real-time applications, interprocessor communication speed must be determined and a system selected that minimizes it for faster application run-time, lower overhead and lower costs. □

J. Virgil Hornstein is senior manager of large systems at Concurrent Computer Corp., Tinton Falls, N.J. Previously, Hornstein was a computer application product manager for Perkin-Elmer Corp. He holds a bachelor of science degree and a Ph.D. in chemistry from Georgia Institute of Technology and a master of business administration degree from Columbia University.

Companies mentioned in this article

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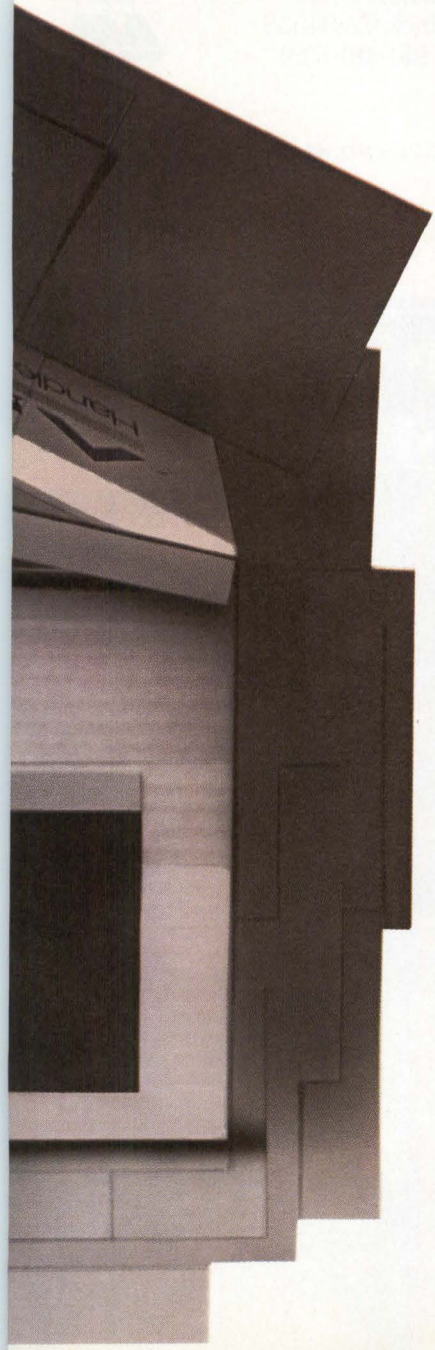

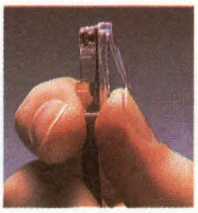

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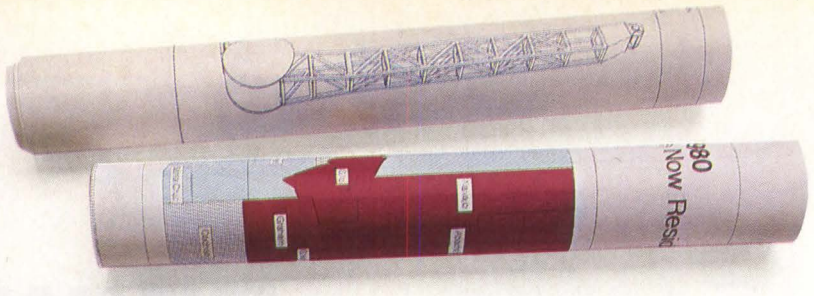

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USER INTERFACES OFFER GREATER POWER

DBMS, graphics and voice-recognition systems use second-generation interfaces to put complex applications at novice users' fingertips

Gene R. Talsky
Contributing Editor

Innovative hardware devices and software interfaces are delivering powerful applications to even the most inexperienced users of IBM Corp. PCs and compatibles. Database management, computer aided design and engineering, statistical analysis, and graphics systems are becoming more widely used as they become easier to learn and use. And voice recognition is proving to be more effective than either mice or keyboard-macro software in minimizing the repetitious keystroking required by most applications software. Interface technology, both in support of these devices and in itself, is making complex and powerful application software more accessible to general computer users, while making it easier for specialists to get the most out of their software.

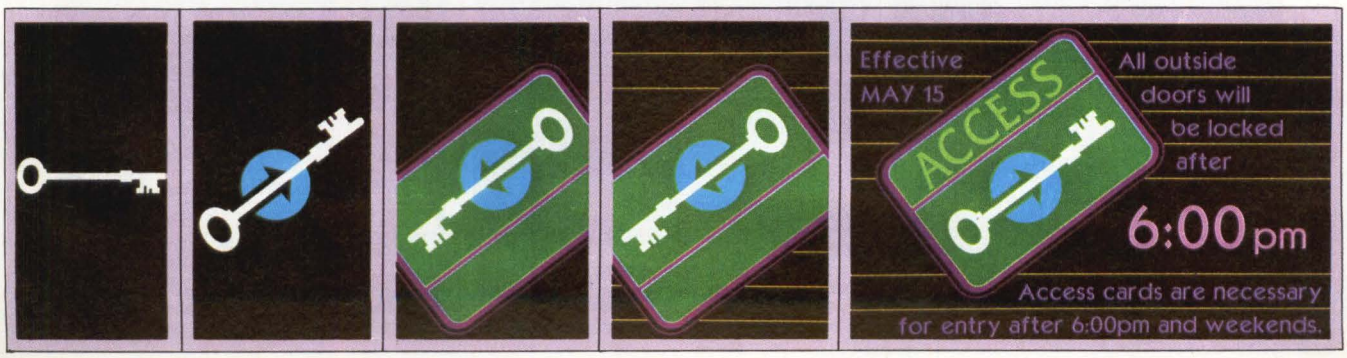
Unlike early CP/M-based business applications, which derived their interfaces from line editors, the hierarchical structures in which today's software menus are nested are particularly user-supportive. Users always know exactly where they are in such structures, because their path is documented on-screen during most operations. And, their screens show them which submenu functions are available to them at any given time.

Historically, the complexities of getting results from graphics software have been more than most business people could cope with. Last year less than 20 percent of large corporations used their PCs for business graphics. The advances in software-interface technology now make it possible for business and professional people to use sophisticated application software to produce complex reports and professional-quality graphs, presentations, designs and drawings. Also, software developers with minimal computer expertise can create comprehensive database applications.

But, it's not all magic yet. The price exacted for this new power is the need for a more thorough understanding of the applications and data. Unfortunately, learning to use these more sophisticated capabilities often proves to be more challenging than learning typical word processing or spreadsheet applications. However, the rewards are well worth the effort.

Interfaces pioneer new technology

Among the software products introduced in 1986 that represent second-generation user-interface technology—powerful capabilities with truly innovative interfacing—are Microrim Inc.'s R:base System V and Maymod Corp.'s DataSpace. Expanding upon traditional menu-selection techniques, R:base System V enables novice users to develop databases and other applications with little or no effort through clever and comprehensive on-screen prompting in its "Express" functions. System



Combining images, *lines and text in a wide variety of fonts, Computer Support's Diagraph/2000 package enables novices to develop professional-level graphics. Users can select graphics from a library of more than 2,000 images.*

V's "Prompt By Example" functions make accessing databases almost foolproof—without the need to learn command syntax.

Maymod's DataSpace, a statistical analysis system for information providers, offers unique capabilities. Through its proprietary logical data-compression technology, DataSpace can store large quantities of data in a highly compressed format, reducing storage requirements by 50 percent or more and significantly speeding access. In addition, DataSpace employs a highly visual and extremely easy-to-use interface that enables even laymen with little statistical expertise to develop complex cross-tabulations for market research, economic and statistical and related analytical applications.

Both R:base System V and DataSpace, however, require users to have a thorough understanding of both their applications and their data.

Decision Resources Inc., acquired by Ashton-Tate this year, exemplifies the classic vertical-menu approach in its ChartMaster and SignMaster packages. Early versions were difficult to use because obscure messages, menu paths and selections offered real challenges to experienced computer users and completely baffled the novices. Later revisions substantially improved the standard menu-driven interfaces. They also serve as the basis for MapMaster and DiagramMaster. The latter incorporates hundreds of predrawn illustrations.

However, newer products offer even greater capabilities with better interfaces. Harvard Presentation Graphics—a desktop publishing package from Software Publishing Corp.—offers an easier menu interface, and includes preformatted presentations for titles, bullet lists, columns, tables and pie and bar charts. The standard formats make it easy to create frequently used charts and graphs. In addition, the package supports film output—both on-site

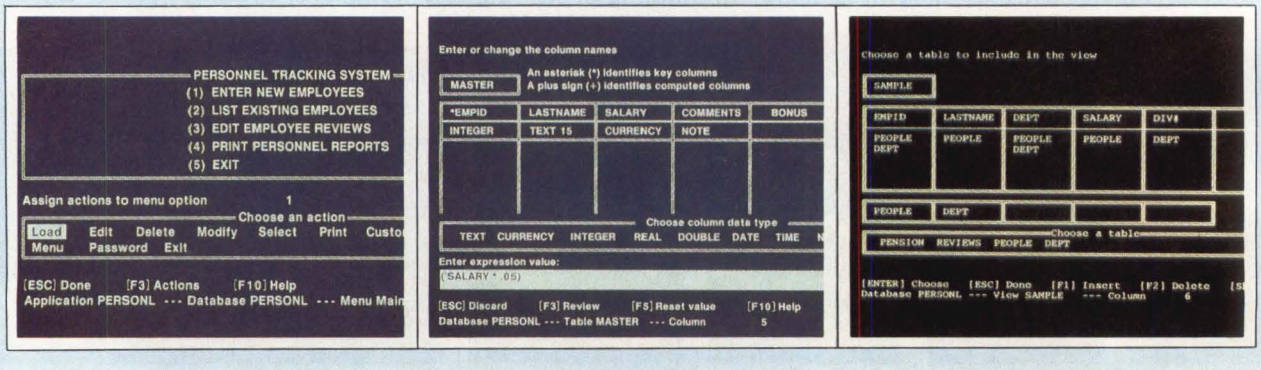
R:base System V exemplifies

R:base System V, from Microrim Inc., represents a revolutionary approach to developing and using a database management system. It is a logical, evolutionary development from the company's earlier R:base 4000 and 5000 systems. Microrim enhanced the Applications Express module as implemented earlier in R:base 5000 to support the development of database applications. And Definition Express enables users to easily and quickly define columns (fields), tables (files/relations) and computed columns.

Database developers can define the rules for each field almost entirely through menu selection. The various relations between tables can be readily established by user-defined views of selected data from one or more tables. R:base System V also provides direct menu access to applicable DOS commands for directory and file access and manipulation. Application Express is now dedicated to applications development, and includes nested menus and dynamic on-screen help menus. Through multiple-choice prompting, the functions for each screen menu item are readily defined, including data entry, editing, deletion and record search and selection.

R:base System V also includes Forms Express and Report Express, rounding out the Express capabilities that make it one of the easiest application-development packages. Forms Express not only makes it easy to design basic input forms, it also enables users to draw boxes around any sections of the form and to designate custom colors for each field. Report Express provides for the development of complex reports with multiple control breaks and compute fields without having to write code. Both Forms and Report Express furnish access to multiple tables for inputting and reporting.

With a several hours effort, most of which can be devoted to interacting with System V's screen menus, instructions and prompts, users can define fairly complex databases with multitable input forms and



systems such as Polaroid Corp.'s Palette and, for more professional quality, outside slide processing concerns, such as Magicorp.

GraphStation, developed by Signature Information Systems Corp. and marketed by Software Clearing House Inc., offers on-screen, nested menus that show exactly where in the hierarchy the user is at all times. Within that hierarchy, GraphStation provides a variety of function options offering maximum flexibility in manipulating both the content and appearance of the graphs it produces. The company has solved the major annoyances of most graphics software by allowing complete modification of the size, shape, appearance and placement of headings and legends for any graph. And, users can make most changes to the graph while both the menus and the graph are on-screen, so that the options available and the effect of the changes are immediately visible.

GraphStation provides for direct on-screen modification, elimination or addition of values of any bar or line. Any graphic element in a chart can be changed—such as from a bar to a line—by simply pointing to one of the bars and making the change through menu selection. Similarly, the chart's fill, shape or line thickness—virtually any aspect of appearance—can be changed through menu options. When the graph is saved after the modifications are made, the changes to the graphic image also revise the data originally entered to create the graph. GraphStation also includes a "draw" capability, enabling creation of images that can be standalone or appended to graphs.

Samna Corp., previously known for its word processing system, this year introduced Decision Graphics, a powerful graphics package that combines a multitude of graphics and statistical capabilities with nested, on-screen menus. Symbols that are automatically-sized proportionately can be used to portray values. Users can exploit windows to portray overlayed graphs and can zoom in on a segment of the

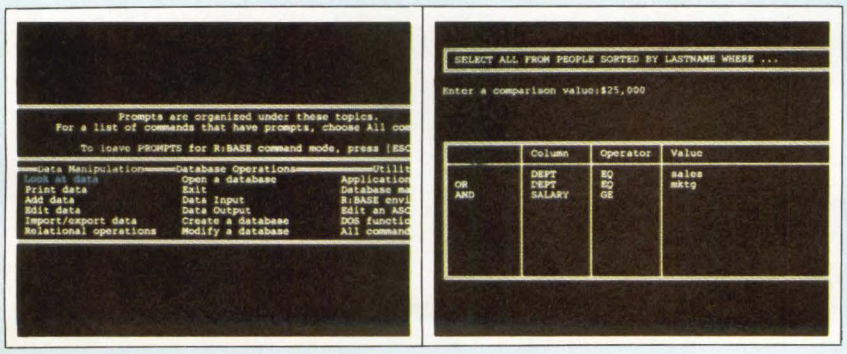
second generation

presentation-ready reports.

R:base System V applications are also easier to use than those of earlier R:base versions and most other DBMS-based applications. Its "Prompt By Example" capability virtually eliminates the need to know the proper syntax for selection or inquiry commands. Further, users can incorporate Prompt By Example in their own applications. The View capability enables users to input data to as many as five different tables from a single form and to produce reports accessing data from all of those tables without defining variables. Views can include only those selected columns and rows that meet defined conditions. The powerful View feature enables users to make up for a lot of design mistakes and omissions. Moreover, Application Express enables the development of menus and selectable options that eliminate the use of most, if not all commands.

Microrim's File Gateway, a carry-over from earlier R:base systems, offers easy conversion of files developed on other systems, including Lotus Development Corp., ASCII, DIF (document interchange format) or Sylk files. It is not even necessary to predefine the System V table into which the data is to be loaded. File Gateway looks at the first few records to provide an interim layout of the data. Users simply modify that layout on the screen. File Gateway then converts the data, providing a running tally of accepted and rejected records. After the conversion is complete, File Gateway displays the rejected records, providing users the opportunity to correct questionable fields or to delete records completely.

System V is representative of the best of the new generation of user-friendly systems, offering complex and comprehensive capabilities to both novices and experts. Although it does require a thorough understanding of data structures and relationships within the database, it is easy to learn because of the way it employs menus and screens.



Menus and extensive *on-screen prompts enable developers to easily build menu-driven applications with Microrim's R:base System V.*

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Lear Siegler ADM-3A	X	X		
Lear Siegler ADM-5	X	X		
TeleVideo 910, 910+, 912, 920, 925, 925E	X	X		
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Enhanced IBM 3708 Attachment	X			

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data in a file by date or by specific values. Three-dimensional graphs can reflect multiple data sets and/or files overlaid on a 2-D graph. Decision Graphics facilitates the most common business graphics need—the continuous updating of data to reflect changing business realities, such as current quarterly figures compared to those of the previous quarter and to the same quarter in the year before. Adding and combining data to create new files requires minimal effort and keystrokes.

Extensive menu options *in Samna's Decision Graphics package enable users to develop a full range of business charts and graphs. Users can combine functions, tables and macros to produce charts via simple cursor selection.*

The main menu contains 10 primary-function selections on the left, a directory of the data files in the center and a directory of user-defined macros on the right—everything users need to readily access functions, to select data and to choose their own macros. As each menu in the hierarchy is accessed, the path remains on-screen, as do the selection options. Additionally, the company provides a "menu road map" card that shows the relationships of the nested menus.

Comprehensive statistical functions—including moving averages, linear regression, exponential and logarithm—are embedded within Decision Graphics, which also provides a slide-show capability. Comprehensive font, line, pattern, color, formatting and scaling capabilities provide users with readily accessed features to enable them to produce high-quality presentation of their data.

Interfaces add creativity

Several new packages provide considerable creative capabilities, enabling both experienced and inexperienced designers to readily develop sales presentations, direct-mail pieces, data sheets and brochures. For example, Computer Support Corp.'s Diagraph/2000 system employs on-screen, horizontal function-key menus, coupled with a comprehensive printed-image catalog to enable users to access more than 2,000 graphic images. Each of its libraries includes several optional disks containing hundreds of specialized images, covering most business, industrial and personal graphics applications. The images include computers and related office-automation equipment, anatomical drawings, maps, portraits, landscapes and cityscapes and various industrial processes.

Many of the libraries allow several graphic images to be joined to form composites, and full-image editing enables users to add their own creativity. Computer Support can also digitize corporate or product logos for users to include in their libraries. The images are complemented by a full range of typefaces.

In using Diagraph/2000 to develop graphics for internal presentations, newsletters, sales literature or direct mail, illustrators and designers simply find the images they want in the catalog, select the proper number to bring them to the screen and start editing. All functions are performed by hitting function keys, which are graphically portrayed on the bottom of most screens, and which include textual explanations. The options for each are listed at the top of the screen. Although little is revolutionary, their simple, direct interfacing makes comprehensive graphics capabilities more accessible to all users.

Visual Communications Network Inc.'s Concorde package offers 14 comprehensive libraries of full-color graphics images, from which users can produce impressive slide shows and demonstrations. Concorde also offers traditional bar, pie, line and other business charts. Although the Concorde interface is not as intuitive as some others, the capabilities it delivers have the potential to make graphics artists out of business users.

Diagraph/2000 and Concorde employ different forms of traditional nested-menu selection techniques. However, each delivers advanced clip-art and creativity capabilities, enabling users who are not artists, designers or illustrators to produce highly effective creative works.

CAD for beginners

Engineers, architects, draftsmen and designers have little difficulty understanding and using CAD systems. However, for most other users, whether they want to design a new product, or a better mouse trap, CAD systems are overwhelmingly complex and difficult. A number of newer CAD systems aim at less experienced users, but they tend to compromise on capabilities.

Autodesk Inc.'s AutoCAD is by far the most widely used PC-based CAD system. However, it is not easy to tap its powerful design capabilities. On the other hand, Autodesk structured its product and marketing strategy to encourage third parties to develop tools to make AutoCAD accessible to wider audiences. One example of how the power of AutoCAD can be made available to amateur architects and engineers is the interface provided by the combination of a

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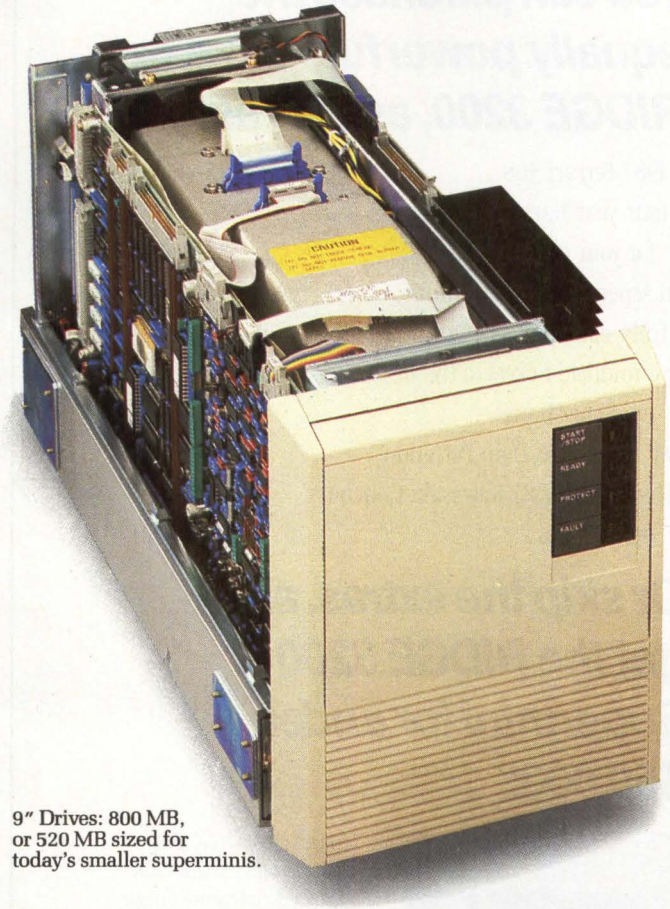

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C&C Computers and Communications

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A 1987 Ferrari 308 ..... ($64,000)
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*Field experience measured on 200 Ridge 32 systems.

Scriptel Corp. digitizer and ACAD Partner software from Chase Systems. By providing preformatted tablets (templates) that are placed under a translucent Scriptel digitizer, ACAD Partner software provides simple access to complex AutoCAD commands, eliminating most of the difficulties along with much of the keyboard entry.

ACAD Partner enables users to pick more than 200 AutoCAD commands by simply moving the Scriptel stylus, or mouse. Templates and Chase software are available for different applications, including engineering, architecture, fluid- and process-flow diagrams and other technical applications. Macro tablets harness the powerful AutoCAD LISP interpreter, providing instant access to macros that Chase uses to automatically provide appropriate dimensions to architectural structures, as well as to apply vanishing-point perspectives and coordinate geometry for producing accurate land-development illustrations.

The package also enables users to develop their own macro tablets, minimizing interaction with AutoCAD and its complex command structure. ACAD Partner also includes utilities applicable to the various design disciplines supported by AutoCAD. Chase software, in conjunction with one of Scriptel's innovative translucent digitizers, provides an excellent example of how new hardware- and software-interface technology enables users to readily obtain masterful results from complex applications.

Unlike AutoCad, Atlas Advanced Mapping Package (AMP), offered by Strategic Locations

DataSpace compresses data for quick access

Every economist, statistician, market researcher, financial analyst and MBA student dreams of having instantaneous access to huge amounts of data to perform complex analyses. Until recently, such analyses required mainframes and highly trained users; IBM Corp. PC hardware and software have not been able to provide fast cross-tabular analysis of large statistical databases. Maymod Corp.'s DataSpace is one of the first PC-level products to offer statistical power with the requisite speed to access large volumes of data.

To do so, DataSpace requires that the information be transformed and that users thoroughly understand the structure of the data in the database. The transformation process converts an existing relational or hierarchical database of fixed or variable records into a proprietary, compressed format for fast access. The transformation is performed by the provider of the information, with the support of Maymod, and is transparent to end users.

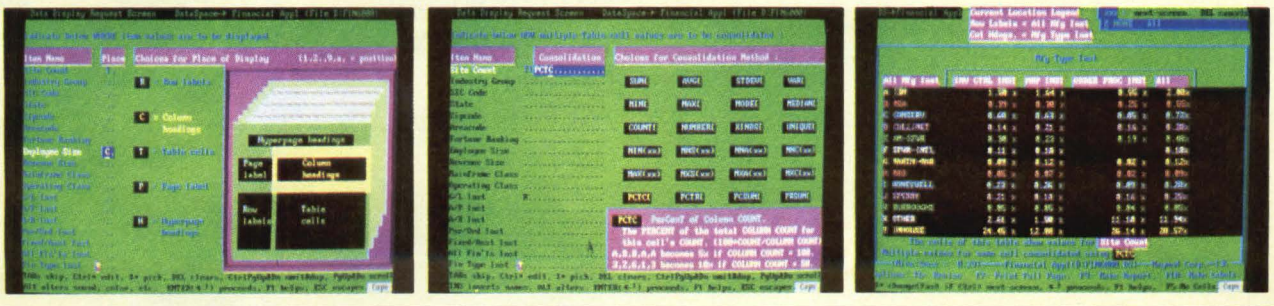
Loading DataSpace on a PC requires less than a minute. The initial DataSpace screens immediately illustrate its unique, highly visual interface. On the left the screen provides a complete scrolling inventory of the data elements available for cross-tabulation. A single stroke designates the data that will constitute a hyperpage, page, column or row. Cell computation options are automatically shown in a separate window.

As users move through the options available for mathematical computation, descriptions of each are shown. These provide concise descriptions of the results that will be obtained by utilizing such mathematical functions as sum, count, average and percentages, as well as complex trigonometric functions. After the options are chosen, the cross-tabulation is displayed within seconds, almost regardless of the size of the database accessed.

Should a cross-tabulation be not quite right—perhaps the data segment is too large or small, or the sums or counts in the cells need to be enhanced by percentages—users can quickly return to the primary selection screen and revise their selection criteria and view the new results. If the initial segment is too large, another criterion can be selected to narrow down the analysis.

After single-keystroke designations, the new results are shown almost immediately. Thus the iterative processes required for complex analysis are reduced to commonplace operations.

A statistical-analysis package, *Maymod's DataSpace employs a unique interface that allows users to establish the structure of the data they are analyzing.*



Disk Crashes Negatively Impact

So Hitachi Disk Drives are Built to Last.

"That *$(#&!! system you sold us died. The disk drive crashed." To the customer on the phone it doesn't matter that you purchased the drive from someone else. Your logo is on the product.

Hitachi understands the feeling. After all, we're one of the largest OEM computer system manufacturers in the world, and we use disk drives in our own equipment, too. If a drive should fail in a piece of our equipment, we'd get those charming phone calls, same as you.

So we use the most reliable disk drives available anywhere: Hitachi disk drives.

The art of making disk drives better.

Hitachi has 1,500 design engineers who work on nothing but disk drives. We design and build our own motors, heads, microprocessors, and custom LSI to ultra-high specifications. Then we subject them to the most stringent Quality Assurance program in the industry. We've learned over the past 15 years of disk drive manufacturing that this is the only way to make drives good enough to use in our own systems.

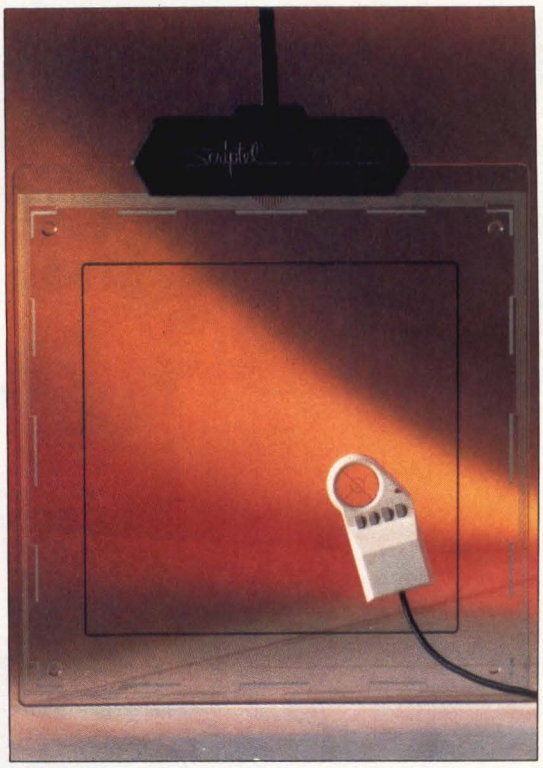
A serious commitment to disk drive solutions.

We have one of the broadest lines of state-of-the-art disk drives you can find, including 3.5", 5.25", 8", and 8.8" Winchesters. We've also made the enormous R & D expenditures necessary to be one of the pioneers in optical storage technology.

Hitachi is serious about staying with the product line for the long haul. Very serious. We believe in forging long-lasting relationships through a combination of superior quality products and superior support.

With Hitachi, you choose a business partner who will be here to work with you, today and tomorrow . . . helping you to keep your phone ringing with new orders, not complaints.

Fast Action:
To obtain product literature immediately, CALL TOLL FREE 1-800/842-9000, Ext. 6901. Ask for literature number PB-001.



Combining a transparent *digitizer tablet and Chase Systems' ACAD Partner software enables novices to tap the power of Autodesk's AutoCAD package. More than 200 AutoCAD commands are accessible simply by moving the digitizer's stylus and pressing the button.*

Planning, has its own user-friendly front-end interface, called ExpressMap. ExpressMap provides user access to Atlas AMP's extraordinary mapping capabilities. Menus and macros enable users to easily choose demographic data and geographic boundaries, including those for all 50 states, with a zoom function that isolates regions as well as boundaries for standard market areas. The company also offers a large number of census and demographic distribution tables that can be overlaid on the maps.

Maps are one of the most effective means of visually portraying data on past, current and projected status of market penetration and share, territorial coverage and development and client distribution. ExpressMap and Diagraph/2000 both enable general business users to produce presentation-quality geographic illustrations for both internal and customer presentations of proposals and sales literature.

Voice recognition says a lot

Voice-driven technologies offer users what may be the easiest possible interface. For example, Roar Technology Inc. provides this emerging interface in its VoiceKey system. Operation merely requires plugging the interface board into a slot in the PC, plugging the microphone or headset into the board and loading the software. VoiceKey provides four separate sets of 128 macros.

VoiceKey has three basic functions: to define or modify a vocabulary, to train or verify a vocabulary and to use a trained vocabulary. The first enables users to define an expression by keying it into the vocabulary table and then entering the keystrokes that the expression is to initiate. Next, users speak the expressions into the microphone, first to train VoiceKey and then to verify that the system recognizes the voiced expression. Using the system entails nothing more than speaking the appropriate expression into the microphone and seeing the results on the screen.

For example, this article was written using Microsoft Corp.'s Word. After booting the system, saying "word" into the microphone caused the PC to change from drive A> to C>, to change the c:\directory to c:\Word and to load the Word program. Similarly, repetitive,

Companies mentioned in this article

Autodesk Inc.
2320 Marinship Way
Sausalito, Calif. 94965
(415) 332-2344
Circle 337

Chase Systems
623 Park Meadow Road
Westerville, Ohio 43081
(614) 899-0400
Circle 338

Computer Support Corp.
2215 Midway Road
Carrollton, Texas 75006
(214) 661-8960
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Decision Resources Inc.
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Westport, Conn. 06880
(203) 222-1974
Circle 340

Magicorp
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Elmsford, N.Y. 10523
(800) 367-6244
Circle 341

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Circle 342

Microrim Inc.
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Bellevue, Wash. 98007
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Roar Technologies Inc.
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Downsview, Ontario
M3K 1Z9, Canada
(800) 268-7985
Circle 344

Samna Corp.
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Scriptel Corp.
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Software Publishing Inc.
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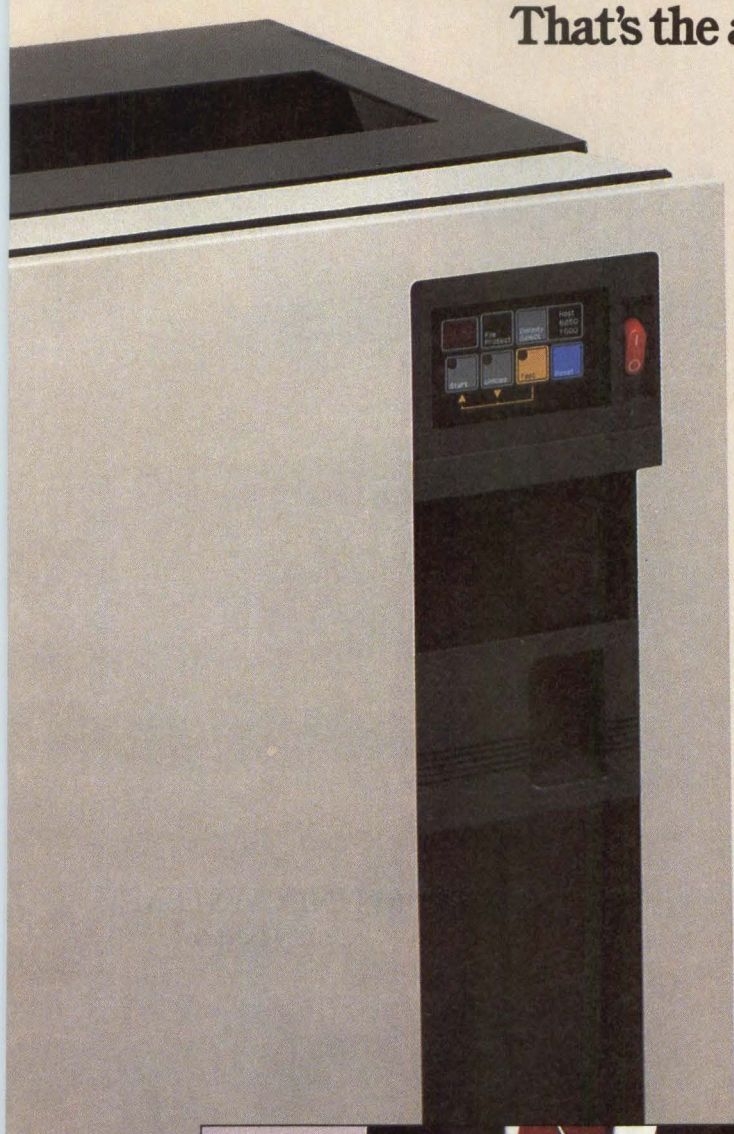
Mountain View, Calif. 94039
(415) 962-8910
Circle 348

Strategic Locations Planning
4030 Moorpark Ave.
San Jose, Calif. 95117
(408) 985-7400
Circle 349

Visual Communications Network Inc.
238 Main St.
Cambridge, Mass. 02145
(617) 497-4000
Circle 350

With this high-performance GCR Streamer, the benefits begin with reliability and end with cache.

That's the advantage you get with a leader.



At Fujitsu America we want our back-up devices to be second-to-none in price, performance and reliability.

That's why we developed the M244X series ½" GCR tape drive with an intelligent 256KB cache buffer. The buffer means you get all the versatility of our start/stop drive, plus the speed and reliability of our streamer technology. Parameters such as transfer rate, block size and ramp times are all switch-selectable so you can easily optimize the drive for your system.

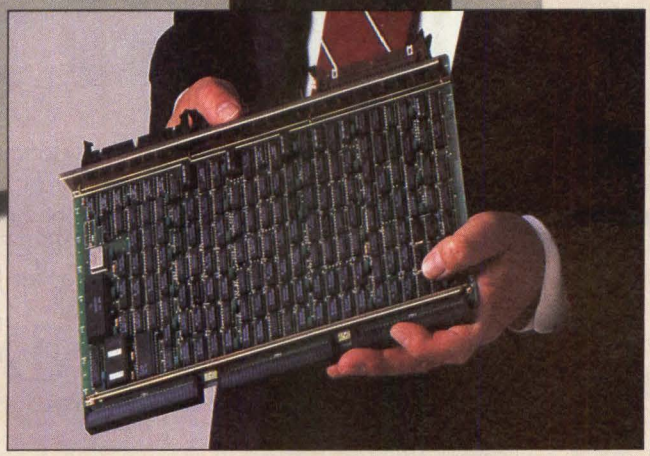
But the cache buffer is just the finishing touch on a tape drive that already outperforms the competition.

By incorporating Fujitsu's advanced LSI electronics, we have eliminated the high-cost, high-failure mechanics found in other low-cost GCR tape drives. As a result, you get a high-performance GCR Streamer with the best reliability rating—and the best price—in its class.

Throughout this drive's design, we have found ways to keep your cost of ownership to a minimum. The drive performs its own internal monitoring and self-adjustment, eliminating costly preventative maintenance. And the sophisticated diagnostics make it possible to isolate system faults without special test equipment.

For information on this or any other Fujitsu tape drive, call (408) 946-8777. Or write Fujitsu America, Inc., Storage Products Division, 3055 Orchard Drive, San Jose, CA 95134-2017.

The Fujitsu M244XAC GCR Streamer, with cache buffer. From price, to performance, to reliability—it's the best tape drive in its class.



Fujitsu Cache Adapter provides a 256KB intelligent memory buffer, increasing system performance.

MODEL	M2442AC	M2444AC
Tape Speed (ips)		
Streaming	100	75
Start/Stop	12.5	25
Recording Density (bpi)	6250/1600	
MTBF	8,000 hours	
Cache Buffer	256 KB	
Transfer Rate	Selectable from 60 KB/sec to 1 MB/sec	
Compatibility	IBM,® ECMA and ANSI	
Interface	Cipher,® Pertec compatible	

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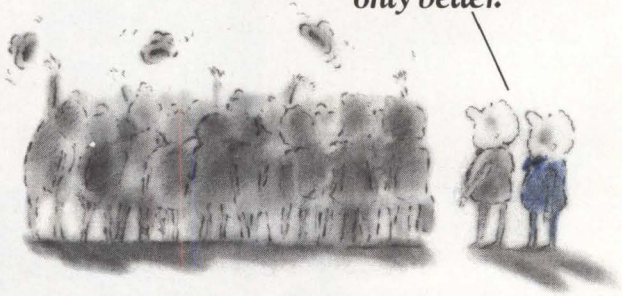
CIRCLE NO. 52 ON INQUIRY CARD

"It's UNIX SYSTEM V, only better."



The fastest way to say UNIX® is "XENIX." Microsoft's XENIX® System V/286 is the fastest version of UNIX available for the Intel architecture. And speed is only half the story. XENIX is full UNIX System V—with a complete set of developer's tools including make, SCCS, and the Berkeley enhancements. Add improvements like the acclaimed Microsoft® C Compiler and it's obvious why XENIX—with over 160,000 installations—is the number one choice for UNIX developers.

And now we've made 386 software development faster as well. Our new XENIX System V/386 Toolkit—available for only $395—lets you develop and run 386 programs on advanced machines like the COMPAQ® DESKPRO 386.®

For more information on the XENIX Toolkit, call (800) 227-4679.

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The Microsoft XENIX System V/386 Toolkit requires either an IBM® PC AT with IBM PC XENIX Release 2.0 or SCO XENIX System V or a COMPAQ DESKPRO 286 or DESKPRO 386 with COMPAQ XENIX System V/286. Price shown is Microsoft's suggested retail price, and is subject to change without notice.

CIRCLE NO. 49 ON INQUIRY CARD

multikeystroke functions can be voice-triggered to define margins, center titles and to boldface or underline sections of the manuscript.

Roar offers two versions of VoiceKey: one with a hand-held microphone, which is as cumbersome as a mouse because it requires removing your hands from the keyboard, and a headset version, which eliminates that drawback.

The most difficult aspect of voice systems is that they require consistent vocal tone, modulation and volume. However, once a user becomes accustomed to talking to a computer, it proves to be no more difficult than talking long distance on the telephone.

Interfaces grow and mature

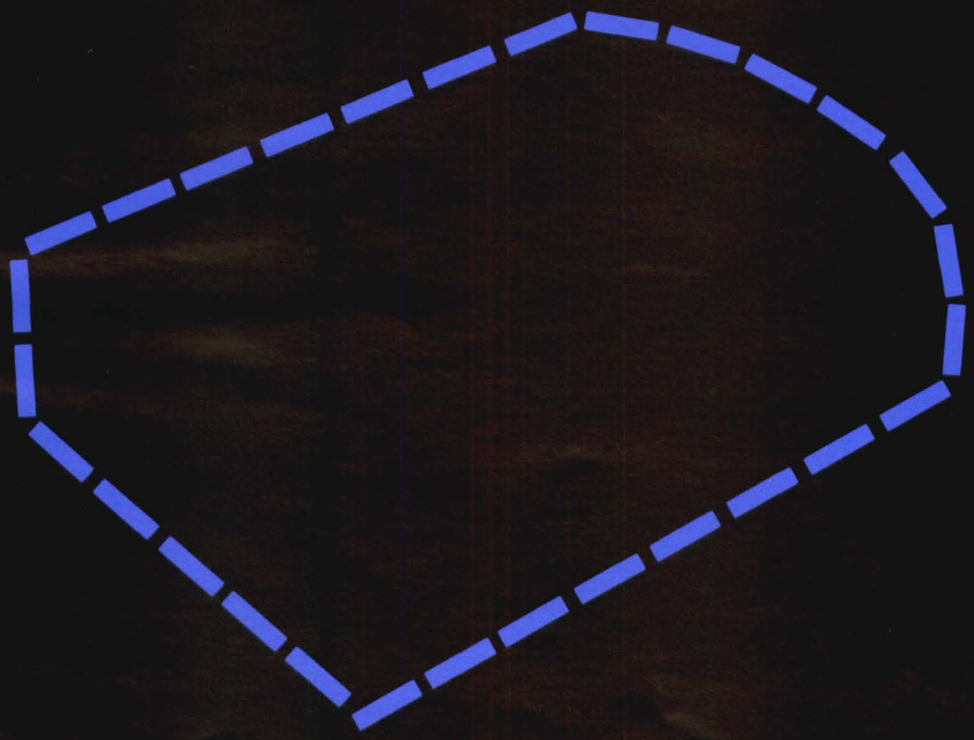
More progress has been made in human-interface technology this year than in all the previous decades of computer usage. It is reasonable to expect that in 1987 software and hardware developments will continue to evolve, making it easier than ever for more PC users to design homes, offices and products; to create artistic printed materials; and to develop sophisticated database applications. Yet, with all this progress at the PC level, minicomputers and mainframes—even with fourth-generation languages, report generators and other tools—still require users to have competent levels of programming skills.

However, with the advent of 16-MHz Intel Corp. 80286-based PCs and 32-bit 80386 PCs coupled with high-speed, high-capacity mass-storage devices in multiuser environments, users will be less and less concerned with direct access to mainframes and minicomputers. They won't have to wait for the two-year software-development backlog to catch up with their requirements. Today's competitive economic realities are forcing them to implement their own solutions. Fortunately, user interface technology is developing apace of their needs. □

Gene Talsky is president of Professional Marketing Management Inc. (PROMARK), Old Lyme, Conn., a computer industry business development and marketing planning service.

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

You can't design the perfect PC...

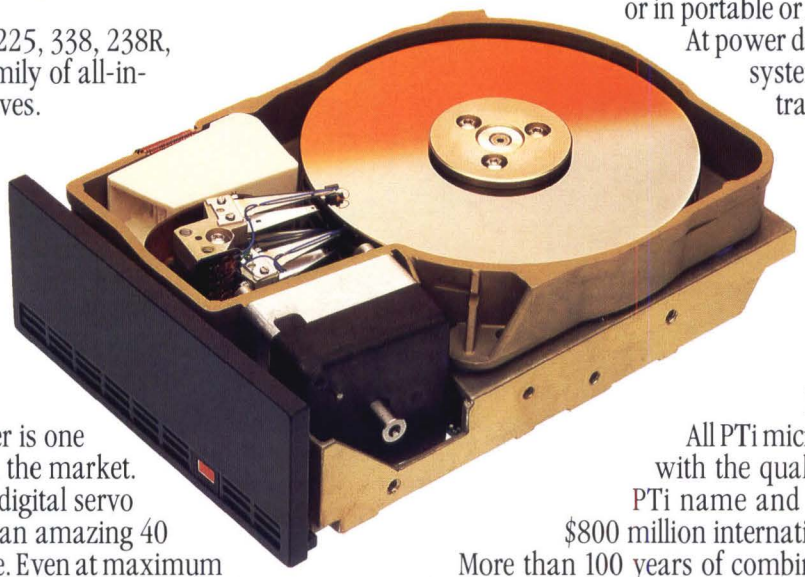


if you lack the drive.

Systems designers have long been searching for the micro Winchester that does everything exceptionally well.

Fortunately, they can get it now from Peripheral Technology, Inc.

Introducing the PT 225, 338, 238R, and 357R. The first family of all-in-one 3½" hard disk drives. High speed, large capacity, unusually low power consumption, and the reliability of an innovative head-lock system. In one lightweight package.



IT FLIES.

A PTi micro Winchester is one of the fastest drives on the market. Using the world's first digital servo positioner, it averages an amazing 40 millisecond access time. Even at maximum seek distance–a blazing 68 milliseconds–it'll turbocharge any PC, instrumentation or multi-user system.

IT'S FRUGAL.

At less than seven watts during operation, PTi drives use less energy running than others do standing still. So your system will run cooler, last longer.

IT'S ROOMY.

Employing two and three platters, PTi micro Winchesters offer capacities from 20 to 47 megabytes. The extra-capacity "R" series was designed for use with the latest controllers supporting run length limited (2,7) data encoding.

WE'VE GOT THE DRIVE.

PERIPHERAL TECHNOLOGY INC.

685 East Cochran St. • Simi Valley, CA 93065 • (805) 581-1000

IT'S SAFE.

PTi has designed an innovative locking system that will make your data absolutely safe in a power outage or in portable or rugged applications. At power down, this innovative system automatically retracts the heads into a landing zone away from the data and then secures them with a unique head-lock mechanism. So power loss doesn't mean data loss.

IT'S QUALITY.

All PTi micro Winchesters come with the quality assurance of the PTi name and the resources of an $800 million international corporation.

More than 100 years of combined experience have been pooled to create the first family of all-in-one disk drives to perfect your design.

So if you're looking for speed, capacity, low power consumption, and safety in one 3½" disk, plug in a micro Winchester from PTi.

If you've got the system, we've got the drive.

SPECIFICATIONS*

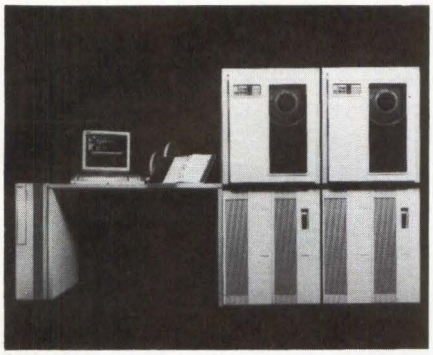
	PT 225	PT 338	PT 238R	PT 357R
Capacity (M bytes)				
Unformatted				
Per drive	25.6	38.4	38.4	57.6
Per surface	6.4	6.4	9.56	9.56
Per track (bytes)	10,416	10,416	15,624	15,624
Sectors per track	32	32	25	25
Access time (Includes head setting) in ms.				
Track to track	14	14	14	14
Average	40	40	40	40
Maximum	68	68	68	68
Track density (TPI)	983	983	983	983
Cylinders	615	615	615	615
R/W heads	4	6	4	6
Disks	2	3	2	3
Recording method	MFM	MFM	RLL(2,7)	RLL(2,7)
Interface	ST412	ST412	ST412	ST412

*For complete specifications, call or write PTI.

NEW PRODUCTS

SYSTEMS

Megan Nields, Assistant Editor



Computer connects up to 160 users

- MC68020 processor
- 14-inch terminal
- Three models

The 32-bit ADDS Mentor 6000 series of multiuser systems connect up to 160 users. Available in three configurations, the computers utilize an MC68020 microprocessor and can support over 4G bytes of disk storage. The unit supplies a 14-inch terminal with an 80- or 132-column display and 16 or 32 programmable function keys. $37,000 to $121,000. **Applied Digital Data Systems,** 100 Marcus Blvd., Hauppauge, N.Y. 11788, (516) 231-5400.

Circle 375

PC utilizes 80286 processor

- 640K bytes of memory
- 20M-byte rigid disk drive
- 1.2M-byte flexible disk drive

Operating up to three times faster than previous models, the IBM PC/XT model 286 utilizes an 80286 processor. The unit features 640K bytes of memory expandable to 12.6M bytes; a 1.2M-byte, 5¼-inch flexible disk drive; a 20M-byte rigid disk drive; and a serial/parallel adapter card. It also supports the PC 3½-inch External Diskette Drive. $3,995. **IBM Corp.,** Information Systems Group, 900 King St., Rye Brook, N.Y. 10573, (914) 934-4488.

Circle 376

Computer emulates IBM PC/AT

- 80286 processor
- 14-inch monitor
- 512K bytes of RAM

Emulating the IBM PC/AT, the TeleCat 286 computer utilizes an 80286 processor running at 8 MHz. It supplies a 14-inch monochrome monitor, a 20M-byte rigid disk drive, 512K bytes of RAM and a 1.2M-byte flexible disk drive. A serial port and parallel port are standard. Features include a disk controller with double buffering and five I/O expansion slots. The unit supports PC/AT-compatible graphics applications with a 640-by-200-pixel resolution. $2,995. **TeleVideo Systems Inc.,** 1170 Morse Ave., P.O. 3568, Sunnyvale, Calif. 94088-3568, (408) 745-7760.

Circle 377

Workstation provides CAD/CAM applications

- IBM PC/AT compatible
- 2.5M bytes of memory
- 19-inch monitor

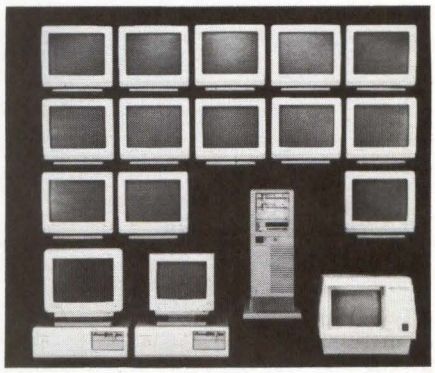
Based on the IBM PC/AT, the CAD-MAX-PC workstation is for CAD/CAM applications. The desktop system supplies 2.5M bytes of memory and a 19-inch color monitor that displays a 1,024-by-800-pixel resolution. $20,000. **Vector Automation Inc.,** Village of Cross Keys, Baltimore, Md. 21210, (301) 433-4200.

Circle 378

Multiuser computers handle 16 users

- Three models
- 1M to 15M bytes of RAM
- Eight terminal ports

Consisting of three models, the System 1100 multiuser computers are aimed at VARs. The system can have up to 16 simultaneous users. It features 1M byte of RAM, expandable to 15M bytes, eight terminal ports and a 60M-byte tape backup. The model 1105 supplies a



48M-byte Winchester disk: models 1110 and 1115 have 87M-byte and 147M-byte disks, respectively. $15,000 to $22,000. **Texas Instruments Inc.,** Data Systems Group, P.O. Box 809063, H-891, Dallas, Texas 75380-9063, (800) 527-3500.

Circle 379

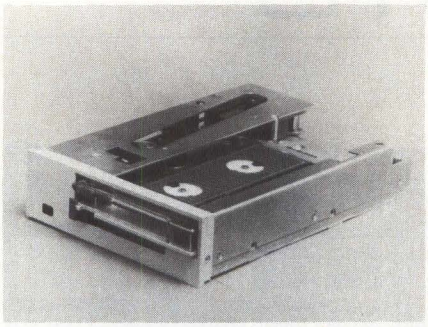
Publishing system suits OEMs, VARs

- 80286 processor
- Proprietary software
- 15-inch monitor

Aimed at OEMs and VARs, the Office Publishing System produces documents incorporating multifont text, graphics, spreadsheets, database information and voice messages. The desktop unit is based on a 16-bit 80286 processor running at 8 MHz with no-wait states. It supports laser and dot-matrix printers and runs software applications based on MS-DOS and CTOS. A 15-inch monitor, proprietary software and graphics controller are included. $6,700 to $7,500. **Convergent Technologies Inc.,** 2441 Mission College Blvd., Santa Clara, Calif. 95050, (408) 727-8830.

Circle 380

DISK/TAPE

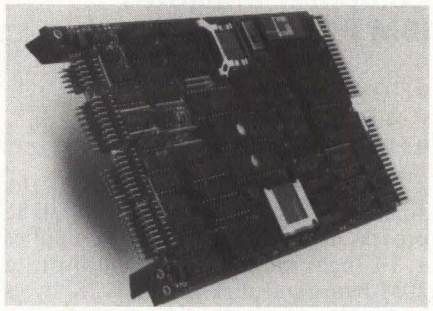


Tape drive stores 52M bytes

- Two transfer rates
- Quarter-inch unit
- 250K-bps transfer rate

The FAD-5000 quarter-inch tape cartridge drive provides up to 52M bytes of formatted storage on a DC600A tape cartridge. The half-height, 5¼-inch unit operates from an IBM PC/XT flexible disk drive controller with a data-transfer rate of 250K bps, or from a PC/AT controller at 500K bps. $300. **Wangtek,** 41 W. Moreland Road, Simi Valley, Calif. 93065, (805) 583-5255.

Circle 381

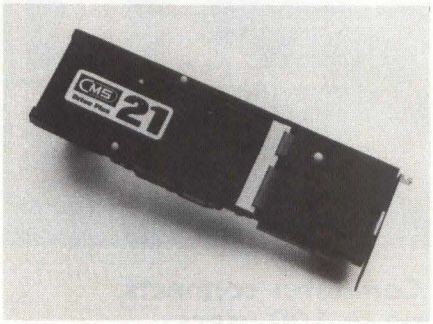


Controller supports four Winchester drives

- 700M bytes of memory
- 3M bytes per second
- 128K-byte buffer

The MQD12 controller supports four 5¼-inch ST506 Winchester disk drives on DEC Q-bus-based computers. Targeting OEMs and system integrators, the dual-width device stores over 700M bytes of storage. Data-transfer rate is 3M bytes per second. Features include a 128K-byte buffer, non-volatile RAM and diagnostic functions such as defect scan and loop. $1,495. **Micro Technology Inc.,** 1620 Miraloma Ave., Placentia, Calif. 92670, (714) 632-7580.

Circle 382



Disk drive furnishes 21M bytes of memory

- 3½-inch unit
- IBM PC compatible
- 80-msec access time

A 3½-inch expansion-card disk drive, the Drive Plus 21 furnishes 21M bytes of memory and an 80-msec average access time. The unit requires only one slot in an IBM PC or PC/XT when placed in the farthest left chassis slot. It suits OEMs and VARs. $595. **CMS,** 3080 Airway, Costa Mesa, Calif. 92626, (714) 549-9111.

Circle 383

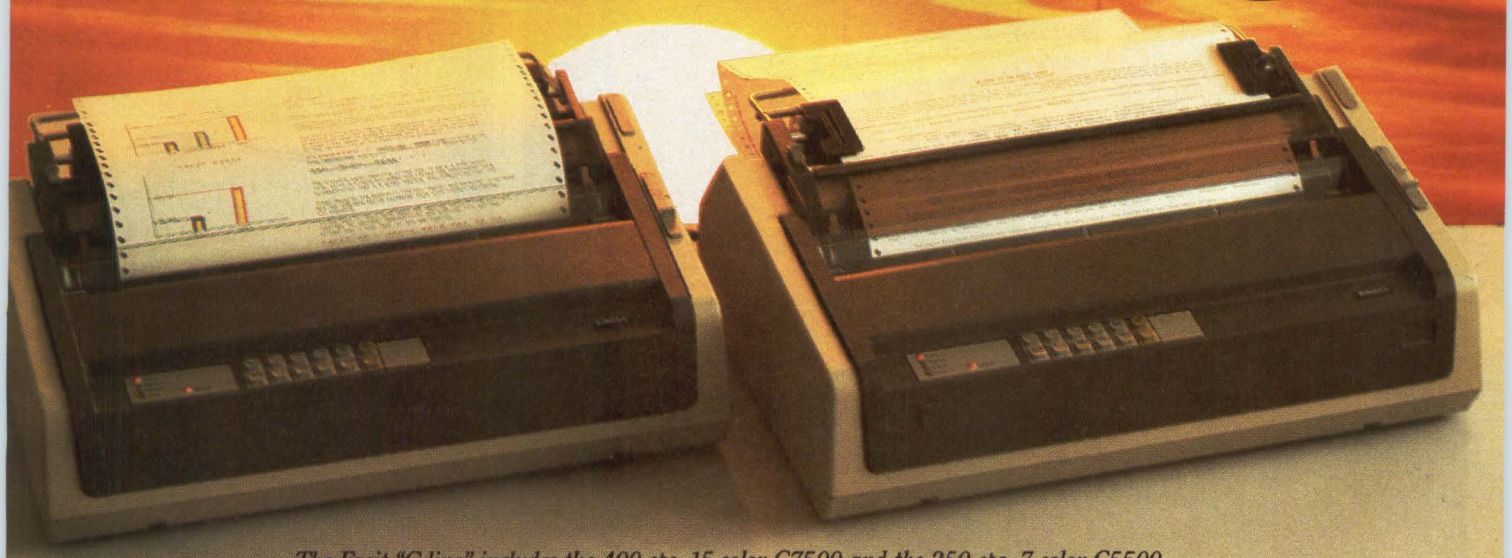
Subsystem stores 20M bytes of RAM

- IBM PC compatible
- 3.7M bytes per second
- Proprietary software

A non-volatile subsystem for the IBM PC, PC/XT, PC/AT and compatibles, BATRAM stores up to 20M bytes of RAM. The device has a 3.7M-byte-per-second transfer rate and contains up to five cards. It suits LANS, CAD/CAM workstations, graphics and A/I applications. Features include proprietary software and error detection and correction. $1,895, $1,295 for each additional card. **Santa Clara Systems Inc.,** 1610 Berryessa Road, San Jose, Calif. 95133, (408) 729-6700.

Circle 384

THE TIME MACHINES



The Facit "C-line" includes the 400 cps, 15-color C7500 and the 250 cps, 7-color C5500

The 400 cps report is finished. You press a button and the printer is ready for a single sheet, 15-color business graphics. Then you change to a multi-font NLQ printout from a second connected computer. At the same time, you also change the paper path for document-on-demand. Then you...

The Facit C7500 and C5500 Matrix Printers not only handle a multitude of different applications. They permit instant switching from one application to another.

Printout options (including NLQ, multi-fonts and graphics), paper handling and all set-up parameters are changed in a matter of seconds using the "Yes" and "No" keys. Two entire parameter sets can even be pre-defined for instant selection.

All at the touch of a key.

INSTANT PAPER LOADING AND SWITCHING

To save more time, paper loading is fully automatic with a choice of three different paper paths. This enables accurate feed of multi-part invoices and paper tear-off without losing a single form. You can even hold a continuous form in stand-by while cut-sheets are printed.

To facilitate easy integration in your system, both parallel and serial interfaces are provided as standard along with Epson FX/JX or IBM Graphics Printer emulation. You can use the pre-defined set-ups to alternate between different hosts, if required.

For a demonstration of how the Facit C7500 and C5500 boost the efficiency of your computer system, contact your nearest Facit representative.

It will be a real timetrip.

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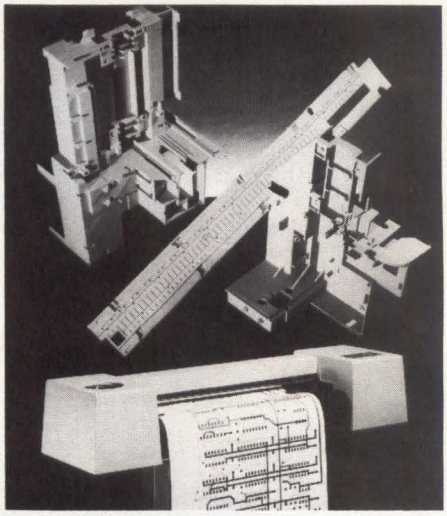
CIRCLE NO. 251 ON INQUIRY CARD

NEW PRODUCTS
PRINTERS



Plotter suits PC-CAD applications

- RS232C interface
- Eight pens
- IBM compatible

An eight-pen plotter, the HP Draftpro handles personal computer CAD applications. The unit is compatible with the IBM PC, HP Vectra and Apple Macintosh. It supports AutoCad, Anvil-1000 and VersaCAD. Features include a standard RS232C interface, 15-ips pen speed, 0.001-inch addressable resolution and 0.2 percent linear accuracy. $5,400. **Hewlett-Packard Co.,** 1820 Embarcadero Road, Palo Alto, Calif. 94303, Phone locally.

Circle 385

Laser printers yield 20 ppm

- IBM compatible
- Three configurations
- 150 fonts

Based on the IBM PC/AT, the Formwriter 10, 10X and 10XD laser printers merge data generated from software, such as Lotus 1-2-3, with electronically stored forms to produce 20 ppm. Up to 5,000 individual electronic forms and 150 fonts can be stored on a proprietary rigid disk and then accessed by proprietary software. Features include dual offset stackers and a 2,000-sheet paper deck. $14,995 to $24,995. **Electronic Forms Systems,** 2395 Midway Road, Carrollton, Texas 75006-2504, (214) 250-7000.

Circle 386

TERMINALS

Monitor displays 1,600 by 1,280 pixels

- 19-inch unit
- 0.25-mm pitch
- 60-Hz refresh rate

The MX-4190 color monitor boasts a 1,600-by-1,280-pixel resolution at 0.25-mm pitch. The 19-inch unit provides 60-Hz, non-interlaced refresh rates. Video bandwidth is more than 160 MHz. Applications include computer graphics, CAD/CAM, animation and simulation. $5,995. **Monitronix Corp.,** 2971 Silver Drive, Columbus, Ohio 43224, (614) 262-0334.

Circle 387

Terminal furnishes dual resolution

- 30, 60 Hz
- 19-inch screen
- 16 colors

A two-resolution graphics display terminal, the ColorTrend model 140 displays a 480-by-360-dot resolution at 60 Hz or a 1,024-by-720-dot resolution at 30 Hz via a software command. The 19-inch unit supplies 16 colors and graphics commands such as pan, circle, zoom and roam. Throughput is as high as 38.4K bytes. It is available in rackmount, desktop or industrialized versions. $4,295. **Intecolor Corp.,** Intecolor Drive, 225 Technology Park, Norcross, Ga. 30092, (404) 449-5961.

Circle 388

Terminal combines voice and data

- IBM 3270 compatible
- 240 soft keys
- Seven windows

The C078 is an IBM 3270 plug-compatible voice/data terminal with integrated telephony, windowing and datacommunications capabilities. Features include auto-dialing of up to 600 telephone numbers and 240 soft keys. Up to seven windows can be accessed and sized to keep displayed information on a single screen. Windows display 3270, remote ASCII and local DEC VT220 sessions. Monitor size is 12 inches, green or amber. $2,695. **Telex Computer Products Inc.,** 6422 E. 41st St., Tulsa, Okla. 74135, (918) 627-1111.

Circle 389

DATACOM

LAN accepts IBM PC

- PC-DOS/MS-DOS software
- Lotus compatible
- RS232C connector

A LAN for the IBM PC and compatibles, Knowledge Network includes memory-resident PC-DOS/MS-DOS software. Modular telephone cables connect up to six computers via RS232C ports. Users can run transfer files while sharing rigid disks, tape drives and other peripherals. The product is compatible with Lotus 1-2-3, dBASE II and III and other programs. $99 per node. **Applied Knowledge Groups Inc.,** 1622 El Camino Real W., Mountain View, Calif. (415) 369-3070.

Circle 390

Modem operates at 19.2K bps

- HDLC protocol
- CCITT V.27, V.29 modes
- Half duplex

For block-mode and file-transfer applications, the RACE-BMX modem runs at speeds up to 19.2K bps. It operates in CCITT V.27 and V.29 mode and offers data compression and compaction. The half-duplex unit autodials up to 10 31-digit telephone numbers and supplies a choice of off-line command modes for setting parameters. All data transfers are fully error-protected by HDLC protocols and 16-bit CRCs. Features include an IBM PC/AT-compatible command mode. $1,195. **Data Race Inc.,** 5839 Sebastian Place, San Antonio, Texas 78249, (512) 692-3909.

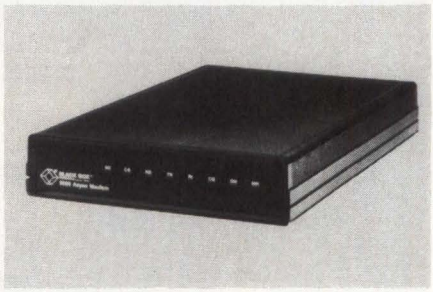
Circle 391

Data switch handles up to 144 lines

- 9,600 bps
- 10-slot chassis
- Three line cards

An asynchronous data switch for port contention and resource sharing, the CX1500 handles up to 144 asynchronous lines of data at 9,600 bps. The unit includes a 10-slot chassis with six line card slots, a system control set with two cards and three line cards. Data and control signals are duplicated via a redundant backplane bus. $80 per line. **ComDesign,** 751 S. Kellogg Ave., Goleta, Calif. 93117-3880, (805) 964-9852.

Circle 392



Modem runs at three speeds

- 4,800, 7,200, 9,600 bps
- Hayes compatible
- RS232C interface

The Black Box Modem 9600 supplies manually selectable data rates of 4,800, 7,200 or 9,600 bps. It runs with the IBM PC, PC/XT, PC/AT and compatibles via an RS232C connection to an asynchronous port or asynch protocol converter. Features include built-in error detection and correction. The Hayes-compatible device operates with many software packages and can be programmed for auto-dial/auto-answer or manual pulse. $995. **Black Box Corp.,** P.O. Box 12800, Pittsburgh, Pa. 15241, (412) 746-5500.

Circle 393

Controller directs IBM PC/XT, PC/AT, RT PC

- 80188 CPU
- MAP applications
- X.25 software

The AdCom2-I is an intelligent communications controller for the IBM PC/XT, PC/AT and RT PC. Targeting MAP, DDN and SDLC applications, the device utilizes an 80188 CPU with local DMA and interrupts. Programmable baud rates range from 64K to 75K. A VRTX operating system and X.25 software are supplied. Features include extensive software support and automatic error checking. $1,495. **Frontier Technologies Corp.,** P.O. Box 11238, 3510 N. Oakland Ave., Milwaukee, Wis. 53211, (414) 964-9689.

Circle 394

Modem operates at 4.8K, 9.6K bps

- Full duplex
- V.32 compatible
- Trellis coded

A CCITT V.32-compatible trellis-coded modem, the RM-9632 aims at full-duplex and leased-line applications. The unit operates at 4.8K bps or 9.6K bps over two-wire dial and either two-wire or four-wire leased-line circuits. Trellis-coded modulation provides forward error detection and correction. RS366/V.25 and serial asynchronous interfaces are provided. Up to 10 numbers can be stored in an integral autodialer. $3,500. **Racal-Milgo,** P.O. Box 407044, Fort Lauderdale, Fla. 33340-7044, (305) 475-1601.

Circle 395

Modems offer V.22 bis compatibility

- Three models
- 2.4K to 19.2K bps
- Talks to MNP

The 4600/VS family of modems offer V.22 bis and Bell 103 and 212A compatibility. The models 4624/VS, 4648/VS and 4696/VS transmit data at 2.4K bps, 4.8K bps and 19.2K bps respectively. They supply compatibility with Hayes and Microcom command sets and can communicate with modems that support the Microrim Networking Protocol. $745, 4624/VS; $895, 4648/VS; $1,795, 4696/VS. **Case Communications Inc.,** 7200 Riverwood Drive, Columbia, Md. 21046-1199, (301) 290-7710.

Circle 396

SOFTWARE

Retrieval software fetches databases

Version 3.0 of the Xtrieve on-line data-retrieval system targets VARs. The software, a menu-driven database query tool, customizes help files and error messages. Features include password security and a built-in report-writer option. Users can view up to eight files at a time. The software requires MS-DOS 2.0 and higher and 256K bytes of RAM. A LAN version is available. $245, single user version; $595, LAN version **Softcraft Inc.,** P.O. Box 9802, #917, Austin, Texas 78766, (512) 346-8380.

Circle 397

Software works with Lotus 1-2-3

HAL, a memory-resident program, works directly with Lotus 1-2-3 to create and manipulate worksheets. It runs on IBM PC, Compaq and AT&T computers using MS-DOS 2.0 or higher and 512K bytes of memory. The software expresses 1-2-3 commands in English and allows users to link one spreadsheet to another, to find and replace words and numbers and to keep a log of commands for review and correction. $150. **Lotus Development Corp.,** 55 Cambridge Parkway, Cambridge, Mass. 02142, (617) 577-8500.

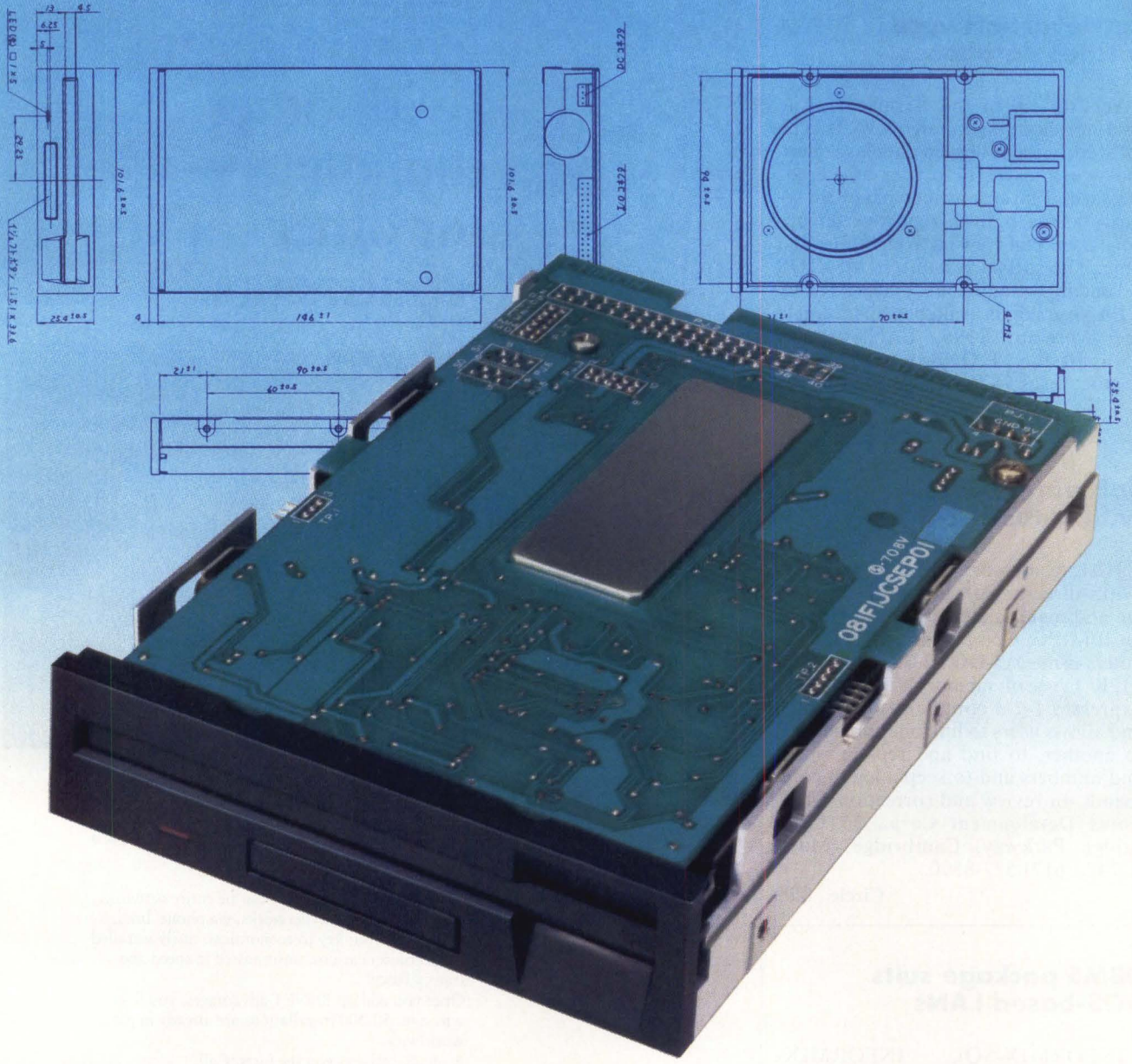
Circle 398

DBMS package suits DOS-based LANs

INFORMIX-SQL, INFORMIX-ESQL/C and C-ISAM are DBMS software packages based on Standard Query Language (SQL) for DOS-based LANs. The products enable the creation of database applications that minimize traffic over LANs by permitting only pertinent files or portions of a file to be transmitted. The software supports the IBM Token-Ring Network, IBM PC-Network, Novell Advanced Netware, 3Com 3+Plus and Ungermann-Bass Net/One. The basic packages accommodate four nodes. $1,995, SQL; $1,495, ESQL/C; $450, C-ISAM. **Relational Database Systems Inc.,** 4100 Bohannon Drive, Menlo Park, Calif. 94025, (415) 322-4100.

Circle 399

CHINON: As serious about technology as you are.



Chinon floppy disk drives are renowned in Japan for outstanding technical excellence and an extremely high level of overall quality. That kind of reputation doesn't come easy in a land where OEM's have some of the toughest standards in the world.

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Chinon America, Inc., 6374 Arizona Circle,
Los Angeles, CA 90045. (213) 216-7611 FAX: (213) 216-7646

PICTURED IS CHINON F-354L: 5V, ONE-INCH, 1MB SLIM-LINE MODEL.

CIRCLE NO. 61 ON INQUIRY CARD

SUBASSEMBLIES

I/O board furnishes eight serial channels

- 128K bytes of RAM
- 9.6K-byte baud rate
- MC68010 processor

An intelligent serial I/O board, the VME ISIO-1 furnishes eight multiprotocol serial channels. The unit handles 9.6K-byte baud rates simultaneously with software-programmable baud rates from 110 to 38.4K bytes. Features include 128K bytes of dual-ported RAM, upgradable to 512K bytes, and sockets for 128K bytes of EPROM. The device utilizes a 10-MHz MC68010 processor. $2,195. **Force Computers Inc.,** 727 University Ave., Los Gatos, Calif. 95030, (408) 354-3410.

Circle 400

Adapter displays 640 by 350 pixels

- IBM compatible
- 16 colors from 64
- 256K bytes of screen memory

Compatible with the IBM Enhanced Graphics Adapter, the Micro Enhancer is a 5-inch, short-card graphics display adapter. The board supplies 640-by-350-pixel resolution in 16 colors from a palette of 64 colors. It fits into any slot on the IBM PC or PC/XT and runs color graphics software on an enhanced monitor with 256K bytes of screen memory. $499. **Everex Systems Inc.,** 48431 Milmont Drive, Fremont, Calif. 94538, (415) 498-1111.

Circle 401

Multibus board offers 4M bytes of RAM

- 32-bit operation
- MC68020 processor
- Four EPROM sockets

The SBE/MPU-20 Multibus board provides 32-bit operation at 16.7 MHz. Based on the MC68020 processor, the unit offers up to 4M bytes of parity-protected dual-ported RAM. Serial and parallel I/O is provided by two multiprotocol, full-duplex serial ports. Maximum baud rate in synchronous operation is 800K bytes. The device supplies four EPROM sockets. $1,995. **SBE Inc.,** 2400 Bisso Lane, Concord, Calif. 94520, (415) 680-7722.

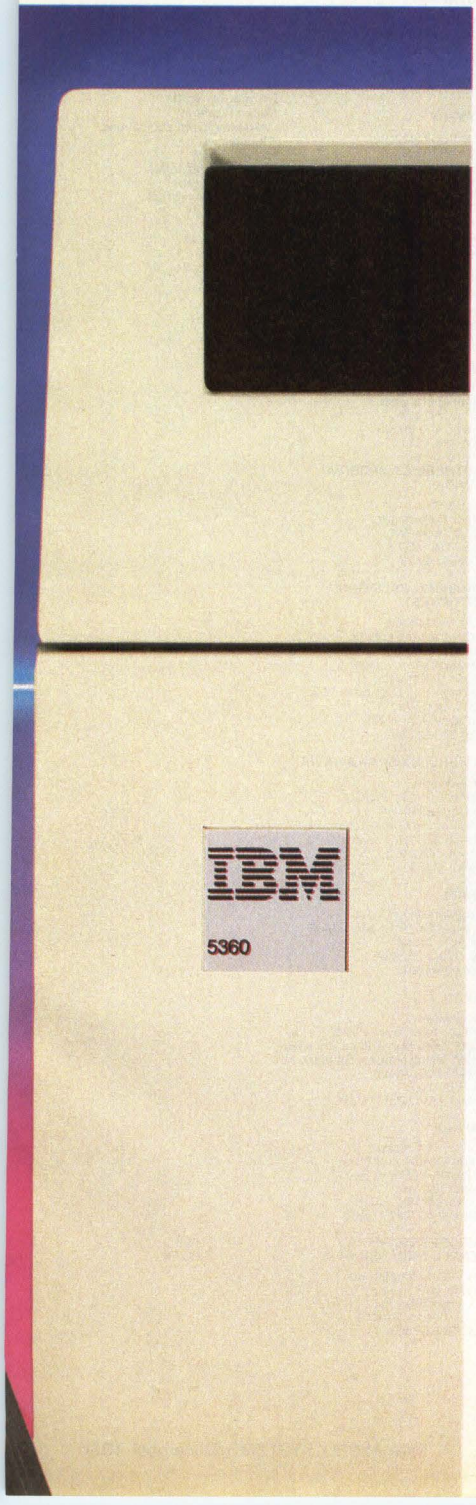
Circle 402

New from Asher Technologies. A more powerful PC-to-Mini connection.

Minilink.

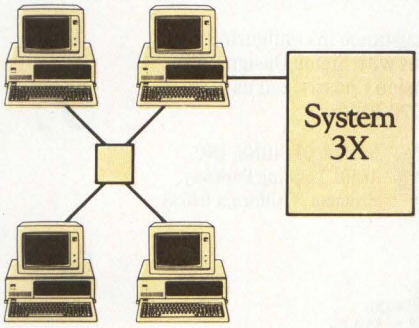
A new speed limit for PC-to-Mini connections

The heart of MiniLink is its Motorola M68000 microprocessor, the most powerful 16-bit processor available. *The M68000 gives MiniLink an incredible throughput rate.* So data flows without delay. The difference shows: There's not a faster PC-to-Mini package around.



A built-in gateway to the future

Only MiniLink offers you a true gateway from a local area network to your System 3X.



Now you can integrate your mini system with your PC system. *Simply plug MiniLink with its software upgrade into any PC on your network* and instantly you can conduct mini sessions on up to seven stations at once.

7 work sessions with cut-and-paste windows

From the moment you're on-line with MiniLink, you're

more productive. *You can perform up to seven separate jobs at the same time, with a single keystroke taking you from PC mode to Mini mode.* MiniLink's concurrent file transfer software allows you to transfer files at the same time you're working in other sessions.

And MiniLink supports windowing, so you can see all of your sessions on-screen at the same time. You can even cut-and-paste from window to window to make use of all your information.

More terminal and printer support

MiniLink emulates the System 3X printers and terminals you need for any application. Printers supported include the 5219, 5224, 5225, and the 5256. Terminals supported include the 5251-1, 5251-11, 5291, and 5292-1. And MiniLink delivers the keyboard "click", column separators, and color display that will help your operators feel right at home on the PC.

Asher Technologies — ahead of the competition in every way

It took a company dedicated to computer communications to bring you MiniLink. That's Asher Technologies.

MiniLink: with its advanced technology and superior design, *MiniLink delivers the speed, flexibility, and growth potential* you need when you're connecting your personal computers to an IBM System 3X Minicomputer.

For more information, contact Asher Technologies, Inc. at 1009-I Mansell Road, Roswell, Georgia, 30076. Or call 1-800-334-9339.

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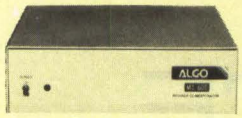

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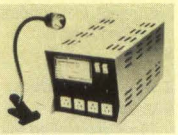

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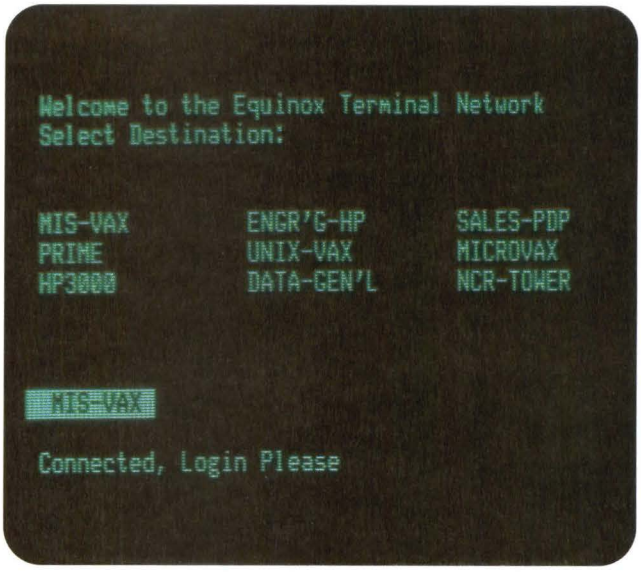

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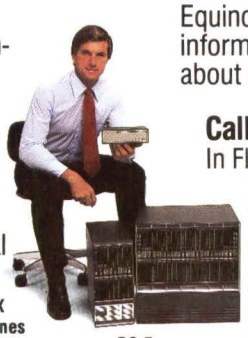

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