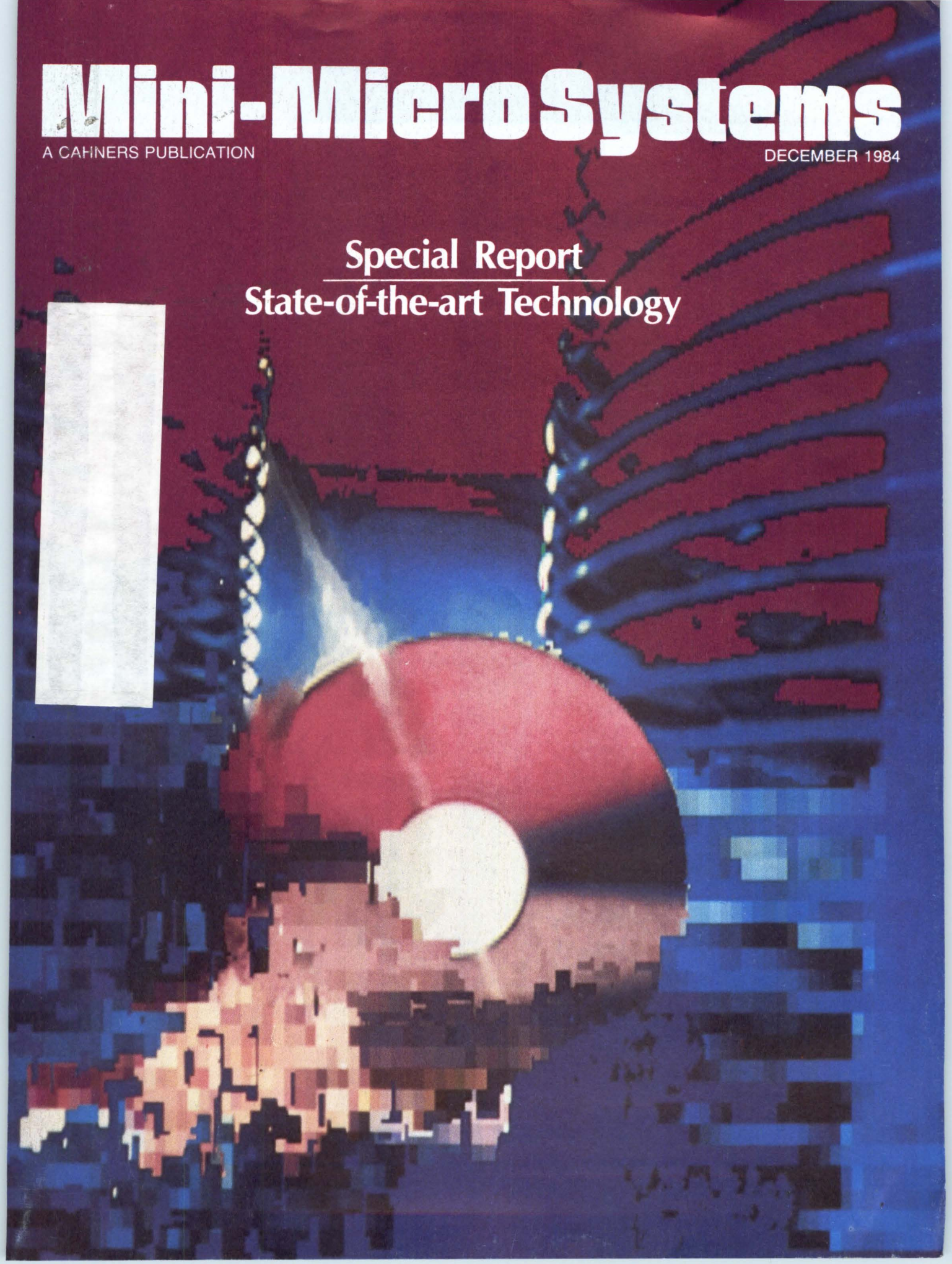
Mini-Micro Systems

A CAHNERS PUBLICATION

DECEMBER 1984

Special Report
State-of-the-art Technology



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Fast Peripherals Alcyon uses the DEC standard Q-bus for connection of peripheral controllers, giving the user access to a wide range of proven subsystems. A fast system requires fast peripherals, and Alcyon offers the fastest. Options include 18 millisecond access disk and 125 ips streaming tape.

Fast Software Alcyon's proprietary 'C' Compiler, and Regulus operating system are optimized for both code size and execution speed. Regulus, a realtime UNIX operating system, provides the ideal computing environment where speed is an issue. Numerous high-level languages and system development tools are available, including Absoft Fortran '77, RM Cobol, Unify relational DBMS, and many others.

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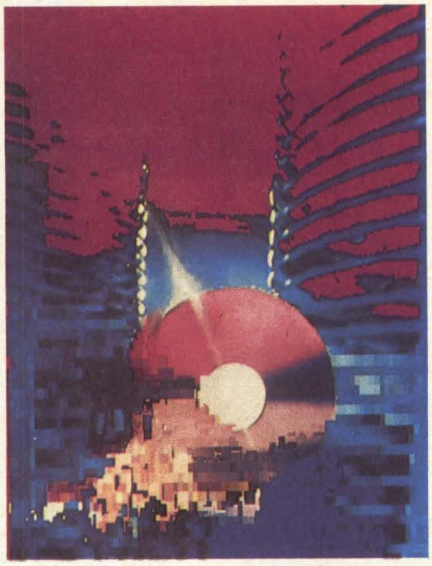
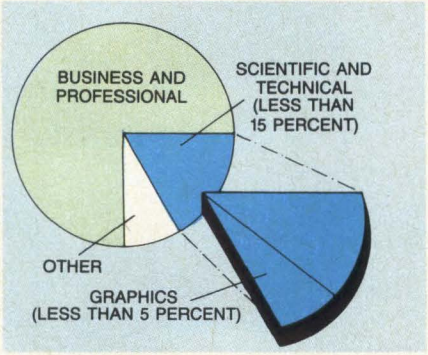
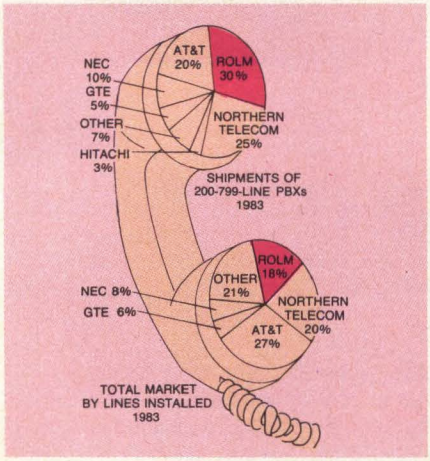
Mini-Micro Systems



p. 117 . . . . . MMS presents its annual state-of-technology report. Computer art created by Anne Tregay, art direction by Vicki Blake.



p. 37 . . IBM PCs: the engineer's choice



p. 69 . . . . . Rolm gets connected

MINI-MICRO WORLD
News

Corporate and Financial

International

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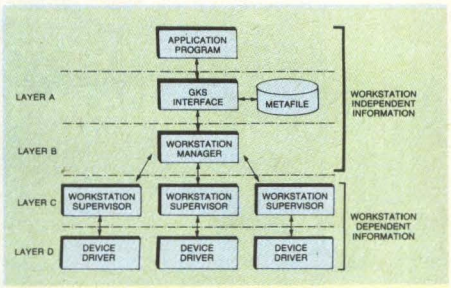
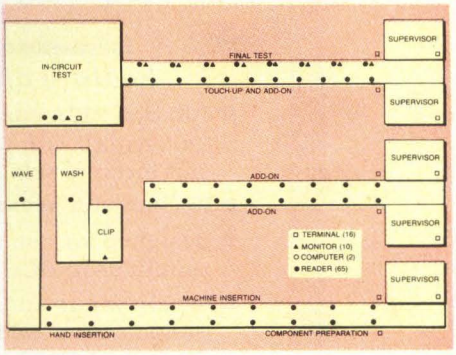
INTERPRETER

INTEGRATOR

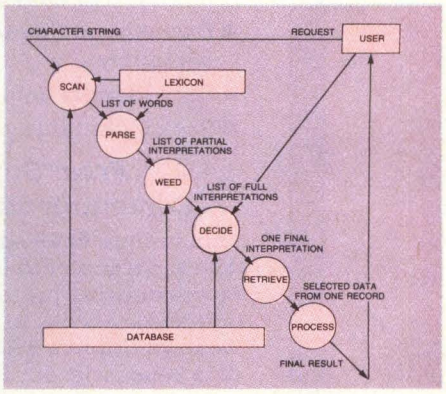
FEATURES



p. 97 . . . . . Is GKS for you?



p. 107 . . . . Circuit cards get automated



p. 163 . . . . Teaching computers to talk

DEPARTMENTS

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VARs can be leaders instead of followers with office systems from Motorola/Four-Phase. Because when your systems supplier is also the leader in advanced microprocessors, you don't have to wait, react or redesign every time you want to upgrade your customers or enter new markets. No matter who your customers serve — business, government, education, or healthcare.

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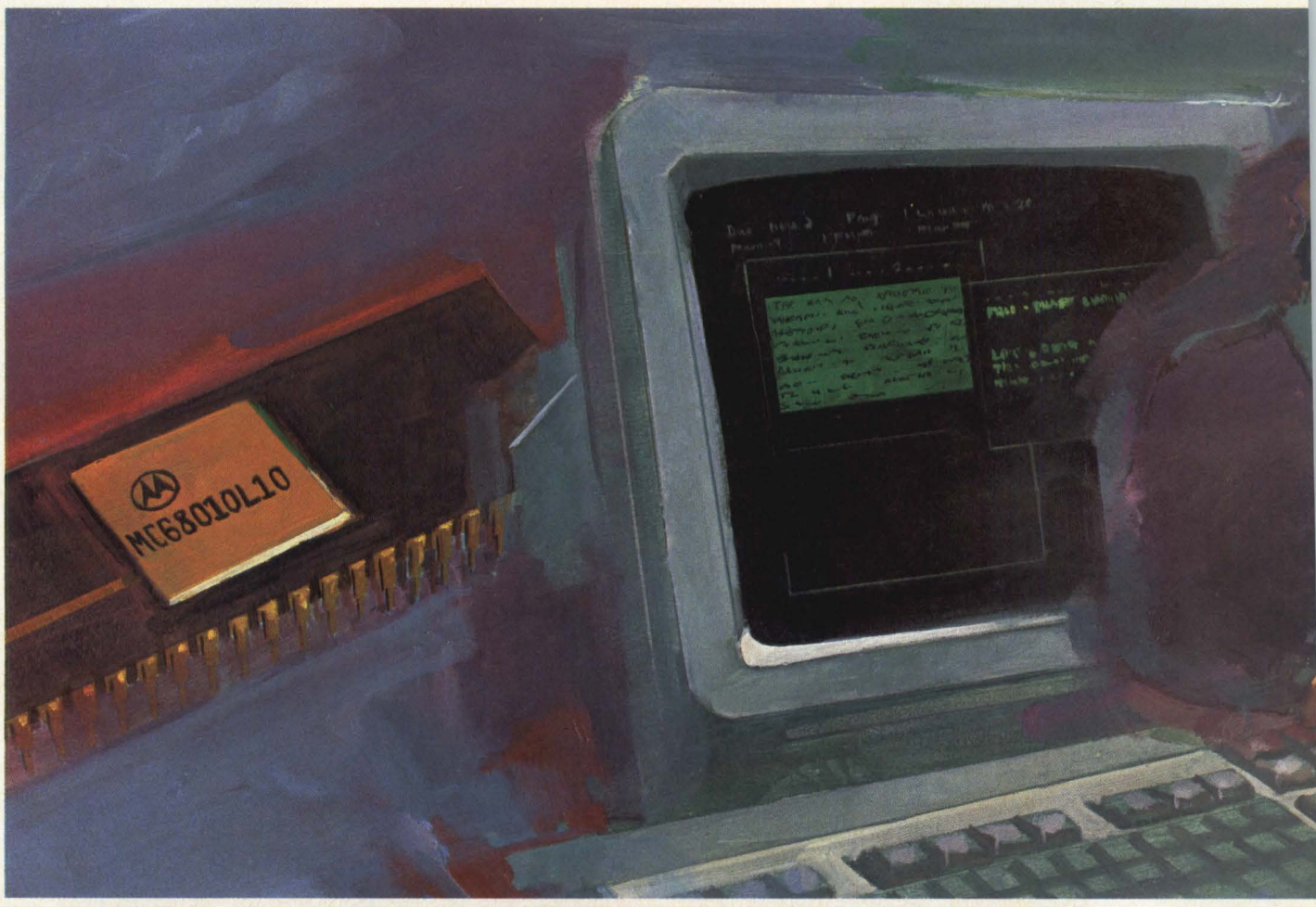
Our systems are based on the industry-standard MC68000 CPU. Hardware is architecturally similar, saving you time and money when you need to upgrade or expand an existing system. We're continually working on enhance-



1973 Leading VARs in the medical field begin developing software around Four-Phase systems. These partnerships have helped Four-Phase become one of today's largest suppliers of systems to the medical market.

1980 Four-Phase establishes one of the first computer-dispatched service organizations, designed to serve both you and your customers. Today, one phone call from anywhere, at anytime, puts a hardware or software field engineer at your service.

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arket success.

ments, too. You have a growth path you can follow for years to come. And that's not all.

Motorola/Four-Phase systems are designed around the UNIX* operating system, with a host of compatible software, languages and industry-standard communication tools.

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From silicon to systems to software, Motorola/Four-Phase takes you through your own market windows and on to VAR success. Contact us today at 1-800-528-6050, ext. 1599. In Arizona, call 1-800-352-0458, ext. 1599. Or write us at 10700 North De Anza Blvd., M/S 52-3B1, Dept. S, Cupertino, CA 95014.

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Four-Phase Systems

1983 Motorola/Four-Phase makes enhancements to the Series 2000 line of communicating desktop computers. For your price-conscious customers with remote office sites, the 2000 features UNIX, the 68010 CPU, concurrent SNA and high-capacity Winchester discs.

1984 We introduce the new UNIX-based Series 6000 family that supports up to 128 users. These multi-user, multi-tasking systems deliver information processing performance today, and expansion flexibility for tomorrow.

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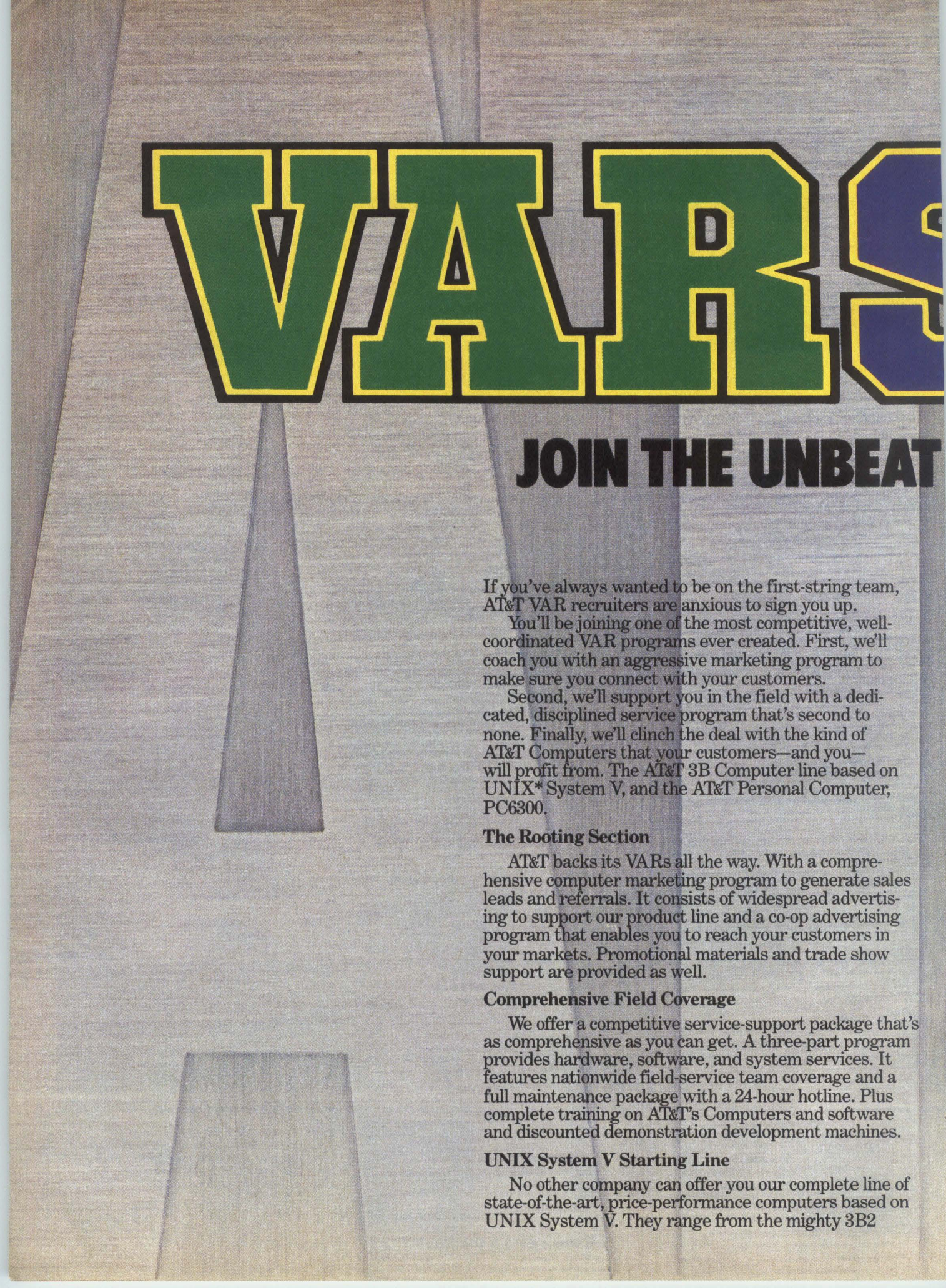

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Second, we'll support you in the field with a dedicated, disciplined service program that's second to none. Finally, we'll clinch the deal with the kind of AT&T Computers that your customers—and you—will profit from. The AT&T 3B Computer line based on UNIX* System V, and the AT&T Personal Computer, PC6300.

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AT&T backs its VARs all the way. With a comprehensive computer marketing program to generate sales leads and referrals. It consists of widespread advertising to support our product line and a co-op advertising program that enables you to reach your customers in your markets. Promotional materials and trade show support are provided as well.

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No other company can offer you our complete line of state-of-the-art, price-performance computers based on UNIX System V. They range from the mighty 3B2

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desk-top super microcomputers to the 3B20 superminis with enough options to tackle any business problem. UNIX System V enables the entire 3B Computer line to work together beautifully.

We also offer the high-performance AT&T Personal Computer, PC6300, that runs popular business and graphics software, including most available MS-DOS** applications. What's more, our unique PC Interface allows our 3B Computers to communicate with your customers' existing personal computers. It bridges the MS-DOS and UNIX Operating Systems, allowing your customers to use their PCs as part of a larger network. And because the computers are based on UNIX System V, they feature software portability, upward compatibility across vendor lines, and multi-user, multi-tasking capabilities.

Besides offering you all this great equipment, AT&T offers you a program for buying and leasing it.

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UNIX System V is particularly important because of AT&T's commitment to support it as an international operating system standard. This commitment includes a full marketing program reaching resellers, users, and senior business management.

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VAR MS

WE'VE BEEN DELIVERING 3½" WINCHESTER DISK DRIVES FOR OVER A YEAR.

Rodime has been setting a new standard in Winchester disk drive storage for more than a year. Its 3½" drive with 5 and 10 megabytes of formatted storage has become the industry leader for sub 4" Winchester disk drives. Rodime has now delivered tens of thousands!

The proven compact drive and proven quantity supplier

With thousands of its 3½" Winchester drives in operation today Rodime has further demonstrated its reputation for reliability, a major design consideration for its 3½" drive, and quality. It has a rugged design with high resistance to shock, an important consideration for portability and for vibration prone environments. Using advanced large-scale integration, the entire electronics for the drive are on a single compact board and there are no adjustments or select-on-test components.

New design horizons

The compact size of Rodime's drive suddenly puts large-scale storage into areas never considered before. The 350 series is one-fourth the volume of a 5¼" Winchester drive. And the 250 series, which includes

mounting brackets and a face plate, fits into the same space as a half-height 5¼" Winchester offering even further shock and vibration isolation. Now, system designers have a new level of flexibility. One area that has received attention is use with portable computers. Several major portable computer manufacturers have already incorporated Rodime 3½" Winchester disk drives into their products. There are other equally exciting areas such as desk top computer systems, intelligent terminals, point-of-sale terminals, industrial controllers, telecommunications systems, navigation and guidance systems, and portable instrumentation. In fact, the list of potential uses is only limited by the imagination of the system designer.

A tradition of excellence

In a few short years, Rodime has established itself as a major force within the Winchester disk drive industry. Rodime is one of the few manufacturers that are delivering 5¼" Winchester drives with a broad range of capabilities up to 54 megabytes. And is the only manufacturer delivering high-performance 3½" Winchester drives in production quantities.

For the compact 3½" Winchester disk or other 5¼" Winchester requirements, look to Rodime. Rodime delivers.

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CIRCLE NO. 7 ON INQUIRY CARD

Editorial

Japanese technology meets users' needs

Consider the fact that the Japanese microcomputer product companies are steadily increasing their share of the worldwide marketplace. What does this mean to U.S. system integrators and users? Well, for one thing, they both benefit from excellent original and innovative products. And these products perform reliably and demonstrate high quality. More important, though, these products meet users' needs. You see, Japanese product market strategy gives users top priority. And the secondary priority helps users too. It provides user sales and service support.

But, meantime, what are many U.S. microcomputer OEMs doing to meet this competition? For one thing, they highlight technically superior, but expensive, products. Frequently overdesigned, these products interest relatively few users. They are complex, hard to understand and even harder to use. Moreover, these products lack definitive purpose. Users buy them, play with them for a time (some studies say less than 10 percent of the work day), and then let them gather dust on the shelf or in a closet.

For another thing, the profit motive appears to drive the American pricing scale. The cost of new American manufactured products is, in many cases, considered to be excessive by industry experts. And, to make matters worse, many American manufacturers announce and ship new products without an established sales and service network. The result? Except for those U.S. microcomputer companies who obey the market rules for satisfying users' needs, such as IBM Corp., Apple Computer Inc., Tandy and Compaq Computer Corp., the number of American microcomputer manufacturers are rapidly dwindling.

What has been the Japanese formula for successful market share? To answer this question for a typical Japanese company, consider Epson Corp. Why Epson? Mainly, because recently I spent a week in Japan touring Epson facilities as a member of an American trade press editors' delegation. Speaking for Epson, managing director Mitsuhiro Tsuchihashi states that his company has achieved worldwide market success because it strives to meet users' diversified needs, strives to develop new and original quality products and strives to meet the challenges of a growing world market. And the company's methods to accomplish these efforts include five- and 10-year product plans that are reviewed semi-annually and annually. Based on these plans, the company formulates its marketing, research and development, manpower and financial strategies. These strategies determine what representative products will be needed in the future marketplace.

According to Epson's senior managing director Susumn Aizawa, after this strategy planning there comes the special challenge of figuring out what users want and then fulfilling that need. Epson, as well as other leading Japanese companies, have achieved success because they listen to users via market research. These companies then plan, develop and produce products to meet predicted demands, using whatever technology is indicated. When the product becomes available, the users' needs usually emerge at the same time, thereby assuring a market for the product. And even before the product has time to earn success, Japanese product designers are already structuring its replacement.

For years, Japanese companies have been criticized for copying American industrial ingenuity. Now with Japanese companies as prime movers in robotics, factory automation, liquid crystal displays, fifth-generation technology and productivity, American OEMs would do well to replicate Japanese vision, strategy and planning in new computer technology.

George V. Kotelly

George V. Kotelly
Editor-in-Chief

Masscomp takes the risk out of choosing a high performance workstation.

How do you know the engineering workstation you choose is really going to work for you?

Considering the number of vendors in the market, and the baffling collection of workstations they offer, the choice is a tough one. With a sizable amount of capital at risk.

Masscomp is a computer company that not only builds workstations, but uses them every day. We've learned from hands-on experience that the heart of a good workstation is an extremely fast computer that delivers exceptional performance. Knowing this, we built our own very fast, high performance system: the WorkStation-500™.

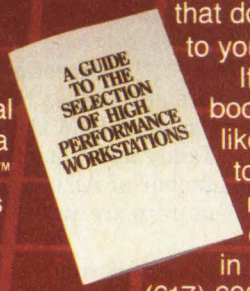
The WorkStation-500 is designed with Masscomp's Performance Architecture™, which uses floating point and array processors of our own design and can deliver over one-half million Whetstones. This architecture provides real-time computational and graphics power in a multi-tasking standalone workstation for technical and scientific users.

In applications like solids modeling, VLSI design, simulation, numerical analysis, and other CAE applications, the system is unsurpassed.

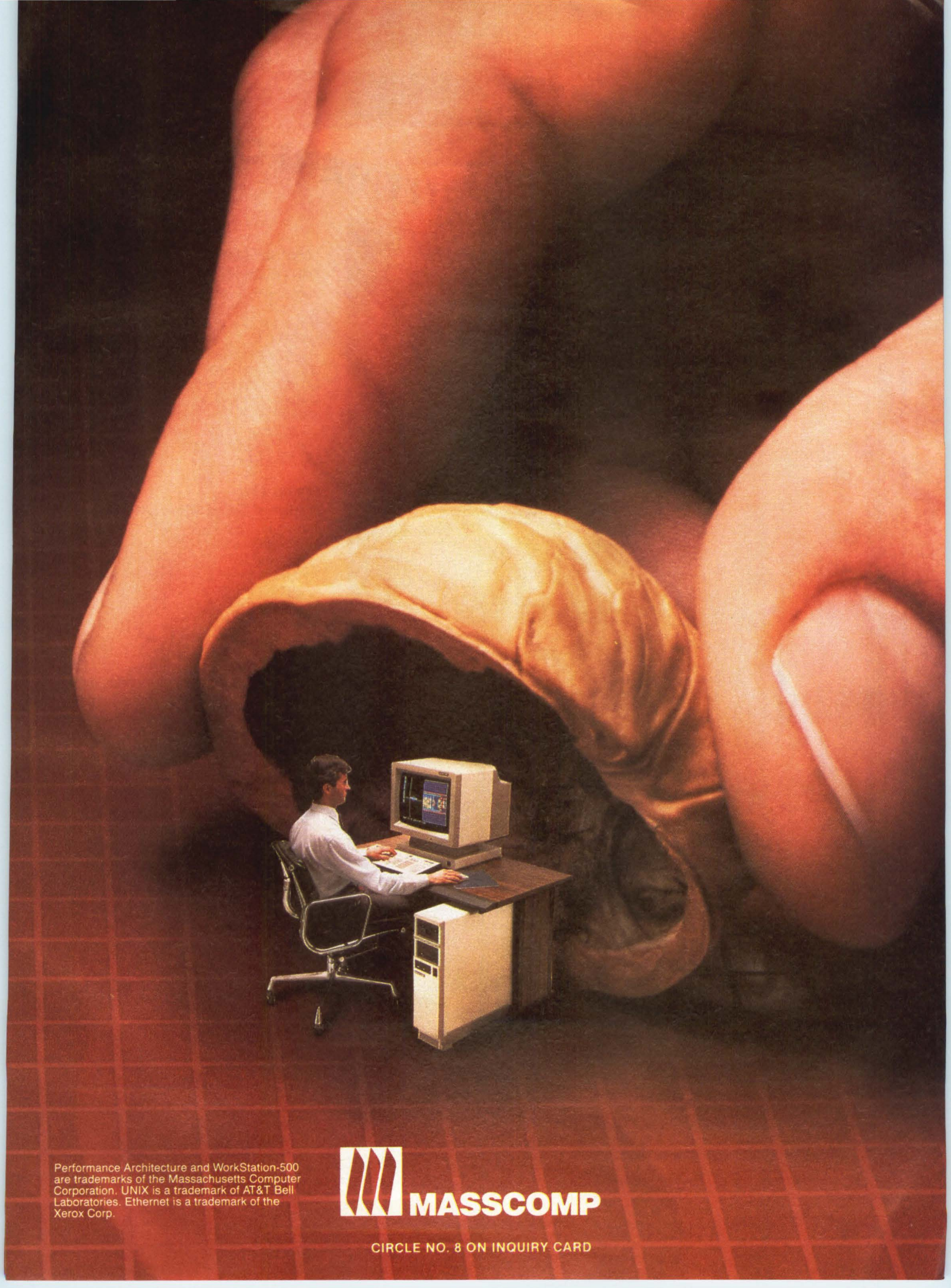
WorkStation-500 has a dual bus architecture and supports a virtual memory, real-time UNIX™ operating system, and provides a choice of many peripherals, graphic subsystems, Ethernet™, and mass storage devices.

We believe you can't find a better price/performance system. But before you commit to the purchase of any workstation, your decision should be an informed one.

That's why we're making available a free booklet, "A Guide to the Selection of High Performance Workstations." It tells you what you need to know about the important issues involved in selecting the right workstation. Reading it will help you choose the right productivity tool, and will greatly reduce the risk of buying a workstation that doesn't perform up to your expectations.



If you'd like a free booklet, or if you'd like to speak directly to one of our sales representatives, call 1-800-451-1824; in Massachusetts, (617) 692-6200. Or write Masscomp, One Technology Park, Westford, MA 01886.



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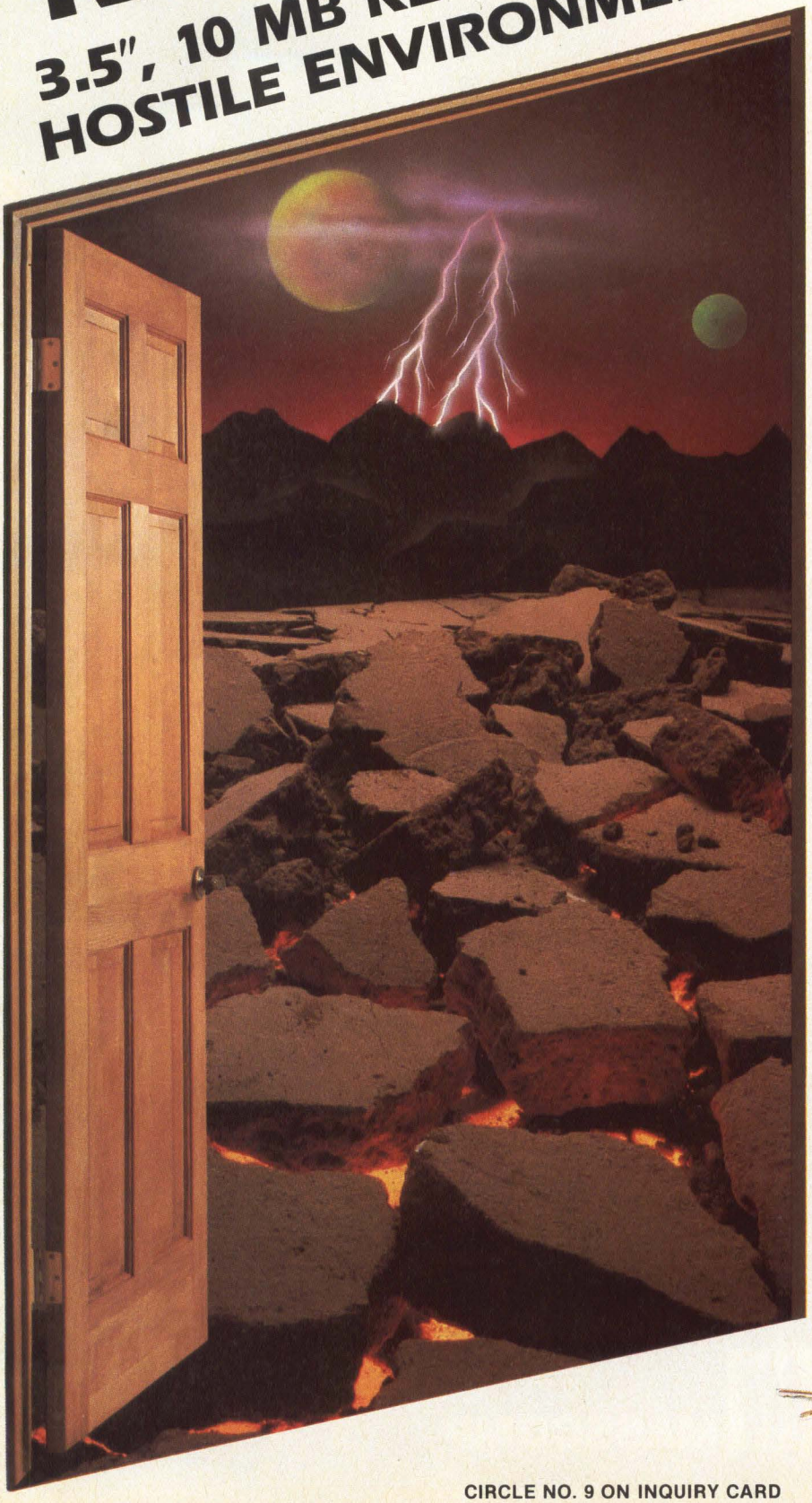
RANGER,

3.5", 10 MB KEY TO HOSTILE ENVIRONMENT PERFORMANCE.



"Mother Nature, You're Under Arrest."

Winchester-based mass storage is no longer at the mercy of the elements. With environment-independent Ranger, you can say hello to a whole new world of portable and severe-environment data processing applications. Ranger's unique suspension system, acoustic dampening and heat dissipating frame and contamination isolated HDA lock out all the bad guys including shock, vibration, heat, humidity, noise, dirt, stiction, magnetic fields and radio frequency.

Stamp Out Designer Siege Mentality.

Ranger brings a welcome breath of fresh air to portable product design. The compact 1.625" X 4.0" X 5.75" form factor and ultra-light 2 lb. package gives designers room to maneuver, eliminating the stress of having to compromise on critical product features because of weight, size or environmental constraints. Every durable detail of Ranger's layout, from the positioning system's opposing thermal loops to the shock and vibration isolated HDA, is configured for accurate, reliable performance, ease of manufacture and an exceptionally long service life.

Freedom To Go Where The Action Is.

Past environmental limitations are no longer a barrier to Winchester portability. Remote siting, exploration, testing and measurement; the possibilities are almost limitless.

To find out how to target rugged Ranger for your design mission, please write LaPine Technology, Inc., 1111 Space Park Drive, Santa Clara, CA 95054, or call us at 408-986-8676.

LAPINE TECHNOLOGY

CIRCLE NO. 9 ON INQUIRY CARD

Letters

PRICING POSTSCRIPT

To the editor:

I would like to acknowledge MMS for including AED Inc. in the July survey of graphics display terminals (MMS, July, Page 235).

Unfortunately, the information published regarding our product pricing was incorrect. I would like to clarify the following prices: AED Graphics Terminals, Model 1024, $11,995.; Model 767, $7,495; Model 512, $4,995. These prices are quantity one, and without a 19-inch color monitor.

I know MMS is committed to quality editorial features and articles. Any clarification you can provide to your readership will be appreciated.

Robin Ratajczak
Manager,
Marketing Communications
Advanced Electronics Design Inc.
Sunnyvale, Calif.

DIAGNOSTIC DISCUSSION

To the editor:

As president of one of the three manufacturers highlighted in the article on diagnostic diskettes for flexible disk drives, (MMS, September, Page 143) I take exception to some of the unfounded assertions and conclusions contained in that article.

It is simply untrue to state, as your article does, that diagnostic diskettes "may be too sophisticated to help the average end user." On the contrary, diagnostic diskettes, which automatically test the parameters affecting interchangeability when inserted into a flexible disk drive, have made it possible for microcomputer users without technical expertise and without sophisticated test equipment to verify the reliability of their drives.

As indicated in your article, interchangeability refers to the ability of data stored on a disk to be read when the disk is transferred to a supposedly compatible drive. Diagnostic diskettes such as the RID (Recording Interchange Diagnostic) by Dymek Corp. provide a simple and cost-effective means of assuring interchangeability and protecting the integrity of data stored on flexible disks.

In view of the substantial investment that software and data libraries represent, the importance of easy-to-use diagnostic diskettes, such as the RID, becomes obvious. The value of applications software is growing more than 40 percent annually, and Dataquest estimates that the average value of a data library is four times that of the system in which it is used. Isn't it worth $34.95 (the price of an RID diagnostic diskette) and 30 seconds a day (the time it takes the RID to perform its series of tests) to help protect those investments? I think the average microcomputer user will answer with a resounding "Yes".

There is virtually no likelihood that a user could, as asserted by another source in your article, "misinterpret the information or use the diskette at the wrong time"— at least not with an RID disk. The Dymek RID performs seven diagnostic tests and gives the user a simple "pass" or "fail" response on the monitor after each test, along with remedial advice if necessary. It is so simple there is no need to interpret screen messages. As to the assertion that users will use the diagnostic diskette at the wrong time, which is voiced by more than one source, there is no foundation to this contention. The more frequently it is used, the more the potential benefit to the user. We recommend that users insert the RID into each flexible drive before each day's computing session.

On another point, your article states that, "diagnostic diskettes simulate typical operation of a drive and measure rotational speed, clamping, noise tolerance, read-write functions, track alignment, erase-crosstalk and positioner accuracy". It is true that these are the seven tests performed by the RID diskette, but it is highly inaccurate to imply by a general statement that all diagnostic diskettes perform these tests.

Duane C. Meulners
Dymek Corp.
San Jose, Calif.

Editor's response:

I don't disagree with Mr. Meulners on much of what he says; but, then, neither does the article, which explicitly states that, for the most part, the diagnostic diskettes are easy to use. The question is, however, whether or not the average end user is knowledgeable enough to fully appreciate the value of the information he or she is getting. The answer is a resounding "No." Moreover, in order for any diagnostic diskette to be useful, it must be used—as you clearly stated—daily. Most analysts believe that it will not be used that frequently. Interestingly, the real test of disk drives' reliability is if they work when turned on. But that is when users first realize they have a problem.

I do disagree, and so did the sources interviewed, that users can't misinterpret the information from the diagnostic diskette, especially when they use it at the wrong time—after the problem exists. Possibly, the market will prove otherwise. For the moment, it appears the real value of diagnostic diskettes is in the hands of system OEMs and resellers.

To address another concern. While Mr. Meulners may consider his RID superior to the competition, the fact is, all of the other diagnostic diskettes do perform the seven tests he recites. The point, however, isn't whose are superior, but whether users need diagnostic diskettes at all.

—C. Warren

IN-SECURITY OVER ARTICLE

To the editor:

I notice in your July issue that you have a detailed article about call-back security systems in which the only system mentioned by name is the LeeMah system (MMS, July, Page 257). Even though we offer a competitive product I would have had no problem with that were it not for the fact that Jim Smith, the author of the article, at no point identifies himself as the chief engineer and designer of the LeeMah system. Indeed, he is so identified in an article about LeeMah appearing in *INC.* magazine earlier this year. Jim Smith, a fine fellow in his own right, leaves the impression in his article that he is a disinterested consultant; indeed, he receives a royalty for every LeeMah system sold.

Mel Schwartz
President
Digital Pathways Inc.
Palo Alto, Calif.

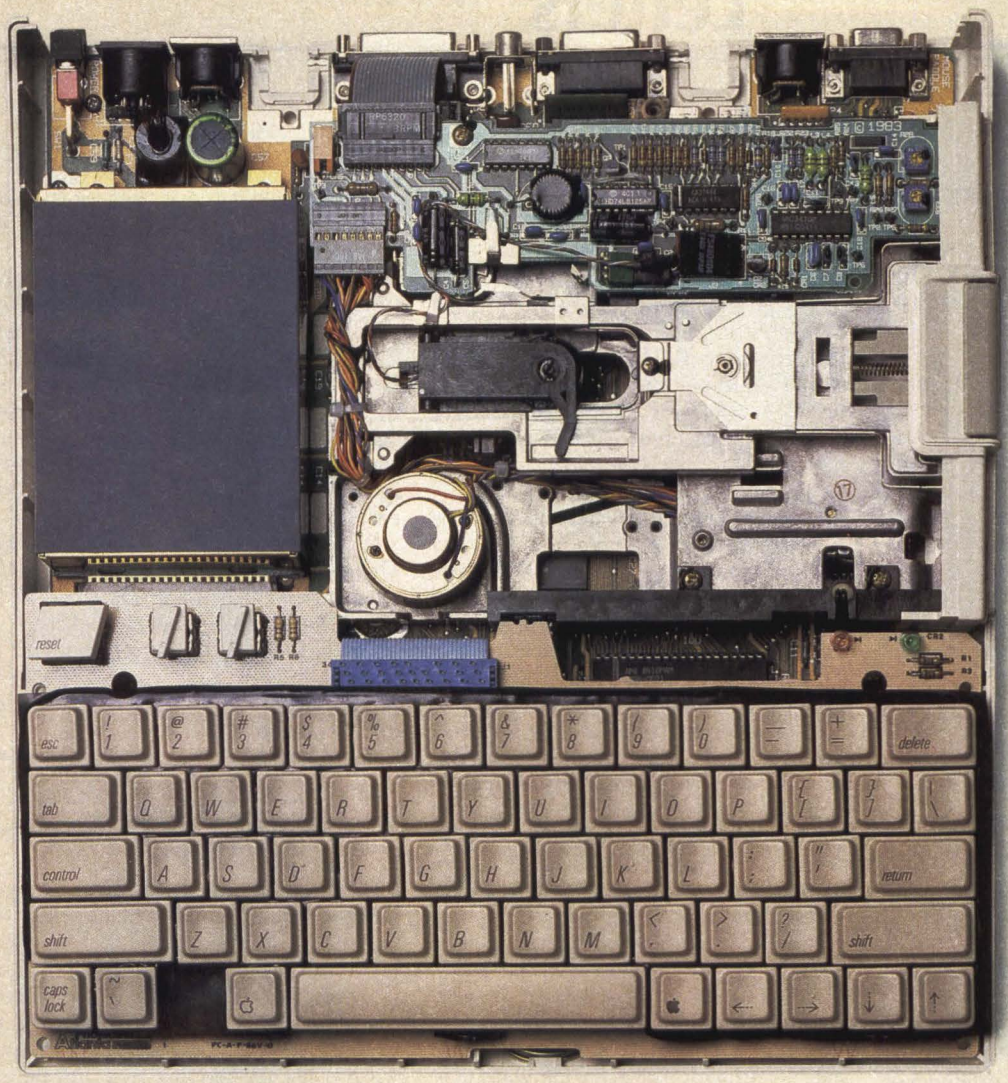
ADDRESS CORRECTION

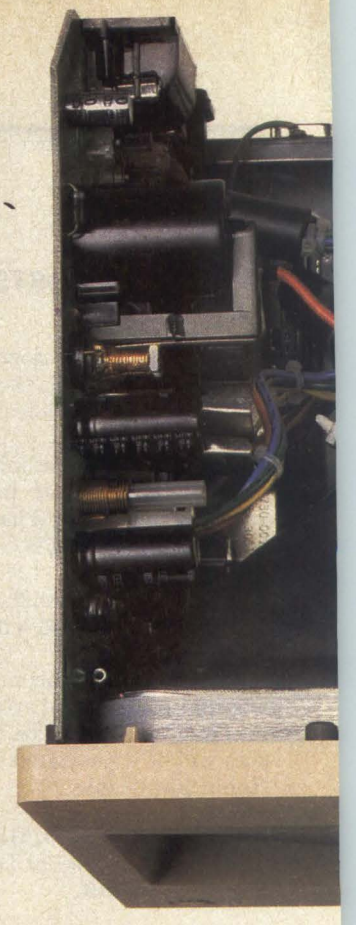
To the editor:

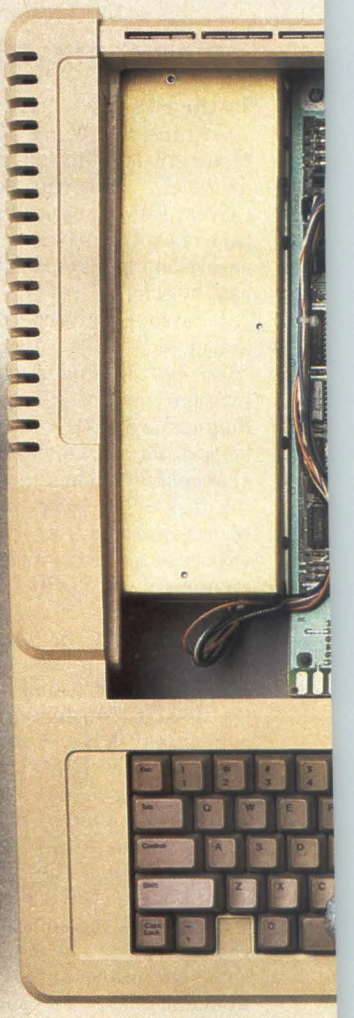
Our company's name was mentioned in a recent article on disk emulators (MMS, October, Page 139), but it was listed with the wrong address.

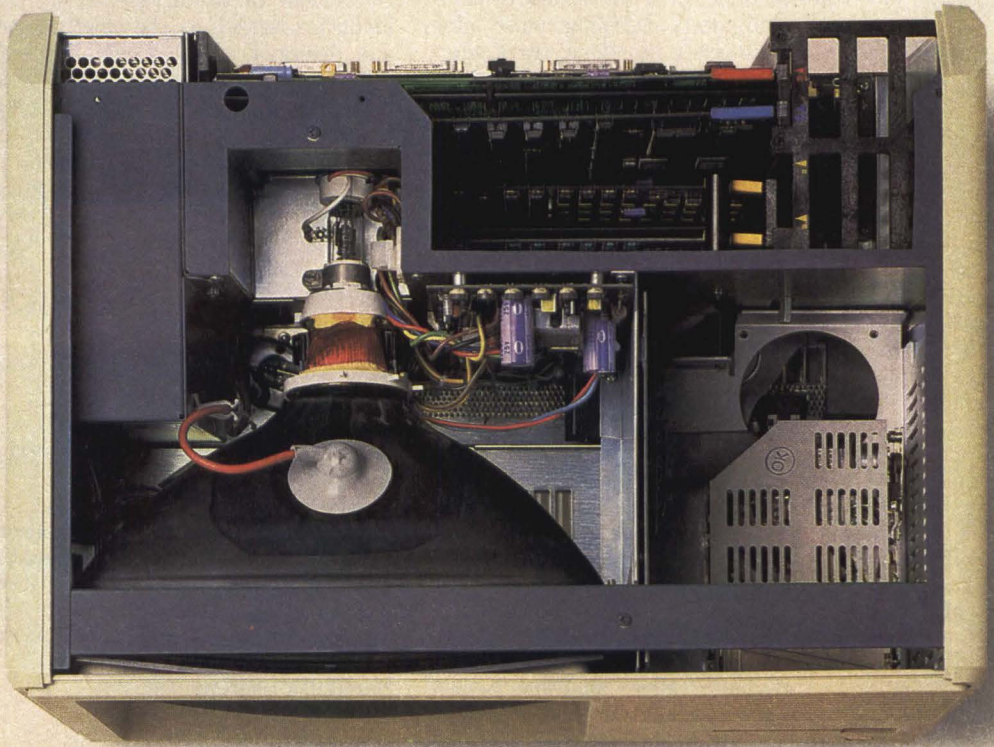
The correct address is listed below.

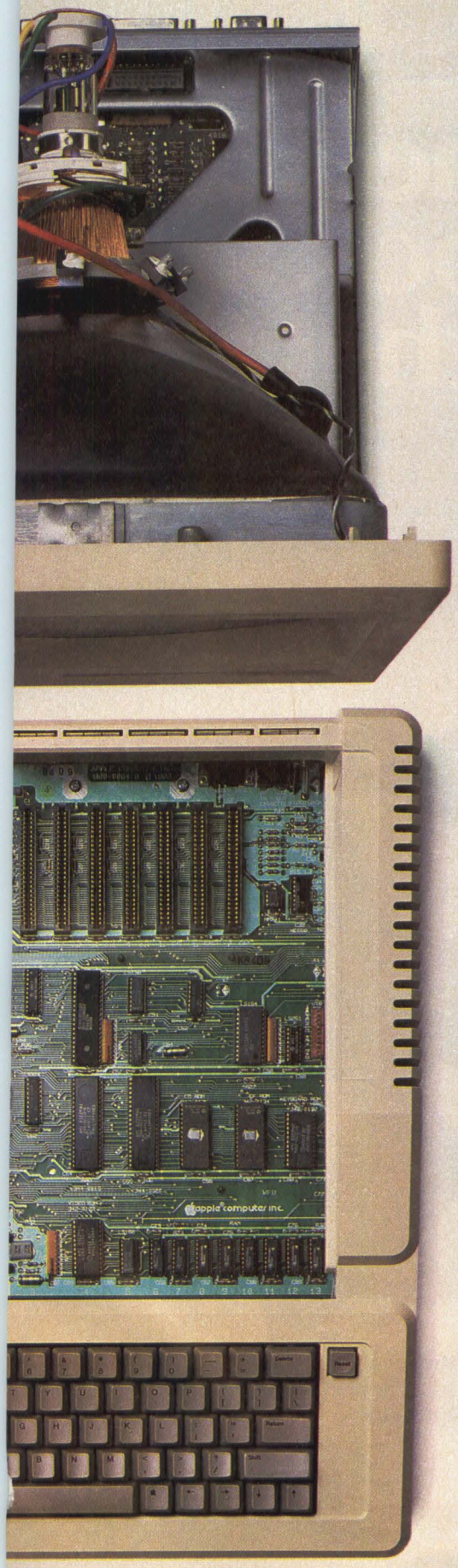
James Bell
SemiDisk Systems Inc.
P.O. Box GG
Beaverton, Ore. 97075











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Breakpoints

PRINTER ADD-ON HELPS PAPER 'REMEMBER'

"Budget" memory using magnetized sheets of paper and a read-write head unit that can be installed in most dot-matrix impact printers is expected to be brought out in Japan this spring and available in export markets by early summer. Japan's Sankyo Seiki Manufacturing Co. has put a read/write head mechanism in a covered roller that replaces the conventional platen on most dot-matrix impact printers. The head reads from, or writes to, what has been called electronic carbon paper, a special paper coated with high-coercivity (3,000 oersted) magnetic particles, priced at about five cents a sheet. The A4-size paper, slightly larger than customary American business stationery, has a 5K-byte memory capacity, or about 1,500 characters. The recording density is 210 bits per inch on 32 tracks. The $40 to $50 attachment shares the power supply and I/O of the host printer. The paper and head make it possible to print and reproduce software from floppy disks or to use the sheets as data-entry media.—I. Kakehashi

RASTER TECHNOLOGIES ANNOUNCES 3-D GRAPHICS TERMINAL

Raster Technologies Inc., North Billerica, Mass., has developed a 19-inch graphics terminal that provides three-dimensional modeling independently of the host computer. The Model One/380 performs 32-bit floating point transformations with perspective, local light-source calculation, hidden surface removal and smooth shading. Non-interlaced resolution is 1,280 pixels by 1,024 pixels at 60 Hz, with up to 24 bits of image memory per pixel. The unit, which supports a superset of both the Siggraph CORE and Graphical Kernel System standards, displays 256 colors from a palette of 16 million. The system has a maximum display list memory of 4M bytes, and contains an internal debugger so basic development can take place without accessing the host. Prices start at $41,500.—D. Bright

LOTUS TO 'JAZZ' UP MACINTOSH WITH INTEGRATED SOFTWARE

Lotus Development Corp. plans March shipments of Jazz—its new integrated software package for Apple Computer Inc.'s 512K-byte Macintosh personal computer. The lack of applications software, particularly spreadsheet programs, has so far hindered Macintosh's usefulness. But Apple expects Jazz to quickly become a best seller and greatly increase the Macintosh's appeal, perhaps doing for the Macintosh what VisiCalc did for the Apple II. The $595 package, which resembles Lotus' 1-2-3 and Symphony packages for the IBM PC and PC-compatibles, comprises five functions: spreadsheet analysis, business graphics, word processing, database management and communications. Jazz also runs on Apple's Lisa computer.—D. Bright

C. ITOH TO INTRODUCE THERMAL PRINTERS

C. Itoh Electronics Inc., Los Angeles, early next year should introduce its first thermal printers, the T1000 and T90. Utilizing a 24-element printhead, the T1000 produces near-letter-quality output at 40 characters per second (cps) and draft-quality output at 80 cps. The 40-column T90 thermal message printer plugs into a standard phone jack and prints messages

received by modem at 40 cps. The T1000 will retail for approximately $350, the T90 for approximately $150.—T. Moran

CARROLL CUTS PRICE, SIZE OF TOUCH SYSTEMS

To attract volume sales from OEMs and systems houses, Carroll Touch, Round Rock, Texas, has developed touch systems with 45 percent fewer parts, and at half the price of its previous products. The company's Smart Frames for 9-, 13- and 19-inch monitors sell for $450, $595 and $795, respectively. The infrared sensors and electronics are all contained in a frame that mounts on the front of the monitors. Infrared beams create an invisible grid in front of the screen; when a finger or other object breaks the grid, the appropriate message is sent to the host computer. A user can paint graphics by tracing a finger across the screen, addressing areas as small as a pixel.—D. Bright

EMULEX PUTS SCSI ON MULTIBUS

The device-independent MB01 host adapter from Emulex Corp., Costa Mesa, Calif., matches the Small Computer Systems Interface (SCSI) bus with the IEEE-796 Multibus. Besides providing an 8-bit data path between the two buses, the eight-port MB01 includes dual in-line package-switch selection for serial or parallel bus arbitration, a direct-copy command for disk to tape backup, support for 8- and 16-bit microprocessors, and 8-, 16- or 32-bit addressing. The $695 adapter fits into any available slot on the Multibus backplane.—C. Warren

MICROSYS EXTENDS STDBUS COMMUNICATIONS

To extend the communications of STDbus systems, Microsys Inc., Glendale, Calif., has introduced the models AM 1232 and 4232 communications cards. The $160 1232 is a two-channel add-on that handles RS422-to-RS232 communication conversion. Four-channel conversion of the RS422 format to the RS232 format is handled by the $95 4232. Both boards are expected to be shipped in volume this month.—C. Warren

APPLE TO OFFER JAPANESE/ENGLISH TRANSLATOR FOR MACINTOSH

Apple Computer Inc. expects to introduce by the end of the year a Macintosh word-processing software product that accepts text in either Japanese or English and translates from one language to the other. The $250 program will initially run on the 128K-byte Macintosh; a more complex version for the new 512K-byte Macintosh is currently under development. The package, which Apple jointly developed with an as-yet-unnamed company, has similar features to Apple's MacWrite word processing program.—T. Moran

TECH FILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS

COMDEX HIGHLIGHTS: Despite the computer industry shakeout, this year's COMDEX show, held in mid-November in Las Vegas, attracted over 1,400 exhibitors—about the same number as last year's show. Show sponsor, the Interface Group Inc., said the exhibits, which were spread out over 55 percent greater

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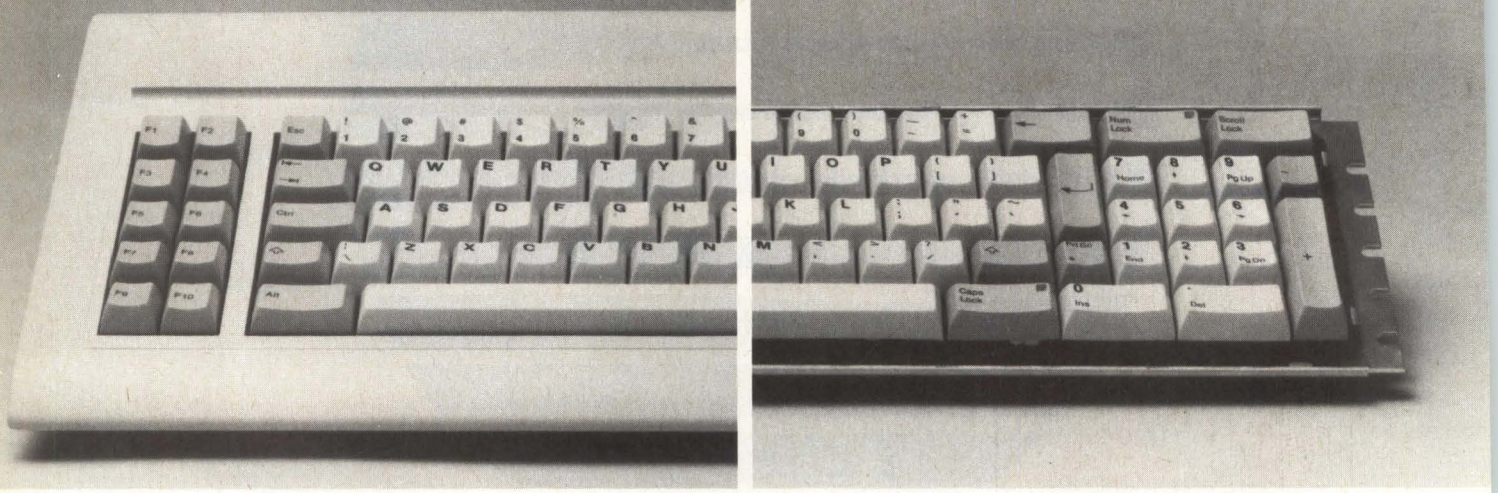

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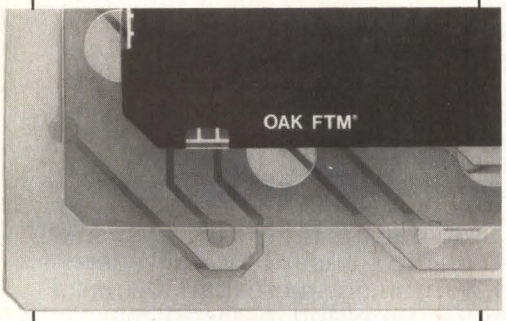

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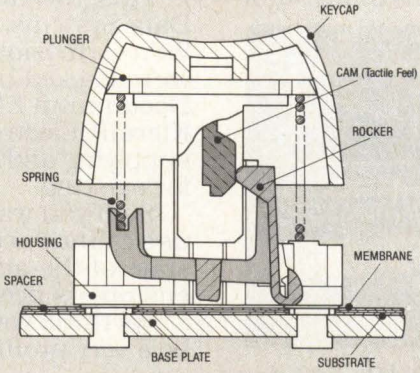

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booth space than last year, drew over 90,000 attendees, compared to 83,000 in 1983. Major product announcements, however, seemed fewer than in the past.

IBM Corp.'s new PC-AT is already stimulating compatible products, some of which were in evidence at the show. **Esprit Computer Products Inc.,** Montgomeryville, Pa., introduced the Esprit X16 microcomputer system running XENIX 3.0. Based on the Intel Corp. 80186 microprocessor, the system can be expanded to support eight users. Microsoft Corp. and Esprit added enhancements such as increased maximum-program size to the XENIX version ported from the AT. A system with 512K bytes of RAM, one floppy disk drive and a 40M-byte Winchester disk drive retails for approximately $9,000. Initial shipments are scheduled for the first quarter of next year.—D. Bright

With a rugged 10M-byte, 3½-inch Winchester disk drive, **Hewlett-Packard Co.,** Greeley, Colo., is planning on capturing a part of the add-on market for portable computers. The Model HP-97501A requires only 9W of power and is the first Winchester disk drive of its size to use sputtered thin-film media. James Porter, president of Disk/Trend Inc., Los Altos, Calif., says that since the HP unit is also the first captive 3½-inch Winchester, what its market impact will be is uncertain. The drive will sell for under $400 in quantities of 10,000.—C. Warren

While most U.S. sub-four-inch disk drive manufacturers are struggling to provide 10M- to 20M-bytes of storage in 3½-inch drives, **Newbury Data Recording Ltd.,** Staines, Middlesex, England, is set to offer as much as 50M-bytes in a four-platter drive, called the Penny. It comes in either a 25M-byte two-platter model, or the 50M-byte four-platter version. Both have a 40-msec average access time and are expected to be in production by this April. The drives were designed by Cambrian Consultants Inc., Calabasis, Calif., and have ST506-/412-compatible interfaces. The company claims the drives will fit in either full- or half-height 5¼-inch form factors.—C. Warren

Add **Tokyo Juki Industrial Co. Ltd.,** Torrance, Calif., to the list of 3½-inch low-power flexible disk drive suppliers. Juki is offering four models that require 12V of direct current: the single-sided, 250K-byte Model 311; the double-sided, 500K-byte Model 312; and the double-density Models 313 and 314, with respective unformatted capacities of 500K bytes and 1M byte. The models 311 and 312 have 40 tracks per inch (tpi) and a transfer rate of 67½K-bytes per second. The Models 313 and 314 have 80 tpi and transfer rates of 135K bytes per second. Shipments are expected to begin the first quarter of 1985. Pricing has not been set.—C. Warren.

Wyse Technology, San Jose, Calif., announced two IBM PC-compatible systems: the $1,995 WY-1100-1 and the $3,495 WY-1101-2. Both models include 256K bytes of RAM, two serial ports, a parallel printer port and a 14-inch monochrome monitor. The WY-1100-1 incorporates two 360K-byte

floppy disk drives, while the WY-1100-2 has one floppy drive and a 10M-byte Winchester disk drive.—T. Moran

Following up IBM's recent endorsement of thermal-printing technology with its Quietwriter printer, **Canon U.S.A. Inc.** and **Okidata Corp.** both announced thermal printers. The $549 F-60 from Canon, Lake Success, N.Y., prints 80 characters per second (cps) in draft mode and 20 cps in letter-quality mode. The $268 OKIMATE 20 from Okidata, Mount Laurel, N.J., achieves 80 cps in draft mode and 40 cps in letter-quality correspondence mode. The OKIMATE 20 uses a three-color ribbon and offers dot-addressable graphics with a resolution of 144 by 144 dots per inch. The F-60 uses single-color ribbons and achieves a resolution of 360 by 180 dots.—D. Bright

CIE Terminals introduced Model 30 of its CI-3500 serial matrix printer. The $1,995 unit emulates line printer protocols and prints 350 characters per second (cps), or 211 lines per minute (lpm), in 80-column format; 138 lpm in 132-column format; and 87 cps or 50 lpm at letter-quality output. The Model 30 is available now.—T. Moran

RANDOM DISK FILES: Newly formed **Cherokee Data Systems Inc.,** Boulder, Colo., is developing a 5¼-inch optical disk drive, code-named "Pathfinder," to be used in harsh environments. The drive, which will use laser-optical recording techniques, is expected to be ready in early 1986, says company vice president Thomas Taylor. Cherokee plans to use readily available laser modules for the read/write functions, and is investigating media alternatives.—C. Warren

Tandon Corp., Chatsworth, Calif., has boosted the capacity of the model TM-703 Winchester drive from 30M bytes (unformatted) to 36M bytes (unformatted). In addition, the company is offering a model TM-755 51M-byte (unformatted) Winchester drive with a 35-msec average access time. The three-platter drive uses a dedicated servo and a linear voice-coil actuator. Tandon expects to have evaluation models ready in January, and production underway in March. The price should be less than $1,000. Besides rigid drives, Tandon is introducing a 1.6M-byte, 96-track-per-inch model TM-65-8. Evaluation units of the single-speed drive should be ready this month, and full production is scheduled in January. OEM pricing should be less than $150.—C. Warren

Microscience International Corp., Mountain View, Calif., soon will make available evaluation models of a 3½-inch, half-height 25M-byte (unformatted) Winchester drive. Called the HH325, the drive has an 80-msec average access time and requires only 10W of power, thus making it usable with virtually any microcomputer's internal power supply.—C. Warren

MINI FILES: Digital Equipment Corp. plans to begin volume shipments of its most powerful computer, the VAX 8600, this April. DEC says the VAX 8600, which is the company's first machine to use emitter-coupled logic circuits, delivers more

LINE PRINTER COMPARISON CHART				
STANDARD FEATURES	CIE TERMINALS CI-300	CIE TERMINALS CI-600	DATAPRODUCTS B-300/600	PRINTRONIX P-300/600
LOWEST PRICE	X	X		
L Q PRINTING	X	X	X	
COMPRESSED PRINT	X	X		
GRAPHICS RESOLUTION				
60 x 72	X	X		X
120 x 72	X	X		X
200 x 144	X	X		
200 x 288		X		
BOLDFACE PRINTING	X	X		
SLANTED PRINTING	X	X		
CHAR. ENLARGEMENT	X	X		
INT'L CHARACTERS	X	X		

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than four times the performance of its industry-standard VAX-11/780 superminicomputer. The VAX 8600 uses the VAX instruction set and thus is compatible with the entire VAX line, DEC says. Prices of systems configured wih VAXcluster hardware begin at $576,000.—D. Bright

MICRO FILES: The new Pro-Lite portable computer from **Texas Instruments'** Data Systems group, Austin, Texas, weighs 10 pounds and is compatible with the TI Professional personal computer. The $2,995 Pro-Lite includes a 3½-inch microfloppy disk drive and a 25-line-by-80-column liquid crystal display. —T. Moran

Fortune Systems Corp., Redwood City, Calif., has developed a family of workstations that run both UNIX and PC-DOS. The Fortune 1000 desktop series comprises an ASCII terminal, an intelligent workstation, a graphics workstation and a UNIX- and PC-DOS-based, networked personal computer with color graphics.—T. Moran

Xerox Corp. will market **Apple Computer Inc.** products in several Central and South American countries, including El Salvador, Nicaragua, Uruguay and Venezuela. Apple says the move is part of its plan to expand its distribution channels in emerging office markets. Xerox, in turn, says it can now offer its customers a full line of office products. The three-year agreement calls for Xerox to distribute all Apple products through authorized dealers and the Xerox sales-and-service network.—D. Bright

SYSTEM FILES: Microtek Labs Inc., Gardena, Calif., has announced a desktop document-imaging system for less than $1,000. The yet-to-be-named scanner accepts text, graphics, drawings, pictures or mixed pages up to 8½ inches by 11 inches. It has a digitizing resolution of 200 pixels per inch. Also, **Datacopy Corp.,** Mountain View, Calif., has developed the model 700 imaging system, which is priced less than $4,000 and should be available in March 1985. Using a flat-bed scanner to capture images, the model 700 interfaces to an IBM Corp. Personal Computer or PC-compatible computer.—C. Warren

NOTES FROM OVERSEAS: Most Japanese trading houses, faced with slow or no growth, have turned to electronics to boost profits. **C. Itoh & Co. Ltd.,** a large trading house, and its C. Itoh Data Systems Co. subsidiary, have acquired 70 percent of Hamilton Avnet Electronics Japan Ltd. The acquisition of the semiconductor marketing company gives C. Itoh a stronger silicon-device market presence.—I. Kakehashi

Optoelectronics is a high-priority research subject in Japan. One of the most active companies in the field, **Fujitsu Ltd.,** has developed a transmission-reception optoelectronic integrated circuit (OEIC) module that has been tested for digital signal transfer at 400M bytes per second over fiber optic cable. The device combines a light-emitting laser diode, a light-detecting photodiode and other optical elements and electronic circuits. The

modules send information at 1 GHz and receive it at 300 MHz. OEICs are expected to be increasingly important in data communications, especially for local networks, factory control networks and long-distance data relays.—I. Kakehashi

Sony Corp. of Japan is offering four new 4-bit CMOS single-chip microcomputers that ease software creation and testing. Called the SPC500 series, the four are available in modules claimed by Sony to be some of the first 4-bit microprocessing units with serial I/O, timers and peripherals that work without changing the central processor. The arrangement of circuit blocks by functions minimizes layout changes when ROM or RAM space is extended or when peripheral functions are added. There are eight address modes, which Sony says will permit execution of 83 percent of all typical computer commands. Sony's software development and evaluation package, with the necessary boards, keyboard and LED display, will have a suggested retail price in Japan of about $2,050. Prices of the devices vary with design and capacity.—I. Kakehashi

Japan's Ministry of Posts and Telecommunications is planning negotiations with other countries to extend its international high-speed, facsimile-based electronic mail service. The first satellite links, between Japan and West Germany, and Japan and the United States, were to begin late last month. The service would reduce the time required to mail a letter from one country to the other to two days or less. Regular air mail takes about five days. The Japanese expect the widest application of the service in the United States, where about 250 post offices already have facilities for electronic mail.—I. Kakehashi

France's aerospace/defense/electronics conglomerate, **Matra Sa,** has teamed up with Norwegian minicomputer maker Norsk Data AS to produce high-performance, 32-bit superminicomputers. The pact was signed despite opposition from France's government-owned Bull Group, which recently inked a similar agreement with U.S.-based Ridge Computers.—M. O'Gara

Beating out ICL Plc., NV Philips, Olivetti SpA, and Sperry Corp., **ITT Corp.** walked away with the core operations of Christian Rovsing AB, the Danish data-communications vendor that recently went bankrupt. ITT has taken a 44 percent share of both the restructured company and its debts. The buy-in follows quickly on the heels of ITT's acquisition of a 49 percent interest in West German minicomputer vendor Computertechnik Mueller.—M. O'Gara

ICL is reselling the 932 Micro from Datamedia Corp., Nashua, N.H. Although the Clan, as the machine is dubbed, can run both the Pick and UNIX System V operating systems, only UNIX is currently offered. Priced between $25,000 and $100,000, the Clan supports up to 16 users and is being aimed at value-added remarketers rather than at ICL's end users.—M. O'Gara

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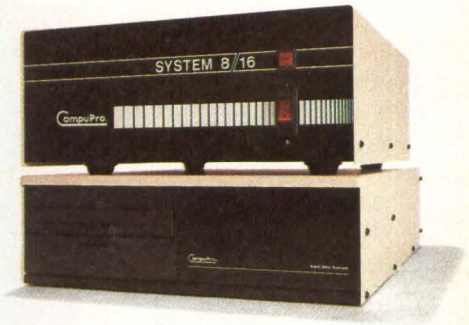

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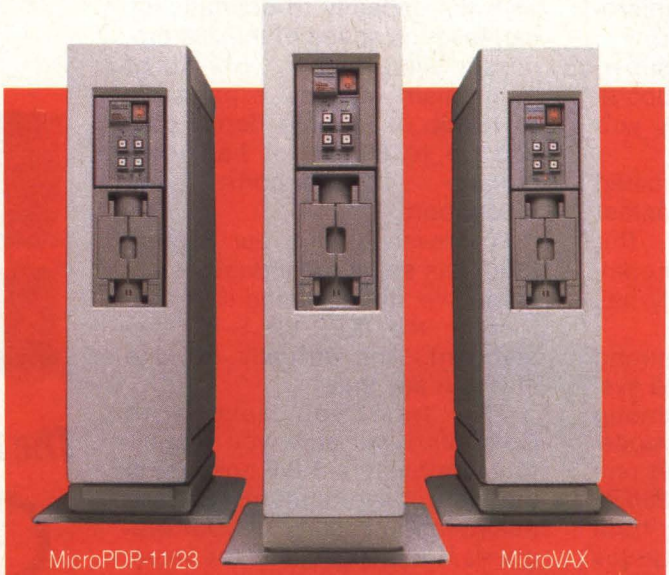

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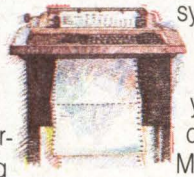

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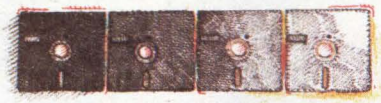

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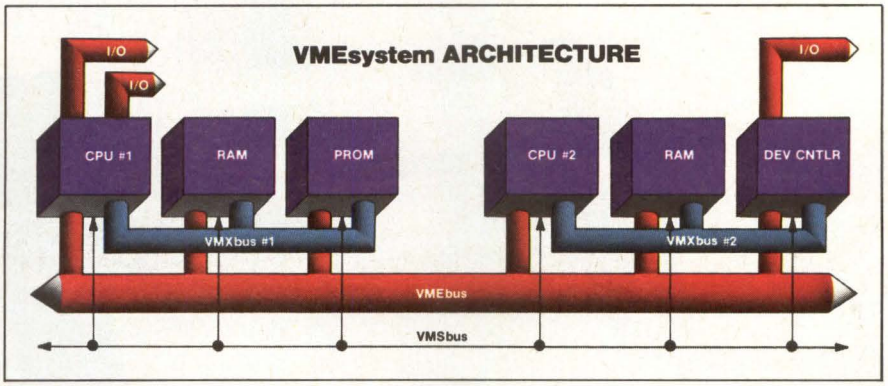

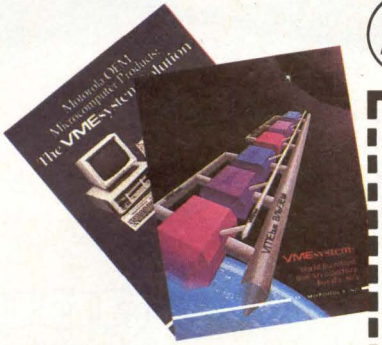

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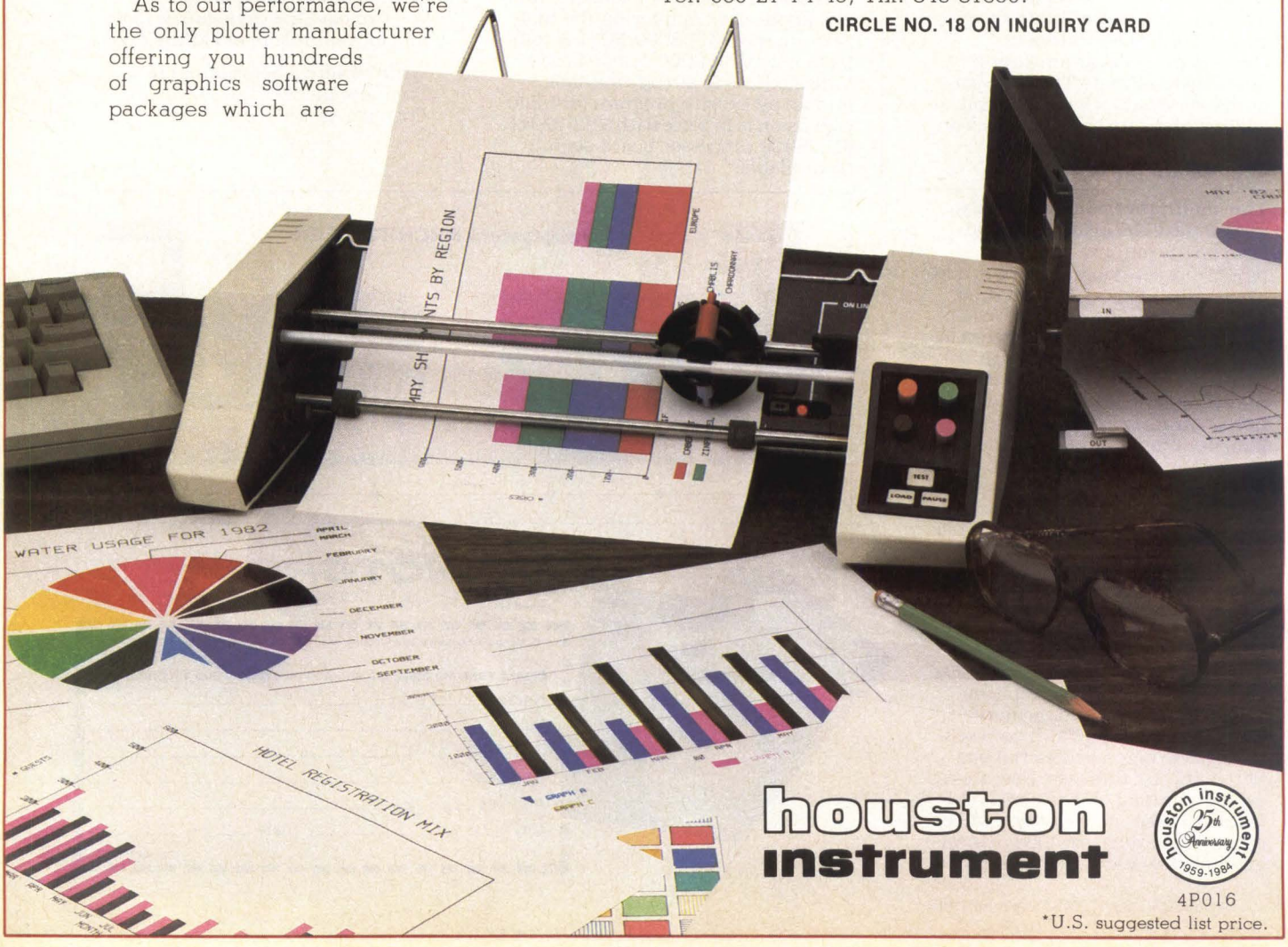

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Ungermann-Bass, GE team up to connect factory systems

Marjorie Stenzler-Centonze
Associate Editor

Most local area network (LAN) standards work has been directed at connecting various office computers and/or networks; factories have been more or less left on their own to plug equipment together. IBM Corp., which has installed more CAD/CAM equipment in factories than any other company, has yet to offer a comprehensive plan to tie its own equipment together, let alone connect non-IBM machines. General Motors Corp., the National Bureau of Standards, Boeing Computer Services Co. and 14 other companies demonstrated a pilot network at the recent National Computer Conference (MMS, July, Page 36) to connect equipment in both factory and office environments. But that network will not be completed until 1988.

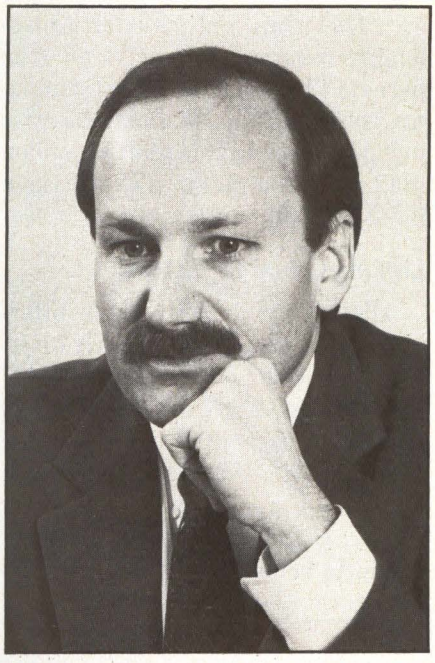
However, General Electric Co., Charlottesville, Va., and Ungermann-Bass Inc., Santa Clara, Calif., recently formed a joint-venture company that will develop a network for factories. That factory network will tie into office networks.

The project could take several years, so until it is ready, the joint venture, called Industrial Networking Inc., will provide an interim solution. Industrial Networking will use as its foundation Ungermann-Bass' office LAN based on the de facto-standard Ethernet LAN. Ethernet is currently under review by IEEE's 802.3 committee; that committee has approved a baseband Ethernet version and is considering a broadband version. While developing and selling products based on Ethernet, Industrial Networking will also build links into those products for a less-developed proposal for a factory LAN called the token bus. The token bus is being considered by IEEE's 804.2 committee.

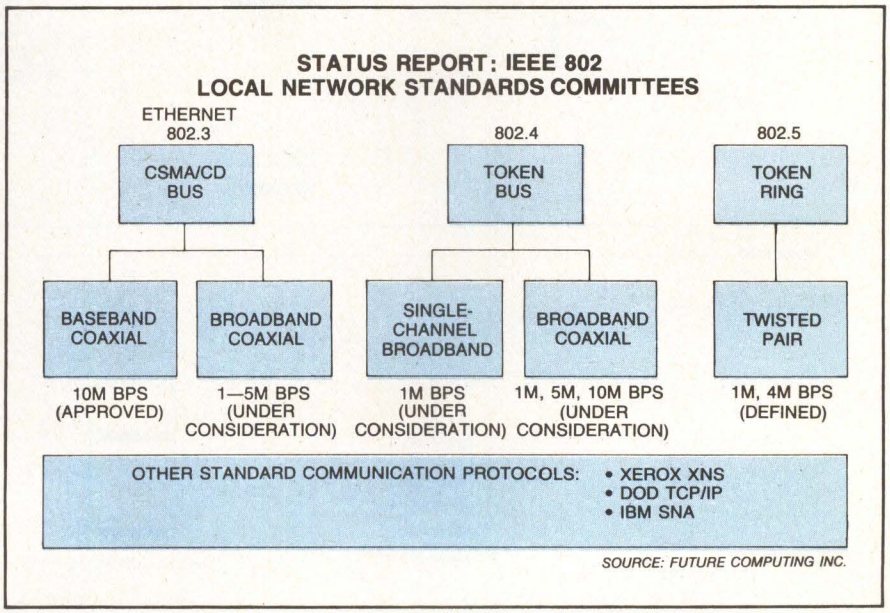
The first product from Industrial Networking, due this month, is an industrialized prototype Ethernet LAN that will connect a variety of manufacturers' equipment found in factories.

LAN for OEMs, integrators

The Ethernet products from Industrial Networking will be sold through OEMs and system integrators. Although Ungermann-Bass owns a 60 percent share of the venture and initially will supply its management team, Ralph K. Ungermann, president and chief executive officer of Ungermann-Bass, stresses that his company will be



Ralph K. Ungermann, *president of Ungermann-Bass Inc., says the network products offered through the Ungermann-Bass/General Electric Co. joint venture will provide a clear path into token bus standards-based systems.*



The IEEE is now working on three local networking standards, *two of which will play a part in Industrial Networking Inc.'s products. Ethernet will be the first stage of a network scheme to link factory devices. When the factory-optimized token bus standard becomes firm, Industrial Networking will link its Ethernet-based offerings to it. The boxes stemming from the three standard proposals denote the medium used for transmission, under which the data speeds are listed.*

treated just like any other customer. "The joint venture is an arm's-length relationship between the parents and the independent company," he maintains. General Electric brings to the organization $6 million in financial muscle, plus expertise in industrial automation.

Linking office to factory

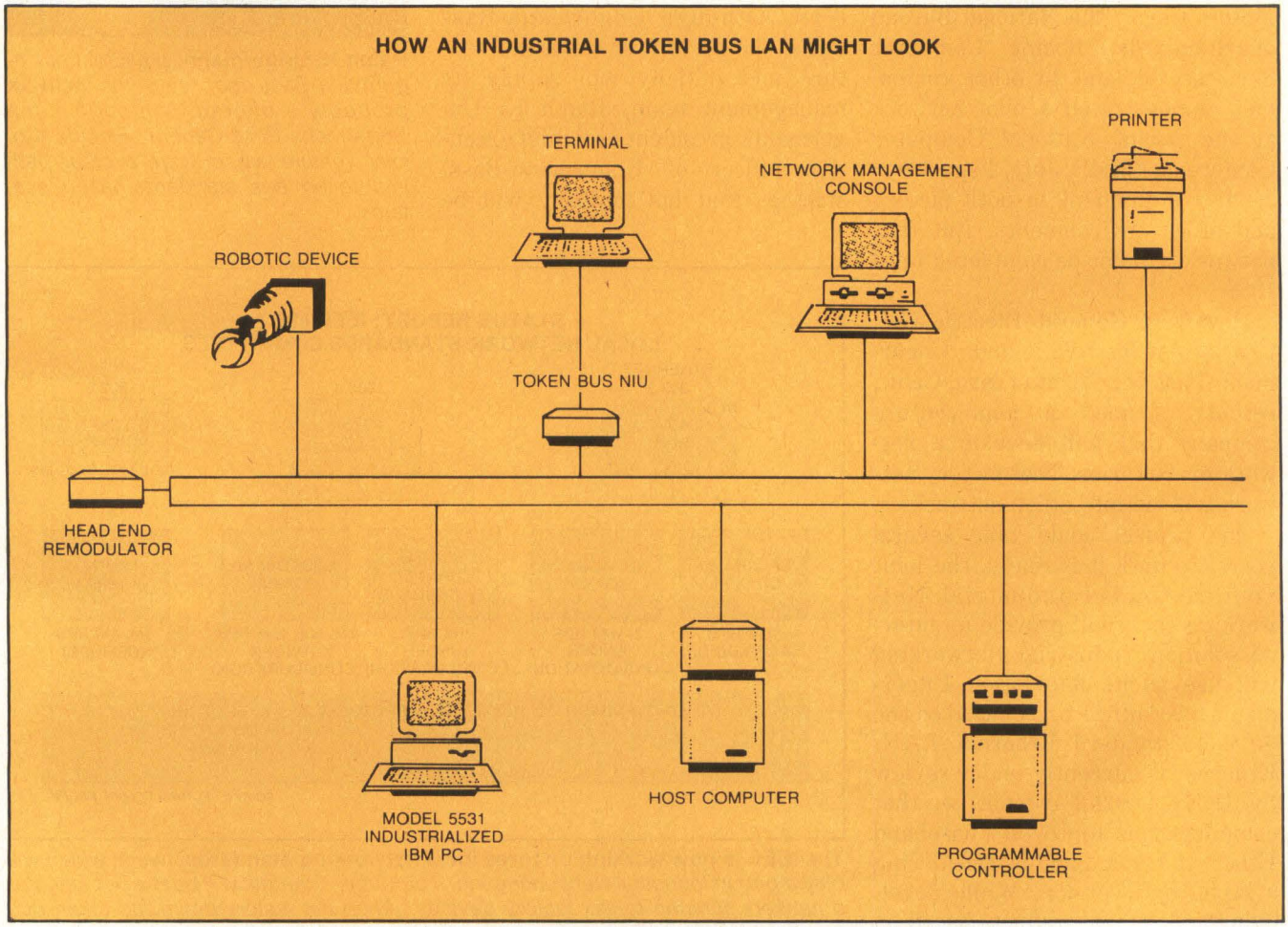
All Industrial Networking offerings will be compatible with existing Ungermann-Bass office LAN products, so Ungermann-Bass will be able to extend its current office network into the factory, to integrate both types of networks.

The Ungermann-Bass Ethernet products bring key technological elements to the venture, comments Christopher Fuselier, manager of industrial communications products operation in General Electric's Industrial Electronics Business Group. "The most widely applied networking systems outside the industrial environment are Ethernet-type systems, and they are going to play an important...role in industrial installations," Fuselier says.

The General Motors network also will help push Industrial Networking's Ethernet products into the market, explains Fuselier. The General Motors network uses the Manufacturing Automation Protocol (MAP), which incorporates the proposed token bus standard. Industrial Networking plans to supply token bus-based products that work with MAP. As General Motors pushes to make that network available in stages, users will want to start laying the groundwork to incorporate MAP, he explains.

Fuselier says there will be a transitional period before all the pieces are available for a standard solution to tying together different vendors' equipment. "We needed an interim solution, namely an Ethernet solution, that would be available to industrial customers who want to start networking now and then have a migration path into [MAP] standards-based systems," he states.

By the middle of next year, In-



The Ungermann-Bass Inc./General Electric Co. joint venture *will create factory local area networks such as this conceptual one that will conform to the emerging industrial token bus standards.*

dustrial Networking plans to begin moving its original customers toward token bus technology. "The token bus standard is still emerging," Ungermann states, "so to commit a factory to it would be foolish. What we really want to do is commit to a known technology that has a nice clear path so later we can swap it out or make bridges into token bus," he remarks.

Sidestepping confusion

Focusing on the token bus is expected to accelerate development of the factory LAN market more quickly than its office LAN counterpart has moved. Ungermann says the office environment has set up a conflict for customers, confusing them with the technology claims of various technologies and access methods. "In the factory we have an alignment behind a single set of standards, and it's going to be very easy for a factory manager to make the decision to install a token bus product. He knows what the industry is lining up behind," Ungermann offers.

The market for factory local area networks is pegged at about $22 million this year, taking into account revenue generated by network connections and software, according to Robert George, director of advanced manufacturing technologies at the research company Creative Strategies International, San Jose, Calif. That figure is projected to reach close to $150 million by 1989, George says. Some analysts expect the market to top $1 billion by the end of this decade.

Ungermann-Bass and General Electric believe they are a step ahead of the industry by offering the ability to interconnect the wide variety of manufacturers' equipment found on most factory floors. "The majority of networking in factories to date has been on a more proprietary basis," Ungermann explains, "and proprietary networks are not nearly as appealing as a vendor-independent general purpose network."

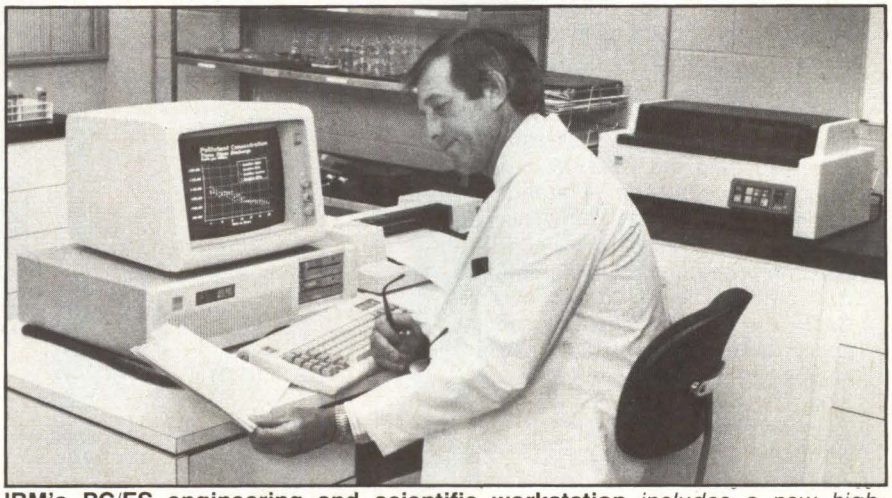
Potential customers of the joint venture include anyone who supplies LANs and integrated systems to the industrial environment—including IBM Corp., GE's Fuselier remarks. "We do not see IBM as a competitor at this point because it does not internally have the types of products we intend to bring to market," he says. Both Fuselier and Ungermann acknowledge, however, that that situation could change any time. □

Third parties give lead to IBM in scientific PCs

Lori Valigra, Senior Editor

It's a rare company that can dominate a market it has not formally entered—unless that company is IBM Corp. Some analysts, after having accorded IBM's Personal Computer (PC) the top slot in commercial applications, now are declaring the giant's product the de facto winner in U.S. engineering and scientific installations.

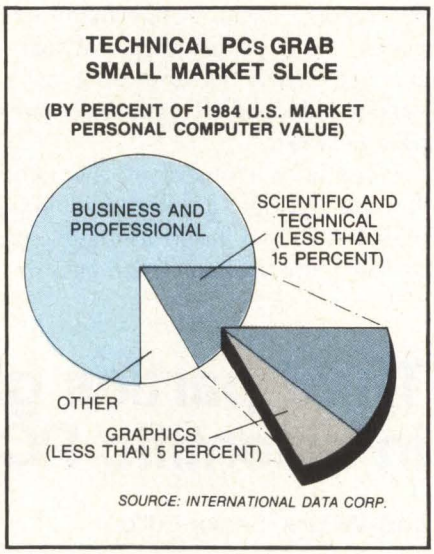
"IBM [PCs] now are the leading resident on engineers' desktops," contends Dr. Joel N. Orr, chairman of graphics consultancy Orr Associates Inc., Danbury, Conn. Ironically, independent resellers had already propelled IBM to the top in that arena even before IBM introduced its own PC Engineering/Scientific (PC/ES) standalone microcomputer this fall. Orr explains: "The PCs are cheap compared with Digital Equipment Corp. and Hewlett-Packard Co. (HP) products, and they are ubiquitous. It's easy to buy IBM [products] through [any] corporation," because many companies have sanctioned IBM as a safe buy. Orr further notes that the high-resolution graphics on the



IBM's PC/ES engineering and scientific workstation *includes a new high-resolution display and adapter card for use with the company's PC, PC/XT or PC-AT (shown).*

PC/ES will make justifying a PC purchase even easier for engineers.

Yet, William Zachmann, vice president of the International Data Corp. (IDC) market research outfit in Framingham, Mass., does not see IBM's move into technical graphics as a mainline strategy. "IBM is trying hard to go after everything it can get," he says. Zachmann estimates that less than 15 percent of the $12.2-billion U.S. personal-computer market is for scientific and technical users. And, of that, less than five percent is for high-resolution graphics applications. He says the scientific market will grow 25 percent yearly by the late 1980s, compared with the loftier 55 percent annual growth rate for business and professional systems.



Aaron Goldberg, director of microsystems services at IDC's Santa Clara, Calif., office, agrees with Orr that IBM has won the top low-end scientific desktop personal computer spot. Though IBM ranked a close third behind HP and Apple Computer Inc. in U.S. shipments into that market last year, Goldberg says Big Blue stepped ahead of them this year. Goldberg estimates IBM had a 19.4 percent share of the 139,000 technical units shipped in the United States last year. Those shipments represent less than 10 percent of IBM's installed PC base, he explains.

Goldberg credits third parties for IBM's rapid growth in scientific applications, especially companies offering IEEE 488 bus cards, which were absent in IBM's PCs until the PC/ES was introduced. "With an

Sharing graphics in groups: IBM offers at least three solutions

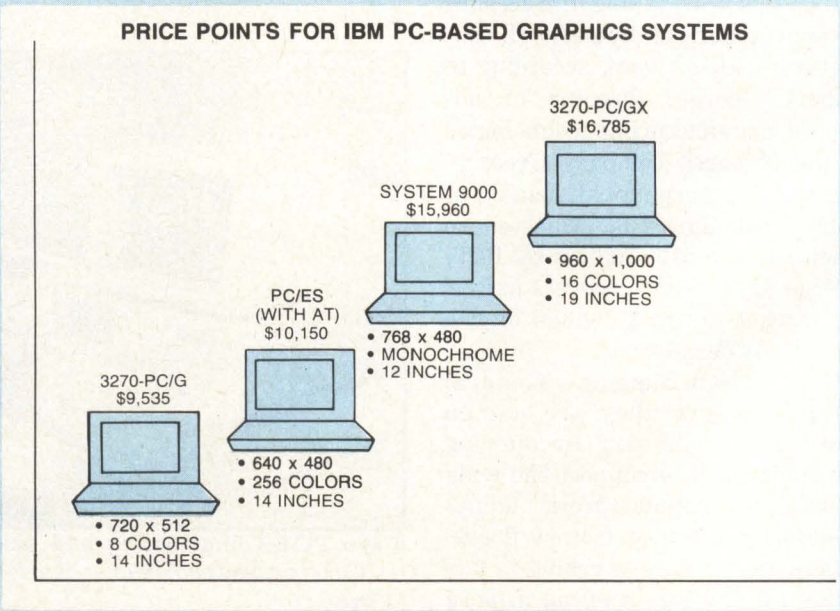
IBM Corp. has not yet introduced a broad multiuser system approach to technical graphics, nor does it have a networking scheme in place to link the different products within technical environments. However, there are at least three ways to share some files in group development settings: IBM's new 7171 ASCII control unit, graphics versions of IBM's 3270-PC multiwindow system and IBM's System 9000, which connects as many as four users.

The $12,420 16-port 7171 connects PCs configured for engineers and scientists to IBM 4300 host computers running the CADAM express computer-aided-design and manufacturing program. The 7171 may play an important role in cementing IBM's personal computers to its high-end CAD products, which already lead the CAD/CAM market with a 30 percent share, according to graphic consulting company Orr Associates Inc., Danbury, Conn.

In the opinion of Kenneth Bosomworth, president of International Resource Development Inc., a Danbury, Conn., market research company, "The 7171 can make a big difference in bringing PCs into the 4300 CAE [computer-aided engineering] environment." Software that accesses mainframe databases also will play a big role, says Bosomworth. IBM's engineering/scientific PC advisory planner, Lou Mamo, says a large database that can deal with office and engineering work in one installation is a complex proposition.

Mamo explains that IBM is piecing together its networking strategy by announcing a future wiring system that will connect other IBM networks such as its PC Net local area network (MMS, October, Page 37).

Lou Reynolds, product group man-



open bus machine there is a lot you can do with add-in cards. You get a lot of functions for less money" than a purchaser would pay for a specialized computer such as HP's 9800 series, he maintains.

The PC/ES series includes the 13-inch, 60-Hz non-interlaced 640-by-480 pixel high-resolution professional graphics display and the professional graphics controller. They are used with the floppy disk-based IBM PC and expansion chassis, the hard disk-based PC/XT, or the high-end PC-AT, which has integral hard and floppy disk drives. The two-and-one-half-card controller takes up two adjacent board slots. It supports 256 colors from a palette of 4,096 and can perform 2D and 3D drawing. A PC color/graphics emulation mode allows the controller to run most IBM PC software. The controller houses an 8088 processor for high-performance graphics, 64K bytes of graphics firmware and 320K bytes of display storage. The price for the professional graphics products used with the 80206-based PC-AT running DOS 3.0 is $10,150.

Graphics consultant Dr. Joel N. Orr, *Orr Associates Inc., says "IBM [PCs] now are the leading resident on engineers' desktops."*

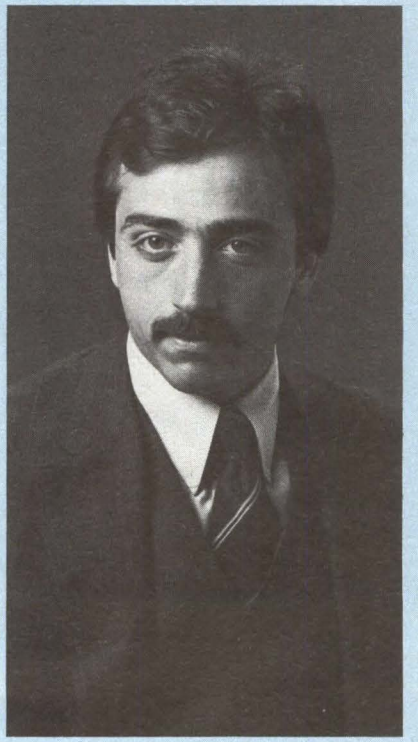
To buttress the PC/ES, which is designed for engineers, scientists, researchers and application software developers, IBM has introduced:

- a $350 PC graphics development toolkit, which includes the Virtual Device Interface (VDI) and other software for creating device-independent programs
- a $175 PC graphical file system, the $295 Graphical Kernel System (GKS), a $225 plotting system and a $295 graphics terminal emulator, which are also application-de-

ager for high-end systems and graphics at Apollo Computer Inc., Chelmsford, Mass., is not concerned yet about heavy competition from IBM because IBM does not have a strong networking scheme in place for its engineering products. Apollo markets a networked engineering workstation system in which intelligence is distributed. "Designers work in teams and must share data," he says. He explains this requires larger disks than are available with the PCs, as well as a high-speed network to transfer files. "IBM is a little ways away, but they'll be there eventually."

Part of IBM's file-sharing approach now is essentially time-sharing, because products such as the 3270-PC/G and 3270-PC/GX must be attached to a host computer to be effective, contends Reynolds. The 3270-PC/G and 3270-PC/GX attach to host mainframes through a 3274 control unit (MMS, June, Page 107). Both products can display seven windows: four for host mainframe applications, two for electronic notepads and one for PC applications. The PC window does not communicate with the host.

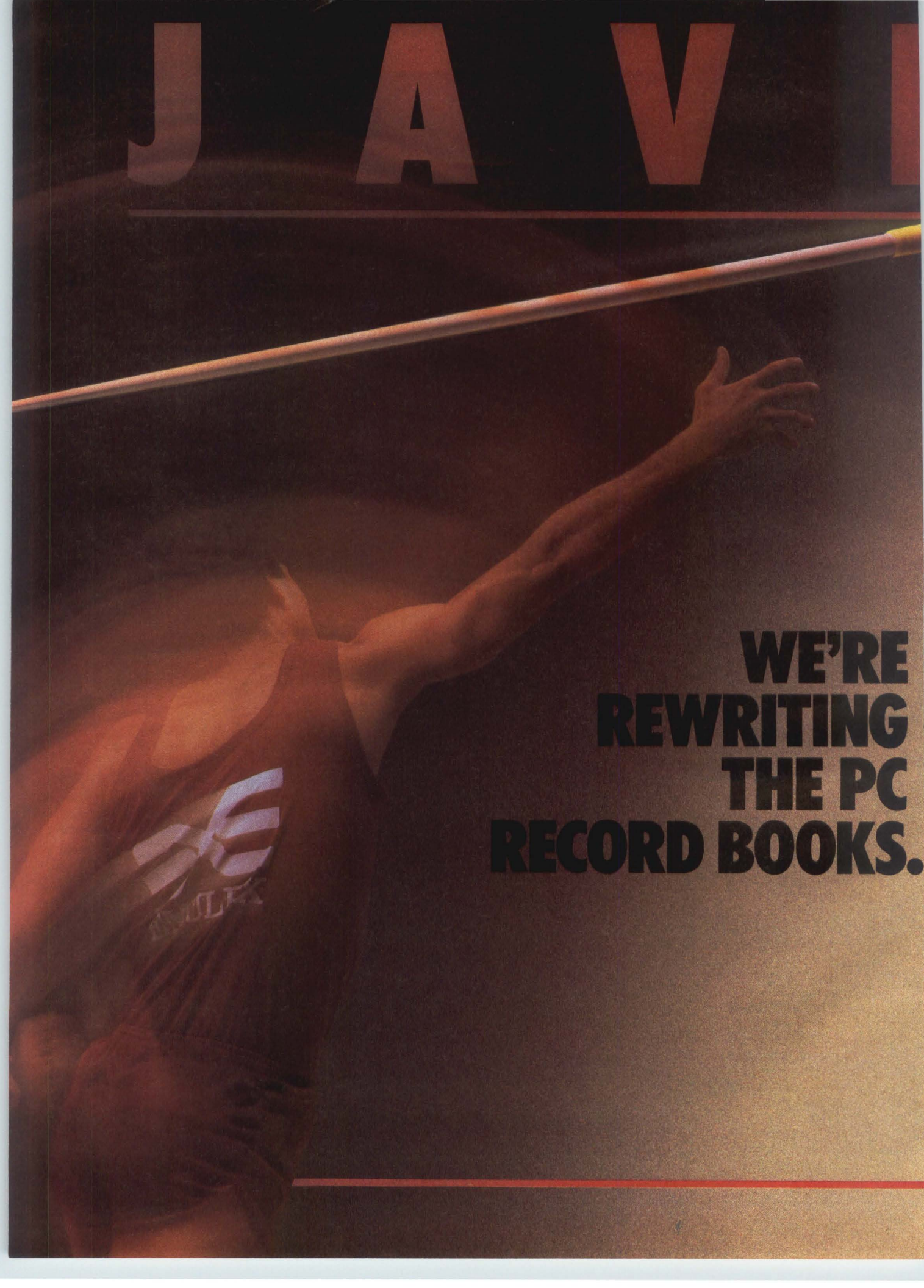
The orphan in IBM's personal computer line, the System 9000, also offers multiuser capability. That system is based on Motorola Inc.'s MC68000 processor, and has not been a big seller for IBM. International Data Corp., Framingham, Mass., estimates IBM sold only 1,000 System 9000s last year.



Lou Reynolds, *product group manager at Apollo Computer Inc., says IBM's technical graphics computers do not yet compete heavily with Apollo's engineering workstation, "but [IBM] will be there eventually."*

"The PC-AT will hurt System 9000 sales quite a bit," predicts graphics consultant Dr. Joel N. Orr, chairman of Orr Associates. A PC/ES based on a PC-AT is priced about $5,500 less than a System 9000. In the System 9000's favor, he points out that it is a 32-bit unit, while the PC-AT still is 16 bits. "The System 9000 is a back-door product," says Orr, referring to its use of the MC68000. "It doesn't fit in with anything IBM makes." Until the PC/ES engineering workstation announcement, however, the System 9000 alone had the IEEE 488 bus for the attachment of laboratory instruments. And, it runs a multiuser XENIX operating system. The PC/ES based on a PC-AT currently is a single-user device that runs DOS 3.0.

The 9002 has a 768-by-480-pixel, bit-mapped 12-inch display. A complete 9002, including XENIX, a 10M-byte hard disk, a diskette drive, memory and a memory-management card starts at $15,960. It also is a monochrome unit, while the PC/ES configured around the PC-AT displays 256 colors.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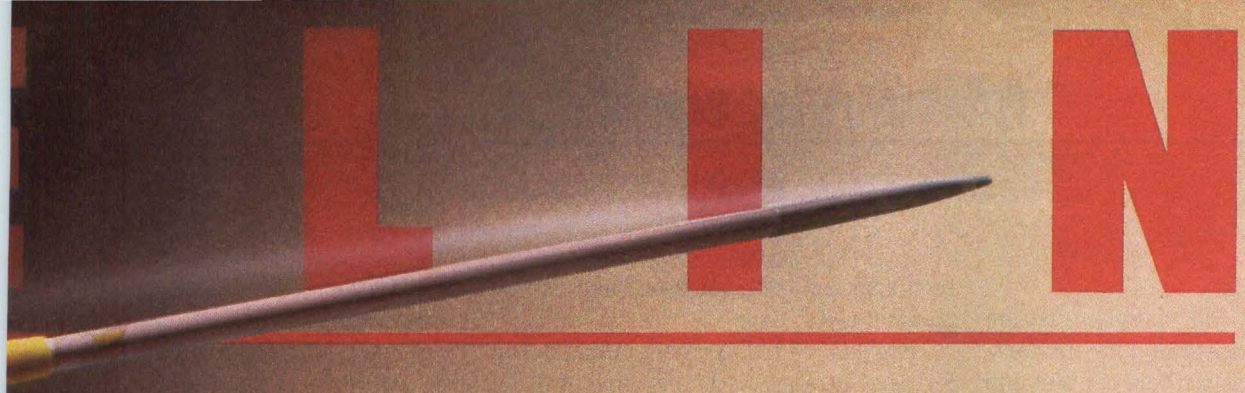

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*The Small Computer System Interface (SCSI) is an interface standard that specifies the mechanical, electrical and functional requirements for a small computer I/O bus interface and command set for peripheral devices commonly used with small computers.

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To support its PC/ES, IBM has published a $10.95 directory listing 340 third-party software programs. The directory includes the program's name, use, system configuration requirements, price and supplier. For example, AutoDesk Inc., Mill Valley, Calif., supplies the AutoCAD CAD and CAE program for 2D microcomputer-aided design and drafting. To run, it requires 256K bytes of main memory on the PC. AutoDesk claims to have installed more than 8,000 copies of AutoCAD worldwide on 15 different manufacturers' personal computers. Orr says products such as AutoCAD have given IBM a presence in the low-end CAD market.

Graphics demand still small

IDC's Zachmann says most laboratories don't require much graphics capability on their personal computers. "The demand is for the expansion slots and the ability to hook personal computers into laboratory equipment." He says that while graphics will help IBM PC sales, third-party vendors have offered similar functions to those IBM just announced. "There is no reason to assume the new IBM graphics [alone] will roll over the [scientific] market to the PC," he emphasizes, noting that Apple Computer Inc.'s II and IIe also have sold well in technical shops because of their expansion slots.

IBM's Ed Marill, project manager for the PC/ES, explains that the product expands IBM's opportunities for its standalone PCs. "The [graphics products for the PC/ES are] general-purpose PC attachments. IBM is trying to capitalize on a lot more of what the engineer or scientist wants to do—for example, spreadsheets or word processing [in addition to technical work]." While the standard PC-AT does run a three-user version of XENIX (MMS, October, Page 35), that PC cannot run XENIX when configured as a PC/ES with professional graphics. This means the PC/ES now is limited to single users employing DOS 3.0. Marill will not comment about whether IBM will offer a multiuser operating system for the PC/ES in the future. □

IBM's scientific graphics PC worries and helps third parties

Lori Valigra, Senior Editor

The reaction of Vectrix Corp., Greensboro, N.C., to IBM Corp.'s new PC/ES workstation exemplifies how established competitors react with concern when IBM enters a market, yet seek new opportunities made possible by the giant's introductions.

IBM's new engineering and scientific workstation, which is based either on the company's Personal Computer (PC) with an expansion box, a hard-disk-based PC/XT, or a PC-AT with internal floppy and hard disk drives, also includes a professional high-resolution graphics display and controller. While the $4,300 graphics set includes features available on existing products, Vectrix is concerned about the influence IBM's brand name has on sales.

"On the one hand, it [IBM's professional product introductions] frightens us to death, because IBM is coming straight into a market we're in. On the other hand, it thrills us to death, because our phone hasn't stopped ringing," says William D. Waller, vice president of

The professional graphics display and adapter, *part of IBM's PC/ES technical PC, displays 256 colors from a palette of 4,096, and performs three-dimensional drawing.*

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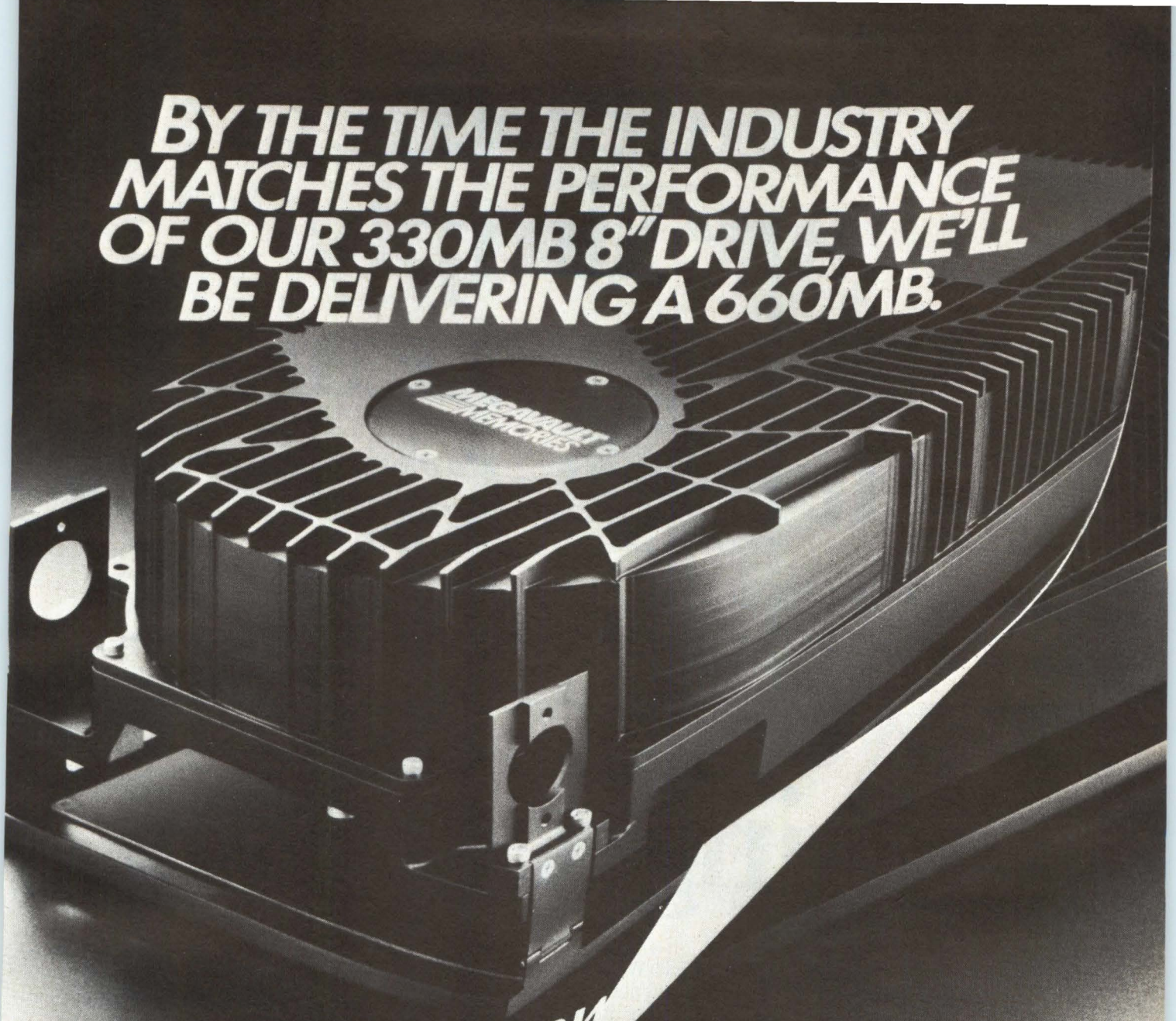

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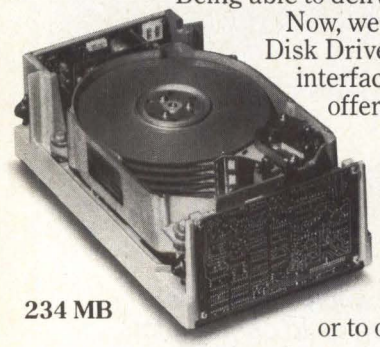

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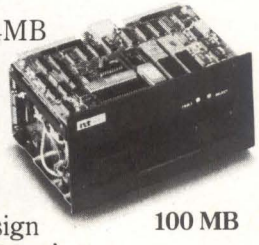

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marketing and sales at Vectrix. Vectrix is one of the few manufacturers already offering high-resolution board sets and monitors similar to those offered on IBM's PC/ES.

IBM's PC/ES and Vectrix' VX/PC graphics products both offer high-end resolution and performance. Waller explains that about 25 companies build low-end graphics boards to improve the standard 320-by-200-pixel, four-color (out of a palette of 16), IBM color/graphics monitors. Plantronics / Frederick Electronics Corp., Frederick, Md., offers the $475, 16-color Colorplus board with 320-by-200-pixel resolution. Other companies, such as Quintar Corp., Torrance, Calif., straddle the range between such low-end products and those of IBM and Vetrix in both price and performance. Quintar offers the $2,195 Q1080 controller that displays 16 colors from a palette of 4,096 with a 832-by- 630-pixel resolution. IBM itself offers an $849 enhanced color display and a $524 enhanced graphics adapter that support 640-by-350-pixel resolution in 16 colors out of a palette of 64.

But Vectrix chose to enter the high end of the market with a more fully featured product, which means a price difference of as much as $4,000 from low-end offerings. Vectrix' VX/PC board set has a 672-by-480-dot resolution and twice as many colors—512 out of a palette of 4,096—as IBM's professional graphics controller, which offers 640-by-480-pixel resolution. The board set carries the same price tag as IBM's, but consists of two rather than two-and-one-half boards. Waller says Vectrix used a custom gate array to replace 90 chips, while IBM uses off-the-shelf components. The Vectrix monitor costs $100 more than IBM's.

IBM's products have placed Vectrix in a precarious position. Waller says Vectrix based its business plan on IBM's ability to create a large demand for such high-resolution-graphics personal computers. When IBM introduced its professional products in September, Vectrix already had more than $4 million in VX/PC orders, and had delivered 500 units worth about $1 million to $1.5 million. But after the IBM announcement, Fortune 500 companies cancelled orders they'd placed with Vectrix. Waller says these IBM shops wanted to evaluate the IBM products. He expects orders to resume after that because of extra features on the Vectrix product, such as a light pen, and pan and zoom capabilities.

IBM'S PROFESSIONAL GRAPHICS CONTROLLER VS. VEXTRIX VX/PC BOARD SET

	IBM Professional graphics controller	Vetrix VX/PC board set
Resolution	640 × 480	672 × 480
Concurrently displayable colors	256	512
Color palette	4,096	16.8 million
No. of memory planes	8	9
On-board intelligence	Intel 8088 processor	Intel 80188 processor
Light pen support	no	yes
Software support	runs "most" of the existing software emulation mode	runs all of the existing software in emulation mode

Source: Vectrix Corp.

Another stumbling block for Vectrix has been educating prospective customers about the merits of high-resolution graphics and explaining the relatively high price tag. But IBM has helped out in that regard. "Probably two-thirds of the people who said 'No' to us in the past two to three months [have done so] because our graphics board set and monitor is $4,400, similar in price to an entire PC/XT system. So, IBM came out and said that graphics costs [this much]. IBM set an expectation and a price level. Now people are calling us back and saying, 'Maybe that isn't so expensive after all.'"

Waller expects many IBM PC-compatible suppliers and OEMs to buy third-party rather than IBM add-on boards. He says Vectrix' discount—30 percent for 100 boards and 40 percent for 300 boards—is better than IBM's. IBM would not disclose its discount schedule. "Our OEMs are delivering IBM computers anyway. The customer doesn't care which company generates the graphics, as long as the graphics are sophisticated," contends Waller. He expects to sell 3,000 VX/PC sets next year, twice that in 1986, and more than 10,000 in 1987.

Vectrix may branch out into the systems business as well. If it does, it will join competitors such as Daisy Systems Corp., Sunnyvale, Calif., which is an IBM value-added reseller of PC-XTs running Daisy's Personal Logician CAE software and priced at about $20,000. Another competitor, IBM value-added dealer Chancellor Computer Corp., Mountain View, Calif., offers a CAD workstation also based on the PC-XT for $21,000 to $35,000.

Vectrix has not offered many software programs with its VX/PC because of its limited resources. But now that IBM has endorsed the industry-standard Virtual Device Interface (VDI) and Graphical Kernel System (GKS) software with the PC/ES and graphics products, Vectrix is more willing to invest in software development. "Now that IBM has a standard, we feel more comfortable developing software [that also could run on IBM computers]," Waller says.

Companies offering popular programs employing graphics for cur-

rent IBM PCs must decide on whether to adopt VDI. Lotus Development Corp., for example, coupled its Lotus 1-2-3 integrated spreadsheet tightly with IBM's hardware to speed the program's execution. VDI, explains IBM's Ed Marill, project manager for the PC/ES, slows the speed of application programs. And, while part of VDI lets many different manufacturers' peripherals work with the PC/ES, another part defines how application program graphics will appear on the computer's display. This means the VDI drivers differ on the professional display and on the standard PC's display. Lotus will have to revise 1-2-3 to include the IBM VDI drivers if Lotus wants its program to run on IBM's new display. "Whether Lotus [and others] find it to their advantage to move to the VDI interface or to keep a tight link to our hardware is up to them," comments Marill. "The VDI is our desire to make the job of the third-party developer easier and safer. As a result [of VDI], the application will survive." □

Decision-support program boosts AI techniques

Carl Warren, Western Editor

The computer industry has long been promising the ultimate dream machine and software that embodies the mind of man. That promise, of course, has been artificial intelligence (AI). One company that has taken an empirical view of what artifical intelligence is and can be is InfoTym Corp., Cupertino, Calif., a subsidiary of Tymshare Computer Technology Group.

The product of note is InfoTym's Reveal software, which employs AI expert system techniques to help users make decisions. This means that a decision process is modeled after the way experts in a particular field arrive at conclusions—i.e., mimicking human logic.

"Reveal doesn't make the decision," remarks David R. Morley, director of sales and marketing for the Softmark Division of InfoTym. "Rather, it puts the facts together so a human mind can decide the direction."

"The development of expert systems using AI is a sift-down process," observes Jack H. Geer, business consultant on expert systems for InfoTym. "[Reveal] is a tool. Right now it's a bicycle, not a jet plane. Yet, it lets the user cut things down into manageable tasks. There is still a great deal to do—we're only at the tip of the iceberg."

According to David Morley, the company uses AI methods of logical inference for symbol manipulation. "Thus, English statements can be used to create a model based on facts and applied rules," he explains.

Geer adds that the product is like a "mind spreadsheet" that uses a knowledge base as an inference engine to classify information and assist in a decision.

Developed for business

The Reveal software package doesn't lock the user into a specific way of doing things; one of its key features is the use of so-called "fuzzy sets"—approximate reasoning. These are "if/then/but" statements such as "X is equal to night if there is a moon and it's dark. But if there is no moon and it's dark, X could be called darkest night or a moonless night."

Reveal also has a number of integrated tools, including a database-management system, text editor, report generator and graphics. "This is a sophisticated programming tool that is designed to be used on [an IBM] 370 mainframe, [DEC] VAX minicomputer, or IBM PC/XT. To make this workable, we have provided a facility that allows the information to be ported—transferred—from a mainframe to a minicomputer or microcomputer and back again. The purpose is to [create] a complete corporate [software] environment. That is part of the decision-making process," notes Geer.

Capturing ideas

The Reveal package has been designed so that it can be used to create knowledge bases for virtually any business function. For example, it can be used to manipulate the information contained in a financial portfolio. "A specialist in inventory management would develop the skill knowledge bases for someone else to use," explains Reveal marketing manager Ronald V. Engdahl. The ideas in those knowledge bases are assigned numerical and hierarchical values so that the data can be used by the computer.

The Reveal software package is priced at $50,000 for mainframes and $25,000 for minicomputers. The PC version price varies. For example, for users who have a mainframe license the price is $2,000. For others, a minimum of ten PC licenses can be purchased for $4,000 each. The basic run-time package is intended for the development of knowledge bases. InfoTym expects knowledge templates to be priced in the $500- to $2,000-range, depending upon the level of expertise and subject matter. □

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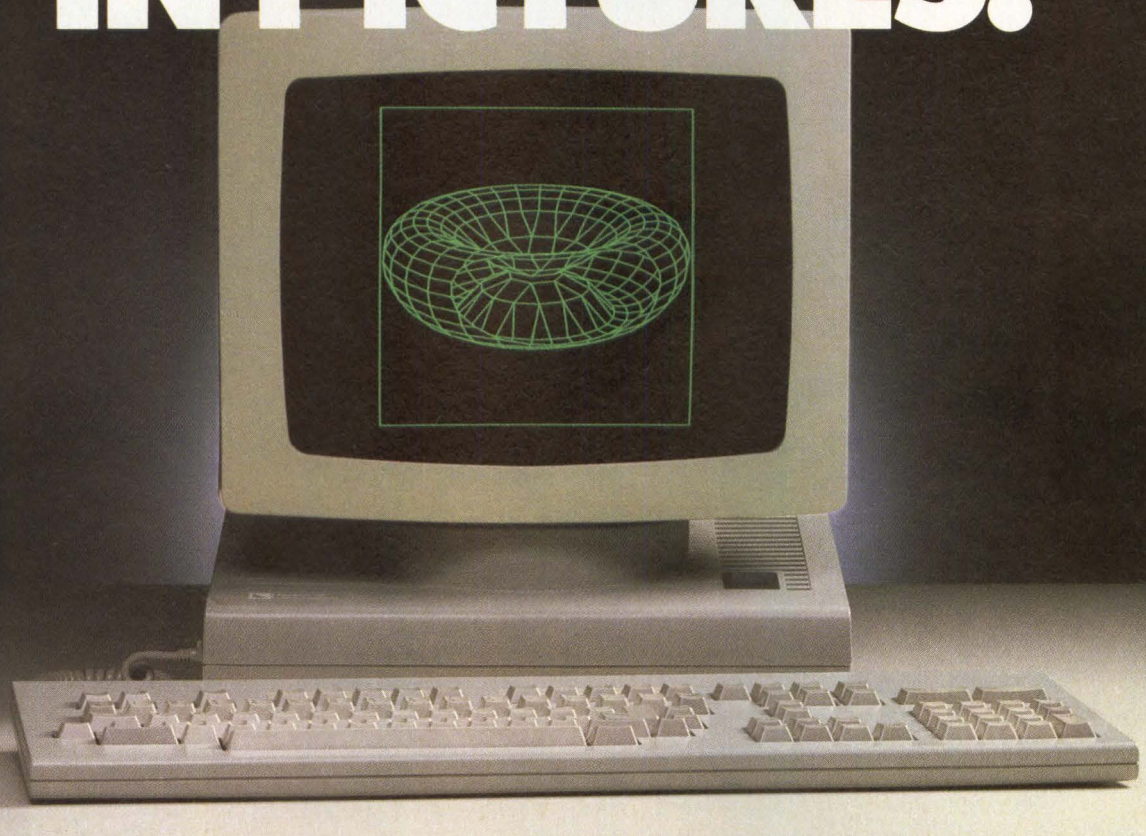

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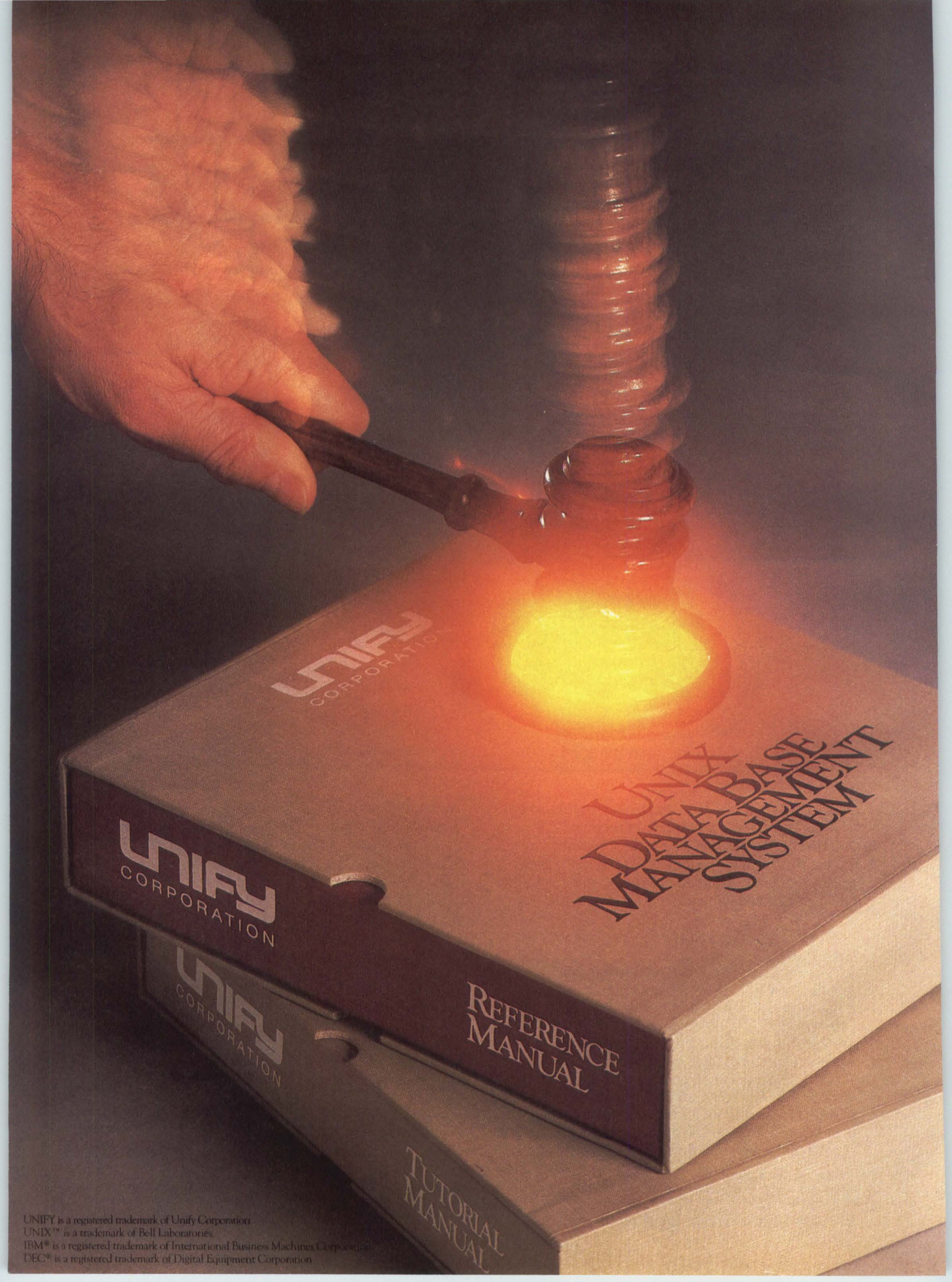

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CIRCLE NO. 23 ON INQUIRY CARD

Mini-Micro's News Trivia Quiz: IBM's ubiquity–winners and losers in 1984

Lori Valigra, Senior Editor

Although 1984 did not become Orwell's year of Big Brother, it *was* the year of Big Blue. IBM Corp.'s aggressive and frequent moves to further its computer business paved the way for some winners and losers among its competitors. But other companies, such as AT&T, also created a flurry of market activity. See how well you paid attention to the year's events by answering the following trivia questions. For the answers, see page 59.

1. How many Personal Computer products did IBM introduce this year?
a) 39
b) 115
c) 202
d) 240

2. What company announced that it would not introduce a major product for two years? What was the product?

Big winnings this year.

3. Name IBM's first acquisition in 22 years.

4. What company won the largest disclosed cash settlement in a computer lawsuit this year?
a) IBM Corp.
b) Data General Corp.
c) Perkin-Elmer Corp.
d) Texas Instruments Inc.

5. What important lawsuit settled early this year paved the way for IBM Corp. to pursue companies copying its ROM BIOS?

6. Which of the following companies didn't introduce a portable computer this year?
a) Data General Corp.
b) Hewlett-Packard Co.
c) Zenith Data Systems
d) Digital Equipment Corp.
e) IBM Corp.

7. True or False: The state of Vermont has the fewest computer stores.

8. Match the following cities with the number of high-technology companies located in them.

1) Boston, Mass.	a) 331
2) Dallas, Texas	b) 316
3) Minneapolis, Minn.	c) 296
4) Portland, Ore.	d) 253
5) San Diego, Calif.	e) 155
6) San Jose, Calif.	f) 142
7) Santa Clara, Calif.	g) 124
8) Sunnyvale, Calif.	h) 52

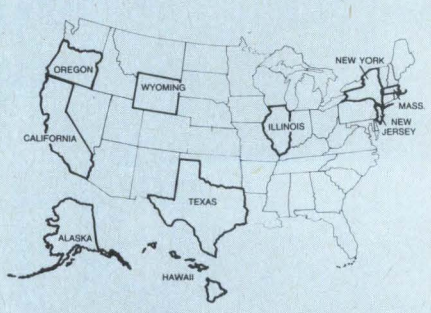
9. How many home-grown computers running standard UNIX did AT&T introduce this year?

10. How many computer periodicals were started this year? How many folded?

11. What computer company paid the most for television advertising this year?

Question 12:
Name the processor for the PC-AT

12. Which of the following two IBM microcomputers introduced this year is based on an 8088 processor?
a) PC-AT
b) System 9002



Question 13:
In which five states do the greatest number of high-technology companies reside?

13. Rank the top five states by the number of high-technology companies located in them. Which state has the fewest high-technology companies? Choose from the states highlighted on the map.

14. Which large communications company eliminated 11,000 positions in one of its subsidiaries to cut costs?

15. The U.S. International Trade Commission ruled in March that 16 companies importing personal computers into the United States were infringing unfairly on one company's copyrights and patents. Name that company.

16. How many standards came under review by ANSI this year? How many were passed?

17. IBM Corp., Apple Computer Inc., Digital Equipment Corp., Zenith Data Systems and Radio Shack together supply 80 percent of the personal computers installed in Fortune 1000 companies. How many companies supply the remaining 20 percent?

18. Name the two large computer companies that had to write down their investments when Trilogy Corp. ceased developing its superchip.

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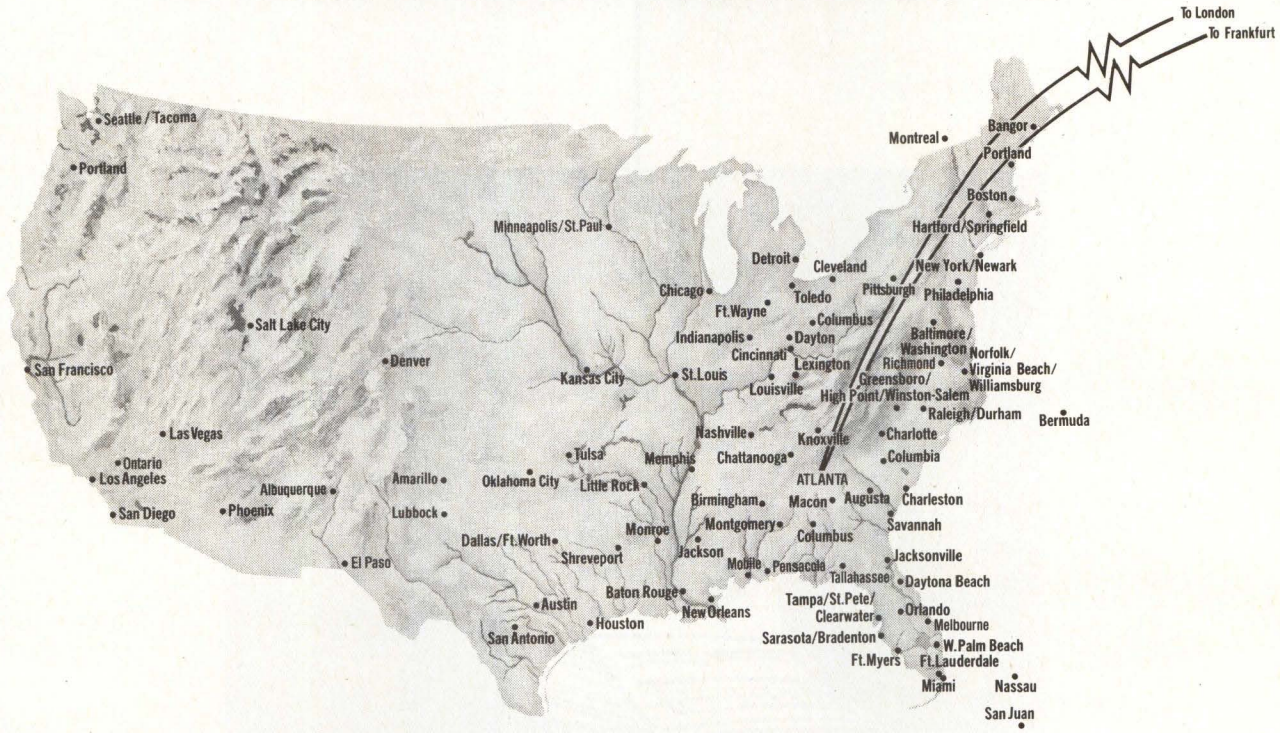

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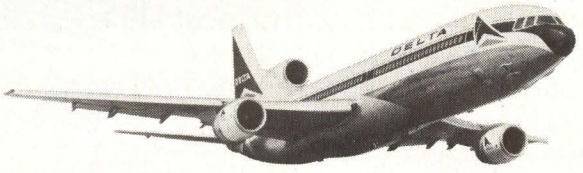

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CIRCLE NO. 24 ON INQUIRY CARD

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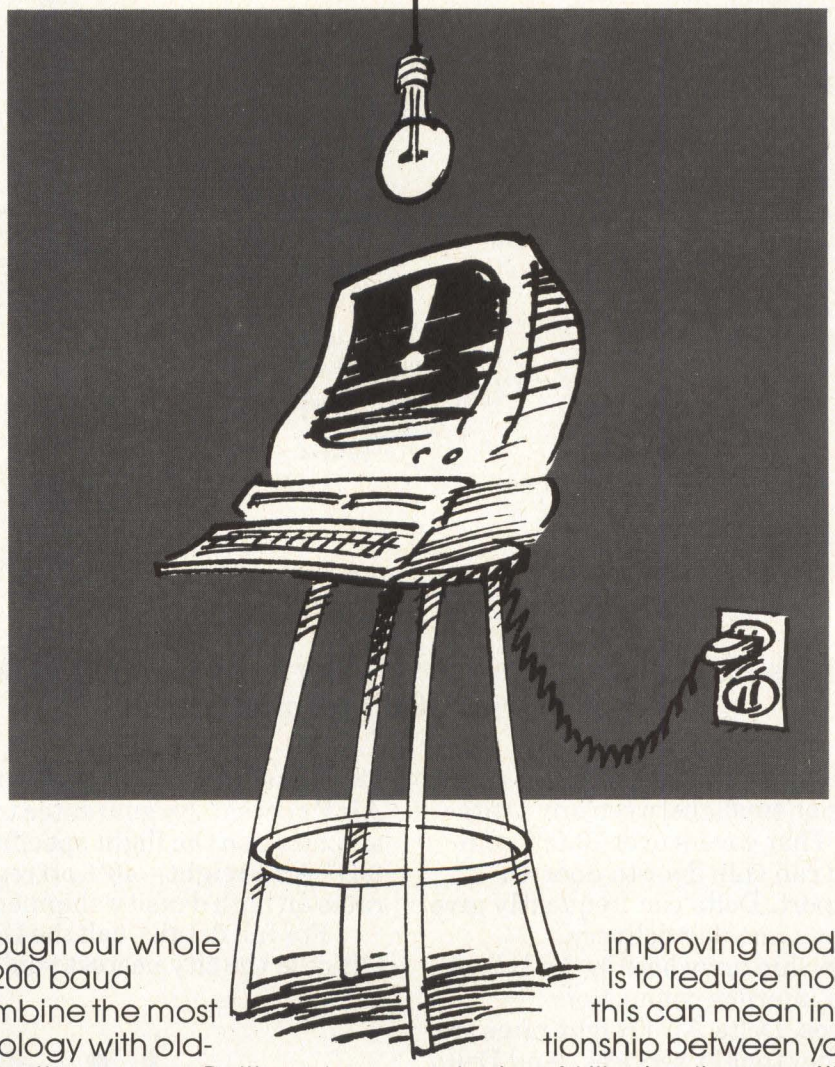

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CIRCLE NO. 25 ON INQUIRY CARD

DRI adds Macintosh-like interface to MS-DOS

Digital Research Inc.'s GEM MS-DOS extension, *with visual aids such as icons and pull-down menus, makes the IBM PC and IBM PC-compatibles (left) look and behave much like Apple Computer Inc.'s Lisa and Macintosh (right).*

David Bright, Assistant Editor

In order to compete with the many windowing products flooding the market, Digital Research Inc., Monterey, Calif., has in the past 13 months added windowing capabilities to its Concurrent CP/M-86 and Concurrent PC-DOS personal computer operating systems. But now the company is covering more bases with an MS-DOS interface that makes the IBM PC and IBM PC-compatibles look and behave much like Apple Computer Inc.'s Macintosh personal computer.

With the Graphics Environment Manager (GEM) products, formerly code-named "Crystal," MS-DOS commands and utilities are replaced by icons such as disks and trash cans and by pull-down menus. Other features of the graphics-oriented shell include overlapping windows, cut-and-paste capability and mouse support.

Runs MS-DOS applications

The software, which conforms to the Virtual Device Interface graphics standard recently endorsed by IBM Corp., runs "absolutely all" MS-DOS applications without modification, asserts graphics systems product manager Tom Byers. GEM, which is an extension to the MS-DOS operating system, uses between 75K bytes and 80K bytes of RAM, depending upon the particular machine. GEM and MS-DOS together occupy less than 128K bytes of RAM, claims Byers. He says DRI will work closely with OEMs to develop the screen drivers necessary for porting the environment from machine to machine.

To run, GEM requires only 256K bytes of RAM (which accomodates GEM, MS-DOS and an application), two floppy disk drives, a bit-mapped graphics display and a mouse. Competing products such as Quarterdeck's DesQ, Lotus Development Corp.'s Symphony and Microsoft Corp.'s Windows require 512K bytes of RAM and a Winchester disk drive. But those products can put more than one application into memory at one time. GEM keeps only one application at a time in RAM, which is why it needs less memory. As a result, however, it is able to run on small machines such as Data General Corp.'s Data General/One laptop portable computer and the IBM PCjr.

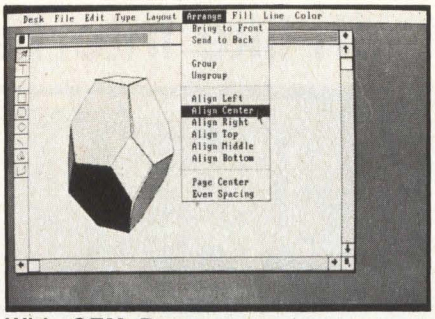
DRI's product will be competing against IBM Corp.'s recently announced TopView windowing product which, unlike the aforementioned windowing packages, performs multitasking, meaning that it actually runs more than one application at a time. DesQ and the others are single-tasking, even though they can load multiple applications into RAM. A multitasking version of GEM running under DRI's Concurrent PC-DOS will be available sometime in 1985, says Byers.

Companion software products to the Graphics Environment Manager include GEM Desktop, GEM Programmer's Toolkit, GEM Draw and GEM Wordchart.

- The **Desktop** application replaces the operating system commands with icons. Byers stresses that the basic GEM software does run without the Desktop application.
- The **Programmer's Toolkit** assists programmers in developing vertical applications. Programmers will be given distribution rights to

bundle necessary GEM software with their applications.

- **GEM Draw,** an enhanced version of DRI's original Draw package, is designed to help the middle manager create presentation graphics. Using icons and pull-down menus, operations such as panning, zooming and centering can be easily performed.
- **GEM Wordchart** is specialized for the creation of company logos and organizational charts. The application features raster fonts so that any item, when enlarged, will remain filled.



With GEM Draw, *managers can use icons and pull-down menus to design presentation graphics. Panning, zooming and centering are several of its features.*

The GEM products (with the exception of the multitasking versions) are scheduled for availability in the first quarter of 1985. Since the size of purchases, as well as DRI's assistance to OEMs, will vary, the company has not published prices for the basic GEM product. GEM Draw and Wordchart list prices should be around $250, according to Bill Higgs, graphics applications product manager. □

New DECmate and Professional computers receive lukewarm welcome

David Bright, Assistant Editor
Stephen Shaw, Washington Editor

Although Digital Equipment Corp. (DEC) has designed a smaller, less expensive DECmate word processor, and upgraded its Professional microcomputer line, analysts expect the innovations to have little market impact.

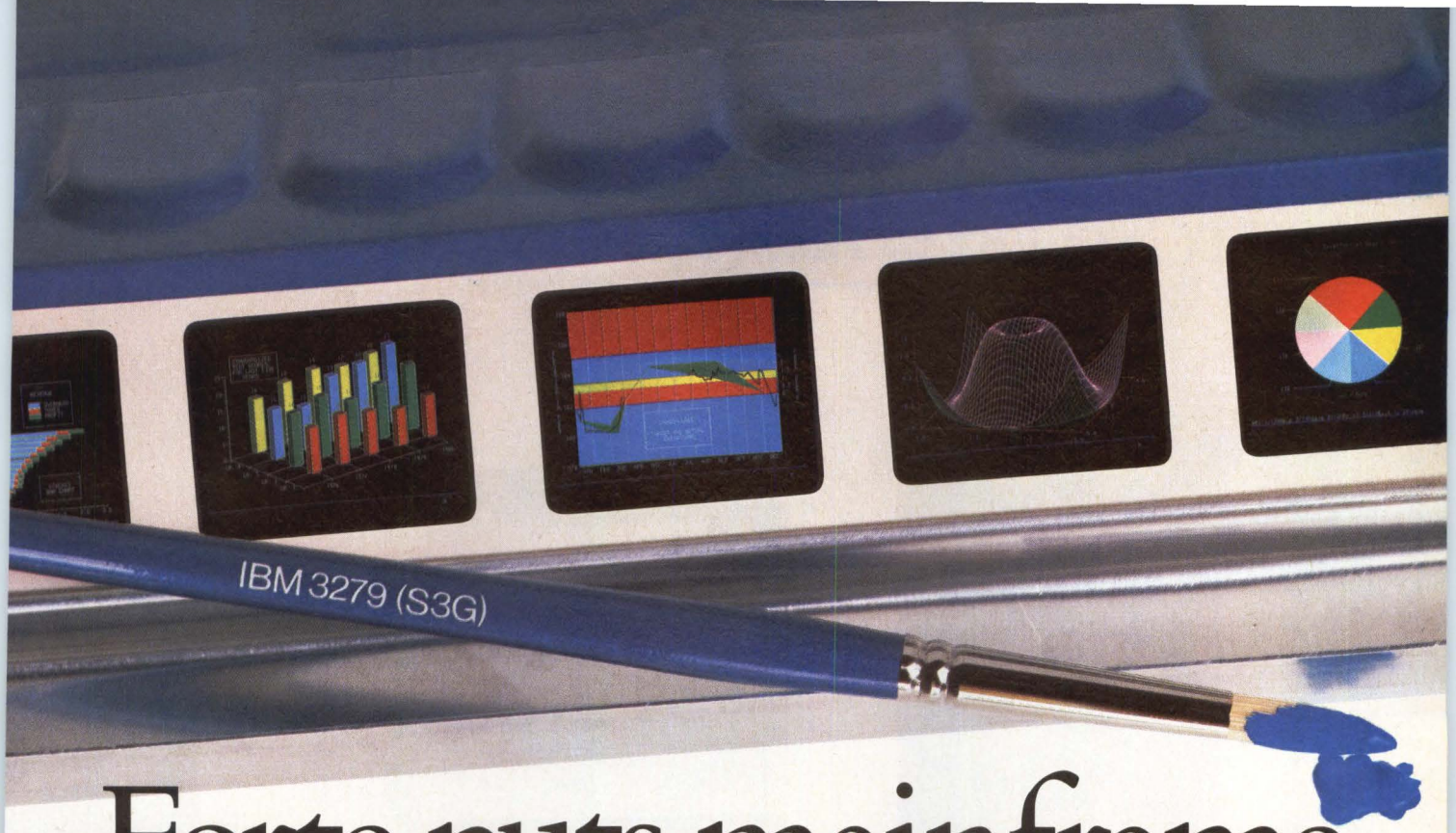
According to Lee Kauffman, a research director at the Gartner Group, Stamford, Conn., the new DECmate III's problem is clearcut: Like the DECmate II, it's not considered state of the art in the industry. And, because the new Pro 380 workstation, like the other Professional workstations, runs a proprietary operating system and software, its marketability is limited, states Egil Juliussen, chairman of market research firm Future Computing Inc., Dallas.

Price, size and storage capability differentiates the new DECmate III and the DECmate II, which DEC will continue to sell. While the DECmate II lists for $3,795 (plus $500 for the WPS word processing software), the new model goes for $2,695 complete, including the WPS software. In quantities of 100, the price per system drops to $2,100. The DECmate III is built around the same proprietary, 12-bit 6120 microprocessor as the DECmate II, but the use of gate array technology has enabled DEC to build its smallest system unit ever. The DECmate III's system unit, which includes two 5¼-inch floppy disk drives, sports a footprint 40 percent smaller than the DECmate II, and is 2 inches shorter. The new unit measures 11½ inches by 11 inches by 5 inches. By positioning the cabling vertically, against the back of the system, instead of horizontally like on the II, even more desk space was saved.

Both the DECmate II and III machines have 96K bytes of non-expandable RAM and both machines can run CP/M programs with the insertion of an optional card containing a Z80 microprocessor and 64K bytes of RAM. The DECmate III has three open slots: one for the CP/M card, one for an optional internal modem, and a third reserved for expanding the system with future products. But adding a 5M- or 10M-byte hard disk drive to the DECmate II—an option that is not offered on the DECmate III—is said to triple performance.

The system unit of the $2,695 DECmate III *word processor, measuring 11½ inches by 11 inches by 5 inches, is DEC's smallest ever.*

DEC also announced two related products: a 34-character-per-second daisy wheel printer, which lists for $1,395, and new WPS software. The international versions of the software have been translated into French, Spanish, Italian, German and the Scandinavian languages. The English version provides editing enhancements and a new techni-



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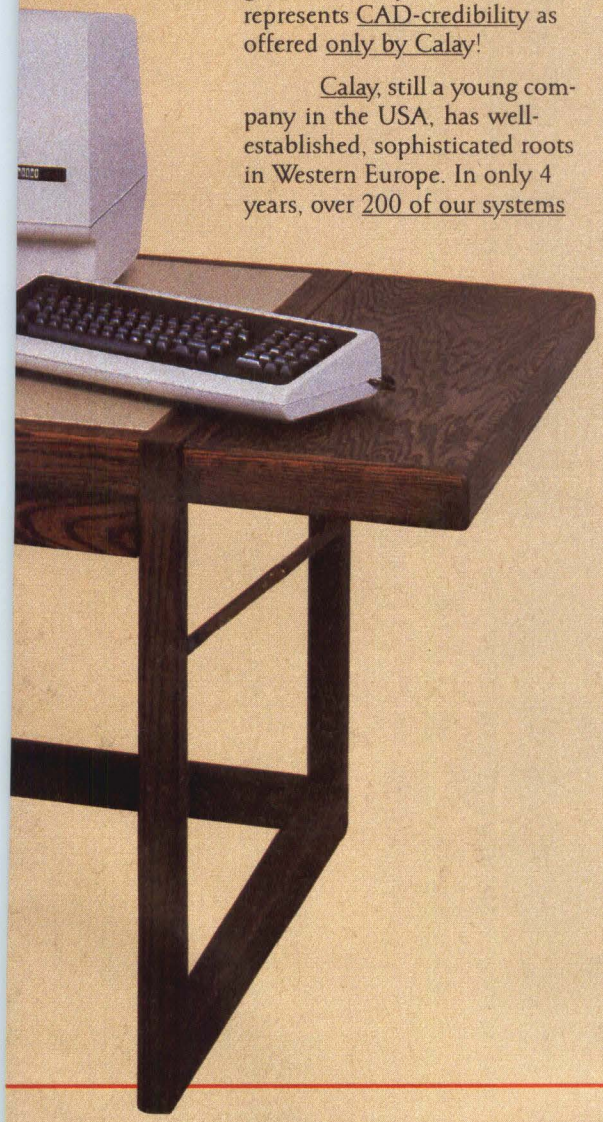

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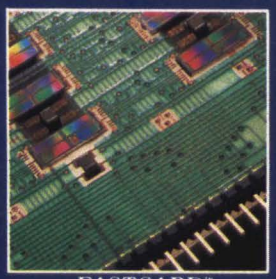

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CIRCLE NO. 28 ON INQUIRY CARD

cal character set.

"It isn't a particularly exciting product," the Gartner Group's Kauffman says of the DECmate III. "We don't understand why they are continuing with that technology." Still, DEC merchandising manager Robert Roller predicts DECmate III's reduced price should attract some customers outside of DEC's installed base. Kauffman says DEC should consider upgrading the DECmate processors to a 16-bit word size. The systems would then have a better chance of competing against other dedicated word processors, and against general-purpose 16-bit personal computers that run word-processing programs.

Roller maintains that DEC has stuck with the 12-bit technology because the machines already offer "excellent" performance. Also, rewriting the software for a different CPU might lead to a system incompatible with the present systems, thereby alienating the more than 100,000 users of WPS. Roller claims that currently WPS is 100 percent upwardly compatible from DECmate's preceding machines through the DECmate III.

DEC's new Professional 380 workstation *boasts double the performance of the earlier Pro 350, thanks to the J11 chip set.*

The new Pro 380 is DEC's first Professional microcomputer to incorporate the powerful J11 chip set, which is a subset of the PDP-11/70 architecture. DEC officials claim that replacing the F11 chip of the Pro 350 system has more than doubled speed. Further, the J11 chip, in conjunction with a new bit-mapped graphics board option, doubles the Pro's color capability so that it can display eight colors simultaneously from a palette of 4,096.

However, Juliussen at Future Computing maintains that upgrading the Professional is not the answer. "There's no place in the office personal computer industry for a proprietary system. The Professional is not going to light the world on fire no matter how much they upgrade it."

Like the Pro 350, the Pro 380 runs the P/OS operating system, which is a subset of the RSX-11 operating system. Optional operating systems are Pro VENIX, XENIX, IDRIS, RT-11, CTS-300 and MUMPS. Configured with a 10M-byte Winchester disk drive and a monochrome monitor, the Pro 380 lists for $8,995. DEC has also reduced the Pro 350's price by $2,000 to $6,995. □

Answers to Trivia Quiz on Page 50

1. c) 202
Source: IBM Corp.'s Entry Systems division
2. IBM's token-passing ring local area network
3. Rolm Corp.
4. c) Perkin-Elmer Corp. won an $18 million cash settlement from Computervision in a patent infringement suit.
Source: Computer Industry Litigation Reporter
5. Apple Computer Inc. vs. Franklin Computer Corp. over Apple's ROM.
6. a) Digital Equipment Corp.
7. True
Source: Computer Intelligence Corp.
8. 8) Sunnyvale—a) 331
7) Santa Clara—b) 316
6) San Jose—c) 296
5) San Diego—d) 253
3) Minneapolis—e) 155
2) Dallas—f) 142
4) Portland—g) 124
1) Boston—h) 52
Source: American Electronics Association
9. Four: The 3B20S, 3B20A, 3B5 and 3B2.
Source: Yates Ventures
10. Thirty-five started, 29 died. Of the 35 start-ups, nine folded. The most successful start-ups are PC Week *and* PC Products. *The major dropout was the Softalk group, which idled 33 employees.*
Source: Communications Trends
11. As of June, IBM logged in $25.8 million, followed by Apple Computer Inc. with $16 million.
Source: Television Bureau of Advertising
12. Neither. The PC-AT uses the 80286, while the System 9002 uses the MC68000.
13. California (4,416) has about four times as many companies as Massachusetts (1,017), which pulled into second place ahead of New York (1,000) early this year. New Jersey has 618 and Texas has 560. Alaska (2) has the fewest.
Source: American Electronics Association
14. AT&T cut the jobs in its AT&T Technologies subsidiary.
15. Apple Computer Inc.
Source: Computer Industry Litigation Reporter
16. 36 were reviewed, 35 were passed.
Source: American National Standards Institute
17. 83
Source: Computer Intelligence Corp.
18. Digital Equipment Corp. and Sperry Corp.

Stock, Boston/Bohdan Hrynewych

HEARD ON THE HILL

Paradyne blasted by House and GAO; system integrators may be affected

Stephen J. Shaw
Washington Editor

Separate reports from the House of Representatives Government Operations Committee and the General Accounting Office (GAO) recommend that Paradyne Corp. be barred from doing any future business with the federal government. Both reports urge that a $115 million contract between the Florida communications equipment manufacturer and the Social Security Administration (SSA) be immediately suspended. The recommendations are a warning that contract-seeking system integrators can expect to have their systems more carefully reviewed in future bidding.

The harsh reports follow a March 1983 inquiry by the Securities and Exchange Commission that accused Paradyne of, among other things, passing off competitors' equipment as its own when bidding on the SSA contract. That contract was to upgrade and modernize the agency's data acquisition system.

Problems cited in the Operations Committee and GAO reports include:

- misrepresention of a DEC PDP-11 processor/controller as a Paradyne Z8000-based processor/controller, which had yet to be developed when Paradyne showed its equipment to SSA officials during a 1980 product demonstration
- failure to pass SSA acceptance tests until the acceptance criteria were lowered by the SSA
- delay of SSA's modernization effort by as much as four years because of continued equipment failures.

The GAO report called for a wholesale review of the entire modernization program as well as for the immediate cancellation of the remaining portion of Paradyne's contract. Paradyne has already been paid $45 million since 1981 for supplying data-communications terminals.

The GAO also criticized the SSA for what it called mismanagement of the contract, poor progress reviews and neglect of internal administrative controls. "[The SSA has] acquired a data communications system that, according to SSA analysis, did not begin to meet contractual system availability requirements on a consistent basis until April 1983—more than two years after the contract award," the report stated.

Representative Jack Brooks, D-Texas, chairman of the House committee, charged the SSA during hearings with overall mismanagement of the modernization program. According to the final committee report, "the Committee is especially perplexed by [the] SSA's casual attitude toward some of the legal and ethical issues spawned by the Paradyne award, including the filing of a suit by the Securities and Exchange Commission charging Paradyne with fraud and deception in winning this contract."

The report charges that the SSA relaxed its internal testing criteria to accept substandard Paradyne equipment, even after it became obvious that the Paradyne terminals were having a negative impact on the SSA system. The SSA confirms that it erased two reels of computer tape reportedly containing evidence of equipment malfunctions that occurred between 1981 and 1984. An SSA spokesman says the erasure was accidental.

Officials at Paradyne vigorously denied the charges levelled against the company in the House committee and GAO reports. "We strongly disagree with the recommendations of both reports. They're unwarranted and harsh," comments Paradyne senior vice president George Pressly.

Pressly says that the Paradyne terminals have met 98 percent of SSA performance standards. He adds that an independent evaluation of the contract conducted by the Mitre Corp. has cleared Paradyne of any wrongdoing in fulfilling its contractual obligations.

Concerning the charge that Paradyne used other manufacturers' equipment and mislabeled it as its own in an initial capability demonstration to SSA officials, Pressly contends "there's a large debate over what we were allowed to bid and demonstrate."

The company does not deny that it incorporated equipment from other vendors in its system demonstration before the SSA. But it insists that it always intended to function as a system integrator in using some non-Paradyne equipment and components. The SSA knew, in advance of Paradyne's bid, says Pressly, "that we would not be the manufacturer of all the components."

Until a final determination is made by the government agencies involved, computer system integrators should be forewarned that government procurement officers are likely to scrutinize carefully all components in proposed computer systems to ensure that contract specifications are met.

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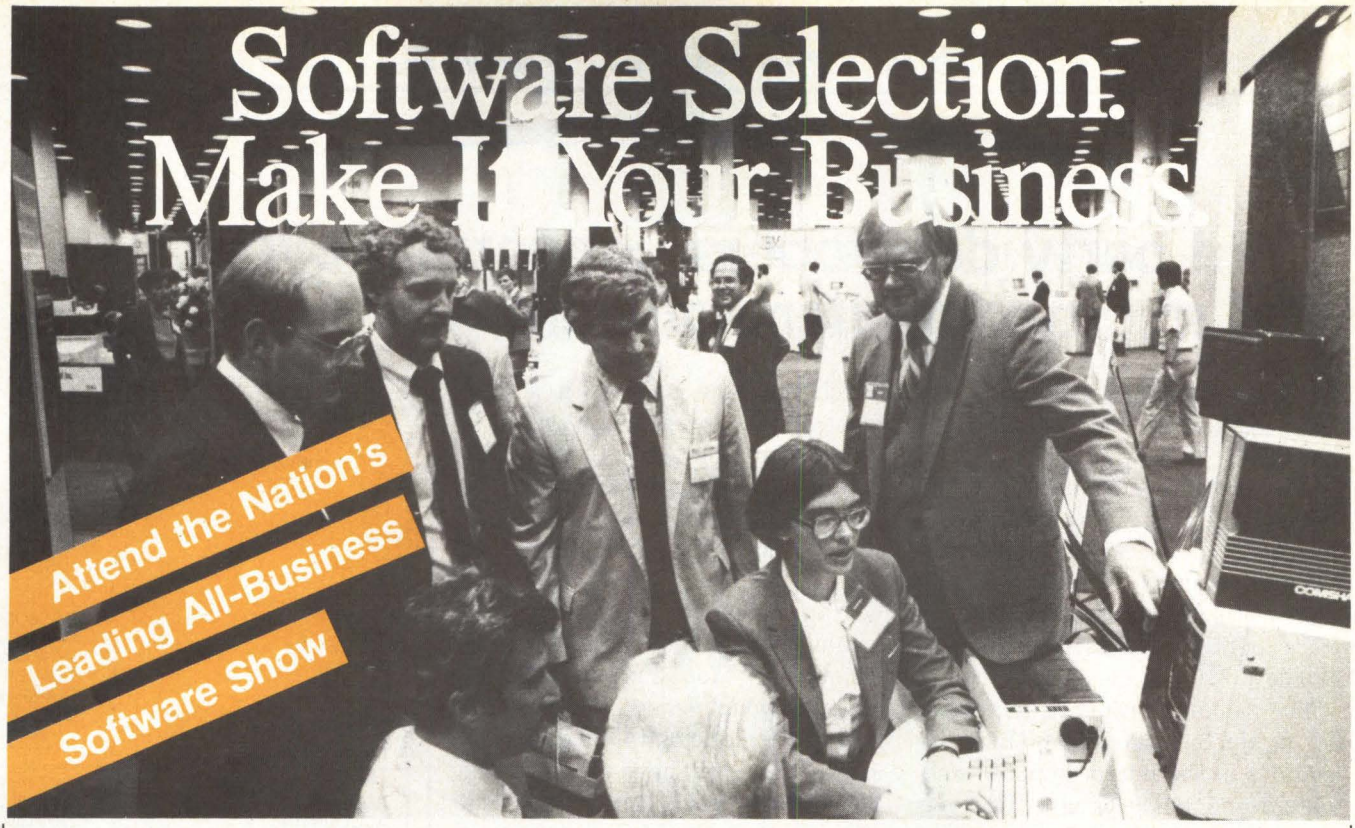

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CIRCLE NO. 29 ON INQUIRY CARD

Third-party developers concerned over IBM microcomputer software

Marjorie Stenzler-Centonze
Associate Editor

The recent announcement by IBM Corp. of 31 internally developed software packages for its Personal Computer (PC) is causing quite a stir among independent software publishers, distributors and retailers.

The 31, plus promised forthcoming products, make clear IBM's intentions in the microcomputer software arena, analysts say. "IBM has two-thirds of the mainframe market and I believe it will be satisfied with two-thirds of everything else, including the [personal computer] market and the software market," Brian Boyle, managing analyst for software and systems at Gnostic Concepts Inc., San Mateo, Calif., states.

The IBM introductions came just weeks after the company planted its feet in microcomputer software territory by announcing TopView, a windowing environment for its PC family, due out the first quarter of 1985. The 31 new programs are divided into two series: the Business Management series and the Personal Decision series. Programs within each series can be used separately or integrated as businesses expand, John Steuri, general manager of IBM Information Services, explains.

The Business Management series is an integrated family of accounting and business management programs consisting of six core programs, each priced at $695. Software modules that add functions can be mixed and matched with any of the six.

The Personal Decision series consists of five core programs, each of which must be used with a data management program. Core programs run from $150 to $300; the data program is priced at $250. All programs will be made available between now and the first quarter of 1985.

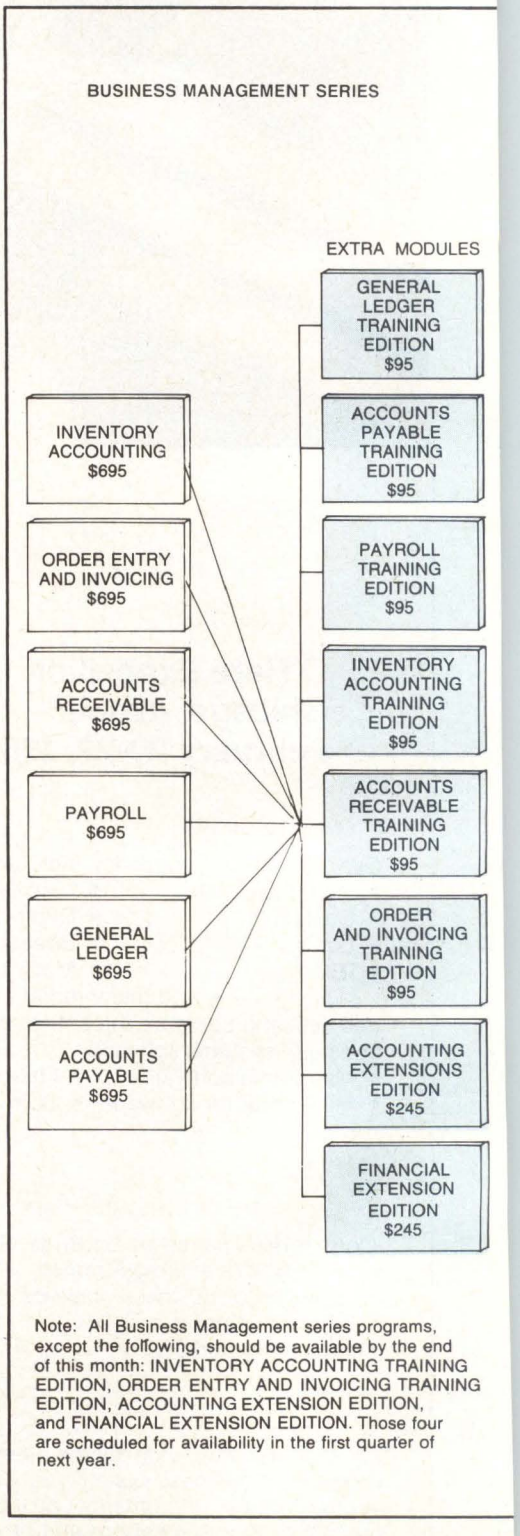
The independents knew IBM would enter their market, Boyle comments. "You don't necessarily make all your money building foundations[for others to build on]. At some point you have to build the house and furnish it and there's a lot of money to be had for all the things that go inside the house."

The most immediate impact on independent software publishers will be a slowdown in retail ordering, says Maureen Fleming, senior analyst with International Resource Development Inc., Norwalk, Conn. Retailers will need to step back and figure out whose products they should or shouldn't support, Fleming says.

Ashton-Tate's executive vice president, Norman H. Block, says he's not concerned about any impact from the IBM software products. "IBM has not announced any products that compete with our two greatest strengths—dBase III and Framework," Block says.

One factor that could hurt inde-

IBM's Personal Decision series software *consists of five application programs used with a data-management program. Attachments and extension modules can be mixed and matched with any of the five. The attachments allow users to communicate with System/36, System/370, 4300, 303X, and 308X processors using Multiple Virtual Storage (MVS) and Virtual Machine (VM) operating systems. The Business Management series from IBM consists of six core products. Additional modules can be attached to any of the six.*



Note: All Business Management series programs, except the following, should be available by the end of this month: INVENTORY ACCOUNTING TRAINING EDITION, ORDER ENTRY AND INVOICING TRAINING EDITION, ACCOUNTING EXTENSION EDITION, and FINANCIAL EXTENSION EDITION. Those four are scheduled for availability in the first quarter of next year.

pendents is the data-interchange format (DIF) micro-to-mainframe communications link built into IBM's Personal Decision series. IRD's Fleming explains, for example, that with DIF, users will be able to adapt Personal Decision series software files to share data with Lotus software users. This means that two users wishing to exchange files will only have to purchase one Lotus package, not two. "While that's good for IBM, its bad for Lotus," she explains.

Another factor that may impact independent software publishers, Fleming says, will be IBM's direct sales force pushing the IBM-developed products. More than 60 percent of IBM PCs are sold directly by IBM to large organizations.

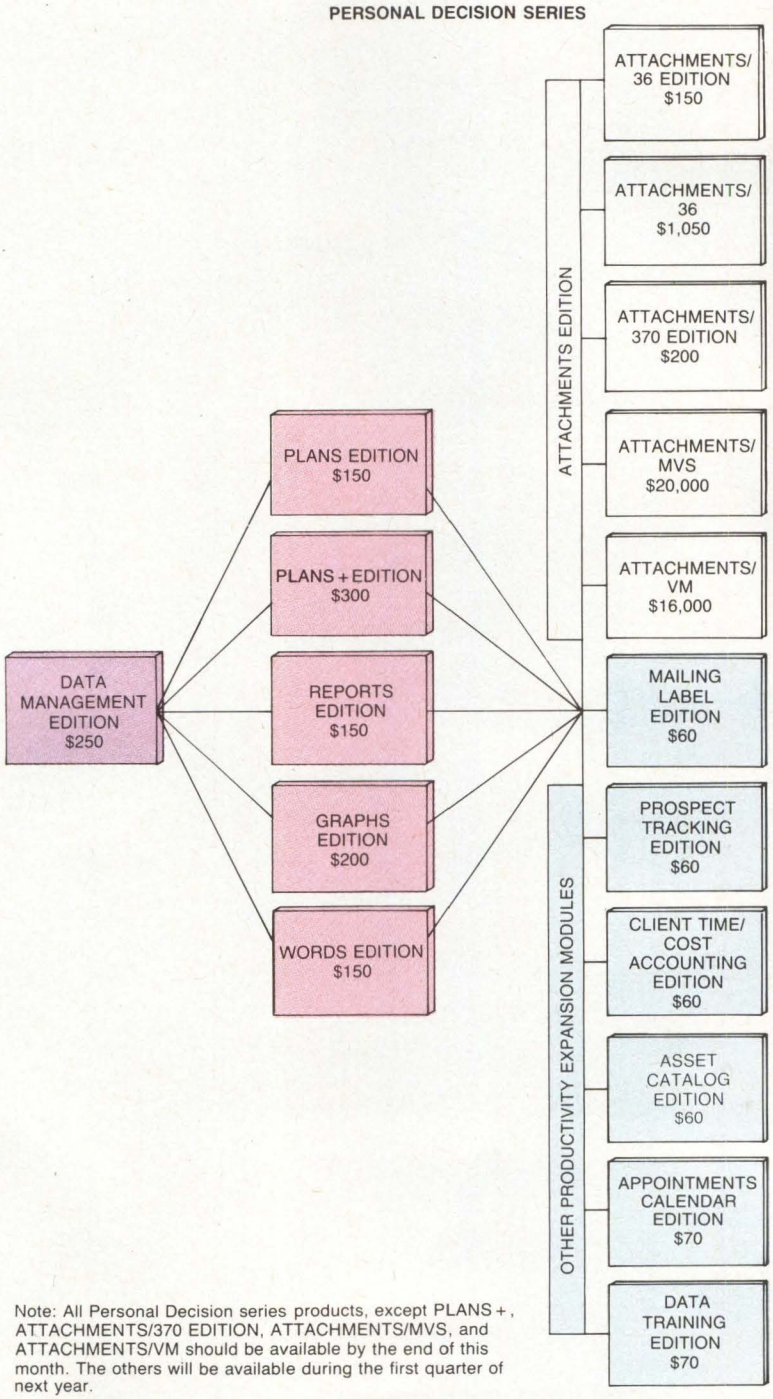
The in-house developed software will also effect IBM-logoed applications packages produced by independent vendors and sold by the IBM sales force. Peachtree Software Inc., Atlanta, Ga., currently produces five products which carry the IBM name. Larry L. Smart, senior vice president of Management Science America Inc. (Peachtree's parent) and general manager of Peachtree Software, says that, if IBM's accounting packages are successful, they could severely cut into the $400,000 yearly revenue generated by IBM-labeled Peachtree software. "That's certainly not good—but [a loss of] $400,000 is not a killer either," Smart remarks.

Gnostic Concepts' Boyle adds that independent software companies and distributors need to form alliances to establish vertical market niches that would be protected from IBM's interest.

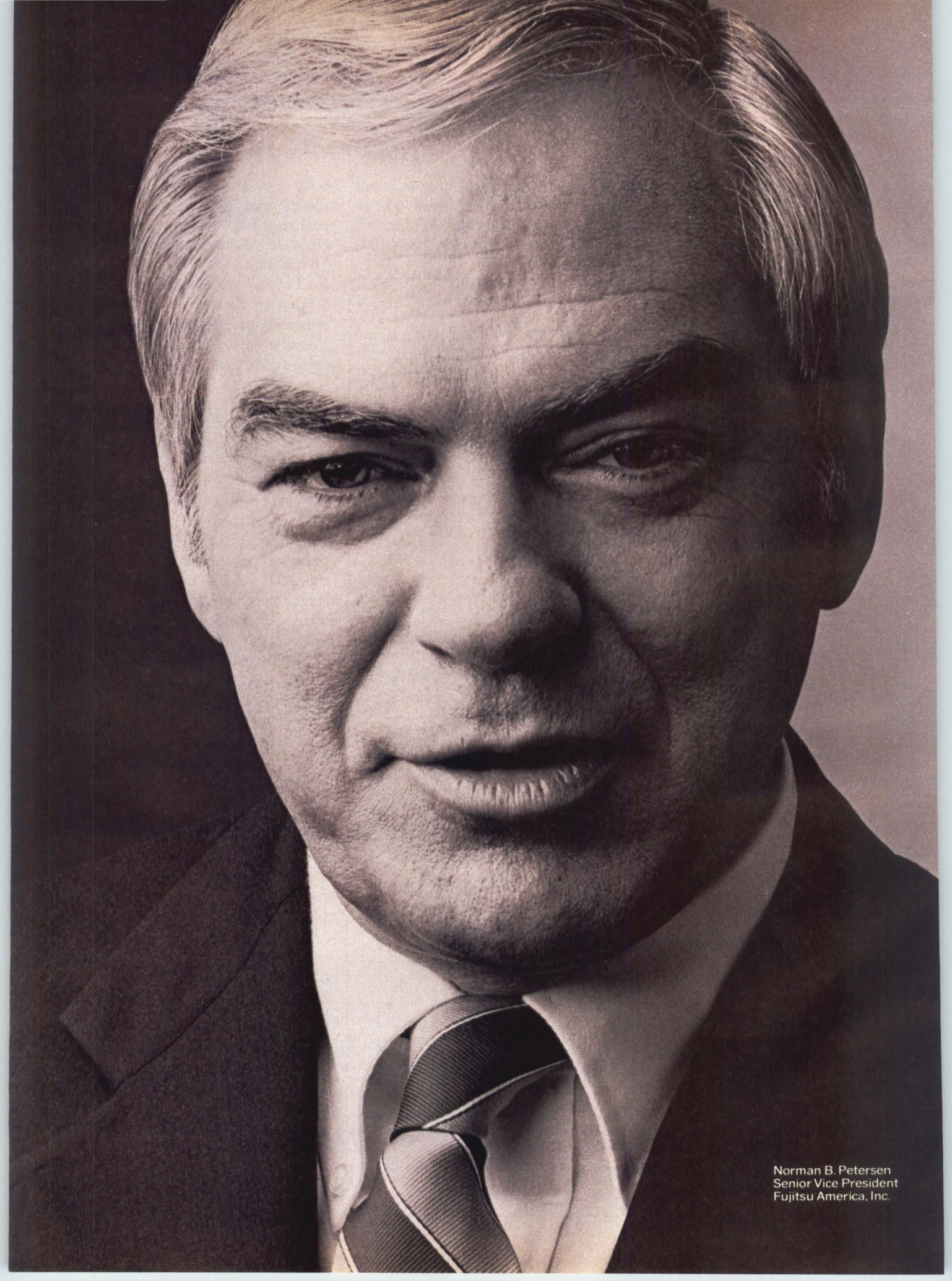
Analysts foresee two major directions in IBM's 1985 software strategy. "As the installed base of the PC-AT computer continues to grow, we'll start seeing AT-optimized software," IRD's Fleming says.

The second direction expected for IBM is multiuser software. "IBM is strongly heading in the direction of networking software," says Boyle. "The company already has an operating system under development that is networked, but they want to introduce it at just the right time." □

BM's 31 FLAVORS OF SOFTWARE



Note: All Personal Decision series products, except PLANS+, ATTACHMENTS/370 EDITION, ATTACHMENTS/MVS, and ATTACHMENTS/VM should be available by the end of this month. The others will be available during the first quarter of next year.



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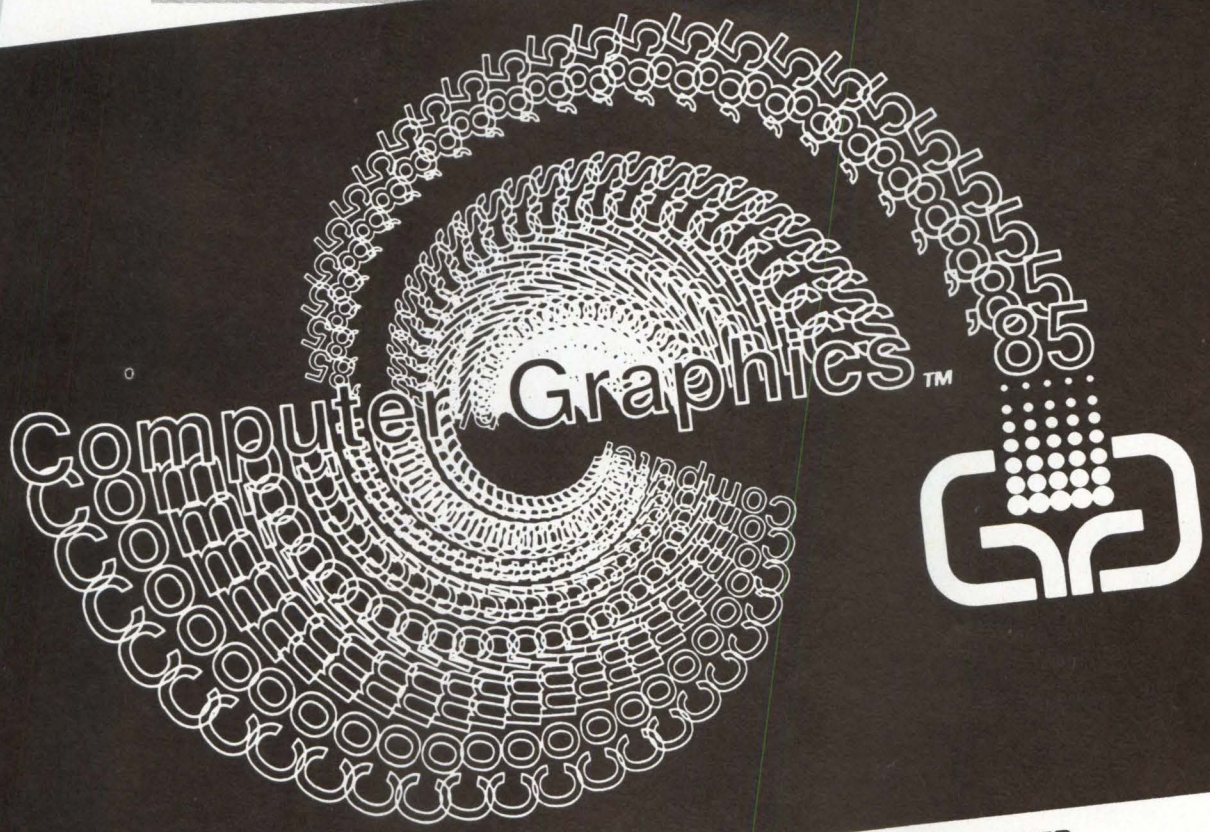

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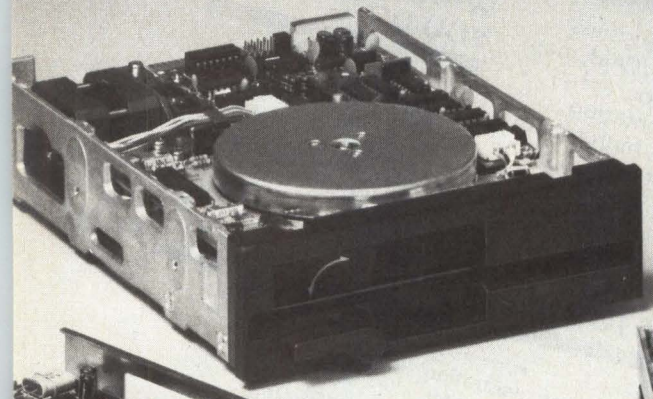

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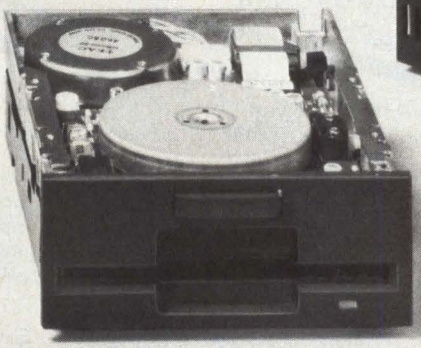

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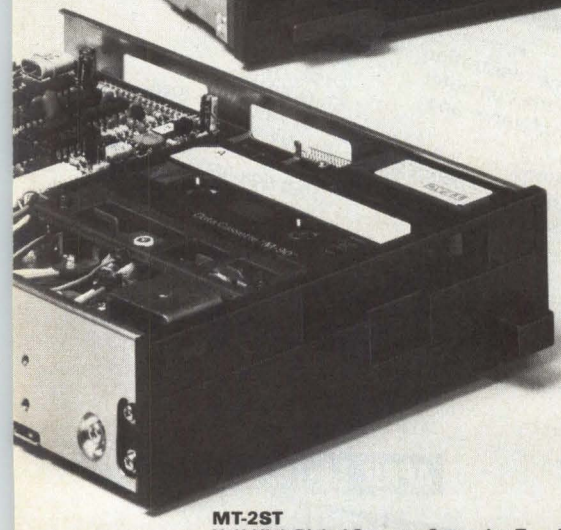

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CIRCLE NO. 33 ON INQUIRY CARD

IBM builds communications muscle with Rolm acquisition and joint ventures

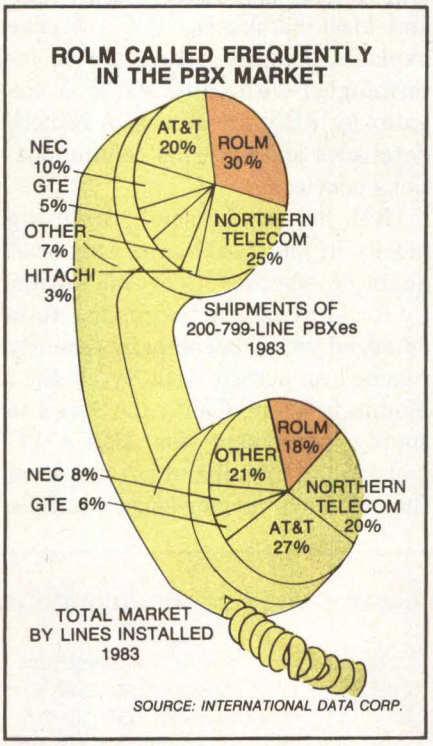
Stephen J. Shaw
Washington Editor

In the past eighteen months, IBM Corp. has rapidly added more "blue" to the portrait of the U.S. communications industry. IBM's latest stroke produced a $1.3 billion swath covering the acquisition of Rolm Corp., a Santa Clara, Calif., manufacturer of private branch exchange (PBX) equipment.

The Rolm takeover—IBM's first outright acquisition in 22 years—fits a developing pattern as IBM begins to reveal its strategy to compete with AT&T Co. and "Japan Inc." in emerging telecommunications markets. Through a series of joint ventures, partial investments, internal product development and, now, a complete purchase, IBM is clearly indicating its intention to become a major force in office automation equipment, local information networks and satellite transmission services.

When IBM upped its financial interest in Rolm from 23 percent to 100 percent, it acquired the third largest PBX manufacturer in the United States with 1983 sales revenues of $659.7 million. More importantly, IBM solidified its foothold in the PBX market after several missteps with earlier ventures. The company has tried, both on its own and in cooperation with Canadian Mitel Corp., to develop a PBX initially for the European market that could be used to carry voice communications and interconnect IBM mainframes for heavy data-communications transfers. The venture with Mitel collapsed in mid-1983 when IBM shifted the focus of its PBX development efforts to Rolm.

In addressing the market for office-automation equipment, IBM may not see the PBX as the hub of the "smart" office, "but IBM certainly recognized the PBX as an essential ingredient, and an element that IBM knew it had to have," comments Richard Imershein, vice president for research of the Gartner Group Inc., a market research organization in Stamford, Conn. "IBM's takeover was a logical move."



Rolm's focus *on high-speed 200-plus-line PBXes, with which it owns 30 percent of the market for products in that class (top), should help the company maintain its 31 percent annual revenue growth. With IBM's marketing clout behind it, Rolm should be able to push its 18 percent overall market share to 20 percent next year (bottom).*

Since IBM acquired its first interest in Rolm in June 1983—15 percent—the two companies have been working toward achieving greater communications compatibility between Rolm's PBX equipment and IBM's high-end systems, according to a Rolm spokesman. Although the Rolm sales force is expected to remain independent, the spokesman said that plans are underway for joint marketing and product development efforts.

"Look for IBM to push for new products, particularly an integrated voice/data terminal," predicts Kim Myhre, a communications analyst with International Data Corp. (IDC), Norwalk, Conn. Up to now, Myhre continues, most PBXes have been designed primarily for voice traffic, with data-communications capability treated by PBX manufacturers as a value-added feature.

Data transfer and switching applications are limited by the relatively low throughput capacity of telephone wire, the primary medium for PBX-to-telephone connections, and the necessity to queue at the PBX for a circuit and a modem or data switch before entering external communications networks. But, Myhre adds, the PBX is perfectly suited as a gateway between local networks and for handling data traffic within a local office-communications network. With Rolm's strong position in the advanced voice/data PBX market, and IBM's seeming ubiquity in desktop personal computers and workstations, the only piece missing is a telephone workstation with advanced PBX features integrated into a full-fledged desktop microcomputer, the analyst concludes.

Rolm currently holds an 18 percent share, by lines installed, of the U.S. market for private telephone exchanges, according to estimates

supplied by IDC. The leading supplier is AT&T, with a 27 percent share, and Northern Telecom Inc., with 20 percent. With IBM's marketing clout behind it, Rolm is likely to increase its market share in 1985 by two percentage points and close in on Northern Telecom, says Jeff Kaplan, senior marketing analyst at IDC. Overall, the market for PBX equipment is growing at a lackluster 3 percent to 4 percent annual rate, but Rolm's concentration on high-end, 200-plus line PBX systems will help to maintain its 31 percent revenue growth experienced from 1983 to this year, the analyst maintains.

PBX complements LAN

IBM could use Rolm's PBX products to complement development of local area networks (LANs), using the LANs for data-only communications among desktop microcomputers, central processors, peripherals and local databases. IDC's Myhre explains that the data could be intermingled with voice traffic at the gateway PBX for access to remote databases and external communications services.

IBM has made some confusing moves in the LAN area that cast doubt on whether its overall strategy for local data networks has fully emerged yet. The company recently reached an accord with Sytek Inc., Mountain View, Calif., for Sytek to supply equipment for IBM's PC Network, a broadband LAN system that employs carrier-sense multiple access/collision detection techniques to pass information between microcomputers. For industrial applications, the company has developed a baseband, token bus LAN. Finally, the company has publicly announced the specifications of a token-passing ring LAN for office-automation techniques. Still, it has made available only a data-grade, baseband-cable wiring system.

None of the LAN systems are compatible, comments Charles Robbins, IBM analyst with IDC. The computer manufacturer has released some details on LAN interface equipment, but has been "deliberately vague with [telling] when either the interface or the token-passing LAN will actually be available," says Robbins. "By creating

IBM casts a wide communications net

Until its recent acquisition of Rolm Corp., IBM Corp. has limited its forays into the communications industry to a series of joint ventures and limited-interest partnerships with companies already active in particular market segments. The following is a summary of the computer maker's recent moves to establish its communications presence and set the strategy for long-term battle against AT&T.

- Last year, IBM acquired a 12 percent ownership in Intel Corp. The agreement contained a 30 percent ceiling on IBM's interest, like in IBM's earlier pact with Rolm. IBM's current interest is 20 percent. Intel has supplied IBM with a number of microprocessors for IBM PCs and other machines, including Intel's 82586 chip that allows IBM machines to access Ethernet and other local area networks.
- IBM has joined with Merrill Lynch to start International MarketNet, a stock market information service for brokerage houses. A pilot project is scheduled to begin in the second quarter of 1985.
- In a home videotex pilot called Trintex, IBM, CBS and Sears Roebuck and Co. will provide home-computer users with a variety of electronic entertainment, teleshopping and information services. IBM has already developed and is marketing software for its PC that allows the microcomputer to emulate a standard videotex terminal.
- In July, IBM upped its 33 percent share in Satellite Business Systems (SBS) to 60 percent when it purchased the interest of the Communications Satellite Corp. Several months earlier, IBM had installed Stephen B. Schwartz, formerly senior vice president of IBM's Communications Group and ex-adminstrative assistant to new IBM chief executive officer John F. Akers, to stem heavy SBS financial losses and gather the satellite carrier more closely to the IBM fold.
- IBM has reached an exclusive agreement with Sytek Inc., Mountain View, Calif., for Sytek's network adapter cards and the translator for IBM's PC Network. The planned local area network for Personal Computers is a broadband, carrier-sense multiple access/collision detection (CSMA/CD) system that IBM has promised will be able to interconnect with IBM's future token-ring network. IBM has also announced a third offering, a baseband token-bus network, for industrial applications.
- In England, IBM planned to work with British Telecom Plc. to develop videotex-type computer network and information services, but the British government blocked the venture in October.
- In West Germany, IBM supplied the German Post Office with the hardware for a project called Bildschirmtext, a videotex demonstration program for home subscribers.
- In Japan, IBM is developing value-added network (VAN) services to be run through telephone lines leased from Nippon Telegraph and Telephone Co. (NTT). The private information networks could be used by banks, retail chains and brokerage houses for internal communications requirements under the government-ordered "privatization" of NTT. IBM is also working with Mitsubishi Corp. and Cosmo 80, a Japanese software development company, to develop new products and communications services for NTT.

Internally, IBM is developing the Information Network, a long-distance data service.

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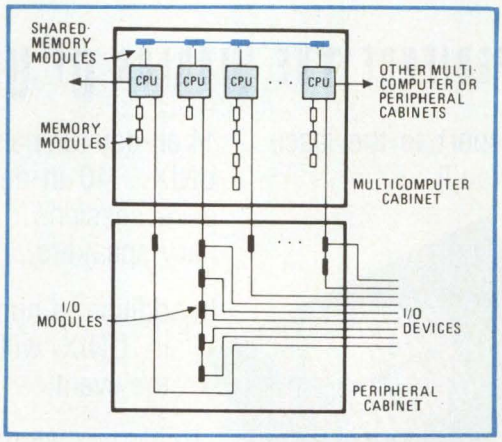

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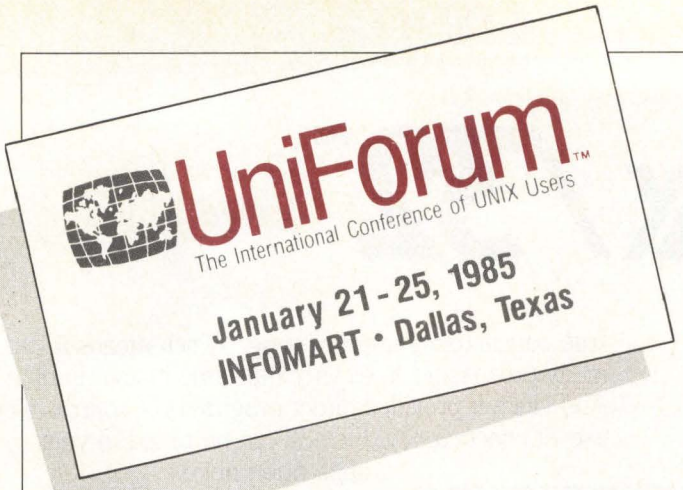

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this confusion, IBM keeps potential customers from committing to another LAN standard," the anaylst comments.

The Gartner Group's Imershein sees IBM's strategy for its office LAN as consistent with its equipment strategy. "IBM is adopting a thorough, step-by-step approach to support office automation—first, desktop computers, then software, then cabling, and finally the LAN. By bringing out its cabling system two years ahead of the office LAN, IBM is telling its customers, put your cabling in now because, if you don't, the LAN will be ready and you won't," Imershein says.

Looking at the long-haul

IBM has not overlooked long-distance communications transmission capability in charting its communications strategy. Since 1975, IBM has been a partner with Aetna Life & Casualty Co. in Satellite Business Systems (SBS), an ambitious venture formed to supply satellite-based private voice, data and video networks. In June, IBM acquired the interest of another SBS partner, the Communications Satellite Co. (Comsat), and increased its total holdings in SBS to 60 percent. Several months earlier, IBM had placed a senior vice president of its Communications Group at SBS as its new chief executive officer. Naming Stephen Schwartz, who had served a stint as adminstrative assistant to John F. Akers, IBM's new chief executive officer, was done in part to stem the $450 million loss SBS has experienced since it was founded, and also to bind SBS closer to the IBM corporate culture, according to Imershein.

If Rolm's PBXes could function as IBM's local link between LANs, SBS' four-satellite system could serve as the long-haul conduit between widely dispersed LANs, argues IDC's Robbins. Not surprisingly, IBM is presently SBS' largest customer. In conjunction with increasing its stake in SBS, IBM successfully petitioned the Federal Communications Commission earlier this year to lift that agency's restraint against joint marketing efforts between SBS and IBM sales personnel. By late August, joint marketing was underway. □

GUEST FORUM

The voice for guest experts

James H. Geisman is president of Market Impact, a Wayland, Mass., management and marketing consulting company.

Will IBM Personal Computers set a new hardware bus standard?

James H. Geisman
Market Impact

Standard bus structures have typically offered third-party companies new revenue opportunities. These companies have prospered by riding the coattails of Digital Equipment Corp.'s Q-bus and Unibus, Intel Corp.'s Multibus and the Motorola Inc./Signetics Corp. VMEbus, to name a few. Now, more than 150 add-in board manufacturers are setting the stage for IBM Corp.'s Personal Computer bus to emerge as the next hardware bus standard.

The PC's motherboard and expansion chassis allow system integrators and end users to do everything any IEEE standard, including the popular Multibus, ever allowed. The PC's hardware architecture is well specified, and multiple sources are available for virtually every type of peripheral. The peripherals range from the usual memory and I/O devices to more exotic attachments for pattern and voice recognition. Despite the diversity, suppliers' products can be mixed and matched with little difficulty by adding one or two software drivers. Hardware compatability problems rarely arise, except in the most time-critical applications.

In many ways, the slots on a PC motherboard are no different from those in a VMEbus card cage housing a Motorola CPU board, or the slots in a Multibus backplane with an Intel CPU card. The biggest difference may lie in the small amount of onboard power and the lack of power supply options on the PC.

Third parties already are developing industrial-grade versions of the PC, into which they plug analog-to-digital converter cards. The result is a ready-made industrial controller. One can also make a turnkey computer-aided-design workstation from a graphics card set, a combination card, a mass storage device and a PC.

With IBM's market power and its complete control over the operating system, CPU and motherboard configuration, the computer industry may find itself endorsing one of the few standards not subject to any standards-setting group's approval.

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CIRCLE NO. 37 ON INQUIRY CARD

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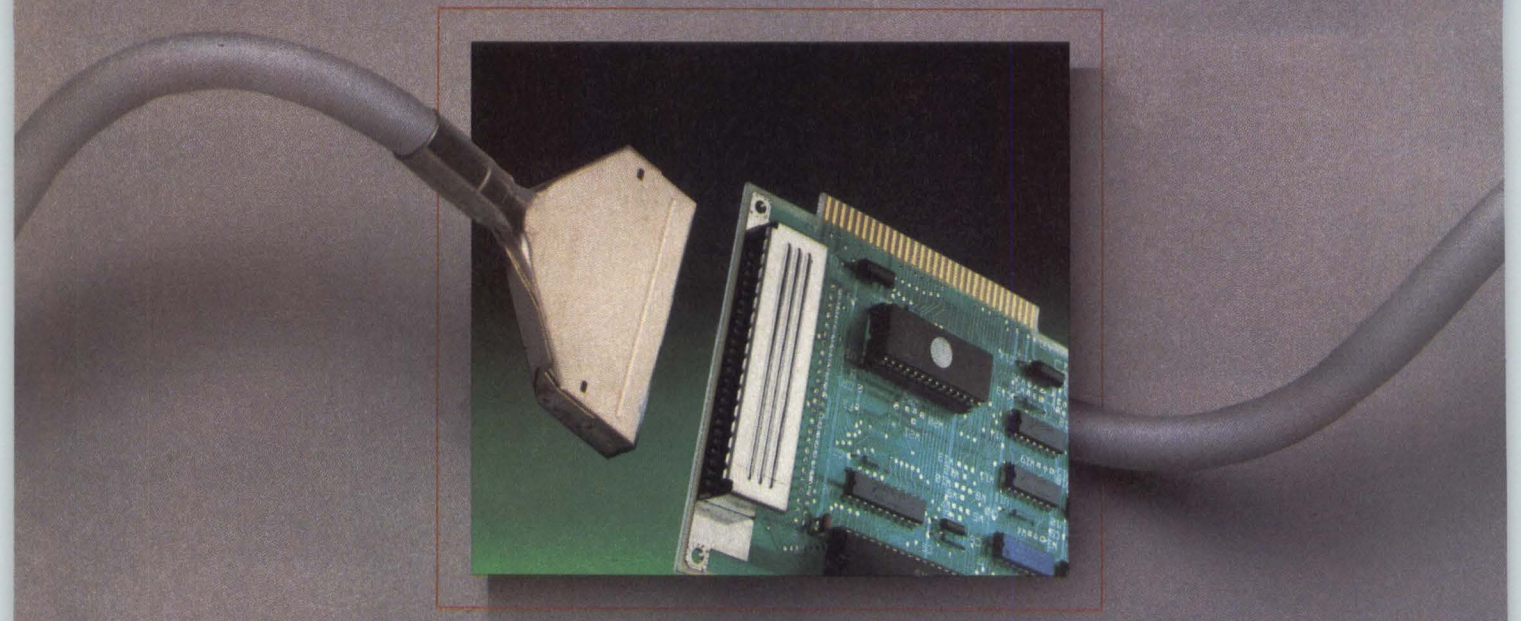

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CIRCLE NO. 38 ON INQUIRY CARD

DEC and Northern Telecom square off against HP and AT&T for best PBX interface

Keith Jones, European Editor

Major computer and telecommunications equipment vendors are battling over the specifications for an interface to allow private automatic branch exchange (PBX or PABX) networks to connect terminals and workstations to a host computer.

In one corner stand Digital Equipment Corp. (DEC), Maynard, Mass., and PBX builder Northern Telecom Ltd., Mississauga, Canada. In the opposite corner are Hewlett-Packard Co. (HP), Palo Alto, Calif., and AT&T Information Systems, Lincroft, N.J., part of American Telephone and Telegraph Co. Both factions want to replace costly individual terminal connections and line cards between the PBX and host computer with one twisted-pair wire. In this setup the PBX would time-division-multiplex multiple channels onto the twisted-pair wire.

AT&T's System 75 *is one of that company's first private branch exchange systems equipped with the Digital Multiplexed Interface, one of two interfaces for connecting terminals and workstations to a host computer via a PBX.*

But the two sides are taking radically different approaches in the data specifications for that wire.

DEC and Northern Telecom are promoting the Computer-to-PBX Interface (CPI) (MMS, February, Page 101), which carries each terminal connection on an 8-bit-wide communication channel. That channel conforms with the T1/SL1 North American public switching standard. Like T1/SL1, the CPI multi-

A closer look at proposed ISDN standards

The advent of digital switching on public telephone networks has opened up the opportunity for companies to provide an integrated services digital network (ISDN). ISDN can time-division-multiplex multiple channels of voice, data and other digitized information for transmission over the public telephone network.

Study groups within the Geneva, Switzerland-based Comité Consultatif Internationale de Télégraphie et Téléphonie (CCITT) are defining a collection of ISDN standards that will be known as the I series.

Of significance to terminal and workstation suppliers is the basic user network interface, I.420. It enables a terminal, designated TE1 by CCITT, to connect over a four-wire twisted pair physical link to an ISDN. The TE1 can be connected directly to the network termination equipment, designated NT1 by CCITT. Alternatively, it can connect to NT1 via any one of a collection of different distribution devices designated NT2.

I.420 will provide each TE1 device with two 64K-bit-per-second channels for data, or possibly data on one channel and digitized voice on another. In addition, it will provide one 16K-bit channel for signalling and also for packet switched data, if required. I.420 allows for a single terminal in a configuration called point-to-point (PTP), or up to eight terminals in a point-to-multi-point (PTMP) configuration.

The U.S. Federal Communications Commission (FCC) has expressed some anxieties about the CCITT approach to ISDN (MMS, June, Page 58). Michael Slomin, legal advisor to the FCC, notes that one of these worries centers on the lack of a defined interface between the NT1 network terminating equipment and the exchange termination on the local public network. CCITT designates this termination point U. The I.420 interface can only be implemented at reference points S or T, which are between the terminal device and the NT2 distribution device and between NT2 and NT1, respectively. A defined interface at U (now undefined) would enable independent vendors to build and supply NT1 devices in competition with common carriers.

plexes 24 of these channels onto one line. The theoretical rate of each multiplexed channel is 64K bits per second (bps). Both T1/SL1 and CPI "rob" one bit periodically from a group of eight bits for signalling, so the data rate is actually 56K bps.

Bit-robbing not good for data

"The bit-robbing method of T1/SL1 is all right for digitized voice, but no good for data," remarks Felicia Choy, program manager at HP's Cupertino, Calif., information networks division. Choy's company and AT&T argue that CPI is incompatible with the Integrated Services Digital Network (ISDN) recommendations being drawn up by the worldwide forum for common carriers, Comité Consultatif Internationale de Télégraphie et Téléphonie (CCITT), Geneva, Switzerland. Unlike T1/SL1, ISDN provides an actual 64K bps on each channel for voice or data over a public, digitally switched, network. Signalling is carried on separate channels, an approach called common-channel signalling.

Therefore, HP and AT&T are promoting the Digital Multiplexed Interface (DMI), which provides clear 64K-bps channels and separate common-channel signalling. "We anticipate that there will be a big move in the U.S. public network from robbed-bit mode to 64K-bit channels," declares John Newell, head of the product family architecture department at AT&T. Newell says that several major computer vendors have announced support for DMI, including Data General Corp., Prime Computer Inc. and Wang Laboratories Inc.

DEC begs to differ

Peter Janca, PBX program manager at DEC in Merrimack, N.H., believes that CPI meets the more immediate needs of the U.S. market, pointing to the base of as many as 30,000 fully digital PBXes already installed in the United States and waiting to be equipped with such an interface. He also points to support for CPI from two other leading PBX vendors apart from Northern Telecom. These are Rolm Corp., now owned by IBM Corp., and Intecom Corp. Janca adds that no special integrated circuits are needed to implement CPI on a PBX or computer apart from those already available for generating the T1/SL1 multiplexed bit stream.

Choy at HP says that chips to implement DMI at both the computer and PBX are becoming available. AT&T's Newell explains that they will support functions such as common-channel signalling similar to ISDN, including the Q.921 data transport protocol recommended by CCITT.

DMI has more channels

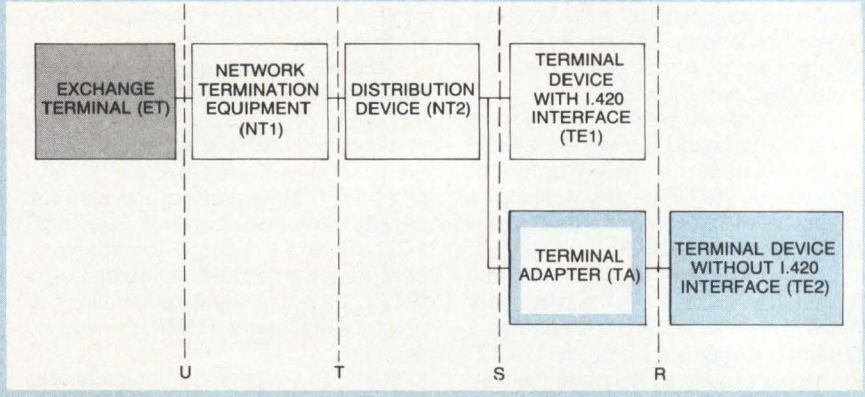
The same signalling method is shared by the two existing versions of DMI. The North American version uses 24 channels, each of 64 bps—23 for data and the other for common channel signalling. The European version of DMI provides 30 data channels plus two for signalling to match exactly the 2,048M-bit-per-second ISDN data rate.

"We expect DMI to become a de facto standard in Europe," declares Cees Lanting, consultant to the HP data communications laboratories at Grenoble, France. He notes that PBX equipment with DMI can communicate with a host computer, both locally and remotely, over a 30-channel point-to-point line. Newell at AT&T notes that DMI includes a mode that provides compatibility with the 56K-bit-per-channel rate on U.S. public data networks.

DMI provides a total of four modes of communication between the PBX and computer, compared with only one provided by CPI.

Connecting the integrated services digital network

Devices in an Integrated Services Digital Network (ISDN) are connected by interfaces located at the defined reference points U, T, S and R. The standard network interface I.420 can only be implemented at points T and S. There is no defined interface at point U, which sits between the network terminating equipment and the exchange terminal on the public network. TE2 terminal devices without the interface can be attached through point R by using the terminal adapter to convert devices with X.21 or X.25 protocols.



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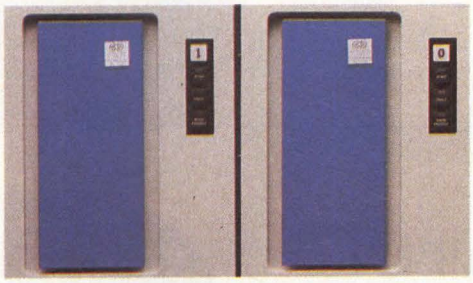

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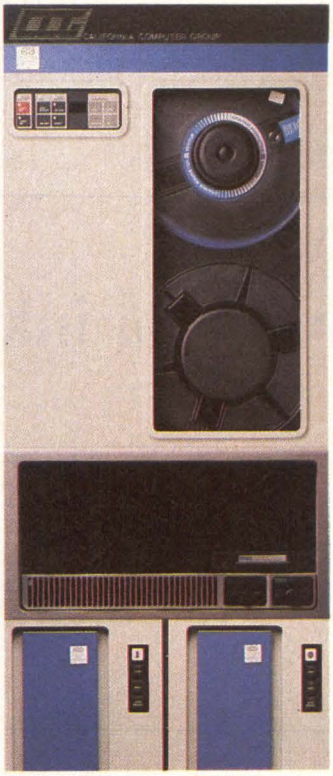

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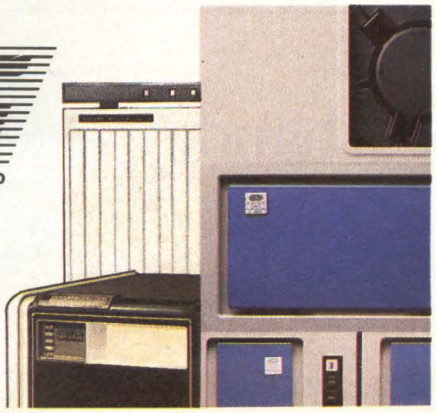

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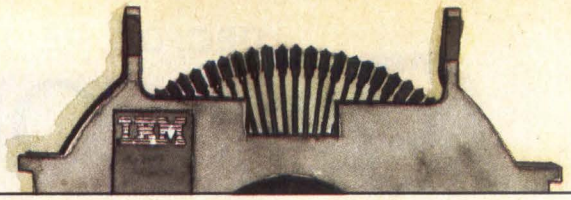

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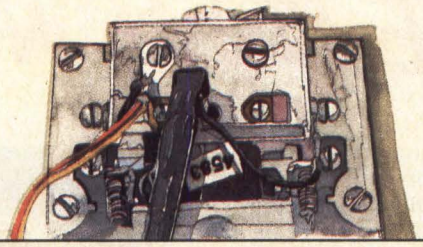

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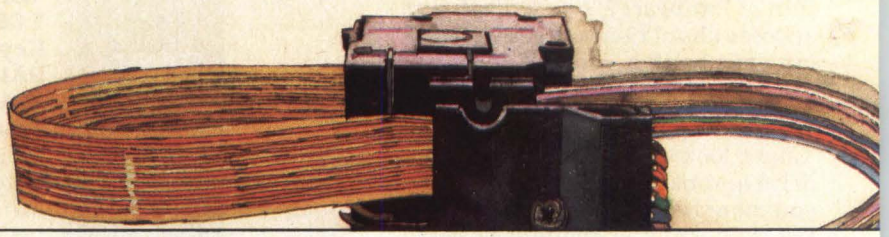

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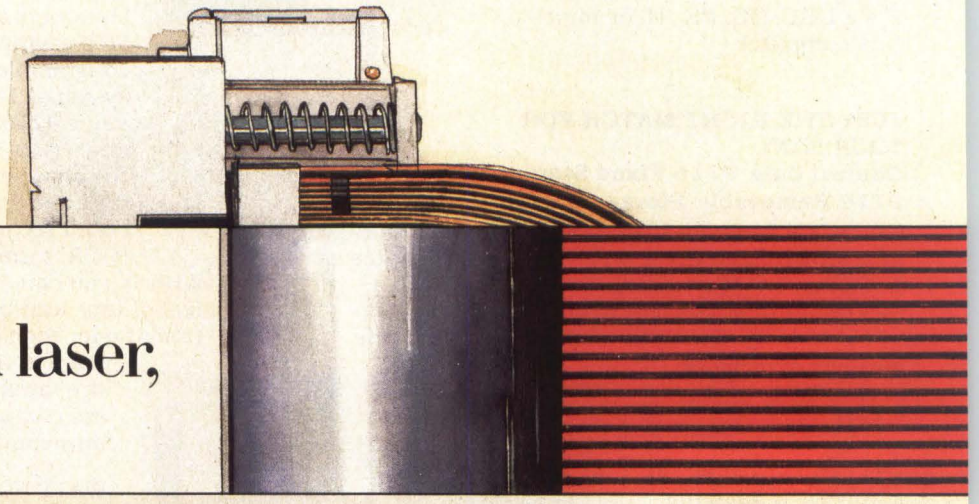

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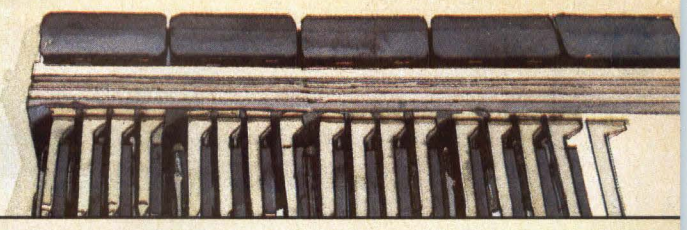

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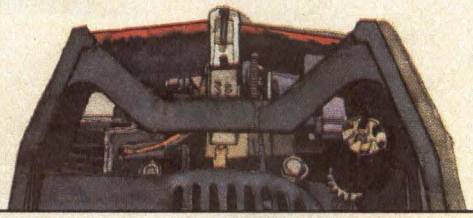

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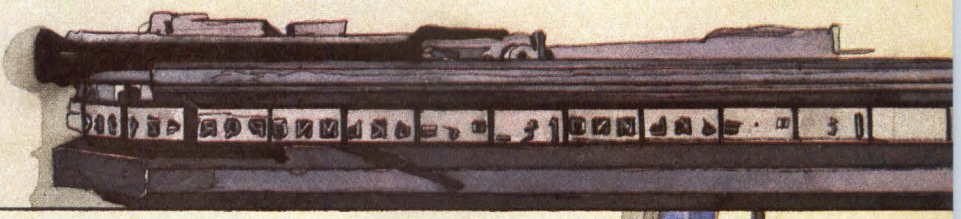

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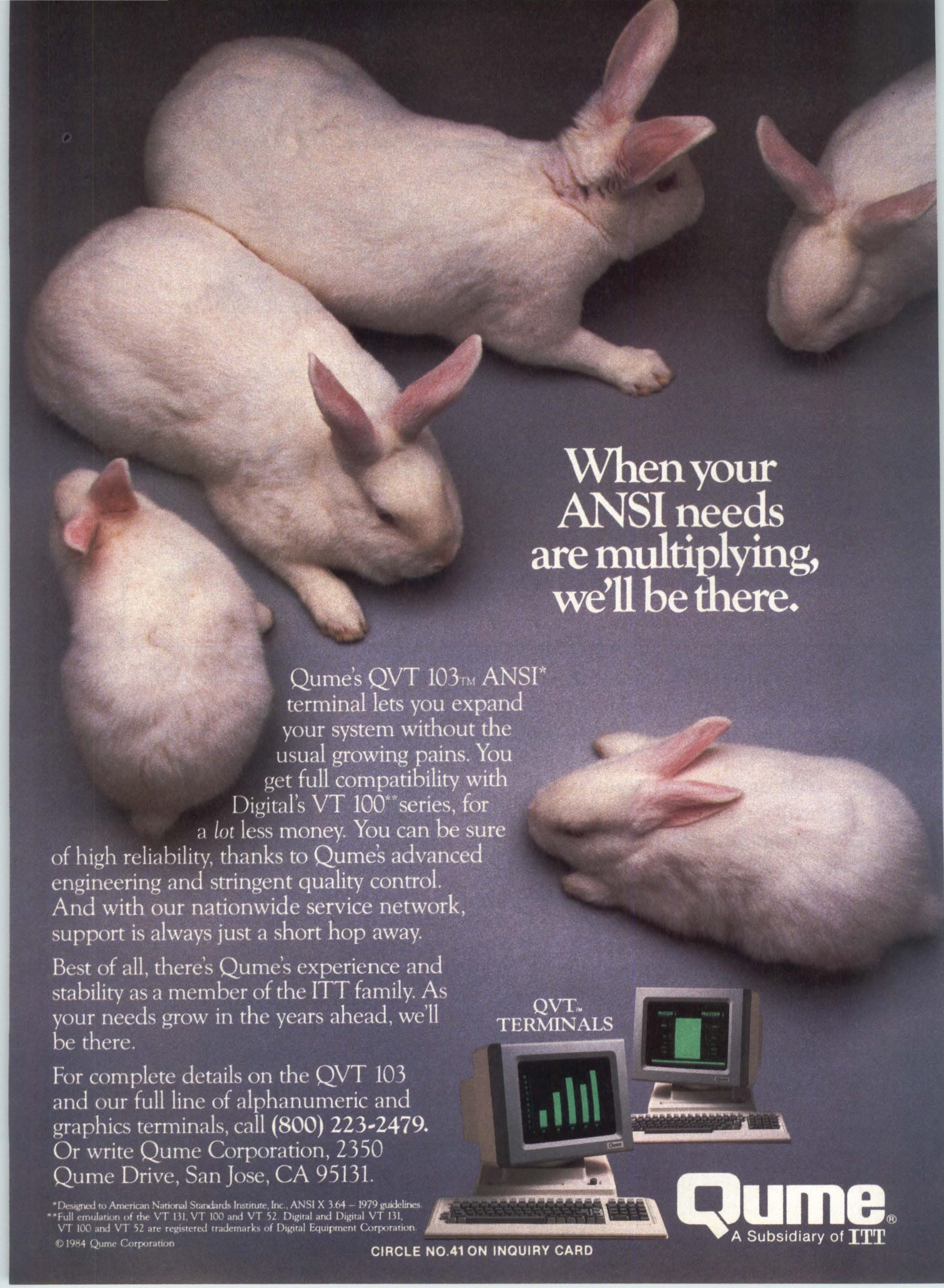

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CIRCLE NO.41 ON INQUIRY CARD

Apart from the 56K-bit compatible mode and a straight 64K-bit mode, there are two others that can support multiple terminals on one channel—an advantage over CPI, according to Lanting. One of the two supports multiple asynchronous terminals, encoding RS232 signals into the common channel protocol. The other supports multiple virtual channels on one 64K-bit channel. Lanting notes that this mode could support multiple dumb terminals.

Newell at AT&T believes the mode is excellent for the windowing features now available on personal computers that allow several applications to be viewed simultaneously.

Newell notes that DMI's 64K-bit channels will enable DMI to support terminals equipped with ISDN's I.420 basic-user network interface, which comprises two 64K-bit channels for data and/or digitized voice and one 16K-bit channel for signalling and packet data. □

NEXT MONTH IN MMS

The Interpreter section of the January issue of Mini-Micro Systems features an article on the battle for foreign investments between Scotland and Ireland by managing editor Jim Donohue.

OVERHEARD OVERSEAS

IBM winning first battle with AT&T in European market war

Tim Palmer
European Correspondent

In a fight for European market share, AT&T Co. and IBM Corp. are mounting their first major offensive campaigns in Italy. AT&T was first to deploy forces there by acquiring 25 percent of Olivetti SpA. IBM then made a more strategically sound entry by linking up with Italy's industrial holding company Instituto per la Reconstruzione Industriale.

What makes IBM's move so formidable is its connection with a holding company owned mostly by the government. IBM can enjoy the financial muscle of Italy's conservative Christian Democrat government, which virtually controls the nation's economic development. Meanwhile, AT&T has followed a red-blooded American inclination to jointly develop and market products with a private enterprise company.

Instituto per la Reconstruzione Industriale oversees STET, the Italian state telecommunications holding company with which most of IBM's dealings have been. IBM and STET have so far reached agreements to develop products in the key fields of factory automation, chip technology and telecommunications research. The Italian government owns 60 percent of STET.

The factory-automation agreement is with STET subsidiary Elsag SpA. IBM and Elsag, which is wholly owned by the government, will form a new company next year in Genoa to tackle the European market for integrated factory systems. IBM will own 49 percent of the venture, and Elsag, the remainder. The agreement is confined to developing industrial automation software. Products will include CAD/CAM machines, flexible manufacturing systems and interconnections between different parts of a factory system. Other Institute per la Reconstruzione Industriale companies are likely to become involved, including Digital Electronic Automation, which makes assembly robots.

On the microchip front, IBM has agreed to buy, in 1985, $52 million worth of power transistors and communications interface circuits from STET's SGS-ATES subsidiary, 10 times the projected value for this year. SGS is the second source in Europe for Zilog Inc., which is why Olivetti chose to build its most important product, the Linea Uno computer family, around Zilog's Z8000 chip. The agreement also covers possible SGS manufacture of proprietary IBM microprocessors at a later date.

The third agreement concerns a joint research effort between IBM Italia and STET's Centro Studi Laboratori Telecommunicazioni (CSELT) telecommunications research laboratory, to study machine recognition of speech and handwriting.

But, IBM is vying for bigger prizes than those agreements. Now under discussion are plans to further collaborate with other companies trying to modernize Italy's cranky, obsolete telephone network. IBM's new proposals also cover database services, value-added networks and a possible factory to build Rolm Corp. PBXes for the European market.

IBM's agreements already represent a severe loss of face—and potential influence—for Olivetti, as well as an effortless outflanking of Olivetti's shareholder, AT&T. Olivetti has quickly activated a program to repair the damage, and is lobbying hard at the Instituto per la Reconstruzione Industriale and STET for an alternative set of proposals to the ones being strenuously pressed by IBM.

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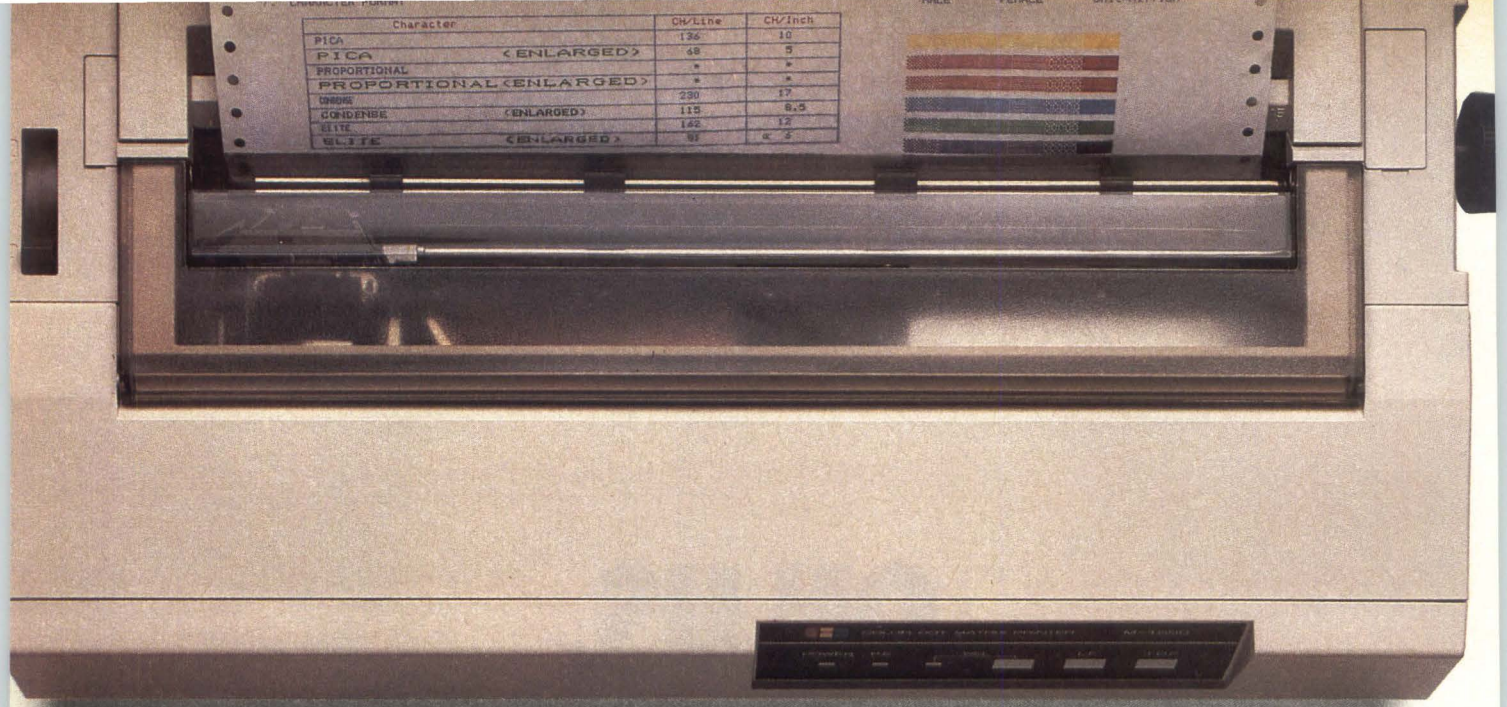

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CIRCLE NO. 43 ON INQUIRY CARD

Office systems struggle for user acceptance

Making personal computers and office workstations more user-friendly in order to overcome buyer resistance poses new challenges to system integrators

Paul Sniger, Senior Editor

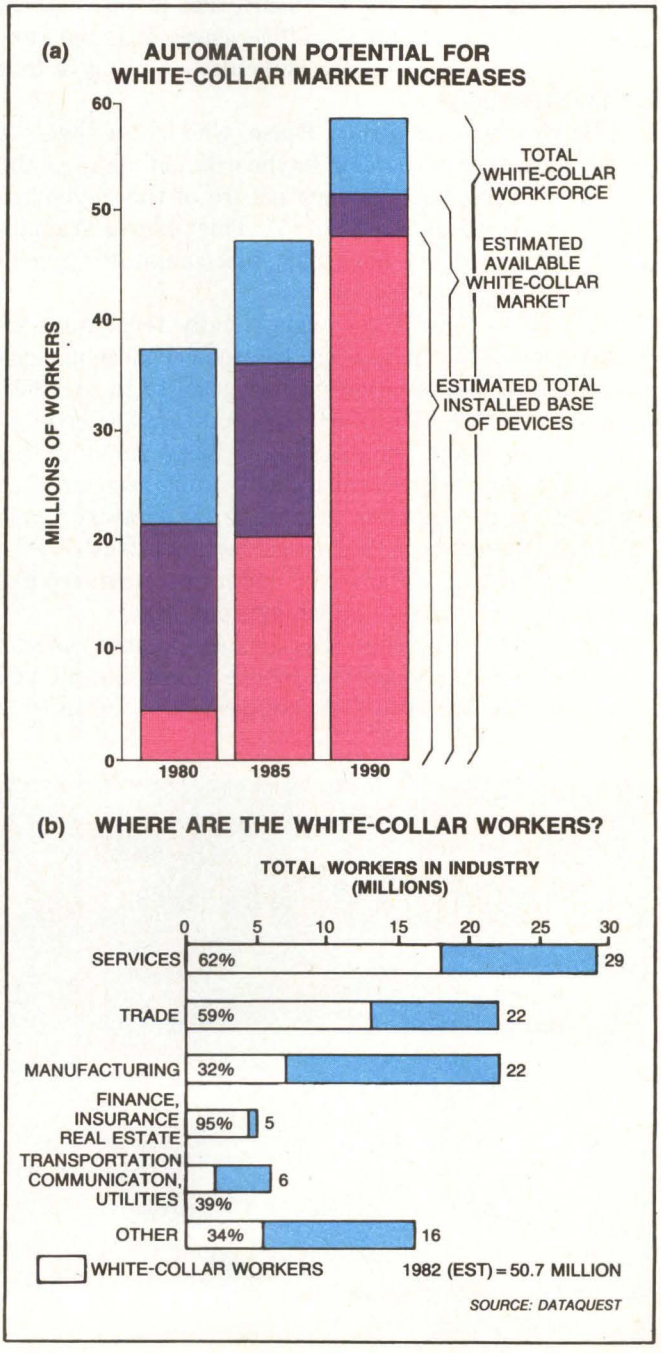
Office automation systems hold the promise of moving mountains of paperwork and leveling the valleys of production, but unless they incorporate user-friendly technologies, they run the risk of being buried in the marketplace.

The potential value of the office automation market is enormous. David T. Kearns, president of Xerox Corp., predicts that next year the United States will spend $270 billion on office automation products and services. That figure is expected to grow rapidly. Research companies like Booz, Allen & Hamilton Inc., New York, N.Y., and Dataquest Inc., Cupertino, Calif., agree that more than nine white-collar workers in 10 will work at computer workstations in the 1990s. That compares to slightly over one worker in 10 only four years ago. The incentive is savings. Booz, Allen & Hamilton estimates that automating the office saves between $2,700 and $5,800 per worker per year.

Computer anxiety rife

However, Venture Development Corp. (VDC), a market research concern in Wellesley, Mass., surveyed 15,000 offices and reported that computers inspire fear. Analyst Leone Pease of VDC says, "People in the office are terrified of computers. Most of these office people have limited experience with computers. It's easier to take them to the dentist than to get them to use some of the so-called user-friendly software and hardware."

Pease said the VDC study found that office managers lack the time or patience to study a large computer manual, or go through tutorial diskettes and then sit in



Total available white-collar *market vs. estimated installed equipment (A) shows automation potential for the total white-collar workforce, as determined by Dataquest Inc. The distribution (B) of white-collar workers in industry concentrates in the service, trade and manufacturing sectors. Each sector has its unique requirements. Nevertheless, installation of office-automation equipment will be proportionally distributed.*

front of a terminal and experiment with it. Confirming this view, Kenneth Bosomworth, president of International Resource Development, Norwalk, Conn., says, "Although complicated computers are fine for technical users, such as CAD/CAM users, they certainly are unsuited to the automated office. I think they're threatening to the average office user."

Menus and mice aid computer transparency

Apple Computer Inc. representatives contend that it is more than merely the keyboard that inspires stress and computerphobia among office users. It is the very design of software and the difficulty of using it that intimidates them.

This view was echoed by Pease, who states that, "It is not that executives fear keyboards, as many of the press maintain, but the very nature of the keyboard-software-and-user interaction." This user-unfriendliness is exhibited, she maintains, in a computer's accompanying documentation.

With most computers, user-friendly techniques involve menu-driven pages that replace verbal commands with icons or picture arrays: Users point to an icon with a mouse or finger. The Macintosh and Lisa 2 microcomputers from Apple, for example, operate simultaneous programs in windows which allow inter-program data transfer, have a pointer controlled by a mouse, have uniform commands so that users need not relearn with each program, and offer easily understood features like cut-and-paste interactive graphics and text.

For example, to erase a file, the user points to an icon of a file folder, pushes the mouse select button and drags the file icon into a garbage-can icon. To make a menu selection, the user slides the mouse to position the cursor onto the menu bar along the top of the screen (or along the side in some applications) and holds down the mouse switch to open the window. The user then positions the cursor over the desired selection in that window and releases the mouse switch.

Windows open to office integration. *Part of the trend toward "people literacy" in business systems, Apple Computer Inc.'s Macintosh and Lisa 2 microcomputers come equipped with icons and windows to spare office workers from learning complex commands and procedures.*

Menus and icons do, however, sacrifice some speed and program compactness for user-friendliness. Non-office users who consider themselves serious word processors, programmers or technicians might prefer the traditional command-driven syntax. Experienced programmers work faster with less friendly computers

Executive workstations *must provide easy access to databases—with no loss of prestige. The Santa Barbara Development Laboratories system, for example, is a touch-screen, keyboard-less executive terminal.*

because command syntax promotes efficiency. For most office users, however, command syntax is difficult to learn and requires constant checking of manuals for spelling and rules. And command syntax's numerous keystrokes can multiply the chances of error.

Keeping documentation thin

Many computers claim to be easy to use and come with attachable mice, but none possesses the unique user-friendliness of the Macintosh. Macintosh was designed so that nontechnical office workers could use it without having seen it before. This is even reflected in the tutorial manuals. Those who feel comfortable with reading manuals can learn from them, or one can take the audiovisual Guided Tour on the machine and let the Mac explain itself. Apple re-coded lengthy procedures to keep the manual thin.

The mouse and printer provide the user with direct manipulation. All commands are direct verbs: Users tell the Mac what to do, not the other way around. This orientation helps give users the feeling they are in charge.

Rather than communicate serially with the user, the Mac's software communicates graphically. Since the human mind works pictorially and not serially, the idea is to have the Mac functions relate to the way people think.

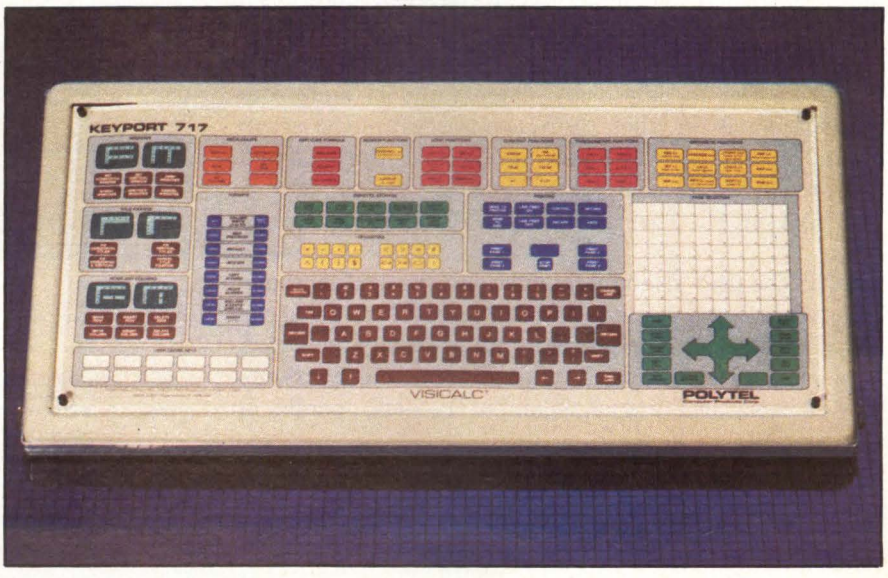
In using Mac, icons minimize the need to remember and type commands. The rules for using the Mac are more like those in our real-life graphics world, rather than like the mechanistic rules of traditional computers. For example, commands like "copy b*.*" are replaced by simple icons.

Another user-friendly approach is a custom-designed overlay keyboard. The "keyport" from Polytel Computer Products Corp., Tulsa, Okla., contains 717 user-programmable keys with an overlay and can be customized to a specific workstation. This method makes copyrighting new products easier and reverse-engineering, or pirating, more difficult than with diskette-based software. Typical office-automation applications require about 150 to 300 keys. The main advantage of dedicated keys, according to Polytel, is that novices can get up to speed faster; the disadvantage is that dedicated keys are less flexible than conventional keys. So it is a valid solution for only a limited segment of the office-automation market.

Executive workstations eliminate keyboards

Many managers are traditionally people-oriented and somewhat uncomfortable at desk-intensive work that involves using keyboards. To help overcome this problem, Santa Barbara Development Laboratories, Santa Barbara, Calif., offers ES-1 executive systems, a multitasking, multimodule system that replaces telephone, Rolodex files, calendars, filing cabinets, pocket calculators, dictation equipment, notepads and personal computers by means of icons and a keyboard-less, touch-screen workstation. The ES-1's proprietary software works in concert with fast, multiple-microprocessor computer architectures and 80M bytes of hard-disk storage.

A similar solution is offered by Hewlett-Packard Co.'s HP150 touch-screen personal computer, which has uncomplicated commands. By touching the screen, users can modify, delete and insert lines; edit, activate



Keyport 717, *a flat membrane keyboard from Polytel Computer Products Corp., permits users to define up to 717 programmable keys and represents one approach to aiding users unfamiliar with computers. Complex commands and menus are reduced to the touch of a single key. Users can thus enter data faster and more accurately with less training.*

The Interpreter

and employ labels; and convert numbers to graphics.

Natural language interfaces

Office systems that communicate in a quasi-natural language reach the highest level in user-friendliness. As user-friendly as they are, mice, joysticks, icons, soft keys, menus and touch-sensitive screens have a major limitation: It is unnatural for people to communicate by menus, icons and mice; they use natural languages, and they want their workstations to do the same.

Commercial, quasi-natural-language computers and software packages that communicate in English are now on the market. Confined until recently to limited commercial applications and to artificial-intelligence environments, natural language computers received a boost last year when IBM contracted with Artificial Intelligence Corp. (AIC), Waltham, Mass., to market AIC's Intellect.

Intellect communicates in English, carrying on what seems to the user to be a natural conversation. Intellect uses grammar rules and a parser that divide sentences into basic elements on which each user writes a lexicon of terms that correspond to his databases. Intellect interfaces simultaneously to multiple packages.

One AI management-information software product that runs on minicomputers and understands English is Themis from Frey Associates Inc., Amherst, N.H. To implement this software, users talk with the database as they would to another person, asking questions and delivering commands by keyboard. In turn, Themis makes logical comparisons and calculations.

Themis understands more than 900 words, and users can expand its vocabulary by adding and modifying words and definitions. Thus, a treasurer can modify the definition of payroll in one way, a clerk can modify it in another and a company president in yet a third. In each case, the software correctly interprets the communication from the specific user. Themis understands communications even when there are typographical errors and misspellings. It also permits the use of pronouns to refer to earlier-listed subjects. The first versions run on the VAX-11 line, using the VAX/VMS operating system.

Of all the user-friendly innovations, natural-language computers could become the big breakthrough in the office automation market. Still, all of these innovations —menus, mice, custom keyboards and touch screens, as well as natural-language computers—are opening up this market. □

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CIRCLE NO. 47 ON INQUIRY CARD

Xebec's New Owl Reduc Storage To

Then.

Microcomputer storage history has progressed by a series of small "next logical steps." A replacement of a component here, a refinement of technology there. But now Xebec has taken a giant step, with its Owl intelligent disk file.

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Ruggedized design includes head landing zone

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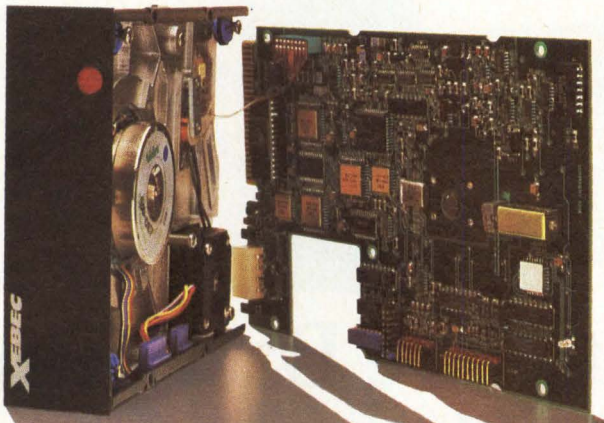

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CIRCLE NO. 48 ON INQUIRY CARD

Graphical Kernel System (GKS) makes its mark in software markets

Though not every developer's cup of tea, GKS is a useful tool for application writers

Lynn Haber, Associate Editor

Despite complaints by some software developers, products implementing the Graphical Kernel System (GKS) standard, designed to help application authors add graphics to their programs, are actively being marketed by some companies and vigorously developed by others.

The German-developed GKS acts as an interface between an application program and a graphics model. It is a low-level standard which is transparent to the application writer. Like most standards, it is intended to address the needs of most of the people, most of the time.

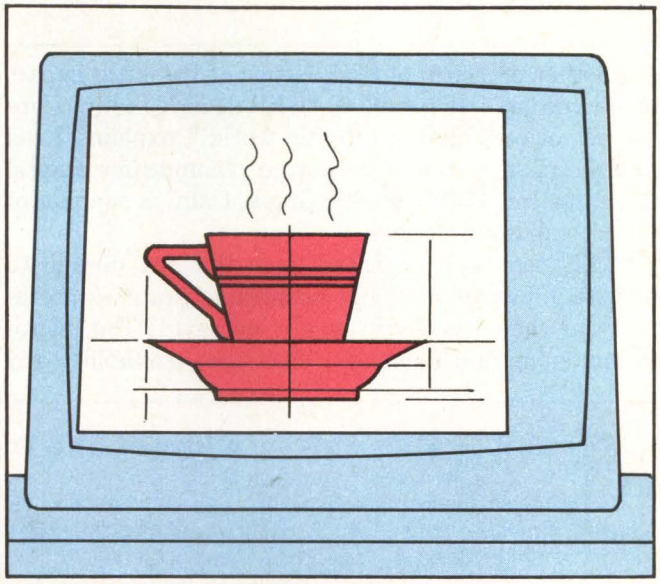
It has recently been adopted by the International Standards Organization (ISO) and is expected to be adopted on a national level by the American National Standards Institute (ANSI) by early 1985.

Based on a set of basic building blocks called primatives, GKS is a two-dimensional, line-drawing interface. Work to extend GKS to three-dimensions is underway. The absence of 3D capability presently evokes much of the negative response to the standard.

"Standards are fine and dandy, but to think there'll be one standard is naive," says Sid Furst, acting manager for graphic software at Lundy Electronics & Systems Inc., Glenhead, N.Y. "Those who like it and feel it will be beneficial to them will use GKS, and those who don't will use something else."

The GKS library consists of approximately 200 subroutines which the application programmer utilizes to produce and manipulate graphics. Defined by a virtual device, GKS is both device- and language-independent. (Information coming into the virtual model gets translated into a universal language. After the information is processed, the information is translated back into its specific language.)

By providing a common definition for graphics functions, GKS allows the applications writer to concentrate on a particular (higher level) application instead of on the low-level software. It also allows for universality and portability.



The GKS concept defines a workstation as a unit comprising a display surface and graphics input devices such as keyboards, tablets and light pens. GKS also allows the offloading of processing to graphics workstations with local intelligence.

GKS criticized

While no one refutes the benefits and necessity of standards, GKS is not without opponents. According to Furst, there are better alternatives. "My personal preference is PHIGS (Programmers Hierarchical Interactive Graphics System), a three-dimensional system, because most of our applications are CAD/CAM (computer-aided design/computer-aided manufacturing)-related," he notes. "GKS is also primarily a display system and not necessarily a modeling system."

The lack of 3D is definitely a drawback to the standard, admits Clinton N. Waggoner, senior vice president at Nova Graphics International Corp., Aus-

tin, Texas. But he says that a 3D extension of GKS has been defined by the standards committee and is undergoing international review. "It's my feeling that by the December (1984) meeting of the ISO, a standard should be defined well enough so that a company like ours would base an implementation on it."

'Many devices out there now can only do some of the things that GKS allows. The standard gives hardware vendors something to look at.'

Another criticism of GKS is that it has little impact on microcomputer graphics. "GKS doesn't really relate to the microcomputer graphic world," explains Fred Langhorst, director of corporate planning for Digital Research Inc. (DRI), Pacific Grove, Calif., a supplier of microcomputer software.

"GKS has been designed over the last decade to address minicomputer and mainframe graphics portability at the source-code level," he says. "The microcomputer market demands object-code portability and higher functionality." Object-code portability comes into play at what is called the Virtual Device Interface (VDI) level. VDI is found at the device-driver level rather than the application level, where GKS is found.

GKS products implemented

Nova Graphics, one of the first companies to implement GKS, has two GKS products. Announced by the software developer in February of this year, NOVA*GKS is a distributed implementation of the GKS. It is a level 2B, FORTRAN release. A second product, written in C and addressing level OB, is aimed at the workstation and personal computer market. The first release, written for IBM Corp.'s PC, is scheduled for the end of this year, according to a company spokesman. The primary market for these products is system integrators.

"Our major thrust is to provide tools for someone else to use to put together a graphics system, the GKS being one of those tools," says Waggoner. "We resell to high-level application developers who don't want to do the low-level graphics."

Prices for Nova GKS by machine class are $20,000 for a mainframe package, $7,500 for a minicomputer,

A look at GKS implementation levels

GKS allows for various levels of implementation—Input Levels A, B, C, and Output Levels M, 0, 1, 2.

Each of the various levels is specifically defined, enabling the user to choose capabilities which will meet his or her requirements.

The functionality that GKS provides is dependent upon six basic building blocks called primitives. These primitives describe various components of a graphic and include the polyline, polymarker, fill area, text, cell array and generalized drawing.

The polyline draws a sequence of connected line segments, the polymarker marks a sequence of points with the same designated symbol, fill area displays a specified area bounded by a polygon, and text draws a string of characters. The cell array allows the user to specify an array of colors and the generalized drawing allows common geometric shapes to be drawn.

Each primitive offers attributes which allow for variations on styling the basic building block. Color, style and width are examples of line attributes.

In the GKS model, attributes can be specified individually, bundled or mixed. When specifying attributes individually, for example, a user may draw a line and then choose a color. Then the user might decide to make the line wider, again choosing the attribute individually. A bundle, on the other hand, is a prepackaged group of attributes, decided upon by the user, which are then applied towards a primitive. Mixed attributes combine bundled and individual attributes.

In terms of GKS implementation, MA would represent the lowest level, whereas 2C stands for the highest. Implementations currently emerging in the marketplace are MA, 0B and 2B, and an occasional 2C.

THE GRAPHICAL KERNEL SYSTEM (GKS) LEVELS

Output level	Input level A	Input level B	Input level C
M	No input, minimal control, only individually set attributes, subset of output functions	REQUEST input, mode setting and initialize devices, no PICK input	SAMPLE and EVENT input, no PICK
0	no graphic input, minimal control, predefined bundles only	REQUEST input, mode setting and initialize input device	SAMPLE and EVENT input
1	full output including full bundle concept graphic segment support and Metafile storage	all of 0B above, plus REQUEST PICK mode, setting and initialize for PICK	SAMPLE and EVENT input for PICK
2	all of 1A above, plus workstation-independent segment storage	same as 1B above	same as 1C above

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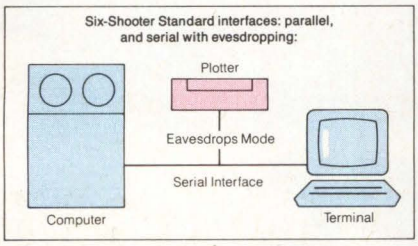
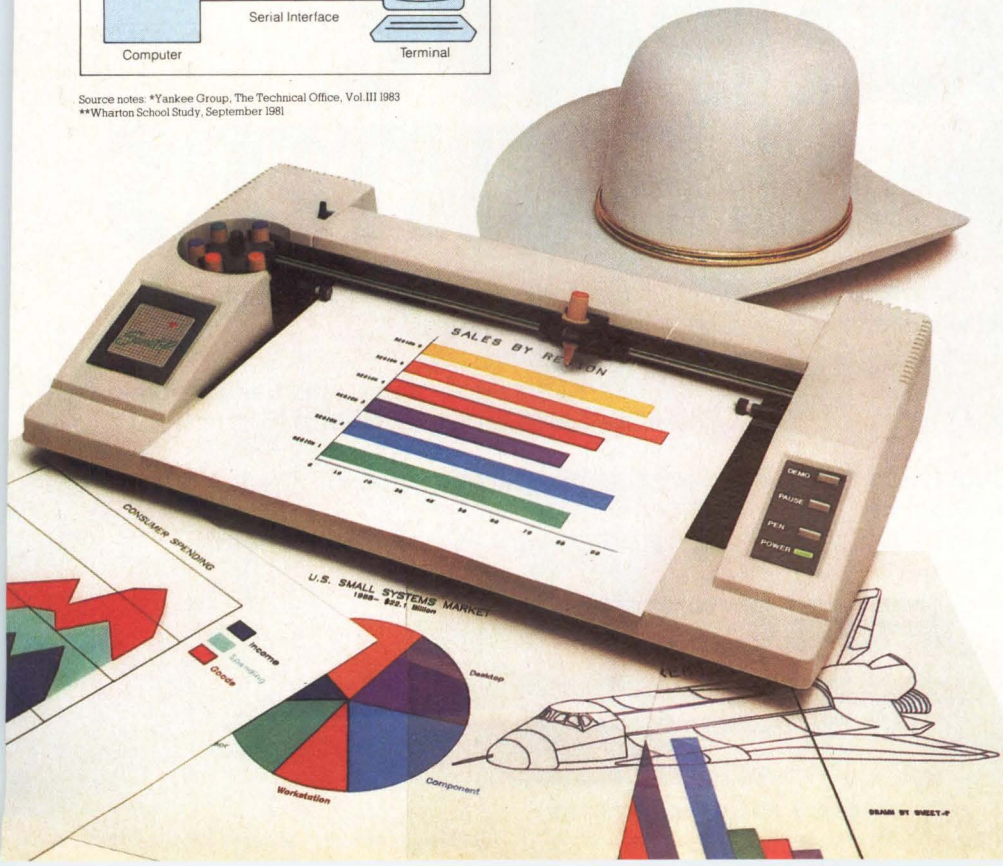


Source notes: *Yankee Group, The Technical Office, Vol. III 1983
**Wharton School Study, September 1981



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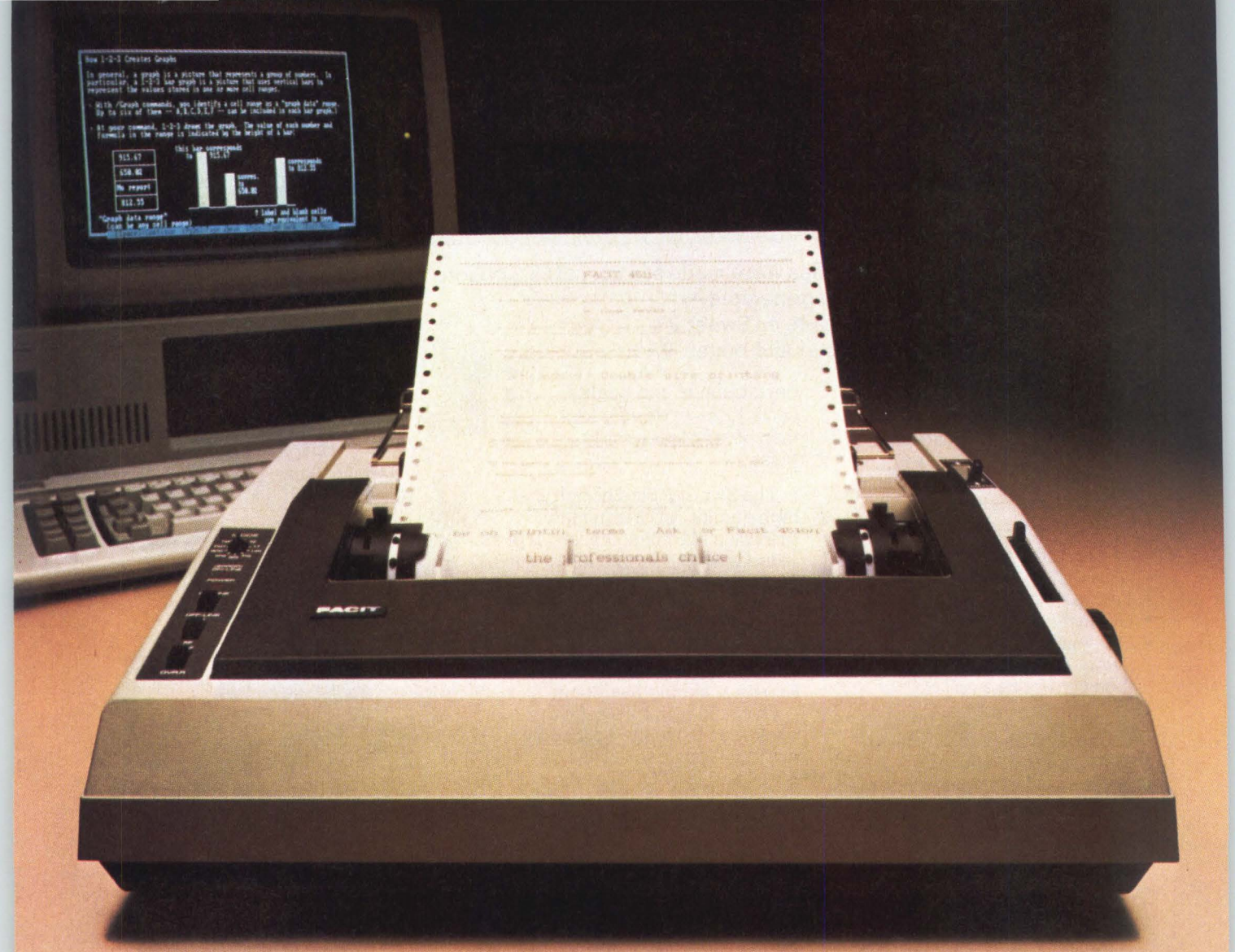

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CIRCLE NO. 50 ON INQUIRY CARD

$1,500 for a workstation and $500 for a personal computer.

According to Waggoner, there are three distinguishing characteristics of the NOVA*GKS product. First, the initial product is a full implementation of the GKS standard, accommodating the full range of processor lines.

The second feature of the Nova product is its distributed architecture design, which allows users of the package to design applications which can perform efficiently on many different graphics hardware configurations. "This design, for example, provides the ability to get some of the processing off of the host computer and reduce the amount of input/output across communications lines," explains Waggoner.

The third feature of this product is that it strictly adheres to the standards. "Our intent is to support standards to the fullest and undergo certification when those procedures are available," he says.

The effect of the GKS standard in the marketplace is already apparent, according to Waggoner. For example, the government is requiring GKS in its contracts. Many Fortune 500 companies are also voicing interest in the standard. "We're getting calls from some major companies who are eager to talk with us and make decisions on how to standardize internally," Waggoner states.

Megatek Corp., San Diego, announced Dimension GKS this past July at SIGGRAPH '84. The product is based on the Nova Graphics implementation of the GKS standard.

The product incorporates an interface to the device library of Template, the company's three-dimensional subroutine graphics package. The interface gives the user access to over 150 device drivers.

According to a company spokesman, the price for the Dimension GKS software is $10,000 for a VAX computer running the VMS operating system. Megatek will soon announce a version of the GKS package to run on the personal computer.

"The company will keep up with future enhancements to the standards, as standards are an important part of the industry," says Rick Kreysar, Template product manager. "We have some customers who need a strict standards package and now we can offer it to them. We can serve a wider customer base."

DRI uses aspects of the GKS to define its Graphics Systems Xtension (GSX). Written for the IBM PC with DRI's software base, GSX is an operating system interface for graphics available across a wide range of computers, according to Langhorst. The GSX is functionally compatible to the GKS model, he says.

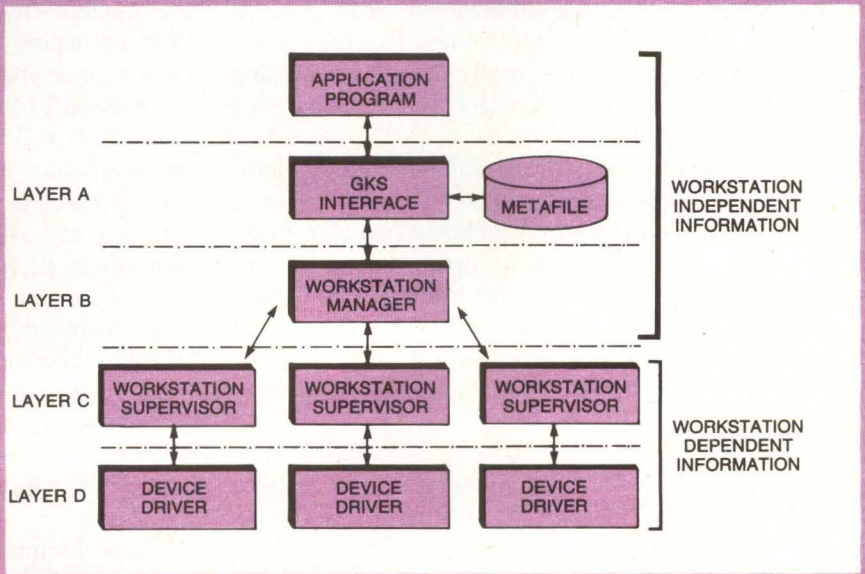
"What is of value here is the whole graphics standardization activity. We have, over the last decade, evolved

Distributed system architecture forms Nova's foundation

The distributed system architecture is the basis for Nova Graphics International Corp.'s GKS product. The distributed architecture pattern allows users of the NOVA*GKS package to design applications, which perform efficiently on many different graphics hardware configurations.

According to Clinton N. Waggoner, the company's senior vice president, the system consists of four layers. All four layers can reside on a single processor, or they can be distributed among processors.

Layer A is the interface between the user and NOVA*GKS. It consists of the functional modules defined by the GKS specification. Layer B is the workstation manager, which manages multiple graphics workstations and handles workstation-independent segment storage. Layers A and B are completely device-independent. Layer C is the software layer required to convert a graphics device into a GKS workstation by software simulation of GKS functions not directly supported by the device. Layer D, the device interface, is more or less equivalent to the device driver component of other graphics software packages.



some models of how graphics should be represented on a screen and what procedural calls should be," Langhorst states.

Has implications for hardware

Approximately one year ago Lundy announced GKS firmware, developed by the company's sister division in England. It was a relatively rare endeavor and an unenthusiastic response prompted the company to put the firmware on the back burner. One benefit of incorporating the commands in a terminal's hardware is that the work is done faster, Furst points out. You also have a truly GKS workstation based on the GKS definition of a workstation, he adds.

'Our major thrust is to provide tools for someone else to use to put together a graphics system, the GKS being one of those tools.'

One of the effects that Tom Wright, chairman of the ANSI X3H3-5 task group managing the organization's GKS effort, sees from the GKS standard is hardware becoming more intelligent, hence more GKS-compatible. "There are a variety of concepts within GKS that can be offloaded from a host into a terminal. Many devices out there now can only do some of the things that GKS allows," he explains. "The standard gives hardware vendors something to look at."

David Straayer, systems engineer at Tektronix Inc., Beaverton, Ore., and member of the X3H3-5 task group, stresses that the application of GKS to hardware should not be done at all. "When you build GKS into a terminal, what you're really doing is providing features in a terminal to work with GKS—and that isn't the same thing as GKS," he says.

According to Straayer, GKS is fundamentally a software standard. More important, he contends, is developing a compatible family of standards covering hardware and software to provide an upward growth path from 2D to 3D to hierarchical systems. "GKS will be a real basis for that family," he asserts. "There is a lot of hardware and software overlap and a real need for compatibility."

Standards bring order to chaos

One of the first companies to develop GKS packages for microcomputers was Graphic Software Systems (GSS) of Wilsonville, Ore. GSS-TOOLKIT Kernel System is a library of functions for microcomputers at the MB level that run under the PC-DOS, MS-DOS and UNIX operating systems. Prices begin at $3,000, not including GSS drivers or royalties, according to a company spokesman.

William B. Merchant, marketing communications manager, says GSS was always motivated by standards. "We figure that standards are the only way to bring order to chaos in the micro-marketplace." The company's future market direction is toward 16- and 32-bit machines as opposed to 8-bit C/PM-based machines, says Merchant. "It appears that PC-DOS, MS-DOS and UNIX operating systems are going to be the operating environments in micros."

Integrated Software Systems Corp. (ISSCO), San Diego, one of the largest suppliers of graphics software in the world, is going with a standard for the first time, according to Joe Rauh, marketing manager in charge of GKS. "We feel GKS is well-defined and could be used as a tool for system integrators," he says.

According to Rauh, the company looked at its base package, called Disspla, for possible conversion to GKS but scrapped the idea because GKS is such a well defined standard. Instead, ISSCO wrote a separate package which strictly conforms to the GKS standard. Rauh reports that the first product, addressing level 1B of the standard, should be available by early 1985. A second package will implement level 2B.

To give some of their Disspla users the segmentation capabilities GKS offers, Rauh adds that the company wrote a second package called Dynamics.

Precision Visuals Inc., Boulder, Colo., also announced a GKS product at SIGGRAPH '84 called GK-2000, a graphics software subroutine library. A basic version of the product which complies with level 0B of the standard was scheduled for the fourth quarter of 1984, according to a company spokesman. An extended version, meeting level 2B specifications, will reportedly be released in the first quarter of 1985.

GK-2000 will be available for a variety of operating environments including Digital Equipment Corp.'s VMS operating system and UNIX. Prices for both versions will vary with the size of the machine and range from $4,500 to $21,000.

Company president James R. Warner believes that no single standard will dominate the graphics industry. "Users will choose on the basis of functionality, the track record of the software and vendor and the requirements of the application under development. Ultimately, any standard is valuable only to the extent that it fulfills a user's needs," he states. □

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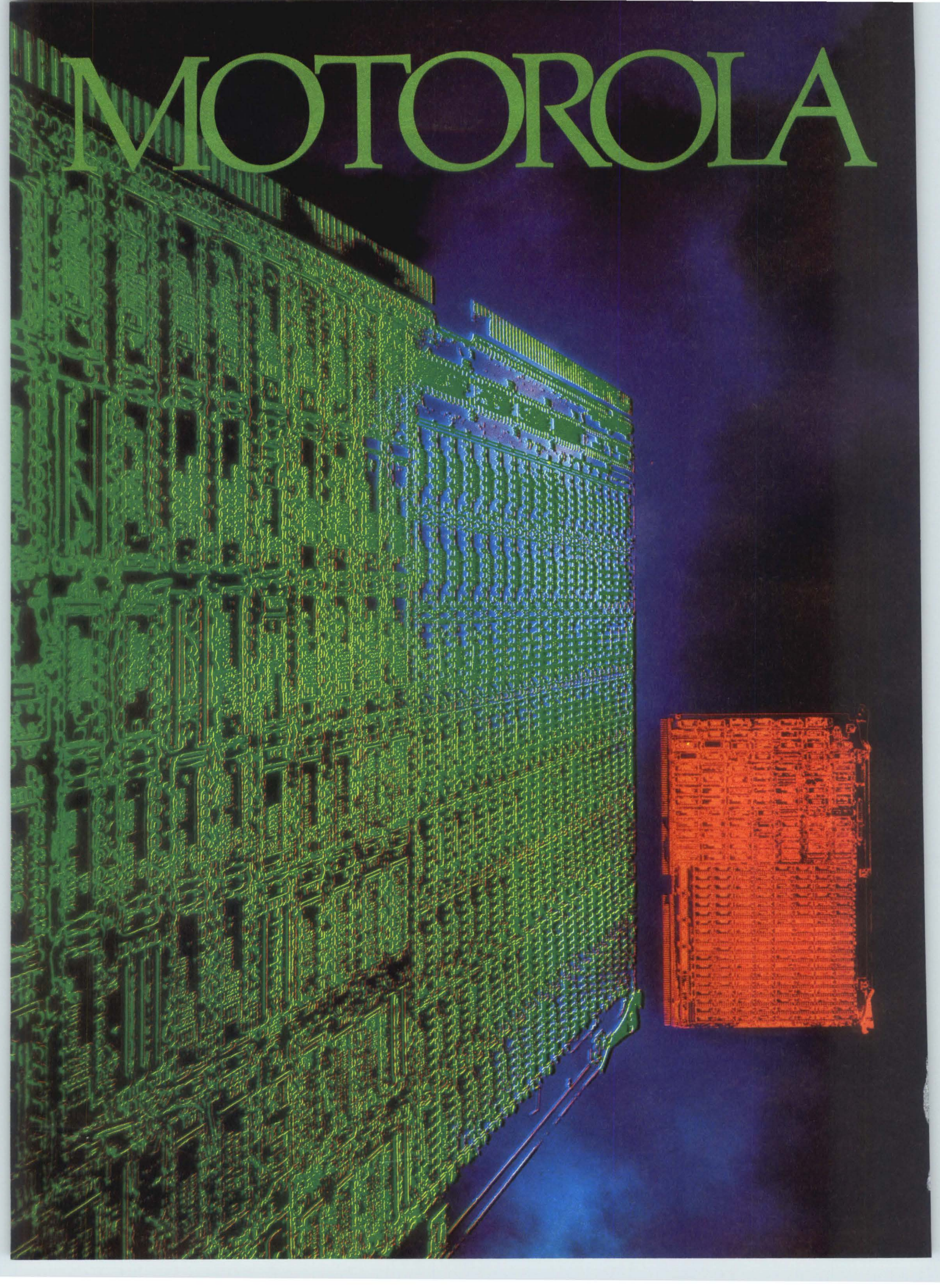
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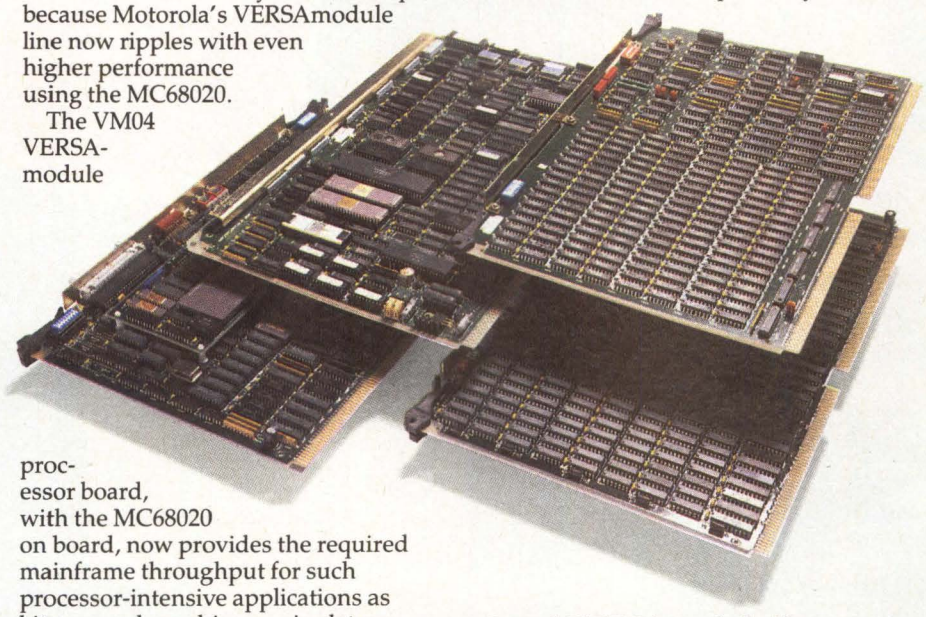

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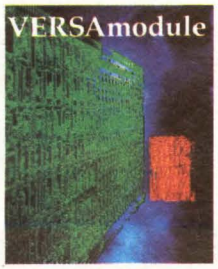

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CONTROL DATA

Automating circuit-card production

Micro-based system provides timely scheduling and accurate job-tracking for circuit-card production facility

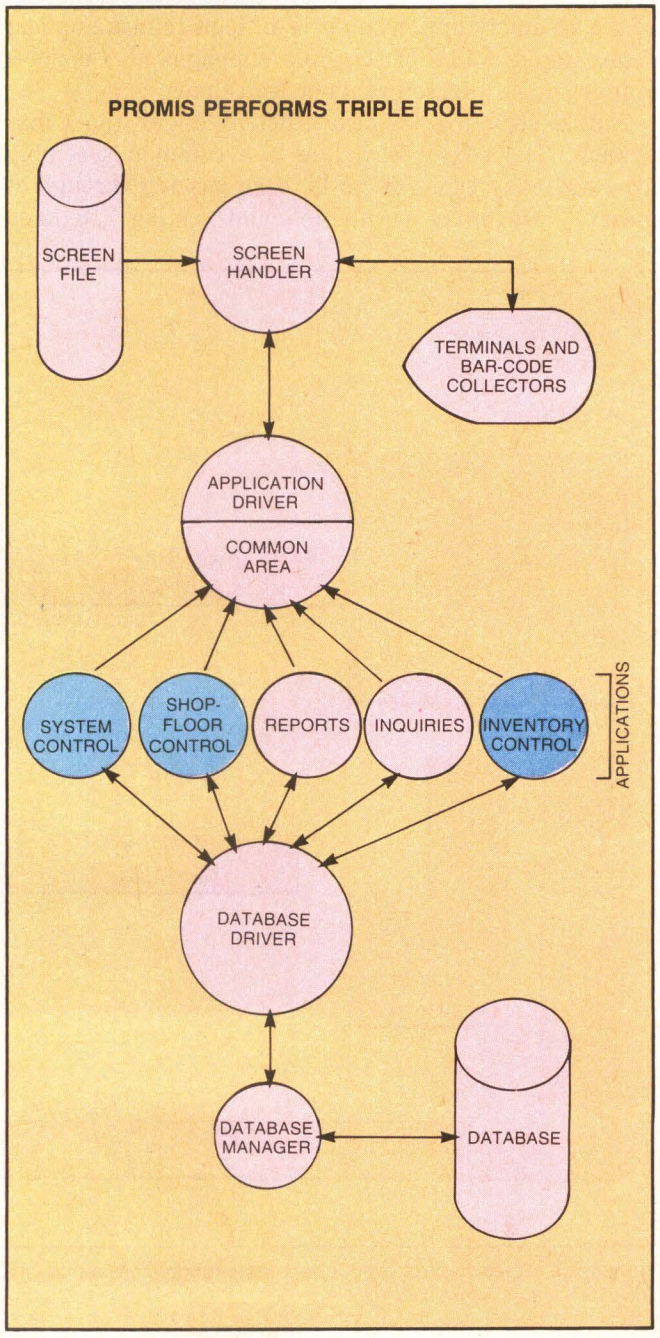
Leonard J. Freestone, Honeywell Inc.

The Test Instruments Division of Honeywell Inc., Denver, produces nearly 1,000 types of circuit cards for use in medical, graphics and tape-recording products. Total output of the manufacturing facility is more than 15,000 cards per month. Scheduling production for such a large variety and volume of circuit cards was difficult when the work was done manually, because production schedulers sometimes lacked accurate reporting information. This in turn caused parts shortages, incorrect allocation of costs, missed due dates for completed jobs and jobs lost on the shop floor.

To solve these problems, Honeywell needed accurate, up-to-the-minute status reporting. Toward that end, the company formed a project team composed of production and engineering personnel to define the requirements of a system to track and control shop-floor activity. Company executives did not want to replace Honeywell's already installed materials-resource-planning (MRP) system, used to plan plant-wide resource requirements, but instead wanted an implementation that could be integrated with the MRP system. They also knew from experience that personal computers cannot track intermediate job steps or provide exact information about when a portion of a job is completed and were thus inadequate.

After the project team defined the system's requirements, Honeywell decided upon an integrated system from Cibar Inc., Colorado Springs, Colo. Honeywell installed the system on its circuit-card line because it is the largest assembly area in the plant and time lost there is the most costly.

Honeywell began defining the scope of the project in



Cibar's ProMIS software for Honeywell's circuit-card production installation *contains three basic modules (blue): system control, shop-floor control and inventory control. System control provides employee timekeeping functions and tracks items through the assembly line. The shop-floor control module then takes over to monitor jobs through assembly and to reroute them if changes are needed. The inventory-control module, not yet fully implemented, will monitor the flow of material from the loading dock to the stockroom. ProMIS is integrated with Honeywell's already installed MRP system.*

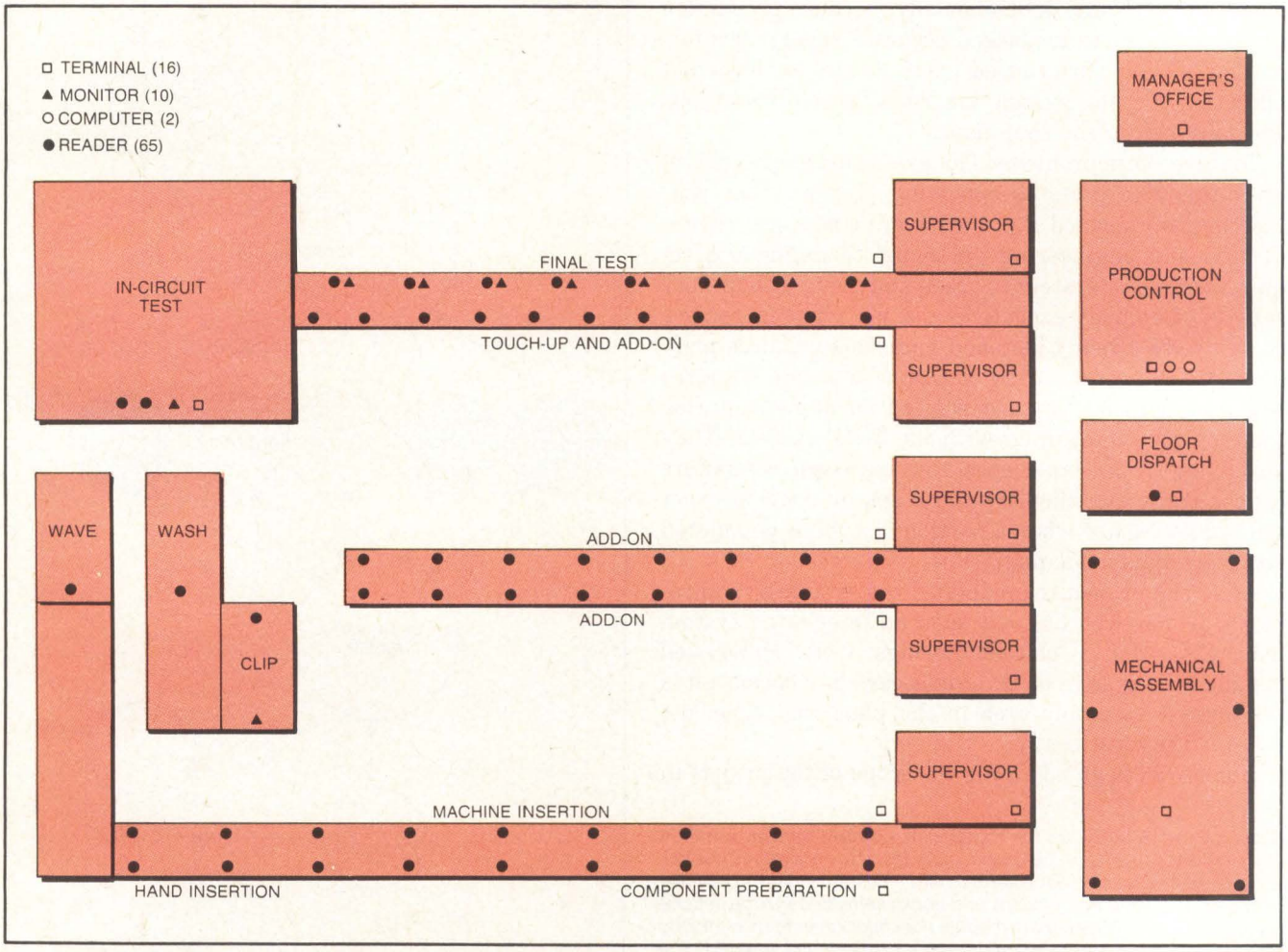
the summer of 1982 and had installed the hardware portion of the system by February 1983. Shortly afterward, Cibar installed the software and began training employees, which typically took less than a day.

The Cibar system gives managers immediate access to accurate real-time data and allows in seconds tracking that once took hours. It records the time spent at each stage of assembly and compares it with standard assembly times, allowing managers to identify and correct schedule slippages. In the past, managers might not notice a slippage until cards reached the end of the assembly line, when it is difficult to make up lost time. Rapid notice of schedule slippages also enables Honeywell to shorten product lead times.

Status reporting is also efficient under the Cibar system. The circuit-card line is a common assembly area for many types of cards, each passing through at least 10 stages of production and testing. To keep customer deliveries on schedule, production schedulers must determine each job's status. Status reporting previously required schedulers to locate a job physically on the shop floor and to estimate how many cards in the job had been through an assembly stage. Cibar's production and manufacturing information system (ProMIS) software tracks jobs through the assembly process by lot or serial number—tasks that production schedulers once did manually. Since beginning to use ProMIS, Honeywell has seen a 20 percent to 30 percent improvement in time savings over the manual method.

Hardware features flexible design

Honeywell's installation consists of the ProMIS software, two Sage IV high-performance microcomputers from Sage Computer Technology (now Stride Micro), Reno, Nev., 16 terminals linked through port concentrators, 10 monitors and 65 satellite stations with Ruby



Honeywell's circuit-card production installation *consists of two MC6800-based Sage IV microcomputers in the production-control office. The use of two processors provides processing speed and redundancy; should one processor fail, the ProMIS software can run on the other one. The installation also includes 16 terminals linked with Ruby Wand bar-code readers.*

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Wand bar-code readers from Interface Mechanisms (Intermec) Inc., Lynnwood, Wash. As many as 10 bar-code readers can be attached to each terminal.

The system developers concluded that the Sage IV was cost-effective, with fast enough processing, sufficient storage capacity and a flexible enough design to run ProMIS effectively. Although the Sage IV's open-system design supports a variety of operating system and language configurations, Cibar chose UCSD Pascal under the p-System because of its structured format and portability.

Each of the dual MC68000-based Sage IVs in the Honeywell implementation has 1M byte of memory, a 5¼-inch Winchester disk drive with 12M bytes of storage and one 640K-byte floppy disk drive. The system developers chose to use two Sage IVs for processing speed and for backup. Should one of the processors fail, ProMIS can run on a single Sage IV. One of six serial ports on each is used as the communications link between processors.

Software modules perform three tasks

ProMIS contains three basic modules: system control, shop-floor control and inventory control. The system-control module contains the basic system utilities for employee timekeeping functions, which are important for the correct allocation of costs. System control updates employee records and the system date and time, records the labor time spent on each task and provides employee attendance information. Honeywell also operates a dual system, using traditional time cards, to back up ProMIS in recording employees' direct and indirect time on each job. The company plans to continue to use both systems until managers and line workers feel comfortable with the automatic system.

In addition to providing employee timekeeping functions, the system-control module tracks items through a series of checkpoints on the assembly line. To set up each job for assembly, operators enter a parts list that corresponds to a work order and then specify a route through the assembly line. Once the route is specified, the Cibar system enforces the sequence of stations. To signal the start of a job, employees scan their own badges and the bar codes on the cards to be worked on. After completing work, they scan a bar code again to signal a job is complete and move the card to its next station. The system has immediate access to the accurate location of each card and the time spent at each stage.

The operator also generates the appropriate number of bar-code labels. The Ruby Wand bar-code readers work much like those in supermarkets, reading labels similar to Universal Product Codes. The readers record material location, job status, operation times and personnel time use. Work orders, employee badges, material containers and menu pads carry bar-code labels corresponding to information entered when a job is released to the shop floor. The system issues labels with a single number code for jobs tracked by lot and labels with sequential numbers for jobs tracked by serial number. Bar-code data collection has proved two to four times faster and much less error-prone than manual data entry by a skilled operator.

Once system control releases a job, the shop-floor module takes over. The shop-floor module monitors the movement of material through assembly, flags all jobs affected by engineering change orders and reroutes them to incorporate the changes. When a circuit card reaches a station, an employee scans its bar code, which makes a message appear on a monitor. If the message says an engineering change order has been issued, the employee transfers the card to the appropriate station for reworking before the card can proceed through production. The shop-floor module also flags failed parts, any repair done on the part and which employee did the repair.

Honeywell has not yet implemented the inventory-control module but will do so when integration with the MRP system is complete in the first quarter of 1985. When implemented, inventory control will monitor the flow of material from the loading dock to the stockroom. The module will also monitor parts receipt, inventory location, job picking and parts disbursement. It will feed information directly to the MRP system from the loading dock, the incoming inspection area and the main stockroom. The inventory-control module will allow users to count inventory using portable bar-code readers in the stockroom rather than manually—a time-consuming, error-prone process. The system will also allow employees to simulate the release of parts associated with different jobs to predict potential parts shortages.

Including bar-code readers and all hardware, the Cibar system cost Honeywell $75,000. The price of the software ranges from $26,000 to $38,000, depending on the amount of customization involved and on whether the inventory module is included. The price includes the license fee, installation and training. □

Leonard J. Freestone is production manager of circuit card assembly at the Test Instruments Division of Honeywell Inc., Denver.

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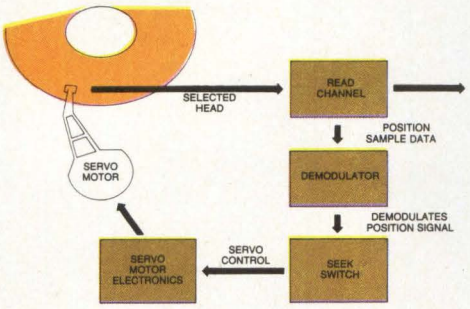
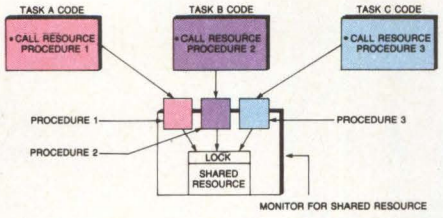
FEATURE HIGHLIGHTS

SPECIAL REPORT: STATE-OF-THE-ART TECHNOLOGY



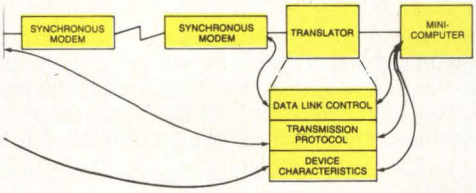
Servo technology boosts capacities

DISK DRIVES: Through use of **embedded servo technology**—fixing positioning information directly on data surfaces—developers can improve disk performance and reduce costs without risking data integrity. See **p. 117**. . .Technological advances in **rigid-disk recording heads** and magnetic media mean more data in smaller spaces and offer system integrators a variety of options. Details appear on **p. 127.**



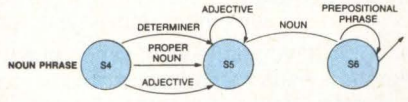
OSs adapt to new application demands

OPERATING SYSTEMS: Operating systems are evolving to meet the demands of local area networks, real-time applications, file-sharing, windowing software and multiuser computer systems. Software engineers are also modifying single-user, multiuser and real-time operating systems to fit an industry-wide push toward de facto standards. See **p. 137.**



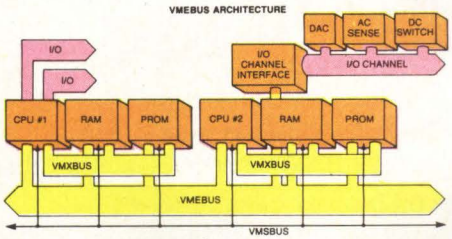
Converters link dissimilar devices

PROTOCOL CONVERTERS: A protocol converter links incompatible pieces of computer equipment and communicates with them in the manner familiar to each. This ability enables a wide variety of equipment to connect to host systems, meeting the increased need for more flexible data communications. For more information, see **p. 147.**



Teaching computers to talk

NATURAL LANGUAGE TRANSLATION: Teaching computers English is difficult, but easier than teaching humans rigid, formal computerese. An explanation of the three-step process—syntax, semantics and pragmatics—begins on **p. 163.**



32-bit bus architectures

32-BIT BUSES: In the second of three articles on microcomputer bus standards, we trace the roots of the four key 32-bit buses—VMEbus, NuBus, Futurebus and Multibus II. See **p. 177.**

Solid-state magnetic-bubble memory from Bubbl-tec®

Mass storage that works where disks don't

Once upon a time, computing was done only in nice, clean places, and a spinning disk could handle the mass storage job quite nicely.

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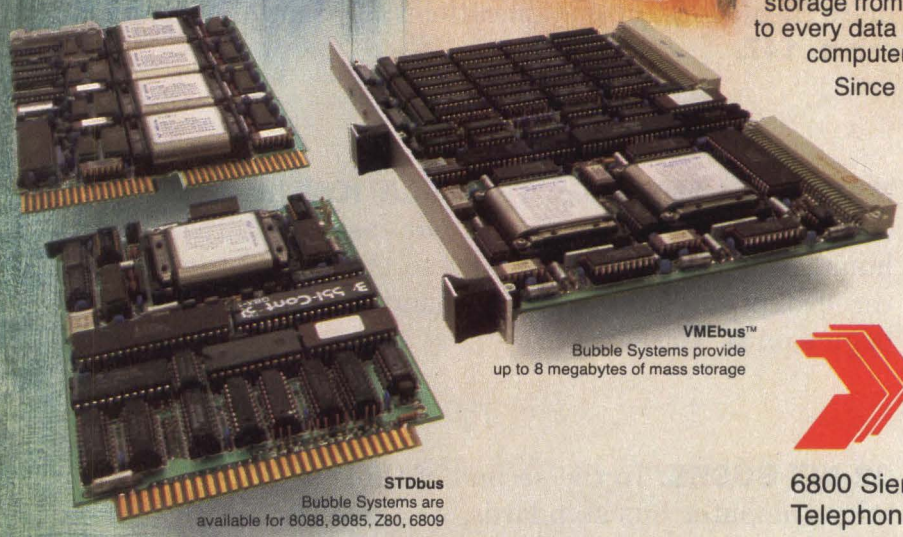

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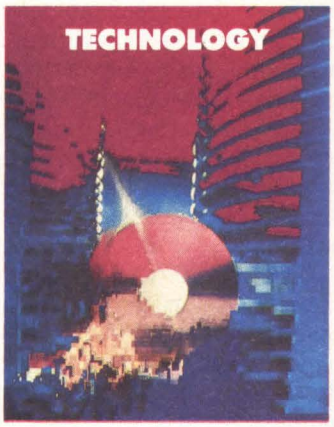


Embedded servo controllers push up disk storage

By fixing positioning information directly on data surfaces, developers can improve disk performance while reducing costs—and without risking data integrity

Ted A. Oliver
Northern Telecom Inc.

The OEM market's insatiable appetite for high-capacity storage devices has led disk-drive manufacturers to attack the problem of achieving higher areal density while maintaining data integrity. The use of embedded servo technology meets these requirements in a manner that is both easy to implement and cost effective.

Traditionally, developers have increased the capacity per unit area on disk surfaces either by increasing track density or by adding to the number of bits per track (flux reversal density).

Increasing bit density, on the one hand, creates a higher bit-read rate that the controller may have difficulty handling. This approach is, therefore, subject to the limitations of existing controllers. If as the rotational speed of the disk is correspondingly decreased to give the controller the same bit-read rate, then latency time increases and performance decreases.

Increasing track density, on the other hand, generally has no adverse impact on performance and isn't hindered by existing controller technology. But increasing track "pitch" (the number of tracks per unit of measurement) is limited by track-following precision considerations and servo-design technology, and assumes head and media availability. Fortunately, increased costs associated with pushing the mechanical integrity of the Head Disk Assembly (HDA) to its limit can be alleviated by refining servo electronics to provide more precise track following.

In embedded servo positioning, position information is pre-recorded directly on *data* surfaces. Using this information for track following results in more tracks per inch (tpi) than can be achieved with an HDA of equivalent mechanical performance, using position information read from a dedicated *reference* surface. Servos employing position information embedded within user data allow greater precision in the positioning of the active head.

In the embedded servo approach, the disk is marked between data tracks at sector intervals with permanent even and odd servo bursts (Fig. 1). These bursts are read and processed by a time-shared data-read channel to provide a sampled-position reference signal. The reference signal is then demodulated and used by the positioning servo system for precise track following on the data surface being read. The active head thus becomes its own track-following device rather than being slaved to a remote positioning system.

Servo has two requirements

Two requirements affect the implemention of embedded servo technology: an efficient coarse actuator positioning system and an easily managed sample position signal.

High actuator speeds during track-seeking preclude using signals from embedded servo information areas for the initial positioning of the head. A coarse actuator positioning system for non-precise positioning of the data head must be provided to cover track-to-track distances. The coarse actuator positioning system resides in the remote servo unit. Coarse positioning does

not depend on the same level of mechanical precision as data track positioning.

Multiple position samples from the embedded servo data are produced upon completion of the coarse positioning process. These samples must be of a form that can be demodulated to a null at the data track center and that are fairly linear with respect to minor off-track motion. In other words, when the actuator is moved slowly across the data tracks, a continuous demodulated linear positioning signal is produced that provides precise track following on the data surface (Fig. 2).

An overhead requirement of five bytes per sector is practical as the portion of data surface allocated for embedded servo information. The amount actually needed depends on the format of the embedded information.

Making embedded servo technology an integral feature of the drive design saves the cost of installing dedicated servo surfaces and heads.

How embedded servos work

Once the coarse actuator position system directs the head to the proper data track, even before the head comes to a complete halt over the disk, embedded servo positioning can begin for track following. Servo data is sequenced with user data and processed through the read channel. The sample bursts from the servo data are combined to form a continuous position signal. During track following, the Seek Switch closes and the demodulated, continuous-position signal reaches the servo electronics. In response to the signal, the servo motor adjusts the positioner in order to maintain the position signal at its null (Fig. 3).

High track density potential is the end product of reducing or overcoming two mechanical difficulties: registration error and track runout. Relative stack tilt, which generally happens when temperature changes or thermal gradients distort the relative parallelism between the disk rotation axis and a line through the data heads, produces registration error. This type of error becomes serious in a system not using em-

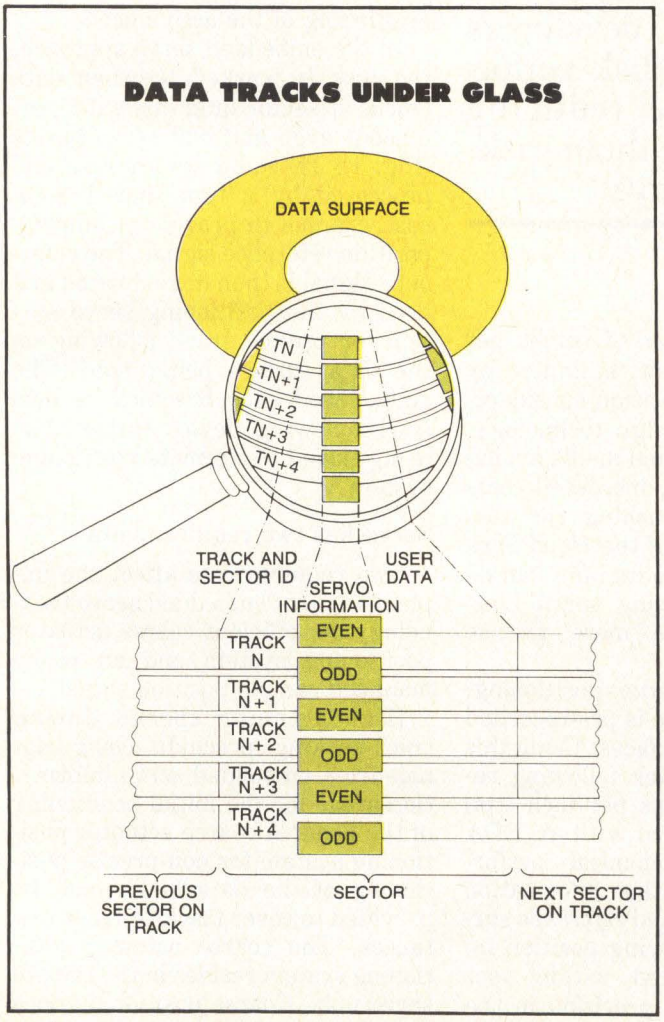


Fig. 1. Embedded servo format *has a positioning data sample associated with each sector on every data surface. The servo information is composed of odd and even servo bursts that are positioned between every track.*

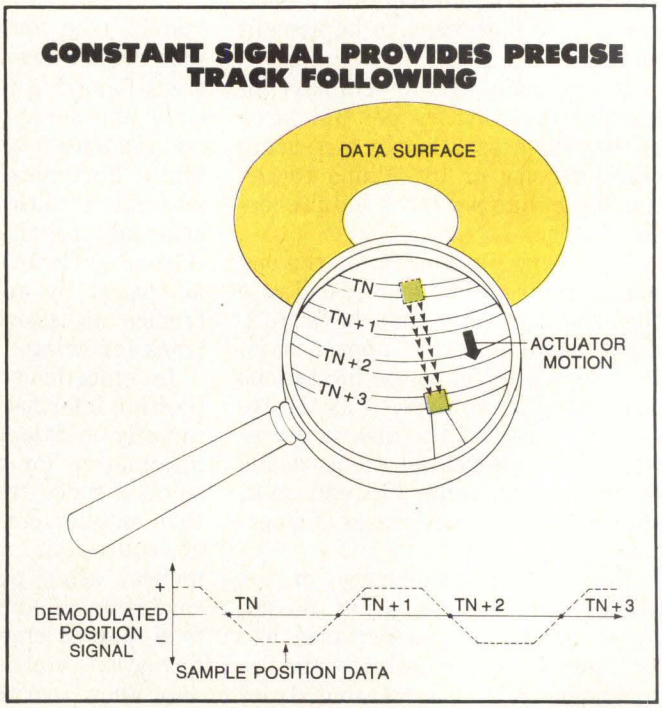


Fig. 2. Embedded servo positioning data *produces a continuous demodulated position signal when the actuator is slowly moved across data tracks. This signal provides precise track following on the data surface associated with the active head.*

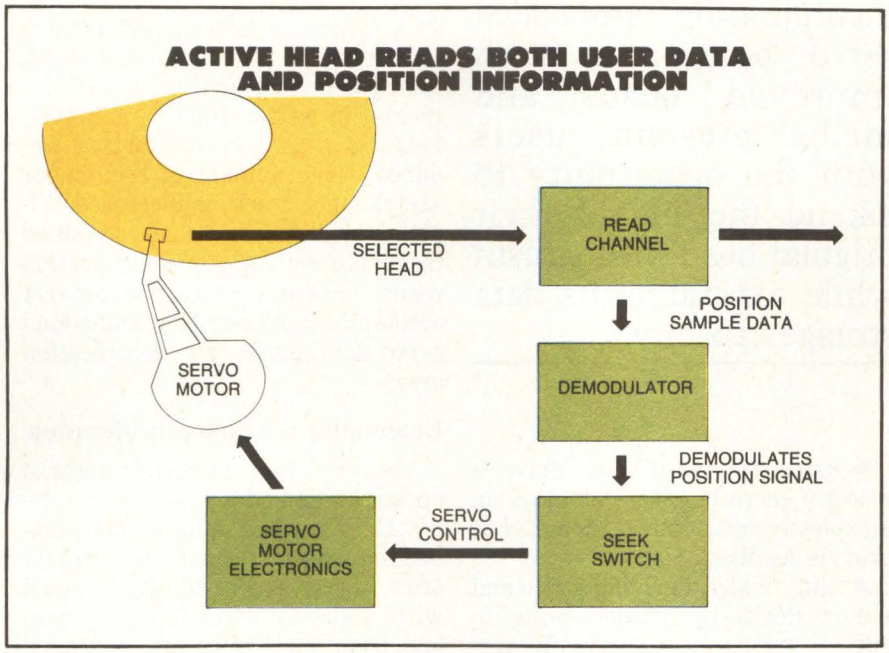


Fig. 3. The embedded servo system *reads both the embedded servo information and the user data in serial fashion. The read channel electronics multiplex this data into demodulated positioning signals that the servo motor electronics use to position the head on the prescribed data track centerline.*

bedded servos, as the data tracks are no longer at precisely the same position as determined by the dedicated reference surface (Fig. 4). The problem might also appear should the HDA be moved or shocked during operation. Track runout, which means the data track on a particular surface is no longer centered relative to the axis of rotation, is usually caused by limited bearing tolerances or stack shift (Fig. 5).

Embedded servo track following, however, prevents the active data

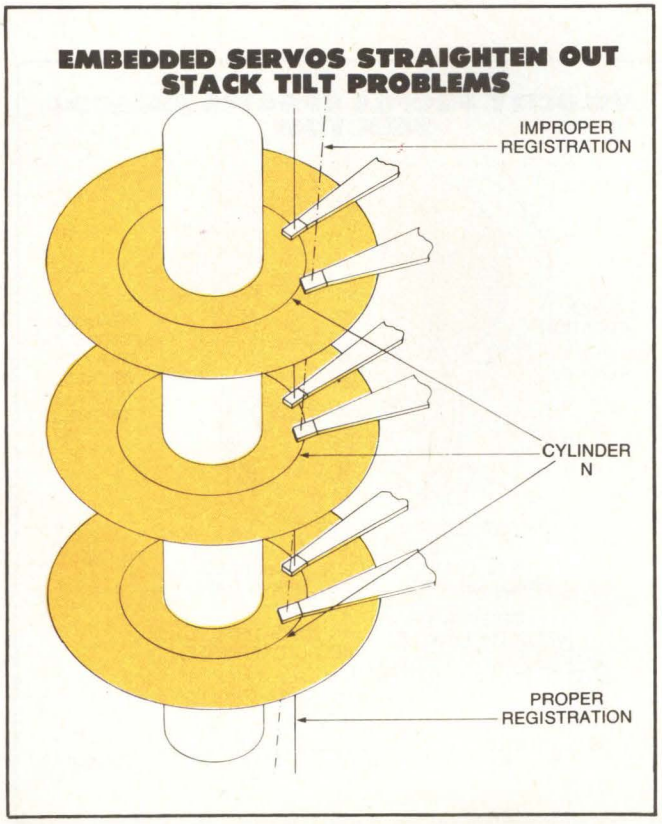
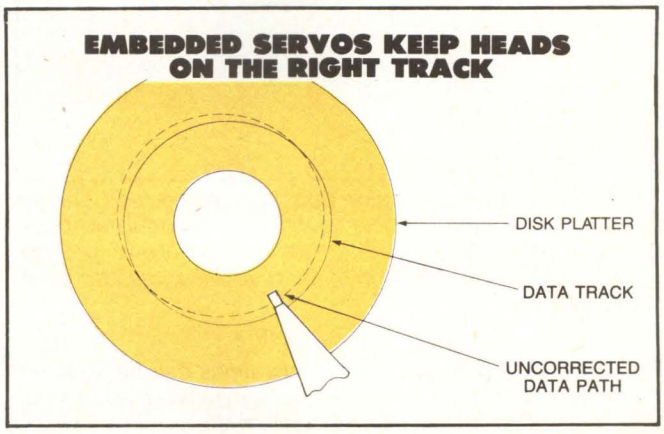


Fig. 4. Improper registration *is generally a product of relative stack tilt. Thermal gradients or a shock to the HDA can cause the disk system cylinder to tilt minutely off its axis and alter the position of data tracks. Embedded servo track following prevents the head from being off-track due to improper registration because it determines its position from reference marks on the data surfaces themselves.*

Fig. 5. Track runout *occurs when the active head is incapable of remaining on a data path of an individual platter because of limited bearing tolerances or stack shift. Embedded servos minimize the problem by providing the head with a means of constantly checking its position relative to the track.*



head from being off-track due to improper registration, and greatly reduces track runout (Fig. 6). Moreover, "head off-track" indication, available from demodulation of embedded servo data, can be used to ensure that the head is settled prior to writing data. This indication can prevent inadvertent off-track writing if the HDA is moved. The only penalty is a requirement for head-switch settling time, which is proportional to the registration error.

Embedded servos simplify design

Embedded servo data suggests a design simplification that results in a reduction of parts and costs, but with an increase in data capacity and integrity. It is possible to use a lower cost, electronic coarse positioning method during the seek operation, because accuracy is provided by the embedded data for track following. Such a coarse positioning method is provided by:

- reading track identification, while seeking and updating a default-velocity profile, whenever reading is successful (Fig. 7)

Incorporating embedded servo positioning with improved heads and media presents users with the opportunity to extend the life of their original head mechanism while expanding its data storage capacity.

- using this profile to drive a velocity servo loop that employs an inexpensive magnetic tachometer to provide feedback
- and, finally, deriving write and sector clocks by phase-locking to pulses, indicating a successful sector identification.

This method of coarse positioning, as employed in the Mercury disk drives from Northern Telecom Inc., Memory Systems Division, Ann Arbor, Mich., allows removal of a dedicated servo surface and servo head with the associated electronics. Although settling after each seek may be slightly longer with this positioning option, actual increase in settle time is minimal. Settling time can be further reduced if the number of sectors, or samples per track, is increased. Finally, a valid sector clock, obtained from successful sector identification reads, provides protection against accidentally overwriting embedded servo data and sector identification areas.

Economics a major consideration

There are economic advantages to opting for embedded servo technology. Data storage units without embedded servos, for example, cannot offer higher track density coupled with improved data integrity, unless their mechanics are upgraded by refining system components—i.e., improved bearing tolerances. Higher costs are inevitable when improving registration and minimizing runout.

In addition, embedded servo technology offers considerable cost savings when mechanical constraints

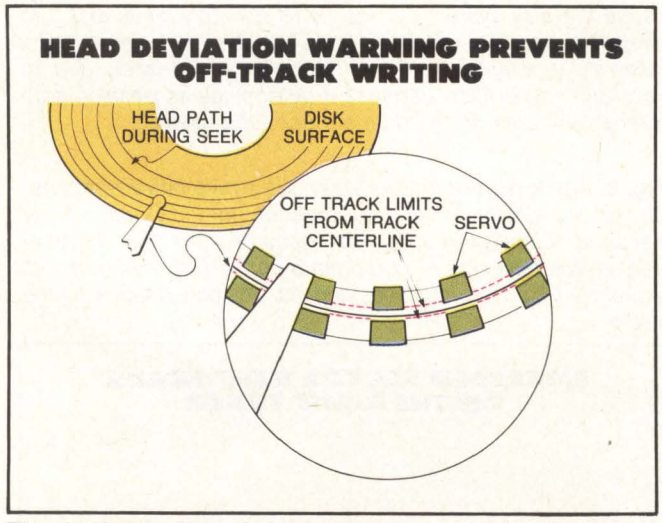


Fig. 6. Head off-track indication *from embedded servos prevents writing off-track. The continuous demodulated position signal from the embedded servo data allows precise measurement of the deviation of the read/write head from the track centerline.*

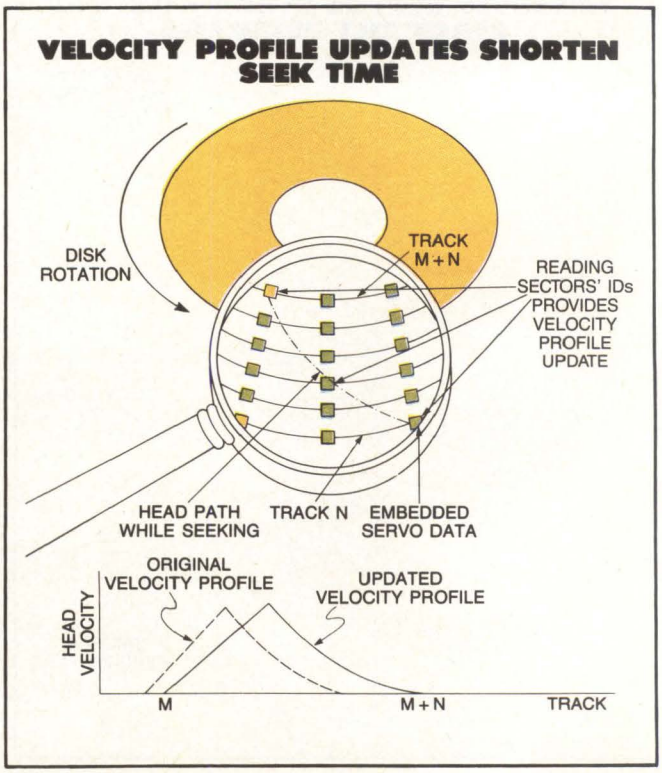
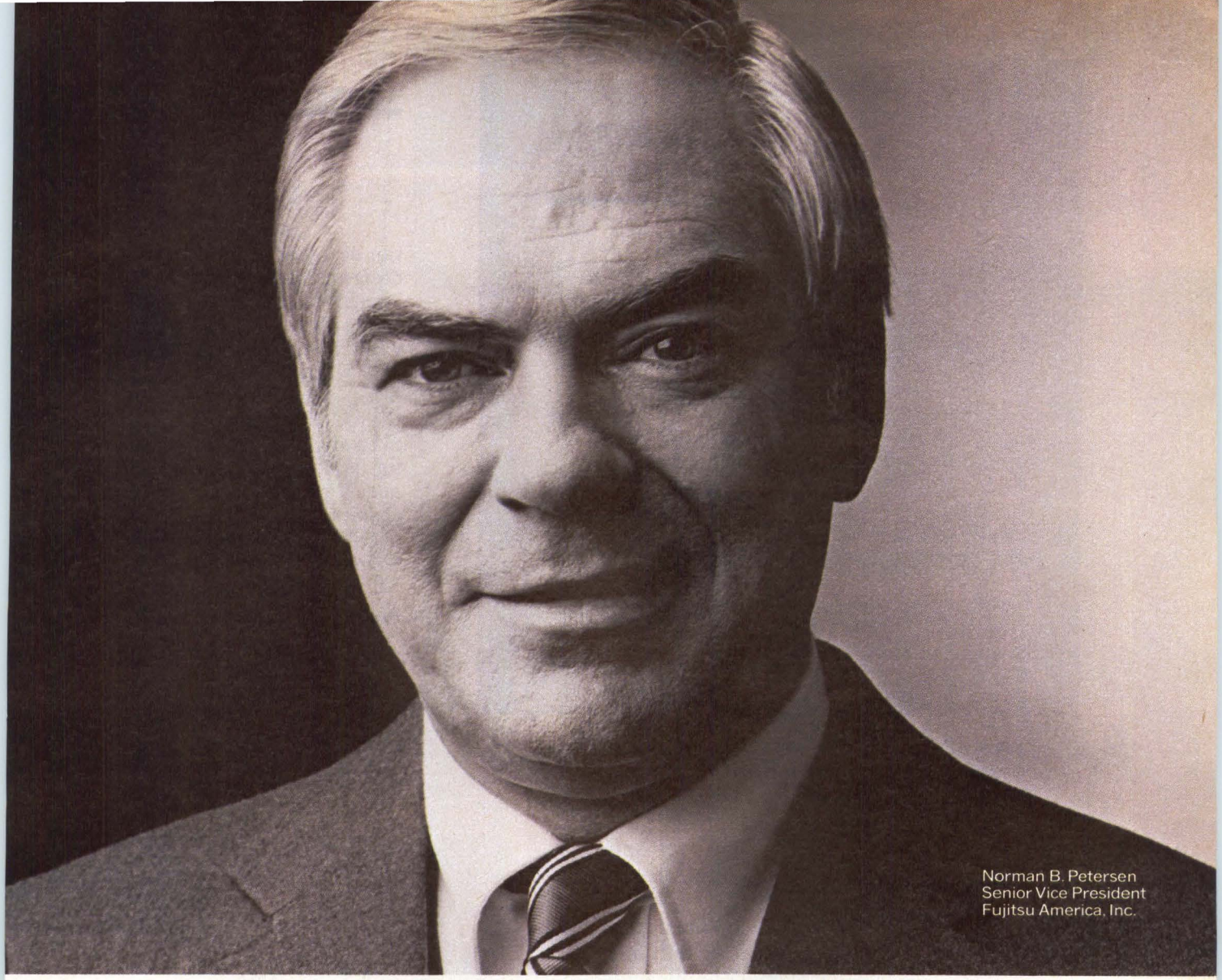


Fig. 7. Velocity profiles *of seek operations can be updated by embedded servo information. This minimizes seek time, cuts cost and simplifies the disk system design.*



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MODEL	TAPE SPEED		DATA TRANS. RATE (KB/sec.)		RECORD. METHOD	RECORD DENSITY (bpi)
	STREAM. (ips)	STRT./STP. (ips)	STREAM.	STRT./STP.		
M2442	100	12.5	625 (GCR) 160 (PE)	78 (GCR) 20 (PE)	GCR/PE	6250/ 1600
M2444	75	25	468 (GCR) 120 (PE)	156 (GCR) 40 (PE)	GCR/PE	6250/ 1600

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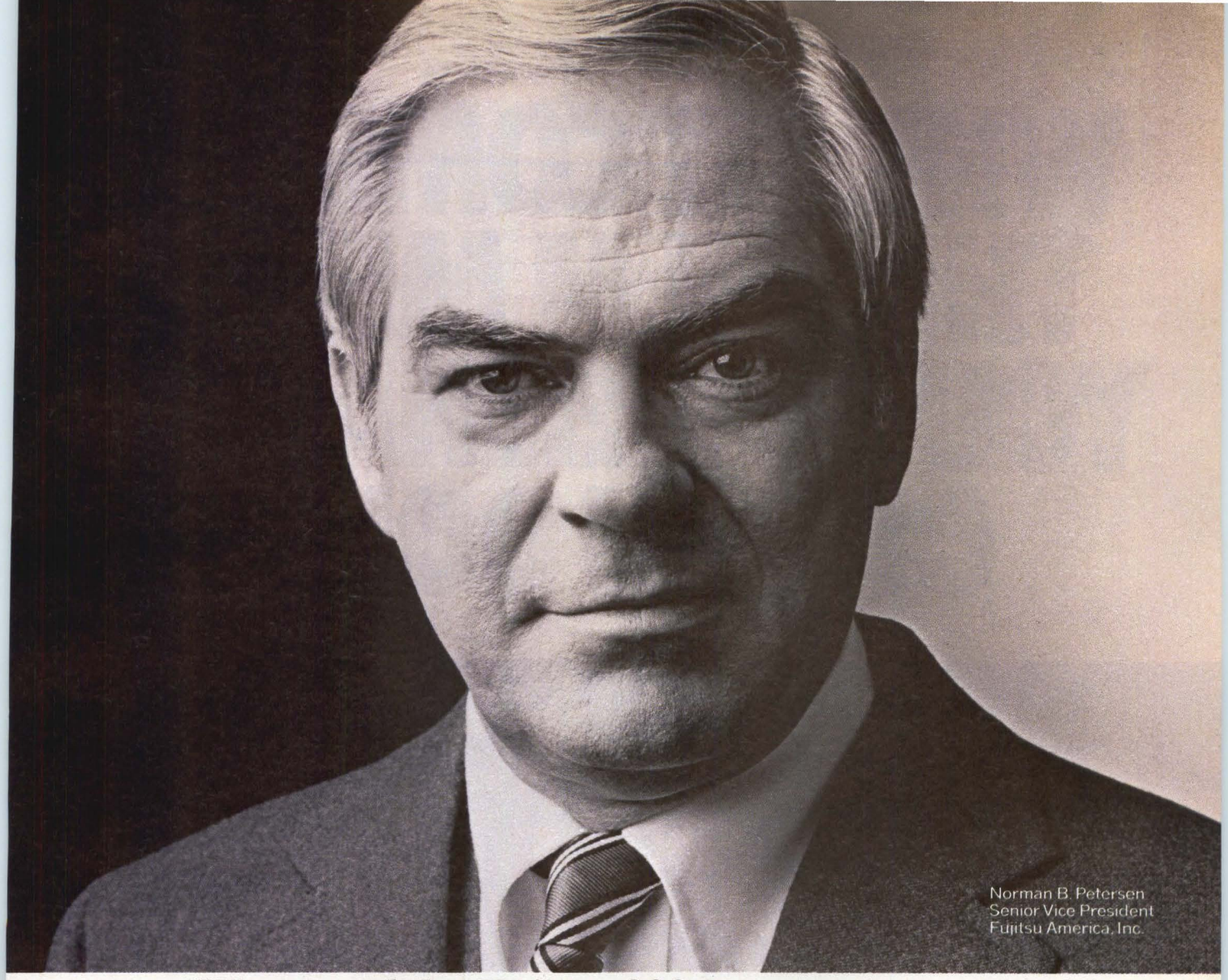
can be relaxed so that a new HDA design is unnecessary for improved capacity and integrity. By incorporating embedded servo positioning with improved heads and media, but still retaining their existing HDA, drive manufacturers may extend the life of their original head mechanism and, at the same time, expand its data storage capacity. The demand for new and expensive mechanical parts declines, or disappears, because embedded servo technology does not require the high mechanical precision of other approaches to the problem. Furthermore, making embedded servo technology an integral feature of the drive design saves the cost of installing dedicated servo surfaces and servo heads.

These sorts of economic considerations are particularly relevant to system integrators when they assess new design efforts and development investments, as well as when they evaluate the advantages of electronic design continuity versus the physical limitations of maximum mechanical design.

Existing disk storage units may provide acceptable data storage for current applications. However, embedded servo technology provides a competitive solution to future demands for maximum storage capacity and performance. □

Ted Oliver is the director of technology, Memory Systems Division, Northern Telecom Inc., Ann Arbor, Mich. He has spent 11 years developing magnetic recording products and holds several patents in the field. Mr. Oliver earned a M.S. in engineering mechanics from the University of Michigan.

Interest Quotient (Circle One)
High 810 Medium 811 Low 812



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The M2436 also offers you a host of big-system features for a not-so-big price. Like a data transfer rate of 1.25 megabytes per second. Auto tape loading. Micro-programmed self-diagnostics. Option of standalone or rack mounting. Plus an STC-compatible interface.

MODEL	TAPE SPEED	RECORD. METHOD (bpi)	DATA TRANS. (kb/sec)	WRITE ACCESS (ms)
2436	200 ips	GCR/PE 6250/1600	1250 (GCR) 320 (PE)	1.6 (GCR) 1.9 (PE)

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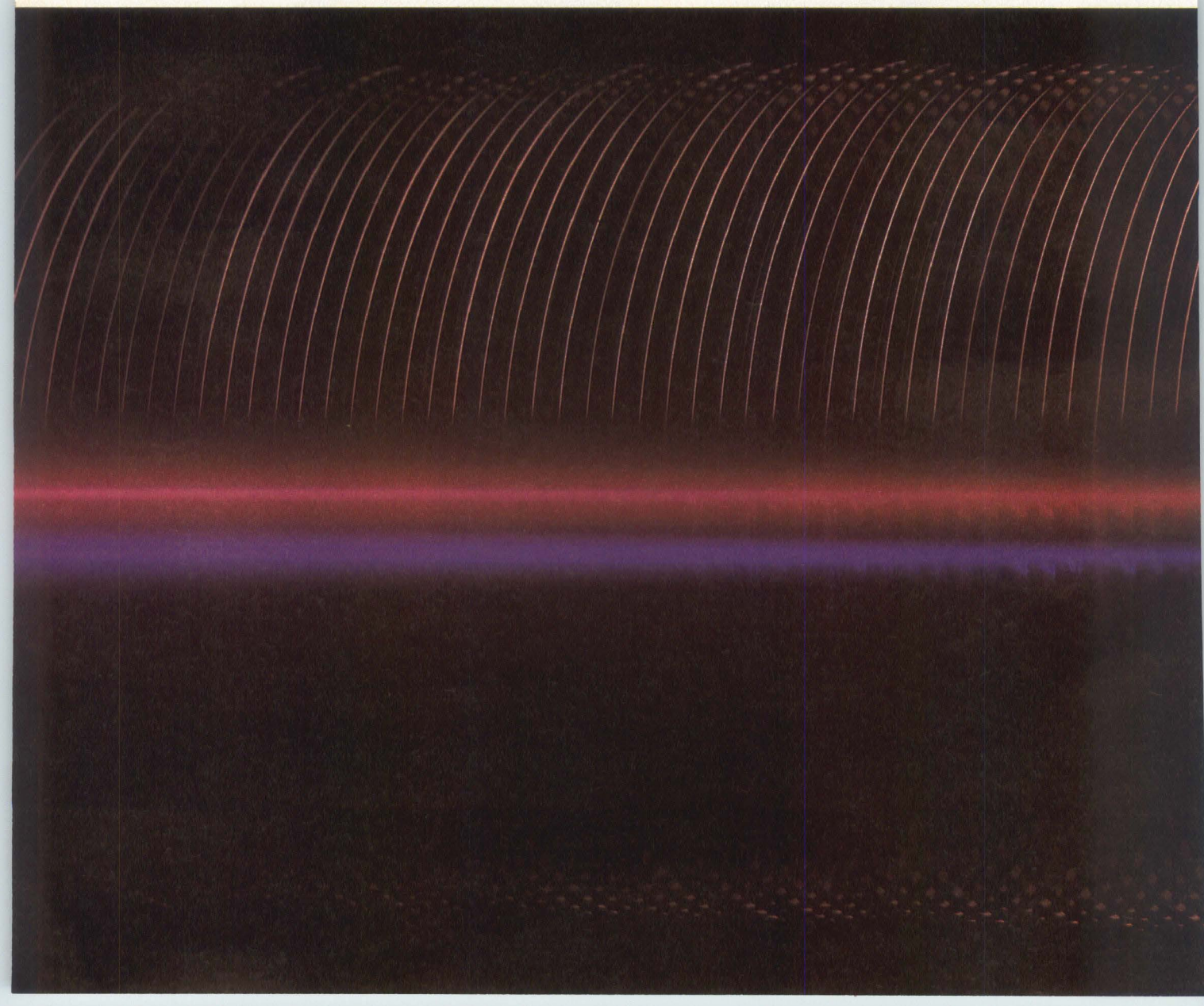

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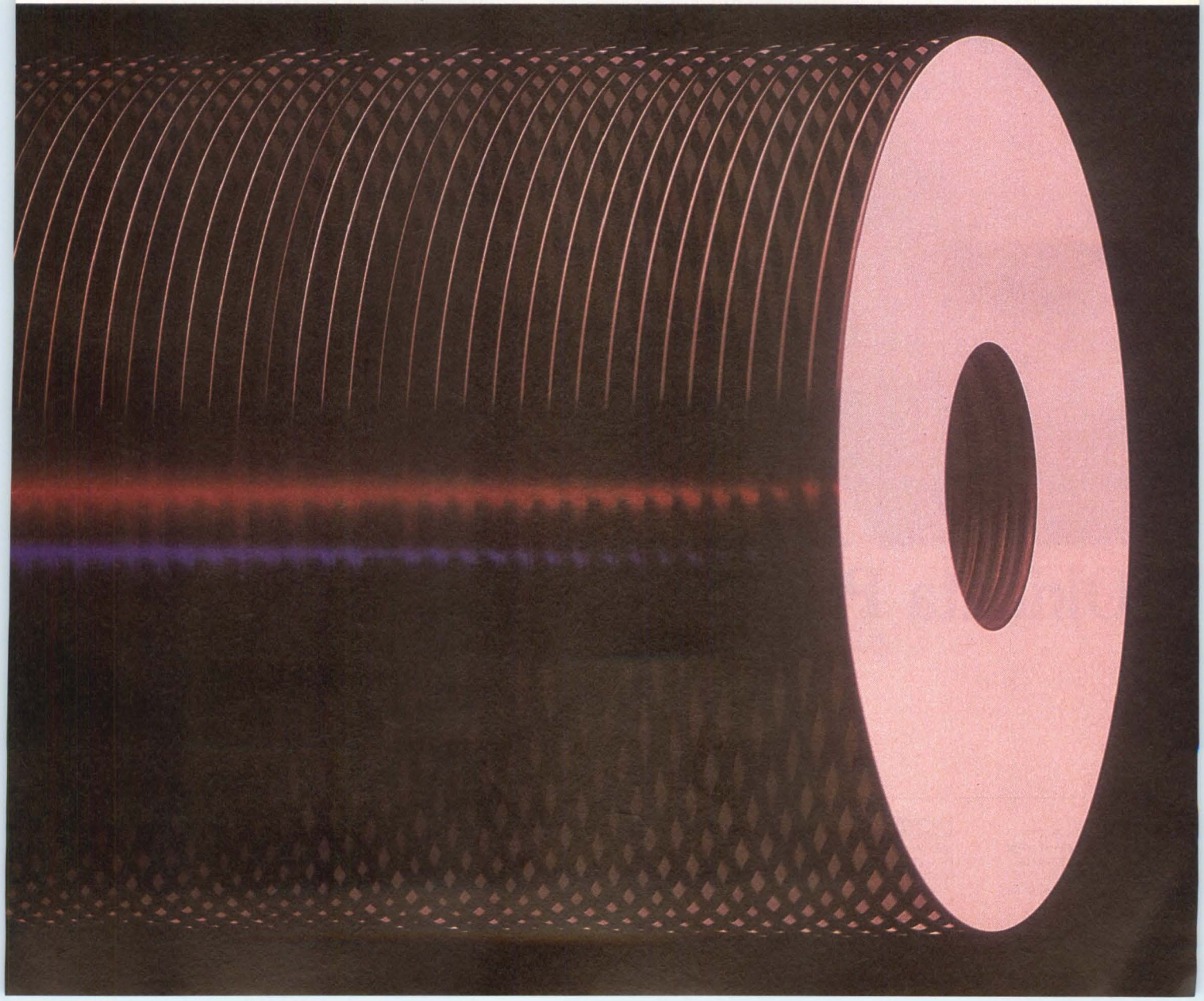

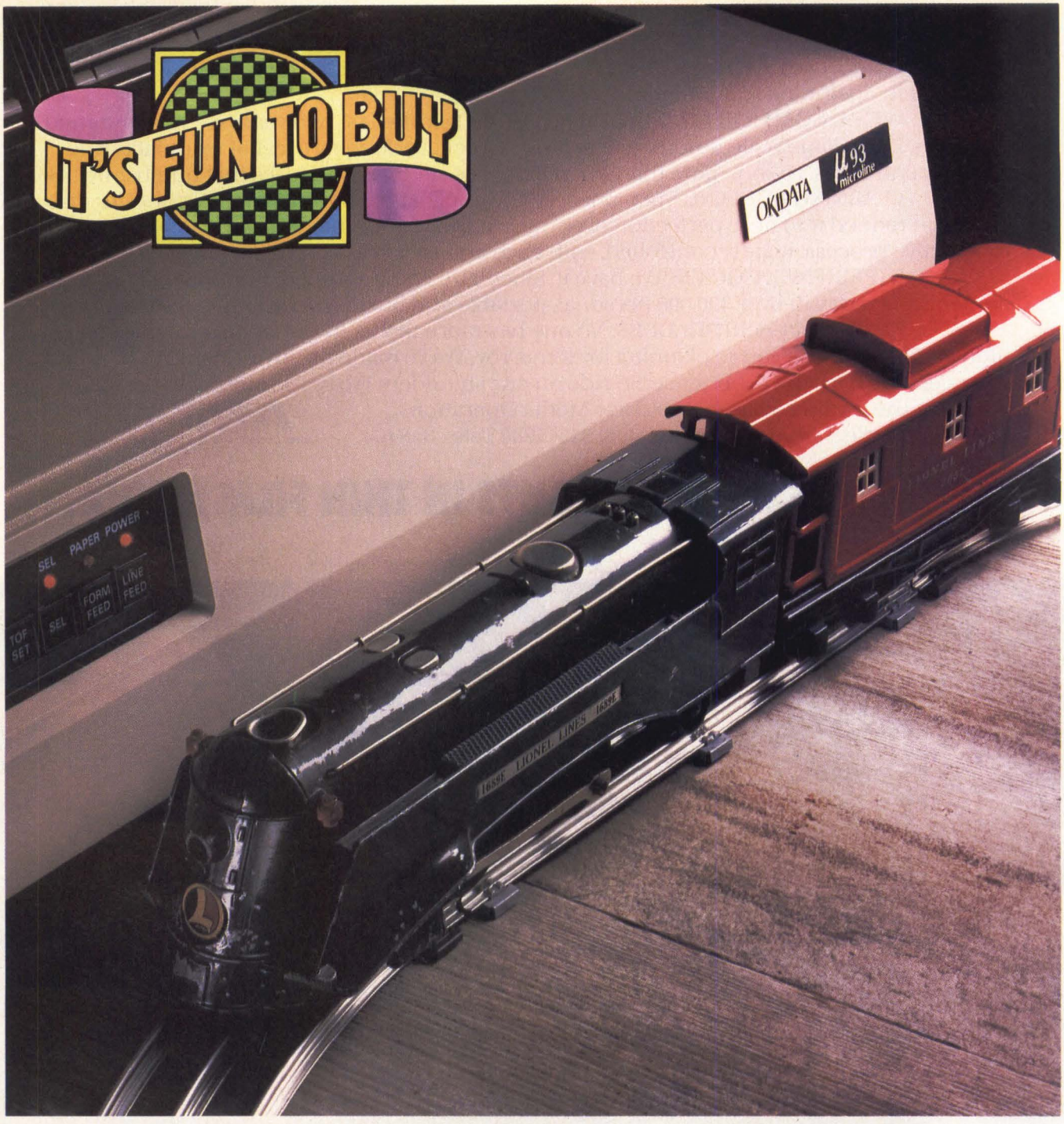

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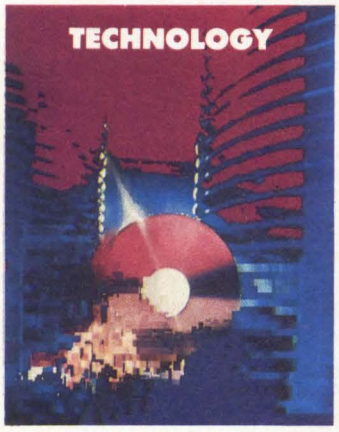


Rigid disk heads keep pace with growing storage needs

Don Collier, Paul D. Frank and **Chris J. Aho**
Applied Magnetics Corp.

The surge of computers into personal and business applications is in part due to quantum leaps in data storage technology. Rigid disk drives continue to pack more data in smaller spaces via increased recording densities, which have doubled every 2½ years since the late 1950s.

Technological advances in recording heads and magnetic media are extending capacities and offering OEMs and system integrators a variety of storage options

The interaction between recording heads and the media upon which data is written is "where the tire meets the road" in the storage-technology race.

Areal densities increase

The size of magnetic recording heads has been steadily shrinking as the result of efforts to increase recording densities. As the recording gaps in these heads shrink, the heads must fly closer to the disk surface. The closely spaced tracks in

IBM SPURS AREAL DENSITY INCREASES

IBM model	First shipment	BPI	Density TPI	BPSI (000)	Megabytes per spindle
350	1957	105	20	2	4.4
1311	1963	1,025	50	51	2.7
2311	1965	1,100	100	110	7.3
2314	1966	2,200	100	220	29
3330-1	1971	4,040	192	780	100
3330-11	1974	4,040	370	1,500	200
3340	1973	5,636	300	1,700	70
3350	1976	6,425	478	3,100	317
3370	1979	12,134	635	7,700	571
3375	1981	12,134	800	9,700	820
3380	1981	15,240	800	12,200	1,260
3380DD?	1985E	20,000?	1220?	24,400	2,520

BPI = bits per inch TPI = tracks per inch BPSI = bits per square inch

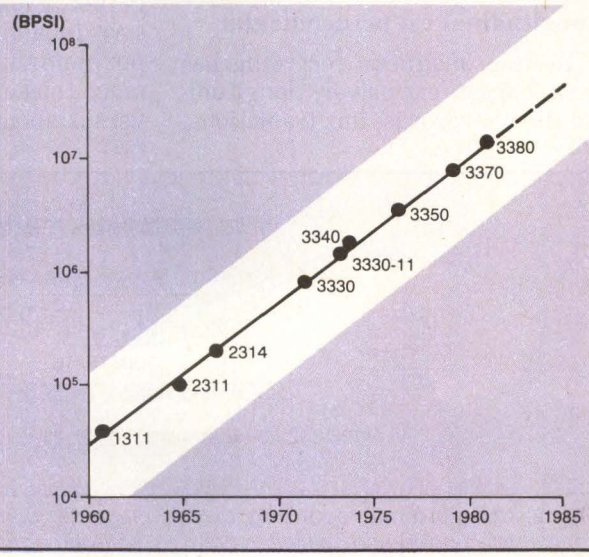


Fig. 1. Areal densities, *expressed in bits per square inch, have increased 6,000-fold over the last 28 years. IBM has led the technological advance, and the company's next move is expected to be a higher-density version of the model 3380.*

turn, require more precise head positioning.

IBM Corp. leads the way in developing recording advances that allow areal density increases (Fig. 1). The progression of key disk drives began with the IBM model 350 in 1957, recording at 2,100 bits per square inch (bpsi), and developed into today's model 3380, which records at 12.2 million bpsi—an improvement of almost 6,000-fold. In 1957, 4.4M bytes of data required fifty 24-inch disks; today, eight 14-inch disks can store 1,260M bytes. IBM's next move, expected any time, will probably be a version of the 3380 that stores one and a half to two times its data.

To produce these areal densities, two primary specifications—bits-per-inch (bpi) and tracks-per-inch (tpi)—have steadily increased. Linear density went from 105 bpi in the model 350 to 15,240 bpi in the 3380, while track densities went from 20 tpi to 800 tpi. To achieve these densities, recording-head gaps dropped from 1,000 microinches to 25 microinches, and flying heights—the distance between the head and the media surface—plunged from 800 microinches to 12 microinches. Manufacturers employed servo head positioners to locate the ever-closer tracks. Meanwhile, some companies began experimenting with new recording methods and media.

Longitudinal vs. perpendicular

To date, magnetic recording has been almost exclusively longitudinal. In other words, flux transitions, or "bits", are oriented in the same plane as the disk medium. Because these transitions, or domains, lie end-to-end, they tend to demagnetize one another, particularly at high densities.

Using thin-film media minimizes the demagnetization effect, but the ultimate solution appears to be perpendicular recording. This technique orients flux transitions at right angles to the media plane. Perpendicular recording reduces self-demagnetization effects at high densities because adjacent transitions no longer oppose each other (Fig. 2).

Stacking transitions on end permits the packing of bits closer together, greatly increasing bit densities. In addition, media coatings for perpendicular recording can be much thicker—up to 40 microinches versus about 2 microinches for longitudinal—and thus should be easier to produce with fewer defects.

As in all magnetic recording techniques, the head/media interface is particularly important. Currently, there are two types of perpendicular head/media schemes on the horizon. The first is a single-layer perpendicular disk media combined with a relatively standard "ring-style" head. These heads are available in quantity, and, once the required media is available, perpendicular recording could quickly gain market acceptance. The single-layer approach will probably yield linear densities in the 18,000 to 30,000-bpi range.

The second head/media strategy will probably pair double-layer perpendicular media with single-pole, or "probe", heads. The second media layer constitutes part of the flux-return path. This is a laborato-

New codes squeeze more into less

One way to pack more data on a disk is to maximize the number of data bits that can be represented by a series of flux transitions. Until recently, disks were coded with one data bit per flux-change for "worst-case" data patterns. Newer codes, such as the (2,7)-run length limited (RLL) code, yield more data bits per flux change.

The (2,7)-RLL code allows three bits of information to be stored for every two flux changes magnetically recorded on the disk. This is done by converting data bits to code bits to actual flux transitions on the media. This intermediate code bit step creates a pattern of 1's and 0's whereby if only the 1's are recorded as flux transitions and the O's left as absences of transitions, at worst-case, only every third code bit results in a flux transition. The (2,7) designation means that at least two and at most seven O's can occur between any two 1's in the code bit pattern. The (2,7)-RLL code yields a 50 percent increase in linear density without the need to increase the flux-changes-per-inch density on the disk.

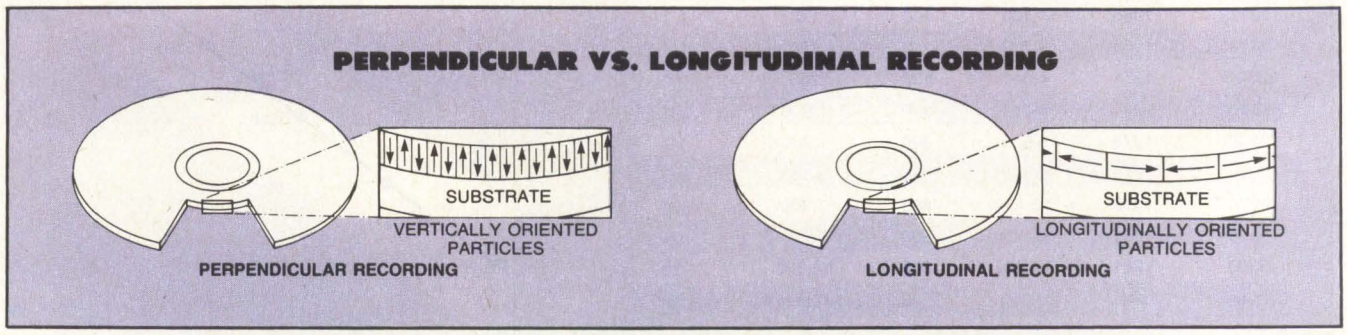


Fig. 2. Longitudinal recording *places magnetic domains horizontally end-to-end, which increases self-demagnetization effects when like poles are adjacent to one another. Self-demagnetization limits recording density. Perpendicular recording orients magnetic domains at right angles to the media plane to increase recording density. With perpendicular recording, flux lines of neighboring domains reinforce one another, thus reducing self-demagnetization.*

ry technology today, but research indicates the possibility of 50,000- to 75,000-bpi densities.

Competition between longitudinal and perpendicular recording continues, with longitudinal proponents using high-coercivity oxide coating and thin-film metallic layers to stay competitive (Fig. 3). Drive manufacturers will have a range of choices, dependent upon price/performance criteria.

Heads divided into five categories

When IBM rolled out their model 3340 disk drive, they employed what is referred to as "Winchester" head technology. Sealing the head and media in a clean "bubble" resulted in higher densities and greater reliability. Winchester technology still prevails, with a number of variations making up five distinct head types, each with its own application spectrum (Fig. 4).

Fig. 4. Five types of rigid-disk heads exist. *Full-size monolithic heads (a) employ an all-ferrite construction and are used with disks that have track densities of 1,000 tracks per inch (tpi) or less. Mini-monolithic heads (b) are two-thirds the size of full-size monolithic heads to reduce mass and decrease flying height. Full-size composite heads (c) are designed for drives using as many as 1,500 tpi. They use a combination of ferrite cores and ceramic sliders. Mini-composite heads (d) are low-mass versions of full-size composite heads. Thin-film heads (e) address the needs of the next generation of disk drives, which require more than 1,500 tpi and 15,000 bits per inch.*

Full-size, monolithic heads were used as the original Winchester heads. The slider (main body) and core (magnetic element) are ferrite. These heads are used in drives with disks from 3½-inch to 14-inch diameters and are limited to about 1,000-

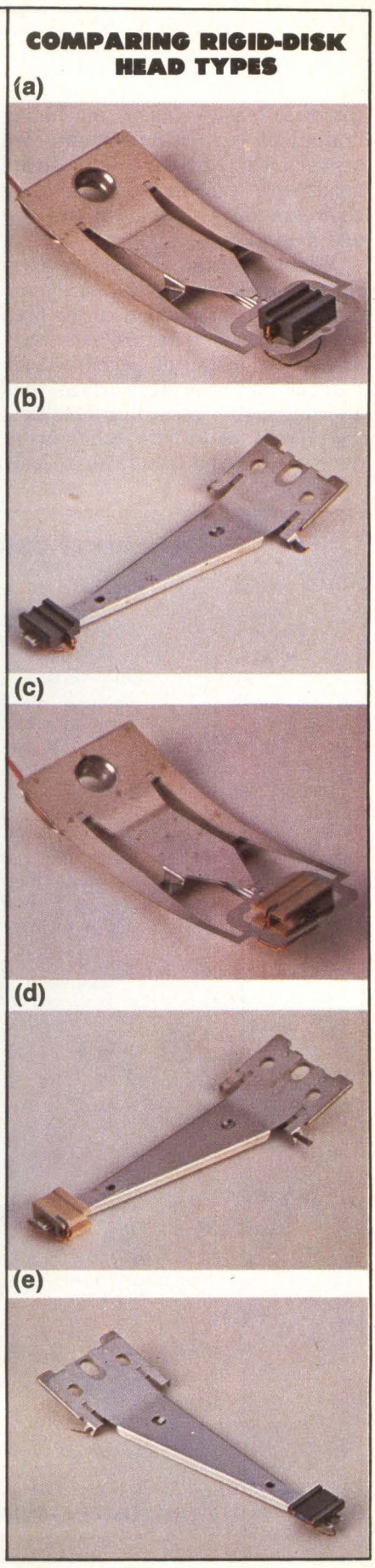
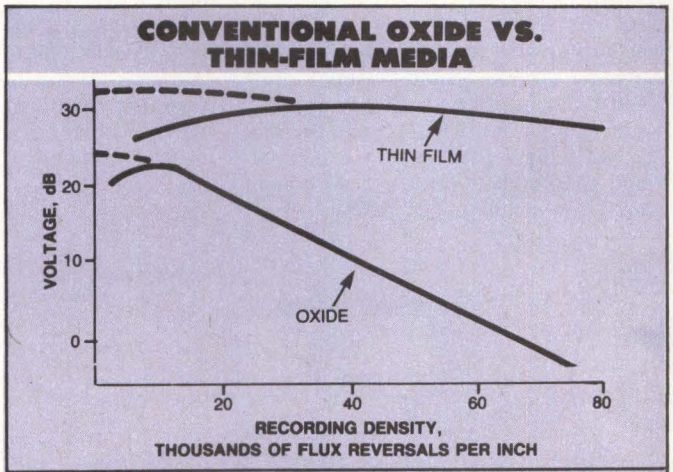


Fig. 3. Thin-film media *improves recording density over conventional ferric oxide media (right). Thin-film media also exhibits superior signal-to-noise ratios (SNR) as density increases (bottom).*



	MEDIA TYPE Conventional oxide	Thin-film	Advantage of thin-film
RECORDING			
Maximum bit density (kbpi)	10-15	>15	improved density
Resolution (%)	<65	>75	improved signal-to-noise ratio
MAGNETIC			
Coercivity (oersteds)	300-600*	600-1,200	higher amplitude
Film thickness (μin.)	20-40	2-5	higher density
PHYSICAL			
Flying height (μin.)	>12	<12	higher amplitude
Surface smoothness (μin.)	1-2	<0.5	lower flying height
Surface hardness	medium	high	fewer head crashes

*Using high-coercivity particulates

tpi track densities due to machining limitations on unsupported core structures. Full-size monolithic heads are the most inexpensive choice because of widespread use and multiple sourcing.

Mini-monolithic heads are two-thirds the footprint of full-size monolithic heads and are mounted on a highly responsive flexure mounting. The special mounting permits heads to fly closer to the disk surface, thus allowing higher recording densities.

Full-size composite heads were developed in the late 1970s to permit higher track densities and improved contamination resistance. These heads include a ferrite core that is encased in glass and ceramic. The core has vertical track walls, which reduces flux side-fringing, producing a head capable of handling as many as 1,500 tpi. Removable-cartridge disk drives often employ full-size composite heads.

Mini-composite heads are mounted in the same type of flexure mounting as mini-monolithic heads to permit closer head/media spacing. The core, normally centered on the back of the slider, is mounted in the back of an air-bearing rail, permitting more efficient disk surface utilization. This combination of advantages has made mini-composite heads a popular alternative for performance and capacity-intensive drive applications.

Thin-film heads can handle track densities to 2,000 tpi while allowing higher recording frequencies. IBM first used thin-film heads in the 3370, 3375 and 3380 drives. Only a handful of vendors supply these heads, usually for large-size drives.

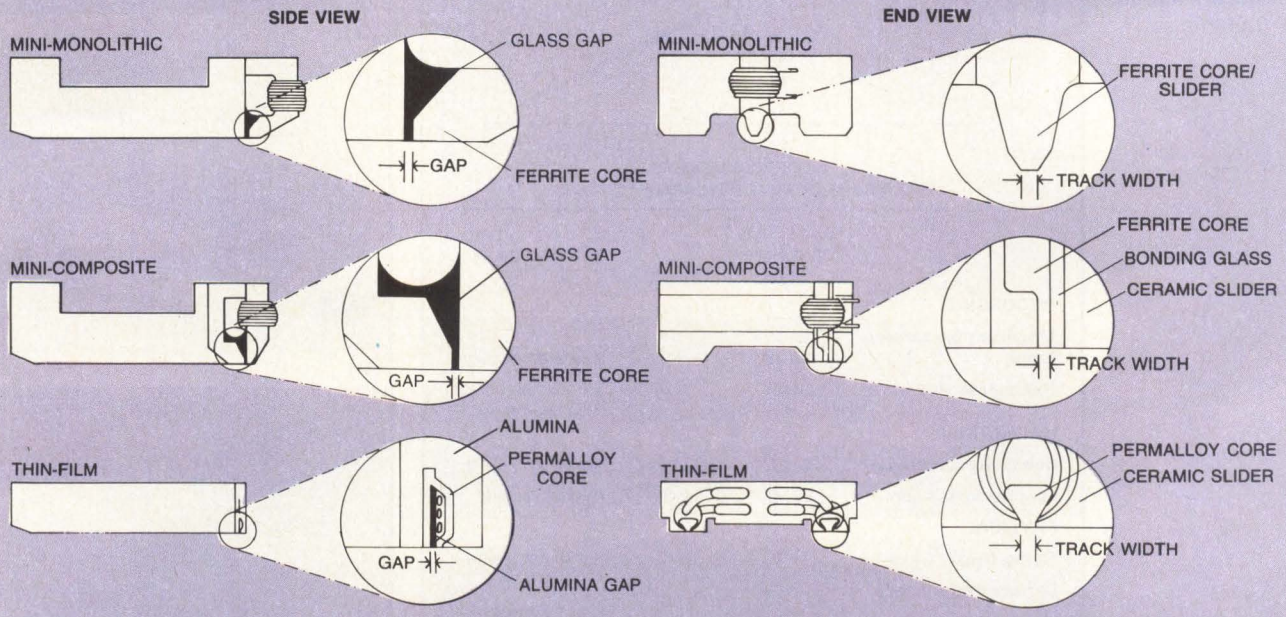
How head construction influences recording density

There are three dominant rigid-disk head types: monolithic heads, composite heads and thin-film heads. In each case, the head construction directly affects possible recording density. Linear densities of these heads are limited by a combination of gap thickness (smaller gap allows higher linear density), flying height (lower flying means higher density) and media properties.

The *mini-monolithic head* is almost totally ferrite, except for the wire coil and glass used in forming the gap and in bonding the ferrite pieces together. With mini-monolithic heads, the techniques of melting and flowing glass, used to form the gap, limit the potential gap thickness. In addition, the fragility of the unprotected ferrite in the gap area imposes practical limitations on reliable flying heights.

Mini-composite heads employ a smaller ferrite core that is formed separately and then glass-bonded into a hard ceramic slider housing. This construction protects the gap area by surrounding it with glass and ceramic, allowing for lower flying heights and thus higher densities. Although mini-composite heads allow somewhat narrower tracks than do mini-monolithic heads, ferrite brittleness and lack of precision in the machining process remain limiting factors to increasing density.

Thin-film head gaps are formed by the vacuum deposition process of sputtering, which allows extremely small gaps. The gap area is completely encapsulated in the hard sputtered Alumina material for protection. Core material in these heads is thin. Some manufacturing techniques used in the production of thin-film heads are being applied to conventional ferrite heads to achieve thinner gaps.



The three dominant rigid disk magnetic head types *include mini-monolithic (top), mini-composite (middle) and thin film (bottom).*

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CIRCLE NO. 62 ON INQUIRY CARD

Costs are still high due to limited quantities, but as they become more popular, manufacturers may use them in smaller-diameter disk drives.

Advances mean greater choice

Higher linear densities require shorter flux transitions. This condition calls for a reduced read/write head gap with the head flying closer to the media surface. Additional increases in density are possible if the thickness of the media is reduced. This interplay has spurred much media development to get thinner coatings, higher coercivity and better surface consistency. Although oxide is the most popular disk media, recent technological advances have resulted in several interesting options.

Conventional particulate coatings are standard oxide coatings based on gamma ferric oxide particles. They are used in longitudinal recording media. There are two types: those made by the standard process that yields needle-shaped, porous particles, and a more recent type developed by Sakai Chemical in Japan. Sakai's process generates smooth ellipsoidal particles that demagnetize more slowly than do the needle-shaped type. With either type, the particles are suspended in a non-magnetic binder that is spin-coated onto a polished aluminum substrate. The result is a 20- to 40-microinch coating of 300- to 400-oersted material capable of supporting bit densities of 10,000 to 15,000 bpi.

Continuous thin films achieve higher density and improved signal-to-noise ratios (SNR). Thin-film media can be either oxide or pure metallic-based. The oxide varieties are normally sputtered using standard ferric oxide (Fe_2O_3) or cobalt-added oxide (when higher coercivity is desired). Metallic coatings use magnetic metal alloys and are either sputtered or plated onto the substrate. The resulting material is capable of supporting bit densities well above 15,000 bpi. The 600- to 1,200-oersted coating is typically two to five microinches thick.

In 1957, 4.4M bytes of data required fifty 24-inch disks; today, eight 14-inch disks can store 1,260M bytes.

Maxtor Corp. and Tandon Corp., for example, incorporate plated-metallic thin-film media in their 5¼-inch rigid disk drives. As volume increases and prices come down, thin-film media will appear in greater numbers.

An example of thin-film media is Ampex Corp.'s ALAR disks, which use an electroless plated cobalt-phosphorus coating. Fujitsu America Inc. is leading the way with oxide thin-film coatings, incorporating them into high-performance models of their Eagle disk drives. To date, the most popular thin-film coatings are plated metallic; sputtered oxide or metallic processes have yet to reach economies of scale necessary for widespread use.

Isotropic media support perpendicular and longitudinal recording. These cobalt-doped, iron oxide-based coatings have no intrinsic particle orientation and thus can be used for either mode. The Spin Physics Division of Eastman Kodak Co. has been experimenting with such media under the trade name "Isomax."

Sputtered cobalt chromium media support perpendicular recording only and come in two forms: single and double layer. Single-layer types can record in perpendicular mode using relatively standard Winchester "ring"-type heads. Lanx Corp. offers rigid disk media of this type. Double-layer sputtered, cobalt-chromium media include a permalloy underlayer that acts as a flux return path for "probe"- type recording heads. Vertimag Corp. plans to offer flexible disk versions with this coating.

Two other types of media for perpendicular recording—*electroplated-cobalt film* and *coated barium ferrite particles*—are still in the early stages of development, although Toshiba Corp. already offers the latter in a magnetic-tape line. □

Interest Quotient (Circle One)
High 813 Medium 814 Low 815

Don Collier is director of marketing analysis at Applied Magnetics Corp. He was recently general manager of Freeman Reports, a management consulting and publishing company. **Paul D. Frank** is vice president of research and development at Applied Magnetics. With the company since 1969, he has held various engineering and management positions and has been involved in the development of thin-film disk and tape heads since 1975. He is a member of the Advisory Council of the Center for Magnetic Recording Research at the University of California, San Diego. **Chris J. Aho** is director of sales and marketing/advanced products for Applied Magnetics. With the company since 1978, he has held engineering, sales and marketing positions.

NEXT MONTH IN MMS

The January issue of Mini-Micro Systems will focus on key products and trends expected in the multifunction matrix printer market.

During the past year, many suppliers have introduced models with graphics, draft quality and near-letter-quality printing capabilities. As the competition intensifies among the low-cost models, prices continue to fall.

Find out how low prices will go and what features systems integrators can expect at various price points.

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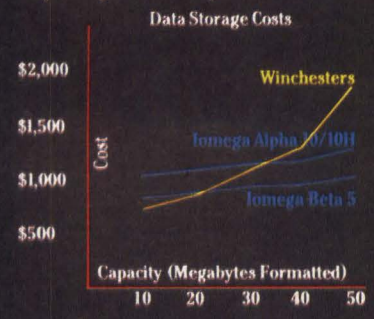
When In The Course Of Business Events . . .

OEMs designing systems for today's businesses face two realities. One, data processing is rapidly becoming more decentralized. It is pushing outwards into individualized work units, defined more by job function and applications, performed by more people in more places, demanding more data flexibility—more data independence.

Which brings OEMs face to face with a second reality. Winchesters. Because the prevailing mass storage technology—in the form of large storage units used for access or downloading, or smaller, high capacity desk-top mechanisms—continues to head in the opposite direction. Rather than freeing users to operate effectively in the new environments of distributed data processing, Winchesters keep them device-dependent, keep them tied to a shared system of storage.

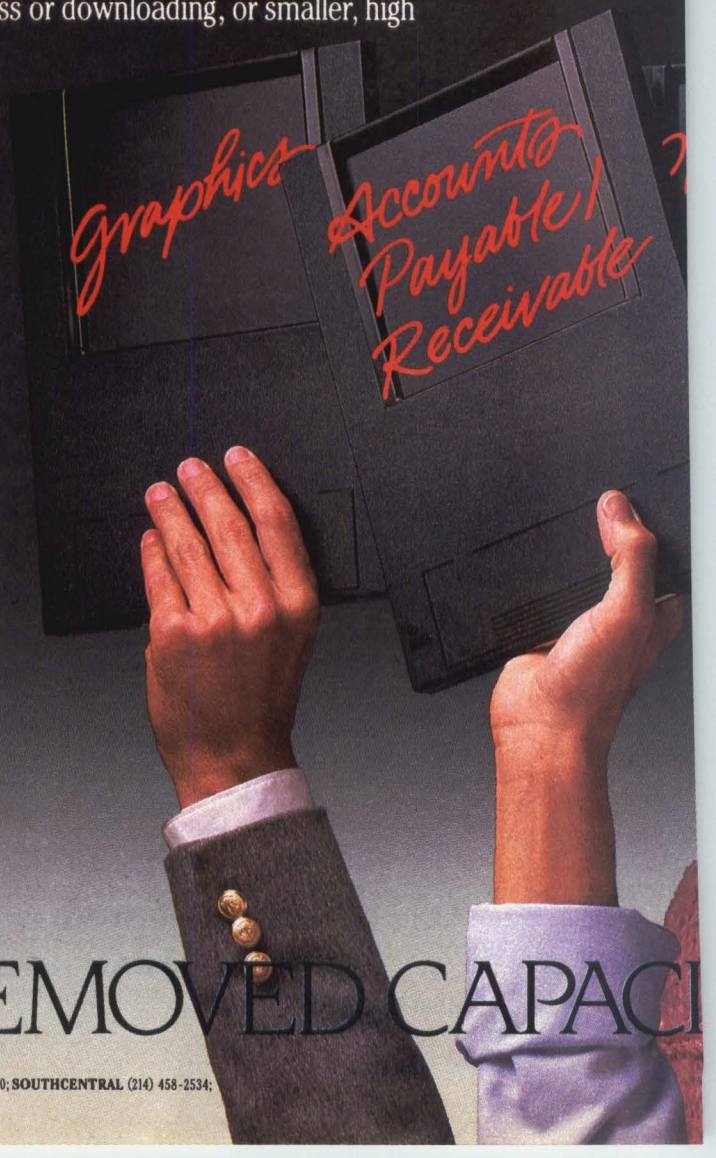


Slavery By Any Name . . .

There are lessons here. That the central issue isn't more data, but more data dynamics. And that Winchesters are hardly data dynamic at all.

Consider the aggravations of "wait your turn" access, or the need for lots of "system savvy" on the user's part. Consider the time consumed in backing up and restoring data. And consider the ever-present risk of a system going down or files lost to expensive head crashes.

Now consider the alternative.



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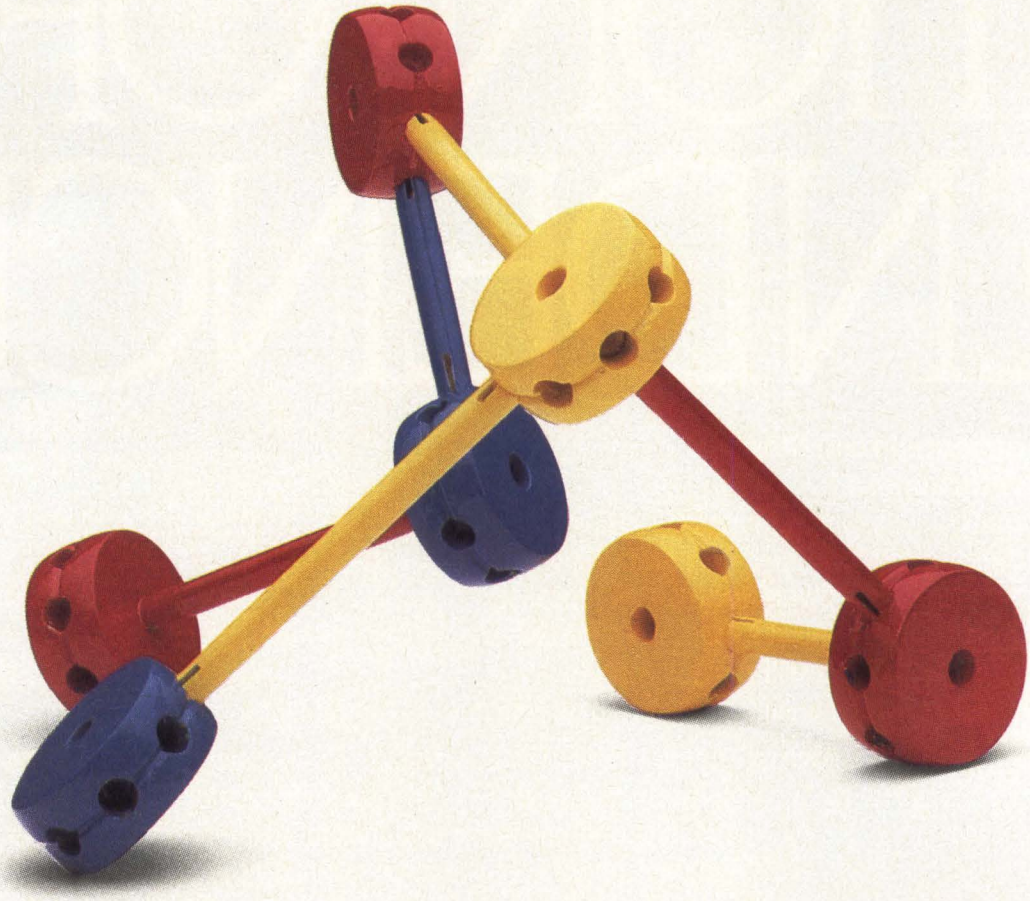

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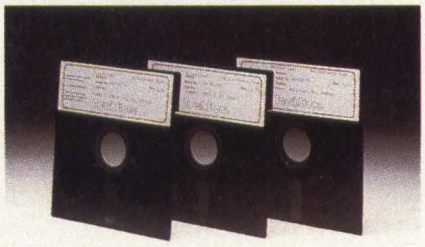

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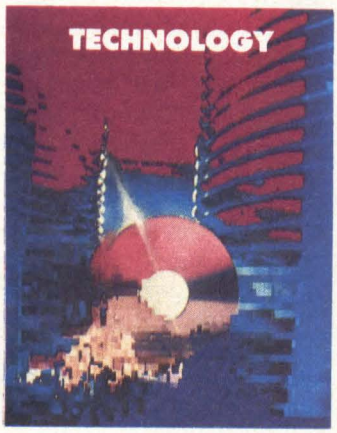


Operating systems conform to application needs

As standardization efforts inch forward, operating systems are adapting to the demands of multiuser computer systems and real-time applications

James F. Ready
Hunter & Ready Inc.

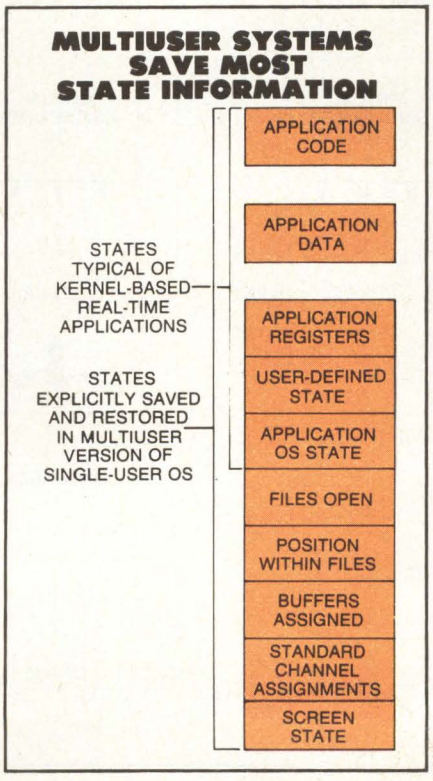
Operating systems are changing to meet the technical and user-interface demands of local area networks, real-time applications, file-sharing and windowing software and multiuser computer systems. With enhancements to support these new and rising technologies, traditional single-user operating systems, such as CP/M and MS-DOS, are evolving to resemble time-sharing systems that allow a number of processes to execute concurrently.

Multiuser operating systems, originally designed for mainframes and minicomputers, are being adapted for microcomputers. And as 16-bit microcomputers begin to tackle complex, real-time applications, real-time operating systems, similarly once confined to mainframes and minicomputers, are emerging to handle the synchronization and communication required for concurrent execution of tasks. Operating systems are also responding to the industry-wide push toward standards, although progress in this area has been slow and inconsistent.

Interfaces set the standard

Four interfaces—user, application, device and media—define an operating system's capabilities. The user interface is defined by a command-interpreter program and by a command set from a user console that an application program can interpret. An operating system's set of system calls comprise the application interface. Application programs use system calls to access operating system functions such as reading from and writing to files on a disk. The device interface establishes the command set, issued by the operating system to peripherals or to device-specific routines, that enables them to carry out I/O operations. The routines, therefore, interface the operating system to hard and flexible disk drives, magnetic-tape drives, line printers and video-display terminals. The media interface is defined by the format of the media used in exchanging data between computer systems.

Although every standard operating system is defined by those four interfaces, some systems are not as "standard" as others. IBM Corp.'s PC-DOS is an example. Despite the existence of a standard set of PC-DOS system calls, many application programs bypass that set and



Multiuser and real-time operating systems *explicitly save state information for each application running on the system.*

instead either use ROM-resident functions, or access hardware devices directly. For example, Lotus Development Corp.'s Lotus 1-2-3 spreadsheet software addresses the IBM PC disk controller directly, rather than using PC-DOS calls to perform disk I/O. As a result, the benefits of a standard interface (e.g., program portability) are lost and the Lotus 1-2-3 program becomes machine-dependent.

A similar incompatibility exists among the many implementations of AT&T's UNIX, where programs that run under Berkeley UNIX Version 4.2 might not run under UNIX System III or System V.

The standards situation becomes even more chaotic for most real-time kernels. Because these embedded systems are so closely tied to the hardware they control, they are more resistant to the push toward standards than the operating systems employed in personal computers for more general word-processing and spreadsheet applications. This situation is rapidly changing, however, with the advent of off-the-shelf kernels and real-time-oriented languages such as Modula II.

Thus, having a "standard" operating system does not mean that a large base of application software will automatically run on any machine using that operating system. For example, Lotus 1-2-3 will not run on Texas Instruments Inc.'s personal computer even though both support implementations of MS-DOS. As a result, TI has been forced to supply its own version of Lotus 1-2-3, which runs only on the TI machine.

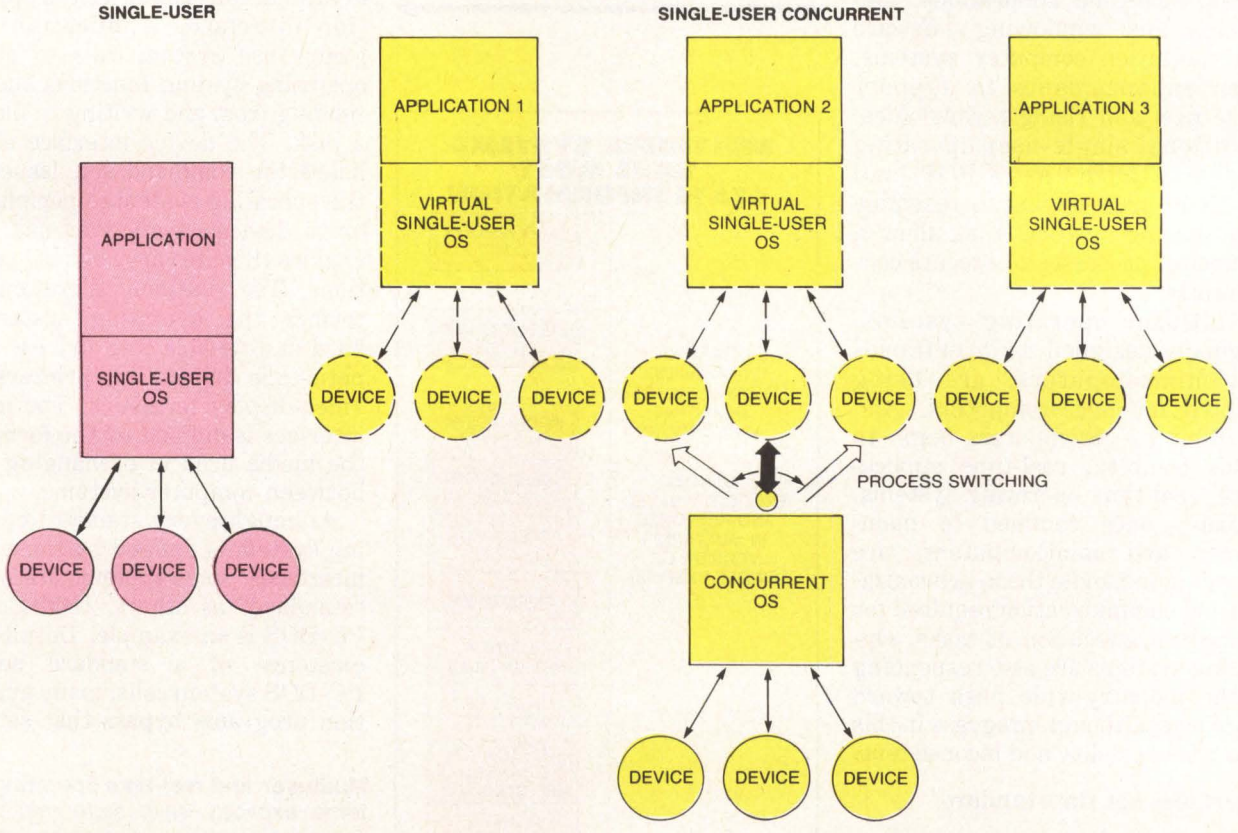
The interface that an operating system presents to another operating system is also the target of

How operating systems handle application tasks

In a single-user operating system, the devices are, at any instant, dedicated to a single application. In many ways, the operating system is a collection of subroutines that perform I/O functions on behalf of the application program.

In a concurrent or multiapplication version of a single-user system, the devices, CPU and memory must be properly shared among the applications. The state of each application, including data such as the CPU register, the priority of the application, the amount of time the application has run, the files that are currently open and standard I/O assignments, is explicitly stored on data structures for each application. Even so, the operating system serves primarily an I/O function with little interaction between applications.

Operating systems for real-time applications divide the application into many sub-functions that execute concurrently. In many such systems, all the I/O is of a specialized nature



standardization efforts. Two major trends are emerging. Digital Research Inc. has standardized the MS-DOS interface. Its Concurrent DOS operating system supports a Concurrent CP/M interface as well as the MS-DOS interface. And both Digital Research and Microsoft Corp. have said they will support a common interface between their single-user operating systems and UNIX. The result will be a reduction in the number of different operating system interfaces and a corresponding increase in the number of applications that can run under a given operating system.

Real-time operating systems are more resistant to the push toward standards than the operating systems employed in personal computers.

However, for such standardization efforts to succeed, the interface must not only be consistent across implementations but must also be powerful enough to handle the needs of the majority of applications. If the interface is not sufficiently powerful, applications programmers will be forced to bypass the operating system interface and go directly to machine-specific characteristics of the system. For example, if the standard interface provides only sequential file access and the application needs random access to a file, programmers are forced to access the disk-controller hardware directly, making the application dependent upon a specific disk controller, thereby losing the benefit of a standard interface.

Operating systems change

Traditional single-user operating systems, such as CP/M and MS-DOS, have been extensively redesigned to accommodate the requirements of new computer-system hardware. Designed solely for single-user, single-process applications, they formerly had no provision for executing concurrent processing. A single-user operating system does not, for example, need to maintain a data structure for saving the state of registers and status bits, because it supports only one application program at a time.

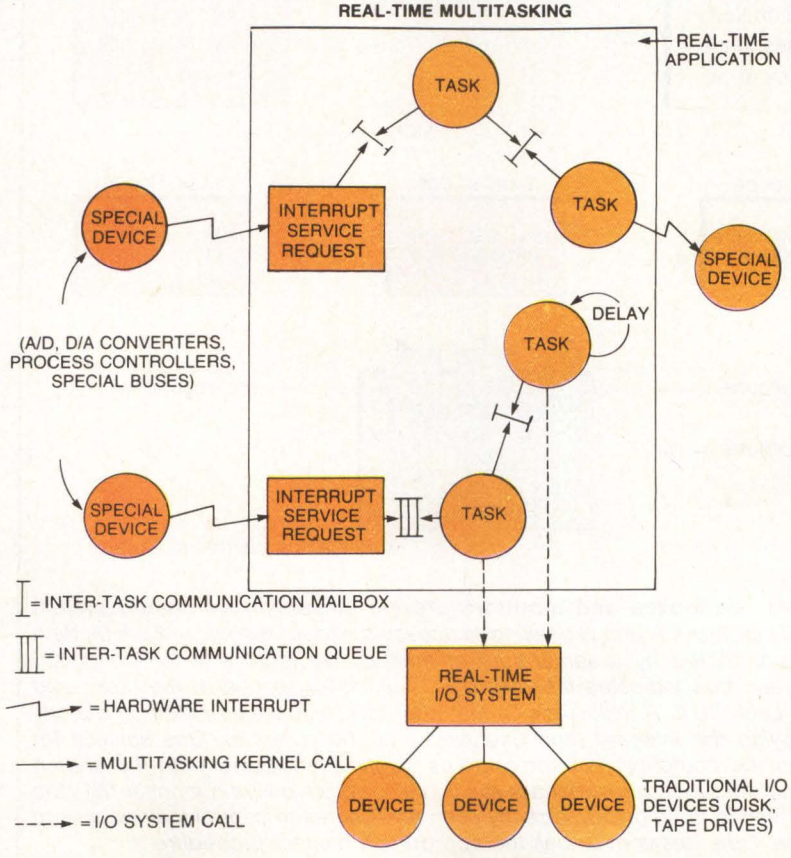
Single-user systems, however, have now been extended to provide each application (or process) running under the operating system with a virtual environment that looks to the application as if it were the only program running. The operating system, therefore, contains the information that allows more than one application to use the file system at the same time. Digital Research's Concurrent DOS and Microsoft's MS-DOS 3.0 operating systems illustrate this trend.

Concurrent DOS is designed to run several MS-DOS-compatible programs and to switch between them under user control. MS-DOS 2.0, an extended version of MS-DOS, can communicate in a local-area-network environment as it executes application programs.

Multiuser operating systems are designed to provide controlled and shared access to expensive computer resources such as the CPU, mem-

(analog-to-digital converters, special buses, etc.). Each device is driven directly by an interrupt service routine (ISR) synchronized with a cooperating task. The tasks themselves interact through structures like mailboxes and queues. A real-time multitasking executive or kernel supports these structures.

If more traditional devices are present, such as disks and magnetic tapes, a multitasking I/O system can be added. Such a system presents an environment similar to that of a multi-user operating system. The real-time system will often have extra features for real-time input/ouput to standard devices. Thus, for example, disks can have files that are contiguously allocated for high performance.



ory and disk drives. They evolved from mainframe computer systems, where it was necessary to efficiently share computer resources among as many users as possible—in contrast to most microcomputers, where the entire machine is dedicated to a single user. In a single-user environment, many operating system complexities are avoided because none of the system's resources need to be shared.

Driven by microprocessor technology, the current trend is to distribute CPU and memory resources to local workstations with only the main file system shared among users. In the Dimension system from Northstar Computers Inc., for example, as many as 12 users are connected to a main file server (based on an Intel 80186), with each user workstation incorporating an 8088 microprocessor and local memory. The workstations run an equivalent of PC-DOS.

With this type of system, many complexities of a multiuser operating system disappear. The status of each application running under the operating system does not have to be maintained, and time-sharing the CPU effectively among the applications is not a problem.

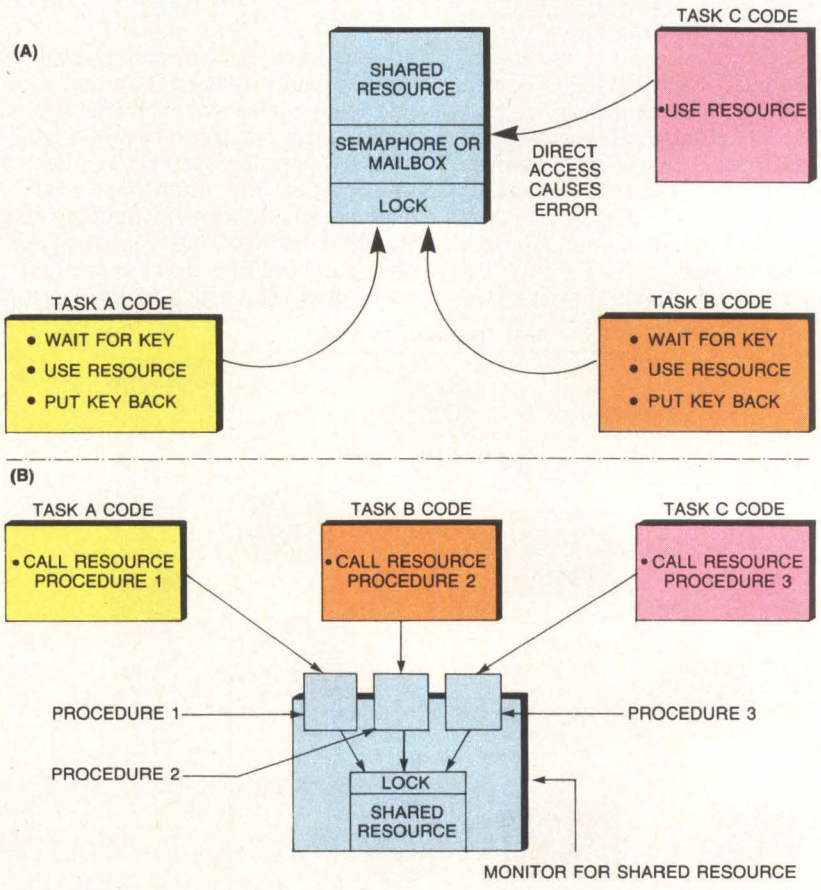
As operating systems have evolved from single-user to multiuser, an increasing amount of state information is saved for applications. In a simple single-user sys-

Semaphores, mailboxes, monitors prevent resource contention

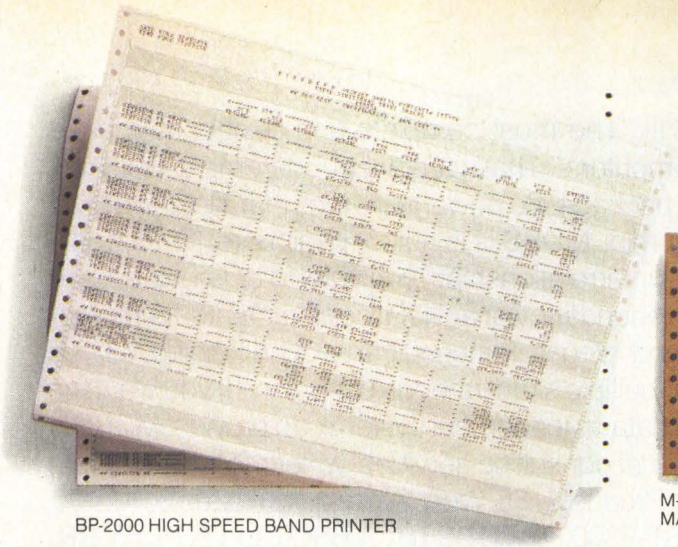
Real-time operating systems use semaphores, mailboxes and monitors to prevent one task from contending for a resource, such as data in memory, that is being accessed by another task. A semaphore is a binary variable whose state records whether or not the resource it is protecting is available. For a given semaphore, if it is equal to "one", the resource is available; otherwise, it is unavailable and the tasks wishing to use it must wait. In order to prevent a task from wasting processor time, the required waiting is usually implemented by suspending the task from further execution by placing it in a queue of tasks waiting for that semaphore. Testing and setting the semaphore is done by a real-time kernel. The kernel ensures that these operations are executed with mutual exclusion to maintain the semaphore's integrity.

A mailbox is simply a semaphore that has a message associated with it. In every other way, however, a mailbox behaves like a semaphore. Although semaphores provide a secure way of handling shared resources in a real-time environment, they have to be used correctly by all tasks sharing resources: A task that accesses a shared resource directly can result in that resource becoming corrupted.

One solution for handling the complexity of semaphores is to encapsulate both the shared resource and the procedures that access it into a structure called a monitor. The procedures inside the monitor correctly use semaphores to control their access to the shared resource. Other tasks wishing to use the resource need only call the appropriate monitor procedure for the desired function.



Semaphores, mailboxes and monitors *prevent contention for shared system resources. Thus Tasks A and B seeking to access a shared resource, such as data in memory, protected by a semaphore or mailbox (A) must wait for the binary message (Key) that indicates the resource is available to one of the tasks and opens the "Lock" to it. A task (Task C) that attempts to access a resource directly risks destroying the integrity (and usefulness) of the resource. One solution for dealing with the complexity of semaphores involves enclosing both the shared resource and the procedures that access it in a structure called a monitor (B). The procedures inside the monitor correctly use semaphores to control their access to the resource. Other tasks must call the appropriate monitor procedure.*



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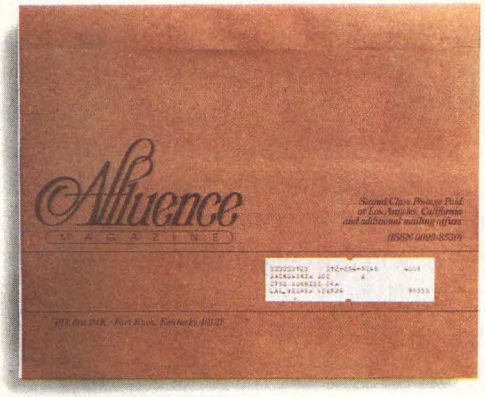

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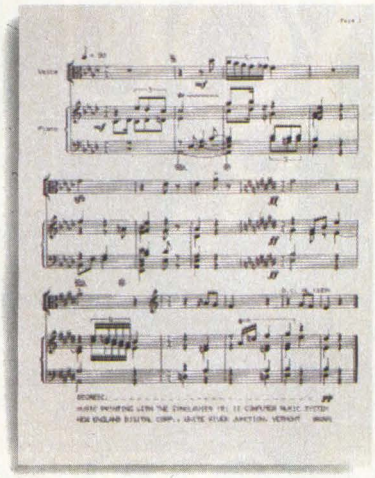

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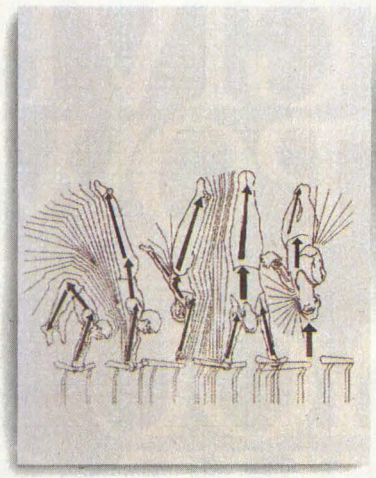

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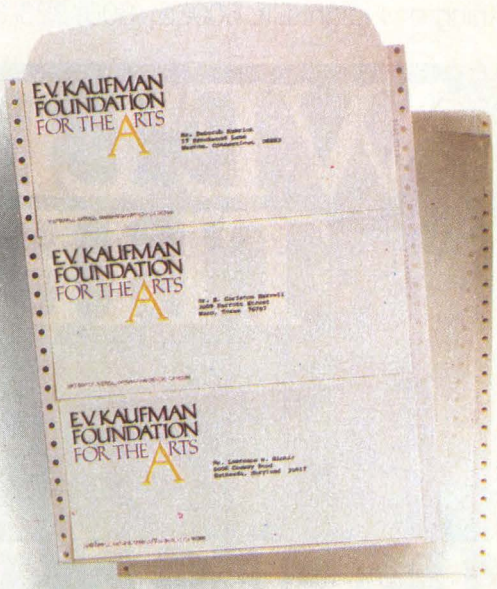

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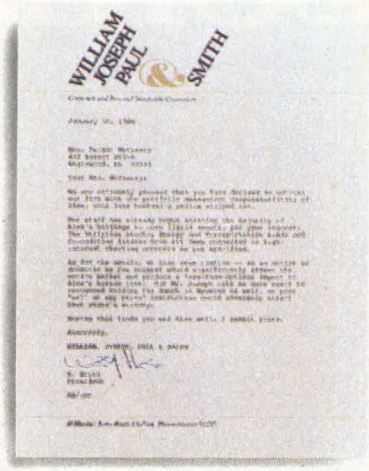

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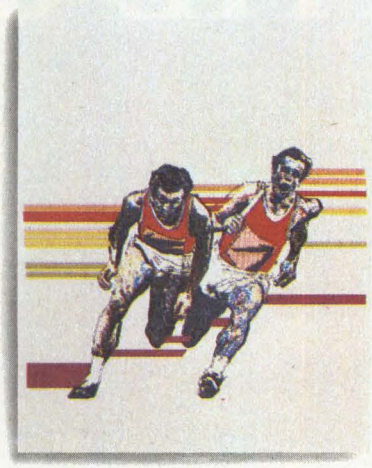

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tem, the state of the CPU itself, plus additional states associated with the operating system, are implicitly saved by the machine in the data area maintained by the operating system. This information is not saved in a re-entrant or shareable manner, because the environment is single-user.

In an operating system that supports many applications, the state of both the CPU and the operating system is formalized and stored in data structures associated with each active application. One problem that occurs frequently is that application programs establish additional states of which the operating system is not aware, making it impossible for the application to be used in a multiuser environment. For example, if the application program writes to the display directly, and not through operating system functions, the screen contents will not be saved and restored as the operating system switches back and forth between applications.

Virtual machines emerge

In order to remove some of the machine-specific nature of applications programs, the concept of a "virtual machine" operating system has evolved. This type of system acts as a host for several other operating systems, thus allowing software packages targeted to one operating system to run under another. For example, the CTOS operating system for the IBM PC XT/370 will allow MS-DOS, UNIX and CP/M-86 and their applications to run under its control.

The virtual-machine concept allows two different implementation strategies. The first is simply to emulate the system calls provided by the operating system being emulated. The second alternative is to run the operating system itself as a process (or task) of the host operating system. Emulation, however, is more efficient because the code for the emulated operating system need not be duplicated. Running one operating system as a task of another, on the other hand, guarantees compatibility between them.

Real-time operating systems were, until recently, mostly confined to mainframes and minicomputers. Microprocessor-based systems used for real-time applications were based primarily on 8-bit processors such as the 8080 and Z80. For these applications, the system had only to handle one isolated function with a fixed computational load and few interrupts. No real-time operating system was necessary as the application could be handled by a monolithic program designed to accomplish a single, dedicated task.

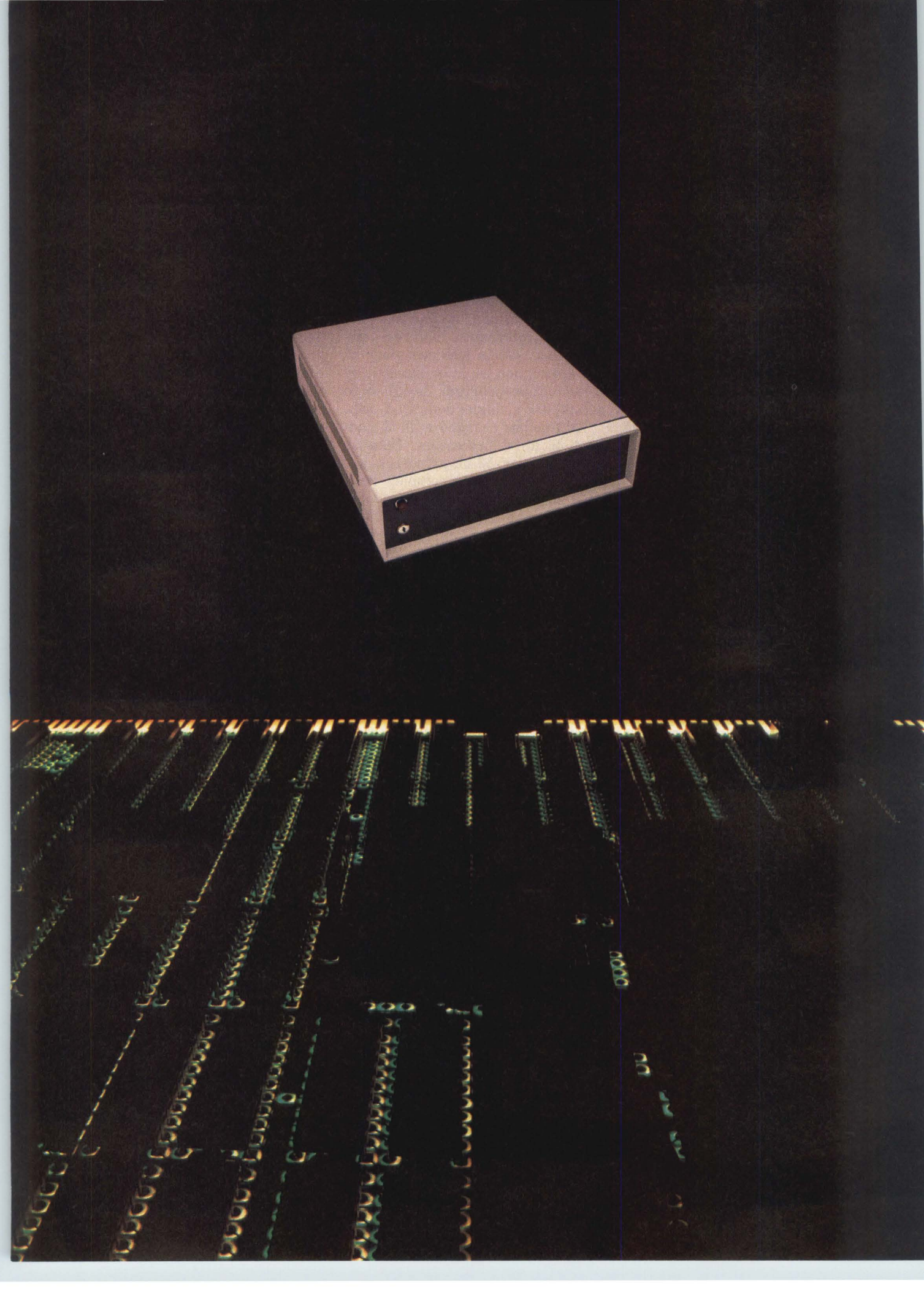
All this has changed with the advent of 16-bit processors. Because of their power, 16-bit processors are being designed into complex real-time applications that often involve handling many concurrent functions. They also require interrupt-driven hardware and stringent timing requirements. A real-time operating system is necessary for these applications to synchronize and communicate between the concurrently executing functions (called "tasks" in many systems) of the application software.

Software technology for real-time operating systems has focused on accommodating multitasking computer systems. Most vendors have developed their own real-time operating system in-house, largely because no off-the-shelf operating system was believed capable of meeting their requirements. However, the emergence of a number of real-time multitasking operating systems, such as Intel Corp.'s RMX86 and Hunter & Ready Inc.'s VRTX, has demonstrated that properly designed real-time multitasking operating systems can be used in a wide range of applications. These systems provide the basic synchronization primitives and communication facilities that are the basis of real-time application software.

Real-time operating systems differ in many ways from traditional user-oriented operating systems. For example, when an interrupt forces the system to switch from one task to another, the operating system must control access to any resources that are shared between different tasks, such as data in memory or a peripheral. If the access is not controlled, one task may access data that is incomplete or incorrect because another task was altering the data when the interrupt occurred. Real-time operating systems are designed to provide the interlocking or mutual exclusion necessary to prevent uncontrolled access to shared resources. Mutual exclusion is implemented in real-time operating systems by a number of mechanisms, including semaphores, mailboxes, queues and monitors.

Real-time operating systems incorporating these mechanisms are currently used in a wide variety of applications involving industrial processor controllers, high-speed data-communications multiplexers and medical instrumentation. Furthermore, the real-time-operating-system approach to real-time systems design has been bolstered by the emergence of the Department of Defense's Ada language, which incorporates many of the features traditionally found in real-time operating systems. Ada thus allows concurrent tasks to be introduced into a program by using a notation similar to that used for Ada procedures and functions. It also provides the mechanisms for mutual exclusion and inter-task communications necessary for sharing resources in a real-time environment. □

James F. Ready is vice president of Hunter & Ready Inc., Palo Alto, Calif. Before co-founding the company in 1981, he worked for Advanced Micro Devices as Z8000 product manager. Previously, he was software product manager for Rolm Corp.'s Mil-Spec Computer Division.



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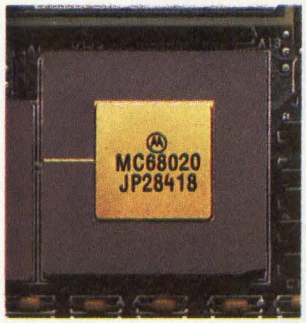

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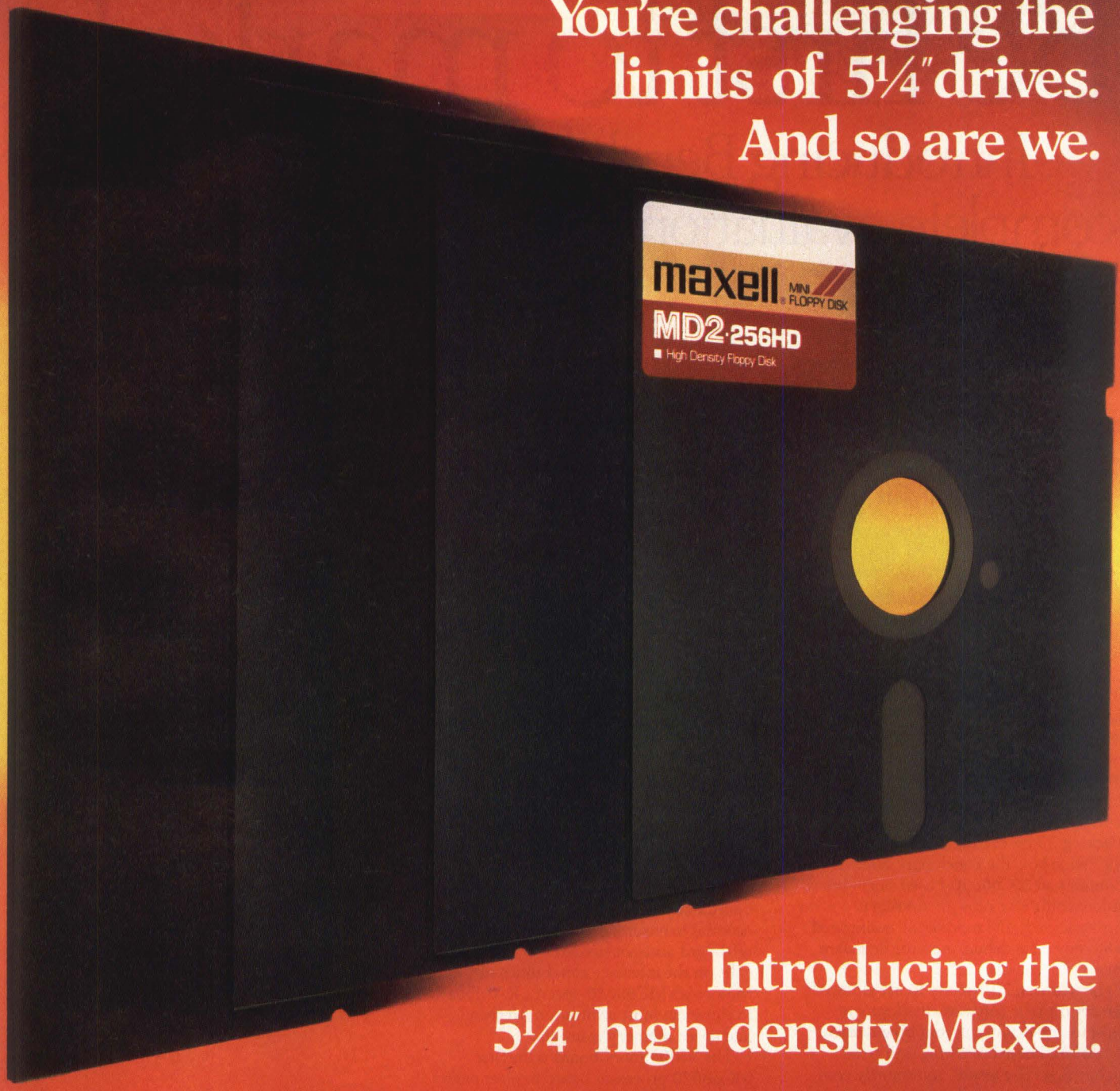

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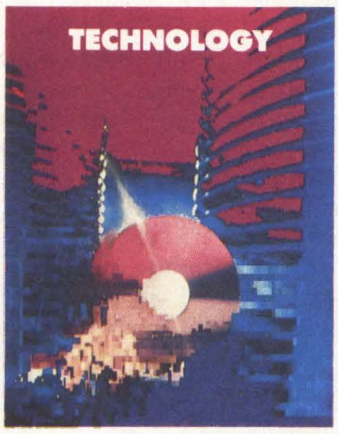

Protocol converters link incompatible devices

David P. Misunas
Micom Systems Inc.

Converters connect dissimilar peripheral units, communicating in required protocols

Users are demanding the ability to attach a wide variety of equipment to host systems in order to meet the rapidly increasing need for more flexible data communications. In some cases, this situation involves replacing a host vendor's expensive terminals with compatible, yet less expensive or more flexible devices from another source. Sometimes, however, the desired re-

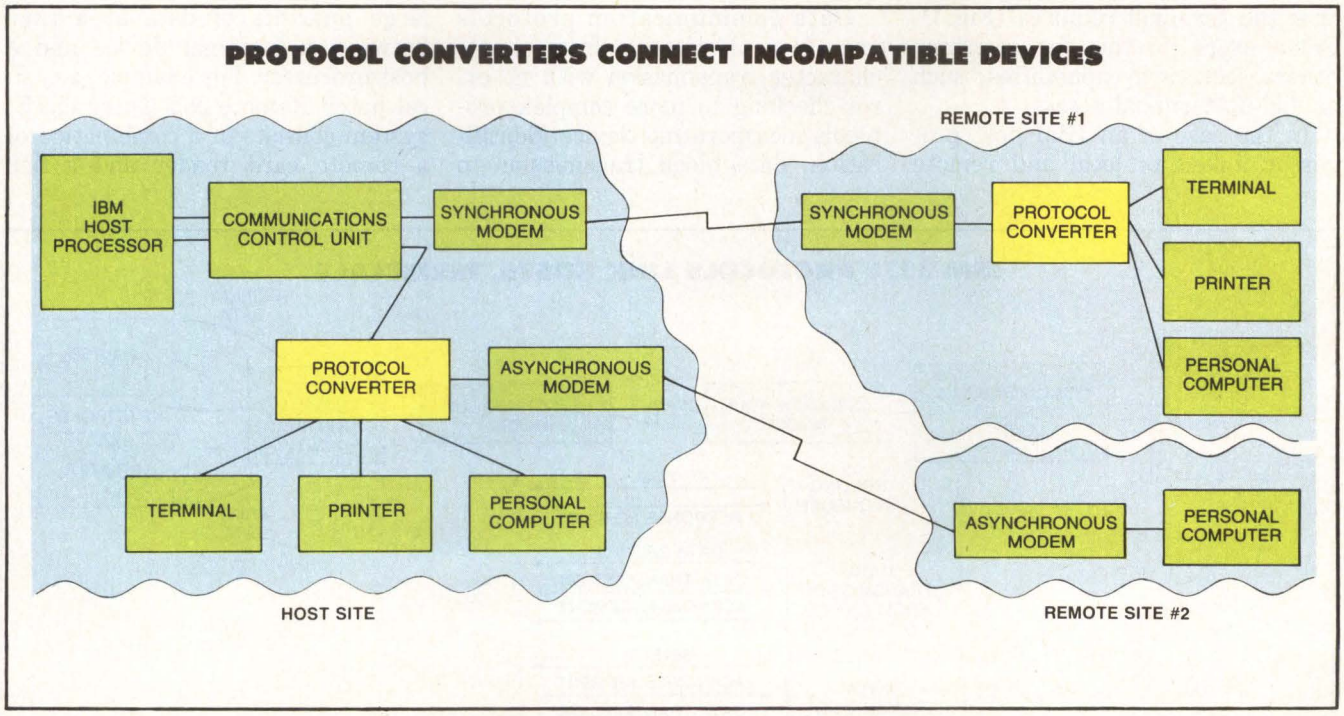

Fig. 1. A typical protocol-converter configuration *connects asynchronous ASCII terminals to an IBM host processor. The ASCII terminals appear to the host as IBM 3270-type terminals. The protocol converters at the host site and remote site 1 appear to the host as IBM 3270 terminal control units. The converters fully support the attached terminals, making them appear as 3270 display screens and providing full 3270 keyboard functionality. Each protocol converter can be directly attached to the computer at the host site, or it can be connected via synchronous modems and a leased telephone line, as shown. Similarly, terminals or personal computers can access the converter as shown in remote site 2.*

placement devices prove incompatible with the host. Protocol converters make them compatible.

Selecting protocol converters for a specific use requires an understanding of the application, a familiarity with the general characteristics of protocols, and some knowledge of the four levels of conversion they perform. With this background, three basic classes of converters can be recognized: translators, extenders and emulators.

Translators perform three levels of protocol conversion: data link control, transmission protocol processing and device characteristic conversion.

Application determines type

Regardless of class, the function of a protocol converter is straightforward. It links incompatible pieces of computer equipment and communicates with them in the manner in which each is accustomed. For example, one popular use of protocol converters is to link low-cost, asynchronous ASCII terminals to IBM host processors. The protocol converter emulates an IBM 3270 terminal to the host while communicating with the asynchronous terminal in the relatively simple protocol that the terminal requires (Fig. 1). Some users do this for economy; others seek new capabilities, such as dial-up terminal access.

In the case of an IBM host processor linked to local and remote terminals, a communications control unit (CCU)—also called a front-end processor—communicates with the terminals, enforcing an IBM 3270 protocol as required by the host software. Each protocol converter appears to the CCU as a 3270 terminal control unit (TCU) while supporting asynchronous ASCII terminals, printers and personal computers. The protocol converter translates complex 3270 screen formats sent by the host into simple character sequences understood by the attached terminal devices. The converter also transforms input from the terminals into the rigid format required by the 3270 protocol.

Data communication protocols vary in sophistication from simple character transmission with no error-checking to more complex protocols incorporating device identification, data block transmission to and from each device, and error detection with recovery and retransmission capabilities. Asynchronous ASCII transmissions, such as those common between minicomputers and their terminals, have a simple start/stop protocol in which characters are sent one at a time, asynchronously, whenever a character is presented to an output port or terminal interface. One "start" bit and one or more "stop" bits surround the character to provide timing for the receiving device. The protocol handles single-bit error detection, via parity checking, but does not handle error correction.

In the mainframe world, IBM communication protocols are de facto standards. Most host systems' protocols, regardless of vendor, are derived from those standards.

IBM sports two major classes

IBM protocols fall into two major classes: batch or interactive. Batch protocols (sometimes called batch transfer protocols) communicate large amounts of data at a time between a terminal device and a host processor. For example, a typical batch Remote Job Entry (RJE) system consists of a combination of a remote card reader and a line

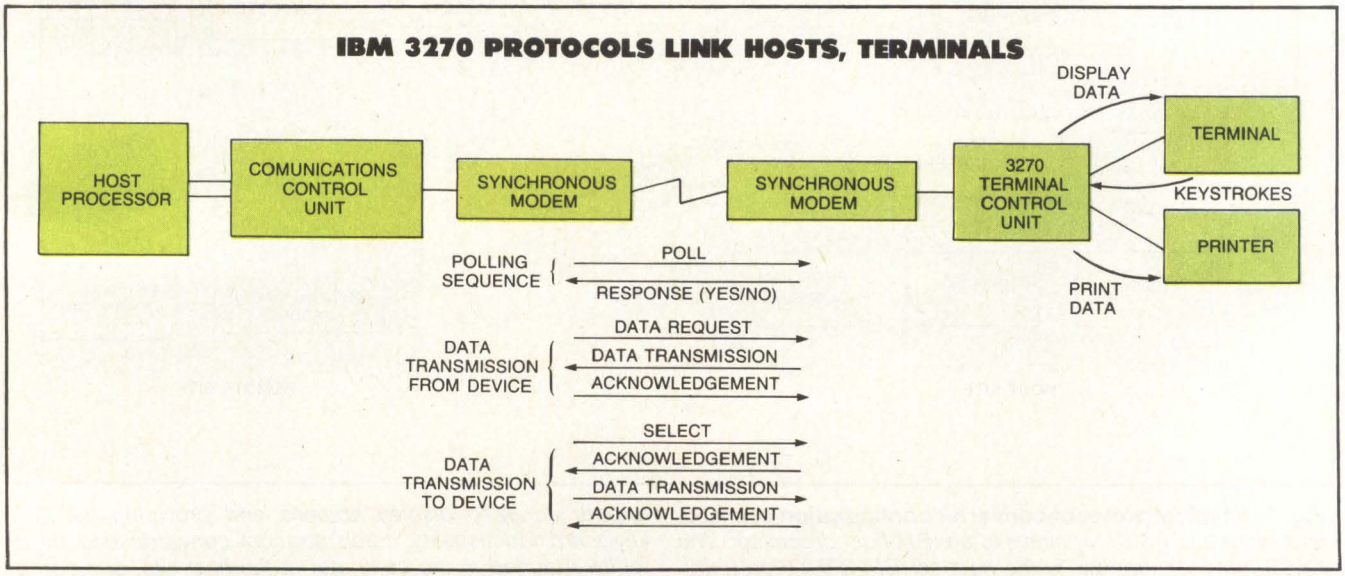

Fig. 2. Interactive IBM 3270 protocols *provide capabilities to maintain the communications link, to poll control units to see if they have data, to select a control unit and transfer data to that unit for forwarding to an attached device, and to detect and recover from errors on the communications link.*

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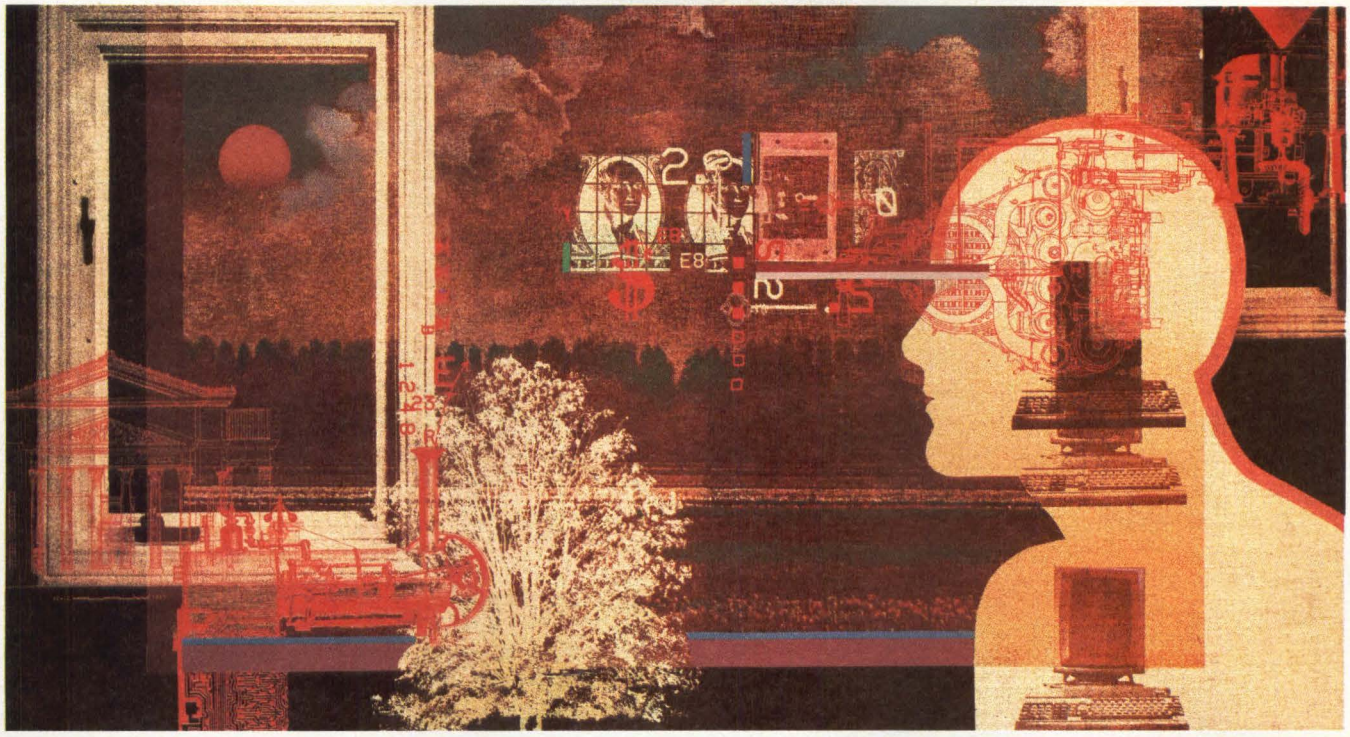

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printer. The reader reads a deck of cards and sends the information to the host, which processes the data and sends it to the printer. Batch protocols are optimized for such infrequent, yet lengthy, data transfers. The major protocols in this area are the IBM 2780, 3780 and 3776. Each of these numbers designates an IBM card-reader/line-printer combination that communicates in a unique protocol.

The other major class of protocols are interactive, or on-line, protocols, which are designed for frequent, short interactions. For example, CRT terminals, electronic cash registers, and bank-teller terminals all transmit and receive a small amount of data at a time, but see intensive use. Thus, the protocols used in these transmissions are optimized for frequent interactions.

The IBM 3270 Information Display System uses interactive polling protocols to communicate between an IBM host communications control unit and CRT terminals and printers (Fig. 2). IBM offers two protocols for 3270 communications: Binary Synchronous Communications (BSC, or bisync) and Systems Network Architecture/Synchronous Data Link Control (SNA/SDLC).

Under the interactive 3270 protocols, the host constantly polls TCUs to see whether an attached terminal has data to send to the host. If it does, the terminal control unit sends the data. Transmission of data to the host also occurs when the terminal user commands it through a specific key sequence, provided the host is ready to receive the data.

In turn, if the host has data to be displayed on the terminal, it stops polling and transmits the data to the terminal control unit for presentation to the terminal. The TCU accepts messages only for its attached terminals. The TCU processes keystrokes locally and maintains the terminal screen.

The variety of tasks typically performed by the 3270 terminal control unit requires highly sophisticated protocol conversion equipment that fully emulates this functionality. Complete protocol conversion requires complex transformations at each of the various communications levels.

Conversion comprises four levels

The four levels of protocol conversion frequently used are data link control, transmission protocol processing, device characteristics conversion and data formatting (Fig. 3).

The simplest level of protocol conversion is data link control, which maps the communications-line handling of one device into that of another. This level involves functions such as modem control, ring signaling, dedicated connections and other data-link configuration parameters.

The second level of conversion is transmission protocol processing, which provides data blocking, device identification, addressing and error detection and recovery. Each asynchronous device type attached to a protocol converter typically uses a slightly different form of communications protocol, so the converter must map the data-transfer mechanism of each protocol into those of the other.

The level of device characteristics conversion addresses the capabilities of the particular devices attached to the protocol converter. In the example in Fig. 1, the protocol converter emulates an IBM TCU to the host, structuring the data format exactly as it would be structured by an actual IBM TCU. Similarly, the protocol converter communicates asynchronously with each attached terminal as if the terminal were attached to a minicomputer. Thus, the translation be-

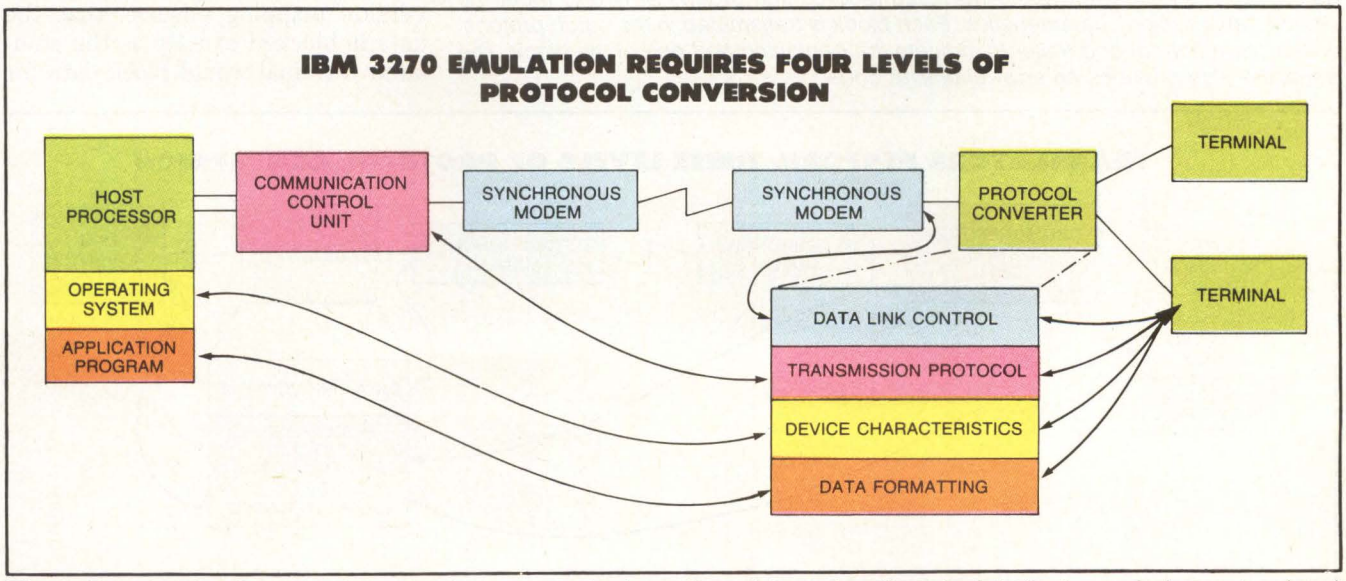


Fig. 3. Four levels of protocol conversion *are required to perform full 3270 emulation. These are straightforward conversions of functions necessary to control electrical connections, interpret and manipulate the transmission protocol and mimic the transmission characteristics of a particular device type and the data formats used by that device.*

tween IBM and start/stop protocols involves a significant remapping of the data structure, which is handled by the device characteristics conversion level.

The highest level of protocol conversion is data formatting. At this level, the converter must manipulate data so it appears as it would on the emulated device. This modification of the data format allows a screen image transmitted from the host to be displayed on the screen of the ASCII terminal exactly as it would appear on a 3270 terminal. Conversely, the protocol converter reformats keystrokes from the ASCII terminal to appear as if they were struck on a 3270 keyboard. Both of these processes require detailed knowledge of device types on the part of the protocol converter. The simultaneous execution of this operation for several terminals attached to one protocol converter requires a sophisticated multitasking operating system within the unit.

The highest level of protocol conversion is data formatting. At this level, data must appear as it would on the emulated device.

In the example in Fig. 1, the protocol converter simultaneously performs all four levels of transformation. This example illustrates the most sophisticated type of protocol converter, usually referred to as an emulator. Other types of protocol converters—such as translators and extenders—do not fully incorporate all levels of conversion.

Translators use three levels

The simplest type of protocol converter is the translator, which receives data on an input port and transforms it into the format required by the device attached to an output port. For example, a translator can convert an asynchronous data stream from a minicomputer into an IBM batch protocol (Fig. 4).

Translators perform three levels of conversion: data link control, transmission protocol processing and device characteristics conversion (Fig. 5). The data link control performed by each side of the translator maintains the electrical connection and supports requirements for initiation and termination of a connection. Transmission protocol processing fully supports the structure of the communication required by each piece of attached equipment. Device characteristics conversion mapping ensures that the data is blocked exactly as the emulated terminal would block data for

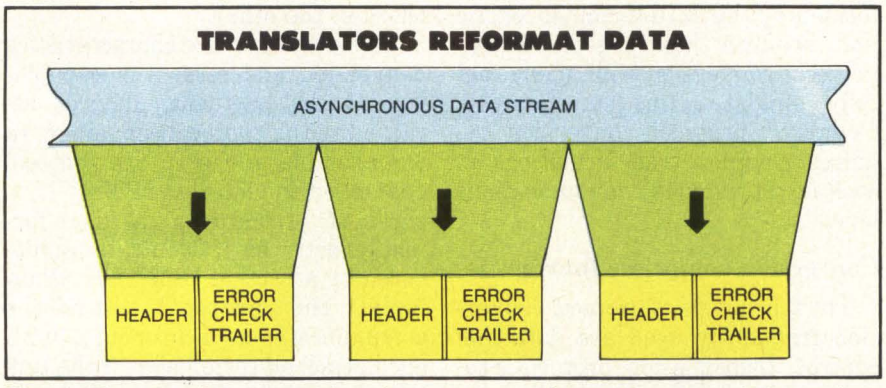


Fig. 4. The translator provides data stream reformatting, *translating a free-running asynchronous data stream received from a minicomputer into a batch protocol. This reformatting involves breaking up the asynchronous data stream into 80-character records and blocking these records into groups of two to meet the device transmission characteristics. Each block is transmitted in the batch protocol with its own header and trailer to indicate the beginning and end of the block. The translator also provides an error checking code.*

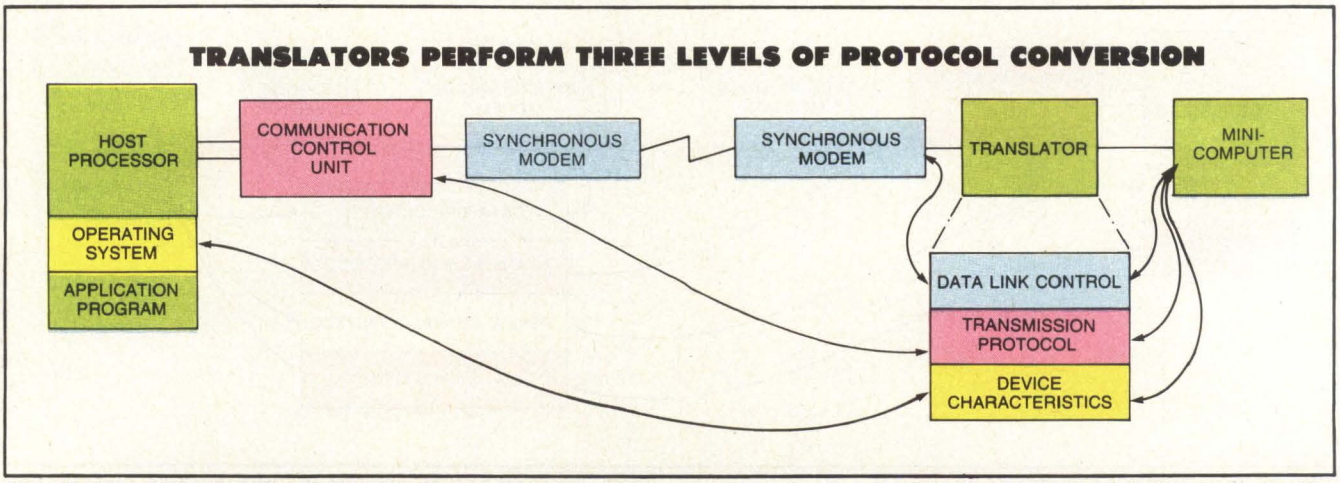
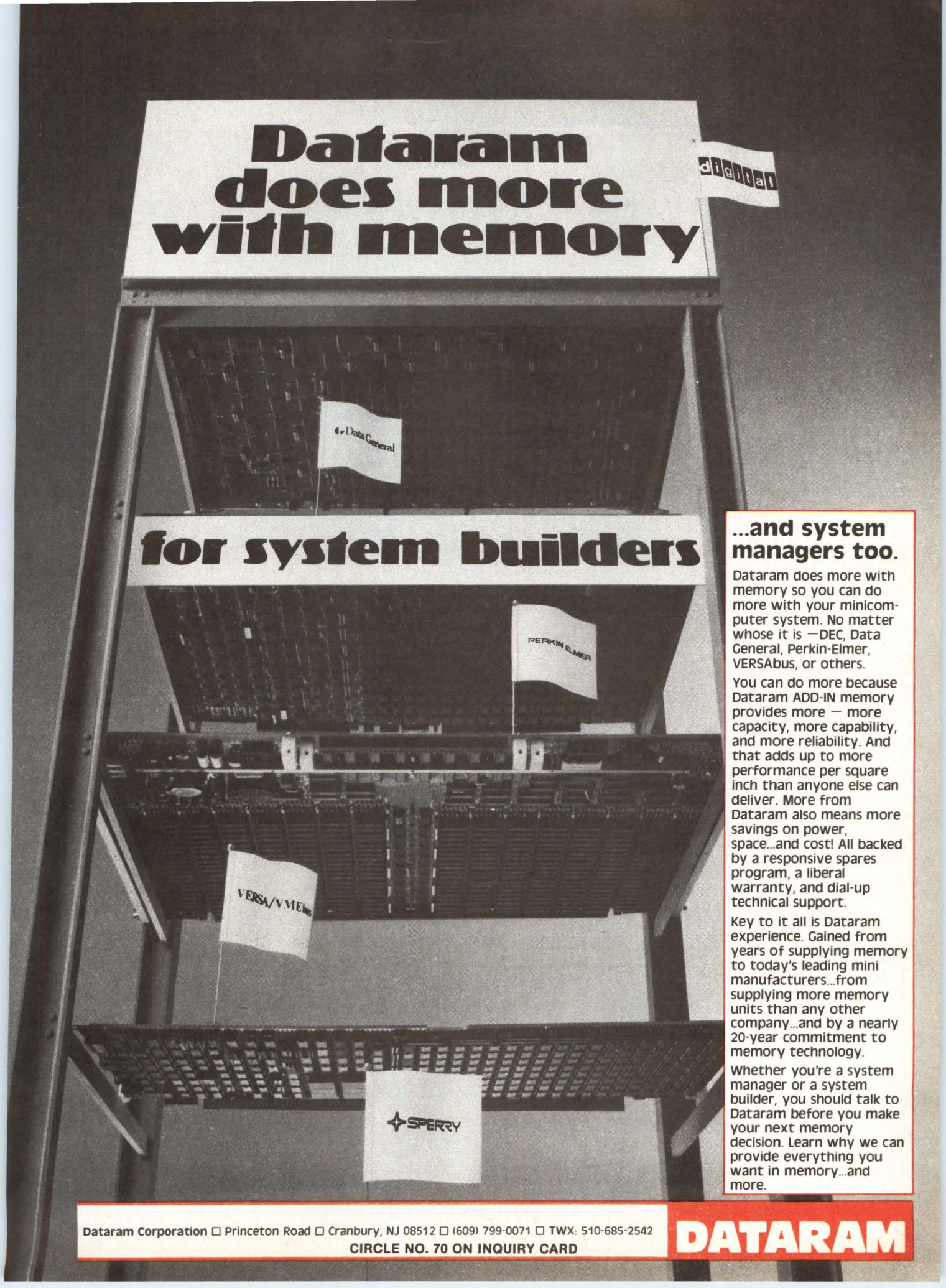


Fig. 5. Translator levels of protocol conversion *provide control of the communications connections and formatting of data into appropriate protocols. A separate host applications program is usually required to process data sent by the translator because the data is not structured in a standard device format.*



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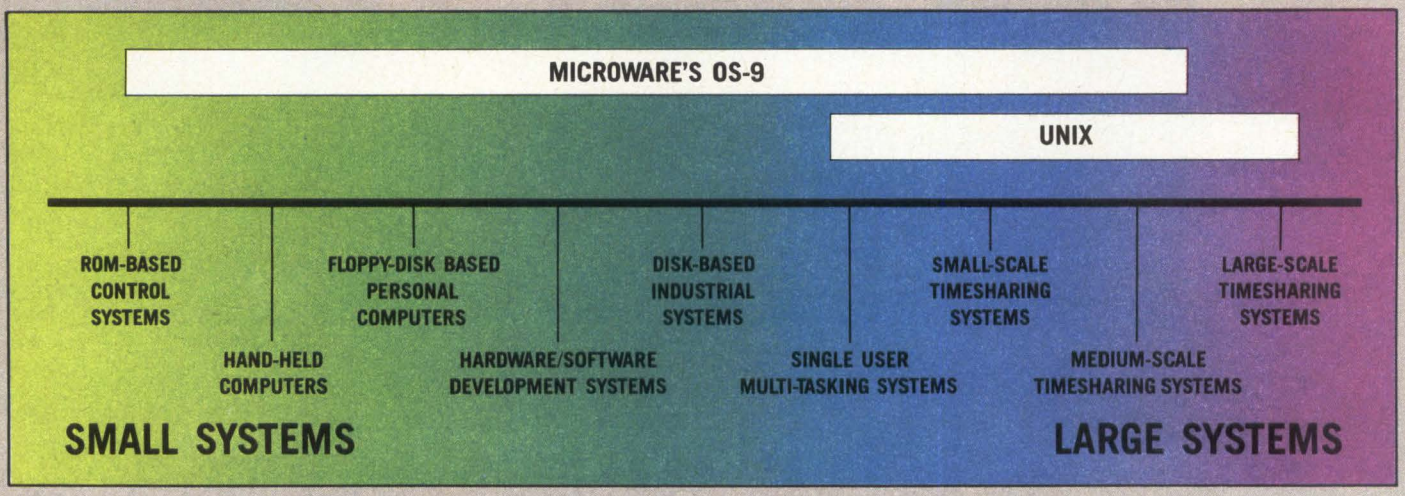

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transmission to the host.

The protocol converter receives data in one transmission protocol and then retransmits that data in another protocol. The only potential data manipulation in a translator is character-by-character code conversion between character code sets, such as the EBCDIC representation used by IBM and the ASCII representation used by most minicomputers and asynchronous terminal devices. This contrasts with the extensive data manipulation performed by the two higher-level protocol converters: the extender and the emulator.

Emulators combine translator and extender capabilities.

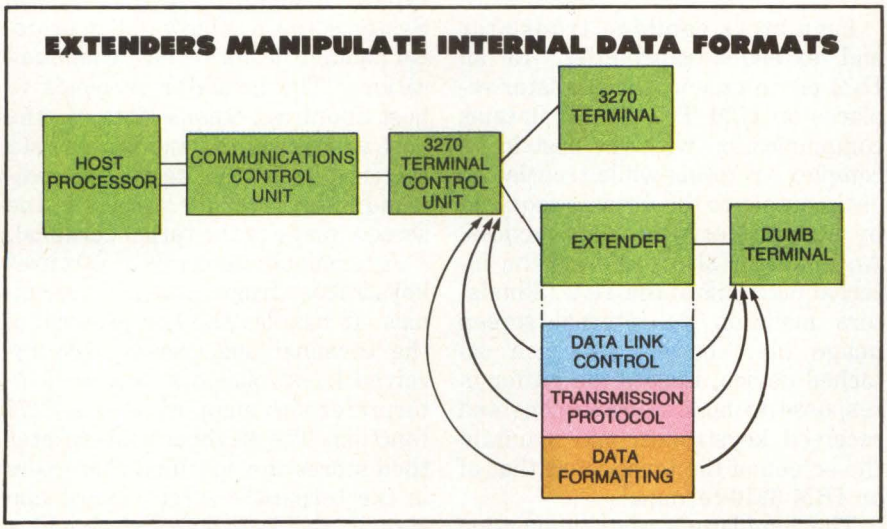

Fig. 6. An extender *incorporates a different three-level mix of protocol conversion than does a translator. Extenders provide actual manipulation of the internal data formats of transmissions, ensuring that the screen of an attached asynchronous ASCII terminal appears exactly as the emulated 3270 terminal screen. An extender does not handle complex communications protocols, as does a translator; its major task is data reformatting. Note that the transmission protocol and data content from the host is handled by the intervening 3270 terminal control unit, rather than by the host system.*

Performing format translation

Whereas a translator operates at the basic protocol level, an extender is more concerned with data format manipulation than with complex protocol handling (Fig. 6). Extenders are efficient in interactive computing environments because they allow incompatible devices to communicate with a host via a standard host-supported TCU.

In a typical IBM environment, the extender attaches to a TCU via the coaxial cable normally attached between the TCU and an IBM 3270 terminal. The extender intercepts transmission from the TCU and translates the content of those transmissions so that they appear in the desired format on the asynchronous terminal. Similarly, the ex-

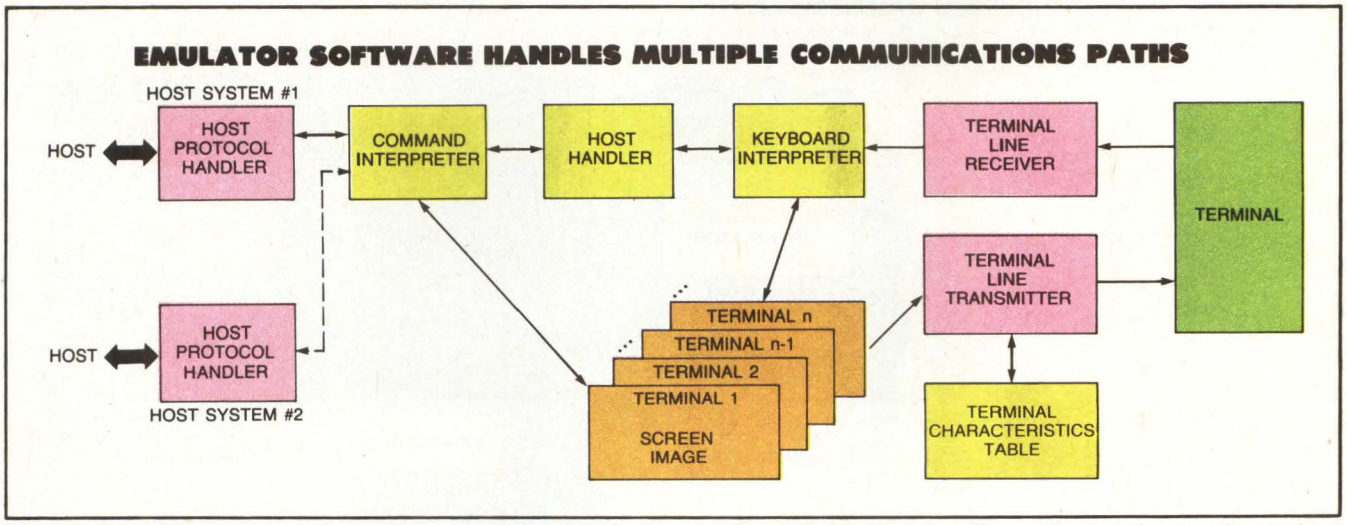

Fig. 7. The software structure of an emulator, *such as Micom Systems Inc.'s Micro7400, includes transmission protocol handlers, which format synchronous data travelling between the converter and the host, as well as start/stop ASCII transmissions to and from attached terminals. Device characteristics are processed by the command interpreter, which receives host requests. The keyboard interpreter maps ASCII terminal keyboards onto those used by the IBM 3270 family, and the host handler maintains the terminal-to-host dialog. The terminal line transmitter uses a terminal characteristics table to provide device-dependent character sequences. Data formatting is reflected in each terminal's screen image buffer. Data-link-control protocol conversion is not shown; those functions are provided by the transmission-protocol handler in conjunction with serial communications controllers or similar hardware.*

tender translates keystrokes received from the attached terminal into the format recognized by the TCU and forwards that data over the coaxial link to the TCU.

As with a translator, the extender supports the data link control and transmission protocol of both the TCU and the devices attached to the unit. But the extender must also interpret the data format to provide the desired display on the target terminal. Data-format interpretation distinguishes extender protocol converters from translator protocol converters.

Manufacturers usually sell extenders as standalone units or as circuit cards that fit in personal computers. A circuit card integrated into a personal computer treats the personal computer as an asynchronous ASCII terminal. Thus the software in the personal computer must perform the proper terminal emulation to communicate via the extender to the TCU and the host processor.

IBM protocols fall into two major classes: batch or interactive.

Emulators combine functions

Emulators combine translator and extender capabilities. In an IBM environment, the emulator replaces an IBM TCU and maintains communication with the host in its complex protocols while translating data content to the formats required by attached asynchronous devices. An emulator also performs the internal functions of the TCU. Emulators maintain an internal screen image (i.e., buffer) for each attached device, update the buffer in response to host transmissions and received keystrokes, and maintain the screen of the terminal as that of an IBM 3270 terminal.

The emulator's data-conversion functions add a level of complexity to those of an extender. The level of device-characteristics translation encompasses buffering and screen maintenance, as well as the transformation between completely different data structures.

In the software structure of a typical emulator, such as Micom Systems Inc.'s Micro7400, a protocol handler performs host communications. The emulator responds to host inquiries, sends data to the host when required and passes data received from the host to a command interpreter for storage in the screen image of the target terminal.

A terminal line receiver captures keystrokes from attached terminals. It handles the line protocol of the terminal and passes each received keystroke to a keyboard interpreter for mapping into a 3270 function. The keyboard interpreter then stores the specified characters in the terminal's screen image and signals the host handler should a transmission be required (Fig. 7).

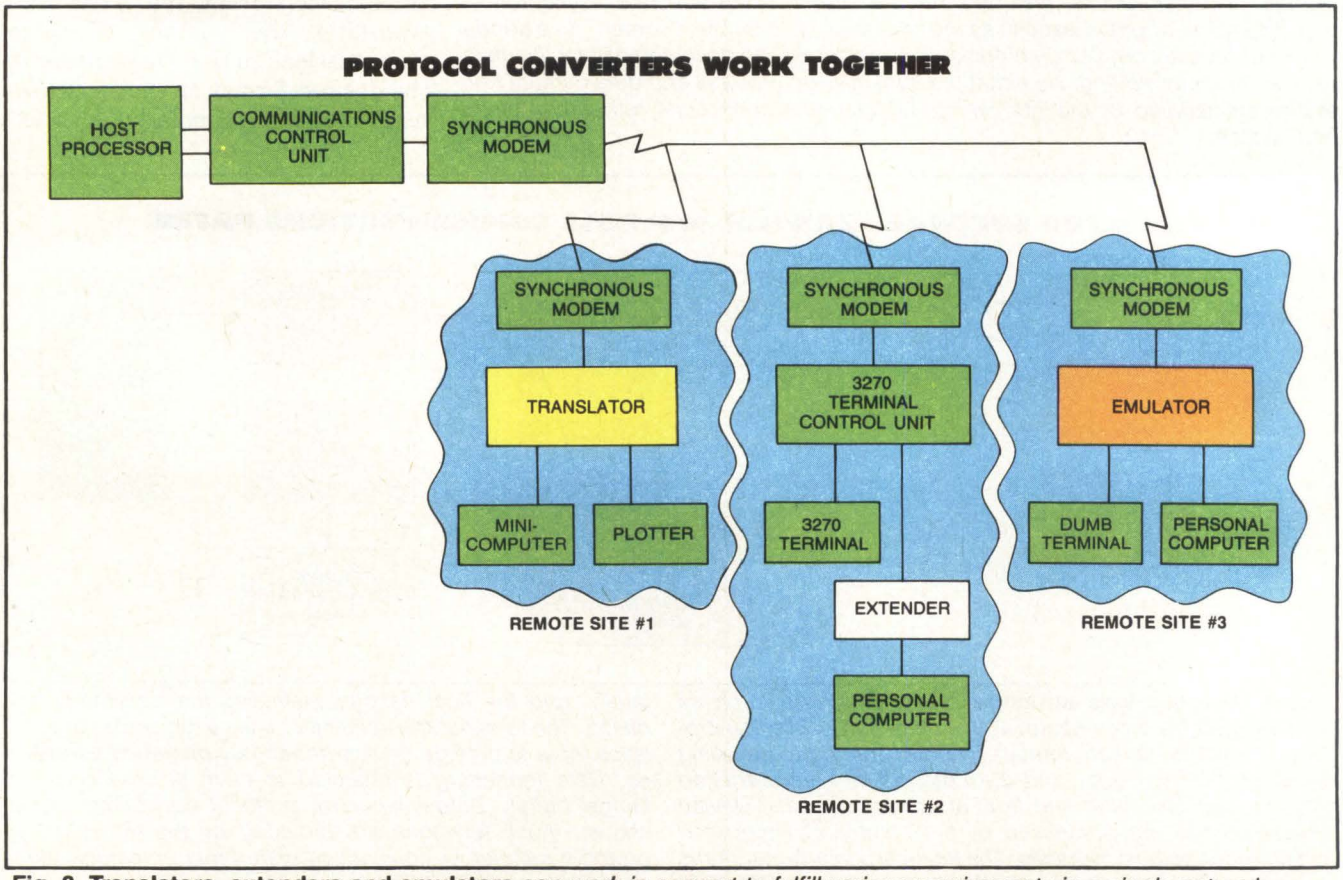

Fig. 8. Translators, extenders and emulators *can work in concert to fulfill various requirements in a single network.*

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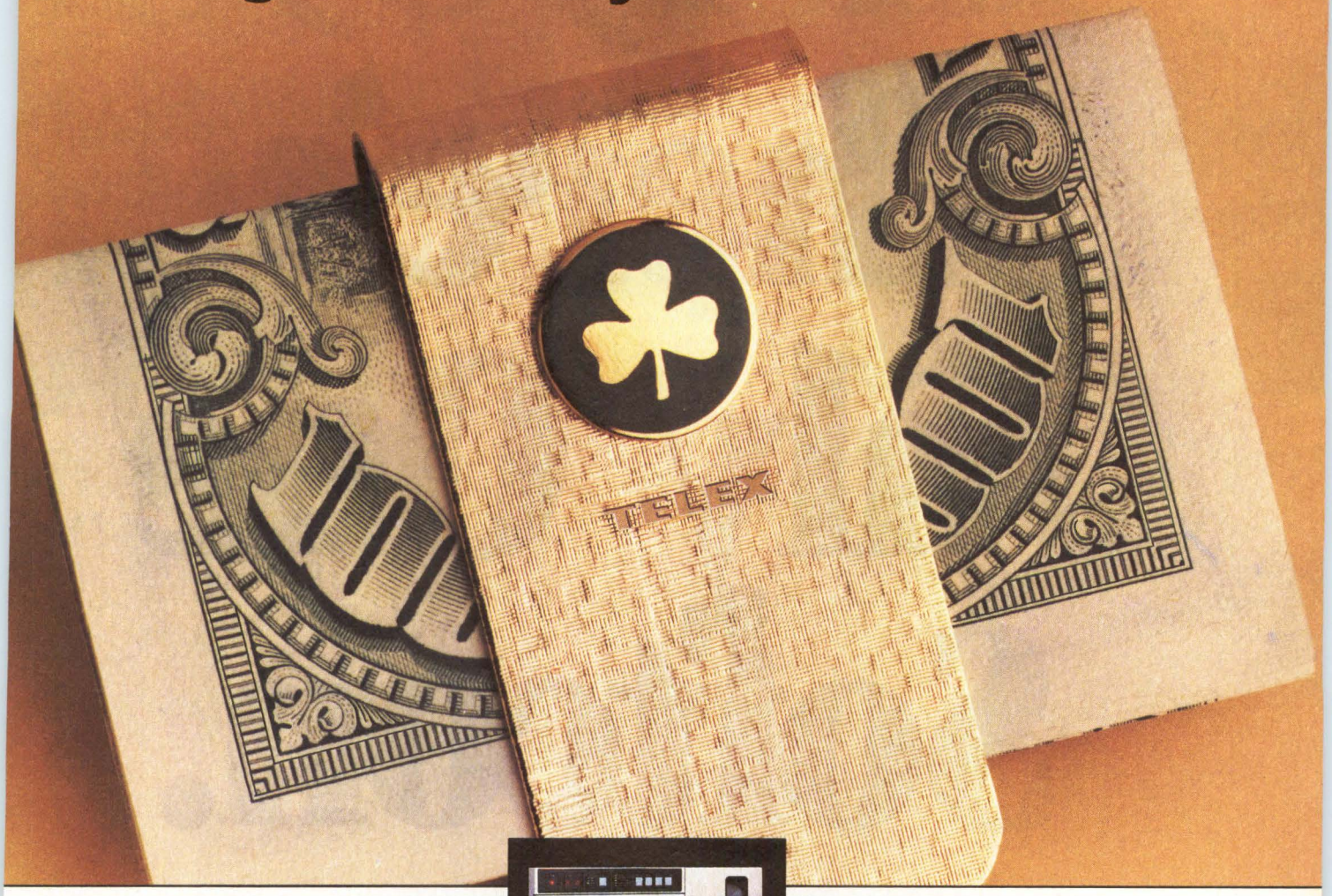

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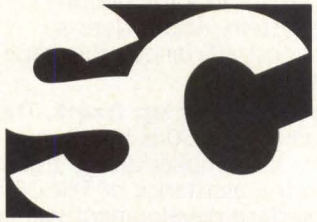

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Whenever a terminal's screen image is to be updated, a terminal line-transmitter module examines the modification and then updates the screen. The terminal line transmitter uses a terminal-characteristics table to understand the capabilities of the attached device and how to most efficiently handle the update.

Converters extend host abilities

Translators, extenders and emulators not only allow the attachment of incompatible devices to a host processor, but can also extend the capabilities of the host and its supported devices. This comes about from the ability of the protocol converter to provide support for the different design philosophies followed by various computer vendors. In other words, protocol converters can incorporate into a system the capabilities of many different environments.

Protocol converters can offer the IBM user extensive asynchronous capabilities such as automatic logon/logoff, banner/broadcast messages, inbound priority, password access control, multiple host switching, command port dynamic configuration and mixed-device support. Until recently, these capabilities have been unavailable to users within the IBM 3270 environment.

A network can incorporate all three types of protocol converters (Fig. 8). In such a configuration, a single communications line connects several remote offices with a host computer, with each office using a protocol converter for a different function. The translator, for example, might provide batch transfer for attachment of a minicomputer and a plotter. An extender might connect non-standard devices to a TCU, and an emulator can support an entire cluster of such devices. In short, the power and versatility of combined protocol converters is often necessary in today's multiple-vendor environments. □

David Misunas is assistant vice president of protocol conversion products at Micom Systems Inc., Chatsworth, Calif. He was formerly president and co-founder of Industrial Computer Controls Inc. (ICCI) prior to its acquisition by Micom in 1983. Mr. Misunas has degrees in electrical engineering and computer science from Massachusetts Institute of Technology, Cambridge, Mass., and holds numerous patents in the fields of computer architecture and audio signal processing.

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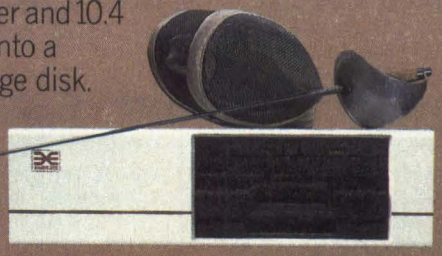

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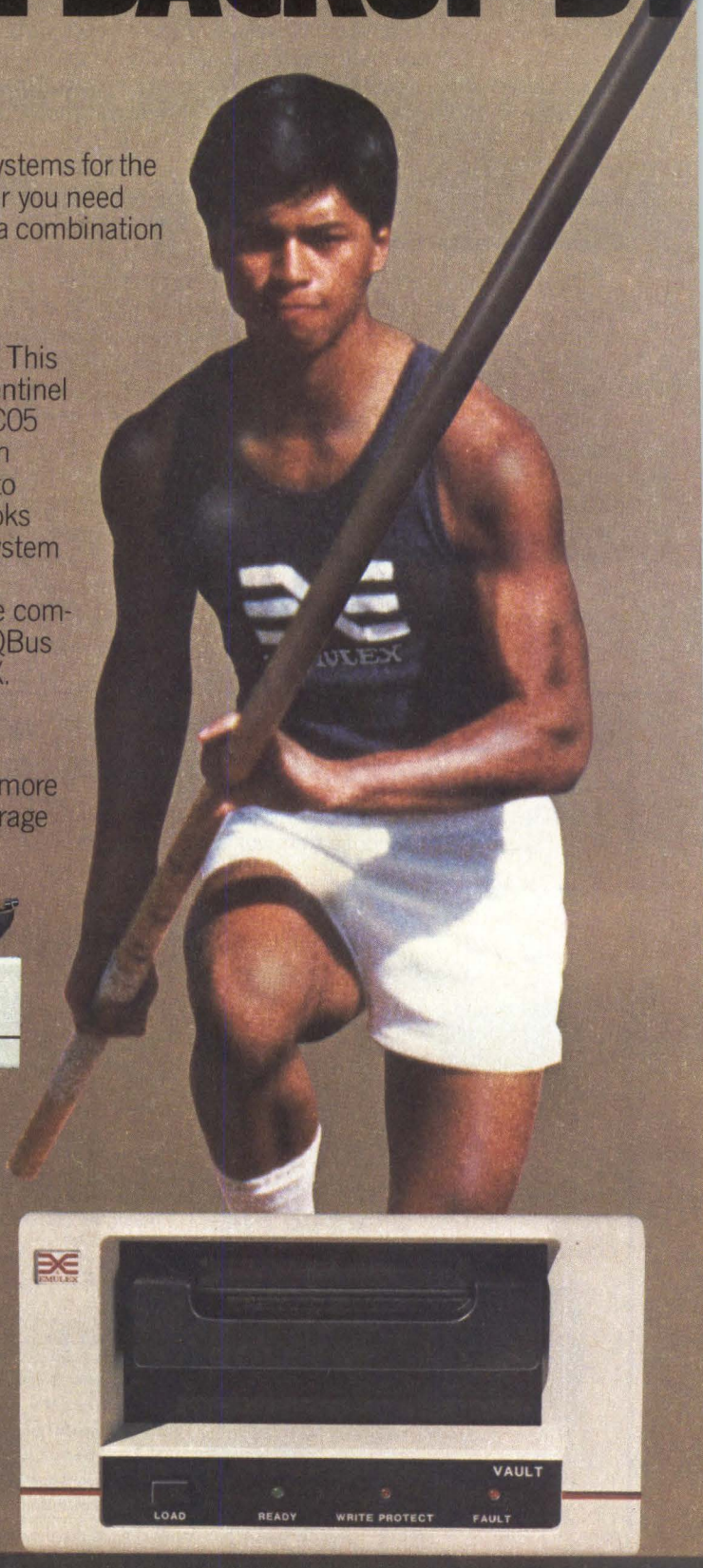

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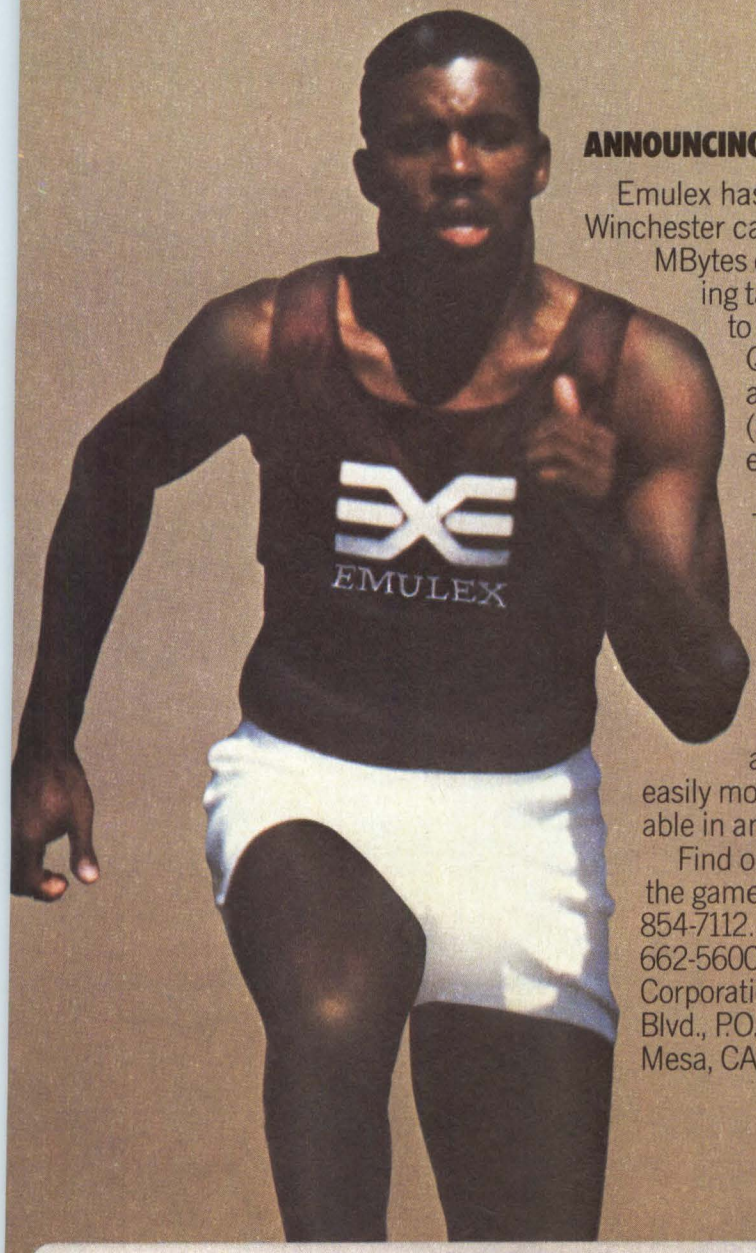

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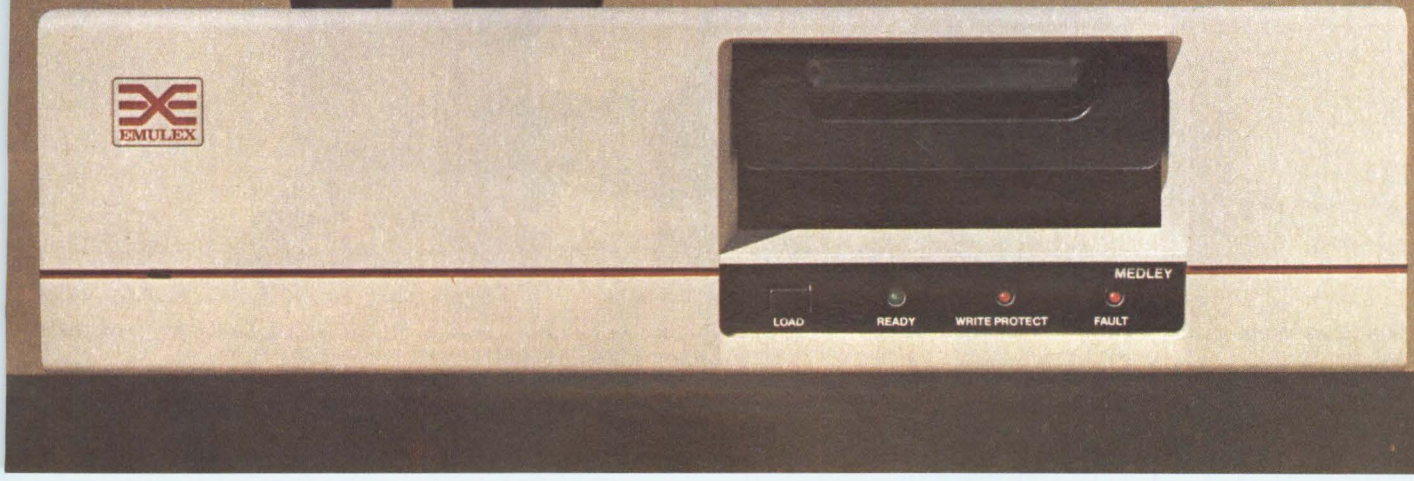

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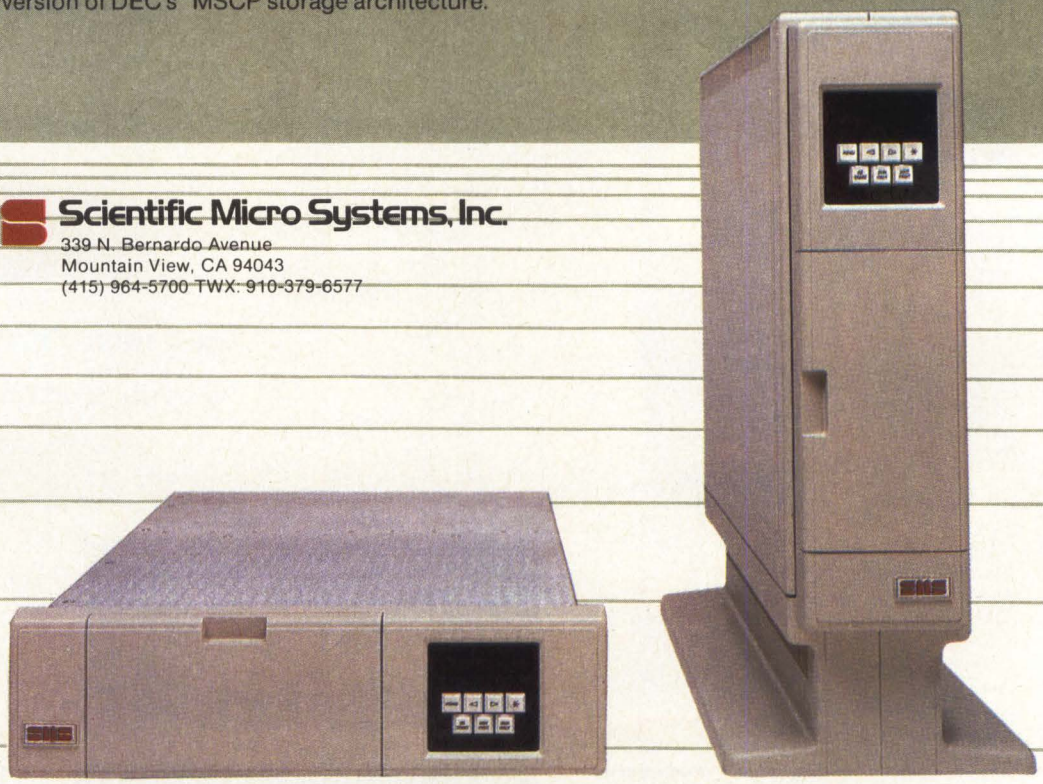
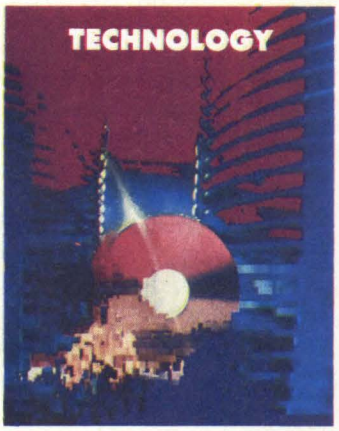




Teaching computers English proves easier than training people

If computers are to be true adjuncts to human nature, they must first learn to speak natural human languages

Dr. Lawrence Harris
Artificial Intelligence Corp.

Natural languages like English are the means humans normally use to communicate with one another. However, when it comes to communicating with computers, humans traditionally have employed a different set of languages—rigid, formal languages such as FORTRAN, PL/1 and FOCUS. Now, for computers to become a broadly used tool, we must either train the people to use these formal structures or program the computer to understand natural languages. The latter approach, although difficult, is much easier than dealing with the human issues involved in training the general population to use programmed languages.

The task of instructing a computer to understand a natural language is a hard one because of the inherent imprecision and ambiguity of language. The process deals with analyzing three general components: syntax, semantics and pragmatics. Syntactic analysis separates the natural language sentence into its constituent parts. This separation aids in the nearly simultaneous semantic analysis in which an internal representation for the meaning of the entire sentence is constructed. Pragmatic analysis goes one step beyond this by considering the intent of the speaker—not just a literal interpretation of the words used.

Current natural language technology has two important applications: as a human interface to database systems and as a vehicle for integrating a variety of traditional software systems. Both of these are having a major impact on the way information is disseminated within major U.S. corporations today.

Syntax is key

The first step in programming a computer to understand an English sentence is to determine the syntactic role played by each word in that sentence. The different meanings of "The boy hit the ball" and "The ball hit the boy" are due to the different roles played by the words in each sentence, because both sentences contain the same words. Syntactic analysis determines which word is the subject and which word is the direct object.

The importance of syntactic analysis is that it provides a "road map" for generating a semantic structure that represents the meaning of the sentence. The process of syntactic analysis is the same as diagramming sentences as taught in grammar school.

In order to automate this process, the rules of grammar and the diagramming structure must be made amenable to computerization. The two most common approaches to the problem are context-free grammar and the Augmented Transition Network (ATN). Context-free grammar consists of replacement rules that specify for the computer the "legal" (i.e., acceptable) constituents of each syntactic component and so are literally the "rules of grammar." The ATN represents each rule as a transition or arc in a network. Within this more visual representation it is a little easier to see the relationship between various rules (see "ATN teaches machines grammer," Page 164). Aside from convenience, the two formalisms are equivalent.

Parse trees point to meaning

The diagramming structure taught in school is difficult to mimic on computers because of the myriad of different lines representing different relationships. A more appro-

priate formalism for computers is the "parse tree" (see "Parse trees bear syntactic fruit," Page 167). The parse tree shows the hierachical relationship among words by imbedding them in a tree structure that indicates which words or phrases modify other words or phrases.

It is important to recognize that the parse tree does not represent the meaning of the sentence, only its structure, but without understanding a sentence's structure, it is impossible to understand its meaning—just as it is impossible to know from the words alone whether the boy or the ball is hit in the earlier example.

Syntactic analysis is the best understood aspect of computational linguistics. Efficient parsers abound for constructing detailed parse trees. The primary difficulty involved in syntactic analysis is ambiguity. Roughly speaking, two types of ambiguity must be dealt with. These are lexical ambiguity, arising from words having more than one meaning; and structural ambiguity, arising from several different legal syntactic arrangements of the same words. Both forms of ambiguity result from there being more than one possible path through the ATN, with each generating a different parse tree. Lexical ambiguity might allow more than one arc because a word such as "run" may rightfully play the role of a verb or a noun. Structural ambiguity might arise because more than one option might be permissible within the ATN itself. For example, when two prepositional phrases follow a noun, they may be nested (as in our example) or both prepositional phrases may modify the lead noun.

It is essential that a parser intended for commercial use be capable of dealing with these and other forms of ambiguity. Many parsers stop when they find the first designation of a word. Worse yet, some ignore ambiguities altogether and so are certain to disappoint users because the richness of the English language is such that ambiguity arises with surprising frequency. It is critical that a true natural language system deal with ambiguity efficiently and effectively. This begins with a parser capable of generating multiple parse trees for ambiguous sentences.

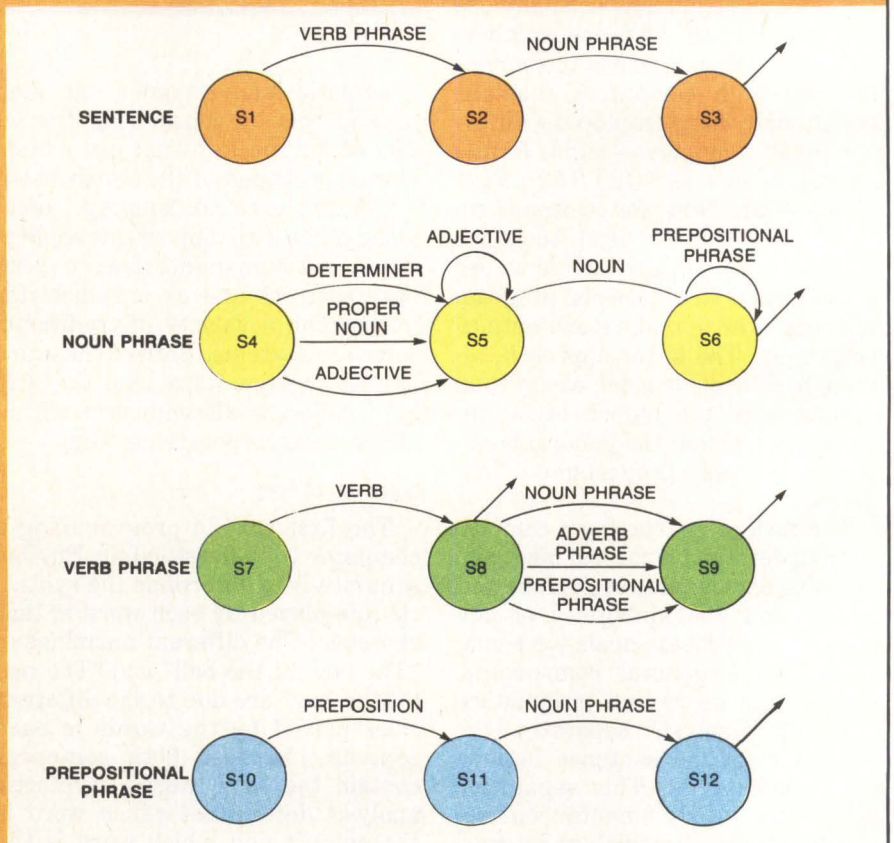
Semantics and meaning

"Semantics" refers to meaning. It is difficult at the onset even to think how a computer could represent meaning at all, much less the meaning of a particular sentence. Before describing different ways of repre-

ATN teaches machines grammar

Augmented Transition Network (ATN) is a device for representing the "rules of grammar" on a computer. The circles represent "states" of a simple machine, and the arcs represent the allowable "transition" that the machine makes as it moves from one state to another. Each transition is labeled with the part of speech that is allowed to trigger the corresponding transition. In this way the higher-level units of speech (i.e., prepositional phrases, verb phrases, noun phrases and ultimately sentences) are defined in terms of lower- level parts of speech such as adjectives, prepositions, nouns and verbs.

For example, the ATN for "prepositional phrase" starting at state S10 defines a prepositional phrase as the sequence of a preposition followed by a noun phrase. Similarly, the ATN for "sentence" starting at state S1 defines a sentence as a verb phrase followed by a noun phrase. ATN represents the rules of grammar in a way that easily allows an input sentence to be "parsed" or "diagrammed" so that the syntactic role played by each word or phrase is understood. The result of the traversal of the ATN is the "parse tree."



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senting meaning on a computer, it is important that we understand the difference between syntax and semantics. The simple phrase "a hot cup of coffee" illustrates the difference. A syntactic parsing of the phrase would indicate that the word "hot" modifies the word "cup." But we know that the true meaning of the phrase is that the coffee is hot, but not necessarily the cup. No matter what semantic representation we choose, it is clear that it will differ from the parse tree.

There are almost as many semantic representations as there are programmed natural language systems. The semantic representation is almost always tailored to the domain in which the system is to be applied. Because no single scheme has been found that works equally well in a variety of applications, it is necessary to customize a representation that is best for the task at hand.

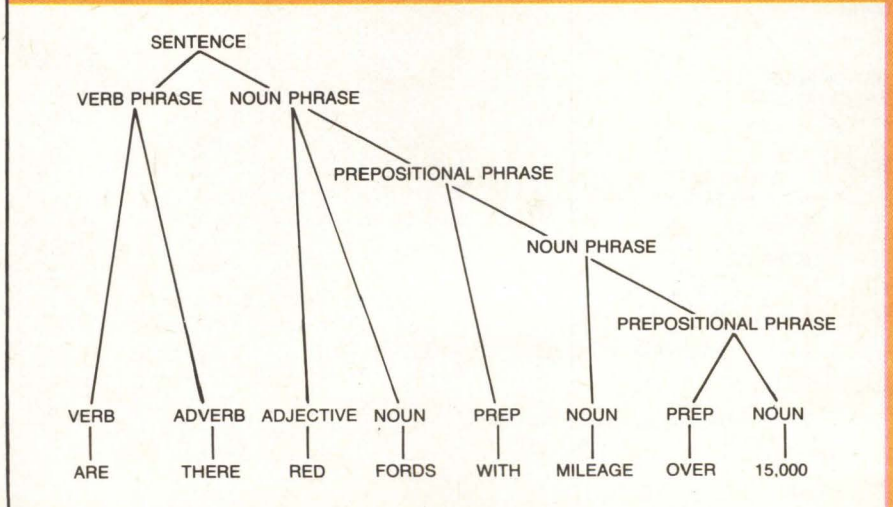
If the task is a logical question-and-answer situation, the semantic representation might be based on predicate calculus to aid in theorem proving. If the task is a database query, the semantic representation might be based on a relational calculus similar to that of a relational database management system. For other applications, a hierarchical classification might be appropriate. In any case, the structure built to represent the meaning of a sentence must be consistent with whatever scheme the natural language system uses to represent the "world knowledge base" i.e., its understanding of the real world in which its users exist. This is because the world knowledge base must have an impact on the understanding of a new sentence (or else you would not know that the coffee should be hot, not the cup). It must also allow the new sentence ultimately to add to the world knowledge base should it represent a new fact. Therefore, the representations must be compatible, if not identical.

If the task is a logical question-and-answer situation, the semantic representation might be based on predicate calculus to aid in theorem proving.

No matter what representation is used, the procedure for building the semantic structure proceeds as follows: initially, there is a definition for each word in the sentence. Because this definition is the meaning of the word, it is a mini-semantic structure. The individual meanings are combined according to how the parse tree indicates they syntactically relate to one another. When one word modifies another, its semantic structure alters the semantic structure of the word it modifies. The mini-semantic structures are merged first word-by-word, then phrase-by-phrase and ultimately clause-by-clause. As more and more words participate in the structure, the structure becomes more complete. Eventually, the structure for

Parse trees bear syntactic fruit

A parse tree illustrates the syntactic role played by each word or phrase in a sentence. The parse tree is created as each word of the sentence traverses the ATN. For example, "Are there red Fords with mileage over 15,000?" would be processed as follows. First, each word is mapped to its part of speech, which corresponds to the bottom row of the parse tree. Second, the ATN begins at its inital state, "S1," where it looks for a verb phrase. Processing at the sentence level pauses while processing at the verb phrase level begins at state "S7."



At this point, the verb "are" is parsed and the link from the verb phrase is created in the parse tree. Next, the adverb "there" is parsed and the link from verb phrase to adverb is established. Then, the upward arrow from state "S9"indicates that a verb phrase has been successfully recognized and can now continue processing at the sentence level of "S2."

This creates the link between sentence to verb phrase in the parse tree. The processing would then continue with the word "red" beginning a noun phrase, and the remainder of the parse tree would be created. A parse terminates successfully whenever the upward arc from "S3" is traversed, indicating an entire sentence has been recognized. The completed parse tree stores the syntactic relationship between each word in the sentence and acts as a road map for building the appropriate semantic structure of the sentence.

the entire sentence is generated.

Although this description seems to indicate that semantic analysis follows syntactic analysis, it is in practice almost essential for the two to take place simultaneously. As the parse tree is constructed, the corresponding semantic structure is built. This allows the semantic world knowledge to affect the syntactic analysis. Often, semantic information will help rule out certain interpretations, and this can be critical in reducing the number of interpretations that must be considered.

Increasing comprehension

The term "pragmatics" refers to those aspects of natural language discourse that are not explicity contained in the words actually used.

It is essential that a parser intended for commercial use be capable of dealing with ambiguity.

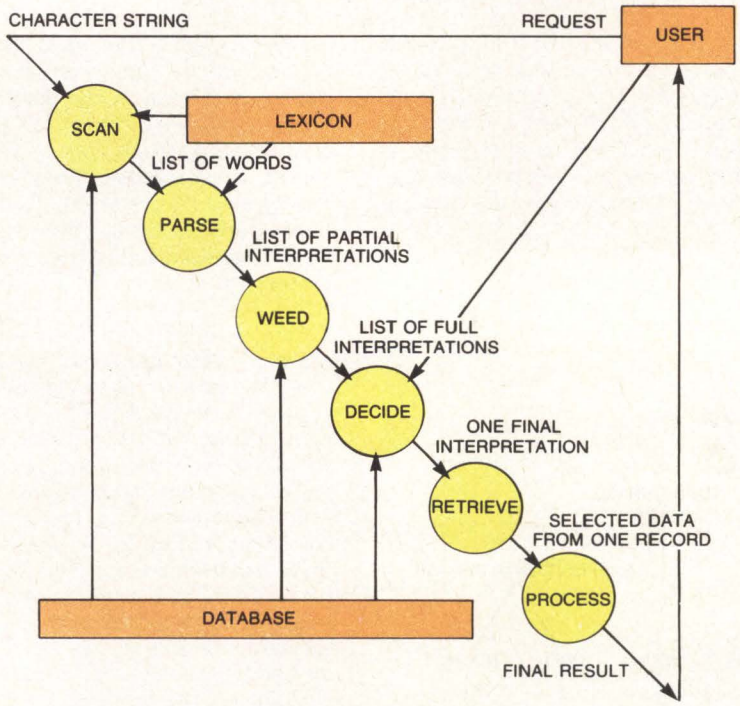
Much of human communication, after all, takes place not by what is actually said, but by what is intended.

Pragmatic analysis usually takes place after semantic analysis is complete and the meaning of the sentence is being merged into the context of the ongoing dialog or the world knowledge base. Often this merging process will indicate that some processing other than the normal is required. For example, in a database query context, there can be questions such as, "Who is Smith?" or "What is the salary of Smith and Jones?" If the normal response to a "who" question is to print a person's name, such a response is clearly inappropriate to "Who is Smith?" because the user already knows Smith's name. Similarly, printing only the two salaries in response to the second query would be inappropriate because the user would not be able to tell which salary was Jones' and which was Smith's. In such cases, pragmatics dictate answering with what the user wants, not precisely what was requested.

Another example, one in the context of a mechanical repair dialog, is the question, "Where is the

A natural language system in action

The levels of analysis that take place within one natural language system, the INTELLECT system from Artificial Intelligence Corp., shows the sequence of steps in which a user's request is answered. The arrows represent pipelines along which data flow. The circles represent programs that alter the structure of the data.



The process begins with the user entering a request via the keyboard. This is presented to the SCAN module as a string of characters. SCAN immediately transforms this string into a list of words. This list of words is passed to the PARSE module, which uses an ATN to generate a set of parse trees and, ultimately, a set of semantic interpretations. There may be more than one interpretation if the request is ambiguous. The parser generates partial interpretations because the user's request may not have been complete. The WEED module attempts to reduce the number of interpretations by first completing them and then looking for any inconsistencies.

Any interpretations that survive WEED are both syntactically and semantically meaningful. If more than one interpretation survives the WEED process, it is up to DECIDE to determine which interpretation was intended by the user. DECIDE may simply ask the user for clarification. The single interpretation that emerges from DECIDE is the one that will be answered. Then, the RETRIEVE process begins extracting relevant information from the database and passes that data to the PROCESS module that formats the results sent back to the user.

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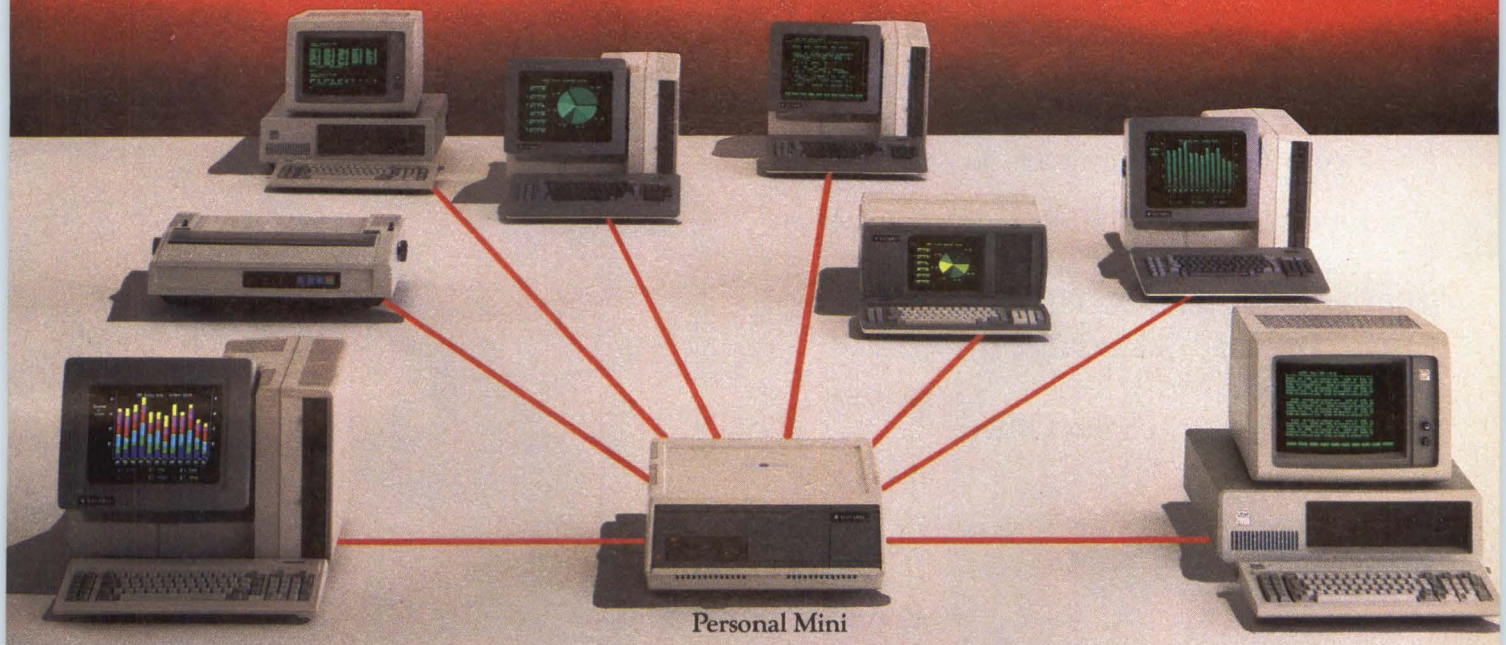

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wrench?" To respond to this sort of query, the system must first determine why the user is looking for a wrench, and if such a step is appropriate at this particular time in the assembly process. If the tool is not right for the time, then the system may not want to answer the question at all. Instead, it should determine where the user really is in the assembly process and react accordingly.

Pragmatic analysis is always very application-dependent, but it can frequently help divest interpretations of ambiguity by indicating how far out of context a particular request may be. Because interpretations within the context of the ongoing dialog are more desirable than those which have nothing to do with the subject under discussion, pragmatic analysis is an important aspect of making a natural language system seem intelligent.

Improves database interfaces

The largest commercial use today for natural language processing lies in database system interfacing. This use of natural language technology allows non-technical users to access directly and analyze the data in a computer database. Prior to such systems, access was limited to technical users who could program requests for information in formal computer languages. Because the decision makers within an organization do not typically have the technical skills necessary to program their own requests, the addition of a natural language interface has the profound effect of putting decision makers directly in touch with the data so critical to their jobs. For this reason, natural language technology can have a dramatic impact on how information is used and disseminated within an organization (see "A natural language system in action," Page 168).

The primary value added by a natural language interface is not derived from the language per se, but is more related to the fact that the user can express a business problem in business terms without having to divide the problem into a sequence of small steps as required by a formal computer language. For example, consider the request, "Compare the average salary of men to that of women." In a formal system the user would have to learn how to express this problem as a sequence of 30 to 40 commands. This might first be a retrieval of the men and women sorted by sex to facilitate the calculation of the subaverages for each sex. These results must be fed into a calculation of the absolute and relative differences between the averages.

> Pragmatics dictate answering with what the user wants, not precisely what was requested.

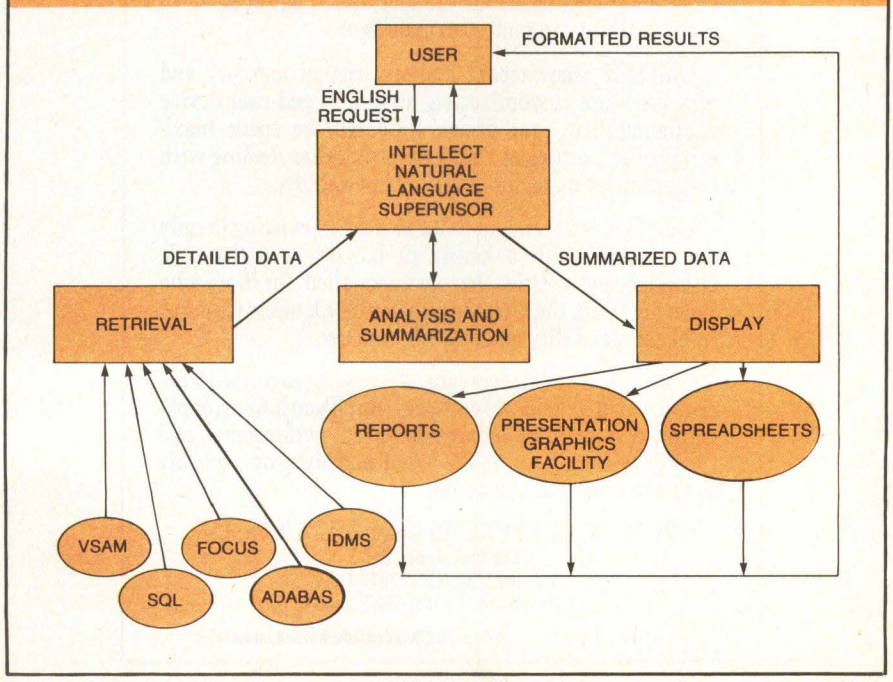
A natural language front-end will not only understand this English wording, but it will also determine the proper command sequence the underlying database system requires to compute the proper result. The user is free to continue to think at the level of the business problem without being forced to consider very detailed programming issues. The importance of allowing business users to concentrate on solving business problems cannot be over-emphasized. It is an essential requirement for making the computer an effective business tool for the non-technician.

Supervisors aid naive users

Another important use for natural language technology in the corporate environment lies within the "Information Center." An Information Center is a central data processing facility that provides end

Supervisor spans computer/user gap

The Natural Language Supervisor uses the natural language system to integrate a variety of traditional software systems such as database, graphics and statistics systems. The result is an extremely high level operating environment in which the power of these traditional systems can be employed by non-technical end users. The Natural Language Supervisor acts as an intermediary for the user by first partitioning the work among the various software tools and then orchestrating their execution to deliver the final results.



users access to a number of powerful tools such as databases, graphics, statistics and financial modeling. By giving access to corporate data and in training users how to use the available tools, an Information Center lets users solve their own problems rather than waiting for Data Processing to write custom applications. The Information Center concept has proved successful in a number of corporations. However, a single user may be forced to learn several systems as well as learn the methods of passing data between them.

In the same way that natural language generates a sequence of commands to a database system, it can also interface to graphics and statistical systems. Thus a single request might require the retrieval of data from the database system, summarization through the statistic system and finally display through the graphics system. The programmed natural language system plays the additional role of partitioning the work among each of the tools and then orchestrating the overall process until the final result is displayed. In this way even the naive user can effectively apply each tool without having to learn how to pass data between them. Instead, the natural language system supervises the entire process. □

Larry Harris is president and a founder of Artificial Intelligence Corp., Waltham, Mass. He is the author of INTELLECT, the company's natural language system. Before 1979, he was a professor of computer science at Dartmouth College. Harris received a B.S. in computer science and engineering and an M.B.S. and a Ph.D. in computer science from Cornell University.

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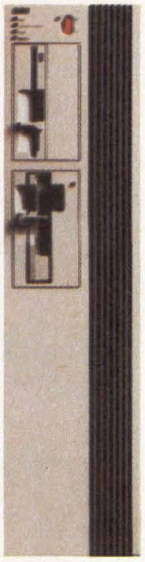

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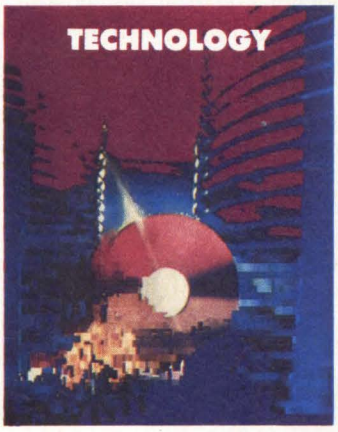

Multiprocessor architectures spark interest in 32-bit buses

VMEbus, NuBus, Futurebus and Multibus II designed to accommodate multiple processors

Rick Dalrymple, Senior Editor

What do almost all of the recently introduced multiuser microcomputers have in common? A multiprocessor architecture. The trend is clear: Both computer manufacturers and system integrators are turning to multiprocessor designs because these architectures lead to systems that are more reliable, available and flexible than single processor-based products. System integrators planning a multiprocessor-based system will be pleased to know that the new 32-bit buses have been specifically designed to accommodate multiprocessor architectures.

Choosing a 32-bit bus, however, is not a simple task. Upon close examination, system integrators will note that each bus stems from a different philosophy. One way to gain a working knowledge of the four key 32-bit buses—VMEbus, NuBus, Futurebus and Multibus II—and to fully understand their philosophical differences, is to trace their roots. This process also discloses the historical role of another 32-bit bus—VERSAbus. But, before beginning this analysis, system integrators should be aware that Digital Equipment Corp. officials confirm that the company is working on its own 32-bit bus. They, unfortunately, are not willing to disclose either a preliminary description or a target introduction date.

As noted in the first article of this series (MMS, August, Page 171), today's popular 8- and 16-bit buses trace their roots back to the mid 1970s when 8-bit single processor systems with 64K-byte addressing represented the state of the art. But, these buses soon will be technologically mature. Using boards with newer state-of-the-art, very-large-scale-integration (VLSI) components, in conjunction with these "older" buses, will appear wasteful because the bus architecture will limit component performance. Clearly, system integrators will want to migrate to a 32-bit bus architecture where new VLSI components can be fully exploited.

While early implementations of 8- and 16-bit buses were in single-processor systems, they recently have been used for single-processor-dominated multiprocessor systems. Although integrators can configure single-processor or single-processor-dominated systems using a 32-bit bus, some will choose to employ coequal or "true" multiprocessor designs. From a hardware point of view these coequal multiprocessor systems would be considered closely coupled. Other integrators may choose to use multiple CPU boards where each CPU board operates so independently that it can run a different operating system. These multiprocessor systems would be considered loosely coupled from a software point of view and closely coupled from a hardware point of view.

In both of these configurations CPU boards share the system's resources. Those resources may include disk drives, printers, communications server and global memory. Each board controlling these resources may contain its own dedicated CPUs and therefore are intelligent cards capable of bus mastery. So, unlike 8- and 16-bit buses that

This is the second in a series on microcomputer bus standards. The first article focused on 8- and 16-bit buses (MMS, August, Page 171). A third article will discuss data transfers, arbitration and interrupts on the emerging 32-bit bus standards.

accommodate only a limited number of bus masters, the new 32-bit buses may be configured using intelligent cards exclusively.

Futurebus influences other buses

Many of the concepts now implemented by VMEbus, NuBus and Multibus II were exchanged and then analyzed in the meetings of IEEE working group P896. Over the last five years, this group has been shaping a specification that takes into account future bus requirements well into the 1990s. The bus specification has understandably been dubbed Futurebus.

The IEEE P896 work has been so influential it has prompted Texas Instruments Inc.'s (TI) NuBus development manager George White to comment, "The P896 committee could declare themselves a success based on their influence on other 32-bit buses alone." Paul Borrill, IEEE P896 chairman, acknowledges his committee's influence, but points out there are several Futurebus concepts not addressed by the 32-bit buses now on the market. He cites fault tolerance and support for cache memory as notable examples.

Of all the 32-bit buses now in specification form, the Futurebus is the closest to becoming the first 32-bit bus to be adopted as an IEEE standard; VMEbus, NuBus and Multibus II are from one to two years away from becoming IEEE standards. Borrill is also the chairman of a new IEEE "P" group chartered to derive an IEEE standard from the Multibus II specifications written by Intel Corp.'s OEM Modules Operation, Hillsboro, Ore. He argues that eventually the IEEE will adopt additional 32-bit buses. "There is no reason why there should only be one standard," maintains Borrill. "Systems integrators have to solve a wide variety of applications and no one bus standard is so versatile that it can meet the needs of every potential application."

VMEbus proponents appear to be following a philosophy that suggests that an interface bus specification should pace technology.

Although the Futurebus specification is complete enough to begin designing modules, so far, no single-board manufacturer has announced plans to support the Futurebus. Borrill says that semiconductor and board manufacturers have expressed interest in Futurebus products. However, the Futurebus is not seen by single-board computer manufacturers as a potentially popular 32-bit bus specification. Currently, most single-board computer manufacturers are focusing their attention on VMEbus and Multibus II. Nevertheless, commerical computer products based on a Futurebus-like backplane have been implemented by Tektronix Inc., Beaverton, Ore. The Tektronix 6000 family of intelligent graphics workstations, introduced last September, supports multiple CPUs, multiple users and multiple graphics displays per user. The systems are aimed at the mechanical and electronic engineering design market.

Committee work on the Futurebus began before most 32-bit interface buses entered the market. Therefore, in addition to its standards function, the IEEE P896 committee served as a design center by bringing together people interested in creating 32-bit buses: VMEbus, NuBus and Multibus II entered the market as Futurebus specifications developed.

System integrators will find that NuBus and Multibus II share several concepts and features with Futurebus. The VMEbus, however, was less influenced by P896 committee work. Introduced in 1980, two to three years before NuBus and Multibus II, the current VMEbus specifications bear a close resemblance to the edge-connector-based VERSAbus.

VERSAbus/VMEbus connection

A little bus history is enlightening. Borrill recalls that the VERSAbus specifications, written by Motorola Semiconductor Products Inc., Phoenix, Ariz., were submitted to the P896 committee in 1979 for consideration as a 32-bit bus standard. Although the submission was rejected on several points, two points stood out as primary objections. First, the VERSAbus used dedicated interrupt lines that the

COMPARING 32-BIT BUSES

	VMEbus	Futurebus	NuBus	Multibus II
Bus type	asynch, 32-bit, nonmultiplexed	asynch, 32-bit, multiplexed	synch, 32-bit, multiplexed	synch, 32-bit, multiplexed
IEEE working group number	P1014	P896	to be issued	to be issued
No. of signal lines (excluding power)	107	71	49	67
Centralized services	clock, arbiter, power up/down	none	clock, bus timeout	clock, bus timeout, reset, card ID
Data widths supported less than 32 bits	8, 16, 24	8, 16	8, 16	8, 16
Handling technique for data widths less than 32 bits	justified (dynamic sizing)	unjustified	unjustified	justified
Geographical addressing	no	yes	yes	yes
Power (V)	5, ±12	5	5, ±12	5, ±12

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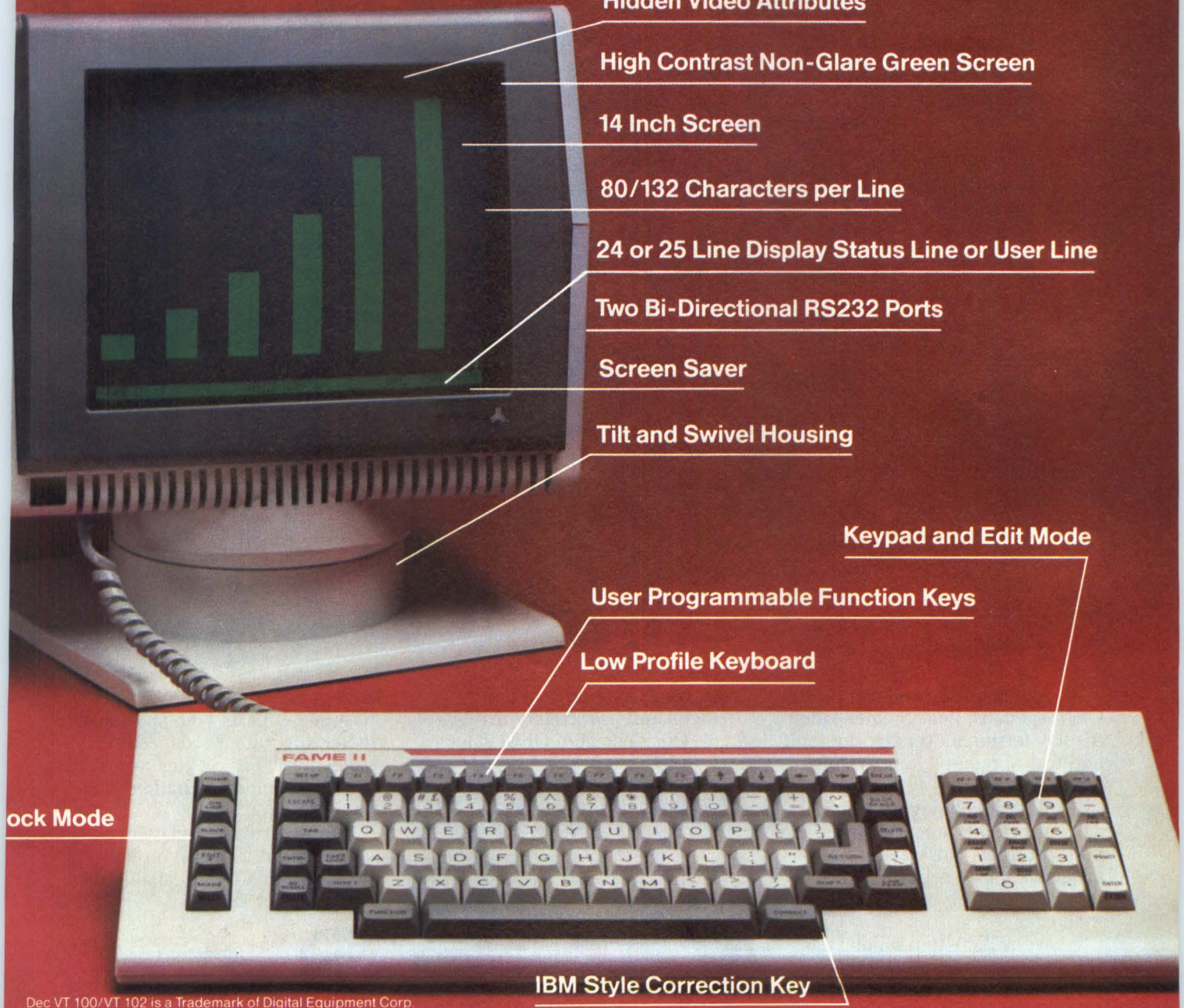

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committee felt would be inadequate to handle the more complex interrupt requirements of future multiprocessor systems. Second, the VERSAbus' daisy chains would prevent the incorporation of several user-configuration features envisioned by the committee. "Because we perceived an immediate need for a well-defined 32-bit bus," says Motorola's John Black, "Motorola, along with other board-level and semiconductor manufacturers, chose to define a Eurocard-based bus derived from the proven VERSAbus definition." The result was the VMEbus (VERSA Module Eurocard) introduced in 1980.

In the clearer light of hindsight, early VMEbus proponents made a wise marketing decision when they decided to pursue an existing solution (the VERSAbus) that addressed:

- The desire for a bus standard that would allow systems initially using boards containing 32-bit microprocessors with 16-bit data widths to later upgrade to full 32-bit data width microprocessors
- The requirement that a bus standard provide both arbitration and interrupt capabilities suitable for multiprocessor system architectures
- The need for a mechanical specification that provided, in addition to room for expansion and higher reliability, a mechanical interface allowing other existing buses to be added as bus extensions.

By adapting the VERSAbus specification to a Eurocard mechanical format, the VMEbus fulfilled the third criterion and introduced a bus that could be used with several existing and developing Eurocard-based 8- and 16-bit buses. By meeting the first criterion, system integrators looking for a way to ease the transition to 32-bit wide data path microprocessors could adopt the VMEbus, knowing in advance the probable system-level impact of shifting to wider data path microprocessors. However, the item that stirs up the most controversy is the second criterion, the requirement that a bus standard provide both arbitration and interrupt capabilities suitable for multiprocessor system architectures.

Eurocards come in different sizes

Although 32-bit buses contain elements that make them incompatible, some compatibility exists at the mechanical interface level. VMEbus, Multibus II, NuBus and Futurebus have all adopted the Eurocard family of boards and IEC 603-2 (DIN) 96-pin connectors. So while they now serve as mechanical interfaces for several popular European 8- and 16-bit buses, they will, due to their flexibility, also continue to allow Eurocard-based buses to keep pace mechanically with new architectures and performance requirements for several years.

Although mechanically compatible within the Eurocard family, 32-bit cards come in different sizes. The table below compares the formats:

	VMEbus	Multibus II	NuBus	Futurebus
Eurocard type	single height, double height	double height extended	triple height extended	triple height
Dimensions	100 x 160mm, 233.35 x 160mm	233.35 x 220mm	366.7 x 280mm	366.7 x 280mm
No. of DIN connectors	1, 2	2	3	3

Capabilities stir debate

Futurebus, NuBus and Multibus II proponents argue that the VMEbus does not provide arbitration and interrupt capabilities to address the upcoming needs of multiprocessor system architectures. VMEbus supporters respond that, on the contrary, the VMEbus is well suited to multiprocessor architectures being implemented by system integrators today. To meet the interrupt capabilities of future multiprocessor systems, work is already underway on another VMEbus document that will define a message-passing technique as a separate layer above the current collection of VMEbus specifications.

All the proponents of 32-bit buses see message passing as a feature that allows an interface bus to meet the more complex requirements of future multiprocessor architectures. According to Motorola's Black, "Back in 1980 a conscious decision was made to define message passing as a separate layer." That thinking is just now being formally shared with members of the VME Manufacturers Group as VMEbus proponents prepare a document for consideration by the VMEbus IEEE working group P1014.

Using history as a guide, VMEbus proponents appear to be following a philosophy that suggests that an interface bus specification should pace technology. As architectures evolve, VMEbus proponents will augment the VMEbus specification with other documentation that defines higher levels of protocol. By moving ahead with the capability already available in 1980, the VMEbus now enjoys the support of over 100 board-level manufacturers worldwide. According to Gnostic Concepts Inc., a Menlo Park, Calif., market reseach concern, the VMEbus became in 1983 the fourth largest bus standard in the U.S. market (based on dollar sales volume of single-board computers).

NuBus, Multibus II enter market

Until this year, system integrators looking for 32-bit bus products had one choice—VMEbus. Now two other 32-bit buses are entering the market. TI's NuBus Operation in Irvine, Calif., began production of NuBus boards earlier this year. In late September, Intel's OEM Modules Operation, announced two Mul-

tibus II interface chips; samples of the interface chips will be available this month and Intel's board-level products are expected to be introduced in the first quarter of 1985. So far, only TI, whose Data Systems Group home office is in Austin, Texas, is marketing NuBus board-level products. As for Multibus II, John Beaston, Intel's Multibus II marketing manager, claims, "By the end of 1985, there will be 30 Intel board, software and system products. Over time, we expect the number of Multibus II vendors to grow to the same number of vendors now supporting Multibus I."

The NuBus was originally developed at the Massachusetts Institute of Technology (MIT) specifically for multiprocessor architectures. The bus was further developed at Western Digital Corp., Irvine, Calif., where it was used as the backplane for a prototype UNIX-based engineering workstation. In February 1983, TI acquired Western Digital's workstation project, obtained a NuBus license from MIT and in June, 1983, introduced the UNIX-based Nu Machine.

According to Steve Ward, associate professor of computer science and engineering at MIT, the first prototype NuBus machine was running at MIT in 1979. In that same year, an asynchronous version of the NuBus specifications was presented to the IEEE P896 committee. The prototype, however, was using a synchronous NuBus. Reflecting on the debate, Ward ob-

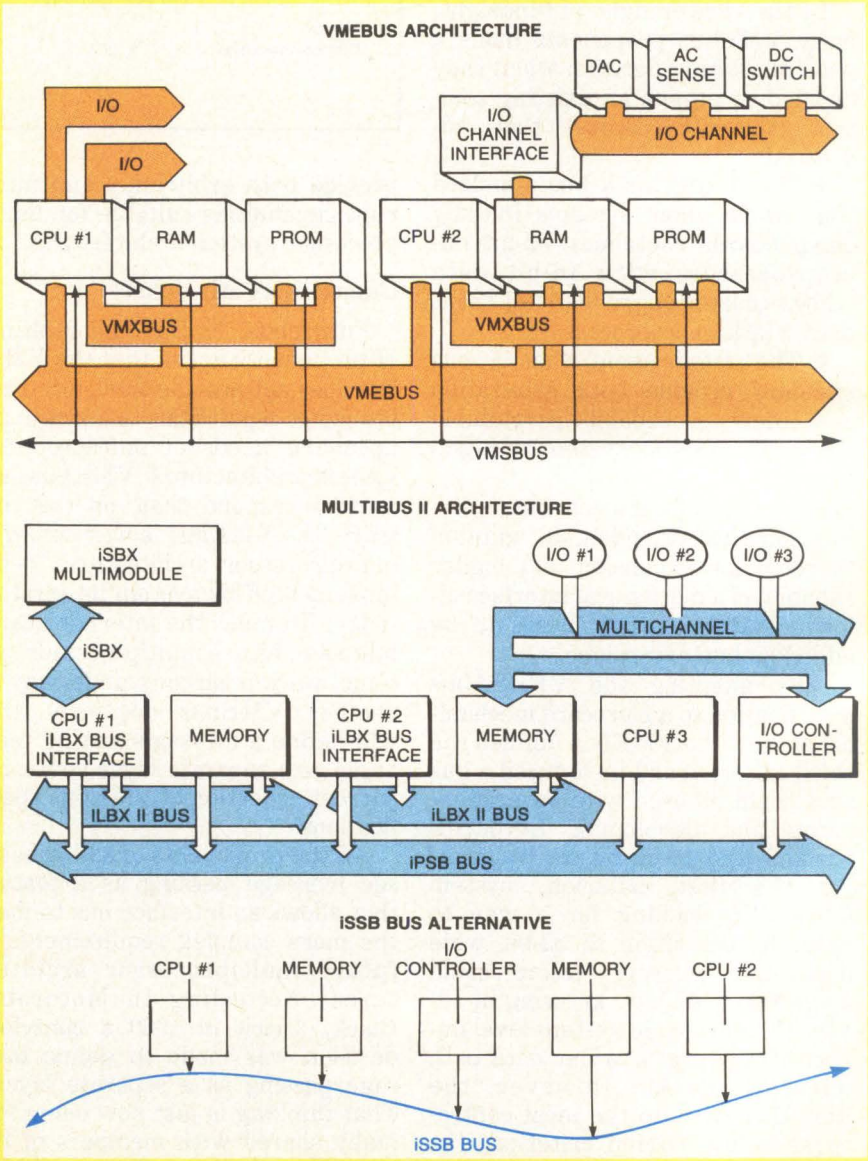
Multibus II and VMEbus offer multiple buses

Both Multibus II and VMEbus architectures contain multiple buses. The VMEbus architecture comprises four buses; the Multibus II architecture, on the other hand, comprises three buses, with bus extensions to two more.

In the Multibus II architecture the main system bus is the Parallel System Bus (iPSB). The system integragrator may choose to use the Local Bus Extension (iLBX II) Bus to remove CPU-to-local memory transactions from the iPSB bus. Another alternative is to use the low-cost Serial System Bus (iSSB) instead of the iPSB bus. The major difference between these two buses is their interconnection scheme. Although the iPSB bus uses a 32-bit-wide data path, connects to the system backplane with a 96-pin connector and runs at 10 MHz, the iSSB bus is one bit wide, interfaces to boards using a 2-pin connector attached to a cable that may be extended up to 10 meters and runs at 2 MHz.

Both the iPSB bus and the iSSB bus support I/O, message passing and arbitration. Because the iLBX II bus allows a CPU card to access memory as if it resided on the CPU card, it has been optimized for execution and only supports memory transfers.

The two bus extensions carried over from the Multibus I architecture to the Multibus II architecture are the Multichannel DMA I/O Bus and the iSBX I/O Expansion Bus. The Multichannel DMA I/O Bus allows high speed block transfers—as many as 8M bytes per second over distances as long as 15 meters—among physically distributed peripherals. Typical applications include I/O bus



serves, "The asynchronous versus synchronous issue is primarily a 'religious' debate. There are good technical arguments for both sides, but, from the system integrators' point of view, it's a push as to which is best."

NuBus uses 'minimalist' strategy

Several goals and the philosophy of the early NuBus design team have been preserved by a newly formed "P" group charged with deriving an IEEE standard based on the TI NuBus specifications. Both TI's White and MIT's Ward describe the NuBus design as a "minimalist" strategy. "The idea," says Ward, "is to strive for an economy of mechanism. Define the mechanism for data transfer, arbitration and interrupts, but do not go on to define specific techniques. The choice of technique should be left to the systems designer."

A design goal of Futurebus, NuBus and Multibus II was to fit all of the the bus lines onto one 96-pin IEC 603-2 (DIN) connector. Following the "minimalist" philosophy, TI has refused to add pins without a clear indication that something of substance is being added. The result is that the current TI NuBus specifications use only 49 signal lines, excluding power and ground. (VMEbus uses 107 lines and has to use a second connector to achieve full 32-bit operation; Futurebus uses 71 and Multibus II requires 67).

The NuBus' low pin count has some side benefits. One is testability. A system integrator can observe the operation of the entire NuBus, including arbitration signals, on a logic analyzer using only 43 channels. The other benefit is that it is possible to implement the bus using just a 64-pin subset, making it highly suitable for adaptation to future VLSI-intensive systems. On the other hand, the reduced number of power lines available with this subset may limit the size of these future modules to a single Eurocard.

Multibus II offers five buses

The "minimalist" NuBus specifications define a single bus and one 32-bit data path. Multibus II, on the other hand, specifies three buses and offers bus extensions to two more. The Multibus II architecture consists of the Parallel System Bus (iPSB), the Local Bus Extension (iLBX II Bus), the Serial System Bus (iSSB) and two buses carried over from the Multibus I architecture—the iSBX I/O Expansion Bus and the Multichannel DMA (Direct Memory Access) I/O Bus (see "Multibus II and VMEbus offer multiple buses", left).

Like its predecessor Multibus I, Multibus II provides a wealth of configuration possibilities. Unlike Multibus I, which grew over time by adding a bus here and tacking on another there, the collection of Multibus II buses are all explained in the Revision C specifications. These specifications describe a synchronous 32-bit bus that specifies more features than any of the other 32-bit buses, a much different philosophy than that held by proponents of the NuBus.

Unlike the other 32-bit bus specification documents, the Multibus II specifications include a chapter devoted to system architectural considerations. Entitled Chapter Six, this section of the Multibus II specifications explains the "layers" of the Multibus II architecture. "The VMEbus specifications did not include such a chapter when systems integrators began to implement VMEbus systems." observes Intel's Beaston. "Now, three years later, a document is being prepared to explain the 'layers' of the VMEbus architecture. Because the 'layers' were not explained up front, I think the VMEbus will encounter backwards compatibility problems. We do not want that to happen on Multibus II systems. That's why we have included a sixth chapter in the Multibus II specifications."

According to Beaston, "By using a multiple bus architecture, Multibus II can address both high performance applications and applications where cost is a primary consideration." To obtain higher performance, the Multibus II architecture may be functionally partitioned so that the iLBX II bus removes processor execution functions from the iPSB bus. Like the iLBX boards found in Multibus I systems, an iLBX II board allows a processor to access off-board memory as if it resided on the processor board. Because it has been optimized for execution, the iLBX II bus does not provide the functions of I/O, message passing, arbitration and board configuration support performed by the Parallel System Bus. The Intel

communications with graphics processors, data-acquisition modules and system-to-system links.

The iSBX I/O expansion bus and associated Multimodules allow the addition of a small low-cost board that attaches directly above a full-sized board. Using these small boards, the system integrator may configure a full-sized board more precisely by adding functions such as high-speed mathematics, memory management and voice synthesis. Unlike the Multichannel bus, which is an Intel bus, the iSBX bus has its own IEEE standard—IEEE 959—and is used in other bus architectures such as the STD-bus and the VMEbus.

The VMEbus and the VMXbus operate in the same manner as the iPSB bus and the iLBX II bus in the Multibus II architecture. Less clear, at this time, is the function of the VMSbus. Work is currently underway by VMEbus proponents to define the functions of the serial VMSbus. One of these functions is likely to be message-passed directed interrupts. When the functions of the VMSbus are defined, it will be part of a VMEbus document separate from the present Revision C specifications. The separate document is expected to define message-passing techniques as a separate layer above the current collection of VMEbus specifications.

The Motorola I/O Channel provides low-cost modular I/O expansion on a local processor bus not tied to a specific board or enclosure. The bus operates at 2M bytes per second and may be extended to 12 feet. Modules can be selected for a wide range of requirements such as analog-to-digital conversion, discrete I/O, and mass storage peripherals.

Multibus II specifications claim that the use of the iLBX II bus can reduce a processor's bus band-width requirements by 60 to 90 percent.

A serial bus low-cost alternative

When cost is a major consideration, the Multibus II architecture offers the Serial System Bus as a low-cost alternative to the Parallel System Bus. Both the iPSB and iSSB buses perform data movement and inter-processor communication functions. The major difference between the two buses is the interconnection scheme. The iPSB bus uses a 32-bit wide data path, connects to the system backplane with a 96-pin connector and runs at 10 MHz. In contrast, the iSSB bus is one-bit wide, interfaces to boards using a 2-pin connector attached to a cable that may be extended up to 10 meters and runs at 2 MHz. Although the performance of the iSSB bus is two orders of magnitude less, its cost is also two orders of magnitude less.

The first generation of Multibus II systems will probably employ the iPSB bus. Subsequent Multibus II systems, however, may employ the iSSB bus instead of the iPSB bus. As VLSI devices become more capable, the printed-circuit-board area required to implement a function will decrease. Thus. in subsequent product generations, the system integrator may choose to lower costs by implementing the same functions on a smaller, less expensive board. The iSSB bus allows the system integrator to also lower the interconnect cost by shifting to a two-pin connector and to serial media. Because the iSSB bus supports the same message-passing interface used by the iPSB bus, the integrator can migrate a second-generation product to an iSSB bus implementation with only minimal software changes.

Multibus II began, of course, as a follow-up bus to Intel's sucessful Multibus I. "The original Multibus II design employed edge connectors and a Multibus I-like form factor." says Intel's marketing manager Beaston, recalling the design evolution of the Multibus II specifications, "After reviewing the work of the IEEE P896 committee and discussing items such as the Eurocard mechanical specifications with committee members, Intel revised the Multibus II specifications to incorporate several Futurebus-like features." According to Beaston, Intel began attending IEEE P896 committee meetings in early 1982.

Multibus II has chosen the extended double-height Eurocard with two DIN connectors. In fact, all four of the 32-bit buses have adopted card sizes from the Eurocard configuration grid (MMS, August, Page 172). As for the other three buses, VMEbus uses both the single- and double-height Eurocards, whereas NuBus and Futurebus have chosen extended triple-height Eurocards (see " Eurocards come in different sizes", Page 181).

Geographic addressing is another feature Multibus II shares with Futurebus and NuBus. A typical problem encountered when installing a board into a computer system's backplane is the setting of bit switches and connecting the appropriate jumper wires. By "reading" its slot position via a set of geographical address lines, a card plugged into a Futurebus, NuBus or Multibus II backplane can automatically configure itself; this eliminates the bit switches and the wire connections. This same procedure may also be used to facilitate automatic system configuration routines.

Although Eurocards differentiate the new 32-bit buses from their edge-connector ancestors, the features that clearly make these buses so different is their message-passing capability, methods of arbitration and interrupt-handling techniques. Those items will be the subject of the third article in this series on microcomputer buses and will appear in a future issue of *Mini-Micro Systems*. □

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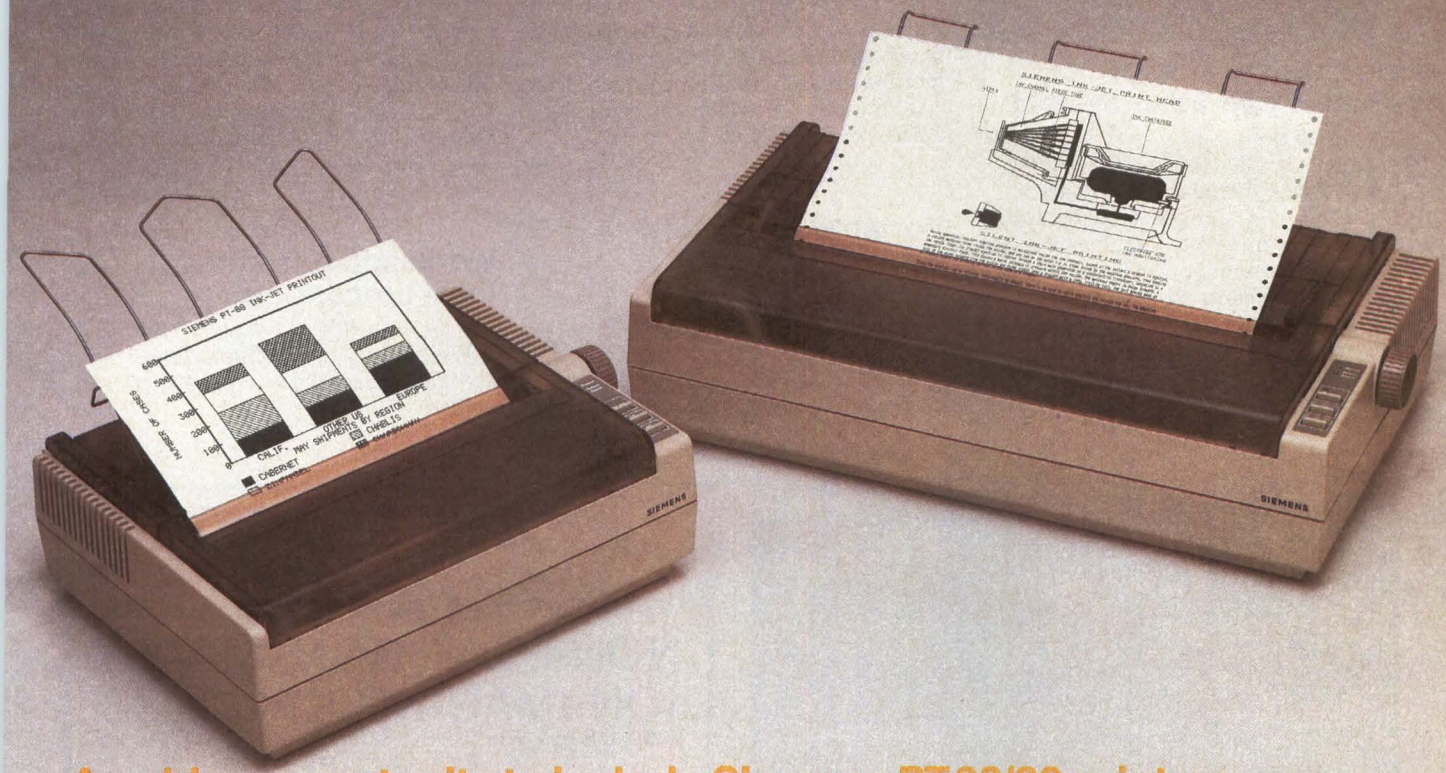

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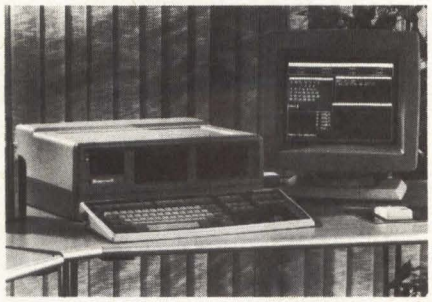

Workstation runs Uniplus operating system

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- 15-inch, 720-by-560-pixel display
- 113-key, detachable keyboard

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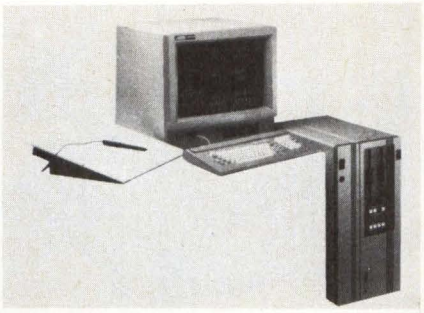

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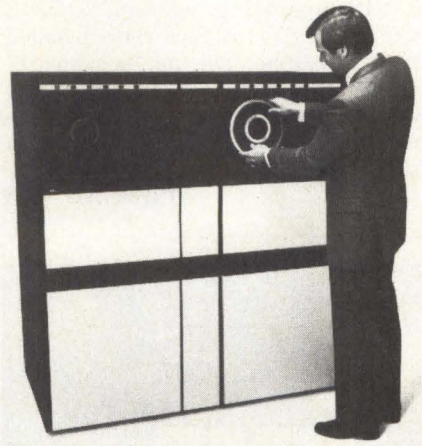
- 384K bytes of RAM
- Ramdisk and Disk Cache software

The C5010V multiuser, 8-bit microcomputer is a floor-standing system based on a 6-MHz Zilog Z80B microprocessor. In its minimum configuration, the system features five RS232C serial ports and one Centronics parallel port, 384K bytes of RAM and a choice of a 5¼-inch 14M-, 21M- or 40M-byte Winchester disk with ¼-inch, 6,400-bpi magnetic tape cartridge backup. The 14M- and 21M-byte drives provide an average access time of 68 msecs; the 40M-byte drive, a 55-msec average access time. Six serial ports, 512K bytes of RAM and 40M bytes of internal disk storage may be added to serve as many as 11 users. Two software features, Ramdisk and Disk Cache, are built into the system. Ramdisk allows the use of main memory as a logical disk for frequently accessed data; Disk Cache provides the same and updates the physical disk for fast-read capabilities. The OASIS operating system, OASIS BASIC and Control/Sort come bundled with the system. The unit measures 17 inches by 8 inches by 15 inches and weighs 30 pounds. $7,990. **Onyx Systems Inc.,** 25 E. Trimble Road, San Jose, Calif. 95131, (408) 946-6330.

Circle No 303

New Products

DISK/TAPE

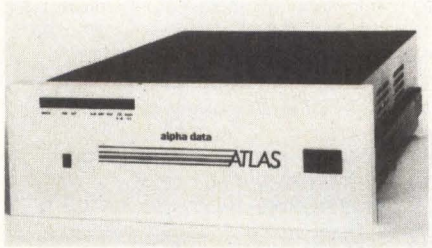


Tape subsystem connects to four channels

- 125 ips
- Reads and writes at 800, 1,600 or 6,250 bpi

The model 4650 tape subsystem features an integrated controller. It uses standard tape reels and nine-track recording technology. When equipped with an integrated data buffer called the Accelerator, it can run 3M-bytes-per-second computer channels. The drive reads and writes at 800, 1,600 or 6,250 bpi. A four-channel switch option connects the tape subsystem to four separate channels, permitting use with multiple CPUs. $45,000. **Storage Technology Corp.,** 2270 South 88th St., Louisville, Colo. 80028, (303) 673-5151.

Circle No 304

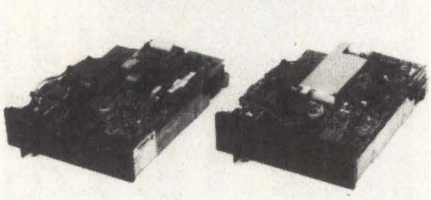


Disk drive stores 160M bytes

- Fifty read/write heads
- 18-msec average access time
- 8000 individual tracks

Achieving an average access time of 18 msecs, the Atlas disk drive incorporates 50 read/write heads on three platters that can be stepped to a total of 160 cylinders or 8,000 individual tracks. Each cylinder provides instant microsecond access to 1M byte of data. In multiuser network environments, the system is interface and format compatible with ANSI/SMD specifications. The drive employs a sealed disk head chamber that eliminates contaminants. $6,000, OEM quantity. **Alpha Data Inc.,** 20750 Marilla St., Chatsworth, Calif. 91311, (818) 882-6500.

Circle No 305



Half-height floppy drives suit desktop computers

- Double-sided
- ½M- or 1M-byte storage
- 94-msec average access time

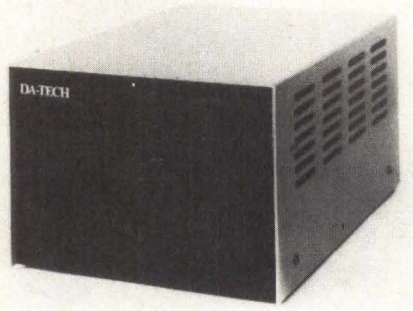
The TM-65 family of 5¼-inch, half-height, double-sided floppy disk drives accommodates portable and desktop computer systems, word processors and intelligent peripherals. The 96-tpi Model TM65-4 offers 1M byte of storage capacity and features an onboard microprocessor that controls spindle speed. The 48-tpi Model TM65-2L drive offers ½M byte of storage capacity. A split-band head positioner driven by a stepper motor achieves an average access time of 94 msecs; transfer rate is 250K bps. The drives weigh less than three pounds and measure 1.68 inches high by 5.87 inches wide by 8.07 inches long. Model TM65-2L, $125; Model TM65-4, $150. **Tandon Corp.,** 20320 Prairie St., Chatsworth, Calif. 91311, (910) 493-5965.

Circle No 306

Floppy disk subsystems store 1.6M bytes

- Directory-controlled file allocation
- Disk copy capability
- Twenty-five system commands

The 2000 series of intelligent floppy disk data storage subsystems includes two or more 5¼-inch, 400K-byte floppy disk drives, a disk controller, power supply and RS232C interface. The standalone file-oriented subsystems use CP/M-structured operations. Features



include directory-controlled file allocation, file and disk copy capability, 25 system and maintenance commands to facilitate data transfer and eight baud rates to 19.2K. The Series 200 Dual Drive Master Module contains two drives, a microprocessor controller and DC power supplies in an 8-inch-by-10-inch-by-16-inch housing. The Series 2200 Dual Drive Expansion Module "slave" unit furnishes two 400K-byte drives and DC power supplies in an identical enclosure. The Series 2240 Quad Drive Subsystem combines the master and slave modules and stores 1.6M bytes of data. Model 2000, $3,300; model 2200, $2,600; model 2240, $5,500. **Da-Tech Corp.,** 92 Steamwhistle Drive, Ivyland, Pa. 18974, (215) 322-9410.

Circle No 307

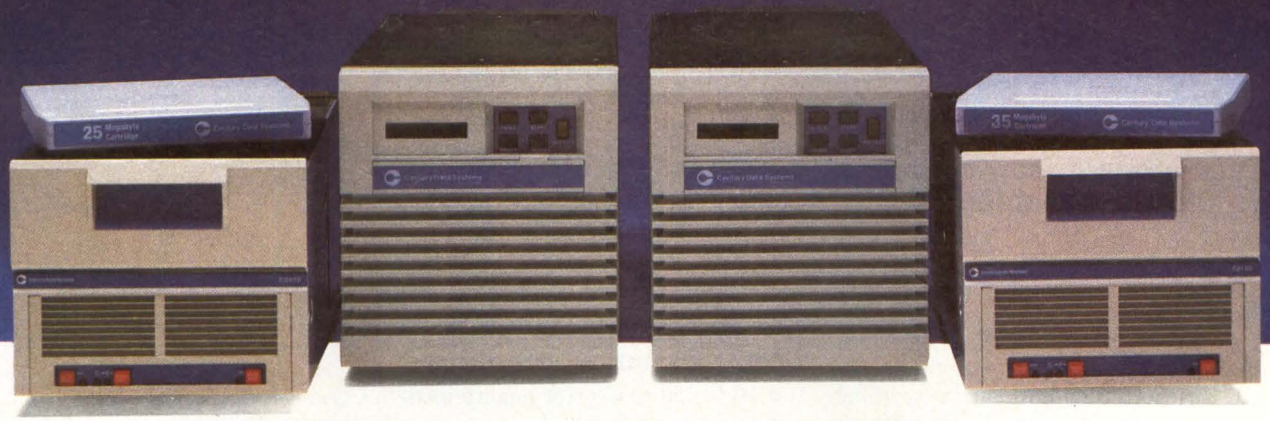
Disk subsystem suits DEC's Q-bus computers

- 10M bytes of Winchester storage
- 400K bytes of floppy storage
- Employs RQDX1 controller

The CI-550 Winchester/floppy subsystem for DEC's Q-bus 18- or 22-bit computers converts a system into a DEC Micro-11 provided it has like handlers and emulations. Furnishing 400K bytes of floppy storage capacity and 10M bytes of Winchester storage capacity, the subsystem transfers data at a rate of 625K bytes per second. Average access time is 75 msecs. The subsystem employs DEC's proprietary RQDX1 controller, utilizing the Mass Storage Control Protocol. The standard RX-50 floppy format allows media portability. Functions provided are error detection and correction, error retry, block mode DMA and bad block mapping. The package includes the RQDX1 controller card, a power supply, an external enclosure and cabling. $2,295. **Chrislin Industries Inc.,** #101, 31352 Via Colinas, Westlake Village, Calif. 91362, (818) 991-2254.

Circle No 308

8 INCH DISK MEMORIES

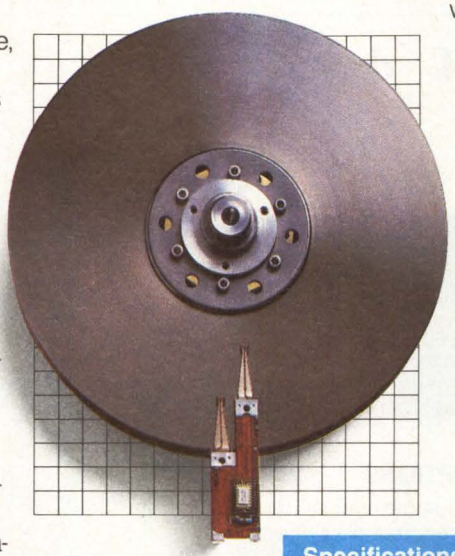


Quality Performers

Century Data Systems now introduces its new C-Series, a line of higher capacity, 8-inch disk memories. These memories are available in a variety of models to offer OEMs the versatility they want, along with the quality and reliability they have come to expect.

This new family of high performance, 8-inch disk memories uses advanced technology and provides compact, reliable mass storage. For example, our new 8-inch Winchester, the C2476, is the ideal choice for computer systems utilizing disk memories in multi-user and multi-task environments which require fast access to large files of data. The C2476 stores 476 megabytes in significantly less cabinet space than previously available models and has an average positioning time of 15 milliseconds.

The C2075, our initial C-Series offering, is an 8-inch fixed/removable disk memory containing 80.2 megabytes of storage. Continuing this line of disk memories is the C2120, our new 122.9 megabyte fixed/removable disk. Both of these disk memories provide OEMs with powerful new sales tools. The fixed Winchester disk portion of the device provides high-capacity, reliable, on-line storage while the removable cartridge extends the on-line storage and provides faster, more convenient backup than tape.



These compact, fixed/removable 8-inch disk memories are the perfect match with large personal computers, microcomputer systems or transaction-oriented systems.

All C-Series products fit in our new, standard 8.5-inch wide package. OEMs using large disk memories can now standardize on one compact package for installation in computer cabinets, equipment pedestals, or on desktops.

Like all our disk memories, the new 8-inch product line is reasonably priced, easy to install, and includes the quality and performance OEM systems require. We invite your inquiries. Write or call: Century Data Systems, Product Marketing, 1270 N. Kraemer Blvd., Anaheim, CA 92806 (714) 632-7500.

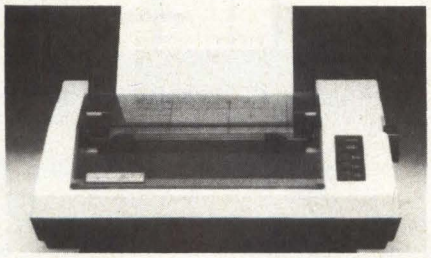
Specifications	C2075	C2120	C2476
Storage capacity, fixed disks	53.5 megabytes	87.8 megabytes	475.9 megabytes
Storage capacity, removable cartridge	26.7 megabytes	35.1 megabytes	———
Positioning time, average	32 milliseconds	32 milliseconds	15 milliseconds
Interface	SMD/LMD	SMD/LMD	ESMD
Transfer rate	1209 kilobytes/sec	1209 kilobytes/sec	1859 kilobytes/sec
		New products	

Century Data Systems
A Xerox Company

CIRCLE NO. 91 ON INQUIRY CARD

New Products

PRINTERS



Dual-mode printer connects to personal computers

- NLQ mode or draft mode
- 140-character set
- IBM PC compatible with control codes

Suited for word processing, data processing, graphics and documentation, the GP-550 performs dot-matrix printing and near-letter-quality (NLQ) printing functions. In the draft mode, the printer operates in a 9-by-9 dot-matrix format at 86 cps with six character sets. A 9-by-16 matrix provides NLQ performance at 43 cps with 12 character sets. At a less-than-60-dBA noise level, the unit prints three copies, including the original on fanfold paper from 4½ to 10 inches or cut sheet paper. Pin feed, friction feed, bottom feed and a replaceable ink cartridge are featured. The 140 standard characters include 96 ASCII characters plus 44 European letters. The standard model comes with a parallel input. Other models interface with Apple Computer Inc. computers, the IBM PC and its look-alikes and other personal computers. $299. **Axiom Corp.**, 1014 Griswold Ave., San Fernando, Calif. 91340, (818) 365-9521.

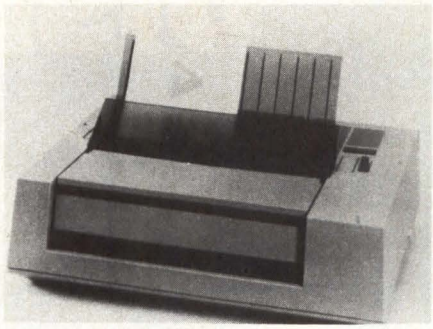
Circle No 309

Dot-matrix printer produces color, graphics

- 80 to 120 cps, letter-quality mode
- 300 cps, draft mode
- 50dB noise level

The GP300LC dot-matrix printer is equipped with color and graphics capabilities and prints at 80 to 120 cps in letter-quality mode and 300 cps in draft mode. Some of the 95-character fonts are OCR-A and -B codes, dot-addressable graphics and forms and logos, which are downloaded and controlled via software. A proprietary 18-needle print head allows single-pass dot resolutions of 18 by 50 dpi in text mode and 144 by 144 dpi for graphics. Noise level is less than 50 dB. A 2K-byte internal buffer and an RS232C interface are standard. $3,200. **Philips Peripherals Inc.**, Unit 12, 385 Oyster Point Blvd., South San Francisco, Calif. 94080, (415) 952-3000.

Circle No 310



Laser printer performs four copying functions

- 240 by 240 dpi at 20 ppm
- 300 by 300 dpi at 16 ppm
- Optical image overlay

Offering laser printing, scanning, photocopying and optical image overlay functions, the M3071 compact laser printer runs at two speeds. It prints 20 pages per minute (ppm) with a 300-by-300-dpi resolution and 16 ppm with a 240-by-240-dpi resolution. The unit uses laser electrophotography for letter-quality printing and halogen lamp electrophotography for copying. Scanning functions are performed by transforming copy data into dot data for computer processing. The optical image overlay and graphics data processes use negative image forms to reproduce copies. $7,340. **Fujitsu America Inc.**, 3055 Orchard Drive, San Jose, Calif. 95134, (408) 946-8777. **Circle No 311**

Lightweight printer serves portable computers

- 13 by 7.5 by 2.8 inches
- 6.6 pounds
- 50 cps in draft mode

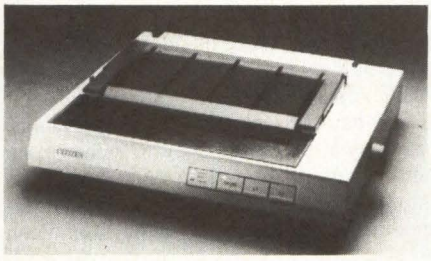
Measuring 13 inches wide by 7.5 inches deep by 2.8 inches high and weighing 6.6 pounds, the Great Little Printer suits portable computer applications. The printer operates at 50 cps in draft mode and at 12 cps in near-letter-quality mode. It handles cut sheet and roll

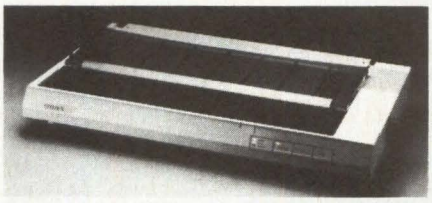
paper. Standard features include enlarged, condensed, emphasized and double-strike print modes as well as superscripting, subscripting and underlining. $299. **Centronics Data Computer Corp.**, 1 Wall St., Hudson, N.H. 03051, (603) 883-0111. **Circle No 312**

Printers work with IBM PCs, Epson micros

- Push tractor paper feed
- 80- or 136-column dot matrix
- 160 cps, draft mode

The MSP series consists of two models, the MSP-10 80-column and MSP-15 136-column dot-matrix printer. Both offer correspondence-quality, bit-image graphics and draft mode. Print speed is 160 cps in draft mode; 40 cps, correspondence-quality mode. Standard printing features include expanded and compressed print, pica and elite, underline feature, eight foreign character sets, superscript, subscript, reverse mode and graphics. Printing is bidirectional in





text mode and unidirectional in graphics mode. The low-profile series offers 100 percent IBM and Epson compatibility, low-noise operation and a push tractor paper feed. $549, MSP-10; $799, MSP-15, OEM quantities. **Citizen America Corp.**, 2425 Colorado Ave., Santa Monica, Calif. 90404, (213) 453-0614. **Circle No 313**

Daisywheel printer features Diablo compatibility

- 96-character wheel
- Bidirectional
- 22 cps in 12-pitch

A serial impact, Diablo compatible, bidirectional logic-seeking printer, the KX-P3151 features a 96-character wheel. Printing 22 cps in 12-pitch or 21 cps in 10 pitch, the printer includes word-processing functions such as bold and shadow lettering, backspace, margins, tabs, underline and justification. A friction feed is standard; usable form lengths are operator variable, from 3 inches to 16 inches. The printer generates four simultaneous copies on non-carbon forms; three copies on carbon paper. Maximum paper width is 15½ inches; printing width, 13½ inches. The impression and copy controls for the Diablo compatible ribbon have a reset alarm, a fast-paper advance and a slow-step advance. $699. **Panasonic Industrial Co.** One Panasonic Way, Secaucus, N.J. 07094, (201) 348-7183. **Circle No 314**

Terminal integrates voice, data

- 2K-by-12 display RAM
- 32K-byte ROM
- Dual microprocessors

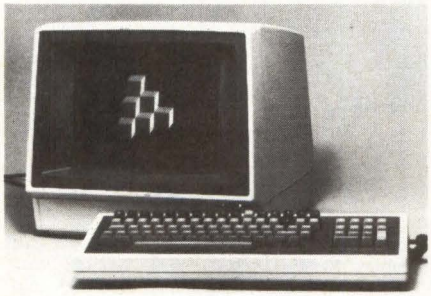
The VDT3000 integrated voice-data terminal replaces five business communication products: business telephone, autodialer, hands-free speakerphone, CRT display terminal and full-duplex, 1,200-baud modem. Measuring 12 inches wide by 10 inches high by 16 inches deep and weighing less than 14 pounds, the standalone terminal features two telephone lines with hold, redial and flash

keys; speed dialing; "soft key" menu trees; single-key automatic sign-on; access to local or remote databases and a 16-key programmable keyboard. It provides two RS232 I/O ports and directories for numbers, host log-on procedures and function keys. The ANSI X 3.64-compatible unit utilizes MC6809 and TMS1200 CMOS microprocessors and holds 2K-by-12 display RAM, 2K-by-4 non-volatile CMOS RAM and 32K bytes of ROM. $1,700. **Thomson-CSF Communications Inc.,** 2 Gannett Drive, White Plains, N.Y. 10604, (914) 694-4450. **Circle No 315**

Color graphics unit serves three uses

- 8 colors
- 30-line-by-80-character format
- 192K bytes of RAM

Suiting CAD/CAM or business graphics presentation applications, the model 6848 system can support a standalone color graphics terminal, a computer ASCII terminal or a 192K-byte printer buffer. Graphics mode displays eight colors from a palette of 16 in 640-by-480-dot, 640-by-400-dot or 640-by-240-dot resolutions, with a 640-by-819-dot virtual resolution. Graphics generation includes dot, line or arc/circle features. Mixed alphanumeric and graphic images can be displayed simultaneously. In text mode, the unit is TeleVideo 925 compatible, displaying 30 lines by 80 characters. The hardware includes RGB interface, power supply, 192K bytes of RAM, 12K bytes of EPROM, RS232 serial port accommodating 110 to 19.2K baud rates and parallel printer port. The model can be configured at 64K bytes (two colors), 128K bytes (four colors) and 192K bytes (eight colors). Starts at $379.95 (without monitor). **Ultratek,** 409 S. Raymond Ave., Alhambra, Calif. 91803, (818)-282-9056. **Circle No 316**



Terminal boasts Tektronix-compatible graphics

- 128K-byte memory
- 1,024-by-500 dot resolution
- Four text formats

The GP-29 low-cost graphics terminal, which is compatible with the Tektronix 4014 graphics display terminal and the DEC text mode operation, comes as a standalone terminal or as a retrofit board for the Zenith Z29 terminal. It holds 128K bytes of memory for multiple pages of off-screen scrolling and graphics features such as dual memory plane operation. Graphics functions such as zoom, pan, area fill, area move and arc drawing feature a 512-by-250-pixel resolution or a 1,024-by-500-pixel resolution. Text mode operation is compatible with the DEC VT100 and VT220 terminals. Standard display appears in 80-by-24, 80-by-49, 132-by-24 and 132-by-49 column-by-line formats. The programmable keyboard furnishes 91 keys. $1,695, model GP-29; $995, retrofit board. **Northwest Digital Systems,** 215 Eighth Ave. North, Seattle, Wash. 98109, (206) 623-4135. **Circle No 317**

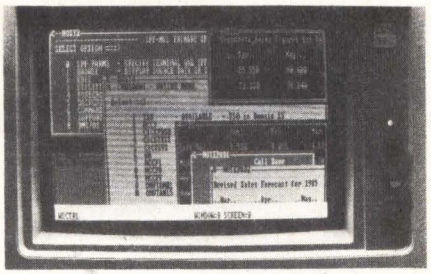
Terminal emulates four configurations

- 300- or 1,200-bps data rates
- 7-inch, amber display
- 56K-byte ROM

The Displayphone PLUS, a combined voice and data terminal, contains a 212A-compatible auto-answer modem with selectable 300- or 1,200-bps transmission rates. Its four terminal configurations include DEC VT100 and VT52 emulation and IBM 3101 and ANSI 3.64 cursor addressing. A fifth cursor addressing protocol emulates Data General, ADDS, Hazeltine and TeleVideo terminals. An RS232 serial interface enables 75- to 9,600-bps data transmission rates in eight steps; a Centronics parallel interface is also provided. The 7-inch amber display features a selectable 40-or 80-character horizontal format with 25 vertical lines and a 5-by-7-dot matrix. It displays 96 ASCII characters, 64 ANSI graphics characters and VT100 graphics characters. The keyboard provides 55 keys and 128 ASCII codes with auto repeat and two-key rollover. The telephone unit features a 90-number directory, automatic dialing and hands-free speaking. Utilizing an 8-bit, 8085A microprocessor, the 11½-by-14½-by-8½-inch unit provides 56K bytes of ROM and 8K bytes of CMOS RAM. $1,595. **Northern Telecom Inc.,** 259 Cumberland Bend, Nashville, Tenn. 37228, (615) 251-4903. **Circle No 318**

New Products

DATACOMM



Interface board, software replicate IBM 3270 PC

- Five host application windows
- 14 keyboard layouts

The 3270-PC Connection, an add-in interface board and software, provides micro-to-mainframe communications for IBM and IBM-compatible personal computers by emulating the IBM 3270 PC. Able to alternate between host and PC applications, the product can window five interactive host-application sessions, a PC-DOS session and two notepads. A screen-control application program interfaces a DOS application and five emulated 3278/79 host sessions. The proprietary gate-array microprocessor rests in a 14-inch board; the 14 keyboard layouts provide international keyboard mapping. The unit comes in a coaxial version and as a remote connection. $1,595. **CXI Inc.,** 3606 West Bayshore Road, Palo Alto, Calif. 94303-4229, (415) 424-0700. **Circle No 319**

Protocol converter emulates IBM terminals

- Three access modes
- Runs IBM PC and host applications concurrently

The PA100 Turbo protocol converter plug-in board allows an IBM PC to emulate a variety of IBM 3278 and 3279 terminals. Acting as an IBM terminal, the IBM PC can capture full screens of data or selective portions of the screen based on user-defined templates. With optional host-resident software, the Turbo provides a menu-driven approach to file transfer. In terminal emulation mode, the Turbo runs PC and host applications concurrently. It connects coaxially to an IBM 3274/76 cluster controller supporting IBM BCS or SNA/SDLC environments. $1195. **Avatar Technologies Inc.,** 99 South St., Hopkinton, Mass. 01748, (617) 435-6872. **Circle No 320**

Network processor emulates DEC DMF-32

- Supports two point-to-point trunk links
- 19.2K-bps data rate

The System 207 Unibus-Interface network processor emulates the asynchronous controller operation of the DEC DMF-32, including the character and

Direct Memory Access (DMA)-mode output capabilities. It transfers data with low CPU overhead from the host computer and supports a cluster of remotely located terminal users. The unit consists of a single hex-size controller board that plugs into a Unibus small peripheral controller slot. The system supports two point-to-point trunk links, each of which can communicate at 19.2K bps, as well as 16 emulated DMF-32 asynchronous controllers for a maximum capacity of 128 virtual circuit connections. $4,950. **Digital Communications Associates Inc.,** 303 Technology Park, Norcross, Ga. 30092, (404) 448-1400. **Circle No 321**

Time-division multiplexer handles six channels

- 1,200- to 19,200-bps synchronous rates
- 0- to 4,800-bps asynchronous rates
- RS232C, CCITT V.24 interfaces

The KiloMux 64 bit-interleaved, time-division multiplexer concentrates as

many as six synchronous or asynchronous separate data links on a single 32K- or 64K-bps trunk. Each channel runs at 1,200, 2,400 or 4,800 bps, and a pair of channels can be combined to provide 19.2K bps. Asynchronous data moves at 2,400 bps per channel; 4,800, for a combined pair. Channels are transparent and can be any combination of synchronous and asynchronous and any intermix of allowable speeds. The multiplexer provides transmission of two control signals per channel. The unit comes with local and remote loopback and features RS232C and CCITT V.24 interfaces. $1,600. **Rad Computers Ltd.,** 8 Hanechoshet St., Ramat Hachayal, Tel Aviv 69710, P.O.B. 13161, Tel Aviv 61131, Israel, 03-483331.

Circle No 322

Controller provides data communication

- 24-bit bus addressing
- 2M-bps operation
- 64K bytes of memory

Conforming to the Multibus standard, the NIB 101/02 communications controller provides on-board, packet-switched data communication for point-to-point data transfer and networking applications. It is HDLC, SDLC, ADCCP and CCITT X.25 compatible. Operating at 2M bps, the unit supports 24-bit bus addressing, utilizing dual-ported data transfers. It includes an on-board CPU, 64K bytes of memory (including 16K bytes of dual-port RAM) and communications circuits. For error-free message delivery, the board contains a sequenced packet protocol. As many as 64 virtual circuits can be open at any one time along with 40K bytes of temporary message storage. Variable size message packets of up to 1,024 bytes are standard. $1,250. **The Destek Group,** 830 E. Evelyn Ave., Sunnyvale, Calif. 94086, (408) 737-7211. **Circle No 323**

New Products

SOFTWARE

Development tool executes applications in one step

- Supports HP 3000 series
- Requires no compilation

Flexible, an application development tool for the HP 3000 series, develops, tests, documents and executes application systems in one step. The applications are non-interpretive, non-procedural and require no compilation. Developers create applications via associate verbs. The package furnishes database and file access and data manipulation capabilities. It provides a sharable working storage and allows recursive processing, do-looping and nested conditional processing, all executed in on-line and/or batch mode. Development features include trace and debug, automatic syntax and logic tests, automatic documentation and a help facility. Prices start at $9,000. **Sages American Group,** 11 Cranberry St., Brooklyn, N.Y. 11201, (212) 875-4477.

Circle No 324

System produces DEC VAX/VMS software

- Includes multi-level overlays
- Supports 8087 numeric coprocessor

The Modula-2/VX86 cross development system produces software for 8086-/8088-based microcomputers on DEC VAX/VMS systems. It comes with a standard library of modules and generates high-speed native code. Features include support of the 8087 numeric coprocessor, large-model and multi-level overlays for large programs, low-level software and hardware access, data-communication and conversion utilities for uploading and downloading programs and symbolic debugging. $4,500. **Logitech Inc.,** 805 Veterans Blvd., Redwood City, Calif. 94063, (415) 365-9852.

Circle No 325

Software synthesizes text into speech

- Male or female voice
- Compatible with Apple Macintosh
- Understands mathematical symbols

The Smoothtalker text-to-speech synthesis software accepts English text from either keyboard or floppy disk and synthesizes the text into an adult male or female voice. The voice is heard through a computer's speaker or an external amplifier. Implemented entirely in software, it is available for the Apple Macintosh computer and comes as a software module that can be incorporated into business and personal software programs and as a complete software package. It understands common English conventions, salutations and mathematical symbols, and enables users to create their own dictionary. Voice speed, volume and pitch are adjustable. $149.95. **First Byte Inc.,** 2845 Temple Ave., Long Beach, Calif. 90806, (213) 595-7006.

Circle No 326

System displays data in 40 formats

- Runs on 16- or 32-bit computers
- Modular
- Operates in real time

Dataviews, an interactive graphics software system, displays dynamic data in real time through a library of graphics subroutines and a menu specification language. The subroutine package includes 2D-graphics primitives and tools for creating, editing and running displays. The system requires no programming; it constructs multiple screens using viewports and 40 available formats such as vector plots, bar charts, line graphs and pie charts. Written in C code, the system runs on 16- or 32-bit microcomputers or superminicomputers and requires 512K bytes of main memory, 3M bytes of mass storage, a cursor control device and a UNIX or UNIX look-alike operating system. $7,500 for single-user workstation. **Visual Intelligence Corp.,** 160 Old Farm Road, Amherst Fields Research Park, Amherst, Mass. 01002, (413) 253-3482.

Circle No 327

Programming environment develops AI

- Implements LISP
- Runs on 32-bit Eclipse supermini
- Includes interactive interpreter

The Common LISP Programming Environment creates, develops and debugs computer programs for artificial intelligence (AI) applications. Working with 32-bit Eclipse MV/Family superminicomputers and DS/Family workstations, the software system is supported by the proprietary 32-bit AOS/VS (Advanced Operating System/Virtual Storage) and the MV/UX UNIX Environment (a hosted UNIX implementation) integrated with AOS/VS. Included in the programming environment are an interactive interpreter for program development and debugging; an optimizing compiler that allows programmers to prioritize specified performance criteria; CCA/EMACS, a full display editor with windowing capabilities; and facilities for calling foreign programs and data. The programming environment prints Common Lisp structures, maintains data created in independent programming sessions with an automatic help-management feature, mixes compiled and interpreted code and debugs a Common Lisp program. $8,000 for MV/Family of superminicomputers; $2,000 for DS/Family of workstations. **Data General Corp.,** 440 Computer Drive, Westboro, Mass. 01580, (617) 366-8911.

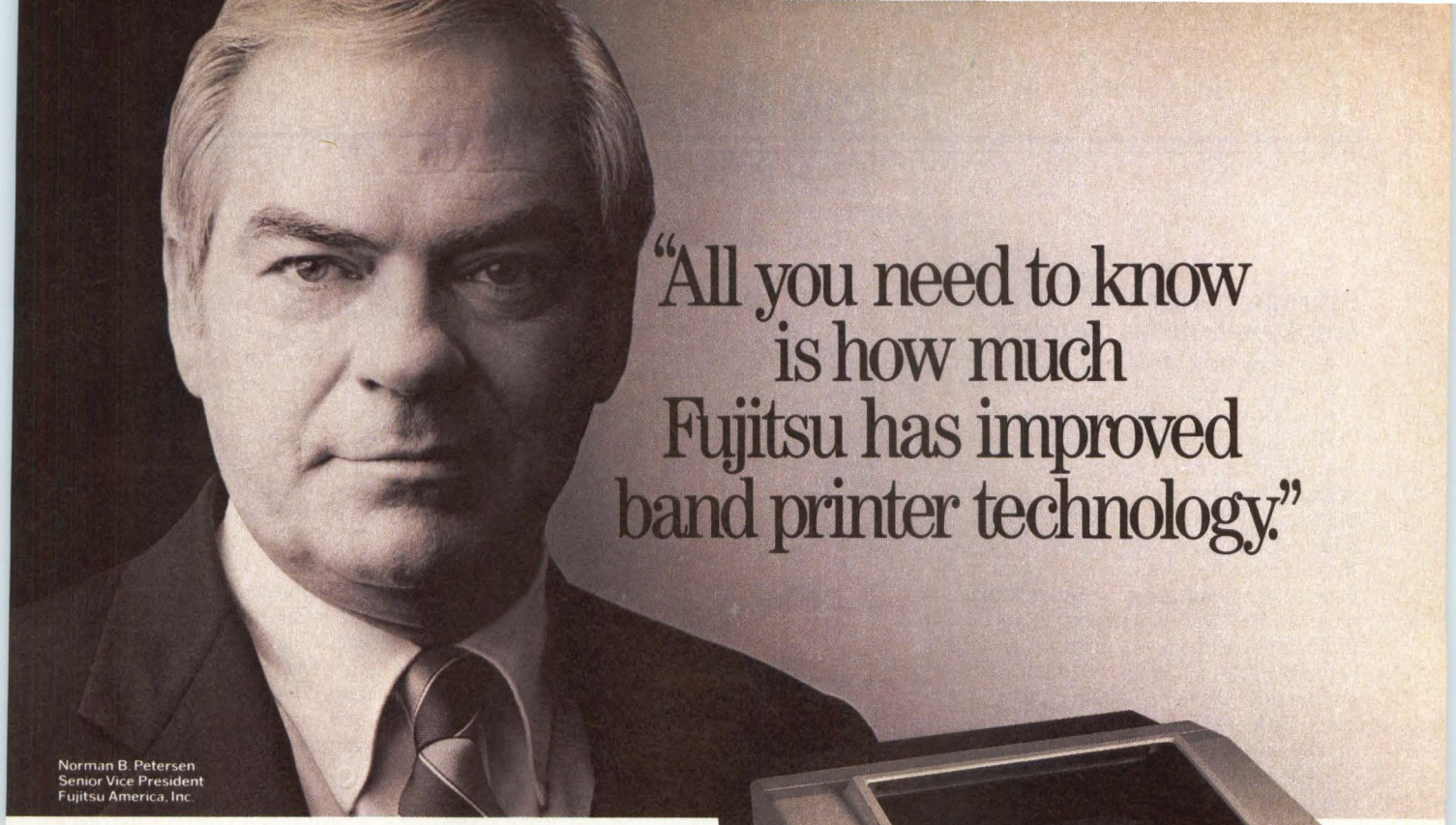
Circle No 328

Graphics package includes hardware,software

- Compatible with Apple II+, IIe and IIc
- Integrates graphics, telecommunications
- 15 original type fonts

The Digital Paintbrush System, a hardware/software color graphics package, integrates graphics production, editing, printing and presentation capabilities in one package. The Digitizing Paintbrush hardware projects graphics images as "slides" on a color monitor, printed as hard copy or as transparencies, and photographed to make 35mm slides. Compatible with the Apple II+, IIc and IIe microcomputers, the software package comes on three diskettes with two backups and consists of four components. The Graphics Design Program has a "paint" program, an "Alpha" mode with 15 original type fonts and an expanding-contracting image-capturing mode. The Presentation Program stores, organizes and displays pictures. The Printout Program makes acetate transparencies or hard copy using a dot-matrix printer. The Graphics Telephone program enables two users to create, edit, save and print out drawings in real time over the phone with a modem. $299. **The Computer Colorworks,** Suite 201, 3030 Bridgeway, Sausalito, Calif. 94965, (415) 331-3022.

Circle No 329



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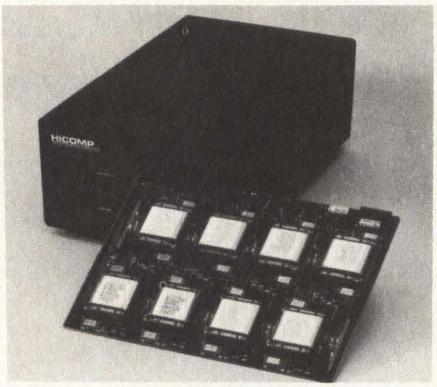
New Products

SUBASSEMBLIES

Storage peripheral employs bubble memory

- Floppy disk emulation
- Block-access mode
- ½M byte or 1M byte of memory

Utilizing non-volatile bubble memory, the MBA-1A mass storage peripheral replaces floppy disk drives in high-reliability applications or in hostile environments. Offering either ½M byte or 1M byte of memory, the unit interfaces to a computer system as a floppy disk drive or as a block access peripheral. In floppy-disk-drive mode it functions as four separate 5¼-inch or 8-inch disk drives supporting single or double density formats with respective data-access times of 338 msecs and 230 msecs. The required interface is a Shugart Corp.-compatible floppy disk controller. In block-access mode, individual blocks of bubble memory are randomly accessed in 512-byte block segments using software commands and an RS232C serial port. The unit is housed in an enclosure the size of an 8-inch floppy disk drive.



1M-byte version, $4,950; ½M-byte version, $3,450. **Hicomp Computer Corp.,** 5016 148th Ave. N.E., Redmond, Wash. 98052, (206) 881-6030.

Circle No 330

Graphics controllers link IBM PC, monitor

- Converts ASCII commands to RGB signals
- 16K bytes of RAM
- 256K bytes of display memory

Offered in two versions, these standalone color graphics controllers connect an IBM PC to a color monitor, a large-screen video projector or a slide-making device. The Q1000 version provides two pages of display, each with 512-dot-by-512-dot-by-4-dot resolution; the Q1080 version offers 832-dot-by-630-dot-by-4-dot resolution. Housed in an 11-inch-by-13-inch cabinet that rests atop an IBM PC, each controller converts ASCII digital graphics commands into analog RGB signals. Standard features include a Z80B CPU and a NEC 7220 graphics display controller chip; 16K bytes of RAM; I/O or communications buffers; 256K bytes of display memory; 32K bytes of EPROM for graphics commands; two RS232C ports and one Centronics-compatible parallel interface. Graphics primitives include dot, line, concatenated vectors, circles, rectangles, arcs, polygons and area fills. Q1000: $1,995; Q1080: $2,195. **Quintar Corp.,** 2525 Maricopa St., Torrance, Calif. 90503, (213) 320-5700.

Circle No 331

New Products

LITERATURE

Handbook narrates power supply design

In its description of DC power supply and DC motor control circuit design, the 152-page *Applications Handbook* emphasizes on-power switching techniques for on-card DC to DC conversion and secondary regulation of single-and multiple-output requirements. The DC motor control section details constant speed and torque applications together with half-bridge and stepper motor drives. A section pertaining to line-operated switching supplies includes fundamental design considerations for reliable switched-mode power supply operation. **Lambda Semiconductors,** 121 International Drive, Corpus Christi, Texas 78410, (512) 289-0403.

Circle No 332

Catalog covers data communications

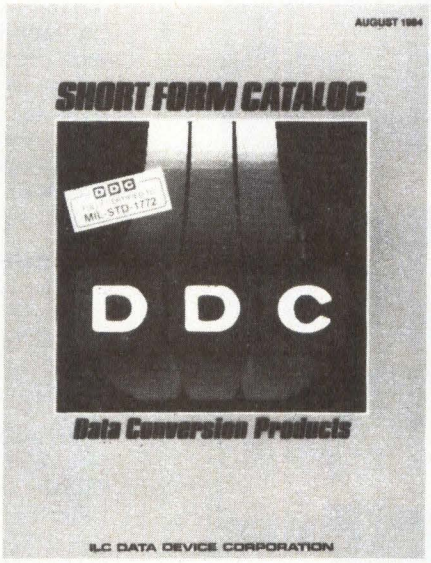
The Codex Corp. 1984 Fall/Winter direct order catalog for data communications features two products, the 5202 and 5202R data modems, plus a selection of cable and statistical multiplexers, limited distance modems, high-speed modems and cable and Bell-compatible modems. It also contains pricing reductions on the LSI "E" series modems and a glossary of definitions of data communication terms. **Codex Corp., subsidiary of Motorola Inc.,** 20 Cabor Boulevard, Mansfield, Mass. 02048, (617) 364-2000.

Circle No 333

Booklet describes mass-storage products

This 6-page booklet on 19 of Xebec's mass storage products is divided into product classification sections. The disk controller and host adapter sections present standard floppy and hard disk intelligent controllers and companion interface cards for desktop computer systems. The hard disk add-on memory storage subsystems include 10M- and 30M-byte models with tape backup. Information is provided for tested pairs and for the Owl intelligent disk drive subsystem. **Xebec,** 3579 Highway 50 East, Carson City, Nev. 89701, (408) 287-2700.

Circle No 334



Catalog features data-conversion products

Describing over 100 products, this 8-page short form catalog from ILC Data Device Corp. furnishes specifications for data bus products, analog-to-digital, digital-to-analog, synchro-to-digital and digital-to-synchro converters. Other products listed include sample/hold and track/hold amplifiers, synchro and selsyn instruments, MIL-STD-1553 components, control transformers and SEM modules. **ILC Data Device Corp.,** 105 Wilbur Place, Bohemia, N.Y. 11716, (516) 567-5600.

Circle No 335

Product directory lists 300 PC companies

This 14-page publication, the *PC Engineering Product Directory*, lists 300 companies that sell software and hardware enhancements and systems that turn personal computers into productivity aids for engineers and scientists. Each listing contains the manufacturer's name, address and phone number as well as a short description of the company's product lines and the computers with which those products are compatible. Products covered include general instrumentation, design automation, and data acquisition and control. $25 or $10 for members of the Personal Engineering Computer Users Society. **Personal Engineering Communications,** Box 983, Back Bay Annex, Boston, Mass. 02117-0983. **Circle No 336**

Brochure covers terminal emulators

This four-page brochure provides product literature on Infotron Systems' new series of terminal emulators, the Virtual Terminal System (VTS) 351 and 352, which permit integration of ASCII terminals, printers and personal computers into an IBM 3270 network. Model 351 accommodates six asynchronous devices; Model 352 supports as many as 12. Based on 8- and 16-bit microprocessors, the VTS series emulates IBM 3277 and 3278 terminals. **Infotron Systems Corp., Communications Department,** 9 N. Olney Ave., Cherry Hill, N.J. 08003, (800) 345-4636.

Circle No 337

Data book describes Rockwell products

The 1,362-page "1984 Data Book" describes Rockwell International Corp.'s Semiconductor Products Division's solid state devices, board-level microcomputer products and modems. Included are sections on 8- and 16-bit microprocessors and peripherals, memory products, intelligent display controllers, microcomputer development systems, four families of microcomputers and a line of integral and standalone modems. $5. **Technical Literature, Semiconductor Products Division, Rockwell International,** 4311 Jamboree Road, P.O. Box C, Newport Beach, Calif. 92658, (800) 854-8099.

Circle No 338

Directory lists 2,500 products

Providing an overview of the data communications industry, the *Data Communications Product Directory* lists over 2,500 data-communications products. This reference tool groups product descriptions into 24 categories such as emulators, local area networks, modems, software and test equipment. Each entry provides a summary of the product's key features, applications and price. Manufacturers and their addresses are indexed by product type. $124. **Architecture Technology Corp.,** P.O. Box 24344, Minneapolis, Minn. 55424, (612) 935-2035.

Circle No 339

Calendar

JANUARY

2-4 **Eighteenth Annual Hawaii International Conference on System Sciences,** Honolulu, sponsored by University of Hawaii and University of Southwestern Louisiana. Contact: Nem B. Lau, HICSS-18 Conference Coordinator, Center for Executive Development, College of Business Administration, University of Hawaii, 2404 Maile Way, C-202, Honolulu, Hawaii 96822, (808) 948-7396.

8-10 **Corporate Electronic Publishing Systems Conference and Showcase,** Hyatt Regency Hotel, Chicago, sponsored by Cahners Exposition Group and InterConsult Inc. Contact: Carol Hurley, Cahners Exposition Group, 999 Summer St., Stamford, Conn. 06905, (203) 964-0000.

8-10 **"T-1 Facilities and Networking" Seminar,** Fort Lauderdale, Fla., presented by Timeplex Inc. Contact: William A. Flanagan, Public Relations Manager, Timeplex, Inc., 400 Chestnut Road, Woodcliff Lake, N.J. 07675, (201) 930-4600. Also to be held on Feb. 5-7, Atlanta; March 19-21, New Orleans; April 16-18, Chicago; May 21-23, New York; June 11-13, San Diego.

14-18 **International Software Update,** Kahala Hilton Hotel, Oahu, Hawaii, sponsored by Raging Bear Productions. Contact: Philip J. Russell, Raging Bear Productions Inc., Suite 175, 21 Tamal Vista Drive, Corte Madera, Calif. 94925, (415) 924-1194 or (800) 732-2300.

16-18 **PC World Exposition,** AstroHall, Houston, sponsored by PC World. Contact: Mitch Hall Associates, P.O. Box 860, Westwood, Mass. 02090, (617) 329-7466. Also to be held on June 12-14, Convention and Performing Arts Center, San Diego; Sept. 11-13, Metro Toronto Convention Center, Toronto; Oct. 16-18, Convention Center, Dallas.

21-22 **4th Generation Data Management Software Seminar,** New York, sponsored by Software Institute of America. Contact: Kristin Kittle Lynch, Operations Coordinator, Digital Consulting Associates Inc., 6 Windsor St., Andover, Mass. 01810, (617) 470-3870. Also to be held on Feb. 4-5, Denver; Feb. 28-March 1, Boston; May 2-3, Detroit.

21-23 **Office Information Systems Conference,** Marriott Harbor Beach, Ft. Lauderdale, Fla., sponsored by Gartner Group Inc. Contact: Lynn M. Bentley, Marketing Manager, Gartner Group Inc., 72 Cummings Point Road, P.O. Box 10212, Stamford, Conn. 06904, (203) 967-6723.

21-25 **UniForum,** Infomart, Dallas, sponsored by /usr/group. Contact: Richard Lewis, Professional Exposition Management Co., Suite 205, 2400 E. Devon Ave., Des Plaines, Ill. 60018, (800) 323-5155.

23-24 **San Diego Electronics Show,** Del Mar Fairgrounds, Del Mar, Calif., sponsored by Electronic Representatives Association of San Diego. Contact: Harry Schwartz, Show Director, Epic Enterprises, Suite 115, 6151 Fairmount Ave., San Diego, Calif. 92120, (619) 284-9268.

Classified Ads

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28-31 Communication Networks Conference and Exposition, Washington, D.C. Convention Center, organized by Hajar Associates. Contact: Judie McDaid, CN National Sales Director, Box 880, Cochituate Road, Framingham, Mass. 01701, (617) 879-0700 or (800) 225-4698.

FEBRUARY

4-6 OAC '85, 1985 Office Automation Conference, Georgia World Congress Center, Atlanta, sponsored by the American Federation of Information Processing Societies Inc. (AFIPS). Contact: Helen Mugnier, AFIPS, 1899 Preston White Drive, Reston, Va. 22091, (703) 620-8926.

5-7 Mini/Micro West, Anaheim Hilton Exposition Center, Anaheim, Calif., sponsored by San Francisco Bay Area Council and Los Angeles Council, IEEE and Northern and Southern California Chapter, ERA. Contact: Tim Parrott, Director of Sales, or Jeannie Oldendorph, Sales Manager, Electronic Conventions Management Inc., 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.

20-22 INFO/CENTRAL and INFO/SOFTWARE, O'Hare Exposition Center, Chicago, sponsored by INFO/SOFTWARE. Contact: Show Manager, INFO/SOFTWARE, 999 Summer St., Stamford, Conn. 06905, (203) 964-0000.

20-23 Computer Business Graphics Conference, Bonaventure InterContinental Hotel, Ft. Lauderdale, Fla., sponsored by Frost & Sullivan Inc. Contact: Carol Every, Industry Representative, Frost & Sullivan, 106 Fulton St., New York, N.Y. 10038, (212) 233-1080.

22-23 IEEE Computer Faire, Huntsville, Ala., sponsored by The Institute of Electrical and Electronics Engineers Inc. (IEEE). Contact: Terry Mizell, P.O. Box 5188, Huntsville, Ala. 35805, (205) 532-2036.

26-28 Automated Design and Engineering for Electronics Exposition (ADEE), Anaheim Hilton and Towers, Anaheim, Calif., sponsored by Cahners Exposition Group. Contact: Michael Indovina, Cahners Exposition Group, Cahners Plaza, 1350 Touhy Ave., P.O. Box 5060, Des Plaines, Ill. 60018, (312) 299-9311.

MARCH

4-7 FOSE Software '85 Conference and Exposition, Washington, D.C. Convention Center, sponsored by National Trade Productions Inc. Contact: Rosalind Boesch, National Trade Productions, Suite 400, 2111 Eisenhower Ave., Alexandria, Va. 22314, (800) 638-8510 or (703) 683-8500.

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— SKILLS: FORTRAN, Ada, Assembly Languages, IBM, CDC & VAX Operating Systems, Computational Geometry, Information Modeling & Data Dictionaries.
— APPLICATIONS: Turn-key Graphic Systems, Solid Modeling, Robotics, CNC-DNC, Real-Time Processing Control, Group Technology.
— CADAM, CAT/A, Computervision, SC/CARDS, Model 204, Systems Engineering, Group Management.

ENGINEERING SYSTEMS

— Bachelor's and/or Master's degree, and 3-8 years' experience.
— SKILLS: Simulation Languages, FORTRAN, COBOL & IBM Assembler, TSO, SPF, DISSPLA, RAMIS, Scientific Programming and Microcomputer experience.
— APPLICATIONS: Simulation, SLAM, Manufacturing, Operations Research, Image Processing, Graphics Application Development, Sneak Circuit Analysis, Program Marketing.

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CIRCLE NO. 243 ON INQUIRY CARD

PROGRAMMER ANALYST FOR PHARMACY SYSTEM

Position available

Position: Programmer analyst for Pharmacy system

Salary: $2,370.00 per month

Education Required: BS in Pharmacy, MS in Medical Biophysics and computing

Licenses Required: Utah State Pharmacy License

Experience Required: 1 year on Tandem 16 Computer System

Description: This company provides software for hospital information systems. The job to be performed requires that the HELP system (Health Evaluation through Logic Processing) be integrated into their pharmacy section. The job also requires the development of a portable terminal system for nurses to record medication administration and thereafter to integrate that information into the HELP system. Thereafter this information will be used for pharmacy and nursing management purposes.

The applicant must have 1 year experience on the Tandem 16 computer system which is the computer system which the employer operates.

Excellent working conditions.

Applicants should send resumes to **Job Service, 1234 South Main, Salt Lake City, Utah, (801) 533-2400, Job # 76799.** An Equal opportunity employer. Ad paid for by employer.

SENIOR PROGRAMMER ANALYST. Will develop, implement, operate and refine programs for financial accounting data base (FRS); personnel data base (PER/PAS); and student record system, employing image resource inquiry and view. To use the following: HP3000 mini-computer (SERIES 68) and VIEW 3000 and IMAGE 3000 software. Required: BS degree in Comp Sci or Comp Info Syst. plus 2 yrs. experience; or MS degree in Comp Sci or Comp Info Syst. Knowledge of COBOL and FORTRAN. Knowledge of management information systems, data analysis and design of data base systems. $24,390/yr., 40-hour week. Apply at the **Texas Employment Commission, El Paso, Texas,** or send resume to the **Texas Employment Commission, TEC Building, Austin, Texas 78778, J.O. #3650 879.** Ad Paid by an Equal Employment Opportunity Employer.

COMPUTER COORDINATOR

Full time position: 40 hours per week, 8:00 a.m. to 5:00 p.m.

Salary: $21,488.00 per year.

Job Duties: Supervise the computing facility, identify computation needs, develop and maintain databases, write programs, recommend purchases, supervise staff, coordinate data processing, coordinate field exchanges, arrange hardware maintenance and prepare reports.

Requirements: The job candidate should possess a Masters degree in the field of Computer Science and the candidate should have one year related job experience in database design and consulting. Candidates should have an advanced degree in Computer Science and one year study in advanced math, statistical and numerical analysis, with one year experience in database design and implementation. Six months experience with the following software: Basic, Fortran, Pascal, SIR, SPSS, Wordstar, text editors and graphics packages. Also six months experience with the following operating systems: CDC NOS, PRIME PRIMOS, VAX/VMS, IBM PC DOS and APPLE DOS.

Resumes with social security numbers should be sent to the **Indiana State Employment Service, 10 North Senate Avenue, Indianapolis, Indiana 46204, attention W.F. Shepherd, I.D. Number: 073035.**

CIRCLE NO. 244

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See P. 205-207 for Career Opportunity Advertisers
See P. 209-210 for Mini-Micro Marketplace

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1. Glossy photo with 50-75 words. We will typeset your ad at no charge.
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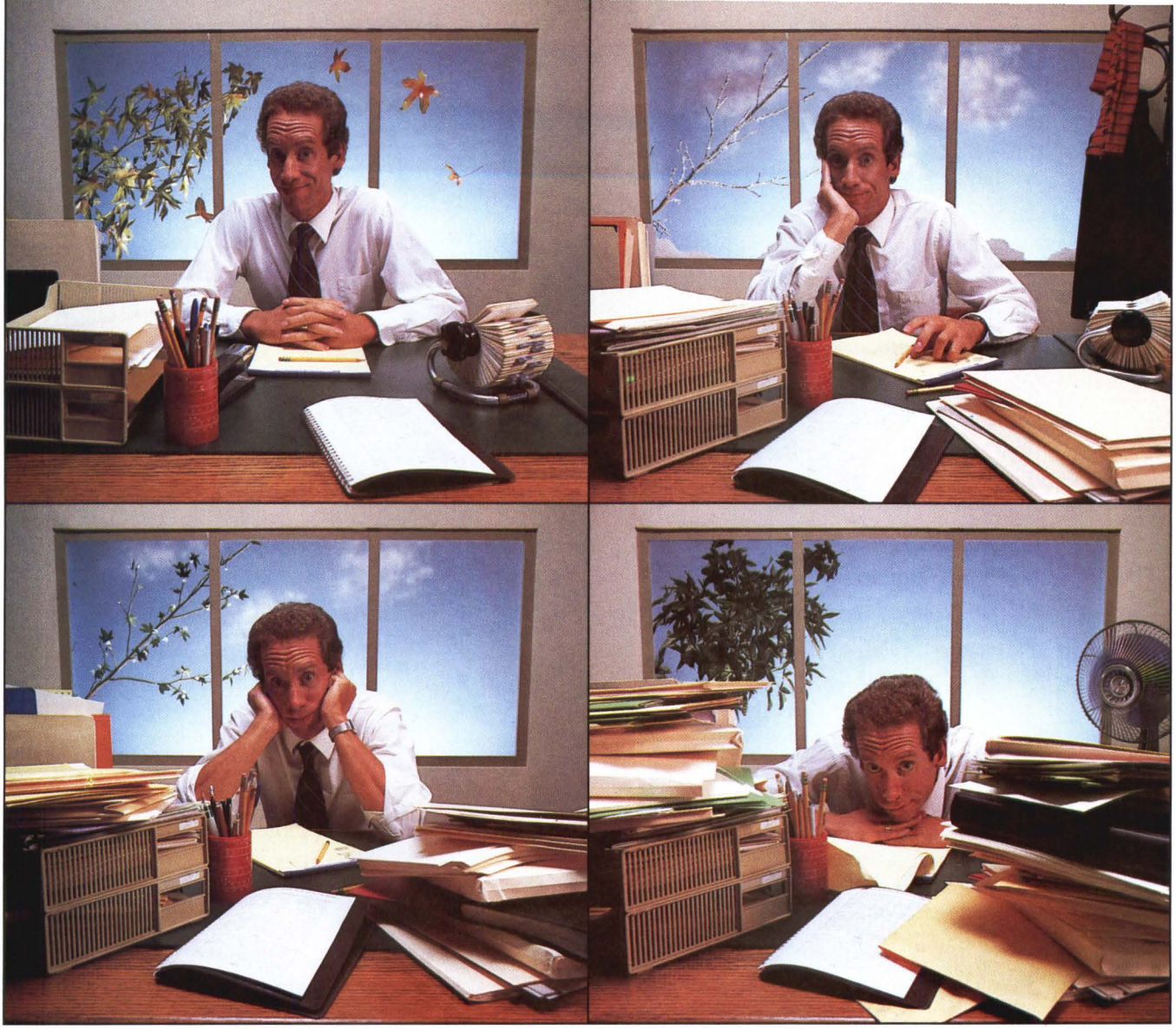

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CIRCLE NO. 102 ON INQUIRY CARD

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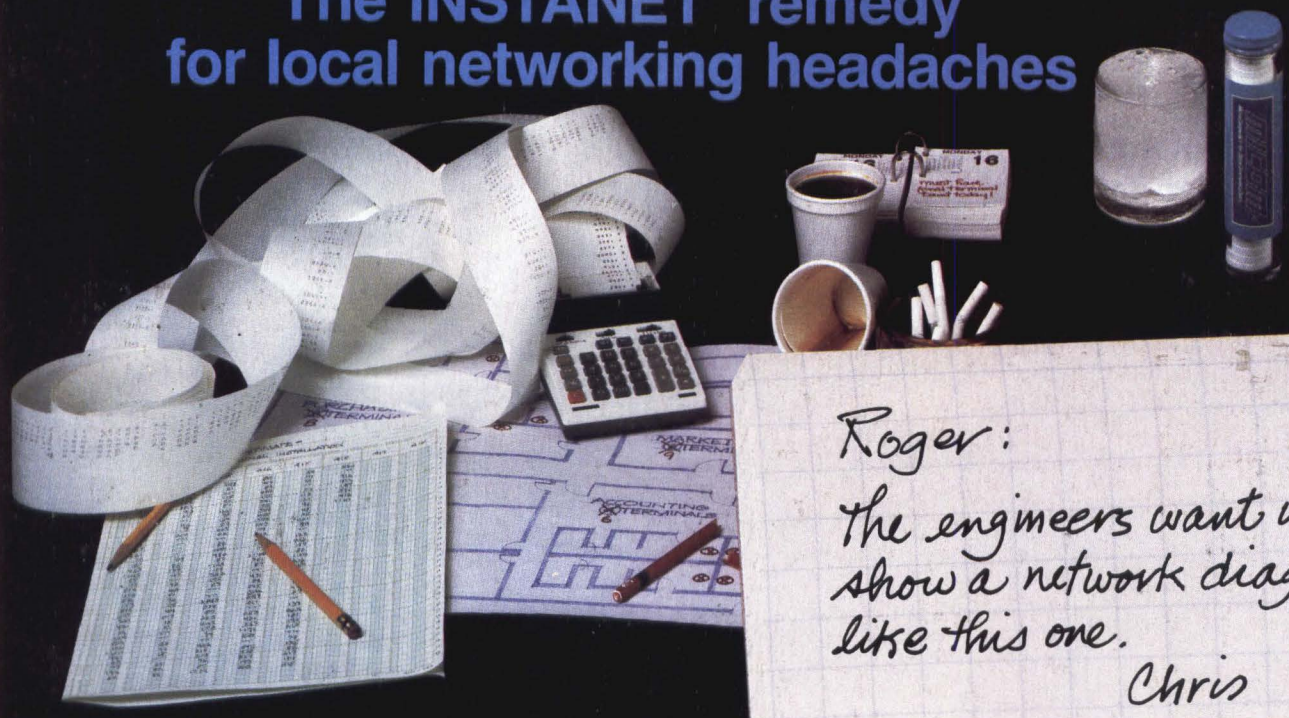

Headache

It's too early to make a long-term commitment to baseband or broadband.

We don't want to get involved with more layers of protocol and more incompatibilities.

Fiber optic cable and coax are expensive and messy to install.

We're not ready to put in a whole network now.

We already own a good deal of datacomm gear.

Division/Group DP Managers want control of their own local datacomm.

We need Gateways:

- To the switched phone network
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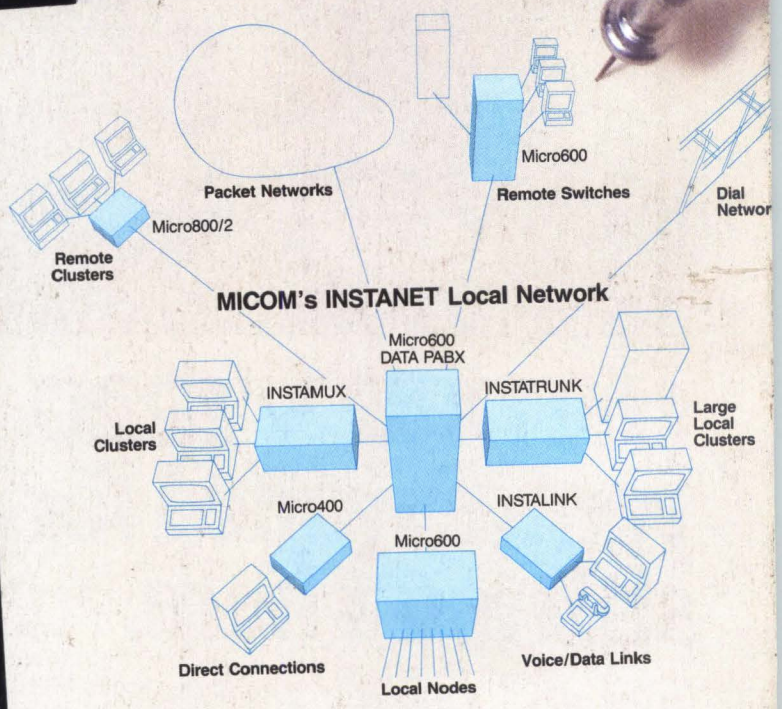
We don't want to spend an arm and a leg.

Roger:

The engineers want us to show a network diagram like this one.

Chris



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