

DECEMBER 1987

Mini-MicroSystems®

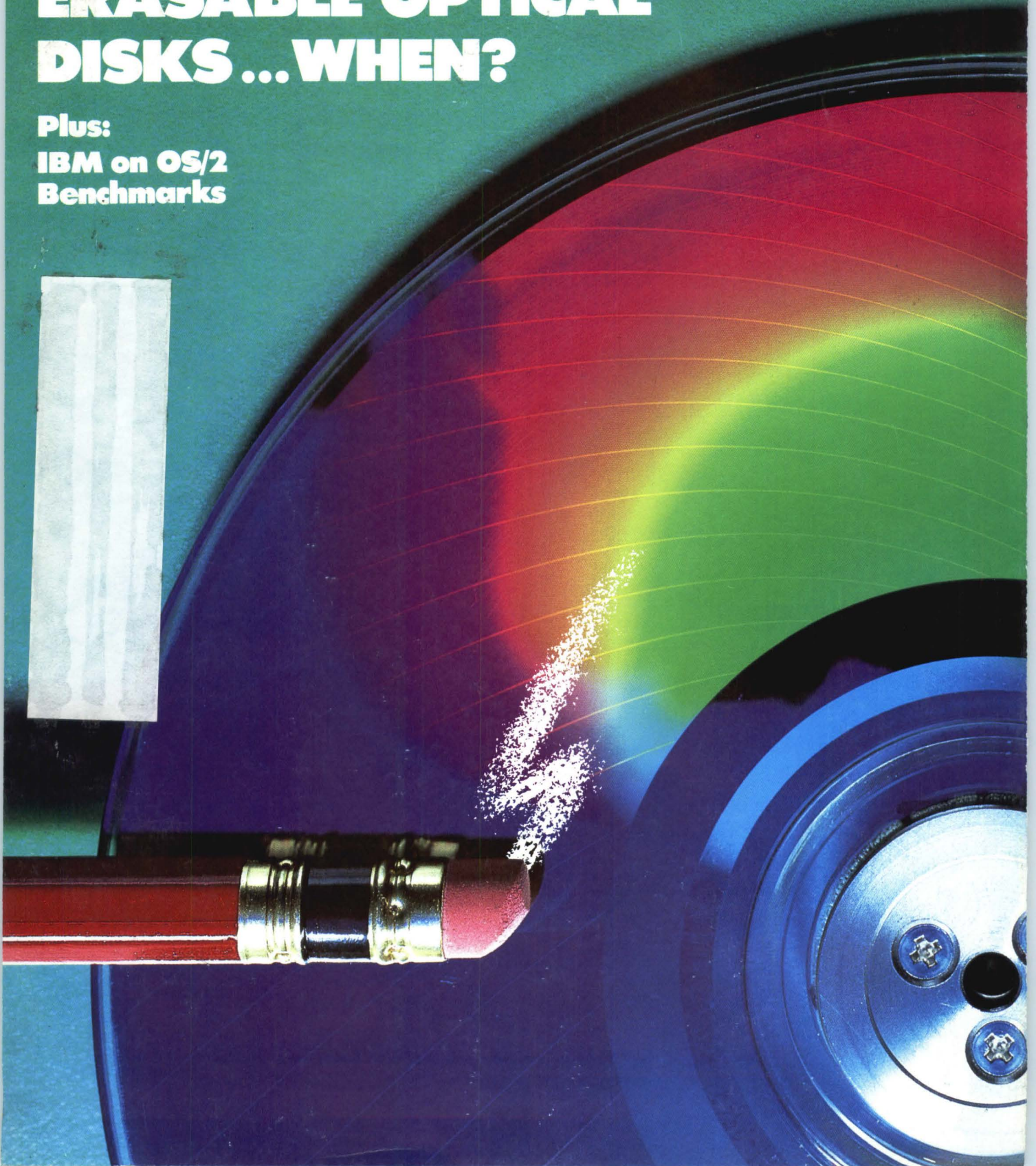
THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

A CAHNERS PUBLICATION

ERASABLE OPTICAL DISKS...WHEN?

Plus:

**IBM on OS/2
Benchmarks**



It's the brightest thing going in optical drives. The Toshiba XM-3100. The fastest half-height 5.25" CD-ROM drive available on the market today. And it's lighting the way to a whole new realm of optical opportunities.

Because the XM-3100 is perfect for all sorts of applications. Like archives, catalogues and libraries. Any application that calls for a reference database with infinite capacity, complete portability, durability and high reliability.

Of course what makes the XM-3100 particularly well suited to the task is Toshiba engineering. With features like both digital and audio output to let your database speak its mind. 400ms average time-to-data to do the job fast. And a SCSI



interface to make system integration painless.

But then, taking pains to do it right is nothing new at Toshiba. After all, we shipped the first optical drive way back in 1981 and we've been in front ever since. With the products, the engineering and the support it takes to be the leader.

To see how the Toshiba XM-3100 can help put you in front, call us at 714-583-3150.

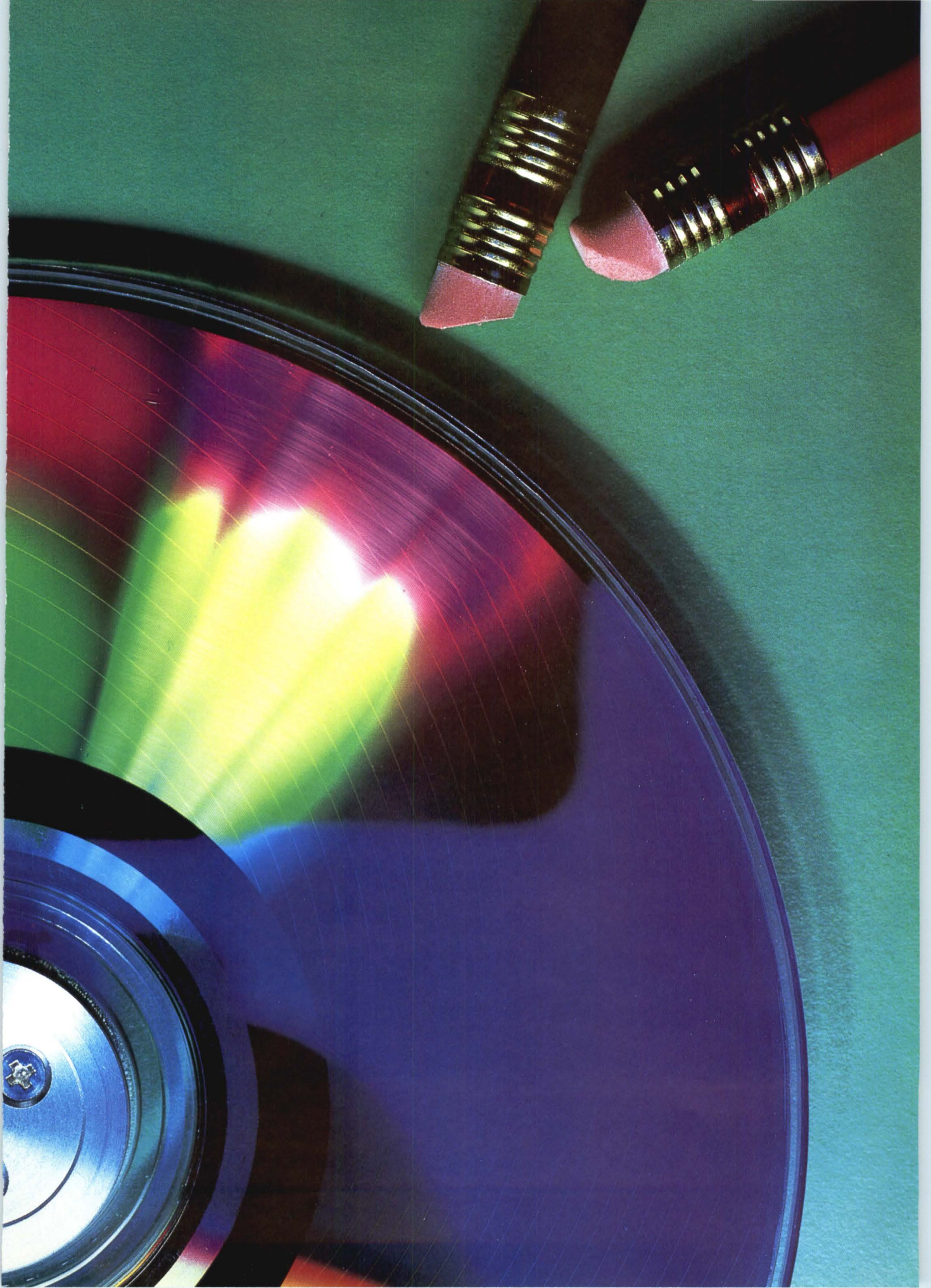
And before long you'll be light years ahead of the competition.

In Touch with Tomorrow
TOSHIBA

Disk Products Division, 9740 Irvine Boulevard, Irvine, CA 92718

© 1987 Toshiba America, Inc.

CIRCLE NO. 54 ON INQUIRY CARD

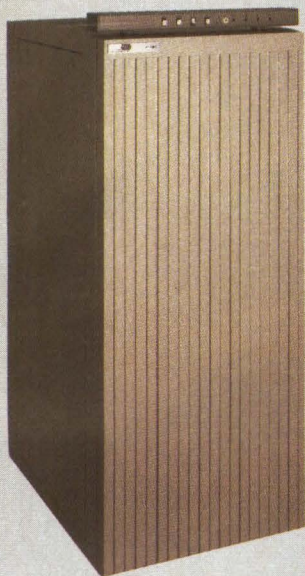


Read At The
Speed Of Light.



Concurrent Computer/Perkin-Elmer users

Concurrent Solutions



Your computer deserves better.

Your old disk drives are strangling your CPU. And costing you money. You pay more every month for maintenance, and more every second in reduced performance. Adding a new disk to your OS/32 or XELOS system couldn't be easier with Macrolink disk controllers.

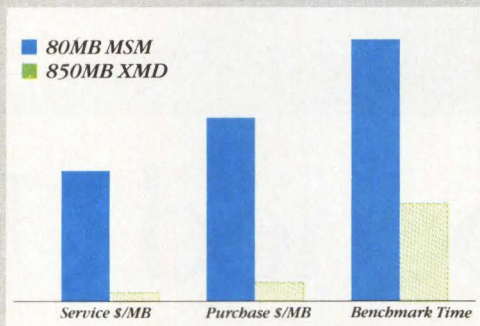
Today's disks give higher performance, cost less and are smaller than ever before. Install 4 Gigabytes of disk in the same space as your old MSM 80. You'll get 2.5 times faster transfers, 50% faster seeks and less total power consumption.

New disks need new generation controllers to realize their full potential. Our MACRO 3+ has

unmatched flexibility that supports any mix of SMD drives available today. Including the full range from Fujitsu and CDC, like the Eagle XP and the 3MB/second 9772 XMD. We don't limit your options, so you can add the capacity you need today and tomorrow. No other controller can match its performance, error free formatting and diagnostics.

For ultimate speed, use our Solid State Disk. With 8MB to 256MB of storage, it's up to 20 times faster than conventional disks, and it can be dual ported. Error scrubbing and error logging are standard features and it uses our 3200 series compatible memory modules.

Our SCSI Disk Controller opens new opportunities for small systems. Low cost 5.25 inch disks with ST-506,

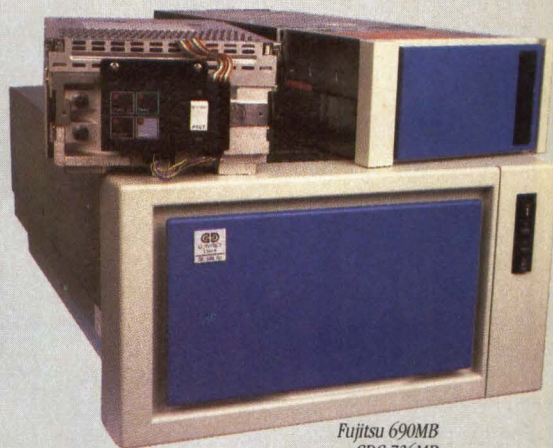


A new disk drive can save you money, and improve your performance.

ESDI and SCSI compatibility. From 20MB to over 700MB.

Interested in Laser Disks? Our SCSI/Laser disk interface gives you 1 Gigabyte of removable media on-line. We've made Write-Once-Read-Many (WORM) technology available for your 3200 today.

Macrolink has more compatible products for your computer than anyone. More Tape Controllers,



Fujitsu 690MB
CDC 736MB
CDC 1.2GB

Memory, Communications, Disks, and just about anything else you might need. Call today for our catalog, and find out why OEMs and End Users make us their first choice. Service and installation is available world-wide, and from Concurrent Computer Corp.

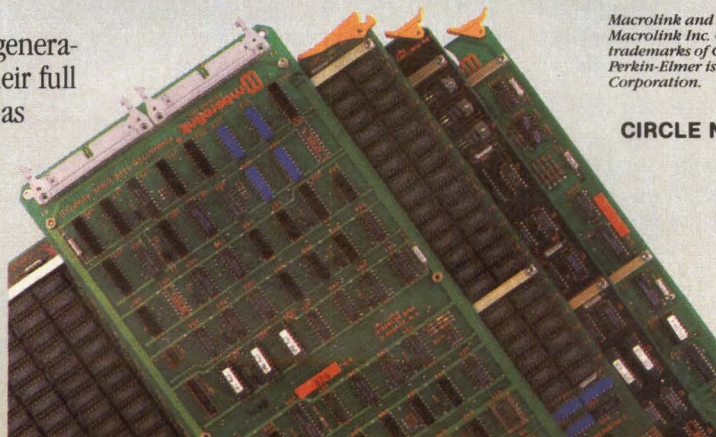
Macrolink Inc., 1500 North Kellogg Drive, Anaheim, California 92807. Phone (714) 777-8800, TWX 910-591-1671, FAX (714) 777-8807.

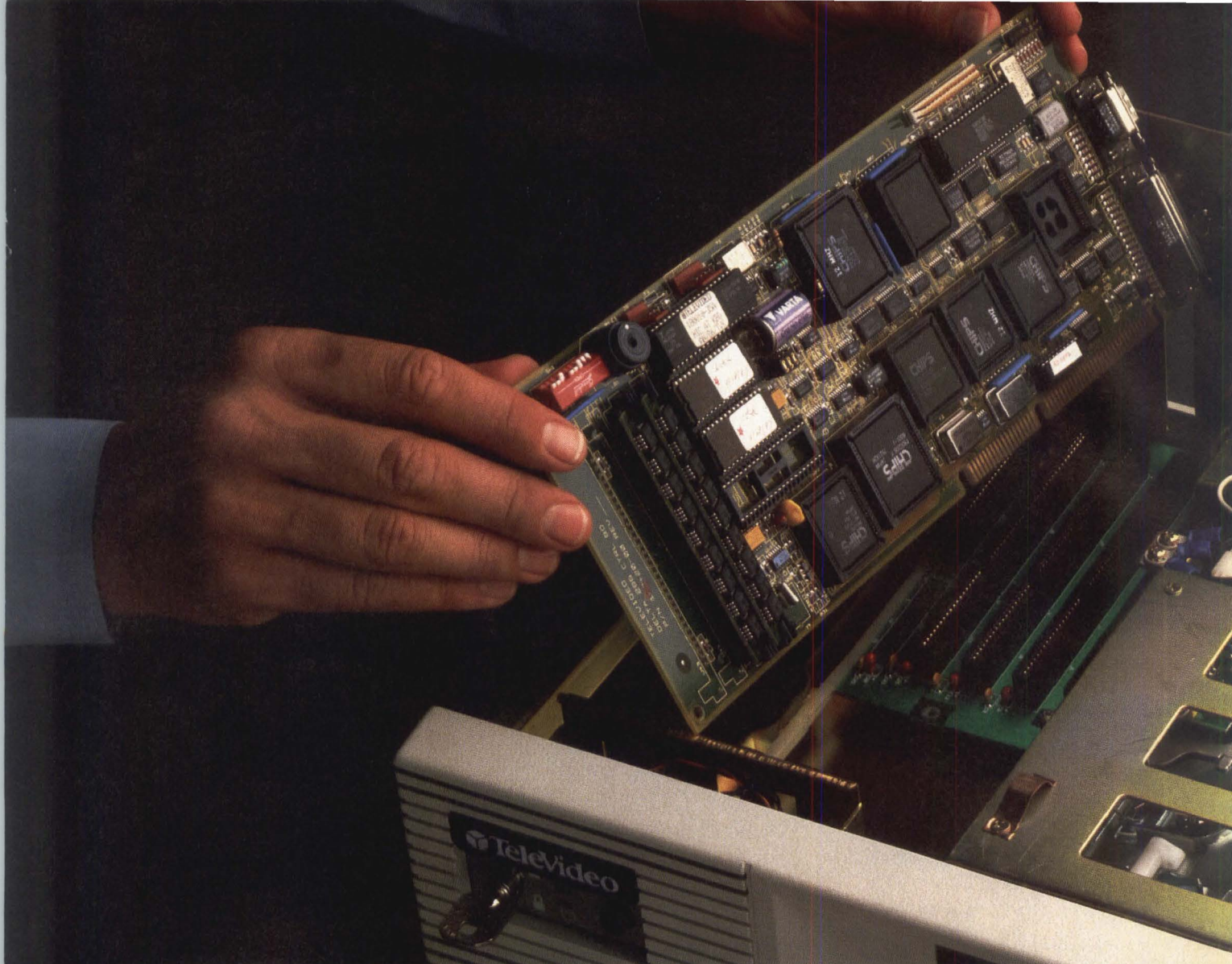
Stay Concurrent with Macrolink.

macrolink® inc.

Macrolink and the Macrolink logo are trademarks of Macrolink Inc. Concurrent Computer and XELOS are trademarks of Concurrent Computer Corporation. Perkin-Elmer is a registered trademark of Perkin-Elmer Corporation.

CIRCLE NO. 2 ON INQUIRY CARD





We've Opened Up All

TeloAS from TeleVideo. Open Architecture Solutions that can be anything you want them to be.

The new TeloAS™ Open Architecture Solutions™ are entirely new ways of looking at TeleVideo computers. Three very flexible systems that let you build the system you need now, then easily expand and upgrade as your needs change later.

All the choices are yours.

Choose the number of slots you need: 4, 5 or 8. Choose the CPU you want: 8088, 80286, or 80386. Choose the drives you want, the monitor you want, the keyboard, the footprint and the price you want. Also choose

the software to match your needs: MS-DOS™, MS OS/2™, UNIX® System V.3, NetWare™ and others. With the TeloAS systems from TeleVideo, the choices are all yours, allowing you to respond to market trends much faster.

TeloAS/I.

TeloAS/I has a passive back plane with 4 board slots. It accepts 8088 or 80286 boards in a low-profile case with a small footprint that fits anywhere. Use it as a LAN diskless workstation. Or, if you configure it with an

8088 board, floppy disk drives, a 14" monitor and keyboard, you have an IBM® PC/XT™ compatible pc.

TeloAS/II.

TeloAS/II has 5 board slots for 3 half-height drives and accepts either the 8088, 80286 or 80386 boards. You can configure it as a 386 with a high resolution monochrome monitor, hard disk and streaming tape drives, and Microport DOSMerge® 386 software and have a small-footprint workstation that runs both MS-DOS and UNIX System V.3.

TeloAS/III.

TeloAS/III has 8 board slots, room for 4 full-height and half-height drives,



Kinds Of Possibilities.

and is suitable for either the 80286 or 80386 boards. One of your many options is to configure it as a 386 and add an EGA standard color monitor, 80387 math co-processor, optical mouse, a hard disk and the right software to get a powerful 386 engineering workstation. It's also the right size for a LAN file server or multi-user host system.

TeloAS/I, II, and III are well thought-out, well-tested answers to your needs for open architecture solutions that expand with you.



Advanced surface-mount technology.

The TeloAS Open Architecture Solutions use the most advanced technology to reduce the number of components and

make the systems easier to maintain and repair. A power-on diagnostics function checks all the major systems each time they're turned on. A separate Diagnostics Diskette gives you an even more extensive test of the hardware, including disk-read and -write. Together with our TeleVideo on-site limited warranty, you're sure of getting dependable products that give you the most for your money.

The TeloAS solutions are three complete systems from the single source for all your computing needs. The TeleVideo family of products includes terminals, stand-alone systems, engineering workstations, multi-user systems and local area networks.

For more information on the new Open Architecture Solutions that can be anything you want them to be, call toll-free, or write today.

TeleVideo Systems, Inc., 1170 Morse Ave., Sunnyvale, CA 94088-3568.

 **TeleVideo**[®]
THE VISION YOU NEED TO SUCCEED.

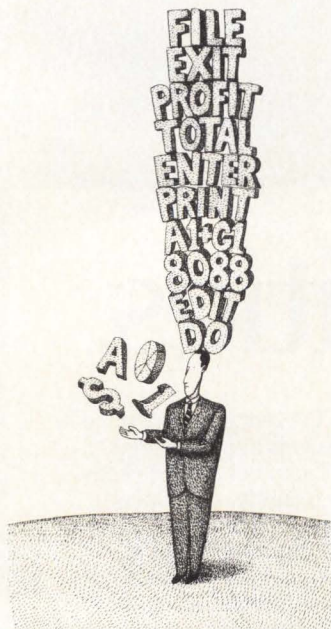
Call 1-800-835-3228

A CAHNERS PUBLICATION



KEEPING AMERICA COMPETITIVE

p. 19 *A Phoenix rises*



p. 65 *A real workhorse*

■ PRODUCT SPOTLIGHT

Winchester disk drive makers check into 'disk hotels' 15
Stacked disk drives increase storage and reliability

■ INTERPRETER

Phoenix Technologies rises to integrate emerging architectures ... 19
A candid conversation with Phoenix's top guns

Twisted-pair Ethernet moves into standards limelight 23
Existing wiring often a better route than coaxial cables

Expanded Multibus I stirs tech tiff with Intel 29
Is there new life in an old, but dependable bus?

■ FEATURES

Erasable optical disks: when, what...why? (cover story) 42
System integrators face tough storage decisions—erasable optical disk drives are due by mid-1988, but competing technologies dim the once-bright optical promise

How OS/2 supports larger applications 65
OS/2 juggles large real-memory, multitasking, priority scheduling, DOS and tools to speed the building of new generation PC applications.

Cahners Publishing Company • A Division of Reed Publishing USA • Specialized Business Magazines for Building and Construction • Computer/Technology • Electronics • Food/Packaging • Manufacturing Industries • Medical, Design & Publishing
MINI-MICRO SYSTEMS® (ISSN 0364-9342) is published monthly by Cahners Publishing Company, A Division of Reed Publishing USA, 275 Washington St., Newton, MA 02158. William M. Platt, President; Terrence M. McDermott, Executive Vice President; Jerry D. Neth, Vice President of Publishing Operations; J.J. Walsh, Financial Vice President/Magazine Division; Thomas J. Dellamaria, Vice President Production and Manufacturing; Frank Sibley, Group Vice President. Copyright 1987 by Reed Publishing USA, a division of Reed Holdings Inc., Saul Goldweitz, Chairman; Ronald G. Segel, President and Chief Executive Officer; Robert L. Krakoff, Executive Vice President. Circulation records are maintained at Cahners Publishing Co., 44 Cook Street.

Apples, oranges . . . and benchmarks 87
Benchmarks can be abused, but aptly applied they help system integrators, OEMs and VARs avoid lemons

Missing links: SAA still a mystery 99
IBM's System Application Architecture leaves independent software vendors and VARs long on questions, short on answers.

■ TECHNOLOGY FORUM

Tape drives: Helical scan recording expands tape capacity 111
by **Winn Schwartau**, Sleepy Hollow Engineering

■ *DATELINE: USA

The priming of Prime in Europe E1

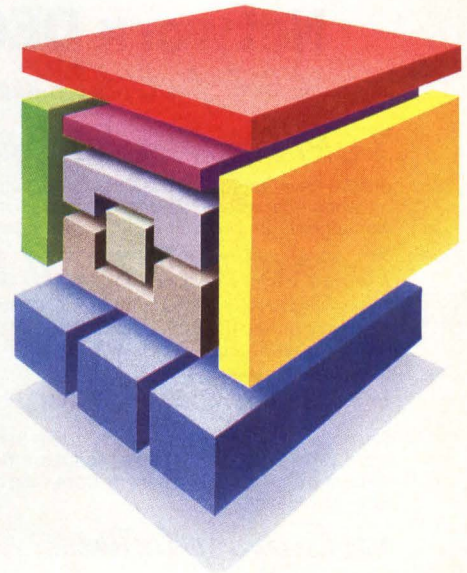
*Appearing in the European edition only

■ DEPARTMENTS

Editorial Staff	6	New Products	116
Editorial	9	Index to Advertisers	128
Breakpoints	11	Mini-Micro Marketplace	131

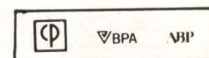


p. 42 . . . Erasable optical disks. Art direction and design by Mary Anne Ganley. Photography by Gerry Baskin. Optical disk supplied by Laserdrive Ltd.



p. 99 Long on questions

Denver, CO 80206. Phone 303/388-4511. Second class postage paid at Denver, CO and additional mailing offices. POSTMASTER: Send address corrections to MINI-MICRO SYSTEMS® at the Denver address. MINI-MICRO SYSTEMS® is circulated without charge by name and title to U.S. and Western European-based corporate and technical management, systems engineers and other personnel who meet qualification procedures. Available to others at the rate of \$65 per year in the United States; \$80 in Canada and Mexico; \$105 surface mail in all other countries; air mail surcharge, \$45 (14 issues). Special HANDBOOK issues, \$15. Single issues, \$6 in the United States; \$8 in Canada and Mexico; \$10 in all other countries.



© 1987 by Cahners Publishing Company, Division of Reed Publishing USA. All rights reserved.

OS-9... Your Real-Time, 68000 Software Solution for Today AND Tomorrow!

If your next project requires a real-time operating system for Motorola microprocessors, make the intelligent decision... OS-9/68000! Your investment in OS-9 experience, tools and applications translates into a valuable resource for your company's future. You see, unlike many other operating systems, OS-9 is modular and expandable; it can be utilized for development and applications over an entire corporate product range. OS-9's reliability and performance has been proven thousands of times in the most demanding applications. And Microware is setting the industry's standard for customer support with professional documentation, comprehensive training seminars, rigorous Quality Assurance and customer Hotline support. So call us today and find out more about how an investment in OS-9 truly is an investment in the future.



MICROWARE SYSTEMS CORPORATION

Headquarters
1900 N.W. 114th Street
Des Moines, Iowa 50311
515-224-1929

Western Regional Office
4401 Great America Parkway
Suite 220 Santa Clara,
California 95054
408-980-0201

CIRCLE NO. 4 ON INQUIRY CARD

Network DEC to UNIX?

What You Didn't Know--Will Help You!

TCP/IP Networking Software...

Did you know that most UNIX computers already support industry-standard TCP/IP networking protocols? And that Process Software Corporation gives you TCP/IP networking solutions for more DEC operating systems than anybody?

For VMS, RSX, RT-11, IAS, And TSX-Plus...

Network to UNIX using just our TCP/IP software and your standard DEC Ethernet hardware on the UNIBUS, Q-bus, VAXBI, or the new MicroVAX 2000. And run concurrently with DECnet, LAT, or LAVC.

Designed To Benefit You...

Say goodbye to special hardware, messy installation, and unneeded layers of software. Our TCP/IP products are modular, efficient, and designed for the operating system they run on. You benefit from ease of use, simple installation and virtually no maintenance.

For Every Application...

And we support the full range of popular TCP/IP applications, including FTP (File Transfer), TELNET (Virtual Terminal), TCP, IP, and UDP programming interfaces, and others.

You won't find a better lower-cost way to connect DEC to UNIX anywhere!

Interested? Call Process Software Corporation today.

PROCESS SOFTWARE 413-549-6994

35 Montague Road • PO Box 746 • Amherst, Massachusetts 01004

DEC, IAS, RSX, RT-11, UNIBUS, VAX, and VMS are Digital Equipment Corporation trademarks. Unix is an AT&T trademark. Ethernet is a Xerox Corporation trademark. TSX-Plus is a S&H Computers trademark.

CIRCLE NO. 5 ON INQUIRY CARD

STAFF

Vice President/Publisher
Donald Fagan

Chief Editor
George V. Kotelly

Managing Editor
James F. Donohue

Senior Editor: **David Simpson**
Irvine, (714) 851-9422
Senior Editor: **Mike Seither**
San Jose, (408) 296-0868

Senior Editor: **Doug Pryor**
Senior Editor: **Tim Scannell**
Senior Editor: **Joseph P. Lerro Jr.**
Senior Editor: **Dennis Livingston**

Associate Editor/Research: **Frances Michalski**
Staff Editor/New Products: **Megan Niels**
Editorial Assistant: **Petina Dody**

Contributing Editors

Andrew Allison
Mini/Micro Computer
Product and Market Consultant
Raymond C. Freeman Jr.
Freeman Associates
Charles LeCompte
Datek Information Services

(617) 893-9130
Special Features Editor: **Wendy Rauch-Hindin**
Dix Hills, N.Y.
(516) 667-7278

Gene R. Talsky
Professional Marketing Management Inc.
Edward Teja
Freehold Corp.

Editorial Production

Chief Production Editor: **Arsene C. Davignon**
Staff Editor/Production: **Mary Anne Weeks**

Editorial Services

Terri Gellegos

Assistant to the Publisher: **Sharon M. O'Connell**

Art Staff

Senior Art Director: **Mary Anne Ganley**
Artist: **Amy Finger**

Director of Art Dept.: **Norm Graf**

Production Staff

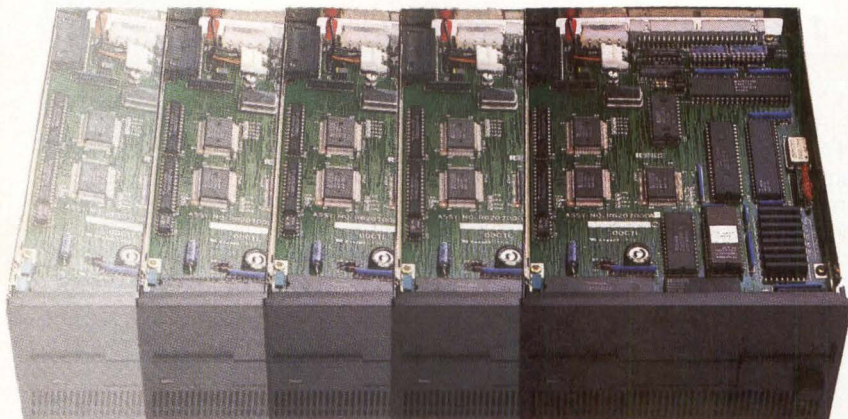
VP Production: **Wayne Hulitzky**
Director/Production: **John Sanders**
Supervisor: **William Tomaselli**
Production Manager: **Joshua Levin-Epstein**
Composition: **Diane Malone**

Editorial Offices

Boston: 275 Washington St., Newton, MA 02158, (617) 964-3030. **Irvine:** 18818 Teller Ave., Suite 170, Irvine, CA 92715. **Los Angeles:** 12233 W. Olympic Blvd., Los Angeles, CA 90064. **San Jose:** 3031 Tisch Way, San Jose, CA 95128.

Reprints of Mini-Micro Systems articles are available on a custom printing basis at reasonable prices in quantities of 500 or more. For an exact quote, contact Katie Pyziak, Cahners Reprint Service, Cahners Plaza, 1350 E. Touhy Ave., Box 5080, Des Plaines, IL 60018. Phone (312)635-8800.

HOW TO END THE OPTICAL ILLUSION.



People have been talking about optical drives for years. But have you ever actually seen one work?

Well, now you can.

Because while others were talking about optical drives and solutions, Maxtor was developing them. And now we're shipping our 800MB 5¼-inch optical WORM drive in volume.

It's the first in our family of optical drives. And it's perfect for high-volume back-up, image or archival storage.

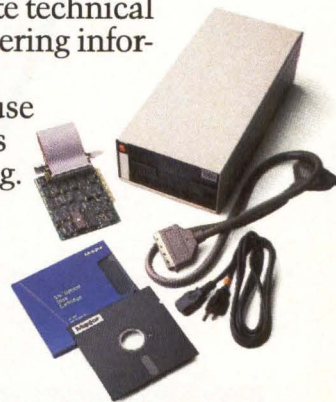
It's offered with a full complement of integration software and hardware, including media, cable and host adapter. Or it's available as a fully-configured plug-and-play mass storage subsystem.

Either way, it's fully compatible with most popular computers.

So don't wait to make optical drives a reality for your system.

Contact the Maxtor distributor or sales office listed below for complete technical and ordering information.

Because seeing is believing.



Maxtor

Sales offices: Atlanta (404) 455-4226, Austin (512) 345-2742, Boston (617) 872-8556, New Jersey (201) 747-7337, Orange County (714) 472-2344, San Jose (408) 435-7884, Woking, England (44)/4862-29814, Tokyo, Japan 81-3-431-8940.

Distributed by Anthem Electronics, (714) 768-4444, (408) 295-4200, (617) 657-5170, Future Electronics, (514) 694-7710, Pioneer Standard Electronics, Inc., (216) 587-3600, (301) 921-0660, Quality Components, Inc., (214) 733-4300, Storex Corporation, (617) 769-3400, Storage Dimensions, Inc., (408) 395-2688.

© 1987 Maxtor Corporation

CIRCLE NO. 6 ON INQUIRY CARD

Introducing Equinox's New Data PBXs.

More for Less.

Since 1984 our first generation Data PBXs have provided reliable data switching and connectivity solutions. After shipping over 1000 systems we learned what was good and what could be made even better. Then we set about designing our second generation. Here's what we came up with:



More Throughput

Our new Data PBXs each provide 25 Mbps throughput for 660 simultaneous full duplex connections at 19.2 kbps. With double the throughput of our first generation, and more than any other comparable Data PBX; that's enough for all the terminals, PCs, computer ports and peripherals you can throw at them.

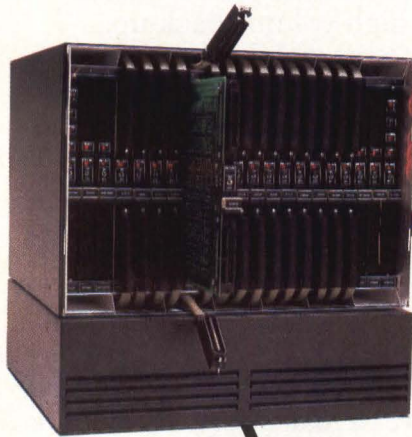
Less \$

Reduced manufacturing costs, due to VLSI technology allowed us to lower prices on our second generation Data PBXs. More features for less money means maximum value for your data switching dollar.

More of the Same

We kept the Equinox hallmarks of reliability, easy installation, comprehensive wiring solutions and user friendly operation.

We based our second generation on the same architecture as our first generation DS-5 and DS-15 Data PBXs. They look the same, configure the same, even the names have stayed the same.



T 1 N e t w o r k i n g

More Connectivity

T1 links join individual Data PBXs to form large multi-node Local or Wide Area Networks supporting many thousands of lines. You can use twisted-pair, telco, microwave or fiber optic links to solve virtually any connectivity problem.

So if you already own an Equinox Data PBX, all the features of our new generation can easily be added to your network.

If you need the most advanced Data PBX available, don't wait a minute more.

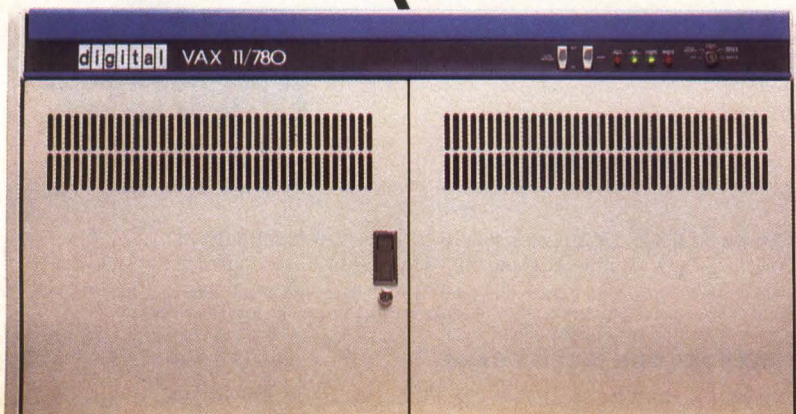


More Network Security

Dialback Security available as an option shields your network from unauthorized access by dial-in users. This feature lets you restrict dial-up access to designated users at pre-defined locations during specified time periods.

Call 1-800-DATA-PBX

In Florida: (305) 255-3500
Equinox Systems Inc.
14260 S.W. 119th Avenue
Miami, FL 33186



EQUINOX

Smart Connections For Dumb Terminals

CIRCLE NO. 7 ON INQUIRY CARD

COMPETITIVENESS = QUALITY

To remain competitive in today's global marketplace, U.S. manufacturers must improve product quality. Meeting that challenge calls for total commitment. Managing for quality, says *Business Week*, means nothing less than a sweeping overhaul in corporate culture, a radical shift in management philosophy and a permanent drive by all organizational levels to seek continuous improvements.

Just a short time ago, "Made in the U.S.A.," represented the best the world could buy. But foreign industries looked for a better way. After years of trial and error, they developed an even higher plateau of product quality. Now, it's up to American industries to respond—or to retire.

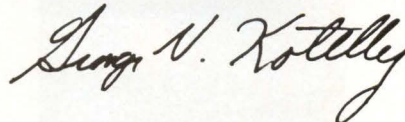
Fortunately, most U.S. companies have chosen to react in a positive manner to the quality challenge. But improved quality doesn't happen overnight. Fixing the manufacturing system, not the products, appears to provide the thrust to improved quality. Using this technique, the causes of product deficiency are detected at the source rather than after assembly. Called statistical process control (SPC), this technique measures a manufacturing process by monitoring progress in product production. SPC spots potential difficulties before they result in defective products.

Statistical quality methods have been used for more than 30 years. In the 1950s, the noted American quality authority, W. Edwards Deming, was invited by Japanese technologists to instruct them on statistical methods for improving quality on the factory floor. Later, the Japanese asked another reknown American quality expert, J.M. Juran, to discuss quality management techniques.

Few U.S. companies paid heed to either acknowledged authority, but Japan Inc. embraced the quality principles of Deming and Juran. Thereafter, in the 1970s, higher quality Japanese products, which set advanced standards for performance, reliability and durability, impacted the global marketplace, quickly stole market share and emerged as the world's premier goods.

Most product design and manufacturing groups in U.S. companies work in isolation. That is, a product is designed and then turned over to production. The design team moves on to the next priority. Meanwhile, the production team struggles to mass-produce an unfamiliar design. Industry quality experts claim that only about 20 percent of a product's defects can be attributed to the assembly line. The other 80 percent gets "designed-in" or comes from low-priced marginal parts.

The cure? Incorporate product-quality principles during the design phase. The means? Use computer-based systems to analyze product quality while the design details are merely images and symbols on a computer screen. The people? Engineers, administrators and assemblers must work together as a coordinated team to ensure product quality. And company executives must let everyone know that they are all essential team members. Quality costs more and takes time, but it ensures competitiveness and, therefore, survival.



George V. Kotelly
Chief Editor

FUJITSU'S GCR STREAMING TAPE DRIVE

The tape drive that flies with the Eagles.

You know the Eagle Disk Drive.

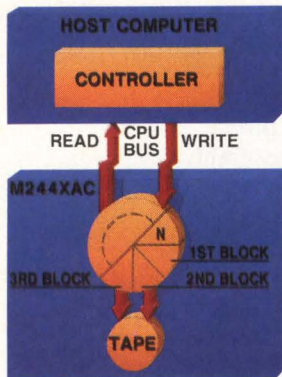
It's second-to-none in performance and reliability.

Did you also know a back-up system exists that matches those impeccably high standards?

The M244X series 1/2" GCR streaming tape drive. From Fujitsu America.

The perfect back-up for the Eagle. And it's compatible with STC, Pertec/Cipher, and SCSI interfaces.

So you can integrate one into your system today.



An intelligent buffer enhances system performance.

A Buffer Adds an Extra Edge.

An intelligent 256K buffer dramatically increases the performance of our GCR tape drive. You get block sizes, ramp times and data transfer rates that are all operator selectable.

And you can set data transfer rates from 60 KB/s through 1 MB/s. That way, you can optimize the drive to fit any system requirement.

Low Cost of Ownership.

Fujitsu's advanced LSI electronics eliminate high failure rates.

In fact, our GCR tape drive utilizes automatic error detection to assure data integrity. Diagnostics isolate system faults and eliminate preventative maintenance. All this to give you an incredible 8,000 hours MTBF.



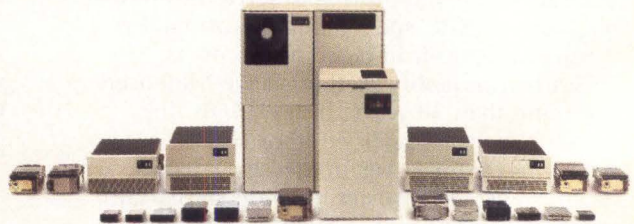
Operator panel displays fault codes for easy troubleshooting.

This keeps cost of ownership low throughout the life of your entire system.

Call today for more information. On this or any of our world famous family of data storage products, including Winchester, tape, optical and flexible drives. 800-626-4686.

Or write Fujitsu America, Computer Products Group, 3055 Orchard Drive, San Jose, CA 95134-2017.

Then soar with the Eagles.



A COMPANY WITH CHARACTER AND DRIVE



FUJITSU AMERICA
Computer Products Group

BREAKPOINTS

A CLUSTER OF NEW PRODUCTS HIGHLIGHTS LOTUS' 1988 CALENDAR

Lotus Development Corp.'s first DBMS will be among several new products the Cambridge, Mass., company is planning for 1988. The DBMS is scheduled for the fall along with a fourth-generation application programming language, the Lotus Extended Applications Facility (LEAF). Scheduled for early spring is the Agenda information manager, demonstrated at COMDEX/Fall in Las Vegas. Other releases: a multiuser version of 1-2-3 (Release 3) targeting computing work groups and a mainframe-based 1-2-3 (Lotus 1-2-3M) aimed at IBM Corp.'s System 370 and 9370. The DBMS will feature a cooperative processing architecture, a graphical user interface, support for IBM's SQL, and a flexible application development environment.—*Tim Scannell*

SPECTRAGRAPHICS WEDS WORKSTATIONS, IBM CAD/CAM GRAPHICS

Spectragraphics Corp. recently announced agreements to provide Digital Equipment Corp., Maynard, Mass., and Hewlett-Packard Co., Palo Alto, Calif., with graphics terminals that emulate the IBM Corp. 5080. The terminals will enable DEC's VAXstation and II/GPX, and HP's 350 workstations to hook up to IBM 4341 mainframes via a Spectragraphics DesignSet Communications Controller and to run such applications as CADAM and CATIA. Spectragraphics, of San Diego, is expected to sign a similar agreement with Silicon Graphics Inc. Spectragraphics already provides 5080-emulation products for Apollo Computer Inc. workstations, as well as for its own line of 5080-emulation workstations.—*Dave Simpson*

IBM AIMS FIRST SAA APPLICATIONS AT OFFICE ENVIRONMENT

Early 1988 is apparently IBM Corp.'s release target for the first products incorporating its Systems Application Architecture. According to details released by the company's Applications Systems Division in Milford, Conn., the products will include an SAA version of IBM's PROFS professional office system that initially will be based on the company's high-end PS/2 machines. However, it may not be a full implementation of the SAA environment, according to IBM senior vice-president Allen Krowe.—*Tim Scannell*

GENICOM PLAYS AN ACE FOR STAKES IN THE POSTSCRIPT MARKET

Look for the first shipments of laser printers equipped with Genicom Corp.'s ACE page description language in the second quarter of next year. ACE is billed as a high-speed alternative to Adobe Systems Inc.'s PostScript. The printers are based on raster image processors that use a Motorola Inc.'s MC68000 processor and a bit-slice coprocessor. The first shipment will be 6- to 8-ppm units that print at 400 dpi. The Waynesboro, Va., company demonstrated the printers at last month's COMDEX/Fall show in Las Vegas.—*Dave Simpson*

NEC ENTERS 286 PORTABLE FRAY WITH LUNCH-BOX POWERMATE

NEC Information Systems Inc., Boxborough, Mass., enters the luggable-computer market this month with a 22-pound lunch-box-like device based on Intel Corp.'s 80286 processor. The Powermate 286 represents the company's first use of 3½-inch micro-flexible disk drives. The portable is available with an 8- or 10-MHz microprocessor and offers three full-size IBM Corp. PC/AT-compatible expansion slots. The system costs \$3,995 with a 20M-byte rigid disk drive and can be outfitted with an optional 5¼-inch flexible disk drive.—*Tim Scannell*

CDC TO FIELD 3½-INCH WINCHESTERS

Control Data Corp. of Minneapolis, which boasts a strong presence in OEM markets for 5¼- and 8-inch Winchester disk drives, has made its first move toward a smaller form factor. Around February, CDC expects to have evaluation units of its 3½-inch Swift family ready for shipment. The top-of-the-line model has an unformatted capacity of 200M bytes. It uses five platters and comes with either SCSI or ESDI interfaces. Average access time is about 16 msec. The rest of the Swift family (variously sporting 150M bytes, 100M bytes and 55M bytes, all unformatted) come with an ST506 interface. Prices will range from \$5 to \$8 per megabyte.—*Mike Seither*

HP CALLS ON DEVELOPERS TO RIDE 'NEW WAVE'

Hewlett-Packard Co., Palo Alto, Calif., is busily lobbying for independent software vendors (ISVs) to support its just-released object-oriented programming environment, called the New Wave Object Management Facility (OMF). At last count, the company had about five ISVs signed up to develop products, and it expects to attract up to 100 more by the end of 1988. New Wave was developed with Microsoft Corp., Redmond, Wash., and is heavily dependent on Microsoft's Windows program. New Wave eventually will be compatible with OS/2 and Microsoft's Presentation Manager environments. Prices are \$195 for the software, \$895 for the developers kit and \$1,100 for training and support.—*Tim Scannell*

VEN-TEL CLAIMS LATEST PS/2 MODEMS WORK WITH MICRO CHANNEL

Ven-Tel Inc. of San Jose has begun shipping add-in modems for IBM Corp.'s PS/2 models 50, 60 and 80 that, reportedly, take full advantage of the automatic-configuration capability of IBM's Micro Channel. The Ven-Tel 24/2 modems operate at 2,400, 1,200 and 300 baud; support communications ports No. 1 through No. 8; and are compatible with the Hayes Microcomputer Products Inc. AT command set. List price: \$549 with Crosstalk Communications/DCA's Crosstalk XVI software, \$449 without.—*Mike Seither*

HP BOOSTS DATA TRANSFER RATE ON 5¼-INCH DRIVE

Hewlett-Packard Co., Palo Alto, Calif., is wringing more performance out of its high-end 5¼-inch rigid disk drives by pushing the data transfer rate up to 4M bytes per second and using the synchronous mode of the SCSI interface. The HP 97530D (which comes in unformatted capacities of 136M bytes, 204M bytes and 408M bytes) uses differential drivers that allow the Winchester to be located as far as 25 meters from the host computer. The company's earlier versions of those drives had to be placed within three meters of the host. The 408M-byte version sells for \$2,100 in OEM quantities.—*Mike Seither*

NON-VOLATILE MEMORY BOARDS GIVE PCs 5M BYTES OF STORAGE

Bubble-memory manufacturer Magnesys, San Jose, Calif., is courting OEMs with its latest solid-state, non-volatile add-in boards for rugged environments. The company's DriveCard comes in 360K- or 720K-byte master-card versions along with a host bus adapter for IBM Corp. PCs and compatibles. Up to six additional satellite DriveCards can be linked to the master card, providing up to 5M bytes of storage. Magnesys claims its memory boards operate in temperatures ranging from zero C to 70 C. Volume pricing at under \$900 is available.—*Mike Seither*

60 Megabytes is more than the other guys can swallow.

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

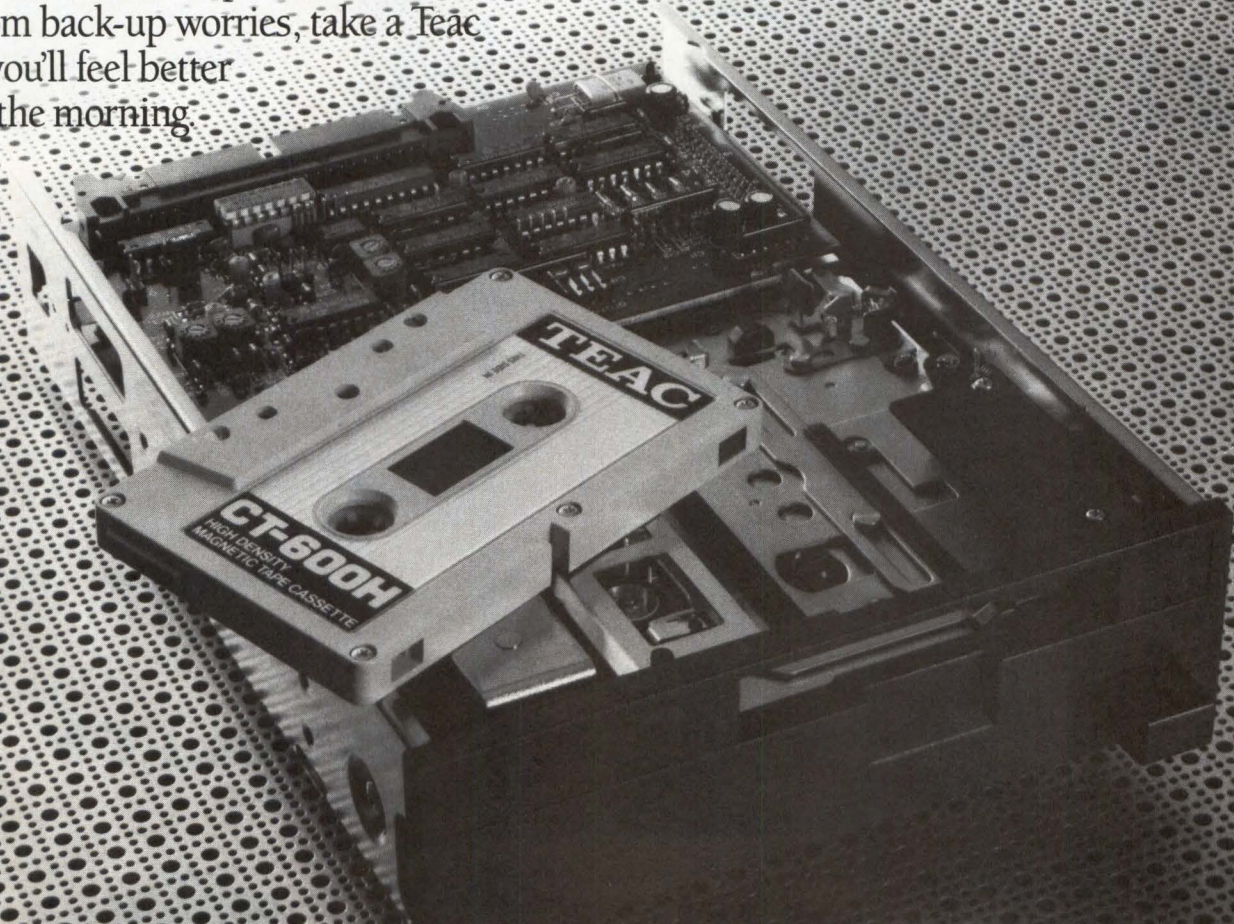
With our MT-2ST and CT-600H cassette tape we've made a giant leap over the competition. Its 90 ips performance can back-up an incredible 60 megabytes in only 12 minutes. And this is data on a medium that's totally interchangeable from drive to drive.

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

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

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

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



Built To Fanatical Standards. **TEAC**

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

East (617) 475-7311 South/Midwest (312) 934-4411 Rocky Mountain (602) 242-4025 (303) 368-8677 (801) 532-2111

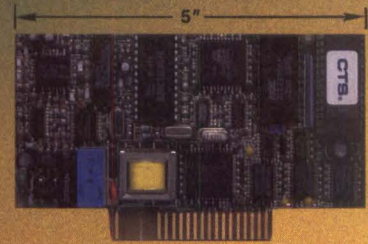
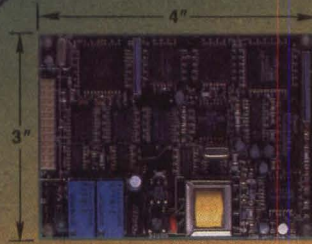
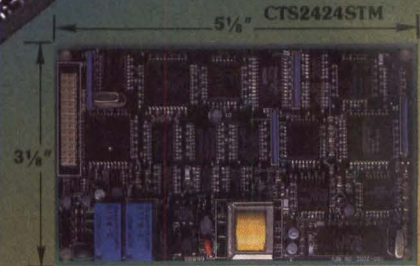
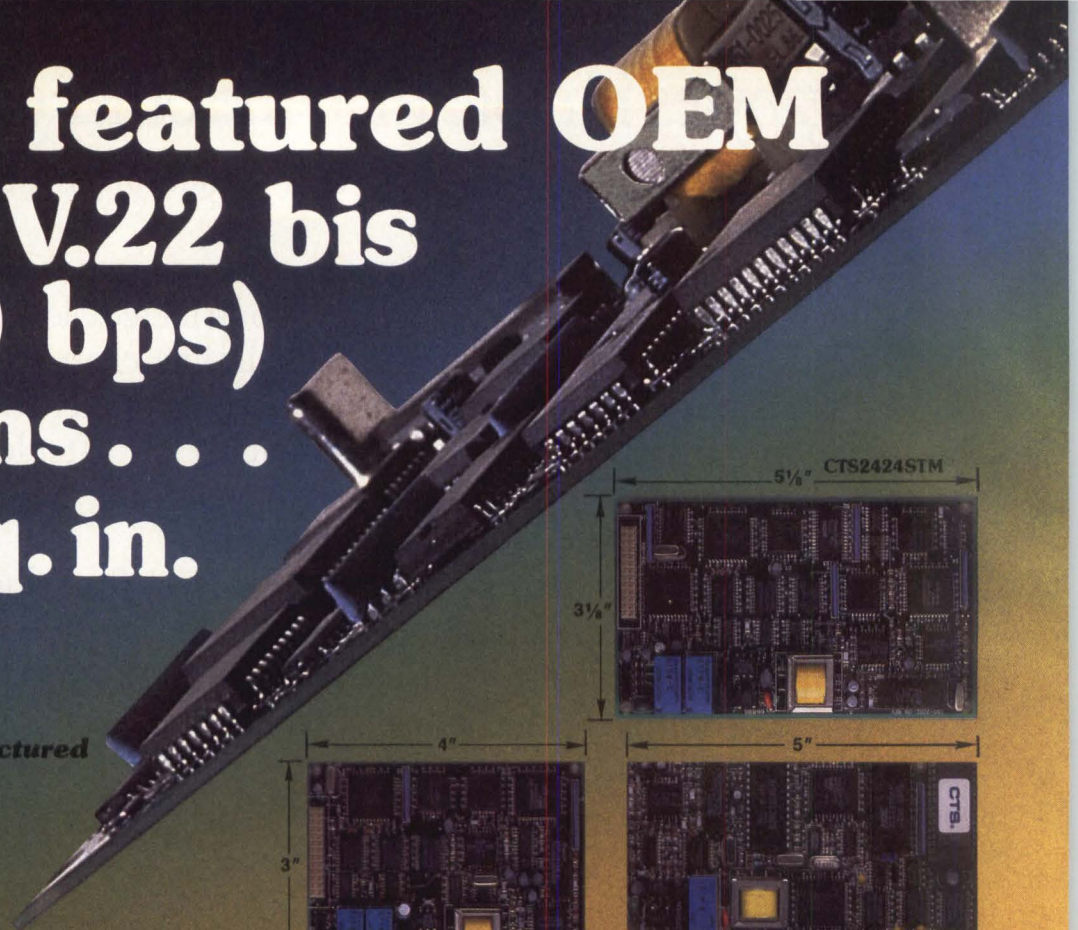
Northwest (408) 727-1427 Southern California (213) 726-0303

CIRCLE NO. 9 ON INQUIRY CARD

© 1986

Fully featured OEM CCITT V.22 bis (2400 bps) modems . . . in 12 sq. in.

- Surface-mount manufactured
- Low power
- Standard or custom



CTS2424STH

CUSTOM DESIGN

Others offer less capability—greater size. CTS offers greater capability—less size. The choice is yours in three advanced, 2400 bps full duplex modems:

CUSTOM DESIGN. First known battery powered modem utilizing surface mount manufacturing technologies for laptop microcomputers □ Occupies less than 13 square inches □ Low power—consumes less than 1 watt.

CTS2424STM. Smallest available standard applications modem with MNP* error correcting Class 4 protocol

□ TTL interfaced □ Compact 16 square inches □ Fully Hayes † command set compatible □ Integral adaptive equalizer in sophisticated CTS C-MOS designed signal processor □ Optional European fallback capabilities of CCITT V.22 A/B, V.23 and V.21 □ Less than \$180.00 each in quantity.

CTS2424STH. Smallest, lowest power standard modem □ Integral adaptive equalizer in advanced CTS C-MOS designed signal processor □ 12 square inches □ Uses less than 1 watt power

□ Incorporates Hayes command set—offers European compatibilities V.22 bis, V.22 A/B, V.23 and V.21 plus guard tone capabilities □ Under \$160.00 each in quantity.

Call toll free today 1-800-328-6104 or write CTS Fabri-Tek, Inc. Datacomm

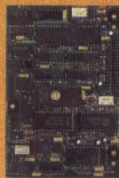
Products Division, 6900 Shady Oak Road, Eden Prairie, Minnesota 55344 for a copy of our new full color brochure entitled CTS Custom OEM Modems.



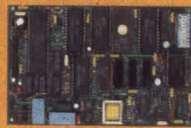
CIRCLE NO. 10

CTS. MEANS RELIABILITY

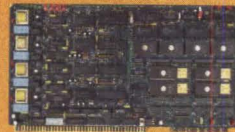
CTS Fabri-Tek, Inc. □ Datacomm Products Division



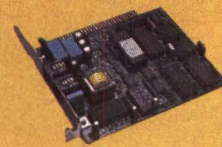
Data Pump Custom Designed 2400 Full Duplex Modem.
Circle No. 11



TTL Interfaced 2400 bps Full Duplex Modem for Small Quantity Users.
Circle No. 12



Quadmodem Four 2400 bps Full Duplex Modems on One Board
Circle No. 13



Half-Pak #24 IBM PC Compatible Half Card 2400 bps Modem
Circle No. 14

New to the Industry Since 1896.

*Registered trademark of Microcom. †Registered trademark of Hayes Microcomputer Products, Inc. ‡Registered trademark of International Business Machines, Inc.

MINI-MICRO SYSTEMS

PRODUCT SPOTLIGHT

DISK SUBSYSTEMS

Winchester drive makers check into 'disk hotels'

Mike Seither, Senior Editor

Following the lead set a few years ago by mainframe disk drive manufacturers a number of 5¼-inch Winchester drive makers and subsystem builders are clustering 360M- and 765M-byte disks together into single systems to create so-called "disk hotels."

Through the use of innovative controller electronics and caching schemes, the disks function as a single unit, offering multigigabyte storage and fast data transfer rates. They also boast a high reliability, all in relatively compact enclosures.

One of the first of these disk clusters comes from Micropolis Corp. of Chatsworth, Calif., which introduced its Parallel Drive Array 1800 Series in November. The first member of the series, model 1804, has a capacity of 1.5G bytes, uses the small computer systems interface (SCSI) and is built with five of Micropolis' 380M-byte, 5¼-inch rigid disk drives. Working in unison, the drives offer a sustained data transfer rate of 4M bytes a second. By comparison, typical 8-inch drives using the storage module device (SMD) interface peak out at about 3M bytes a second.

One of Micropolis' chief competitors, San Jose's Maxtor Corp., has also been pushing the idea of clustered drives through its subsidiary, U.S. Design Corp., Lantham, Md. U.S. Design has a 3G-byte cluster that has four 765M-byte, 5¼-inch Winchester drives. Also, a handful of other disk drive makers have, or are about to follow up with, similar products.

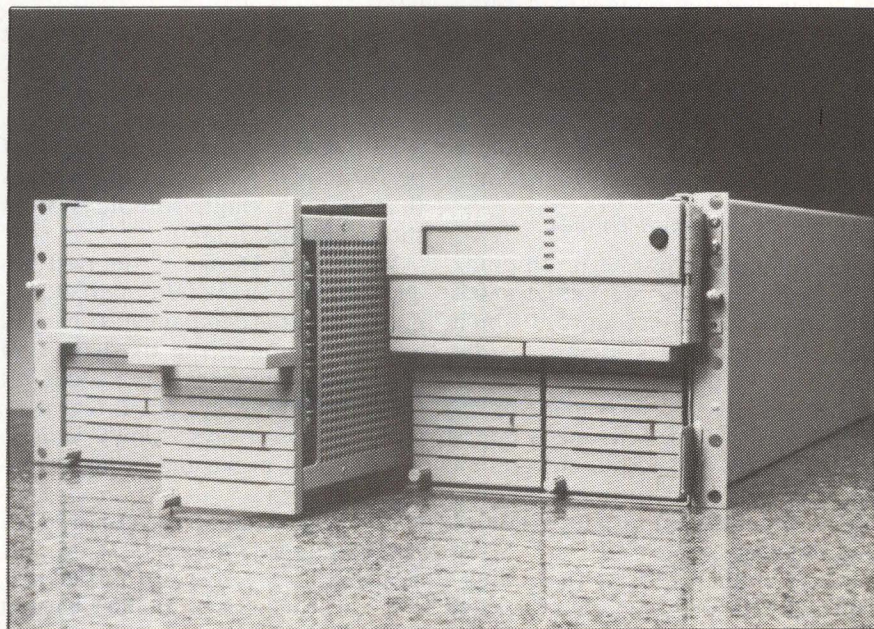
Analyst James Stone, who follows the computer storage industry for Shearson Lehman in New York, says that many of the soon-to-be-produced high-capacity 5¼-inch Winchesters (380M bytes and above) will find their way into clustered systems. "They'll be aimed squarely at the minicomputer market" as a replacement for conventional 8- and 9-inch drives, he maintains.

More disks in the driver's seat

In the mainframe world, Amperif Corp. is generally credited with pioneering clustered mass storage, often

referred to as disk arrays. The Chatsworth, Calif., OEM convinced Unisys Corp. (then called Sperry Inc.) that clusters of 8-inch Winchesters—the mainstay of minicomputers—could do the job better than mainframe-class 14-inch drives. For example, Amperif's 16-drive subsystem uses less power, takes up a quarter of the floor space and stores twice the data as IBM Corp.'s latest 7.5G-byte, 3380 14-inch drive system.

Companies like Micropolis basically follow the same clustering blueprint for their disk hotels, except for using smaller rigid disk drives. In the



The Parallel Drive Array 1800 from Micropolis (shown from the rear) uses five 380M-byte Winchesters, one of which is a parity drive that ensures the data integrity of the other four.

SPOTLIGHT

DISK SUBSYSTEMS

Micropolis model 1804 Parallel Drive Array, four drives are used for actual data storage, while a fifth drive is used for parity. The fifth drive also is available to replace data in real time, should one of the other four drives fail. For the complete subsystem to go down, a second drive would have to fail before the first one was repaired.

Thanks to the parity system Micropolis claims that the 1804's rating for mean time between failure (MTBF) is 140,000 hours, almost five times as high the MTBF for most single drives.

"Provided that you replaced the first failed drive within 24 hours, the calculated MTBF could go above a million hours" on a parity-based subsystem like the one Micropolis builds, says Bob Katzive, vice president of Disk/Trend Inc., the Los Altos, Calif., outfit that tracks the drive business.

Drives in the Micropolis 1804 are deliberately designed to be easily replaced. The individual Winchesters have slide-in mounts and can be installed in about 4 minutes, according to Micropolis. In fact, the drives can be replaced while the system remains operational. That's because the parity units enable data to be reconstructed on the replacement drive, says Micropolis marketing manager Tom Kent.

Access times under 2 msec

Micropolis has just begun shipping evaluation units of the model 1804, which fits into a standard 19-inch rack. Production systems, to be priced at \$8 per megabyte in OEM quantities, are expected to be available in early 1988. Micropolis hopes to sell the 1804 to system integrators who market superminicomputers, high-end workstations and graphics and imaging systems.

"We couldn't address these high-end markets without this clustered approach," says Kent.

U.S. Design, which builds add-on storage subsystems for Digital Equipment Corp.'s Q-bus and UNIBus

computers, introduced its 3G-byte cluster drive earlier this year. Each one of the four Maxtor 765M-byte Winchesters uses one of the company's proprietary 4200 disk controllers that contains up to 4M bytes of caching memory and algorithms that predict disk-access patterns.

U.S. Design president Bill Anderson claims that the 4200 controllers boost average access times by an order of magnitude because of a 70 percent "hit rate" of data inside the cache. So while the drive may carry a specification of an 18-msec average access time, the cache produces the data in about 1.4 msec.

At the COMDEX/Fall show last month in Las Vegas, U.S. Design displayed a 19.2G-byte configuration made up of eight VIP 3000 four-drive clusters housed in racks 19 inches wide and 60 inches tall. Although the company doesn't intend to sell such a system right now, Anderson contends the company was trying to make a point.

"We believe 5¼-inch drives can offer the densest storage per square foot of any rotating magnetic media," Anderson says. Moreover, he asserts, it's possible to achieve higher levels of performance with multiple drives than with a single-spindle system such as the IBM 3380.

While U.S. Design in the past has concentrated on the DEC market, Anderson says the company has changed gears by unbundling its drive and controller technology and pedaling it to high-volume system integrators who, Anderson says, "don't want to worry about packaging storage products."

Another company enamored of parent company Maxtor's 765M-byte Winchesters is Aviv Corp. of Woburn, Mass. The subsystem builder has put four of the drives into its DFS (disk file system) 904-1765 cluster—a 2.4G-byte package 5¼ inches wide, 19 inches high and 22 inches deep.

The cluster can fit inside a standard DEC MicroVAX chassis or stand alone as a pedestal.

This month, System Industries Inc., a storage vendor that targets the DEC market, plans to introduce a new controller that will allow 16 380M-byte, 5¼-inch Winchesters to be clustered, says Ron Bingham, vice president of R&D for the Milpitas, Calif., company. Since July, the company has been shipping two- and four-drive clusters of the 380M- and 765M-byte, 5¼-inch drives. Before that, System Industries packaged chiefly 8- and 9-inch rigid disk drives for the DEC market.

"There is no doubt 5¼-inch will replace 8-inch," says Bingham. "The physics get better as you scale down—less heat, less space, better access times."

Back in the mainframe world, even IBM apparently is reading the writing on the wall and thinking about downsizing from 14-inch devices. IBM's 3380 business, estimated to be in excess of \$9 billion annually, is expected to increase a year from now when Big Blue brings out a high-performance 10¼-inch replacement for the 14-inch 3380. In addition, IBM is at work on a 1G-byte, 5¼-inch Winchester that analysts expect to see packaged as a cluster.

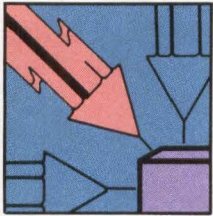
"IBM can't afford to let itself be outflanked by PC Mers [plug-compatible manufacturers]," says Katzive of Disk/Trend. "Compare \$8 a megabyte to \$32 a megabyte, and you can see why the smaller drives are an attractive approach."

Where will all of this clustering lead? Technically downward in one sense, if the activities at leading disk drive makers are any indication. Apparently, 5¼-inch drives will not be the limit in miniaturizing clusters. Amperif, the company that started the whole cluster trend, is already buzzing about its plans to check 3½-inch Winchesters into disk hotels. □

We've got

the most affordable, state-of-the-art data PBX you can buy.

Period.



Sequel's SDC family is the first series of intelligent data switches to offer you all large network management features, whether you need a few or hundreds. Features like single sign-on, time-of-day clock, toggling, redundant power and logic, security call-back, and more.

Think Small. Then Grow Big.

You can start out with as few as six local ports and expand to as many as 1,536, worldwide. □ Sequel's SDC family links together terminals, I/O ports, printers, modems, and any device that sends or receives data up to 19.2K bit/s. Without line drivers or multiplexers. Even at maximum usage, the 19.2K bit/s rate persists.

Meet The Three.

The SDC 660 gives you a range of six to 60 ports. □ If you outgrow it, keep all the cards and buy the SDC 6192 chassis. Now you can grow to 192 ports. □ If you need to expand further, the SDC 6192 Network is the answer. Plug Sequel's local networking card into as many as 8 chassis and expand up to 1,536 lines.

Break The \$100-Per-Port Barrier.

With all this to offer and more, our switch costs less than any other. The low \$100-per-port price begins at 30 ports.

Find Out For Yourself.

Call today and we'll demonstrate to you why Sequel's SDC family is so fast, flexible, and affordable. And why Sequel means "We're What's Next."

Standard Features Sampling

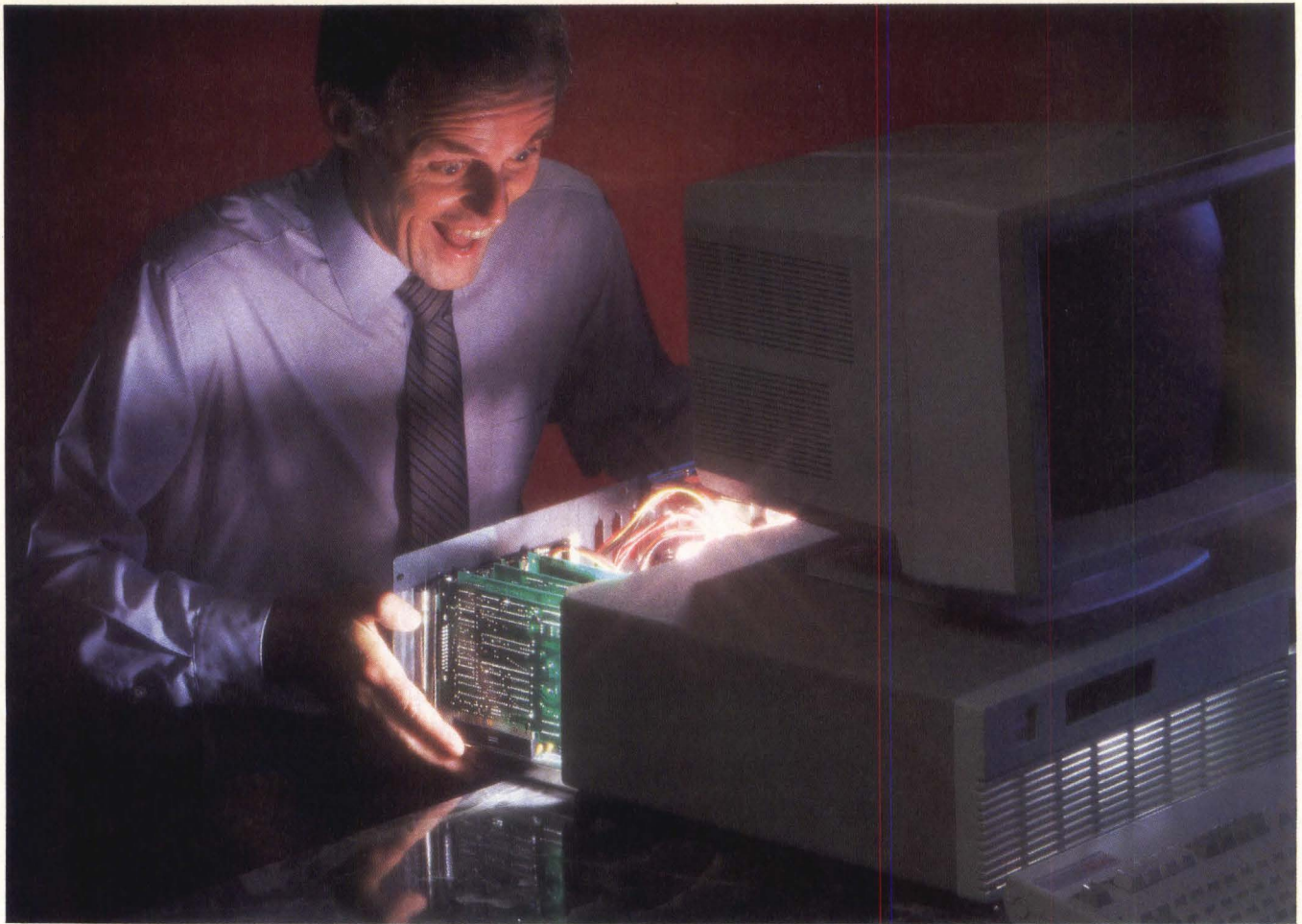
- *Port contention by name, number, or class*
- *Help menus*
- *Simultaneous toggling*
- *Priority queing*
- *Auto baud*
- *Network status display*
- *Password-controlled protection*
- *Alternate destination routing*
- *Time-of-day reconfiguration*
- *Single sign-on*



SEQUEL

Sequel Data Communications, Inc.
5246 Greens Dairy Road Raleigh, NC 27604
(919) 790-0300 Telex 5106002826

CIRCLE NO. 15 ON INQUIRY CARD



LOOKING FOR HIGH PERFORMANCE? CHECK UNDER OUR HOOD.

Open up our new 386, and you'll see the difference. Every major component has our name on it. So you're getting the kind of quality and performance throughout that you'd be proud to put your name on.

For years, we've been designing and manufacturing high performance components for the most respected names in computing. Now, all the refinements we've achieved for other manufacturers are available under one hood, under our own name. Or yours.

Because we design and manufacture the engine right here, stateside, in our own 45,000 square foot facility, we don't have to com-

promise on quality or performance. That means you don't, either.

And because we do everything right here, ourselves, you always know exactly who to call for any kind of support you need. The people who will answer your call aren't "support" people. They're the people who designed and built your machine.

We offer a full line of 386 and 286 systems off the shelf, or configured to your private label specs. Pick up the phone right now, and check us out.



FORTRON

Outside California,
call toll-free,
800-821-9771.

In California,
(408) 432-1191.

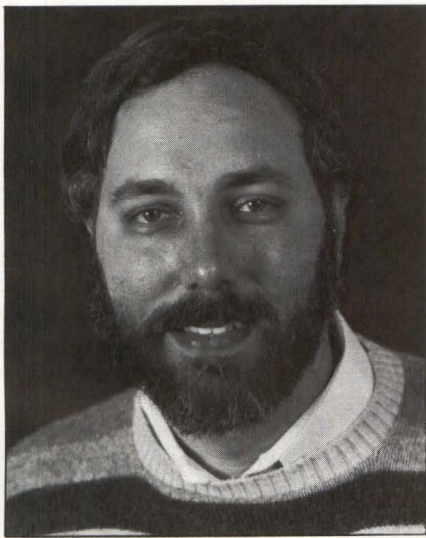
2380 Qume Dr., Ste. F
San Jose, CA 95131

SEE US AT COMDEX

CIRCLE NO. 16 ON INQUIRY CARD

INTERVIEW

Phoenix Technologies rises to integrate emerging architectures



Neil R. Colvin

The name of Phoenix Technologies Ltd. recalls the mythological bird that was consumed by fire, only to rise stronger from its own ashes.

Phoenix the company, based in Norwood, Mass., is the end result of several companies and projects launched by its founder, Neil J. Colvin. They ranged from a 1970s garage-type computer manufacturer, which was then only one of five or six in the United States, to a maker of compilers and debuggers for the CP/M programming environment. These companies came and went as Colvin made the transition from hardware to software, where he foresaw more action and more profits.

As in the myth, Phoenix Technologies has risen to become a strong force in the computer industry because of

the past-corporate-life experiences of its founder, and of others who were hired from many of those early companies. However, unlike the bird, the influence Phoenix Technologies has on the computer industry is real—particularly as personal computers become more powerful, and the lines separating workstations and minicomputers continue to fade.

The following is an excerpt of interviews held with Colvin, Phoenix Technologies' chairman, CEO and chief scientist; and Lance Hansche, vice chairman and vice president of strategic planning. Posing the questions for Mini-Micro Systems is senior editor Tim Scannell.

MMS. What forces do you see pushing computer systems development and integration right now?

Colvin. I think we're in a very strange situation. The hardware is advancing almost an order of magnitude faster than the software. The capabilities of the machines that are being produced today, and that are being designed for production tomorrow and the day after, are ahead of our capabilities to use them in the software sense. The industry is becoming constrained, and to a large extent driven by software.

MMS. What about all the concern for newer software architectures designed for Intel Corp.'s 80386 and both Microsoft Corp.'s and IBM Corp.'s version of OS/2?

Colvin. A lot of software developers, except for the very big ones, are very concerned about putting a lot of effort into software for an operating system that's going to run on less than

10 percent of the machines. What about the other 18 million machines out there that run DOS and not OS/2, and all the [IBM] Model 30 and Model 30 equivalents that can't run OS/2? There's a lot of software development happening for LIM 4.0 [Lotus-Intel-Microsoft] for instance. A lot of people see the LIM 4.0 standard as a viable alternative, because it doesn't lock them out of the marketplace. They have access to every machine ever produced.

Hansche. I believe that most of the new extended-operating-environment stuff is interesting to us as engineers, it's interesting to the press because it's news, it's interesting to a small segment of people using PCs, and it's interesting to MIS [management information systems] departments because it's a chance to get back control of all those nasty personal computers out there. But, if you go to the bulk of the people using PCs, they could care less. They want their word processing, they want their spreadsheets, and beyond that, they ask very little of their machines.

Windows is going to be fun to play with, but, good God, what is OS/2 and what does it mean to me?

MMS. What about the area of windows and windowing technology, is that a concern to Phoenix Technologies?

Hansche. Windows is very important to us and the hardware industry, because it begins to move the software away from absolute hardware knowledge. Without that, our ability to innovate and really add value is constrained by how many drivers

INTERVIEW

we're willing to write. If you take the intersection of all the creative software in the world and all the creative hardware and particular video and then try to write drivers for that intersection, you'd go mad. We know. We've tried.

MMS. How does Phoenix view the IBM PS/2, is it a personal computer, or more of a workstation?

Hansche. We view the PS/2 as more of a workstation because, other than packaging things and the ease of adding boards, it has very little to offer the user until the Micro Channel starts taking on coprocessors. When you start adding coprocessors, which are typically not cheap, you'll find the PS/2—classes 60 and up—growing in cost and going very easily into the workstation market.

MMS. Has Phoenix been talking or collaborating with IBM on Micro Channel compatibility or products?

Hansche. No, IBM doesn't really work with us much on this stuff. The chippers [semiconductor manufacturers] have all had at least one serious conversation with IBM about what it all means. What is happening strategically is that the chippers will all emulate the product in the first go round and then try and actually design better solutions, which will bypass any potential patent.

MMS. Are you working with non-IBM computer manufacturers to make a PS/2 clone of some type?

Hansche. We told our customers that, if they really want "micro channel machines," then we'll see that they have those products. That is our duty to them. It is better for them to receive standard technology from us than it is to build it internally. The dark side of that, however, is that we are then responsible to them for any standard technology, since they have given up their internal ability to do it.

MMS. What about UNIX? With all the promotion of OS/2 and its multitasking capabilities, is there still a chance for growth in UNIX-based commercial applications?

Colvin. I think this is the best chance UNIX has ever had. Every single processor in the world current-

ly being produced today—processor, not computer—runs UNIX. There is no exception.

UNIX has been ignored or, in some cases, shunned by the vast majority of users partially because they don't understand it and partially because nobody has ever tried to sell it. UNIX is the most portable operating system ever written. It is the most standardized operating environment ever written. Software written for UNIX can be, in most cases, very easily ported from machine to machine. OS/2 isn't the first solution to multitasking. It doesn't even take advantage of the 386, while UNIX with DOS under it takes full advantage of the 386.

MMS. So, will UNIX be the operating system platform of the future, over OS/2?

Colvin. I would like to see that happen. Who knows? IBM definitely has a vested interest in doing something else.

MMS. What about IBM's AIX [Advanced Interactive Executive]? Is it a viable UNIX alternative, or will it fragment the market even further?

Colvin. No. The RT PC [which employs AIX] has never gone anywhere. From most peoples' point of view the RT is dead. Its very interesting. You look at something like UNIX 386 or XENIX 386, since they're both fully operational at this point in time, and you compare it with OS/2. In OS/2 you run a DOS application in a compatibility box and a protected-mode application in the background. The DOS application runs about one-quarter the speed of a PC/XT, even though its on a 386. But, run a DOS application under UNIX or VP/IX, which is our implementation of DOS under UNIX, and you find that the DOS application runs at about 94 percent of what it would run under UNIX by itself—while you're running a UNIX task in the background.

There's such an incredible difference. The [UNIX] platform is the right platform and not the wrong platform. And a lot of people are going to start seeing that and making decisions in that direction.

MMS. Where is Phoenix Techno-

logies planning to make its next big push or, at least, concentrate the majority of its efforts?

Colvin. The next big push is in the whole peripherals area. To integrate and to unify peripherals to provide much greater flexibility for the software vendors, and for the manufacturers to hook up peripherals to various parts of their machines and not cause major confusion for the customers. Also, to provide consistent software interfaces to peripherals.

MMS. What about desktop publishing? Phoenix has a desktop publishing group and is actively working on products for that industry. How do you view this area as a whole?

Hansche. Right now, it's a badge of honor to say "I'm in desktop publishing," or "I am in the new wave of graphic arts."

Well, those waves are small and short. Most people don't want to use most of that stuff. Twenty percent of the things [in desktop publishing] they'll use all the time, and the rest is just window dressing.

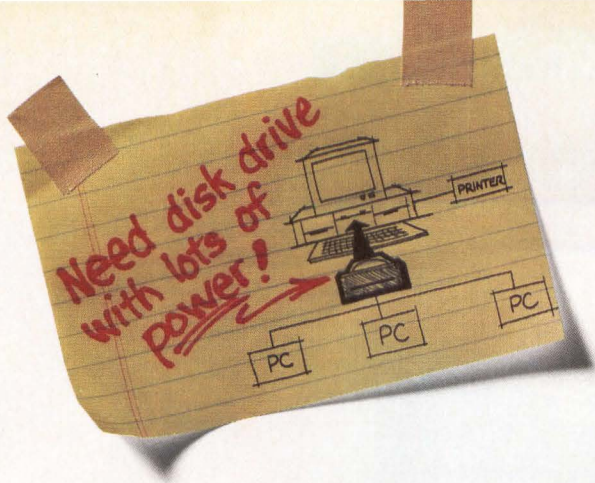
Basically, we went into it to rearchitect the whole thing so that the price of the controllers could be dropped.

We want to see personal page printers . . . so cheap that getting any other kind of printer is illogical, unless you're looking for color.

MMS. With all this talk of standardization, and the rush by some companies to force standards, do you see this as a potential problem for you?

Colvin. We don't see standards as an obstacle, we see them as opportunities. The more standards there are that people feel they have to have, the more opportunity there is for us. It will be our effort to make sure standards are easily consolidatable and to provide people with environments that allow them to easily move to these new standards, without having to redo their entire product line from scratch.

We're very much in favor of unifying the standards, but, at the same time, our whole technology is to allow for multiple standards in a single environment. □



The Hall-Mark solution:



Micropolis 1300 Series Winchester Disk Drives.

The Micropolis 1300 Series 5¼" disk drives combine fast access with high capacity to deliver reliability and quality — making them the industry leader.

Designed to meet the toughest requirements, the 1320 Series high-performance ST-506 drives offer capacities ranging from 43 to 85 Mbytes and boast the highest MTBF in the industry.

The 1330 Series has a capacity range of 44 to 71 Mbytes, formatted. These ST-506 PC Kits are configured with everything needed for mounting in an IBM PC, XT or AT, including partitioning software, cables, mounting hardware and a detailed installation guide.

The 1350 Series ESDI drives offer capacities up to 170 Mbytes with ultra-fast data transfer rates. If ESDI is your interface, the 1350 is your high-performance, high-capacity solution.

The embedded high-performance SCSI controller on the 1370 Series provides unformatted capacities to 170 Mbytes and conforms to the ANSI SCSI standard and the Common Command Set.

Call Hall-Mark today for more information on the 1300 Series or any Micropolis product. Hall-Mark offers solutions to your computer systems and peripheral needs.



A COMMITMENT TO EXCELLENCE

© 1987 Hall-Mark Electronics Corp./400-0002
Hall-Mark Electronics is a subsidiary of the Tyler Corp.

Alabama
Huntsville (205) 837-8700
Arizona
Phoenix (602) 437-1200
California
Bay Area (408) 946-0900
Orange County (714) 869-4100
Sacramento (916) 722-8600

San Diego (619) 268-1201
San Fernando Valley (818) 716-3300
West Los Angeles (213) 217-8400
Colorado
Denver (303) 790-1662
Connecticut (203) 269-0100
Florida
Ft. Lauderdale (305) 971-9280

Orlando (305) 855-4020
Tampa Bay (813) 855-5773
Georgia
Atlanta (404) 447-8000
Illinois
Chicago (312) 860-3800
Indiana
Indianapolis (317) 872-8875

Kansas
Kansas City (913) 888-4747
Maryland
Baltimore (301) 988-9800
Massachusetts
Boston (617) 935-9777
Minnesota
Minneapolis (612) 941-2600

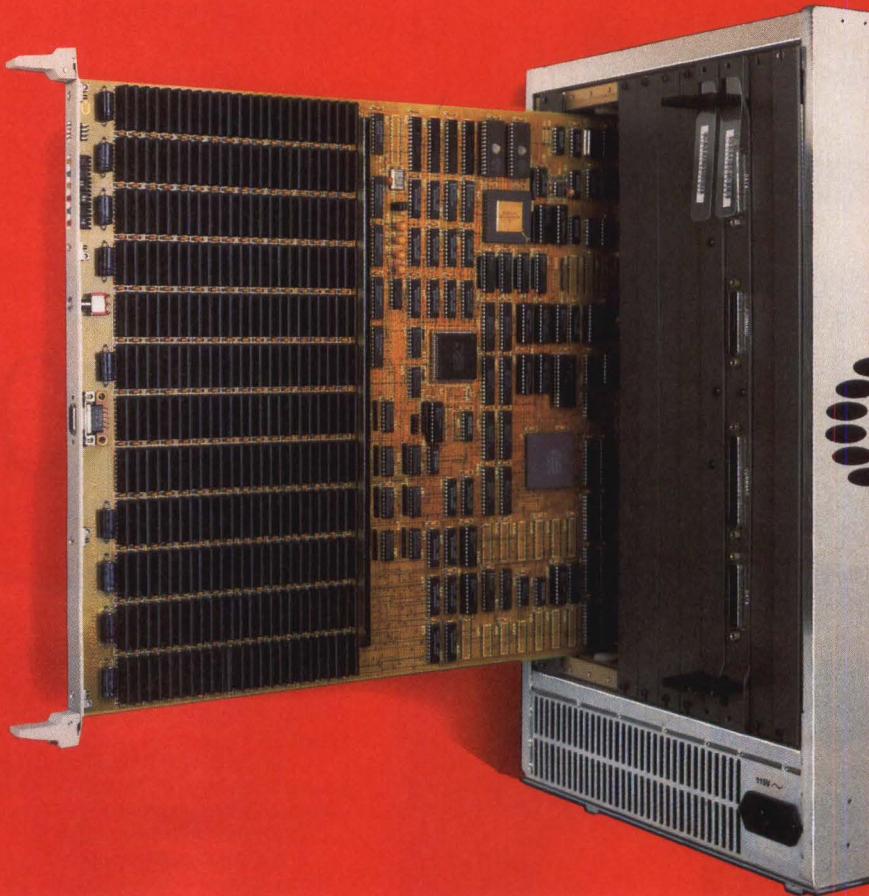
Missouri
St. Louis (314) 291-5350
New Jersey
Fairfield (201) 575-4415
New York
Long Island (516) 737-0600
Rochester (716) 244-1005
North Carolina
Raleigh (919) 872-0712

Ohio
Cleveland (216) 349-4632
Southern Ohio (614) 888-3313
Oklahoma
Tulsa (800) 231-0253
Pennsylvania
Philadelphia (215) 355-7300

Texas
Austin (512) 258-8848
Dallas (214) 553-4300
Houston (713) 781-6100
Utah
Salt Lake City (801) 972-1008
Wisconsin
Milwaukee (414) 797-7844

CIRCLE NO. 17 ON INQUIRY CARD

Clearpoint's New 32MB Memory for the Sun 3/2XX and 4/2XX Delivers the Ultimate in Density and Upgradability



NEW!
Clearpoint Announces
Sun 3/60 Memory

Plus Powerful On-Board and Remote Diagnostics

Four Times the Density of Sun Memory for the 3/200

The SNX2RAM offers the highest density possible for the Sun 3/2XX, plus compatibility with the Sun 4/2XX. The board uses advanced megabit ZIP DRAMs and the unique Clearpoint EDC chip set to achieve this unprecedented density.

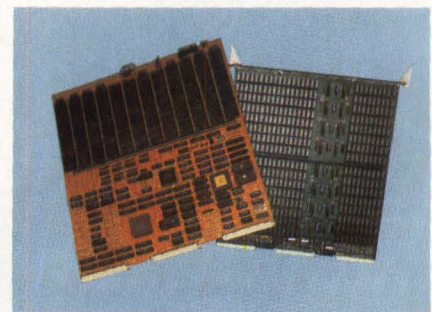
Reliability and Service for the Most Demanding Requirements

Clearpoint engineered the SNX2RAM for maximum reliability. A processor monitors the card's performance using on-board diagnostics. It can be interrogated either directly from a terminal or remotely through a modem, allowing instant problem resolution. Combined with Clearpoint's lifetime warranty 24-hour before repair replacement policy and Federal Express Spares Depot, Clearpoint guarantees a superior level of support. Why settle for less?

The Same Memory for Both the Sun 3/2XX and the Sun 4/2XX

Only Clearpoint offers the identical 32 MB card for both the 3/2XX and 4/2XX systems. This gives customers the best upgrade flexibility, and the highest capacity today.

Available in 8, 16 and 32 MB Capacities



CLEARPOINT INC.

99 South Street • Hopkinton, MA 01748-2204
U.S.A. 1-800-CLEARPT Telex: 298281 CLEARPOINT UR
Massachusetts 617-435-5395/435-2301
Europe: Clearpoint Europe b.v.
Tel: 31-23-273744 Telex: 71080 CLPT NL
Canada: Clearpoint Canada Tel: 416-620-7242
Japan: Clearpoint Asia
Tel: 03-221-9726 Telex: 32384

Call or write for
■ the SNX2RAM User's Manual
■ The New Designer's Guide to Add-in Memory
■ Clearpoint's Product and Services Catalog



Sun is a trademark of Sun Microsystems.

If my memory serves me right... It must be Clearpoint.

CIRCLE NO. 18 ON INQUIRY CARD

NETWORKING

Twisted-pair Ethernet moves into standards limelight

Tim Scannell, Senior Editor

Look out fiber. Stand aside coaxial. The next big push in desktop local area connections is a medium as familiar as your telephone, yet as dependable as sophisticated high-speed links.

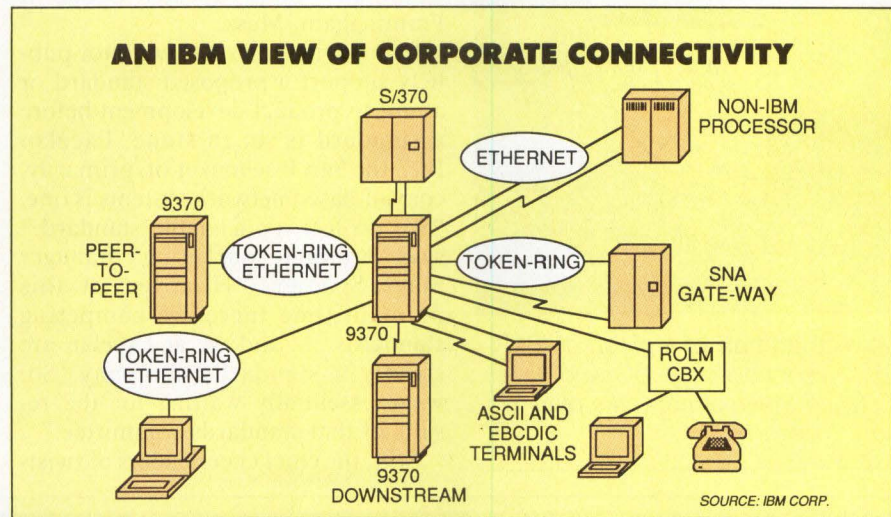
It is also cheaper and more available than most competing technologies, which would attract users and compel system integrators to boost supply to meet the anticipated demand.

What is this miracle technology? Not a miracle at all, really, but good old 10M-bit-per-second (bps) Ethernet. The difference is that it now runs over unshielded twisted-pair wiring, instead of shielded coaxial cable. This wiring is the same found in the private automatic branch exchange (PABX) systems of most offices. The desktop telephones linked to these systems often use only a fraction of the wire capacity, which leaves the rest for local computer and peripheral connections, say proponents of the 10M-bps twisted-pair push.

"We think this is going to be a very, very important technology for our customers," says Joseph Skorupa, manager of product marketing at MICOM-Interlan Inc., Boxborough, Mass.

Apparently, so do a lot of other companies that have joined MICOM-Interlan in its efforts to convince the Institute of Electrical and Electronics Engineers (IEEE) to establish a standards committee for 10M-bps twisted-pair Ethernet. These include Digital Equipment Corp., 3Com Corp., Ungermann-Bass and Wang Laboratories Inc., all of which sent representatives to a preliminary standards meeting held in Boston in October. They were expected to present their case before the IEEE last month in Florida.

"When it becomes standardized,



Here is a typical IBM network consisting of IBM personal computers, 9370 minicomputers and a System/370 mainframe. All of the machines are linked via token-ring Ethernet (PC Net) and the Systems Network Architecture (SNA) protocol.

people can then interoperate and make selections based on features and functions rather than trying to remember whose product works with who else's," Skorupa explained.

Iron out the differences

Before you plug your computer into your telephone and take your twisted pair out for a run, however, be aware that a lot has to be ironed out before things really get rolling. As those who have gone the route know, standardization is no easy task. To establish a recognized standards committee, a group must first demonstrate that a proposed technology is viable and has market appeal. Then, it must be shown that the technology has a distinct identity and conforms to existing IEEE specifications that may be affected by a new entry—in this case the IEEE's 802.3 network rules.

Even if twisted-pair Ethernet is standardized, it still may not catch

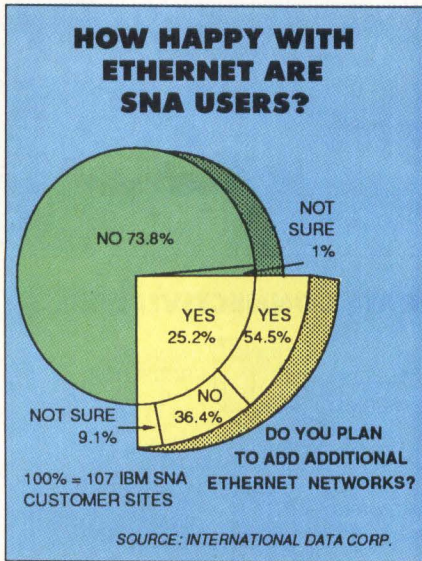
fire unless enough companies seriously dedicate themselves to developing products that strictly adhere to its format. For example, DEC took part in the initial work group meetings for twisted-pair Ethernet and even unveiled a product at its DECworld meeting in Boston last September. However, CEO Kenneth Olsen admits he reluctantly bowed to user demands for twisted-pair Ethernet, preferring to promote coaxial Ethernet—what some critics call "cheapernet"—as the medium of choice.

"Coax is so much easier," he remarked. "But alas, a number of our customers have put twisted pair into their building, and they're too embarrassed to take it out."

The DEC difference

To further complicate things, DEC's version of the 802.3 Ethernet is not totally compatible with the

NETWORKING



More than half of a group of IBM SNA users polled by IDC who have installed Ethernet networks plan to add more.

Ethernet offerings of other companies. It apparently has some technological quirks that are unique to DEC. As a result, DEC is actively pushing its version as the standard by the sheer numbers of its Ethernet users, observes Kim Myhre, an analyst with International Data Corp.'s (IDC) Communications Research Group in Framingham, Mass.

Some companies also will not publicly support a proposed standard or admit to product development before a standard is set in stone. Excelan Inc., the San Jose maker of, primarily, coaxial-based network systems is one. "We do feel it's a viable standard," says product marketing manager Steve Spanier. "However, at this point in time there are competing standards . . . and we at Excelan are strictly a standards company. So, we're essentially waiting for the results of that standards committee." Still, the chief cheerleaders of twist-

ed-pair Ethernet are undaunted. In fact, MICOM-Interlan started showing an unshielded twisted-pair Ethernet product in mid-October at the NetWorld show in Dallas. They are also sure there is more support for the proposed standard than most companies are willing to admit. "I would be surprised to see any major player in the Ethernet marketplace who does not have a 10M-bit Ethernet product," observes MICOM's Skorupa.

Besides DEC and 3Com, companies that have unveiled twisted-pair Ethernet products include Hewlett-Packard Co. and SynOptics Inc.

Casts a net for Big Blue

While twisted-pair Ethernet would seem to compete with its coaxial cousin, it really targets everyone's favorite whipping boy—IBM Corp. At the moment, IBM's PC Net architecture—an IEEE 802.5 token-ring coax-

The Newest Name in Electronics Contract Manufacturing Has Been Leading the Way For 24 Years.

Avco Electronics is becoming AVEX Electronics Inc.

As a subsidiary of the J.M. Huber Corporation, we will continue to offer the best in cost effective, quality contract electronics manufacturing services. Backed by the resources of a 104-year-old corporation, our state-of-the-art capabilities will continue to expand to meet industry needs.

Our experienced staff remains ready to assist you with virtually any electronics manufacturing problem. SMT or through-hole. Design, assembly or test.

If you'd like to reduce capital expenditures, lower manufacturing costs or shorten your product's time to market, consider the AVEX Electronics alternative. For more information about our cost effective manufacturing solutions, call our Director of Marketing at (205) 837-6500.

AVEX Electronics Inc.
A Subsidiary of J.M. Huber Corporation

Great new name.
Still Experienced. Cost Effective.
Customer-Oriented.

HOW TO XL IN BUSINESS.

It's simple. Get acquainted with NEC's powerful new Astra[®] XL family. The Astra MicroXL, XL/8, XL/16 and XL/32 series. Each of these multiuser systems, using the UNIX[®] System V operating system, offers true compatibility and upgradability.



The XL family is MC68020-based, with up to 16MB main memory, up to 2GB of disk storage and can accommodate up to 32 users. Plus, it runs a range of IBM and other communications protocols and offers advanced networking capabilities.

In addition, the Astra XL family is ready to work right now with the most popular software development tools available. Including databases like UNIFY*, office automation software like Q-OFFICE +[®] and a variety of popular languages like C, COBOL, FORTRAN and more.

At NEC, we're continually advancing the technology of computers and communications. With the kind of products and programs you'd expect from a \$17 billion industry leader.

The new Astra XL family. It's just what you need to excel in business.

NEC

C&C Computers and Communications

For more information and the name of the NECIS VAR nearest you, call 1-800-343-4418 (in MA 617-264-8635).

For more information on our VAR and ISV programs, call 1-800-443-4849 (in MA 617-264-8635).
Or write: NEC Information Systems, Dept. 1610, 1414 Massachusetts Ave., Boxborough, MA 01719.

CIRCLE NO. 19 ON INQUIRY CARD

INTRODUCING DOCUMATE. OTHERS TRIED, BUT WE GOT IT STRAIGHT.

*The New 3-Way
Printer With The
Straight Paper
Path.*



There's never been anything like DocuMate, the new three-function bar code, label and demand document printer from Facit.

We Know What You Have To Go Through.

Six-part forms can be a six-part headache. That's because many ordinary printers don't fully penetrate multi-part forms or keep them aligned. And they lack true tear-off capability, wasting forms. With its unique, flat platen and V-shaped top, our new DocuMate gives you perfect feed-through and immediate tear-off.

A Bar Code Shouldn't Make Waves.

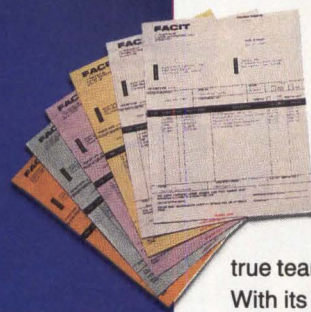
Our straight path keeps bar codes in line with unmatched precision and readability. And because bar coding is software resident, you can choose from 11 different bar code configurations.

When The Pressure's On, We Can Handle It.

Printing 10,000 labels in succession could get sticky for an ordinary printer. DocuMate prints them without peel-off. You can even mix in bar codes and variable size characters up to 9.5" tall.

There's no end to what you can demand from DocuMate. Like front load and bottom feed for true counter-top convenience. Plug-in font cards that make type style changes a snap. And a rugged, easy-to-load—quick-to-service clamshell case. The silence inside is unheard of. So is the price.

For more information, write Facit, Inc., 9 Executive Park Drive, PO Box 334, Merrimack, New Hampshire, U.S.A., 03054. Or call (603) 424-8000.



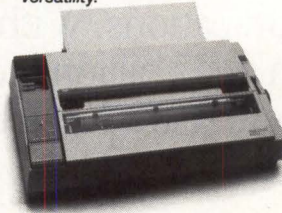
Facit DocuMate 3000 Demand Document Printer—features 11 resident bar codes, immediate paper tear-off, text and graphics, label printing, and up to six-part forms.



Facit P7080—A Laser Printer—For high-volume workloads with multiple emulations, face-down stacking, and optional PostScript emulation and bar codes.



Facit B3350 Matrix Printer—IBM, Epson compatible, plug-in character font cards, four-way paper handling, and other options provide exceptional versatility.



FACIT

Our Value Adds to Yours
CIRCLE NO. 22 ON INQUIRY CARD

NETWORKING

ial-based technology—is the most popular personal computer local area network in Fortune 1000 corporations, by a small margin. In its "Professional Automation Report," Forrester Research Inc., Cambridge, Mass., notches this market penetration at about 43 percent, as compared with Ethernet's 40 percent share.

Two things will fuel 10M-bps twisted-pair Ethernet's advance over PC Net-type of installations. First is its inherent speed, which is 2½ times faster than the 4M-bps PC Net. Second is the cost. Since the wiring is already in place, users do not have to drill holes and install expensive coaxial cable to connect computers and peripherals.

More importantly, it will also save money when workstations and personal computers are shifted around an office—which typically happens at least once per year, according to some estimates. Again, since twisted-pair wiring already wends its way through most office buildings, the cost to move a single coax-tethered workstation may be reduced by \$1,200 to \$1,700, according to MICOM-Interlan.

Timing is also on the side of twisted-pair Ethernet, or any type of networking for that matter. Local area networking is hot. Currently, only about 10 percent of installed departmental computer systems are connected within a network, according to IDC. Most of these connections have occurred in single-vendor environments, whereas multivendor sites make do with simple, often fragmented networking schemes, says IDC's Myhre.

What will most certainly attract system integrators to twisted-pair Ethernet, however, is MIS (management information systems) disappointment with IBM's network strategy. In a recent survey of 107 large-system sites—those with two or more mainframe computers, operating to some extent with IBM's Systems Network Architecture (SNA)—IDC found that nearly half of those polled were either not sure or did not believe that IBM had a clear and competitive LAN strategy. More than 62 percent also felt that IBM's network would be better if it were faster.

More than 25 percent of those surveyed also had some type of Ethernet already installed.

Of course, IBM has a few networking tricks up its sleeve, most notably a 16M-bps shielded, twisted-pair token-passing network that it has reportedly demonstrated to a number of select customers. However, with speed come sacrifices in distance. The maximum distance between work-

stations linked in a 10M-bps network without controllers and signal boosters is about 100 meters, says MICOM-Interlan's Skorupa. At 100M-bps the distance degrades substantially, to several meters.

Besides, noted Skorupa, "Some people are already running 50M and 80M bps on unshielded twisted-pair networks. So, 16M bps is, quite frankly, nothing earth shaking." □

Honeywell Keyboards Can Help You



The Honeywell 84RX Silent-Tactile PC-compatible keyboard can be used with the IBM PC, PC-XT, PC-AT and most compatibles.

Get The Sale.

When you put a Honeywell Silent-Tactile keyboard on your system you are providing the finest quality PC-compatible keyboard available.

End-users prefer the ergonomic design and silent-tactile feel of Honeywell keyboards. They will also appreciate the fact that you have selected the best for them.

You should think about the quality of keyboards you put on your system. Your customer will. Ask for Honeywell Silent-Tactile keyboards – and Touch The Quality.

For your free "Honeywell Keyboard Reseller Kit", and the distributor nearest you, call toll-free:

1-800-445-6939

In Texas, call collect: 915/543-5566

Together, we can find the answers.

Honeywell

Keyboard Division, 4171 North Mesa, Building D, El Paso, Texas 79902 915/544-5511



**MOVE UP
TO A
NEW LINE**

**FROM
HOUSTON
INSTRUMENT**

Prepare to be impressed. Meet the new line of high-performance plotters from Houston Instrument.™ HI's sleek new DMP-60 series is designed to impress even the most demanding CAD professional.

Discover unprecedented flexibility—blended with ultra-fine resolution, speed, and software compatibility. Benefit from HI's rigorous standards for quality, reliability, and service. All at prices starting from \$4,695.*

Watch the DMP-60 series double as a scanner with HI's unique SCAN-CAD™ option. Quickly produce multicolored drawings when you use the Multi-Pen adaptor. Plot several originals—without tying up your PC when you add HI's buffer expansion board.

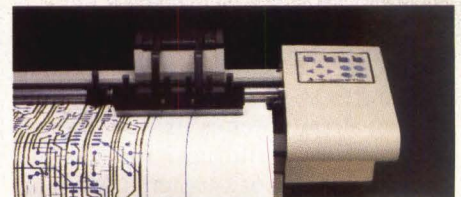
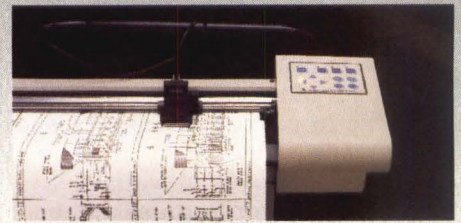
Select media as small as 8½" x 11" or as large as 36" x 48". Load either DM/PL™ or HP-GL 758X-compatible software. Then watch as your plotter quickly produces a drawing polished to a precise resolution of 5 ten-thousandths of an inch. Smile when you see smoothly formed circles, curves, and lettering.

Explore HI's host of support

programs including an overnight plotter-replacement service. And then relax, knowing that HI's new plotters rest on 27 years of engineering excellence.

Move up. To a fine, new line. From Houston Instrument. Begin by calling 1-800-444-3425 or 512-835-0900 or writing Houston Instrument, 8500 Cameron Road, Austin, TX 78753.

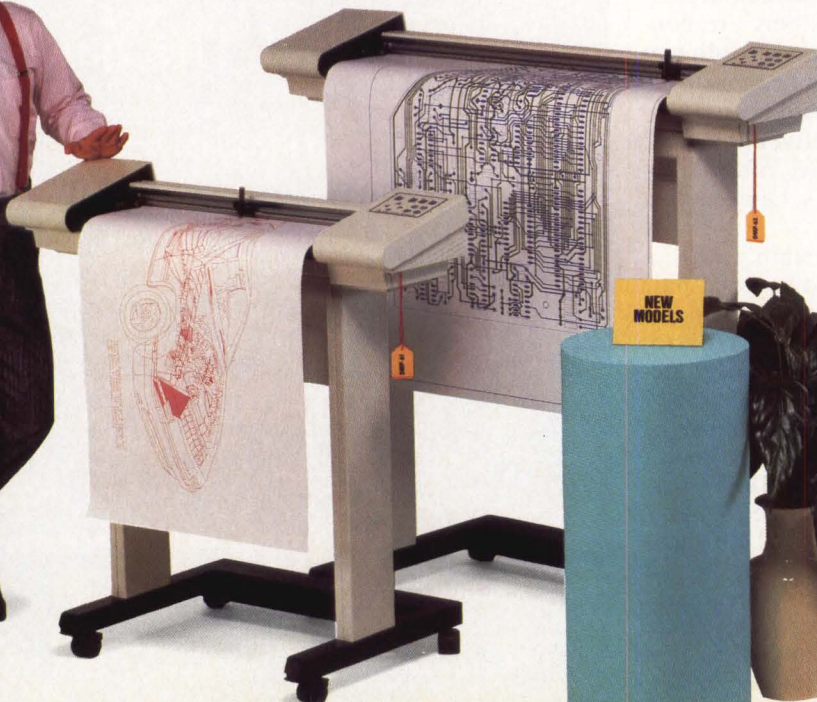
**U.S. suggested retail price.*



**HOUSTON
INSTRUMENT**

A DIVISION OF **AMETEK**

Houston Instrument, SCAN-CAD, and DM/PL are trademarks of AMETEK, Inc.



CIRCLE NO. 27 ON INQUIRY CARD

BUS TECHNOLOGY

Expanded Multibus I stirs tech tiff with Intel

Megan Nields, Staff Editor

Can new life be pumped into an old, but still widespread and useful bus technology? More importantly, is resuscitation even necessary?

Zendex Corp., based in Dublin, Calif., thinks so and has proposed a new specification for Multibus I that would allow for 32-bit data transfers and a 256M-byte physical address space. Right now, Multibus I architectures are limited to 16-bit data transfers and have a 16M-byte physical address space.

"Zendex wants to see Multibus I specifications grow to meet user's demands in a slow, defined way," says Jerry Underwood, a hardware engineer for the small company. "We want to encourage Multibus I manufacturers to see new alternatives while embracing current specifications."

Maybe. But Intel Corp., the developers of Multibus I and later of the more powerful Multibus II, disagrees. Officially, the Hillsboro, Ore., company does not feel 32-bit expansion is necessary for most general applications, and they want Zendex and others to leave Multibus I the way it is.

"We are happy with Multibus I the way it stands," insists Mike Pritchard, Intel's product marketing manager for Multibus I. "There is no doubt that in certain applications people can benefit from Zendex's design. But the general market will not have much need for it."

Puts a stop to stopgaps

Zendex's theory is simple: In order to remain competitive and meet the needs of most open-architecture systems, the current crop of Multibus I-compatible board products must boost their performance to match that of 32-bit microprocessors. This is basically done by increasing both memory speed and I/O throughput.

Board designers tackle this problem in a number of ways. To rejuvenate memory, for example, they can provide a 32-bit local-memory data bus, implement memory caching and interleaving, or use high-speed dy-

namic and static random-access memories. To decrease the impact of a slow bus-transfer rate, they can also offload as many I/O operations by

giving responsibility to the host processor board.

At best, however, these are stopgap solutions. As the demands of an open

Honeywell Keyboards Can Help You



The Honeywell 101RX and 101RXe (with enhanced "enter" key) Silent-Tactile PC-compatible keyboards can be used with the IBM PC, PC-XT, PC-AT and most compatibles.

Keep A Satisfied Customer.

When you provide Honeywell Silent-Tactile keyboards with your systems, you are making certain your customer has the best.

For more than 25 years, OEMs and people who use keyboards for a living, have chosen quality Honeywell keyboards.

Now, you know your customers will be satisfied because they have the best keyboards available. Ask for Honeywell Silent-Tactile keyboards – and Touch The Quality.

For your free "Honeywell Keyboard Reseller Kit", and the distributor nearest you, call toll-free:

1-800-445-6939

In Texas, call collect: 915/543-5566.

Together, we can find the answers.

Honeywell

Keyboard Division, 4171 North Mesa, Building D, El Paso, Texas 79902 915/544-5511

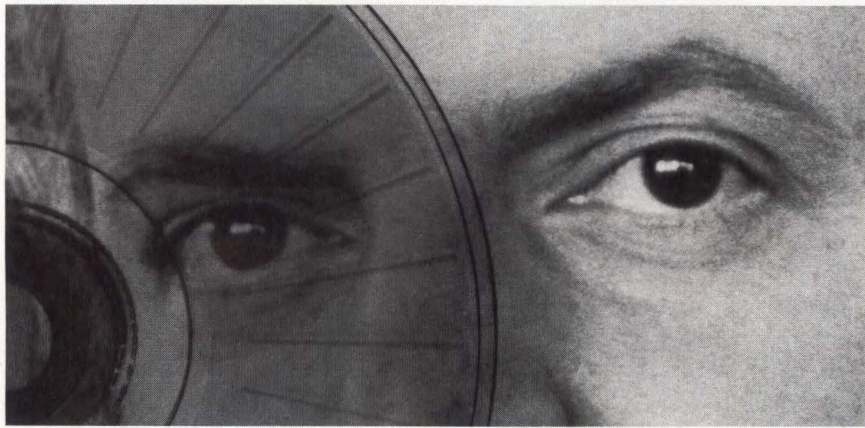
BUS TECHNOLOGY

architecture on a system increase, keeping up becomes more difficult, says Russ Gamble, vice president of marketing for Zendex.

Zendex's answer to the problem is to rewrite the specifications for the P2 connector. Their product—deemed Tru-32—uses 28 undefined lines on the P2 Multibus I connector to ex-

pand the data bus from 16 to 32 bits and the address bus from 24 to 28 bits. These lines increase physical address space from 16M to 256M bytes. In operation, Tru-32 allows each board in a system to check to see if it is equipped for extended data transfers. If it is, Tru-32 will accommodate increases in data speeds. If not, stand-

What You Can't See

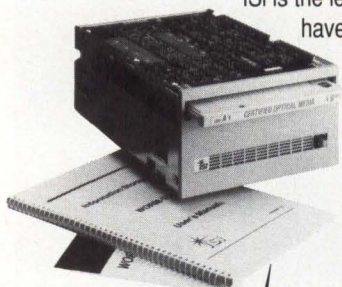


Transparent Optical Software

ISI's WORM is the Only Optical Disk Drive with a Completely Transparent User Interface

Our WORM-TOS™ software for MS™-DOS compatible computers, is the most advanced user interface for optical disk storage in the industry. Using WORM-TOS, ISI's 5 1/4 - inch WORM drives operate transparently to the user. So, ISI drives with software are completely user-ready, "plug & play" storage devices. As an OEM or VAR, that makes your job a lot easier.

Our aggressive and comprehensive reseller program is another way we make your job easier. It includes technical support for hardware and software, service and the margins you've been looking for.



ISI is the leader in optical disk drives* because our WORM drives have the performance, pricing and proven reliability you need. And, our WORM gives you the added insurance of a licensed second source. Call us today for complete information on our OEM/VAR program, and arrange for an evaluation unit. 1-800-333-WORM, ext 187.

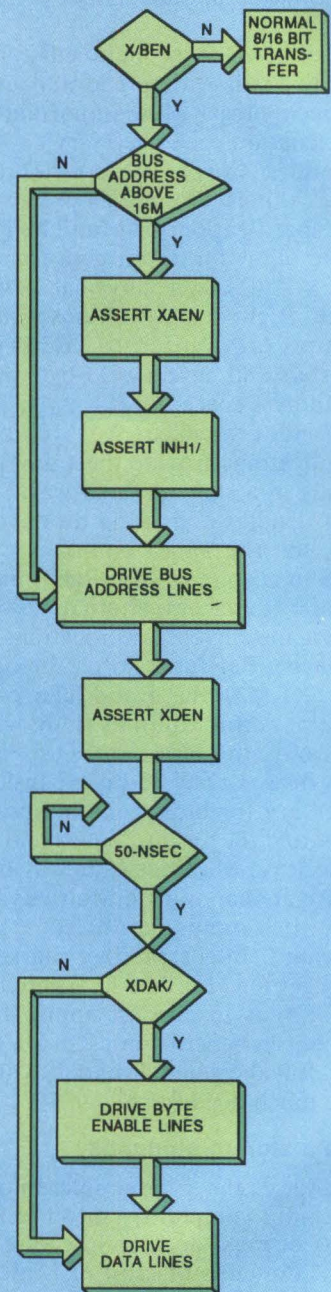
*According to market share reports compiled by International Data Corporation and Rothschild Consultants, ISI has a market share exceeding 60% of the total 5 1/4-inch optical drive shipments through 1986.

Information Storage inc.

2768 Janitell Road
Colorado Springs, Colorado 80906
(303)579-0460, FAX (303) 579-0450

MS-DOS is a trademark of Microsoft Corporation
WORM-TOS is a trademark of Information Storage inc.

TRU-32 CONTROL FLOW



SOURCE: ZENDEX CORP.

In the Zendex Tru-32 expansion idea for the Multibus I, one board queries another to see if the second board is equipped for extended data transfers or addressing. If not, operations follow the traditional Multibus I specifications.

ard Multibus I specifications are implemented. Tru 32 initially will be implemented on an Intel 80386-based single-board computer with a memory board and will cost between \$4,000 and \$6,000. It is due to be shipped in the first quarter of 1988.

Zendex maintains that its product is a good solution for people who want greater I/O throughput at a low cost; particularly in industrial automation, military, medical and aerospace applications. The goal is to prolong the life of a good architecture, points out Carl Dossenbach, Zendex vice president of marketing.

"We're coming from the angle of, 'How can you possibly put everything on the same board?' You have to have a generic architecture that is allowed to grow," he says. "We're not out there to hurt Multibus II, we're just enhancing Multibus I."

Intel's response to Zendex's expansive view of Multibus I has been a one-page release decrying the whole idea. In the statement, Intel says:

1. 32 bits are required only for memory operations, not I/O, unless they are direct memory access (DMA) functions.

2. As faster processors became available, the system bus became inadequate for memory execution. As systems built around the Intel 8086 microprocessor were developed, the Multibus I specification was enhanced to include iLBX (Intel local bus extension). This was necessary because memory technology had not yet advanced to the point where executive memory could be located on the processor board cost-effectively.

3. As memory migrated to the CPU board, the Multibus became an I/O bus. The memory-to-CPU performance does not typically have as large an affect on overall system performance as does the operation of the local CPU and memory.

4. The performance boost achieved by widening data paths is less than that achieved by increasing the performance of the local CPU and memory.

All true, says Zendex's Underwood. But these arguments relate to any bus structure. The Zendex specification,

on the other hand, supports a much more dense global memory, without forcing users to "go through the pain of upgrading to more sophisticated technology and software," Underwood says.

"You don't have to abandon an industry to get the latest and the greatest," adds Dossenbach, noting

that his scheme would preserve the Multibus I customer base.

Intel also is concerned for the Multibus I users, but maintains they are satisfied with the present technology and don't want to upgrade. "I'm happy for Zendex. They've managed to maintain IEEE-796 compatibility," says Pritchard. "But maturity

Honeywell Keyboards Can Help You



The Honeywell 84TC sealed touch panel PC-compatible keyboard is ideal for harsh environment applications and can be used with IBM PC, PC-XT, PC-AT and most compatibles.

Provide A Better System.

Whatever the PC application, there's a quality Honeywell Silent-Tactile keyboard for your system.

Every Honeywell keyboard incorporates the quality, value, reliability and technology that OEMs have chosen for more than 25 years.

Your customers interact with their keyboards more than any other system component. Doesn't it make sense, whatever the application, to provide the best? Ask for Honeywell Silent-Tactile keyboards - and Touch The Quality.

For your free "Honeywell Keyboard Reseller Kit", and the distributor nearest you, call toll-free:

1-800-445-6939

In Texas, call collect: 915/543-5566

Together, we can find the answers.

Honeywell

Keyboard Division, 4171 North Mesa, Building D, El Paso, Texas 79902 915/544-5511

BUS TECHNOLOGY

and compatibility are the great strengths of Multibus I. Many people don't want to do anything to change it."

'We're selling trucks'

The key question, though, is how Multibus II fits into the scheme of things. Although Zendex concedes that Multibus II and VMEbus can execute some applications more gracefully than other buses, it also feels that there are a lot of situations where it is not appropriate.

Zendex's Gamble claims that Multibus II is not designed for I/O applications but for applications where processors want to talk to processors, such as with multiprocessor computers where single CPUs are dedicated to specific functions like disk control or communications. "Some people say we're not making a substantial step. Our philosophy is, if you want a Porsche, buy a Porsche. We're selling trucks."

Not all bus/board manufacturers

share Zendex's enthusiasm for putting more into Multibus I. Michael Curran, president of Micro Industries in Westerville, Ohio, points out that Tru-32 doesn't implement the DIN connector system—a major advantage of 32-bit buses. He feels there may be a short life span for edge-connector buses.

Tom Cramer, president of Single Board Solutions, Cupertino, Calif., finds promise in the Tru-32 idea, but with some reservations. He believes that 16 bits are adequate for most applications, and that the cost of upgrading to 32 bits might not be worth the effort. When access to greater amounts of memory is needed, however, Cramer sees Tru-32 as a better idea than the iLBX specification.

Such criticisms are expected, says Gamble. "We are giving the world a lot more power at a little cost, and some people are upset that they didn't think of this themselves. But other people are coming to us saying, 'Thank you for doing this.'" □

LOOKING AHEAD IN MMS

Be sure to watch for these editorial highlights in coming issues of Mini-Micro Systems:

- The January issue will examine Postscript clones and reduced instruction set computing micros.
- The February issue focuses on color output devices and the arrival of color for desktop publishing systems.

Reprints of Mini-Micro Systems' articles are available on a custom printing basis in quantities of 500 or more. For specific quotations, contact Katie Pyziak, (312) 635-8800.

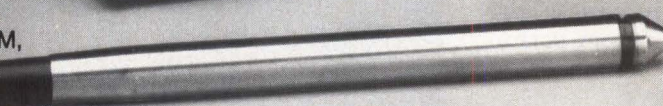
CABLE READY.



Turn your computer terminal into a bar code station with the decoder that's cable ready.

Welch Allyn's HBD-K2 Decoder comes ready to work. By simply plugging in the interface cable, you instantly configure the HBD-K2 without the need for awkward switches or jumpers. It's designed to be compatible with many of today's most widely used terminals including IBM,

Telex, and Zenith. And, it can be used with both handheld laser and traditional "wand" scanners. Contact Welch Allyn for specific details.



Jordan Road
Skaneateles Falls, NY 13153-0187
Telephone: (315) 685-8945
Telex: 325435
Fax: (315) 685-3172

CIRCLE NO. 29 ON INQUIRY CARD

Once again,
Compaq
raises the standard
of performance
for personal computers.

This time
by a factor of two...



Introducing the two on earth



The new COMPAQ DESKPRO 386/20™

Last year, we introduced the COMPAQ DESKPRO 386™ the most advanced personal computer in the world. Now the world has two new benchmarks from the leader in high-performance personal computing. The new 20-MHz COMPAQ DESKPRO 386/20 and the 20-lb., 20-MHz COMPAQ PORTABLE 386 deliver system

performance that can rival minicomputers. Plus they introduce advanced capabilities, without obsoleting your investment in software, hardware and training.

Our new computers employ an industry-standard 20-MHz 80386 microprocessor and sophisticated 32-bit architecture.

But to make these two of the world's fastest PC's, we did more than just increase the clock speed.

For instance, both are built around a concurrent bus architecture. Two buses—one for memory and one for peripherals—eliminate information bottlenecks, allowing each component

It simply works better.

most powerful PC's and off.



and the new 20-MHz COMPAQ PORTABLE 386™

to run at its maximum speed. Together, they insure the highest system performance without sacrificing compatibility with industry-standard peripherals.

Both computers offer disk caching. Both offer the most memory and storage within their classes. Both let you run software being written to take ad-

vantage of 386 technology. And both run new MS-DOS®/BASIC Version 3.3 as published by Compaq. With it, our new portable and our new desktop can break the 32-megabyte limit on file sizes that handcuffs other PC's, allowing you to build files up to the size of your entire fixed disk drive.

And from now until December 31, 1987, both computers come with a free package of new Microsoft® Windows/386 Presentation Manager. It provides multi-tasking and switching capabilities with today's DOS applications to make you more productive. But that's just the beginning. To find out more, read on.

COMPAQ®

The question wasn't but how to get the

System Board with 20-MHz Cache Memory Controller

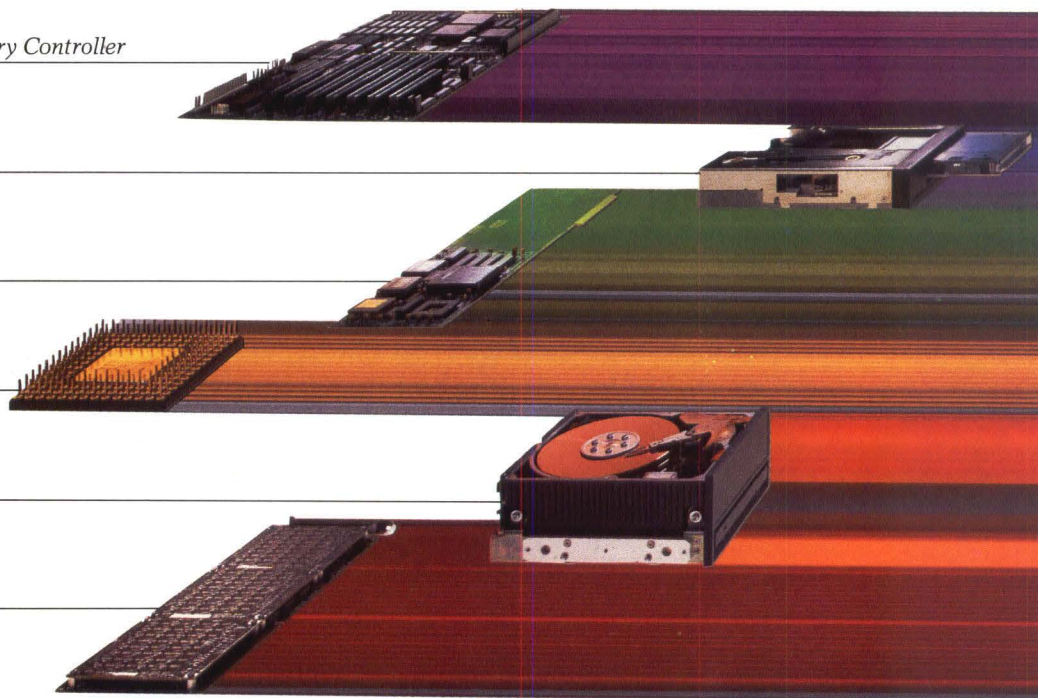
135-MB Tape Backup

Weitek Coprocessor Board

20-MHz 80386 processor

300-MB Fixed Disk Drive

16 MB of 32-bit RAM



The most powerful personal computer in the world

The COMPAQ DESKPRO 386/20 is an impressive 50% faster than 16-MHz 386-based personal computers. Even more impressive is the fact that it's up to 25% faster than other 20-MHz 386's. That's because the processor is just one small part of how the COMPAQ DESKPRO 386/20 outperforms every other PC

in the world today and even many minicomputers.

The big reason is the new COMPAQ Flexible Advanced Systems Architecture, which optimizes overall system throughput while maintaining full compatibility with industry-standard peripherals. It does this by combining an

advanced memory caching scheme with memory and peripheral buses that operate concurrently.

Complementing the speed of the microprocessor is the new advanced 20-MHz Intel® 82385 Cache Memory Controller. Like an efficient secretary that keeps frequently used information close at hand, it allows the microprocessor to operate at 0-wait states 95% of the time.

While one bus handles these high-speed operations, another *simultaneously* handles periph-

It simply works better.

how to get to 20 MHz, most out of 20 MHz.



erals operating at the industry-standard 8 MHz.

This flexible approach allows you to dramatically increase system throughput while preserving your investment in monitors, disk drives, and expansion boards. It can also accommodate today's and tomorrow's most advanced peripherals without constraining their performance.

Take options like our new Weitek™ Coprocessor Board. Never before offered in a PC, it can increase the speed of calculation-intensive, engineer-

ing and scientific applications by a factor of six, giving the COMPAQ DESKPRO 386/20 the performance of a dedicated engineering workstation at a fraction of the cost.

Compaq also provides 130- and 300-Megabyte Fixed Disk Drives with some of the industry's fastest access times. And when used with disk caching software, they represent the highest-performance storage subsystems available.

As for memory, Compaq offers 32-bit high-speed RAM.

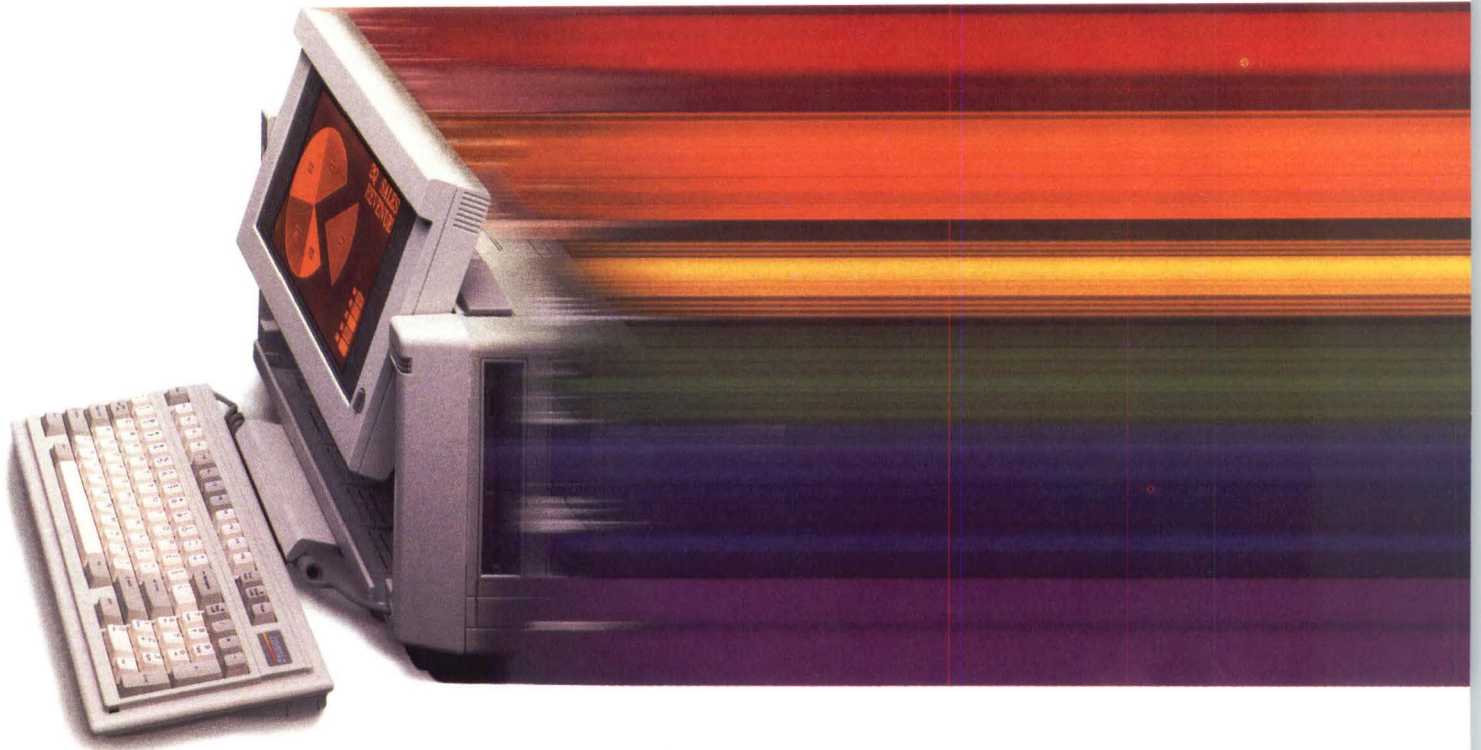
One full megabyte comes standard and is expandable to 16 megabytes without using an expansion slot. Plus, we included the COMPAQ Expanded Memory Manager. It supports the LIM standard so your software can break the 640-Kbyte barrier even before OS/2™ is released.

As tasks become more complex and users demand more advanced capabilities, Compaq responds by raising the standard of performance in personal computing.

COMPAQ

DESKPRO 386/20™

Everyone expected Compaq But no one



Pound for pound, it is the world's most powerful computer

Compaq has long been recognized as the world leader in both 80386 technology and portable computing. So it isn't surprising that we would combine the two.

But no one expected the new COMPAQ PORTABLE 386 to run at 20 MHz. And no one even

dreamed that it would offer 100 megabytes of storage, disk caching, and much, much more.

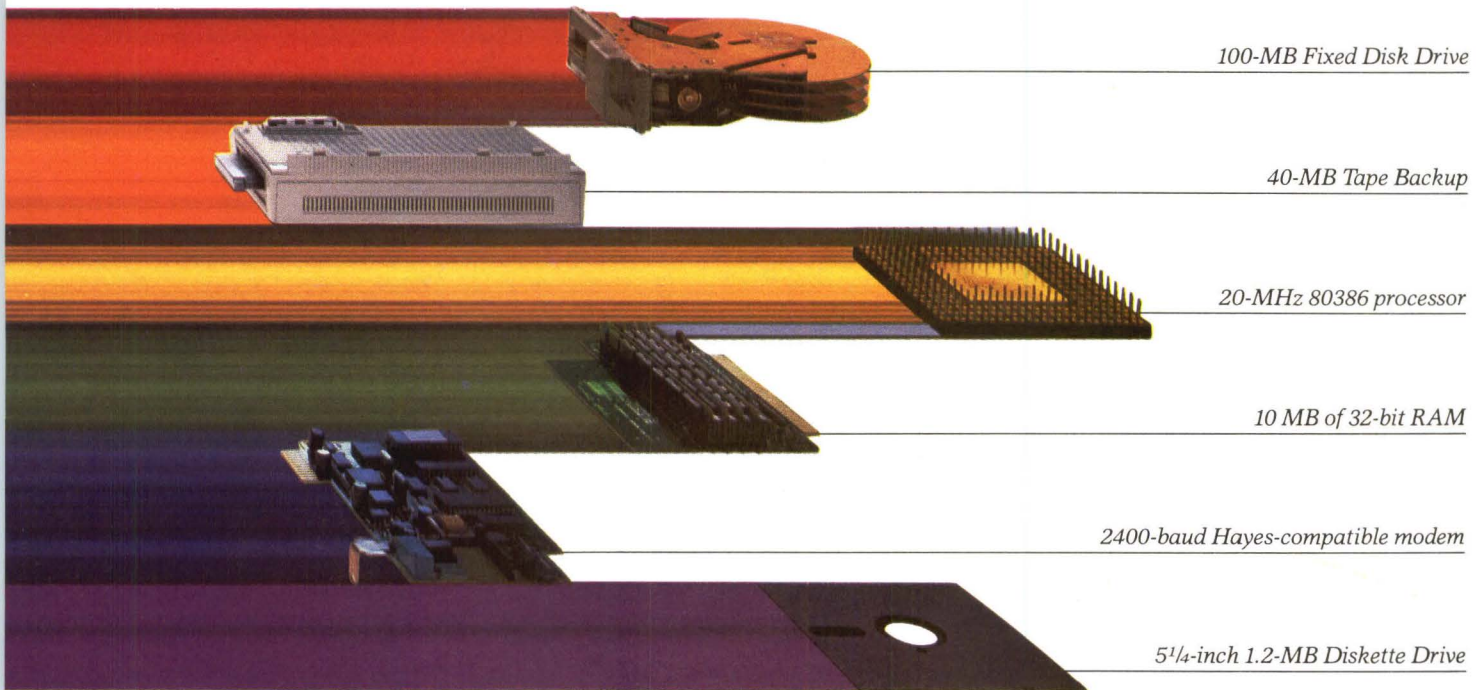
Our newest 20-lb. portable computer goes far beyond an 80386 microprocessor with a handle. It's not just the most advanced portable in the world.

Pound for pound, it's the world's most powerful computer. Period.

Like the recent COMPAQ PORTABLE III™ which changed the shape of full-function portable computing, the COMPAQ PORTABLE 386 makes no compromises. It offers more speed, memory, storage and features than any other portable PC. It runs your current software up to 25% faster than 16-MHz 386 PC's. Beyond that, its performance in calculation-intensive

It simply works better.

to introduce a 386 portable PC. expected all this.



100-MB Fixed Disk Drive

40-MB Tape Backup

20-MHz 80386 processor

10 MB of 32-bit RAM

2400-baud Hayes-compatible modem

5 1/4-inch 1.2-MB Diskette Drive

applications is increased even more when you add an optional 20-MHz 80387 coprocessor.

Memory? Get one megabyte of 32-bit, high-speed RAM standard or go as high as 10 MB internally. And like all of the COMPAQ 386-based PC's, it features the COMPAQ Expanded Memory Manager.

With our high-performance 100-megabyte internal fixed disk drive, you can actually fit 500 lbs. of data-filled pages into a 20-lb. PC,

unsurpassed storage for a portable. If that's too much for you, we also offer a 40-megabyte model.

We've become famous for building desktop computer capabilities into our portables without leaving anything out. The COMPAQ PORTABLE 386 is more proof. It has a high-resolution, 640 × 400, 10-inch plasma display; a full-size, portable enhanced keyboard; two industry-standard expansion slots in a lightweight, optional plug-on unit; a choice

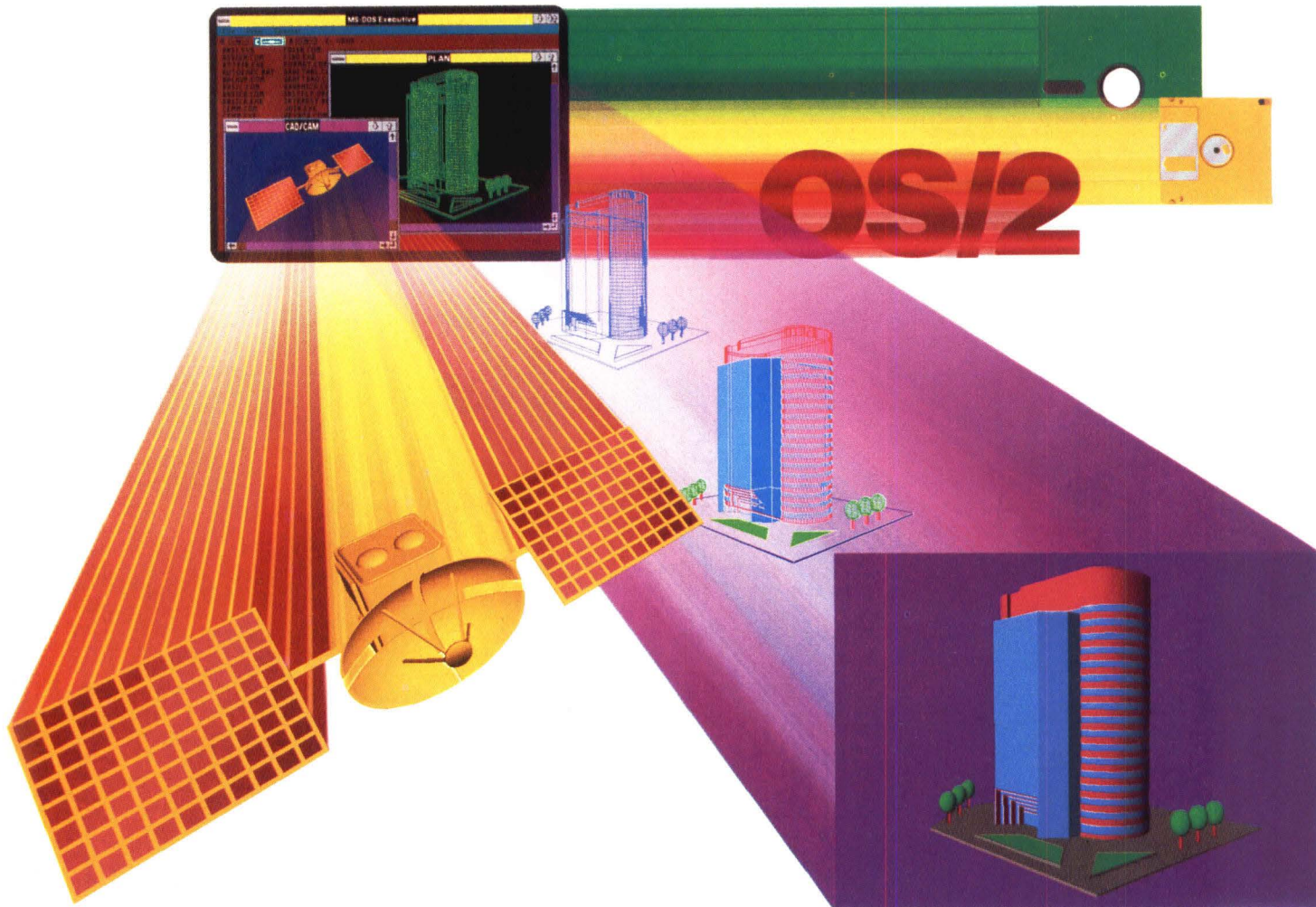
between an optional 2400- or 1200-baud Hayes[®]-compatible modem; a full-size 5 1/4-inch 1.2-MB diskette drive; even an optional 40-MB tape backup.

These features, combined with the ultimate in portable performance, make the COMPAQ PORTABLE 386 the *biggest PC this small.*

COMPAQ

PORTABLE 386™

Compaq moves you ahead without leaving you behind.



Compaq offers the most complete line of high-performance 386 solutions. They all run industry-standard software and hardware, protecting the investments you've already made.

At the same time you won't be left behind when other technologies become important. Multi-task with existing applications using Microsoft Windows/386 Presentation Manager. Add VGA

graphics if you wish. Run OS/2 when it's available. And now 3 1/2-inch drives are even an option for our desktops.

We optimize the most advanced technology while maintaining compatibility with the past, present and future. This makes COMPAQ PC's a wise decision for serious business users. Because at Compaq, we don't burn bridges, we build them.

See the COMPAQ DESKPRO 386/20 and COMPAQ PORTABLE 386 at an Authorized COMPAQ Computer Dealer. And from now through December 31, 1987, get Microsoft Windows/386 Presentation Manager *free* when you buy a 386-based COMPAQ computer. For more information, call 1-800-231-0900, Operator 40. In Canada, call 416-733-7876, Operator 40.

Weitek™, Lotus®, Intel®, Microsoft®, MS-DOS®, Hayes®, and OS/2™ are trademarks of their respective companies.
©1987 Compaq Computer Corporation.
All rights reserved.

COMPAQ®

It simply works better.



JOIN THE #1 VAR TEAM. Don't delay—the ball is in your court.


At COMDEX it was evident how fiercely competitive today's marketplace is. That's why you need Tandy—a seasoned pro—as your hardware vendor. Because Tandy's All-Star lineup of products, marketing and support can't be beat. With the Tandy Value-Added Resale Program, you'll get impressive features including industry standard products, full one year warranty on Tandy computers, competitive discounts and strong aftermarket service and support. It's a complete VAR program to give you a winning edge in selling against your competition.

A Super Game Plan

Tandy VARs have no annual volume commitment. Discounts are based on the number of computers ordered at one time. You'll receive additional discount points for leased orders and bonuses based on quarterly purchases. Our player's contract covers all computers, printers, accessories and supplies, and includes extra incentives for VARs who sell network and multiuser systems. A convenience buying option allows Tandy VARs to purchase selected accessory items from Radio Shack Computer Centers at a discount.

Take a Quick Time-out

If you didn't get to visit with the Tandy team at COMDEX, give us a call or return the coupon today. One of our team players will pass along more information on how your business can profit from the increased opportunities the Tandy VAR program offers.

 **Tandy Corporation**
Value-Added Resale
(817) 390-3099

MMS 12/87
**Send me more information on
Tandy's VAR Game Plan**

Dept. 88-A-577, 300 One Tandy Center
Fort Worth, Texas 76102

Name _____
Company _____
Address _____
City _____
State _____ Zip _____
Phone _____

CIRCLE NO. 30 ON INQUIRY CARD

ERASABLE OPTICAL DISKS: WHEN, WHAT . . . WHY?

System integrators face tough storage decisions—erasable optical disk drives are due by mid-1988, but competing technologies dim the once-bright optical promise

David Simpson, Senior Editor

The road to erasable optical disks has been fraught with wrong turns and false starts, but a handful of manufacturers will reach the finish line by the middle of next year. Consequently, system integrators who buy large volumes of storage devices can no longer ignore optical technology when planning future data storage hierarchies. However, a larger question looms on the horizon: Who needs them?

The slow progress of erasable optical technology has embarrassed industry pundits, stymied system integrators and forced a few early players into bankruptcy. However, in case you're still a non-believer, consider what a device with the following could do for your data storage strategy:

- A full 650M bytes in a 5¼-inch form factor
- Removable media
- An embedded small computer systems interface (SCSI), or an enhanced small device interface (ESDI), for easy attachment to a variety of hosts
- A 1M-byte-per-second burst transfer rate with a maximum sustained data rate of 510K bytes per second
- Expected OEM pricing (quantity 10,000) of about \$1,500, with end-user subsystem prices around \$4,500.

Sony's erasable optical disk drives include a SCSI interface.

Those specifications describe Sony Corp.'s new erasable optical disk drive. According to Jim Moore, account manager for the optical storage group, Sony is shipping limited quantities of engineering samples and plans production shipments by the second quarter of next year.

Sony, Sharp Corp. and Verbatim Corp. (in conjunction with its parent company, Eastman Kodak Co.) are the apparent front-runners in the race for commercially available erasable optical disk drives and media. Other companies expected to ship production volumes in 1988 include Olympus Optical Co. Ltd. (which uses media from 3M), Maxtor Corp. and Canon Inc. in Japan.

Slow access slows prospects

Other key specifications of the Sony drive include a 1,024-byte sector size, 18,750 tracks, 1,800 revolutions per minute (rpm) and an average access time of 120 msec. While the drive includes a SCSI interface, Sony will make an ESDI interface available if the OEM market demands it. Sample prices for the drive (including the controller) and media are \$6,600 and \$200, respectively.

Because of the initial high price, erasable optical disk drives will probably not find much acceptance in the personal computer market, at



least for a few years. "PCs won't be a big market [for 5¼-inch erasable optical disk drives] until the price comes down to, say, \$1,500," admits Moore. And the slow access times will probably prohibit the use of these drives in the mainframe arena. The drives' 120-msec average access times are a far cry from the sub-20-msec access times available with Winchester drives of similar capacities.

The most likely home for erasable optical disk drives, at least for the next few years, is in applications that do not require fast access times but do require high capacities, removable media and rewritability. Imaging and CAD/CAM jobs typically handled by engineering workstations are prime examples. In addition, government agencies and banks may opt for optical because of the data security advantages it offers.

Sony will ship hardware only. Supplying software, such as device drivers and retrieval packages, is up to the OEM or system integrator. However, that may not prove too difficult a task. Moore maintains that it's "not much harder than writing device drivers for magnetic disk drives" and would take a programmer a matter of weeks, at most, not months.

Bob Abraham, vice president of Freeman Associates, a data storage market research outfit in Santa Barbara, Calif., concurs: "Device

drivers are not a big job," he says, adding that the big integration job lies in evaluation and testing. "Large system integrators will go through a painfully long process of evaluation and testing," he says. Abraham expects initial erasable optical disk drives to find their way into new systems, and that Sun Microsystems Inc.-level machines are the most likely hosts.

'The check's in the mail'

Although Sony is expected to win the race for erasable, Sharp will most likely follow closely on Sony's heels with a 5¼-inch drive. Reports from the Tokyo Business Show last May, at which Sharp showed the drive, indicated the following: 211M bytes per side on double-sided media; 150-msec average access time; a burst recording data rate of 1.14M bits per second (bps) with a sustained data rate of 0.228M bps; a rotation rate of 900 rpm; and an embedded SCSI controller. The media is available now, and sample drives were scheduled for shipment last month for around \$7,000.

Sharp's magneto-optic media comprises a glass substrate, an aluminum-nitrite layer and an aluminum reflector layer, housed in a cartridge meeting International Standards Organization standards. Sharp will sell the drive to OEMs and will also separately sell magneto-optic heads and lasers.



Verbatim Corp. also will ship an erasable optical drive in 1988. Verbatim will manufacture both the media and drive and sell the media, while Kodak sells the drive.

The exact specifications were sketchy at press time, but sources at both Verbatim and Kodak confirmed the following: a 3½-inch drive using thermo-magneto-optic technology (see Diagram); capacity exceeding 50M bytes, but not more than 100M bytes; an average access time under 70 msec.; and a data transfer rate of more than 1M bps. The drive will come in a half-height form factor and will include either an ESDI or SCSI interface.

Those specifications represent the official line. Industry insiders, however, think the drive will hold 65M bytes and have a much more attractive average access time of 35 msec. Kodak/Verbatim officials would not confirm those specifications.

Kodak will sell the drive either as an OEM

unit or as a subsystem. According to Chandran Cheriyan, marketing manager for Verbatim's 3½-inch erasable program, the company will ship evaluation units in the second quarter, with production volumes due before the end of the year. Cheriyan says the drive will cost 25 percent to 50 percent more than Winchester with similar capacities. Kodak, a major player in the 12-inch and 14-inch write-once optical arena, has no plans for a 5¼-inch drive.

The comparatively low capacity of the Kodak drive leads many potential buyers to wonder what its advantages are relative to standard 3½-inch Winchesters. "The main advantage," says Cheriyan, "is removability, and that the data can be locked up." Cheriyan adds that removable Winchesters—potential competition for erasable optical disk drives—have experienced reliability problems that have stalled acceptance.

One of the major technological debates in the

Write-once optical drives crawl toward standards

CDROM (compact disk ROM) technology is fairly well-established and looking for applications, while erasable optical disk drives are floundering between hype and hope. Overall, optical write-once technology is healthy but hardly free of controversy. Much of the action centers on the 5¼-inch form factor.

The 5¼-inch write-once market is mired in a miasma of controversy concerning standards. Three bodies are at work on the problem—ANSI, ECMA (European Computer Manufacturers Association) and ISO (International Standards Organization)—but it's unclear if or when consensus will arrive.

One of the major debates centers on recording format; specifically, the servo format for tracking. Until IBM Corp. announced the Model 3363 write-once optical drive with its PS/2 systems last April, there were two dominant methods: sampled servo and continuous composite servo. IBM's 3363 threw a wrench in the works by not conforming to either, thus establishing a third possible standard. Reportedly, IBM has already shipped over 10,000 3363s, which are manufactured by Matsushita Ltd. in Japan. On the other hand, it is generally acknowledged that the 3363 is over two years old from a technology standpoint. This might prompt the company to introduce a completely different drive in the near future, possibly one that complies with ANSI standards—if they exist.

Of the two non-IBM servo methods, continuous composite is currently the more popular. The big question for system integrators is whether to wait for standards or to buy now.

The advantages and disadvantages of each of the methods are acrimoniously debated in ANSI committees. Currently, both approaches are de facto

standards. But media interchangeability requires a single standard. Resolution of the controversy is not expected before the first quarter of next year, and many observers don't think it will happen that quickly. Quite possibly, the two standards will survive.

Standards help optical drives

Despite the controversy, it's important to note that, because of the applications that write-once drives are being used for, standards may not be that important. Few users need interchangeability except, perhaps, within their own company. Hank Meyer, manager of product line management at Maxtor Corp., says: "Very few customers are pressing for interchangeability. Standards are much more key to erasable optical disk drives, where interchangeability is more important." Meyer explains that most of his company's write-once drives (which are manufactured by Ricoh Ltd. in Japan) are being used strictly as archival backup units.

Jeff Dulude, vice president of marketing at Optotech Inc., another major manufacturer of 5¼-inch write-once drives, agrees: "Users don't really care about interchangeability," he says, adding, however, that it will become more important as write-once drives go beyond their current applications. Dulude says that most of Optotech's drives are used for archival storage, with a much smaller percentage being used for image processing, and data collection and distribution. The devices replace microfilm or microfiche and, to a lesser degree, tape drives.

A recent report on the Japanese market revealed that twice as many optical disk users cited high cost and lack of rewritability as their primary reasons for dissatisfaction as did those citing incompatibility and

erasable optical field revolves around magneto-optic vs. phase-change recording. (Kodak's thermo-magneto-optic recording is essentially synonymous with magneto-optic recording.)

Magneto-optic recording combines the heating effect of a laser with the magnetic properties of a ferromagnetic recording layer. The laser raises the temperature of the recording layer above the Curie temperature so that the applied magnetic field can set up magnetic domains representing 1s and zeros. To read the data, an incident beam of polarized light is rotated on the basis of magnetic orientation. By taking advantage of the Kerr effect, a polarized analyzer in the read head distinguishes between polarities.

One drawback to magneto-optic recording is that it currently requires two revolutions to overwrite data—one to erase and one to write. This in turn slows down write-transfer rates. Nevertheless, magneto-optic technology is con-

sidered to be more promising than phase-change recording, and enjoys more proponents among those companies planning erasable optical disk drives. In fact, Ed Rothchild, president of Rothchild Consultants, a San Francisco research company specializing in the optical disk market, contends that magneto-optic will be the only type of erasable disk technology available for the next two and a half years.

However, not everyone agrees. For example, Panasonic Technologies Inc., a U.S. division of Matsushita Electrical Industrial Co. in Japan, is currently working on both phase-change and magneto-optic products. Tony Jasionowski, manager of memory products at Panasonic, is not convinced that magneto-optic recording will necessarily be the way to go.

For one thing, Jasionowski contends, if both phase-change and magneto-optic media use plastic substrates, phase-change media will have longer life spans. The difference may be

insufficient capacity. The report was prepared by ODS Corp. in Japan and is available in the U.S. from InfoCorp, a market research company in Cupertino, Calif.

Products in the 5¼-inch write-once category vary widely. Capacities range from 200M bytes on IBM's 3363 to 800M bytes (400M per side) on drives from Maxtor and Laserdrive Ltd. Optotech and ISI (Information Storage Inc.) are other major suppliers. Most vendors offer IBM PC or SCSI interfaces, and some sell versions for specific workstations.

Other form factors for write-once drives include the 3½-, 8-, 12- and 14-inch. As yet, there is little activity and no products in the 3½-inch size, although industry convergence on that form factor for flexible and rigid disk drives could spur increased development efforts over the next year.

There are no major U.S. manufacturers of 8-inch write-once optical drives, and analysts agree that it's a dying form factor. However, it may be kept alive because of shipments by Japanese manufacturers to captive markets.

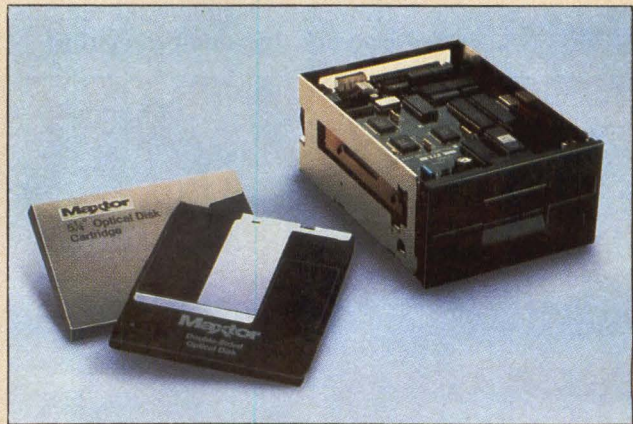
The 12-inch write-once drives are the granddaddies of optical storage, representing the largest revenue percentage of the total market. There are no standards for this class of drive, and most observers think that the market has progressed too far for any standards to develop. Capacities of 12-inch drives generally are in the 2G- to 3G-byte range.

The fastest growing application for large optical disks is in full-scale image- and document-processing systems, where sophisticated data-retrieval software and jukebox configurations are key distinctions among systems.

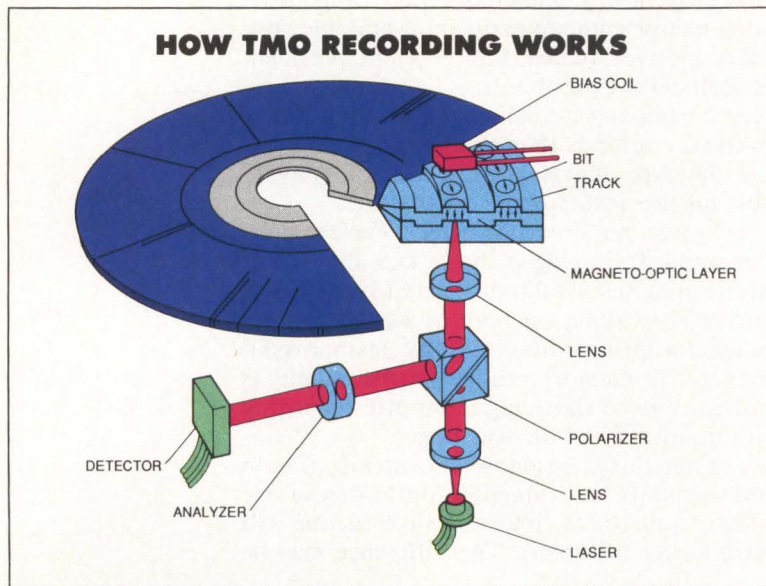
Although most high-end activity revolves around

12-inch drives, Eastman Kodak Co.'s 14-inch drive, which the company integrates into large document-processing systems, has been well-received. The drive holds 3.4G bytes per disk surface. Kodak sells the drive to end users or OEMs.

Rothchild Consultants of San Francisco estimates 1987 shipments of 5¼-inch write-once optical drives at around 25,000 units and those of 12-inch optical write-once drives at about 12,000. Similarly, Freeman Associates of Santa Barbara, Calif., which tracks the market by capacity categories, pegs 1987 shipments of under-1G-byte write-once drives (almost all of which are 5¼-inch units) at 26,000; and over-1G-byte write-once drives (including 8-, 12- and 14-inch units) at 23,000.



Maxtor's RXT-800S offers 400M bytes on both sides of a 5¼-inch disk for document storage and retrieval archival backup applications.



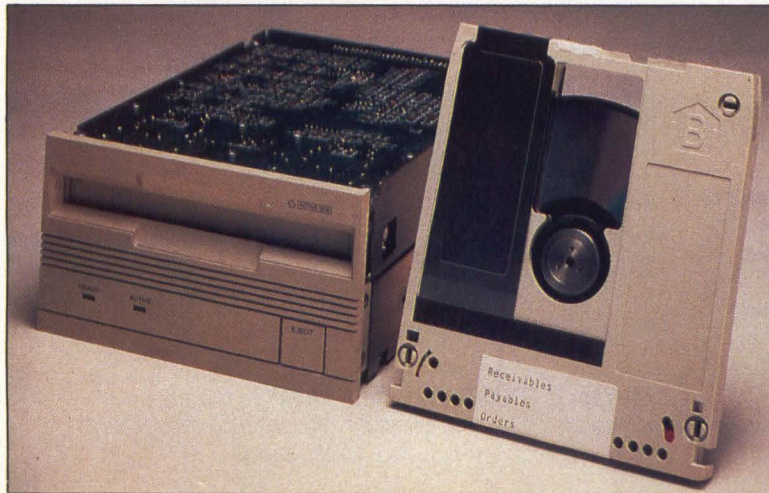
minimal where glass is the substrate, but glass substrates cost more. They also are weightier, thereby requiring more power to rotate the disk.

Another advantage of phase-change media is the ability to do single-beam (one laser diode) overwriting, compared to the more conventional two-diode technique. This increases speed and decreases the drive cost. Single-beam overwriting is possible with magneto-optic media, too, but development of this approach is behind that with phase-change media.

In addition, the CNR (carrier-to-noise ratio) of phase-change media is higher. "The CNR of magneto-optic heads tends not to be as good, because it uses a Kerr rotation angle that is very slight, so you have to compensate for that by amplifying the signal," explains Jasionowski.

However, Jasionowski admits that the cyclability (the number of times you can re-

Packing 810M bytes, *Laser-drive's 5¼-inch write-once optical drive, the model 810, includes Winchester emulation software in its embedded SCSI controller.*



In thermo-magneto-optic technology, an optical head writes on the disk by focusing a laser beam on a magneto-optic recording layer while, opposite, a bias coil exerts a magnetic field. The absorbed light heats the layer's film at the point of focus, lowering the coercivity at that spot. This permits the bias field to magnetize that region of the disk.

write or erase on a disk) of magneto-optic recording is better. With phase-change, there is a limit, usually specified at about 1 million cycles. But Jasionowski adds that 1 million cycles is perfectly adequate for most personal computer environments and, in fact, may exceed the life of the product anyway.

Panasonic Technologies, in concert with its parent Matsushita, will field an erasable optical disk drive "within a year of making the decision on whether to go with phase-change or magneto-optic recording," according to Jasionowski.

Who needs it?

Not everyone is greeting the arrival of erasable optical disk drives, or for that matter write-once optical drives, with enthusiasm. Beyond the technological issues looms the ultimate, nagging question: Who needs them?

"For erasable optical disk drives to succeed, they have to be low-cost enough to displace tape or high-performance enough to replace Winchesters," says Jeff Dulude, vice president of marketing at Optotech Inc., a major producer of 5¼-inch write-once drives. Given the initial specifications of erasable optical disk drives, they have a long way to go to achieve either goal. Access times are far slower than those of Winchesters, thus making them unsuitable for high-speed transaction database applications. Also, erasable optical disk drives cost much more than tape drives, and their transfer rates are slower than those of streaming-tape drives.

The major reason for the slow access times of optical drives is the large size and mass of the read/write head, which requires a lot of energy to move. To decrease access times, manufacturers will have to decrease the mass of the read/write head, and software companies will have to develop operating system modules that improve data organization on the disk. On the other hand, although slow compared to magnetic disks, optical disks offer vast improvements over microfilm or paper.

The key advantage of erasable optical disk drives is removability, a characteristic shared

Write with light.

Now you can add 5¼" optical storage to SUN, microVAX, IBM PCs, PS/2, and Macintosh in less than an hour.

That beats the installation time for many hard disks. And it's possible because Optotech's subsystems come complete. Drives... controllers... drivers... documentation. The works. And they're ready to work with existing software.

There's even a fast answer for adding optical storage to other micros and minis... our SCSI controller and software toolkit.

Start cashing in on the huge demand for optical storage. Optotech makes integration so easy, there's no reason to wait. Think of the millions of computer installations in CAD archival storage... imaging and graphics... document storage... data distribution... data collection... and more. Optical is the perfect storage solution. Because it combines hard-disk convenience with data permanence and media removability... which means unlimited capacity on a miser's budget.

Let your imagination go. Think of the opportunities optical storage opens up with removable 400-megabyte cartridges. Fast, random access. Unmatched data security. Easy data distribution. Inherent data backup. And mag tape cost... with more than three times the data life.

Why wait? Your customers want optical storage today. And Optotech is the number one choice. We have more drivers for more machines than anyone else. And the fastest transfer rates, thanks to proprietary direct-read-during-write technology. We've shipped thousands of optical drives since 1985. And have become the world's largest OEM supplier.

So don't wait for the competition to take the optical orders. Write with light. And write them yourself.



Optotech, Inc.

Bringing your data to light

Trademark owners: SUN, Sun Microsystems;
microVAX, Digital Equipment Corp.;
IBM, PC, PS/2, International Business Machines Corp.;
Macintosh, Apple Computer Inc.

**Call 1-800-OPTICAL, extension 103,
for more information.**

740 Wooten Road, Colorado Springs, CO 80915, 303-570-7500

CIRCLE NO. 31 ON INQUIRY CARD

087107



by one of the technologies that it is supposedly going to replace: quarter-inch and half-inch tape drives. On the other hand, because they use sequential rather than random access, tape drives provide much slower data access times than optical drives.

Rothchild expects the first generation of erasable optical disk drives to be used as backup units for Winchesters. Thus, the optical drives will be competing with streaming tape drives. As optical disk manufacturers decrease the mass of the heads (from their current 50 to 130 grams to, say, under 10 grams), erasable optical

disk drives will compete head-on with Winchesters. Rothchild expects that to happen in about three years.

Adding to the confusion is imminent competition from the two new kids on the data storage block: helical scan recording and vertical recording.

Helical scan expands options

Helical scan refers to the way in which magnetic tape is wrapped around the drum upon which the recording heads are mounted. Rather than being passed across a stationary recording

Integrating software for optical disk drives

Brian A. Berg, Berg Software Design

Most optical disk drives on the market today use the small computer system interface (SCSI). As a result, the support software typically includes a SCSI interrupt handler. This low-level piece of software can be used for any type of device on the SCSI bus (i.e., magnetic tape or disk drives as well as optical drives).

A key feature of the SCSI architecture is that all of these devices can reside on the same bus, using a single host adapter. Portions of the software that issue SCSI commands and handle the return status from a device can also be common code for other devices that use the SCSI common command set.

The software that harnesses the device-driver code must deal with the write-once nature of the drive and media. The write-once characteristic results in defects being detected only when the user writes on the media. Thus, one of the requirements of a reliable write-once system is a way to verify data after it has been written. Some drives use a technique called "direct read during write" (DRDW) to verify each bit immediately after it has been written. In contrast, drives that do not use this technique require additional drive software to verify data. This process involves rotational latencies and often negatively affects data throughput while writing.

When formatting data on a write-once disk, there are two critical decisions to make. First, the logical format to be supported on the disk must be determined. It may be a standard file system such as UNIX or MS-DOS, a customized file system, or the logical format proposed by the ANSI X3B11 committee. Next, the manner in which data is added and updated must be defined.

A common technique for updating data involves writing from each end of the disk. Data sectors and sectors containing file pointers are written sequentially, starting at the beginning of the disk. The addresses of the current file pointers are periodically rewritten reverse-sequentially from the end of the

disk. Locating the most current file pointers is accomplished by taking advantage of a special characteristic of write-once media—the ability to distinguish written sectors from unwritten sectors. Due to this characteristic, a written sector that follows an unwritten area near the end of the disk will contain the latest set of file pointers.

The file pointers can be located at a later time by using a binary search algorithm or a backward "leap-frog" algorithm. The latter would search for an unwritten area near the end of the disk by trying to read the first sector of each track. It would start with the last track on the disk and continue backward until an unwritten sector is found. It would then search forward for the first written sector.

A possible trend in second-generation write-once drives is to embed this technique into the controller firmware, within the drive. The benefit of this would be the complete transparency of the write-once nature of the system. However, many current applications for write-once systems use this characteristic to their advantage (e.g., to guarantee that data written will always be available). Hence, this sort of second-generation write-once system would not be desirable in such an application.

This technique for updating data is only applicable to write-once systems, because erasable optical media needn't differ in logical format from magnetic media. Erasable optical systems require an initial pass over the media to complete an erase-before-write cycle, a step that is handled by firmware embedded in the drive. Therefore, software development for erasable systems should be much simpler than that for write-once systems.

Brian A. Berg is a software design consultant with Berg Software Design, Sunnyvale, Calif. He has been involved with four write-once optical implementations during the last three years, including the recently announced LD-510 drive from Laser Magnetic Storage International (LMS).

Only one
company has
the technology,
the resources,
and the vision
to top the
68020.



MOTOROLA



Introducing the 68030.

The next generation.

In 1984, we introduced the 68020. Now, three years later, it has the largest installed and broadest application base of any 32-bit MPU on the market. Having set that standard in the first place, we feel qualified to raise it. Which is why the only microprocessor that really surpasses the 68020 is our second generation 68030.

Meet the *Oh thirty!*

The '030 is twice the microprocessor its predecessor is. It's the first to sport an instruction cache, data cache and MMU on-chip. Combined with a Harvard-style parallel bus architecture that allows simultaneous, multiple fetches of instructions and data, processor throughput is pushed to unmatched levels.

What can you do with all that performance? Anything you like—from low-cost personal workstations to super-computers—and the 68030 will help you to do it less expensively.

With its burst fill mode for the dual caches, you'll be able to squeeze SRAM performance from low-cost DRAMs. It gives you graphics capability without the need for a graphics co-processor. And there's true object-code compatibility between the '030 and the '020. All this adds up to economies you can count on.

An architecture you can build on. And count on.

Application software that runs on any 68000 family MPU runs on the 68030. There's also a full array of development tools, and a new 68882 floating point co-processor, with up to 4x the performance of its predecessor. All of which gives your product plans an enormous amount of continuity. And that's not going to change. Since the 68030 supports both MS-DOS™ and UNIX® V.3, you can have your pick of over \$12 billion worth of applications—and the broadest possible market.

With Motorola, you can see forever.

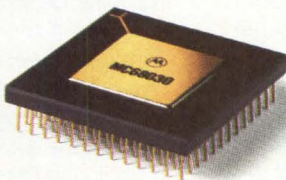
Our plans for the rest of the 68000 family extend well into the future, offering continuing compatibility and leading-edge performance. So you can go with Motorola, not just for what our microprocessors can do now, but what you'll be able to do with them later on.

For more information about the new 68030, call us toll-free at 800-521-6274 or write, Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036.

We're
on your
design-in
team.



MOTOROLA



To: Motorola Semiconductor Products, Inc.
P.O. Box 20912, Phoenix, AZ 85036

345MMS120087

Please send more information on the *Oh thirty!*

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Call me (_____) _____



head, the tape is wrapped in a helical fashion around a rotating drum, much as tape would wrap around an ice cream cone. Data is recorded in "stripes" at an angle to the horizontal plane of the tape.

Three standards for helical scan media exist: 8 mm, VHS (video home system) and DAT (digital audio tape), each of which are derived from consumer markets.

The main advantage of helical scan tape recording is increased data density (see "Helical-scan recording expands tape capacity"). Also, because of its consumer origins, the media and drives are relatively inexpensive.

One of the first commercially available tape drives using helical scan technology was Emerald Systems Corp.'s VAST (virtual archive storage technology) Device, introduced in September. The \$6,995 VAST Device packs 2.2G bytes in a 5¼-inch disk drive using audiocassette-size cartridges. The major OEM supplier of helical scan drives is Exabyte Corp.

Although helical scan drives use sequential access (as opposed to the much faster random access of optical and Winchester drives), that is not a drawback in strictly archival applications, where data is infrequently accessed. Michael Harris, product manager at Emerald Systems, expects the VAST Device to be used primarily in archival applications. Harris adds that helical scan drives will have faster throughput rates than will erasable optical disk drives. Emerald began production shipments of the drives last month.

Another advantage of helical scan tape drives is cost. The 2.2G-byte cassettes for the VAST drive cost \$40, or about 2 cents per megabyte.

Although helical scan technology would appear to be a logical competitor to erasable optical disk technology, that may not be the case. For example, Lee Elizer, president of Peripheral Strategies Inc., a Santa Barbara, Calif., market research company specializing in data storage, thinks that the two technologies

Test equipment tracks optical media quality, performance

Ben Carter

California Peripherals Corp. (CaliPer)

The data storage industry used to wonder whether it could achieve low enough error rates for optical media. Not any longer.

The quality of 5¼-inch (130-mm) write-once media has stabilized, and the industry is working on erasable media. In addition, 3½-inch (89-mm) media in both write-once and erasable versions is already in the development stage. Further, the cost per megabyte of optical disk storage is low enough to allow the incorporation of powerful error-correction codes. These codes reduce the error rates of optical media to levels below those of both Winchester disk and magnetic-tape devices.

California Peripherals Corp. (CaliPer) has seen proof of these quality advances from companies that analyze their optical media with CaliPer test systems. These are manufactured and marketed under license from the Nakamichi Corp., Japan. CaliPer's test equipment can currently evaluate more than 15 parameters of optical media quality and performance, on a sector-by-sector or track-by-track basis, at spindle rotation speeds of up to 3,600 revolutions per minute. These parameters can be tested in a variety of combinations to analyze mechanical, electrical and optical characteristics.

Mechanical test parameters include disk warp and tilt, and the rate and speed of both axial and radial deviation (which affect the laser's ability to stay in focus). Electrical test parameters include defect mapping and signal-to-noise ratio (which affects data

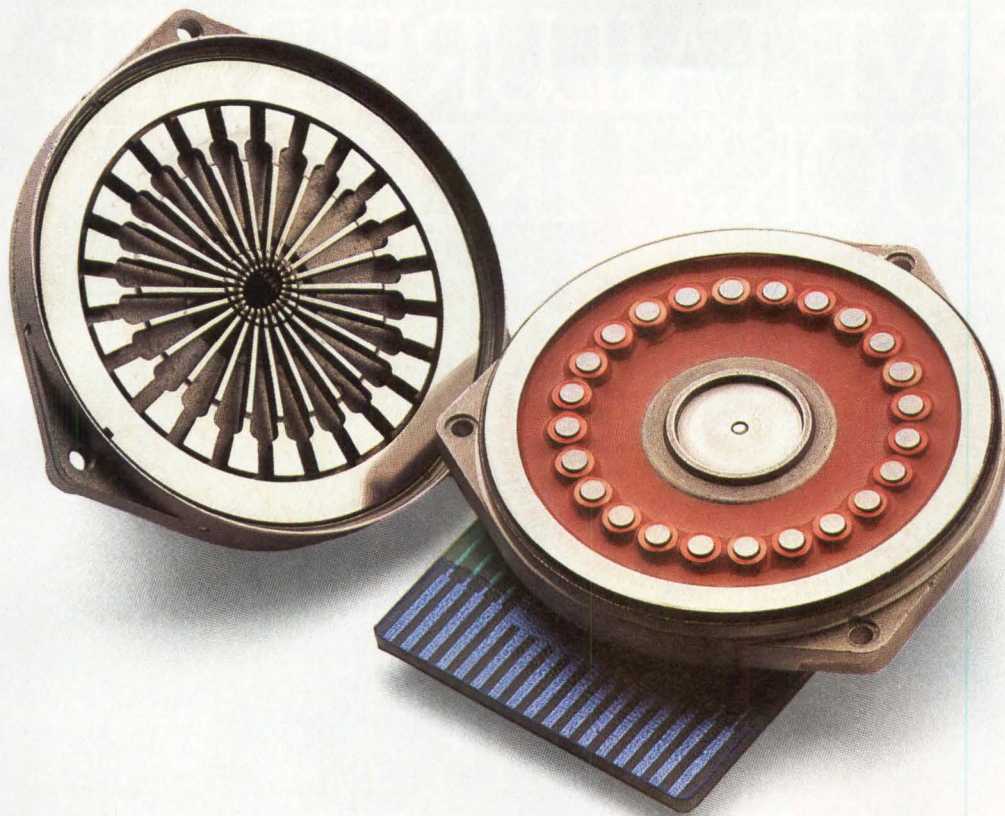
detection). Optical parameters include read, write and erase performance, plus the affect of protective coating and associated stresses on the transmission of given laser frequencies.

With more than a dozen manufacturers expected to ship magneto-optic erasable media by the end of 1988, accurate optical test parameters will become increasingly important.

One critical concern is the difference between laser power needed for write operations as compared to that needed for read operations. Write-once drive manufacturers need only care about read power, but magneto-optic erasable drive manufacturers must worry about both. And, because too much power during the read operation can erase data and shorten the life of the laser diode, precise test capabilities are critical.

Another challenge facing both write-once and erasable optical drive development is the need for test-parameter standardization. Currently, there is only a handful of test equipment suppliers, but de facto standards have developed. In addition, the ANSI X3B11 committee has established an initial four-part standards document, which was submitted to the International Standards Organization in October. In compliance with the ANSI document, leading test equipment manufacturers are working with media vendors to ensure that media is interchangeable between drives from various manufacturers.

Ben Carter is the marketing manager for optical products at California Peripherals Corp. (CaliPer), Torrance, Calif.



HEADS UP, JAPAN.

Above you see the most ingenious printhead developed in years.

It's a new stored-energy head that uses less energy and delivers more speed than traditional ballistic printheads.

And according to *Infoworld**, delivers constantly superior print quality, with letter quality comparable to a laser.

You'll find this printhead, with its seven patents on design, materials, and production process, only on Mannesmann Tally's newest family of printers. Including the 24-needle MT330 word processing printer, a 10,000 page-per-month, 300 cps printer. And

the 18-needle MT340 data processing and industrial graphics printer, a 13,000 page-per-month, 400 cps machine.

We invite you to compare either of these heavy-duty printers to their Japanese counterparts.

Because head to head, we win.

And body to body? Again from *Infoworld*: "...most plastic and metal components appear quite a bit sturdier than their Japanese equivalents."

Again, bad news for Japan. But very good news for you.

To take advantage of this news at a pleasantly surprising

price, call the number below for the name of your nearest dealer.



MT340

MT330 with optional dual bin sheet feeder

MANNESMANN
TALLY

800-843-1347 Ext. 32

In Washington state, call:
206-251-5524 Ext. 32

**Infoworld*, July 6, 1987

FOR MORE INFORMATION, CIRCLE 32

HERE'S WHAT OUR DISK DRIVE FAILURE RATE LOOKS LIKE,



**ONLY ONE OUT OF TEN NEC DRIVES WILL
FAIL IN THEIR LIFETIME.**

NEC has the lowest failure rate in the business. During the average lifetime of an NEC drive, only one out of ten will ever fail.

The best our competition can offer is two out of ten. So if you use their drives, you'd better keep your fingers crossed.

Our new 9" drive makes us look even better. Its MTBF rate is 50,000 POH. The highest rating for any disk drive currently available.

How do NEC drives get to be more reliable? It starts with the design. We test the design using *computer models*. We also test every component for reliability. Then each drive is dropped, heated, frozen, doused and violently shaken. In production we burn-in every drive for up to 48 hours. At 120° F.

Testing like this also allows us to guarantee the lowest DOA rate you'll find: 1%. And we'll put it in writing.

Higher reliability is not the only thing you can depend on with NEC. You'll also get solid support with a hotline to our plant for instant technical answers.

COMPARED TO THE COMPETITION.

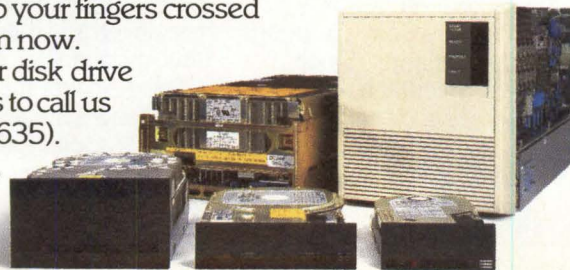


NEC has been coming through with reliable drives for over 25 years. Today we're a \$15 billion company with sales worldwide. So you won't have to keep your fingers crossed that we'll still be in business a year from now.

If you're not getting all this from your disk drive supplier, it's time you used your fingers to call us at 1-800-343-4418 (in MA 617-264-8635).

Or write: NEC Information Systems, Dept. 1610, 1414 Massachusetts Ave., Boxborough, MA 01719.

C&C Computers and Communications



CIRCLE NO. 38 ON INQUIRY CARD

NEC DISK DRIVES.
RELIABILITY
RUNS IN THE FAMILY.

NEC

NEC Information Systems, Inc.



can coexist. Elizer states: The two technologies won't compete for the same applications, because 8 mm and DDAT (data DAT) capacities will be much higher than those of erasable optical products and because of the random vs. sequential addressing trade-off. Elizer adds that the big unknown at this point is pricing.

The primary application areas for helical scan products, according to Elizer, are archival storage, fixed-disk backup and data distribution.

Although media standards are fairly well established, the industry still has to settle on recording formats and interfaces before it can achieve media interchangeability. And that isn't likely to happen before late 1988 or early 1989. Most probably, standards for both 3½-inch and 5¼-inch erasable optical disk drives will arrive before standards for helical scan products.

Ups and downs of vertical recording

In vertical recording, magnetic particles are oriented perpendicularly to the plane of the media, rather than horizontally as in conventional magnetic recording. Although the advent

of vertical recording drives has been trumpeted for almost as long as erasable optical disk drives, products now appear to be on the verge of coming to market.

Commercially available drives using vertical recording will start to appear next year. Expected capacities are 1.8G bytes for 8-inch drives; 1.2G bytes for 5¼-inch drives; and 120M bytes for 3½-inch drives.

The vast capacities and random access of vertical recording drives could pose formidable competition for erasable optical disk drives. However, for applications where removability is a prime concern, optical disks may be the better solution. And many early participants in vertical recording for rigid disks have dropped out of the race, thus casting doubt on the availability time frames cited by the few current participants.

The drawbacks to erasable optical disk drives seem formidable, at least for the time being, and will give system integrators good reason to hesitate before embracing the new technology. However, few industry participants doubt that erasable optical disks will eventually earn a

CDROM standards: the making of High Sierra

Two years ago, a lack of standards was bugging the compact disk ROM (CDROM) industry. That lack was a critical threat to business, vendors said. They couldn't make volume sales without standards.

Today, nobody worries much about standards. And business is starting to boom. While U.S. shipments of CDROMs this year will total just 30,000 drives, valued at \$20.7 million, in 1991 they should total more than 1 million drives, valued at \$168 million. That's according to Venture Development Corp., a market research concern in Natick, Mass.

"I think it's amazing that we've come as far as we have with standards for CDROM in the short time they've been around," says Bill Zoellick, vice president at Avalanche Development Co., Boulder, Colo. "The industry has done pretty well in getting its house in order."

How did the CDROM people do it? A bunch of them invented the High Sierra Group, that's how.

In mid 1985, CDROM vendors had no standards at all. They did have the "Yellow Book"—a set of specifications for the disks put out by Sony Corp. of Japan and N.V. Philips of The Netherlands. Since those two companies license the manufacture of CDROM disks, the Yellow Book was a de facto physical standard.

For example, it set the diameter of the disk (12 centimeters); the amount of information in a data

block (2,352 bytes, of which 2,048 are user data); the use of a spiral track; a formula for error correction; and a mode for sector-by-sector addressing.

Lacking was a file-management standard. That's a common directory structure and a file format for converting the disk from a collection of sectors with data into a collection of files.

Typical were stories of users needing drives from different manufacturers to read different CDROM disks. "Imagine if you had that situation with floppy disks," says a vendor who was around in those days. "It was killing us."

But, the vendors faced the elephantine pace typical of standards-writing organizations, like the ANSI. In writing standards, says Paul Peters, systems coordinator at the New York Public Library, "ANSI is not that interested in making it a timely process."

No vacation from standards

So, a group of U.S. CDROM vendors decided to throw caution to the wind (there are anti-trust law risks involved when vendors get together) and write a draft proposal for a file-management standard.

For their first meeting, in August 1985, they picked Lake Tahoe, a California resort. "It sounded like an interesting place to go in August," says John Einberger, vice president of software development at Reference Technology Inc., Boulder, Colo., and one of

MAGNETO-OPTIC SPEC SUMMARY

	Sony	Sharp	Kodak/Verbatim
Disk diameter (inches)	5¼	5¼	3½
Capacity (M bytes)	650 (325 per side)	422 (211 per side)	>50
Sector size (bytes)	1,024	1,024	N/A
Average access time (msec)	120	150	<70
Number of tracks	18,750	18,750	N/A
Rotation speed (rpm)	1,800	900	N/A
Transfer rate (M bytes per sec.)	1	max: 2.4; effective: 0.150	>0.125
Data rate (K bytes per sec.)	510	burst: 142; sustained 28	N/A
Interface	SCSI	SCSI	SCSI, maybe ESDI
Availability	samples: 4Q '87; production: 2Q '88	samples: 4Q '87; production: 2Q '88	samples: 2Q '88; production: 4Q '88
Sample price	drive: \$6,600; media: \$200	drive: \$7,000; media: N/A	N/A

Source: Mini-Micro Systems

permanent place in the data storage hierarchy.

Big three poised to enter

Underscoring its importance, IBM Corp. (at its Tucson, Ariz., facility), Digital Equipment Corp. (in Shrewsbury, Mass.) and Hewlett-Packard Co. (in Boise, Idaho) have all set up

internal R&D units for erasable optical disk drives. In fact, industry insiders have reason to believe that IBM will introduce a magneto-optic erasable drive in 1988, although it's unclear whether it will be manufactured in Tucson, Japan, or both.

Although these companies may eventually

the organizers of the meeting.

They became the High Sierra Group (named for the hotel where they met). After six more meetings over the next nine months, the group had a draft proposal, which it submitted to the National Information Standards Organization (NISO) in the U.S. and to the European Computer Manufacturers Association (ECMA). That done, still mindful of the anti-trust risk, the High Sierra Group disbanded.

The file-management standard, still about 95 percent the original High Sierra proposal, is nearing approval by the International Standards Organization.

That's a sprint from no standards to an international standard in a little more than two years.

Einberger uses an analogy to explain CDROM standards: "Think of the Yellow Book as saying, 'We're going to write on paper, the paper is going to be 8½ by 11 [inches] and we're going to have lines on it.' It doesn't tell you how to write on the paper." What the High Sierra Group did was to say, "In order that somebody can read this piece of paper, we're going to suggest that when you write on it you ought to start in the upper left hand corner and write across."

Standards may not be the burning issue in the CDROM world today, but there still are problems to solve. One revolves around disk cartridges and the other around retrieval software.

Half-height CDROM drives, now coming on the market, require cartridges to protect the disks in the cramped quarters. In Japan, vendors appear to be adopting Sony's version of the cartridge. But, in Europe, Sony's old partner, Philips, seems to be working on another version.

"It's odd, isn't it?" asks Einberger. "You'd have thought they would have seen this coming years ago and would have figured out how to solve it." In any event, he says, "there's a fair amount of stirring of the pot right now to try to standardize on the cartridge." But no standards body is working on the issue.

Vendors are engaged in a heated argument about standards for retrieval software. The argument is about what to standardize: the file indexes on the disk, the retrieval engine, the user interface or something else.

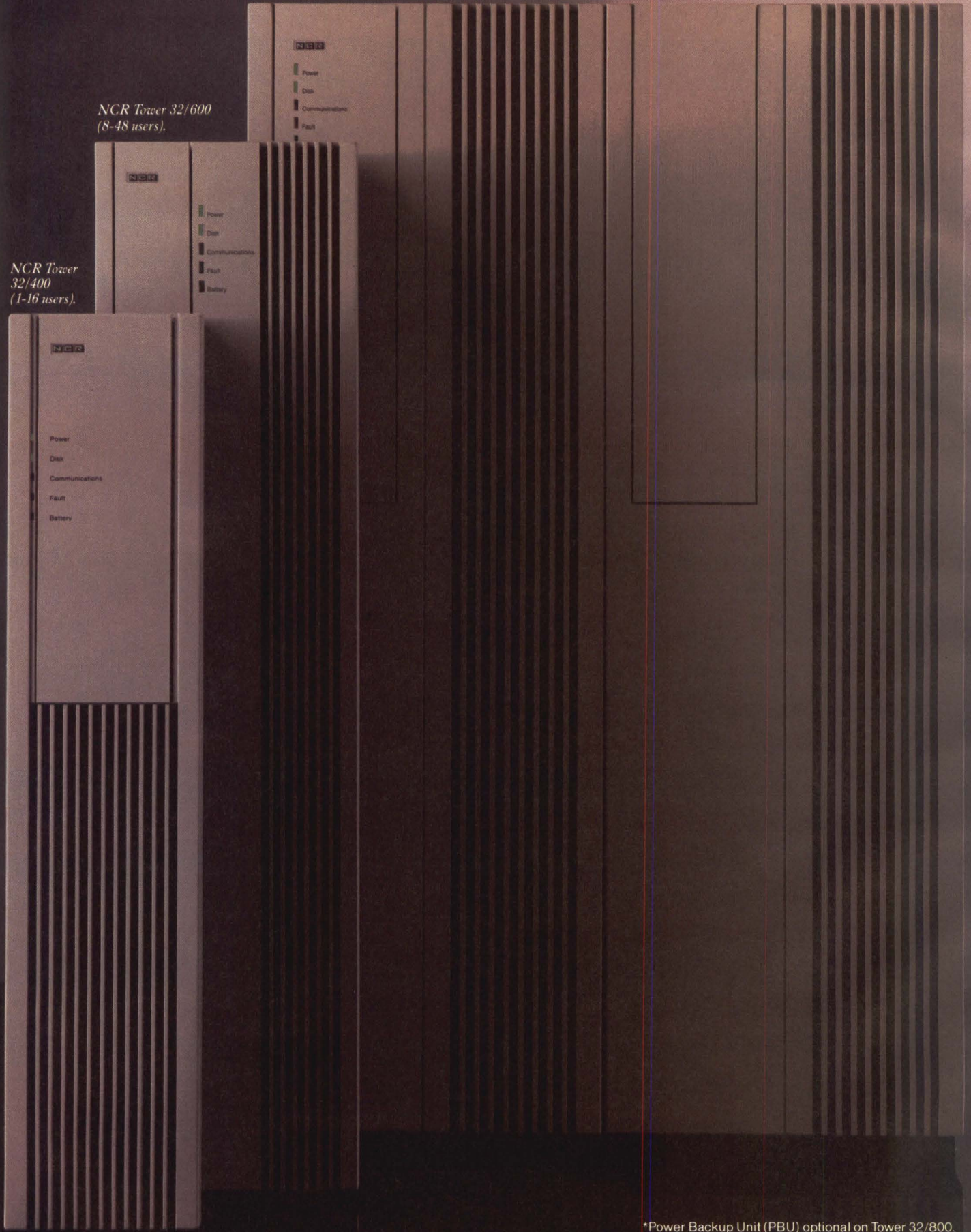
The problem is that CDROM technology is evolving, and some vendors fear standards would choke off progress. "Putting on standards is a good way to lock off innovation," says Zoellick.

However, many CDROM vendors believe a standard of sorts is evolving at the user interface, spurred by the advent of the windowing interface in the IBM Corp./Microsoft Corp. Operating System/2. As with the cartridge issue, no standards organization is considering retrieval software.—James F. Donohue

*NCR Tower 32/800
(32-128 users).*

*NCR Tower 32/600
(8-48 users).*

*NCR Tower
32/400
(1-16 users).*



*Power Backup Unit (PBU) optional on Tower 32/800.

THE RESULT OF CAREFUL FAMILY PLANNING.

At NCR, we're committed to building the finest high-performance supermicros in the industry: The NCR Tower® family.

But that's not our highest priority.

Because our careful family planning was inspired by something far more important than product specs.

Your needs.

While others build computer families in name only, we offer you a family in the true sense of the word.

To give you a clear upward migration path for software and peripherals, we make NCR Towers upwardly-compatible. So your customers can grow from the Tower 32/400 up to the Tower 32/800 with the same software. And just a minimum of maintenance.

To make sure every NCR Tower not only talks to one another, but third party products as well, we build every Tower around open, industry standards. UNIX™ System V,™ enhanced for commercial reliability. 680XX-series processors. Multibus™ SCSI. And support for all major protocols. To protect your system from obsolescence.

And when we're finished building in the features you demand, we give you reliability features you may never have thought of asking for: Remote and in-service diagnostics. Consistent error-logging. Automatic power failure recovery.* And more.

You see, our engineers gave birth to the Tower family. But your needs have always told us how to raise it.

Today, we stand taller than ever. Our new top-end Tower 32/800 (32-128 users) is built around an ingenious *incremental multiprocessor* architecture. 68020 application and file processors. A distributed UNIX operating system that optimizes throughput. And gives you more configuration flexibility than ever before.

It's the latest prodigy in a family of geniuses. Backed up by a \$5 billion company that spends more than a quarter of a billion on R&D, and maintains an army of 5,500 service personnel in 400 field locations across the nation. And the most complete VAR support in the industry.

All of which make doing business with NCR a well-conceived idea.

© 1987 NCR Corporation. Specs subject to change. Contact your nearest NCR sales representative for the latest information.

THE NCR TOWER. A SMART FOUNDATION TO BUILD ON.



OEM Systems Division, NCR Corporation, USG-1, Dayton, OH 45479.

CIRCLE NO. 34 ON INQUIRY CARD



turn to outside sources for erasable optical disk drives, they are not expected to enter the market until standards become more clear. Their eventual participation gives system integrators even more reason to think twice before betting on the front-runners. "Being first," says Pana-

sonic's Jasionowski, "doesn't mean you're going to be the winner." □

Interest Quotient (Circle One)
High 523 Medium 524 Low 525

Companies mentioned in this article

California Peripherals Corp. (CaliPer)
19701 S. Vermont Ave.
Torrance, Calif. 90502
(213) 538-1030
Circle 340

Canon Inc.
Tokyo, Japan
U.S. contact:
Canon U.S.A. Inc.
1 Canon Plaza
Lake Success, N.Y. 11042
(516) 488-6700
Circle 341

Eastman Kodak Co.
343 State St.
Rochester, N.Y. 14650
(716) 724-5887
Circle 342

Emerald Systems Corp.
4757 Morena Blvd.
San Diego, Calif. 92117
(619) 270-1994
Circle 343

Exabyte Corp.
1745 38th St.
Boulder, Colo. 80301
(303) 442-4333
Circle 344

Information Storage Inc. (ISI)
2768 Janitell Road
Colorado Springs, Colo. 80906
(303) 579-0460
Circle 345

Laserdrive Ltd.
1101 Space Park Drive
Santa Clara, Calif. 95054
(408) 970-3600
Circle 346

Laser Magnetic Storage International Co. (LMS)
4425 ArrowsWest Drive
Colorado Springs, Colo. 80907
(303) 593-7900
Circle 347

Matsushita Ltd.
U.S. contact:
Matsushita Electric Corp.
of America
1 Panasonic Way
Secaucus, N.J. 07094
(201) 348-7320
Circle 348

Maxtor Corp.
211 River Oaks Parkway
San Jose, Calif. 95134
(408) 432-1700
Circle 349

Olympus Optical Co. Ltd.
Tokyo, Japan
U.S. contact:
Olympus Corp. T.D.C.
23456 Hawthorne Blvd.
Torrance, Calif. 90606
(213) 373-0696
Circle 350

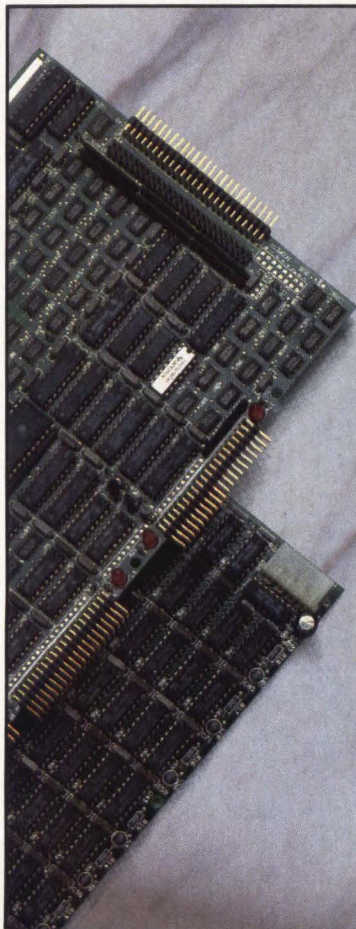
Optotech Inc.
770 Wooten Road
Colorado Springs, Colo. 80915
(303) 570-7500
Circle 351

Panasonic Technologies Inc.
1 Panasonic Way
Secaucus, N.J. 07094
(201) 348-7320
Circle 352

Sharp Corp.
Osaka, Japan
U.S. contact:
Sharp Electronics Corp.
Sharp Plaza
Mahwah, N.J. 07430
(201) 529-9500
Circle 353

Sony Corp. of America
1 Sony Drive
Park Ridge, N.J. 07656
(201) 930-6585
Circle 354

Verbatim Corp.
323 Soquel Way
Sunnyvale, Calif. 94086
(408) 773-3000
Circle 355



Experience a remarkable wait reduction

There's absolutely nothing else like the new TurboCache™ cache buffer system on the market today!

TurboCache is a unique storage subsystem that consists of a CPU board containing the processor and bus interface and up to 8 RAM boards (each with 2 megabyte capacity).

So, when you TurboCache your multi-user system, you'll notice the difference immediately. Here's why...

- TurboCache reduces the industry average data access time of 70 ms to 1.5 ms.
- Sends data as fast as the host adaptor is capable of receiving it.
- Completely self-contained — with its own memory and controller. Uses no main system resources and requires no main system processing time.
- Requires no software changes to either the system or user programs.

- The software provided for communication through the RS-232 is screen-oriented and menu driven with "help" available for all options.
- Simple plug-in boards install up to 35 feet from the host adaptor... AND... up to 35 feet from the disk controller.
- Stores up to 3,073 disk areas.
- "Transparent" operation.

That's TurboCache. And that's why it'll significantly increase your system's productivity and cost efficiency.

Now that you have all the facts, don't delay. Add on TurboCache today — *and lose wait fast!*

maxon
SYSTEMS INCORPORATED
A wholly owned subsidiary of Maxon Electronics Co. Ltd. of Korea

SALES OFFICE
353-B Vintage Park Drive
Foster City, CA 94404
Phone: 415/377-0269

© 1987 — Maxon Systems, Inc.

TURBOCACHE™

Reflection.

A family of solutions for a host of problems.



How can you connect hardware and software systems as diverse as Hewlett-Packard and DEC minis, IBM and Macintosh PCs, Novell, Ungermann-Bass, and Bridge's 3Com- and IBM-compatible LANs? With the Reflection Series software solution.

Reflection supports the widest variety of minicomputers, personal computers, LANs, and communication protocols of any single vendor.

Sophisticated features like command language, file transfer, background processing, and the PLUS backup option, give you the power you need to achieve your unique connectivity objectives.

RSVP and Dispatch address special needs of host-connected PCs. They take you one step further in automating your Reflection office.

Call us today to join over 100,000 satisfied Reflection users.

1-800-872-2829

VAR INQUIRIES WELCOME

- Reflection 1 Plus**
HP 2392A and VT102 emulation.
- Reflection 2 Plus**
VT220 and Tektronix 4010 graphics.
- Reflection 3 Plus**
HP 2623A, HP 2392A and VT102.
- Reflection 7 Plus**
HP 2627A color graphics, HP 2392A and VT102.
- Reflection for the Macintosh**
HP 2392A emulation.
- DISPATCH**
New independence from HPDesk.
- RSVP**
Links your PC with host-connected printers.

REFLECTION™
SERIES
SOFTWARE

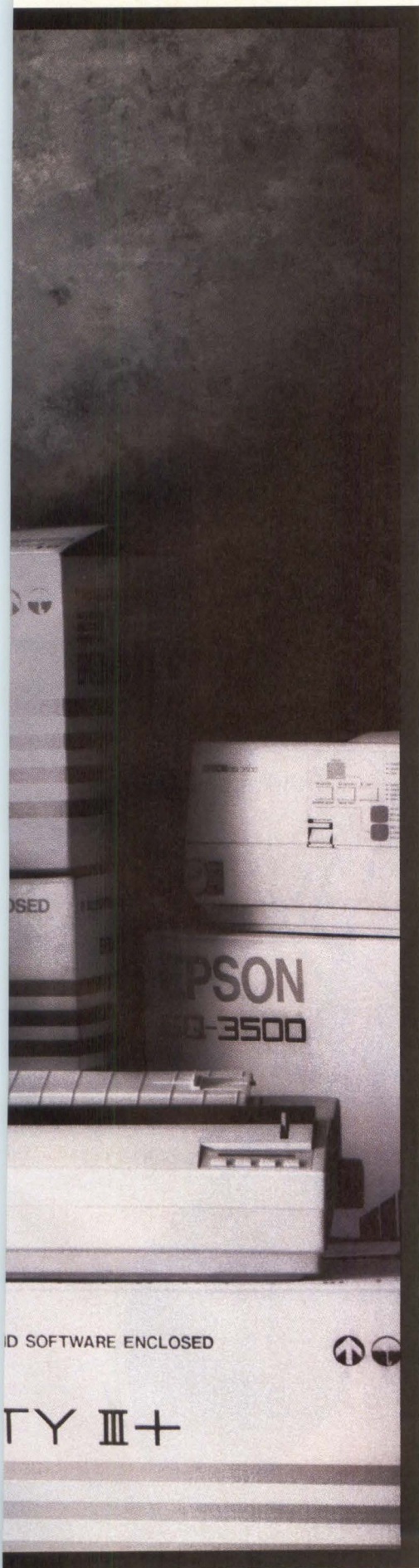
Walker Richer & Quinn, Inc.

2825 Eastlake Ave. E., Seattle, WA 98102 (206) 324-0350

CIRCLE NO. 36 ON INQUIRY CARD



Epson is a registered trademark of Seiko Epson Corporation. Equity is a trademark of Epson America, Inc., 2780 Lomita Blvd., Torrance, CA 90505. (800) 421-5426.



Every ten seconds, of every hour, of every business day, America unwraps a brand new Epson® computer or printer.

Take Jack Boland. Jack just added 27 more Epson printers and powerful Equity™ computers to his company's fleet of hard-working Epson office products.

Because, to hear Jack tell it, you can never have too much of a good thing.

EPSON

**WHEN YOU'VE GOT AN EPSON,
YOU'VE GOT A LOT OF COMPANY.™**

The perfect PC takes bigger bytes.

Now here's a design dilemma that's hard to swallow.

On one hand, the market demands a PC with a smaller footprint to take up less space on a desk. On the other, the market demands high-capacity disk drives with ultra-pronto access to stored data.

PTi's solution: take bigger bytes.

Our 3.5" micro-Winchester hard drives are available in capacities from 20 to over 57 MB, and standard (MFM) or run length limited (RLL) configurations that offer more usable formatted storage space than comparable drives.

But that's just the first course.

Because PTi drives answer the market's "more speed" demands with an average access

time of just 35 ms. And they stay cool and last longer, because at under seven watts operating, Peripheral Technology drives use less power running than others do standing still.

Worried about data integrity? Don't. Because PTi drives feature a one-of-a-kind system to automatically retract the heads to a safe landing zone at power down, then secure them with a unique head-locking mechanism.

And for dessert, PTi drives are available in standard 3.5" packages, or with a special 5.25" frame and bezel.

You want to design the perfect PC?

Get the perfect drive.

From Peripheral Technology.



PTI
PERIPHERAL TECHNOLOGY INC.

685 East Cochran Street, Simi Valley, California 93065 • (805) 581-1000

We've got the drive.

CIRCLE NO. 37 ON INQUIRY CARD

HOW OS/2 SUPPORTS LARGER APPLICATIONS

OS/2 juggles large real-memory, multitasking, priority scheduling, DOS and tools to speed the building of new-generation PC applications

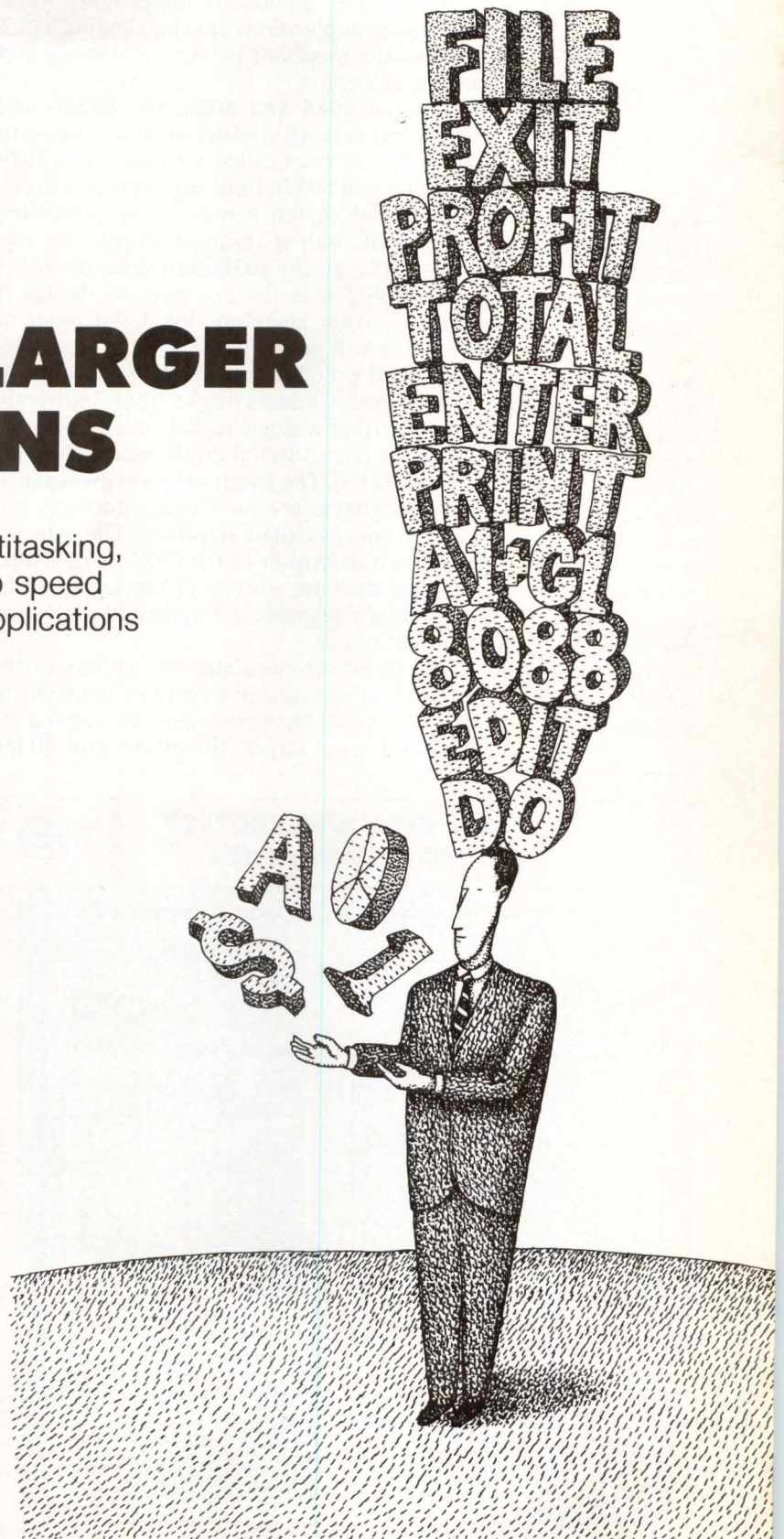
J. R. Gillig, E. E. Iacobucci, F. L. Rawson III, and J. A. Tunkel, IBM Corp.

IBM Corp.'s new Operating System/2 (OS/2) offers system functions commensurate with the expanding capabilities of personal computers. Its primary features are support for large real-memory and the concurrent execution of multiple applications. OS/2 is also intended to be easily extendable and provides tools to aid application developers and system integrators in the development of complex applications. Yet OS/2 retains many of the characteristics of DOS. OS/2 executes on Personal System/2 models 50, 60 and 80 and on the PC/AT and PC/XT model 286.

IBM has announced two versions of the Standard Edition of OS/2 (1.0 and 1.1) in addition to the Extended Edition. This article describes the features of OS/2 common to all of these products (see "A check list of OS/2 system features").

Large memory support

The Intel Corp. 80286 and 80386 processors extend the addressing range of the 8086 and 8088 processors by adding a new mode of operation called "protect mode." Both the 80286 and 80386 can also execute in 8086/8088 mode, which is called "real mode." The 80286 and 80386 can switch between real and protect modes under program control. In order



to run a DOS application under OS/2 while OS/2-mode applications are also running, OS/2 switches the processor between real mode and protect mode.

Like the 8086 and 8088, the 80286 and 80386 processors divide memory up into ranges of addresses called segments. The 8086 and 8088 and 80286 limit segments to a maximum of 64K bytes, because these processors can generate only a 16-bit offset into the segment. Although the 80386 can generate 32 bit offsets, OS/2 uses the processor as though it were an 80286. Therefore, the 32-bit mode of the 80386 will not be described in this article.

When the 80286 or 80386 is running in protect mode, addressing is done indirectly through either a single global descriptor table (GDT) or one of the multiple local descriptor tables (LDTs). The 16-bit values in the segmentation registers are no longer addresses but rather indexes called selectors. The selector refers to a descriptor in the GDT or LDT that contains the base address of the segment, the length of the segment and usage and protection information.

The processor calculates the address of the location being accessed by adding the segment base address to the offset value. By making the base addresses larger, the 80286 and 80386

provide 24 bits of real addressing range for a maximum storage size of 16M bytes (Fig. 1). The 80386 can further extend the addressing range of the processor, but this extension is not used by OS/2.

The memory layout in the OS/2 system is split to minimize its use of storage below 640K bytes (Fig. 2). This provides the largest amount of room possible for real-mode programs. Real-mode programs are run in the area below 640K bytes, so that they have the same addressing environment as they do in DOS.

Each OS/2 protect-mode program has its own LDT, which contains the descriptors for the data, code and stack segments that it uses. There is a single GDT for every program in the system. Although any individual segment is still limited to 64K bytes in size, a protect-mode program can use a large number of segments. Thus, since the 80286 and 80386 can address up to 16M bytes in protect mode, a program may have an address space that is much larger than the 640K-byte limit that DOS imposes.

The hardware-protection features of protect-mode require the operating system to manage segments, determining both their base addresses in real storage and their lengths. Accordingly, OS/2 provides system calls that allocate and deallocate segments for programs. There are also operating-system routines to manage data areas larger than 64K bytes.

The whole is greater . . .

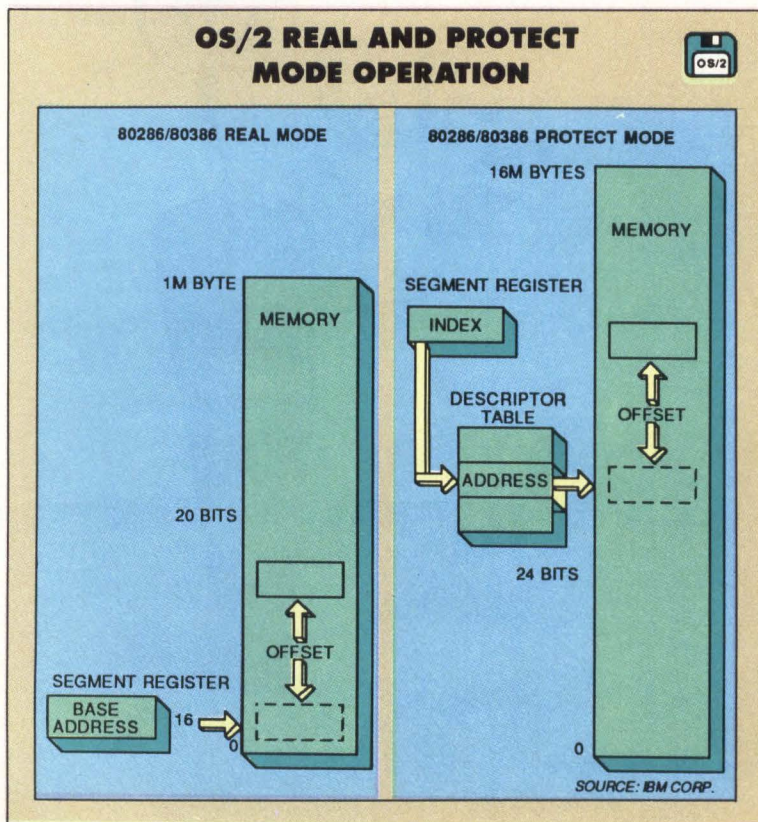
OS/2 manages physical memory in such a way that more memory can be allocated than the machine actually has. This feature, known as "memory overcommit," allows the user more flexibility by permitting the system to execute programs that are larger than the amount of physical memory installed on the machine.

Segments that are not actively being used may be swapped out to the rigid disk, only to be swapped back into memory when they are needed. Since all the memory that a segment uses must be contiguous, OS/2 moves segments around in main memory in order to accommodate segments that are currently needed.

To help user programs manage the storage in the segments that they are using, OS/2 provides a set of routines to suballocate the space in a segment. Although these routines are provided with the operating system, they run as a part of the user program, rather than as system routines.

Linkage to such routines is very efficient and does not involve the overhead associated with an operating-system call. The smallest unit of

Fig. 1. In the real mode of the 80286 and 80386, addresses are calculated by adding the base address in the segment register to an offset. In the protect mode, the value in the segment register is an index into a descriptor table containing the base address of the segment, which is then added to an offset value.



storage that the operating system is required to manage is a segment.

OS/2 supports both multiprogramming and multitasking. A multiprogramming system allows the concurrent execution of multiple applications. A multitasking system distributes processor time among multiple programs by giving each short periods of time on the processor.

OS/2 allows a user to run up to 12 concurrent sessions. A different application may be run in each session. For example, one session can be executing a compilation while another is doing a file copy and a third is running a spreadsheet.

OS/2 implements multitasking using "processes" and "threads." A process is the collection of resources under the control of a program. On OS/2 all programs execute as processes. All resources used by the program become part of the process. Allocated memory, files, queues and semaphores are some of the resources that are owned by a process. When a process terminates, OS/2 frees the resources that the process had been using.

In OS/2, the basic unit of execution is the thread. Every process in the system has at least one thread. A program may choose to employ multiple threads within a process. For instance, a program could be written to read from the disk with one thread while the data was printed with another thread. This permits the overlapping of processing and I/O activity.

Threads do not own system resources. Other than their own execution stack, they use the resources of the process that owns them. A new thread can be created by any other thread in the process. If all the threads in a process are terminated, then the process itself is terminated.

Pre-emptive scheduling

OS/2 implements what is known as a "pre-emptive time-slicing scheduler." This means that a thread executes for some relatively short period of time before the scheduler gets control again. When it does, it may determine that another thread ought to run. If so, it pre-empt the currently running thread by saving its state and dispatching the other thread. However, OS/2 allows the user to configure the maximum and minimum time-slice values.

All the threads in the system compete for processor time. The OS/2 scheduler implements a multilevel priority scheme with dynamic priority variation and round-robin dispatching within a priority level (Fig. 3).

Dynamic priority variation means that the scheduler changes the priority of threads based on what they are currently doing. This im-

proves overall system performance and ensures that the system responds rapidly to user interactions.

Round-robin dispatching within a priority level ensures that if there is more than one thread at the same priority level all of the threads at that level have an equal chance to execute.

When multiple processes are running, the scheduler identifies one as the foreground process. The threads of this foreground process are given a higher priority than others in order to make the system even more responsive to the interactive user.

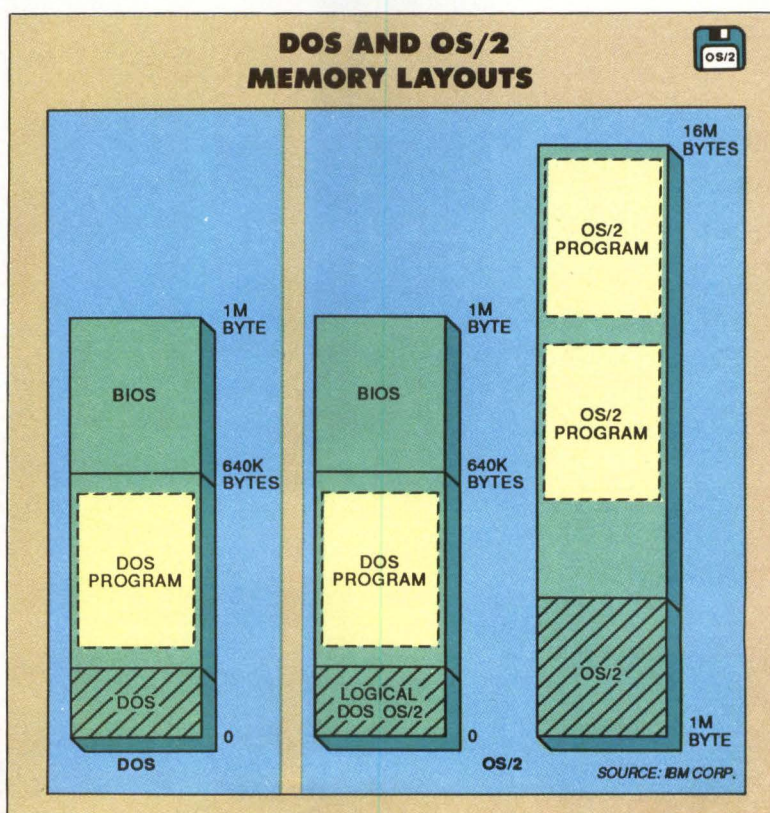
Protect application turf

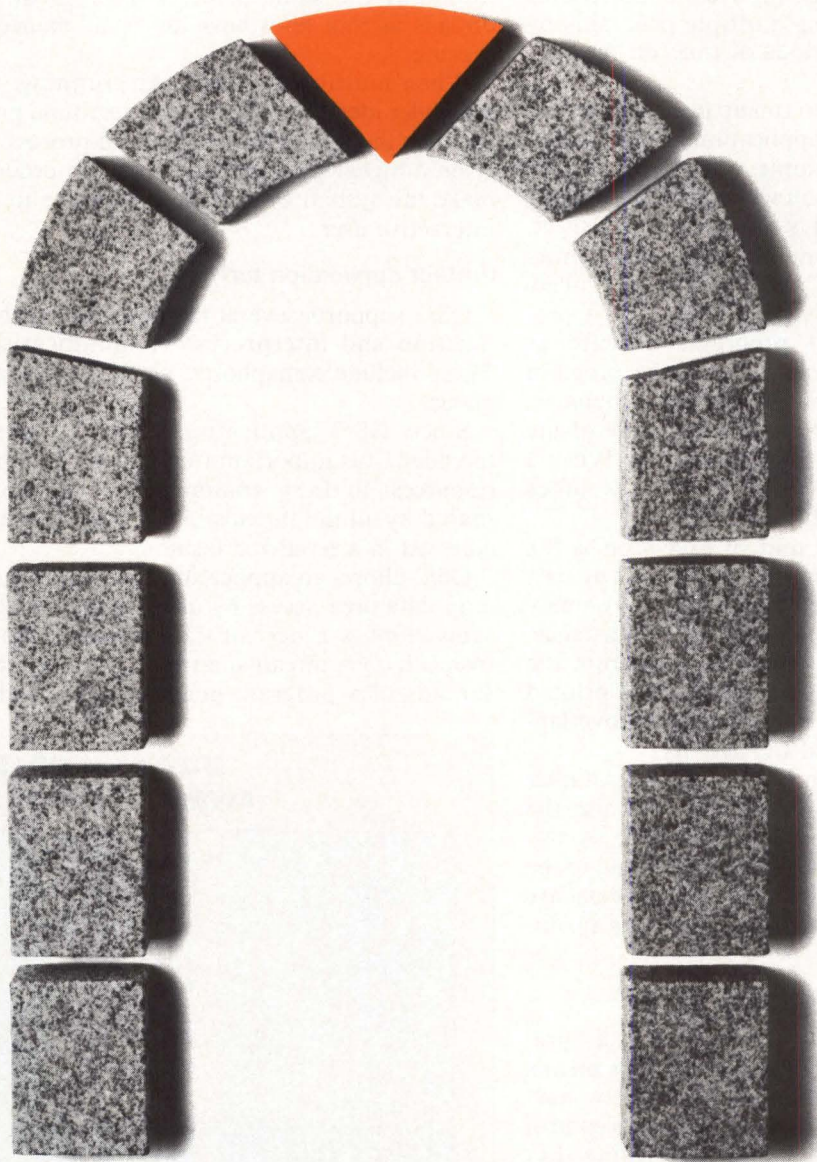
OS/2 supports several facilities for synchronization and interprocess communications. These include semaphores, signals, pipes and queues.

Since OS/2 applications may be multi-threaded, it is important that they protect their resources. To do so, common data areas, those shared by all the threads in a process, must be accessed in a serialized fashion.

OS/2 allows an application to serialize common data area access by using semaphores. A semaphore is a part of data structure that is owned by one thread at a time. If two different threads of a program need to access a data

Fig. 2. The IBM OS/2 memory layout is split to reduce storage to below 640K bytes and to provide the largest possible space for real-mode programs, which run below 640K—as they do in DOS.





CORTELCO*
Second Largest U.S.
Manufacturer of Telephones
and Key Systems



**COURIER INFORMATION
SYSTEMS**
Leading Supplier of IBM-
Compatible Display Systems



FRIDEN ALCATEL
Innovative Supplier of
Postage Meters, Mailing and
Shipping Systems



PABX SYSTEMS CORP.**
Supplier of Advanced Small
and Medium Size PABX and
Key Systems

ALCATEL IS...

The keystone to the future of American business communications.

A future in which your company's success will be in proportion to the quality of your information systems.

A future in which Alcatel will play a major role.

Because Alcatel is a group of more than 240 companies brought together in a joint venture by two world leaders in the fields of computers and communications ...ITT Corporation and CGE.

In the U.S., seven Alcatel companies, all established leaders in their respective fields, have joined to form Alcatel Business Systems.

This unique group of companies shares an unequalled depth of experience in voice and data communications. From PABX and key systems to business information systems that include computers, workstations, peripherals and mailing systems to complete service and support organizations.

Each of the Alcatel Business Systems

companies also shares in, and benefits from, the massive worldwide resources of the parent company. Resources that include R&D expenditures that exceed \$1 billion a year and an ongoing corporate commitment to the American marketplace.

This means that the relationship American business has enjoyed for so many years with the former ITT companies will now be even more productive and profitable. Because every Alcatel company is committed to providing customers with the finest integrated communications and business information solutions available.

With more than 150,000 employees in 110 countries and sales of \$13.3 billion, Alcatel is the second largest supplier of public network equipment, mail systems, telecommunications and business information systems and services in the world.

So if the future of your company is of concern to you...remember the keystone. Because the keystone is Alcatel.



For more information on Alcatel and the Alcatel Business Systems companies, call 1-800-556-1234 (ext. 247) or in California 1-800-441-2345 (ext. 247); or write Alcatel Business Systems, 2350 Qume Drive, San Jose, CA 95131.

QUME CORPORATION
Leading Manufacturer of
Computer Peripherals

SERVCOM
Computer Maintenance and
Support Services

XTRA BUSINESS SYSTEMS
Complete Line of High
Performance Microprocessor-
Based Computers

*Formerly Apparatus Division of ITT
Telecommunications.

**Formerly ITT Business Communica-
tions Corporation and Thomson CSF.

CIRCLE NO. 33 ON INQUIRY CARD

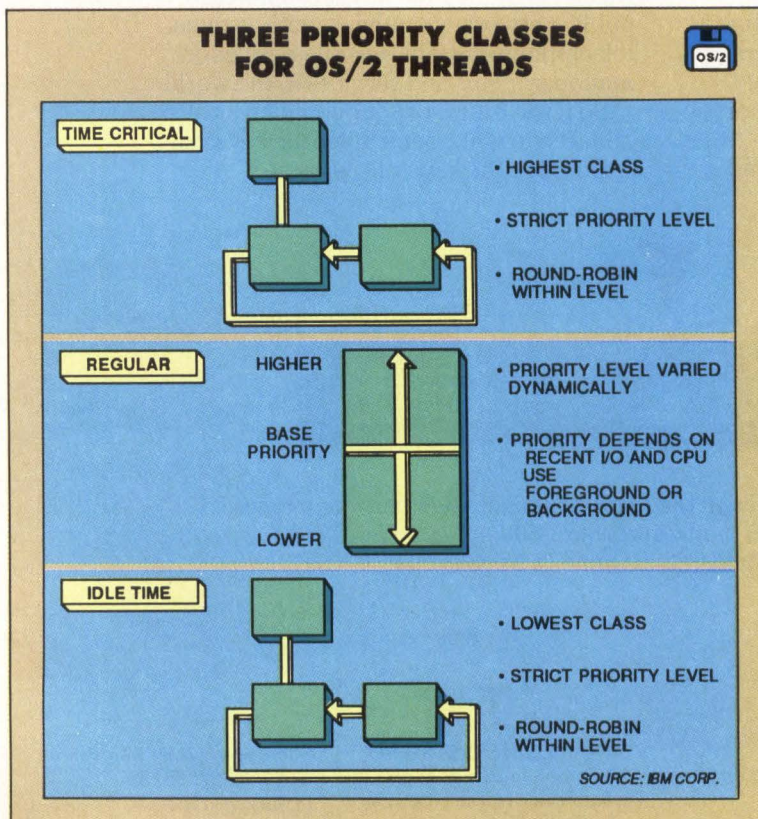
structure, each must request the semaphore. OS/2 grants the semaphore to one of the requestors and blocks the other until the first relinquishes control.

OS/2 has two types of semaphores, system semaphores and RAM semaphores. System semaphores may be used to serialize between threads in different processes. The operating system tracks the ownership of system semaphores. RAM semaphores differ in that they are a simple, efficient form of semaphore that can be used to serialize among the different threads of a single process.

Signals are used to notify OS/2 processes that some external event has occurred. A process can define signal handler routines that are invoked when the various signals are received by the process. An example of a signal defined for OS/2 processes is the signal indicating that the user has pressed control-break and that the process, therefore, should terminate itself.

When a signal is received, if there is no signal handler defined, the system usually either ignores the signal or terminates the process. If there is a signal handler defined for the signal, then it is invoked under the original thread of the process. OS/2 also provides a function that permits a process to disable and to enable signaling.

Fig. 3. The IBM OS/2 scheduler implements a multilevel priority scheme with dynamic priority variation and round-robin dispatching within a priority level.



OS/2 provides both pipes and queues for interprocess communication. A pipe permits two processes to communicate using the system's file I/O calls. The first process writes data into the pipe, while the second reads it from the pipe. However, the data is never actually written to fixed disk or flexible disk. It is kept in a segment in main memory.

Queues are implemented using a set of OS/2 queuing system calls. These permit a process to define a queue and to read messages from it. Many other processes may write to a queue, but only the owner may read from it. OS/2 gives the owner of the queue control over that queue, permitting that process/owner to not only look at the elements on the queue but also to remove elements, purge or delete the queue.

Dynamic linking and demand loading

OS/2 implements new mechanisms for linking and loading programs. DOS links code segments statically by appending them to the application's .EXE file, causing this .EXE file to grow with each referenced routine. The entire .EXE file is loaded when DOS starts the program.

OS/2 permits static linking, but it differs from DOS in that it also supports the linking of code segments when a program is loaded.

Whenever the OS/2 program is linked, the linker includes only a reference to a dynamic-link, or "dynamlink," library containing the code. The actual code itself is not included. When the program is loaded into storage, OS/2 resolves the references to the dynamically linked segments.

The programmer has a choice as to when a dynamically linked code segment is actually loaded into storage. Dynamically linked segments may be loaded when the main program is first loaded by the system. Or, the segments may be loaded only when they are actually referenced through a "FAR CALL."

In the latter case, at load time the system sets up the references to the segments in such a way that the program takes a hardware fault when it executes the FAR CALL instruction. The OS/2 fault handler determines that the reference is to a dynamically linked segment that is not loaded and loads the segment into storage (Fig. 4).

Dynamic linking and demand loading offer several benefits. For one, applications will generally use less memory since seldom-used routines may not be loaded until they are needed. Second, applications consume less disk storage space because there is a single copy of common routines, rather than a copy bound into each application. Third, dynamlink libraries can be updated to newer levels without relinking the

Why wait?

Get your screen image color copies faster, bigger, and better. The Versatec Model 255 captures your high resolution screen image in four seconds, so you can get back to work sooner. And you get your A-size copy in as fast as sixty seconds.

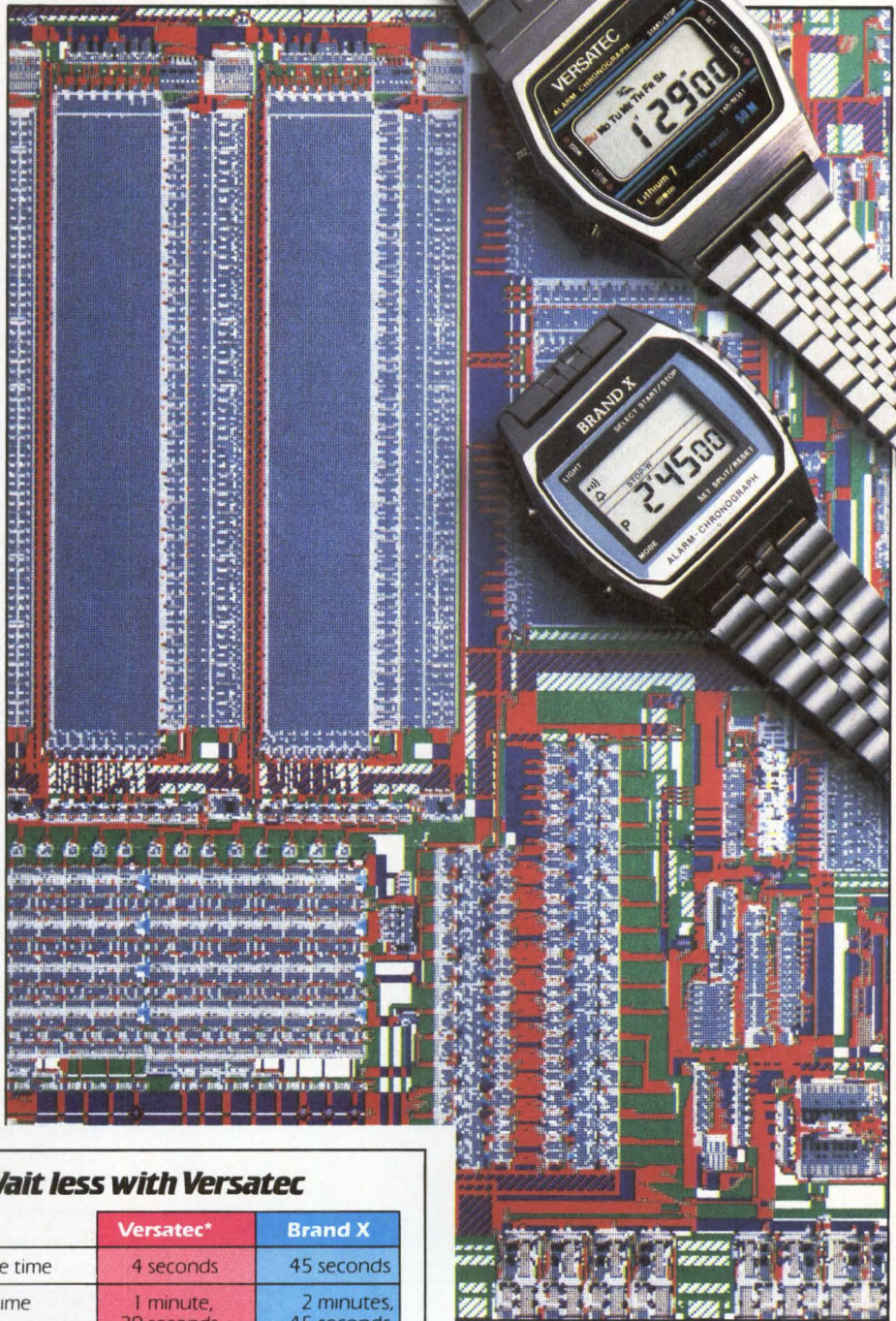
Use the 255 with the Versatec Versacolor thermal transfer plotter. It gives you high quality 300 point-per-inch resolution for smoother lines, better-looking small text fonts, and a larger image size.

See what you can do with the Model 255. Choose from more than 4000 colors. Output on A or B size paper or transparencies. Rotate and expand images for the largest possible image. Use color balancing to adjust copy colors to more closely match the screen. Window and capture any portion of the screen. And make up to 99 copies automatically.

With the 255's optional eight megabytes of memory, you can capture multiple images off one or more screens. No waiting for one job to finish plotting before capturing another.

Or consider Versatec's Model 250 RGB video controller. This lower-cost alternative offers eight colors, captures the screen image in less than a second, and can simplify system configuration with daisy-chaining.

Why wait? Versatec copies most popular workstations and terminals. Conveniently located Versatec service centers deliver prompt, qualified installation and support. For more information, circle our readers' service number or call toll-free 800/538-6477.*



Wait less with Versatec

	Versatec*	Brand X
Screen capture time	4 seconds	45 seconds
Total output time (B-size)	1 minute, 29 seconds	2 minutes, 45 seconds
Resolution	300 ppi	200 ppi
Color balance	Yes	No
Memory	2 MB (8 MB, opt.)	1.9 MB

*Model 255 video hard copy controller and Versacolor thermal plotter.

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

Versatec and Versacolor are trademarks of Versatec, Inc. Xerox is a trademark of Xerox Corporation.

Plot data courtesy of Emerald Design/Silicon Graphics.

VERSATEC
A XEROX COMPANY

CIRCLE NO. 39 ON INQUIRY CARD

applications that use them. Many of the functions of OS/2 are implemented as dynalink libraries to improve the modularity of the system and to make it easier to share storage between processes.

Application programming interface

OS/2 uses calls to implement its application-programming interface (API), rather than the software interrupts (INTs) used by DOS and by the BIOS. A "calls" technique was chosen because the software-interrupt mechanism for invoking system services has a number of disadvantages.

First, the number of INTs is very limited, thus restricting future growth. Second, it is impossible to add new parameters to existing INTs in a compatible fashion. This makes it difficult to extend current interfaces. Third, the software-interrupt interfaces are easy to code in assembler, but they do not translate very well into higher level languages.

In view of these drawbacks, rather than using software interrupts, the OS/2 API is based on the dynamic-link mechanism of the system. Dynamic linking allows an application to make direct calls to system services. The references are resolved by the loader when the application is started. System service calls are coded in the

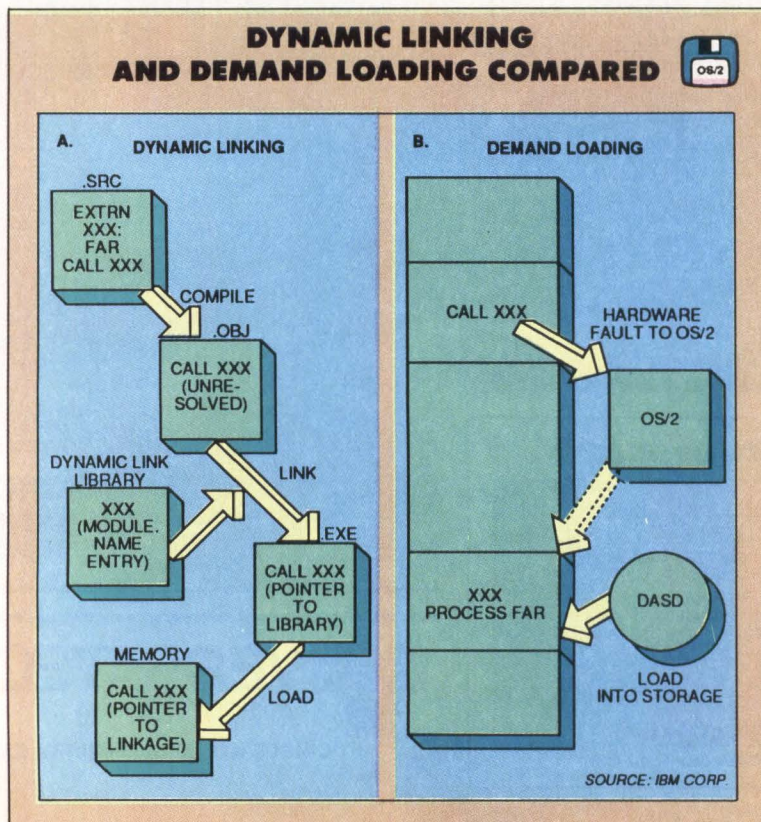
same fashion as application subroutine calls.

Parameters are passed on the application stack through a convention that is consistent with that used by many compilers. The system API can be directly supported by higher level languages. There is no need for bindings that remove parameters from the stack, load the registers and issue a software interrupt.

The OS/2 API can be easily extended by adding new function names to the system library. Subsystems can also be added by introducing new dynalink libraries. The application developer is provided with a single, consistent mechanism for accessing base system functions and extensions. The dynamic-link mechanism enables the system to change APIs in future releases while maintaining compatibility for the existing calls.

There is a subset of the OS/2 API called the Family API. It is supported by both OS/2 and DOS 3.3. Programs written to the Family API can be linked and bound to produce .EXE files that are executable on either OS/2 or DOS. On OS/2 the Family API calls are handled in the usual manner by the system. On DOS there is a special piece of code bound to the application, which translates the Family API calls to software interrupts. This code also loads and transfers control to the program, so that it seems to be executing in the OS/2 environment.

Fig. 4. (A) At link time, an IBM OS/2 program gets a reference to the dynamic-link library containing the code. At load time, OS/2 resolves the references. (B) Dynamically linked segments load only when they are referenced via a FAR CALL, triggering a hardware fault signal.



Compatibility with DOS

OS/2 executes real-mode programs one at a time in low storage. Real-mode programs run only when the DOS environment is selected as the foreground session. Protect-mode applications may continue to execute in the background.

When the real-mode program is put into the background by the user, it is frozen and does not run again until the user returns it to the foreground. This means real-mode data communication functions cannot be reliably supported in the DOS environment when the user switches to a protect-mode OS/2 application.

The software interrupts issued by real-mode programs are serviced by OS/2. This includes both the DOS software-interrupt function calls and the BIOS software interrupts. This arrangement permits the real-mode application and the protect-mode applications to share, under the control of the operating system, common resources and services such as the file system. Some BIOS functions that are particularly difficult to emulate are given to the ROM BIOS to execute. In this case, the system serializes itself, so that the ROM BIOS code operates correctly.

In order to service real-mode programs, OS/2



The Hall-Mark solution:



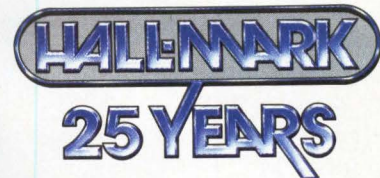
The UDS FaSTalk 2400

With Universal Data Systems' FaSTalk 2400 modem, getting your message from one place to the next has never been easier — and faster.

The FaSTalk 2400 is an ultra slim modem, no bigger than the base of a standard telephone, yet it's ultra fast and ultra powerful. The FaSTalk 2400 transfers information at a fast 2400 bps, and with its unique Talk/Data switch, you can switch from voice to data and back to voice again in the same phone call.

Fully Hayes® compatible, the UDS FaSTalk 2400 utilizes the AT command set allowing it to function with a variety of the most popular software. With the FaSTalk 2400 and Mirror II software, UDS offers one of the most sophisticated, powerful and easy-to-use communication packages on the market.

Call Hall-Mark today for more information or a demonstration of the UDS FaSTalk 2400 modem. Hall-Mark can help you with data transfer problems and all your computer systems and peripherals needs.



A COMMITMENT TO EXCELLENCE

© 1987 Hall-Mark Electronics Corp./400-4028
Hall-Mark Electronics is a subsidiary of the Tyler Corp.
Hayes is a trademark of Hayes Microcomputer Products, Inc.

Alabama
Huntsville (205) 837-8700
Arizona
Phoenix (602) 437-1200
California
Bay Area (408) 946-0900
Orange County (714) 669-4100
Sacramento (916) 722-8600

San Diego (619) 268-1201
San Fernando Valley (818) 716-3300
West Los Angeles (213) 217-8400
Colorado
Denver (303) 790-1662
Connecticut (203) 269-0100
Florida
Ft. Lauderdale (305) 971-9280

Orlando (305) 855-4020
Tampa Bay (813) 855-5773
Georgia
Atlanta (404) 447-8000
Illinois
Chicago (312) 860-3800
Indiana
Indianapolis (317) 872-8875

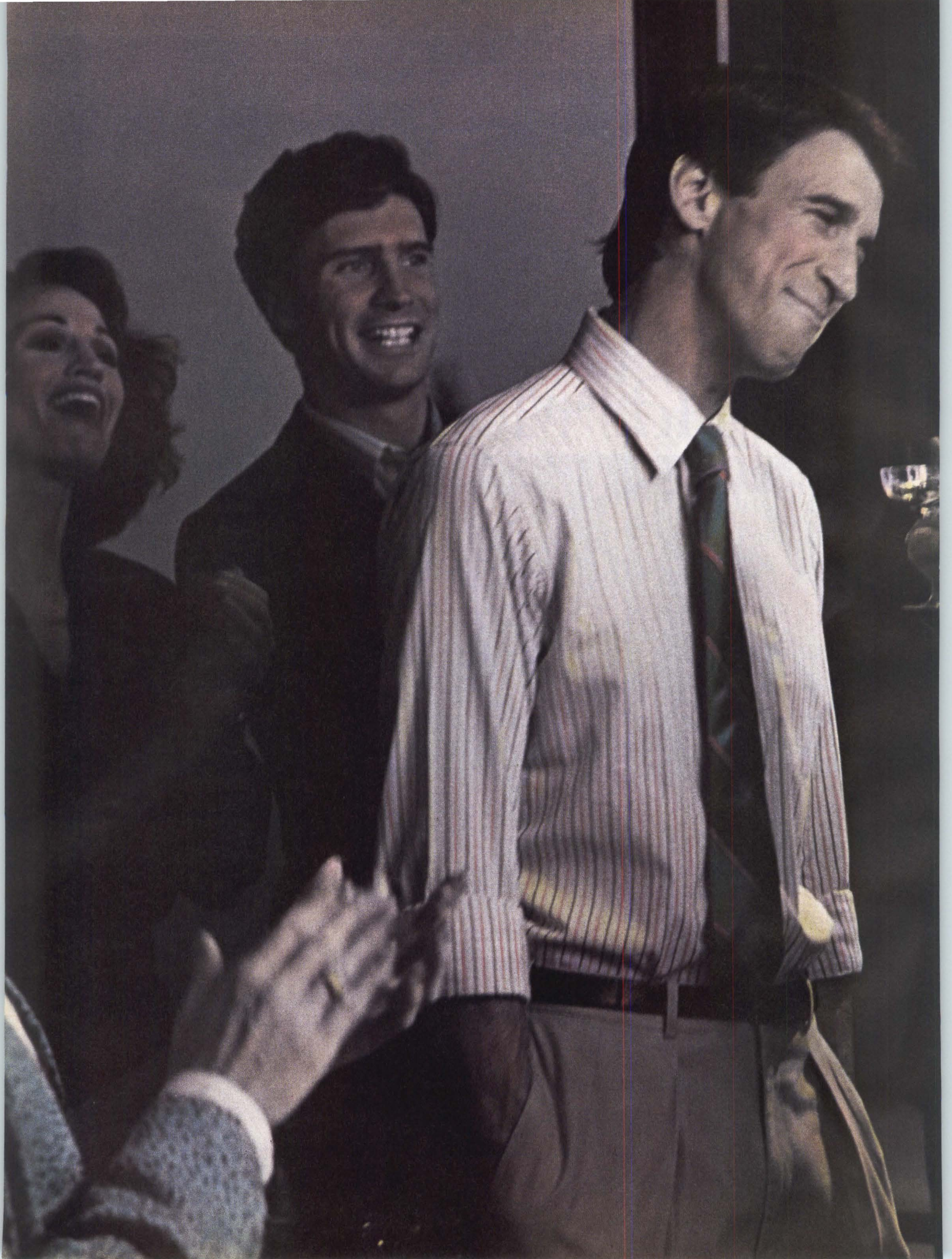
Kansas
Kansas City (913) 888-4747
Maryland
Baltimore (301) 988-9800
Massachusetts
Boston (617) 935-9777
Minnesota
Minneapolis (612) 941-2600


Missouri
St. Louis (314) 291-5350
New Jersey
Fairfield (201) 575-4415
New York
Long Island (516) 737-0600
Rochester (716) 244-1005
North Carolina
Raleigh (919) 872-0712

Ohio
Cleveland (216) 349-4632
Southern Ohio (614) 888-3313
Oklahoma
Tulsa (800) 231-0253
Pennsylvania
Philadelphia (215) 355-7300

Texas
Austin (512) 258-8848
Dallas (214) 553-4300
Houston (713) 781-6100
Utah
Salt Lake City (801) 972-1008
Wisconsin
Milwaukee (414) 797-7844

CIRCLE NO. 40 ON INQUIRY CARD

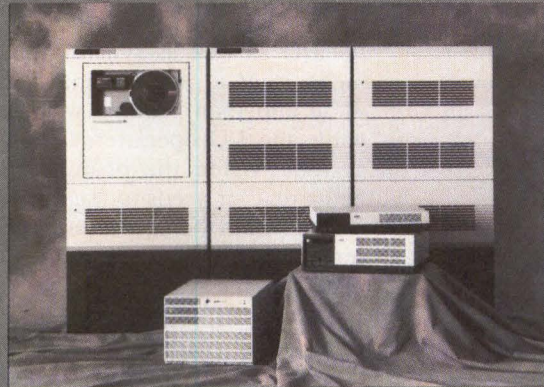




“I'm told they don't throw many parties down in DP.

So I asked Doug to come up to ours. Doug's the real brains behind our new 3B system. He's the reason our computers can now talk to the IBM in Accounting and the DEC in Manufacturing. If you know anything about DP, that amounted to doing business across the Berlin Wall. Doug had a brainstorm and suggested AT&T. Their approach is standardizing communications between different systems. I don't have to tell you that's opened some doors around here. We owe Doug a lot.

AT&T comes through.”



The AT&T 3B Computers

AT&T now offers a full line of departmental workgroup computers serving up to 300 users. A rich library of system and applications software includes host connectivity, development tools, programming languages, database management, OA, and a world of other **UNIX[®]** System programs.

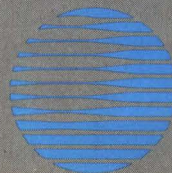
LAN standards: Interfaces to Ethernet*, AT&T ISN, STARLAN Network, DECnet** and more put different departments in touch.

Industry standards including IBM† 3270, SNA†, BSC and X.25 link mainframe, midrange and micro environments.

Communications software moves data transparently between applications via packages like LU 6.2, AT&T Document Exchange and others. For the full story on AT&T's surprising 3B Computers, call now: 1 800 247-1212.

From equipment to networking, from computers to communications, AT&T is the right choice.

*Ethernet is a trademark of Xerox Corp.
**DECnet is a registered trademark of Digital Equipment Corp.
†IBM is a registered trademark and SNA is a trademark of International Business Machines Corp.
©1987 AT&T



AT&T

The right choice.

CIRCLE NO. 74 ON INQUIRY CARD

Dynamic linking allows an application to make direct calls to system services.

requires storage space below 640K bytes. Consequently, there is less application space available in the DOS environment than in a system running DOS 3.3.

Provides synchronous filing

OS/2 uses the same file-system formats as DOS 3.3, so that media written by one system can be read by the other. Like DOS 3.3, OS/2 permits the user to organize the files on a rigid or a flexible disk into tree-structured directories. The file-naming and drive-letter conventions of OS/2 are the same as those of DOS 3.3.

The OS/2 file system provides the same file-sharing features as DOS 3.3, allowing a file to be shared among processes that are running concurrently. File access can be serialized among threads of the same process, using semaphores.

Unlike DOS, OS/2 provides asynchronous file I/O as well as synchronous file I/O. This means that a program may issue a read or a write and then proceed with other processing while the I/O operation is being done by the system. When the program needs the data being read or needs to reuse the buffer containing the data being written, it can wait on a semaphore that is set when the I/O is completed by the system.

Also, since the file system runs under the thread of the caller or, in the case of asynchronous I/O, under the thread created to run the request, file-system operations are multithreaded. This means OS/2 does not wait for disk I/O to finish. Instead, it can dispatch other

threads and do other work while the disk is returning the data requested.

For devices larger than 32M bytes, OS/2 provides a method of partitioning the disk into logical drives, each with its own drive letter. This partitioning scheme is identical to that in DOS 3.3, so media compatibility between the two systems is maintained.

Device drivers are bimodal

Like DOS, OS/2 has two types of device drivers: character device drivers and block device drivers. Also like DOS, OS/2 device drivers may be broken down on the basis of strategy and interrupt routines. However, OS/2 device drivers must operate in multitasking environments. Thus, they must be written to relinquish control whenever they are forced to wait for I/O to finish.

In addition, since OS/2 operates in both real and protect mode, the device drivers must be capable of "bimodal operation," i.e., must be able to execute in either real or protect mode. In particular, an asynchronous I/O may be started by the device driver in one mode, but the device driver may receive the interrupt for it in the other mode.

To assist in implementing such device drivers, OS/2 has a common interrupt manager that handles all hardware interrupts and routes them to the correct device driver. Also, the system provides a number of services called device-helper, or "DevHelp," routines that a device driver may call. These DevHelp calls provide services for the device driver such as

A check list of OS/2 system features

- Real memory larger than 640K bytes;
- Multiprogramming—the ability to run more than one application at a time;
- Protection between applications;
- Multitasking—the ability to divide applications into pieces that are independently scheduled by the system;
- Interprogram communication and synchronization, so that programs can work together;
- Dynamic linking, so that library routines can be bound to a program and loaded into storage only as needed;
- A "call" application-programmer interface rather than the software-interrupt application-programmer interface of DOS and BIOS;
- A "family" application programming interface intended to allow applications to run on OS/2 or DOS 3.3;
- An environment for executing existing DOS applications;
- The same file-system and media formats as DOS to simplify data and media interchange between the systems;
- A set of device drivers for various IBM Corp. devices;
- A way for users to add new device drivers and to replace ones supplied by IBM;
- Monitors that act as filters on the input or output streams for character devices;
- A set of subsystems for video, keyboard and mouse;
- A command processor and a set of utilities that are extensions of those found in DOS;
- An installation program to make it easy to install both the system and applications;
- National language- and country-specific support.

THE PRINTING EDGE.



Fast, quiet, reliable and cost-effective, the S3000-II has been designed specifically as a high volume (30 ppm, up to 150,000 per month), high resolution printer. And it is thoroughly backed by the expertise, technical support and nationwide service of DeRex.

In today's economy you can't afford to simply keep up with the competition. You must stay a step ahead in every aspect of your business.

When it comes to printer systems, DeRex will give you the necessary edge to fulfill all your printing needs. Every time.

THE PRODUCT EDGE

DeRex has a full line of high quality, state-of-the-art, field proven, impact and non-impact printers, from 200 cps to 75 ppm, for IBM (including mainframe, System 3X, PC [channel attach and remote]), DEC, Hewlett-Packard, Wang, Prime, NCR, Unisys and just about every computer system available.

THE TECHNICAL EDGE

DeRex offers the expertise of one of the most experienced teams in the industry, to guarantee the correct solutions for your specific printer system needs, as well as total compatibility with your computer system.

THE SUPPORT EDGE

Every DeRex product is backed by the best product support program you can find anywhere, with experts available for customer support and ongoing field service throughout North America. A special central dispatch toll free number guarantees prompt results wherever and whenever the need arises.

THE PRICE EDGE

Because printers are our only business, the pricing edge is sharpest of all. By staying on the leading edge of printing technology, DeRex guarantees you the latest state-of-the-art printers at the lowest possible cost.

You'll be in good company when you join DeRex's list of hundreds of satisfied customers.

Call or write today. And get the printing edge on your side. From DeRex, the printer source.



ELECTRONIC PRINTER SPECIALISTS

7716 Wiles Road
Department 107
Coral Springs, FL 33067
(305) 753-0840
(800) 245-7282

CIRCLE NO. 41 ON INQUIRY CARD

BUY GIG.

AVAILABLE NOW. THE NEW SABRE SERIES 8" DISK DRIVE WITH GIGABYTE MEMORY.

If you've been waiting for a gigabyte of storage in a small form factor your wait is over. Introducing the gigabyte addition to our Sabre Series of 8" disk drives.

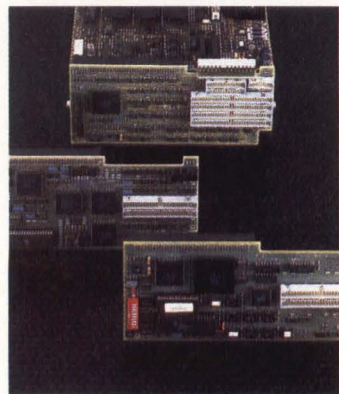
HIGHER PERFORMANCE TOO

Like all Sabre Series models performance is paramount. The model 1230 offers 1.230 gigabytes and 3 Mbyte per second transfer rate at 24 MHz. It features 16 ms average seek time and offers several interface options including SMD-E, SCSI and IPI-2.

But if you don't need all that capacity just yet...start with our 368, 500, 736 or 850 Mbyte model and grow...with us.

QUALITY DESIGNED IN

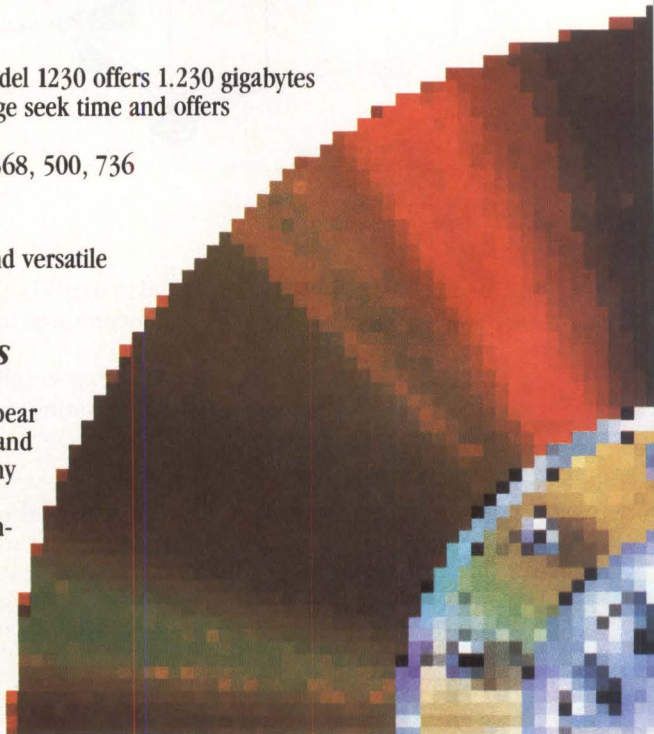
Sabre drives are designed for heavy duty use. They're rugged and versatile and can operate mounted vertically, horizontally or at any other angle. Built to last so we can spec them at a conservative 30,000 hours MTBF.



COMPETITIVE PRICES PLUS SERVICE SECOND TO NONE

You get both. We don't disappear after the sale. We know that service and support are important to you. It's why we have the largest and best trained support organization of any OEM manufacturer in the world. We stand behind you...because your success is our success.

For more information, call us toll-free at 1-800-828-8001, ext. 82. (In Minnesota call 612-853-3400, ext. 82.)





CIRCLE NO. 42 ON INQUIRY CARD

OS/2 uses the same file-system formats as DOS 3.3, so that media written by one can be read by the other.

converting logical and physical addresses, semaphore handling, storage locking and request-queue management. In particular, there is a set of DevHelp calls that permit the device driver to translate addresses into a common form that can then be translated back into the correct format for use in either real or protect mode.

Filters and monitors screen I/O

Since OS/2 uses the protect mode of the 80286 and 80386, applications cannot revector interrupts to their private interrupt handlers to monitor characters coming from or going to devices. However, there are many programs that act as filters on character input or output streams, and they need to be able to process every character.

To provide this capability, OS/2 implements monitors. Character device drivers permit processes to register as monitors. Once registered, a monitor may alter the character stream going to or coming from a device.

The monitors registered for a particular device driver are chained together. On output, commands and data going to the device driver are placed into a monitor-request packet that is passed in turn to each monitor on the chain by the OS/2 monitor dispatcher. The monitor manipulates the data in the monitor-request packet and passes the packet back to the monitor dispatcher.

When the monitor dispatcher reaches the end of the monitor chain, it passes the monitor-request packet back to the device driver, which updates the request being made to the device and does the output. On input, the data received from the device is placed in the monitor-request packet and passed to each monitor before being returned by the device driver to the program requesting it.

An example of a device monitor is the OS/2 print spooler, which uses multiple threads. One thread intercepts the characters that are being written to the printer and writes them to a disk file instead. Other threads read characters from the disk and pass them back to the printer device driver to be written to the printer.

Replaceable video, keyboard, mouse

OS/2 manages the video buffer so that the display can be used by multiple applications concurrently. Each session has a single logical display, keyboard and mouse.

The system manages sessions so that when a session is in the foreground, a process performing video output sends it directly to the hardware video buffer. When the session is moved to the background, the hardware video buffer is saved to a logical video buffer for the session.

While the session is in the background, the process sends its video output to this logical video buffer. When the user returns the session to the foreground, the system copies its logical video buffer to the hardware video buffer.

Keystrokes and mouse inputs are directed to one of the processes in the foreground session. There are programming interfaces to control which process receives them.

OS/2 has a base session manager that permits the user to switch between sessions using a hot key. The session manager maintains a list of all currently active sessions that can be used to select the foreground session. It also permits the user to go directly from one session to another using a hot-key sequence.

Video, keyboard and mouse are implemented as three separate subsystems. Each of them can be replaced by the user, if desired. They are also examples of dynamic link packages. These subsystems provide high-performance protect-mode replacements for the video and keyboard BIOS functions and the real-mode mouse device drivers that are used on DOS.

A familiar command processor

The command processor for OS/2 is an extension of the COMMAND.COM command processor of DOS. With minor exceptions the familiar command set of DOS is supported, and the syntax of the commands and the meaning of the parameters to the commands are the same.

There are some new commands that are unique to OS/2 because they support new capabilities. In particular, OS/2 provides a START command that permits the user to start a program in another session and let it execute asynchronously to the command processor.

OS/2 supports a compatible extension of the DOS batch-file language. This permits old batch files to be brought over from DOS and used on OS/2. However, the OS/2 batch-file language is more powerful than the one in DOS. For example, it allows the user to nest batch files, and it also permits alternative commands to be placed on the same line so that, if a first command fails, a second is executed. Unlike DOS, OS/2 commands routinely set the error level, so it is easy to determine whether a command has succeeded or not.

The STARTUP.CMD command file, if present, is executed during system start-up and may be used to contain initialization commands. It is the functional equivalent of DOS' AUTOEXEC.BAT file. The AUTOEXEC.BAT, if present, is executed when the DOS environment is started. In addition, at the start of each

Let Your CPU Reach Its Full Potential

With Data Access and Retrieval At Electronic Speeds

For disk intensive applications you need a peripheral storage device that performs as quick as your CPU. That's why we designed the MegaRam *solid-state* disk. It can access stored data thousands of times faster than a rotating disk. With this dramatic speed, your computer is kept working...not waiting. In fact, it can provide a typical increase of 50% in CPU throughput! And, the MegaRam is completely transparent to your software and hardware; your CPU will treat it as another disk drive.

When to Buy a MegaRam Solid-State Disk

1. When you need to have more users simultaneously accessing a data base without degrading response time.
2. When you need to monitor more status inputs with process control computers while working in real time.
3. When your telecommunications computers need to handle more lines and more traffic.
4. When you need your sort routines to run faster and compile programs to take less time.
5. When you need a peripheral storage device for hostile environments.

Or, for any other disk intensive application, including Data Base Management, Graphics, Process Control, or for real time processing situations such as Image Processing and Data Acquisition.

With Reliability and Reduced Maintenance

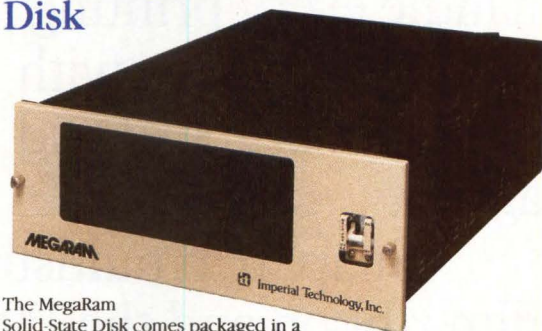
The solid-state MegaRam, with no moving parts, provides the performance and reliability of main memory while maintaining the

storage capacity and convenience of a peripheral. It requires no adjustments and virtually no maintenance. So, your CPU not only runs faster but uninterrupted as well.

Your CPU Can Deliver Its Full Promise of Performance

If your CPU requires faster data access and retrieval, operates in hostile environments, or demands maximum disk reliability, you'll find the MegaRam a smart, cost-effective investment. Call or write today for full details.

The MegaRam Solid-State Disk



The MegaRam Solid-State Disk comes packaged in a 7-inch high, 19-inch rack mounted chassis with its own controller, power supply and blower assemblies.

Available from 2 to 512 Megabyte capacities for the following computers:

DEC • Hewlett Packard • Gould • Prime • Data General • C.D.C. • Westinghouse • Sperry Univac • Many Others.

Features

Full Software and hardware compatibility • Error detection and correction • Field expandable • Zero latency time • No moving parts.

Options

Battery Back-Up • Megastream tape back-up • Custom designed interfaces • Dual port capability.



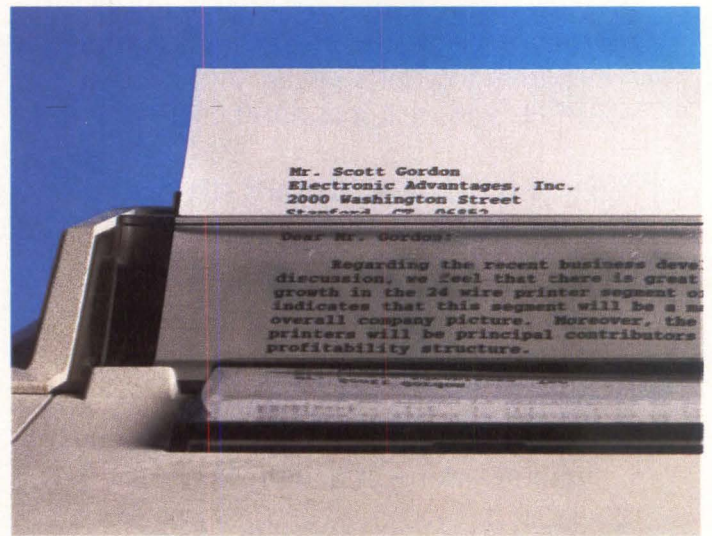
Imperial Technology, Inc.

831 S. Douglas Street
El Segundo, California 90245
Telephone: (213) 536-0018
Telex: 664469 • FAX: (213) 536-0124

THE ONE PRINTER IF YOU'RE HAVING

The one and only NEC Pinwriter® P9XL dot matrix printer. It can handle every printing job around the office with exceptional speed and agility.

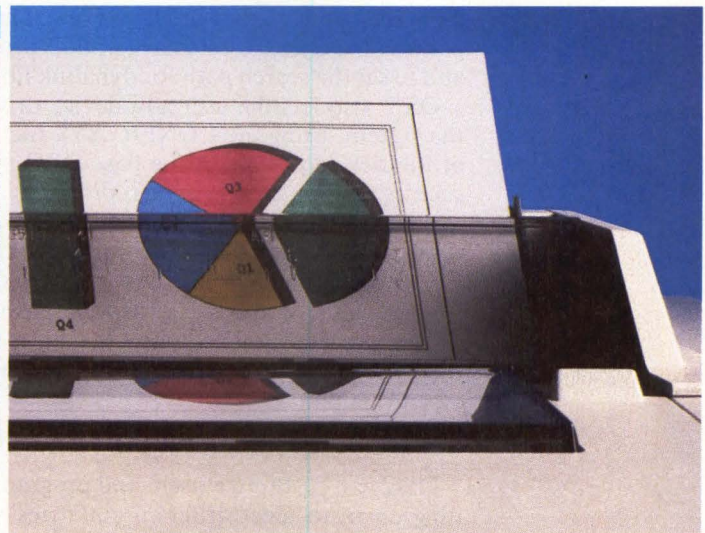
Snap in a multistrike film ribbon and the P9XL will turn out top-drawer letters and documents. At a speed of 140 cps in letter quality mode. And with its impressive speed of 400 cps in draft mode, it can barrel through payroll, invoices, multipart forms, and continuous forms. Switch to color and you can whip around a few curves, charts, graphs and presentations. On paper or transparencies.



BETTER TO HAVE ONE THAN TO HAVE ONLY ONE.

INGALLS ASSOCIATES, INC.
PUBLICATION INFORMATION REPORT

NAME	STREET ADDRESS LINE 1	CITY	FEDERAL
NUMBER	STREET ADDRESS LINE 2	STATE / ZIP CODE	AIRBORNE
	301 W. WASHINGTON ST.	ST. LOUIS	MO
	34 SE SECOND STREET	BOCA RATON	FL
	SABCOX BUILDING	AKRON	OH
	11 S. FORGE ST.	AKRON	OH
	2966 UNION SQUARE	BURLINGTON	KY



In fact the only thing the P9XL doesn't do around the office is break down. But then NEC is the largest manufacturer of 24-pin printers in the world. With the highest reliability standards in the industry.

So if you want a single printer that can do everything, there's only one in the running. The Pinwriter P9XL.

**NEC PRINTERS. THEY ONLY STOP
WHEN YOU WANT THEM TO.**

NEC

NEC Information Systems, Inc.

For more information and the name of the NECIS dealer nearest you, call 1-800-343-4418 (in MA 617-264-8635). Or write: NEC Information Systems, Dept. 1610, 1414 Massachusetts Ave., Boxborough, MA 01719.

CIRCLE NO. 44 ON INQUIRY CARD

Although the 80386 can generate 32-bit offsets, OS/2 uses the processor as though it were an 80286.

session the system executes OS/2INIT.COMD, if present.

OS/2 utilities are implemented using the Family API, so the same programs can be used as real-mode programs in the DOS environment or as OS/2 protect-mode programs. The DOS environment uses the COMMAND.COM command processor of DOS to process commands entered at the keyboard.

Installation and configuration

OS/2 has an installation facility that provides an interactive installation process for the operating system and products that run on it.

If there is a CONFIG.SYS file in the root directory of the system, OS/2 processes it during system start-up. This file contains configuration and start-up information about the system, analogous to that of DOS. For example, it permits the user to start background processes and to set the search path for dynalink libraries.

OS/2 also lets the user add device drivers to the system, using the CONFIG.SYS file. Some of the device drivers in the base OS/2 system, such as that for asynchronous communications, can be replaced by user-written device drivers that are specified in CONFIG.SYS. CONFIG.SYS may also contain device drivers for devices not supported by the base OS/2 system. Several other options can be specified in CONFIG.SYS to tune the system and to set system parameters.

National language support

OS/2 can customize itself, and programs running on it, to meet different countries' needs. Among the things that differ among countries that can be specified in OS/2 are the time and date format, language collating sequence and language case mapping. Also, OS/2 permits the user to select a keyboard layout from 17 national choices.

The character encoding (called a code page) for keyboard input and display, and the spooled printer output, can be selected from five choices including the standard United States Personal Computer code page and a multilingual code page. Run-time code page switching is available through user command or program API between two system-configured code pages.

OS/2 system messages are displayed in one of 11 languages available in separate OS/2 versions.

Versatile development environment

OS/2 has available a comprehensive set of development tools that enable the application developer to create efficient and complex software with less effort than with previous systems.

For example, new OS/2 language processors that produce OS/2 object code include IBM C/2, IBM COBOL/2, IBM FORTRAN/2, IBM Macro Assembler/2, IBM Pascal Compiler/2 and IBM BASIC Compiler/2.

The IBM OS/2 Linker provides a number of new features while maintaining the ability to create DOS-style executable modules. Foremost of these new features is support for the dynamic-linking feature of OS/2. The linker can create dynalink libraries, and it permits other programs to make FAR CALLs to these routines.

The OS/2 BIND utility provides an additional optional processing step for OS/2 executable modules. An executable module that is passed through the BIND step, assuming it has been coded to the Family API and coded as a mode-independent program, is capable of executing in both a DOS and an OS/2 environment.

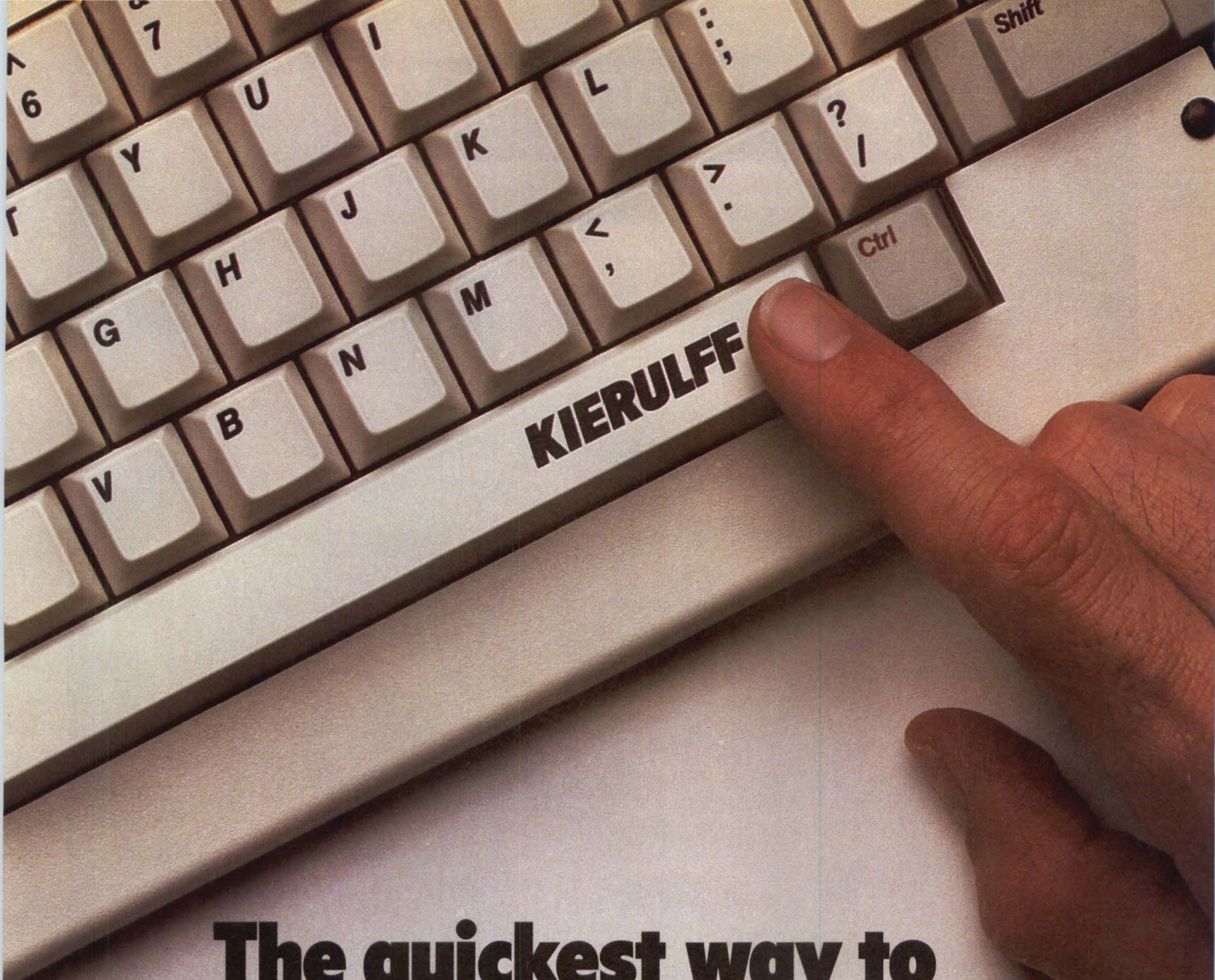
The OS/2 Toolkit contains two utilities that make the processing of user messages by an application both simple and reliable. They also make possible the creation of applications intended for an international audience, without the necessity of modifying application code each time a new language needs to be supported.

In addition, the Toolkit contains a set of sample programs that are provided in source code in several languages. These documented programs show, in a simplified manner, how applications may interface to the various programming facilities of OS/2. Sample programs exist for mouse interactions, process and thread creation, dynamic linking, and other programming tasks of interest to the OS/2 programmer. There are also programming aids for the C and MASM (macro assembler) programmer to ease the task of declaring and interfacing to the OS/2 programming interface.

In summary, OS/2 is a logical extension of IBM DOS 3.3 that provides large real memory beyond 640K bytes, multiprogramming and multitasking. Yet, OS/2 retains the ability to run most DOS applications. Furthermore, OS/2 is designed to be extended to serve as a base for future requirements. □

J. R. Gillig, advisory programmer, Advanced System Design; **E. E. Iacobucci**, senior programmer, OS/2 System Architecture; **F. L. Rawson III**, senior programmer, OS/2 System Architecture; and **J. A. Tunkel**, advisory programmer, OS/2 System Architecture, work in advanced system design at IBM Corp.'s Entry Systems division, Boca Raton, Fla.

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



The quickest way to get in touch with AT&T.



Make contact with Kierulff.

That's where you'll find AT&T's complete range of computer products and peripherals. From FAX machines,

PC 6300s, Industrial Workstations, 6500 Multifunction Communications Controllers and the entire 3B family. Plus everything in between.

You'll also find a line of professionals on AT&T systems who do much more than deliver hardware.

These people are experts at configuring AT&T systems for industrial applications. And more importantly, they'll help you pinpoint the exact AT&T product you need to meet your specific requirements. Which may not sound like much, unless you consider the breadth of AT&T's product line.

Kierulff people can provide other extras, too. Like

fast and accurate AT&T technical information. Service and repair. AT&T extended warranties. And the



industry's only Systems Product Guide — the most complete single-source of product information available on AT&T and 21 other leading manufacturers of systems, computer peripherals, software and accessories. And it's yours free for the asking.

Best of all, Kierulff's 30 stocking locations nationwide ensure you'll get the AT&T product you need, when you need it. Maybe that's why we're AT&T's largest distributor.

So call 1-800-FOR PROS. It'll get you in touch with the Kierulff office nearest you.

And a quick AT&T solution.

KIERULFF
Our people are the best part.

CHINON: Scanning the future.



Chinon's design engineers have a serious commitment to produce the most technologically advanced products that the mind of man can imagine.

That commitment has created subsystems, peripherals and components that could change the way we think about computers—and change the way computers are used.

The Scanner and the CD-ROM units pictured here are the types of products that continually move the leading edge forward. The Scanner could change the way business works by making true OCR technology more affordable and easier to use than ever before. The unique scanning head design means that the document to be scanned remains fixed, unlike other scanners that

can only accept a single sheet fed through the unit. It is also extremely compact and lightweight, and is designed to set new standards of cost-effectiveness.

CD-ROMS can provide users with access to databases that, only a few years ago, were possible only with a mainframe system.

Technology is still moving as fast as the best minds can advance it. At Chinon, our commitment to that progress keeps our products at the very forefront of the leading edge. We're bringing the future of computing to the needs of today.

CHINON

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

CIRCLE NO. 46 ON INQUIRY CARD

APPLES, ORANGES . . . AND BENCHMARKS

Benchmarks can be abused, but aptly applied they help system integrators, OEMs and VARs avoid the lemons

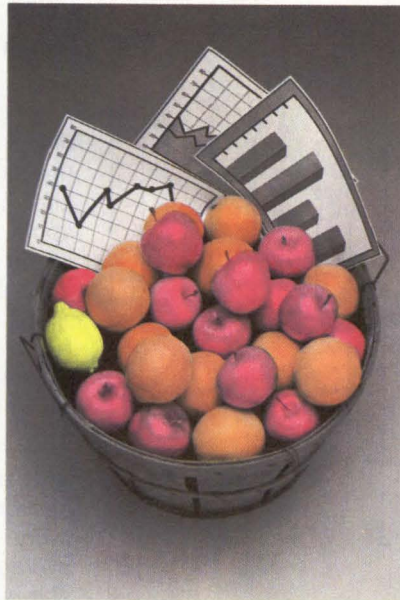
Andrew Allison,
Contributing Editor

While microprocessor and computer system manufacturers shout from the rooftops the importance of selected benchmark results, a backlash is developing among resellers and end users. Why? Because they are becoming more aware of the gap between implied and attainable performance. It is especially important for resellers, standing as they do between manufacturers and end users, to understand how (and how not) to use benchmarks.

Useful as benchmarks are to measure and compare the relative performance of computers, they should form only part of the evaluation equation. Although benchmarks can identify products that meet minimum performance criteria, a reseller needs to know the best combination of price, application software, and pre- and post-sales support.

"After the value-added product has been developed, benchmarks are needed to identify areas where performance can be improved, often by the system supplier as well as by the VAR," says Dan Feldman, manager of performance analysis at Advantage Systems Inc., a third-party wholesaler of banking system software. "They measure the effectiveness of enhancements and help configure systems to meet specific customer requirements when a VAR is bidding systems or when the customer needs more capacity."

Benchmarks can also be used to verify performance. In Advantage Systems' market, with



typically \$750,000 worth of software running on \$3 million to \$4 million on-line transaction processing (OLTP) systems, specific performance criteria are usually written into the purchase agreement. In such applications, performance-measurement tools provide a vital protection for both customers and resellers. In addition, benchmarks provide a means of evaluating your competitive position.

Unfortunately, metrics like MIPS (million instructions per second), MFLOPS (million floating-point operations per second) and KLIPS (thousand logical inferences per second) are meaningless unless the instruction mix is specific and relevant to your application. IBM Corp.'s J.C. Gibson, developer of the "Gibson Mix" (precursor of today's synthetic instruction mixes), has suggested that load-and-store speed is an equally good predictor of CPU performance. It's also less ambiguous. And Jack Dongarra, author of the widely quoted Argonne National Laboratory LINPACK program, says, "A benchmark is only good if you know what you're measuring. If you don't, it's useless."

LINPACK is an application-specific program that measures the ability of a given FORTRAN compiler and arithmetic unit to solve dense systems of linear equations. Like the synthetic Whetstone and Dhrystone benchmarks, which test arithmetic and non-arithmetic CPU capabilities, respectively, LINPACK gives little

weight to I/O. So, it is not particularly relevant to the interactive, multiuser and multitasking operating environment.

Nevertheless, the rigor that academic laboratories apply to benchmarking can provide lessons for technical and commercial computer

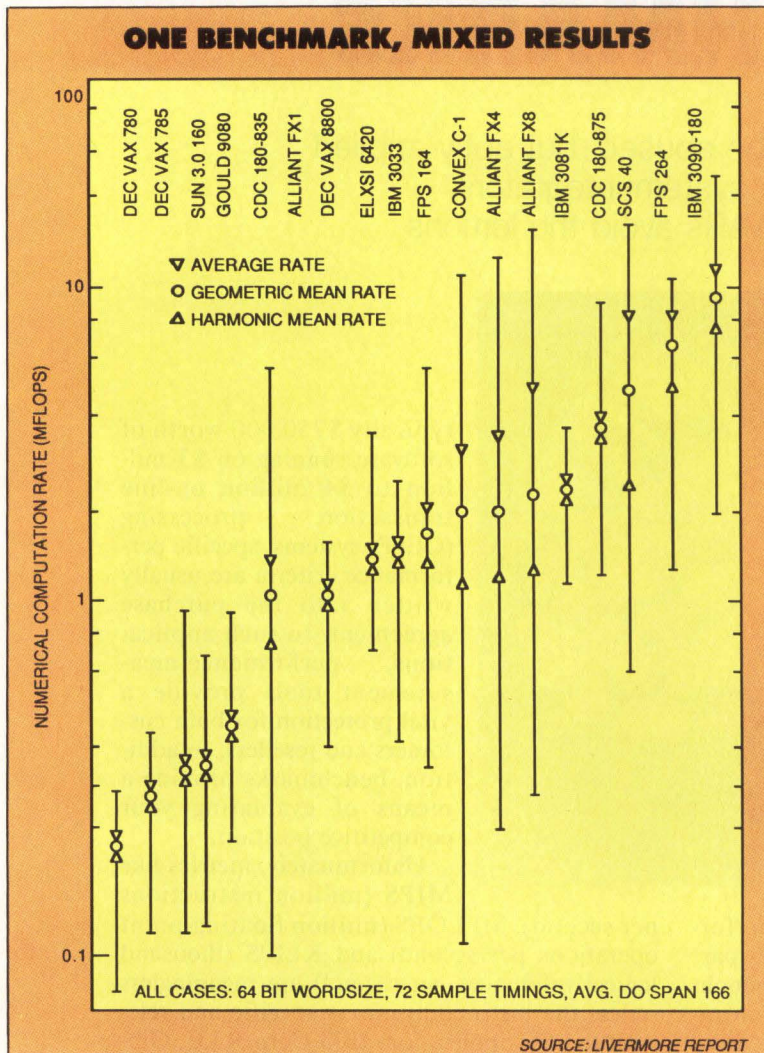
purchasers. For example, a Lawrence Livermore National Laboratory report, *The Livermore Fortran Kernals: A Computer Test of the Numerical Performance Range*, (UCRL-53745, December 1986), by LLNL computer scientist Frank McMahon, furnishes interesting background information.

The LFK test consists of 24 FORTRAN samples that have been found to characterize CPU performance for most FORTRAN applications. Results of this benchmark (see Graph) show the substantial difference that the specific code can make. The harmonic mean, which weights results according to execution speed in order to account for the fact that fast kernels spend less time executing, provides the best indication of likely performance.

Weigh benchmark variables

The performance of a computer system depends, among other things, on architecture, operating system and compiler efficiency, configuration (especially relating to cache, main and disk memory size and speed), algorithms, application mix and system loading. In many applications, the speed with which data is moved in and out is more important than the speed at which it is processed, and I/O and file-transfer capability govern performance. This is particularly true for interactive systems, in which response time is both critical and

LFK test results for several scientific processors illustrate the normalized performance range for the 24 Livermore kernels and the average, geometric and harmonic mean rates. The harmonic mean weights results according to execution speed to account for the fact that fast kernels spend less time executing and provides the best indication of likely performance.



A reseller's guide to benchmarking

1. Avoid paying too much attention to individual architectural features or clock frequency. Focus instead on how well the specific hardware-software system does in your applications environment.

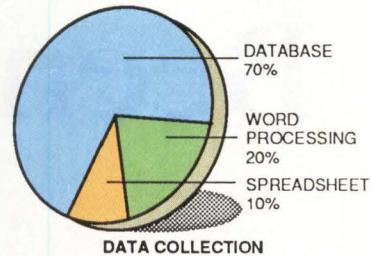
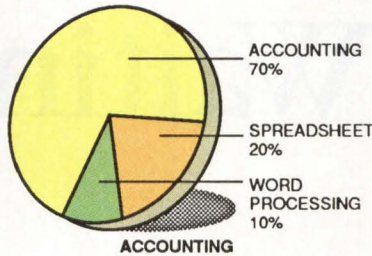
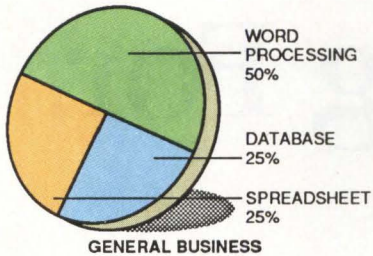
2. Start by taking the time to characterize your application and establish the minimum acceptable performance level. Then identify appropriate benchmarks. To evaluate several systems, use standard, easily portable benchmarks to reduce the number of candidates to a manageable level.

3. Obtain results for the chosen benchmarks, weight them according to the characteristics of your application, and determine the harmonic mean-execution rate. Then weigh the equally important price, vendor-support and name-recognition factors to come up with the best overall price/performance.

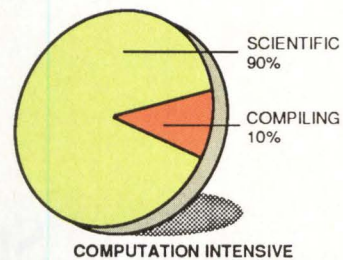
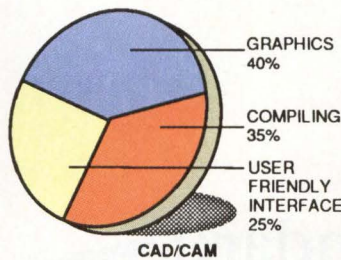
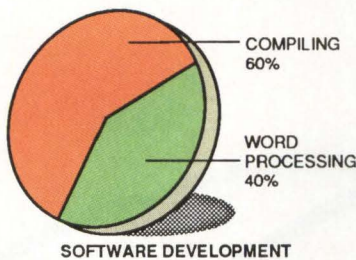
4. Finally, in the words of software engineer Neal Rhodes of Sales Technologies Inc., "Spend enough time with each new system to discover its quirks."

MIX AND MATCH TO PREDICT PERFORMANCE

BUSINESS ENVIRONMENTS



ENGINEERING ENVIRONMENTS



SOURCE: AIM TECHNOLOGY

The results of individual function tests in the UNIX benchmark suites can be weighted for various application mixes within given environments. The charts illustrate how Aim Technology estimates the application mix in standard environments.

HOW POPULAR PLATFORMS STACK UP

Company	Model	SP-1*	SP-2**	SP-3†	SP-4‡
Alliant	FX8 1CE	73	133	296	98
	FX8 4CEs	53	123	207	88
Apollo	580 FPX	374	370	1,311	276
	3000	978	440	4,029	511
Celerity	C1200	321	447	1,578	303
Convex	C1 XL	72	N/A	193	88
Data General	MV/2000 DC	700	360	3,643	448
	MV/20000	112	50	553	63
Digital Equipment	VAX Micro II	706	712	3,393	502
	VAX 8600	155	222	767	122
Floating Point Systems	M64/20	120	485	450	128
	M64/60	18	33	76	25
Harris	H CX7	144	178	640	126
	H 700	630	1,072	2,712	545
	DPS90 CP6	41	204	193	56
Honeywell	HP9000 320	925	936	4,590	653
Hewlett-Packard	HP9000 350	546	348	2,532	294
	4361-5	257	230	1,284	176
IBM	4381-2	102	109	524	84
	750	837	605	4,447	616
Prime	9950	349	260	1,771	235
	32/5	837	960	3,450	503
Ridge	32/130-330	489	505	2,050	418

Notes:

N/A - not available

*SP-1 - flat plate

**SP-2 - 1/2-pound weight dropped 40 feet

†SP-3 - pressure vessel

‡SP-4 - 2-D axisymmetric thermal/stress

Source: Swanson Analysis Systems Inc.

ANSYS bench- mark results

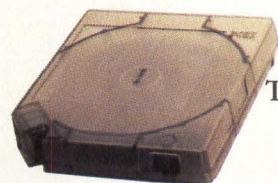
tabulate the CPU seconds used by various machines and models while running benchmarks provided by Swanson Analysis Systems Inc. The times are the best made available to SASI for each computer and are given without reference to configuration, system load, etc.

The 3480 Connection You've Been Waiting For.

Standard

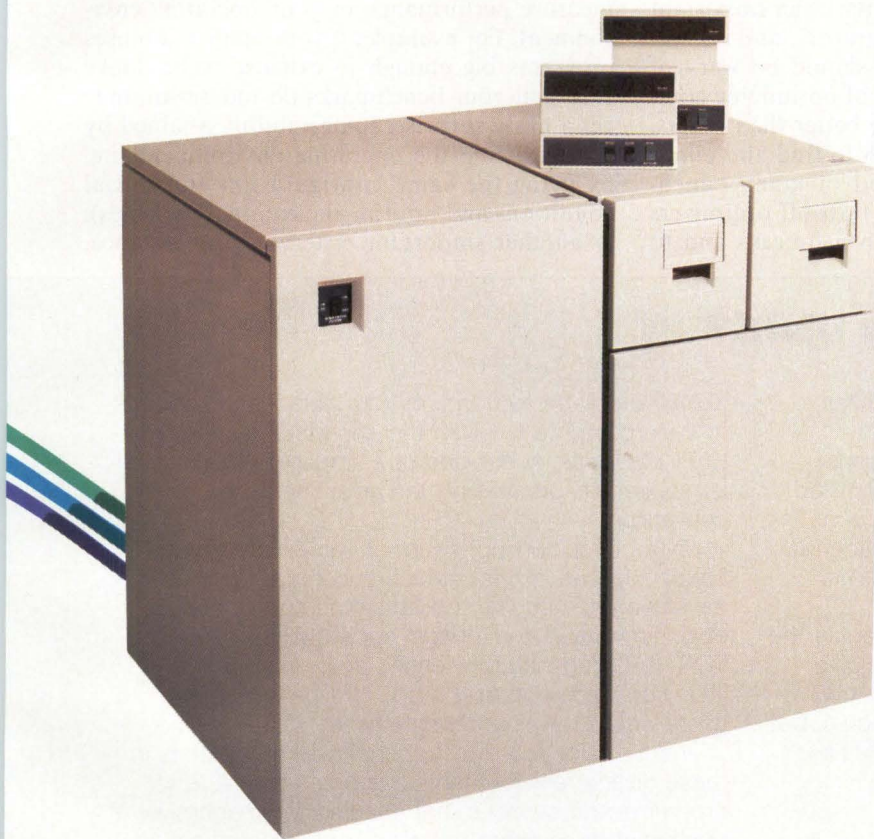
FIPS 60/61

SCSI



The 3480

Without the Wait.



High Performance... that's very well connected.

The Aspen System 480 is the first 3480-, ANSI-compatible cartridge tape drive designed specifically for the OEM and VAD/VAR marketplace. It provides 100% data and format compatibility with the IBM 3480—while offering unmatched connectability. The System 480 buffered controller lets you attach Aspen drives to virtually any system, through IBM, SCSI and StorageTek interfaces.

The Art Of Simplicity.

Complete compatibility and unlimited flexibility are just the beginning of features that make Aspen the integrator's specialist. The 480 equals or exceeds 3480 standards in speed, data integrity and long-term reliability. The system's outstanding price/performance ratio is only possible by design... by a clean, elegant design that revolutionizes 3480 potential.

Our tape path allows complete loading or unloading in 3½ seconds... and the strategic use of air-bearings ensures higher data reliability and longer tape life. Extensive resident diagnostics, pre-aligned mechanical sub-assemblies, and the elimination of special maintenance tools are all representative of the leading-edge *convenience* that's built into the Aspen System 480.

What your customers have in their imaginations... Aspen has... TODAY.

Just contact us at (303) 678-0808 for The Aspen 480. The 3480 solution that makes sense... and satisfied customers.

Connection You've Been Waiting For. Without the Wait.

 **ASPEN**[™]
PERIPHERALS

1351 South Sunset Street
Longmont, Colorado 80501

(303) 678-0808

CIRCLE NO. 47 ON INQUIRY CARD

dependent upon file-system and communications performance.

Since the purpose of a benchmark is to permit an apples-to-apples comparison, any differences in test conditions or exceptions should be given special attention. Benchmark results that do not include information about the conditions under which they were derived can be quite misleading.

Benchmarks written in high-level languages check the target system's compiler and associated utilities in addition to the operating system and hardware. The ease with which a program can be ported is, itself, an important benchmark. System integrators and value-added resellers, therefore, should be wary of some pitfalls. First, beware of optimizing compilers. Some optimizers are better than others, and some are smart enough to find and eliminate the empty loops used in many benchmarks. It's a good idea to turn off optimizers when compiling standard benchmarks and to

test optimization separately.

There's another kind of optimization to be concerned about. Gregory Baryza, director of product management at OLTP supplier Stratus Computer Inc. points out, "Because the originators tend to be conditioned by the operating environment in which the benchmark is developed, it's very difficult to write a neutral one." In other words, benchmarks tend to be optimized for the system on which they're developed. Therefore, many industry insiders caution against relying on a single benchmark.

Benchmarks need to be flexible enough to measure performance in your operating environment. For example, if your application uses programs big enough to exhaust cache, make sure that your benchmarks do too or you may get a nasty surprise. Repeatability, attained by standardizing the operating environment (i.e. by using the same configuration and initial conditions and limiting the external variables), is another important criterion. For instance,

What's so unique about UNIX?

The proliferation of UNIX-based systems makes benchmarking especially important. "The UNIX environment facilitates the porting of applications software, including porting from platforms optimized for software development to applications platforms," says Neal Rhodes, software engineering manager at Sales Technologies Inc., a value-added reseller of sales force automation tools to Fortune 200 companies. "The first port, which tends to identify the trouble spots, is the hardest. At Sales Technologies, porting the software initially developed on an AT&T Co. 3B/2 to the NCR [Corp.] Tower took 12 hours, but the second port, to a Convergent [Technologies Inc.] system, took only four."

Unfortunately, although the various UNIX specifications are beginning to converge, porting is not always quite that easy. This is especially true for porting between AT&T's System V and the University of California at Berkeley's UNIX Version 4.2 BSD, which have different file structures. Because resellers usually evaluate alternatives to systems already used, the ease of conversion is itself an important benchmark.

Portability is enhanced by the fact that, like the operating system itself, most utility and application software is written in C (which makes compiler performance important). On the other hand, portability is complicated by the existence of multiple implementations of the three major dialects of UNIX (System V, UNIX 4.2 BSD and Microsoft Corp.'s

XENIX) on platforms ranging from personal computers to supercomputers. Given the enormous number of UNIX platforms, some kind of a screening mechanism is required before making the investment in conversion.

UNIX benchmarking is further complicated by the broad application base, which encompasses software development, document preparation and scientific, engineering and commercial applications. Unlike FORTRAN-dominated scientific processing, there is little workload uniformity in the UNIX environment, but users want to evaluate their own workloads.

The flexibility required to benchmark computers in these diverse environments has created a need for programs and services that enable the prospective purchaser to compare the price and performance of a number of systems with minimal investment. Two companies that started out with quite different approaches, Aim Technology and Neal Nelson & Associates, dominate this market. Although the services offered by each are converging, Aim's focus has been on the licensing of performance measurement and enhancement software, while Neal Nelson has concentrated on reporting the results of tests run by the company (MMS, August, Page 87). The *Neal Nelson Business Benchmark Reports*, which compare (as of 6/1/87) the results of 18 separate tests on any two of 130 configurations from 36 suppliers tested in 20-, 40-, 60-, 80- or 100-user format, cost \$96 each.

the dispersal of data within the mass-storage subsystem (known as fragmentation) can degrade performance by as much as 20 percent.

Not even the time to execute the benchmark can be taken for granted. You need to know whether you're looking at user CPU time (the amount of time spent executing the application or benchmark), system CPU time (the amount of operating system time used), or elapsed (wall-clock) time.

Application-specific benchmarks

More often than not, resellers will be benchmarking against an existing configuration, and they will be concerned about the performance of their own application. Given the application-mix and operating-environment dependencies, the closer the benchmark is to your usage, the better.

The increasing reliance on high-level languages is making it easier to port proprietary software, but widely used third-party applica-

tion packages and benchmark suites have a role to play. If you are reluctant to disclose proprietary software, evaluating platforms in parallel with software development, or looking at a lot of candidate systems, you may have to rely on such programs.

In the CAD/CAE area, for example, finite-element analysis software from companies like Swanson Analysis Systems Inc. (ANSYS) and McNeal-Schwendler Corp. (MSC/NASTRAN) has been widely ported, and specified problems are frequently used for benchmarking. (The accompanying table showing ANSYS benchmark timing results for some popular CAE platforms illustrates the importance of specifying the test conditions.) McNeal-Schwendler offers a similar summary, also without specifying the configuration and workload data necessary for true benchmarking.

"There are too many new systems for all to be supported by application-specific benchmarks," says Swanson Analysis president John

Aim, a supplier of UNIX systems performance-enhancement and measurement software (an \$8 million market this year rising to \$159 million in 1991 according to Dataquest Inc. of San Jose) introduced in 1982 its Benchmarksuite I, which provides an in-depth analysis of a simple system. Benchmarksuite II, introduced in 1984, provides comprehensive single-user testing with 38 functional tests and a report generator that compares results for up to 20 systems in a user-defined application environment. Last year, the company introduced Benchmarksuite III, a 31-program multiuser-multiprocessor test suite that can be loaded for peripheral resources and application environments to provide workload simulation.

Aim's response to the success of the Neal Nelson reports, the *Aim Performance Reports* (two to four page graphic summaries comparing the Suite II and III results of one UNIX system with an AIM Standard System) was unveiled last October. These reports are being offered at no cost for a six-month introductory period and then by subscription.

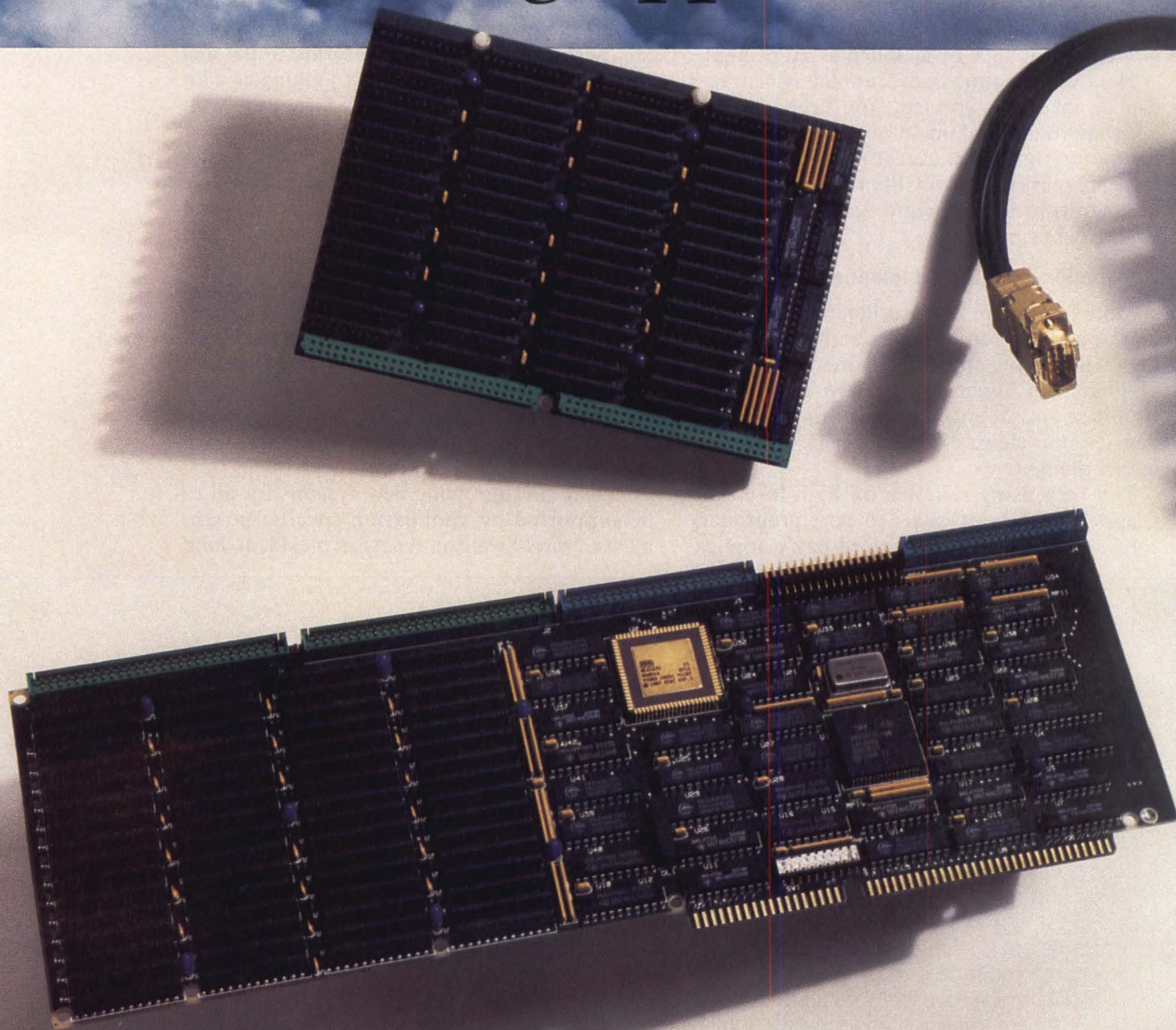
Although many resellers are reluctant to make a final decision based on a standard benchmark, these flexible suites do a good job of predicting real-world performance. "The Aim suite's ability to simulate applications environments and produce figures of merit provides a comprehensive analysis of UNIX-based systems performance," says Dick Nisley, director of marketing at Convergent. "In Convergent's

experience, application-program performance corresponds closely with that predicted by Aim's product." Ron Parsons, technical marketing manager at Sequent Computer Systems Inc. suggests that Aim III also does a good job of predicting multimicroprocessor system performance.

Altos Computer Systems Inc., in contrast, is committed to Neal Nelson's *Business Benchmark*. Altos product marketing manager Sandra Caldwell says, "Aim III was not available when Altos made its choice, and the multiuser capability of the *Business Benchmark* was required." She adds, "Altos is happy with the results obtained with the Nelson benchmark and intends to stay with it, but benchmark results should always be taken with a grain of salt. You need real-life tests to find out how a system is really going to work." Altos' decision may have been influenced by the fact that Neal Nelson & Associates is an Altos VAR, an endorsement of Altos' products that carries with it some risk of optimization for the Altos.

A similarly flexible benchmark suite, Power Meter from The Database Group Inc., is offered for MS-DOS systems. It includes 23 different tests in four categories: overall system (i.e., spreadsheet, word-processing, database, CAD/CAE and program development), CPU and memory, disk (random/sequential seeks and data transfer) and video/graphics performance. Like the UNIX benchmark suites, Power Meter provides application-environment simulation.

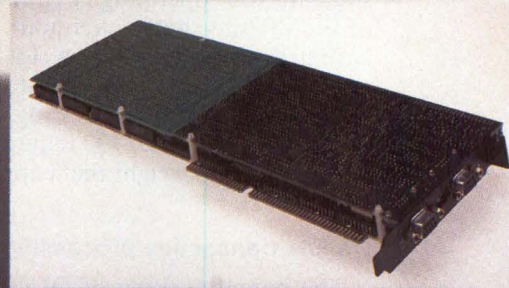
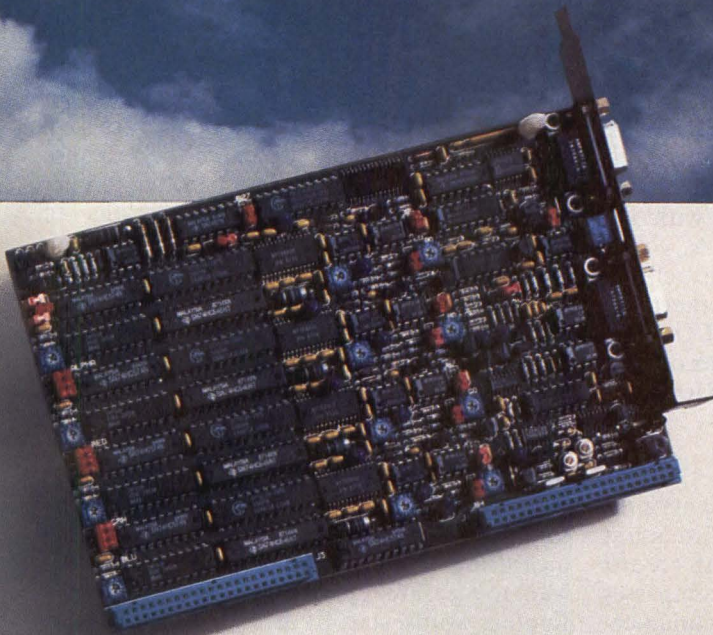
Now Taking Applications.



Take a look at the specs on VISTA™, a good look. Notice the processing, programming, and video capabilities? Now think real hard about what *you* could do with the power of VISTA and a microcomputer. Incorporate it with your system to create a digital pre-press proofing station for publishing. Design a graphics workstation which outputs both colorful hi-resolution slides and broadcast-quality animated images. Construct a CAD system which merges computer generated images with real-life backdrops for architecture, packaging or other industries. And, after you've brainstormed your way to new horizons of videographics possibilities, get your own VISTA and start working.

Introducing VISTA™ Videographics.

VISTA is a powerful single-slot videographics adapter which captures and displays video signals in real time.



Let's Get Specific.

We knew you couldn't resist seeing the facts, and frankly, our engineers wouldn't have it any other way. Here is an overview of VISTA's key features.

FEATURES:

- 4Mbytes of Video RAM on-board
- Texas Instruments' TMS 34010 GSP
- Flexible, programmable resolutions
- NTSC and PAL compatible
- Four 8-bit channels for real-time capture
- Fully integrated genlock
- Processor memory expandable in 2Mbyte increments to 12Mbytes
- Four 2K x 8-bit CMOS static RAM LUTs
- Display can be color-mapped, RGB, or a versatile combination of both
- Interlaced and non-interlaced display
- Binary and fractional programmable zoom capability, creates horizontal and vertical magnify or minify
- Smooth horizontal and vertical programmable panning, includes wrap-around and split screen
- Suggested Retail Price: \$5995.

ADDRESSABLE RESOLUTIONS:

32 bits/pixel	16 bits/pixel	8 bits/pixel
1024x1024	2048x1024	4096x1024
512x2048	1024x2048	2048x2048
256x4096	512x4096	1024x4096

CAPTURE RESOLUTIONS:*

NTSC		PAL	
(RS-170A)		(CCIR-624)	
756x486		738x576	
604x486		590x576	
504x486		492x576	
432x486		422x576	

*Resolutions are programmable; these are nominal ones for interlaced NTSC and PAL compatible.

DISPLAY RESOLUTIONS:*

NTSC		PAL		Non-Interlaced	
(RS-170A)		(CCIR-624)			
1512x486		1476x576		1024x768	768x576
1008x486		984x576		(60 Hz)	(50 Hz)
756x486		738x576			
604x486		590x576		768x768	756x486
504x486		492x576		(80 Hz)	(60 Hz)

*Resolutions are programmable; these are nominal ones.

COMPUTER REQUIREMENTS:

Host Type:	IBM PC AT and 100% Compatibles, Compaq 386, Apollo DN 3000-single-slot board
Data Bus:	16-bit or 8-bit (self-configuring)
Bus Clock:	6MHz to 12MHz
Power Consumption:	15 Watts

It's So Flexible, We've Added Support.

With its Texas Instruments TMS 34010 graphics processor, large quantity of video memory, and proprietary video cross-point, VISTA can be programmed for an array of powerful market-specific videographic applications. To help you maximize VISTA's potential, Truevision offers a range of C-language programming tools for developers. And when your system is market-ready, we'll support your marketing efforts with our TRUEVISION SOFTWARE CATALOG, TRUEVISION NEWS, and THE PULSE.

We're For Higher

Resolution...Power...Flexibility...Quality. Join the many key manufacturers and developers already working with the state of the videographics art, VISTA. Call us at 800/858-TRUE for more information on the VISTA Developer's Program. We're ready to take your application today.

AT&T
Electronic Photography and Imaging Center
7351 Shadeland Station, Suite 100
Indianapolis, IN 46256
800/858-TRUE



IBM is a registered trademark of International Business Machines Corp. International Inquiries: contact Techexport at 617/890-6507 (USA), or London at 44-1-991-0121. In Italy, contact SIRIO Informatica at 39-2-301-0051. Suggested retail price is US domestic price.

CIRCLE NO. 48 ON INQUIRY CARD

Swanson. For example, the company is now porting ANSYS only to systems for which there are customers prepared to license the program. If you can't find a third-party benchmark or simulate your operating environment with one of the off-the-shelf benchmark suites, you'll have to synthesize your own. To do this, select a subset of system-independent tasks (kernels) representative of the processing, disk I/O, communication and other I/O requirements of your application and weight them appropriately (see Pie Charts).

On-line transaction processing

The benchmarking of OLTP systems provides an example of the need for defining test conditions. Primarily associated with credit/debit operations, OLTP actually encompasses inventory control, health care, telecommunications and other interactive database applications. OLTP systems incorporate special features, such as fault-tolerance, modularity and database integrity. Nevertheless, the standard OLTP benchmarks actually evaluate database processing, communications and file subsystem capability (disk I/O) . . . all important to interactive systems in general.

The two most widely used OLTP benchmarks are ET-1 (also known as Debit/Credit), which simulates bank teller usage and TP-1, developed by Stratus to emulate ATM activity. TP-1 uses larger files, more complicated access routines and disk I/O. Unlike ET-1 (which performs only communications and disk I/O),

TP-1 executes processing operations.

OLTP benchmark results, quoted in transactions per second, should include the response time, the size of the database and the number of interbranch (i.e., network) transactions (15 percent typical). A response time of 95 percent in under 1 second is a requirement in many applications, but since many low-end systems cannot achieve this speed, 90 percent in under 2 seconds is often used for minicomputer-based systems. The recommended database size is 100K-byte account records, 100 teller records and 10 branch records, each 100 bytes in size, per anticipated transactions per second.

Stratus' Baryza offers a caution that applies to all benchmarks: "Be careful that you are measuring what you want to, and that what you want to measure is pertinent your application." In other words, start by deciding what it is that you are looking for and how well the benchmarks correspond to your requirements. □

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

Interest Quotient (Circle One)
High 526 Medium 527 Low 528

Companies mentioned in this article

Advantage Systems Inc.
950 Winter St.
Waltham, Mass. 02154
(617) 890-2400
Circle 325

Aim Technology
3350 W. Bayshore Road
Palo Alto, Calif. 94303
(415) 856-8649
Circle 326

Altos Computer Systems
2641 Orchard Parkway
San Jose, Calif. 95134
(408) 946-6700
Circle 327

Apollo Computer Inc.
330 Billerica Road,
Chelmsford, Mass. 01824
(617) 256-6600
Circle 328

Argonne National Laboratory
9700 S. Cass Ave.
Argonne, Ill. 60439
(312) 972-2000
Circle 329

Convergent Technologies Inc.
Box 6685
San Jose, Calif. 95150
(408) 434-2848
Circle 330

The Database Group Inc.
Suite 2 Plaza West
3031 Tisch Way
San Jose, Calif. 95128
(408) 241-2981
Circle 331

Lawrence Livermore National Laboratory
P.O. Box 94550
Livermore, Calif.
94550
(415) 422-1647
Circle 332

The MacNeal-Schwendler Corp.
815 Colorado Blvd.
Los Angeles, Calif. 90041
(213) 258-9111
Circle 333

Neal Nelson & Associates
185 N. Wabash Ave.
Chicago, Ill. 60601
(312) 332-3242
Circle 334

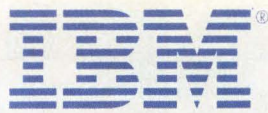
Sales Technologies Inc.
Suite 700
3399 Peachtree Road N.E.
Atlanta, Ga. 30326
(404) 239-0799
Circle 335

Sequent Computer Systems Inc.
15450 S.W. Koll Parkway
Beaverton, Ore. 97006
(800) 854-0428
Circle 336

Stratus Computer Inc.
55 Fairbanks Blvd.
Marlboro, Mass. 01752
(617) 460-2000
Circle 337

Sun Microsystems Inc.
2750 Coast Ave.
Mountain View, Calif. 94043
(415) 960-1300
Circle 338

Swanson Analysis Systems Inc.
P.O. Box 65
Houston, Pa. 15432
(412) 746-3304
Circle 339



Who says you have to pay extra to get an ASCII terminal equipped with these three letters?

Introducing the new family of IBM 3151 ASCII displays.

Now you can have the most versatile ASCII terminals IBM has ever made, for the lowest price IBM has ever offered. Our new 3151 family gives you more functions, and greater compatibility with more ASCII host system computers, for single unit purchase prices starting at less than \$400* per terminal.

Three models and up to 16 emulations make them flexible.

The entry level Model 110 comes with 10 non-IBM emulations built in, and provides an 84-key keyboard with 12 definable function keys.

The full-function Models 310 and 410 come with 11 emulations, and are easily capable of more (such as DEC VT220/100/52™ and WYSE WY-50/50 +™) by simply adding a new low-cost, slimline cartridge.

Their 102-key keyboards, equipped with up to 36 definable function keys, are also recappable, so you can adapt them to fit just about any program.

We worked harder to make them easier to use.

Besides being designed for compatibility with other computers, IBM's new ASCII terminals are more compatible with people.

New 14" flat screen displays provide a non-glare viewing surface and smooth scrolling. Our 310 and 410 models also offer a choice of 80 or 132 column displays, with crisp character resolution, in green or amber-gold.

What's more, we built the logic into the monitors, making all three models more compact and more reliable.

However, the most important feature of our new displays isn't on the screen, but above it: the IBM name. IBM provides not only a choice of a one or three year warranty, but a tradition of quality, service and support.

It's no wonder these three letters have come to symbolize so much to so many people. And at these prices, they'll be even more in demand. For additional information, contact your IBM Marketing Representative, or call 1-800-IBM-2468 for a supplier near you.



Model 310

Model 410

Model 110

* Prices subject to change without notice.

© IBM 1987. IBM is a registered trademark of the IBM Corporation. DEC VT220/100/52 are trademarks of Digital Equipment Corporation. WYSE WY-50/50+ is a trademark of WYSE Technology.

CIRCLE NO. 49 ON INQUIRY CARD

● GREAT ● PERFORMERS



never work without a net.

Only AVNET Computer Technologies, Inc. offers you the products, the support, the service—everything you need for truly great performances in your workplace.

AVNET is an advanced product dealer, offering a full line of today's most sophisticated PC hardware and accessories.

No other computer dealer offers the AVNET value-added difference. • 29 locations nationwide—coast to coast. • AVNET's experienced National Service Organization—a wealth of technical training and support just a phone call away. • AVNET's own leasing and rental programs, customized to your needs. • Custom PC configuration, and complete assembly and test facilities. • National Distribution—Products are available when you need them.

From 29 offices nationwide... let us show you how AVNET's value-added difference can make the difference in your performance. **Call 1-800-255-2281, or in Minnesota, 612-942-9170.**

The DATASOUTH 180 Demand Document Printer—for ASCII computers.

- Forms access printer with tractors located below the platen and tearoff bar above.
- Full form printing from top to bottom, without losing the form that follows.
- Multi-part printing, up to six copies.
- Bi-directional dot matrix printing at 180 cps.
- Easy-to-use control panel permits printer configuration and eliminates cumbersome dip switches.

 **Datasouth**



AVNET COMPUTER TECHNOLOGIES, INC.

Where Technology and Support Come Together

10000 West 76th Street, Eden Prairie, MN 55344

CIRCLE NO. 50 ON INQUIRY CARD

AVNDS 005

MISSING LINKS: SAA STILL A MYSTERY

IBM's Systems Application Architecture leaves independent software vendors and VARs long on questions, short on answers

Mary Jo Foley

Special to *Mini-Micro Systems*

IBM Corp.'s intention to provide a common software environment across its microcomputers, minicomputers and mainframes received a lot of press when the company announced it formally this spring. Almost overnight, the environment, dubbed Systems Application Architecture, or SAA, became the industry's hottest buzzword.

In July and August, Fujitsu America Inc., San Jose, and Hitachi America Ltd., San Bruno, Calif., rushed to announce their own (in Hitachi's case, IBM-compatible) SAA types of environment. And even before they knew the details, software developers were expressing optimism that SAA would enable them to achieve substantial money and time savings in product development and in maintenance.

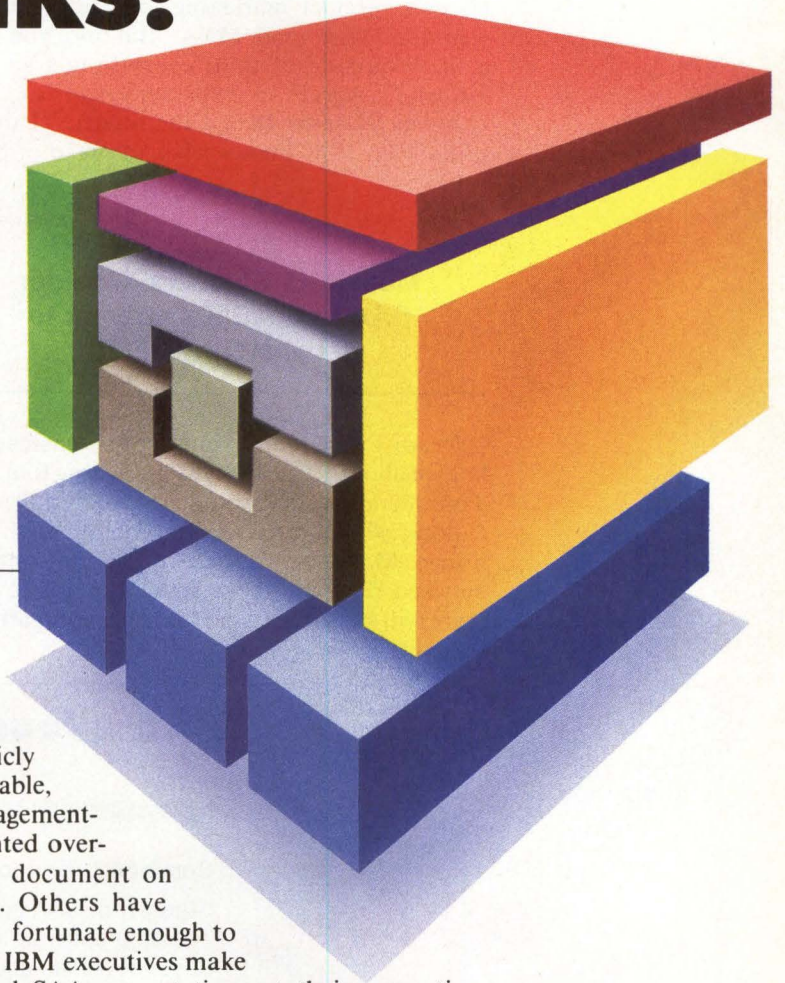
Despite this early hoopla, value-added resellers (VARs), independent software vendors (ISVs) and—some argue—even some IBM executives still know precious little about SAA. They are unsure how to achieve SAA compatibility and whether such a state will be possible and/or necessary. Will they need to modify existing software or write entirely new versions? Will IBM help? The only fact ISVs and VARs are sure of is that they are long on questions but short on answers.

Granted, some of the biggest ISVs report that IBM has provided them with copies of its

publicly available, management-oriented overview document on SAA. Others have been fortunate enough to have IBM executives make formal SAA presentations at their respective companies and offer vague guidance on IBM's software intentions. A couple of analysts claim to have seen copies of manuals that explain each of the four SAA components—common user access, common programming interface, common communications support and common applications—in greater technical depth (see "SAA's four key components"). IBM has promised that these manuals should be available by year's end.

SAA remains an enigma

However, for the most part, the majority of ISVs and VARs seem to know little about the set of software conventions and protocols, which promise to become de facto industry standards—as do most IBM products and services. Numerous IBM VARs and systems houses contacted by *Mini-Micro Systems* had never even heard of SAA. And not surprisingly, IBM refused numerous requests made by MMS



Many IBM watchers consider SAA to be IBM's attempt to derail archival DEC.

to elaborate on its SAA strategy.

"Everybody—including IBM—can sing the SAA song verbatim, based on the published materials," notes Steven Scheidt, director of systems product marketing for Cullinet Software Inc., Westwood, Mass. "But once you step a little outside of that, everything's an unknown." Agrees a representative of ISV Cincom Systems Inc., Cincinnati, "I don't think even IBM knows what to make of SAA yet."

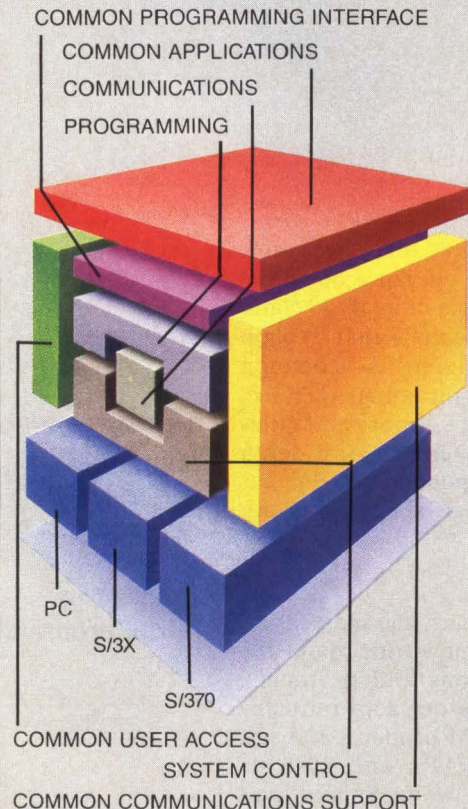
Many IBM watchers consider SAA to be IBM's attempt to derail archrival DEC.

Despite the confusion, some basics are known about SAA. SAA is a marketing tool, not a product or group of products. Analyst George Colony of Forrester Research Inc. in Cambridge, Mass., describes SAA as "the contract between IBM and its customers to assure that there will be galactic glue to ensure compatibility across [IBM's] hardware lines."

These lines (the only ones that IBM has included under the SAA umbrella so far) are the PS/2 microcomputer, System/3X minicomputer and System/370 mainframe families. The degree to which vendors' system- and application-software products for each of these families "complies" with SAA depends on how closely they adhere to the user-interface, program language and communication standards IBM has outlined in its SAA definition. So far, IBM has touted two of its new software offerings as being SAA-compliant: the still-to-be-shipped OS/2 operating system for the PS/2 (along with the Presentation Manager user interface) and Release 3 of its Database 2 (DB2), based on the Structured Query Language/Data Systems (SQL/DS) language, for its System/370 line. But Big Blue also has declared that many existing IBM products fill the SAA bill. They include the Graphical Data Display Manager (GDDM), Netview and DisplayWrite/36, among others.

The difficulty or ease with which other companies will develop SAA applications remains to be seen. One communications company racing to adapt SAA is Orion Network Systems Inc. of Berkeley, Calif. At a recent user group

SAA's four key components



Common user access

Elements: SAA-compliant user interface software must maintain physical consistency, syntactical consistency and semantic consistency. (IBM Corp. has not yet made public the factors that determine this consistency.)

Examples of IBM software known to adhere to standard: Presentation Manager windowing package for PS/2; System/370 GDDM (Graphical Data Display Manager).

sustain the following standards and support facilities: 3270 Data Stream; Document Content Architecture (DCA); Intelligent Printer Data Stream (IPDS); Systems Network Architecture Distribution Services (SNADS) and Network Management Architecture; Document Interchange Architecture (DIA); LU (Logical Unit) Type 6.2 communications protocol; Low-Entry Networking Nodes Type 2.1; Synchronous Data Link Control (SDLC); Token-Ring Network; X.25 network standard.



Common communications support

Elements: SAA-compliant communications software must

Examples of IBM software known to adhere to standard: Print Services Facility (PSF); Graphical Data Display Manager (GDDM); Netview; Advanced Communications Function/Virtual Telecommunications Access Method (ACF/VTAM); Advanced Communications Function/Network Control Program

meeting, Orion customers, all non-IBM OEMs, voiced the desire to make products that can fit into IBM shops. Orion president Paul Rampel projects that writing sufficient C language code to integrate and support the communications features of the new scheme will require 75 work years of development (see Table). That estimate does not include compiler features, graphics and database interfaces. "It is clear that many non-IBM vendors will seek help from third parties," says Jim Mullen, Orion vice president of sales and marketing.

SAA eyes VAX/VMS

Specifics aside, many IBM watchers consider SAA, first and foremost, to be IBM's attempt to derail archrival Digital Equipment Corp.'s successful computer strategy. Members of this camp cite the ability of DEC's VAX hardware (ranging from its MicroVAX microcomputers, through to its VAX 8800 superminicomputers) to run compatible versions of the VMS operating system. They credit this to the Maynard, Mass., company's growing ability to compete favorably against Big Blue, especially in the midrange.

But at least one analyst, Gig Graham, pro-

gram director for software-management strategies at The Gartner Group in Stamford, Conn., questions the applicability of the VAX-SAA parallel. "Employing a single architecture is DEC's own marketing strategy. VMS and DECnet (DEC's proprietary networking product) are DEC's SAA," he contends. A more appropriate comparison may be made between SAA and the UNIX System V interface definition created and distributed by AT&T Co., Graham claims.

The only fact ISVs and VARs are sure of is that they are long on questions but short on answers.

Like the System V interface definition, that of SAA ultimately will take form in published documentation. At present, IBM is in the process of hammering out the finer points. It is promising that technical manuals on each of the four main SAA components will be available by the end of 1987. Several analysts predict that documentation availability will be

(ACF/NCP); Communications Manager (Enhanced Edition 1.1) for OS/2; DisplayWrite/36; Personal Services/36; System/36 Office Management System; System/36 System Support Program and Communications Features; Personal Services/38; System/38 Control Program Facility and Communications Management Functions.

Common programming interface

Elements: SAA-compliant programming languages are C, COBOL and FORTRAN. IBM also includes specifications for application generators, procedure language, nonprocedural language and a dialog interface (for microcomputers) in its programming interface.

Examples of IBM software known to adhere to standard:

Application generators—IBM's System/370 and EZ-RUN (which runs under the OS/2's DOS-compatibility mode) and Cross System Product/Application Execution products; nonprocedural languages—SQL/DS (Structured Query Language/Data Systems; procedures language—REXX (part of the VM operating system); dialog interface—EZ-VU Run Time Facility; standard programming languages. An SAA-compliant C product does not now exist. But IBM says such a product ultimately will be based on ANSI C (IBM C/2 for the PS/2). IBM's 1985-ANSI-COBOL-based VS COBOL II (with IBM extensions) and COBOL/2 for the PS/2; and its VS FORTRAN Version 2 (with IBM extensions) and FORTRAN/2 for the PS/2 are its other languages of choice.

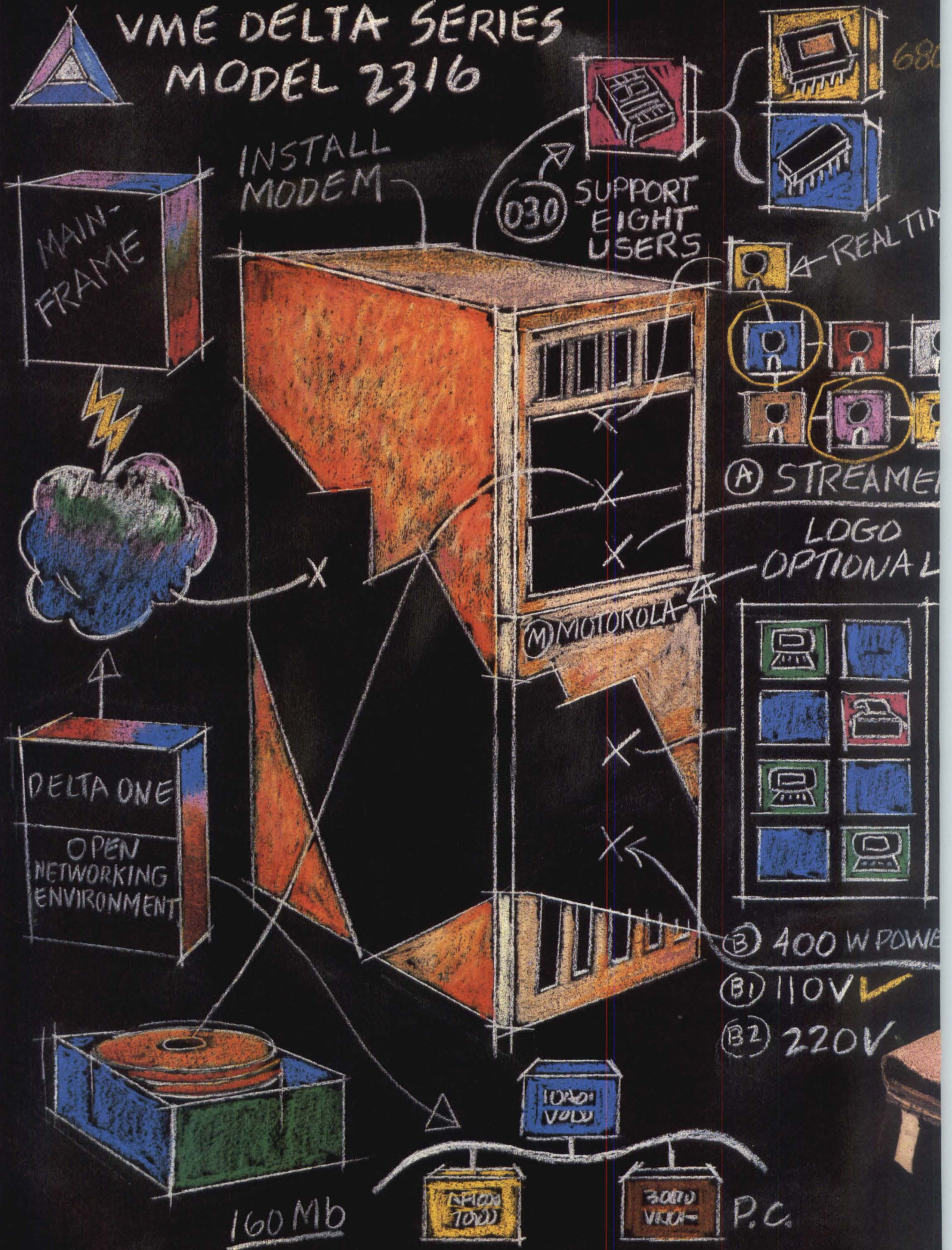
Common applications

Elements: SAA-compliant packages (at least those under development within IBM) will adhere to the above-outlined common user access support and common programming interface guidelines.

Examples of IBM software known to adhere to standard:

IBM says its initial common applications development work is in process. It claims it initially is focusing on integrated-office (document processing, document library, personal services, mail) and decision-support software. IBM's Release 3 of its DB2 for its System/370 family of mainframes is one existing SAA-compliant package.

VME DELTA SERIES MODEL 2316



We believe an original equipment manufacturer should get something original.



At Motorola, we'll address your OEM computer system needs. Not with just another pretty picture. But with an **unfinished** VME Delta Series™ computer. It's an original concept many Fortune 500 companies are finding much more becoming.

We let you do the chalking.

We believe the fastest way to get you to market is to go back to the drawing board. And let you decide the options you want—before manufacture.

You cut per-user costs by choosing only what you need. And keep your OEM edge by delivering better price/performance.

That's Delta Series Flexibility, Part I.

Originals that stay that way.

Part II? Take the 2316, our entry-level supermicro for up to eight users, taking shape to your left. Its six VME slots can house all the system components you need for most small workgroup or cell applications.

Yet it's a VME Delta Series computer. So it improves with age. And can be upgraded in unlimited ways as your needs or technologies change. Thanks to VMEbus open architecture, the 2316 gives you access to thousands of VME hardware/software/accessory products. And you can upgrade to even higher performance Delta systems without costly software modifications.

Networking that's more than small talk.

In a word, the 2316 offers connectability. It lets you interconnect your products into powerful local and wide area networks. Engineering workgroups can share databases and equipment locally. And remote

mainframes, like IBM® host computers, can be easily (and economically) accessed.

A great double-feature: UNIX and real-time software.

The 2316's impressive array of support includes both our AT&T-validated version of UNIX® System V Release 3 and our VERSAdos™ real-time executive under one roof, for creating powerful multi-user/multi-tasking systems. Also included: the 2316's extensive library of high-level languages, DBMS and office automation software...so your development team can erase time.

The 2316 lets you start with a clean slate.

If you'd like to investigate a range of computers built on the idea that no two OEMs are alike, call us.

Your chalkboard is reserved.

800-556-1234, ext. 230. In California:
800-441-2345, ext. 230.



Popular standard options.

- CPU: MC68020 with future upgradability to MC68030.
- Mass storage: capacity for two full-height and one half-height devices.
- Floppies: 1.2Mb or 655Kb.
- Hard disk: up to two. 67Mb ST506 or 160Mb ESDI.
- Streamer tape.
- Serial ports: 4 or 8.
- Wide area networks: X.25 or SNA.
- Local area networks: XNS ETHERNET® or RFS over TCP/IP.
- Memory: 2 Mb or 4 Mb.
- Software: SYSTEM V/68™ (UNIX 5.3), VERSAdos (real-time), C, Pascal, FORTRAN, UNIFY™, Oracle®, Informix® and others.
- Power supply: 110V or 220V. 400W.
- Logo: Yours or ours.

VME Delta Series, SYSTEM V/68 and VERSAdos are trademarks of Motorola, Inc. IBM is a registered trademark of International Business Machines, Corp. UNIX is a registered trademark of AT&T. Ethernet is a registered trademark of Xerox Corporation. UNIFY is a trademark of UNIFY Corporation. Oracle is a registered trademark of Oracle Corporation. Informix is a registered trademark of Informix Software. © 1987, Motorola, Inc.



MOTOROLA Microcomputer Division

Approaching our technology from your point of view.

closer to the first quarter of 1988 (around the same time the Microsoft Corp.-developed OS/2 is expected to start shipping).

One ISV's two cents worth

Contrary to what's believed in some quarters, IBM is not devising SAA in a vacuum. Some of the larger ISVs have offered their two cents worth regarding what should be included and/or deleted from SAA, based on the sketchy first-draft provided by IBM's SAA overview document. (Whether or not IBM will take their concerns into consideration is another matter.)

For one, Atlanta software giant MSA Inc. told IBM, according to MSA vice president of applications technology and research Philip Ross, "If you're not careful, you may aim SAA too far away from anyone to be useful." MSA's quibble with IBM? "In some senses, SAA, as it is [written] currently, applies to zero percent of our customer base," Ross says. IBM has said the mainframe operating environments that it plans to include as part of SAA are VM/CMS and MVS/XA (TSO/E). But 50 percent of MSA's IBM-mainframe customer base is running VSE versions of MSA's accounting, general ledger and other business software. The other 50 percent is running VM software, but primarily under CICS, Ross points out.

The possibility that IBM will revamp its initial SAA specifications to include CICS, as well as other facilities—including RPG 2 and IMS/DC—is rumored. MSA also is pushing for increased support and more product offerings (especially compilers) for the C and the 1985

Orion Network Systems Inc. estimates that integrating and supporting SAA communications features will require 75 work years of software development.

ANSI COBOL programming languages that IBM has included in its preliminary SAA specs.

Other vendors, too, are suggesting improvements in SAA as IBM outlined it earlier this year. "The overview document doesn't give enough information for us to evaluate our products" in terms of how closely they comply with SAA, a Cincom representative says. He adds that Cincom, a vendor of database management, manufacturing and other application

IBM has included PS/2s, System/3Xs and System/370s under its SAA umbrella.

software for IBM and DEC hardware, always has supported IBM standards, such as SQL and SNA (Systems Network Architecture). Both are part of IBM's current SAA definition. In the meantime, he says, "We're working with major research organizations to try to figure out what SAA will mean."

Database vendor Cullinet is experiencing similar difficulties. The company is in the midst of attempting to review its products in order to determine how closely each complies with SAA as IBM has outlined it thus far. Cullinet is planning a series of announcements by the end of the year regarding how it sees itself fitting into the SAA picture, says director of systems product marketing Scheidt.

"It's a bit frustrating that we can't get more information from IBM," acknowledges Scheidt. He points out that IBM has been more explicit in defining the SAA environment for microcomputers than it has for minicomputers or mainframes. At the mainframe level, for instance, IBM has not announced what the preferred SAA windowing environment will be, while it has singled out Presentation Manager at the low end, he says.

"We want to play by their rules, but we would prefer to define it (SAA) a little more broadly," Scheidt adds. In particular, SAA fails to address the reality of multivendor customer installations—especially those including DEC hardware—he claims. Cullinet's ongoing attempt to ensure the portability of applications across various vendors' microcomputers, departmental minicomputers and mainframes—a strategy Cullinet calls its 3X3 Architecture—addresses this need directly, he says.

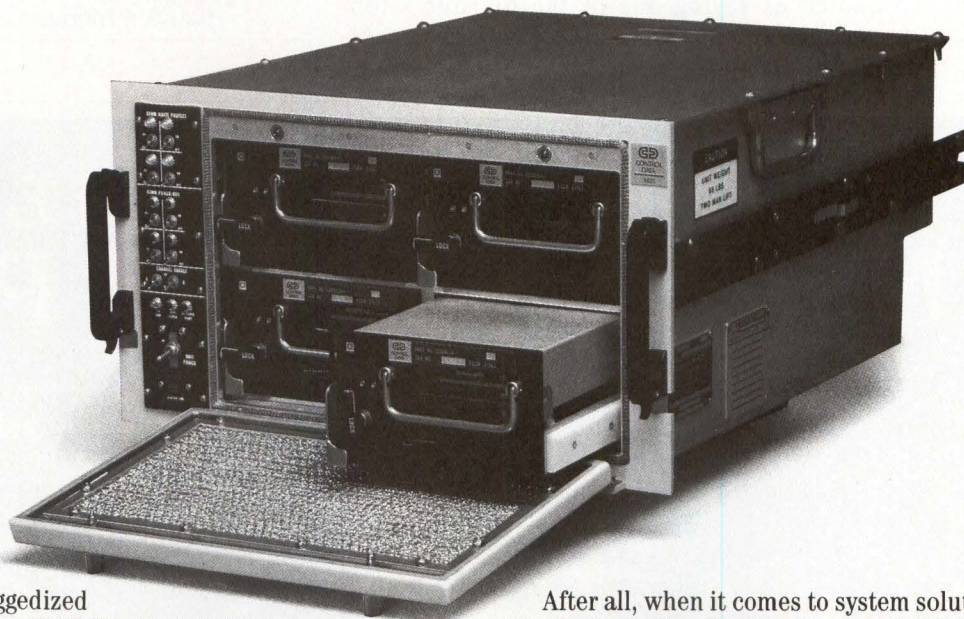
Unwarranted attention

But even if IBM hadn't announced SAA, Cullinet would have continued its own cross-

<u>SAA Component</u>	<u>Lines of Code</u>
1. Logical Unit 6.2 (APPC)	75,000
2. Node Type 2.1 (LEN)	75,000
3. SDLC support	5,000
4. Token Ring	10,000
5. X.25 (includes X.3, X.28, X.29, QLLC)	80,000
6. 3270 emulation	75,000
7. Document Interchange Architecture (DIA)	50,000
8. SNA distribution services (SNADS)	125,000

*The above estimates, excluding Token Ring, are based on Orion Network Systems Inc.'s current implementations.

Kierulff offers a Control Data military disk drive you can treat like the enemy.



Control Data's Ruggedized Advanced Disk System (RADS) is built to take the punishment of a military environment.

RADS is designed for TEMPEST requirements. It'll easily operate in extreme heat, cold and humidity. Even dust and dirt won't pose a threat to its ability to store up to 728MB of information on four removable disk storage memory modules.

Tough doesn't mean slow. Seek time is typically only 18ms. And you don't need to give it any special attention since RADS can operate on 115 VAC, 47-400 Hz single phase power and will mount in a standard EIA cabinet.

And, when it comes to customer service, Kierulff can handle just about anything you can throw at us, too.

As an example, we'll help you solve a technical design problem or correctly integrate our recommended system.

After all, when it comes to system solutions, Kierulff wrote the book. Our Systems Product Guide is the industry's most complete, single-source of product information on



18 leading manufacturers of systems, peripherals and accessories. Contact us for your copy or look for Volume 3-KE of the Gold Book.

So call 1-800-FOR PROS (1-800-367-7767). It'll connect you with the Kierulff professional nearest you.

And the Control Data military disk drives that are ready for anything.

KIERULFF
Our people are the best part.

hardware compatibility endeavors, Scheidt says. Other vendors probably would have continued their own efforts to increase compatibility and portability between and among IBM and non-IBM hardware and software products. These facts support Gartner Group analyst Graham's contention that the emphasis on SAA "compatibility" by both the press and the IBM user/value-added vendor communities is unwarranted.

"Some [software] product retooling will take place" as a result of SAA, Graham claims, "but not a lot more than what's happening now. SAA is not the means to write compatible code. And just complying with SAA doesn't mean code will be portable." Instead, he says, SAA demonstrates that, from IBM's point of view, "there are no longer strategic products; just strategic interfaces."

This is not to say that vendors and users can afford to ignore SAA. Joseph Guglielmi, the vice president heading IBM's newly formed Application Software division, was recently quoted as saying one of the division's top priorities is to facilitate the use and acceptance

of SAA within both IBM and the software community.

But precisely how ISVs and VARs should best prepare for SAA remains a question. IBM's intentions in the S/3X arena are especially murky. Most market watchers expect IBM to merge its S/36 and S/38 products into a hybrid (under the code name Project Silverlake) within the next couple of years. In the meantime, third-party vendors can do little more than piece together the clues IBM has provided in the microcomputer and mainframe environments, MSA's Ross admits. For its part, MSA is studying the PS/2 and its software (as it becomes available), he says, "because we believe it will be so closely in synch with the rest of SAA."

The bottom line, Ross acknowledges, is that, "A lot of SAA is still very undefined. And many of those areas where specifics have been defined are not available yet." □

Mary Jo Foley is a freelance business and technology writer based in Washington, D.C.

Interest Quotient (Circle One)
High 514 Medium 515 Low 516

Multibus™ I & 68020: A New Standard of Power

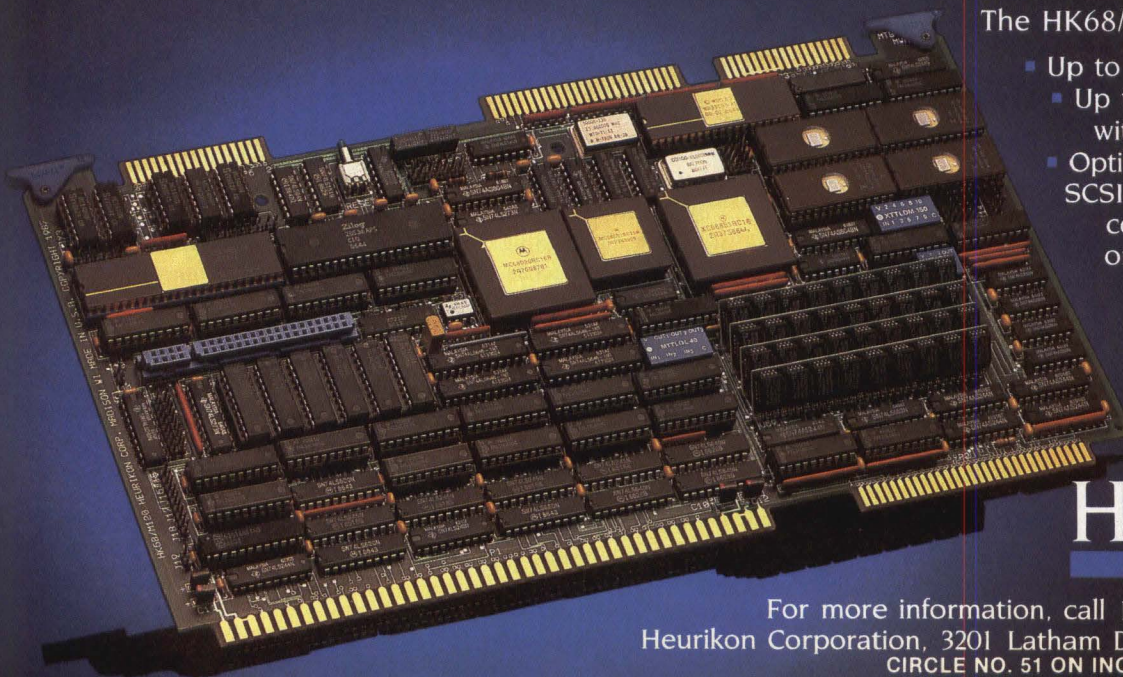
Heurikon introduces the most powerful 32-bit single board microcomputer for Multibus I.

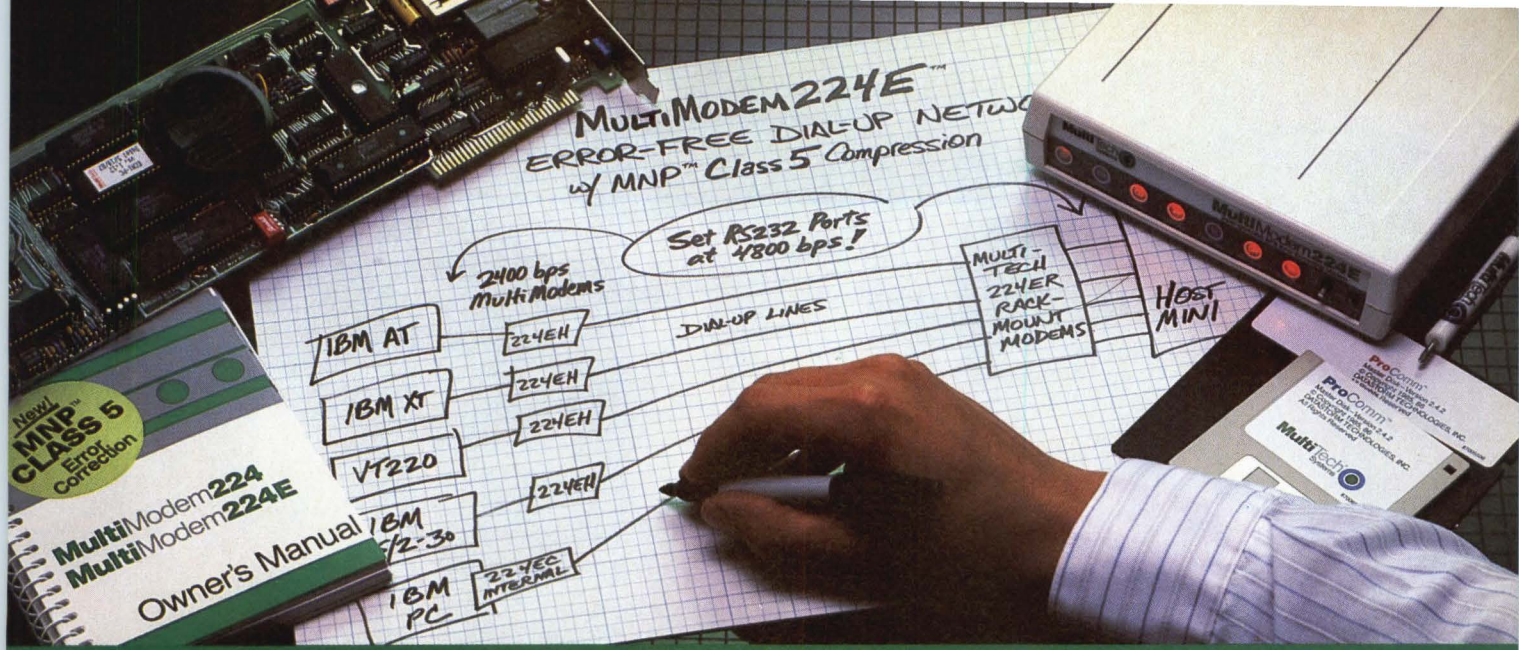
The HK68/M120 features include:

- Up to 25MHz Motorola 68020
- Up to 4MB on-board DRAM with parity
- 256K EPROM
- Optional 68851 PMMU
- Full SCSI interface
- 16-bit iSBX™ connector
- iLBX™ memory expansion bus
- Two serial ports
- Optional 68881 floating point coprocessor
- Mailbox interrupt support
- UNIX™ and real-time support.

HEURIKON CORP

For more information, call 1-800-356-9602, Ext. 409
Heurikon Corporation, 3201 Latham Drive, Madison, WI 53713
CIRCLE NO. 51 ON INQUIRY CARD





MNP™ Class 5 Data Compression Modems from Multi-Tech Systems: When it has to be as *fast* as it is good

- In the dial-up modem world, Class 3 MNP is the hands-down choice for hardware-based error correction. With its 100% error-free transmission, the MNP protocol is used in dozens of manufacturers' 1200 & 2400 bps modems, and our MultiModem224E modems have been recognized as the best of their kind (see box).
- Well, the best just got better. Multi-Tech modems now offer MNP Class 5 data compression along with error-correction. Class 5's 2-to-1 compression and serial port speed conversion means that you can buy a 2400 bps modem from Multi-Tech and run it at speeds of up to 4800 bps*. Error free!
- Multi-Tech Class 5 modems will communicate automatically with MNP Class 4 and Class 3

modems, as well as non-MNP modems. And if you wish, you can even upgrade your present Multi-Tech Class 3 & 4 modems to Class 5 (call us for details).



In the May 12, 1987 edition of PC Magazine where 87 modems were reviewed, only three were awarded *Editors Choice*: "For a high-performing 2,400-bps modem with a slew of extras, check out Multi-Tech Systems' MultiModem224E... with [its] high immunity to line noise and the extra advantage of MNP error correction, [this modem] should do a fine job of managing fast, error-free data communications."

- Our Class 5 modems incorporate all of the features of our Class 3 versions. Features like phone number & configuration memory, auto-repeat dial and "AT" command compatibility. And Multi-Tech's seventeen years of modem manufacturing experience.
- Please call us toll-free at **1-800-328-9717**, for additional information... get a modem that's as fast as it is good!

* The compression throughput of MNP Class 5 is, like all compression schemes, dependent on the type of data being sent. The more "compressible" the data, the greater the throughput. For example, a typical text file transfer at 2400 bps should yield a throughput of between 4400 and 4900 bps. And the MultiModem224E's speed conversion and flow control features let you set your modem's RS232C port at 4800 or even 9600 bps, to take full advantage of the Class 5 compression.
Trademarks: Multi-Tech, MultiModem—Multi-Tech Systems, Inc.; PC Magazine—Ziff Davis Publishing; MNP—Microcom Network Protocol licensed from Microcom, Inc.



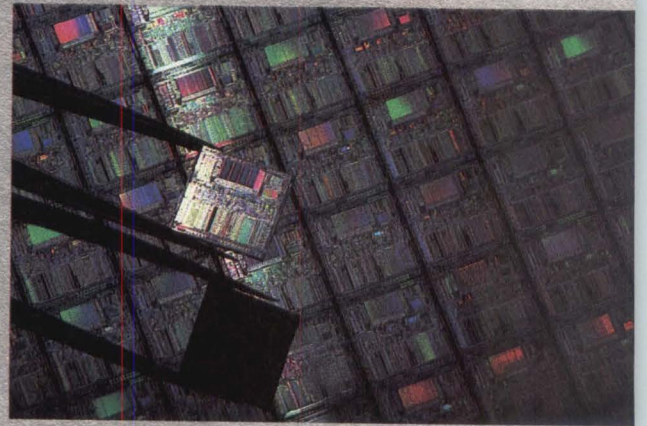
CIRCLE NO. 53 ON INQUIRY CARD

The right answer every time.

Multi-Tech Systems, Inc. • 82 Second Avenue S.E. • New Brighton, Minnesota 55112 U.S.A.
1-800-328-9717 • 1-612-631-3550 • FAX 612-631-3575 • TWX 910-563-3610 (U.S.A.) • Telex 4998372 MLTTC (International)

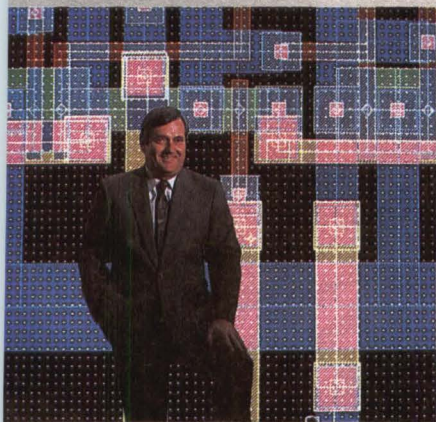


Digital
has
it
now.



“Our Dracula™ layout design verification software was developed and based on Digital systems, and for very good reason,” states ECAD President Jim Hill. “Our customers in Integrated Circuit design regard Digital’s VAX™ systems as the standard. Recognizing that, we’ve developed a line of software products that have made us the standard of our industry.”

According to Mr. Hill, Digital’s unmatched software compatibility offers real benefits in creating customer acceptance. “We know that whatever Digital system the customer has purchased, our software will run on it successfully. That kind of confidence is rare in the IC design industry. And Digital’s hardware and



“ECAD seized an 80% world market share – the key was writing our design software to the industry standard, Digital.”

software consistency helps us deliver a better product, faster and at a lower cost.”

“We’re aggressively pursuing a worldwide market,” Mr. Hill adds. “And Digital has the worldwide presence to help us sell each market with strong local support. Our software and Digital’s systems sell each other. ECAD and Digital have evolved a strategic partnership, one that gives us a proven competitive advantage in the marketplace.”

To get your competitive advantage now, write to: Digital Equipment Corporation, 200 Baker Avenue, West Concord, MA 01742. Or call your local Digital sales office.

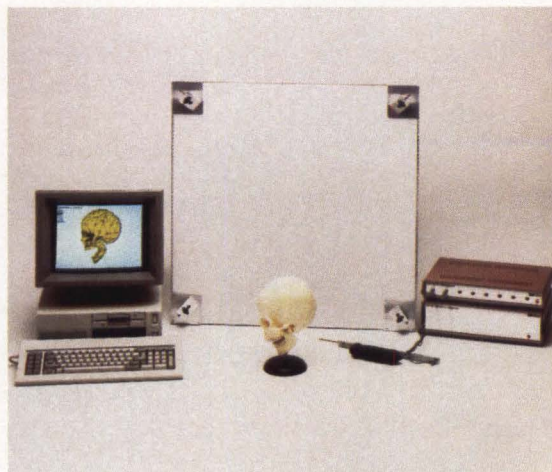
digital™

Still trying for 3D from a flat tablet?

We're not.



Wrong.



Right.

That's because our GP-8-3D Three Dimensional Digitizer will input XYZ data, REAL TIME, imagine the time saved in developing 3D models for CAD/CAM, Graphics, Solid Modeling, or whatever your design requirements are.

Our digitizer will give you the freedom to:

- Digitize volumes up to 9' cubed, user adjustable.
- Resolution of .01 cm.
- Digitize any material including metal.
- Optional 8 or 16 channel multiplexer.

It makes sense, saves time and effort to digitize 3D directly into your system, whether you are a workstation manufacturer, or user. Driver and graphic software packages available from PyxSys, Inc. (303) 447-0248. Call Science Accessories immediately for complete details, specifications, and demonstration.

For more information contact: Skip Cleveland (203) 255-1526

SAC[®] SCIENCE
ACCESSORIES
CORPORATION

970 Kings Highway West, P.O. Box 550 • Southport, CT 06490
(203) 255-1526 • Telex 964300 • FAX (203) 254-7271

CIRCLE NO. 55 ON INQUIRY CARD

TAPE DRIVES

Helical scan recording expands tape capacity

Winn Schwartau
Sleepy Hollow Engineering

Tape drives based on helical scan technology, such as the VAST (Virtual Archive Storage Technology) Device from Emerald Systems Corp., now offer high-capacity data handling (e.g., more than 250M bytes) in the desktop environment.

The VAST Device is based on the proven helical scan technology used in professional and home video recorders. But, digital data recording is significantly more error-prone than video and requires extensive modifications to the recording system to achieve a sufficiently reliable tape subsystem.

The VAST Device, with all of its associated electronics, weighs 12 pounds and has dimensions of 13 by 9½ by 6 inches. The device interfaces to IBM Corp.'s PC, PC/XT, PC/AT, PS/2 Model 30, Compaq Computer Corp.'s Desktop 286 and 386, and compatibles via a 60-inch cable and a SCSI (small computer systems interface) board that plugs directly into the PC. Up to seven SCSI interfaces may be addressed per PC slot, resulting in a total capacity of 16G bytes. Emerald Systems' device incorporates advances over established helical scan recording technology.

Recording technology made easy

Helical scan recorders were first commercially produced by Ampex Corp. in 1961 for use with video

Winn Schwartau, is president of Sleepy Hollow Engineering, a high-tech marketing consultancy specializing in new product introductions. He has spent 14 years in the professional audio/video field and 11 years in computer-related areas.

recording. They employ many of the rules of magnetic recording, yet yield a much higher data density.

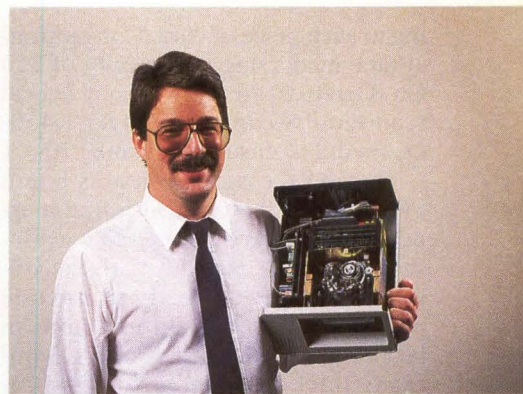
Rather than having three fixed heads in a tape path, as in conventional tape drives, in helical scan recording three heads are mounted on a drum that rotates at 1,800 revolutions per minute (rpm). The tape is wrapped around the drum in the shape of a distorted "C" (C wrap) at an angle of about 5 degrees to the face of the drum.

The recorded data (track) is not a longitudinal path along the tape, but a track that crosses the tape at an angle.

Recording on helical tracks, or stripes, offers several technical advantages when compared to conventional longitudinal recording. For example, it uses a narrow-width, narrow-gap, single-track head that is easy to manufacture—rather than a complex multitrack head, as in conventional longitudinal recording.

While head manufacturing technology is beyond the scope of this article, consider the following statements. In a multitrack head, nine, 18 or even more heads must be properly made, then precisely glued together to make a multitrack head stack. The multitrack read head must be exactly aligned to the individual heads of the erase and write head stacks, all of which need to firmly and accurately attach to the tape drive mechanism.

In addition, fixed multitrack head stacks have the inherent problem of "fringe effect," in which data "smears" to the outside of the written track and into the guard-band area. Helical scan heads, on the other hand, are individually manufactured and installed in the rotating drum assembly, without these encumbrances.



To achieve helical scan recording, three heads are mounted on a drum.

Helical scan recording also allows for reducing the tape speed. In the case of the VAST Device, the tape speed is 0.43 inches per second (ips), which is substantially slower than the common 60 ips, 90 ips or faster speeds of fixed-head systems. Although the tape speed is slow, the rotating heads make contact with the tape for an actual head-to-tape speed of about 150 ips. This allows higher linear recording density and reduces tape wear.

In the recording pattern, a series of very narrow stripes (0.00098 inches wide) are written acutely across the tape. Each stripe (about 3 inches long) represents a single rotation of the head travelling at 1,800 rpm. Each track can hold about 8K bytes of user data, and there are 820 tracks per lineal inch of tape. Thus, with an effective areal recording density of 35.4M bits per square inch, a 346-foot tape can store more than 2.3G bytes of user data. (The actual formatted capacity is slightly less, due to error correction.)

Ultra-fine media offers advantages

Helical scan recording requires media with much higher coercivity and retentivity than conventional recording media. This is because there is less magnetic material correspond-

TAPE DRIVES

ing to each piece of data. Conventional tape media has a coercivity of 350 Oe (Oersteds) to 450 Oe, but helical scan requires approximately 1,450-Oe media to ensure data integrity.

The VAST cassette contains 8-mm video media that uses ultrafine magnetic metal particles. Each needle-shaped particle is about 1/25th the volume of conventional iron-oxide particles and is only 0.15 microns in length. The tape itself is only 13 microns thick (compared to a typical iron-oxide VHS video tape thickness of 20 microns). But, it has a breaking strength of over 6½ pounds and a residual elongation of only 0.02 percent. The cassette is only 3 by 2¼ by one-half inches, taking up 1/100th the equivalent storage volume of a 200M-byte, half-inch tape.

Due to the fine particulate nature of the coating and its high sensitivity to contamination, a double-sided door surrounds the tape to provide protection during periods of non-use.

Errors easily corrected

Putting gigabytes of data onto a single cassette requires extensive soft-

ware support and manipulation, as well as elaborate error-correction schemes. To simplify these tasks, the VAST Device uses a simple stripe/track data format. Tape formatting is automatic and transparent to both the user and the host, thus simplifying installation and use of the device.

Each stripe is 3.037 inches in length

If a hard error is indicated after 12 unsuccessful attempts, the media is probably defective.

and holds a maximum of 8.1K bytes of formatted user data. The data are organized into eight data blocks, each with 1K user bytes, 16 address bytes and 400 bytes of appended ECC (error correction code). A servo zone with the equivalent of 1.2K bytes is located within each track, providing mechanical, motor and servo feedback information for precise tape positioning.

However, error correction is key to any storage device, especially one that stores more than a gigabyte per cassette. Proprietary error-correction codes in the VAST Device allows for 10^{-15} bit write errors and 10^{-13} bit read errors.

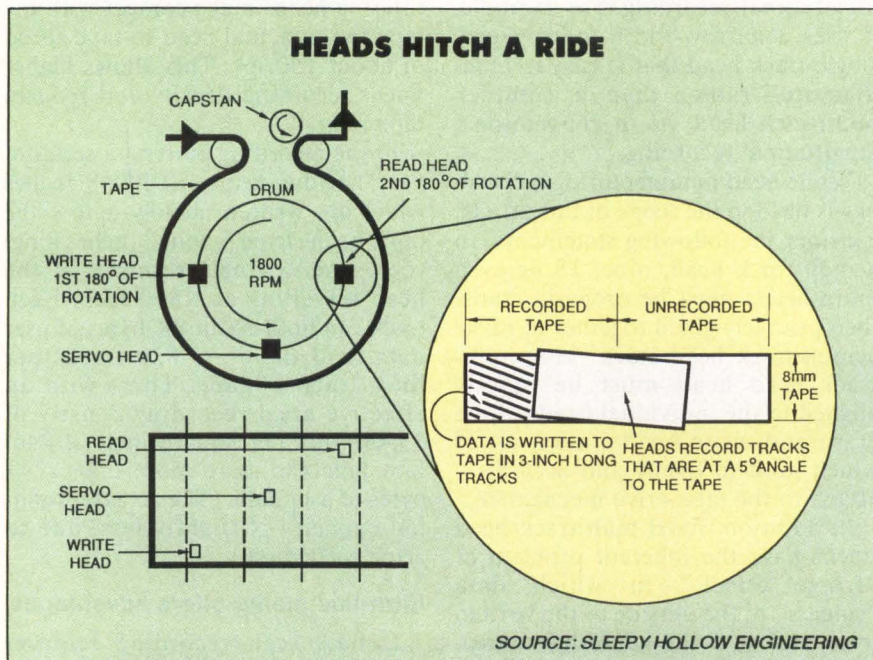
The ECC used in the VAST Device is powerful enough to correct an erroneous data burst of 256 bytes and 80 additional random errors in each 1K-byte data block.

The basis for the device's ECC is a modified Reed-Soloman interleave. To oversimplify, the device uses a read-after-write scheme, which is difficult to implement with helical scan recording.

In a read-after-write implementation, the first half (180 degrees) of the drum's rotation is used for writing and formatting. The second half of the rotation is used for the read-and-verify process. The servo information is interspersed throughout the complete rotation.

But, this scheme would seem to create a problem. While the write head is writing the diagonal track during the first 180-degree rotation of the drum, the tape is also moving. By the time it gets to the second 180-degree drum rotation to read and verify the previously written track, the tape has moved just enough so that the read head will miss the data altogether. To compensate for this, the tape could be repositioned after each write half-cycle, to read and verify. But, this would cause a substantial loss in throughput speed and the margin for error would increase unacceptably.

To solve this problem, the VAST Device uses the previously mentioned three heads on a rotating drum. The erase head has been taken off the drum and a fixed, full-width erase head has been placed in the tape path. To compensate for the lateral movement of the tape, the read head (and the servo head) of the VAST Device is out of the write head's plane. When the second half of the drum rotation occurs, the read head is already properly positioned to read and verify the written data. (In conventional helical scan recording, both the write-and-



The write head, servo head and read head are drum-mounted. They lie in three different planes and record at a 5-degree angle to the tape.

TAPE DRIVES

read head lie in the same plane.)

There are two ECCs in the VAST Device. The first one is the write ECC, which occurs on the fly during the data-writing process and is transparent to the user and host. During the read-verify process (of the write cycle), the ECC is effected by the ECC code written during the first 180 degrees of drum rotation in each data block.

During the write operation, if an error is detected, the system rewrites the same 1K-byte data block 11 blocks farther down the tape. This horizontally repositions the written data to the next track. And it moves the data vertically away from where it was previously written, to escape any potential, isolated, media defects. During this rewrite, the system maps out serial data-address shifts on the fly, always knowing where the accurate data is located.

During the second attempted write, another read-verify occurs. If the data passes the ECC, then the next block of data is sequentially written. However, if another error is detected, the system will again write the same data block 11 blocks down the tape. The VAST Device will perform this operation up to 12 times until the written data is verified. If a hard error is indicated after 12 unsuccessful attempts, the media itself is probably defective.

The second implementation of the device's ECC occurs during a later read-only pass. Under the sophisticated buffer-management scheme, the read-only ECC is able to correct a previous write error. When the ECC corrects a write error, the rewrites are tossed away and the read process continues.

If the error is non-recoverable by the read-only ECC, the read sequence continues 11 blocks down the line. The system keeps track of the locations of both good and bad data. After 12 unsuccessful attempts at reading the subsequent rewrites, the tape will reposition itself back to the first read-write error location. It will then attempt to accurately read the data blocks by skewing the tape-head position for off-track reading. Eight such

attempts are made before a hard error registers.

Electronics control processes

The VAST Device contains a complex array of electronics that controls the various processes. The microprocessor board drives the device and its internal peripheral components.

A 256K-byte data buffer resides on the SCSI interface board, permitting transmission burst rates of 1.5M bytes per second and a nominal data transfer rate of 250K bits per second (bps). Logical user data blocks of 1K byte are formatted into physical blocks for writing to tape. Each block is then appended with the appropriate tag and address information. Buffer management operations are performed in firmware.

The read/write board contains all of the write-head driver circuits, the read-head preamplifiers and equalization circuits, and the frequency

generator and current driver for the erase head.

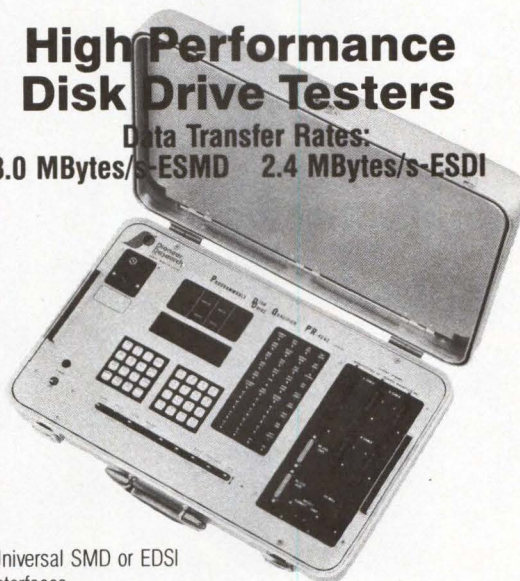
The motion-control system directs the drum and capstan servos, reel motor, load motor, mode-change motor and control solenoid. Sensor circuits for the drum, capstan, reel tachometers, EOT/BOT (end of tape/beginning of tape), tape length, write protect and door status are interfaced to the other logic systems.

The only external components that the VAST Device uses (which are included) are the 52-conductor, shielded interface cable that connects the device to the PC Bus (or IBM PS/2 Micro Channel), and a single, half-slot SCSI board. The software installs on the resident rigid disk. □

Interest Quotient (Circle One)
High 520 Medium 521 Low 522

High Performance Disk Drive Testers

Data Transfer Rates:
3.0 MBytes/s-ESMD 2.4 MBytes/s-ESDI



- Universal SMD or EDSI interfaces
- Menu-driven software links to PC/XT/AT
- Up to six preprogrammed tests
- Canned diagnostics with direct alphanumeric readout
- Auto drive configuration
- Front panel programmable to 100 steps
- Reads, writes & updates error maps
- Multidrive testing
- Remote operation

Pioneer Research

1745 Berkeley St., Santa Monica, CA 90404
Call 800/233-1745, 800/848-1745 (in California)

CIRCLE NO. 57 ON INQUIRY CARD

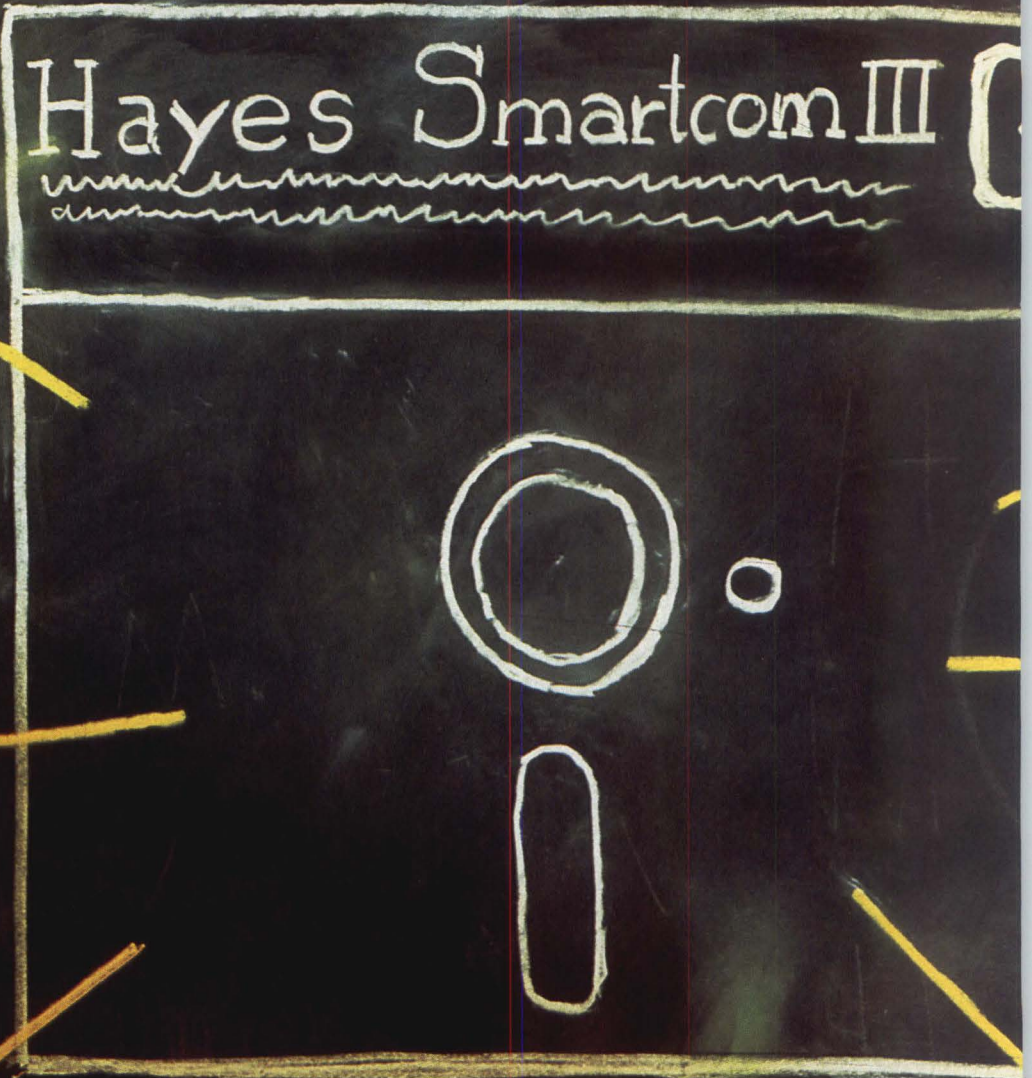
THIS TIME WE OUTSMARTED

115,200
Baud Rate

Hayes Smartcom III

SCOPE™
Advanced
Scripting
Language

Peruse
Buffer



EVEN OURSELVES.

Full-Featured
Editor

File
Compression

New Transfer
Protocols

We at Hayes have always been credited with being ahead of our time. Now, we're even ahead of ourselves. Introducing Smartcom III,[™] clearly the most advanced, full-featured communications program ever designed for the IBM[®] PC-XT, AT, PS/2 family and your Hayes modem.

Smartcom III includes on-line help facilities for the novice as well as more advanced features for the power user. Features like a peruse buffer to automatically store information for later disk capture, printing or editing, an editor for creating and revising text, both on-line and off-line, and the support for multiple communications sessions with two remote systems simultaneously. Smartcom III also offers on-line DOS operations for the performance of common disk and subdirectory operations without ever having to exit the Hayes program. It even provides file compression and scrambling techniques for the enhancement of effective throughput and private data transmission.

Plus, with Smartcom III's Simple Communications Programming Environment, SCOPE,[™] the transmission process can be totally automated. This easy-to-use scripting language comes complete with a learn mode and provides access to the programming tools used to create Smartcom III itself.

So now that you know what Smartcom III is capable of, you may wonder where intelligence of this caliber will lead you. And the answer to that is the future.

If you currently use Smartcom II[®] or Crosstalk[®], take advantage of our special introductory offer:

If you purchased Smartcom II prior to 1/1/87, return the original program disk to us along with \$60 and we'll upgrade you to Smartcom III; if you purchased Smartcom II after 1/1/87, return it along with \$30 and dated proof of purchase for a Smartcom III upgrade. And if you use Crosstalk, send any version of the original program disk along with \$60 and we'll give you the same Smartcom III upgrade.

This offer good through 12/31/87 only in the USA and Canada.

For more information, contact your local Hayes Dealer, write Hayes at the address below, or call 404-441-1617.



Hayes[®]

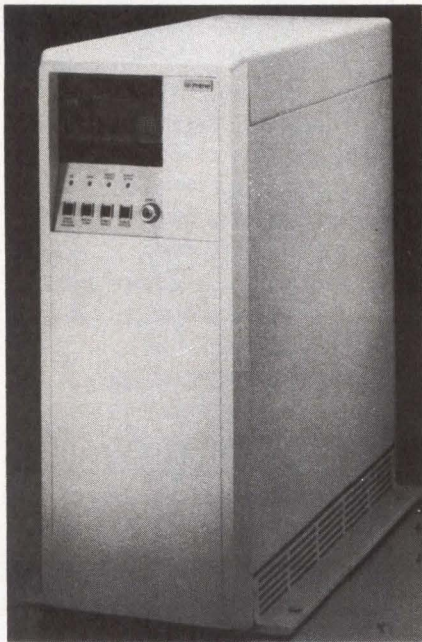
Hayes Microcomputer Products, Inc., P.O. Box 105203, Atlanta, GA 30348.

CIRCLE NO. 58 ON INQUIRY CARD

NEW PRODUCTS

SYSTEMS

Megan Nields, Staff Editor

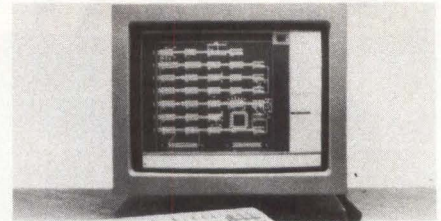


UNIX, IBM programs coexist on 386 supermicro

- 10 asynchronous lines
- 90M-byte storage
- 60M-byte tape backup

An 80386-based supermicrocomputer, the PRIME EXL 316 runs programs for UNIX-based systems and IBM PCs simultaneously. A standard configuration includes the UNIX V.3 operating system, 2M bytes of memory expandable to 8M bytes, 90M bytes of formatted disk storage, a 60M-byte streaming tape backup system and 10 asynchronous lines. The system accommodates up to 58 asynchronous lines. \$23,900 and higher. **Prime Computer Inc.**, Prime Park, Natick, Mass. 01760, (617) 655-8000.

Circle 542



Server series runs on UNIX

- 10-MIPS performance
- OSN networking
- Single-board upgrades

A UNIX-based series of high-performance network server workstations, the Sun-4/200 workstations are compatible with Sun's Open Systems Network (OSN) networking protocol. The systems use proprietary Scalable Processor Architecture (SPARC) to deliver 10-MIPS performance at a cost of about \$5,700 per MIPS. They are compatible with Sun's midrange servers: the 3/160, 3/180, 3/260 and 3/280. These systems can be upgraded to a 4/200 server with the addition of a single board. \$36,900, 8M-byte 4/260S; \$104,900, 32M-byte 4/280S. **Sun Microsystems Inc.**, 2550 Garcia Ave., Mountain View, Calif. 94043, (415) 960-1300.

Circle 544



Desk-side system boasts 1.6 MIPS

- Up to 40 users
- 774M bytes of storage
- LAN-compatible software

An addition to the 50 series of desk-side computers, the model 2455 provides a 50 percent boost in storage capacity and an 88 percent increase in performance to that line. The unit supports up to 255 simultaneous processes for up to 40 direct users. It stores up to 375,000 pages of typed information in a system the size of a typical typewriter stand and operates at 1.6 MIPS. The 2455 can handle up to 12M bytes of main memory, as well as three 258M-byte, 5/4-inch Winchester disk drives in the same cabinet. The LAN-compatible system can be linked to other computers via the proprietary LAN300 software and Ethernet. Applications include CAD/CAM. \$62,810 and higher. **Prime Computer Inc.**, Prime Park, Natick, Mass. 01760, (617) 655-8000.

Circle 541

Workstation achieves 4-MIPS

- Surface DRAM
- Motorola MC68020-based
- 32M-byte memory

Available in monochrome or color versions, the Domain Series 4000 Personal Super Workstation features a Motorola MC68020 microprocessor, and incorporates a 25-MHz 68881 floating-point coprocessor. The Series 4000 uses 1M-bit surface-mounted DRAMs capable of delivering up to 32M bytes of main memory. Up to eight planes of color are packed onto a single IBM PC/AT-compatible graphics controller board, resulting in up to 16 million colors. \$5,000 to under \$10,000 for monochrome and color versions. **Apollo Computer Inc.**, 330 Billerica Road, Chelmsford, Mass. 01824, (617) 256-6600.

Circle 543

Diskless computers target LAN operations

- 10-, 12.5-MHz 80286
- Up to 640K bytes RAM
- Three configurations

The three versions of LANstation systems are based, respectively, on a 10- or 12.5-MHz Intel 80286 processor and an 8088-based Turbo XT that operates at 8 MHz and is expandable to 640K bytes of RAM. All three systems feature a zero wait state and function as "diskless" stations in a LAN. The units supply both serial and parallel ports, as well as a choice of monochrome or color video displays. \$599, Turbo XT; \$979, 10-MHz model; \$1,279, 12.5-MHz version. **Racore Computer Products Inc.**, 170 Knowles Drive, Los Gatos, Calif. 95030, (408) 374-8290.

Circle 545

Not only do we know who it's for, we know who's calling and what the message is. That's because an NCR 286 CPU board is at the heart of an innovative new voice mail system. Handling the calls for as many as a thousand users, sixteen at a time. All in a single personal computer chassis. And the next call we take may be for you.

The message we want to leave you here, of course, is that NCR PC technology is at work in many places beyond accounting and data processing. Like manufacturing control systems in factories everywhere. Diagnostic imaging equipment in clinics and hospitals. Even a new CD ROM jukebox at play in record stores.

What's behind this frenzy of applications activity?

We know for whom the bell tolls.

For some it's the versatility of split board architecture. For others it's the compact size and low power requirements of VLSI and surface mount technology. But for everyone it's the way we configure the pieces to meet the specific demands of the application. Without chewing up the calendar or your budget in the process. In short, we're easy to work with.

Because we have the engineering know-how and the manufacturing can-do to deliver the goods. Without hitches, without surprises, and without fail.

So, as you look into developing new products, or improving your existing ones, look into NCR.

For more details about how NCR PC technology can fit into your plans, call us at (513) 445-0670. Our response is sure to ring your chimes.

A SMART FOUNDATION TO BUILD ON.



CIRCLE NO. 59 ON INQUIRY CARD

NCR Corporation
 Personal Computer Division
 OEM/Technology Sales
 Dayton, Ohio
 45479



LASERVIEW PLUS: THE EDITORS' CHOICE IS NOW SUPPORTED BY ALL THE STANDARDS.

*"... unquestionably altered
the definition of high
resolution."*

PC Week

*"... provides the
sharpest image of all."*

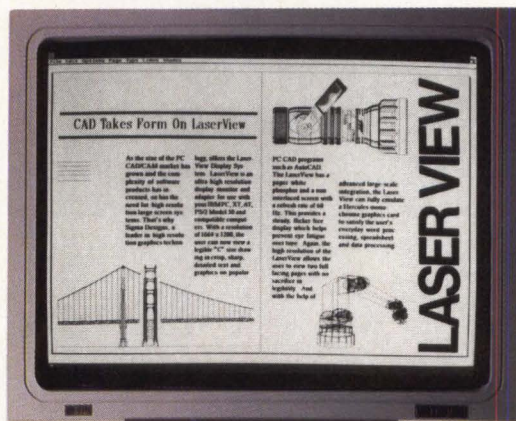
PC World

*"LaserView: The Master
of the Raster"*

Bits & Bytes Review

*"... Breathtaking...
the Rolls Royce
of large screen monitors."*

InfoWorld



What They've Seen:

LaserView, the ultra-high resolution, 2,000,000 pixel (1664x1200) display system for IBM PC, XT, ATs.

The ultimate system for displaying two full facing pages of legible text and graphics for your publishing applications.


Or detailed design drawings without excess panning for CAD/CAM applications.

What You'll Get:

LaserView PLUS™, everything the editors raved about, PLUS a whole lot more: IBM-Monochrome and Hercules compatibility. And now LaserView stands alone. Literally! You can run all your standard software without a second monitor. So the premium display for professional graphics applications is now the only display you'll need.

For details and the dealer nearest you, call 415-770-0100.

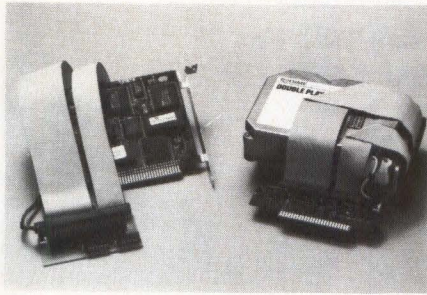
LaserView and LaserView PLUS are trademarks of Sigma Designs, Inc. IBM is a registered trademark of International Business Machines. Hercules is a trademark of Hercules Computer Technology, Inc.

 Sigma Designs, Inc.
46501 Landing Parkway
Fremont, CA 94538

S I G M A D E S I G N S

CIRCLE NO. 61 ON INQUIRY CARD

DISK/TAPE



**Subsystem suits
IBM PS/2**

- 45M bytes
- Proprietary board
- 28-msec access time

The Double Play disk drive subsystem offers 45M bytes of storage for the IBM PS/2 Model 50. The 3½-inch unit includes a proprietary interface board and partitioning software. It boasts a 28-msec average access time, an ST412/ST506 interface and an 18,000-hour MTBF. Automatic head parking and locking are provided. \$899. **Rodime Inc.**, Peripheral Systems Division, 29525 Chagrin Blvd., Pepper Pike, Ohio 44122, (216) 765-8414.

Circle 546

**WORM drive frees
LAN space**

- Up to 115M bytes
- 2.5M-bps transfer rate
- Proprietary software

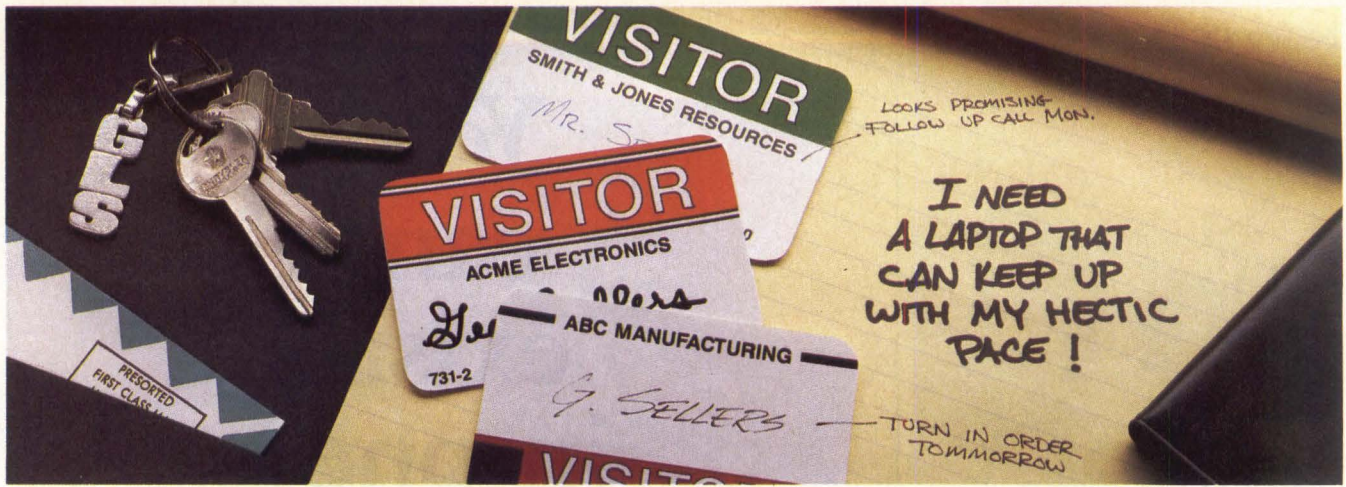
The ISi WORM disk drive subsystem frees LAN rigid disk space for read-write data files. It stores up to 115M bytes per side. An external subsystem includes a disk drive, controller card, disk and proprietary software. Average access times are 135 msec for a full data band, 18 msec for 1M byte and 1 msec track-to-track. Data transfer rate is 2.5M bps. The optical disk supplies 14,901 tracks with 32 sectors per track. \$2,595, internal version; \$2,795, external version. **Information Storage Inc.**, 2768 Janitell Road, Colorado Springs, Colo. 80906, (303) 579-0460.

Circle 547

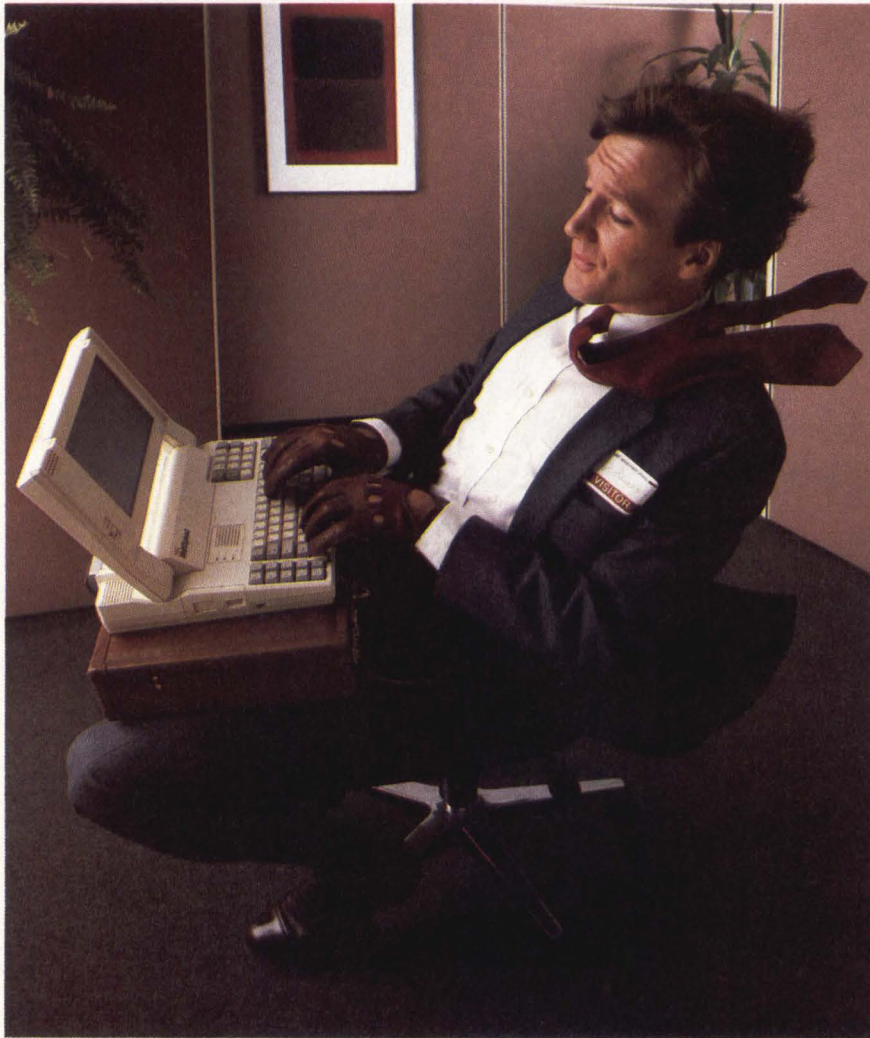
You
can
exist
in one
environment.

But you can't
prosper.

You've spent a lot of time and effort developing your product. And you've given a lot of thought in choosing which environment. But the fact remains, one environment isn't enough. You need more if your applications are going to realize their full potential in the marketplace.



The Hall-Mark solution:



The NEC Multispeed

Talk about life in the fast lane, with the NEC Multispeed you have the fastest processing speed of any competitive laptop on the market. It has more power, more memory and twice the speed of the IBM convertible, and that gets you your answers when you need them — NOW!

Weighing only 11.2 pounds, the Multispeed with its 640K of main memory, six built-in software programs plus dual disk drives or 20MB Winchester, can run most software applications that a big desktop PC can.

Call Hall-Mark today for more information or a demonstration of the NEC Home Electronics Multispeed. When you're on the go, you need a computer that can keep up the pace. Hall-Mark can put you in the driver's seat with the fastest portable on the market. Add to your Multispeed from Hall-Mark's fine selection of monitors, printers, or diskettes, and you will see why we have the solutions to fit your computer systems needs.



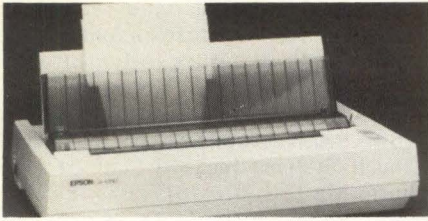
A COMMITMENT TO EXCELLENCE

© 1987 Hall-Mark Electronics Corp./400-4022
Hall-Mark Electronics is a subsidiary of the Tyler Corp.

- | | | | | | | |
|--|--|--|---|---|---|---|
| Alabama
Huntsville (205) 837-8700 | San Diego (619) 268-1201
San Fernando Valley (818) 716-3300
West Los Angeles (213) 217-8400 | Orlando (305) 855-4020
Tampa Bay (813) 855-5773 | Kansas
Kansas City (913) 888-4747 | Missouri
St. Louis (314) 291-5350 | Ohio
Cleveland (216) 349-4632
Southern Ohio (614) 888-3313 | Texas
Austin (512) 258-8848
Dallas (214) 553-4300
Houston (713) 781-6100 |
| Arizona
Phoenix (602) 437-1200 | Colorado
Denver (303) 790-1662 | Georgia
Atlanta (404) 447-8000 | Maryland
Baltimore (301) 988-9800 | New Jersey
Fairfield (201) 575-4415 | Oklahoma
Tulsa (800) 231-0253 | Utah
Salt Lake City (801) 972-1008 |
| California
Bay Area (408) 432-0900
Orange County (714) 669-4100
Sacramento (916) 722-8600 | Connecticut (203) 269-0100
Florida
Ft. Lauderdale (305) 971-9280 | Illinois
Chicago (312) 860-3800 | Massachusetts
Boston (617) 935-9777 | New York
Long Island (516) 737-0600
Rochester (716) 244-9290 | Pennsylvania
Philadelphia (215) 355-7300 | Wisconsin
Milwaukee (414) 797-7844 |
| | | Indiana
Indianapolis (317) 872-8875 | Minnesota
Minneapolis (612) 941-2600 | North Carolina
Raleigh (919) 872-0712 | | |

CIRCLE NO. 72 ON INQUIRY CARD

PRINTERS



Letter quality printer achieves 264 cps

- 88 cps letter quality
- 6K-byte buffer
- 55 dBa

A 136-column, bidirectional, 24-pin printer, the LQ 1050 is compatible with Epson LQ escape sequences and extended graphics. The unit reaches speeds of 264 cps in draft mode and 88 cps in letter-quality mode, prints at 55 dBa and has a 6K-byte buffer. Roman and Sans Serif, resident fonts can be printed at various pitches in either normal or condensed modes. A SmartPark paper-handling feature allows users to print single sheets without removing continuous-feed paper from the tractor feed. Serial and parallel interfaces, built-in tractor, two slots for font modules, forms handling and envelope printing are standard. \$1,099 (an LQ 850, the 80-column version costs \$799). **Epson America Inc.**, 2780 Lomita Blvd, Torrance, Calif. 90505, (213) 539-9140.

Circle 548

Printer outputs 300 dpi

- 30 ppm
- Six resident forms
- 16 fonts per page

Boasting LaserJet Plus and Diablo 630 emulation at 300 dpi and a throughput of 30 ppm with memory resident fonts, the S3000G ion page printer suits high-volume applications. Paper-handling options include a 2,000-sheet elevator and six resident fonts. In addition to all-points-addressable graphics, the devices support line, arc and circle draw commands. The printer supports downloadable fonts and prints up to 16 fonts per page. It includes six resident forms. Centronics, Dataproducts and customizable interfaces are available. \$10,500, quantity 100. **Delphax Systems**, 35 Pacella Park Drive, Randolph, Mass. 02368, (617) 961-2312.

Circle 549

You
can
migrate
your
application.

But you still
can't prosper.

Migrating your application from machine to machine is the only way for your product to realize its potential. But migrating has always been labor-intensive. Expensive. And a lot of times the results aren't what you expected.

TERMINALS



Touch screen suits IBM PS/2

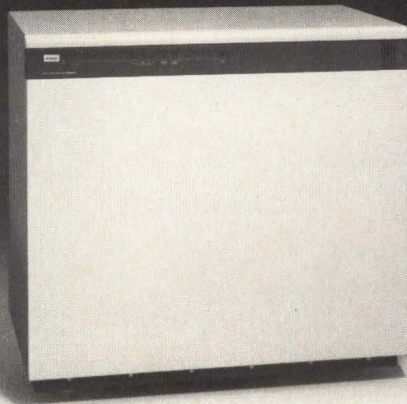
- 1,024 by 1,024 touch points
- RS232 controller
- RGB input

Equipped with an analog capacitive touch screen, the PS Touch Monitor has a resolution of 1,024 by 1,024 touch points. An intelligent RS232 controller

permits a range of baud rates, data formats, communication parameters and operating modes to be software-selected. The monitor has an RGB analog video output and can be used with IBM PS/2 computers. \$995. **Micro-Touch Systems Inc.**, 10 State St., Woburn, Mass. 01801, (617) 935-0080.

Circle 550

Noise and Voltage Problems Disappear.



We Guarantee It.

Our LINE 2[®] Power Conditioners make noise and voltage fluctuation problems disappear. Featuring ULTRA-ISOLATOR[®] noise suppression and exclusive POWERLOGIC[®] microcomputer-controlled voltage regulation, they provide up to 130 dB of common-mode noise attenuation and correct voltage fluctuations as large as 25% below nominal in less than 16 milliseconds. Models are



available in power ratings from 125 VA to 30 kVA.

Our **Product Performance Guarantee** states that if a LINE 2 Power Conditioner doesn't eliminate voltage and noise problems to your satisfaction, we'll refund the purchase price in full!

For more information about LINE 2 power conditioners, call (619) 279-0831 or call your local Square D distributor. And give your sensitive equipment *guaranteed* protection.

TOPAZ[®]
A Subsidiary of Square D Company

Monitor supplies 1,024 by 768 pixels

- 60-Hz refresh rate
- Flicker-free operation
- Automatic transient protection

The CM-1420 color graphics monitor features a 14-inch screen, 1,024 by 768 pixels and a black Trinitron CRT with an aperture pitch of 0.01 inch. It provides a 60-Hz, non-interlaced refresh rate for flicker-free operation. The monitor incorporates an automatic transient protection device that prevents phosphor burn. The raster size stability is less than 0.5 percent from minimum to maximum brightness. \$2,245. **Seiko Instruments USA Inc.**, 1130 Ringwood Court, San Jose, Calif. 95131, (408) 943-9100.

Circle 551

Terminal stores voice and data

- 32K bytes of RAM
- Two lines
- 16 characters

The pocket-sized MultiPortable "smart" card personal computer terminal with both voice and data features has a 66-character QWERTY keyboard; a two-line, 16-character LCD; 32K bytes of RAM; and 32K bytes of ROM. As a smart telephone, it stores names, addresses and numbers in an electronic directory for automatic dialing. The monitor has Touch-Tone or pulse dialing capability, auto redialing and a speaker for "hands free" operation. For data transfer, the terminal has an optional 1,200-bps modem that communicates via standard telephone networks and two RJ11 telephone jack interfaces. Under \$500. **Multimil Inc.**, 670 International Parkway, Richardson, Texas 75081, (214) 644-7724.

Circle 552

Now you can use Migration Mastersm from SEED.



And you can really prosper.

Introducing Migration Master from SEED Software. A unique combination of software and services that simplifies the movement of software from one hardware system to another.

What makes Migration Master so special? For one thing Migration Master allows you to maintain one set of source code. And that by itself makes your job a whole lot easier, which in turn makes your product a whole lot more profitable.

But there's more to it than that. Because when you have Migration Master, you have a combination of the latest in software technology, and SEED's expertise and commitment to service. You have more than a set of utilities. You have

a commitment from SEED to solve your migration problems.

So call our toll-free number (800-445-3267) and ask about Migration Master. And we'll show you how we can help you prosper.

SEED[®]

SOFTWARE CORPORATION
Because you need more than software.

You need solutions.

A subsidiary of ManTech International Corporation

CIRCLE NO. 65 ON INQUIRY CARD



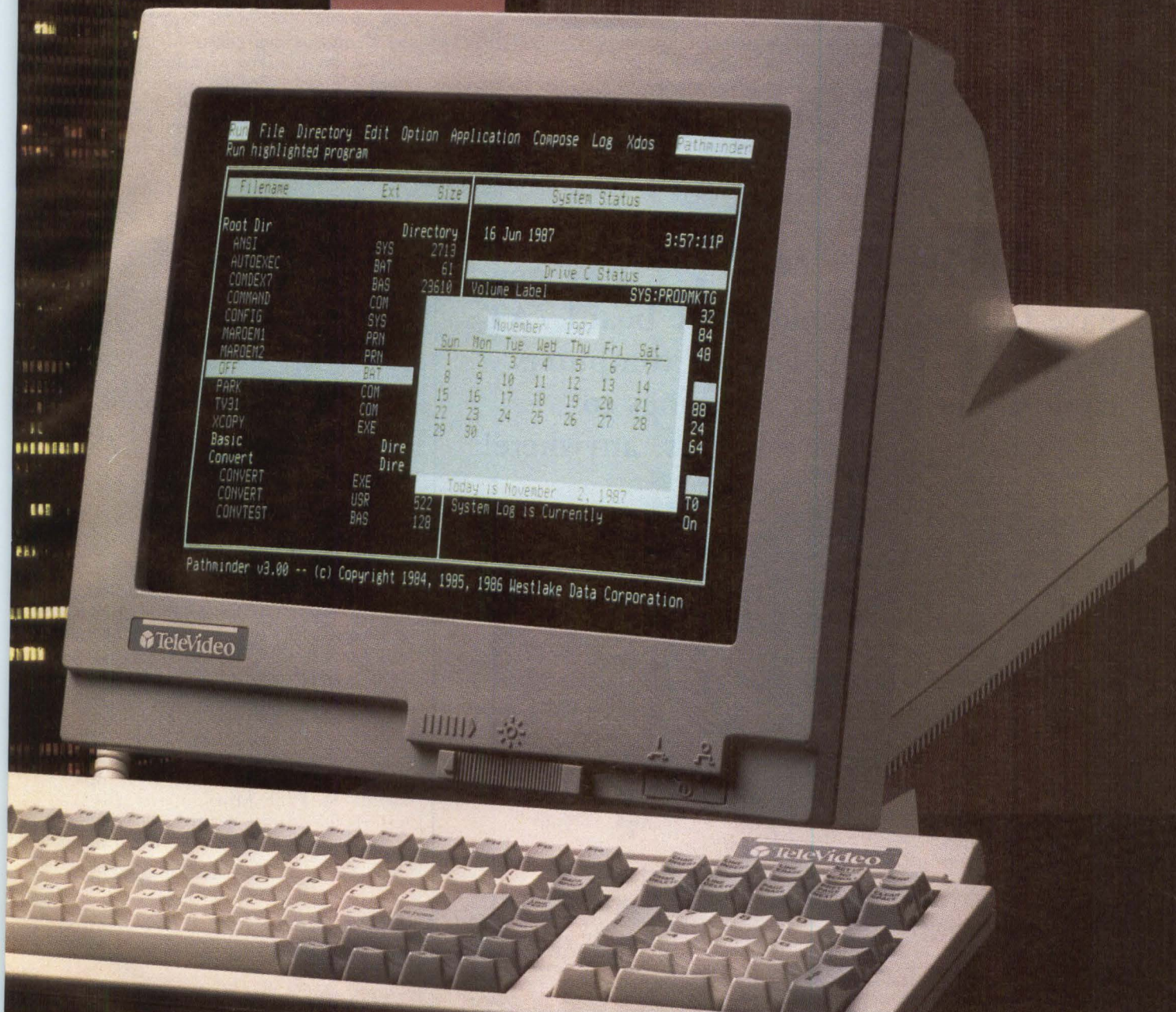
The New TeleVideo 965. An Incredible Display Of Power And Versatility.

For just \$599, the new 965 gives you ASCII, ANSI and IBM® PC compatibility in a single terminal.

The 965's versatility is unparalleled. It supports 23 terminal emulations, more than any other model in its class. You

even get your choice of ASCII, ANSI or IBM Enhanced PC keyboard styles to fit any job.

There's a 14" flat display in green or page-white with crisp, clear characters in a high-resolution 10x16 character matrix. A 2-position keyboard with a true accounting keypad, 20 user-programmable editing keys, and 128 programmable function keys.



The 965 can display up to 49 data lines, enough to show large spreadsheets or two normal display pages of text at the same time. No other terminal this affordable can do that. There's also an interactive calculator mode and dedicated memory for even more custom features.

The 965's state-of-the-art

single board design uses a 16-bit CPU and sophisticated gate array to give you a high-performance, very reliable terminal that's very easy to service. There's also a full one-year end-user warranty.

All in a sleek terminal that takes up very little space.

The 965 terminal, a whole new look from TeleVideo. Call

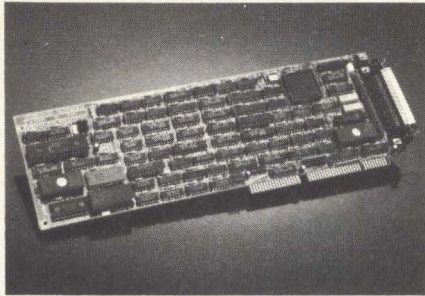
us toll-free or write today for more information.

TeleVideo Systems, Inc.,
1170 Morse Avenue, Sunnyvale,
CA 94088-3568.

 **TeleVideo**[®]
THE VISION YOU NEED TO SUCCEED

Call 1-800-835-3228

SUBASSEMBLIES



PC-to-host adapter suits IBM PC

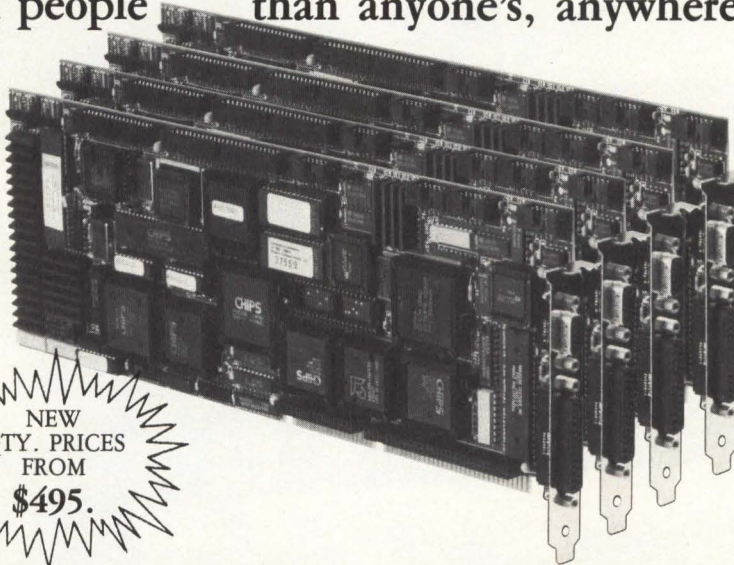
- 10M-byte transfers
- Multitasking
- 255 mailboxes

Able to support synchronous and asynchronous peripherals concurrently, the AHA-1540 IBM PC/AT-to-SCSI host adapter offers data-burst transfer

rates of 10M bytes per second. The transfer rate reaches 5M bytes per second, synchronous mode, and 2M bytes per second, asynchronous mode. A programmable mailbox architecture supports 255 tasks through which the host communicates with the I/O system. \$285, quantity 100. **Adaptec Inc.**, 580 Cottonwood Drive, Milpitas, Calif 95035, (408) 432-8600.

Circle 553

THE BIG "4" . . . we now have four stand alone single board /AT computers. This makes our computers come closer to being all things to all people than anyone's, anywhere!



NEW QTY. PRICES FROM \$495.

1. CAT 900 SB/AT COMPUTER

Total system expansion in a single card slot. It's /AT compatible, 12 MHz operation with 0 wait states, up to 4 mega bytes of main memory, 2 serial ports, parallel port, 64K PROM, PROM resident diagnostics, on board BIOS, and PROM resident set-up routine. Dynamic clocking logic allows the onboard memory and processor to operate at maximum speed without inducing operational problems with slower I/O devices.

3. CAT 902 SB/AT COMPUTER

Adding the SCSI Interface and high resolution graphics for CGA and Monochrome compatible displays further decreases the system add-on board count. It's /AT compatible, 10 or 12 MHz, up to 1 meg of main memory, 2 serial ports, 1 parallel port, floppy disk interface, 128K bytes of ROM memory, PROM resident diagnostic, set-up routines and RTC.

2. CAT 901 SB/AT COMPUTER

Adding the ST506 hard disk Interface and Floppy Disk Interface decreases the number of add-on boards in the system; in addition, it's /AT compatible, 12 Mhz operation with 0 wait states, up to 4 mega bytes of memory, 2 serial ports, parallel printer port, 64K bytes of disk cache, PROM resident diagnostics, on-board BIOS and PROM resident set-up routine. Dynamic clocking logic prevents problems with slower I/O.

4. CAT 922 SB/AT COMPUTER

With 16 MHz speed and the addition of EGA, CGA, and Monochrome compatible high resolution graphics this board provides near 386 benchmark performance. It's /AT compatible, with up to 4 mega bytes of main memory, 2 serial ports, parallel printer port, SCSI interface with a unique 64K SCSI buffer, floppy disk interface, PROM resident diagnostic, set-up routines and battery backed RTC.

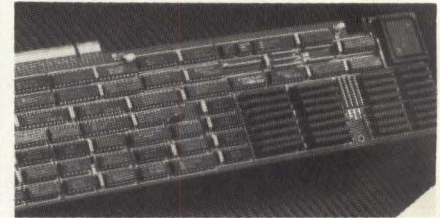
CALL TOLL FREE AND ASK FOR DETAILS

Diversified Technology

P.O. BOX 748 • RIDGELAND, MS 39158

1-800-443-2667

IN MS 601-856-4121



Graphics controller enhances PS/2 screen

- 1,024 by 1,024 pixels
- 16 colors
- 1M-byte memory

The first graphics controller for IBM PS/2 computers, the ARTIST 10/16 achieves 1,024-by-1,024, interlaced, and 1,024-by-768, non-interlaced resolutions. Engineered for the IBM Micro Channel bus, the product has 1M byte of graphics memory, a 64-MHz bandwidth and offers 16 colors from a 4,096-color palette. \$2,995. **Control Systems Inc.**, 2675 Patton Road, P.O. Box 64750, St. Paul, Minn. 55164, (612) 631-7800.

Circle 554

SBC based on the 8051

- 128K-byte memory
- RS232C port
- Two 28-pin sockets

Aimed at the wide variety of applications attainable by the Intel family of 8051 microcontrollers, the SBC-51A single-board computer can be used standalone or as part of an industrial control unit. Its two 28-pin sockets can be configured for RAM, EPROM and EEPROM chips. Product offers an on-board RS232C interface, 32 buffered and registered I/O lines and supports 128K of directly addressable memory. \$299. **Zytek Inc.**, P.O. Box 2400, Berkeley, Calif. 94702-0400, (415) 524-1946.

Circle 555

Case History #47582

"With over a million lines of source code, MortgageFlex is probably the largest application ever written for a LAN," says Lester Dominick, the developer of this monster program for mortgage banking back office management. "We probably encountered just about every programming challenge imaginable, but DataFlex's powerful 4th generation programming language proved more than a match for every situation."

A Straightforward English-like Syntax

"MortgageFlex is very easy to maintain and, because of DataFlex's English-like structure, new programmers with minimum training find it easy to figure out what programmers before them have done. DataFlex macro commands also take much of the burden off the programmers by

automatically taking care of the tedious chores of index manipulation, screen handling, cursor positioning and file management. We also like the way DataFlex uses indexes because it really lets the program take advantage of the capabilities of the system and run extremely fast."

Multi-user Capabilities for Today and Tomorrow

"We chose DataFlex 4½ years ago because of its outstanding multi-user capabilities and are very pleased with the way in which DataFlex has been continually adapted to new hardware and made even better as technology has improved. Not only do DataFlex programs run on more multi-user and LAN systems than any other DBMS product, but do so with absolutely no changes in the source code from system to system! I don't have to tell you what that means to

a developer with a million and a quarter lines of programming."

Take the first step to more efficient program development today. Return the coupon below for your free DataFlex Demonstration Diskettes.

Toll Free Sales Numbers Nationwide
1-800-451-FLEX
In Florida
1-800-331-3960

"100 data files, 4,500 fields and 1.2 million lines of source code. Just try that with anything but DataFlex!"

*Lester Dominick
MortgageFlex Systems, Inc., Irvine, CA.*



DATA FLEX

Data Access Corporation
14000 S.W. 119 Avenue
Miami, Florida 33186
(305) 238-0012
TELEX: 469021 Data Access CI
FAX: (305) 238-0017

For more information call from your modem 1-800-444-8080 (300-1200 baud, 8 bit, no parity 1 stop bit) and enter the access code FLEX15 when prompted.

CIRCLE NO. 62 ON INQUIRY CARD

FREE SELF-RUNNING DATAFLEX DEMO (PC-DOS/MS-DOS ONLY)

Find out more about DataFlex's ease of use and programming power. Mail this coupon today for your free self-running demonstration diskettes.

Name _____

Company _____

Address _____

City _____ State _____ Zip _____

Phone () _____

How many computer systems are in use at your company? _____

Do you use a Local Area Network or Multi-User computer? _____

Will you be running the Demo off a hard disk? _____

Data Access Corporation, 14000 S.W. 119 Avenue, Miami, Florida 33186

MIN12/1/87

ADVERTISERS' INDEX

COMPANY	PAGE NO.	INQUIRY NO.	COMPANY	PAGE NO.	INQUIRY NO.
Alcatel Business Systems	68, 69	33	Interphase Corp.	C3	67
Analog & Digital Peripherals	131	200	Kierulff Electronics	85, 105	45, 52
Aspen Peripherals	90, 91	47	Macrolink	1	2
AT&T Electronic Photography & Imaging Center	94, 95	48	Mannesmann Tally	53	32
AT&T 3B Computers	74, 75	74	Maxon Systems, Inc.	60	35
Avco Electronics/Avex Electronics, Inc.	24	21	Maxtor Corp.	7	6
Avnet Computer Technologies, Inc.	98	50	Method Systems Inc.	131	203
Blast Communications Software	131	205	Motorola/Micro-Computer Div.	102, 103	73
Cahners Exposition Group	129	70	Motorola Semiconductor Products	49-51	—
Chinon America	86	46	Multi-Tech	107	53
Clearpoint	22	18	National Computer Graphics Association	130	69
Compaq Computer Corp.	33-40	—	NCR Corp. PC	58, 59, 117	34, 59
Computerwise Inc.	132	210	NEC Information Systems Inc.	25, 82, 83	19, 44
Control Data Corp.	78, 79	42	NEC Peripherals	54, 55	38
CTS FabriTek, Inc., Datacomm Products Division	14	10-14	Optotech	47	31
Data Access Corp.	127	62	Peripheral Technology	64	37
Data Track	132	206-208	Philips TRT	E2, E3	100
DeRex, Inc.	77	41	Pioneer Research	113	57
Digital Equipment Corp.	108, 109	—	Process Software Corp.	6	5
Diversified Technology	126	71	Microware, Inc.	6	4
Epson America Inc.	62, 63	—	Radio Shack (Tandy Corp.)	41	30
Equinox Systems	8	7	Science Accessories Corp.	110	55
Facit	26	22	Seed Software	119, 121, 123	65
Flagstaff Engineering	131	202	Sequel Data	17	15
Fortron	18	16	Sigma Designs	118	61
FTG Data Systems	131	201	TEAC Corp.	13	9
Fujitsu America Inc. — Computer Products Group	10	8	TeleVideo Systems	2, 3, 124, 125	3, 60
Grafpoint	132	211	Topaz Electronics Div.	122	66
Hall-Mark Electronics	73, 120	40, 72	Toshiba	C2	54
Hall-Mark/Micropolis	21	17	Universal Data Systems Inc.	C4	68
Hayes Microcomputer Products	114, 115	58	Versatec Inc. (a Xerox Co.)	71	39
Heurikon Corp.	106	51	Walker, Richer, & Quinn	61	36
Honeywell Keyboard Division	27, 29, 31	24-26	Wave Mate	131	204
Houston Instrument Div. of Bausch & Lomb	28	27	Welch Allyn	32	29
IBM Corp.	97	49	Zericon	132	209
Imperial Technology Inc.	81	43			
Information Systems International	30	28			

See P. 131-132 for Mini-Micro Marketplace

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

MINI-MICRO SYSTEMS REGIONAL SALES OFFICES

NEW ENGLAND

Len Ganz
National Sales Manager
275 Washington St
Newton, MA 02158
(617) 964-3030

John J. Fahey
Regional Manager
199 Wells Ave.
Newton, MA 02159
(617) 964-3730

NEW YORK/MID-ATLANTIC

Joseph T. Porter, Regional Manager
487 Devon Park Dr.
Wayne, PA 19087
(215) 293-1212

SOUTHEAST

Larry Pullman, Regional Manager
6520 Powers Ferry Rd.
Suite 395
Atlanta, GA 30339
(404) 955-6500

MIDWEST

Rob Robinson, Regional Manager
Margaret W. Donahue
Sales Coordinator
Cahners Plaza
1350 E. Touhy Ave.
P.O. Box 5080
Des Plaines, IL 60018
(312) 635-8800

SOUTHWEST

Don Ward, Regional Manager
9330 LBJ Freeway, Suite 1060
Dallas, TX 75243
(214) 644-3683

MOUNTAIN STATES

John Huff, Regional Manager
44 Cook St.
Denver, CO 80206
(303) 388-4511

SOUTHERN CALIFORNIA

Tim Eidson, Regional Manager
18818 Teller Ave.
Irvine, CA 92715
(714) 851-9422

NORTHERN CALIFORNIA/ NORTHWEST/NEVADA

Frank Barbagallo
Northwestern Regional Sales Manager
Sherman Building, Suite 100
3031 Tisch Way
San Jose, CA 95128
(408) 243-8838

BENELUX/UNITED KINGDOM

Jan Dawson
Tracey Lehane
Cahners Publishing Co.
27 Paul St.
London, EC2A 4JU, England
011-44-1-628-7030
Telex: 914911
Fax: 01-628-5984

ISRAEL

Elan Marketing Group
13 Haifa St., P.O. Box 33439
Tel Aviv, Israel
972-3-252967
Telex: 341667

ITALY/FRANCE/SPAIN

Alasdair Melville
Cahners Publishing Co.
27 Paul St.
London, EC2A 4JU, England
011-44-1-628-7030
Telex: 914911
Fax: 01-628-5984

JAPAN

Kaoru Hara
Dynaco International Inc.
Suite 1003, Sun-Palace Shinjuku
8-12-1 Nishishinjuku, Shinjuku-ku
Tokyo, 160, Japan
03-366-8301
Telex: J2322609 DYNACO

SCANDINAVIA

Martin Sutcliffe
Cahners Publishing Co.
27 Paul St.
London, EC2A 4JU, England
011-44-1-628-7030
Telex: 914911
Fax: 01-628-5984

TAIWAN

Donald Shapiro
Trade Winds, 2nd Floor
132 Hsin Yi Rd., Sec. 2
Taipei, Taiwan
3932718 & 3913251
Telex: 24117 FC Trade

WEST GERMANY/ SWITZERLAND/ AUSTRIA/EASTERN BLOC

Uwe Kretzschmar
Cahners Publishing Co.
27 Paul St.
London, EC2A 4JU, England
011-44-1-628-7030
Telex: 914911
Fax: 01-628-5984

Mini-Micro Marketplace/ Direct-Response Postcards/ Career Opportunities

Carol Flanagan
275 Washington St.
Newton, MA 02158
(617) 964-3030

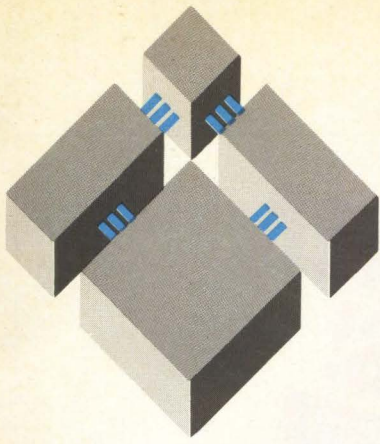
Cahners Magazine Division
Terrence M. McDermott, President
Frank Sibley, Vice President
Computer Group
Tom Dellamaria, VP/Production

Promotion Staff

Katherine Doyle
Director, Marketing Services
Kathleen Hackett
Promotion Manager

Circulation

Denver, CO:
(303) 388-4511
Sherri Gronli, Group Manager



Connect '88

*The Technical Conference and Exposition
for the MIS/DP Professional*

March 8-10, 1988

**Jacob K. Javits Convention Center
New York, N.Y.**

Connecting dissimilar systems into a coherent whole is the primary mission of today's MIS/DP professional. "Connect '88" is geared to enterprises employing large-scale information systems, providing an intensive environment where products, services and technology can be efficiently presented to and evaluated by professional end users.

"Connect '88" will focus on both IBM and non-IBM connectivity solutions for the large-scale enterprise.

The event will be the premier showcase for the integration of departmental solutions, distributed processing and information centers in an IBM/DEC environment, typically an S/370 or PCM host, and often an SNA or OSI network.

It will highlight a full range of offerings—networking, datacomm equipment, software, services and peripherals—available to MIS professionals, in-house systems integrators and value-added resellers.

This three day event will feature:

- Symposium on strategic futures
- Conference sessions on implementing currently available technologies
- Vendor technical seminars
- Exhibition of product/system technologies

Plan now to participate.

Co-sponsored by:



GARTNER GROUP, INC.

DATAMATION



**Cahners
Exposition
Group**

CIRCLE NO. 70 ON INQUIRY CARD

Mail to:

XJ

Connect '88

Cahners Exposition Group
999 Summer Street
P.O. Box 3833
Stamford, CT 06905-0833

Yes, I'm interested in attending the "Connect '88" conference and technical showcase. Please send me full details.

Name _____

Company _____

Position _____

Address _____

City _____

State _____

Zip _____

Telephone _____

Please send me information on being an exhibitor at "Connect '88."

MAKE THE RIGHT COMPUTER GRAPHICS CONNECTIONS!

NCGA '88 CONNECTS YOU WITH COMPUTER GRAPHICS POWER AND SYSTEMS INTEGRATION SOLUTIONS!

MAKE THE CONNECTION NOW!

Simply return the response coupon or call 1-800-225-NCGA, and detailed information will be on its way to you. Remember — "NCGA '88 and Systems Integration" link you with the solutions you need today.

NCGA '88

Conference, March 20-24, 1988
Exposition, March 21-24, 1988
Anaheim Convention Center
Anaheim, Calif.

Send me complete information about

- the NCGA '88 exposition
- the NCGA '88 conference
- exhibiting at NCGA '88

NAME _____
TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ ZIP _____
STATE _____

Send coupon to:

National Computer Graphics Association
Department HN, Suite 200
2722 Merrilee Drive
Fairfax, VA 22031

NINTH ANNUAL
CONFERENCE AND EXPOSITION
DEDICATED TO COMPUTER
GRAPHICS APPLICATIONS

NCGA '88 MARCH 20-24, 1988

NCGA '88
ANAHEIM CONVENTION CENTER
ANAHEIM, CALIFORNIA



SPONSORED BY THE
NATIONAL COMPUTER
GRAPHICS ASSOCIATION

GET THE COMPETITIVE EDGE

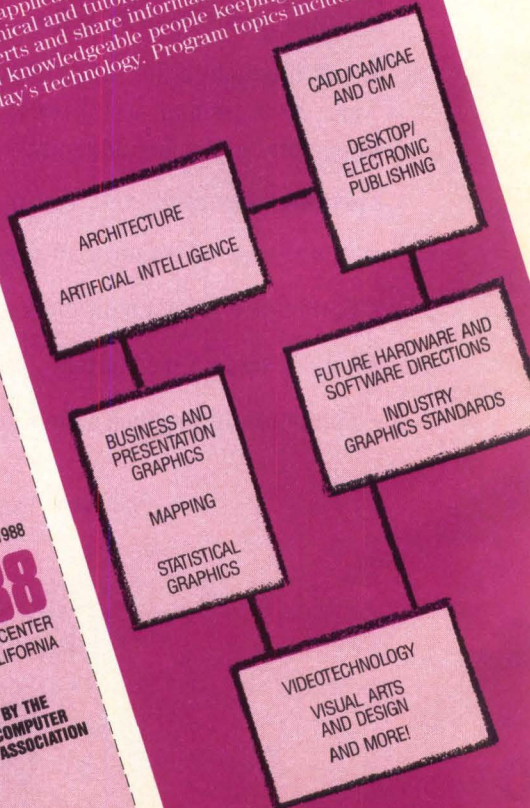
Computer graphics technology is having a positive impact on how people perform their jobs. At NCGA '88, you'll see demonstrations of how industry standards, open systems architecture and database management can work together in CAD/CAM, business graphics, desktop publishing and visual arts to make your company more efficient, productive and responsive.

THE PLACE FOR EXCITING NEW PRODUCTS

See the latest advances in technology and the newest products at NCGA '88 — the largest computer graphics conference in the world. Explore and experience the excitement of more than 200 companies showcasing new hardware, software and services.

A FIVE-DAY COLLEGE OF LEARNING

NCGA '88 is a great place to learn new technology and find out the best ways to implement your application. Register for any of over 100 technical and tutorial sessions. Meet the experts and share information with interesting and knowledgeable people keeping pace with today's technology. Program topics include:



MMS 12/87

MINI-MICRO MARKETPLACE

ATTENTION: BUYERS AND SELLERS OF PRODUCTS AND SERVICES IN THE COMPUTER SYSTEMS INTEGRATION MARKETPLACE:

READERS: For additional information on the companies in this section, please circle reader service numbers on the Reader Inquiry card

IBM COMPATIBLE RS232 EASI-DISK 3 1/2 5/4" FLOPPY DATA STORAGE & TRANSFER SYSTEMS



Information Transfer to/from Non IBM Compatible Systems to/from IBM systems: (Over RS232 or 488 Interface).

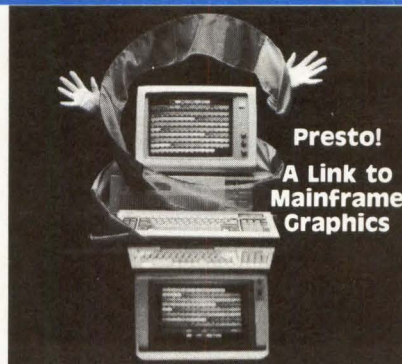
- Reads & Writes IBM DOS 3 1/2 5/4" Disks
- RS-232C I/O or 488
- Rugged Portable Package/Battery Option
- ASCII or Full Binary Operation
- Baud Rates 110 to 38.4K Baud
- Automatic Data Verification
- Price \$895 in Singles - OEM Qty's. Less.

28 other systems with storage from 100K to 35 megabytes.



ANALOG & DIGITAL PERIPHERALS, INC.
815 Diana Drive Troy, Ohio 45373
513/339-2241 TWX 810/450-2685

CIRCLE NO. 200 ON INQUIRY CARD



Find out how our whole family of EMU-TEK graphics terminal emulation software makes good sense for the work you do. Call today for more information.

FTG DATA SYSTEMS

(714) 995-3900
(800) 962-3900 (800) 972-3900 (Calif.)
10801 Dale St., Suite M-2
Stanton, CA 90680

CIRCLE NO. 201 ON INQUIRY CARD



9-TRACK TAPE • OCR SCANNING WORD PROCESSING CONVERSIONS

CONNECT your systems! We manufacture conversion systems for your PC/XT/AT. Our "DISKETTE CONNECTION" can read and write almost any WP or computer diskette. Our "SCANNING CONNECTION" captures text and images for your desktop publishing system. Our "TAPE CONNECTION" can read and write 800/1600/6250 GCR tapes. System prices start at \$1195.

**Flagstaff Engineering • 1120 Kaibab
Flagstaff, AZ 86001 • 602-779-3341**

CIRCLE NO. 202 ON INQUIRY CARD

MSI's Mini and Mighty Multiplexers Extend Standard 8-Channel Capabilities



Special MSI features include:

- Unique 5-year guarantee on parts and labor
- Distance/speed adjustability via internal jumpering with 1-, 2-, and 3-mile options
- Low prices
- Power supply is UL/CSA-approved; 220 vac/50 Hz power is optional
- Off-the-shelf availability • Dealer inquiries invited

Mighty-Mux™

- Independent data rates up to 19.2 kbits/second per channel
- Receive, transmit, CTS/RTS, or DTR/DCD lines accommodating hardware handshake for each of 8 channels
- Coaxial or fiber optic common channel options

\$495

Mini-Mux™

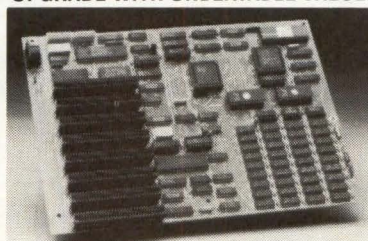
- Independent data rates up to 9.6kbits/second per channel
- Receive, transmit lines accommodating software handshake for each of 8 channels

\$395

METHOD SYSTEMS INC.
3511 Lost Nation Road
Willoughby, OH 44094
(216) 942-2100 • 800-533-6116

CIRCLE NO. 203 ON INQUIRY CARD

UPGRADE WITH UNBEATABLE VALUE!



High Performance, Low Cost Bullet-286E System Board

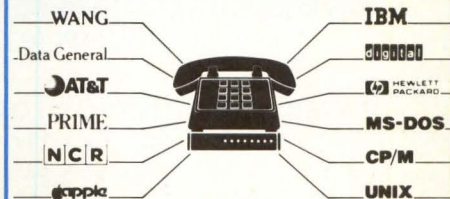
- CPU & Disk I/O Faster Than 8 MHz "AT"
- High-Speed 80286 Processor, PC & XT Models Available
- Socket for 80287 Math Co-Processor
- Sockets for 1 MByte Zero Wait-State RAM
- Includes Automatic Disk Caching in RAM Above 640K
- BIOS and 8-Slot Expansion Bus Compatibility Guaranteed
- Faster "386 Performance" Boards Also Available
- 30 Day 100% Money Back Guarantee; 2 Year Warranty
- OEM quantity price: \$199 (list price with RAM: \$895; one unit with RAM for evaluation: \$439)

WAVE MATE, INC.

2341 205th Street, #110, Torrance, CA 90501
Phone: (213) 533-8190 Fax: (213) 533-5940
WAVE MATE EUROPE, Phone (32 2) 649-1070
Fax: (32 2) 649-2727, Telex: (46) 61828

CIRCLE NO. 204 ON INQUIRY CARD

BLAST™



PC TO MINI TO MAINFRAME COMMUNICATIONS SOFTWARE

The low cost solution for linking hundreds of PCs with central systems!

- An Asynchronous Connectivity Tool • No Boards - Uses standard RS-232 ports • Provides distributed data management • Sends binary or text data or commands • Sends spreadsheets, programs, etc • 100% error-free data transfer • Links different operating systems • Uses phone lines, LANs packet nets • Connects multiple sites, unattended • Uses any low-cost modems, any speed

• \$250 / Micros • \$495-895 / Minis • \$2995 up / Mainframes

COMMUNICATIONS RESEARCH GROUP

5615 Corporate Blvd. Baton Rouge, LA 70808 (504) 923-0888

(800)-24-BLAST

CIRCLE NO. 205 ON INQUIRY CARD



IBM-PC/XT/AT/PS2 or HEWLETT PACKARD LIF COMPATIBLE 3.5" or 5.25" FLOPPY RS-232-C DATA COLLECTION AND TRANSFER SYSTEMS WITH UP TO 2.4 MBYTE OF STORAGE.

STOP!! ARE YOU RE-KEYING INFORMATION From Your Instruments, Data Loggers, And Analytical Equipment? Our Tracker 1400/1500 Can Record Data From Your Equipment's RS-232-C Interface On A Disc That Can Be Transferred Directly To Your IBM PC/XT/AT/PS2 or HP Computers.

- Power Fail Protected With NO DATA OR FILE LOSS
- Remote Polling Via Auto Answer Modem
- Front Panel Manual Or Remote Operation
- 3 1/2 Or 5 1/4 Single Or Dual Disc System
- Up to 223 Files/Disc
- Single Board OEM Versions Available

For All of Your RS-232-C Data Storage Needs up to 40 Mbytes Call



Data Track USA
9451 Sohaph Lane
Columbia, MD 21045
301-992-9143 Telex: 6971182 COLRESH

CIRCLE NO. 206 ON INQUIRY CARD

"D" SIZE PLOTTER

\$2295⁰⁰
RETAIL

\$1,695⁰⁰
INTRODUCTORY
OFFER



- Model PC 3600
- Repeatability .001"
- Speed at 7" Per Second
- Vacuum Paper Hold Down
- High Resolution Circles: Suitable for PCB Artwork

(415) 490-8380 **ZERICON**

4423 ENTERPRISE ST. • FREMONT, CA 94538

CIRCLE NO. 209 ON INQUIRY CARD

NEW SOLID STATE DATA COLLECTION AND NETWORK POLLING SYSTEM



TRACKER 2000 is an Intelligent 1Mbyte RS-232-C Data Buffer Used To Log Data From Telephone Switches, Factory and Environmental Instrumentation, Data Loggers and Acquisition Systems. The 2000 Can be Polled Via Telephone Line by Computer or Using our Software in Your PC/XT/AT.

- 6 hr. Battery Backed Complete Operation
 - X-Modem Error Check
 - Password Protection
 - Data Control Handshaking
 - Remote Polling Via our PC/XT/AT Software or Yours
- Now You Can Collect Data From Your Remote Locations Through Your PC/XT/AT During the Night and Have It Ready to Analyze in the Morning

For All Your RS-232-C Data Collection Needs Up to 40Mbyte Call



DATA TRACK USA
9451 SOHAP LANE
COLUMBIA, MD 21045
301-992-9143
TELEX: 6971182 COLRESH

CIRCLE NO. 207 ON INQUIRY CARD

\$249. TERMINAL



- Featuring
- Standard RS-232 Serial Asynchronous ASCII Communications
 - 48 Character LCD Display (2 Lines of 24 Each)
 - 24 Key Membrane Keyboard with embossed graphics
 - Ten key numeric array plus 8 programmable function keys
 - Optional RS-422 multidrop protocol mode
 - Keyboard selectable SET UP features—baud rates, parity, etc.
 - Size (5.625" W x 6.9" D x 1.75" H), Weight 1.25 lbs.
 - 5 x 7 Dot Matrix font with underline cursor
 - Displays 96 Character ASCII Set (upper and lower case)
 - Optional Bar Code Wand (shown)

COMPUTERWISE, INC.

302 N. Winchester • Olathe, KS 66062 • 800-255-3739 • TELEX 705337

CIRCLE NO. 210 ON INQUIRY CARD



TRACKER 1700 STAND ALONE 15 TO 20 MBYTE POWER FAIL PROTECTED RS-232-C CARTRIDGE TAPE SYSTEM

- Uses DC-300 Data Cartridges
 - Automatic Power Fail Restart with NO DATA LOSS
 - Auto-answer for Remote Sight Polling
 - 24K Battery Backed CMOS Buffered Stop-Start system
 - Dual RS-232-C ports with Independent Baud rate select
 - Ideal replacement for Columbia, Tektronix, Tandberg and Quantex AN/USH-26 Tape Drives
 - Quantity priced under 2000.00
- Ideal applications: Data Logging, Telephone Call Logging, File Transfer, Data Archiving, Process Control Systems Monitoring. For All of Your RS-232-C Data Storage Needs Contact



Data Track USA
9451 Sohaph Lane
Columbia, MD 21045
301-992-9143
Telex: 6971182 COLRESH

CIRCLE NO. 208 ON INQUIRY CARD

Get the whole story on graphics terminal emulation.



To find out more about software that lets your PC emulate **TEKTRONIX™ 4105/6/7/9** and **DEC VT100™** terminals, call or write:

GRAFPPOINT

1485 Saratoga Avenue
San Jose, CA 95129
Tel. 1-800-425-2230
In CA, call 1-408-446-1919

CIRCLE NO. 211 ON INQUIRY CARD

Advertise in MINI-MICRO MARKETPLACE

Fill out this form to place your product in this special advertising section

RATES EFFECTIVE OCTOBER 1987

	1x	3x	6x	12x	24x	48x
1/9 pg.	\$750	675	650	635	590	570
2/9 pg.	\$1,390	1,305	1,270	1,190	1,145	1,100

15% commission to recognized agencies

SIZES

1/9 pg.:	2-1/4"x3"
2/9 pg.:	2-1/4"x6-1/2" or 4-1/2"x3"

MATERIALS

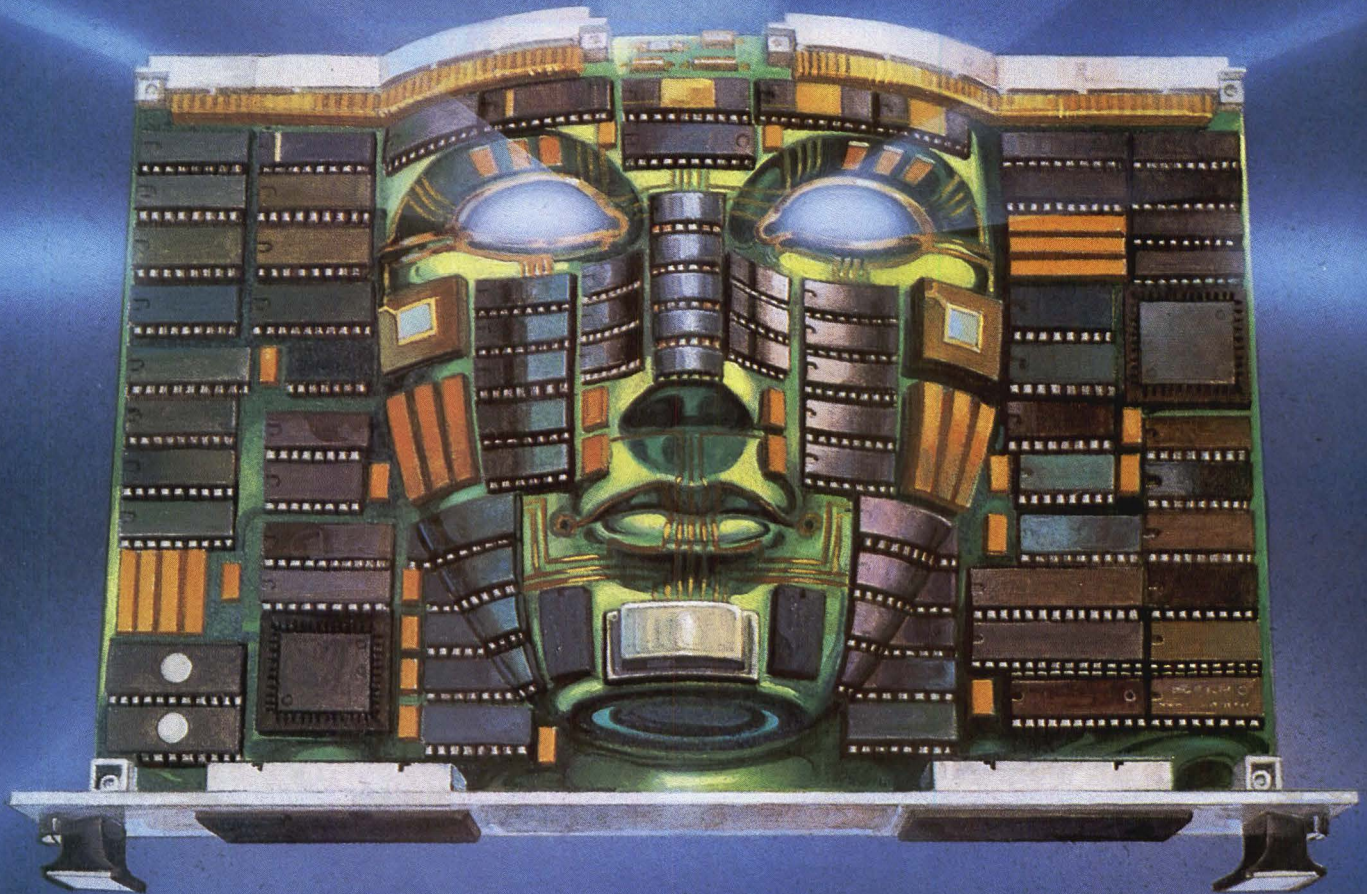
- Film negatives, right reading, emulsion side down
- Reproduction proofs
- Camera-ready mechanicals

Circle issue(s) to run: Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

Name _____
Title _____
Company _____
Street _____
City _____ State _____ Zip _____
Telephone _____
Signature _____
Material enclosed _____ Material to come _____ Send information _____

ORDERS & MATERIALS TO:

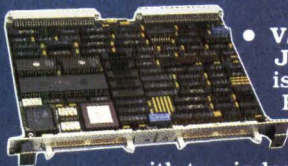
Carol Flanagan
Mini-Micro Systems
Cahners Publishing Company
275 Washington Street
Newton, MA 02158
(617) 964-3030



INTERPHASE

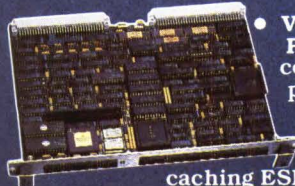
Changing The Face Of SCSI

SCSI never looked so good. Always a beautiful vision, early SCSI was not always a pretty sight. It was incompatible, incomplete and slow. Interphase is changing the face of SCSI by applying more than a decade of high-performance peripheral controller leadership to a range of new Ultra-Fast and full-functioned SCSI VMEbus host adapters.



- **V/SCSI 4210 JAGUAR** is an Ultra-Performance caching host adapter with two independent and simultaneous SCSI ports and Command Queuing. It offers true Multi-Threaded control of any mix of up to

14 Synchronous and Asynchronous SCSI devices. Advanced systems concepts like disk striping and segregating high-end devices from slow or unbuffered ones become real. And Interphase's 30 MByte/s BUSpacket InterfaceSM provides the industry's fastest VMEbus speed.



- **V/ESDI 4201 PANTHER** combines the performance advantages of a host resident caching ESDI disk drive controller with the flexibility of a full function SCSI port for backup, all in a single VME slot.

- **V/MIX 3210** is the unique combination of a SCSI host adapter, Centronics printer port, and Versatec or Benson plotter port. All three become high-speed DMA devices, and at a price you'd expect for any one function alone.



FACE FACTS

Interphase SCSI solutions achieve true VME system-level performance with existing SCSI devices and let you take advantage of the new generation of full-function SCSI devices as they are available. Don't let a "dumb" host adapter make you look bad. See the changing face of SCSI. Call Interphase today.

(214) 350-9000



INTERPHASE
corporation

2925 Merrell Road • Dallas, Texas 75229 • Telex: 9109976245 NASDAQ-NMS:INPH

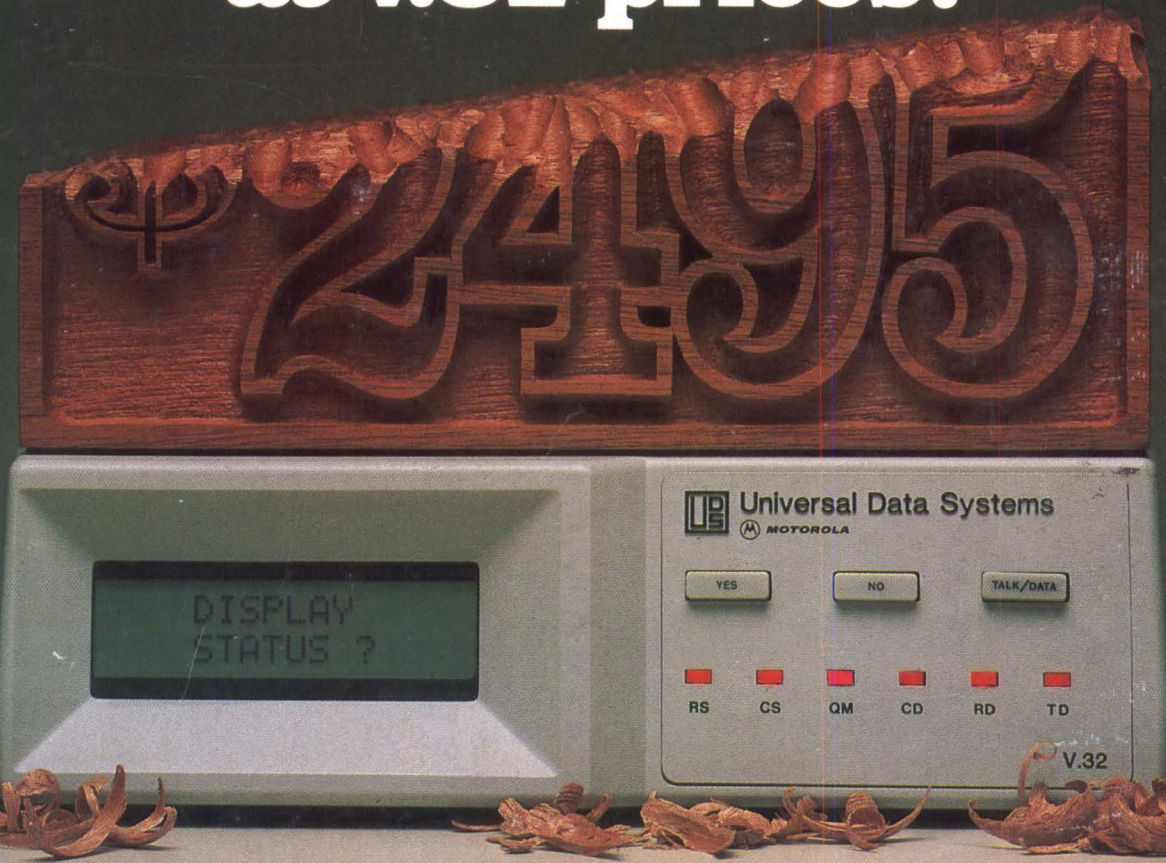
Interphase International

93a New Street, Aylesbury, Bucks. HP20 2NY, England (0296)435661 Telex: 826715 AERO G

Interphase is a registered trademark of Interphase Corporation. BUSpacket Interface is a service mark of Interphase Corporation.

CIRCLE NO. 67 ON INQUIRY CARD

UDS is chipping away at V.32 prices!



Full duplex 9600 bps communication over dial-up telephone lines becomes more cost-effective than ever, as UDS announces a 36% price cut for the popular V.32 modem.

A unique echo cancellation technique (patent pending) permits reliable performance over all types of surface and satellite links. Set-up and operation are greatly simplified by a 3-key system of responses to menu prompts on an integral LCD screen. The same screen displays results from the modem's extensive self-test regime.

The unit also features auto dial, auto answer, call progress detection and adaptive line equalization. If degraded line quality prevents 9600 bps communication, a 4800 bps fallback mode is available.

If modem cost is the reason you haven't upgraded your dial-up system to V.32, the rules have just changed.

For detailed specifications and quantity prices, contact Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Telephone 800-451-2369; Telex 752602 UDS HTV.

\$1595

New Quantity One Price



Universal Data Systems



CIRCLE NO. 68 ON INQUIRY CARD

Created by Dayner/Hall, Inc., Winter Park, Florida