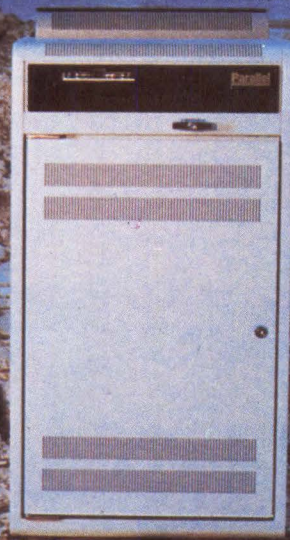


Mini-Micro Systems

A CAHNERS PUBLICATION

MAY 1984



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addresses salient failure modes**

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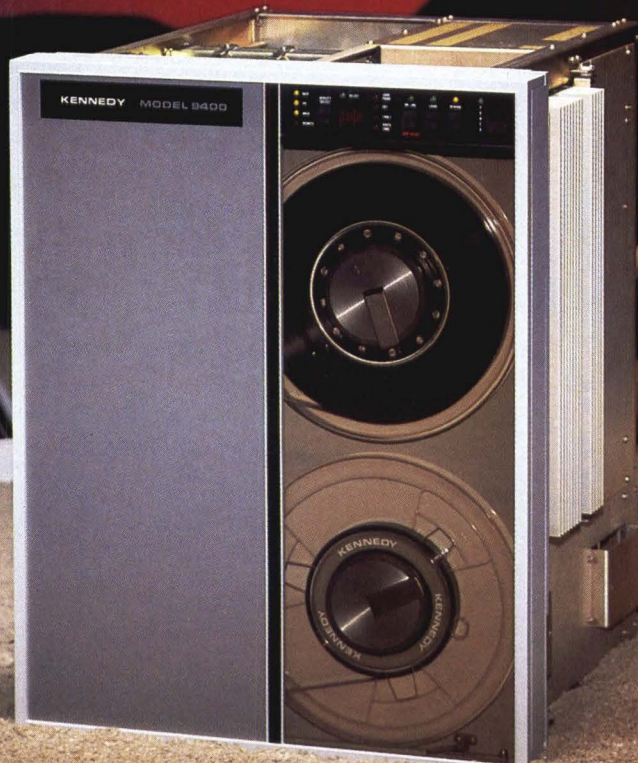
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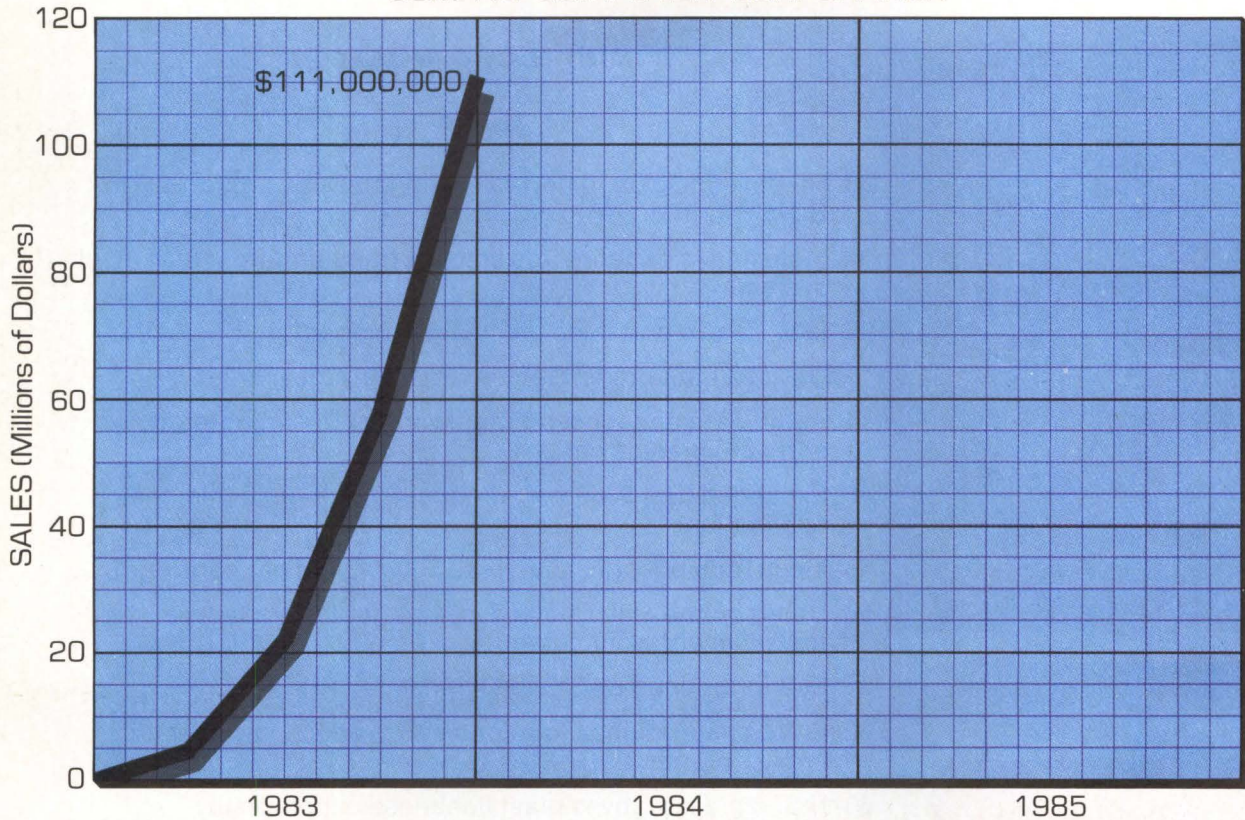
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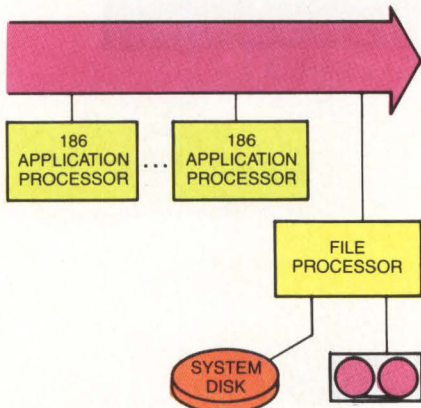
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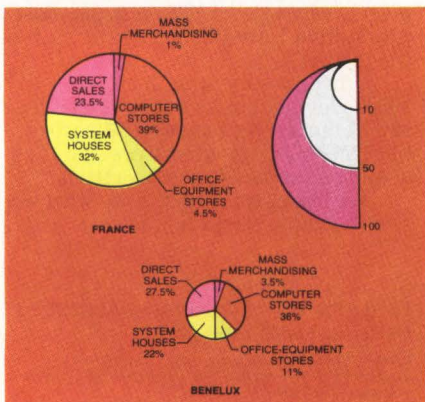
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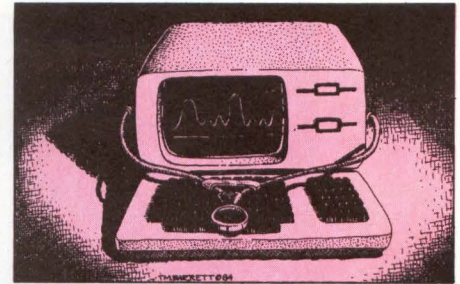
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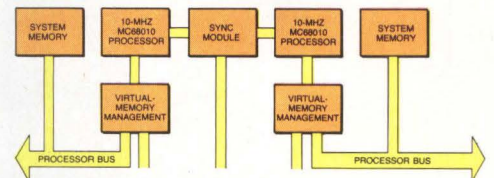
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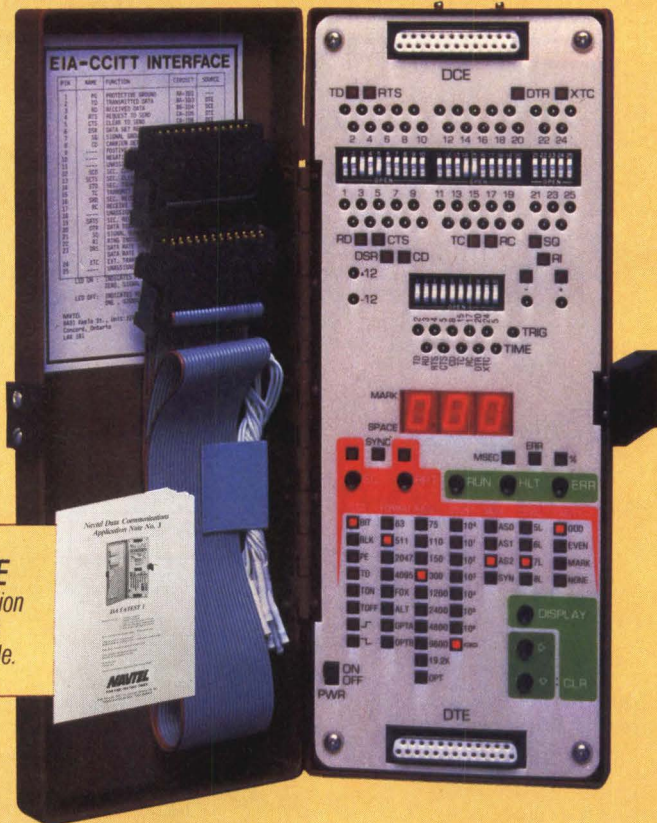
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MINI-MICRO SYSTEMS (ISSN 0364-9342) is published monthly (with additional issues in spring, summer and fall) by Cahners Publishing Company, Division of Reed Holdings, Inc., 221 Columbus Avenue, Boston, MA 02116. Norman L. Cahners, Chairman; Saul Goldweitz, President; Ronald G. Segel, Financial Vice President and Treasurer. MINI-MICRO SYSTEMS is published by the Cahners Magazine Division; J. A. Sheehan, President; William Platt, Executive Vice President. Circulation records are maintained at Cahners Publishing Co., 270 St. Paul St., Denver, CO 80206. Second class postage paid at Denver, CO 80202 and additional mailing offices. Postmaster: Send address changes to MINI-MICRO SYSTEMS, 270 St. Paul St., Denver, CO 80206. MINI-MICRO SYSTEMS is circulated without charge by name and title to U.S. and Western Europe based corporate and technical management, systems engineers, and other personnel who meet qualification procedures. Available to others at the rate of \$55.00 per year in the U.S.; \$60.00 in Canada and Mexico; \$75.00 surface mail in all other countries; \$120 foreign air mail (15 issues). Single issues \$4.00 in the U.S.; \$5.00 in Canada and Mexico; \$6.00 in all other countries.

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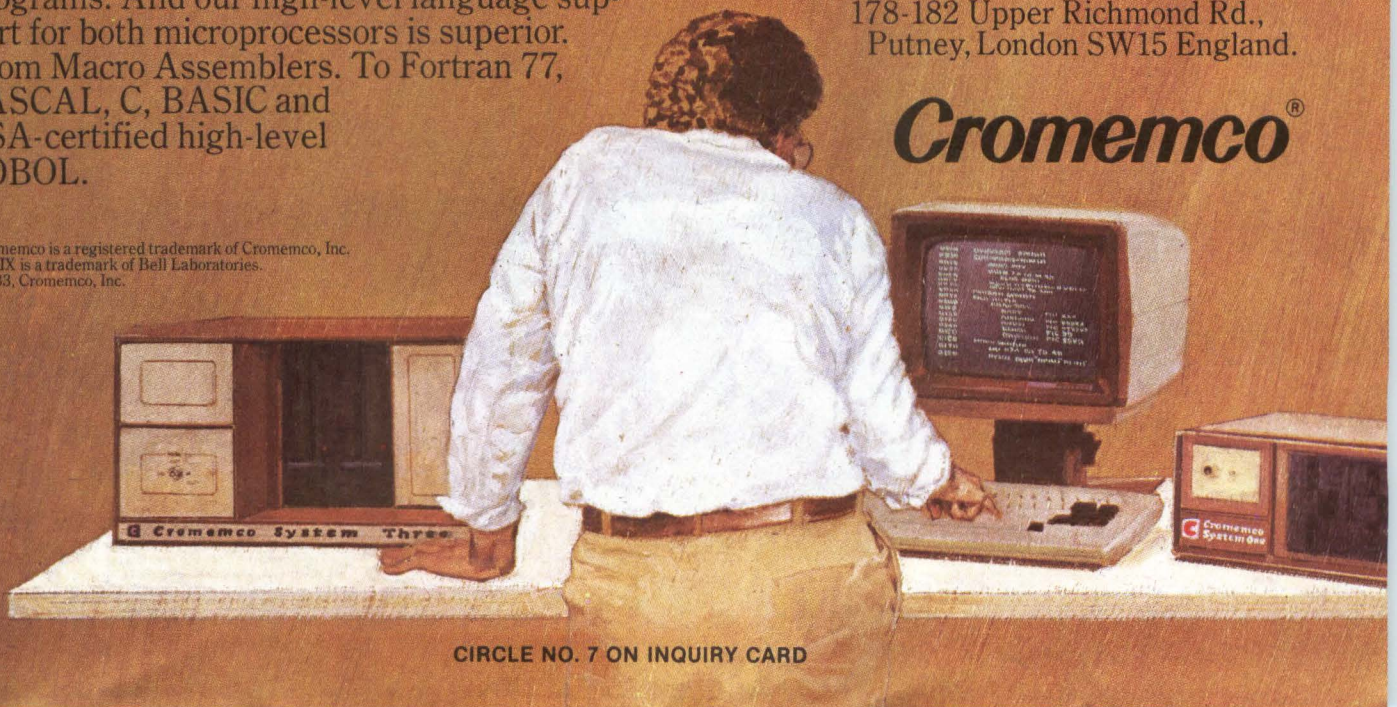
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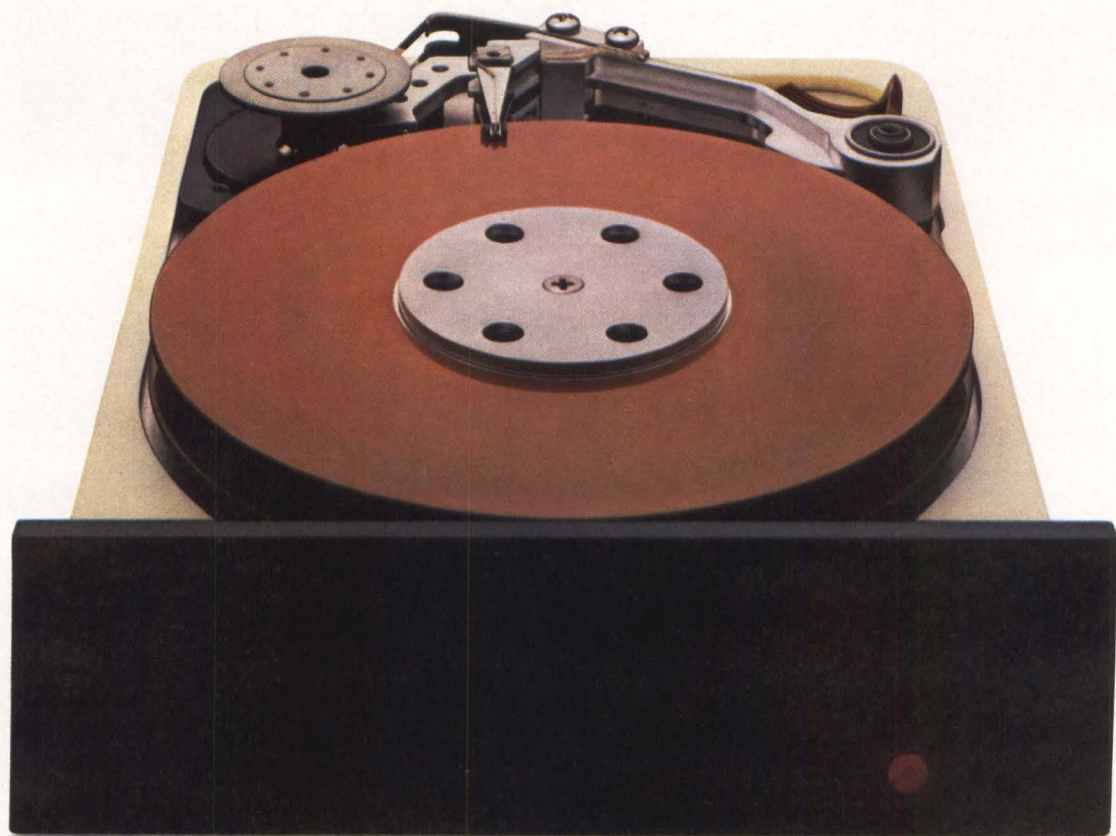
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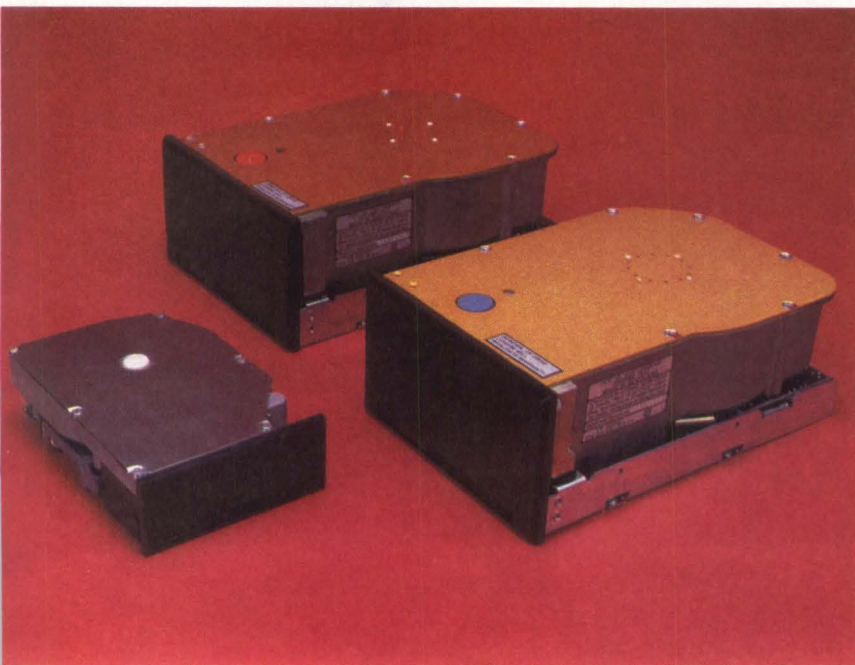
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Office automation mandates reflection and redirection

In his keynote address delivered at the 1984 Office Automation (OA) Conference last February, David Kearns, president, chief executive and a director of Xerox Corp., indicated that there exists no clear sense of mission when automating office functions nor a clear sense of the prevailing urgency of OA needs. The office of the future, said Kearns, requires the management and measurement of clear-cut goals, operating plans, business strategies and performance plans. And all of these must come before equipment strategy. Citing the boom of personal computers as an example of the lack of goal orientation, Kearns commented that computers are, for the most part, incompatible, isolated and uncommunicative. Recommending remedies for the less-than-spectacular acceptance of OA in the field, Kearns called for capital investment in a combination of people, machines, facilities and support services.



Another obstacle that OA must overcome to attain widespread market acceptance is the absence of a workable definition of the term. Disagreement about OA's goals among system manufacturers, integrators and users has actually spawned office resistance to advanced technology. One of the better OA definitions to date appeared recently in the trade press. Dr. Karen Rancourt of Wang Laboratories Inc. states: "Office automation is an ongoing dynamic process comprised of people, organizations, technologies and tools, integrated to meet business goals and objectives."

Note that both industry experts emphasize people as the primary ingredient in the OA success formula. Office information communications deal with people interactions in the form of correspondence, reports, meetings and conversations. However, says Rancourt, most OA installations have attempted to force-fit people, machines and organizations into available technologies and tools. As a result, most users have disputed new office procedures and changes because OA standards are non-existent, costs are prohibitive, equipment proves overwhelming and system integration is inflexible. Consequently, installation attempts come across as though the changeover itself were the problem. Rancourt concludes that it is the process used in making the changeover that prevents successful OA integration. All OA explorations and decisions, therefore, should involve the users concerned.

Accordingly, to achieve equipment success in the OA arena, system integrators must avoid technology-driven hardware and software and move toward more people-oriented computer systems. Improving the effectiveness, efficiency, productivity and quality of business communications, rather than automating existing ones, demands more than just the addition of ergonomic or user-friendly features; it demands complete user transparency. Computers, peripherals and software should be configured around and integrated for people—not the other way around. And instead of the term "office automation," with its negative connotation of substituting machines for people, let's change it to something more positive, such as "office integration." What do you think?

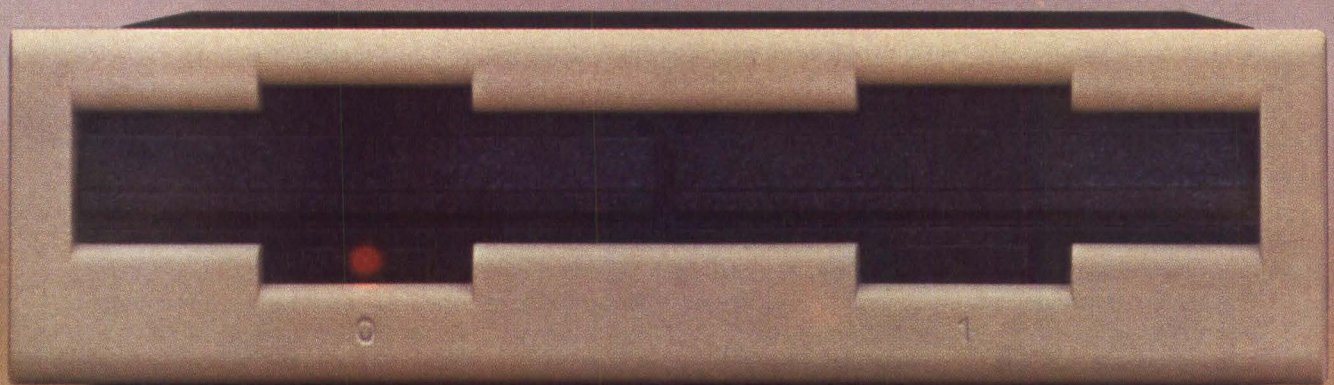
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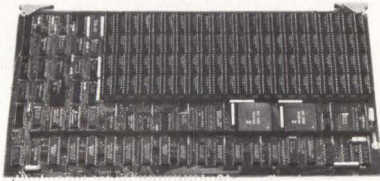
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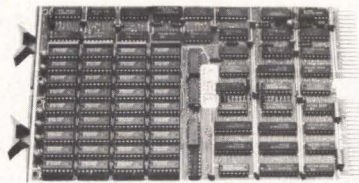


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CIRCLE NO. 12 ON INQUIRY CARD

Letters

COMPUTER ARCHITECTURE

To the editor:

I found the article "Computer Architecture" by Efreem G. Mallach (MMS, December 1983, Page 145) to be very interesting but believe it missed one of the first, if not the first, multimicroprocessor computer systems—the CP9000 communications processor. M/A-COM DCC Inc. designed the CP9000 (well-known as the TP4000) in conjunction with Telenet in the 1975 time frame. Although modest by today's standards, it supported up to 62 6502 8-bit microprocessors (each with 8K bytes of local memory), connected via a high-speed bus sharing a common 256-byte memory.

As the article describes, multiple processors are often better than just one when a task must be done more quickly. The CP9000 addressed the difficult problem of growth in a packet network by adding a microprocessor-based line-processing unit for each group of eight data lines. Previously, this had been done by a standard minicomputer with fixed processor and memory resources. The CP9000 was found to be far superior and is still the principal switching vehicle in the Telenet network.

A second area mentioned in the article is fault tolerance. Again, the CP9000 pioneered in this technology. All buses, memories, power supplies and main processors are fully redundant with built-in switch-over mechanisms.

William P. Simmelink
Director of Marketing
Communications Group
M/A-COM DCC Inc.
Germantown, Md.

Author's response:

I appreciate Mr. Simmelink's taking the time to tell *Mini-Micro Systems* readers about the CP9000. Because it was apparently developed for a single customer and was not marketed as a general-purpose system, the CP9000 did not get the publicity of later products from other companies. That lack of publicity does not reduce its technical merit one iota.

There may well be other early multimicroprocessor systems that are equally little known. If enough people write to me about their multimicroprocessors from the mid-1970s, I'll try to assemble the information into an article.

Efreem G. Mallach
Needham, Mass.



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CIRCLE NO. 14 ON INQUIRY CARD

Breakpoints

PHOENIX TO UNVEIL OFF-THE-SHELF PC-COMPATIBLE ROM BIOS

Phoenix Software Associates Ltd., Norwood, Mass., plans to release the ROM portion of an IBM-compatible basic input/output (BIOS) system, the MS-DOS operating system and other software packaged for those integrating IBM PC-compatible systems. Phoenix, which has done many ports of MS-DOS to a variety of hardware clone systems, also offers a \$30,000 off-the-shelf software BIOS. Each licensee must write the BIOS portion of the MS-DOS operating system. Many licensees choose to implement part of the BIOS in ROM, as IBM has. Phoenix expects its product to foster price wars because would-be compatible manufacturers can integrate systems quickly. —L. Valigra

SHUGART PLANS HIGH-CAPACITY 3½-INCH MICROFLOPPY

Shugart Corp., Sunnyvale, Calif., is developing a high-capacity 3½-inch microfloppy drive for possible introduction by year-end or the first quarter of 1985. The drive is expected to have an unformatted storage capacity of 3.3M to 5.8M bytes and to use the same form factor and hard-jacket media housing as that used on the Shugart SA300 series drives. To achieve the higher capacities, Shugart is exploring the use of standard 600-oersted media, Spin Physics' Isomax small-particle media and a perpendicular recording media developed by Vertimag Corp. According to Shugart president William Bayer, the company is working to resolve issues such as double-sided head designs and positioners. Working with Shugart on the perpendicular-recording version using the Vertimag media is 3M, which is developing methods to package the sputtered perpendicular media in a Sony Corp.-type floppy media cartridge. Similarly, Spin Physics is seeking ways to reduce the thickness of the particle layer on the substrate to less than 5 mils. —C. Warren

BOEING WILL IMPLEMENT OSI COMMUNICATIONS STANDARD AT NCC

At June's National Computer Conference, Boeing Computer Services will demonstrate what could be the first major cooperative effort to implement the International Standards Organization's Open Systems Interconnect (OSI) model for communications. One participant in the demonstration will be Charles River Data Systems (CRDS) Inc., a Framingham, Mass., supplier of supermicrocomputers running the UNIX-like UNOS operating system. A source at CRDS says the connections will be concentrated on the transport layer of the OSI model, which is the machine-to-machine connection layer. The National Bureau of Standards (NBS) is backing the demonstration, and participants include Digital Equipment Corp., Hewlett-Packard Co., Honeywell Inc., NCR Corp., Intel Corp. and CRDS, according to the CRDS source. The demonstration will include the 802 standards committee's recommendation for a local-area network, which will transfer files between the participating vendors' machines. The CRDS source says the NBS is validating the participants' products, so that each implementation meets OSI criteria. —L. Valigra

ADDS ADOPTS TAIWAN MANUFACTURER'S PC-COMPATIBLE

Hoping to speed its entry into the IBM PC-compatible market, Applied Digital Data Systems (ADDS) Inc., Hauppauge, N.Y., is readying its PC-clone, PC-1, for release as early as next month. ADDS adopted the PC-1 from Multitech Indus-

Breakpoints

trial Corp., whose MPF-PC is the result of a design project created by the Taiwanese government-sponsored Electronics Research & Service Organization. ADDS' PC-1 probably will include 64K bytes of memory, a monochrome monitor and one floppy disk drive and will sell for \$2,100, notes ADDS technical support specialist Michael Genes. ADDS is the exclusive U.S. distributor of the Multitech product. Multitech also offers Apple Computer Inc.-compatible units. —L. Valigra

CONVERGENT TO UNVEIL EIGHT-USER SUPERMICRO

Convergent Technologies Inc., Santa Clara, Calif., is expected to ship the one-to-eight-user MiniFrame supermicrocomputer this month. The system supports Convergent's demand-paging implementation of UNIX System V, which first appeared on the Company's MegaFrame superminicomputer. Starting price for the MiniFrame is less than \$5,000. It is based on Motorola Inc.'s MC68010 virtual-memory processor operating without wait states. An entry-level configuration is expected to include a 13M-byte hard disk drive, memory-management software with demand paging, a high-speed floppy disk drive for backup, 512K bytes of RAM, two RS232 ports, a Centronics-compatible port and a high-speed RS422 port. Convergent will sell the MiniFrame only to OEMs. —T. Moran

NEC ENTERS PC-COMPATIBLE MARKET

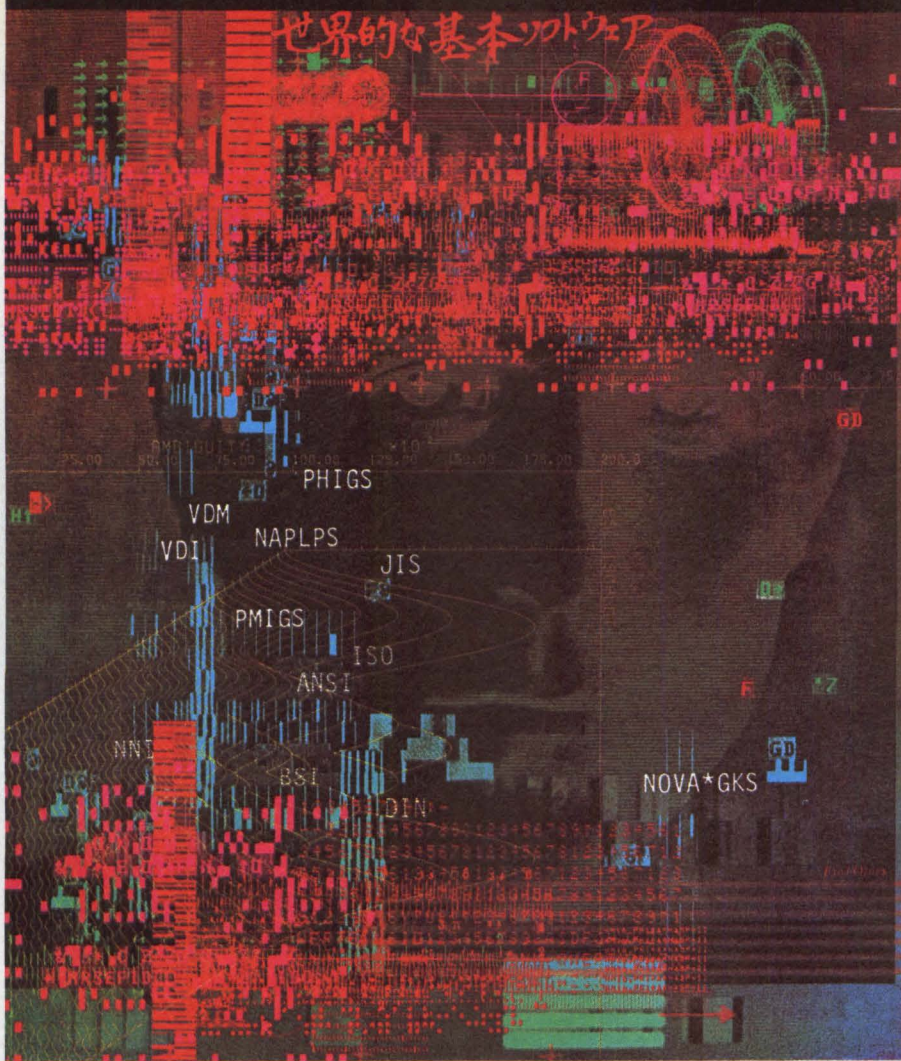
NEC Information Systems Inc., Boxborough, Mass., is entering the IBM PC-compatible market with a microcomputer that is part of its Advanced Personal Computer (APC) series. Unlike earlier APC models, the new microcomputer uses 5¼-inch rather than 8-inch floppy disk drives to make it appropriate for a more general market, NEC sources say. The system is based on a version of the Intel 8086 processor manufactured by NEC in Japan, runs MS-DOS 2.11 and has 128K bytes of RAM in its basic configuration. Price for a version with one floppy drive and a CRT display is \$1,995. The display includes NEC's powerful 7220 graphics processor. A UNIX System III operating system on a combination hardware/software "softcard" will be available. —L. Valigra

FRANKLIN UNWRAPS PORTABLE RUNNING MS-DOS, CP/M

Franklin Computer Corp., which this year reached an out-of-court settlement in its long-running legal battle with Apple Computer Inc., should this month introduce its CX-2M portable computer. The 27-pound CX-2M runs the MS-DOS and CP/M operating systems and Apple II+ software. It incorporates the 8086, the Z80 and the 6502 processors; half-height floppy drives; and a 7-inch green phosphor screen with a resolution of 640 by 200 dots while running MS-DOS. A CX-2M with 128K bytes of RAM for MS-DOS, 64K bytes of RAM for the Apple-compatible Franklin DOS, 64K bytes of RAM for CP/M and two floppy drives sells for \$2,395. —D. Bright

DRIVETEC TO DOUBLE FLOPPY CAPACITY

To meet the needs of system integrators for more storage on removable media, Drivetec Inc., San Jose, Calif., is preparing to offer a 6.66M-byte version of its model 320 floppy disk drive, which currently stores 3.33M bytes unformatted. The 320 has a track density of 192 tracks per inch (tpi) and a data-transfer rate of 500K bits per second and can read 48- or 96-tpi diskettes. The new drive, possibly ready for sampling by selected OEMs in late summer, will offer charac-



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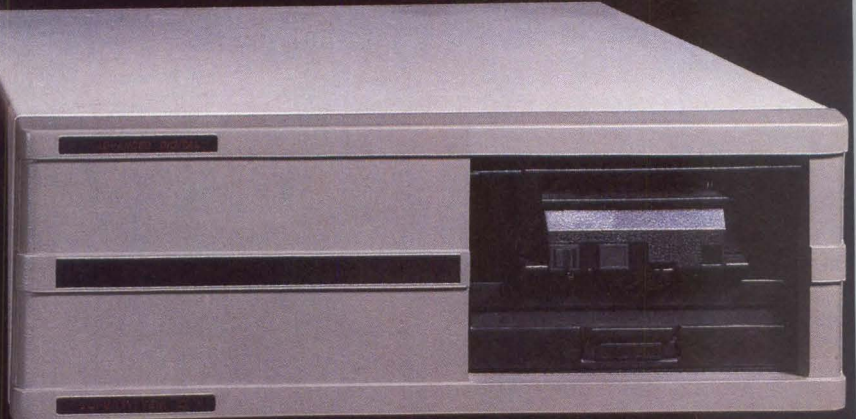
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Breakpoints

teristics similar to the original but with doubled track density, making it plug-compatible with current drive controllers. Company marketing manager Vladimar Langer says the next generation of drives will offer 13.2M bytes, a 19,816-bit-per-inch density and a 1M-byte-per-second data-transfer rate. The increased rates will necessitate the use of new controllers and interfaces for the drive.—C. Warren

SHARP TO ANNOUNCE \$350 FOUR-PEN PLOTTER

Sharp Electronics Corp.'s Industrial Equipment Division, Paramus, N.J., plans to introduce the \$350 four-pen CE-515P plotter at this month's Comdex show in Atlanta. Sharp intends to begin selling the plotter in August to business personal computer users through distributors and dealers. Graphics speed for the approximately 3-pound plotter ranges from 0.22 to 3.24 inches per second, and resolution is 0.008 inches. The plotter uses black, blue, green and red ball-point pens and draws on A4-, A5-, B5- and letter-size paper. It also can use 4.56-inch-wide rolls of paper. A Centronics parallel port and an RS232C port are standard. Sharp is seeking software vendors to develop device drivers for the plotter.—D. Bright

TWO 5¼-INCH OPTICAL DRIVES MAY COME OUT IN 1985

Information Storage Inc., Colorado Springs, Colo., is vying with Laser Memory Systems Inc., Calabasas, Calif., for market share for a 5¼-inch optical drive that will debut early in 1985. Information Storage's drive should be similar to Laser Memory's unit: each will have 100M to 200M bytes of storage, write-once/read-always capability and a price of less than \$1,000. Although Information Storage program manager Martin Houser won't release many details of the forthcoming drive, he does say that the company has a \$1.5 million R&D budget and that financing is expected.—C. Warren

VICTOR FOUNDER CHUCK PEDDLE STARTS A NEW COMPANY

Chuck Peddle, founder and former president of Victor Technologies Inc., is back in business, this time with an R&D start-up called NNA Inc., for No Name Available. NNA, which has headquarters in Scotts Valley, Calif., will seek design projects from domestic and foreign companies. Peddle says he has a gentleman's agreement with Britain's ACT Plc. to finish an IBM PC-compatible prototype. NNA's president is Bob Taylor, former Victor technical vice president, and the staff includes about 20 technical "refugees" from Victor, Peddle says.

—M. O'Gara

TECH FILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS

Hannover Fair Review: Activity at this year's Hannover Fair industrial trade show, which attracted about 400,000 to Hannover, West Germany, mirrored that of many U.S. exhibitions: **there was a flurry of new IBM PC-compatible machines, crowds around Apple Computer Inc.'s Macintosh microcomputer and many new systems sporting small disk drives.**

Several major European companies are leapfrogging to the next level of integration—complete systems—to enter the IBM PC-compatible market quickly.

Breakpoints

U.S. manufacturers have been creating PC clones or configured systems from component parts, such as Faraday Electronics Corp. with its IBM PC-compatible motherboard. But several European companies are buying complete personal computer systems from other companies and selling them under their own monikers. **Commodore International Ltd.**, for example, attracted crowds to its booth to view its portable personal computer, a system purchased from Bytec-Comterm Inc., Ottawa. Likewise, **Philips Kommunikations Industrie AG**, West Germany, showed its personal computer, a desktop system from Corona Data Systems Inc.—L. Valigra

Six Taiwanese manufacturers made a major push to entice U.S. and European buyers to adopt their IBM PC-compatible desktop units. The six—CAF Computer Corp., ADI Corp., Mitac Inc., Multitech Industrial Corp., President Enterprises Corp. and Tatung Electronics Corp.—are seeking U.S. and European dealers and OEMs for their products, which sell for around \$2,000 each in floppy disk-based versions. The products from CAF, Multitech and Sony Taiwan (which did not exhibit) stem from a design created by the government-sponsored Electronics Research & Service Organization in Taiwan. Tatung's product is based on Intel Corp.'s 80186 processor.—L. Valigra

Japanese companies, including Casio, Panasonic and Sharp Corp., featured IBM PC-compatible units. **Kyocera Corp.** showed its PC-compatible KC-1000 and KC-2000 at Hannover, but the systems are not yet available for sale. A Kyocera spokesman says the products will be available this summer in the United States. The KC-1000 will be priced at about \$1,000 for OEMs, and the KC-2000 will sell for around \$1,100, with neither including a display. The KC-1000 is based on Intel's 8086 processor. The 8087 and 8089 processors are optional. The KC-1000 has 32K bytes of ROM, 128K bytes of RAM, 128K bytes of video RAM, a slimline 5¼-inch floppy disk drive, an RS232 port, a parallel port, three open slots and MS-DOS 2.01. The KC-2000 has 8K bytes of ROM, 128K bytes of RAM, a slimline floppy drive, one parallel port, one serial port, five slots and 4K bytes of video RAM. It uses Kyocera's proprietary KC-DOS V.2.10 operating system, a PC-DOS 2.1 look-alike.—L. Valigra

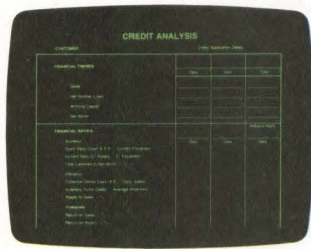
Meanwhile, **the new IBM Portable PC surfaced in Europe for the first time.** IBM hasn't put it on the market yet, but to ward off the competition it put a solitary American model running English-language software on its Hannover stand. It looks like Big Blue is not going to let the grass grow under its feet again as it did last time with a long delay between U.S. and European introductions, thereby losing market share to the start-ups, such as Victor Technologies Inc.—M. O'Gara

Small floppy disk drives stole the spotlight at Hannover, with six companies showing new models of 3½-inch microfloppies. BASF, Mitsubishi Electric, Olivetti OPE, TEAC Corp., Tokyo Electric Co. Ltd. and Toshiba Corp. all had models on display. Systems incorporating the small drives appeared in Hewlett-Packard Co.'s HP150 microcomputer and in Apple Computer Inc.'s Lisa and Macintosh microcomputers.—L. Valigra

The whole page:



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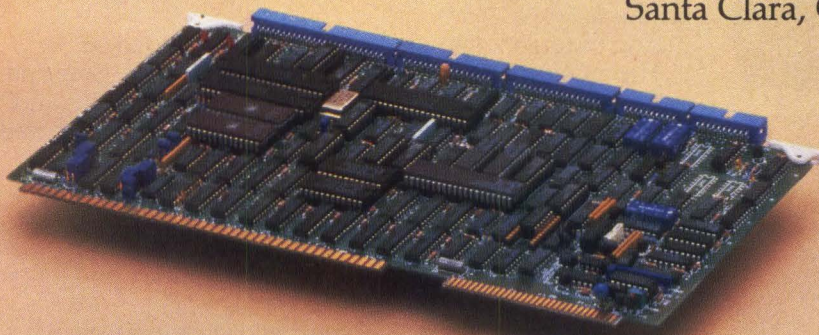
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CIRCLE NO. 18 ON INQUIRY CARD

Breakpoints

Officials at BASF's Ludwigshafen, West Germany, headquarters are targeting U.S. disk drive manufacturers as potential purchasers of plated media that BASF unveiled at Hannover. BASF now offers a second source to supplier Ampex Corp. According to the BASF specification, the plated media's magnetizable film is about 0.05 μm . thick. To produce the media, BASF plates aluminum disks with a nickel coating using a wet-chemical, currentless deposition process. The nickel coating is then polished, and the cobalt-phosphorous recording layer is deposited. A protective coating can then be applied. BASF quotes a typical data density of 12,000 flux changes per inch and a track density of 1,000 tracks per inch. Company officials believe the plated disks are as well-suited for conventional manganese-zinc ferrite heads as for thin-film heads. —K. Jones

Epson Corp.'s busy booth hosted many new products, including the lap-sized PC-8 portable computer. The PC-8 incorporates a Z80 CPU, 64K bytes of main memory, 6K bytes of video RAM, 32K bytes of operating system ROM for CP/M and Microsoft Corp.'s BASIC language. It has a 72-key keyboard, a 480-by-64-dot liquid-crystal display with eight 80-character lines, microcassette software and an RS232C interface. Options include RAM packs, floppy disk drives, an acoustic coupler and a small printer. Memory is expandable to 120K bytes. Price for the PC-8 is less than 3,500 German marks, or about \$1,000. Availability is scheduled for this month in the United States and Europe. Also available with the PC-8 is a portable Wordstar word-processing program, a financial program called Portable Calc and a portable scheduler program. —L. Valigra

Also at Epson's booth was the JX-80 four-color dot-matrix printer. It uses a ribbon that can be used to mix as many as seven different colors. It prints at 160 lines/sec., has a Centronics parallel interface and IEEE 488 or RS232C options. Price is 2,000 to 3,000 German marks, or about \$800 to \$1,400. —L. Valigra

Reporters poking around the **Sperry Corp.** stand at Hannover **turned up a prototype Keytronics Corp. keyboard meant to make the lives of Wordstar word-processing software users easier.** The keyboard will make some now-cumbersome coding automatic and will provide for voice input. The end-user price in Germany is roughly \$280. Deliveries are slated to start in about two months. The intelligent board is the brainchild of German design house Rafi GmbH, which has set up a joint venture called Eurokey GmbH with Keytronics. —M. O'Gara

RANDOM DISK FILES: Microscience International Corp., Mountain View, Calif. **is preparing to enter the 3 $\frac{1}{2}$ -inch Winchester disk drive arena with its "Mighty Mouse" product.** It will join others expected at July's National Computer Conference (MMS, April, Page 21). Thus, the drive will hold 12M bytes of unformatted information and be ST-412-compatible. —C. Warren

In a move that took the $\frac{1}{2}$ -inch tape-backup industry by surprise, **IBM introduced** in March **the model 3480 $\frac{1}{2}$ -inch tape subsystem for use with 3380 hard disk systems.** The drive offers 200M bytes of storage and a 3M-byte-per-second data-transfer rate using an 18-channel thin-film head with chro-

Breakpoints

mium dioxide tape. The product's significance may lie in the tape cartridge rather than in the drive. Measuring 4 inches by 5 inches by 1 inch and housing a single reel with a picker arm for automatic loading of the tape, the cartridge has virtually established the physical requirement standards for 1/2-inch cartridges. Dan Collier, an industry consultant and general manager of the *Freeman Report*, Santa Barbara, Calif., expects IBM's announcement to cause compatibility problems for manufacturers of low-end 1/2-inch drives.—C. Warren

This month, **MegaTape Corp.**, Duarte, Calif., should introduce a 500M-byte version of a 1/2-inch backup tape drive. The drive is downwardly compatible with the company's 300M-byte model MT-300 cartridge drive. According to Gary Webb, vice president of marketing, plans call for production units to appear early in the third quarter.—C. Warren

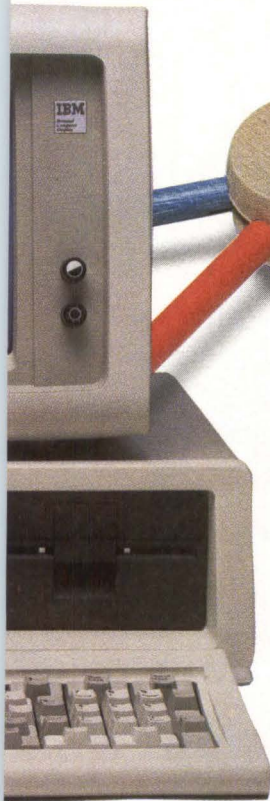
MICRO FILES: American Telephone & Telegraph (AT&T) Co., which began the year by announcing an OEM agreement with Convergent Technologies Inc. for a proprietary line of information-processing equipment, recently unveiled a homegrown crop of computers, the 3B family of six computers. The 3B family ranges from a supermicrocomputer desktop unit priced at \$9,950 to a high-end minicomputer priced at \$340,000. The 32-bit machines, to be sold through OEMs and value-added resellers, are based on the UNIX System V operating system and Western Electric's 32-bit processor. There is still no word on the much-speculated-about personal computer forthcoming from AT&T, but analysts say the machine, priced at less than \$5,000, will be available this summer through retail channels. In addition to its first lineup of computers, AT&T introduced the Ethernet-compatible 3BNET local-area network, which links 3B computers, and the PC Interface, which enables personal computers that run the DOS operating system to communicate with each other and with 3B computers.—M. Stenzler-Centonze

NOTES FROM OVERSEAS: Reports of IBM's upcoming lap-sized computer, code-named Poseidon, reached Europe last month. The machine will reportedly have a 1M-bit bubble memory, software in ROM, a communications port and an 80-character-by-8-line or 80-character-by-6-line display. Indications are that Matsushita Electric Co. Ltd. will produce the IBM product, which is expected to sell for \$800.—M. O'Gara

N.V. Philips, Eindhoven, the Netherlands, and **Control Data Corp.** (CDC), Minneapolis, have set up a joint company to manufacture and market optical-disk products, including a 1G-byte drive undergoing field trials. Called Optical Storage International (OSI), the joint company also embraces the two joint development centers set up by the companies in 1982—Optical Media Laboratory, Eindhoven, and Optical Peripherals Laboratory, Colorado Springs, Colo. Those labs will also operate under the OSI name. The OSI strategy calls for the manufacture of the drives at Santa Clara, Calif., while the disk media are expected to be manufactured at a Philips plant in Blackburn, England. Philips owns 51 percent of OSI, and CDC owns the remaining 49 percent.—K. Jones

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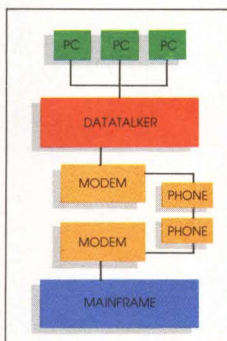
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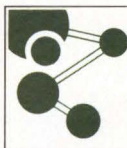
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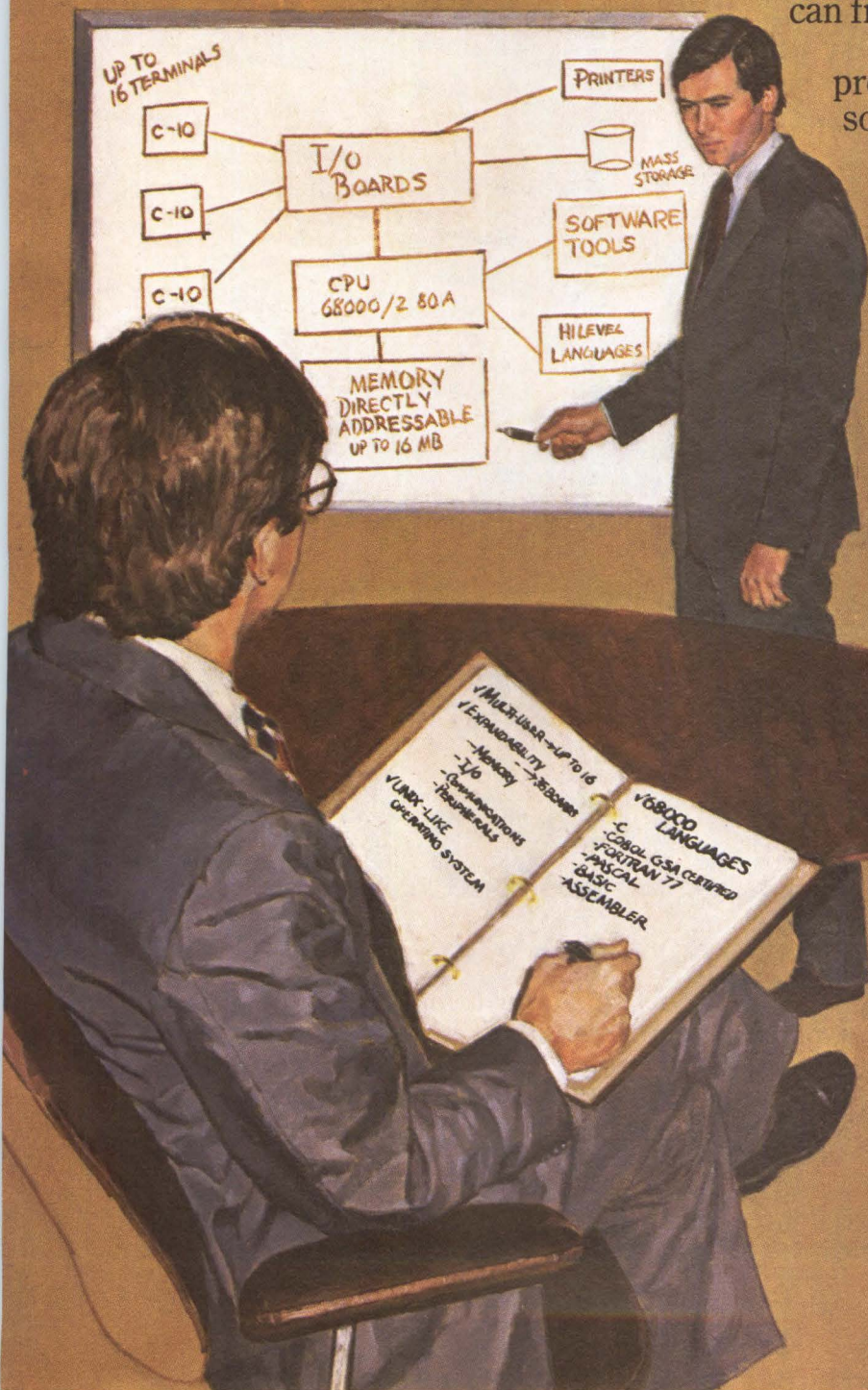
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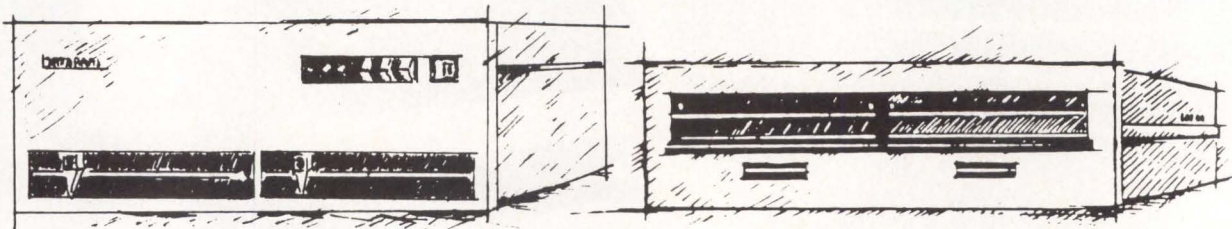
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Mini-Micro World

NEWS

HP unveils 9-pound portable with MS-DOS, Lotus 1-2-3 in ROM

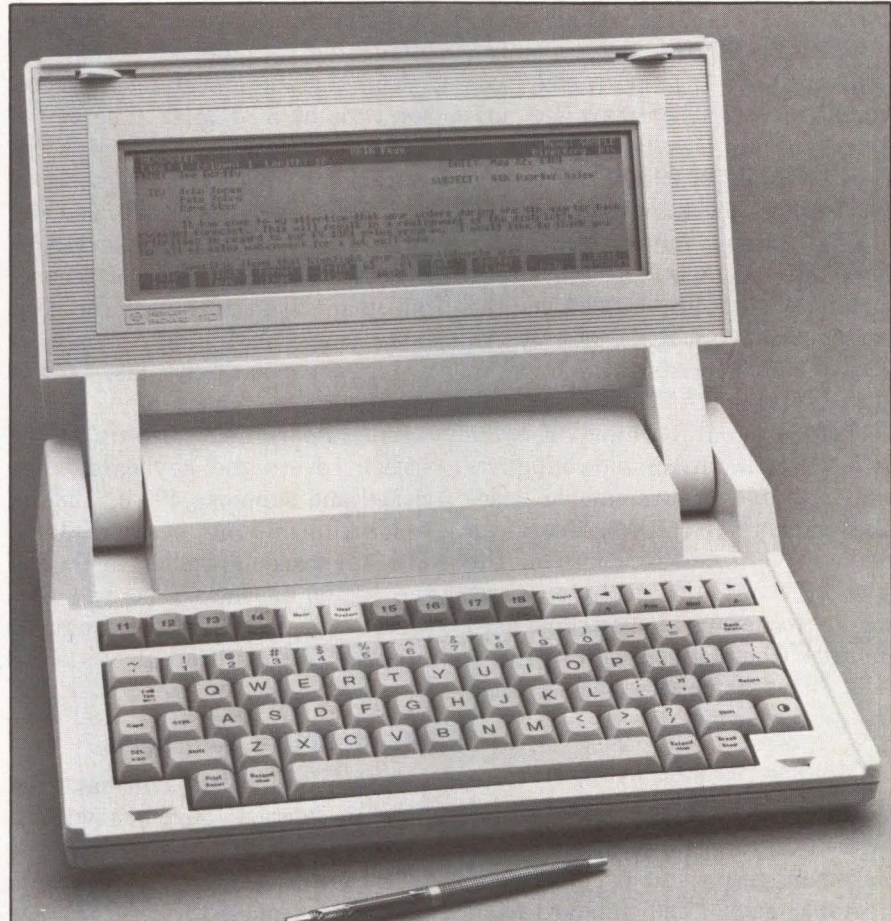
Tom Moran, Associate Editor

The latest addition to Hewlett-Packard Co.'s growing family of products for personal and business computer markets is the Portable (HP model 110) personal computer, a nine-pound, MS-DOS "knee-top," or lap-sized, system. The Portable is designed to bridge the weight/performance gap between bulky, full-function transportables and low-function knee-top machines. Measuring 10 by 13 by 3 inches, the Portable fits into a 5-inch-wide briefcase.

HP has tentatively set retail price for the Portable at approximately \$3,000. The price includes Lotus Development Corp.'s 1-2-3 integrated software package, MS-DOS and other software in ROM. The Portable has a flip-up, 16-line-by-80-column liquid-crystal display (LCD), a built-in modem, a built-in rechargeable lead/acid battery and an AC adapter/charger. An RS232 serial port, an HP interface loop (HP-IL) port and an integral 300-baud Bell-compatible modem with RJ-11 telephone jack provide data communications and interfaces to other devices.

HP tries for 700K-byte floppy

HP has also introduced the HP9114 portable disk drive, a battery-powered 3½-inch Sony Corp. microfloppy drive. At press time, HP planned an initial capacity of 700K bytes for the drive. If that goal is not met, the initial capacity will be 270K (the same as the drives on the HP150), and a 700K-byte drive will follow. The higher capacity depends on Sony's ability to deliver the double-sided version of its 3½-inch microfloppy drive.



HP's Portable personal computer contains MS-DOS and Lotus 1-2-3 in ROM and sports a 16-line-by-80-column LCD.

With a projected retail price of about \$700, the 9114 measures 11.5 inches wide by 8 inches deep by 3 inches high, weighs 5½ pounds and interfaces to the Portable through the HP-IL interface. The Portable is file-compatible with the HP150, IBM PC and Compaq Computer Corp.'s Compaq portable. HP expects the Portable to be compatible with other IBM work-alikes.

"We're redefining the [portable] market by making no compromises," says Cyril Yansouni, general manager of HP's Personal Comput-

er Group in Cupertino, Calif. "The reason why people have been using categories [like portable and transportable] is that, as you move from category to category, you're making trade-offs." Yansouni claims that until now most portables have been dedicated or very expensive. "Now we have a full-power CMOS (complementary metal-oxide semiconductor) machine that runs all the popular software." HP will begin shipping the Portable a few weeks after its announcement.

The inclusion of MS-DOS, Lotus

Mini-Micro World

NEWS

1-2-3 and the large amount of memory make the Portable price-competitive, Yansouni says, adding that this has not been traditional for HP. For people who want Lotus 1-2-3, the Portable should be strong competition for the IBM, Compaq and other MS-DOS portables. The Portable will also challenge machines from Gavilan Computer Corp. and the \$1,995 PC 5000 from Sharp Electronics Corp.

The Portable differs from other knee-top systems in the large amount of software in ROM and the segmentation of ROM and RAM. The Portable boasts 272K bytes of static system RAM, 384K bytes of socketed custom ROM and 8K bytes of both display RAM and configuration erasable programmable read-only memory (EPROM). Users can dedicate different amounts of the system RAM (in 4K-byte increments) for use as an electronic hard disk drive emulator. Data in RAM is kept intact via battery backup when the system is turned off.

'ROM disk' speeds system

The most unusual feature of the system is the "ROM disk." Steve Sakoman, project manager for the Portable, says, "The standard ROM contains Lotus 1-2-3 and the BIOS. We provide a driver in the operating system (OS) that treats the rest of the ROM (about two-thirds) as a read-only disk." The ROM disk includes the OS, the Personal Application Manager user interface, MemoMaker word-processing program and the Terminal communications program. Terminal drives the auto-dial-answer modem and emulates an HP2621 terminal in character mode only. It provides up- and down-loading capability and a data-capture mode. The Portable can be programmed to send and receive unattended. Emulation of the 3270 terminal is in the works.

Sakoman says that, because of the size of the ROM, HP is putting a large amount of quality assurance into the code. The ROM is socketed to allow for upgrades, such as the addition of Lotus's Symphony integrated package.

The Portable's 8086 microprocessor runs at 5.33 MHz. Use of the ROM disk significantly speeds the system over non-ROM disk designs. Although the 9114 disk drive's data-transfer rate over the HP-IL averages only 36M bits per second, Sakoman says that a user can copy into the RAM disk, "making everything blazingly fast," says Sakoman.

The Portable's flip-up LCD screen covers the keyboard when closed and supports 480-by-128-dot resolution bit-mapped graphics. The keyboard is similar to that of the HP150 but lacks a keypad. The system has eight programmable function keys that provide 16 functions.

16-line LCD is from Japan

Sakoman says HP will have the first production portable with a 16-line LCD. HP will obtain the LCDs from several vendors in Japan. "I wouldn't expect to see 24-line LCD technology for about a year," says Sakoman, "although initial samples are available now." When 24-line LCDs are available, HP expects to be among the first to

offer them. However, the 16-line versions cannot be field upgraded to 24 lines.

Designed and to be produced at HP's Corvallis, Ore., division, the Portable uses all CMOS technology to minimize power requirements. The system also turns itself off after a user-selected interval of non-use. HP says a charge on the lead/acid battery will last for one to two weeks under what HP considers normal conditions. When tested with a program designed by HP to drain power, the battery lasted for 20 hours of continuous operation.

The 9114 disk drive also uses a lead/acid battery, and HP claims it has a similar charge life. Combined with the battery-equipped HP-IL version of HP's ThinkJet printer, the Portable and the 9114 give HP a modular system of high-performance, battery-powered portable devices.

Company sources will not reveal sales projections for the Portable. HP will distribute the Portable and the 9114 disk drive through its direct sales force and 750 domestic retail dealers.

A design team in HP's Corvallis, Ore., division designed four custom CMOS ICs for the Portable—a 256K-bit ROM, a 64K-bit static RAM, an LCD controller and a chip that contains the keyboard interface, system timer and serial port. □

LASER MEMORY OPTICAL DRIVE HAS 150M BYTES

The newly formed Laser Memory Systems Inc., Calabasas, Calif., is preparing to launch a 150M-byte, write-once/read-always, removable-platter optical disk drive in the fourth quarter. According to company founder and chief executive officer Ray Brook, the drive, tentatively dubbed the LaserFile, should be in mechanical prototype versions by June. The drive has 15,800 tracks per inch and will use a 120-mm. platter and, most likely, a small computer systems interface. According to Brooke, the goal is to work up to reversible media, which he says is not readily available. The drive is expected to sell for less than \$1,000 in OEM quantities.

Molecular's supermicros smooth transition from 8- to 16-bit systems

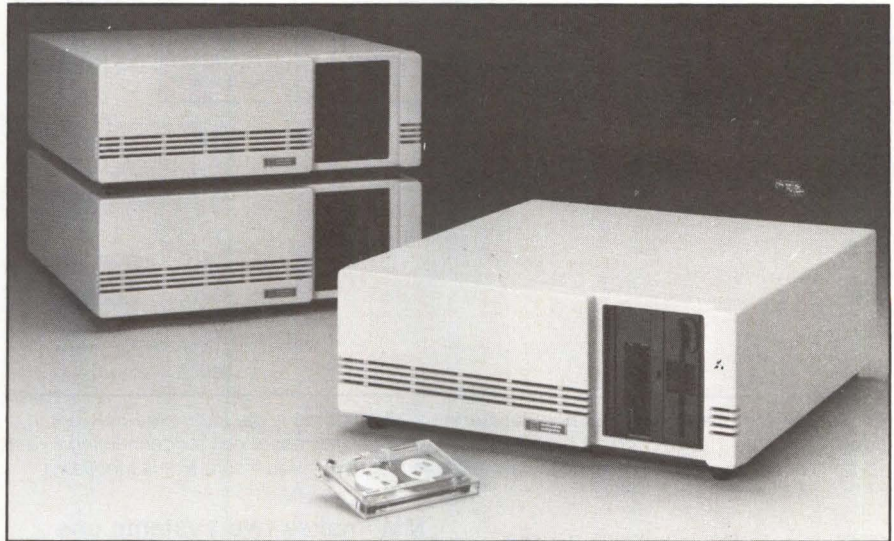
Chris Bailey, Western Editor

Molecular Computer, San Jose, Calif., has introduced what it claims will be a strong multiuser solution for accessing 8- and 16-bit software: two new supermicrocomputer systems capable not only of concurrent execution of the popular 8- and 16-bit operating systems—including CP/M-80, MP/M-80, CP/M-86, MP/M-86 and MS-DOS—but also of growing incrementally from three to 64 users.

The systems, the Series 9 and Series 36, are software-compatible with Molecular's X family of multiuser systems and accept a maximum of nine and 36 application processors, respectively. But unlike Molecular's older computers, the new systems provide "on-demand" processing that permits users to execute applications simultaneously on any multiple set of 8- or 16-bit processors. Previously, each user was assigned a single dedicated application processor. In the new Series 9 and 36, with the use of eight-port terminal concentrator processors (TCPs), each user can concurrently access as many as eight application processors.

According to Jerry Braun, Molecular's product manager, "These systems offer OEMs and value-added resellers a smooth transition from the 8- and 16-bit worlds. In a single multiuser system users can execute applications written for both 8-bit CP/M-MP/M or 16-bit MS-DOS environments."

Both systems are based on Molecular's proprietary networking m/BUS with 8-bit AP/Z80 (Z80A-based) and 16-bit AP/186 (80186-based) application processors. The m/BUS, a local-area network in a



Series 9 supermicrocomputers from Molecular Computer permit users to execute applications simultaneously on a set of any multiple 8- or 16-bit processors. In the foreground is a Series 9 unit; a Series 9 and an expansion unit are in the background.

box, is a high-speed (400K-byte-per-second) bus that uses a carrier sense, multiple access with collision detection (CSMA/CD) protocol similar to Ethernet to provide high-speed data transfers between multiple processors and I/O devices.

TCP key to the 9/36 series

The key to both on-demand processing and transparent multiple operating system support is the introduction of a terminal concentrator that has been added to Molecular's networked architecture. The TCP connects users with the desired application processors and permits the easy transition between CPUs and operating systems. For example, a user can start a job stream on one processor and then access a second processor to execute a program running under a different operating system. When the job stream is complete, the user can reattach to the processor and

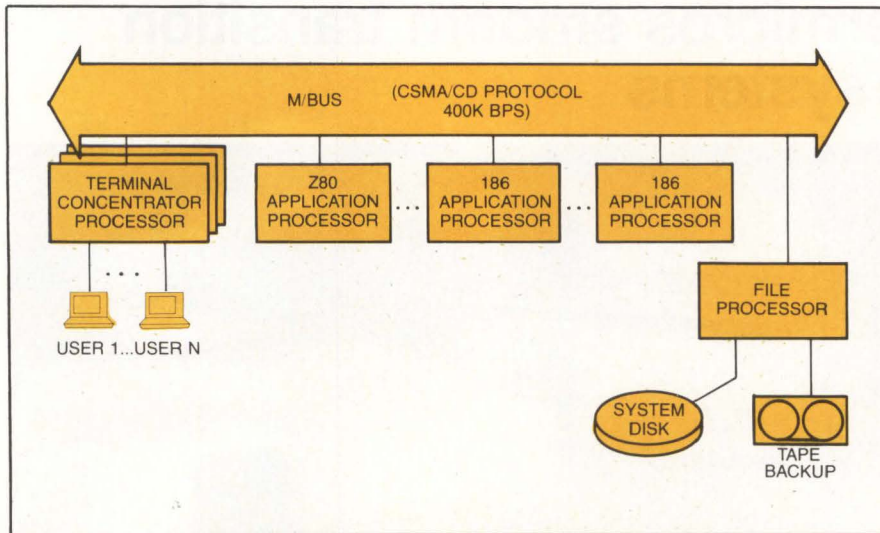
release it for use by another user or execute another program.

The TCP, a two-board set, consists of a standard 16-bit 80186 application processor and a multiplexer card. The processor has 256K bytes of RAM; the multiplexer card uses four two-port dual asynchronous receiver/transmitters that provide eight ports of serial I/O at 19.2K bauds per port. All communications between user terminals and application processors pass through the TCP. In turn, the TCP controls the configuration of users and processors under a firmware-based multitasking operating system executing on the TCP. The firmware oversees the operation of each terminal port and provides the system log-in functions for each user.

The resident firmware controls the allocation of system processor resources and temporarily permits each user to "own" as many as eight

Mini-Micro World

NEWS



The key to the power of the Molecular Series 9/36 systems is the local-area-network-in-a-box architecture that supports a parallel CSMA/CD inter-processor bus for connecting 8- and 16-bit processors. Each user can access as many as eight processors simultaneously.

application processors at a time.

In keeping with the aim of increasing performance through a distributed-logic architecture, the system includes Z80 processors for print-spooling, data-communications and file-server functions. In particular, the file server contains 64K to 256K bytes of cache RAM that helps improve overall disk I/O performance. These intelligent I/O processors eliminate the I/O-processing overhead in shared-logic systems.

Series 9 packs 20M or 30M bytes of Winchester disk storage, a 320K-byte floppy disk drive and an optional streaming-tape drive into a desktop system. A minimum system offers system integrators an expandable multiuser configuration for as little as \$8,995.

Series 36, designed for larger multiuser configurations, is housed in a free-standing 12-inch wide by 31½-inch long by 24-inch high cabinet. It supports a 60M-byte, 5¼-inch Winchester disk with space for two additional drives, a 320K-byte floppy, an optional tape drive and as many as 36 application processors. Prices start at \$18,995.

MMI makes two systems one

Aware of the customer resistance to multiuser systems that limit growth beyond six to 12 users, Molecular has developed the Molecular modular interconnect (MMI) bus that allows the m/BUS to be extended between system enclosures. Thus, two or more systems can be joined to operate as one large system. As many as five expansion cabinets may be attached, supporting additional application processors, file processors and mass-storage devices. This setup provides a virtually linear growth path from a low-end three-user configuration with 20M-bytes of hard disk storage to a powerful 64-user system supporting more than 400M bytes of on-line disk storage. This gives system integrators a means of avoiding technological obsolescence. As new mass-storage technologies become available, new disk/file processor subsystems can be introduced in separate expansion cabinets that attach via the MMI.

In addition to standard CP/M and MS-DOS software packages, Molecular offers ATOM, a set of office-automation software packag-

es designed for its supermicro-computer family. Included are the m/WORD word processor, the m/CALC electronic spreadsheet and m/MAIL electronic-mail facility. These menu-driven programs support a consistent user interface and an extensive HELP facility. Planned additional ATOM applications include a relational database manager, a filer, data-communications software and a business graphics package.

MS-DOS compatibility is key

John Kiefer, senior analyst for InfoCorp, a Cupertino, Calif., market research organization, says MS-DOS compatibility will make the Series 9/36 attractive to integrators and OEMs. He notes that in the last three years Molecular has achieved success by providing a stable, reliable multi-user system capable of running industry-standard CP/M-based software. With the new systems, he believes, Molecular is in a position to duplicate that success with the emerging base of MS-DOS software. "The key to the success of the microcomputer was the availability of standard operating systems that permitted the development of a large number of 'transportable' application-software packages. For the supermicro market to accelerate, application software must be portable between hardware systems."

Molecular believes that the availability of the MS-DOS operating system on the Series 9/36 will be the key to expanding the company's market penetration. Product manager Braun points out that most software suppliers for popular programs running on the IBM PC under PC-DOS have transported or are transporting their programs to the hardware-independent MS-DOS environment.

□

IBM, Zenith portables challenge Compaq

David Bright, Assistant Editor

Compaq Computer Corp.'s Compaq portable established itself as a benchmark in the fast-growing IBM PC-compatible portable ranks soon after its introduction in 1982. But IBM Corp. itself and Zenith Data Systems Corp. may now be threatening Compaq's stronghold in the market with their own portables—the IBM Portable PC and the Zenith Z-160.


Officials at Compaq, Houston, say they anticipated IBM's announcement and will continue to ramp up production of its portable. Compaq, which had sales of \$111 million in the first year of production of the Compaq, opened a 457,000-square-foot facility on the same day as IBM's announcement. "Demand [for the Compaq] continues to be high," says a Compaq spokesman. The Compaq portable can be upgraded to the Compaq Plus, which incorporates a 10M-byte Winchester disk drive, making the computer compatible with the IBM PC XT. The IBM Portable does not yet come in a hard disk version, and IBM says initial supplies of the unit will be limited.

Base prices of the three manufacturers' machines are similar. List prices are \$2,795 for the IBM, \$2,799 for the Zenith Z-160 and \$2,995 for the Compaq.

Portables are 8088-based

The Compaq, Zenith and IBM machines use the Intel 8088 microprocessor and have built-in 9-inch monitors. The IBM Portable PC, basically a repackaged PC, includes 256K bytes of RAM, expandable to 512K bytes, a 360K-byte, half-height floppy disk drive, PC-DOS 2.1, a color graphics monitor adapter and an optional second floppy disk drive. It has an

IBM PORTABLE PC VERSUS COMPETITORS



Company Product	IBM Corp. IBM Portable Personal Computer	Compaq Computer Corp. Compaq	Zenith Data Systems Corp. Z-160 PC Portable
Dimensions (in.)	20 x 8 x 17	20 x 8.5 x 15.3	19.5 x 8.4 x 19.1
Weight (lbs.)	30	28	38
Processor	8088	8088	8088
Main memory	256K bytes, expandable to 512K bytes	128K bytes, expandable to 512K bytes	128K bytes, expandable to 640K bytes
Display	9-in., amber, 640 x 200 dot	9-in., green, 640 x 200 dot	9-in., amber, 640 x 200 dot
Keyboard	detached, 83 keys	detached, 83 keys, identical to IBM	detached, 84 keys
Storage	360K-byte, 5¼-in. floppy drive (optional second drive)	320K-byte, 5¼-in. floppy drive (optional second drive)	360K-byte, 5¼-in. floppy drive (optional second drive)
Total slots	7 (3 full-sized, 4 short)	5 full-sized	8 full-sized
Expansion slots available	1 full-sized, 4 short	3 full-sized	4 full-sized
Operating system	PC-DOS	MS-DOS	MS-DOS
Price (\$)	2,795	2,995	2,799

83-key, detachable keyboard that is identical to the PC's. Its card cage has seven slots. Five are expansion slots, but only one of those is full-sized. That compares with five full-sized slots on the Compaq, of which three are available for expansion. The Portable PC weighs about 30 pounds and comes with a carrying case. IBM is distributing the Portable through retailers, IBM Product Centers and direct sales.

The Zenith Z-160 portable is a repackaged version of the Z-150 desktop model that the company introduced at the same time as the Z-160. "Both offer features not found in the IBM PC or other compatibles, and both offer more value," claims Randall Griffin, Zenith Data Systems vice president of product management and plan-

ning. However, at 38 pounds, the Z-160 is one of the heaviest PC-look-alike portables on the market. Griffin says the company may reduce the system's weight by altering the casing, power supply and fan.

The Z-160's keyboard layout is a modified version of the IBM Portable PC's. The Z-160's keyboard has an enlarged, L-shaped return key with a double-width shift key below it. It has an extra "enter" key next to the keypad. Two standard diagnostics levels are power-on with light-emitting diode indicators and ROM-based, menu-driven displays. Disk-based diagnostics are optional. Griffin says the diagnostics boot up in less than 5 seconds. To insert a diskette into the Z-160, a user must first pull up a

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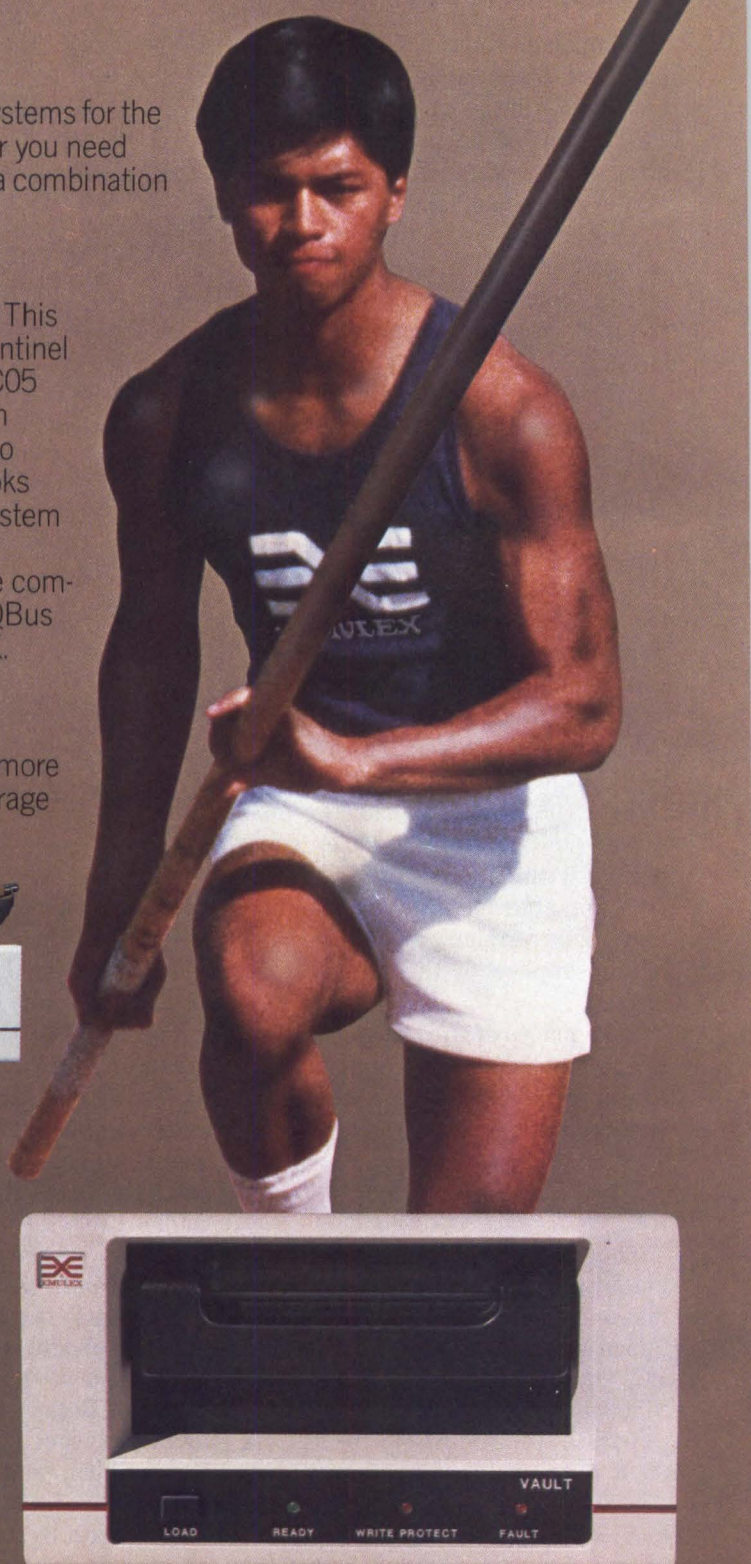
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SABRE is 5 1/4" high and slips into any 19" RETMA enclosure. A desktop version is also available. Both come complete with power supply, host adapter and connecting cables.

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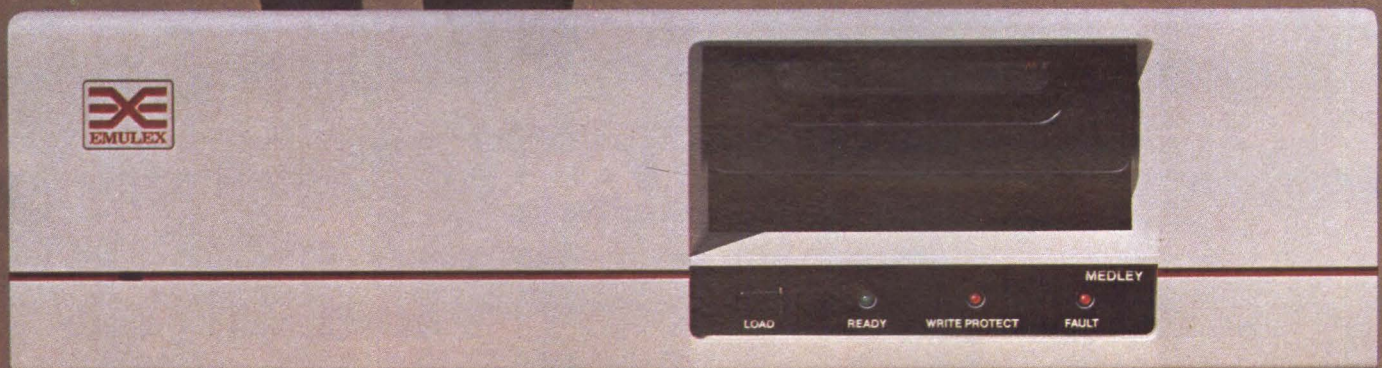
For convenience, Medley's disk drive, tape drive and power supply all fit into an attractive cabinet that easily mounts in a standard 19" rack. The Medley is also available in an attractive desktop version.

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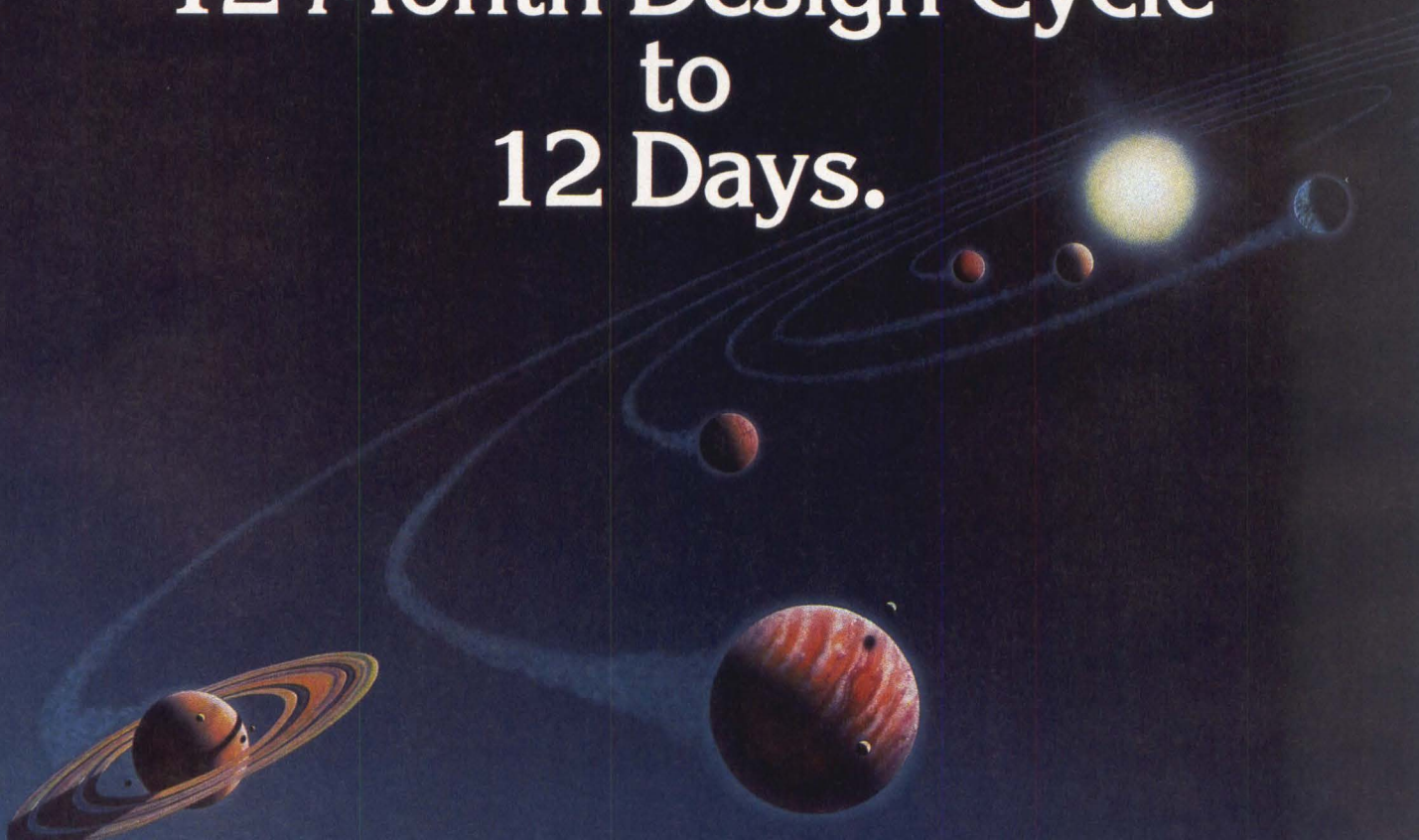
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separate disk drive housing in the top of the unit. The Zenith card cage contains eight full-sized slots, with four open in the basic configuration.

The Z-160's basic memory of 128K bytes is expandable to 640K bytes. Zenith has tested at least 25 IBM expansion boards on the Z-160 to ensure compatibility, according to Griffin.

Zenith runs 175 PC packages

Zenith has tested more than 175 software packages for the IBM PC on the Z-150 and Z-160. They include Lotus Development Corp.'s 1-2-3, Microsoft Corp.'s BASIC and C compilers and VisiCorp's VisiCalc. Zenith Data Systems will also market software under the Zenith name that "exceeds the perfor-

mance of off-the-shelf software," states Thomas Dornback, vice president of software development.

Zenith will distribute the Z-160 through its 23 North American distributors, through retail outlets such as Control Data Business Centers, through Heathkit Electronics Centers and via mail order from Heath. □

DEC/3M pact prods 1/2-inch tape-cartridge market

David Simpson, Associate Editor

In a move to make order of the chaos of the 1/2-inch tape-cartridge market, Digital Equipment Corp. and 3M Co. recently announced a joint program to develop a cartridge and recording-format standard for data interchangeability. The CompacTape cartridge and associated drive—which is still in development at DEC—provide 20M to 200M bytes of Winchester backup. The companies submitted the proposal to the American National Standards Institute (ANSI) X3B5 committee in mid-February.

The testing version of the 1-by-4.15-by-4.165-inch single-reel, self-threading cartridge has 600 feet of tape. The tape has 22 tracks and uses a modified-frequency-modulation (MFM) recording format at a minimum density of 6,667 bits per inch.

3M will manufacture and jointly market the tape cartridge, but only DEC will manufacture and market the drive. DEC officials decline comment on drive specifications, and analysts predict that DEC is at least a year away from shipping the drive in high quantities.

A lack of standards plagues the

market for 1/2-inch tape cartridges. Although Rosscomp Corp., MegaTape Corp. and Tandon Corp. are the only manufacturers shipping 1/2-inch tape-cartridge drives, recent announcements from Electronic Processors Inc. (EPI), Memorex Corp., Data Electronics Inc. (DEI) and Tandberg Data Inc., promise more competition by year-end.

"DEC's move is a throwing down of the gauntlet to other 1/2-inch tape-cartridge manufacturers," says Don Collier, an analyst with Freeman Associates, a Santa Barbara, Calif., research and consulting company.

Reaction from other manufacturers varies. "The DEC announcement is an endorsement of 1/2-inch tape cartridges," says Gary Webb, vice president of marketing at MegaTape. MegaTape's MT-300/1210/1220 1/2-inch tape-cartridge drive is the capacity leader with 330M bytes. The company plans to introduce the 500M-byte MT-2000 series in the third quarter of this year. The MegaTape units employ a dual-reel cartridge in a rack-mount enclosure, making them considerably larger than other 1/2-inch tape-cartridge drives.

Webb says that MegaTape is considering 5 1/4- and 8-inch form

factors and that the company might develop a product compatible with a standard, should one emerge. MegaTape will announce a second source for the MT series drives this year, according to Webb.

Rosscomp director of engineering Bob Richmond echoes Webb: "DEC's announcement is confirmation of the viability of the 1/2-inch tape-cartridge approach and shows the move from 1/4- to 1/2-inch tape." Rosscomp's Series 50 and Series 80 use a single reel, or spool, measuring 4 inches in diameter. Rosscomp plans to introduce a 320M-byte drive by year-end and is expected to announce a second-sourcing agreement within the next few months. Richmond says the DEC drive won't have any short-term effect because DEC doesn't have the backing of a secondary OEM source. But he admits that the proposed DEC/3M standard may influence the market in the long term. Richmond also believes that the relative complexity of DEC's drive may discourage near-term second sourcing.

Tandon's TM951 tape cartridge is similar to DEC/3M's and holds 50M bytes. Company officials decline comment on the differences between the products because specifications on DEC's drive were not available to them.

The 1/2-inch tape cartridge manufactured by Memorex and used by EPI in its STR-STREAM II drive is

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similar to the DEC/3M cartridge. The major difference is in the way the drive pulls the tape out of the cartridge. DEC's prototype has a leader at the end of the tape, while EPI/Memorex's approach uses a hook mechanism on the tape with the leader located on the take-up reel. "Whatever standard emer-

ges," says EPI product manager Vince Stinton, "EPI is in a position to adapt." EPI expects to begin quantity shipments in July or August. The Memorex drive, licensed under an agreement with EPI, is due by year-end. The companies submitted the design to an ANSI committee for considera-

tion as a standard last November.

The other entrant in the 1/2-inch tape-cartridge market is a joint effort by DEI and Tandberg. DEI will manufacture the cartridge, and both companies will develop the drive, which is scheduled for high-quantity shipments by year-end. Company officials will not

SORTING OUT THE 1/2-INCH TAPE CARTRIDGE MARKET

Company Model	Media package	BPI	No. of Tracks	Recording format	Unformatted capacity (M bytes)	Drive interface	Price (\$)	Notes
Data Electronics Inc./ Tandberg Data Inc.								
Magnum	1 - x 4 - x 6-in. dual-reel 3M-type (1/4-in.) cartridge		18		100	QIC-02	N/A	drive and media in development stage; specifications not final; deliveries scheduled for year-end
Digital Equipment Corp.								
CompacTape (cartridge)	1 - x 4.15 - x 4.165-in. single-reel cartridge (manufactured by 3M Co.)	6667 nominal	22	MFM	20-200	N/A	N/A	drive in development stage; specifications not final
Electronic Processors Inc.								
STR-STREAM II	1 - x 4.1 - x 4.2-in. single-reel cartridge (manufactured by Memorex)	12,000	20	MFM	130	ESDI	\$1,500 (single unit) < \$1,000 (OEM quantities)	3.25 x 5.75 x 8 in.; prototypes are scheduled for May/June; production volumes for July/August
MegaTape Corp.								
MT-300/1210/1220/2210/2220*	1.1 - x 9.8 - x 6.4-in. dual-reel cartridge	9600	24	GCR	330 (MT-300/1210/1220) 500 (MT-2210/2220)	Pertec/Cipher	\$3,200-\$4,000 (Q100)	MT-300/1210 is 8.75 x 19 x 17.5 in., MT-1200 is 10.2 x 8.4 x 24 in., MT-2210/2220 is scheduled for Q3 shipping
Memorex Corp.								
1110	1 - x 4.1 - x 4.2-in. single-reel cartridge	12,000	20	MFM	130	ESDI	N/A	3.25 x 5.75 x 8 in.; year-end scheduled delivery date; drive manufactured under license with Electronic Processors Inc.
Rosscomp Corp.								
Series 50 (5 1/4-in.) Series 80 (8-in.)	4-in. diameter, 1-in. thick single reel	8000	24	GCR	40, 80, 160	BSTI, QIC-02, SCSI, Pertec 9-track	\$1,385-\$1,895 (Q100)	Series 50 is 3.25 x 5.75 x 8 in., Series 80 is 4.62 x 8.55 x 11 in.
Tandon Corp.								
TM951	1 - x 3.5 - x 3.5-in. single-reel cartridge	6400	20	MFM	50	5 1/4 -in. floppy standard or 5 1/4 -in. Winchester standard	< \$500 in large-volume OEM quantities	3.38 x 5.88 x 8 in.; drive is in evaluation stage

*The MT-300/1210/1220 use 1000-foot tape. The MT-1220 is compatible with the CDC 9715 FSD drive. The MT-2210/2220 accepts 1000- or 1500-foot tape.



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release specifications of the drive, but the cartridge is a dual-reel unit similar to the 1/4-inch 3M cartridges. The DEI/Tandberg drive accepts 1/4- and 1/2-inch tape.

With the DEC announcement, says Freeman Associates' Collier, buyers will begin to perceive a

critical mass forming in the market for 1/2-inch tape cartridges. Although MegaTape and Rosscomp are shipping to OEMs, many value-added resellers are waiting for a de facto standard or at least assurance that a drive will have a sufficient number of second sources

for an adequate supply.

The biggest unknown in the 1/2-inch tape market, however, is IBM Corp.'s long-awaited "Ocotillo" drive, which some analysts expect this year. The DEC announcement "may draw IBM out of the 'no-comment' mode," says MegaTape's Webb. □

Ashton-Tate announces Framework, enters integrated software market war

Marjorie Stenzler-Centonze
Associate Editor

Ashton-Tate, Culver City, Calif., recently unveiled Framework, a unified software product that the company claims adds new dimension to the burgeoning integrated software market.

Framework consists of a data structure, or "frame," which resembles windows on a screen. The product includes word processing, spreadsheet, data management,

graphics and an embedded procedural language plus an external frame mode, which gives users the ability to access and operate PC-DOS application programs within Framework. In addition, Framework offers an outline mode that enables frame-by-frame organization of ideas and documents in a numbered outline form.

"Framework is quite different from other integrated products," states David Cole, president of

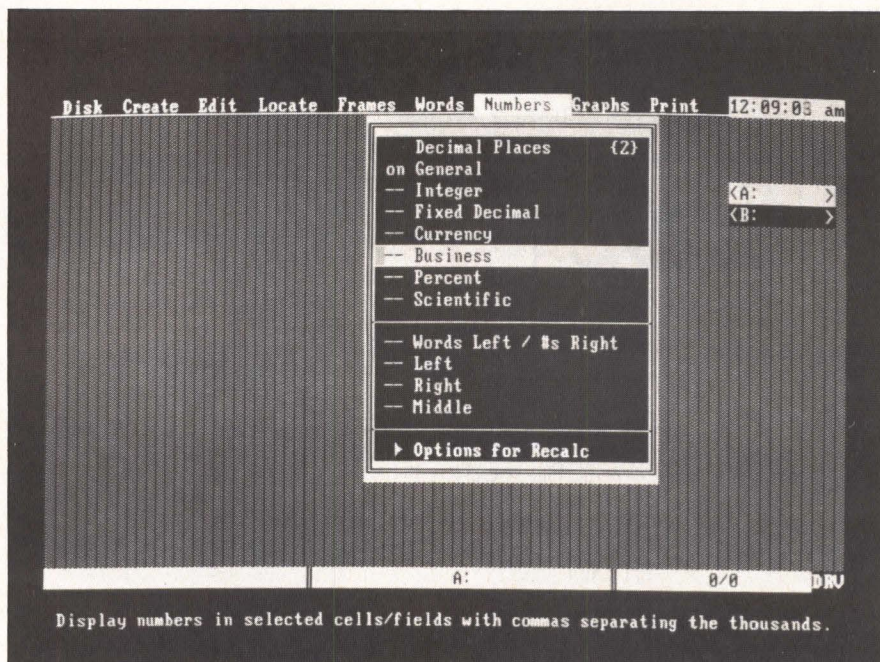
Ashton-Tate. "Virtually every process in the product is accessible to all other processes and even to outside products because it's engineered around a database as the nucleus."

Entire program in memory

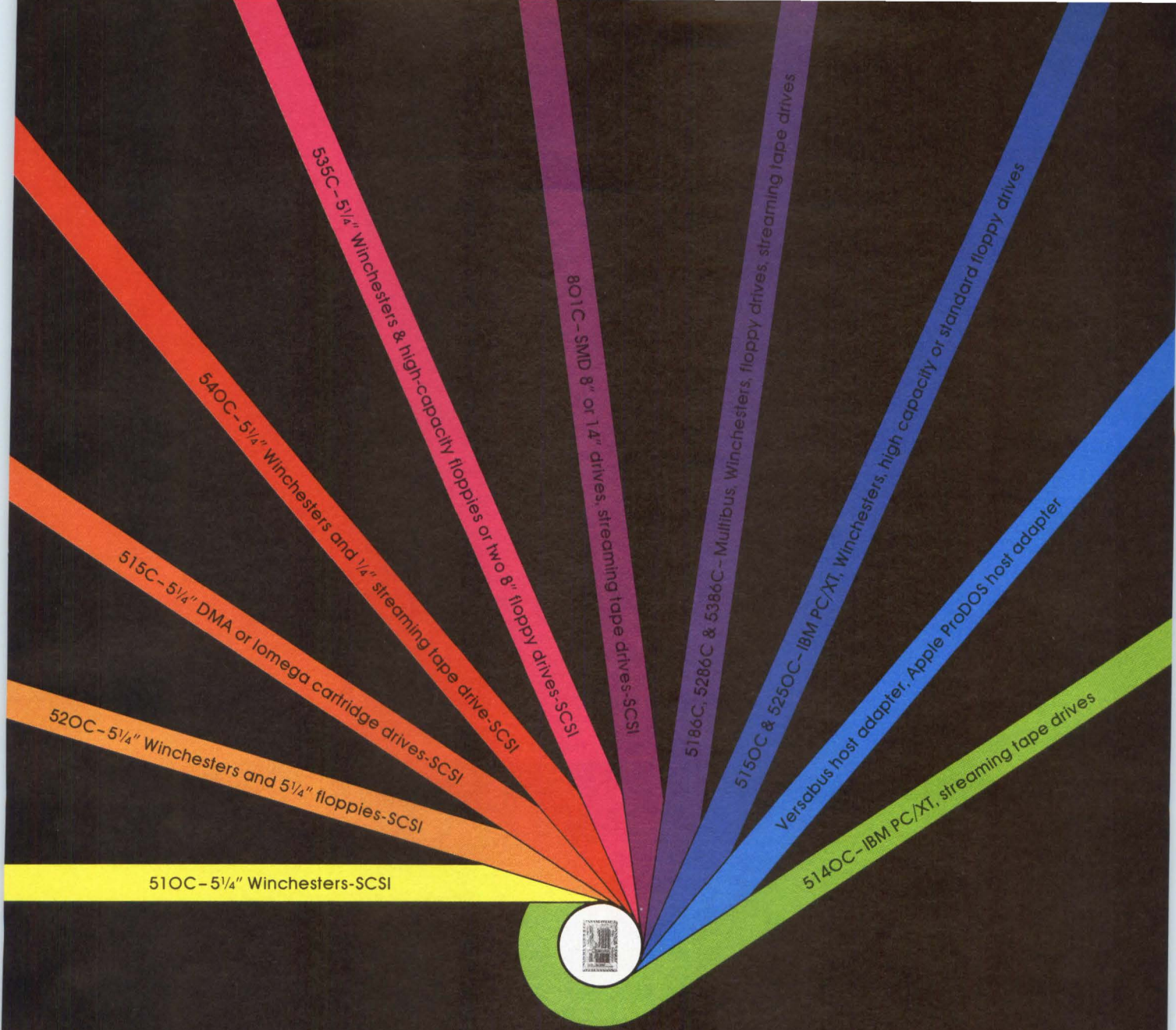
Martin Mazner, product manager at the company, says Framework offers software developers a spreadsheet and word processor that gives standalone programs a run for their money. He also points out that the whole program is memory-resident, "which makes it incredibly quick." Mazner claims Framework enables the user to move from one area on a spreadsheet to another, repainting the screen faster than Lotus Development Corp.'s 1-2-3 integrated software program.

Telecommunications is now offered through a windowing function. The company is readying communications functions integrated at the base level, Mazner says. Ashton-Tate will offer that function as an upgrade to current users in the months to come.

Framework should hit retail shelves in July and is expected to be priced at \$600 to \$700, Mazner says. The program runs on the IBM PC and PC-compatible microcomputers and requires 256K bytes of memory and a single disk drive.



Ashton-Tate's FRAMEWORK software program features English word commands. A keystroke "pulls down" menus offering further commands. A sentence at the bottom of the screen explains each command.



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Ashton-Tate unveils multiuser dBASE II

Ashton-Tate, Culver City, Calif., will begin shipping a multiuser version of its dBASE II relational database-management system this month. The system, which enables users to share information files, features lockout capability to prevent more than one user at a time from accessing and updating a file.

"Current network technology allows microcomputers to share data, but, as we tie these computers together, there needs to be traffic direction to avoid a collision of users trying to change the same record," says David Cole, president and chief executive officer of Ashton-Tate.

The multiuser dBASE II enables a user to lock onto a record or file, modify the database and unlock and release the record. Locking is not required to read data.

Ashton-Tate will offer a starter kit that allows four users to access a network or multiuser environment. Prices for the kit start at less than \$1,000. Four-user upgrades start at less than \$500.

Ashton-Tate supports 3Com Corp.'s EtherSeries network and a TurboDOS environment. Cole says the company will adapt the product to some new players in the local-area network market. Plans call for the support of Corvus Systems Inc.'s Omninet, Novell Inc.'s Netware and Orchid Technology's PCnet. The company has announced support of Apple Computer Inc.'s Macintosh microcomputer, but the date for availability of that support has not been set. Multiuser dBASE II will be available for the Apple Lisa II during the fourth quarter of this year.

Ashton-Tate president David Cole claims having a database as the nucleus of the company's Framework software helps make Framework "quite different from other integrated products."



Framework's English-like procedural language and a special DOS window place the product a step up from other multifunction products, Mazner points out. The window enables a user to create a frame, enter the frame, invoke a command to operate PC-DOS within that frame and then run other programs within the program, Mazner explains. Framework will run under Microsoft Corp.'s Windows, he notes.

Ashton-Tate expects the outlining feature to be a major draw. "It gives users the ability to throw down thoughts and concepts and then flesh them out and organize them at will," Mazner says. As users reposition frames, all other frames are renumbered to follow the sequence adjustments.

The company is mounting a major marketing and support program to launch Framework in the computer retail market, says company president Cole.

Ashton-Tate's strategy is to offer first-time business computer users all the primary software when the computer leaves the store. "The idea is to give users all the core software in a single package with an easy set of commands," Mazner comments, "and then make it open for people to develop specialized

applications written in our command language."

Ashton-Tate will not initially push Framework as an OEM product, but company officials say the product's success in the retail arena is likely to make it attractive as an OEM product later. □

JAPANESE WANT TO PATENT SOFTWARE

The Japanese Ministry of International Trade and Industry (MITI) has proposed eliminating the copyright protection for all software, including application- and operating-system programs, sold in Japan. Japan instead proposes to protect software under a patent-type scheme with a 15-year protection term. The current protection term runs for the author's lifetime plus 50 years. The MITI proposal would empower the Japanese government to designate licensees of software without compensation to the companies that own the programs. The Computer and Business Equipment Manufacturers Association (CBEMA) reacted strongly to the proposal by saying its members would re-evaluate their business plans in Japan if the proposal were adopted. CBEMA has urged that Congress consider reciprocal measures. Japan should act on the MITI proposal during the Japanese Diet by the close of the current legislative session on May 23.

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Expanded IBM 9000 system targets multiuser business applications

Lori Valigra, Senior Editor

The tip of IBM Corp.'s multiuser business system solution appeared recently in the form of a System 9000 engineering/scientific workstation extended to support business professionals. It precedes an expected announcement from IBM's Entry Systems division, which handles the Personal Computer, of yet another multiuser system this year.

The new 9002 desktop system, which IBM claims has the power of a minicomputer, is based on an 8-MHz Motorola Inc. MC68000 processor and runs Microsoft Corp.'s XENIX version of American Telephone & Telegraph Co.'s UNIX Version 7 operating system, as well as supporting the standard IBM-proprietary CSOS real-time, multitasking operating system resident in RAM.

But the 9002 gives no answer to those awaiting IBM's corporate strategy for UNIX. The forthcoming Entry Systems product is rumored to be based on the Intel Corp. 80286 and run an unspecified version of UNIX. IBM had previously announced Interactive Systems Corp.'s version of UNIX for the PC, which IBM calls the Personal Computer Interactive Executive (PC-IX).

Another question to be asked by manufacturers of multiuser systems is which of the IBM multiuser machines will set the industry standard to propel the multiuser market. Uncertainty about software standards and competition from personal computers have kept the shipment growth of \$12,000 to \$25,000 microcomputers to a minimum, according to information



IBM's 9002 multiuser, multitasking desktop microcomputer is based on the Motorola MC68000 microprocessor and has the XENIX operating system available as an option. Price for a configured system with XENIX is \$15,960.

released at InfoCorp's Strategic Issues Conference. Shipments of units in that range increased 16 percent from 1982 to 1983, which represents an increase of 18,000 units, according to InfoCorp numbers. IBM's price for the multiuser 9002 falls in the low end of the range.

Desktop 9002 is smaller

In the 9002, IBM presents a desktop system 28 percent smaller than the earlier 9001 engineering/scientific model. Measuring 16 by 18 by 6.7 inches, the 9002 can be used by one professional, or, with the optional XENIX operating system, as a host supporting three additional users through attached terminals, such as an IBM 3101 display terminal. Each user can run several tasks. As many as four 10M-byte hard disk drives, four 5¼-inch or 8-inch floppy disk drives and an

IBM 5182 color printer can be attached to the disk-less unit.

Included is the 9002's 12-inch raster display, which has a 768-by-480 pixel bit-mapped screen. The display shows 30 rows of 80-character lines, is green phosphor, has 10 user-definable keys beneath the screen, has a tilt-and-swivel adjustment and can be configured with an optional built-in diskette drive.

The 83-key keyboard includes the full ASCII character set, a numeric keypad, cursor control, print control and 10 programmable function keys. Also resident on the detached keyboard is a 57-key keypad arranged in three rows for data entry. The keypad and keyboard are separate on the 9001.

Included are 128K bytes of RAM, expandable to 5.2M bytes in 256K-byte increments, and 128K bytes of ROM.

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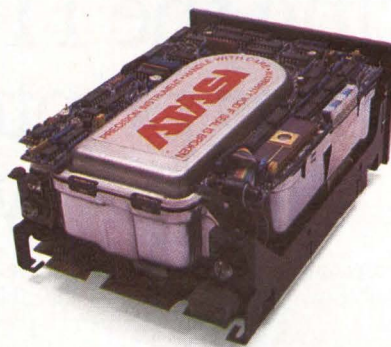
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XENIX will be sold by VARs

XENIX is scheduled for availability in the second quarter of this year. Though the 9002 will be marketed by IBM Instruments Inc., Danbury, Conn., which released the 9000, IBM's National Accounts and National Marketing divisions, selected IBM National Distribution division value-added remarketers (VARs) and authorized distributors, XENIX initially will only be available from IBM Instruments. IBM expects the other sales groups to sign on for XENIX. The one-time license charge for XENIX is \$995.

As many as four users can be supported simultaneously on XENIX. XENIX has memory-management and file-protection facilities, is multitasking and includes a full C compiler for developing structured application and system programs. An assembler and linker also are available. Optional support is for FORTRAN, Pascal and RM/COBOL. IBM advises those wishing to ship XENIX outside of the United States that they will require a government license to do so.

The RAM-resident CSOS operating system supports system calls and maintains file systems designed as hierarchical directories. It uses the same calls on all files and devices with which it communicates. CSOS uses software interrupts and inter-process message buffers to link small general-purpose processes, thus eliminating the need for a large special-purpose program. With its command-language interpreter, users can execute programs in the foreground or background. The command language interpreter also allows batch control files and easily redirects and chains an input/output program. IBM provides a CSAR file utility in XENIX so files can be transferred to and from CSOS.

With a system unit, display, keyboard and standard operating system, the 9002 sells for \$6,495. A 256K-byte memory card is priced at \$1,395. A complete system with XENIX starts at \$15,960, including the required 10M-byte hard disk, diskette drive, more memory and a memory-management card. FORTRAN and Pascal each carry a \$595 one-time license fee. RM/COBOL's license fee is \$1,250. List price of the 5182 color printer is \$1,995. IBM will give discounts for volume purchasers of both the hardware

and software. The 9002 also is scheduled for second-quarter availability.

The 9001, priced at \$5,695, includes a display, but no diskette drives or keyboard. The keyboard is priced at \$270, and an expansion card sells for \$95. A \$2,095 integral printer/plotter provides hard-copy output. Memory expansion to 5.2M bytes is the same as the 9002's, as are the attachable floppy and hard disk drive options. The 9001 measures 22.3 by 18 by 6.7 inches. □

MegaTape boosts capacity to 500M bytes per cartridge

Ron Shinn, Senior Editor

The new 500M-byte, ½-inch MT-2000 series tape-cartridge drive from MegaTape Corp., Duarte, Calif., keeps pace with increasing capacities of 14-inch Winchester disk drives by attempting to provide a one-cartridge-per-disk-drive storage overlap. MegaTape claims that is the ultimate in Winchester backup and user convenience. The concept has led the company from a 200M-byte drive, delivered in 1980, to a 300M-byte design—the MT-300 and MT-1000 series—introduced and shipped in 1983, and to the current 500M-byte drive.

The capacities of MegaTape's tape cartridges have lagged behind those of the new Winchester disks they are intended to back up by about two and a half years. As the company is introducing the 500M-byte MT-2000, for example, makers of 14-inch disk drives are regularly announcing 600M-byte capacity drives. Gary Webb, MegaTape vice president of marketing, says that

600M-byte versions of the cartridge will be available this year. The 600M-byte versions will be compatible with the 500M-byte MT-2000.

To add capacity to its basic 300M-byte design, MegaTape uses 1,500 feet of higher-coercivity, thinner tape in the MT-2000. That compares with the 1,000 feet of tape used in the MT-300 and MT-1000 series cartridges. MegaTape has also changed the cartridge's read/write electronics to match the higher coercivity. The 300M- and 500M-byte cartridges will operate in the new MT-2000 series, but the MT-300 and MT-1000 series will still include only 300M-byte cartridges.

Ampex Corp. makes the tape for the MegaTape cartridge, and at least two other second sources will join Ampex to produce the new, thinner media, according to Webb. Single-unit price of the 300M-byte cartridges is \$120, and 100-unit price is \$85 each. Webb points out that a single 300M-byte MegaTape cartridge holds as much data as eight 10½-inch reel-to-reel tapes

Mini-Micro World

NEWS



MegaTape's MT-2000 series tape-cartridge drives add capacity by using 1,500 feet of high-coercivity, thin tape. The model MT-2210 (pictured) stores 500M bytes in a book-sized cartridge.

recording at 1,600 bits per inch (bpi). Based on media alone, the cartridges—at about \$15 each—are about equal in price to reel-to-reel tapes. The MT-2000 cartridges will be priced about 20 percent more than the 300M-byte cartridges and will contain 40 percent more tape to reduce per-bit storage costs.

The MT-2000 cartridge drive can accommodate capacity increases of as much as 1G byte without incorporating new technology, says Webb. As a result, the cartridges will be upwardly compatible, meaning that all MegaTape cartridges will operate in all future transports. Webb says a 1G-byte drive will be ready for shipment in 1986.

"There are three parameters that you can press for higher capacity—track density, recording density or tape width. Our track density is 44 tracks per inch (tpi), which is equal to the lowest-performance floppy disk. To get 1G byte, all we really have to do is go to 96 tpi, and this can be done." Webb says floppy disk technology is pushing 170 tpi. He says that, if MegaTape cannot

achieve at least a two-to-one increase through increasing track density, it will try increasing recording density, which is 9,600 bpi. "We know that recording technology experiments are pushing 50,000 bpi in laboratories," Webb says. But he says the company will probably not use the third option—increased tape width—to increase capacity because it would prevent upward compatibility of the cartridges.

Webb says that a second-sourcing agreement for the drives should be finalized by mid-year. "This is part and parcel of our business plan," says Webb. He believes that, if the company acquires a second source for the drives, it will be the only maker of ½-inch drives with a high-capacity second source.

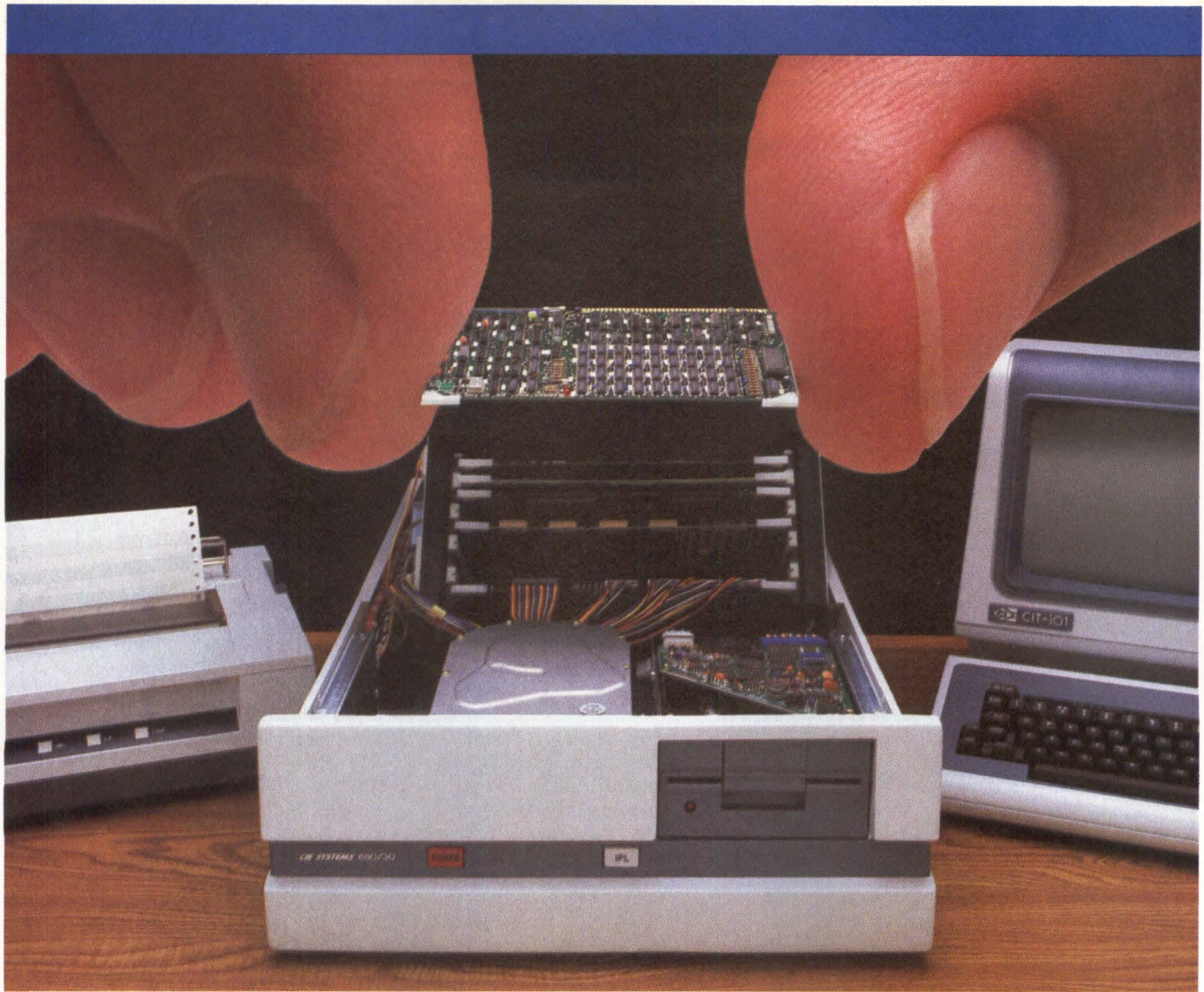
MegaTape's goal for 1983 was to ship 200 machines, and Webb says the number of shipments approached that goal even though the company didn't begin shipments until the last quarter of the year. The company has aggressive plans for 1984—shipments of 3,000 to

4,000 units. "We're now at a rate of about 100 machines a month, and our backlog is around 1,000 machines," Webb says.

The company is also looking at other possibilities such as smaller versions of its current drive that would be compatible with 8- and 5¼-inch Winchester. "But right now," says Webb, "we have a full business plan with higher-capacity drives. We will introduce two additional capabilities for all of our machines in the future—cache memory and more diagnostics. The cache memory will allow the drives to operate in systems that have not perfected streaming software, and enhanced diagnostics will tell the user which module and in some cases which component has malfunctioned."

The MegaTape drives operate at 200 or 50 inches per second (ips) in streaming mode and 50 ips in start/stop mode. The recording density is 9,600 bpi, and the tape has 24 tracks across its ½-inch width. A two-track head that supports the tracks is stepped 12 times to cover all tracks. Packaging is for standard 19-inch-wide rack mounting or desktop use, and both the MT-1000 and MT-2000 series are available as full- or half-width models. The half-width version is made by turning the full-width model on its side. It was developed for use with the Control Data Corp. 9715 disk drive. The MT-300 is available only in a full-width version.

Prices for the MegaTape drives in single-unit quantities are \$4,700 for the MT-300 (300M bytes, full-width, no intelligence), \$5,500 for the MT-2210 (500M bytes, full-width, intelligence), \$4,950 for the MT-1220 (300M bytes half-width, intelligence), and \$5,750 for the MT-2220 (500M bytes, half-width, intelligence). □



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CIRCLE NO. 29 ON INQUIRY CARD

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HEARD ON THE HILL

Check customs before traveling with your computer

Stephen J. Shaw
Washington Editor

Computer manufacturers and system integrators planning to export their products or simply wanting to take their portable computer along on their next trip abroad should check first with the U.S. Customs Service. The equipment could end up with the hundreds of other computers, components and peripheral devices that customs officials have seized during the past several years.

In cooperation with the Department of Commerce, the Customs Service runs "Project Exodus," a two-year-old program intended to staunch the flow of critical U.S. technology to the Soviet Union and its allies. Customs inspectors conduct ongoing investigations into suspected cases of computer smuggling, like the one that netted parts of a Digital Equipment Corp. VAX-11/782 mini-computer in Sweden and West Germany that were en route to Eastern Europe.

Based on tips and experience with certain airlines and destinations, customs authorities target specific outbound flights for inspections of cargo and personal checked and carry-on baggage.

From Oct. 1, 1982, through March 15, 1984, Project Exodus racked up 721 seizures of computers and parts, including peripherals, valued at approximately \$18 million. Approximately one-third of all seizures recorded by the Exodus program since it was started in early 1982 have involved computer-related equipment. The remainder was equipment seized for violations of arms-control statutes, such as components for advanced weapons systems, and for violations against other provisions of the Export Administration Act. Customs officials were unable to

determine how many of the seizures by the Exodus program involved equipment with embedded microprocessors but suggested that the percentage was high. "Not much is high-tech unless it does have a computer in it. We don't record it as such, though," comments a customs official.

The growing popularity and advanced sophistication of transportable and portable microcomputers have put customs officials into a quandary. They must decide whether briefcase-sized microcomputers that incorporate bubble-memory systems, 256K-bit RAMs and flat-screen video monitor devices should be considered "critical technology." If such devices are critical technology, they are subject to stringent export controls when a businessman takes them on a trip abroad. But microcomputers are showing up on international flights in such large numbers that enforcement of export regulations may be futile.

Microcomputer technology is advancing far more swiftly than customs guidelines for seizure and detention. Since the Commerce Department, which is charged with interpreting the Export Administration Act, decides all seizure and detention incidents on a case-by-case basis, guidelines for what constitutes "critical technology" for computers are vague. "I wish I could tell my inspectors that, for instance, 64K bytes is a cutoff point, but I can't since every [seizure and detention] case stands on its own merits, according to Commerce," says a customs source.

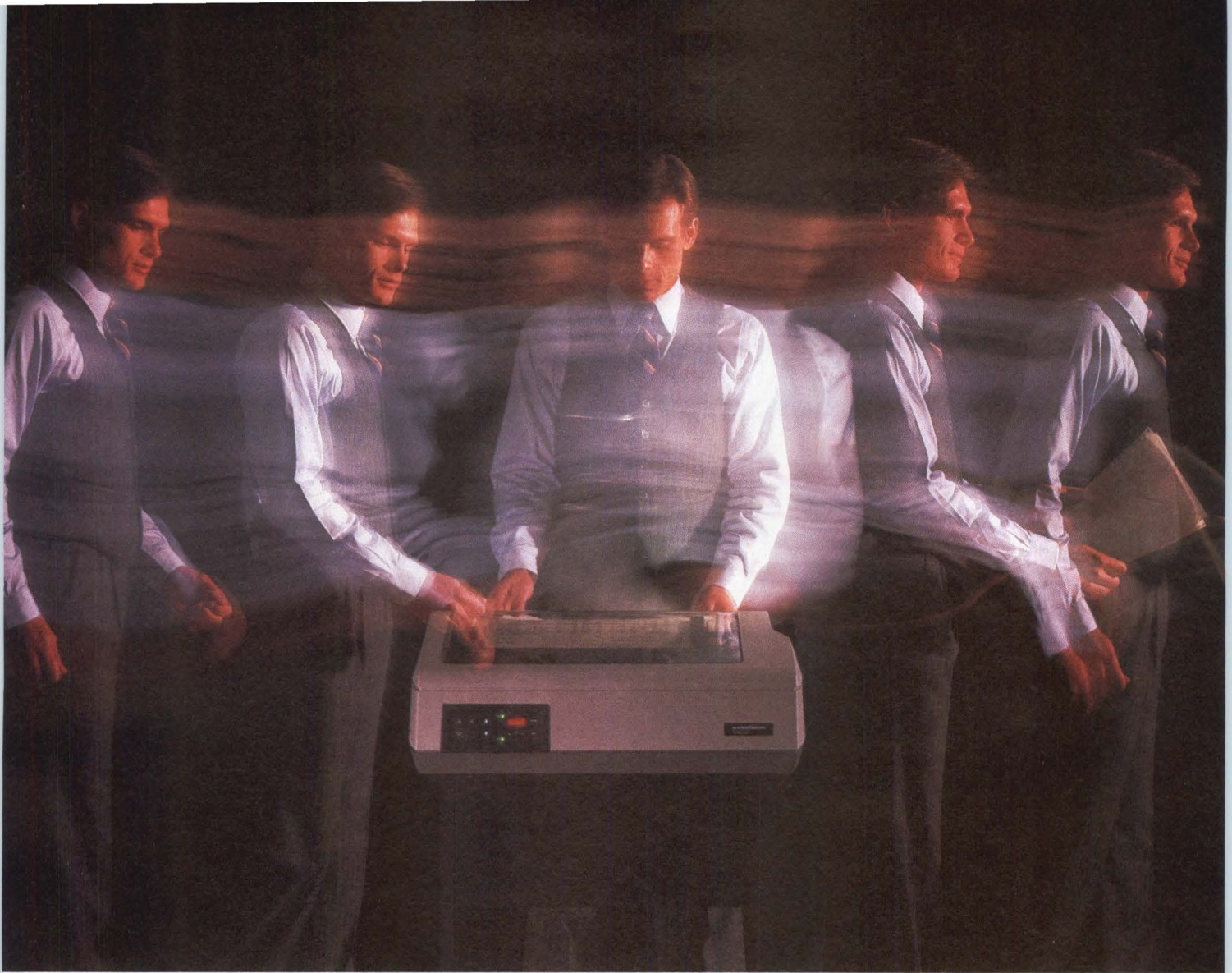
Computer users and trade associations have complained that vigilant customs inspectors have seized microcomputers carried onto or checked as personal baggage on international flights. Such complaints

prompted William von Raab, commissioner of the Customs Service, to meet with members of several electronic industry associations in February to iron out the problem. "Our priority is not to go out and dump planes to look for microcomputers," von Raab told the associations.

Following the meeting, the Customs Service announced guidelines that have resulted in a reduced number of portable personal computer seizures, according to a Customs Service spokeswoman. The guidelines state that travelers may take their personal computers and related equipment out of the United States as long as the traveler owns the computer, does not intend to sell the computer abroad and does not plan to go to a country for which an export license is required (the Soviet Union, China, Eastern Europe, Cuba, Iran, Libya, Vietnam, Laos and Kampuchea).

If a traveler's employer owns the computer or if the traveler plans to use it for "commercial" purposes—as a sample or display, for instance—Customs could seize the machine. Financial penalties range to as much as 10 percent of the computer's value, and it could take a user as long as six months to recover the lost equipment. Customs officials advise travelers who want to avoid seizure to complete a Shipper's Export Declaration form and submit it to the customs office at the airport before departure even if the traveler intends to return to the U.S. with the computer.

Since these guidelines are subject to various interpretations as applied to specific cases, travelers should check with their local customs office to avoid problems. Otherwise, their expensive computer equipment could be left standing at the gate as the plane takes off.



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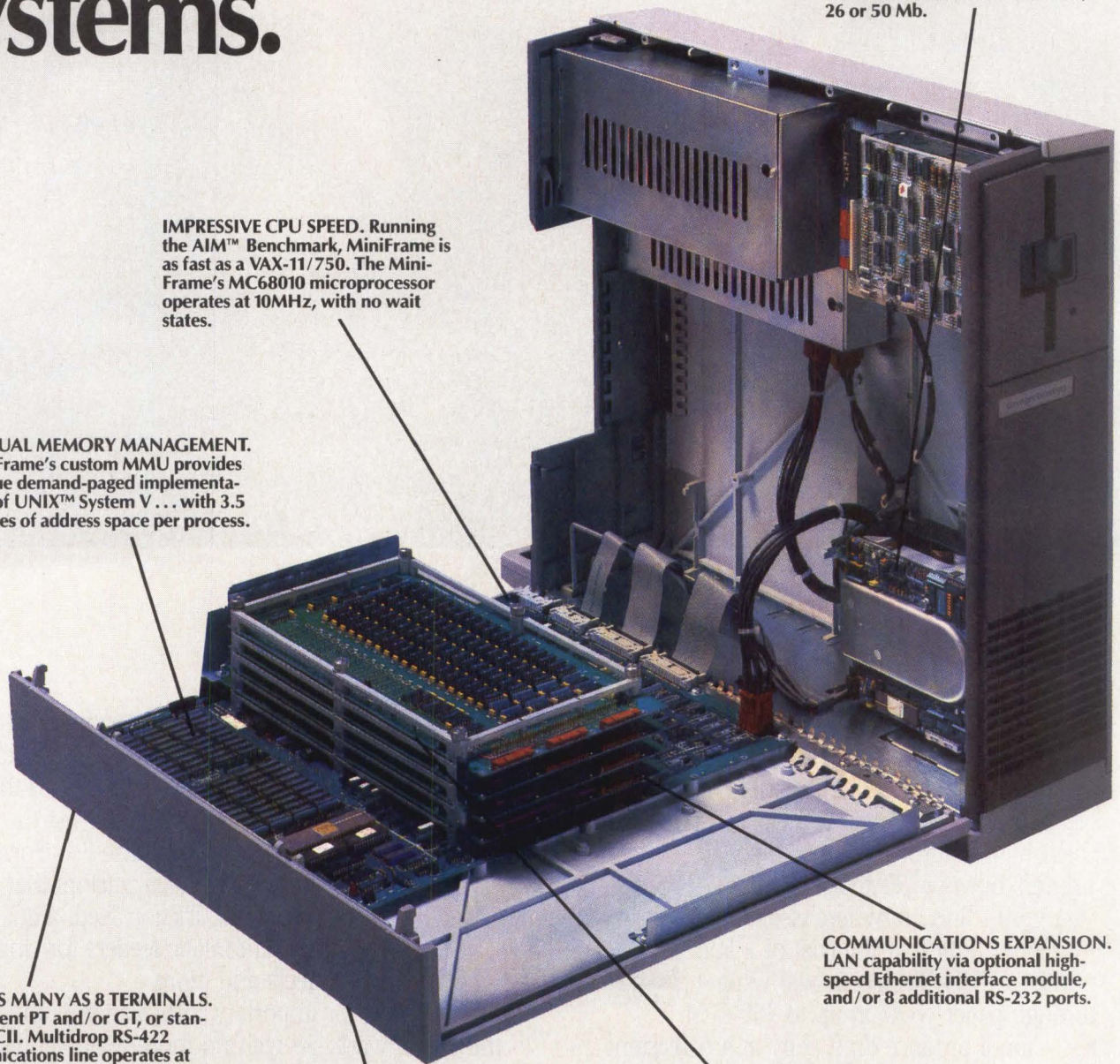
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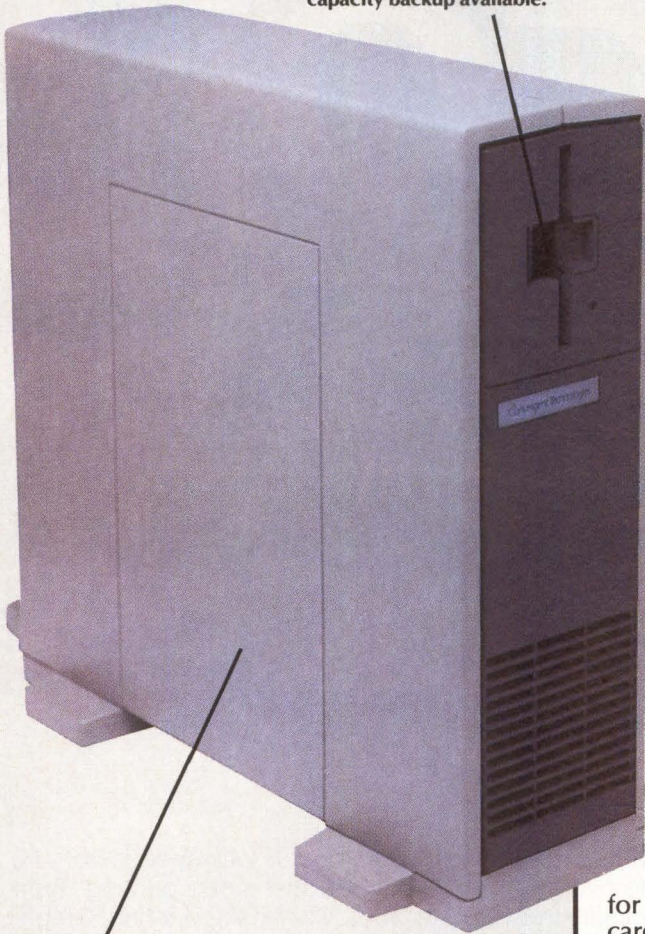


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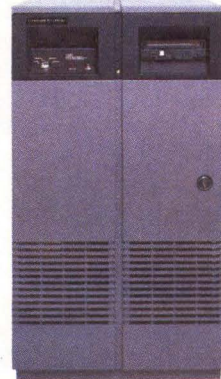
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CIRCLE NO. 32 ON INQUIRY CARD

SMI introduces BASIC-to-C translator

Edward Foster, Associate Editor

S-Tran, a BASIC-to-C language translator from Software Manufacturers Inc., (SMI) Carson, Calif., provides a direct software migration path to UNIX for BASIC language programmers and users.

SMI is delivering three versions of S-Tran—for Microsoft BASIC, OASIS BASIC and for the IBM PC XT—according to Ernest J. Hutchins, president of SMI. “Our next announcement will be the Apple Lisa and Macintosh versions,” he says. “Beyond that, we expect to release C BASIC and SMC BASIC by the third quarter of this year.” The company also plans to support HP BASIC and DEC BASIC.

“We have produced multiple versions of S-Tran because no single software tool would be capable of translating all forms of BASIC due to its considerable variances,” Hutchins says. He adds that SMI started with OASIS BASIC because it offered the opportunity to enhance multiuser software with UNIX performance. “With S-Tran, converted OASIS BASIC applications can be used on UNIX-based machines in the 8- to 16-terminal category,” he claims, “compared with three to four terminals for the BASIC version.”

Although SMI describes S-Tran as a translator, the product can be called a multipass compiler when linked with the C compiler that comes with most UNIX-based systems.

Menu selectors prompt S-Tran users as S-Tran performs syntax checking, formatting, translation and C source-code generation. S-Tran translates programs individually or in batches merged in a common data file.

When S-Tran completes a translation, it returns the user to the menu selector to link to the system's C compiler. Other features of S-Tran's menu include a data file-conversion program and communications routines to move software applications to the target system for translation.

SMI officials agree with many industry experts who predict that UNIX will become an industry standard operating system, but SMI officials also say there is a serious shortage of application software available for UNIX. According to James Getzinger, SMI's vice president of marketing, “There are a lot of good applications within BASIC that can fill this void, and SMI plans to provide the migration path.”

With its marketing strategy oriented toward directly or indirectly providing UNIX applications, SMI is also offering an accounting software package, Spectrum, which S-Tran converted from BASIC.

With two product lines—one for end use and one for development—SMI will market UNIX-based applications to computer manufacturers and distributors, as well as tap potential new sales channels through software companies that can adapt their proprietary packages using S-Tran. “The entire concept of UNIX is portability, thus avoiding hardware dependence,” asserts Getzinger. “Until now, software companies have been restricted to selling their products only on the number of systems they could support.” With S-Tran, however, users can implement standard C source code on systems using a wide range of computer languages.

SMI chairman Russell C. Gerns, who led a group of investors in a recent venture-financing round for SMI, believes the company will be successful because “S-Tran has the capability to port software...a software developer must take a serious look at using it.” □

DBMS MERGED WITH UNIX OA UTILITIES

Horizon Software Systems Inc., San Francisco, and Relational Database Systems (RDS) Inc., Palo Alto, Calif., have announced a cross-licensing agreement whereby they will offer RDS's Personal Informix database-management software as a component of Horizon's family of UNIX office-automation utilities. The Horizon package includes mail/merge, telephone logging, calendar management, sorting facilities, word processing and spreadsheet capabilities. The office-automation packages will create Informix database files, thus allowing direct access and manipulation by any RDS database-management programs or by commercial packages incorporating RDS's C-indexed sequential access method. Price of the system has not been set.

COMPLEXX MAKES SOFTWARE FOR MACINTOSH

Complexx Systems Inc., Huntsville, Ala., is yet another company jumping into the Apple Computer Inc. Macintosh bushel of value-added vendors. According to a Complexx spokesman, the communications software that works with the company's XLAN network and TRIMUX probably will be ported to the Macintosh windowing functions. The company claims this will maintain the high-level user interface Macintosh users expect.

Mini-Micro World

NEWS

C. Itoh, Delphax join forces to produce low-cost non-impact printer

Edward S. Foster, Associate Editor

An ion-deposition printer priced at less than \$10,000 and printing 30 pages per minute (ppm) will be the result of a recently announced contract between Delphax Systems, Mississauga, Ontario, and giant Japanese trading concern C. Itoh, represented in the United States by C. Itoh Electronics Inc., Los Angeles.

Both companies will market the new printer, which will be demonstrated at trade shows this month. The desktop-sized printer will offer a print resolution of 300 by 300 dots per inch (dpi). Delphax, the only provider of ion-deposition print engines, is supplying the technology for the device and will manufacture some components; C. Itoh will provide marketing and financial clout and will sign an

as-yet-unnamed Japanese manufacturer to help produce the device in high volumes.

The printer will provide a high level of price and performance, claims Mark Takeuchi, president of C. Itoh Electronics. By comparison, the page printer that industry observers believe to be the largest seller—Xerox Corp.'s 2700—is priced at \$18,995 and offers 300-by-300-dpi resolution at a speed of 12 ppm. C. Itoh officials estimate that more than 10,000 units of the printer will be sold in 1985, and end-user value of the units will be \$100 million.

Delphax pursues low-volume

Delphax president and chief executive officer Gary Sharpe says the new device, which he dubs "the Office Printer," will be targeted at

low-volume, high-speed office applications. Delphax now offers a \$60,000 60-ppm ion-deposition unit that is fundamentally different from the new printer, says Sharpe. "While our first printer had the imaging capabilities for graphics applications, such as forms generation and check printing, it was still primarily a line-printer replacement." Sharpe believes the new desktop version will be appropriate for office applications now performed by high-speed serial printers.

Sharpe says the critical trade-off for the new printer in undercutting the price of the previous unit was designing a lower duty cycle, particularly in regard to paper handling. "For a desktop device, you have to have a limited paper-stacking capability with the expect-

C. Itoh previews other products

C. Itoh Electronics Inc.'s venture into non-impact printing is one of several moves the company and its subsidiary, CIE Terminals, Irvine, Calif., have made since reaching an out-of-court settlement with Printronix Inc., also of Irvine, over a patent-infringement suit.

As C. Itoh announced the settlement of the suit in February, the company also announced plans to introduce a 350-character-per-second serial dot-matrix printer and two matrix line printers to replace those that were the objects of the suit.

The suit involved the CI-300 and CI-600 dot-matrix line printers marketed by CIE Terminals and manufactured by Citizens Watch Co. of Japan. After the printers were first demonstrated in May 1982, Printronix warned C. Itoh and Citizen Watch that it believed the printers infringed on

Printronix patents for dot-matrix printer mechanisms. Citizen filed legal action in November 1982 to have Printronix's patents declared invalid, and Printronix immediately countersued Citizen and C. Itoh for patent infringement. Last year, Printronix also filed a complaint with the U.S. International Trade Commission to block imports of the printers.

Under terms of the settlement, C. Itoh will continue to sell an undisclosed number of CI-300 and CI-600 printers in the United States while readying new models for production. The legal actions were all dismissed without admission of validity or infringement of the Printronix patent claims, but C. Itoh agreed to pay an undisclosed sum to Printronix.

C. Itoh president Mark Takeuchi characterizes the sum paid to Printronix as "approximately the

amount of [Printronix's] out-of-pocket expenses for continuing the litigation." He emphasizes that CIE Terminals will begin delivering its new matrix line printers during the third quarter of this year. He says the company's patent attorney has assured C. Itoh that the new printers do not infringe on Printronix patents. C. Itoh gave Printronix representatives the opportunity to inspect prototypes of the printers, but the representatives did not state whether they saw patent difficulties.

David Mayne, senior vice president of corporate development for Printronix, does not take exception to Takeuchi's description of the amount of money paid to Printronix, but does comment that Printronix achieved its essential objective—"to terminate the importation of a device which we believed to be an infringing product."

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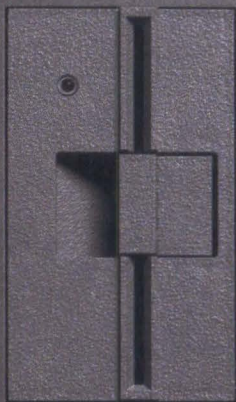
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Mini-Micro World

NEWS

tation that the user can reload paper as needed," he says. "Otherwise, you find yourself right back with a giant standalone unit that costs a great deal more."

Delphax has improved technology over the previous printer by using 300-dpi resolution instead of 240 dpi and a 6-mm. rather than 8-mm. dot diameter.

IBM compatibility possible

Sharpe expects the Office Printer to be used for intermittent, on-demand office printing. For that reason, Delphax expects to offer optional configurations for the printer, such as an IBM PC-compatible processor within the electronics, to allow direct interfacing to standard office peripheral devices. "You could, for example, put a floppy or Winchester disk drive on it to spool up jobs from external sources," he says. A user could then walk up to the printer and call up any document to be printed, much as he might an office copier.

Sharpe predicts that some users will interface a daisy-wheel printer to the ion-deposition device, using the high-speed printer for in-house and draft-quality printing and the slower daisy-wheel printer to re-print texts for letter-quality output. "Many users will find the print quality of the Office Printer perfectly acceptable for correspondence," he notes, "but there are still going to be those who feel it looks too much like a copy to be sent out."

Robert Cowan, vice president of marketing for C. Itoh Electronics, is more positive about the new printer's acceptability as a letter-quality device. "At 300-dpi densities, it is going to be the high-quality office printing device," he asserts. He also expects to see it used in data-processing applications as a line-printer replacement. "With this resolution, you can get the

equivalent of two computer printout pages on one 8½-by-11-inch sheet of paper and still have it quite readable." Even at standard type sizes, Cowan points out, the printer functions at a rate roughly equivalent to 2,000 lines per minute.

Cowan expects C. Itoh to demonstrate the printer with a PC-like controller, but C. Itoh will not make the final decision about control electronics and options until about the fourth quarter of this year.

Cowan and Sharpe say that the two companies have not determined how they will divide the marketing of the printer. However, Sharpe says that Delphax does not plan to sell to end users, and Cowan expects C. Itoh to market the printer through all possible distribution channels. Both companies expect the final end-user price of the unit to be in the \$5,000 to \$10,000 range, depending on options, with OEM quantity discounts available. □

U.S. trade representatives blast Japanese export policy

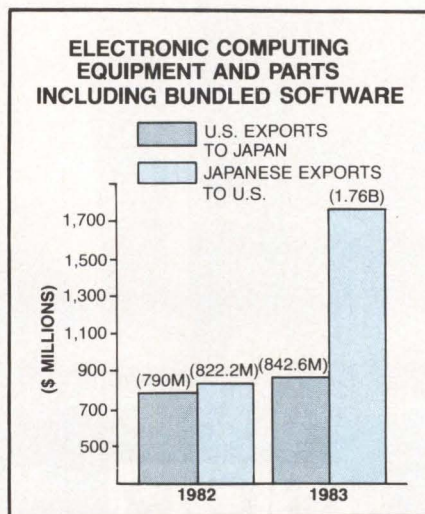
Stephen J. Shaw
Washington Editor

"The Japanese market remains essentially closed," the undersecretary of commerce for international trade Lionel H. Olmer told a group of computer and other high-technology industry executives in March at a forum on international

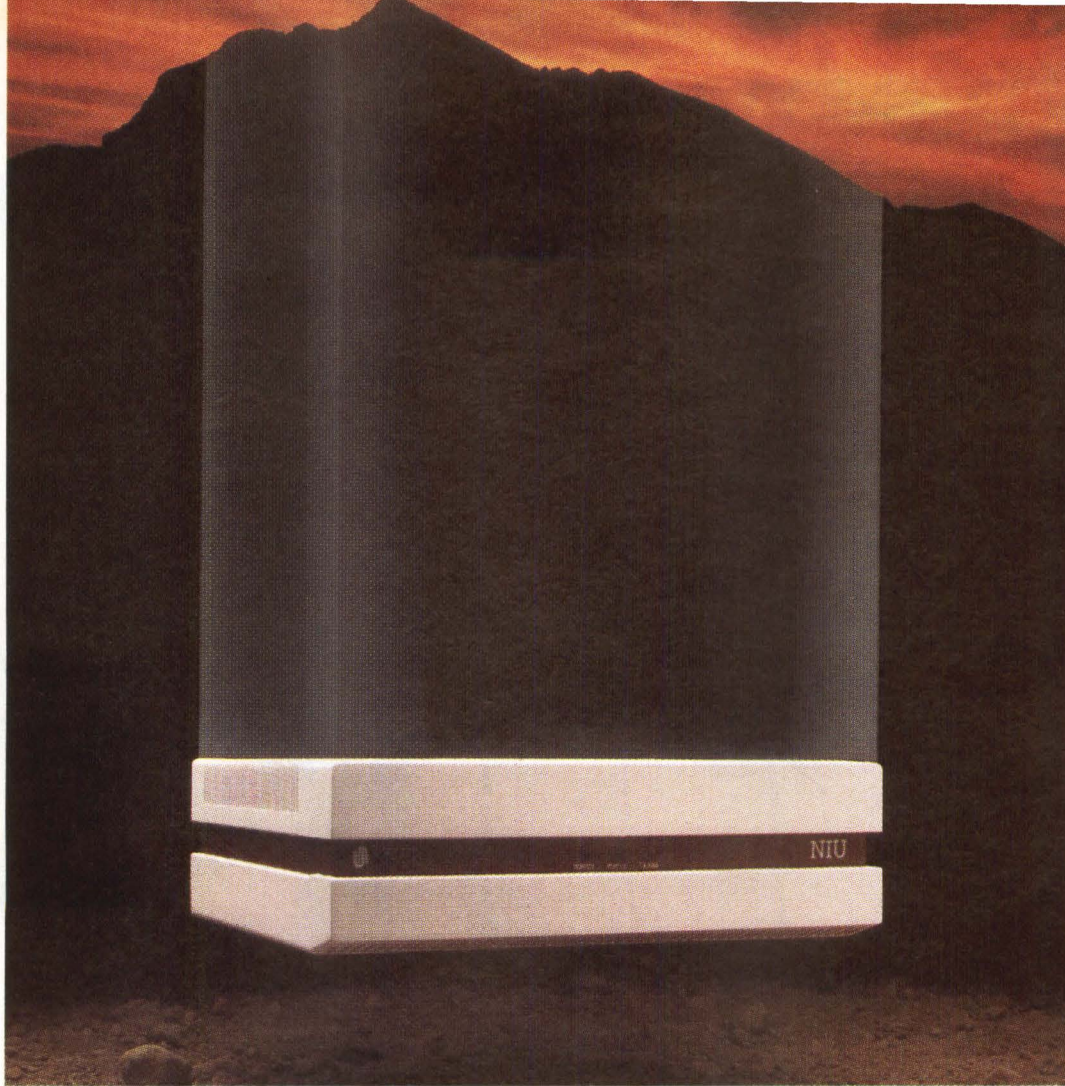
trade issues. "Our trade efforts with Japan have been completely unsatisfactory over the last year."

Olmer's bleak assessment of the state of high-technology trade relations between the United States and Japan comes on the heels of recently released figures from the U.S. Department of Commerce. Those figures reveal a massive U.S. trade deficit in computer equipment with Japan that has increased almost 30-fold during the past two years. Commerce calculates that U.S. exports to Japan in 1982 of electronic computing equipment and parts, including bundled software, reached \$790 million while comparable imports from Japan totaled \$822.2 million. Alarming as the resulting deficit—\$32.2 million—is, it is trifling compared with what was to come last year.

In 1983, says Commerce, U.S. exports of computers and related equipment increased a modest 7 percent over the previous year to \$842.6 million. Imports from Japan, however, more than doubled to approximately \$1.76 billion during the same period.



The trade deficit in electronic computing equipment and parts, including bundled software, between the United States and Japan jumped from \$32.3 million in 1982 to \$919 million in 1983. (Source: U.S. Department of Commerce)



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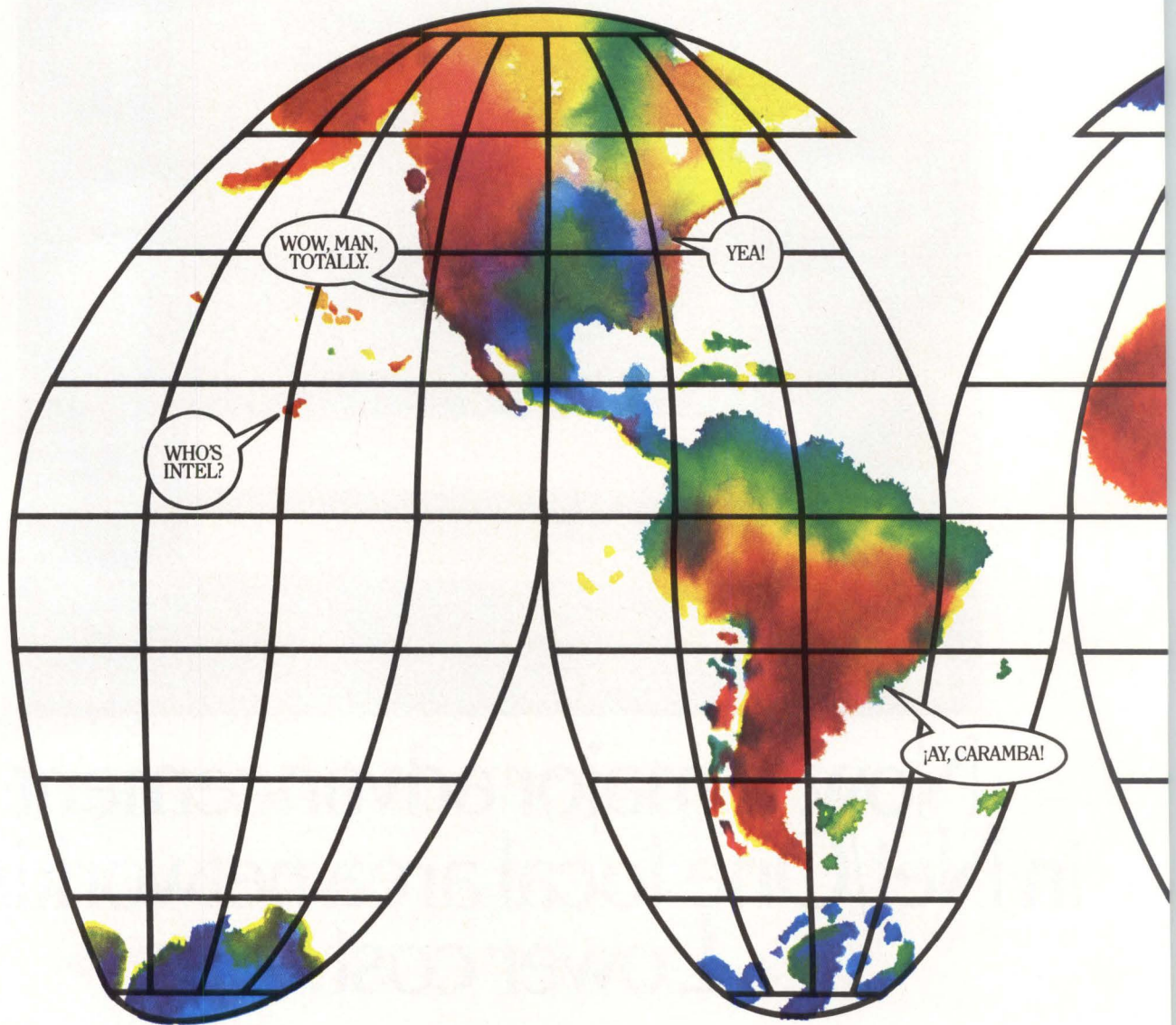
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MINI-MICRO SYSTEMS/May 1984

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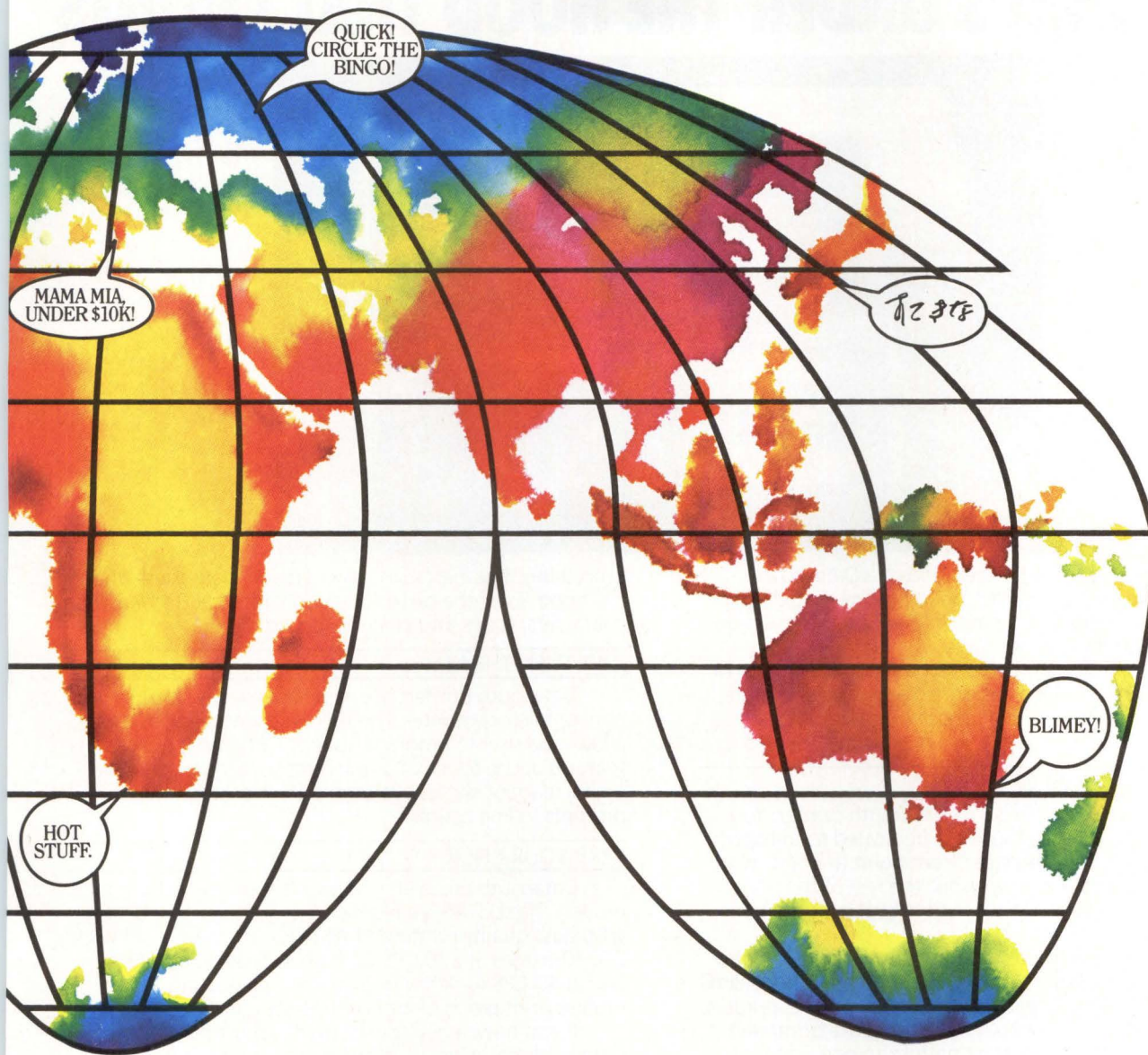
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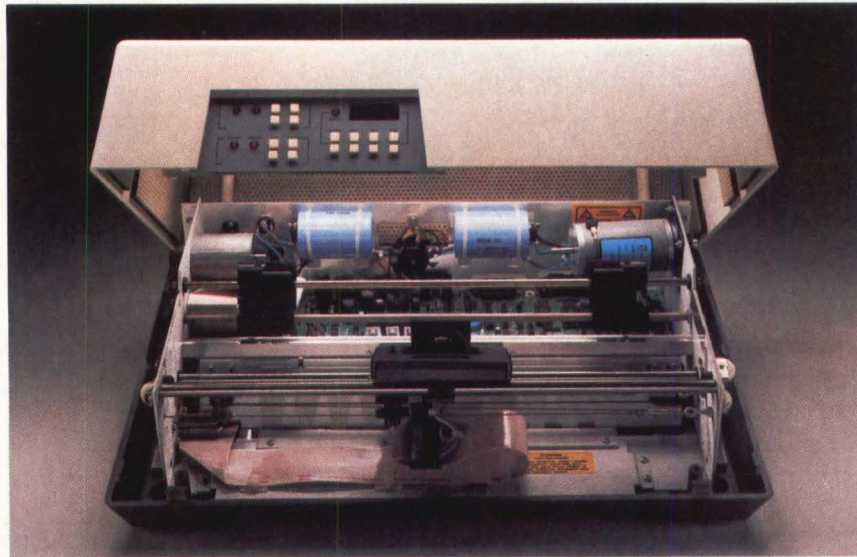
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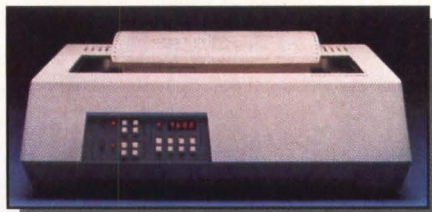
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NEWS

Trade talks move slowly

The 1983 \$919 million trade deficit in computer equipment, part of an overall U.S. trade deficit with Japan pegged at between \$18 billion and \$22 billion, has helped fuel a growing impatience on the part of Reagan administration officials toward the slow pace of negotiations

to resolve trade differences. The trade differences bar increased access to Japanese high-technology markets. U.S. trade and industry representatives are applying increasing pressure on the Japanese government to liberalize several long-standing restrictive trade practices.

Efforts are also under way to kill new proposals that have recently surfaced in the Japanese Diet that the United States fears would further restrict software and information-processing companies' entry into Japanese domestic markets. Indications are that the Japanese are beginning to take seriously the

NTT agreement slow to live up to expectations

Nippon Telephone and Telegraph (NTT), Japan's government-run telecommunications giant, had agreed in 1980 to allow foreign organizations to compete on an equal basis with Japanese companies for a share of NTT's \$3 billion annual equipment-procurement budget. The results of the NTT Agreement have been slow to develop and are largely disappointing for U.S. computer and electronic companies. The U.S. companies saw the accord as a means not only to sell to NTT but to gain entry into wider Japanese computer and telecommunications markets.

In testimony before the House Subcommittee on Telecommunications, Consumer Protection and Finance, the undersecretary of commerce for international trade Lionel H. Olmer underlined the importance of renewing the agreement. NTT, said Olmer, represents approximately 40 percent of the Japanese telecommunications market. Perhaps more important, he continued, is the tremendous influence NTT has over the development of Japanese high-technology and associated companies.

"Without access [to NTT], U.S. companies would be at an inherent disadvantage compared to their Japanese competitors, who have long had access to U.S. telecommunications technology," Olmer testified.

In economic terms, U.S. companies have had little success with NTT despite Japanese assurances. In 1980, the first year of the NTT agreement, U.S. companies sold a paltry \$12 million worth of equipment to NTT, according to the American Electronics Association (AEA). There has been some improvement since then. In 1981, U.S. sales increased to



Japanese foreign minister Shintaro Abe, along with U.S. trade representative William Brock, signed an accord this year. The accord extends an agreement that allows foreign organizations to compete on an equal basis with Japanese companies for Japan's \$3 billion annual equipment procurement budget.

\$39.6 million and jumped again in 1983 to \$140 million, or 5 percent of the total NTT equipment procurement for that year.

A spokesman for the North American Telecommunications Association (NATA) says that a significant percentage of NTT's procurement of U.S. equipment was low-technology supplies—copper wiring and coaxial cables. Rolm Corp., ITT Corp. and Northern Telecom Inc. have succeeded in placing some of their digital private-branch exchanges (PBXs)

with NTT, and Paradyne Corp. has sold NTT some high-speed modems. NTT has purchased only one American computer system, a VAX 11/780 from Digital Equipment Corp., NATA records indicate.

In contrast, Japanese companies have moved quickly to capitalize on the breakup of American Telephone and Telegraph (AT&T) Co. and the newfound ability of former Bell Operating Companies to buy from sources other than Western Electric Co. Nippon Electric Co., for example, has already captured an estimated 5 percent of the U.S. PBX market, according to the AEA. Overall, Japanese companies are projected to capture 10 percent of the U.S. PBX market by the end of this year.

"Japanese companies can sell into the United States three to four times the volume of what the United States is selling to NTT as a result of the AT&T divestiture," comments Ralph Thompson, AEA senior vice president.

This year, U.S. trade representative William Brock and Japanese foreign minister Shintaro Abe signed an accord that extended the term of the NTT agreement for three more years, subject to one-year bilateral reviews on its progress. The extension incorporates several modifications that U.S. officials hope will result in a more sales by U.S. companies to NTT.

Brock concedes that the agreement does not necessarily guarantee increased U.S. sales. "The extension of the NTT agreement is only one step on a long road...I do not believe that sales by American firms to date are anywhere near their potential. It is essential that this potential be fully realized," Brock says.

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Mini-Micro World

NEWS

growing sentiment on Capitol Hill toward enacting protectionist trade legislation to staunch the flow of Japanese high-technology products

Proposal advanced to get foreign VANs off NTT highways

A contentious issue raised in a recent proposal by the Japanese Ministry of Posts and Telecommunications (MPT) would restrict foreign ownership shares of value-added networks (VANs). The anticipated increase in the number of privately owned information-processing networks has alarmed MPT. It is afraid that in a national emergency the government would not be able to control independent and foreign-owned telecommunications systems.



Japanese prime minister Yasuhiro Nakasone's ruling party, the Liberal Democratic Party, backs a proposal that would restrict foreign ownership shares of value-added networks.

The issue of who should own and control VANs—data networks in which a system operator adds value to the information transmitted through packet switching, protocol conversion, digital processing and other computer-based techniques—is tied up with the planned organizational shake-up of Nippon Telephone and Telegraph (NTT). Now owned wholly by the Japanese government, NTT is expected to be opened to private Japanese investment. Under a reform bill now pending before the Diet, up to 50 percent of NTT's stock will be offered for sale exclusively to domestic investors. Unlike AT&T's

divestiture, NTT will not be split up but will be allowed to acquire manufacturing capabilities of its own for the first time.

The relaxation of government control over NTT and the government monopoly of domestic telecommunications has raised MPT concern that American companies will dominate the Japanese market for VANs. Accordingly, the ministry has advanced a three-point plan to avoid this scenario:

- companies that own their own circuits would be required to obtain an MPT license to operate. Foreign participation would be limited to a 33 percent investment.
- companies that lease circuits from NTT would also be required to be licensed by MPT, and foreign ownership would be limited to 50 percent.
- companies that provide local or specialized services, such as banking networks currently in operation, and that do not engage in the resale of circuits or information-processing services would be required to notify MPT of the details of their networks, but they would not need special permission to operate. There would be no restrictions on foreign ownership in these types of networks.

With the approval of the Japanese government, IBM Japan has run several experimental VAN systems for videotex and integrated voice/data networks in Japan. According to John Choy, an economic analyst at the Japan Economic Institute, Washington, IBM Corp. and American Telephone and Telegraph Co. were poised to enter the Japanese VAN market in early 1983, but pulled back after MPT started to make noises about restricting foreign participation.

Japan watchers are divided over whether the Japanese Diet will formally adopt the MPT proposal. But Choy says the measure has strong backing from the Liberal Democratic Party, the ruling party of Japanese prime minister Yasuhiro Nakasone. "It's got a good chance of going through," he comments.

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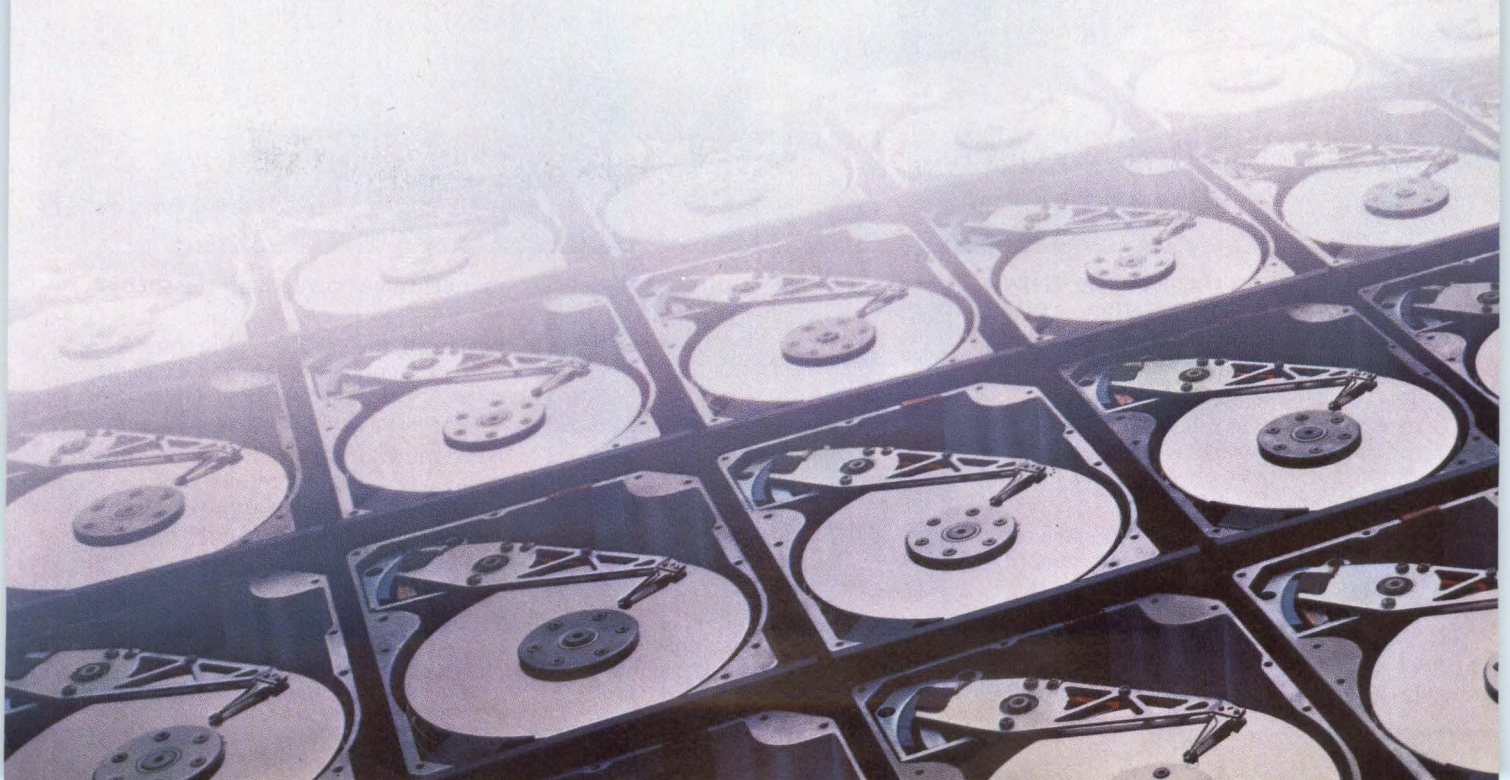
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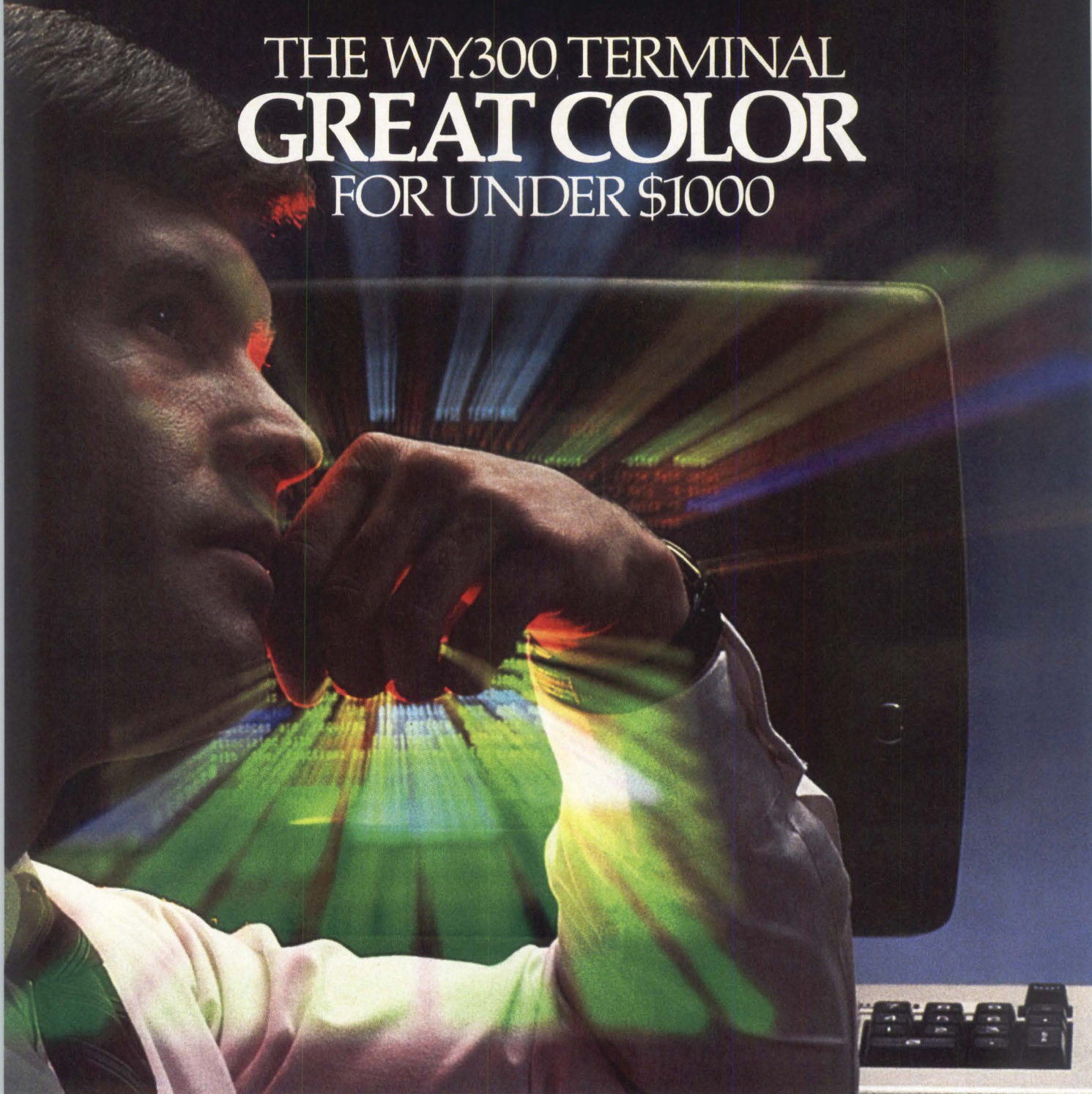
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to the United States.

Vice president George Bush and

MITI proposal draws fire

Computer software sold in Japan has customarily been protected under Japanese copyright law. No one could sell or copy programs without the consent of the author for a period of time usually equivalent to the author's lifetime, plus 50 years.

Although Japanese courts have upheld copyright protection of software and have accorded computer programs the same rights of authorship accorded to other literary works, software has never explicitly been listed as a protected means of literary expression in Japanese statutes. Several months ago, the Japanese Ministry of Education proposed amending the copyright statutes to include software. When the trade ministry learned of the proposed revision, it drafted its own legislation that would exclude software from copyright law and replace it with patent-type protection for only 15 years.

If the MITI plan goes into effect, certain U.S. software programs that have been available in Japan for more than 15 years would be unprotected. The proposal would also force software vendors to grant licenses to Japanese companies in special cases of national interest that would allow resale without additional royalty payment.

The proposal has raised a storm of protest among U.S. government officials and industry executives. "If this goes [into effect], there's a very strong chance of retaliatory measures being enacted here," says Ralph Thomson, senior vice president of the American Electronics Association (AEA). He adds that AEA has conducted several briefings on the measure with American computer companies, including a meeting with Steve Jobs, chairman of Apple Computer Inc. During the meeting, Jobs indicated that the measure would force Apple to reconsider the viability of its Japanese operations. Apple, which runs a wholly owned subsidiary in Japan, cannot confirm Jobs' comment, says a company spokeswoman.



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Mini-Micro World

NEWS

U.S. trade representative William Brock are scheduled to visit Japan this month. U.S. officials have intensified their efforts to force Japanese trade concessions before the trip to give the U.S. representatives some positive news to report

afterward. Computer and high-technology trade issues likely to be on the agenda include:

- implementation of an agreement to liberalize the procurement policies of Nippon Telephone and Telegraph (NTT). The three-year-

old pact, which was extended this year, has produced minimal results for U.S. companies attempting to sell computers and software to the giant Japanese telecommunications company;

- a proposal by the Japanese Ministry of International Trade and Industry (MITI) that would replace the copyright protection afforded computer software with shorter patent-like protection;

- a proposal by the Japanese Ministry of Posts and Telecommunications to restrict the foreign ownership of value-added networks;

- liberalization of foreign companies' access to Japanese capital markets;

- full implementation of an agreement to eliminate U.S. and Japanese semiconductor tariffs;

- access to the Japanese market for domestic communications satellites and associated ground-control equipment, including minicomputers—a market that the Japanese government has restricted;

- reduction of the disparity between the relative value of the yen and the dollar. Current exchange rates are pricing some U.S. computer equipment out of the market in Japan.

Concern over U.S. access

Concern over some of these unresolved U.S.-Japan trade differences is not limited to U.S. industry and its desire for increased access to lucrative Japanese computer and telecommunications markets. According to an MITI official at the Japanese Embassy in Washington, the Japanese government is alarmed at legislative efforts in Congress and at the state level. The Japanese government views those efforts as restricting Japanese companies' access to U.S. markets. Those efforts include:

- the "unitary tax" imposed by

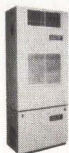


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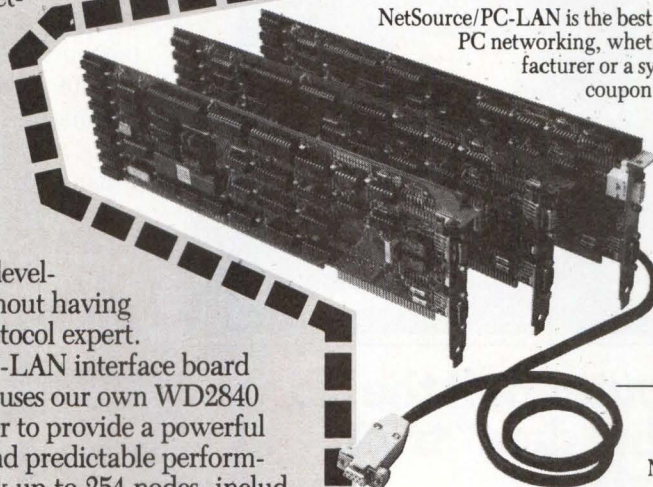
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Mini-Micro World

NEWS

several states, including California, that taxes foreign companies based on their total worldwide revenues, rather than on revenues generated by facilities within the state;

- Congressional legislation that

would limit the percentage of foreign components in American products;

- Federal legislation to abolish the semiconductor tariff, now pending in Congress, that could be

blocked by rising protectionist fever and Congressional resentment over the U.S.-Japan imbalance.

U.S. desires access

U.S. trade officials are trying to pressure the Japanese Finance Ministry to speed the liberalization of Japan's capital markets. This would allow foreign companies greater access to additional funding sources for domestic expansion projects. The United States is not satisfied with the pace of the liberalization, which is based on a pledge Japan made to president Ronald Reagan during his trip to Japan last November.

Beryl Sprinkel, undersecretary for monetary affairs at the U.S. Department of the Treasury, reportedly gave the Japanese Finance Ministry a deadline for fulfilling the pledge to Reagan during a meeting in late February. According to a Commerce Department trade specialist, Sprinkel is pushing the Finance Ministry to raise what are considered to be artificially low interest rates to increase the relative value of the yen compared with the dollar. Higher interest rates would increase capital availability and lower the prices of American products in Japan.

U.S. hopes to eliminate tariffs

Congress is in the final stages of enacting legislation that would give the president authority to negotiate with Japan to eliminate semiconductor tariffs. The legislation—S. 144, incorporated as Title III of H.R. 3398—is expected to receive final positive action from the Senate this spring.

As the 1984 presidential election draws closer, the volume of rhetoric from administration officials on unresolved U.S.-Japan trade issues in the computer and information industries is certain to increase.



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MMS 5/84

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The image shows a green PCB populated with various electronic components. Key components include:

- U1:** # 5222 H5C8100
- U2:** # 8119CA+ MM74PC04N1
- U3:** # 8217A+ MM74PC74N1
- U4:** # 8217A+ MM74PC74N1
- U5:** # 88214A+ MM82PC08N1
- U6:** # 815 MS2000
- U7:** # 8117C MM74PC08N1
- U8:** # 8117C MM74PC08N1
- U9:** # 8117C MM74PC08N1
- U10:** # 8130CA+ MM74PC02N1
- U11:** # 8117C MM74PC08N1
- U12:** # 8117C MM74PC08N1
- U13:** # 8117C MM74PC08N1
- U14:** # 8117C MM74PC08N1
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- U17:** # 8117C MM74PC08N1
- U18:** # 8117C MM74PC08N1
- U19:** # 8117C MM74PC08N1
- U20:** # 8117C MM74PC08N1
- U21:** # 88221A+ MM82PC08N1
- U22:** # 88221A+ MM82PC08N1
- U23:** # 88221A+ MM82PC08N1
- U24:** # 88221A+ MM82PC08N1
- U25:** # 88221A+ MM82PC08N1
- U26:** # 88221A+ MM82PC08N1
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- U99:** # 88221A+ MM82PC08N1
- U100:** # 88221A+ MM82PC08N1

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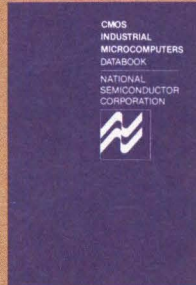
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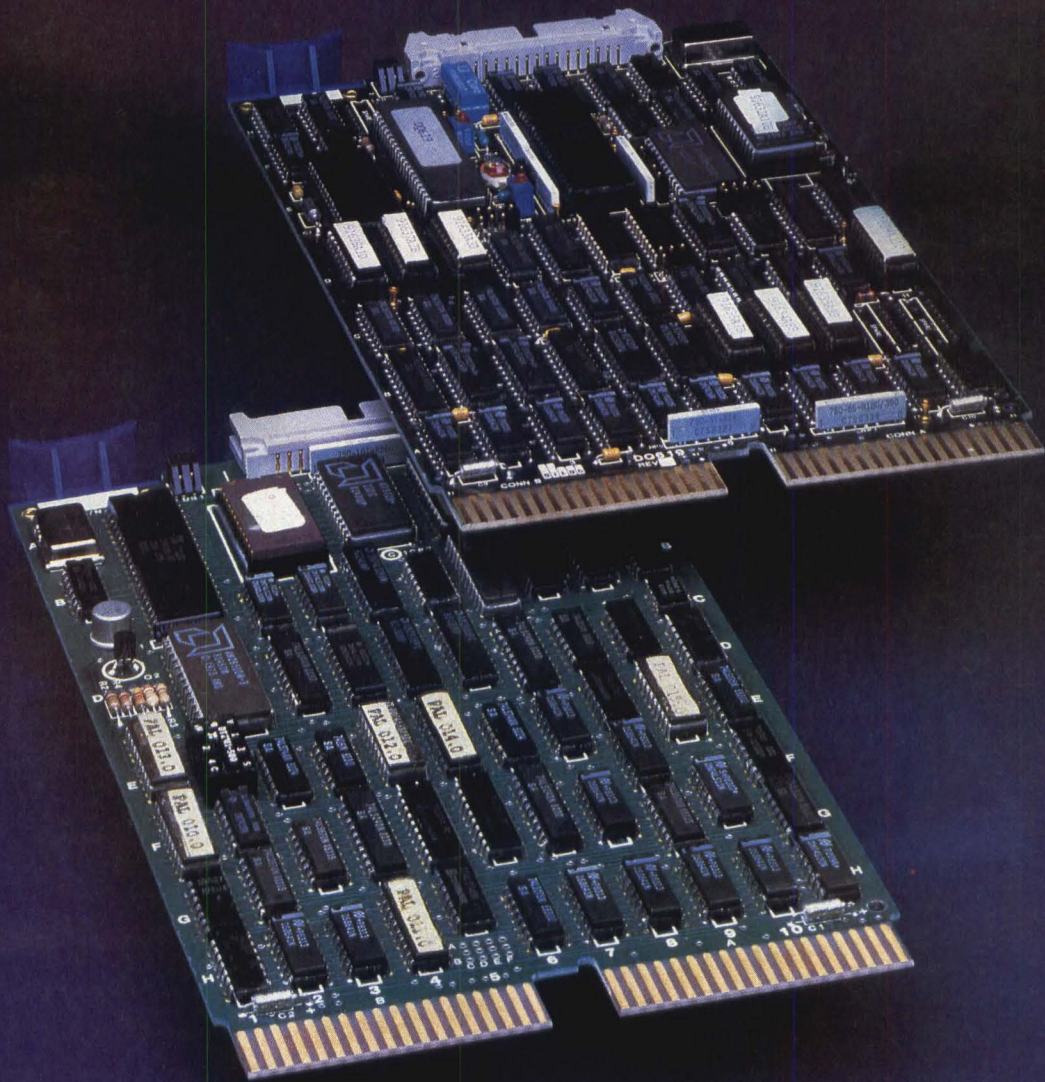
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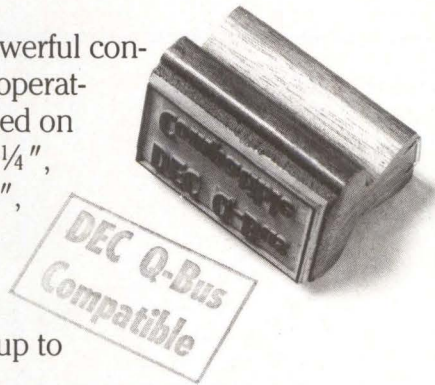
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MAY 1984

Prototype Design Center opens in Silicon Valley.

A new Design Center has been established in Los Gatos, California, to make it easier than ever for systems builders to tap WD's specialized expertise in disk controller and network subsystems. The Design Center reinforces WD's "technology partners" concept of making the Company's design and engineering group a direct extension of the customer's engineer efforts. The Northern California Design Center, first of several planned across the nation, is linked to WD's headquarters computer-aided design center in Irvine, California.

71% of office micros projected to be IBM or IBM compatible by 1989.

Pointing out that 71% of all office computers and 64% of all home computers will be IBM or IBM-compatible before the end of the decade. Zenith Data Systems has entered the IBM-compatible market with a new line of desktop computers. The new Z-100 PC series has a footprint 20% smaller than an IBM PC and text display input-output rate that's almost twice as fast. WD has received a multi-million dollar contract to provide Zenith with FD179X floppy disk controller VLSI devices and a customized version of the WD1002-WX2 disk controller board.

WD launches major SMT production program.

Improved system efficiency, higher density and greater reliability are a few of the reasons board-level manufacturers are eagerly pursuing surface mount technology (SMT). WD is making strategic investments in SMT and, to that end, has taken, an equity position in Array Technologies, Inc. High volume SMT production facilities will soon be brought on-line at the Company's Camarillo, California and Cork, Ireland manufacturing facilities. WD is committed to the design and production of its standard network and storage management board-level products using SMT.

Robotics network automates pipe mill.

TAK Automation, Burlingame, California, has developed a highly automated pipe mill system, using a network of robots for handling and storage of materials. The robots are equipped with WD's NetSource/25 X.25 Packet Switching Controllers, which control the flow of data between both fixed and roving robots and a central computer. NetSource/25's media independence permits the use of fiber optic links for communications, or, in the case of roving robots, radio links. Centralized control of the robots boosts quality and productivity, according to a TAK spokesman.

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Mini-Micro World

CORPORATE AND FINANCIAL

Personal printer, portable computer advance HP's market strategy

Tom Moran, Associate Editor

With the introduction of its low-cost ThinkJet family of fast, quiet printers (MMS, March, Pages 17 and 36), and the Portable personal computer, Hewlett-Packard Co. is delving further into broad personal and business computer markets. HP believes that the future of the company hangs on its success in those markets.

Since its formation in January 1983, HP's Personal Computer Group, Sunnyvale, Calif., has introduced the HP150 touch-screen desktop personal computer, the ThinkJet series, the Portable and the portable disk drive that accompanies it.

Before the formation of the Personal Computer Group, HP was making personal computers at a number of divisions. That led to marketing conflicts and competition between machines such as the 125 and the 80 series of desktop personal computers.

Organization was not HP's only problem in moving into consumer areas. "In consumers' eyes, we just entered the market last year," says Cyril Yansouni, general manager of the Personal Computer Group. "In our eyes, we entered the market in 1968 [when] we created the desktop calculator for engineers. Our only big mistake was that we never called them personal computers." Yansouni says that, when IBM entered the PC market, it encouraged a lot of first-time users. "And now we had a choice: do we stay in the niche, do we keep just selling to engineers and scientists, or do we expand. And the conclusion was, we have to expand."

HP's reasoning was that, because



HP's growing family of portable personal computer products can all be linked to its HP150 touch-screen desktop system (left). The Portable (right), the ThinkJet printer (background) and the 9114 disk drive offer a modular system of battery-powered portable devices.

personal computers are general-purpose machines, other companies could make them into products for engineers. "So, we felt we could not protect our niche for too long if we stayed only in the niche," says Yansouni.

HP lagged behind in marketing

HP's biggest challenge was to learn new market-research techniques, says Yansouni. "It's one thing to know what engineers want. I ask five people, and I've got my market research. With the consumer, you've got to talk to more people, and you have to use a different language. We are becoming very much more market-oriented." He says people in the organization had to change the way they do things.

Aaron Goldberg, research manager for research concern International Data Corp., believes that HP may not have the marketing expertise to

succeed. He lauds HP's decision to assign R&D people to the sales outlets temporarily as "a stroke of genius because it forces engineers to understand the end-user market."

ThinkJet is HP's 'bright hope'

Yansouni says HP is a price leader with the ThinkJet printer—not just a technology leader. "The perception of the industry is that [the personal printer] marketplace has been captured and owned by the Epsoms and so on of the world. And here we come with a product that's quiet, cheap and high-performance."

Yansouni estimates that about 100,000 to 120,000 of the Epson-, Okidata-type draft-quality printers in the \$400-to-\$600 range are shipped worldwide every month. He claims that HP can ramp to production of 40,000 units a month without a major reallocation of resources because HP uses an

Mini-Micro World

CORPORATE AND FINANCIAL



Cyril Yansouni, general manager of HP's Personal Computer Group, says the ThinkJet family may capture as much as a third of the worldwide market for low-cost dot-matrix printers.

improved inventory system, robotics and other advanced manufacturing techniques that are part of a six-year productivity-improvement effort.

HP is working on higher dot density for its ThinkJet printers, and this will enable the company to produce letter-quality units. HP expects phototypesetting quality to follow in three to five years as well as color. Yansouni does not expect HP to announce a color ink-jet product in the next year.

A major shift in distribution

HP's distribution channel has traditionally been geared to large systems that require weeks to install. The company now must add retail channels to accommodate personal computer buyers who want a system immediately and may buy another brand if another manufacturer has a system available now rather than next week. To address that problem, HP last year organized the Personal Computer Distribution Operation, which ships all personal computer products from

HP, including software, accessories, plotters, the HP150, the ThinkJet and the Portable.

Although doubt still exists about whether consumers will accept touch screens, HP had delivered 20,000 HP150s to dealers by the end of HP's fiscal quarter in January. Major deliveries began in November. HP projects total sales of 100,000 units for the 150 by the end of 1984.

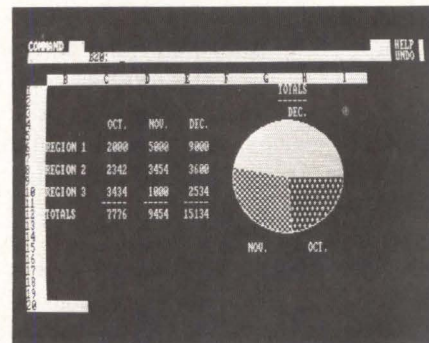
The company estimates that 1982 sales in the personal computer

business were \$400 million to \$500 million. Sales hit \$700 million in 1983. Those figures include hand-held products and terminals but exclude plotters and mass-storage devices. "We make all of our terminals in my group, because we think that terminals and personal computers are going to become the same thing," Yansouni says.

Paul Ely, executive vice president for computer operations, says HP will introduce another major personal computer product in June. □

Financings

Read-Rite Corp., Milpitas, Calif., has grabbed \$13.4 million in its first round of financing. The money will be used to produce thin-film magnetic recording heads for disk drives. The financing package comprises venture capital, a research and development partnership and a capital equipment lease line. Hambrecht & Quist and Concord Partners were the lead investors....**Lotus Development Corp.** competitor **Ovation Technologies** has raised \$5.5 million in its second round of venture funding. Most of the money will go towards marketing the Canton, Mass., company's integrated Ovation software package for the IBM PC. Oak Investment Partners led the financing. Ovation received \$1.3 million in its first round....Year-old graphics workstation supplier **Cadmus Computer Systems**, Lowell, Mass., has closed a \$7.75 million second round of financing, bringing the total to \$11.25 million. Citicorp Ventures, Charles River Partnership, and L.F. Rothchild, Unterberg, Towbin, participated with 11 other investors....**Verticom Inc.**, Sunnyvale, Calif., one of the first to produce a North American Presen-



Ovation Technologies recently raised \$5.5 million to market its integrated software package for the IBM PC. The package features a common workspace for spreadsheet, graphics and word processing.

tation Level Protocol Syntax (NAPLPS)-compatible color graphics terminal, has attracted an additional \$1.9 million in its second round. The first round netted \$1.5 million. The investment group included Vanguard Associates and Ventech Partners. NAPLPS is a proposed graphics standard for simultaneously handling graphics and text....**Custom Silicon Inc.**, a Lowell, Mass., manufacturer of custom integrated circuits, has obtained \$1.1 million in venture capital and equipment financing....Automatic sheet-feeder company **LQ Corp.**'s recent financing of \$2.8 million brings the Meriden, Conn., company's total to \$5 million.

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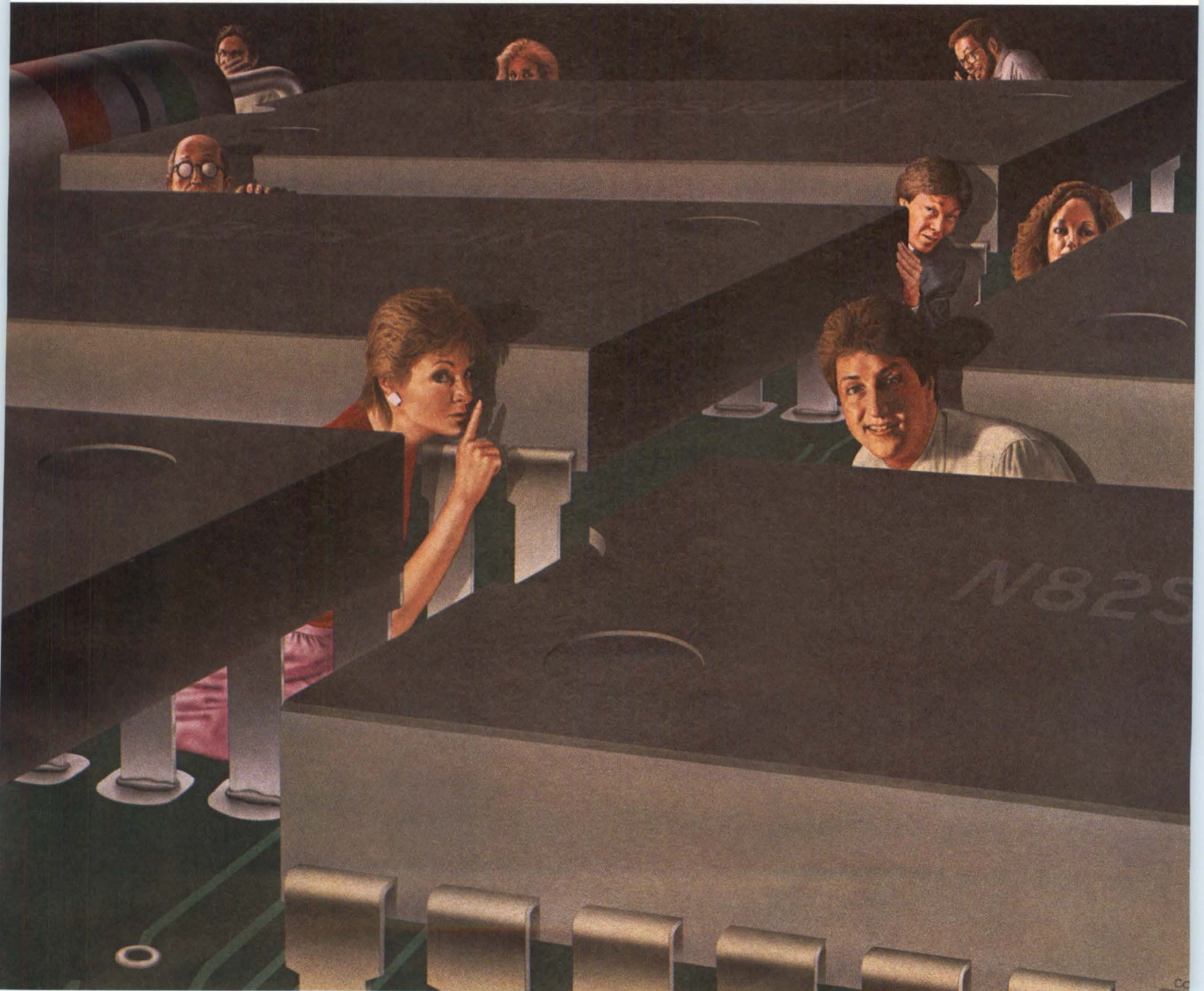


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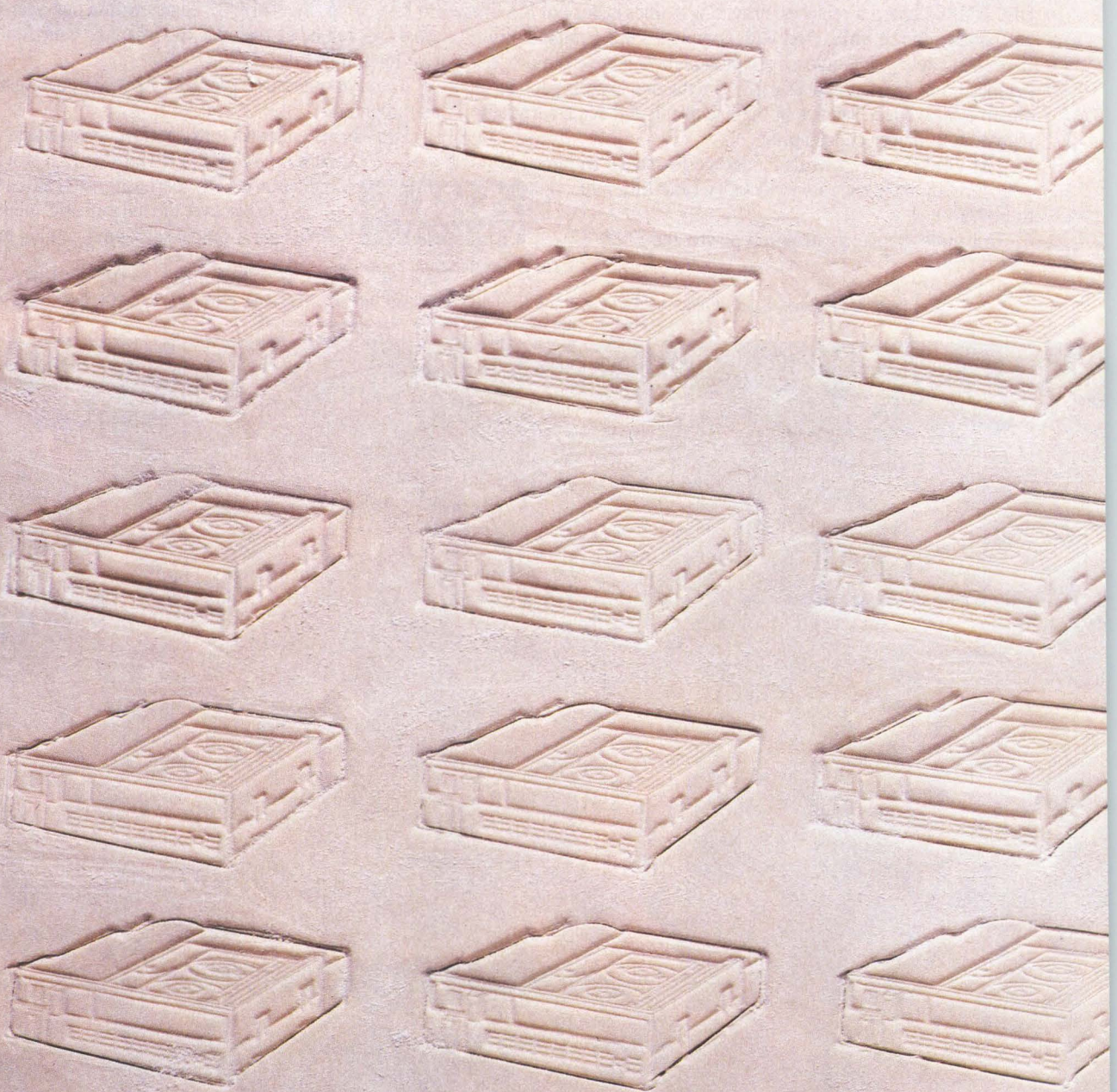
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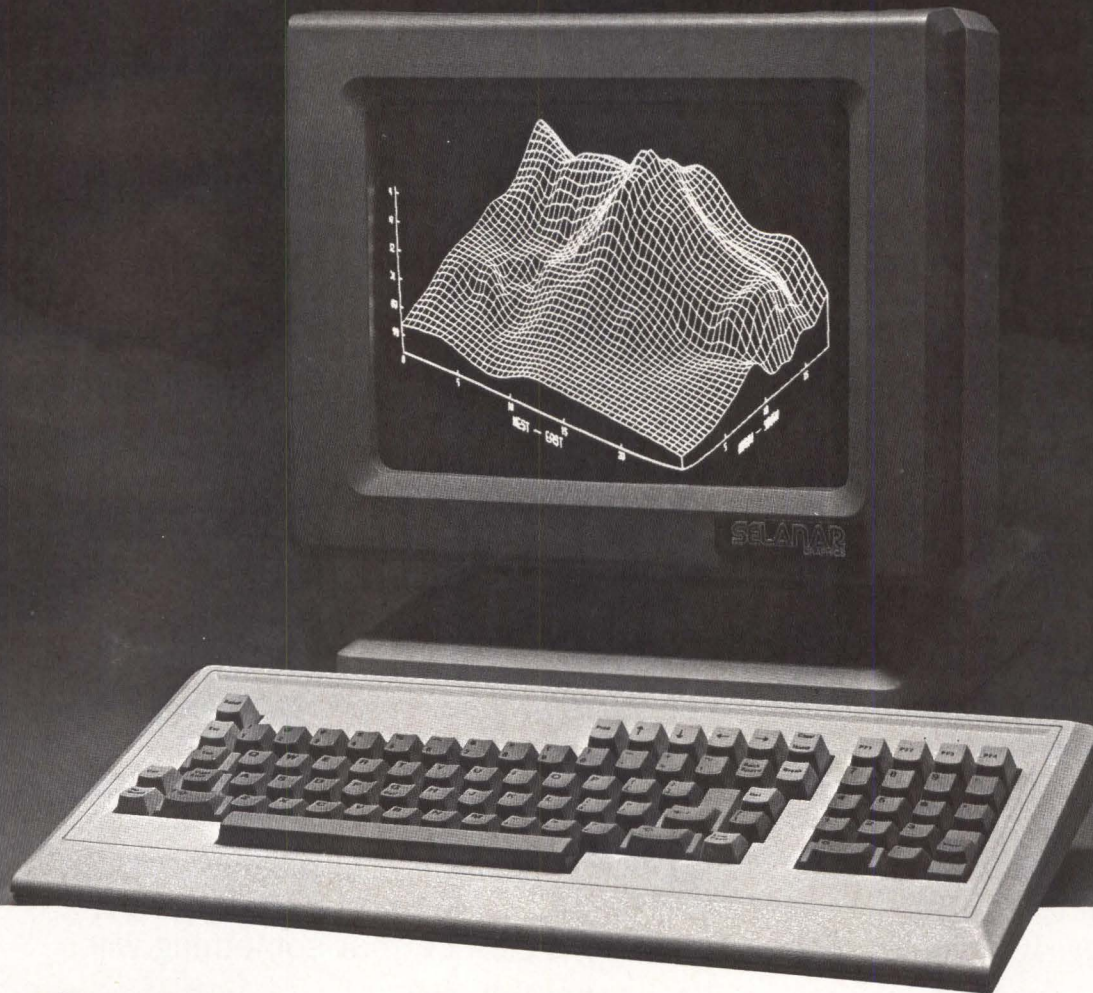
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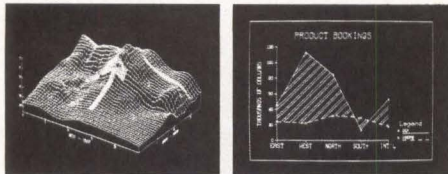
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CIRCLE NO. 48 ON INQUIRY CARD

Mini-Micro World

CORPORATE AND FINANCIAL

Until recently, automatic sheet feeders have cost almost as much as the printers to which they attach. But the lure of potential high-volume markets is now tempting both new and established vendors to

introduce aggressively priced models, some as low as \$200 in large quantities. Advent Technology Plc. and L.F. Rothchild, Unterberg, Towbin participated....**Tecstor Inc.**, Huntington Beach, Calif.,

plans to step up its 14-inch Winchester disk drive production with its recent \$2.8 million in venture funding. Citicorp Venture Capital Ltd. is the largest investor.

GUEST FORUM

A column for guest experts to speak out



Gilbert Mintz is a founding partner of Broadview Associates, a Fort Lee, N.J. consulting organization that specializes in mergers and acquisitions in the information-processing and software industries.

Acquisition fever rises among microcomputer software vendors

Gilbert Mintz
Broadview Associates

Over the past four years, there have been nearly 500 mergers and acquisitions in the information-processing and software industry with a value of approximately \$2.9 billion in cash and stock. Last year, a record number of 146 transactions resulted in mergers and acquisitions totaling \$1.01 billion.

While software companies accounted for 60 percent of those transactions, it is just as significant that the percentage of total acquisitions involving microcomputer software companies rose from 6 percent in 1982 to 17 percent last year. Broadview Associates expects this trend to continue as industry outsiders, including major wholesale and retail distributors, consumer goods manufacturers and publishers, as well as companies committed to the software industry, acquire more microcomputer software companies.

In prior years, large publicly owned information-processing companies such as Automatic Data Processing, Control Data Corp., Electronic Data Systems and General Electric Co.'s Information Services Co. were the dominant acquirers.

Though acquisition continues to be critical in these companies' growth strategies, the smaller software companies have now become the merger activists in the \$26 billion information-processing and software industry.

Broadview Associates and the Association of Data Processing Service Organizations documented this trend in 1983 as part of a semiannual mergers and acquisitions index. According to the index, last year showed a mix of companies and a diversity of products. Informatics General Corp. acquired insurance-industry microcomputer software specialist Sigma Software Systems, income-tax processor Computer Language Research purchased Microcomputer Tax Systems, McKesson—one of the nation's largest drug and packaged goods wholesalers—and Action Industries acquired personal computer program distributor Software Knowledge Unlimited, Management Science America entered the educational software market with Edu-Ware Services, McGraw-Hill bought Aardvark Software Inc., Computer Associates International purchased EasyWriter word-processing software marketer Information Unlimited Software Inc.,

Wyly Corp. acquired application-software developer Open Systems Inc. and ASK purchased Software Dimensions Inc.

Despite their charisma, microcomputer software companies face numerous marketing challenges that are uncharacteristic of other parts of the software industry. To establish and then maintain brand-name recognition for their products, they must engage in costly packaging, sales promotion, point-of-sale merchandising, product endorsement and cooperative retail and national advertising programs. Often, funds that should be used to develop new products must be diverted to the multimillion-dollar promotional budgets required to launch and market products.

In an industry in which a single product error can lead to corporate disaster, Broadview expects that many companies with a demonstrated ability to develop successful business and consumer microcomputer software products will continue to avoid these dilemmas by merging with larger organizations with proven distribution, promotion, sales and financing know-how.



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Mini-Micro World

INTERNATIONAL

Microsoft makes XENIX compatible with UNIX System V

Keith Jones, European Editor

Microsoft Corp., Bellevue, Wash., plans to make its UNIX-based operating system, XENIX, source-code compatible with UNIX System V from AT&T Technologies Inc., Greensboro, N.C. AT&T has earmarked its System V as its UNIX standard. Microsoft's European distributor, Logica UK Ltd., London, has begun investigating the technical problems of achieving compatibility with System V. Microsoft's aim is to have its products remain compatible with the current release of XENIX—XENIX 3.0.

One of the major vehicles for System V will be the Intel 286 processor. Digital Research Inc., Pacific Grove, Calif., will port System V to the 286 (MMS, March, Page 33). But, because System V is

not yet available on the 286, some companies are choosing XENIX for their 286-based computers. One example is Northern Telecom Data Systems, Hemel Hempstead, England, the European computer arm of telecommunications giant Northern Telecom Ltd., Mississauga, Ontario. The company has opted for XENIX as the main operating environment on its new Vienna family of multiterminal systems.

Beverly Josephs, senior analyst with the software information service of Gnostic Concepts Inc., San Mateo, Calif., notes that System V compatibility will enable XENIX to support the library of application programs being compiled by AT&T and Digital Research. Josephs doubts that the System V version of XENIX and System V itself will conflict because

XENIX has a niche as the system for smaller UNIX hosts, such as IBM Corp.'s PC, Digital Equipment Corp.'s Professional series and Apple Computer Inc.'s Lisa.

Tandy praises compatibility

One successful vendor of UNIX-oriented systems, Tandy Corp., Fort Worth, Texas, has no intention of abandoning XENIX in favor of AT&T's System V, according to the company's director of computer merchandising, Mark Yamagata. At the same time, he acknowledges the appeal of System V compatibility under XENIX.

Logica's software products division commercial manager, Hector Hart, claims that many of UNIX System V's advantages over System III are available in XENIX 3.0, so there is little necessity for XENIX system integrators to change to UNIX System V, especially in view of the upcoming XENIX System V compatibility.

XENIX accounts for the lion's share of UNIX environments in the field. But some industry observers believe that users may drop or pass by XENIX as AT&T moves to dominate the market for the software product it invented. "Why wait for a System V-compatible version of XENIX when you can go to AT&T?" asks Jean Yates of Yates Ventures, a Los Altos, Calif., consulting concern.

Applications should run on both

John Kiefer, senior analyst with research company InfoCorp, Cupertino, Calif., believes that most applications written for XENIX should be able to run under UNIX System V. Dominic Dunlop, techni-

Sphinx brings UNIX applications to the United States

British software vendor and UNIX specialist Sphinx Ltd., Maidenhead, England, plans to introduce European UNIX software packages in the United States via a new office in Menlo Park, Calif. Sphinx's early offerings should include a version of the icon-driven UNIX interface developed at Loughborough University of Technology, Loughborough, England (MMS, December 1983, Page 93).

Sphinx managing director Dr. Pamela Geisler says other likely products include a production-control system and a package that integrates spreadsheet, word processing and graphics features. The European products will have to be sufficiently well-proven so they don't need "detailed support," notes Geisler, because the office will open with only six staff members.

Sphinx's U.S. debut enjoys the

financial support of venture-capital partnership New Enterprise Associates, San Francisco. Sphinx will augment its cash flow by selling some products in the United States that it now sells in Europe.



Dr. Pamela Geisler is managing director of Sphinx, which is ready to release UNIX software through its new Menlo Park, Calif., office.

Mini-Micro World

INTERNATIONAL

cal director of UNIX application software vendor Sphinx Ltd., Maidenhead, England, agrees: "Microsoft has not locked users into XENIX."

Altos Computer Systems Inc., San Jose, Calif., one of the most successful vendors of XENIX hosts, could recompile applications to run under another UNIX-based operating system "without a major effort," according to Robert Bozeman, the company's director of marketing. Bozeman believes that IBM will announce a bigger multiuser UNIX host this year. "We are waiting for a standard to be set, and IBM and AT&T are the two players," Bozeman declares. Kiefer at InfoCorp says that IBM is readying a superset of System V for its rumored upcoming machine, which is configured around the Intel 286 and is code-named "Popcorn."

Bozeman at Altos does not regard IBM's current UNIX microcomputer implementations as serious competition. These implementations are XENIX on the Motorola MC68000-based 9000 series from IBM Instruments Inc., Danbury, Conn., and Personal Computer Interactive Executive (PC-IX) for the PCs. PC-IX is a modification of IS/3 from Interactive Systems Corp., Santa Monica, Calif. IS/3 is based on UNIX System III.

Nadine Malcolm, senior marketing specialist at Interactive, says her company, like Microsoft, is seriously looking at System V compatibility for IS/3. But she acknowledges that there is no guarantee that IBM will adopt System V.

IBM's UNIX choices still not clear

John Ulett, product manager at Microsoft, refuses to confirm that System V compatibility for XENIX is being planned with IBM in mind.

Ulett notes that Microsoft could "junk" its UNIX System III-based version of XENIX in favor of a System V based-implementation. But he believes that would be of no advantage to users. "We offer an alternative to purchasers of generic UNIX. They simply need to be able to check the box for System V to make sure they can run System V programs." Citing XENIX's availability on the Intel 286 and the Motorola MC68000 series processors, Ulett says, "System V porters are starting from scratch on these processors. We just need to add system calls for System V features."

Compatibility will include support of the System V facility that allows two programs to exchange messages within main memory. Microsoft has not made a decision about whether to offer another

System V feature—disk block transfers of 1,024K bytes compared with 512K bytes under System III. Ulett says that larger blocks use space inefficiently on small disk files. He notes that XENIX already provides another System V facility, record locking.

XENIX also supports shared memory but takes a different approach from that of System V. "Shared data is held in the kernel of XENIX, avoiding pointers that have to be handled by a memory-management unit." Ulett notes that AT&T developed System V for the DEC VAX and that porting the shared-memory feature to other processors poses problems. A spokesman for AT&T acknowledges that it developed System V for the VAX and that the shared-memory feature will be tailored to other processors, including the 286. □

CALIFORNIA LEADS IN ELECTRONICS EMPLOYMENT

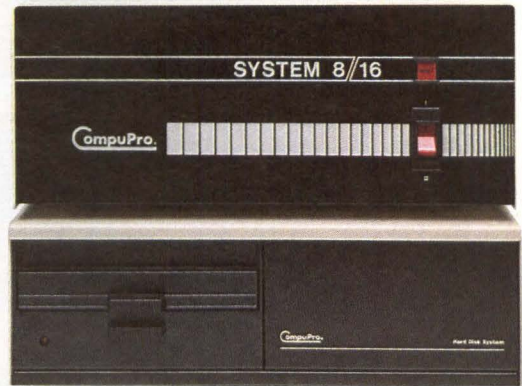
Worldwide sales by U.S. electronics and information-technology companies reached \$240 billion during 1982, according to an American Electronics Association study. Worldwide employment for those companies totaled 3.7 million in June 1982. Domestic employment was 2.1 million. The top 10 states for electronics employment were California, with 485,000 in the electronics work force, New York with 215,000, Massachusetts with 177,000, Texas with 105,000, Illinois with 102,000, New Jersey with 90,000, Florida with 86,000, Pennsylvania with 78,000, Minnesota with 66,000 and Arizona with 57,000. AEA broadly defines "electronic industry" companies as those that manufacture electronics components or products and systems that require electronic components.

GROUP MOVES TOWARD CASSETTE STANDARDS

Headed by industry consultant Ray Freeman, the working group for Data Cassette Compatibility (D/CAS), is rapidly solidifying interface, recording and unrecorded cartridge standards for small tape drives. The proposed standard is compatible with the individual track format of the QIC-24 spec adopted for 1/4-inch cartridge streaming-tape drives. The goal is to have the specs ready by the July NCC, says Freeman. Currently, the D/CAS-5 spec defines a device interface, and the D/CAS-6 spec defines the recording format. D/CAS-12, which defines the unrecorded cassette, was to be addressed at last month's meeting. Members of the D/CAS working group include Memtec Corp., Salem, N.H., Raymond Engineering Inc., Middleton, Conn., and Verbatim Corp., Sunnyvale, Calif.

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MINI-MICRO SYSTEMS/May 1984

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CIRCLE NO. 52 ON INQUIRY CARD

Mini-Micro World

INTERNATIONAL

Europeans debate tariff on ICs

Keith Jones, European Editor

The British government is backing European computer builders in a campaign to reduce the Common Market's import tariff on semiconductors. The tariff—now 17 percent—is intended to protect Europe's IC manufacturers against U.S. and Japanese competition.

But European computer builders contend that the tariff has failed and is threatening future European system manufacturing because of the high cost of imported semiconductors. They warn that if the tariff is not lowered it will force them to transfer their manufacturing to areas outside the Common Market, including the United States.

Under the General Agreement on

Kenneth Baker, British minister of state for industry and information technology, is leading the push to persuade the Common Market to reduce semiconductor import tariffs to 6 percent.



Tariffs and Trade, the Common Market has reduced the tariff on complete systems to 6 percent over the past few years and may reduce it even further. But the tariff on ICs remains high. System builders contend that, as ICs increase in complexity and sophistication, they represent a growing proportion of total manufacturing costs.

In a report to Kenneth Baker, Britain's minister of state for industry and information technology, the National Economic Development Office (NEDO), London, describes the European tariff situation as anomalous. Baker has accepted NEDO's recommendation that the Common Market reduce IC tariffs to the same level as that of computers over a two-year period. Now, he must convince the Common Market. A spokeswoman for the Department of Trade and Industry in London says the department will open negotiations with the Common Market in Brussels, Belgium, as soon as possible.

IC, computer tariffs may be equal

The British Microcomputer Manufacturers Group (BMMG), an association of 19 small- to medium-sized manufacturers, commissioned the NEDO report. "The problem is worst in Britain because the microcomputer manufacturing industry is more advanced here than in Continental Europe," explains BMMG chairman David Broad, who is also chairman of personal computer manufacturer Comart Ltd., Huntingdon, England.

European computer system manufacturers share the view of BMMG, according to Gunther Moeller, secretary general of European trade association Eurobit,

Frankfurt, West Germany. He calls the 17 percent tariff nonsense and says European chip manufacturers have not kept up with U.S. and Japanese IC builders despite the tariff that has protected the European manufacturers for more than 10 years. He concedes that the Common Market sometimes suspends the tariff on a device if there are no European sources for it, but he says component manufacturers strongly resist such suspensions.

IC makers might oppose cut

Most members of the European Electronic Component Manufacturers Association, Brussels, Belgium, are likely to oppose a tariff reduction, according to association secretary Neville Lyons. The only group in the association that will approve a cut is Britain's Electronic Components Industry Federation (ECIF), London. But Lyons notes that ECIF is different from other groups in the association in that ECIF's members include circuit board manufacturers that want board and system assembly to remain in Europe. ECIF will accept a cut only if the British government or the Common Market financially supports its members whose profits are affected by the tariff reduction.

While NEDO recommends a tariff cut, it acknowledges that the tariff's impact is not universally damaging. NEDO concludes that the tariff raises average IC prices in Europe by as much as 8½ percent—not 17 percent. But it affects some companies, particularly small manufacturers of computers, more than others. BMMG's Broad asserts that component distributors use the tariff to justify prices that are 15 percent higher than U.S. prices. □

Convergent, Future Technology pursue high-volume buyers in Europe

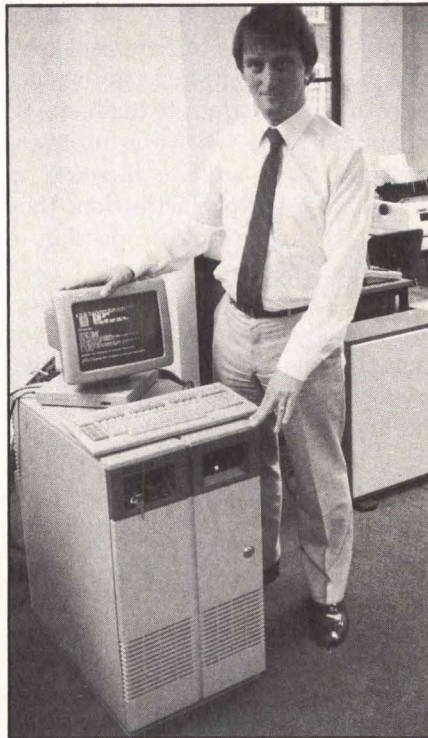
Keith Jones, European Editor

Marketing professional micro-computers is often more difficult than designing and building them. The costs and complications of supporting an extensive distributor/dealer network can be prohibitive. Two companies active in Europe—Convergent Technologies Inc., Santa Clara, Calif., and Future Technology Systems Ltd., London—are avoiding these marketing problems by targeting only high-volume customers that can handle their own sales to end users and system integrators.

The larger of the two, Convergent offers a more extensive product line. But Future has the advantage of manufacturing facilities that are close to its European customers—in Beith, Scotland. Both companies have acquired several major customers in Britain and are negotiating big contracts in other parts of Europe. Convergent has a solid foothold in France with the Bull Group, Paris, whose Bull-Transac division sells Convergent workstations as the B4000 desktop terminal.

European customers important

Convergent ships products to several large U.S. customers, notably Burroughs Corp. and NCR Corp., which generated most of Convergent's \$163 million revenues in 1983. But European customers will not have to wait for products if demand exceeds supply, says Bob Groves, Convergent's international vice president, who works out of the company's European sales offices in Amersham, England. He says European contracts will be as big



Bob Groves, international vice president of Convergent Technologies, stands before the company's Megaframe computer, which employs multiple application processors, each based on the Motorola MC68010.

and therefore as important to Convergent as are its United States deals. "The minimum volume we are interested in is around \$20 million over two or three years. The total number of potential customers in Europe is only about 30," he says. Groves sees European manufacturers as his most likely customers but does not discount very large system integrators such as accounting system vendor Star Computer Group Plc., London.

Future Technology will sell directly to system integrators that will buy 500 to 1,000 units a year, according to managing director Peter McHugh. Future is also targeting computer and office

system manufacturers.

Both companies have policies to steer clear of end-user sales. Future will confine its end-user business to British public-sector customers. Groves says Convergent's policy is "written in blood" because the company's OEM customers fear that Convergent might start selling at lower prices to end users than the OEMs do.

To survive, both companies must stay at the forefront in product development so that their customers can justify buying from an outside source rather than building in-house. "Our only real competition comes from our customers' own engineering departments," notes Groves. Ralph Gilman, senior vice president of consultancy InfoCorp, Cupertino, Calif., attributes Convergent's success to high-quality engineering and the ability to sell products to OEM customers at lower costs than the OEMs could manufacture them in-house.

Future offers customizing

McHugh at Future points to his company's establishment of a subsidiary dedicated to design and development projects—Future Technology Developments Ltd., Glasgow, Scotland. The subsidiary's work will be to customize and enhance standard products and to develop special products for specific customers. One of the first special projects, being developed for common carrier British Telecom, is a board that can provide a computer with support for the teletex text-interchange standard. McHugh believes any country employing the same version of teletex could use the board.

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Mini-Micro World

INTERNATIONAL

Customizing Future's standard products involves not only modifying colors and cabinet shapes to suit individual customers but also modifying electronics to support specific screen resolutions and special peripherals such as streaming-tape drives. Convergent's Groves notes that his company's customizing is confined to changing colors and modifying casing plastics. The only company receiving totally customized products from Convergent is American Telephone and Telegraph Co. A separate Special Systems Division at Convergent handles customizing for AT&T.

Competition may heat up

Of Convergent's three other product-based divisions, only its Distributed Systems Division, which builds workstations, is faced with direct competition from Future, according to Groves. He believes that Future offers nothing to compete directly in power with the two products from Convergent's Data Systems Division, the Mini-frame, which is configured around a 10-MHz Motorola MC68010 processor, and the Megaframe, which employs multiple application processors, each based on the MC68010. The multiple application processors communicate over a 32-bit-wide, 11M-byte-per-second bus with multiple file and terminal processors, each based on an 8-MHz Intel 186 processor.

McHugh at Future notes that his company's next generation of machines will be based on an Intel 286 chip and thus will compete more directly with Megaframe. Future's main offering, the PC 86, is configured around the 8-MHz Intel 8086, as are Convergent's IWS and AWS workstations. A short supply of the Intel 186, the CPU of Convergent's IWS/AWS successor, the N-Gen workstation, is delaying



Peter McHugh, managing director of Future, expects his company's next generation of machines to compete with Convergent's Megaframe.

shipments of that product.

Both offer multiple OSs

On the software side, both companies offer multiple operating environments. Future's FTOS system adds menu and password features to Concurrent CP/M-86 from Digital Research Inc. Future offers Release 3.1 of Concurrent DOS, which supports applications written for the PC-DOS 1.1 environment on the IBM Corp. Personal Computer.

The Convergent equivalent to FTOS is CTOS, which supports

CP/M and two systems from Microsoft Corp., MS-DOS and XENIX, Microsoft's version of UNIX. UNIX does not lend itself to Future's current products, according to McHugh, but will be offered with the upcoming 286-based machines. CTOS also runs on Convergent's larger machines. Groves notes that the environment on Megaframe includes UNIX System V with full virtual memory. "We beat Motorola in putting System V on the 68000," Groves asserts. "We move fast." □

TRAINING EFFORTS SPUR ADA

According to *AdaData*, a newsletter published by International Resource Development (IRD) Inc., the total Ada market, still in its infancy, should boom from \$150 million this year to nearly \$1 billion in 1986. IRD says that growth will be due to increased commercial activity and training costs. "This mushrooming interest in education and training is going to drive the entire market from relative obscurity to major proportions in a remarkably short time," states the newsletter. From 1984 to 1986, commercial training expenditures for Ada are expected to rise from \$6 million to \$55 million, and Department of Defense programmer training costs will rise from \$25 million to \$300 million. Sales of validated compilers should increase from \$9 million this year to \$160 million in 1986. The newsletter predicts that small computer and software vendors will "grudgingly acknowledge" their need to compete with large companies in the Ada market.

Mini-Micro World

INTERNATIONAL

MARKET BAROMETER

A column devoted to an expert's look at an industry



Gordon Curran is director of Intelligent Electronics Europe, Paris, a marketing consulting and research company specializing in the European market for microcomputers and related products.

European PC distribution: the market's bottleneck

Gordon Curran
Intelligent Electronics Europe

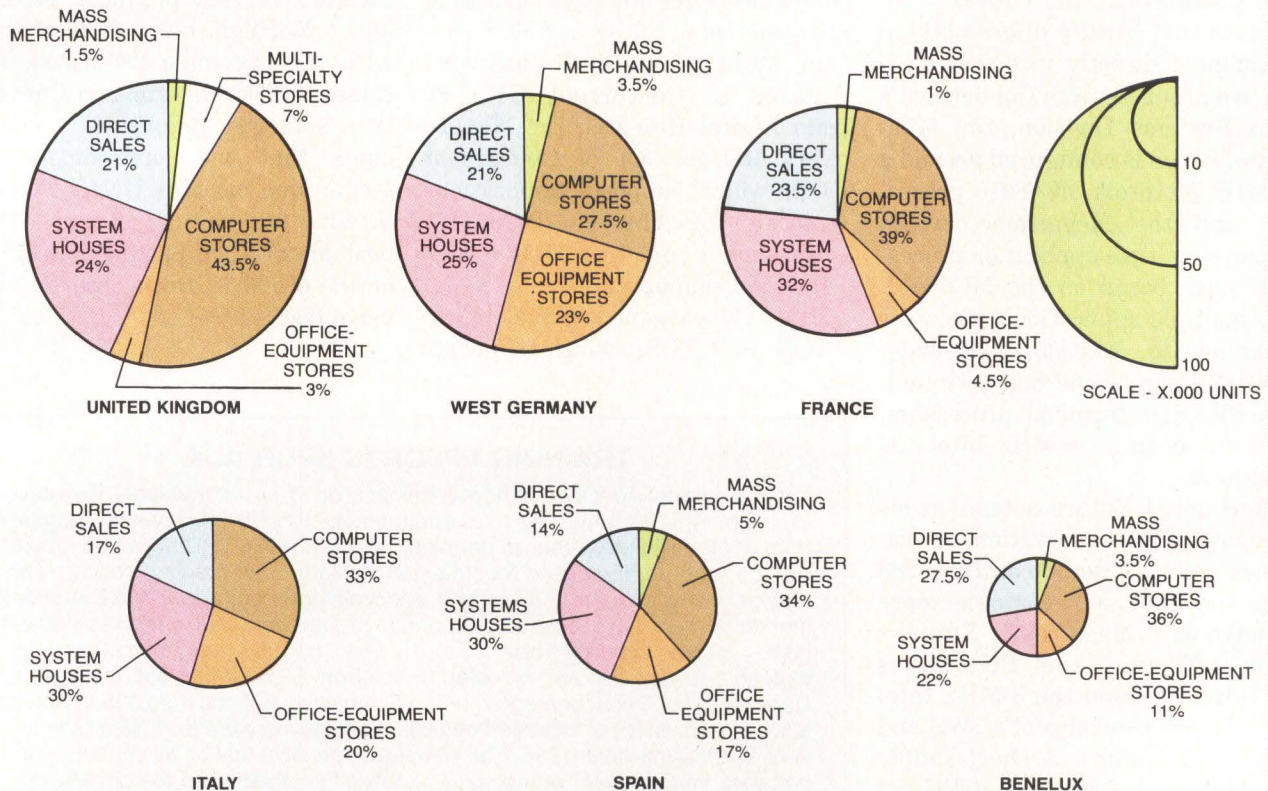
Personal computer markets in the major European countries have developed differently, but all countries have one factor in common: a shortage of distribution channels. As a result, many manufacturers are

chasing too few dealers. The shortage of dealers makes it tough for manufacturers. Despite it, however, unit sales advanced 50 percent in 1983 over 1982 and are forecast to advance 40 percent this year.

Throughout Europe, there are no more than 1,250 qualified business and commercial computer stores and


about the same number of office-equipment stores that carry computers. Office-equipment stores are usually tied to one manufacturer through concession agreements. Italy's Olivetti SpA and Germany's Triumph Alder Co., both known for their typewriters, control more than half of the concession-type agree-

HOW BUSINESS MICROCOMPUTERS ARE DISTRIBUTED IN EUROPE
(UNIT SALES, 1983)



SOURCE: INTELLIGENT ELECTRONICS EUROPE

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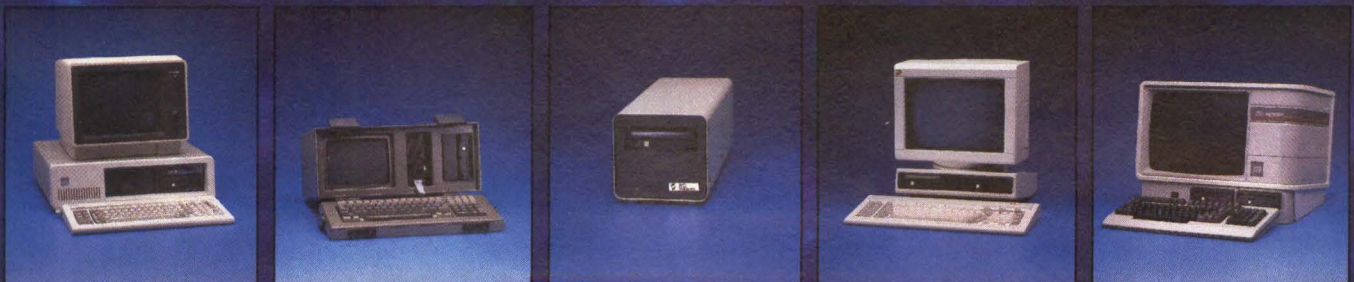
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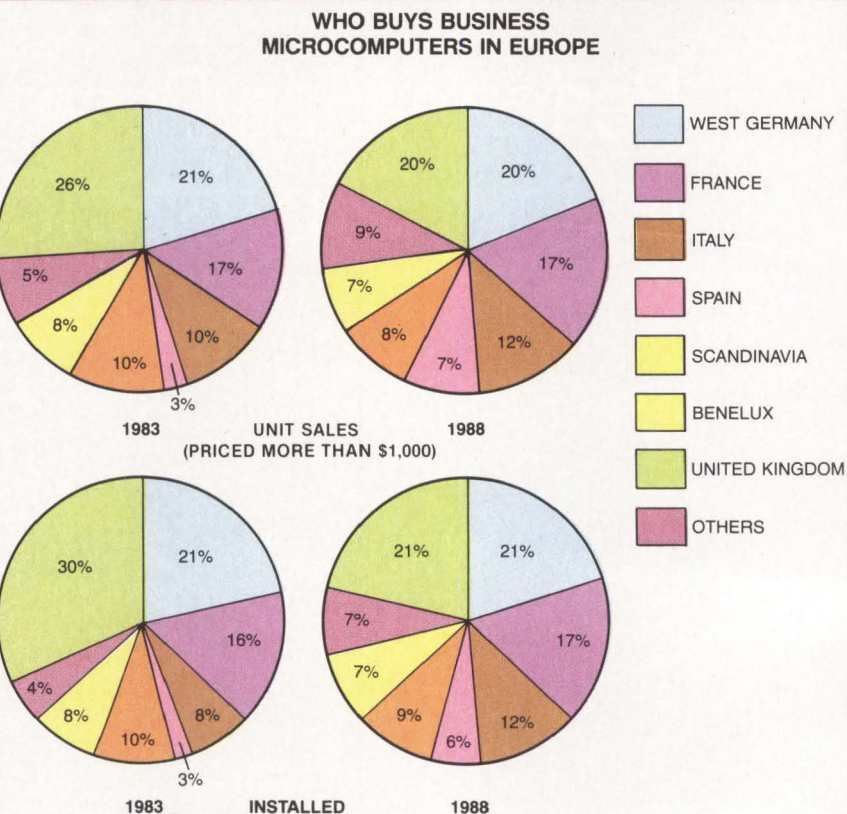
ments in Europe.

IBM Corp.'s stringent dealer requirements have a significant influence on the quality of computer shops in Europe. Most new European outlets for IBM products compare favorably with those in the United States. New European computer stores include RYO, Paris, which has more than 4,000 square feet of display area; Gecotek in Brussels, Belgium, the first of a chain of computer stores in that country owned by mass retailer GB INNO; Microland, Geneva, Switzerland; and Steiger Computer, London, advertised as the world's largest computer store. All the stores are well-designed, offer a wide choice of products and services and have extensive training facilities.

In spite of rapidly improving standards and ever-increasing numbers of outlets, only the strong companies and popular products are getting dealer shelf space. Most stores can efficiently carry only three or four brands. IBM now uses nearly 900 of the best dealers in Europe and is searching for more. Apple Computer Inc. also has approximately 900 dealers. Both companies are effectively increasing their product ranges and requiring extra shelf space, thus heightening the pressure on other manufacturers to get their products into stores.

Big names such as Digital Equipment Corp., Hewlett-Packard Co. and, possibly, ITT Corp. have a better chance of acquiring shelf space in outlets. Manufacturers such as Texas Instruments Inc. and NCR Corp., IBM PC-compatible equipment manufacturers and mainframe and minicomputer manufacturers now offering microcomputers and wishing to adopt a dealer distribution policy will have to work hard to get even minimal dealer coverage.

Of the European companies, market leader Olivetti has the best chance of retaining its position in retail stores. The Commodore International dealer network, which was larger than Apple's in Europe just a short time ago, and the Sirius/Victor network, which is much stronger in Europe than in the United States, are crumbling. However, British company ACT, with its Apricot microcomputer, retains many Sirius/Victor



SOURCE: INTELLIGENT ELECTRONICS EUROPE

outlets, particularly in Britain.

So far, Japanese companies have not achieved distribution or market share in Europe. Sharp Corp. and Epson Corp. are the only major Japanese manufacturers with effective European distribution.

For the moment, system houses are an alternative channel for manufacturers seeking distribution in Europe. Although system houses exploit vertical markets, they have neither the ability nor the expertise to succeed in mass-volume markets. Several system houses recognize this and are opening retail stores to cater to the increasing demand for packaged software. In many instances, setting up stores qualifies system houses as IBM dealers.

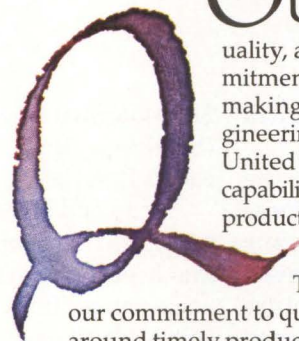
Standing aloof from this scramble is Tandy Corp. with more than 700 stores in Europe. With new products and an aggressive promotional campaign aimed at professional users, Tandy should continue to command a significant market share.

One bright spot for European

distribution is action being taken by the powerful mass-distribution organizations that exist in most European countries. These organizations are moving to enter the dealer market. Large German retailers Karstadt, Kaufhof, Hertie and Horten; Netherlands group Vroom & Dreesman; Belgium's GB INNO; and Spain's El Corte Ingles have opened computer shops and have ambitious plans for development within their countries. Computer dealers in France and Britain are starting multibranch operations with the goal of operating national distribution chains. This should help improve the dealer network situation over the next few years.

As for Pan-European operations, companies such as ComputerLand find it difficult to build a significant presence. One reason is that European cultural and mental barriers between countries are more formidable than physical borders when it comes to getting even adjacent countries to cooperate.

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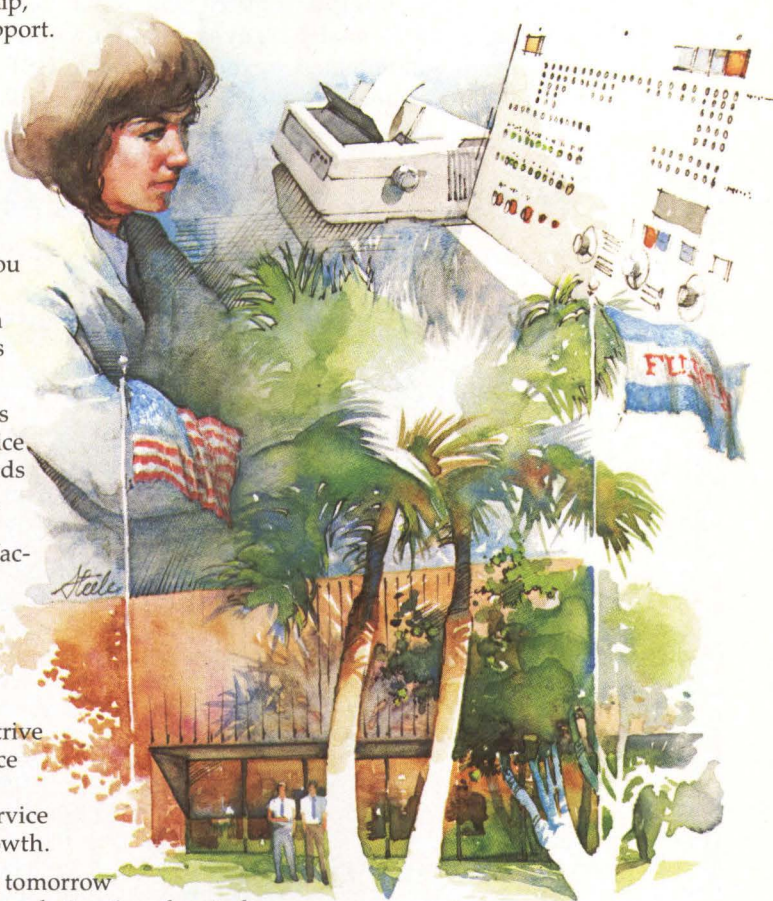
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France's Bull Group enhances its minicomputers

Keith Jones, European Editor

France's Bull Group, the largest European minicomputer manufacturer, has significantly enhanced its three incompatible minicomputer product lines. The company has enhanced its Solar family, aimed at scientific/industrial system integrators, and has added a 32-bit model to the line. Bull Group will enhance its other two families, aimed at

business system integrators—Mitra and Mini 6—with new models.

Bull officials have made Mini 6 the company's future in the business minicomputer field. A company spokesman notes that Mitra development will be slower in the future than that of Mini 6. Bull acquired Mitra and Solar last year when a government-owned electronics group, Thomson-CSF, transferred ownership of Société Européenne de

Mini-informatique et de Systèmes (SEMS) to Bull. The acquisition is called Bull Sems.

At the end of last year, Bull Sems put aside development of a 32-bit machine, according to a Bull spokesman. It is now to build and sell a 32-bit computer from Ridge Computers Inc., Sunnyvale, Calif., which runs UNIX system V.

Deliveries of new 16-bit Solar machines from Bull Sems should

OVERHEARD OVERSEAS

IBM hopes to absorb popular X.25 in new SNA 'standard'

Tim Palmer
European Contributor

The X.25 packet-switching protocol has been one of the few success stories for Pan-European cooperation. All the major European markets have adopted the protocol for their public packet-switched networks. This means that even IBM Corp. has had to provide X.25 implementations for its major products.

But no company owns X.25, and IBM is usually unhappy with an industry standard it does not own. IBM's long-term strategy is to swallow X.25 into the Extended Network Architecture (XNA), a new and more comprehensive version of Systems Network Architecture (SNA). If XNA is widely adopted, IBM terminals and terminal computers will once again be the first choice for every major buyer. System integrators that want to pick up the crumbs left by IBM will either have to incur the expenses of implementing the enhanced IBM protocol or drop out of the race.

In Italy, IBM is wooing the government with a proposal that it take over the management and implementation of an X.25 national packet-switched network project. That project still is not operational after five years of development. In exchange, IBM wants a preferential position as a supplier of terminals to the telecommunications authorities and most likely a shift of the protocols used from X.25 to XNA.

As a sweetener, IBM has suggested that it might build a plant in Italy to manufacture Rolm Corp.'s digital private-branch exchange (PBX) for the European market. To interface easily to the IBM version of the Rolm PBX, users will have to implement either IBM SNA or IBM local network interfaces on the systems they build.

In Britain, IBM has persuaded common carrier British Telecom to build the first European node for IBM's Satellite Business Systems joint venture with Communications Satellite Corp. and Aetna Life and Casualty. IBM is also lobbying

behind the scenes for a major role in future British public networks and has almost certainly won the contract to build a national electronic funds-transfer network on behalf of British clearing banks.

In West Germany, IBM fought a bitter battle to win the contract from common carrier Deutsche Bundespost for implementation of the national videotex network, Bildschirmtext. The project is nine months behind schedule, and the cost overruns would have knocked out a company without IBM's resources. But IBM has achieved one of its primary aims—a close working relationship with the national postal and telecommunications authority.

Given the stakes that IBM is playing for in networking and the time frame of its strategy, it seems hardly a coincidence that the company has chosen to make its 1984 gift to European colleges a data network, the European Academic and Research Network (EARN).

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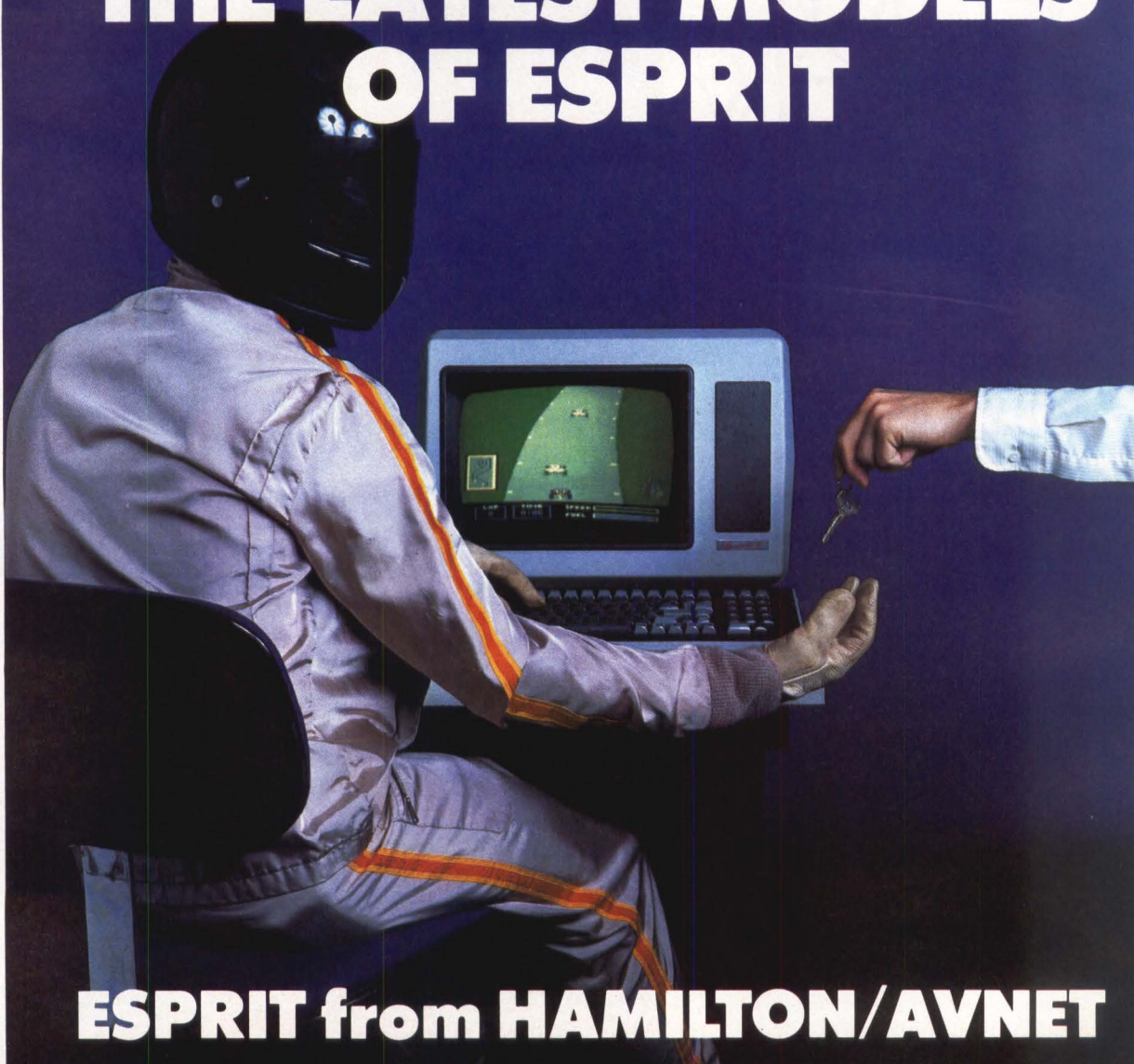
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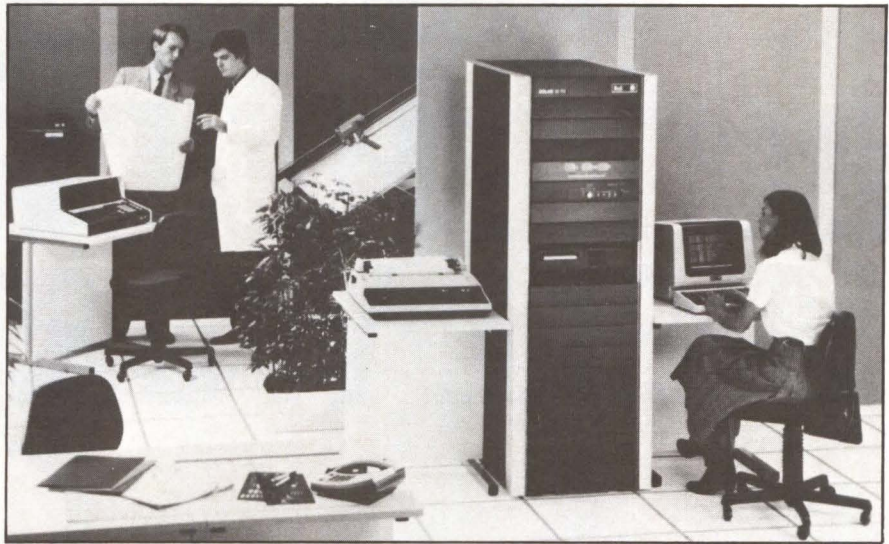
start in July. The smallest is the 16-35, which provides a central processor and 512K bytes of main memory on a board. The 16-35 is based on a 4.4M-byte-per-second bus. Three larger models each incorporate two buses—a 14M-byte-per-second bus for processors and memory modules and a 4.7M-byte-per-second bus for the input/output system. The single-processor Solar 16-70 comes with as much as 2M bytes of main memory, and the 16-90 comes in single- and dual-processor models.

Bull has enhanced the Mitra family with a top-end machine, the 725, which can "map" the standard Mitra 1M-byte logical address space onto 4M bytes of physical main memory. The 725's 32K-byte cache memory is twice the size of the previous high-end Mitra machine, the 625. Offered as standard with the 725 is a disk access "accelerator," which manages as many as 16 disk drives with storage-module-drive (SMD) interfaces. It contains as much as 16M bytes of RAM, which can be used either as an "electronic" disk drive or as a cache memory for the attached disk drive.

Bull, Honeywell cooperate

Bull Systèmes is the outlet for the computers that emerged from Cii Honeywell Bull's long-standing relationship with Honeywell Information Systems (HIS) Inc. As such, Bull Systèmes will sell Bull's Mini 6 computers. HIS' parent is Honeywell Inc., whose share in Bull has been cut from nearly half to less than 10 percent since Bull's nationalization. But Bull continues to build Honeywell computers for customers in Europe, except in Britain and Italy, where HIS maintains its own marketing operations.

Bull and Honeywell still cooperate in product development. The Mini 6 line is closely related to HIS' DPS 6 family. Both run the GCOS 6



The single-processor Solar 16-70 minicomputer from Bull Sems, Paris, includes as much as 2M bytes of main memory. It incorporates a 14M-byte-per-second bus for the processor and memory modules and a 4.7M-byte-per-second bus for the I/O system.



The Mini 6/290 16-bit minicomputer from Bull-Systèmes, Paris, includes 512K bytes of memory, uses the Megabus architecture and, starting in September, will run UNIX Version 7 as an alternative to the GCOS Mod 400 operating system.

Mod 400 operating system. The smallest of the three new Mini 6 machines, the single workstation Mini 6/10, employs the same processor, the 16-bit LSI-6, as the microSystem 6/10 launched by HIS in Britain last year. Like the HIS machine, the Mini 6/10 runs GCOS 6 Mod 400 as standard and can host MS-DOS and CP/M-86 using an optional processor board based on the Intel 8086. But, unlike Mini 6/10 purchasers, microSystem 6/10 customers can receive an option of 20M bytes of Winchester disk storage in addition to standard dual floppy disk drives. The microSystems

buyers can also opt for a larger model, the microSystem 6/20, which comes with as much as 40M bytes of Winchester storage and supports as many as five workstations or printers.

Bull customers who want more power than the Mini 6/10 offers can consider the other new Mini 6 machines, the Mini 6/210 and 6/290, which fit between the Mini 6/10 and the larger machines in the Mini 6 family. They are both based on the Megabus architecture employed by all the larger Mini 6 machines and by the HIS DPS 6 models above the microSystems. □

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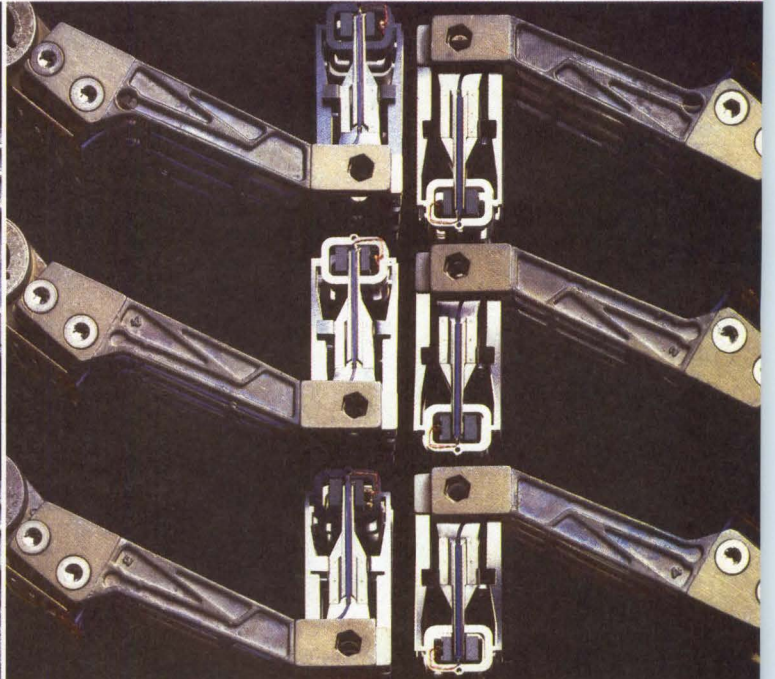
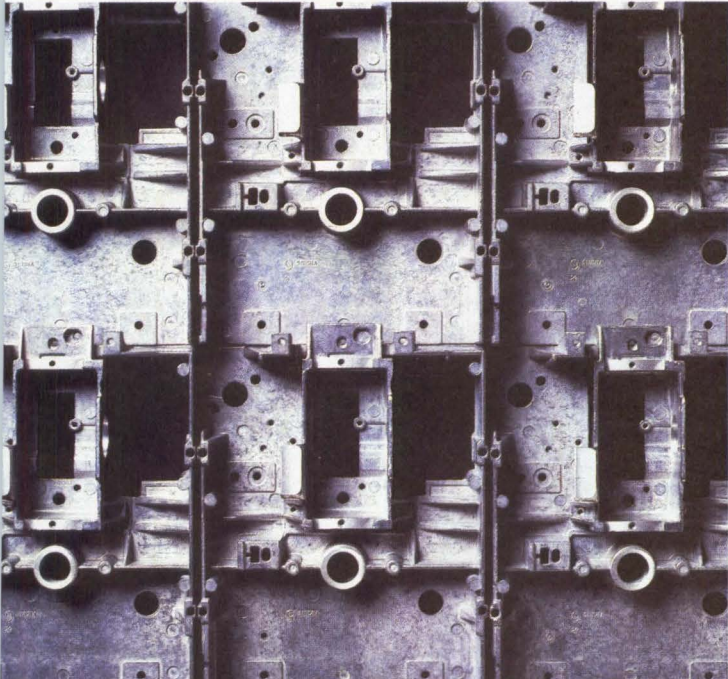
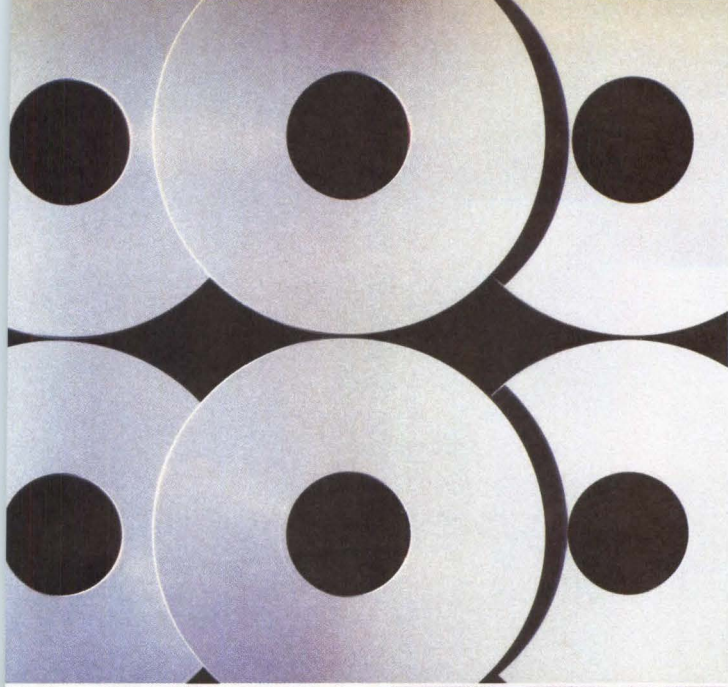
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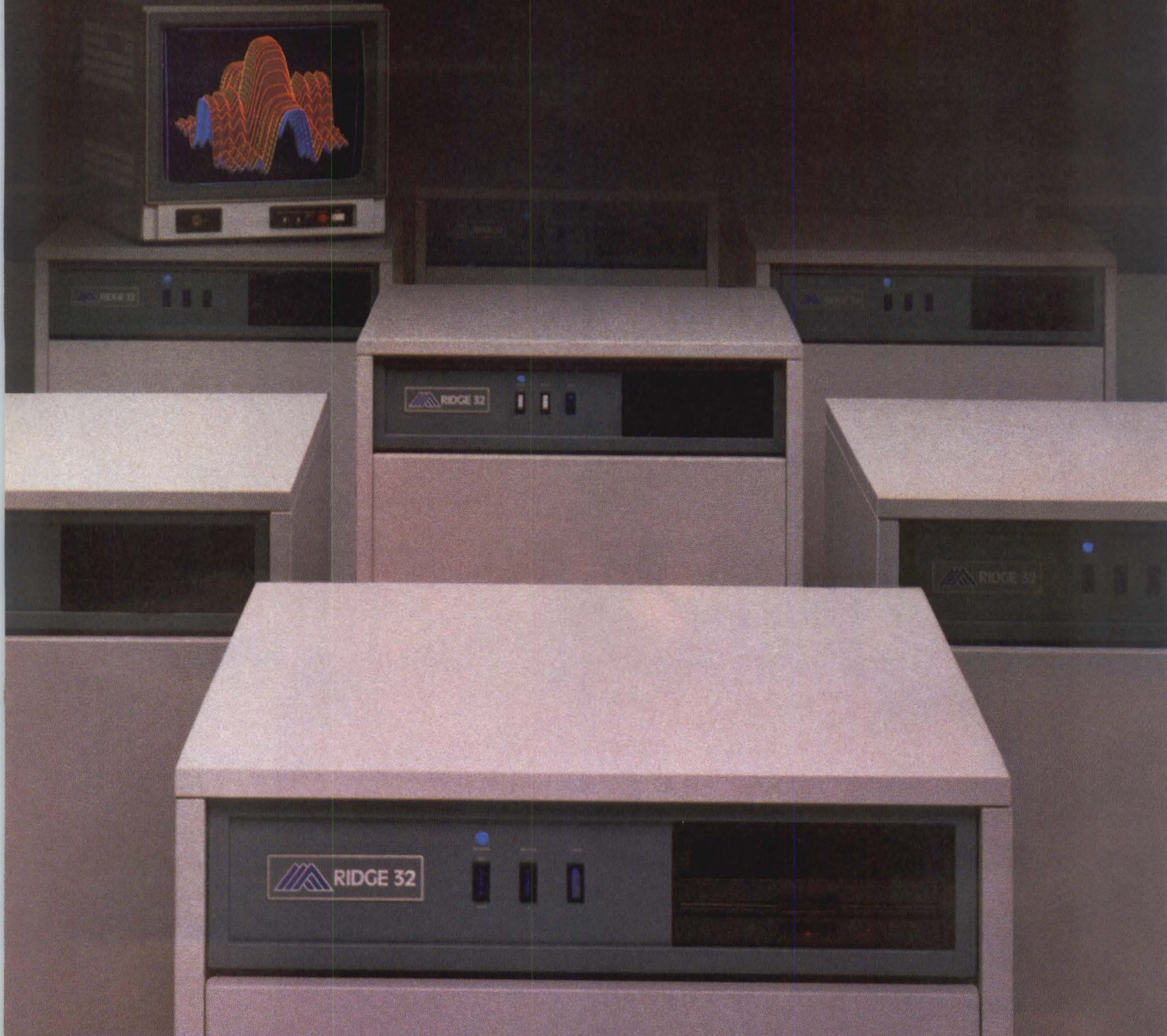
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The Interpreter

An analysis of news, issues and trends affecting the computer industry

Artificial intelligence faces a crossroads

Developers of expert systems must choose between LISP and Prolog

Edward Foster, Associate Editor

Publicity surrounding Japan's Fifth-Generation computer project has done much to alert system developers to the long-term potential of artificial intelligence (AI). It has also engendered an emotional controversy in the United States between proponents of the two leading development languages, LISP and Prolog. At issue is not which language computers will use in the 1990s but which offers greater potential for developing current AI software products, such as expert systems.

LISP has been the predominant AI language in the United States since the 1950s when it was developed at the Massachusetts Institute of Technology. Prolog, developed in Europe in the early 1970s, is the language of choice among AI researchers there. In addition, the Japanese Fifth-Generation computer project chose Prolog as its software-development language.

"It is a complex issue involving a number of things that are going to influence the industry for the next five years, if not throughout the rest of the decade," predicts Dr. Douglas Partridge, a senior scientist at Hughes Research Laboratories' Corporate AI Center, Calabasas, Calif., where he helps develop in-house expert systems. Partridge believes that logic programming, represented by Prolog and its dialects, is ascending in the American AI community. But he questions whether it can be "matched to the way people approach the kind of problem-solving tasks expert systems will have to do."

Many LISP advocates have greater doubts about Prolog. They admit bewilderment about why the Japanese chose Prolog to develop Fifth Generation software. "They've made a serious mistake," says one. "Prolog is an elegant way to approach research problems, but it is too limited in its inherent structure for serious applications." The growing number of U.S. converts to Prolog suggests that such attitudes are the result of a general misunderstanding of Prolog and logic programming. There may be an emotional tie to LISP by some researchers forged by the years they've spent learning it.

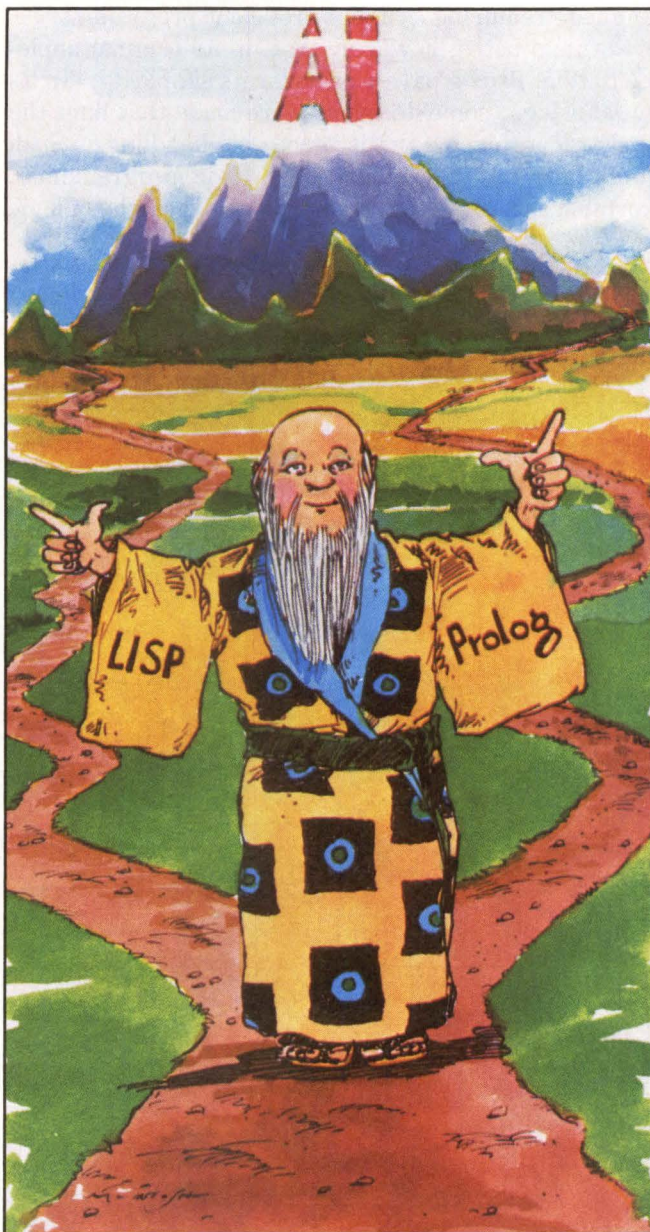


Illustration by Jon McInrosh

Unless the type of application or the programmer's experience weights the decision, the choice between LISP and Prolog will remain difficult.

The Interpreter

Neither language suits everyone

In spite of the passions the LISP-vs.-Prolog controversy arouses, there is a consensus about each language's strengths and weaknesses. "Prolog is very simple to use," says William Kornfeld, vice president of software technology for Quintus Computer Inc., Palo Alto, Calif., a new company developing Prolog software. "Programming is much easier in Prolog than in LISP, which has evolved into a very complicated language requiring a highly proficient programmer."

Kornfeld notes, however, that, in its original implementation, Prolog pays a price for its simplicity: "In its initial design, some decisions were made that limit the kinds of problems it is good at handling." Such limitations are not inherent in logic programming, Kornfeld asserts. He stresses that the potential of logic

programming—not current Prolog dialects—has won over Prolog's advocates.

The most obvious deficiency in current Prolog is its inefficiency in searching a large knowledge base, the AI equivalent of a database. Prolog uses a "depth-first" mechanism—it searches to the end of each possible solution until it finds one that meets certain criteria. An exponential explosion of combinations makes the search of any large knowledge base practically impossible.

"Prolog does not offer any facility for heuristic search mechanisms of the type the programmer employs in LISP," says Mache Creeger, director of marketing for LISP Machine Inc., Culver City, Calif. Heuristic mechanisms, which break a decision into increments, help a system narrow its search by identifying those areas of a knowledge base that will be most fruitful to

The software development environment for LISP users is more sophisticated than the one Prolog offers. This screen dump for a Symbolics 3600 system demonstrates some of the tools, such as debugging facilities and graphic representation of LISP structures,

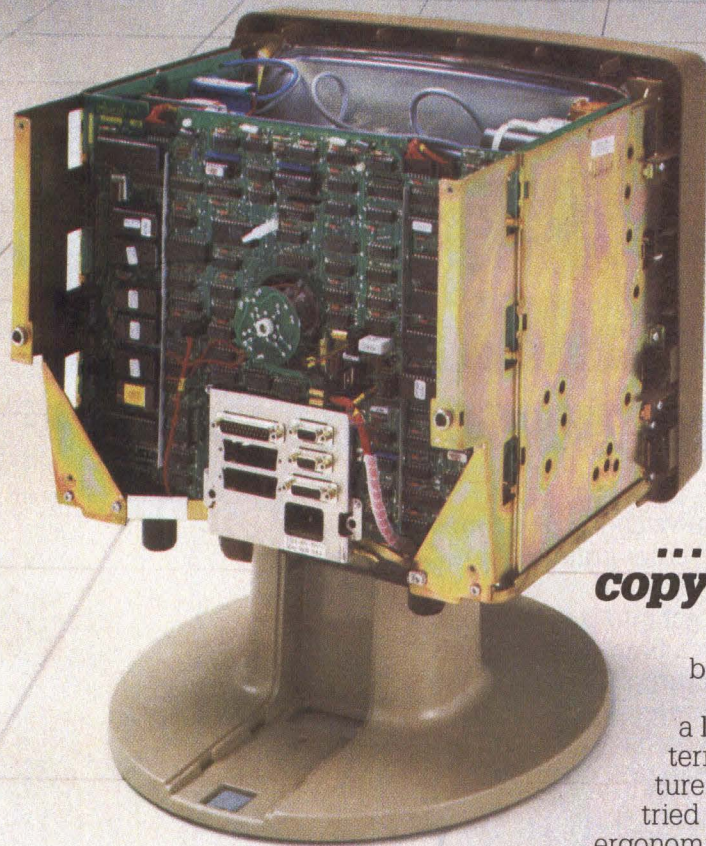
available to programmers. One of the first objectives of the Japanese Fifth-Generation project is to develop a similar system for a Prolog environment.

The screen dump displays a Lisp Listener environment. At the top, there's a menu with options like 'Object operation', 'Create cons', 'Create symbol', and 'Display number'. Below this is a stack frame for the 'FACTORIAL' function, showing return-stack, push-local, and builtin instructions. A code editor window shows the definition of the factorial function:

```
(defun factorial (number)
  (if (< number 2)
      nil
      (* number (factorial (- number 1))))))
```

At the bottom, there's another menu with options like 'Windows', 'Create', 'Select', 'Split Screen', 'Layouts', 'Edit Screen', and 'Set Mouse Screen'. The bottom of the screen shows system information like 'Lisp Listener 2' and 'Lisp Listener 2'.

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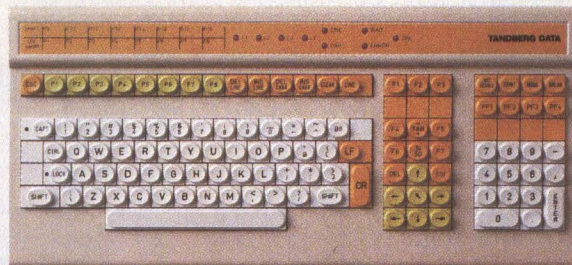
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The Interpreter

search. "A depth-first approach is simply not appropriate in an expert system application because you need to be able to explore a broad range of options quickly."

Creeger cautions others not to jump on the Prolog bandwagon too quickly, arguing that no one approach or language will solve all AI problems. He points out that, despite its name, LISP Machine is not limited to LISP. It recently introduced a version of Prolog called LM-Prolog that runs on its Cadr and Lambda LISP machines.

Integrated languages borrow from both

LM-Prolog is just one of many languages that integrate aspects of LISP and Prolog. Developed at the University of Uppsala in Sweden, it allows researchers doing Prolog work to use development tools for LISP environments. "Prolog is very good for such things as expert systems, but it is weak in development tools such as editors, debuggers and I/O facilities," notes Sten-Åke Tärnlund, a professor at Uppsala. "LM-Prolog allows for use of development tools that already exist in the LISP environment." Tärnlund is, nevertheless, committed to logic programming, asserting that when "people develop expert systems in LISP or other programming languages they are really implicitly developing a Prolog system."

Dr. J. Alan Robinson, research director at the Center for Advanced Technology at Syracuse Universi-

ty, Syracuse, N.Y., is also attempting to combine LISP and Prolog. Robinson laid the theoretical groundwork for Prolog's creation with his work in the 1960s on resolution theorem proving. He voices concern about the antagonism of the LISP-Prolog debate: "There really ought not to be a controversy." He maintains that developers must bridge the gap between logic and functional programming before a Prolog-based system can be practical. "Prolog is purely relational; you don't have a way to write an evaluative expression as can be run in functional programming."

Robinson's current project is developing a version of an integrated language he calls Super-LOGLISP, and he is working closely with another project at the center to explore parallel processing architectures. The coexistence of the two projects underscores one of Japan's arguments for choosing Prolog for its Fifth-Generation project: the Japanese believe that logic programming lends itself to parallel processing architectures. Robinson reports that researchers at Syracuse expect to complete software prototypes of Super-LOGLISP in two years and hardware prototypes of parallel processors in three to five years.

Robinson envisions a true fifth-generation computer that employs a language with both LISP and Prolog characteristics. That does not, however, resolve the dilemma that faces those developing expert systems and other AI-based software for conventional computer

A 1-minute course in Prolog programming

Prolog programming is based on declared facts and conditional rules that programmers can manipulate in a declarative fashion. A fact consists of a relationship or a predicate and an object or objects. Standard Prolog notation for the English statement "John is father of Mary" would be

Father (John, Mary).

A simple query to a database with this fact stored in it of

? - father (X, Mary).

meaning "Does Mary have a father?" will produce the answer

X = John.

Once Prolog finds a fact that satisfies the desired goal, it stops searching the database unless asked to continue searching for additional facts that also meet the criteria. Conditional rules are declared by the notation ":-" which can be read as "if." The rule

Parent (X, Y) :- father (X, Y).

would mean "X is the parent of Y if X is the father of Y." Prolog can logically apply such rules to facts in the database to answer more complicated queries. For example, after a program states the following facts, Prolog can logically answer questions about relationships described in them.

Prolog statement

Father (John, Mary).

Father (Paul, John).

Grandfather (X, Y) :- parent (Z, Y),
father (X, Z).

Parent (X, Y) :- father (X, Y).

When the following question is asked

? - grandfather (X, Mary).

then Prolog will answer

Applications that lend themselves to such declarative programming can be relatively quick and easy to write. However, it is difficult to know whether the answer the program provides is necessarily the best solution to a problem. This drawback is magnified in a large database.

English meaning

John is the father of Mary.

Paul is the father of John.

X is grandfather of Y if some
Z is parent of Y, and X is father of Z.

X is the parent of Y if X is the father of
Y.

Is there an X that is grandfather of
Mary?

X = Paul

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systems in the immediate future. Dr. S. Jerrold Kaplan, chief development officer for Teknowledge Inc., Palo Alto, Calif., feels that most developers won't have to choose between LISP and Prolog. "Anybody worrying about the problem in those terms now is attacking it the wrong way," he insists. "The choice for most will be picking the specific expert system development tool to use."

Is LISP portable?

Teknowledge and many other recent AI start-ups are bringing software tools to market that make the AI implementation-language transparent to a user—who might be the expert whose knowledge is being recorded. However, companies like Teknowledge must still grapple with the LISP-vs.-Prolog debate. Kaplan believes a number of questions remain unanswered about the ultimate implementation language. "LISP is definitely more mature, which means for many applications its software development tools will be superior," he says. "Currently, it is my impression that Prolog is the more portable language of the two, but that situation can change quickly."

Proponents of both languages make conflicting claims concerning portability. "LISP is not at all good as an application language for an expert system," states a Prolog advocate at a major systems house. "Generally, you use it to implement an expert system shell in something else such as EMYCIN, [an application language used in expert systems]. Prolog, on the other hand, looks like it might prove better as an application language than EMYCIN, as well as functioning as the implementation language, as LISP does."

Most observers characterize LISP as a lower-level language than Prolog. Critics suggest this makes it too dependent on dedicated hardware to run efficiently. However, LISP supporters argue that its low-level nature makes it malleable enough to incorporate the virtues of higher-level languages, including Prolog, wherever needed.

Prolog still lacks development tools

"LISP and Prolog really aren't competitors because Prolog is essentially a user-level language," says Henry Baker, director of business development for Symbolics Inc., Cambridge, Mass. "LISP, on the other hand, is a system-building language." One of the main reasons LISP has survived as long as it has, argues Baker, is that it allows developers to build layers on top of the underlying LISP structure for higher-level languages, such as Prolog, APL, Ada or FORTRAN. "I think what

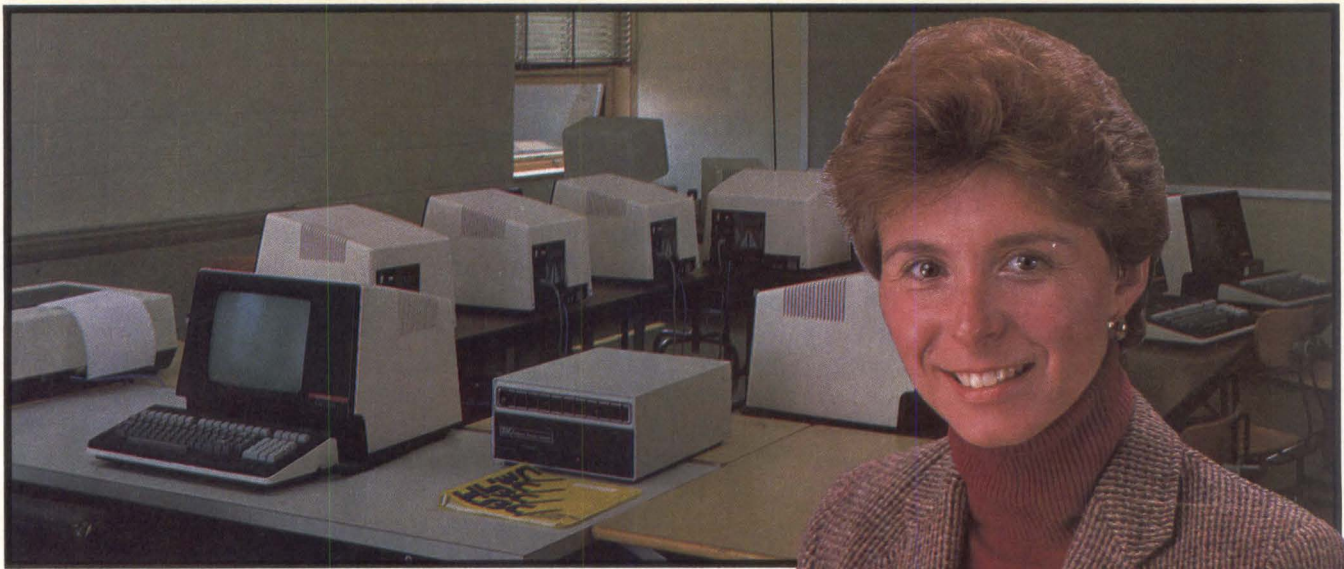
we will see are some excellent, powerful Prolog systems written in LISP and running in a LISP environment," Baker maintains. "Prolog is very elegant and starts from a far more sophisticated base than LISP does. The problem Prolog has with controlling the search of its database is strictly a technical one, and I'm sure we will eventually see implementations that get around a lot of that. The intrinsic problem that will remain is the very strong statement that Prolog makes about the type of logic it uses."

Baker and Hughes' Partridge believe Prolog has a more general limitation: it is too strongly tied to mathematical logic, rather than the less-precise logic involved in common-sense problem solving. To mimic common-sense approaches, AI researchers have developed a variety of problem-solving mechanisms, one of which is "fuzzy thinking." Most of these mechanisms employ the heuristic facilities provided by the LISP environment.

Although Prolog advocates agree with many of Baker's points, they refuse to accept his belief that logic programming has intrinsic limits. Quintus' Kornfeld acknowledges that "there is still going to be some need for LISP, at least until fast Prolog programming systems are available. It will be 20 years before things that look like LISP die out."

LISP's strengths are its dedicated architecture, well-developed software-development tools and long-established popularity with the U.S. AI community. However, Prolog's supporters believe that logic programming will dominate when Prolog becomes mature. "It's true that the tools one finds today are all in LISP," says Ray Weiss, of Silogics Inc., a Los Angeles start-up company developing software under Prolog. "You can see the fact that Prolog has a particular kind of search strategy as its great weakness or a great strength. The essential difference is that, when you see a good LISP program, you can be sure a very good programmer wrote it. For expert systems and other things to become commonplace on a variety of systems, you are going to want to consider the trade-offs between the many years required to develop it and the sheer amount of software the market needs."

The choice between LISP and Prolog seems likely to remain difficult for expert-system developers until progress renders both languages obsolete. In some cases, the type of application or the experience of the developers themselves will make the choice easier. And, while not a certainty, the paths leading from both languages could eventually lead a developer to one destination. □



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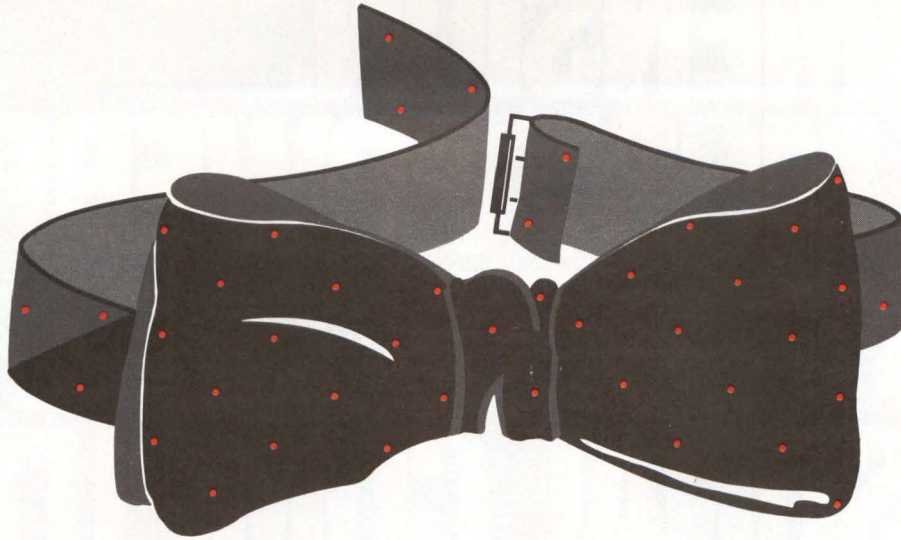
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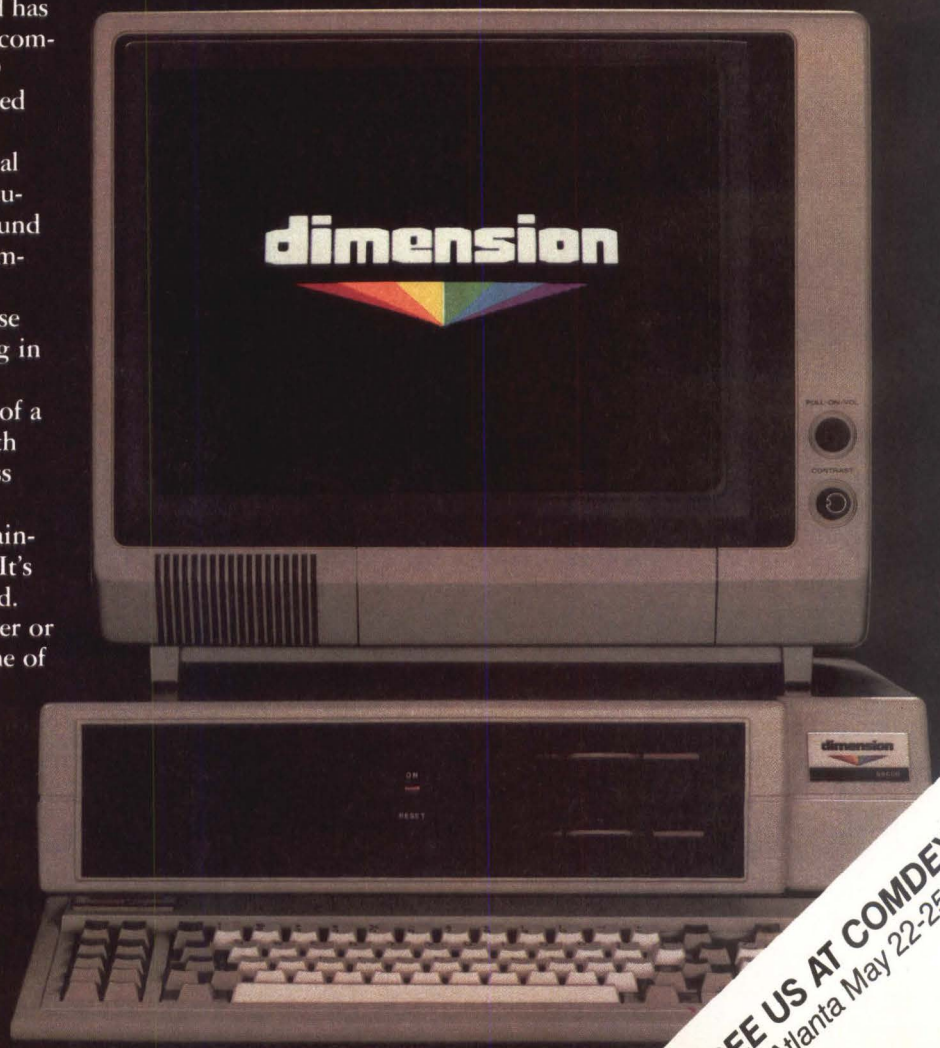
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DEALER INQUIRY

The Interpreter

Plated promises and sputtering shipments characterize thin-film media makers

Robert Sehr, Associate Editor

Before an audience of his fellow disk drive entrepreneurs gathered at the Dataquest Inc. Memory Industry Conference, Norman Dion, founder and chairman of Dysan Corp., recalled an experiment with plated media he took part in 20 years ago at IBM Corp. In those times, areal densities on the 14-inch platters were about 0.022M bits per square inch. Today's 5¼-inch platters are approaching densities of 25M bits per square inch. But even back then, there was a demand for higher density media.

The experiment, Dion recalls, was a dismal failure. IBM discovered it could not achieve a cost-effective plating process that could be transferred to high-volume manufacturing. Dion believes that, despite the rush to thin-film media today, nothing has changed IBM's basic finding that technology can't be rushed. "Technology is organic; it grows in increments," he says.

Dysan, the largest supplier of 5¼-inch oxide platters, wants to do nothing to hasten the demise of its best-selling product. But the message from the market seems clear: thin film is in. No fewer than three dozen companies or divisions of companies have dedicated themselves in the past year to meeting a demand that disk drive analyst Jim Porter, author of *Disk/Trend Report*, published in Mountain View, Calif., believes may reach 4 million 5¼-inch disks by 1986.

Analyst Ray Freeman, president of Freeman Associates in Santa Barbara, Calif., says there is a "market of opportunity" within the 17.9 million rigid Winchester platters measuring 5¼ inches or less that will be shipped in 1988. Most of those, Freeman believes, will be thin-film media platters.

Freeman notes, however, that the proliferation of both OEM and captive suppliers has made it unlikely that most of them will remain profitable, especially since thin-film media is often a capital-intensive rather than labor-intensive business, requiring a lot of capital up front. "It's not clear how they can all survive," he comments.

Plated media takes an early lead

Of the two types of thin-film media—plated and sputtered—the most widely available is plated. Two methods of plating are in use: electroless, primarily a

chemical batch process, and electroplating, which uses electric current to coat the disk with chemicals. The most common disk now shipped uses the electroless process. Shipping those disks are the industry's original suppliers—PolyDisc Systems Inc. (now a subsidiary of National Micronetics Inc., San Diego) and Ampex Corp., San Jose, Calif.

Ampex developed the first plated media in 1966 under the trade name "Alar" to increase recording densities in its instant-replay video equipment. Until 1981, however, there was little industry demand for plated or any other kind of thin-film media. The IBM PC and the resulting proliferation of 5¼-inch Winchester—not to mention portable computers—changed all

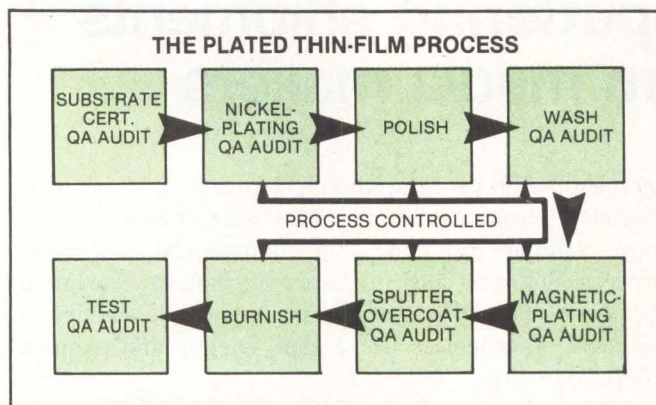
ANNOUNCED PLAYERS IN THIN-FILM MEDIA

Company	Location	Process
Advanced Disk Technology	West Lake Village, Calif.	plated
Akashic Memories	Santa Clara, Calif.	sputtered
Ampex Corp.	San Jose, Calif.	plated
Anelua Corp.* (NEC)	San Jose, Calif.	sputtered
Applied Information Memories	Milpitas, Calif.	sputtered
Argo	Radnor, Pa.	plated
Burroughs/Memorex	West Lake Village, Calif.	plated
Burton Magnekote	Culver City, Calif.	plated
Control Data Corp.*	Minneapolis, Minn.	plated
Datapoint Corp.*	Mountain View, Calif.	plated
Disc Tech One Inc.	Santa Barbara, Calif.	plated
Domain Technology	Milpitas, Calif.	plated
Evotek*	Fremont, Calif.	plated
Fujitsu America Inc.*	Santa Clara, Calif.	sputtered
Hewlett-Packard Co.*	Boise, Idaho	sputtered
Ibis Systems Inc.*	Duarte, Calif.	plated
Information Memories Inc.	Santa Clara, Calif.	plated
KemTec	Burbank, Calif.	N/A
KSI Disc Products Corp. (International Memories Inc.)*	Chino, Calif.	plated
Lanx Corp.	San Jose, Calif.	sputtered
Lin Data Corp.	Santa Clara, Calif.	sputtered
Media Technology Corp.	San Jose, Calif.	plated
Micro Disc (SyQuest Technology)*	Fremont, Calif.	sputtered
Nashua Corp.	Nashua, N.H.	plated
National Micronetics Inc. (formerly Poly-Disc)	San Diego, Calif.	plated
Oktel (Xidex)	Campbell, Calif.	N/A
SAE Magnetics	Santa Clara, Calif. Chatsworth, Calif.	plated
Tandon Corp.*	Santa Clara, Calif.	plated
Tri-Media Corp.	Fremont, Calif.	sputtered
Ultra Disc	San Jose, Calif.	plated
Xerox Magnetics	San Jose, Calif.	plated

*Signifies captive supplier

Source: Freeman Associates

The Interpreter



Media Technology employs a method by which a sputtered overcoat is added to the nickel plating. This overcoat enhances durability and reliability, the company claims. (Diagram courtesy of Media Technology Corp.)

that. Plated media delivered the higher capacities and ruggedness the compact machines needed.

Ampex shipments of plated disks jumped from less than 25,000 in 1981 to 430,000 in 1983. In 1986, Ampex expects to ship 3 million disks from its new \$15 million facility in San Jose, Calif., and another planned facility in San Mateo, Calif., which will produce only sub-5¼-inch platters.

Although Ampex has enjoyed a clear lead—almost a monopoly—in plated-media shipments, it has not entirely cherished the role. In thin-film media, yields and shipments are key, and Ampex has frequently disappointed its customers on both counts, as is often the case when one source has the only game in town. By setting up licensing-fee agreements, Ampex is sharing its technology with fledgling competitors, thereby broadening the supplier base. “It’s a nightmare to be a sole supplier of anything,” says Ed Fleming, general manager of Ampex’s disk media operations division. “It has been our effort to generate competition.” Rather than being apprehensive about the new competitors, he says, “I just hope they get rolling faster than they are.”

The only new OEM supplier out of the starting gate appears to be Domain Technology, Milpitas, Calif. Domain was founded in October 1982 by former Memorex Corp. Media Products Group president Richard Martin and Datapoint Corp. director of technology Frank D. Ruble. The company has \$4 million in venture capital and began shipping products last October.

Other companies preparing OEM shipments of plated disks include a new Xebec Systems Inc. subsidiary, Information Memories Inc., Santa Clara, Calif., headed by Burton Sisco, a co-founder of Evotek. Another disk drive manufacturer, Storage Technology Corp., has

unleashed its captive supplier of 14-inch platters, Media Technology Corp., San Jose, Calif., allowing it to enter the OEM plated-media battle. Similarly, International Memories Inc. has set up a plated-media subsidiary, KSI Disc Products Corp., in Chino, Calif. The list has grown faster than a venture capitalist’s stock portfolio (see Table, Page 129).

Advocates of electroplated thin-film media claim Ampex’s electroless method carries a hazard within its batch process: contamination of the chemicals means contamination of the entire batch. In contrast, the electroplating process, which uses electrical current to coat the surface of the substrate with nickel, can be controlled on every disk. “You’ve got to have superb process control with electroless plating, something that’s not always possible,” says a spokesman for Media Technology. “Although the [electroplate] process is more costly, you buy it back in yields.”

Fleming acknowledges that process control is top priority in the Ampex Alar process. He says Ampex has made a major investment in process-monitoring equipment so that technicians can check every step of the chemical-plating process, both manually and with instruments. Every disk that passes through the line is individually certified, Fleming emphasizes.

Sputtered media enters the arena

Many proponents of plated media believe it is a temporary solution to the density issue. They believe the real answer is sputtered media, a dry, well-controlled but much more expensive process. Unlike plating, sputtering is performed in a vacuum chamber, which eliminates oxygen contamination. The sputtering process needs no lubricants and ends the threat of heads sticking to the landing zone. An outgrowth of semiconductor technology, sputtering is very costly. “Sputtering has always had allure for academic types,” says Fleming, “but it’s not very practical for volume manufacturing.”

However, some of the “academic types” who favor sputtering work in influential corners. Hewlett-Packard Co. announced late last year that it would supply its own sputtered disks for its new line of 5¼- and 3½-inch disk drives (MMS, October 1983, Page 27). Digital Equipment Corp. is experimenting with sputtering processes, as is the most influential disk drive user of them all: IBM.

OEM suppliers of sputtered media are also ramping up. Applied Information Memories, Milpitas, Calif., has announced plans to start manufacturing both sputtered media and disk drives this spring at a facility in Austin, Texas (MMS, September 1983, Page 40). Lin Data

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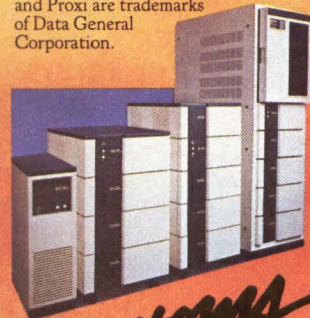
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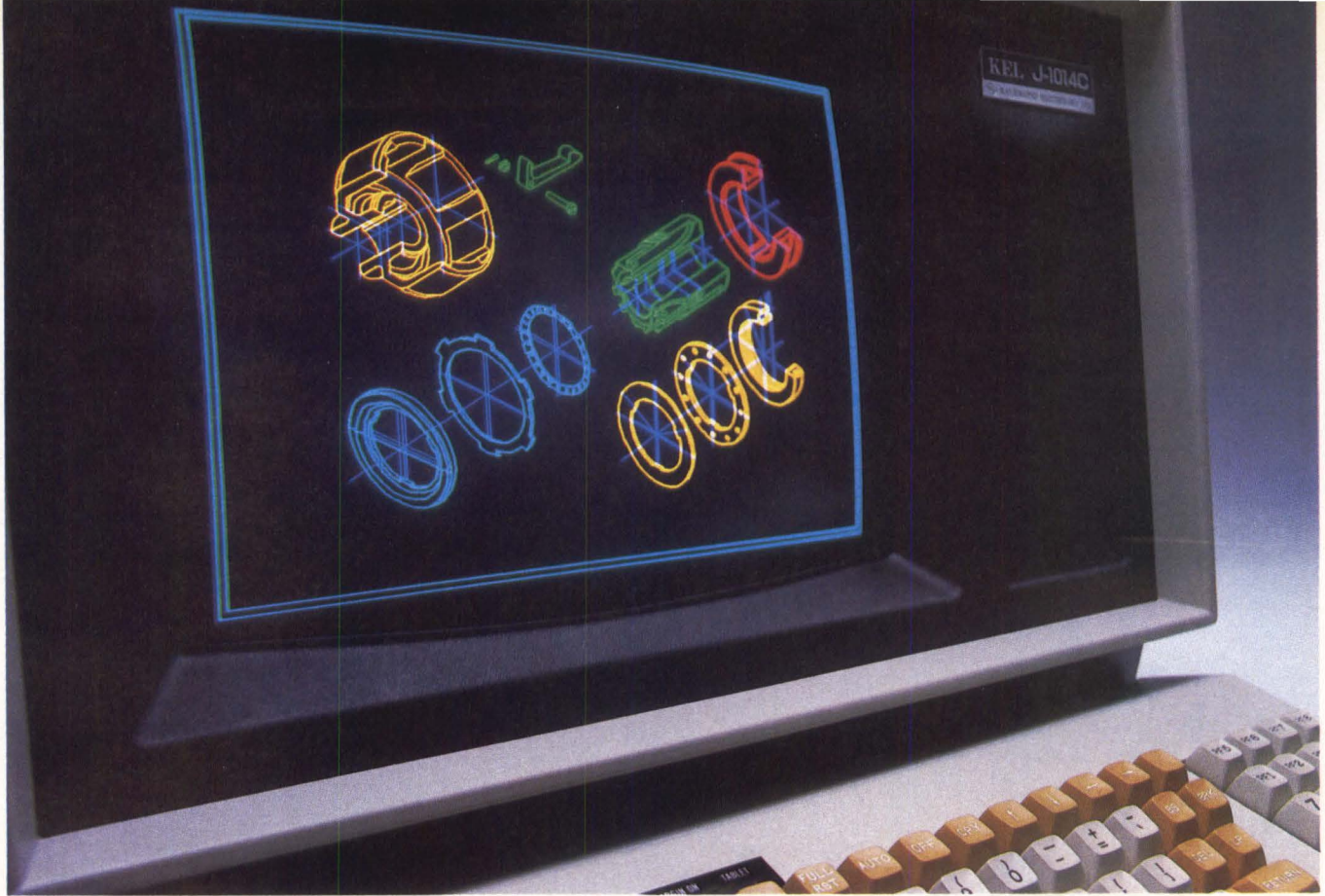
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The Interpreter

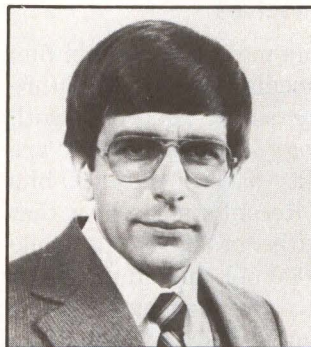
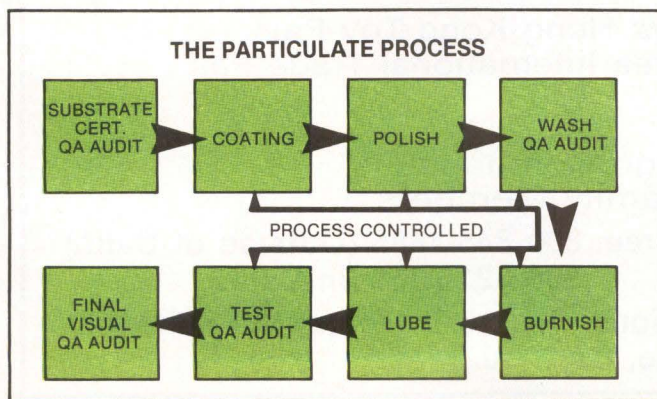
Corp., Santa Clara, Calif., survived a legal challenge from IBM against the company's founder, Young S. Lin, a 16-year veteran of Big Blue's Magnetic Recording Center in San Jose, Calif. The outcome of the challenge was that Lin Data agreed not to use proprietary IBM processes or hire any more IBM employees. Lin Data is now gathering some \$4 million in venture capital to begin producing samples of sputtered media and is preparing for spring production.

The major stumbling blocks to using sputtered media are high entry-level costs and delays in receiving sputtering equipment. Dr. James H. Smith, director of Advanced Media Development at Evotek, which supplies electroplated media for its high-performance, 5¼-inch Winchesters, prefers sputtered to plated media but believes sputtered media's time has not yet come. "When you get over 20,000 flux changes per inch, plated media just won't do it," he says. "However, it will be able to handle the current and next generation of disk drives."

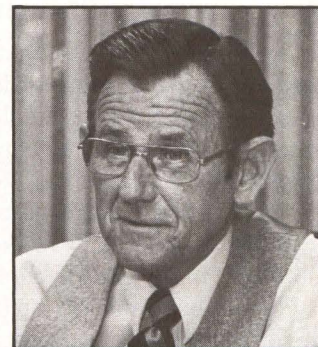
Smith claims that, because so little production equipment to make sputtered media is available, anyone entering the market should be prepared for delays in equipment deliveries. However, Varian Associates, Santa Clara, Calif., a veteran manufacturer of sputtering equipment for the semiconductor industry, reports no inordinate delays.

Richard Lavine, administrator of Varian's magnetic disk project, says the company's new model MDP-100 sputtering machine can produce as many as 180 sputtered disks per hour, depending on the process. The process is fastest for ordinary longitudinally

For four decades, manufacturers have used the particulate process to coat oxide disks. While oxide disks remain the popular choice for 8- and 14-inch platters, they are falling out of favor with smaller form factors. The reduced size and new recording methods for platters measuring 5¼ inches or less often demand higher density than current oxide particles can produce. (Diagram courtesy of Media Technology Corp.)



Oxide media suppliers use the same kind of particles to coat disks today that they used in 1947, says Jim DeStefano, manager of business strategy for Dysan. Using newer particles such as Isomax, developed by Spin Physics, will strengthen the viability of oxide media, making thin-film media unnecessary, he predicts.



Sputtered media will not be required until perpendicular recording becomes commonplace, believes Ed Fleming, general manager of Ampex's disk media division. In the meantime, he says, plated media provides high density in a small package at a lower cost than sputtered media.

recorded disks and much slower for vertically recorded disks, which require greater thickness. The machine costs \$1 million, and Lavine reports that delivery time is only six months. There are at least three other manufacturers of sputtering equipment in the United States and Japan.

James V. DeStefano, manager of business strategies for advanced technologies at Dysan, believes the cost of sputtering machines will probably not decrease, despite increased demand from disk media manufacturers. "Semiconductor technology has already put sputtering machines far down on the cost curve," he says. "It's unlikely that they will drop much further." DeStefano agrees, however, that sputtering is a big improvement over plating because sputtering does not allow contamination of materials and because the sputtered surface melds itself into the coating of the disk instead of into the substrate.

Although Dysan's DeStefano and Ampex's Fleming disagree on every other issue, they both agree that the cost of making sputtered media may push manufacturers to raise prices. If the prices go too high, they may not hold. "The market will determine the ultimate price of the disk," Fleming says, "no matter what the actual cost of making the disk may be."

As a result, Fleming says, some manufacturers of sputtered media will not have big enough profit margins to give them a return on their investments. Disk drive manufacturers will not necessarily be willing to pay a premium for sputtered media, Fleming concludes, since market pressures force them to achieve the highest performance at the lowest cost.

The Interpreter

Manufacturers position themselves

DeStefano maintains that the move toward thin-film media and away from oxide media may be premature because disk drive technology cannot keep pace with advances in coating technology. Today's drives are barely able to break the density barrier of 10,000 bits per inch (bpi), he emphasizes. Recent studies show that oxide media can achieve densities of 32,000 bpi, while thin-film media can reach 44,000 bpi. In addition, new oxide-particle media, such as the Isomax isotropic media developed by Eastman-Kodak Co. subsidiary Spin Physics Corp., can reach densities of 46,000 bpi and may eventually reach 62,000 bpi, DeStefano claims. "What is our economic incentive to go through all of the pain, aggravation and cost of thin-film media, when drive technology is nowhere near ready for it?" he asks.

Although analyst Freeman agrees with DeStefano's analysis, he maintains that Dysan will have to respond to the demand for thin-film media. "It's a real and very large market," Freeman points out. "If Dysan wants to retain its dominant market role, it will have no choice but to respond to the market."

In the meantime, the battle is on to wrest the thin-film media leadership role from Ampex, and Ampex is fighting back. Ampex recently signed a licensing agreement with German-based media giant BASF that allows BASF to make Alar disks. Ampex had previously granted a similar license to Ultra Disc, a subsidiary of Computer & Communications Technology Corp., Santa Barbara, Calif.

Fleming acknowledges that Ampex has had problems in meeting customer demand. "Just one customer, like a Seagate [Technology], could wipe out our total manufacturing capacity," he notes to explain licensing other manufacturers to make Alar disks.

Getting a \$15 million manufacturing facility on-line was no small effort, Fleming admits. Even though the lines are now producing 73,000 disks per month, yields are still not as high as the company would like. "We are still debugging some of the equipment," Fleming adds. "As the equipment improves, the product will improve." Ampex can be sure that its competitors are waiting for any missteps it might make along the way. □

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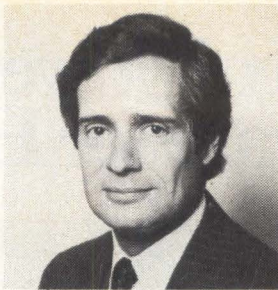
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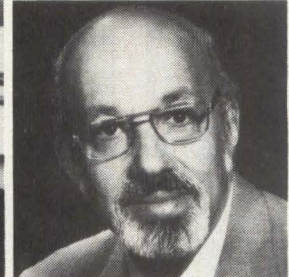
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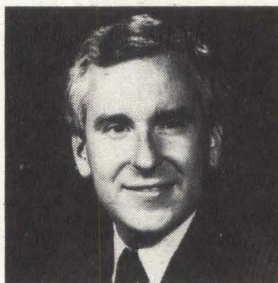
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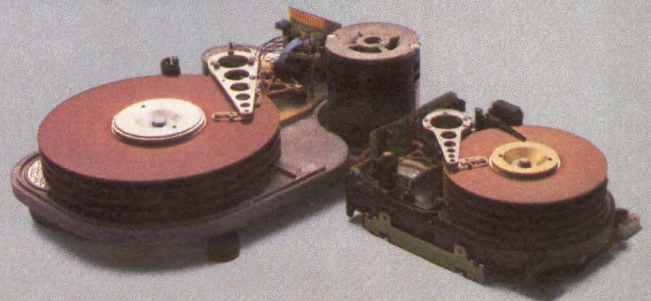
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CIRCLE NO. 75 ON INQUIRY CARD

The Interpreter

An analysis of news, issues and trends affecting the computer industry

Why can't Europe produce computers?

Members of Western Europe's computer industry analyze their failure to compete with U.S. and Japanese manufacturers

Keith Jones, European Editor

Western Europe matches the United States in the production of many traditional commodities—chemicals, steel and motor vehicles, for example. In electronics, production of telecommunication equipment and consumer electronics goods, it compares favorably with that of its U.S. counterparts. But computer manufacturing stands among Europe's least successful industries.

In most sectors of the European computer market, U.S. vendors dominate. IBM Corp. conquered the mainframe market many years ago, and Digital Equipment Corp. and several other U.S. manufacturers took over the minicomputer market soon after. Most recently, U.S. suppliers captured the lion's share of the burgeoning business market for microcomputers. Even in Europe's mightiest industrial citadel, West Germa-

In each of five major European markets, U.S. suppliers of business microcomputers far outnumber those from any other foreign country. Except in Britain, U.S. suppliers outnumber domestic suppliers as well.

Country of origin	Number of suppliers in				
	France	German FR	Italy	Netherlands	United Kingdom
France	26	1	1	2	
German FR	10	43	5	3	4
Italy	2	1	22	1	1
Netherlands	2	3	3	6	2
United Kingdom	10	8	5	9	82
Sweden	1	3		1	2
Other European	2	3	2		
USA	40	71	43	36	55
Japan	14	22	13	12	17
Canada	2	1		1	2
Other	1	2	1		2
Total	110	158	95	71	167

Source: Logica UK Ltd.

ny, U.S. vendors dominate most market sectors; IBM has a stronger hold over the mainframe market there than it does in many other parts of Europe.

A few exceptions counter otherwise complete U.S. domination of Europe's computer market. Nixdorf Computer A.G. is a formidable contender in West Germany's small business systems market. Britain's ICL Plc. retains most of its domestic mainframe base despite fierce competition from IBM. France boasts an impressive computer services industry. And Italy is home for Olivetti SpA, one of the few European-based companies to have a significant presence in most parts of Western Europe.

National boundaries fragment the market

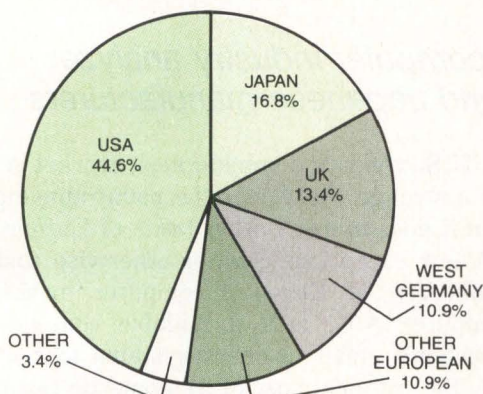
Unlike Olivetti, most European-based computer manufacturers sell a majority of their products within the boundaries of their own countries. Industry observers identify this market fragmentation as perhaps the biggest obstacle to the manufacturers' success. "People talk about the United States of Europe, but there is no such thing," remarks microcomputer market analyst Gordon Curran, a director of Intelligent Electronics, Paris. "Success in one country is not good enough. Bigger American vendors can spend far more money on advertising and distribution than European manufacturers." Curran cites language barriers and the non-existence of European-wide distribution and maintenance companies as two obstacles keeping European companies from growing big enough to compete effectively with U.S. competitors.

A study done by Logica UK Ltd., London, entitled "Telematica 1984," confirms the dominance of U.S. microcomputer vendors. Logica UK consultant Stephen Timms points out that U.S. vendors outnumber European suppliers in every European country. "U.S. companies are first with the technology," Timms declares. "The investment [in a new technology] is too large for small European companies, while big European manufacturers take a long time to realize the significance of a technology."

The fragmented European market also discourages investment from venture capitalists, the entrepreneurs

The Interpreter

COUNTRY OF ORIGIN OF BUSINESS MICROCOMPUTER SUPPLIERS IN WESTERN EUROPE, 1983



SOURCE: LOGICA UK LTD.

U.S. manufacturers claimed three-quarters of the 1983 installed base for business microcomputers in Western Europe, leaving European suppliers with less than a quarter. In its study entitled "Telematica 1984," Logica UK Ltd. estimates that the installed base for business microcomputers in 1983 was 752,000 machines.

MANUFACTURERS' SHARE OF 1983 INSTALLED BASE OF BUSINESS MICROCOMPUTERS

Manufacturer	Market share %
Apple	19.2
Commodore	18.7
IBM	9.8
Olivetti	7
Victor	6.5
Hewlett-Packard	4.6
Intertec	3
Tandy	2.8
Digital	2.4
Bull	2.1
Televideo	1.9
Xerox	1.9
Triumph Adler	1.5
Comart	1.2
Burroughs	0.8
Other	16.6
Total	100

Source: Logica UK Ltd.

U.S. suppliers accounted for nearly half the companies selling business microcomputers in Western Europe in 1983. In contrast, all European suppliers combined accounted for just over a third. (These statistics include only those suppliers that sell products in at least two countries in Western Europe.)

who nurture so many successful U.S. computer companies through their formative years. Venture capitalist Peter Dicks, a director of Abingworth Ltd., London, explains how differences in the U.S. market make it easier for new companies to develop there: "The United States is a vast domestic market; a company can grow without having to export in its early life." Even though Abingworth is based in London, it primarily backs U.S. enterprises.

Another London venture-capital house, 3i Ventures, directs most of its investments toward British companies because its funds come from leading British banks, including the Bank of England. But 3i director Geoff Taylor explains that his organization still puts about one-third of its money into U.S. high-tech companies and has just opened an office in Newport Beach, Calif. This allows 3i to keep in touch with developing technology and to maintain a U.S. presence that can help establish British companies there.

Taylor believes that innovative British companies can grow as fast as young U.S. enterprises by ignoring Continental Europe and entering the huge, homogeneous U.S. market instead. "The biggest advantage we can offer a British company is to help them get into the U.S. market," argues Taylor. "Continental Europe is not a major market for a young British company to go after. It is not a Common Market; it is six to 10 individual markets and is very fragmented."

OTC stock markets spur venture capital

Dicks and Taylor both credit an American-style over-the-counter (OTC) stock market established a few years ago with improving Britain's venture-capital environment. "An OTC market enables a young company to go public early in its life," explains Dicks. "This puts a value on the investor's holding and makes the investor some money."

The French also set up an OTC, called the Second Marché, in January 1983 and passed legislation similar to that in the United States to facilitate setting up venture funds and allow low capital gains taxes. A company can go on the Marché after only three years. Alan Patricof Associés SARL, Paris, set up the first venture-capital fund last June.

The European climate for venture-capital formation also contrasts with that in the United States, say Dicks and Taylor, in that talented people in the United States seem more willing than their European counterparts to risk leaving a large company to start a new enterprise. Not only are U.S. entrepreneurs attracted by the promise of rewards in the OTC market, but also they are encouraged by the success of others, Taylor

believes: "Managers in the United States these days know other people like themselves who have succeeded in their own businesses—so there has been a snowball effect."

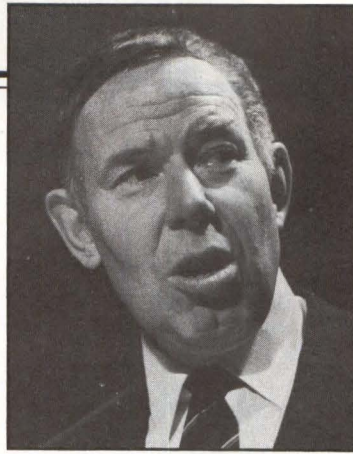
Carlo de Benedetti, chairman of Olivetti, underlines the importance of venture capital in the success of new U.S. companies. Speaking at a London conference last year sponsored by Britain's leading business newspaper, the *Financial Times*, he cited a study of 72 U.S. companies that were started with venture capital. They required \$200 million in venture funding from 1970 to 1979, but by 1979 they employed 130,000 people and had generated revenues of \$6 billion. De Benedetti also sees European OTCs as a prerequisite for increased venture-capital activity in Europe.

Government-funded research holds promise

The Common Market, run by the European Commission (EC), targets publicly funded strategic research as the long-term cure for Europe's computer malady. The EC plans to spend \$750 million over the next five years on the European Strategic Program of R&D in Information Technologies (ESPRIT) program. The program's goal is to put European companies in the race with the United States and Japan to develop fifth-generation computing technologies. Participating companies will match the commission's contribution, boosting total funding to \$1.5 billion. (MMS, July 1983, Page 81).

To qualify for funds, companies must form consortia with companies from at least two Common Market countries. The Common Market believes that the "pre-competitive" nature of the research should eliminate tensions between participants. Thus, the Common Market will try to avoid the problems it encountered in an ill-fated attempt at Pan-European computer industry cooperation in the early 1970s. The project tried to create Unidata, a company on the scale of IBM, which would have merged the computer product lines of Siemens A.G., West Germany, multinational company N.V. Philips, the Netherlands, and an ancestor of the Bull Group, France. Plans called for each company to manufacture computers for one product line and to sell the entire line. Unidata crashed when the French government decided that a trans-Atlantic accord was more promising and merged the French operation with Honeywell Inc., Minneapolis, to form Cii Honeywell Bull.

National interests have not yet killed ESPRIT, but they did delay final approval of its funding. Problems grew out of a disagreement among member countries about contributions to the overall Common Market



Rather than pursue the fragmented European market, British disk drive supplier Rodime Plc. focused its efforts almost immediately on the U.S. market, explains director of marketing Malcolm Dudson. Dudson credits this strategy with Rodime's success.



"The biggest advantage we can offer a British company is to help them get into the U.S. market," asserts Geoff Taylor, divisional director of London venture capital house 3i Ventures. To do this, 3i set up an office in California and invested a third of its funds in U.S. high-tech companies.

budget, of which ESPRIT's costs account for only a fraction. Far from concerning the future of high technology in Europe, the dispute centered on the Common Market's massive agricultural subsidies.

Some members of Europe's computer industry view ESPRIT with skepticism. The Association of European Independent Information Industry (AEIII), a group of small- and medium-sized manufacturers of computer peripherals and small systems, believes that large companies will get most ESPRIT funds. AEIII members claim that the commission is too preoccupied with ESPRIT to consider funding a board of experts to identify and investigate those peripheral technologies European manufacturers should develop. Such a board could help European manufacturers recapture local markets for disk drives, printers and other items now dominated by U.S. and Japanese vendors.

AEIII spokesman Donald Willis complains, "The Common Market recognizes peripherals as a critical area, but it is too tied up with ESPRIT at the moment. We will have to wait until the end of 1984 for something to happen." European suppliers' technical expertise is far behind that of their U.S. competitors, he believes. As evidence of the problem's severity, he points to licensing agreements that European peripheral builders must negotiate with U.S. companies to manufacture products that incorporate the latest technological advances.

Don Toombs, consultant with the European arm of consulting company The Yankee Group, Boston, voices

The Interpreter

even stronger criticism of ESPRIT. In analyzing measures European companies might take to survive in the potentially huge office automation market, he concludes, "ESPRIT will not get Europe into office automation; Europe needs a marketing strategy—not more technology."

Europe fares well in telecommunications arena

Despite these shortcomings, the EC is taking one practical step toward creating a more homogeneous market in Europe by encouraging Pan-European telecommunications standards. Europe's common carriers cover only one country each, and most are publicly owned. The EC wants to standardize end-to-end digital communications between terminal equipment.

One area of incompatibility is teletex, a standard for message interchange. Some carriers plan to use packet-switched networks to carry teletex messages, while others favor circuit-switched networks. This year, the 26 members of the Conférence Européenne

des Postes et de Télégraphes (the Conference of European Postal and Telecommunications Authorities) took a step toward greater uniformity by agreeing to the EC's goal of standardization.

Olivetti's de Benedetti stresses the advantage of cooperation between common carriers and believes that Europe must become a "wired continent like its American neighbor," supporting innovative value-added networks. He argues that government-owned telecommunications authorities are too protective of their domestic markets, delaying innovation rather than acting as leading edge customers for products such as private automatic branch exchanges. De Benedetti also believes that Europe's last chance to claim a leading position in the information technology industry may rest on its performance in the office-automation market.

European companies are keeping up with U.S. companies in awareness of one key technology in the office automation arena: local-area networks (LANs).

Two successful British companies stand out as exceptions

The huge, homogeneous U.S. market enables young U.S. computer companies to get big quickly before they tackle the fragmented European market. Two European companies can attribute their success to following this strategy themselves: at a very early stage in their development, they established the United States as their main market. The two companies are Winchester disk drive builder, Rodime Plc., Glenrothes, Scotland, and vendor of COBOL programming tools for microcomputers, Micro Focus Ltd., Newbury, England.

In 1979, when Micro Focus was still tiny, co-founder Paul O'Grady moved to the United States, where he chalked up OEM deals with major computer manufacturers, including Digital Equipment Corp., Intel Corp. and Convergent Technologies Inc. O'Grady believes that Micro Focus Inc., the U.S. arm of the company, based in Palo Alto, Calif., is as American as any company that originated in the United States, even though product development for Micro Focus still takes place in England. Although Britain represents the biggest segment of the European market for microcomputer products, O'Grady maintains that Micro Focus would

have blundered by relying on Britain as an adequate base for growth: "No microcomputer company can survive just in Britain, because it cannot achieve the size and momentum of a U.S.-based company. So we made the United States our home market." He advises other European companies to follow suit but cautions, "it is absolutely essential [that the companies] send out their very best people."

"Heroic" is the word Rodime director of marketing Malcolm Dudson uses to describe Rodime's decision to sell its disk drives in the United States. "But we had to do it; the European market is not big enough," he concedes. Rodime set up a U.S. sales office—now based in Mission Viejo, Calif.—in 1981, about a year after the company started.

Sales generated in the United States now account for the lion's share of Rodime's revenues. U.S. customers include Compaq Computer Corp., Houston, which is expected to buy \$20 million worth of Rodime's 3½-inch Winchesters this year, and TeleVideo Systems Inc., Sunnyvale, Calif., which has contracted to buy \$50 million worth of drives. To consolidate its success, Rodime built a manufacturing facility in Boca

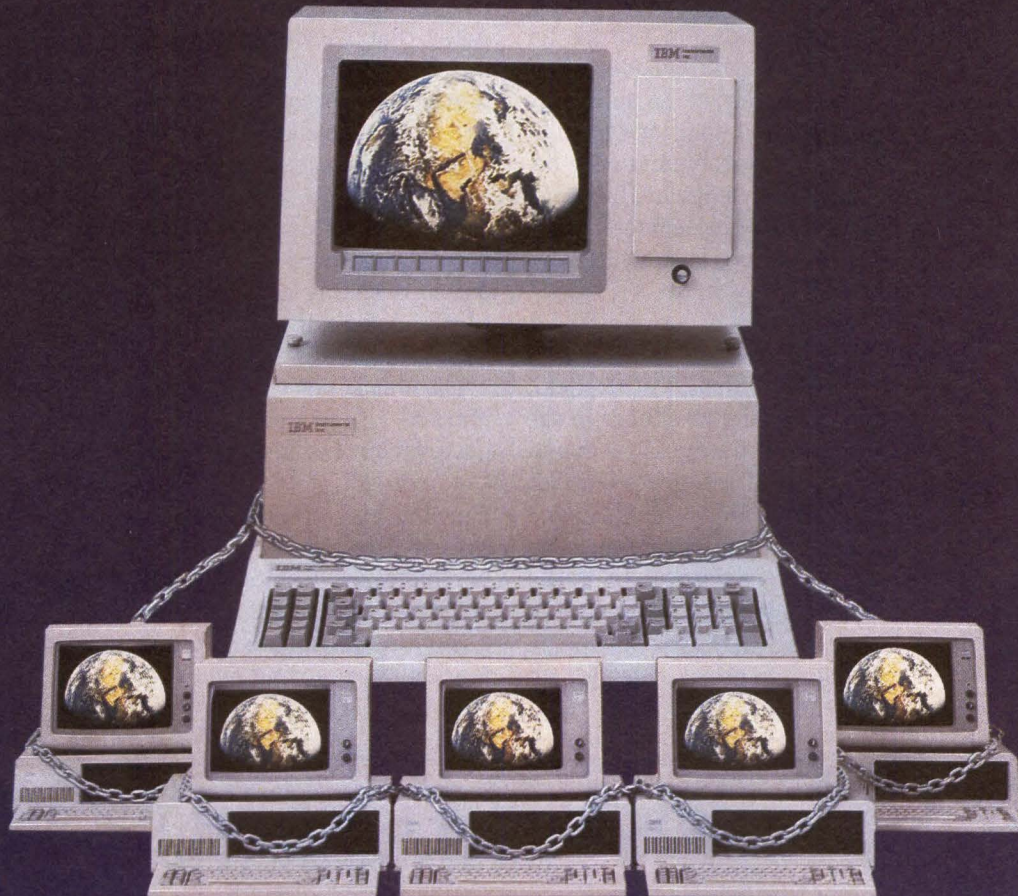
Raton, Fla., conveniently close to the personal computer plant of a huge potential customer: IBM Corp.

Aside from their decisions to enter the U.S. market, both Micro Focus and Rodime have other ingredients for success. Both launched the right products at the right time, and both primarily addressed the OEM market, which requires smaller sales and marketing investments than entering the end-user market would have. But both companies insist that an early and powerful U.S. debut was vital to their success.



Rodime Plc.'s manufacturing plant in Glenrothes, Scotland, can't turn out Winchester disk drives fast enough to meet U.S. demand for them. Rodime dealt with its success in the U.S. market by building a manufacturing facility in Boca Raton, Fla.

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CIRCLE NO. 76 ON INQUIRY CARD

The Interpreter

Logica consultant Sarah-Jane Austin sounds an optimistic note in her study of data networking in Europe for "Telematica 1984." She reveals that European computer manufacturers possess the expertise to integrate LAN technology into overall system solutions to their customers' information processing problems. She believes that European suppliers' knowledge of European requirements for telecommunication interfaces gives them an advantage over U.S. vendors in reaching this market.

Integrated-circuit makers raise obstacles

In contrast to strength in the communication field, European companies display a serious weakness in the key area of advanced integrated circuitry. U.S. manufacturers supply most of Europe's integrated-circuit (IC) market. To explain the superiority of U.S. and Japanese IC suppliers, observers point to the massive government-funded space and defense programs in the United States and government support of industry in Japan.

Gunther Moeller, secretary general of Eurobit, an

association of European computer manufacturers, notes that European IC companies failed to catch up despite the 17 percent tariff imposed by the Common Market to protect local suppliers from overseas competition. Moeller dismisses the tariff as nonsense because tariffs on printed-circuit boards that include mounted chips are only 5 percent, and tariffs on complete computer systems are only 6 percent. Rather than protecting European IC manufacturers, the high tariff on chips simply adds to European computer manufacturers' costs and may force them to transfer manufacturing to countries outside the Common Market.

Eurobit is not the only group lobbying the Common Market to reduce its tariffs on ICs; the British government has also declared its intention to press the Common Market for a reduction. In the meantime, Eurobit and other groups that purchase chips will suffer. Moeller reports that Eurobit can sometimes persuade the Common Market to suspend tariffs on advanced chips unobtainable from sources in Europe. Even then, chip manufacturers within the Common Market voice strong opposition. □

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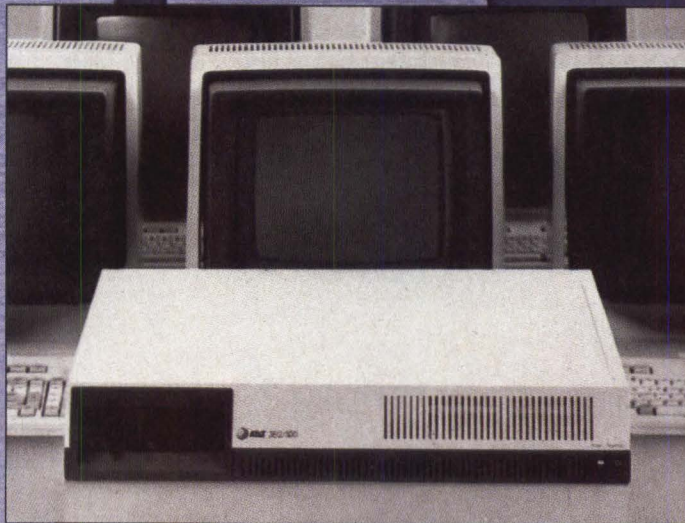
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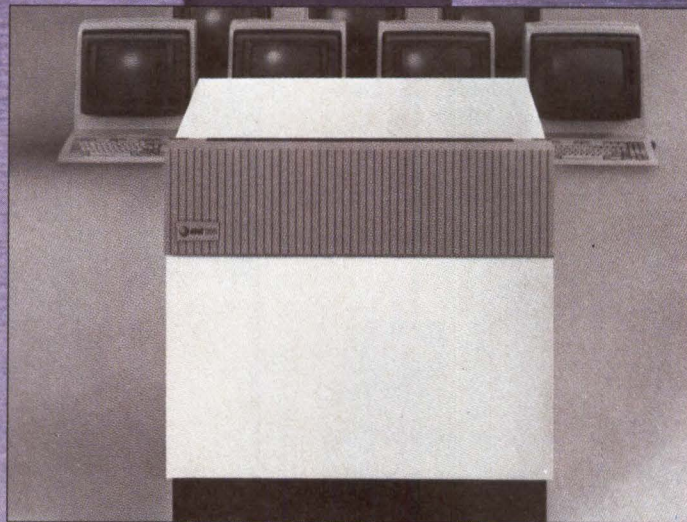
It incorporates 256K DRAM chips for high-capacity main memory of up to 2 megabytes. So more is delivered than with the average microcomputer, and at a lower cost per station.

It's the 3B2/300. From AT&T.

Perfectly targeted for an office where several people need a desk-top computer, and there's a need to accommodate growth. And it can function as an intelligent network host or file server for PCs.

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3B5

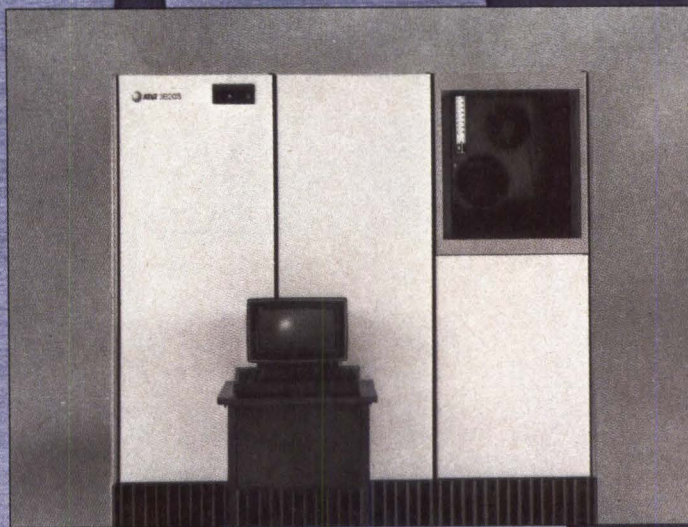
These general-purpose, midrange, true 32-bit, super minicomputers are designed to run UNIX System V and can accommodate up to sixty users without putting a dent in response time.

They are remarkably easy to use, and easy to maintain because they are self-diagnostic. They are flexible, powerful tools for a variety of applications, such as software development, office systems, and CAD/CAM.

They're the 3B5/100 and 3B5/200. From AT&T.

They can be configured to suit customer needs with a wide variety of I/O, peripheral, memory, and communications options for cost-effective growth. This makes them good investments for your customers.

These computers fit neatly into the office environment. And are incredibly quiet, cool, efficient, and plug into standard wall outlets.



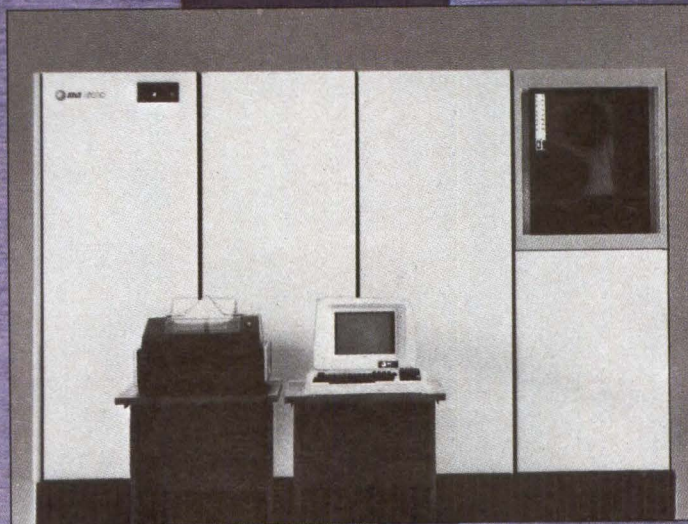
3B20S

The 3B20S computer is the high-end supermini of the 3B family. It runs UNIX System V and is designed to meet the rigorous needs of data centers, developers, office service organizations, and manufacturing locations.

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And the growth from the 3B20S to the 3B20A occurs as painlessly as possible with only a modest increase in cost.

Both computers are energy efficient and easy to install. They perform without complex and expensive environmental controls. And unlike most computers of this capacity, the 3B20S and the 3B20A do not require air conditioning or raised floors.



3B20D

It is a powerful, 32-bit super minicomputer that will set a new standard for uptime. It runs the new UNIX RTR operating system, providing time-sharing and introducing real time and fault-tolerant features.

It operates continuously even during hardware faults, data-base mutilations, repair, software updates and growth.

It is the 3B20D. From AT&T.

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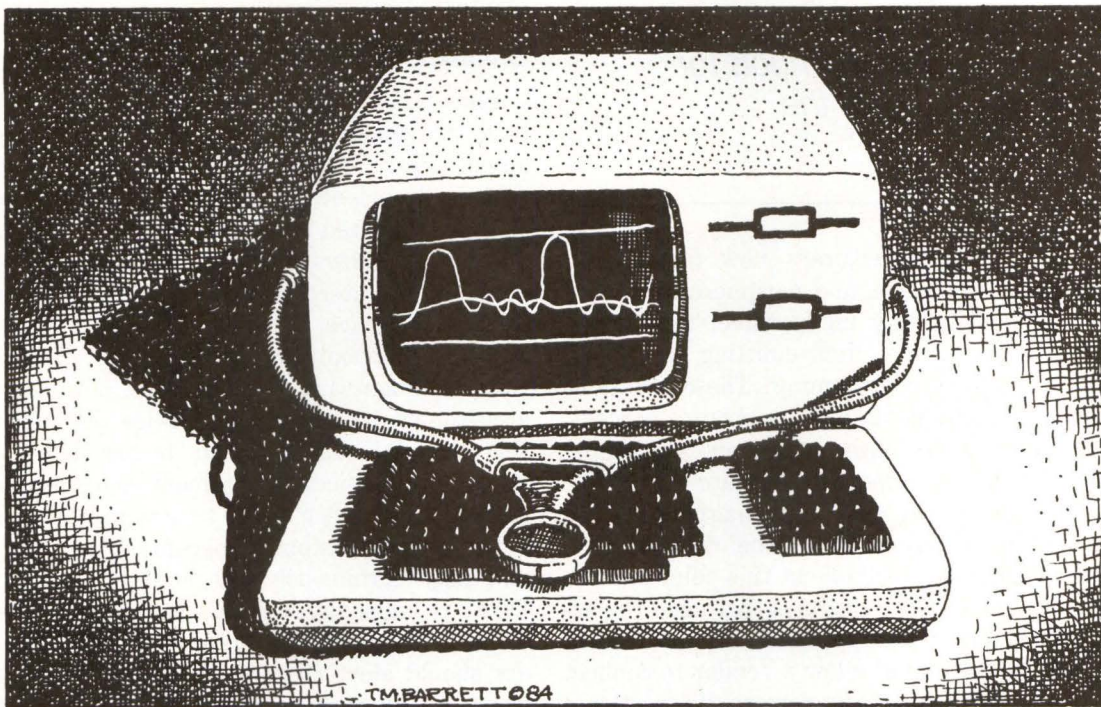


Illustration by Tom Barrett

George Fink, Data Systems Design

As hardware prices decrease, the percentage of service cost to hardware cost is increasing. According to some estimates, 35 percent of computer-ownership costs can be attributed to service, and that figure is moving toward 50 percent. Indications are that system buyers will not be willing to pay this much for service.

Traditional service has disadvantages

Consequently, computer manufacturers, OEMs and system houses are looking for a cost-effective alternative to traditional direct and third-party service. Direct service, for example, entails high overhead. It requires full-time personnel, training programs, diagnostics equipment, staff travel costs and possibly nationwide or

worldwide service centers. In addition, as a supplier's market base expands, a system supplier may lack the resources for maintaining a large service organization to provide timely customer response.

Third-party service also has disadvantages. With some third parties and some levels of service, customer costs can closely approach those of direct service. An uneven level of service is also common when third-party service personnel haven't received sufficient training in a supplier's products. And it is difficult for the supplier to monitor service accurately when service reports get filtered through a third-party organization.

A third-party service organization must also support *all* the companies it represents—often a difficult task even with a large staff. The organization thus may not be able to give timely response to customer-service

The Integrator

requests at peak times or in areas where local demands are high. Even if diagnosis is rapid, the organization may lack the spare parts to make repairs.

Hardware costs rise only slightly

Taking advantage of microprocessor power and the low cost of peripherals and small systems, a number of small companies in national markets are providing an alternative form of service that combines remote and on-board diagnostics, customer self-help and module

Indications are that system buyers will not be willing to pay as much for service as they pay for the equipment itself.

replacement. Some manufacturers now include on-board diagnostics in systems and peripherals. Adding the diagnostics is relatively inexpensive, usually requiring only a few switches, light-emitting diodes and some extra microcode programming. These additions typically increase equipment costs by about 5 percent.

When problems arise with equipment containing on-board diagnostics, customers can initiate the service operation themselves by running diagnostics and contacting the manufacturer with the results. Frequently, the information available at this point enables the manufacturer to identify modules that need replacing. In an extension of this approach, some systems contain built-in modems that allow a vendor to connect a terminal via telephone and run remote diagnostics.

A critical service element is equipment modularity, which allows for rapid module replacement. The many reliable, overnight-delivery services make replacement extremely cost-effective.

Alternative service saves money

On-board diagnostics offer a distinct financial advantage, appreciably lowering customers' service costs. Even with overnight delivery charges and the 5 percent increase in hardware costs, the cost to include diagnostics is minimal compared with the expense of supporting direct or third-party service. The approach can also shorten repair times; even when a technician is on-site, problem analysis without on-board diagnostics can be time-consuming.

This alternative service also eliminates some problems that plague traditional forms of service. For example, because on-board diagnostics don't depend on

field-service personnel, high travel costs, slow response times and the problems of maintaining a consistent level of service virtually disappear. The only limiting factor is the number of phone calls requesting module replacement that a vendor can handle.

On-board diagnostics provide other direct benefits. They can help troubleshoot boards in the manufacturing and testing process before shipping. At a customer site, built-in diagnostics aid the incoming-inspection process; units with built-in diagnostics can often be tested without interfacing to a computer terminal or printer.

On-board diagnostics aren't for novices

Like other forms of service, on-board diagnostics have drawbacks that users must weigh against the advantages. For example, although they're effective for technically oriented users, OEMs and system houses, they are unsuited to unsophisticated end users. Vendor experience shows that end users have neither the training, the interest nor the confidence to use self-help computer service.

Even technically sophisticated customers have some concerns about this type of service. For example, users accustomed to traditional service are often unaware that modules can be "dead on arrival" (DOA). In a traditional service arrangement, the supplier's service staff would screen such occurrences. In a self-help arrangement, customers become more aware of DOAs and may erroneously conclude that the number of DOAs is unusually high. Consequently, when customers select a self-help and module-swap service, suppliers should alert them to the fact that initial failures won't be masked as they are in other service and installation methods.

Service alternatives keep evolving

The industry may see even further evolution in service alternatives. On-board modems, for example, will increase the trend toward remote problem debugging by factory technicians and engineers. A local technician—and ultimately a master diagnostic computer—might also be added to the debug loop. For now, one trend is clear: more OEMs and system houses are opting for economical alternatives to the ever-rising costs and personnel requirements of traditional service forms. □

George Fink is executive vice president of marketing at Data Systems Design, San Jose, Calif.

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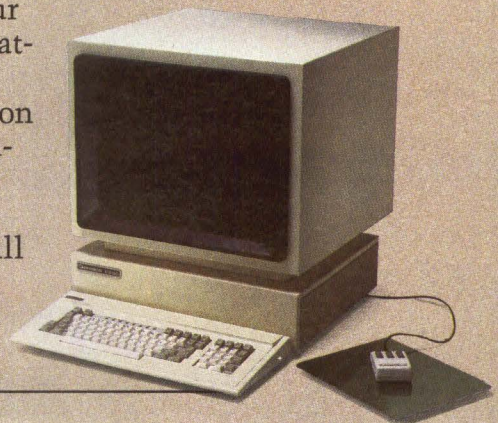
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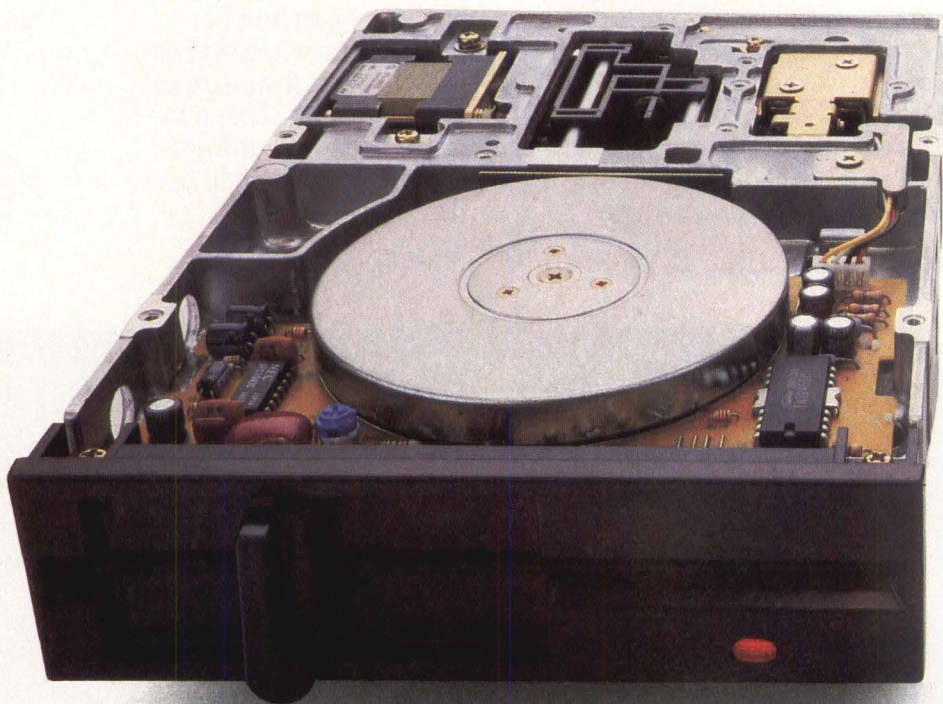
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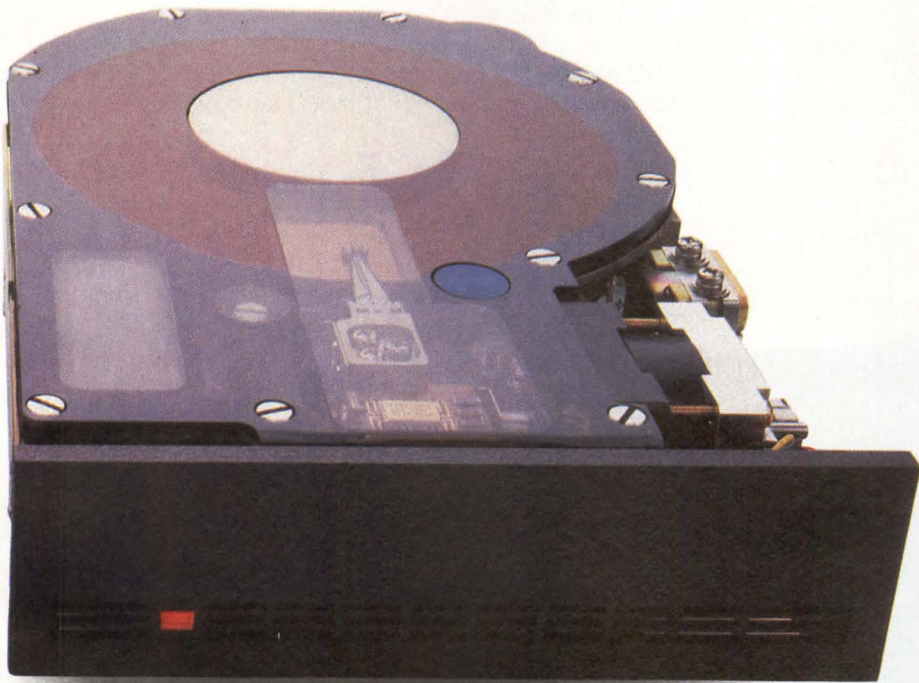
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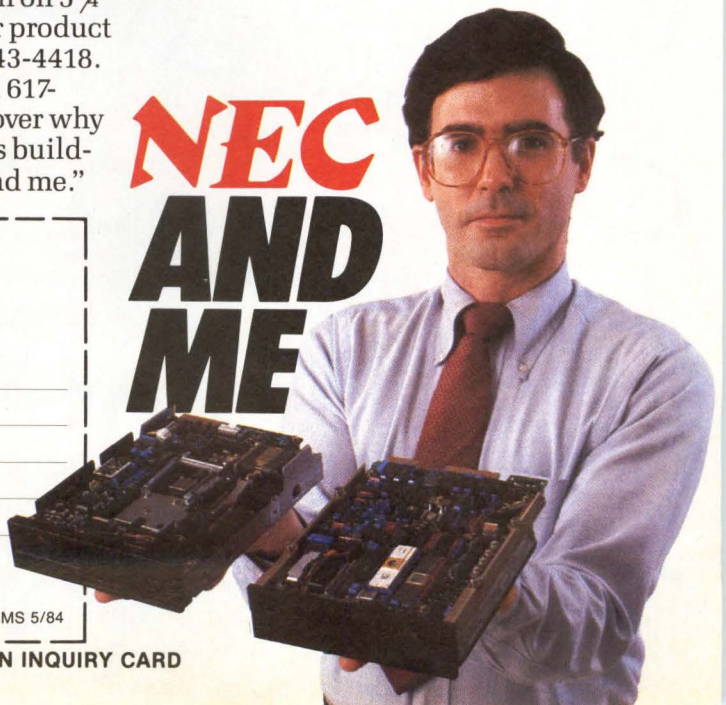
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Transportable operating system promotes network benchmarks

Able to run on eight popular local-area networks, the NetWare file-server operating system acts as a benchmark for testing performance

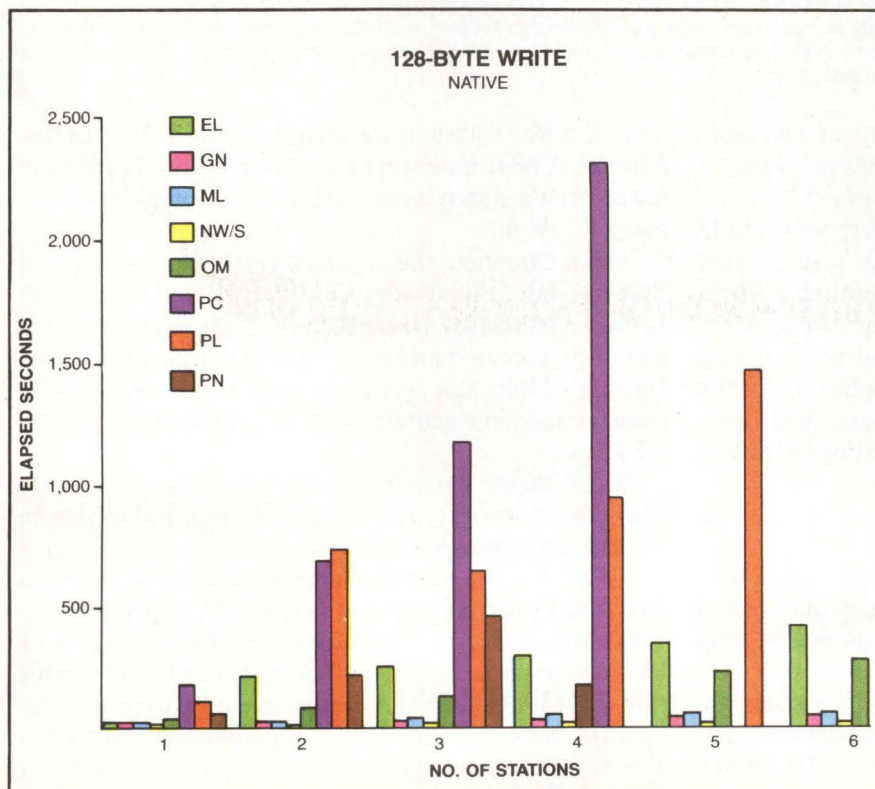
Ray Noorda, Novell Inc.

Without a controlled high-level software environment, no common ground exists to assess basic local-area network (LAN) performance. As a result, there have been few accurate benchmark tests of popular LANs. For that reason, Novell Inc., Orem, Utah, began a series of benchmark tests on eight major LANs. Novell used its NetWare file-server operating system to compare the LANs performance in speed, functionality, usability and security. This article discusses Novell's first LAN benchmark study, which compared the speeds of several popular LANs.

To allow valid comparisons of LAN performance,

Novell replaced the native operating systems of several commercial networks with its NetWare software for file-server management. The test team implemented the NetWare data server on IBM Corp.'s PC and PC XT computers. The data server ran using NetWare products for the Novell LAN and those of seven other manufacturers.

The team installed each network according to manufacturers' instructions and set up the networks as an average user would. They also refrained from fine-tuning the NetWare products to improve test results. To keep test conditions constant, the team used IBM PCs or work-alikes as network stations wherever possible and used an IBM PC XT as a data server. The



The time required to write 100 128-byte records 10 times differed considerably for networks tested. Note that no bars exist for PAXnet with four to six stations and that none exist for PCnet with five or six stations. These networks experienced "drive x: not ready" errors while attempting to service the higher number of stations and could not complete the test.

Key to graph legends

EL = 3Com EtherLink
GN = Gateway G-Net
ML = Davong Multi-link
NW/S = Novell Star + NetWare/S
OM = Corvus Omninet
PC = Orchid PCnet
PL = Nestar PLAN 2000
PN = Proteon proNET

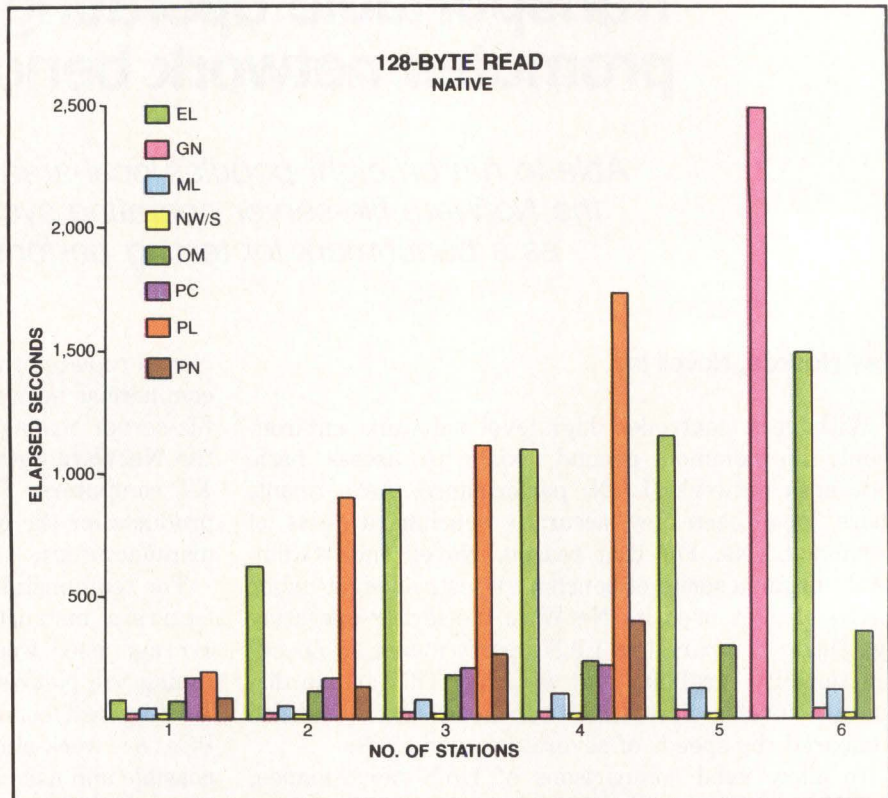
The Integrator

LAN benchmark test backgrounds

To test eight major local-area networks (LANs), the Novell Inc. test team wrote test programs in MicroSoft BASIC and then compiled them with the MicroSoft BASIC compiler for speed. To draw graphs, they used SuperCalc3, a Hewlett-Packard Co. plotter and a Compaq Computer Corp. computer.

NetWare tests were conducted with both dedicated and multipurpose servers. Only the results and price performance for the dedicated server are shown.

To obtain more detailed information about these LAN benchmark tests, write to Novell Inc., 170 N. Industrial Park Drive, Orem, Utah 84057, on your company's letterhead.



The time required to randomly read 1,000 records from the file created by the 128-byte write test appears in this graph. Note that PAXnet and PCnet experienced "drive x: not ready" errors while attempting to service five and six stations simultaneously and could not complete the test.

PC XT has a hard-disk drive, which makes it a suitable shared resource. The personal computers used as stations ran the MS-DOS 2.0 operating system.

Because most LAN suppliers offer their products in specific price/performance categories, test results should indicate which networks are best suited to which applications. Ranking and evaluating throughput makes it easy to establish the relative cost/performance benefits of the networks for specific applications. The information will help users select products and draw reasonable conclusions about implementations of different LAN topologies and access schemes.

Networks exhibit a range of features

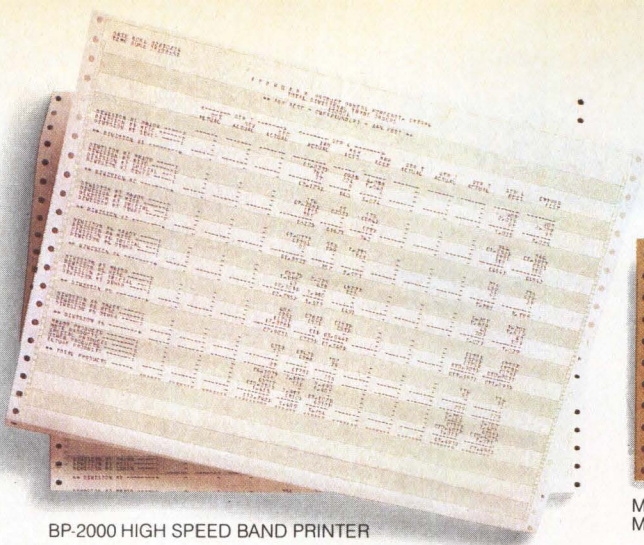
Omninet, from Corvus Systems Inc., San Jose, Calif., operates with Constellation II software and has a bus-type architecture that can support as many as 64 nodes over a maximum distance per link of 4,000 feet. Passive links can be as long as 1,000 feet. Twisted-pair RS422 wiring serves as the physical transfer medium. The network supports a data-transfer rate of 1M bit per second (bps) and employs a carrier sense multiple

access with collision avoidance (CSMA/CA) access scheme. A 6801 microprocessor from Motorola Inc. and fewer than a dozen additional devices complement the network circuit.

Unlike Omnet, the ARCnet network from Davong Systems Inc., Sunnyvale, Calif., based on the ARCnet LAN developed by Datapoint Corp., employs a token-passing access scheme. ARCnet operates with Davong's Multi-link software, uses coaxial cable as its transfer medium and supports a data-transfer rate of 2.5M bps.

PLAN 2000, made by Nestar Systems Inc., Palo Alto, Calif., incorporates a topology identical to that in the Davong approach.

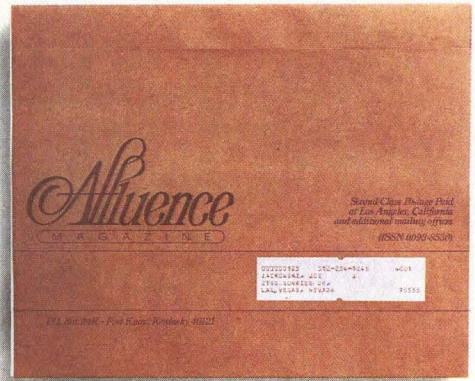
G-Net, from Gateway Communications Inc., Santa Ana, Calif., can connect as many as 255 nodes as far as 4,000 feet apart on one bus using RG-59, RG-11 or RG-62 coaxial trunk lines. The system's data-transfer rate is 1.43M bps, and its access scheme is carrier sense multiple access with collision detection (CSMA/CD). The G-Net system does not have a native operating system other than NetWare.



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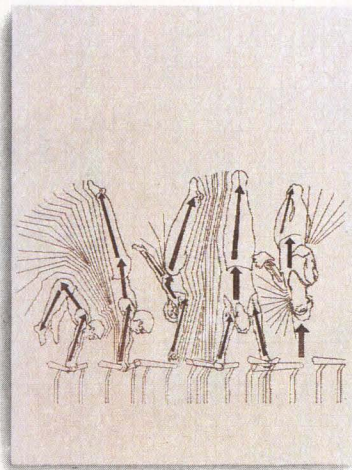
M-100L MATRIX PRINTER



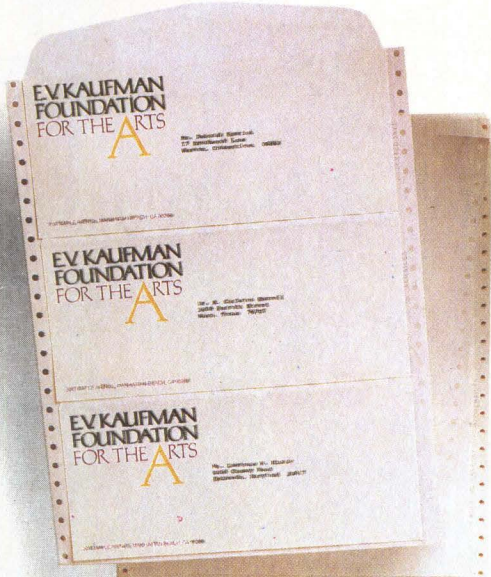
B-600 MEDIUM SPEED BAND PRINTER



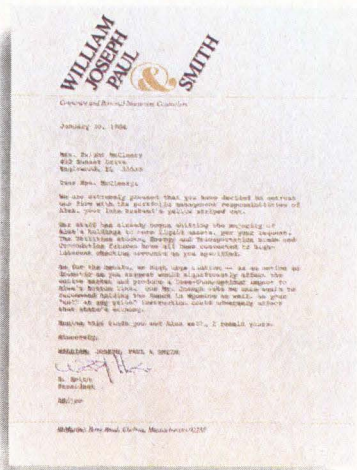
P-80 MATRIX PRINTER



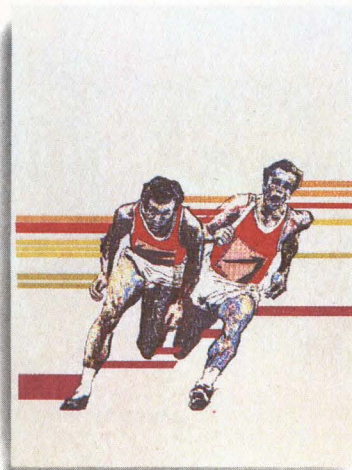
MODEL 480 MATRIX PRINTER



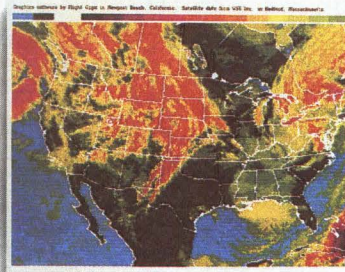
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Like the Ethernet LAN standard from Xerox Corp. on which it is based, the EtherLink network from 3Com Corp., Mountain View, Calif., furnishes a 10M-bps data-transfer rate and employs coaxial cable for station-to-station links. EtherLink uses the EtherSeries operating system and a CSMA/CD access arrangement.

The Novell network employs a star topology using the Netware/S operating system with a dedicated MC68000-based data server at the center of the star. As many as 24 personal computers can share the data server. Each station can be as far as 3,000 feet from the server, connected by twisted-pair lines.

Produced by Orchid Technology, Milpitas, Calif., PCnet has an operating system of the same name. The bus-based system links workstations to 75-ohm RG-59 coaxial cable. Nodes on the network can be as far apart as 4,000 feet, and links can handle a 1M-bps data rate.

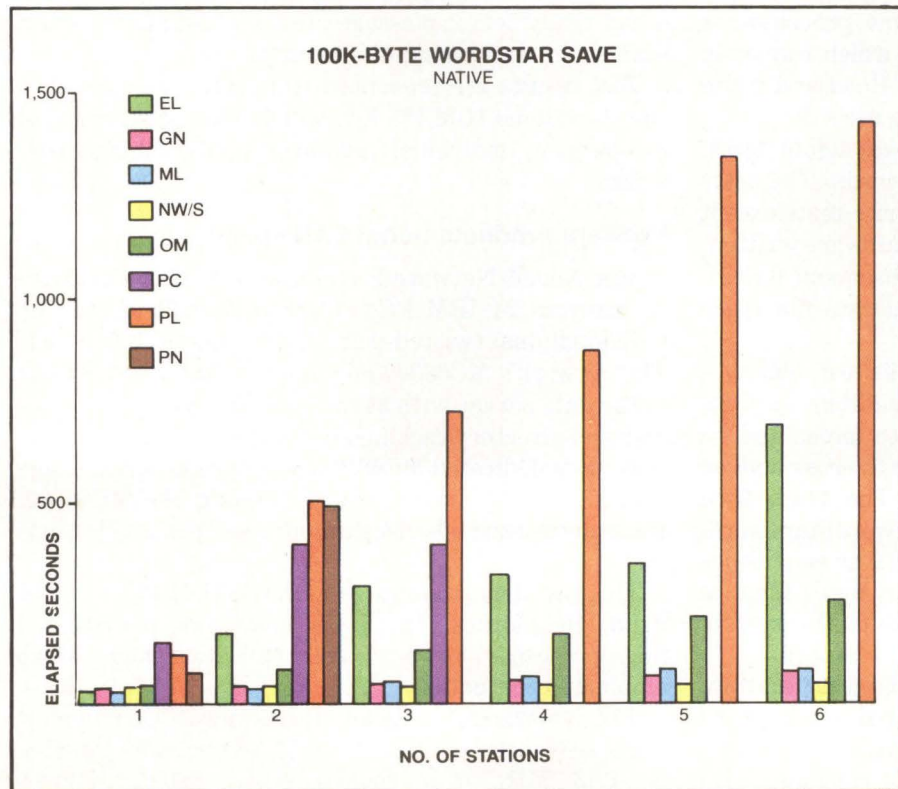
An unusual architecture is incorporated in the proNet network from Proteon Associates Inc., Waltham, Mass. This network uses the PAXnet operating system and employs a duplex path that connects devices to a local wire center. Wire centers are connected with duplex lines to form a string-of-stars configuration. Wire centers can handle eight or 16 nodes. The proNet data-transfer rate is 9.94M bps, and the transfer medium between wire centers can be coaxial cable, twin-axial cable, optical fiber or infrared

or microwave links. The last three media work well in electrically noisy industrial environments.

The test team began benchmark tests by running each network with its native operating-system software and then running the same tests using NetWare. In most cases, the team could configure networks to incorporate the IBM PC XT as a dedicated data server or as a data server that could also act as a workstation. But, there were exceptions. For example, the Corvus LAN's native software does not support the IBM PC XT as a data server. It requires that a proprietary disk-server control unit be used in concert with a separate Corvus Winchester drive. The test was run, therefore, with Corvus' Constellation II software used with the Corvus system.

Another anomaly in the ordered series of tests involved three of the eight native operating systems. With Corvus' Constellation II, Davong's Multi-link and 3Com's EtherSeries operating systems, the test team had to create a separate volume for each user writing data to the shared disk. This precaution eliminated race conditions while disk blocks were allocated to each user's data files on the shared disk during the "create" and "delete" tests described below.

The DOS 2.0 operating system ran the workstations. To make valid comparisons between networks running with native operating systems vs. NetWare, testers



The time required for WordStar to save a 100K-byte file is another indication of a network's speed. Again, PAXnet and PCnet were unable to complete this test because of errors received while the network was attempting to service the higher number of stations simultaneously.

The Integrator

turned on the DOS verify switch (software that verifies written data) when they used the native operating systems. This was not necessary with NetWare, which automatically performs read-after-write verifications. The testers used the IBM PC XT, with 512K bytes of memory, for testing both NetWare and native operating systems.

Test team members conducted LAN benchmark tests using from one to six workstations. They began with one workstation and added more as they completed the tests. Tests used currently available NetWare software and hardware from Novell and other vendors. For additional comparison, the test team ran the same tests using the IBM PC floppy disk drive and the PC XT Winchester disk drive. Network operating systems employing the IBM PC XT in the native mode included Orchid's PCnet, Davong's Multi-link, PAXnet's pro-NET, Nestar's PLAN 2000 and 3Com's EtherSeries.

Methodology is key

"Write" and "read" tests served as the primary evaluation method to check speed. Using native software, the benchmark test program writes 100 records, each 128 bytes long, to a non-shared file. The program then resets to the first record and writes 100 records over the previous data. It repeats the process 10 times for a total of 1,000 written records. The recorded time equals the time required to write 1,000 128-byte random records sequentially. The same procedure is then used for the 128-byte read test, which randomly reads the previously written records. Read and write tests are then repeated using 512-byte records.

The test team next performed create/delete tests, which center on 128- and 512-byte records. The tests perform the same operations as the write tests except that they delete data files after 100 records are written. The program recreates the files for subsequent writes. This sequence forces the server to allocate file space repeatedly.

A 355-byte write test followed. In this test, 355-byte records are written under the conditions of the previous write tests. The record length forces uneven sector sizes, which requires the server to cross uneven sector boundaries during the test. The team then performed a "save" test using the WordStar word-processing package. This test for WordStar establishes the time required to save a 100K-byte file, or approximately 50 text pages, and exit to the system after a user gives the "save and exit" command.

A 100K-byte "copy" test concluded the test program. This test determines the time required to copy the same file used in the preceding WordStar save test into another file, using the DOS "copy" command. Its

purpose is to load the data server and data-link hardware with as much traffic as possible to demonstrate performance at peak loads. Therefore, the test also provides information that shows the aggregate data-transfer rate of a given network topology.

Test results for Orchid's PCnet were incomplete because the network could not adequately process the requests from additional workstations. In the PCnet configuration, an IBM PC XT acts as both the network server—for this test, Station 6—and as a workstation. When a workstation was added, the system returned a "disk x not ready" error message, even when Station 6 was idle.

Similarly, Davong's Multi-link could not adequately serve all six workstations while running simultaneous 100K-byte file copies for the copy test. The sixth station, acting as both network server and workstation, completed the "copy" command very quickly (in 2 to 8 seconds), but the other stations seemingly stopped dead. After approximately 15 seconds, one of the remaining five stations returned a "fatal multi/OS error; fatal-duplicate message found in queue," signifying that the system was down. Two other stations followed with a "disk error writing drive x" error message.

Difficulties on Proteon's PAXnet prevented benchmark tests from being executed on more than three or four stations. The system repeatedly returned a "disk x: not ready" error message after it attempted to run a number of stations simultaneously.

Test results are presented from three perspectives: the standalone IBM PC XT, which was the standard of comparison, individual networks and combined networks.

NetWare products boost LAN speed

The Novell Netware/S star topology accommodates as many as 24 IBM PCs attached to a file server by individual dual twisted-pair lines as long as 3,000 feet. The network's MC68000 microprocessor runs at 8 MHz in the data server with as much as 1M byte of RAM for disk and directory caching and hashing. In addition, the network's dedicated MC68B03 microprocessors manage network communications lines, freeing the MC68000. Each networked PC uses a dedicated communications line.

This board communicates with the IBM PCs at 600K baud. In addition, the LAN board has a dedicated microprocessor for each communication line, which eliminates contention.

The NetWare/G software for Gateway Communications' G-Net, establishes a CSMA/CD network running at 1.43 MHz over coaxial cable, using Gateway

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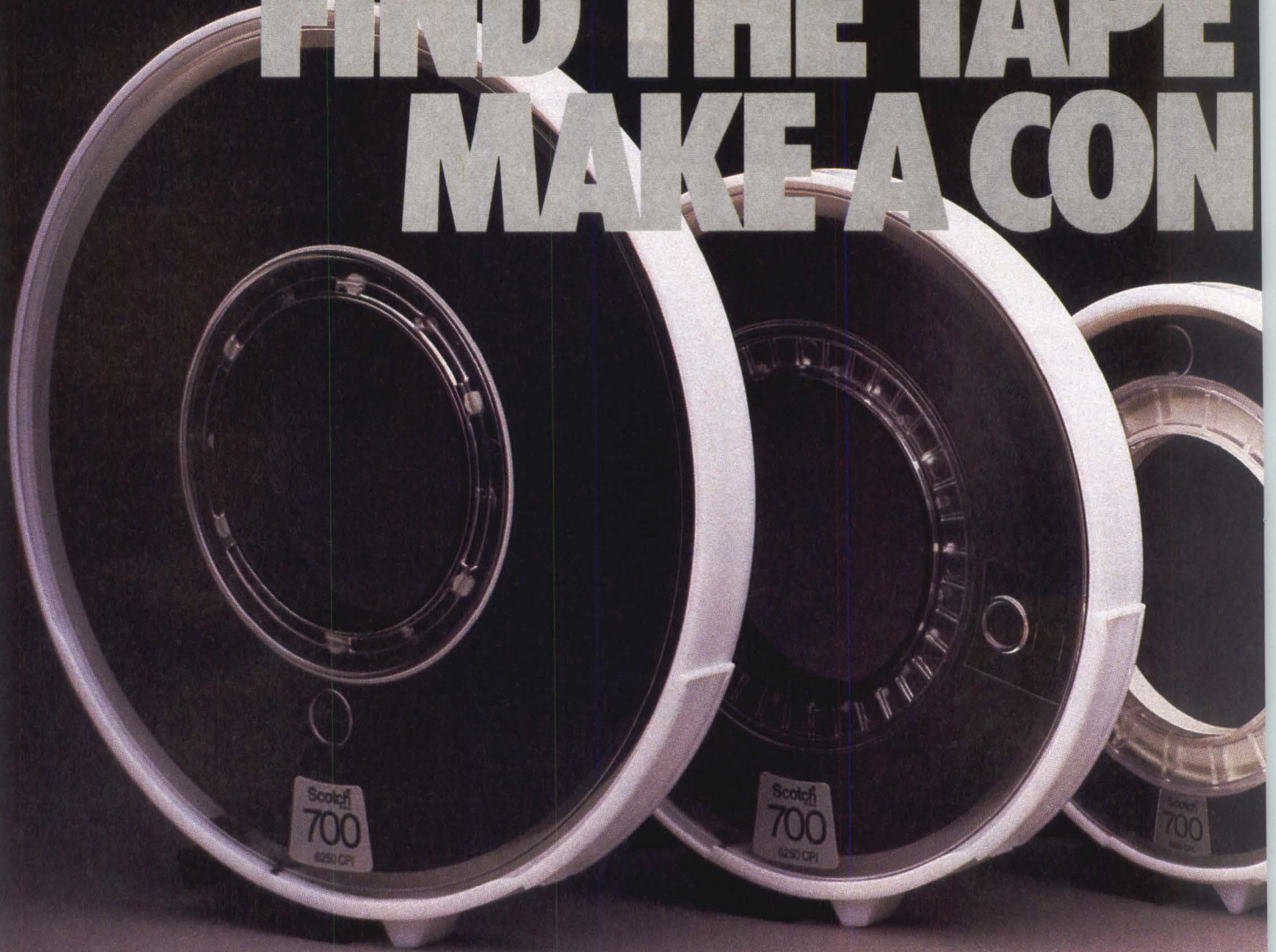


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TS11-compatible tape coupler that allows you to interface the CDC Sentinel $\frac{1}{4}$ " streaming tape drive. And it features software transparency and standard operating system support on your Unibus system.

Last, but not least, is the TC13. This universal tape coupler works across the Unibus of PDP-11 and VAX-11 CPUs. It handles industry-standard $\frac{1}{2}$ " tape transports, including conventional start/stop, streaming, and the new generation of GCR units.

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Communications' network-interface module. A dedicated Z80B microprocessor with 64K bytes of dual-ported RAM takes over the burden of managing network communications from the IBM PC. This assistance is critical to the IBM PC acting as the data server. The interface Z80 board can store many data packets (the amount of data the network can transfer at one time), thereby guaranteeing that no packets are lost. The data packets are quickly created or accessed via the dual-ported RAM. Because neither the data server nor IBM PC shell software needs interrupts, the overhead of interrupt servicing is eliminated.

Data packets arrive at 1.43 MHz. However, after a packet is received, the Z80 needs time to acknowledge receipt of the packet before making it available to the IBM PC microprocessor. This overhead slows the effective data-transfer rate.

The NetWare/O software for Corvus' Omninet uses Corvus network transporter cards. Omninet runs at approximately 899K baud. Each Omninet board has its own dedicated microprocessor to manage network communications and 4K bytes of RAM to use as a packet and command buffer. The Omninet transporter card guarantees that packets are received 99.9 percent of the time. However, this setup burdens driver software with the overhead of handling the lost packet cases. Because the Omninet board can buffer no more than four received packets simultaneously and also lacks interrupts, all four receive buffers in the data server could become filled under worst-case conditions. Consequently, the board would lose additional packets sent to the server.

Moreover, the RAM buffer in the Omninet board is not dual-ported; it is accessed via special auto-incrementing I/O ports. Consequently, accessing the board RAM uses more overhead, and transfer time is about 20 percent longer than memory-to-memory moves.

The NetWare/E software for the 3Com EtherLine network-interface board communicates at 10 MHz with the IBM PC. It has interrupts and direct memory access (DMA) to optimize data transfers from the interface board to the IBM PC memory. Because of the fast network communication rate, Ethernet LANs work well in a multiple data-server environment.

Although an Ethernet LAN has a wide physical communications bandwidth, 3Com's implementation has several bottlenecks that slow the 10M-bps transfer rate, particularly in a single data-server environment. Most bottlenecks occur at the data-server IBM PC as data packets transfer between data-server RAM and the 3Com board's buffer RAM. The 3Com board uses an Ethernet controller chip manufactured by Seeq Tech-

LAN PARTICIPANTS IN BENCHMARK STUDY

Manufacturer	Network	Native OS	NetWare OS
Corvus	Omninet	Constellation II	NetWare/O
Davong	ARCnet	Multi-link	NetWare/D
Gateway	G-Net	N/A	NetWare/X
3Com	EtherLink	EtherSeries	NetWare/E
Nestar	ARCnet	PLAN 2000	NetWare/N
Novell	NetWare/S	NetWare/S	NetWare/S
Orchid	PCnet	PCnet	NetWare/C
Proteon	proNET	PAXnet	NetWare/P

nology Inc. that needs a special RAM buffer for receiving and sending packets. The major problem with the 3Com design is that the board can send or receive only one packet at a time. So, whenever a packet is received or needs to be sent, the controller chip must be turned off while the packet is transferred between the 3Com board's work RAM and the IBM PC microprocessor's RAM.

Problems result because it takes 5 to 10 times longer to transfer a packet than to receive one, even if DMA is used. Therefore, the data server EtherLink board is unable to receive packets for a significant percentage of time when the network is active. Because no "packet received" acknowledgment mechanisms exist at the Ethernet hardware level, there is no way for the requesting IBM PC to know that the data server isn't listening—except that it never receives a response to its request.

The NetWare/P software for Proteon's proNET consists of a 10-MHz token ring that provides positive acknowledgment of a packet's receipt. The board contains separate, single receive and send buffers, DMA and interrupt support. The proNET board performs better than 3Com's Ethernet, even though both have the same communication rate and the same bottleneck in transferring packets between the boards' packet buffer area.

Two factors account for the improved performance. The first is the use of separate receive and send buffers, which let a packet be loaded for sending without disabling reception of another packet. The second factor is the "packet has been received" acknowledgment that the token ring provides. Knowing that a packet has been received improves retry-logic performance in the network driver software. If a packet sent by an IBM PC is not accepted, then the workstation immediately tries again (as soon as it regains the token), rather than waiting until it becomes obvious that the data server PC didn't receive the packet.

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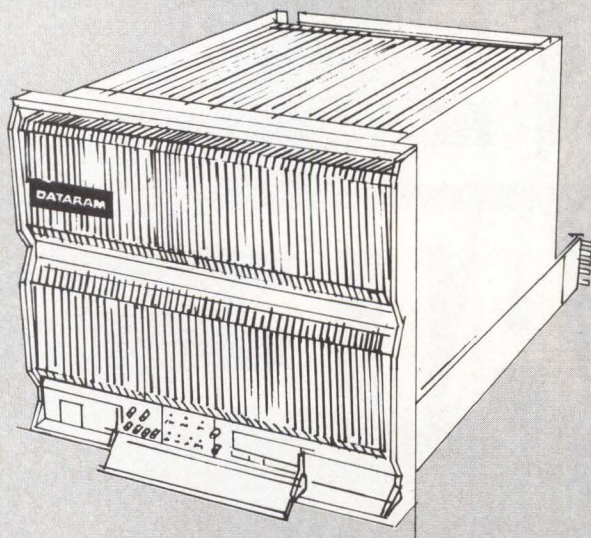
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GOULD/SEL	32 MB
INTEL (MULTIBUS)	64 MB
CSPI	2.0 MB

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DATARAM

The Integrator

These retransmissions don't significantly slow operation because the network communication rate is so fast. Performance of proNET would probably improve if the network could receive multiple packets in its packet buffer.

The NetWare/D software is used for Davong's network multifunction card and the NetWare/N software for Nestar's PLAN 2000 boards. Both boards use the ARCnet controller chip provided by Standard Microsystems Corp., and their performance and functional characteristics are virtually identical. An arbitrary open-ended star connects network stations via 93-ohm RG-62 coaxial cable that provides a 2.5-MHz bandwidth.

The network hardware also provides four 512-byte pages of RAM buffer for transmitting or receiving. Thus, the server can do double-buffering. While one packet is copied into the server's memory, the ARCnet controller can receive another packet simultaneously. The dual-ported RAM buffer on the network-interface board also allows the data packets to be copied directly in and out of the board. This procedure is faster than sending data through I/O ports, as some other network hardware requires.

The main limitation of the ARCnet protocol is its small packet size. A station can transmit no more than 508 bytes in any one packet. Therefore, a request to write 512 bytes to a file, for example, must be split into two packets—one long and one short. The added overhead in cumulative transmission time for the two packets is minimal, but the station can transmit only one of the two packets when it receives the token. It must wait for the token to cycle completely around the network before it can transmit the second half of the request. If network server requests become frequent, some degradation in overall response usually emerges because of the time required to get both halves of a large request across the network. This worst-case scenario would occur only under heavy network use.

Ray Noorda is president of Novell Inc., Orem, Utah.

Each of the networks used in the Novell Benchmark was purchased before January 1, 1984. The exception to this is the Nestar PLAN 2000, which was purchased in February of 1984. Each network was purchased through normal sales channels and installed according to end user instructions. Novell Inc. realizes that possible enhancements could have an effect on the performance figures for any one of the networks.

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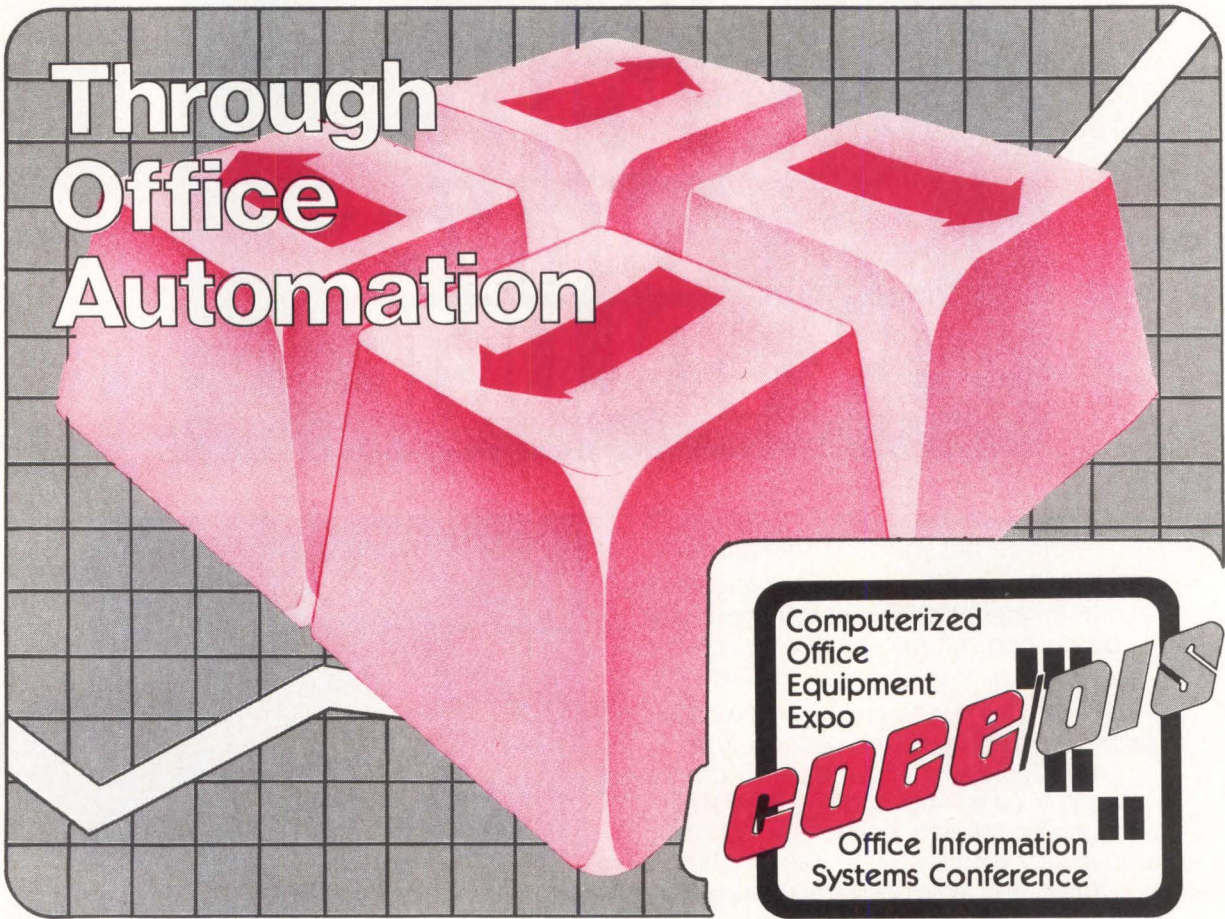


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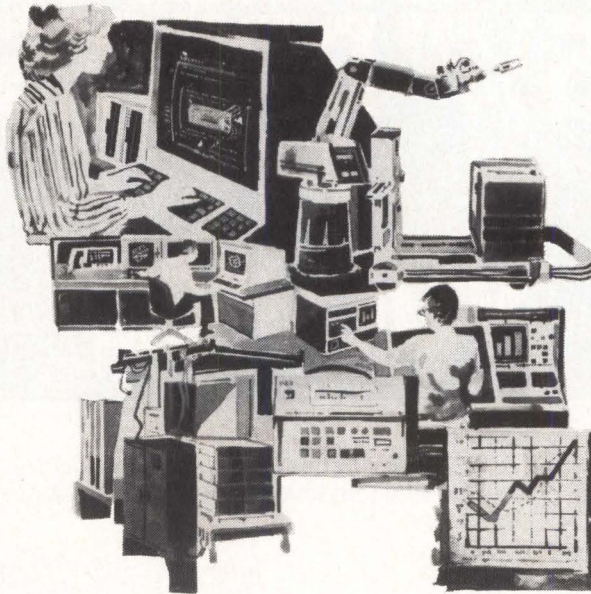
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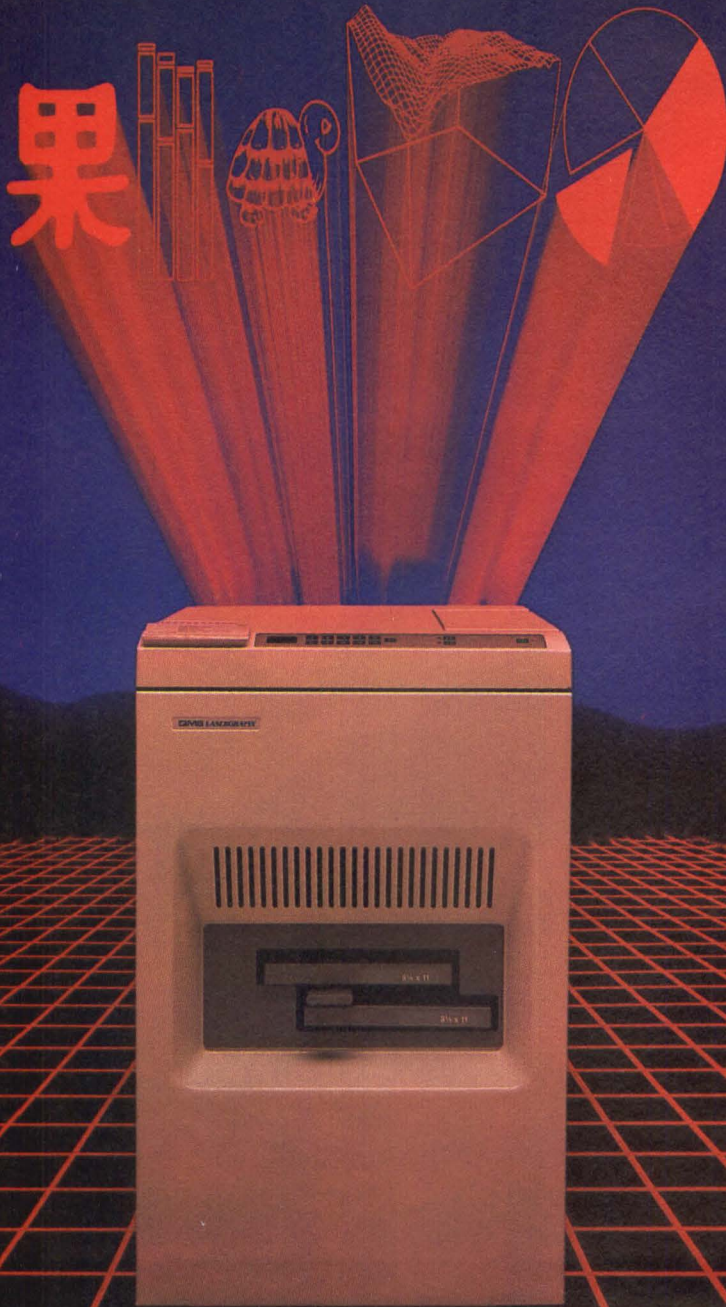
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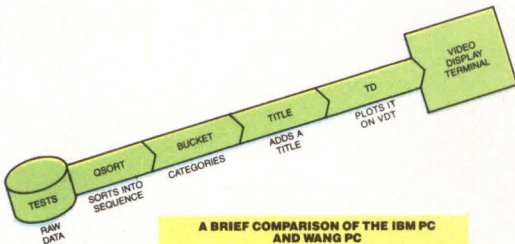
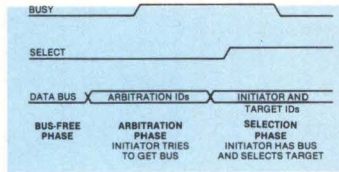
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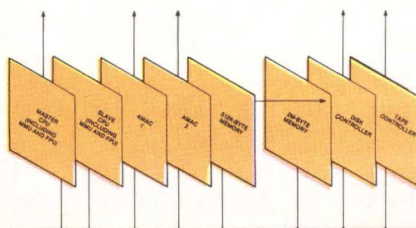
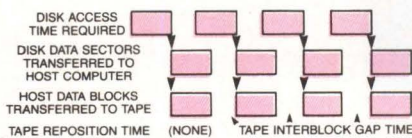
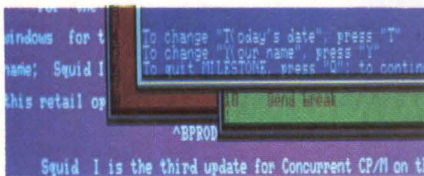
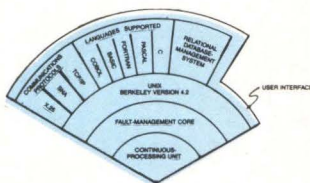
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FEATURE HIGHLIGHTS



A BRIEF COMPARISON OF THE IBM PC AND WANG PC

	IBM PC	WANG PC
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Internal CPU word size (bits)	16	16
CPU-to-memory word size (bits)	8	16
CPU clock rate (MHz)	4.77	8



MINI-MICRO SYSTEMS/May 1984

OFFICE AUTOMATION: Terminals: Looking for high text speeds and full color graphics in an office terminal? Digital Equipment Corp. may have what you seek. Its VT200 terminal family features both of the above, plus a UPS, keyboards for 16 languages and a variety of ergonomic features, such as a low-profile keyboard, non-glare screens and white, green or amber phosphors. For more information, turn to **p. 221**.

Computer bus: Buses represent the "superhighways" of computer systems. They carry data, addresses, control signals and power between system components. The SCSI bus is the leading intelligent interface for 5¼-inch Winchester disk drives and is used by 30 percent of installed small business systems. To find out if this component can ease your traffic jams, see **p. 241**.

Utilities: UNIX-based office-automation systems, pushed by AT&T and IBM endorsements, will experience explosive growth starting next year. They will surely eclipse MS-DOS and PC-DOS in the 16- and 32-bit standard arena. The UNIX trend promises a wider selection of brands and products for system integrators. For a closer look, see **p. 253**.

Product evaluation: Associate editor Roy Friedman tested the Wang Professional Computer and found a fast CPU, an ergonomic display monitor and a powerful editor, assets which pose a challenge to the IBM PC. See **p. 263** for further observations.

PARALLEL PROCESSING: Several proven techniques can be used to remedy a failed system. These vary primarily in the length of the recovery sequence and the demands placed on end users and integrators. One technique, the fault-tolerant computer, has moved beyond on-line processing only and become less expensive. Check the details on **p. 183**.

MULTIFUNCTION SOFTWARE: Numerous software makers have developed integrated software packages that nearly match mainframe capability in solving complex business problems. Beginning on **p. 195**, MMS presents a profile article on these manufacturers, accompanied by a product table on **p. 207**.

STREAMERS: Most ¼-inch cartridge-tape drives perform only image backup for Winchester drives. Full-function streamers, however, such as the Model 92190/92192 Sentinel from Control Data Corp., provide data compression, individual-file backup and archival storage previously found only on larger and more expensive ½-inch cartridges. For more information, see **p. 231**.

MICROCOMPUTERS: A multitude of systems exist that claim to bring the power of UNIX to a low-cost system. These systems vary greatly in execution speeds and multiuser support. Unidot Systems Inc. has developed a dual-CPU, VAX-compatible micro that also includes on-board cache memory and intelligent I/O processors. Turn to **p. 275** for a look at Unidot's Cerebra.

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Fault-management system lowers cost, expands applications

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to notification and repair*

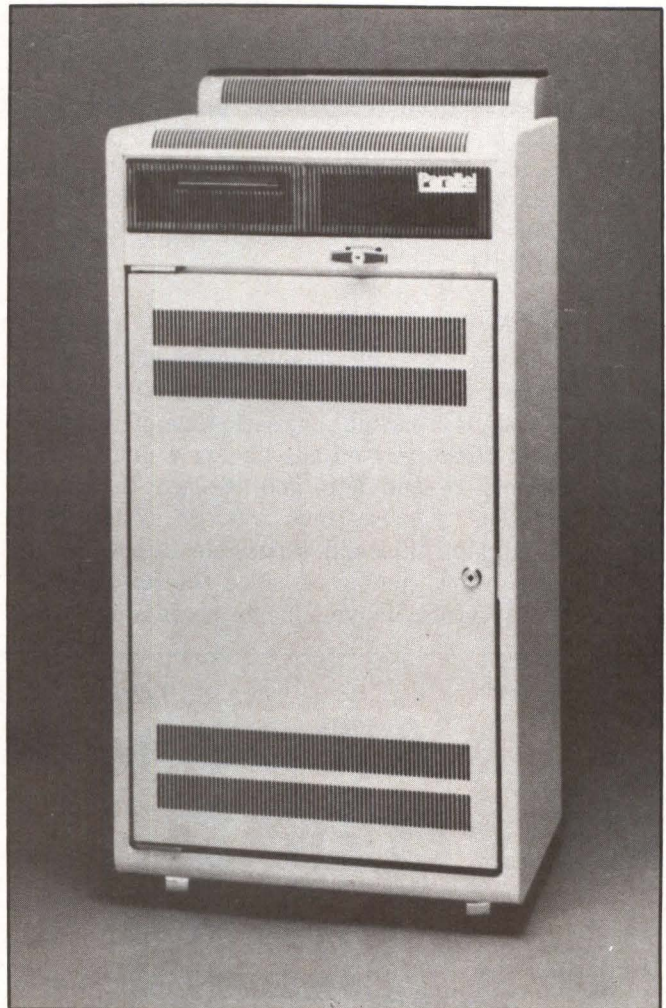
Mark Pine, Parallel Computers Inc.

All computer systems are susceptible to failure. Depending upon a system's architecture and the nature of the failure, a failed system can render data invalid, stop operating or continue operating with no perceptible indication that a failure has occurred. Several proven techniques can be used to return data to a valid state and resume normal operation. These techniques differ primarily in the length of the recovery sequence and the demands placed on end users and software integrators. Fault-tolerant computers that markedly reduce recovery time have traditionally been used mainly for on-line transaction processing and command a significant cost premium. Advances in hardware and software technology, however, enable today's fault-management computers to lower the cost of fault management and expand the applications of fault-management systems.

Recovering from a system failure

Most computer systems are designed with little or no ability to recover from a system failure. When a failure occurs, the system usually stops operating and data is frequently lost. In most cases, a field-service engineer must be called to repair the system and restore it from a backup data image created before the failure. This approach to fault management places a considerable burden upon the system end user and mandates a recovery period of hours or even days. Because of data loss and downtime, it is unsatisfactory for most applications.

Early attempts to shorten the recovery period employed a second redundant computer as a backup and required the application software to update the backup



Redundant architecture, duplicating all vital components in the Parallel 300 computer, protects data integrity and implements continuous operation.

system on a regular basis. Although it shortened the recovery period, such an approach failed to address the issues of fault detection and automatic recovery. In addition, it mandated substantial application software development and therefore was unsuitable for most applications.

Fault-tolerant computer systems continue to operate even after the failure of a system component. They aim at eliminating data loss and reducing the recovery period to seconds or minutes. Detecting, identifying, isolating and automatically recovering from failures, these systems vary significantly in cost and impact on the software integrator and focus mainly on medium-and/or large-scale transaction-processing applications.

Fault-management computers are also fault-tolerant and, therefore, provide immediate automatic recovery. Encompassing all phases of fault management, they also furnish notification and repair capabilities (Fig. 1). Supporting continuous operation and preserving data integrity, they return a system to its original state before the failure.

Design innovations, combined with lower hardware costs, have driven fault-management systems into the minicomputer/supermicrocomputer price/performance class. And when an end user considers costs of ownership, including the cost of service, downtime and loss of data, a fault-management system becomes the least expensive alternative for a broad range of applications (Fig. 2).

Implementing fault management

Protection against system failures with conventional computer systems typically involves manually copying system data onto a backup magnetic tape or disk on a regular basis. Recovery entails having a field-service engineer come to the site and replace the faulty component. The recovery must restore system data from the backup medium and, if possible, duplicate data accessed and work completed since the last backup. Because the system is unavailable for processing during

recovery, it is unsuitable for many on-line operational-information-system (OIS) applications, which require constant access to data.

In contrast to traditional computer systems, fault-tolerant computers address the issues of fault protection and recovery and provide continuous operation without loss of data in the event of a component failure. Based on a redundant architecture in which critical system components are replicated, these systems differ

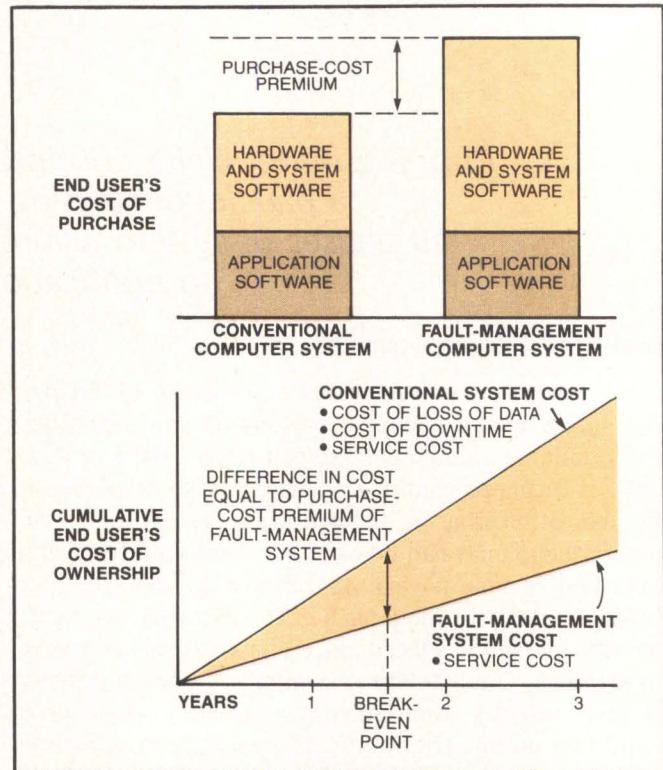


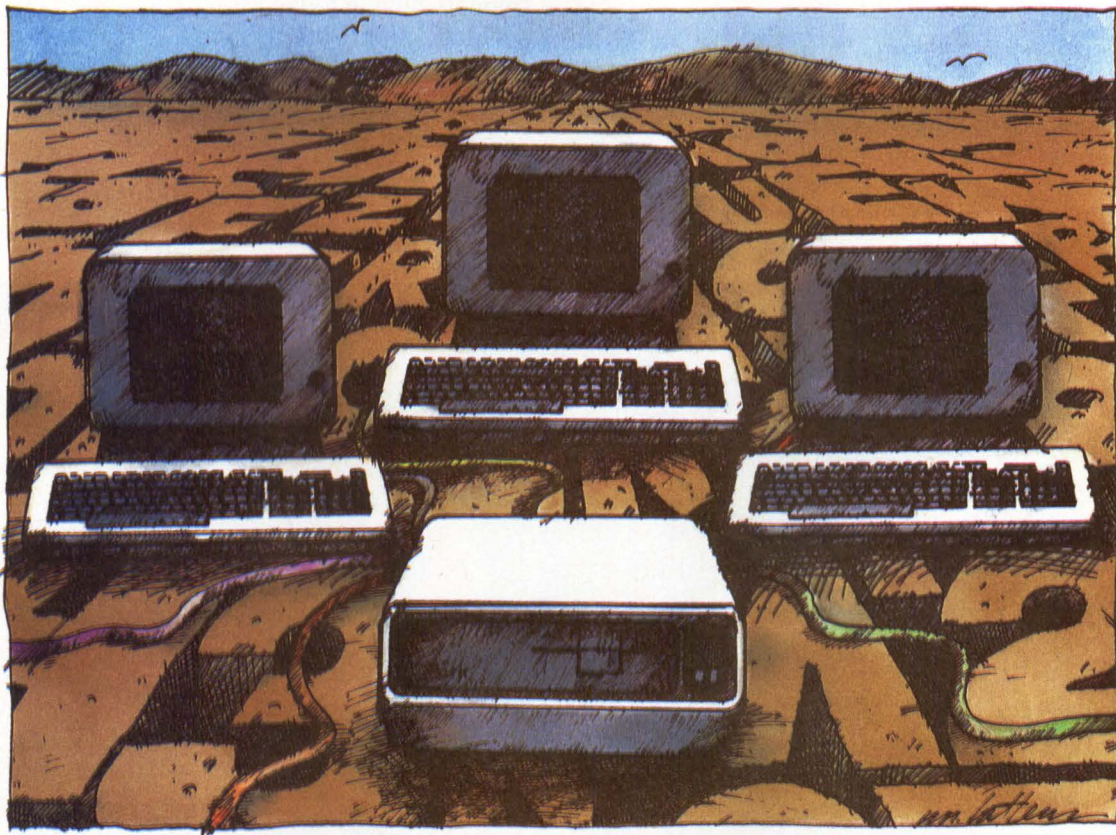
Fig. 2. Although fault-management computers cost more than conventional systems, they are economically justifiable for many applications. The crucial factor is an end user's cumulative cost of ownership. The break-even point is reached when the conventional computer system's total cost—comprising service cost, cost of downtime and cost of loss of data—equals the purchase cost premium of the fault-management system.

FAULT-MANAGEMENT SYSTEMS			
System features	Fault-tolerant systems Recovery		
	<ul style="list-style-type: none"> • fault detection • identification of source • isolation of area containing fault • re-configuration of system • resumption of processing 		
End-user action required	<ul style="list-style-type: none"> • none 		
		Notification <ul style="list-style-type: none"> • notification to user • diagnosis of fault • define required user actions 	Repair <ul style="list-style-type: none"> • user-serviceable design • no tools required • step-by-step instructions provided
		<ul style="list-style-type: none"> • obtain replacement module 	<ul style="list-style-type: none"> • follow instructions to return system to original condition

Fig. 1. Fault-management computer systems provide notification and repair capabilities in addition to the automatic-recovery functions of fault-tolerant computers.

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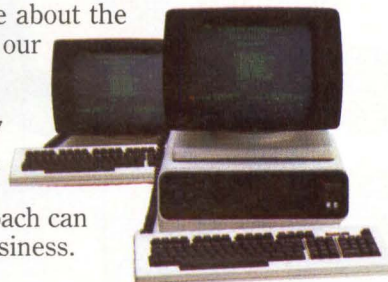


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	FAULT-TOLERANT COMPUTER SYSTEMS			
	Conventional computer	Checkpointing	Voting	Parallel processing
Number of processors	N	N + 1	$\geq 3N$	2N
Frequency of creating data image	daily (typical)	1 sec. (typical)	continuous	continuous
Image medium	tape backup	"sleeping," backup processes	active processes	active processes
Fault detection	by operator	automatic	automatic	automatic
Fault recovery	24 hours * (typical)	30 sec. (typical)	< 1 sec. (typical)	1 sec. (typical)
Software overhead	none	20% (typical)	< 5%	< 10%
Special application software usually required	—	yes	no	no

* May be only partial recovery due to unrecoverable data

Fig. 3. Approaches to recovery from system failure differ among conventional computers and checkpointing, voting and parallel-processing fault-tolerant computer systems. Conventional computers rely on the copying of data to a backup tape. Recovery from failure requires restoration of the system from the backup media and the replacing of the faulty component by a field-service engineer. In a

checkpointing system, one process periodically copies critical data at checkpoints to a backup process running on a different processor. Processing is restarted from the passive, backup process. Checkpoints must be inserted by the software developer into the application program, raising software overhead.

primarily in the techniques used to achieve fault tolerance at the processor level.

Software checkpointing was one of the earliest techniques employed for attaining processor fault tolerance. In this approach, one process periodically copies (checkpoints) critical data to a backup process running on a different processor. When it detects a failure of the main processor, the system restarts the process from the last checkpoint on the backup processor.

A major drawback of this approach, however, is that the application program must implement the checkpointing. This places a considerable burden on the software integrator: he must include checkpoints in the application program and ensure that they are correctly located. Furthermore, software running on another machine or available from a third party cannot be easily transported to this type of system.

Voting fault-tolerant systems typically employ three or four processors performing the same task and periodically comparing the results. When a discrepancy occurs, the processor in disagreement is considered faulty and configured out of the system while the system continues to operate with the remaining processors. This method eliminates the need for checkpoints in the application software and results in substantially lower software-development costs. Inherent in the voting approach, however, is the extensive use of redundancy. Because it involves a substantial cost premium compared to conventional computer systems, it limits the applications for voting fault-tolerant systems.

A more recent approach to implementing fault tolerance employs a pair of closely coupled processors executing in parallel. The processors synchronize at well-defined points to ensure that they are both operating correctly. If a processor failure occurs, it is detected by the faulty processor itself or by the other processor at a synchronization point. The faulty processor is then configured out of the system, and operation continues without interruption on the remaining healthy processor.

Because coupled-processor systems provide software-transparent fault tolerance, they do not require checkpoints in the application software. And, because they only duplicate critical components to achieve continuous operation and data integrity, they are cost-effective. Figure 3 compares the three approaches to fault tolerance with the recovery methods of conventional computer systems.

Coupled processors provide continuous operation

Parallel Computers Inc.'s Parallel 300 fault-management system is based on the closely coupled processor approach. Offering continuous operation and data integrity in the minicomputer/supermicrocomputer price/performance class, it addresses the recovery, notification and repair phases of fault management and satisfies the stringent demands of OIS applications.

The computer's redundant architecture duplicates all vital components (Fig. 4). The heart of the system is a pair of closely coupled parallel-processing units (PPUs) that use Motorola MC68010 virtual-memory micro-

processors running at 10 MHz without wait states. Main memory ranges from 1M byte to 4M bytes. All tasks are executed simultaneously on both processors. If a processor fault is detected, the faulty processor is logically removed from the system while the application continues to run on the other processor. Synchronization between processors and re-configuration of system components occur transparently to end users and to their application programs.

The disk subsystem comprises duplicate Winchester disk drives and duplicate disk controllers. All data recorded on disk is mirrored on both drives. System performance is enhanced by reading from the drive with the disk head closest to the required data. If a read or write error occurs because of a media defect, the system automatically maps out the bad track and updates it from the good drive. If the failure involves a hardware malfunction, the faulty drive is configured out of the system along with its associated controller. When a disk controller fails, the system logically removes the controller and its associated disk drives from the system. When a disk subsystem failure occurs, immediate and automatic system recovery without loss of data is attained by accessing the properly functioning disk controller and drive.

Duplicate power modules with integrated batteries minimize power-failure problems. If either module fails,

the working power module energizes the computer system. The batteries also isolate the system from external power-source transients, voltage reductions, voltage spikes and power loss. This configuration also greatly reduces the occurrence of disk head crashes, transient disk writes and file system contamination often associated with external power fluctuations. Most approaches to external power-failure protection provide battery backup only for a system's internal memory. In contrast, the Parallel 300's power subsystem keeps the entire system, including the disk drives, operating for as long as 90 minutes after a power failure, allowing for orderly system shutdown during prolonged power outages.

The fault-management computer runs under the UNIX operating system. Because fault tolerance is implemented transparently within the system, users see the standard UNIX interface. Application programs can be transported from any UNIX system to the computer without modification. UNIX provides a powerful development environment that can reduce software-development costs. And because it is a de facto industry standard, many application programs using UNIX are available from third-party software houses (Fig. 5).

The computer system works with the Intel Multibus, an industry-standard interconnect bus. OEMs can

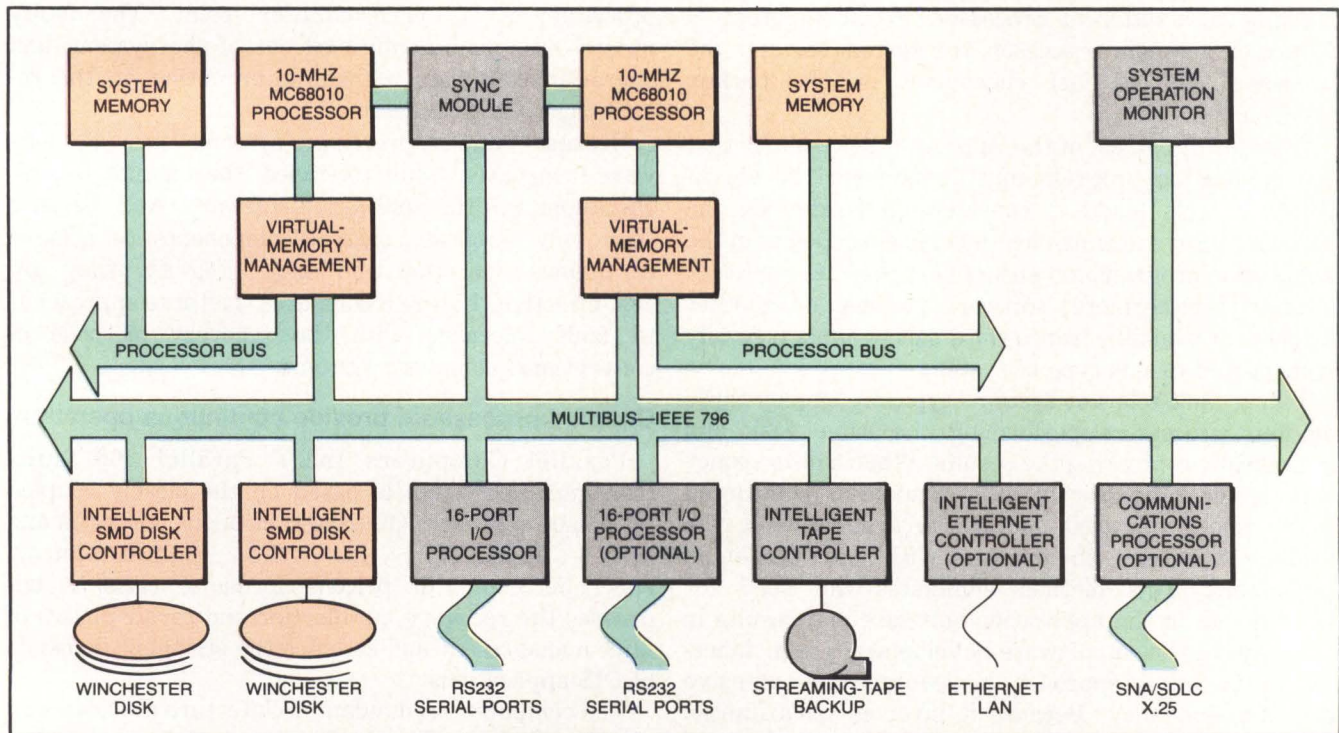
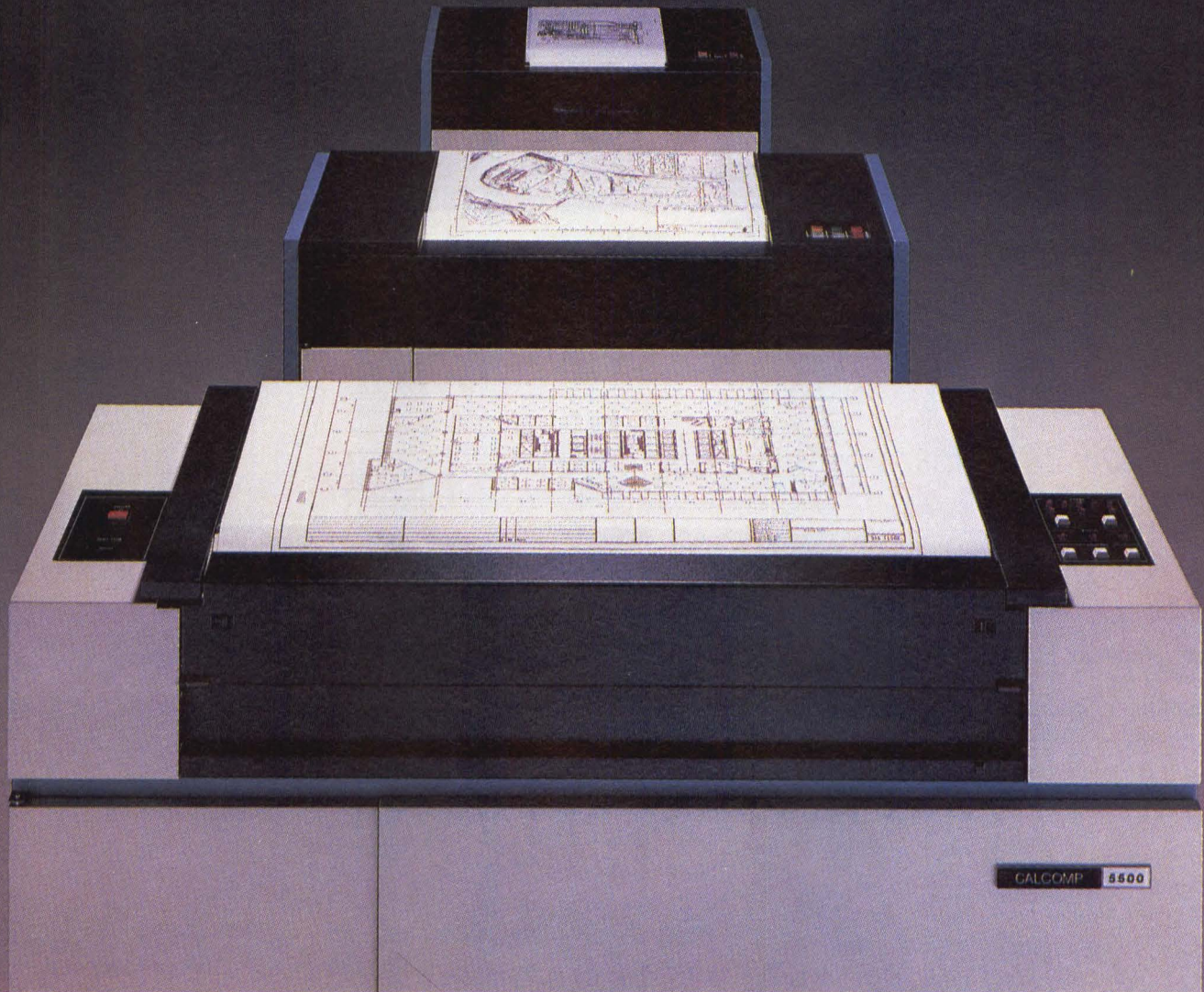


Fig. 4. Dual 68010 virtual-memory microprocessors simultaneously executing all tasks and duplicate Winchester disk drives protect continuous operation. If a processor fault is detected, the faulty

processor is logically removed from the system while the application continues to run on the other processor.

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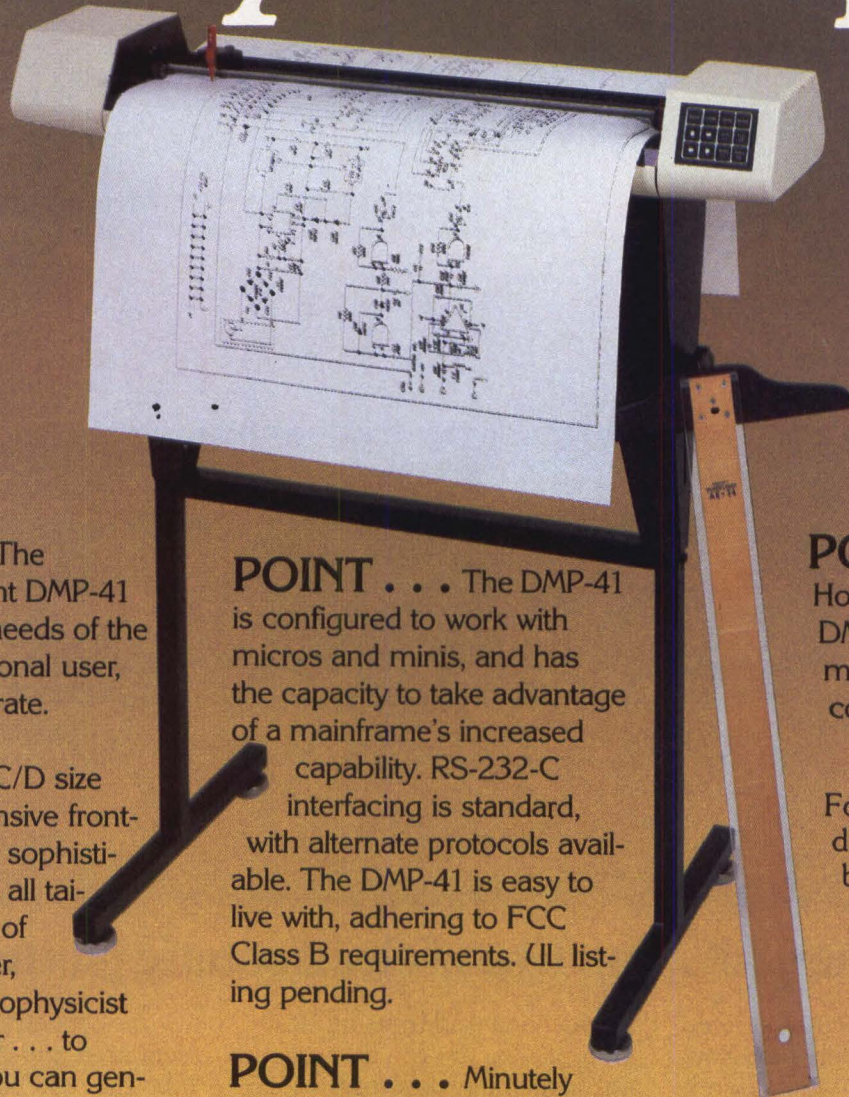
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Are fault-management computers worth their purchase-price premium?

Fault-management computers cost more than conventional computer systems. System integrators and end users deciding whether this purchase price premium is economically justifiable must consider one important factor: the cost of downtime and data loss inevitably involved with the conventional system. If this cost is greater than the higher initial cost of providing continuous operation, they will select the fault-management system. If, on the other hand, this cost is less than the fault-management computer's purchase cost premium, they will most likely decide on a conventional system that cannot provide continuous operation.

Historically, the higher cost of fault-management systems has restricted these computers to a limited set of applications, such as electronic funds transfer, that mandate data integrity and continuous operation. In contrast to conventional computer

performance specifications, these characteristics measure what could be called "performance in the field." Reliability, availability for processing and serviceability determine how well a system meets the demands of an end user's application. When evaluating a computer for a specific application, system integrators and end users should consider both conventional performance parameters and performance in the field.

During the 1970s, companies tended to allocate computer resources more directly to their operational departments. These Operational Information Systems (OISs) typically run on-line applications and perform a specialized set of tasks for a department. They serve a vital role in the department's operation by improving productivity as well as performing tasks that are impractical without them. Minicomputer manufacturers have capitalized on this trend

by targeting their products at this market. Recently, a new wave of computers aimed at the same market but based on microprocessor technology have become available from Convergent Technologies Inc., Plexus Computers Inc. and other manufacturers.

OISs have system-availability and data-integrity requirements that, in most cases, are not adequately satisfied by conventional minicomputers or supermicrocomputers. Some manufacturers address the shortcomings of conventional computer systems by offering service contracts that guarantee system uptime of 95 percent to 99 percent. These methods improve system availability but are extremely expensive and still result in one day to five days of downtime out of every 100 days of operation. In addition, they do not address the potentially catastrophic effects of system failure upon data integrity.

adapt the Parallel 300 to their applications by adding specialized and general boards to the system from more than 100 manufacturers.

Other Parallel 300 features support the addition of OEM-added boards, and a set of software procedures

permits the integration of value-added components into the system. The system provides fault-management and driver-specific functions. If an add-on board fails, it can be put into a reset state so that it cannot affect system operation. If a board locks onto the bus, the

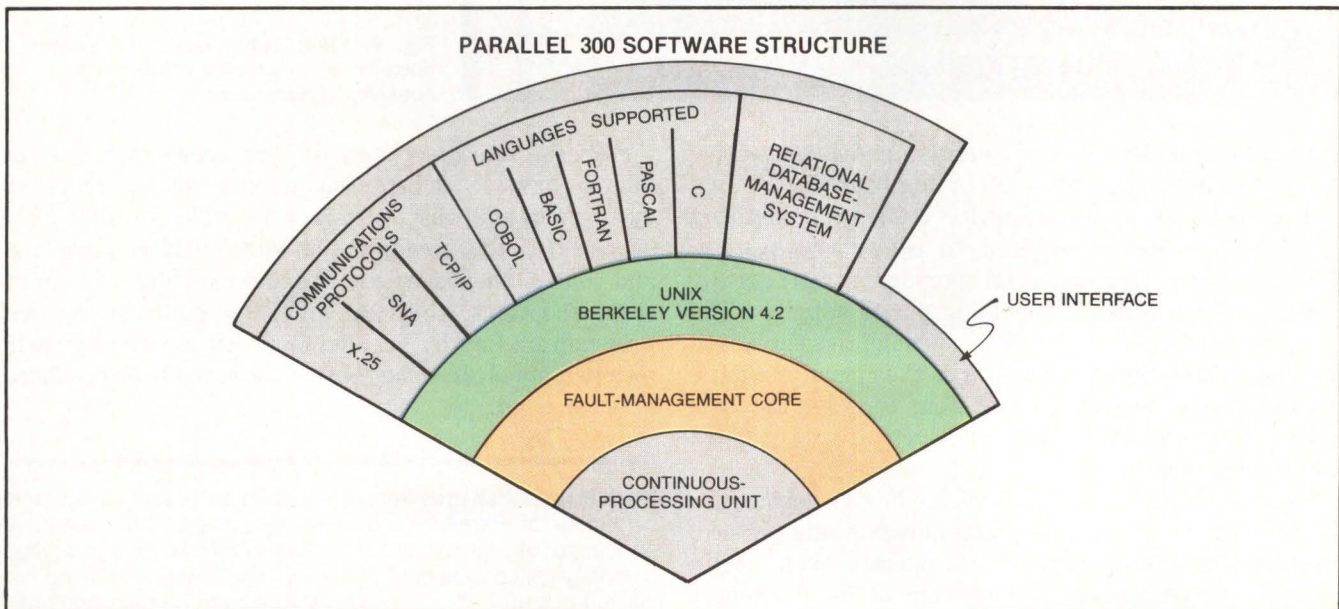
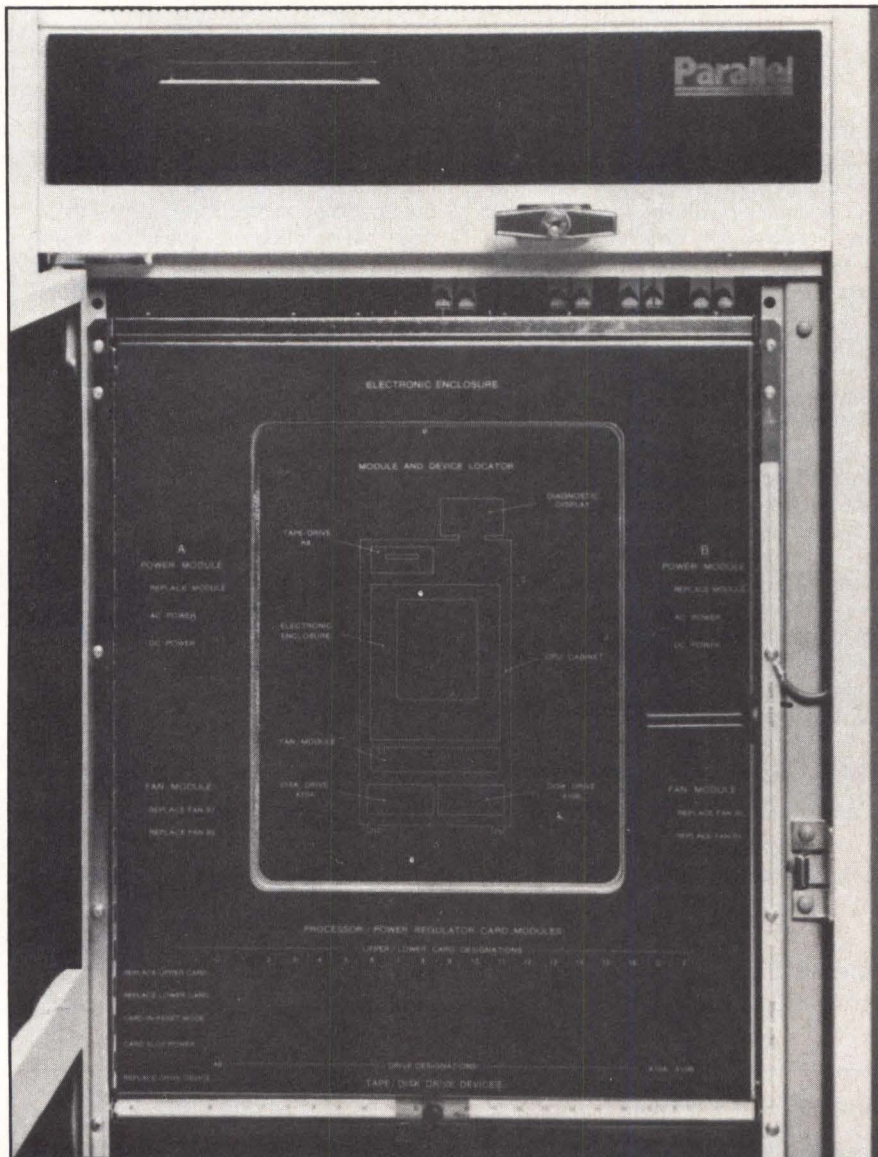


Fig. 5. Application programs from any UNIX system can run on the UNIX-based Parallel 300 without modification. Because the system transparently implements fault tolerance, end users see the standard UNIX interface.



Spec summary

- **Model:** Parallel 300 fault-management system
- **Manufacturer:** Parallel Computers Inc., 3004 Mission St., Santa Cruz, Calif. 95060
- **Processor/speed:** each parallel-processing unit's (PPU's) 68010 runs at 10 MHz without wait states
- **High-speed local memory for PPU:** 1M to 4M bytes
- **System memory:** 8-inch Winchester disk drives; 80M to 160M bytes per drive; two to eight drives per system
- **Backup tape drives:** 20M-byte, 1/4-inch streaming-tape
- **I/O:** processor supports 16 to 32 RS232C ports per system
- **Communications:** communications processor supports SNA and X.25 protocols; Ethernet local-area network controller and Arpanet TCP/IP protocol available
- **Operating system:** Berkeley version 4.2 UNIX
- **Languages:** C, Pascal, FORTRAN 77, BASIC, COBOL
- **Utilities:** standard UNIX, Vi Editor, C Shell, UNIX-to-UNIX copy; relational database-management system available
- **Price/delivery:** \$50,000 to \$100,000, depending on configuration; available for immediate delivery

Fig. 6. Fault lights notify the system operator of inoperative components, speeding system repair.

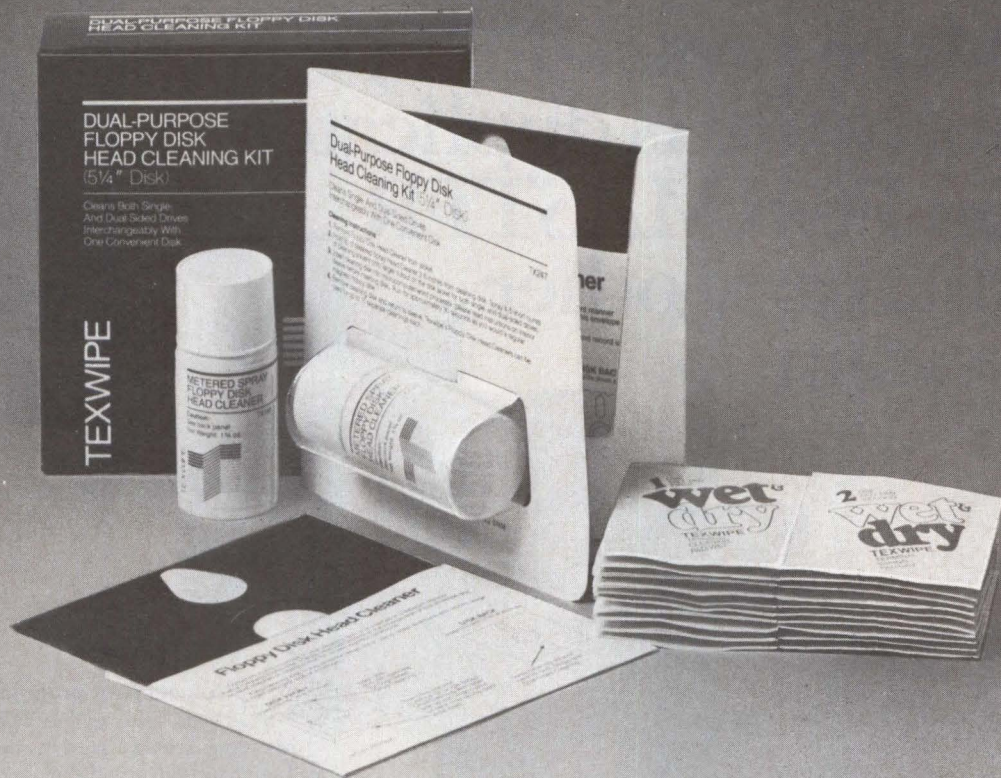
status monitor detects the condition and takes appropriate action to disable the offending board.

The computer reduces service costs by minimizing the time and labor required to repair the system. Without tools, non-technical personnel can quickly replace all components, including power supplies. The computer detects and identifies a problem, isolates it to the specific component and notifies the operator via the system status display, the system console, the disk error log and fault lights adjacent to the failed component (Fig. 6).

Step-by-step instructions indicate how to replace the faulty component and bring the new one into service. Because the system continues to operate even after a component has failed, the requirement for immediate service response—usually crucial to OIS applications—is eliminated.

Service costs associated with recovery from system failure have a substantial impact on a computer system's overall costs of ownership. The Parallel 300's user-serviceable configuration allows OEMs to reduce and control their service costs and provides a range of service options: they can offer an end-user service program backed by Parallel or direct service by their own personnel. In either case, a large field-service force is not needed. □

Mark Pine is vice president of research and development and a founder of Parallel Computers Inc., Santa Cruz, Calif. A co-founder of Digimedics Corp., Santa Cruz, he served as that company's vice president of engineering before assuming his current position. Pine received a B.A. from and did graduate work at the University of California, San Diego.



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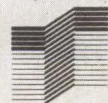
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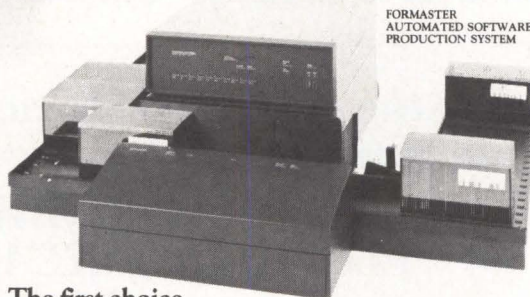
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Carl Warren, Western Editor

Spawned by the success of Lotus Development Corp.'s 1-2-3 integrated software package and the availability of more capable microcomputer hardware, numerous software makers have developed integrated software packages that nearly match mainframe capability in solving complex business problems. This software follows distinct guidelines, giving virtually all the packages a me-too flavor.

For example, the latest integrated software packages provide four standard functions: numerical analysis, list/database management, text editing/word processing, business graphics and—in an increasing number of packages—a fifth function: communications. A check of available packages reveals that these functions are

typically implemented as VisiCalc-type spreadsheets, data handlers that range from simple list managers to full-blown relational database-management systems, memo- and report-writing functions that provide simple text editing, sophisticated word processing, business graphics that enable users to create charts, modem communications and 3270 terminal emulation.

Until now, system integrators have overlooked communications packages. Furthermore, high-resolution pointing devices—such as cursor-type mice—are becoming more important to system integrators interested in adding windowing and free-form graphics. The use of such devices, along with more complex software, however, requires powerful CPUs and more system memory, which are available in current 16-bit computer-based systems.

To link business functions in an easily viewable manner, the Lotus Symphony employs a window-management system that the company claims tightly couples word processing, spreadsheets, database, communications and graphics. Lotus plans to provide details on the Symphony architecture, enabling integrators to insert additional applications.

Editing Record 3 of 9 (Match 2 of 2)
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<p>Dear Michael: I am pleased to inf disability policy, announced some rate</p> <p>Your current disabi</p> <p>Monthly Bene Waiting Peri</p>	<p>Joseph Condon 7 Goldsmith Ave. Brockton, MA 07765</p> <p>Dear Joseph: I am pleased to inform you of some very good disability policy. The Workingman's Insuranc announced some rate changes that may affect</p> <p>Your current disability insurance policy sta</p> <p>Monthly Benefit \$1,500.00 Waiting Period (days) 30</p>

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Decision support proves important

One of the prime motivating factors, other than the prospect of large returns on investment, for creating full-featured integrated packages is to provide business managers with sophisticated decision-support systems. According to Wesley A. Lee, product planning manager for Context Management Systems Inc., Torrance, Calif., a decision-support system is "a combination of hardware and software that provides an operating environment in which managers and other corporate users can increase their effectiveness in the decision-making process." Lee believes that, for a decision-support system to be effective, the user (manager) must have immediate access to the data; hence, integrated packages now contain communications capability.

Context Management's Corporate MBA package includes both 3270- and modem-type communications, which allow a user to perform analytical operations on remotely accessed data, extending the viability of the automated decision-support system. Although Context Management has established the requirements for integrated decision-support packages, Lotus Development, Cambridge, Mass., has won awards with its 1-2-3. The company is attempting to continue its market success with an enhanced product called Symphony. Symphony combines word processing, database management, a spreadsheet, graphics and a window-management system.

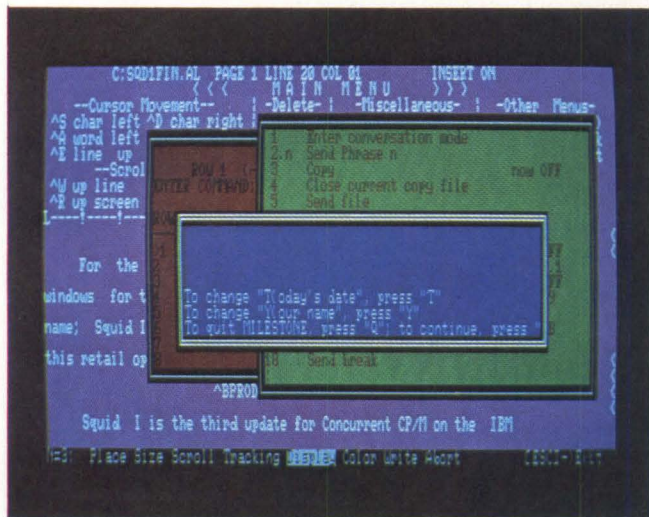
But, with more than 80 new entrants in the

integrated software arena, Lotus and Context Management are facing stiff competition, the most notable of which is Ovation Technologies Inc., Canton, Mass. Ovation offers a five-function package with features similar to those provided by Context and Lotus. This package furnishes command-processing continuity, which the company claims makes the software easier to use and learn.

Context Management's Lee and company president David Saykally confirm that command-processing continuity is important. "The user can't be saddled by technical decisions related to the use of the product," says Lee. In addition, Bob Demoura, software engineer at Digital Equipment Corp., Marlboro, Mass., warns that integrators shouldn't force users down a narrow application path. Rather, flexibility should be the watchword.

Although IBM Corp.'s PC and its clones and Apple Computer Inc.'s Macintosh are the prime targets for writers of integrated software, some authors aren't forsaking 8-bit machines. For example, Arktronics Corp., Ann Arbor, Mich., offers the Jane software package for Apple II and IIe computers and for the Commodore 64 with only 64K bytes of memory. The package comes with word processing, list-manager and

Serving as a sophisticated sleeve that surrounds both the operating system and the applications, Quarterdeck's DESQ employs overlapping windows and manages inter-application communication. By using artificial-intelligence techniques, DESQ "learns" the nuances of applications that are tied into the system.



Digital Research's Concurrent CP/M release 3.1 incorporates a window manager for viewing multiple concurrent operations. This sophisticated package provides for virtual-machine operations, thus extending the use of storage systems. The OEM version is PC-DOS/MS-DOS-compatible. Graphics functions and network hooks are included to ease integrating the operating system and applications in a distributed network system.



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spreadsheet packages. The display method uses a pseudo-window approach and icons, which a user selects using a three-button mouse. The mouse comes with an electrically programmable read-only memory (EPROM) that prevents unauthorized copying of the software. Arktronics has also developed a 16-bit version for the IBM PC, PCjr and 100 percent-compatible PC computer clones.

Packages speak to each other

Another major performance factor of integrated software is that it provides for intra- and inter-application communications. This capability allows data to be entered only once per module or allows the rest of the system to share standalone application. It also eliminates the need for complex data-transformation utilities that a user must write or operate separately.

Making entered data available to all parts of the system enables a user to view multiple data scenarios, as well as to include data in the desired presentation format, such as for business graphics, a letter or a memo.

Intra-application communication is only part of the new integrated packages. Most users are demanding that these packages also be able to use data created under other software applications, such as Micropro International Corp.'s Wordstar or Ashton-Tate's dBase II. Thus, software makers are providing inter-application utilities that permit data to be imported and exported in different formats.

The common formats are the data-interchange format (DIF), Microsoft (SYLK) and standard CP/M systems data format (SDF). The DIF is the most popular, mainly because Software Arts first used it with the VisiCalc program and Lotus and Context Management later adopted it. Microsoft, though, is seeking higher-level integration than DIF offers. The company supplies a rich set of attributes that allows system integrators to furnish several layers of compatibility when transporting or exporting data between applications that support the SYLK format.

Applications look through windows

Because of the excitement surrounding Apple's Macintosh and the ready availability of bit-mapped displays, many integrated applications employ the windows function to establish the user environment. Unlike system-level windowing packages (see "Throwing open the sash on windows software," right), windowed applications supply their own window managers. Many windowing packages employ specific hardware attributes, requiring a special version for each implemented machine. This dedication minimizes application transportability and, in many cases, generated data transportability.

In addition, software writers have found many ways to implement windows. One common way is to overlap windows, as in Apple's Macintosh, and another way is tiling, whereby windows abut each another. Abutting is more memory-tolerant than overlapping, and it usually provides a method of dynamically sizing the window, depending on cursor placement. Although abutting

Throwing open the sash on windows software

Users looking for a windowing package rather than a windowed application have an assortment from which to choose. Although only a few software manufacturers make windowing shell environment packages, the packages do have wide-ranging capabilities. For example, a minimum package puts windows on a single application, and fully extended operating system hardware includes multitasking capability.

Extending the OS

Windowing software from Digital Research Inc., Microsoft Corp. and VisiCorp extended the functions of operating systems to windows, graphics and intra- and inter-application communications. All three companies are aggressive in providing extended capabilities. Digital Research, with its Concurrent CP/M release 3.1, offers PC-DOS compatibility in the OEM version. Microsoft expects to include networking in its MS-Windows, and VisiCorp offers Visi^{on}, which comes with a full line of application software.

A neat shell

Other packages, called "shells," surround the applications and the operating system. For example, in Trillian Computer Corp.'s Visuall, the windowing software also handles intra-application communications, thus further simplifying the interface. Shells typically operate with a pointing device, such as a mouse. Graphicon Systems' Inview and Quarterdeck Office Systems' DESQ can be used with keyboard inputs, and Visi^{on} requires the use of an optical mouse. Microsoft's Windows and Digital Research's Concurrent CP/M both work with a mechanical mouse or with keyboard input because both tailor easily to the system architecture.

Requires modification

Windowing software that extends the operating system also extends hardware functionality. To make applications operate properly, system integrators must modify the applications to match the windowing software's internal operation. Window packages that serve as shells, on the other hand, normally work with any software and need only to be told of an application's existence. Built-in utilities handle data conversions and display characteristics. Both DESQ and Inview contain an automatic learn function that simplifies combining software in the shell.

doesn't always require the use of a pointing device such as a mouse, overlapping windows typically do. In overlapping windows, the sophisticated window manager uses many hardware functions to permit the correct repainting of an underlying window.

According to Terry Myers, president of Quarterdeck Office Systems, Santa Monica, Calif., the trend is

toward user-personalized packages, and integrated packages provide a path to such packages. "There are really only a few things that you do on a regular basis [with integrated packages], and you want quick access [to these functions]. The desktop metaphor that Apple is popularizing is an accurate way of depicting what we and all the other software manufacturers are trying to

Company Product	Memory (K bytes)	Application shell	OS extension	Systems	Price (\$)	Notes, features, options
DIGITAL RESEARCH INC. P.O. Box 579 Pacific Grove, CA 93950 (408) 649-3896 Circle No. 829						
Concurrent CP/M release 3.1	256	●		8080/8086 based systems with bit-mapped displays	150	multi-tasking operating system with windows, supports GSX graphic extensions and 8087 math chip, OEM version: PC-DOS compatibility
GRAPHICON SOFTWARE INC. 399 Sherman Ave., Suite 10 Palo Alto, CA 94306 (415) 329-1791 Circle No. 830						
INVIEW	256	●		IBM PC/XT and 100% IBM PC compatibles	295	operates with monochrome or color display cards, has "learn" capability, requires DOS 2.0
MICROSOFT CORP. 10700 Northup Way Bellevue, WA 98004 (206) 828-8080 Circle No. 831						
MS-Windows	192	●		8080/8086 based systems with bit-mapped display	795	OEM/Ind. Software Vendor Toolkit includes: Windows, C and Pascal languages, menu manager
QUARTERDECK SOFTWARE INC. 1918 Main St., Suite 240 Santa Monica, CA 90405 (213) 392-9851 Circle No. 832						
DESEQ	512	●		IBM PC/XT, Compaq, DEC Rainbow 100	399	has monochrome and color capability, overlapping windows, establishes inter-application communications
STRUCTURED SYSTEMS GROUP INC. 5204 Claremont Ave. Oakland, CA 94618 (415) 547-1567 Circle No. 833						
Window Master	256	●		IBM PC/XT and 100% IBM PC compatibles	295	includes graphics, handles inner-application communications
TRILLIAN COMPUTER P.O. Box 481 Los Gatos, CA 95031 (408) 374-5001 Circle No. 834						
VISUALL	128	●		IBM PC/XT, PCjr	50-70 (PCjr) 99.95 (PC/XT)	does not allow data exchange between application programs; serves only as a "window shell" around individual applications
VISICORP 2895 Zanker Rd. San Jose, CA 95134 (408) 946-9000 Circle No. 835						
Vision	512	●		8080/8086 based systems with bit-mapped displays	95	requires DOS 2.0, hard disk, RS232C port and optical mouse

do." Myers concedes that there are a number of ways to depict a desktop but believes users are more comfortable in an environment with a windowing function.

Query Computing Systems Inc., Torrance, Calif., offers an interesting twist on the "to-window-or-not-to-window" question—the Quick Integrated Office (QIO) package. According to Steve Bostwick, company president and chief designer of the product, windowing methods complement product operation: "Graphics depict various functions such as file cabinets on the screen; pop-up and pull-down windows serve as guideposts for the user—not as fancy front ends to increase the price."

Generic integrated software usually consists of five standard functions.

Besides conservative use of QIO's window functions, Query has used only generic calls to the operating system. "Our goal," explains Bostwick, "was to create an application that could be transported across a wide range of machines. By coding in PL.1 and using a modular design, we can quickly port QIO from machine to machine and operating system to operating system."

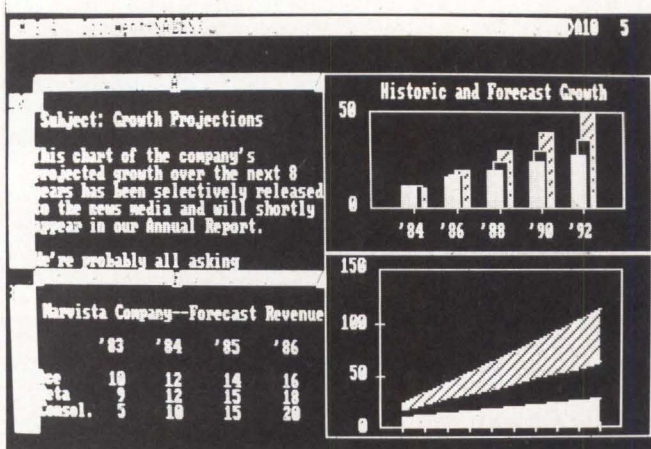
Another company with a different slant on integrated software is Fox & Geller Inc., whose OZ financial-management package company president Jeffrey Fox defines as a new category of integrated software. Unlike other packages, OZ integrates profit-and-loss forecasting, financial reports, variance analysis, business graphics and 3D data analysis. Like other five-function integrated packages, OZ lets users employ the data entered once to perform all functions. But OZ does not include a standard spreadsheet, database

manager or windowing functions. Users can get windowing functions with OZ by attaching it to Quarterdeck's DESQ or to Graphicon Systems' Inview shells.

Another company that is taking its own approach to integrated software is Softrend Inc., Salem, N.H., with its \$495 Aura package. This full-featured database-management system provides free-form screen entry design and report creation, a spreadsheet with linking and zoom capability and a word-processing package that simultaneously handles as many as three documents. Aura performs these functions without using windows. Instead, it uses menus that travel with



Offering an innovative approach to an integrated system, the Gavilan mobile computer closely couples the operation of software and hardware. It incorporates a touch-panel pointing system for manipulating the cursor.



Offering a full-featured, five-function integrated business package, Context Management's Corporate MBA uses a tiled windowing system, rather than overlapping windows, to avoid overtaxing system resources and to promote ease of use.

the user's current level of operation, thus allowing the user to get help with one keystroke.

Aura also provides high-level graphics flexibility. Rather than restrict users to creating standard business charts, Aura includes a free-form capability and library functions, permitting users to create lines, boxes, circles, arcs and polygons using keystrokes and a cursor rather than a mouse. The Aura package can be easily integrated into virtually all the windowing packages.

Possibly the most ambitious approach is offered by Martin Marietta subsidiary ITSoftware Inc., Princeton, N.J. The company's IT packages contain linked modules that offer everything from database management to high-level statistical software. Each module can stand alone but can simultaneously provide links to the other modules in the family. In addition, ITSoftware ensures that the microcomputer software

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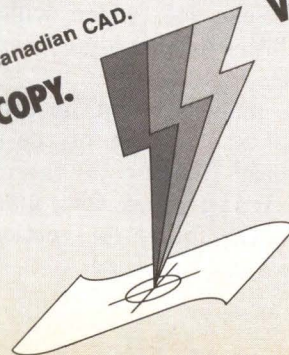
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is fully compatible with mainframe software. Like Context Management, it offers 3270 emulation using Digital Communications Associates Inc.'s IRMA board for the IBM PC.

Taking a similar approach is Innovative Software Inc., Overland Park, Kan., with its The Smart Set. Sold as separate modules, the package comes with word-processing, spreadsheet and database-management functions. Innovative uses windows to enhance rather than surround each application. "The question is one of loosely coupled vs. tightly coupled. We chose the former because it allows more flexibility," says company president Michael J. Brown.

A reasonable interface guess

What the user interface will ultimately be isn't clear to various hardware manufacturers. For example, Edward E. Kuerner, software and communications support manager for Qume Corp., San Jose, Calif., the maker of PC-clone Extra system, says, "It's too early to tell because the jury is still out. And I don't think anyone will really have a clear picture for about a year." Qume has committed to using Microsoft's Windows to handle the user interface and hopes it is the right choice.

Gary White, manager of microsystem commodity software development at Honeywell Information Systems, says that Honeywell will use the interface that permits the company to handle commodity software with a minimum of trouble. Now, Honeywell prefers using Microsoft's Windows to provide Honeywell with an integrated performance platform. Similarly, DEC believes that its Rainbow microcomputer will be many things to many people. DEC isn't locked into one windowing concept but has elected to use both Quarterdeck's DESQ and Microsoft's Windows. The concept, according to a company spokesman, is that the window portion serves as the actual interface between user and machine.

Extensions attain prominence

Extensibility is key to what software integrators want. They are seeking ways to develop software packages that can be upgraded with the least difficulty. Ashton-Tate, for example, is expected this month to introduce dBase III, which will offer windows and possibly utilities for providing inter-application communications.

Software makers might be premature in planning extensions because most of the products announced over the past five months aren't yet ready to be delivered. It's unclear how much the market can absorb, but the future for vertical packages appears bright. □

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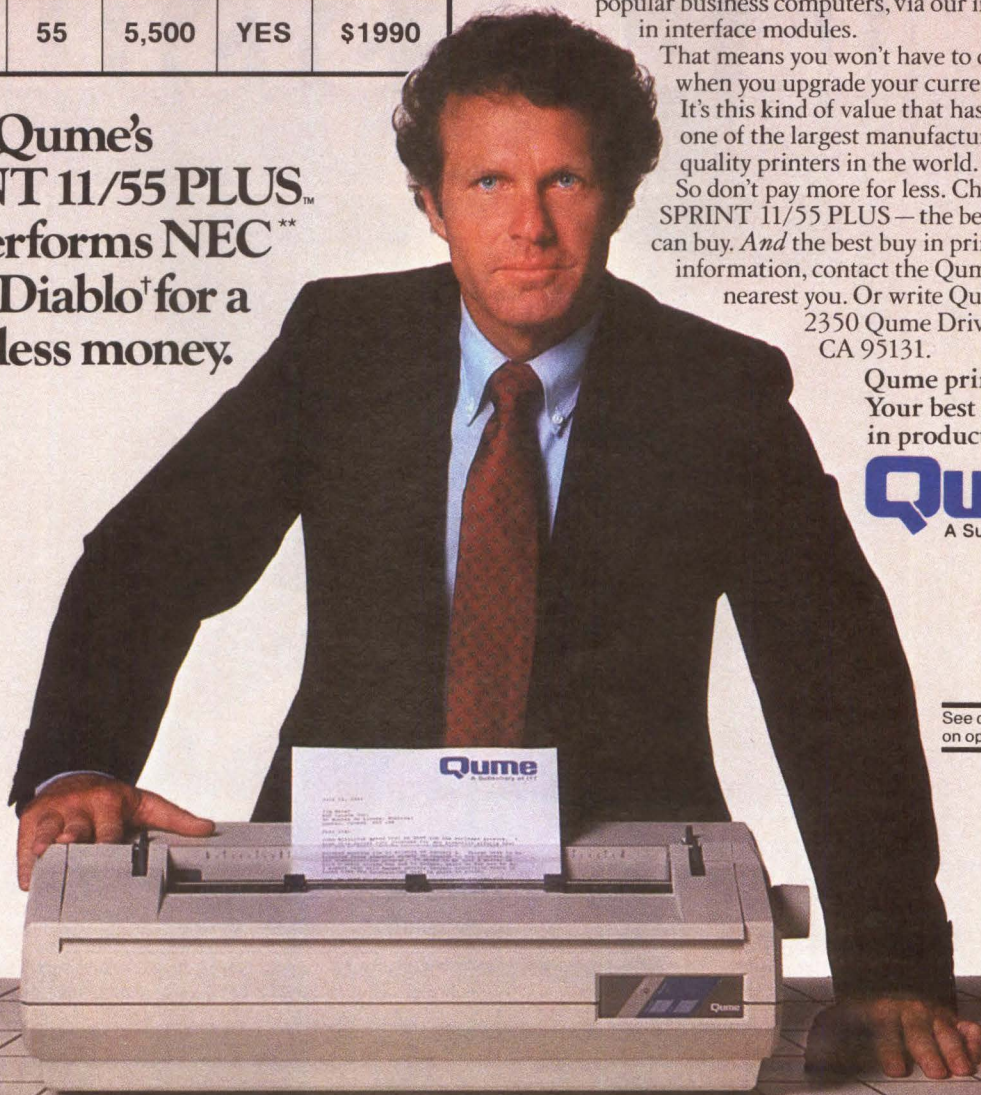
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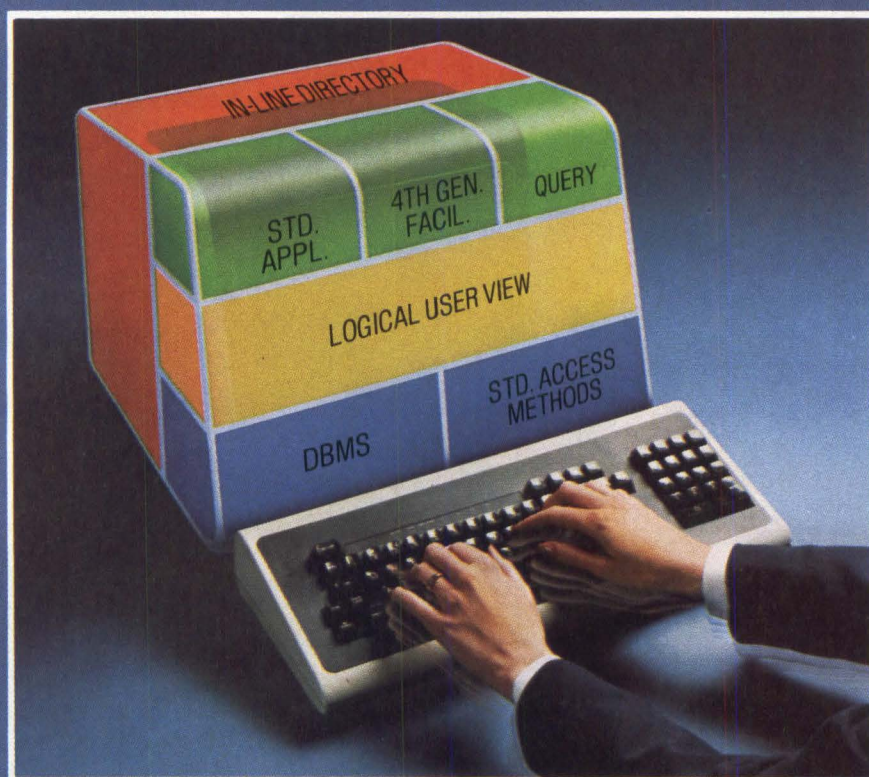
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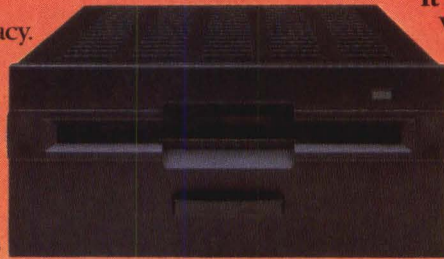
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ADVANCED BUSINESS COMPUTING INC. 1580 N. Northwest Highway Park Ridge, IL 60068 (312) 298-0997 (800) 232-6901 Circle No. 837									
DATA SPECTRUM	●	●		●		Apple II series, Franklin, IBM PC and compatibles	64	250	word processing limited to text editing, performs simple mathematical functions
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ALADIN	●		●	●		Apple, IBM PC and compatibles, NCR, HP, Victor	64 (Apple II) 256 (Apple III) 128 (PC-DOS 1.1) 192 (PC-DOS 2.0)	595 (Apple) 795 (others)	relational database, interfaces to PASCAL, supports network communications, integrates with other packages such as dBASE II, Lotus
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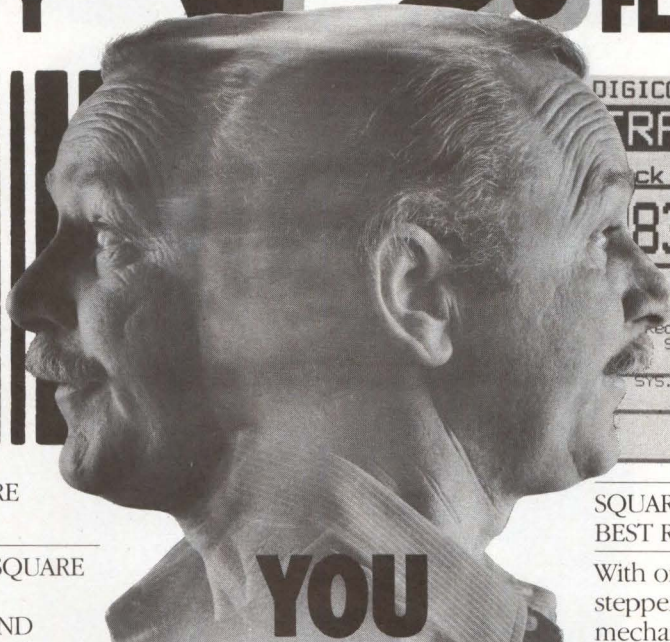
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Company Product	Database	Spreadsheet	Graphics	Word processing	Communications	Systems	Memory required (K bytes)	Unit price (\$)	Notes, features, options
CULLINET 400 Blue Hill Dr. Westwood, MA 02090 (617) 329-7700 Circle No. 843									
PERSONAL COMPUTER SOFTWARE	●	●	●	●	●	PC-DOS	256	1,200	relational database, electronic mail capabilities when connected to mainframe
EMERGING TECHNOLOGY CONSULTANTS INC. 2031 Broadway Boulder, CO 80302 (303) 447-9495 Circle No. 844									
OFFIX	●			●		IBM PC and some compatibles	192	149	mail merge facility, report generation, help screen, on-line tutorial
EXECUTEC CORP. 12200 Park Central Dr. Dallas, TX 75251 (214) 239-8080 Circle No. 845									
SERIES ONE PLUS	●	●		●		most MS-DOS machines	192	495	graphics module available \$295; built-in EXECUBUS Master program
INNOVATIVE SOFTWARE 9300 W. North St. #380 Overland Park, KS (913) 383-1089 Circle No. 846									
SMART SET	●	●	●	●	●	IBM PC and compatibles	128	475-595	compatibles must emulate IBM PC exactly, pricing varies with module options
LOTUS DEVELOPMENT CORP. 161 First St. Cambridge, MA 02142 (617) 492-7171 Circle No. 847									
LOTUS 1-2-3	●	●	●	●		IBM PC and compatibles	256	495	graphics card permits simultaneous graphics/text display, automatic worksheet loading, word processing limited to text editing
Symphony	●	●	●	●	●	IBM PC, XT	320	695	open-ended feature allows user to customize or add to product, limited time offer to 1-2-3 users: trade-in 1-2-3 for Symphony at \$200
MARTIN MARIETTA DATA SYSTEMS/IT SOFTWARE P.O. Box 2392 Princeton, N.J. 08540 (609) 799-7500 (800) 222-0592 Circle No. 848									
IT	●	●	●	●	●	IBM PC and compatibles	128, 320	125-250	IBM SNA capability, price varies with module options
METASOFT CORP. 6509 W. Frye Rd., Suite 12 Chandler, AZ 85224 (602) 961-0003 Circle No. 849									
EXECUTIVE BENCHPAK 4.0	●			●		IBM PC and compatibles	128	495	price includes spelling checker and administrator modules
EXECUTIVE BENCHPAC POWERPAC 1		●	●			IBM PC and compatibles	128	395	includes administrator module
EXECUTIVE BENCHPAK POWERPAC 2		●	●	●		IBM PC and compatibles	128	595	price includes administrator module, opt. spelling checker
EXECUTIVE BENCHPAC POWERPAC 3	●	●	●	●		IBM PC and compatibles	128	795	price includes administrator module
EXECUTIVE BENCHPAC SUPERPAC	●	●	●	●	●	IBM PC and compatibles	128	995	word processing includes spelling checker, administrator module includes "notebook" and "message" functions

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WITH THE NEW INTERMEC SQUARE MATRIX PRINTER YOU GET SUPERIOR PRINT QUALITY AND TOTAL FORMAT FLEXIBILITY AT DOT MATRIX PRICES.

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For Literature, Circle Number 198.

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SQUARE MATRIX PRINTERS OFFER BEST RELIABILITY.

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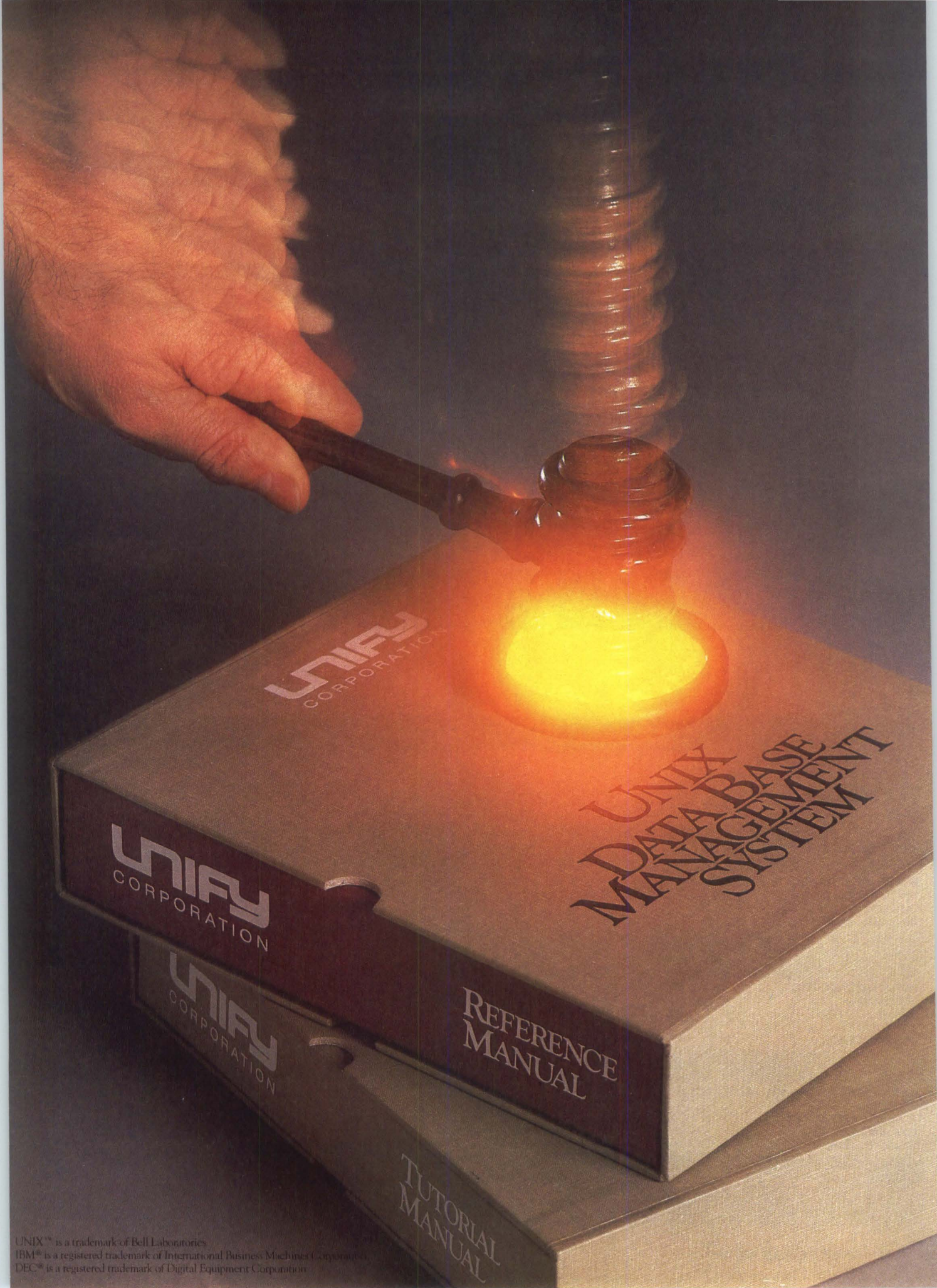
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MINI-MICRO SYSTEMS/May 1984

MULTI-FUNCTION SOFTWARE

Company Product	Database	Spreadsheet	Graphics	Word processing	Communications	Systems	Memory required (K bytes)	Unit price (\$)	Notes, features, options
MICRO SOFTWARE INTERNATIONAL 44 Oak St. Newton Upper Falls, MA 02164 (617) 965-9870 Circle No. 850									
PRACTIWORD/ PRACTICALC 3/ PRACTIBASE	●	●		●		IBM PC, PCjr	64, 128	99/module	each module sold separately, delivery June, 1984
MICROSOFT CORP. 10700 Northrup Way Bellevue, WA 98004 (206) 828-8080 Circle No. 851									
MULTIPLAN		●				Apple II	56	275	electronic worksheet
MOSAIC SOFTWARE INC. 1972 Massachusetts Ave. Cambridge, MA 02140 (617) 491-2434 Circle No. 852									
INTEGRATED 6	●	●	●	●	●	IBM PC, XT; Compaq	320	495	sixth module performs DEC-VT 52, 100 and IBM 3101 terminal emulation
NOUMENON 512 Westline Dr. Alameda, CA 94501 Circle No. 853									
INTUIT	●	●	●	●	●	IBM PC, XT; Corona, Columbia, Compaq	256	395	4-function calculator, communications enhancement available
ODESTA 3186 Doolittle Northbrook, IL 60062 (312) 498-5615 (800) 323-5423 Circle No. 854									
HELIX	●	●	●	●		Apple III, Lisa, Macintosh		395	relational database, form generation, limited spreadsheet capabilities
OVATION TECHNOLOGY 320 Norwood Park S. Norwood, MA 02062 (617) 769-9300 Circle No. 855									
OVATION	●	●	●	●	●	IBM PC and compatibles, Tandy 2000	512	795	all functions can be performed on one screen, utilizes 30 common commands, can transport data from other similar software packages
PRENTICE HALL INC. 200 Old Tappan Rd. Old Tappan, NJ 07675 Circle No. 856									
THE PROFIT CENTER	●	●	●	●		IBM PC/XT; most MS-DOS machines	128	250 & up	21 modules, interfaces to several popular systems
PYRAMID DATA LTD. P.O. Box 10116 Santa Ana, CA 92711 (714) 639-1527 Circle No. 857									
NUMBER CRUNCHER III JR.	●		●	●		IBM PC, XT; Compaq, Corona	128	695	includes word processing application generator
QUERY COMPUTING SYSTEMS INC. 2707 Toledo Torrance, CA 90505 (213) 320-0561 Circle No. 858									
QUICK INTEGRATED OFFICE (QIO)	●	●	●	●	●	Apple, Commodore, IBM PC, PCjr; Epson QX-10		79.95	modules purchased individually, add-ons range from \$19.95-\$59.95



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and industry standard IBM SQL query language make it easy for non-programmers to develop data base applications.

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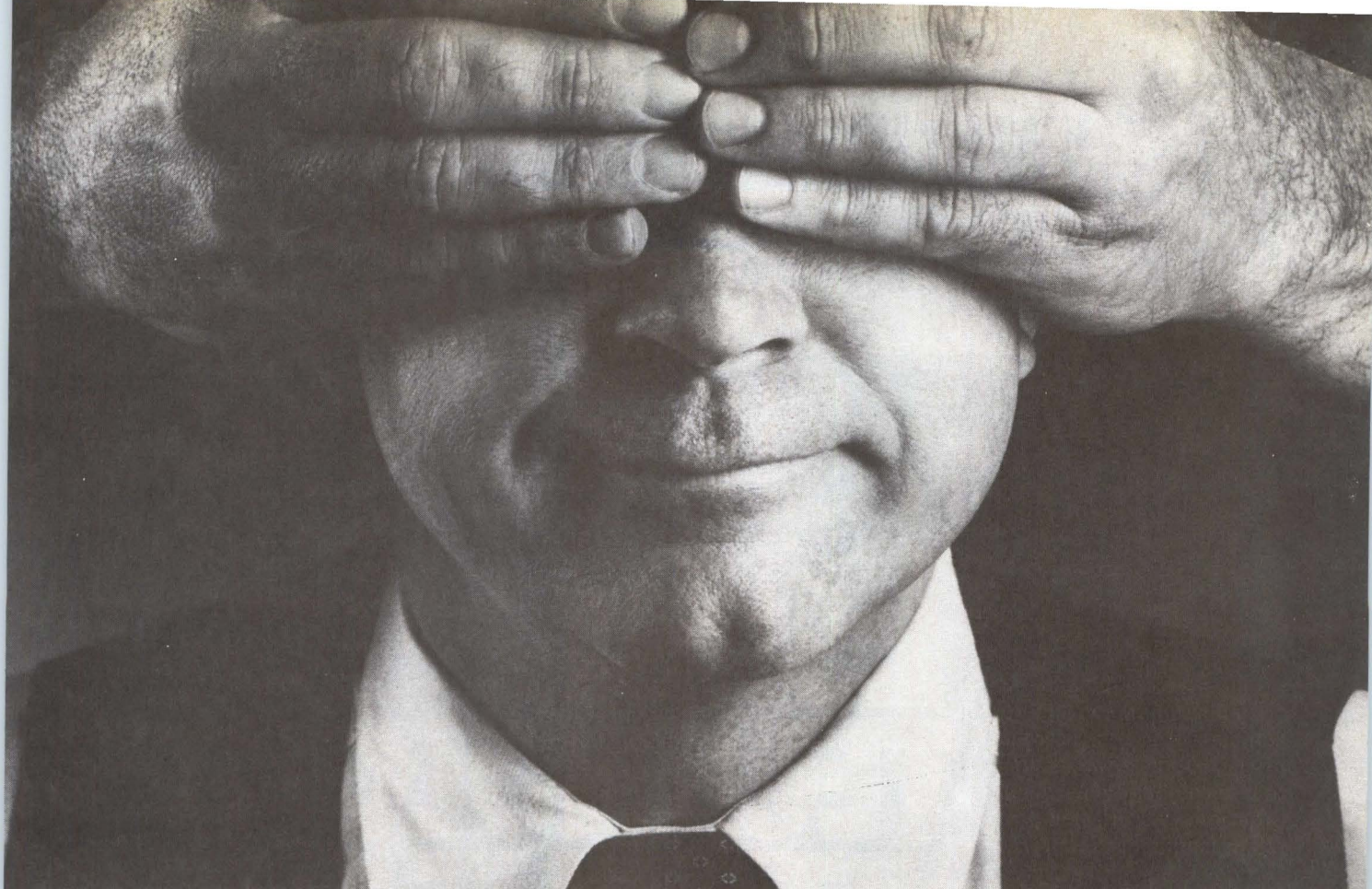
To order, contact UNIFY, Department MM-3, 9570 S.W. Barbur Blvd., Portland, Oregon 97219, 503-245-6585.

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CIRCLE NO. 106 ON INQUIRY CARD

MULTI-FUNCTION SOFTWARE

Company Product	Database	Spreadsheet	Graphics	Word processing	Communications	Systems	Memory required (K bytes)	Unit Price (\$)	Notes, features, options
SCIENTIFIC MARKETING INC. 3303 Harbor Blvd., Suite G-9 Costa Mesa, CA 92626 (714) 957-0225 Circle No. 859									
MARKETFAX	●			●		all CP/M 8-bit and MS-DOS machines	64, 128	under 300	specialized package for securities market applications, handles mail list and letter generation
SI TABS 990 Hillside Ave. Victoria, British Columbia, CANADA V 8T 2A1 (604) 381-3113 Circle No. 860									
EASYTABS	●			●		IBM PC, Victor, Apple IIe	64	189/ module	add-on modules include accounts receivable, general ledger
SOFTWARE PRODUCTS INTERNATIONAL 10240 Sorrento Valley Rd. San Diego, CA 92121 (619) 450-1526 Circle No. 861									
OPEN ACCESS	●	●	●	●	●	IBM PC and compatibles	256	595	needs graphics card, uses 3-button mouse
SOFTREND INC. 2 Manor Parkway Salem, NH 03079 (603) 898-1896 Circle No. 862									
AURA	●	●	●	●		IBM PC and compatibles	128	495	works with or without graphics card
SORCIM CORP. 2310 Lundy Ave. San Jose, CA 95133 (408) 942-1727 Circle No. 863									
SUPERCALC ³	●	●	●	●		IBM PC and compatibles		395	word processing limited to text editing, limited data database capability
STRUCTURED SYSTEMS GROUP INC. 5204 Claremont Ave. Oakland, CA 94618 (415) 547-1567 Circle No. 864									
WINDOWPAK	●	●	●	●		IBM PC	256	495	extension of Structured System's WORDMASTER, includes 5 application packages



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If you still haven't seen the Pioneer hard disk drive tester in action, it's time to take a look. And judge for yourself.

Beginning with the price tag, every aspect of the Pioneer Qualifier™ is designed to meet your requirements for pocketbook *and* performance.

It's the only tester to interface with any and all SMD drives.

It's the only one with a hefty 20-megabit per second capability. Even at triple the price.

It's the only one that can read and transfer Fujitsu's error map right into your computer. In seconds.

It's the only one that will format to your custom specs. And it does it at one megabyte per second. Over five times faster than by computer.

It pinpoints your errors to a specific media sector. And separates the correctable from the uncorrectable. So you can detect and log either set.

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And also checks the address mark capability of your drive? And isolates

intermittents in the output? And works with embedded servos? And can be multiplexed to test four drives at once?

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California). Rep opportunities available.



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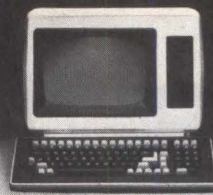
CIRCLE NO. 107 ON INQUIRY CARD



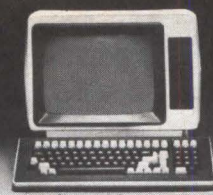
Esprit I



Esprit II



Esprit III



Esprit III Color



ESP-6310



Executive 10

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Executive 10/25



Executive 10/51



Executive 10/78



Executive 10/102



Executive 10/102G

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PEACE OF MIND TECHNOLOGY.

CIRCLE NO. 108 ON INQUIRY CARD

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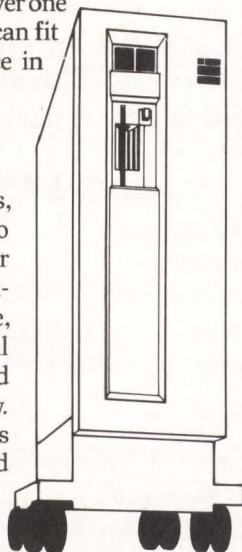
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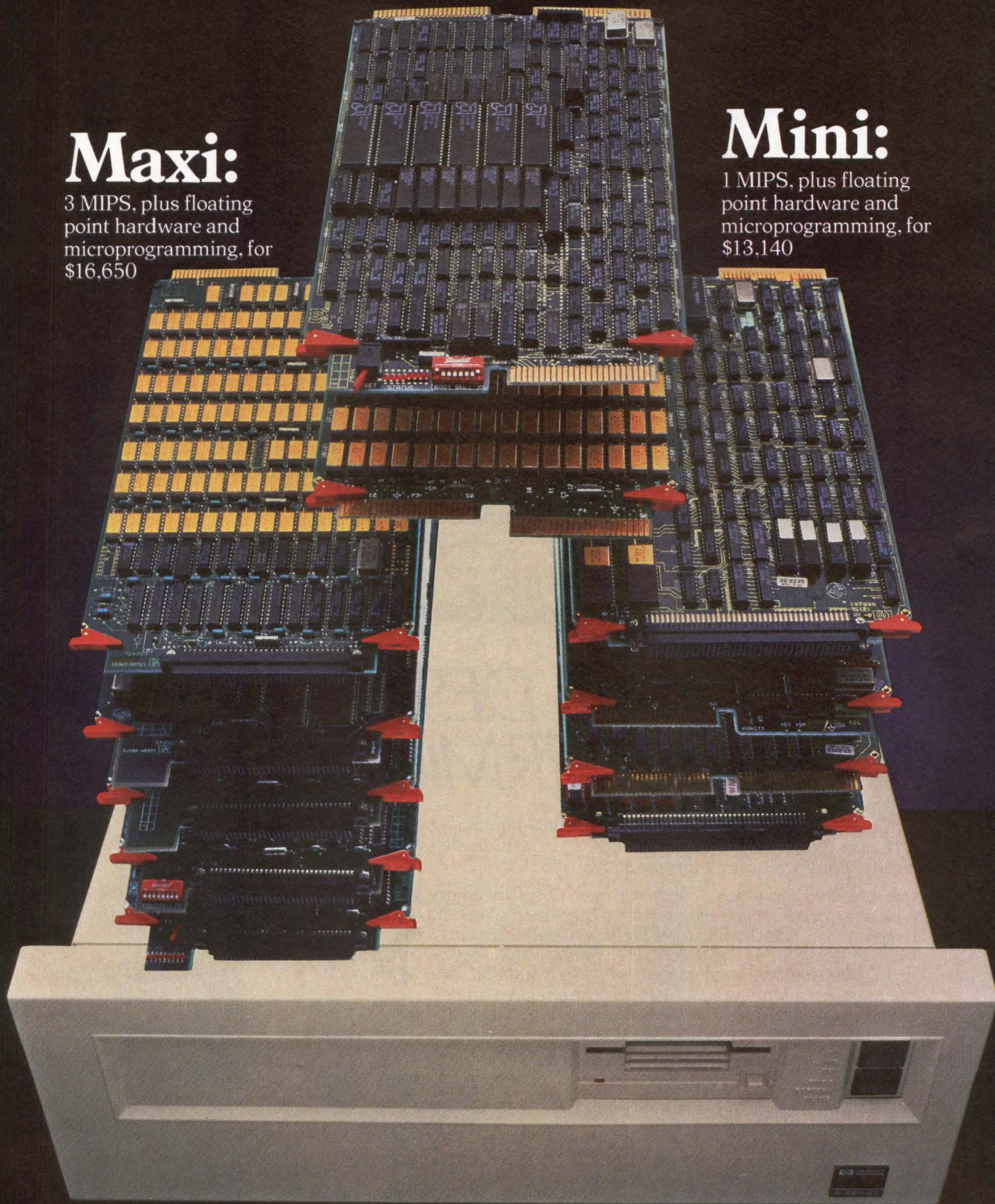
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New York/New York	(516) 496-4777
Texas/Dallas	(214) 258-6776
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VT200 terminals incorporate higher text speed and multinational features

A direct CRT drive in the VT220 and three processors in the VT240/241 boost performance and save space

Robert E. Huettner, David A. Banks and John F. Elsbree Jr., Digital Equipment Corp.

Digital Equipment Corp.'s VT200 terminals extend the capabilities of the VT100 family by providing higher text speed and full color graphics. They also feature a variety of international characteristics, including a universal power supply, keyboards for 16 languages and compliance with international standards. A variety of ergonomic features, such as a low-profile keyboard; non-glare screens; and white, green or amber phosphors, also differentiates the VT200 family from the VT100 line.

The terminals incorporate unconventional packaging and design to increase performance and reduce size. The VT220, for example, uses a direct CRT drive instead of composite video signals. In the VT240/241, the graphics controller handles bit-mapped planes in parallel rather than in sequence, which doubles display speed. In addition, the VT240/241 uses three processors and implements in firmware many functions usually executed in hardware.

Packaging saves space, cost

The VT200 family comprises the VT220 monochromatic text terminal, the VT240 text and monochromatic graphics terminal and the VT241 text and color graphics terminal. The terminals use the same keyboard and monitors found in DEC's Professional, Rainbow and DECmate II personal computers.

The low-end VT220 consists of a keyboard and a 12-inch monitor. The monitor assembly contains the CRT electronics, terminal-control logic and power supply. The VT240 and VT241 include 12- and 13-inch monitors, respectively, and a system box containing the power supply; I/O hardware; and terminal, character and graphics display processors.

In the VT220, the CRT electronics, terminal-control logic and power supply are on two boards instead of

three, as in traditional terminals. Although three boards would fit into the monitor casing, using two boards saves space and reduces production-testing time. The power supply and monitor electronics are on one board at the base of the monitor's frame, and the terminal-control logic is on a second board at the side of the frame.

The large spacing of etched lines required by the International Electrotechnical Commission (IEC)-380 safety standard contributed to a power-supply/monitor electronics board size of 95 square inches. To obtain additional board area, engineers mounted the fly-back transformer, which is usually located with other monitor circuitry, on the other side of the frame.

The VT220 does not need a cooling fan because its components are positioned for minimal heat concentration. Convective air flows through a rectangular grill in the bottom of the enclosure through slots in the top surface. Another spacesaver is a switching power supply that replaces the large linear power supplies used in traditional terminals. The 35W switching supply operates at 65 percent efficiency compared with

Digital's VT200 family includes the VT220 monochromatic alphanumeric terminal (left), the color graphics VT241 (center) and the monochromatic-graphics VT240 (right). Prices are \$1,295, \$3,195 and \$2,195, respectively.



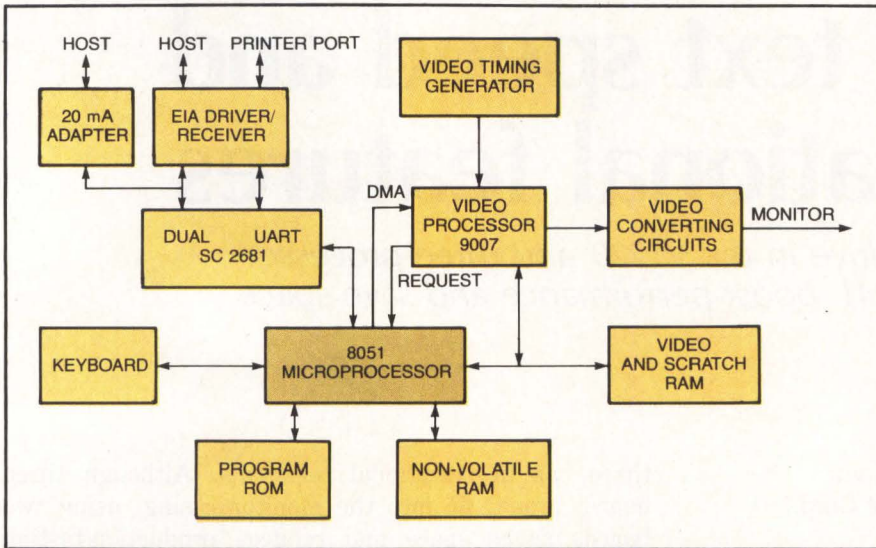
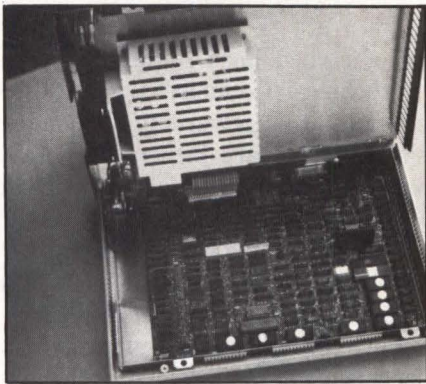
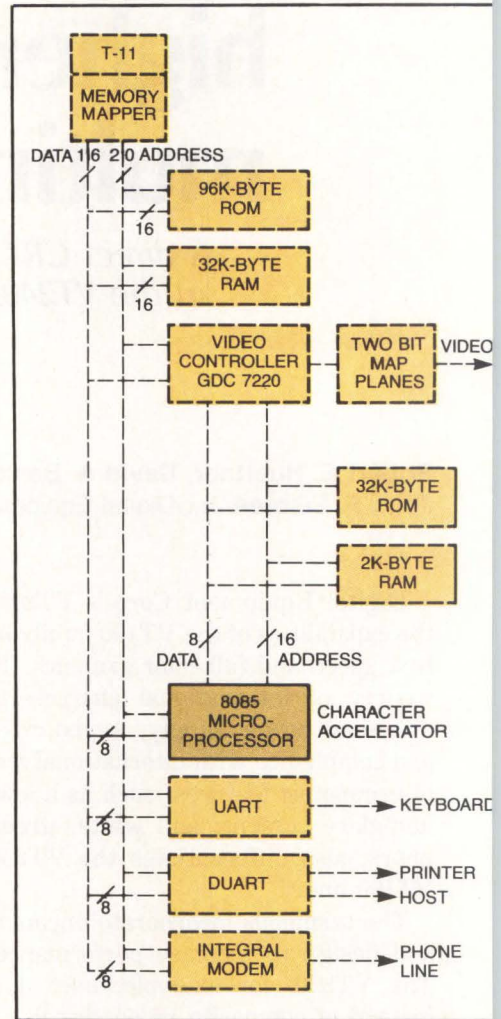


Fig. 1. (above) The VT220 terminal-control logic board includes a special-purpose 9007 video processor and an 8051 microprocessor. The 8051's built-in peripheral functions reduce cost and size and increase text speed.



The VT240/241 system box (left) contains the system board (three microprocessors, RAM and ROM devices and I/O circuits), an optional integrated modem board and an upper chassis containing the power supply and associated circuits and switches.

Fig. 2. (right) The VT240/241 system board includes three microprocessors. DEC's T-11 handles all I/O operations (including communications protocols), control of the keyboard and GDC 7220 video controller, the setup mode and the color palette. The main function of the 8085 processor is character acceleration, which off-loads time-consuming tasks from the T-11.



50 percent efficiency for most linear power supplies. Putting the monitor electronics and terminal-control logic into one enclosure reduces costs and increases monitor-drive performance. The monitor receives video data alone, rather than composite video (a video signal and a composite synchronization signal), which eliminates sync-stripping circuitry. Instead of the RS170-standard 0.7V maximum for video data, the direct drive provides a voltage swing of about 2V, resulting in tighter display control and sharper images. The VT220 control logic board (Fig. 1) contains standard IC devices and keyboard interface circuitry that is the same as that in DEC's personal computers. The board implements several functions, including the timing circuitry, in a custom gate array to conserve board space. The two principal components on the board are the special-purpose Standard Microsystems Corp. (SMC) 9007 video processor and the 8051 microprocessor. The 8051's built-in peripheral functions reduce cost and size and, more importantly, increase the terminal's text

speed, which is the maximum number of characters per second (cps) that a terminal can accept from a host computer. The VT200 models have a text speed of 960 cps without restraint or a line rate of 9,600 baud. This speed doubles the 480-cps text speed provided in the VT100 family. The processor board contains 28K bytes of program ROM, with 4K bytes built into the 8051 and two external chips of 8K and 16K bytes. Without the 8051's built-in ROM, the terminal would require two external 16K-byte ROMs. The keyboard, printer port and host interface require one universal asynchronous receiver/transmitter (UART) and one dual UART. A separate single UART is unnecessary because the 8051 has an integral UART. The dual-UART package includes two general-purpose registers for communications tasks and miscellaneous functions that would otherwise require additional hardware. Five bit positions in the 8-bit output register provide status signals for display video, 132-column mode, bank select 1 and 2 (memory

SIMPLY OUTSTANDING



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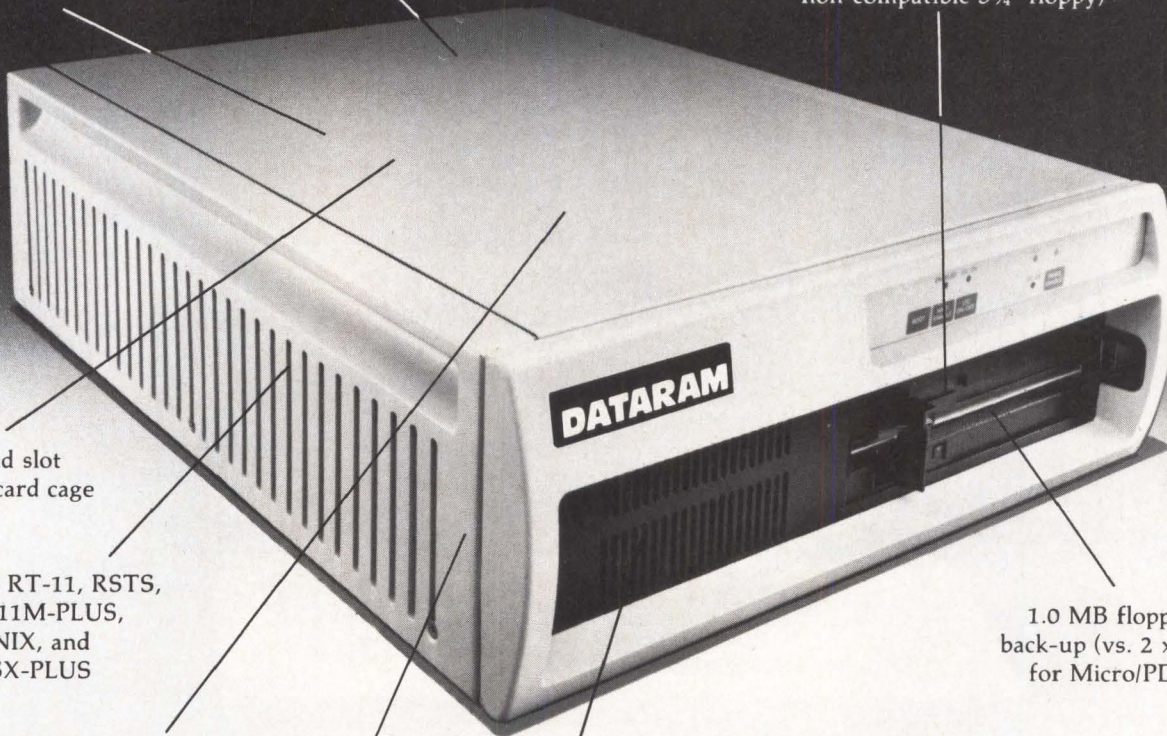
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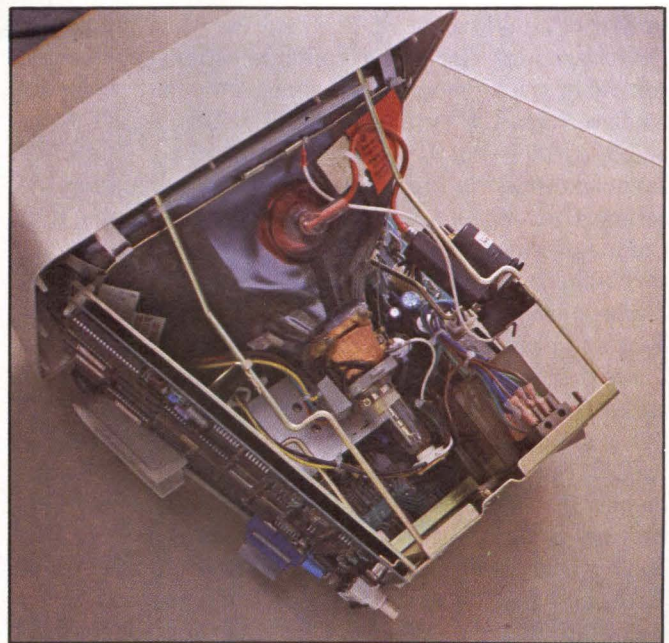
address groupings) and blink. The three other bit positions are used for communications functions.

The 8051 microprocessor and 9007 video processor use the same bus to access video RAM. The 8051 transfers character codes from the host to video RAM, and the 9007 transfers the codes from video RAM to the line buffer, which generates the video drive.

In conventional video terminals, the general-purpose microprocessor is idle for approximately 10 percent of the time while the video processor controls the bus to video RAM. In the VT220, the 8051 uses that time to perform keyboard processing operations. Eliminating idle processor time is the main reason for the VT220's high text speed. The 8051 also includes efficient firmware (written in assembly language) and a fast clock rate. The 8051 runs at 11 MHz, in contrast to 3 MHz for the 8080 microprocessor in the VT100.

Three processors handle text, graphics, I/O

The system box for the VT240/241 terminals is identical for the monochromatic graphics VT240 and the color graphics VT241. The box contains a 10.4-by-14.8-inch system board that handles all functions, excluding the optional integrated modem and the power supply. The board is mounted in the lower portion of a metal chassis shielded against electromagnetic interference. The communications panel on the rear of the chassis contains connectors for the monitor, modem, bidirectional printer port, 20-mA and EIA interface ports, composite output to slave monitor and an auxiliary keyboard connector. The keyboard can hook up to the monitor or to the system box. The removable upper portion of the chassis contains the A/C power components, including the 75W switching power sup-

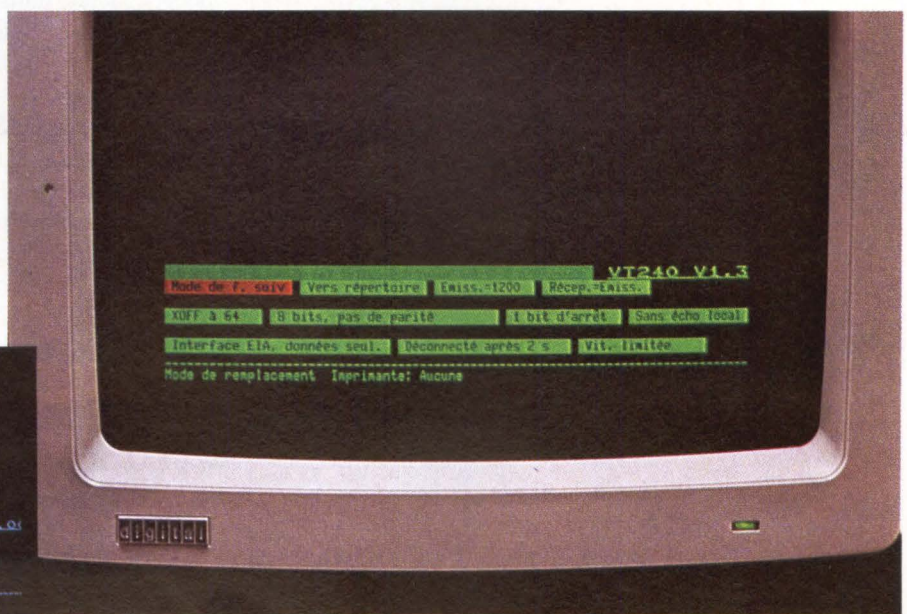
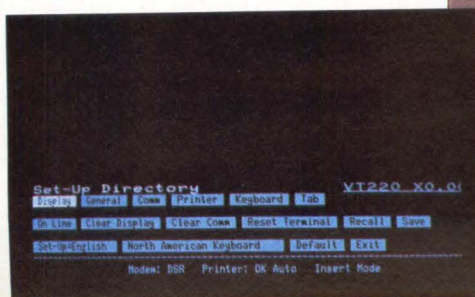


The VT220 monitor assembly contains two printed-circuit boards—one across the bottom for CRT electronics and power supply and another on the side for terminal-control logic. Combining monitor electronics and terminal-control logic in one package permits sending video data, rather than composite video, to the monitor, which eliminates the need for sync-stripping circuitry.

ply, a 3-inch axial cooling fan, an on-off switch, a fuse and a voltage-selection switch.

The VT240/241 system board includes three processing engines: a T-11, an 8085 and an NEC America Inc. graphics display controller (GDC) 7220 (Fig. 2). DEC's T-11 is a general-purpose, 16-bit microprocessor that has the same instruction set as low-end PDP-11s and a read cycle time of 750 nsec., which is roughly equivalent

The VT200 set-up mode displays a directory screen from which the user can select among six set-up screens and ten set-up instructions (below). The communications set-up screen, shown in French (right), includes action fields and parameter fields.



to that of a mid-range PDP-11/34. The T-11 handles all I/O operations (including communications protocols), control of the keyboard and video controller, the setup mode (using a 128-byte non-volatile RAM), a CRT saver and the color palette (RAM lookup table). The CRT saver extends the life of the phosphor by blanking the screen after 30 minutes of inactivity and returning it at the next keystroke or upon receipt of a character through the communications port.

The 8085 off-loads time-consuming tasks from the T-11 and handles character acceleration, without which the text speed would be reduced to about 180 cps. When an escape sequence informs the T-11 that the VT240/241 is to perform as a text terminal, the T-11 places the ASCII codes of the characters to be displayed in a display list and passes the accumulated display-list characters and position information to the 8085. The 8085 retrieves the character matrices from ROM or RAM and creates a series of GDC commands to write them into bit-map memory. The video controller reads the bit-map memory and creates displays by transferring the data to shift registers. When operating as a graphics terminal, character acceleration is disabled and the 8085 doesn't participate in generating images.

The 8085 also performs text-oriented tasks which otherwise would have to be done by the T-11, including smooth scrolling and split-screen functions, character attributes (bold, blink and inverse video) and user-loadable character sets. When the VT240/241 is in graphics mode, the T-11 receives commands from the

host in either the Tektronix Inc. 4010/4014 graphics protocol or in remote graphics instruction set (ReGIS), DEC's general-purpose graphics protocol.

The GDC 7220 typically recognizes only one bit-map plane at a time, but color graphics (in the VT241) and shades of gray (in the VT240) require processing two bit-map planes. Conventionally, the GDC processes multiple planes in sequence. The VT240/241, however, includes support logic that permits the 7220 to handle two planes simultaneously, thus doubling display speed. The two bit-map planes provide four color possibilities per pixel, and are used to address the color palette, which has six color outputs and two monochrome outputs. The VT241 can simultaneously display four colors out of a palette of 64, and the VT240 can simultaneously display four fixed shades of gray. The color palette, or lookup table, includes RAM and a digital-to-analog converter.

The GDC's support logic consists of two identical programmable array logic (PAL) circuits, which select the bit-mapped memory planes that are to be written into at any given instant. The PAL circuits allow the 7220 to modify an image already resident in the bit-mapped planes and eliminate the need for 20 to 25 discrete ICs.

The VT240/241 board contains 96K bytes of ROM for the T-11 and 32K bytes for the 8085. Most of the T-11's firmware is used for setup, communications protocols, VT100 and VT52 emulation, PDP-11 instruction set and character sets. Implementing the 8085's split-screen and smooth-scrolling functions in firmware eliminates the extra costs and board space required by 22 to 29 discrete ICs.

Marketing video terminals internationally requires incorporating multiple languages and meeting multiple government or industry standards. While standards' compliance is built into the basic terminal design, multiple languages have been provided for in the form of language-specific replaceable character ROMs. All models have a 256-character multinational character set. The terminals comply with major international safety standards, including Underwriters Laboratories (UL), Canadian Standards Association (CSA), *Verband Deutscher Elektrotechniker* (VDE) and International Electrotechnical Commission (IEC)-380. The VT200s also comply with Class B electromagnetic radiation standards (Federal Communications Commission and VDE). □

SPEC SUMMARY

	VT220	VT240	VT241
Display	12-in. non-glare monochromatic	12-in. non-glare monochromatic	13-in. non-glare RGB color
Keyboard	105-key detachable with 15 programmable function keys		
Screen format	24 lines by 80 or 132 characters		
Interfaces	EIA RS232, RS423 and 20 mA standard		
Character sets	ASCII, UK National, Digital Special Graphics (line drawing), Digital Supplemental and user-definable sets		
Character matrix	7 x 10	8 x 10; 5 x 10 in 132-column format	8 x 10; 5 x 10 in 132-column format
Communications	full-duplex asynchronous		
Communication speeds	75, 110, 150, 300, 600, 1,200, 2,400, 4,800, 9,600, 19,200 baud		
Parity	selectable		
Dimensions: (in.)			
monitor	11.1 x 13.1 x 15.25	9.5 x 11.5 x 12	12.8 x 15 x 17
keyboard	2 x 21 x 6.75	2 x 21 x 6.75	2 x 21 x 6.75
system box	n/a	3.5 x 18 x 12	3.5 x 18 x 12
Total weight (lbs)	30.5	36.5	59.1
Price	\$1,295	\$2,195	\$3,195

Robert E. Huettner is business unit manager, **David A. Banks** is product manager, and **John F. Elsbree Jr.** is engineering manager in the video engineering department of Digital Equipment Corp., Maynard, Mass.

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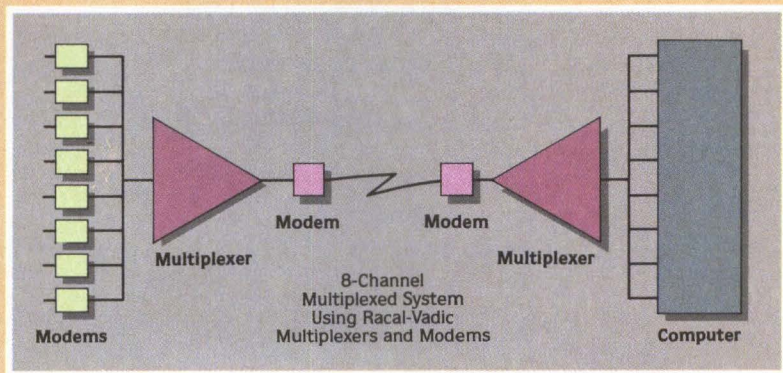
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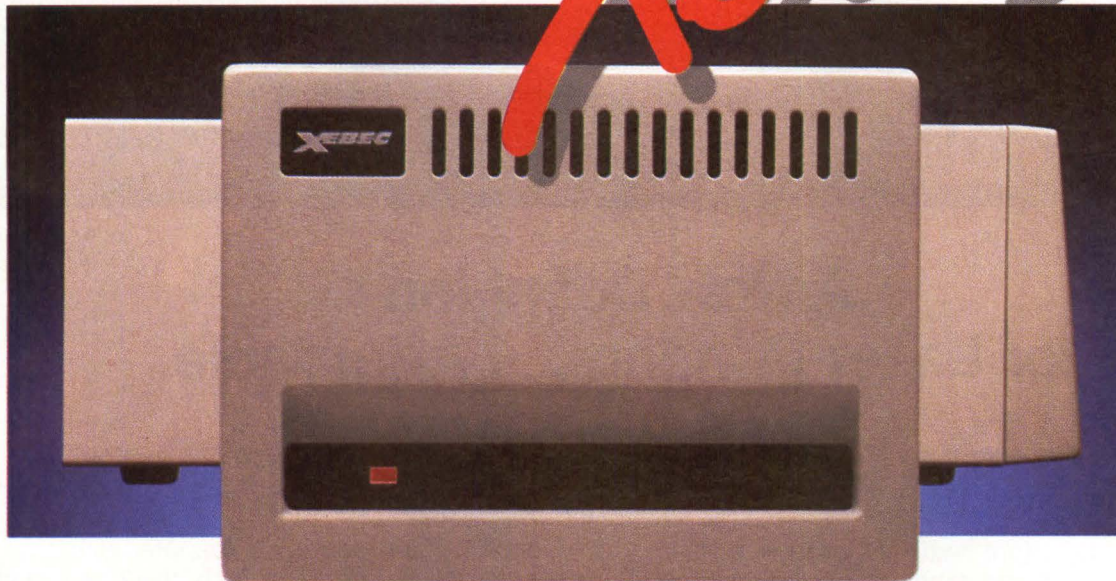
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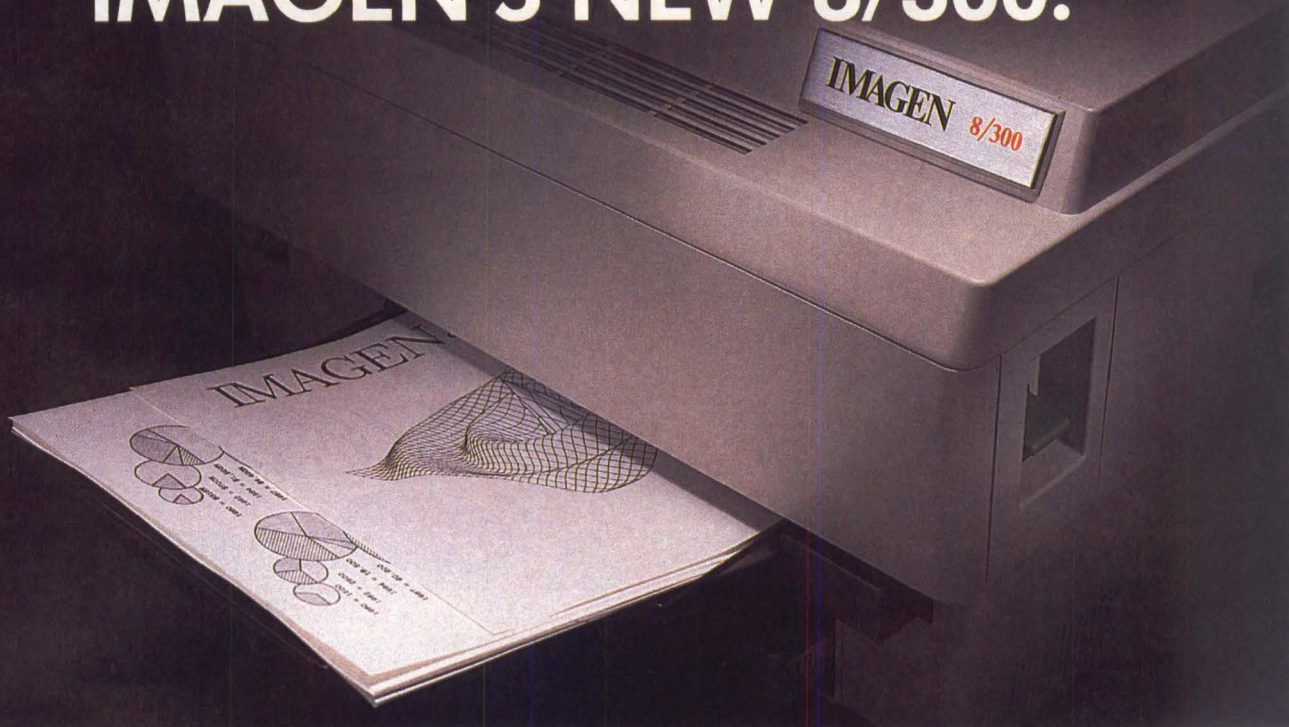
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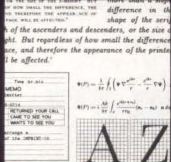
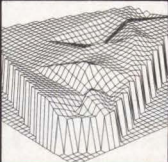
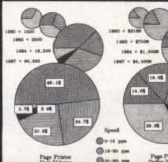

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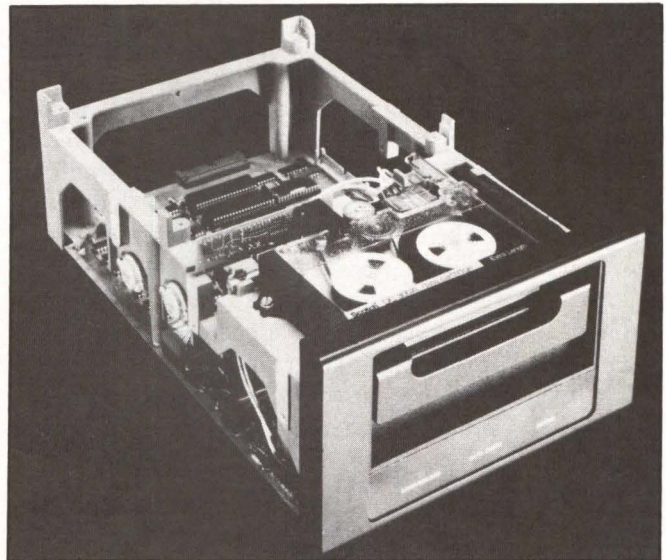
Streaming-tape applications extend beyond backup

Besides mirror backup, full-function 1/4-inch-tape cartridges can provide data compression, file backup and software distribution for Winchester disk drives

A. Sharon and W. Homans, Computer Peripherals Inc.

Streaming-tape drives serving as backup devices can protect data stored on Winchester disk drives from head crashes, computer system hardware and software failure and operator error. Most 1/4-inch cartridge-tape drives, however, can perform only mirror, or image, backup for Winchester drives, copying the entire contents of the disk onto the tape. However, files fragmented on the disk will remain fragmented when transferred to tape. Furthermore, recovery of randomly scattered file segments from tape is difficult and usually involves considerable software overhead. In contrast, full-function, 1/4-inch streaming-tape drives, such as the Control Data Corp. (CDC) model 92190/92192 Sentinel, are not restricted to mirror backup. They can use 1/2-inch streaming-tape-drive software without software modification to implement many of the functions provided by larger and more expensive 1/2-inch cartridge drives, including data compression, individual-file backup, software distribution and archival storage.

In today's multiuser systems, Winchester disk drives typically contain many files that vary in size from tens of kilobytes to tens of megabytes. The operating system's file-management software dynamically allocates the files belonging to different users on the disk. When initially created, file segments are often placed on disk in as contiguous a manner as possible to expedite the backup process. However, additions and changes to the file are usually not adjacent to the



Storing 51M bytes of formatted data on a 450-foot cartridge and 68M bytes on a 600-foot cartridge, CDC's 92190/92192 Sentinel 1/4-inch streaming-tape drive can perform many of the functions of 1/2-inch streamers, including disk compression, individual-file backup, software distribution and archival storage. Operating at 55 inches per second, it repositions in 350 msec. and supports write-error recovery and variable-length records.

original data. This fragmentation can reach the level where no two file segments are contiguous. Retrieving portions of a file that are scattered throughout the disk obviously requires longer and more frequent seek operations and eventually results in degraded system performance.

Disk or data compression, which can be implemented

by using a full-function, 1/4-inch streaming-tape drive, can eliminate frequent seek operations and preserve system throughput by rearranging file segments into a contiguous sequence. The segments are copied sequentially from the various disk locations onto the temporary storage of a streaming-tape unit, then transferred back to the disk and stored contiguously. Many multiuser operating systems, such as UNIX, Pick and OASIS, have software utilities for this function, and the tape produced during disk compression can be used as file-oriented backup for the disk.

Disk compression can eliminate frequent seek operations by rearranging file segments into a contiguous sequence.

File-oriented backup can restore single files

Winchester disks can be backed up by image or by file. Image, or mirror, backup can protect against a system failure by dumping the contents of the disk onto a back-up device in exactly the same order as the files were recorded on the disk.

Because image backup is straightforward, image-dump utilities are simple to write, and they execute quickly, as do utilities to restore the disk from the backup media. However, image backup has some disadvantages. For example, it would be impractical to use it to restore files. Because files fragmented on the disk remain fragmented on the backup tape, recovery of randomly scattered file segments becomes a major and time-consuming software undertaking.

The biggest drawback involves restoring the full disk from the backup media when only one file is damaged. Users who update their files after the backup is completed must update their files again, which can be a problem if the updated data is no longer available. Furthermore, both the disk and the system are

Fig. 1. How hard-disk data rate affects backup streaming-tape drive operation is shown in these timing diagrams. Four 512-byte Winchester disk data sectors transfer to the host computer's 4K-byte main memory data buffer, are compressed into one 2K-byte data block and are then transferred to the backup streaming-tape drive. In A, the Winchester disk supplies data faster than needed by the backup tape, permitting it to stream continuously and allowing the host computer time to stream continuously. Data is thus available to the drive at the end of each inter-block gap. Under low disk-throughput conditions, on the other hand, data cannot be supplied fast enough to support another task. In B, the disk supplies data at exactly the rate the tape drive requires to stream continuously. Data is thus available to the drive at the end of each inter-block gap. Under low disk-throughput conditions, on the other hand, data cannot be supplied fast enough to support another task. In C, no data is immediately available at the end of each inter-block gap, and the tape automatically goes into a repositioning sequence—slowly decelerating, stopping, reversing, stopping again and slowly accelerating—greatly lengthening backup time.

unavailable to users while the full disk image is being restored.

On the other hand, with file-oriented backup—implemented with a full-function streaming-tape drive—a user can back up individual files to protect them from accidental damage and can keep the backup tape. Implementing file-oriented or -selective backup is similar to disk compression. The file data is selected, and a utility gathers the fragmented data blocks from the disk for sequential recording on the backup tape. On multiuser systems the utility can usually run

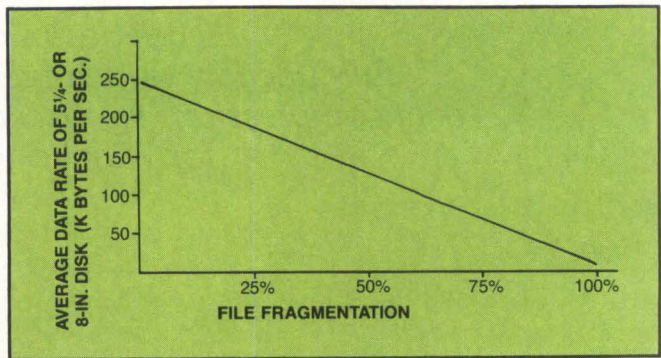
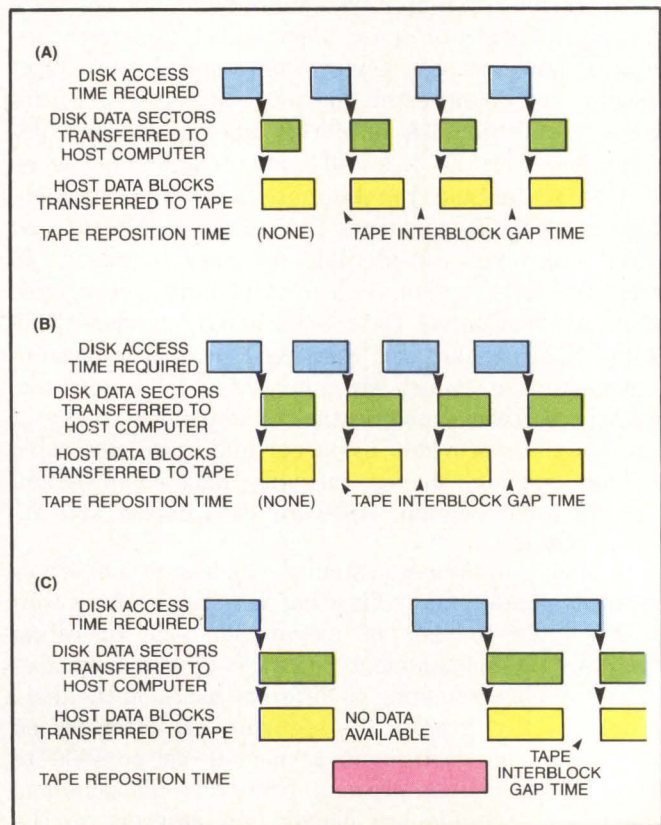


Fig. 2. File fragmentation can significantly reduce Winchester disk throughput in file-oriented backup operations. With a disk sector size of 512 bytes and an average access time of 50 msec., the average data-transfer rate slows to only about 10K bytes per second when files are 100 percent fragmented.



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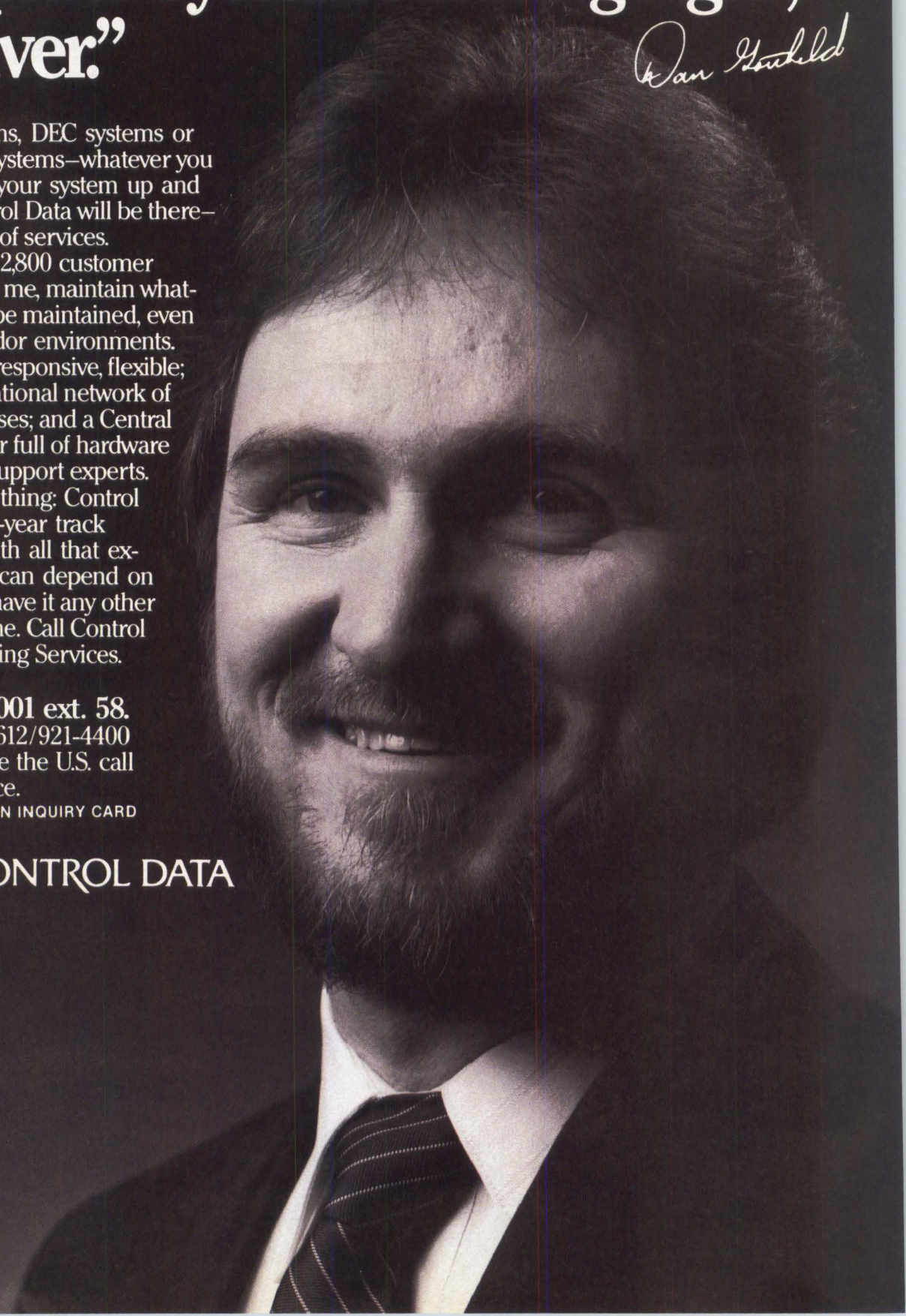
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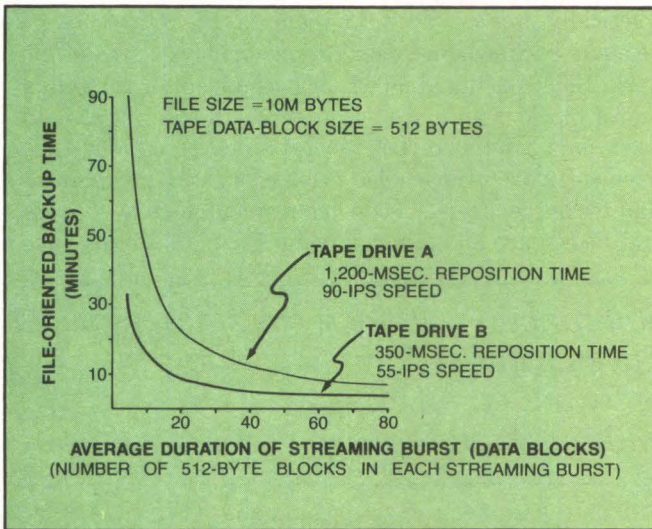


Fig. 3. A streaming-tape drive with a short reposition time (Drive B) usually completes a file-oriented backup operation faster than a streamer with a longer-reposition-time specification (Drive A). The more often the drive has to stop for repositioning—that is, the shorter the streaming burst—and the more time it needs to reposition, the longer the backup will take. Thus, tape drive A, streaming in 10-block bursts, requires about 42 minutes to do the same job that drive B can do in only 15 minutes. In this comparison, data for the next burst of streaming becomes available from the host computer during the reposition period.

simultaneously with other users' tasks.

The backup method employed has a major impact on tape system data rate. Operating the tape in a continuous streaming mode permits the use of smaller, less powerful motors and lowers the cost of operation. To achieve continuous streaming, the disk data-transfer rate must equal or exceed the tape system's recording rate (Fig. 1). This is easily achieved with image backup.

File fragmentation adversely affects disk drive performance. Assuming a disk sector size of 512 bytes and an average access time of 50 msec., at 100 percent fragmentation, average disk transfer rate is reduced to 10K bytes per second.

Typical 5¼- and 8-inch Winchester disk drives provide an instantaneous transfer rate of 5M bits per second or 625K bytes per second. Allowing 20 percent overhead for formatting, the average transfer rate is actually 500K bytes per second. Because ¼-inch streaming-tape devices operate at a considerably slower rate—in the 50K- to 100K-byte-per-second range—streaming can easily be sustained.

File-oriented backup is more difficult to analyze in terms of disk drive performance. Drive throughput is

Standard ½-in. streaming-tape-drive commands	Supported by ¼-in. full-function drive	Supported by ¼-in. limited-function drive
Read forward	Yes	Yes
Read reverse	No*	No
Write	Yes	Yes
Write file mark	Yes	Yes
Erase variable	No*	No
Erase fixed	Yes	Yes
Data security erase	No*	No
Space forward	Yes	Yes
Space reverse	Yes	No
File search forward	Yes	No
File search reverse	No*	No
Functions		
½-in.-tape-standard error correction	Yes	No
Variable-length records	Yes	No
Reverse operation	Yes	No

Fig. 4. A full-function, ¼-inch streaming-tape drive can implement many ½-inch-tape-drive commands and functions without software modification. Commands marked with an asterisk require additional electronics in the drive adapter for emulation on CDC's Sentinel tape drive.

directly related to the degree of file fragmentation. With no file fragmentation, throughput is essentially identical to that achievable by image dumping, and backup occurs at the maximum tape data-transfer rate. On the other hand, 100 percent fragmentation would considerably increase file backup time (Fig. 2). Assuming a disk sector size of 512 bytes and an average access time of 50 msec., the average disk transfer rate will equal only about 10K bytes per second. Other factors that can further degrade system throughput include directory and header transfers and host computer delays. In addition, some utility programs incorporate a verify operation that can slow the data-transfer rate to less than 10K bytes per second.

In most fast file-oriented backup utilities, data compression must be used to obtain disk data rates greater than 150K bytes per second (if the tape drive can support it). Superminicomputer systems, in which cache-directory and header information optimize seek time, reach transfer rates between 50K and 150K bytes per second, depending on fragmentation level. Typical minicomputer and microcomputer systems fall in the 20K- to 100K-byte-per-second range. However, if file-oriented backup is not run during off-peak hours, other tasks running concurrently can further reduce throughput.

A ¼-inch streaming-tape drive with limited capabilities and a start/stop duty cycle might be adequate for image backup and restore if used only for that function.

1/4-IN.-STREAMING-TAPE DRIVE APPLICATIONS AND THE DRIVE CAPABILITIES REQUIRED TO IMPLEMENT THEM

APPLICATIONS	CAPABILITIES REQUIRED			
	Backspace	Forward and reverse file search	Frequent start-stop operation	Fast repositioning
Backup				
• Image backup	No	No	No	No
• Image restore	No	No	No	No
• Selective backup	No	No	Yes	Yes
• Selective restore	Yes	Yes	Yes	Yes
Other functions				
• Disk compression	No	No	Yes	Yes
• Software distribution	Yes	Yes	Yes	Yes
• Archiving	Yes	No	Yes	Yes
• Real-time data collection	No	No	Yes	Yes

Extending 1/4-inch-streamer applications beyond image backup and restore requires a drive with backspace, forward and reverse file search, frequent start/stop and fast reposition capabilities. Standard functions found in all 1/4-inch cartridge drives—read and write capability—are not included.

Because the drive can be kept streaming most of the time, the long stop and start times usually associated with such streamers do not noticeably affect backup time. File-oriented backup, however, like disk compression, requires the tape drive to stop and start or reposition frequently. How often depends on the extent of file fragmentation, disk and system characteristics, tape speed and the amount of data buffering between the host computer and tape drive. Generally, a streaming-tape drive with a short reposition time requires significantly less time to back up a disk than a speedier streamer with a longer reposition time (Fig. 3). In many configurations, the difference can be dramatic.

A heavy duty cycle consisting of hundreds or thousands of repositions during a single file backup can be disastrous to a 1/4-inch cartridge-tape drive not specifically designed for that application. Cartridge streamers, such as CDC's Sentinel, which can reliably operate under a heavy reposition duty cycle, have motors sized for high torque and heat dissipation and carefully optimized acceleration/deceleration ramps.

A look beyond backup

File-oriented backup/restore applications and other functions beyond image backup and restore require a full-function, 1/4-inch streaming-tape drive (see Table). The ability to backspace, for example, is critical. It is

practically impossible to append a file onto a tape without backspacing over a previously written file mark. Backspacing ability is also required for rereading a data block if an error is detected in the initial read operation. Furthermore, most 1/2-inch streaming-tape drive software utilities use the backspace command for read-error recovery. A 1/4-inch streaming-tape drive with backspace and other expanded capabilities can use

Full-function, 1/4-inch streaming-tape drives can use 1/2-inch cartridge software commands without modification.

1/2-inch-tape-drive software commands (Fig. 4). Using a drive without these expanded capabilities forces the system integrator or user to create new utility software.

Reverse file-search utilities that can search for file marks in forward or reverse direction expedite file-oriented activities. A 1/4-inch tape drive able to support reverse file search and multiple backspace commands can use 1/2-inch tape utilities.

Although important, file-oriented disk backup is not the only function a full-function tape drive can perform in a system. It can also be used for system software loading (software distribution), archival storage and other applications, including real-time data collection in factory-floor environments. The drive can also use 1/2-inch-tape-drive software utilities for these applications. □



Al Sharon is business/product planning manager at Computer Peripherals Inc., Norristown, Pa., a Control Data Corp. subsidiary. Before joining CPI in 1979, Sharon held marketing and disk product planning positions at Digital Equipment Corp. and engineering and management positions at Honeywell Information Systems Inc. and Xerox Corp.



Bill Homans, principal applications engineer at CPI, came to the company from Leeds and Northrup Corp., where he was a project engineer. He previously worked at Microdata Corp.

The writers acknowledge with thanks the technical assistance of R. Harris of Leeds and Northrup Corp.

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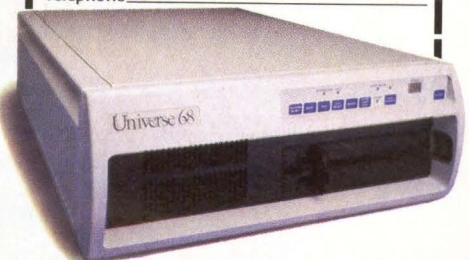
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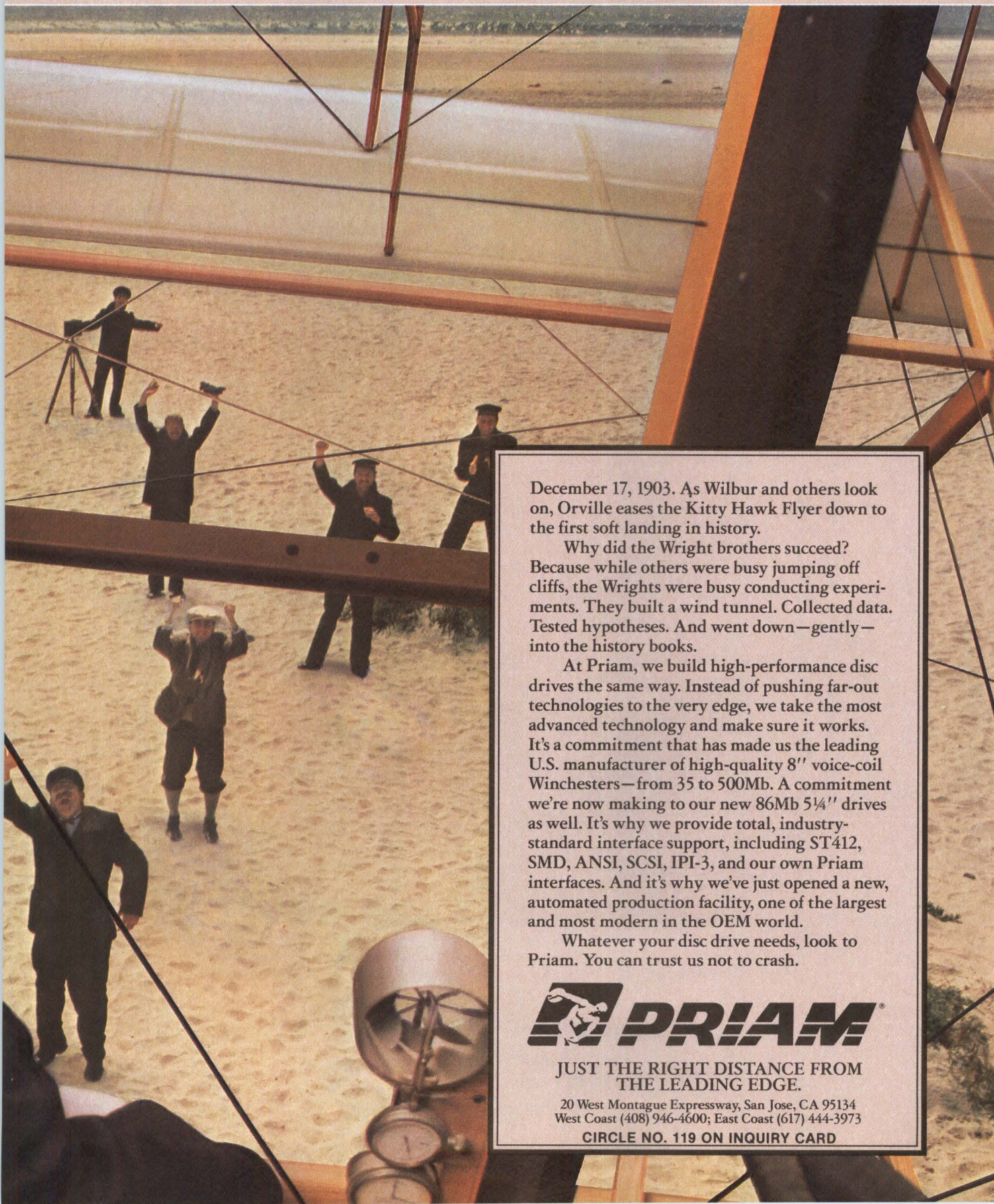
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SCSI bus solves peripheral interface problems

Freeing system integrators from interfacing non-compatible peripherals and subsystems, the SCSI bus promises universal interchangeability, wider device selection, increased integration flexibility and lower cost

Richard Barrett, Adaptive Data & Energy Systems

Bus systems represent the "superhighways" of computer systems. They carry data, addresses, control signals and power between system components. The small computer systems interface (SCSI) bus, for example, can lower system-integration costs by providing a flexible and interchangeable mix of peripherals for personal computers and small business systems. Originally labeled the Shugart Associates system interface (SASI) bus, the SCSI bus is the leading intelligent interface for 5¼-inch Winchester disk drives. It is used by an estimated total of 10 percent of installed personal computers and 30 percent of installed small business systems.

Start with SCSI basics

SCSI, a specification for a peripheral bus and command set, is a high-performance peripheral interface that allows data to be distributed among peripherals independently of the host, thus freeing the host for more user-oriented activities.

The SCSI has 50 pins (Fig. 1) and 18 signals—nine for an 8-bit data bus with parity and nine to coordinate inter-device data transfers. The control signals govern bus status, selecting one of four states. Unlike the early non-arbitration SASI buses, SCSI starts in the bus-free phase (Fig. 2), with the "busy" line (number 33), the select line (41) and the data-bus lines (0 to 7) set FALSE. Peripherals seeking bus control activate the busy line to enter the arbitration phase, with the highest-address initiator given priority.

Next, in the selection phase, the highest-priority peripheral, or initiator, selects a device or target, or the target re-selects the initiator because of target disconnect. Once the physical inter-device path is

established, the bus enters its information-transfer phase, placing the bus in one of the initiator-to-target transfer modes: data out/in (000/001), command (011) or message out/in (110/111) phases.

Fig. 1. Ribbon-cable signal designations assign ground to all even pins (2, 4,...48, 50). All lines require 220-/330-ohm terminators. To drive several SCSI devices and two terminator resistors, a driver must sink 48 mA at 5V. Daisy-chaining is limited to 6m. Differential bus-drive modes interconnect cables between 6m. and 15m. long to "cancel out" noise caused by electromagnetic interference. Even-numbered pins carry negative-signal waveforms, and pin 1 becomes the shield ground. But, unlike other differential driver/receivers, arbitration uses open-collector devices for wired-OR arbitration. Active high assertion is needed for steep rise times at high data-(block) transfer rates—typically 500K to 1.5M bytes per second for direct-memory access.

SIGNAL	PIN	SIGNAL	PIN
	Ground	1	ATN
DB0	Data Bus 0	3	Attention
DB1	Data Bus 1	5	Ground
DB2	Data Bus 2	7	BSY
DB3	Data Bus 3	9	Busy
DB4	Data Bus 4	11	ACK
DB5	Data Bus 5	13	Acknowledge
DB6	Data Bus 6	15	RST
DB7	Data Bus 7	17	Reset
DBP	Bus Parity	19	MSG
Spare		21	Message
Spare		23	SEL
Spare		25	Select
Spare		27	C/D
			Cmd/Data
			REQ
			Request
			I/O
			I/O
			Ground
			47
			49

ATN	- Attention: indicates initiator has message to send to target
BSY	- Busy: indicates bus is busy
ACK	- Acknowledge: with REQ, completes asynchronous handshake for data bus transfers
RST	- Reset: clears all activity on bus
MSG	- Message: indicates bus is in message-transfer phase
SEL	- Select: used during device selection phase
C/D	- Command/Data: defines type of information on bus—Command/Status or Data
REQ	- Request: with ACK, completes asynchronous handshake for data bus transfers
I/O	- Input/Output: indicates data-flow direction on bus

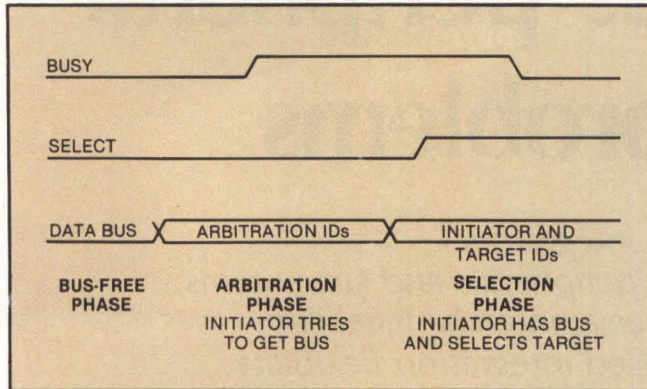


Fig. 2. SCSI handles both addressing and arbitration priority, by assigning to each device a single, unique, physical data-bus signal. Order on the data bus establishes priority, with the DB7 device given highest priority. This reduces the time and hardware required for arbitration but limits the number of devices on the bus to eight. During arbitration, each arbitrating device reads the data bus to determine if it has highest priority. The arbitration winner then asserts the select (SEL) signal, terminating the arbitration phase and starting the selection phase. All other devices drop off the bus to await the next bus-free phase.

Using a bus for a peripheral interface is unconventional. An interface normally connects only two devices, as in the RS232C, because it allows only one sender and one receiver to be connected. The ST-506 (Seagate Technology) specification allows only one disk and one controller on each radial connection. A single controller can support four disk drives but uses four interfaces. In contrast, a bus has multiple independent interchangeable slots, which are critical to SCSI performance advantages.

SCSI resembles backplane buses

The SCSI bus is architecturally similar in signal organization, multiple-master capability and operational phases to backplane buses (Fig. 3). First, the SCSI signal set contains an 8-bit data bus and various control/status signals that are on the same pins at all points on the bus. SCSI does not require daisy-chaining or physical positioning.

Second, like many sophisticated backplane buses, SCSI can have multiple masters. But, unlike many backplane buses that establish priority by hard-wired techniques, such as daisy-chaining priority lines, SCSI uses a voting cycle. For user convenience, SCSI establishes master priority exclusively in the voting, or arbitration, cycle and requires no physical modification as devices are added.

Third, like most backplane buses, SCSI defines several operational cycles, or bus phases. It has normal read and write phases for data transfer and several other phases for bus arbitration and message transfer.

An unconventional approach

Although both the SCSI and the backplane are

computer buses, their goals differ. Backplane buses provide transfers between module types, or printed-circuit boards, with many functions and varying intelligence levels. A CPU module, for example, can have extremely sophisticated bus command and response capabilities, whereas the low-intelligence memory module must quickly respond to a given address with a read/write cycle. To accommodate these opposing functions, a backplane bus provides as few restrictions as possible.

The SCSI bus, in contrast, specializes in bulk data transfers between peripherals and hosts. Because all SCSI bus devices are similar, the SCSI specification assumes sophisticated response capability from each device, allowing the definition of an entire command set. This functional distinction enables SCSI to depart from conventional bus design in implementation, command-set definition, data-rate restrictions and message- and data-transfer sequences.

For mounting, backplane buses are typically plugged at right angles into a printed-circuit motherboard, housed in a card cage. This makes the housing integral to the electronic interconnection and is convenient for the cards because they lack other natural mounting locations. Peripheral controllers, unlike computer cards, fit into well-defined mounting locations atop associated peripherals, with mounting holes on some peripherals almost as standard as electrical interfaces. Thus, the 50-pin ribbon cable SCSI bus is a natural interconnection mechanism for controllers when they are mounted atop the peripherals, since it allows peripheral power, cooling and space requirements to determine the mounting arrangement.

Command-set definition in microcomputer buses differs from that of the SCSI bus. In computers, the command set is a function of the microprocessor CPU rather than the backplane. Many microprocessors are available on microcomputer buses such as the Multibus, the S-100 and the STD bus. The command set, therefore, must be backplane independent. In contrast, the SCSI bus command set is integral to the entire I/O bus concept. Fixing the I/O driver modules in the software's operating system frees system integrators from the traditional constraints imposed by peripheral and controller vendors. The high-level, block-oriented SCSI command set also forces the host CPU to off-load peripheral housekeeping tasks to the controller.

Third, most backplane buses place no restrictions on the minimum-burst data rate. Timing specifies maximum data rate, but idle time between each data transfer remains unlimited. In contrast, a key SCSI feature is its bias toward a HIGH on the average data rate. Each SCSI bus controller is intelligent enough to know when it must stall a transfer when the receiving device is full and when the sending device is empty. To

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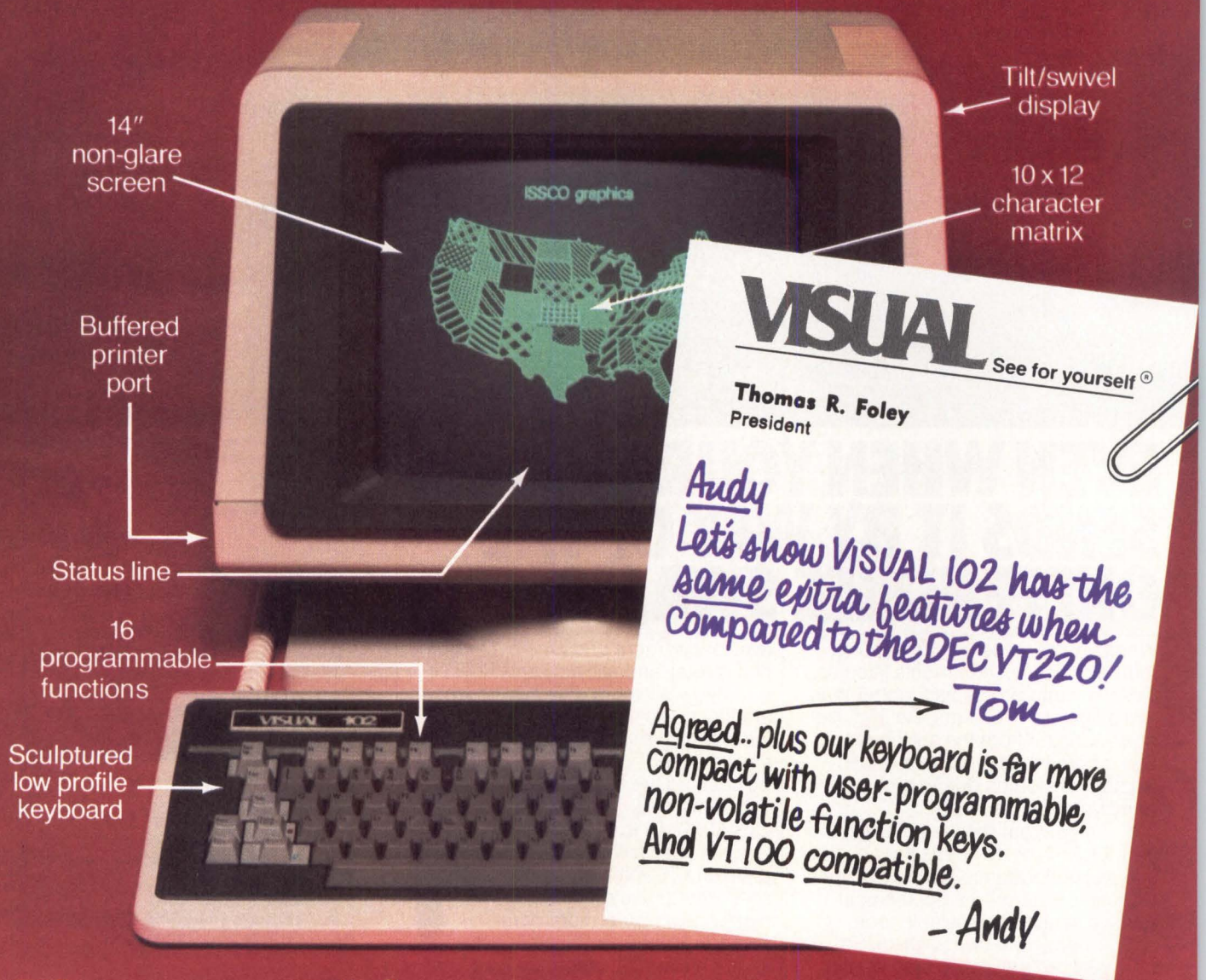
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stall a transfer, the intelligent device breaks the transfer and disconnects from the bus, freeing the bus for use by other devices. Interleaving several transfer tasks on the bus increases the total throughput rate. Consequently, processes need not wait for others to complete before starting. Although data-transfer device delays, such as disk latency, still occur, interleaving increases total bus usage by sharing the bus.

Fourth, backplane buses lack identification tags for transferred data. Although some backplane buses do contain a memory/I/O line, the level of differentiation it provides is minimal. The SCSI bus provides a hardware signal for identifying message (pin 39) and data (pin 43) transfers. Controllers communicate with each other via messages, allowing high-level interaction and preconditioning for data transfers.

By decoupling peripherals from the system, SCSI makes it easier for distributors and dealers to sell peripherals without interface and reconfiguration problems.

SCSI has advantages galore

The SCSI offers advantages to system integrators, system sellers (distributors and retailers) and end users. It also helps computers evolve into an expandable system of interchangeable components. It benefits system integrators by simplifying software and hardware integration and system performance. In software integration, the command set allows the operating system to work at a high level. Instead of computing head, cylinder and sector-address locations, the operating system simply specifies a logical block number because the SCSI controllers handle all the logical-to-physical mapping. The command set allows the controller to handle differences between disk families; the operating system thus needs only one disk driver, not one for each disk type.

In hardware integration, a system integrator using SCSI need incorporate only one connection to the bus to handle all the system's peripherals. The best approach is to use a dedicated microprocessor for SCSI bus control, communicating with the host memory through direct-memory-access channels. SCSI controllers are mounted on each peripheral, drawing their power from the peripheral rather than from the SCSI cable.

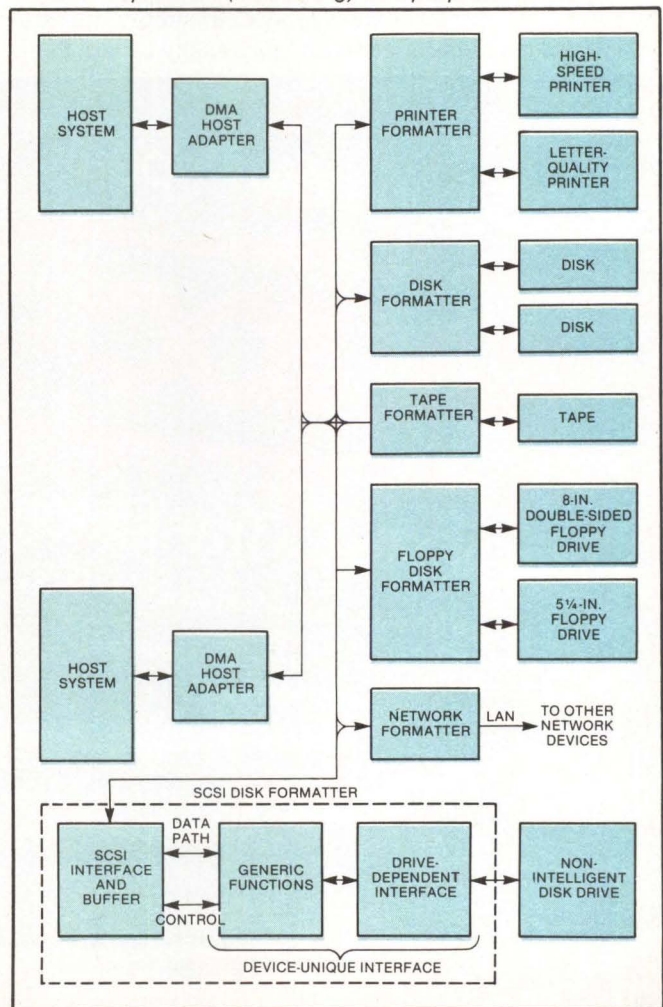
System performance also benefits from use of SCSI. SCSI has a 1.5M-byte-per-second maximum data rate that might eventually be increased. It also reduces error rates: data-bus parity (pin 19) protects all transmissions, and an optional differential bus-driver

feature, using 6m.- to 15m.-long cables and the even pins, offers extra protection from noise. In addition, SCSI identifies and recovers from errors.

By decoupling peripherals from the system, SCSI makes it easier for distributors and dealers to sell peripherals without interface and reconfiguration problems. Using the "device ID" command after any system reset, the computer interrogates every address on the SCSI bus to determine which device, if any, resides there. The device responds by describing the functional characteristics of its peripherals. Knowing currently available peripheral characteristics, the operating system can configure the system for optimum performance.

End users benefit the most from using the SCSI as the standard peripheral interface. With SCSI, peripherals become as "personal" as the personal computer or small business system. The advantages of this include convenient expansion with sealed-system peripherals,

Fig. 3. Multiple-initiator/multiple-target SCSI system configuration provides host-to-host communications, peripheral-to-peripheral data transfer, multithreaded operations to a peripheral controller and concurrent operations (multitasking) on a peripheral controller.



independence from peripheral developments, lower acquisition and maintenance costs, portability, greater reliability, or mean-time-between-failure rates and lower downtime and better fault isolation, yielding lower mean-time-to-repair rates.

Many manufacturers are selling computer products as sealed boxes that prevent users from expanding the system by incorporating peripherals and interface cards. But SCSI will solve that problem: peripheral systems with two plugs—SCSI IN and SCSI OUT will permit users to purchase lengths of 50-lead connector cable to add peripherals. With independence from peripheral developments, users will not have to wait for improved systems. Instead, SCSI guarantees users compatibility with new peripherals. Lower acquisition costs mean higher production volumes, and those in turn mean reduced costs. Controller prices, for example, should drop to less than \$150.

Because SCSI uses replaceable modules, it also reduces downtime. Users of SCSI can unplug failed peripherals and reboot the system. The computer reconfigures itself to the reduced configuration, while the peripheral is repaired or replaced. Thus, peripheral failure is not catastrophic; the system simply operates in a degraded mode. Users can more easily isolate faults

because intelligent SCSI controllers assume this task from the operating system. Each SCSI controller includes self-diagnostics embedded in firmware and reports failures to the operating system using the message signal.

Interface allows retrofits and adaptations

The best time to integrate the SCSI bus is when a system is new. This allows system integrators to implement the SCSI from the start to take advantage of all the bus' features and to plan for expansion. But SCSI can also be retrofitted into systems. This requires an SCSI host adapter. Modifying the operating system means only adding peripheral drives for those on the bus. □

Richard Barrett, president and chief executive officer of Adaptive Data & Energy Systems, Pomona, Calif., co-founded the company in 1980. Previously, he was project director for Walt Disney Productions subsidiary Ride Communications and worked under contract to General Motors Corp. He has published several papers in his field and is a member of the IEEE. He obtained his BSEE and MSEE from Rice University, Houston.

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CIRCLE NO. 123 ON INQUIRY CARD

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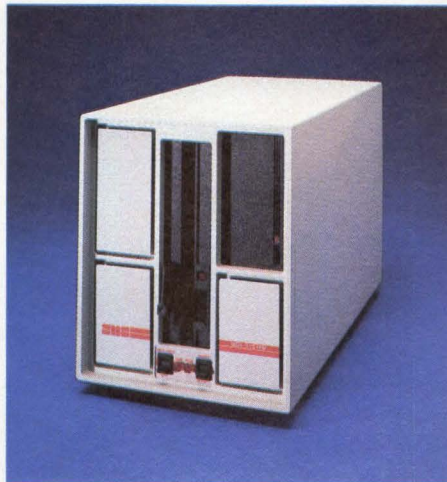
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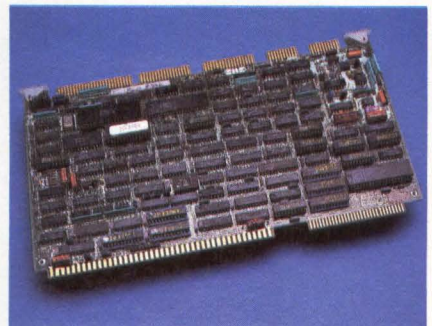
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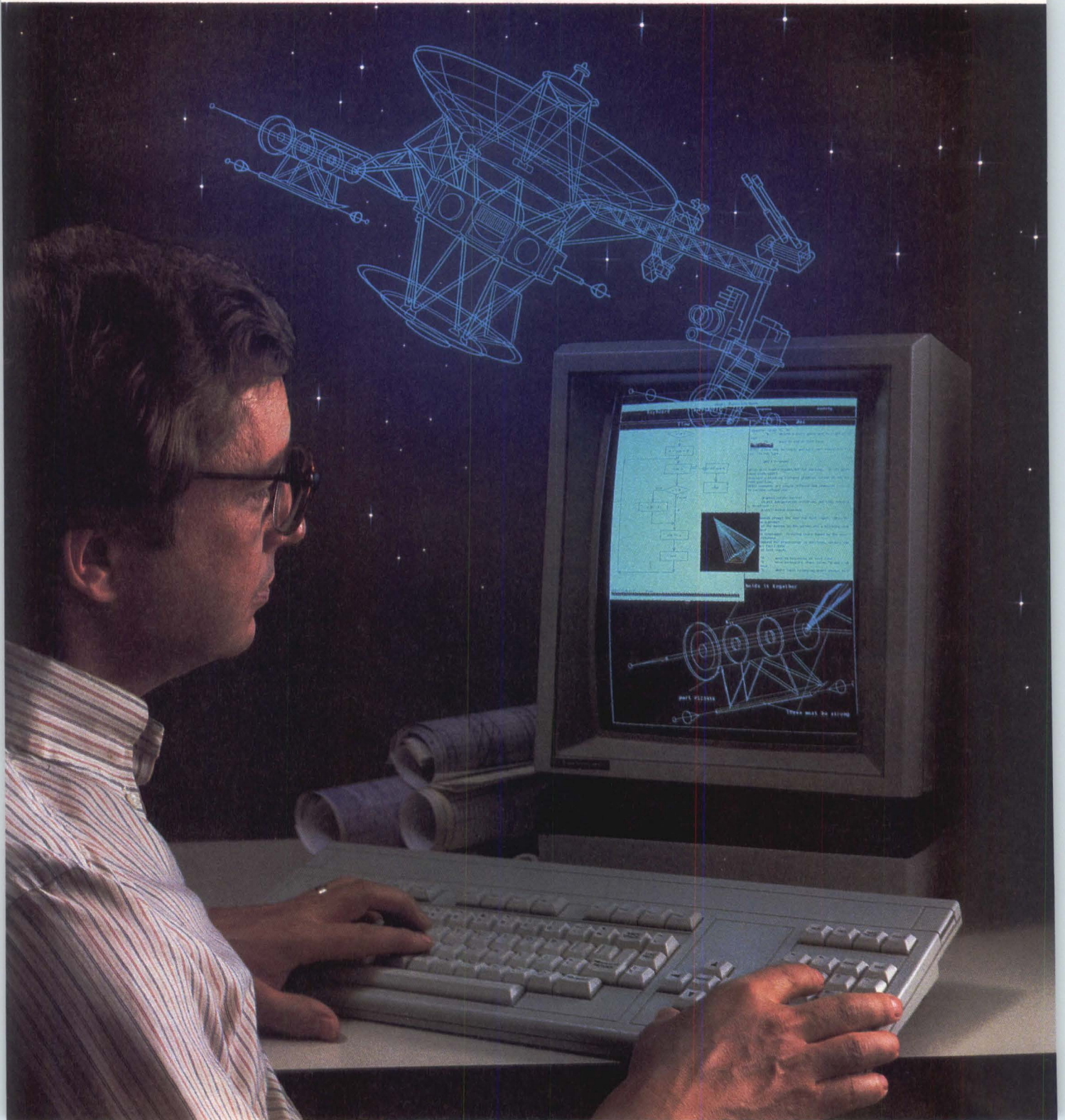
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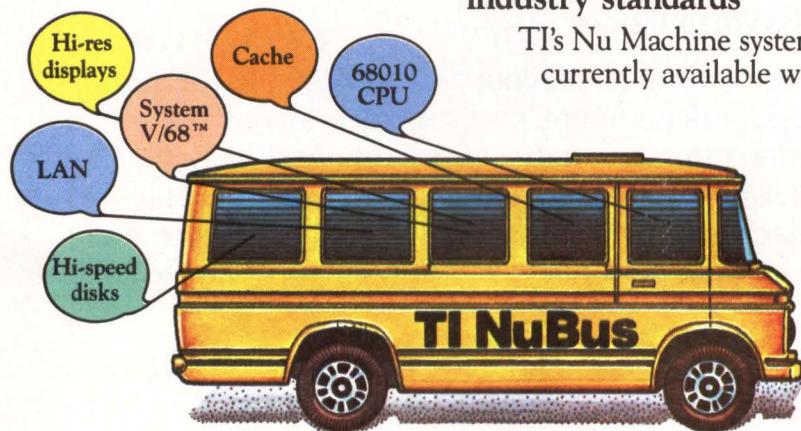
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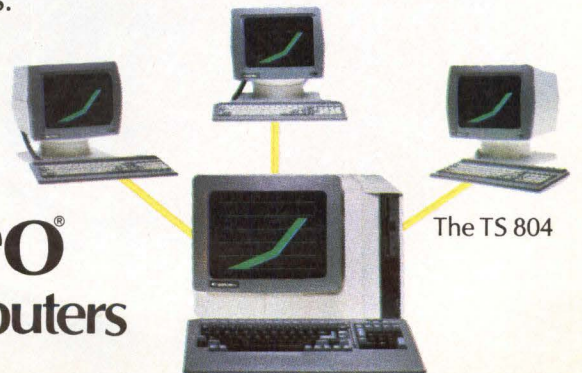
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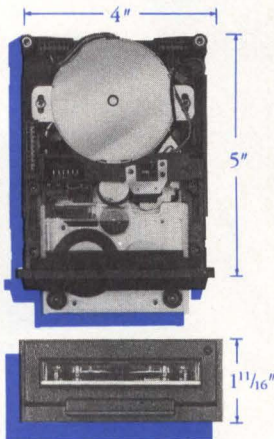
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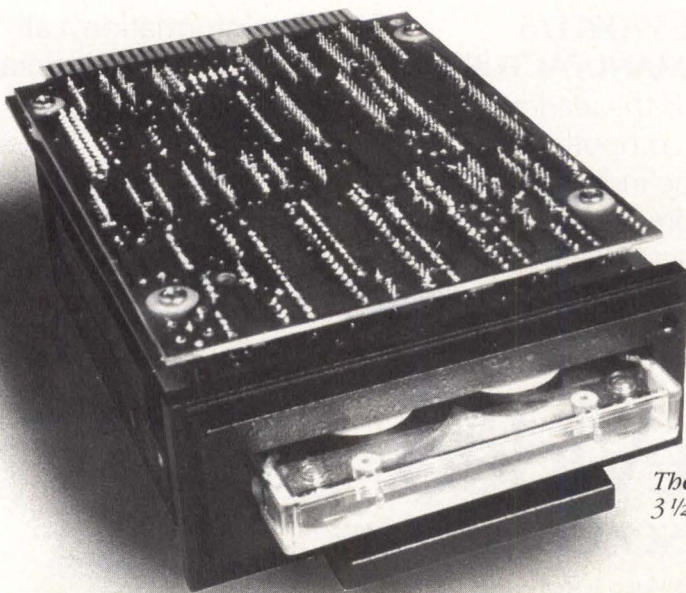
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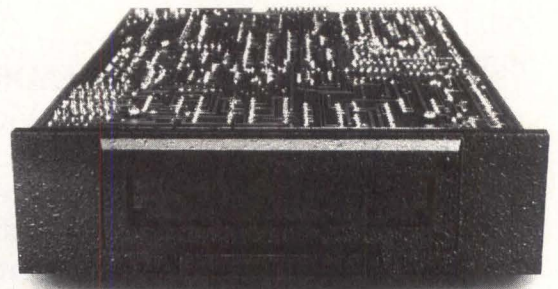


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UNIX's place in office automation is assured

System integrators will find a growing array of brands and products from which to select

Paul Sniger, Senior Editor

UNIX-based office-automation systems will experience explosive growth starting next year. The UNIX operating system is a multiuser, 16- and 32-bit standard backed by American Telephone & Telegraph Co. and IBM Corp. As 32-bit workstations enter offices, UNIX acceptance will grow, eclipsing MS-DOS and PC-DOS, just as MS-DOS and PC-DOS overshadowed CP/M.

UNIX-based 16- and 32-bit workstations in offices connected by the AT&T- and IBM-sanctioned local-area networks (LANs) to be introduced this year will replace centralized minicomputer installations for integrated information networks. Software system integrators now offer office-automation products that extend UNIX file-system hierarchy to include other residents on LANs.

AT&T is readying its line of UNIX-based 32-bit microcomputer workstations and portable computers for its invasion of the office arena, and IBM is not far behind with its recent endorsement of UNIX through

its Personal Computer Integrated Executive and Columbus, a UNIX-like operating system IBM is rumored to be working on. With these announcements, the future of UNIX in offices and in the personal computer field is assured.

UNIX standardization promises wider selection

The first signals that UNIX would be a driving force for system integrators came more than a year ago when AT&T introduced UNIX System V in January 1983. With System V, AT&T enhanced performance by adding improved spooling, shared memory and semaphores. These enhancements told system integrators that AT&T was aiming directly at commercial UNIX users, specifically automated offices. The licensed version of System V is the same UNIX as that used in-house at AT&T, thus synchronizing internal AT&T and external system integrators. With System V, AT&T offers direct software support for UNIX to system integrators—through the AT&T Technical Systems Group—a significant shift. System integrators

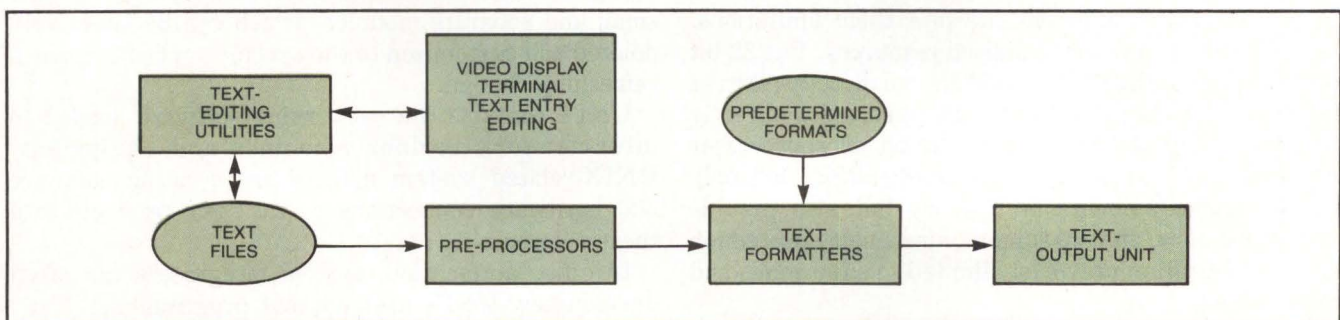


Fig. 1. UNIX text-processing starts with text-entry editing, bidirectionally interacting with the UNIX text files through the text-editing utilities. Text formatting and printing, on the other hand,

are unidirectional. After the text editors prepare the text, formatters format it before outputting it in the desired media.

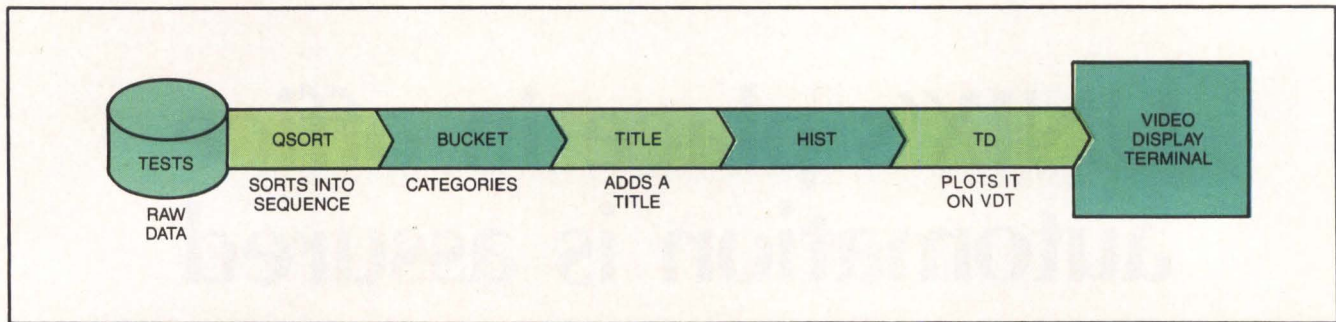


Fig. 2. UNIX pipe facilities used by the shell permit pipelining. A vertical bar, the pipe character, instructs the shell to pipe the program output directly to the next input. The five programs shown here are designed to work together, new programs from existing functions

need not be written. In this case, several utilities are joined by pipes to make a graphics task convert raw test result data into graphics histograms. Most such file-processing functions are performed without programming.

licensed earlier versions and enhanced them themselves.

Support is to source licensees that modify and port UNIX, but AT&T's Information Support division will provide end-user support later. To reassure system integrators of its commitment, AT&T promises that upcoming versions of UNIX, such as System VII, will be upwardly compatible with System V's kernel. System integrators can write for System V, safe in the knowledge that their software will run unmodified on upgrades. In addition, AT&T claims its new UNIX documentation is an improvement over previous versions.

Last May, AT&T made agreements with Intel Corp., National Semiconductor Corp., Motorola Inc. and Zilog Inc. to develop AT&T UNIX versions. This will make it easy for integrators to develop UNIX-based systems because generic ports will be ubiquitous industry standards. Integrators will then flood the market with AT&T UNIX-based office systems.

Other forces push office-automation UNIX

UNIX-like features are surfacing in MS-DOS, PC-DOS, CP/M and other operating systems, and the trend is growing. UNIX is still too large for most 16-bit workstations and desktop computers, so MS-DOS and PC-DOS remain dominant, despite their limitations, because they can tolerate limited resources. But 32-bit workstations and 256K-byte RAMs can directly address far more memory. A 16-bit microprocessor directly addresses only 64K bytes, and a 32-bit microprocessor addresses 4,000M bytes. These workstations not only address large amounts of memory but also provide virtual memory, on-chip support for memory protection and sophistication previously limited to superminis and mainframes.

IBM and AT&T have used 256K-bit RAMS extensively in their 32-bit microprocessors. Low cost, removable-cartridge disk drives are more common.

Taken together, these trends guarantee that components required for lower-cost UNIX systems will be available.

Minicomputer makers such as Digital Equipment Corp., Hewlett-Packard Co. and Data General Corp. were quick to offer UNIX versions. DEC now offers the Berkeley UNIX for its VAX line and Version 7 for its PDP-11s. DG is trying an Eclipse version of UNIX as an extension of AOS, its current UNIX-like operating system. AOS is not compatible with AT&T UNIX. HP intends to fall in line and center its 32-bit line around UNIX.

More choice for system integrators

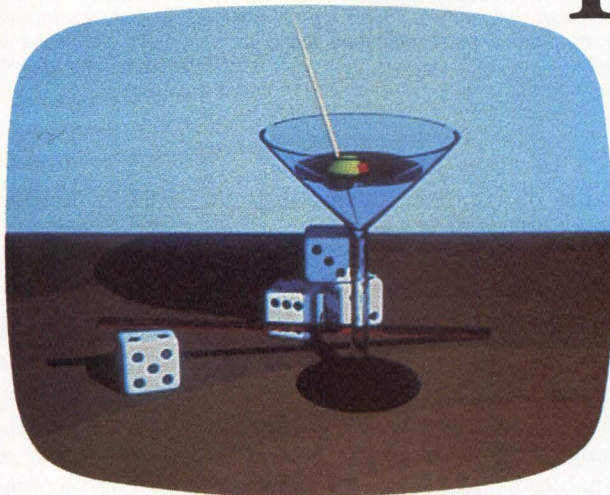
UNIX transportability introduces more competition for equipment and computer makers, allowing system integrators to select from a greater array of brands and products, as no single maker can supply all required software and hardware. And, since integrators can easily customize UNIX to a particular user's needs, a richer variety of applications and sophisticated changes become feasible. Existing operating systems too often suffer from a clumsy structure of programs and incorporate numerous interrelated programs with their fixes, all in a confusing jumble of commands that make changes difficult due to the interrelationships. UNIX's small and separate modules, which can be selectively deleted and customized to the specific application, are a refreshing change.

UNIX contains the networking software needed to inter-network various machines and equipment. UNIX-related system makers are creating software and hardware connections to tie their products into these networks.

In office automation, system integrators can often develop new UNIX uses without programming. They combine several UNIX commands to handle simple office workday tasks by using pipes and shell scripts. The shell program connects and interprets system user

We were going to compare Vectrix graphics to IBM's. Unfortunately, there is no comparison.

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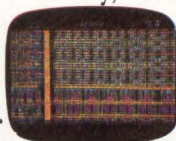
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commands and interprets user requests, calls programs from memory and executes them one at a time in a series called a "pipe." The kernel program schedules tasks and manages data storage. Utility programs, called "utilities" for short, perform routine and special system maintenance functions.

Customizing to specific programs is easier

System integrators are also writing programs for sale to lower-volume users, something not economically feasible before. Many general- and special-purpose programs are being written to connect data from a file or program into a different form. When an integrator needs a new program, he writes it as a shell procedure, not as a C program, by typing command names with specific arguments.

Customizing UNIX, due to its separate modules, is a plus. Other operating systems curse the software integrator with a file structure that adds to the drudgery of file and program manipulation and maintenance. UNIX's unique file structure lets system integrators store programs, data and documents in the file system, protected by the file mechanism or more complex software.

System tools automate common programming tasks and tie them into single-command sequences. Maintaining a library of files is easier, as fewer techniques are needed. Users minimize errors by combining existing small commands into different structures. UNIX can be individualized for a particular office and for separate workstations. UNIX integrators can adapt frequently used programs for the office; individual users can write, shift and change their own programs.

UNIX supports office automation

UNIX text-processing utilities support creation, editing and formatting of tabular data, text, equations and documents. They also support messaging, mailboxing, calculating, calendars and appointments, reminding, screen-oriented editing, on-line newsletters and graphics.

In 30 or so utility programs, UNIX supports office functions. These include text editors and formatters, text-processing aids and electronic mail.

The standard UNIX has line and full-screen editors, with editors and word processors added by third parties. The editors enter text and store it as a file and subsequently revise it. There are more than a dozen text-processing utilities, with programming commands like the line-oriented editor "ed" and screen-oriented editor "vi."

Text-processing utilities spell, hyphenate, index and handle other functions. Direct use of these utilities is tedious, so macro packages provide pre-defined formatting commands for functions like page numbering and

ed	Edits a text file, using line-oriented editing
vi	Edits a text file, using screen-oriented editing
pr	Prints a text file with simple headers and page breaks
nroff	Formats text for printing on character-oriented printing devices
troff	Formats text for printing on high-resolution printing devices
tbl	Formats tabular data
eqn	Formats mathematical text and equations
cw	Formats text in a typewriter-style font for printing on high-resolution printing devices
mm	Formats common office documents, such as letters and memoranda
mmt	Formats text for viewgraphs
deroff	Removes formatting commands from a text file
spell	Corrects spelling errors
hyphen	Finds hyphenated words in a text file
diffmk	Compares two versions of a file and produces a version with "change bars"
ptx	Produces a permuted index

Fig. 3. Text processing utilities fall into several categories. Acronyms may seem esoteric, but each accomplishes more per command than in other systems, and they are powerful. Icon-driven end-user interfaces, such as those recently announced by Loughborough University of Technology in England, simplify this further by using pictorial representations. Icons and pull-down menus are what office-automation system users want, and esoteric commands will be replaced by fewer user-threatening communications.

table of contents formatting. The cost is a loss in flexibility, but it's worth it.

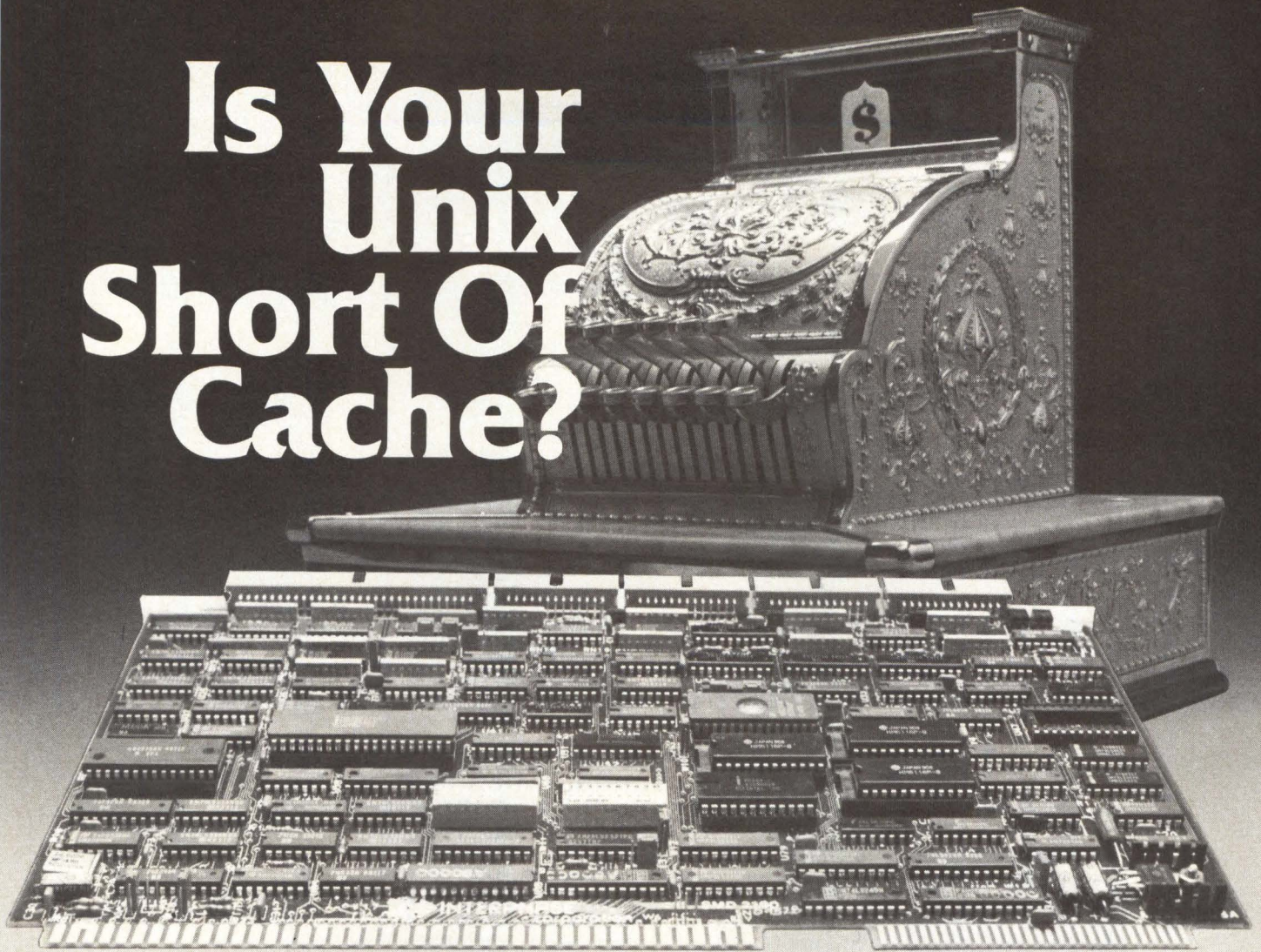
UNIX links to the world

With the electronic-mail utility, users send messages over the public telephone network or UNIX communication facilities. Users can route mail through one or more intermediate systems anywhere in the world, as long as they are in the network. The mail utility also enables users to examine their mailbox, dispose of mail, go on to the next message, delete it, save it, forward it or repeat it.

Calendering utilities permit appointment-tracking and reminding. The calendar utility prints any month asked for. It is flexible in formatting: a date can appear anywhere in a line. An on-line newsletter utility permits a quick perusal of news.

In specialized graphics utilities, terminals, printers and plotters are joined by UNIX pipes to create graphics. The utilities analyze data and transfer it into various forms—like scattergrams, pie charts and histograms. Five filter programs take raw data from the file tests and sort it into a sequence. The data is categorized, given a title and converted into a histogram; then it is plotted on the CRT. Some UNIX systems are weak in graphics, but improvements are coming almost daily. □

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MIS Week	4.61
Computer Decisions	4.03
Digital Design	4.03
Communications News	3.64
Electronic News	3.25
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Information Systems News	2.60
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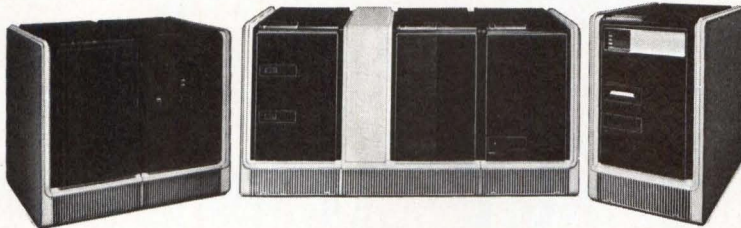


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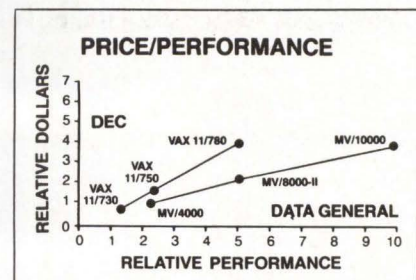
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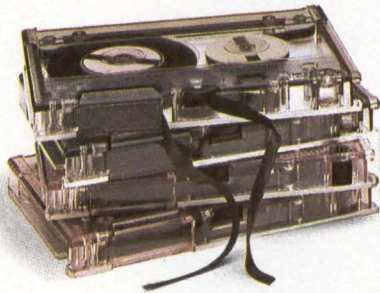
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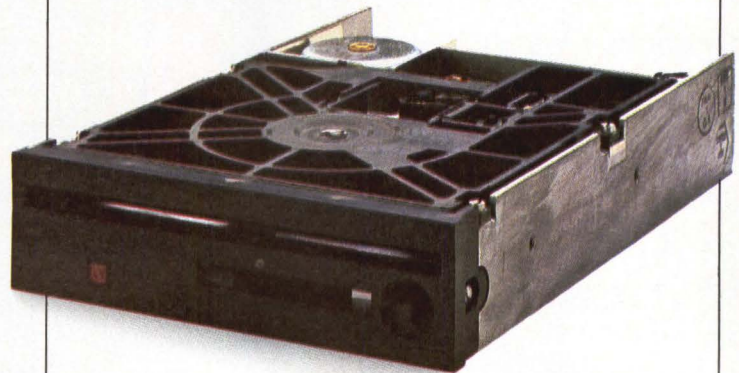
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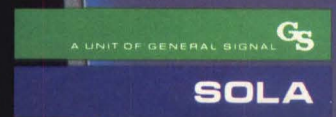
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Wang Professional Computer surpasses IBM PC in performance and ease of use

*A fast CPU, an ergonomic display monitor and a powerful editor
make the Wang PC an effective software-development environment
for end users and system integrators*

Roy R. Friedman, Associate Editor

The Wang Professional Computer from Wang Laboratories Inc. belongs to the growing class of machines that are "almost compatible" with IBM Corp.'s Personal Computer. The Wang PC and machines such as Texas Instruments Inc.'s Professional Computer run Microsoft Corp.'s MS-DOS operating system, and their disk files have the same format as those of the IBM PC. These machines are more nearly IBM PC-compatible than Digital Equipment Corp.'s Rainbow 100 and Hewlett-Packard Co.'s HP-150, which run MS-DOS but do not have IBM-compatible disk formats. On the other hand, the Wang PC and TI Professional do not run off-the-shelf IBM PC software, and they do not support IBM PC expansion boards. They are thus in a different category from the "PC clones" from such vendors as Compaq Computer Corp. and Leading Edge Products Inc.

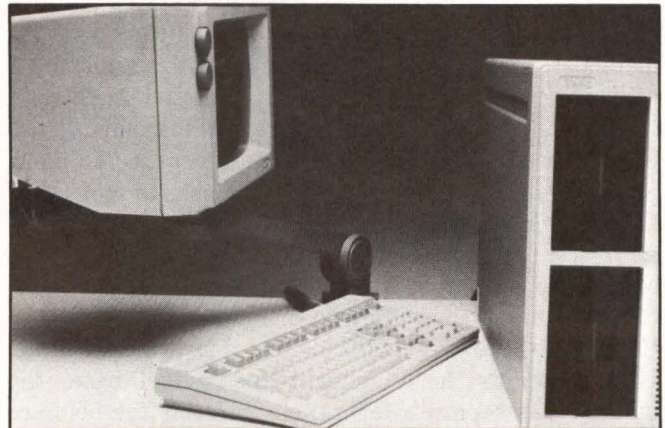
Total compatibility with the IBM PC is not necessarily an asset, however. What makes the Wang PC, TI Professional and HP-150 attractive are the ways in which they differ from the IBM PC. For example, the TI offers hardware support for voice recognition, and the HP features a touch-screen display. The Wang PC also provides several advantages over the IBM PC:

- Its full 16-bit architecture is based on Intel Corp.'s 8086 CPU. In contrast, the IBM PC incorporates an 8088 CPU, which has an 8-bit-wide external data path.

As a result, a CPU-to-memory data transfer requires two bus cycles on the IBM but only one on the Wang.

- Its internal clock runs at 8 MHz vs. 4.77 MHz for the IBM PC (and 5 MHz for the TI Professional). The combination of a faster clock and a more powerful CPU allows the Wang PC to run 40 percent to 500 percent faster than the IBM PC in CPU-intensive applications.

- Its keyboard contains 101 keys vs. 83 for the IBM PC, allowing dedicated keys for many operations that share a key on the IBM keyboard. The Wang's keys also are labeled according to their use by the text editor and



The Wang Professional Computer consists of a system unit, a display monitor and a detachable keyboard. The system unit (right) houses the CPU, memory and disk drives, and it can stand vertically or horizontally. The display monitor rests on a swivel base; a movable arm clamps the swivel base to the side of a desk.

word processor, facilitating operation of these programs.

- Its display monitor swivels and rests on an optional arm that moves in three dimensions and clamps to a desk or windowsill. As a result, users can position the monitor at various viewing distances, heights and angles, and the monitor need not consume desk space.

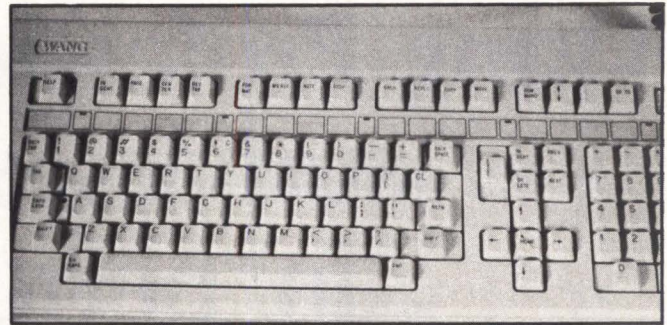
With all these features, it might seem surprising that the Wang PC hasn't attracted more attention. There are two explanations. First, Wang did not ship its PC until early 1983—more than a year after IBM shipped its PC. By early last year, software vendors had written hundreds of applications for the IBM PC, giving it an insurmountable lead in quantity of software supported. Second, Wang decided not to compete with IBM and other vendors for the retail mass market and instead concentrated on selling PCs to major accounts. Although only a few retail outlets carry the machine, Wang claims to have sold more than 75,000 units.

The Wang PC hardware is a "closed system," so there is no significant OEM market for expansion boards as there is for the IBM PC. However, many OEMs resell Wang PCs with added software. According to Wang, these OEMs account for approximately 20 percent of unit sales. They offer turnkey applications such as vehicle maintenance, equipment leasing, travel planning, court reporting and insurance-policy management.

'Ergonomics' is more than a buzzword

"Ergonomic" is one of the most overworked adjectives in today's computer market. Vendors are using the term to describe everything from software to power supplies. But the Wang PC is one product that truly meets the definition of the word.

The mechanical arm that supports the display monitor is perhaps the PC's most impressive feature. By allowing a user to adjust the monitor's viewing distance, height and angle, the arm significantly reduces screen glare. What most vendors describe as a "non-glare" screen is simply a screen whose surface has been treated with a chemical to reduce reflected light. Such a screen can still reflect an enormous amount of light to a user's eyes if a bright light source, such as the fluorescent bulbs used in most offices, strikes the screen from certain angles. The Wang PC alleviates this problem by providing so many viewing configurations that there is bound to be one that is comfortable. In addition to the PC's arm and swivel base, the monitor has separate brightness controls for boldface and normal-video images. By adjusting these controls and the position of the arm and monitor, a user can comfortably view the PC's display in conditions ranging from direct sunlight to almost total darkness.



The Wang PC's keyboard contains a standard typewriter keypad (left), HELP and CANCEL keys (top corners), 16 programmable function keys (top) and dedicated keys for cursor control and arithmetic (center and right).

The Wang system comes with a 12-inch green-on-black display screen. The standard resolution is 800 by 300 pixels, approximately the same as the IBM PC's 720-by-350-pixel monochrome display and considerably better than the IBM's 640-by-200-pixel color/graphics display. Each Wang PC text character occupies an 8-by-10-pixel area within a 10-by-12-pixel cell. Although the Wang PC requires an adapter board for screen graphics, the adapter does not reduce the clarity of text as it does on the IBM PC.

The detachable keyboard is another outstanding feature of the Wang PC. It consists of 101 keys arranged in four functional groups. The traditional "typewriter" keys comprise the largest group. But, unlike the much-maligned IBM keyboard, the Wang PC incorporates these keys in their traditional typewriter locations, facilitating data entry by experienced typists. The Wang keyboard contains 25 labeled function keys, such as INDENT, COPY and MOVE, of which 16 are programmable. The two non-programmable keys are HELP and CANCEL, which are probably the most commonly used by novices. Dedicated keys are available for each digit, arithmetic operator and cursor movement. The ability to use dedicated keys rather than shared keys as on the IBM PC speeds input and reduces errors.

Advanced editor aids application development

According to Wang, more than 30 percent of Wang PC users develop applications. This number includes end users who write programs for personal or corporate use, value-added resellers that create turnkey systems and software vendors that port applications to the Wang PC. A key development tool for all of these groups is the Wang PC's text editor. Instead of offering EDLIN, Microsoft's line editor that is standard with most versions of MS-DOS, Wang provides a proprietary full-screen editor called PCEDIT.

What makes PCEDIT so remarkable is its ease of use. This is one program for which a user manual might

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be unnecessary. Because text editing involves many individual operations such as insert, delete, search, replace, copy and move, users of most editors have to remember many sequences of characters and function keys to invoke the operations. But with PCEDIT, all a user has to do is press the one labeled key that corresponds to the desired operation. For example, to initiate an insertion, the user presses the INSERT key, and, to initiate a search operation, he presses the SRCH key. Moreover, there is no command syntax to remember. PCEDIT prompts a user for all the information that's required to perform the editing operation. If this isn't easy enough, there's also a HELP key.

PCEDIT has several other helpful features: it scrolls both horizontally and vertically, highlights the line containing the current cursor position and displays the

The mechanical arm that supports the display monitor is perhaps the Wang PC's most impressive feature.

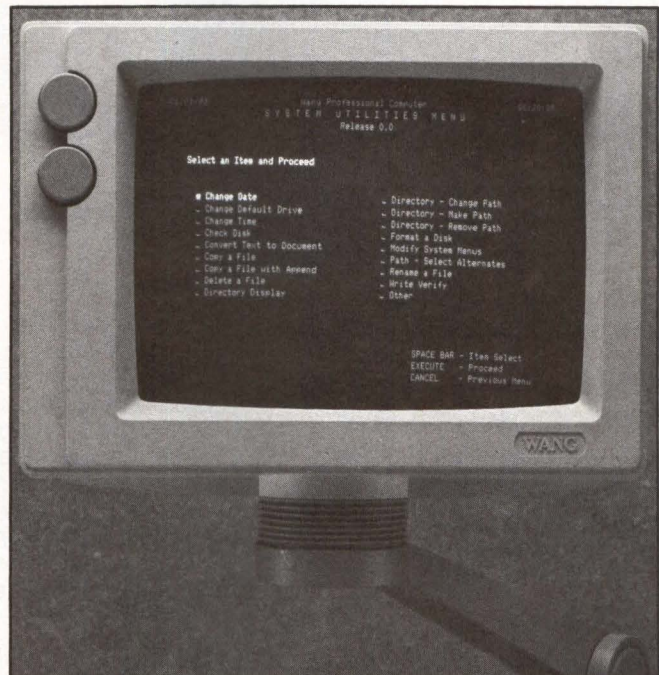
current text line number, which is useful for move, copy and print operations. PCEDIT isn't perfect, however. It's not possible to save edited changes on disk (an important precaution against unexpected system failure) without leaving the editor and then re-entering it. Also, the user can't edit a line while conducting a search operation. During a search, an occurrence of the desired string may appear beyond the first 80 columns of a line. When this occurs, the display scrolls so the editor can highlight the string, but it forgets to scroll back to the normal position for the remainder of the search, making it hard to see additional occurrences of the string.

The only serious design flaw with PCEDIT is that it lets the user clobber line ends without notification. This problem can happen if the maximum-line-width parameter is smaller than the width of the line the user is editing. Although PCEDIT displays this parameter and

users can easily modify it, there's no reason why PCEDIT shouldn't complain when it detects an operation that a user could not reasonably want to do.

Common languages permit portability

Both the Wang PC and the IBM PC support Microsoft's BASIC, Pascal, FORTRAN and COBOL. Thus, software portability between the two systems is relatively easy to achieve as long as programs do not bypass the operating system by directly addressing the basic I/O system (BIOS) or the hardware. Many popular programs, such as Microsoft's Multiplan, Lotus Development Corp.'s 1-2-3 and Software Arts Inc.'s TK!Solver, do bypass the operating system, foregoing portability for the sake of performance. As a result, these programs must have separate versions for the Wang PC and the IBM PC. But, for programs that do not



The system utilities menu facilitates file and directory management. Users need not remember the spelling or syntax of many individual commands.

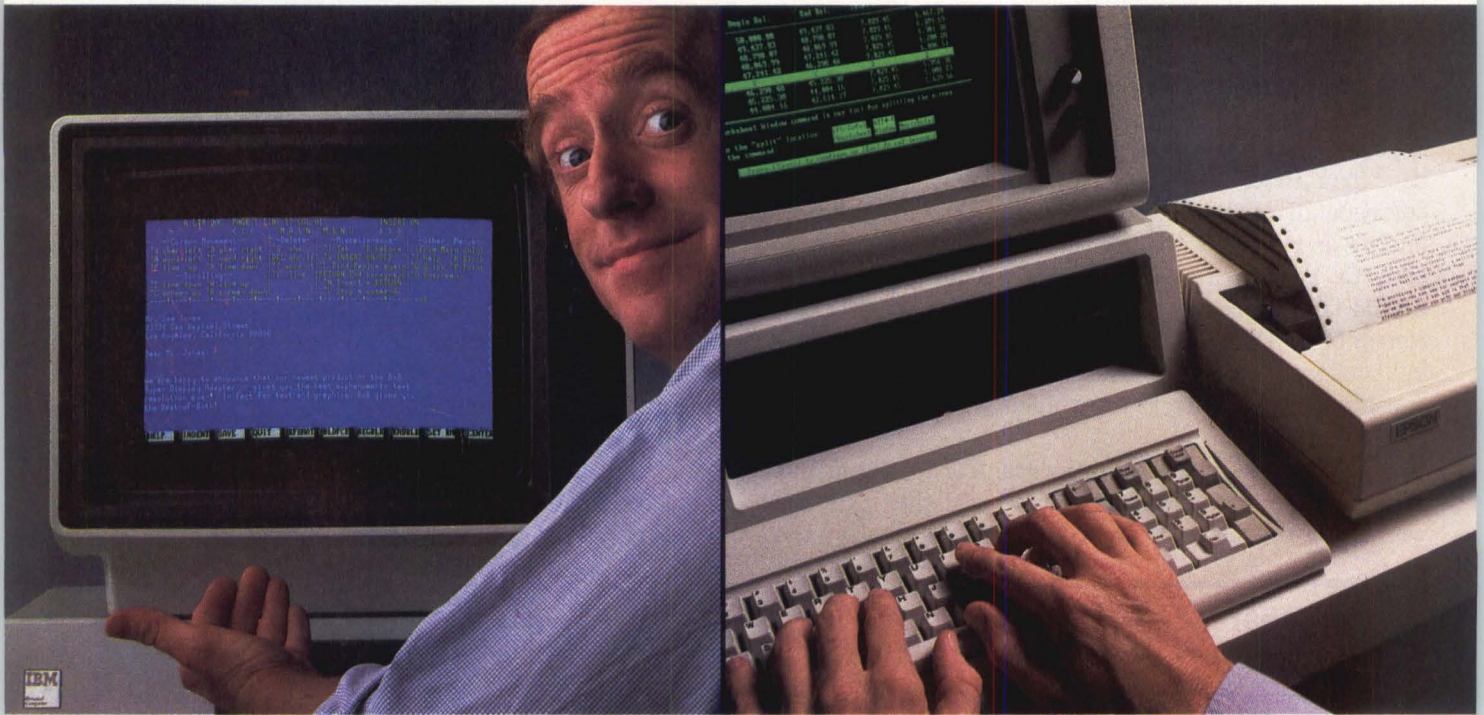
Which software packages run on the Wang PC?

Every Professional Computer from Wang Laboratories Inc. comes with Microsoft Corp.'s MS-DOS operating system and BASIC interpreter. Optional software falls into three categories: core, distributed and evaluated. Core software, which Wang distributes and supports, includes Microsoft's Multiplan; SofTech Microsystems Inc.'s p-System; Micro

Focus Inc.'s Level II COBOL programming environment; and Wang's programs for word processing, database management, business graphics and data communications. Distributed software, which is sold by Wang and supported by a third-party vendor, includes Lotus Development Corp.'s 1-2-3, Visicorp's Visi^{On}, Software Arts Inc.'s TK!Solver and various account-

ing programs from Peachtree Software Inc. Evaluated software consists of approximately 400 programs from independent vendors. Most of these programs are business-oriented, but Wang PC users should have little trouble finding a suitable software package for common applications.

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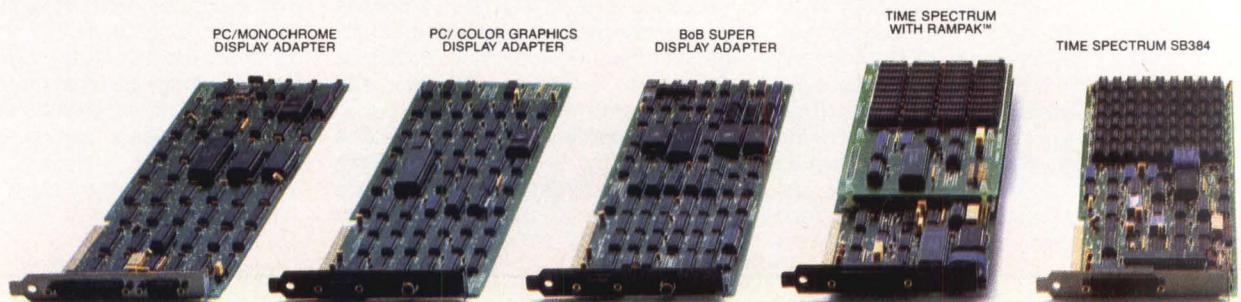
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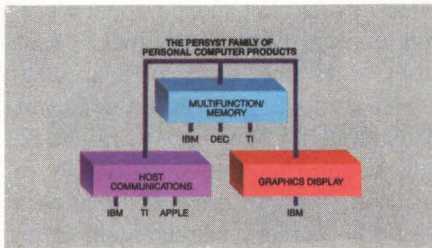
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17664	3-08-83	12:00p
560	2-02-84	7:22p
133	1-01-80	12:08a
4	2-16-84	1:34p
273	2-16-84	3:49a
631	2-16-84	3:56a
280	2-22-84	11:24a
172	2-24-84	5:46p
615	2-24-84	5:50p
563	3-01-84	2:25p
1018	3-02-84	9:06a
311296 bytes free		

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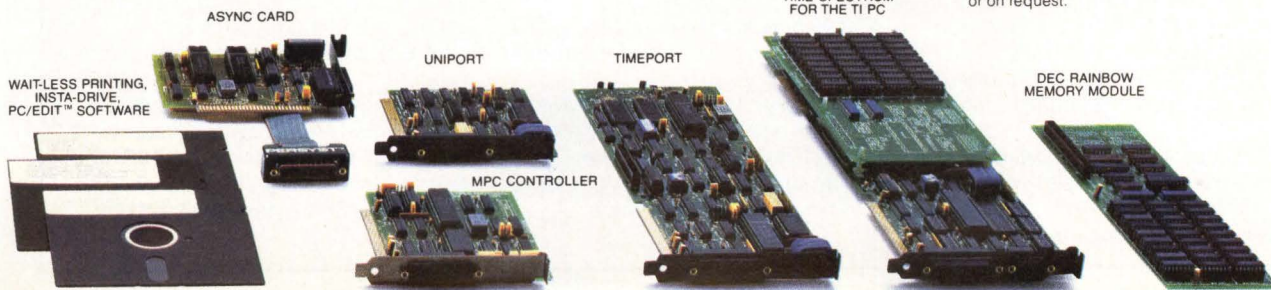
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require the utmost in execution speed, portability between the Wang PC and the IBM PC means that software integrators can exploit the advantages of the Wang system to develop, test and debug applications that run on the IBM PC.

To determine how easily a program could be ported from the Wang to the IBM, I tested a large BASIC

The ability to perform arithmetic and cursor movement using dedicated keys speeds input and reduces errors.

program that invokes many of the features of the language. Using Microsoft's BASIC interpreter, which is standard on both systems, the program ported as long as it was saved using the ASCII option of BASIC's SAVE command. If a user does not specify the ASCII option when saving a file, the BASIC interpreter compresses the source code to reduce disk utilization. The Wang and IBM versions of interpreted BASIC use different compression algorithms, preventing portability of compressed-code files.

Using compiled BASIC, I was able to run a single source-code version of the test program on both systems by compiling and linking the program in each environment. To achieve portability in this way, a user must have a BASIC compiler and a linker on each system, and the two compilers must support the same version of the language.

Another approach to portability is to transfer linked object code (.EXE files) between systems, eliminating the need for separate compilers and linkers. This method works as long as the transported program does not exploit BASIC's built-in capabilities for graphics, sound or cursor control, which are hardware-dependent at the object-code level. Languages such as Pascal and FORTRAN, which do not provide these capabilities, are better suited to object-code portability.

Memory utilization is another important issue in software development. The minimum memory configuration on the Wang PC is 128K bytes, but this number is misleading. To facilitate customer distribution of updates, Wang has located the PC's BIOS and BASIC interpreter in RAM rather than in ROM. Therefore, only about 87K bytes in a 128K-byte configuration are available to users. Furthermore, the 87K must hold a program's run-time support library. In the latest version of Wang's compiled BASIC, the run-time library (BASRUN.EXE) occupies 43K bytes, leaving relatively little memory for user programs. Although most programs require the support of only a subset of the library, there is no facility for linking selectively to the needed modules. As a result of these constraints, most application developers should order the Wang PC with at least 256K bytes of RAM.

For very large applications, the Wang PC can support as many as 896K bytes of RAM. The catch is that users probably can't access that much memory unless they program in assembly language. The version of the BASIC compiler on the evaluated Wang PC supports a maximum of 64K bytes of code and 64K bytes of data. The 64K-byte limit corresponds to the size of one memory segment on an 8086/8088 processor. Some compilers from Microsoft, Digital Research Inc. and other vendors now allow multiple code and/or data segments, allowing users to exploit more memory.

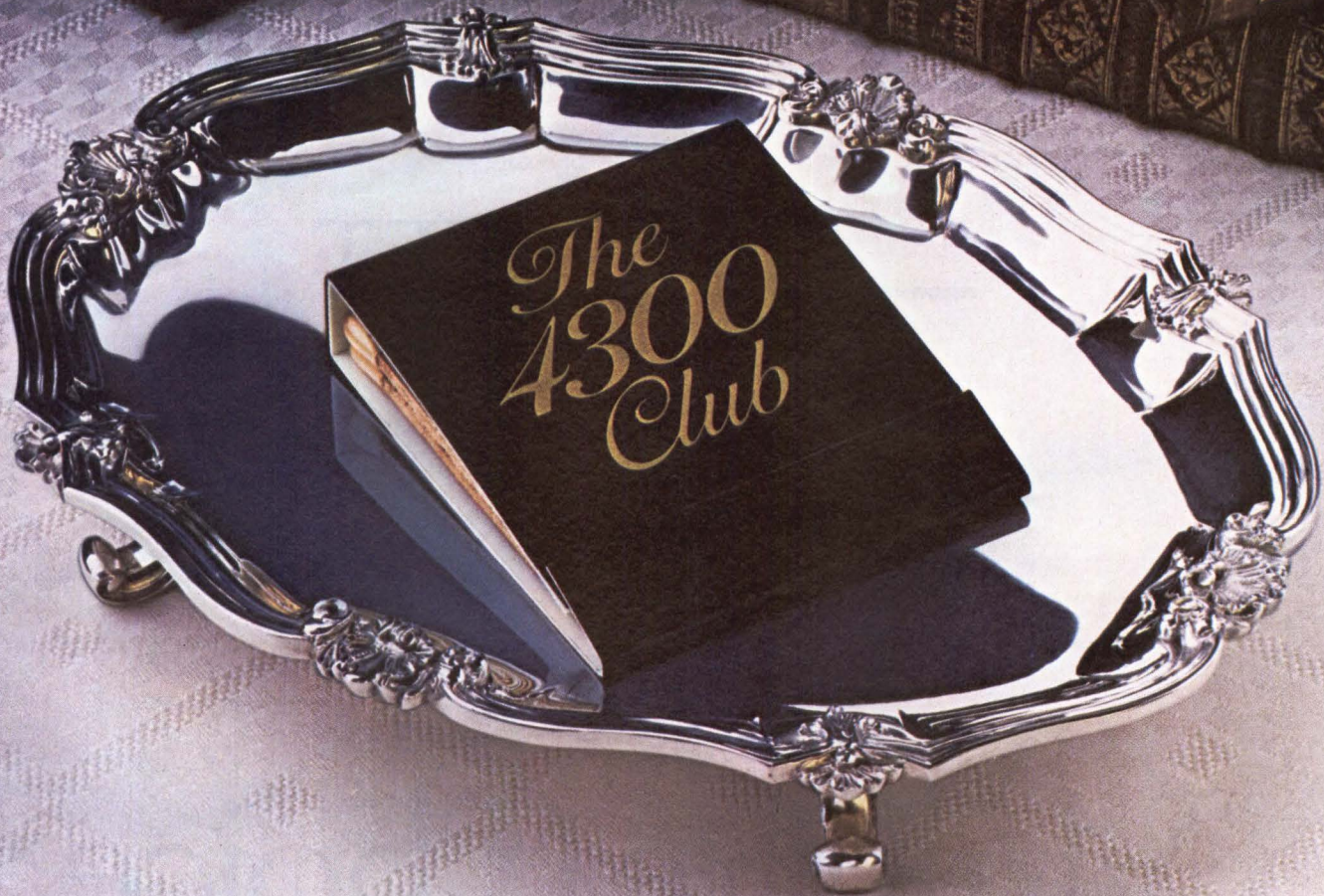
Regardless of the amount of memory on a host system, software integrators may need to fit applications into specified amounts of memory on a target system. For example, a 256K-byte Wang PC might be used to develop applications that run on a 64K-byte IBM PC. For this reason, integrators should have a simple way to find out the memory requirement of an application, but this is not the case. Determining the memory size of user code is easily done by performing a DIR command on the .EXE files. But there is no easy way to determine the size of statically allocated user data. The only guidance the system provides is to tell

Spec summary

- **Product:** Wang Professional Computer
- **Manufacturer:** Wang Laboratories Inc., 1 Industrial Ave., Lowell, Mass. 01851, (617) 459-5000
- **Weight:** system unit: 28 pounds, CRT: 14 pounds, keyboard: 4½ pounds
- **Architecture:** 8-MHz 8086 CPU, eight-slot expansion chassis, parallel and serial ports
- **Operating system:** MS-DOS 2.0

- **Display:** 12-inch monochrome screen, 25 rows by 80 columns of text, 800 by 300 pixels
- **Keyboard:** detachable, 101 keys including 16 programmable function keys
- **Memory:** 128K to 896K bytes
- **Disk storage:** one standard 5¼-inch, double-sided floppy disk drive, an optional second floppy drive or 10M-byte Winchester drive

- **Expansion options:** remote or local communications, Wang VS/OIS workstation emulation, graphics adapter, CP/M-80 emulation
- **Software options:** core, distributed and evaluated (see "Which software packages...," Page 267)
- **Price:** two floppy drives, CRT and 128K bytes of RAM: \$3,790; one floppy drive, 10M-byte Winchester, CRT and 128K bytes RAM: \$5,650



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A BRIEF COMPARISON OF THE IBM PC AND WANG PC

	IBM PC	WANG PC
Microprocessor	8088	8086
Internal CPU word size (bits)	16	16
CPU-to-memory word size (bits)	8	16
CPU clock rate (MHz)	4.77	8
RAM (K bytes)	64-640	128-896
Total keyboard keys	83	101
Programmable function keys	10	16
Display screen diagonal (in.)	12	12
Rows, columns of text	25, 80	25, 80
Screen resolution for text (pixels)	720 by 350	800 by 300
Screen resolution for graphics (pixels)	640 by 200	800 by 300

users at compile time or link time when they've exhausted the memory on the host system.

Sub-directories fail to achieve potential

The Wang PC runs MS-DOS version 2.0, which supports sub-directories and thus allows users to organize disk files into logical groupings. Also, MS-DOS limits a root directory to 128 files, so using sub-directories is the only way to store a large number of files on a hard disk. Unfortunately, users cannot realize the benefits of sub-directories on current versions of the Wang PC software.

There are so many files in the Wang PC's system code that the 128-file limit in the root directory leaves relatively few files for a user. When the user runs out of space in the root directory, the system generates an unhelpful "file creation error" message. Moving user programs into sub-directories doesn't solve the problem because Microsoft's languages do not support sub-directories. For example, if a program needs to read a data file named PROG.DAT, then that file must reside in the root directory. If a user moves PROG.DAT into sub-directory USRDAT, the program can't access the data file using the pathname /USRDAT/PROG.DAT. Performing a /CD USRDAT command before executing the program doesn't work either, as the program will still look for the file in the root directory. The only way around this problem is to store data files in a sub-directory and copy them to the root directory when they are needed—a cumbersome procedure.

Another source of frustration is the Wang PM012 letter-quality printer that came with the system I evaluated. The printer is noisy, slow and somewhat unreliable. With the furnished version of the operating system, printing a file by copying the file to device "PRN:" sometimes causes the system to crash. (The latest version of the operating system has apparently

solved this problem.) Moreover, attempting to print within BASIC using the LLIST or LPRINT statements also causes system crashes—a problem that Wang blames on Microsoft and vice versa. Another problem is that the printer paper becomes improperly aligned after only a few pages because there are no sprockets to fit into the holes along the edges of the paper. As a result, a user must "stand guard" while hard copy is being printed. The Wang PC also lacks a simple way to print an image of the display screen—an operation similar to SHIFT + PrtSc on the IBM PC.

The printer requires a cartridge ribbon that has a surprisingly short life span. The cartridge bears the Wang name with a part-reorder number. I made several calls to dealers of computer supplies but was unable to find one who knew of the Wang ribbon. When a dealer visited my office and inspected the ribbon, he immediately identified it as a standard Diablo Systems Inc. ribbon that is widely available from office-supply stores. Although Wang may find it advantageous to sell printer ribbons directly, it should not pretend that it is the sole supplier for a standard \$5 part.

Menus facilitate general operation

Menus, a feature that some users love and others hate, are easy to use but can be a nuisance. Therefore, Wang has taken the sensible approach of offering menus and allowing users to bypass them.

The Wang PC's main system menu consists of such choices as "applications," "communications," "DOS command processor," "program development" and "system utilities." Users can easily modify the list of menu items to correspond to the options in the users' configuration. To bypass follow-up menus, a user selects the "DOS command processor."

A nice touch is the way the system remembers how a user invokes an operation. For example, if the user enters the word-processing program by selecting it from the applications menu, the system returns to that menu when done. But if the user enters the word-processing program by typing "WP" from the MS-DOS command level, the system returns directly to the operating system.

Most system integrators and sophisticated end users will probably bypass the menus most of the time. But even for these users, the menus are helpful in carrying out infrequently used operations such as comparing files. Wang's menus prompt a user for all the information required by an operation, so the user doesn't have to remember how to spell a command or the kind of delimiter (space, comma or slash) for separating parameters. The Wang PC's menus are an example of a feature that enhances a product's utility and costs relatively little for a vendor to implement. □

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Optimizing a dual-processor micro for UNIX

NS16000-based system boasts virtual memory, VAX-compatibility, cache and dedicated slave processors

Robert M. McClure, Unidot Systems Inc.

System integrators can choose from a multitude of microprocessor-based UNIX machines, each claiming to bring the power of UNIX to a low-cost system. However, these systems vary greatly in execution speeds and multiuser support. In contrast to the single-processor approach typical of most of today's "UNIX engines," Unidot Systems Inc. has developed a dual-CPU microcomputer that also includes on-board cache memory, intelligent I/O processors and dedicated slave processors that support demand-paged virtual memory and floating-point arithmetic. Unidot's desire to run application programs compatible with Digital Equipment Corp.'s VAX minicomputer dictated in large part the choice of CPU, architecture and UNIX version.

The on-chip MMU cache memory contains the 32 most-recently-accessed logical addresses and their translated physical addresses.

Choosing the CPU

Several requirements exist for a system designed to run VAX-implemented, UNIX-compatible application packages. These include virtual memory to support large applications, fast disk access to support page swapping from secondary storage to main memory, fast terminal-I/O handling for multiuser applications and data-format compatibility to facilitate portability.

UNIX is available for several established 16- and 32-bit processor families, including Intel Corp.'s 8086, Zilog Inc.'s Z8000, Motorola Inc.'s 68000 and National Semiconductor Corp.'s 16000. However, because of their different architectures, significant differences in



The Cerebra series of virtual-memory microcomputers is based on the NS16032 chip (one in the Cerebra I and two in the Cerebra II). Both models incorporate the IEEE-796 Multibus and 512K to 2M bytes of main memory, and both support the GENIX operating system.

performance and ease of UNIX implementation exist in each family. Unidot chose the 16000 for its Cerebra systems because of the chip's high-level language support, VAX-compatible virtual-memory support, matched memory-management unit (MMU), matched hardware floating-point unit (FPU) and code compactness.

The 16000 allows instructions to be used with any addressing mode, any operand length (byte, word or double-word) and all general-purpose registers. This simplifies the compiler code-generator design. In the 8086, on the other hand, not all instructions apply to all registers or to all addressing modes, which complicates compiler design. With the 16000, most data accesses in C and Pascal can be made without doing address calculation into registers (Fig. 1).

```

loc1 = ...           /* simple local reference */
*loc2 = ...         /* indirect local reference */
loc2[3] = ...       /* indirect local with offset */
*(loc2 + 2 + reg1) = ... /* indirect local, index and offset */
/* above can be repeated with arg instead of loc */
ext[reg3 + 2] = ... /* external with index and offset */
*(reg2 - 5) = ...   /* register indirect, offset */
reg2[reg1 + 4] = ... /* register indirect, index + offset */

```

Fig. 1. Data references, given as a brief C program, can each be made directly within an instruction by appropriate selection of addressing mode with the 16000. This is in contrast to doing address calculation into registers. All data types—including char, short, int, long, float and double—can be addressed with equal ease.

In addition, the 16000 allows all addresses and immediate data to be 1, 2 or 4 bytes, which reduces code size. The 68000, in contrast, has no 1-byte addressing. Even external variables, for which addresses must usually be 24 bits, can be accessed indirectly in the 16000 through a local vector table that can often be addressed by a single byte. The most-frequently-used operation codes are also the shortest (i.e., only 1 or 2 bytes long).

Also important for system designers, the 16000 family has both a 16082 MMU and the IEEE-standard 16081 FPU. Like the 8086, the Z8000 does not have an MMU, and the 68000 does not have a matched FPU.

The arrangement of bytes in the 16000's memory is also important. Both the 16000 and the VAX address the least-significant byte of a multibyte item, which is also the lowest numerical address of any of the bytes in the data. This is also the arrangement in the 8086 family. On the other hand, the 68000 and the Z8000 organize data by most-significant byte first. The arrangement of bytes in the 16000 facilitates writing programs that are portable between the VAX and the 16000.

But the most important reason Unidot chose the 16000 centers on its virtual-memory support. A virtual-memory system appears to users as if the entire logical address space were available. If, when the MMU translates a virtual address into a physical address, it

finds that the requested page is not in main memory, a page fault (hardware trap) occurs and the operating-system software loads the requested page from disk. The instruction is then executed (re-tried). Called a page swap, this process is transparent to users. The 8086, in contrast, does not provide for restarting an instruction after a page fault and thus does not support virtual memory.

Architecture speeds throughput

A microcomputer intended to support the high-level technical applications running on large minicomputer and mainframe systems must be designed to optimize data throughput. The Cerebra series increases performance through the use of dual CPUs, on-board cache memory (in addition to, and independent of, the MMU's cache), dedicated slave processors and intelligent I/O processors.

The Cerebra I and II systems are identical, except that the Cerebra II features dual 10-MHz 16032 processor boards. Both models use a Multibus architecture with 24-bit addressing, multiple direct-memory addressing controllers, a 16082 MMU, a 16081 FPU, 16K bytes of 45-nsec. static RAM (for cache and local memory) and a battery-backed time-of-day clock (Fig. 2).

In the dual-processor Cerebra II, one processor board acts as the system master, executing both system (kernel) code and user application programs. The second processor serves as an intelligent slave dedicated to running only user application programs (Fig. 3). This dual-processor system enhances throughput speed in a multiuser environment by 60 percent to 80 percent over a single-processor system.

The on-board cache memory is 4K words deep and contains recently-accessed physical addresses and associated data (2 bytes of data for each address). In internal tests, the hit ratio, or probability of finding requested data in cache, is as high as 95 percent.

Users gain fast memory access at minimal cost with on-board cache memory. If main memory is on separate boards from the main processor, the overhead in accessing a byte, word or double word includes the delay times of physical address decoding on the memory board and routing the data back to the processor board through the drivers and receivers on the main processor board. Due to the memory-bandwidth restrictions of the Multibus, this requires inserting wait states into the processor cycle for every data and instruction fetch or write cycle.

Avoiding this overhead requires extremely fast and expensive main memory on a private bus or a local cache. For a system intended to support only a small amount of memory, the first option might be accept-

HOW THE CEREBRA CACHE WORKS

When a CPU buses a virtual address (VA) to the memory-management unit (MMU), the MMU translates the VA into a physical address (PA). Using low-order, or least-significant, bits of the VA, the MMU checks the cache, which contains PAs and associated data, to see if the data is available on the CPU board. The MMU then reads both the high-order bits of the PA, as well as the 16 bits of associated data.

In the first clock cycle after the MMU has completed its translation, it compares the high-order bits of the PA with the high-order bits of the address stored in cache. If the comparison matches, the MMU signals a "hit," and data is immediately available to the CPU. If the comparison does not match, the MMU signals a "miss" and requests access to the Multibus. This

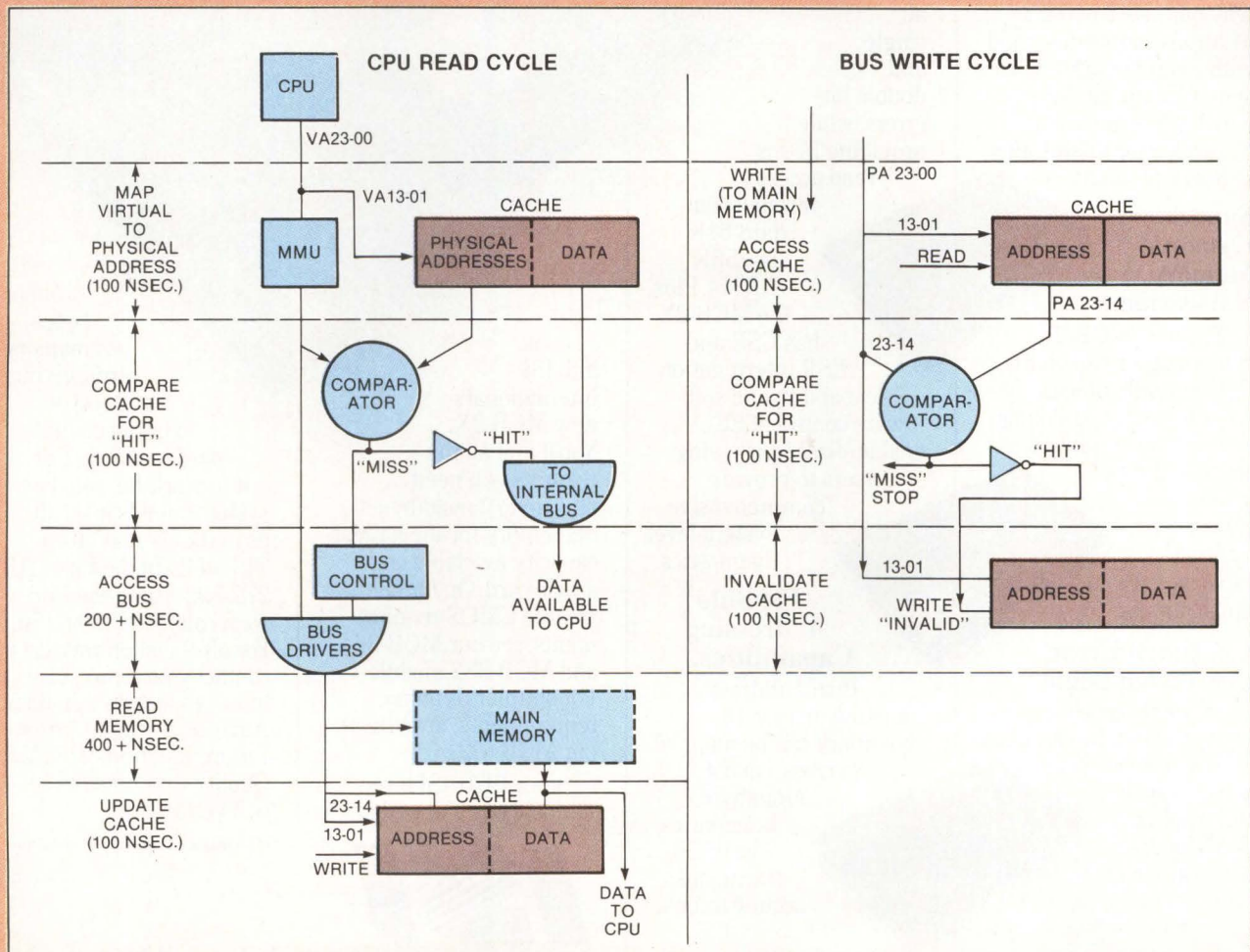
action first requires getting control of the bus, which takes at least two bus cycles—or more if another processor or peripheral is using the bus.

After the PA is sent over the bus, a main-memory read cycle begins. Depending on memory speed, the requested data is later sent to the CPU card. At this time, the CPU updates the cache by storing the data and high-order bits of the physical address in cache. Thus, the system automatically updates the cache to ensure that it contains most-recently-accessed data and that the cache contents are consistent with main memory.

Besides handling memory access when the CPU tries to read data, the cache logic must deal with special cases. For example, if another unit, such as a disk controller or another

processor, wants to perform a main-memory write, the cache control uses the PA from the bus to read the cache (right).

The MMU compares the PA with those stored in the cache, just as if the address were generated locally on the CPU board. If the comparison reveals a miss, then no further action on the cache is required because the data being manipulated in main memory is not present in the cache. If the comparison reveals a hit, then the data in the cache is marked invalid by writing an "INVALID" bit into the cache at that address. The next time that data is read from main memory, the CPU updates the cache. Thus, cache contents are always consistent with main-memory contents.



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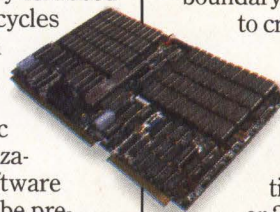
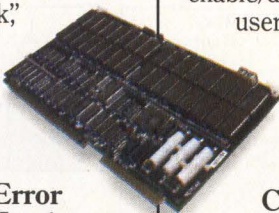
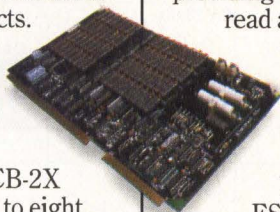
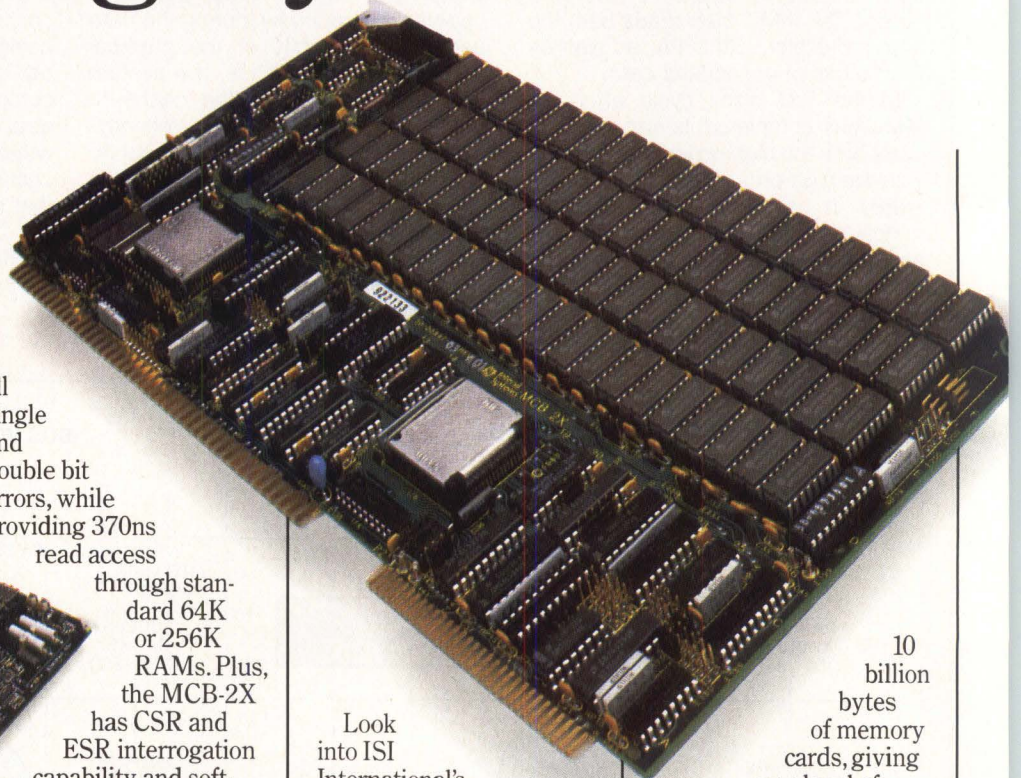
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able, but the cache option has several advantages in a multiuser system that can support as much as 16M bytes of real memory. With cache hit ratios expected to be around 90 percent in an actual UNIX environment, bus loading typically will be lower than 50 percent, even with dual processors and a heavy I/O load.

The cache uses a store-through design with bus monitoring to ensure that data in the cache is always consistent with main memory. The CPU automatically updates cache contents at the same time as main memory is updated. It is not necessary to "flush," or "purge," the cache. Thus, the cache is transparent to the operating system (see "How the Cerebra cache works," Page 277).

The Cerebra systems incorporate the MMU and FPU slave processors of the 16000 family, which reside on the CPU board. These dedicated slave processors use the instructions and addressing modes of the main processor. The MMU performs logical-to-physical address translation in 100 nsec. after the first access to a given page. It fully supports demand-paged virtual memory, as does the VAX, but provides several other

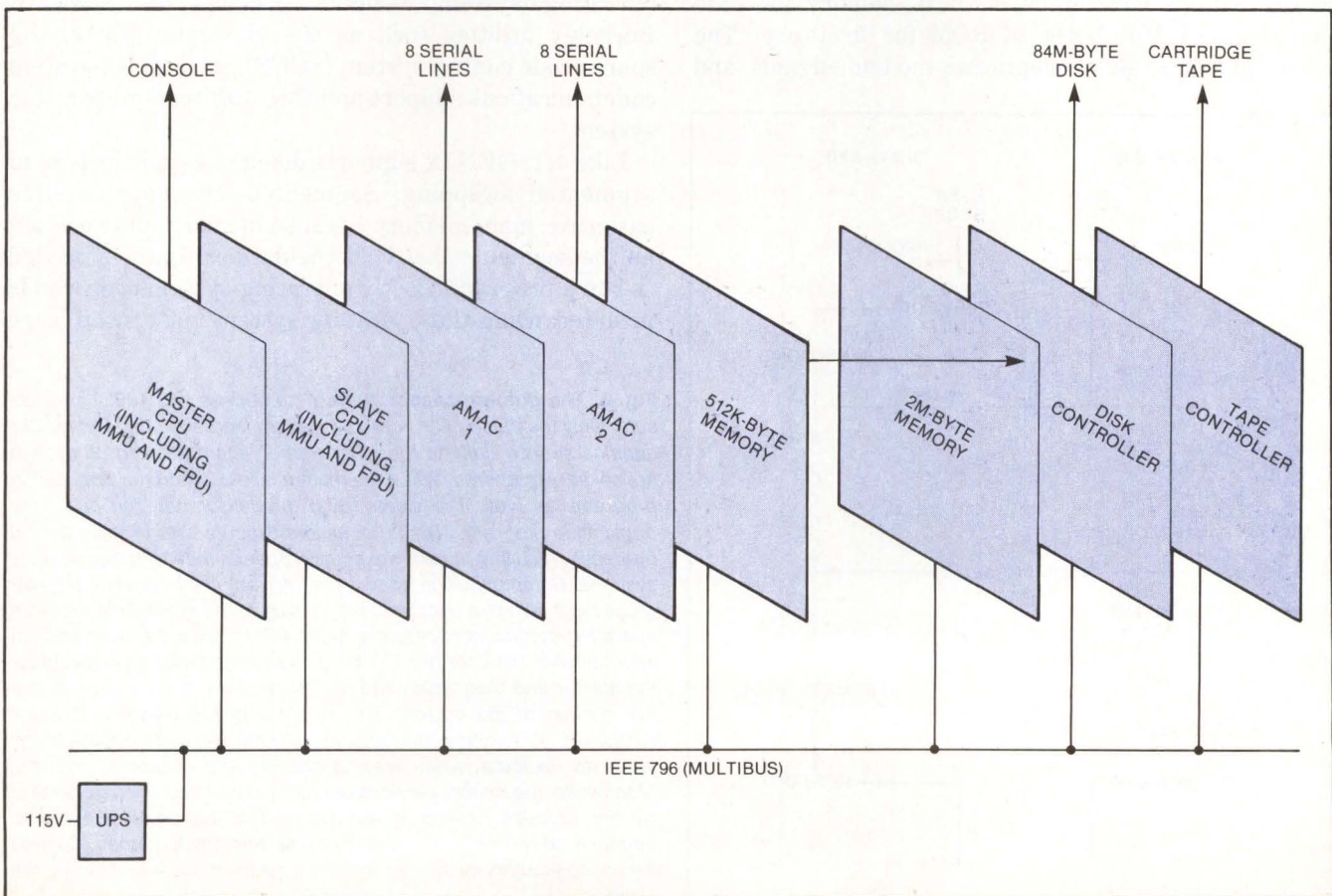
features including more debugging capabilities. The MMU also marks read accesses (indicating which physical pages have been read) and write accesses (indicating which pages have been modified), which facilitate working-set calculations to reduce paging traffic. Other features not available on the VAX include the MMU's ability to perform virtual and physical memory breakpointing and to "remember" the last two branch points in user code.

The MMU performs logical-to-physical address translation in 100 nsec. after the first access to a given page.

The MMU divides logical memory into 32,768 pages of 512 bytes each. To a programmer, memory appears as a full 16M-byte address space. The programmer works only with one set of addresses—virtual, or logical addresses—while the MMU automatically

Fig. 2. The Unidot Cerebra II has dual 16032 processor boards in a Multibus-based system. Intelligent disk controllers and advanced multiline asynchronous controller (AMAC) boards off-load the main

processors from I/O-handling tasks. Application programs run transparently in the dual-CPU system.



translates virtual addresses into physical addresses (MMS, October 1983, Page 260). If a page does not reside in main memory, the MMU and operating system automatically transfer the page from disk to memory, and the program continues in a manner transparent to users. This means that programs running on VAX or mainframe-level computers and having very large databases, high-resolution graphics or many users can be ported to the less costly Unidot systems.

The lack of hardware floating-point support in most microprocessor systems running UNIX limits those systems in many scientific and technical applications because execution is too slow. The 16081 FPU in the Cerebra systems handles the calculations in these computation-intensive applications. The FPU supports 32- and 64-bit IEEE-format floating-point data and uses all addressing modes of the 16000 family, making it easy for compilers to generate code.

Another performance killer often encountered in UNIX systems is terminal-character handling, a problem that the Cerebra systems solve with an eight-port serial controller called the advanced multiline asynchronous controller (AMAC). The AMAC uses the NSC08032 processor with an 8-bit bus. The AMAC board contains 64K bytes of local memory for data buffering and 16K bytes of ROM for firmware. The board supports all conventional modem signals and

baud rates to 38.4K baud.

I/O performance in most UNIX systems suffers because the host must perform a significant amount of processing for each character sent or received and must process all interrupts. The AMAC handles all character processing in the Cerebra system, thus relieving the host.

The interrupt burdens (CPU overhead time) in most UNIX systems can reach 1 msec. per interrupt and effectively limit output to 9,600 baud while consuming available processing power. The AMAC handles all character interrupts and limits them to a maximum of 16 per second, regardless of the character-transfer rate. On-board buffering ensures that overruns do not occur even if an interrupt is not serviced for a long time. In applications such as screen-oriented editing using non-intelligent terminals, the AMAC doubles the number of users that the system can support.

Readily available versions of UNIX include System III and System V from Bell Laboratories, 4.1 and 4.2 from Berkeley, Microsoft Corp.'s XENIX and a variety of look-alikes such as Whitesmiths Ltd.'s IDRIS and Mark Williams Co.'s Coherent. The VAX runs the Berkeley 4.1 edition, which was the base system used by National Semiconductor to develop the GENIX operating system. GENIX includes the standard Berkeley utilities such as the *vi* screen editor, the source-code control system (SCCS), *uucp*, inter-system communications support and the *nroff* text-preparation system.

Like 4.1, GENIX supports demand paging instead of segmented swapping. Segmented swapping requires extensive main memory because memory must contain all the segments that hold the data or routines needed to run a program. Costly operating-system overhead is incurred when the operating system must swap large

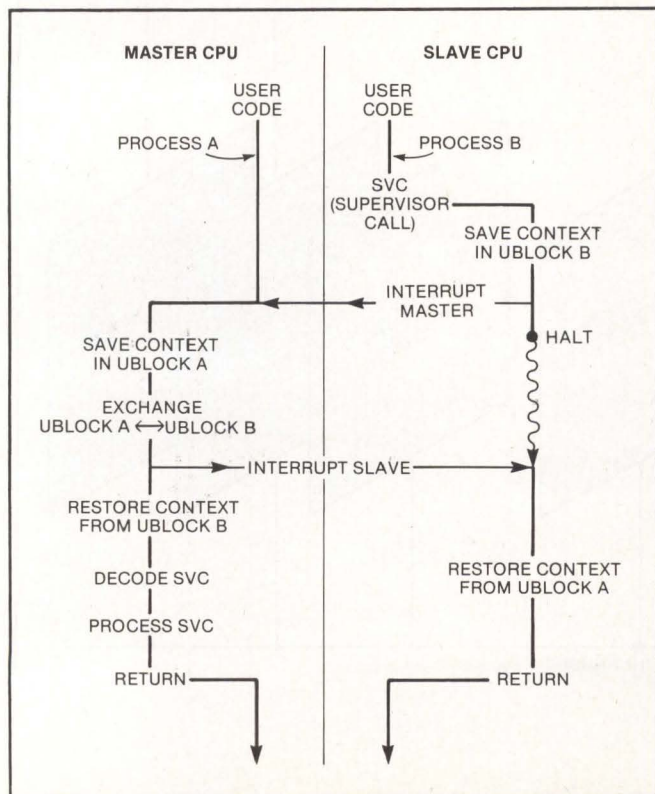


Fig. 3. The dual-processor system comprises two 16032 processors. Only the master CPU can run system (kernel) code. The master handles service calls to the UNIX kernel, interrupts and all system housekeeping chores. When the master is idle, it can run application programs as well. The slave 16032 processor can run only user application programs. Both processors execute user tasks in typical operation, resulting in better execution speeds than single-processor systems. Communication occurs via interrupt lines between the two processors. When a user process running in the slave CPU requests operating-system services, the slave CPU stores the user context information in the user block (UBLOCK B), generates an interrupt for the master and then waits. The master receives the interrupt, stores the context of the current user process in the master's U block (UBLOCK A), exchanges U blocks with the slave and instructs the slave to execute what was previously the master's process. Meanwhile, the master services the request that had been generated by the process running in the slave. This approach is required because only one CPU can execute the UNIX kernel. Context switching enables the master to handle system calls without idling the slave.

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PF in VT100 Mode	0	64
Data Routing From Function Keys	NO	YES
Non-Volatile Function Memory	NO	YES
Four-Page Memory	NO	YES
Eight-Page Memory Option	N/A**	YES
Bi-Directional Printer Port	NO	YES
Dual Set Up Tables	NO	YES
Dual Host Support	NO	YES
Compose Key	YES	YES
Graphics Option	NO	YES
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* Based on latest information supplied by manufacturer. ** Not applicable.

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MINI-MICRO SYSTEMS/May 1984

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281

SUMMARY SPECIFICATIONS OF UNIDOT SYSTEMS INC.'S CEREBRA SERIES

- **CPU:** NS16032 (one in the Cerebra I system, two in the Cerebra II)
- **Main memory:** 512K to 2M bytes
- **Operating system:** GENIX
- **Bus:** IEEE-796 (Multibus)
- **Mass storage:** standard equipment includes an 84M-byte Winchester and a 14M-byte cartridge-tape back-up unit
- **Standard number of I/O ports:** 16
- **Price range:** \$25,000 to \$65,000

segments from disk to main memory. With demand paging, only those pages of memory actually in use need reside in main memory, which reduces operating-system overhead as well as the amount of required main memory. The 16000 divides virtual-address space and main memory into equal-sized pages of 512 bytes each. Demand-paged, virtual-memory support will not be available from Bell Laboratories until the release of System VI.

GENIX capitalizes on the 16000's ability to restart instructions to speed process creation. UNIX typically creates processes by copying the currently-running process. If this process is large, such as for the shell (command line interpreter), considerable CPU time must be expended in the creation of a memory image

(the process "copy") that is immediately discarded. GENIX creates processes by copying much smaller mapping tables instead of duplicating a process. GENIX protects the real pages against writing during process creation, so that an attempt to write into a data page is trapped, and a new, writable copy of the page is supplied before restarting the instruction. GENIX takes advantage of the mapping facilities of the MMU in other ways, such as providing direct access to a bit-mapped display and write protection and demand paging of the kernel. □

Robert M. McClure is president of Unidot Systems Inc., Golden, Colo.

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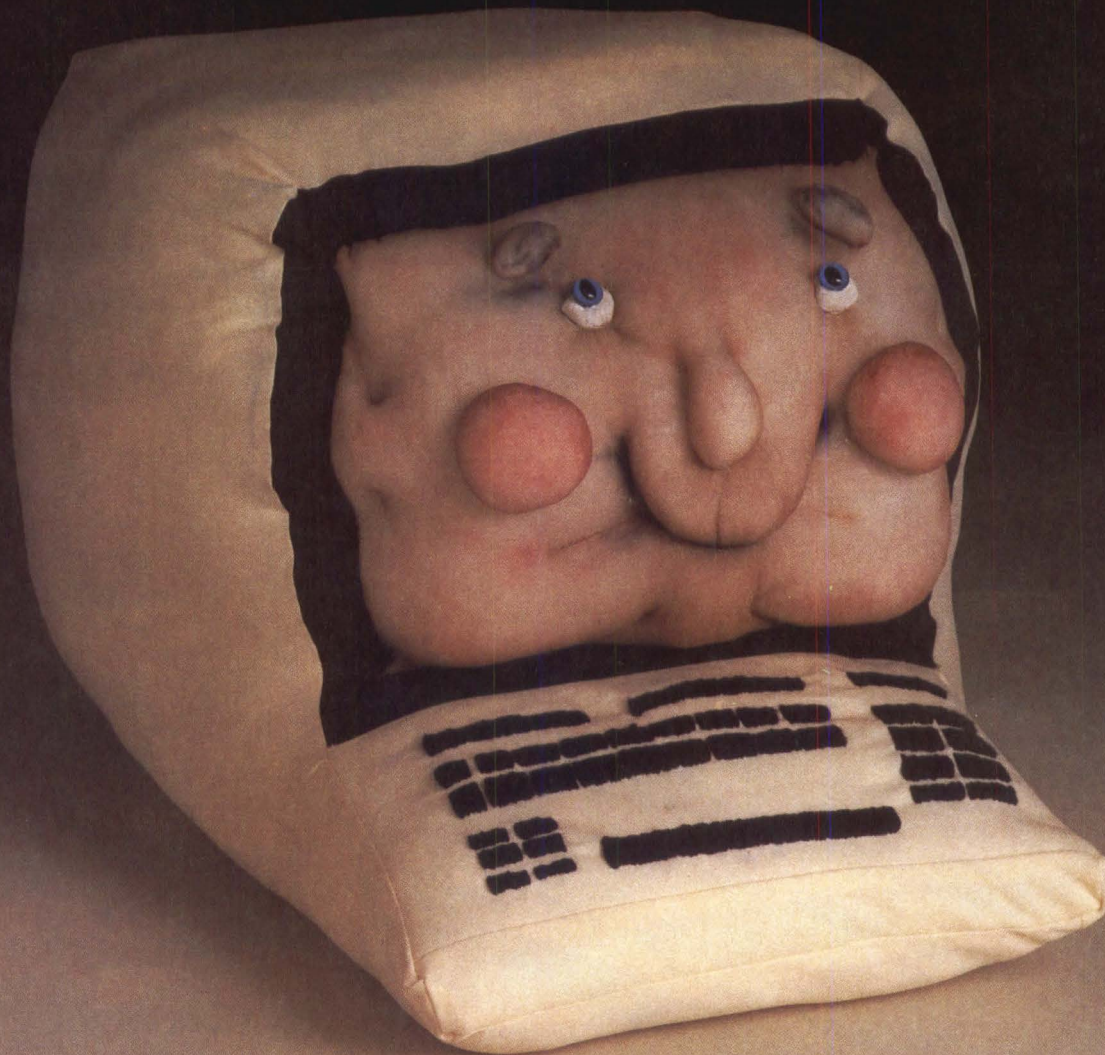
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New Products

SYSTEMS

Products unite processing and networking



Mohawk Data Sciences' Hero personal computer and Super 21 communications processor permit 10 programs to operate concurrently so that data can be transferred among mainframe applications, departmental databases and local programs such as spreadsheet analysis and word processing.

Mohawk Data Sciences has introduced the Hero family of networked personal computers and Super 21 communications processors. Targeted at IBM 3270 networks, these products allow users to integrate desktop personal computing with IBM host computer applications.

Super 21 links as many as 16 Hero workstations or other MDS terminals in a local-area network while providing

access to mainframe computer programs and corporate and public databases via Intelligent 3270 software. Interaction between the communications processor and the host can be tailored so that a user can retrieve data, process and store the data locally and then return the data to the mainframe for updating the central database. Super 21 software supports all major data-communications protocols. The comput-

er connects directly to an interactive IBM 3270 Systems Network Architecture or IBM 3776 remote-job-entry network. Super 21 also supports binary synchronous, asynchronous and X.25 protocols.

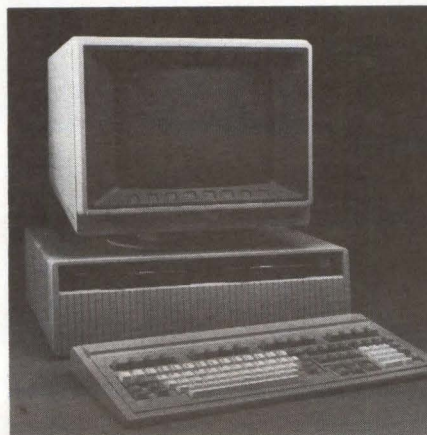
The Hero workstation consists of a video display, a keyboard, a modular processor and textbook-sized floppy or hard disk storage units that snap together for expansion. The central processor module includes a 16-bit 80186 microprocessor, 256K bytes of RAM, two RS232C ports, one RS422 port and one Centronics-compatible parallel printer interface. The workstation permits 10 programs to operate concurrently under the H/OS operating system. It also supports the MS-DOS 2.0 operating system and allows file sharing between the two operating environments. Users can execute programs written in COBOL, BASIC, Pascal and FORTRAN.

A typical entry-level system consisting of four networked Hero personal computers with a keyboard, a display and 256K bytes of memory each and one Super 21 communications processor configured with 5M bytes of disk storage, 256K bytes of memory, a communications controller, two communications ports and Intelligent 3270 software sells for approximately \$22,550. **Mohawk Data Sciences, Systems Division**, Seven Century Dr., Parsippany, N.J. 07054, (201) 540-9080.

Circle No 300

Workstation comes in three versions

The desktop model 7350 Professional Computer incorporates a 68000 CPU, a video display unit, a detached keyboard, a 15M-byte Winchester disk drive and two double-sided, double-density floppy disk drives. It is available in a single-user professional workstation, a color graphics workstation and a multifunction cluster controller console. The single-user workstation offers the UniPlus+ (a UNIX System III derivative) operating environment. It comes with 320K bytes of user memory and can be upgraded to a multifunctional



cluster controller. The color graphics workstation adds a color graphics display featuring a 27-color palette from which 16 can be displayed simultaneously. This version has 448K bytes of user memory and supports the DI-3000 graphics library and Grafmaker data-presentation software. The multifunction cluster console version includes an additional 1M byte of memory and allows the attachment of as many as three terminals to provide a four-user cluster configuration. \$8,400 to \$11,750. Delivery is 90 days. **Perkin-Elmer Corp., Data Systems Group**, 2 Crescent Place, Oceanport, N.J. 07757, (201) 870-4768.

Circle No 301

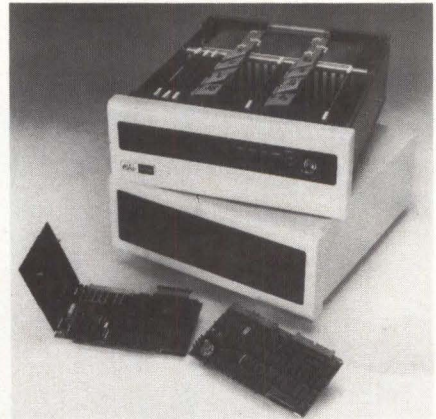
New Products

SYSTEMS

UNIX micro features fast disk transfers

Powered by a 10-MHz MC68000 microprocessor, the model 83/80 microcomputer features the UNIX operating system with Berkeley enhancements. The unit conforms to IEEE-696/S-100 bus standards. It is equipped with an

industry-compatible SMD disk controller that yields average transfer rates of 800K bytes per second in read mode and 560K bytes per second in write mode. All sectors on a track are transferred within a single disk rotation, regardless of where the head first settles. The controller supports one or two 80M-byte



hard disks. The machine's standard 512K bytes of dynamic RAM with parity is expandable to 3.25M bytes. The four-channel RS232C I/O boards use direct memory access for all outputs. The C programming language comes standard with UNIX; optional languages include FORTRAN-77, Pascal, BASIC and RM/COBOL. \$20,990 including an 80M-byte hard disk and UNIX. **Dual Systems Corp.**, 2530 San Pablo Ave., Berkeley, Calif. 94702, (415) 549-3854.

Circle No 302



Portable computer has 9-inch display

The TI Portable Professional Computer, which is hardware- and software-compatible with the desktop TI Professional Computer, features a 16-bit 8088 microprocessor, 64K bytes of RAM, expandable to 768K bytes, five expansion slots and a 5¼-inch, half-height floppy disk drive with space for 320K bytes more storage under MS-DOS 1.1 and 360K bytes under MS-DOS 2.1. The computer incorporates a 9-inch mono-

MINI-MICRO SYSTEMS/May 1984

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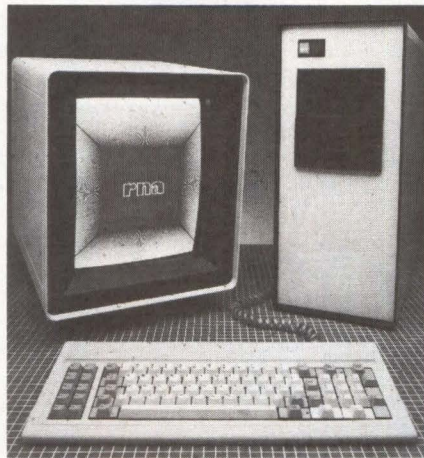
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chrome or color display that furnishes a 25-line-by-80-column format and 720-by-300-pixel resolution. It can also drive an external 12-inch monochrome or 13-inch color monitor. The portable supports communications products for the desktop model, including TTY, 3270 and the EtherSeries of local-area network products. Prices start at \$2,395. **Texas Instruments Inc., Data Systems Group**, P.O. Box 402430, H-689, Dallas, Texas 75240, (800) 527-3500.

Circle No 303



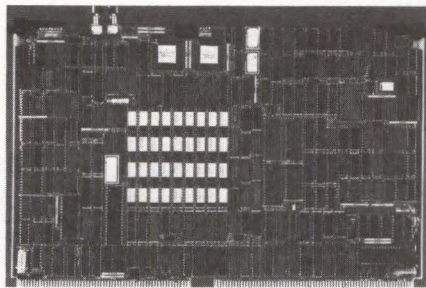
with a maximum rate of 5 million per second. Implemented on the IEEE-796 bus, the basic configuration provides 1M byte of RAM. The operating system, similar to the UCSD p-system, supports Pascal and FORTRAN. The system's black-and-white display offers 1,024-by-800-pixel resolution. Character display is 60 lines of 84 columns. \$20,000, including 1M-byte RAM, a 15M-byte Winchester disk drive, a display, the operating system and a Pascal compiler. **RNA Inc.**, 4377-B First St., Pleasanton, Calif. 94566, (415) 846-1870.

Circle No 305

Workstations offer multiple user modes

The Sun-2 family of workstations features local-area network communications capability, an ergonomic design and an optional hardware floating-point processor. The desk-side Sun 2/120 can be configured as a network node or as a self-contained standalone system. The Sun 2/170 rack-mountable system can act as a file server equipped with high-capacity disk drives, a ½-inch tape unit and other peripherals. Both models use a Multibus backplane, with nine slots in the Sun 2/120 and 15 slots in the Sun 2/170. They use a 10-MHz MC68010 processor that provides 16M bytes of virtual address space per process. The units run UNIX 4.2 bsd and come with all standard UNIX utilities, C, FORTRAN, Pascal, a graphics library based on the ACM Siggraph Core Standard and a window-based user interface. Prices start at \$16,300. **Sun Microsystems Inc.**, 2550 Garcia Ave., Mountain View, Calif. 94043, (415) 960-1300.

Circle No 306



Mono-board micro is VERSAbus-compatible

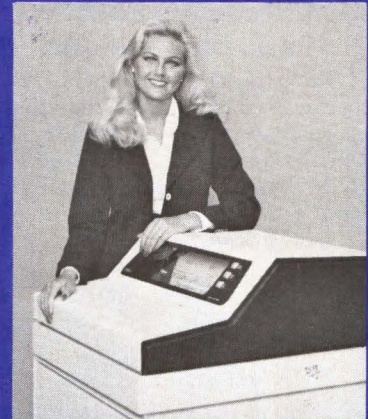
The VM03 mono-board microcomputer incorporates a 10-MHz MC68010 virtual-memory microprocessor and an MC68451 memory-management unit. The VERSAbus-compatible board furnishes 256K bytes of dynamic RAM with parity check, a dual-port RAM controller, two 28-pin sockets for 64K bytes of user-supplied ROM/EPROM devices, two multiprotocol serial I/O ports with RS232C interfaces for modem or terminal usage, a triple 16-bit programmable timer/counter and a real-time clock. Software support includes the VERSAdos real-time multitasking disk operating system with file-management capabilities, a real-time multitasking ROMable Executive package and a debug monitor. \$3,900. **Motorola Semiconductor Products Inc.**, P.O. Box 20912, Phoenix, Ariz. 85036, (602) 828-3501.

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Desktop computer attains 5-MIPS peak performance

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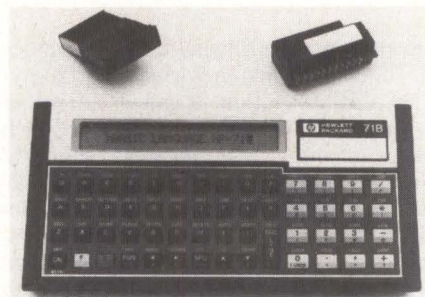
New Products

SYSTEMS

Computer handles numeric calculations

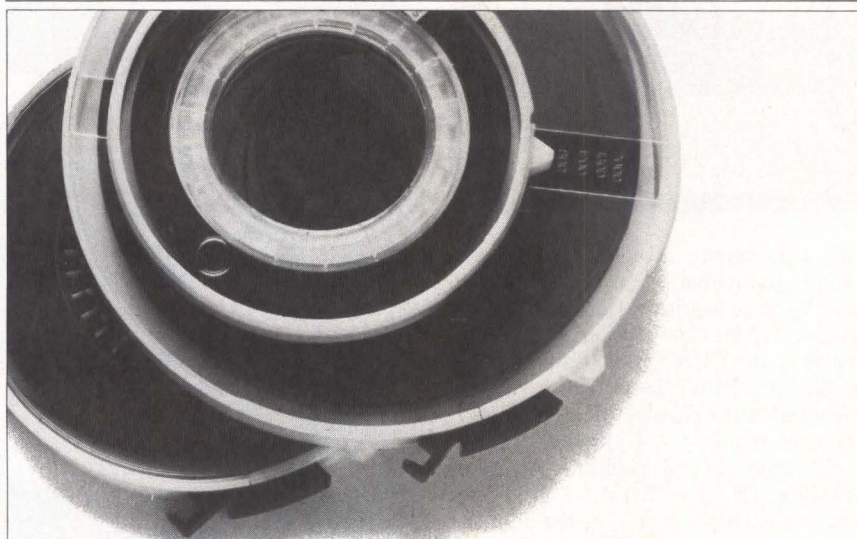
The HP-71B hand-held computer performs numeric computations and calculations. The computer features enhanced BASIC, calculation mode, 17.5K bytes of RAM, 64K bytes of ROM and four plug-in slots for memory

expansion. The unit measures 3 $\frac{3}{8}$ by 7 $\frac{1}{2}$ by $\frac{1}{2}$ inches and weighs 12 ounces. It has a block QWERTY keyboard and a 10-digit numeric pad. The keyboard can be redefined, and overlays are available for customization. A one-line, dot-matrix LCD shows 22 characters of a 96-character line at one time. A plug-in



slot in the rear of the machine accommodates the HP interface loop. The information-transfer rate of the HP-IL module is 5K bytes per second. Less than \$550. **Hewlett-Packard Co.**, 1820 Embarcadero Rd., Palo Alto, Calif. 94303.

Circle No 307



PLUG THIS IBM-COMPATIBLE 9-TRACK TAPE SYSTEM INTO JUST ABOUT ANY PORT

The IBEX Model TS-110 Magnetic Tape system is immediately compatible with any micro- or mini computer, mainframe, modem or special device having a standard port—RS-232, RS-422, or GPIB/HPIB. It appears to that device as a buffered printer or terminal. Simple, transparent ASCII control codes provide tape drive control for any number of functions.

Outstanding features include:

- Universal RS-232, RS-422, GPIB/HPIB compatibility
- IBM-standard format compatibility
- Ease of operation—only 6 ASCII characters required
- Operation at any baud rate to 38.4K baud
- Single system can be alternately used to transfer data from one computer to another

Plug up that missing link in your computer operation today with the IBEX TS-110 Magnetic Tape System.

For complete technical data, call, TWX or write:

IBEX

IBEX COMPUTER CORPORATION
20741. Marilla Street, Chatsworth, CA 91311
(818) 709-8100 - TWX 910-493-2071

CIRCLE NO. 144 ON INQUIRY CARD



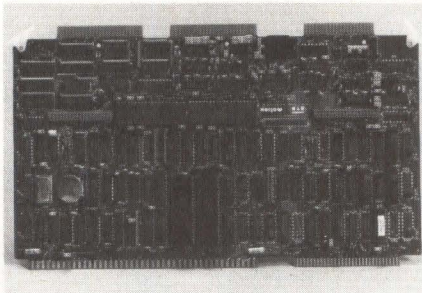
System operates with three microprocessors

The Omni Convertible multiple microprocessor system contains a variable processor architecture (VPA) that permits concurrent operation with as many as three microprocessors employing CP/M Plus, MS-DOS, UCSD p-system, UNIX, the company's proprietary Omni-DOS and other operating systems. Forming the VPA's framework is a shared memory ranging from 128K bytes to 1M byte dual-ported to a pair of 8- and 16-bit buses. The system's 8-MHz Z80H runs 8-bit application programs. A plug-in CPU board with a TI 9995 microprocessor inserted in one slot of a four-slot 16-bit Multibus controls the system keyboard, parallel printer port and an RS232C port. The TI 9995 runs the Omnitext proprietary word-processing software. The system's third CPU board, based on an Intel 80186 or 80286 or a Motorola 68000 microprocessor, plugs into a second Multibus slot. Prices start at \$6,000. **Omnidata**, 5717 Corsa Ave., Westlake Village, Calif. 91362, (213) 991-5810.

Circle No 308

New Products

DATA COMM



Communications board operates at high speed

The COM-1 communications board enables Multibus systems to communicate with computers and peripherals at high speeds using DMA. Eight on-board Multibus DMA channels handle data transfers between any combination of Multibus RAM and I/O ports. One bidirectional 16-bit parallel I/O port transfers data between a Multibus-based system and a DEC VAX, PDP-11 or LSI-11 computer at speeds as high as 400K words per second. The board includes four high-speed serial channels. Three of the channels conform to the RS232C interface standard and use RS423 line drivers and receivers to accommodate baud rates as high as 307.2K baud. The fourth serial port can be strapped for one of four modes: the RS449 interface standard with RS422 drivers (800K baud maximum), RS449/RS423, RS232/RS423 (300K baud) or as an LAN mode interface. \$2,495. **Matrox Electronic Systems Ltd.**, 5800 Andover Ave., Montreal, Quebec H4T 1H4, Canada, (514) 735-1182.

Circle No 309

Full-duplex modem operates at 2,400 bps

The microprocessor-based model R2424 full-duplex modem operates over the DDD network or two-wire private lines. It operates synchronously or character asynchronously at 2,400 or 1,200 bps. At 1,200 bps, the modem is Bell and Rixon 212A-compatible. A front-panel talk/data switch that allows calls to be answered manually (by telephone) or automatically (controlled by the data-terminal equipment) makes alternate voice/data communications possible. A front-panel switch labeled AN/AUTO/OR (answer/auto-answer/originate mode) permits proper opera-



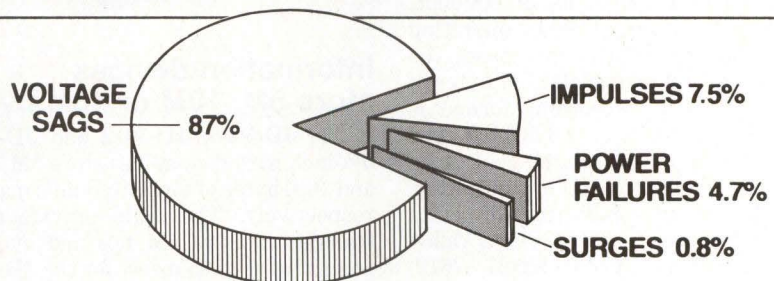
tion over the DDD network or two-wire private lines. The modem can perform analog and digital loopback, remote digital loopback, local self-test and end-to-end self-test. \$1,195. **Rixon Inc.**, 2120 Industrial Parkway, Silver Spring, Md. 20904, (301) 622-2121.

Circle No 310

BELL LABS FINDS 87% OF POWER DISTURBANCES AT COMPUTER SITES ARE VOLTAGE SAGS!

Sags. Not Spikes. Not Surges. Voltage Sags!

Bell Telephone Laboratories monitored commercial electric power at 24 computer sites of Bell Operating Companies, Western Electric, and the AT&T Long Lines Department. Utility-supplied power was monitored for up to 22 months, with an average per site of more than 11 months and total observation time of 270 months. Here is what Bell found:



Sags Outnumbered Spikes Even During Storms!

Surprising, indeed! Even to the Bell Systems engineers who conducted the study.*

Your Power Is Probably Like Ma Bell's

Chances are your computer is exposed to the same kind of power line sags, impulses and occasional failures. Nasty, costly events that can cause data loss, faulty computations, disk-head crashes and sudden shutoffs.

With Sags The Key Culprit, Why Zero In On Surges?

Is it wise to lay out money for surge

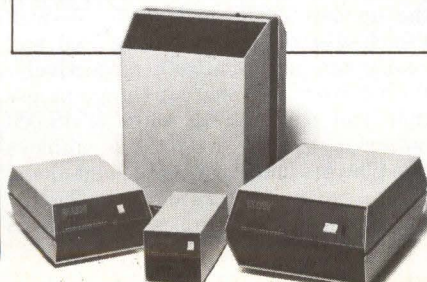
suppressors and spike clippers that give no protection against voltage sags? And leave your computer open to the most frequent power disturbances? Think about it!

Do The Job Right — With ISOREG

ISOREG power modules **block sags, spikes, and surges** and deliver good clean power to computers even when line voltages drop to 60% of normal — for minutes.

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*"The Quality of U.S. Commercial AC Power," Goldstein, M.; and Speranza, P.D.; IEEE April 1982.

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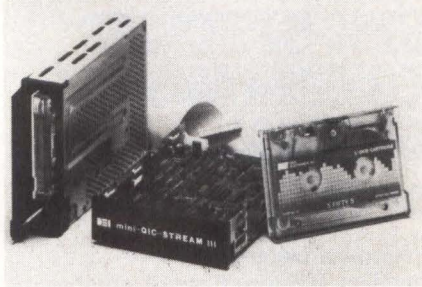
289

New Products

DISK/TAPE

Tape drive meets QIC-02, -24 standards

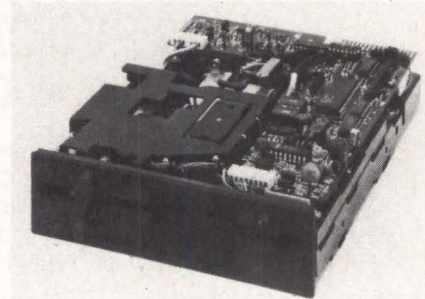
Fitting the industry-standard, half-height, 5¼-inch disk drive footprint and offering a formatted data-storage capacity of 60M bytes, the Mini Qic-Stream III ¼-inch streaming digital cartridge-tape drive is compatible with QIC-02



and -24 data-format standards. Using serpentine recording, the drive allows four- or nine-track operation on ANSI-standard 450-, 555- or 600-foot, ¼-inch data cartridges. When operating at the standard 90-ips tape speed, the drive can accept or transfer 5M bytes of data per minute. Recording format is GCR, and data density is 8,000 bpi. The basic drive becomes an intelligent drive with the addition of a formatter/controller module. \$425 to \$875. **Data Electronics Inc.**, 10150 Sorrento Valley Rd., San Diego, Calif. 92121, (619) 452-7840. **Circle No 311**

3.9-inch Winchester packs 30M bytes

The half-height SQ338F 3.9-inch Winchester disk drive stores 30M bytes of data (formatted). The unit, measuring 1.625 by 4.8 by 8 inches, allows users to increase storage capacity by placing two drives into the space of one 5¼-inch Winchester or minifloppy drive. The three-platter drive offers the pin-outs, timing, data-transfer rates and track/sector formatting of industry-standard 5¼-inch Winchester disk drives. The drive features a data-transfer rate of 5M bps and an average access time of 85 msec. It uses controller interfaces designed for ST506/412 drives, a closed-loop, embedded digital servo mechanism and graphite-coated thin-film metallic alloy disks. \$1,100 (1,000 units). **SyQuest Technology**, 47923 Warm Springs Blvd., Fremont, Calif. 94538, (415) 490-7511. **Circle No 312**



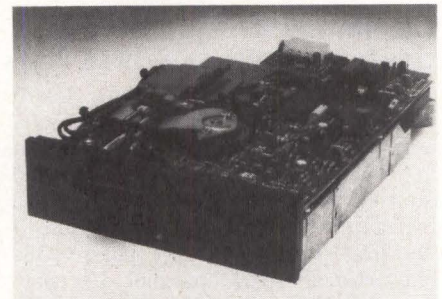
Information devices store 5M, 10M or 16M bytes

The JD-5006, JD-5012 and JD-5020 5¼-inch hard disk drives store 5M, 10M and 16M bytes of formatted information, respectively. The units provide data-transfer rates of 5M bps and average access times of 85 msec. for the JD-5006 and JD-5012 and 120 msec. for the JD-5020. The MDP-1 and MDP-2 5¼-inch floppy disk drives accommodate 1M byte and 500K bytes of unformatted information, respectively. The MDP-1 is a double-sided, 96-tpi drive with 80 tps; the MDP-2 is a double-sided, 48-tpi drive with 40 tps. Data-transfer rates are 250K bps. All the drives measure 1¾ inches high. Prices are available from the vendor. **US JVC Corp.**, 41 Slater Dr., Elmwood Park, N.J. 07407, (201) 794-3900. **Circle No 313**

Winchesters boost system throughput

Aimed at multiuser microsystems, the models 3075 and 3065 5¼-inch Winchester disk drives store 75M and 65M bytes (unformatted), respectively. Both feature a 24-msec. average access time and have MTBF rates of 18,000 power-on hours. Model 3075 employs five platters and eight heads, and model 3065 uses four platters and seven heads. Both have closed-loop servo systems

and voice-coil linear actuators. They adhere to industry-standard form factors and use the ST412 interface. Model 3075: \$1,950 (1,000 units), model 3065: \$1,800 (1,000 units). Evaluation units will be available in the second quarter. **Atasi Corp.**, 2075 Zanker Rd., San Jose, Calif. 95131, (408) 995-0335. **Circle No 314**



Floppy disk drive stores 1M byte

The microprocessor-controlled TM55D-4 half-height, 5¼-inch floppy disk drive uses LSI circuitry and a brushless DC direct-drive motor. The 96-tpi, double-sided drive stores 1M byte. Employing a split-band head positioner driven by a stepper motor, the drive achieves a 3-msec. track-to-track access time. Average access time is 94 msec. The data-transfer rate is 250K bps. Approximately \$200 in OEM quantities. **Tandon Corp.**, 20320 Prairie St., Chatsworth, Calif. 91311, (213) 993-6644. **Circle No 315**

Microfloppy drive packs 1M byte

The models 321 and 322 microfloppy disk drives feature single-sided, 500K-byte and double-sided, 1M-byte storage capacities, respectively, on 3¼-inch flexible media. Average access times are 282 msec. for the model 321 and 175 msec. for the model 322. Data-transfer rates are 250K bps. The drives are plug-compatible with standard double-sided, double-density, 96-tpi, 5¼-inch floppy disk drives and use a standard 5¼-inch interface. They also share their 80-tps media format with 5¼-inch floppy disk drives. Model 321: \$155, model 322: \$190. **Micro Peripherals Inc.**, 9754 Deering Ave., Chatsworth, Calif. 91311, (213) 709-4204. **Circle No 316**

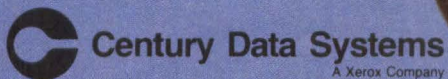
More than A Memory A Commitment To Quality

Every department, every person in our organization is dedicated to one goal—to deliver the finest in disk memories.

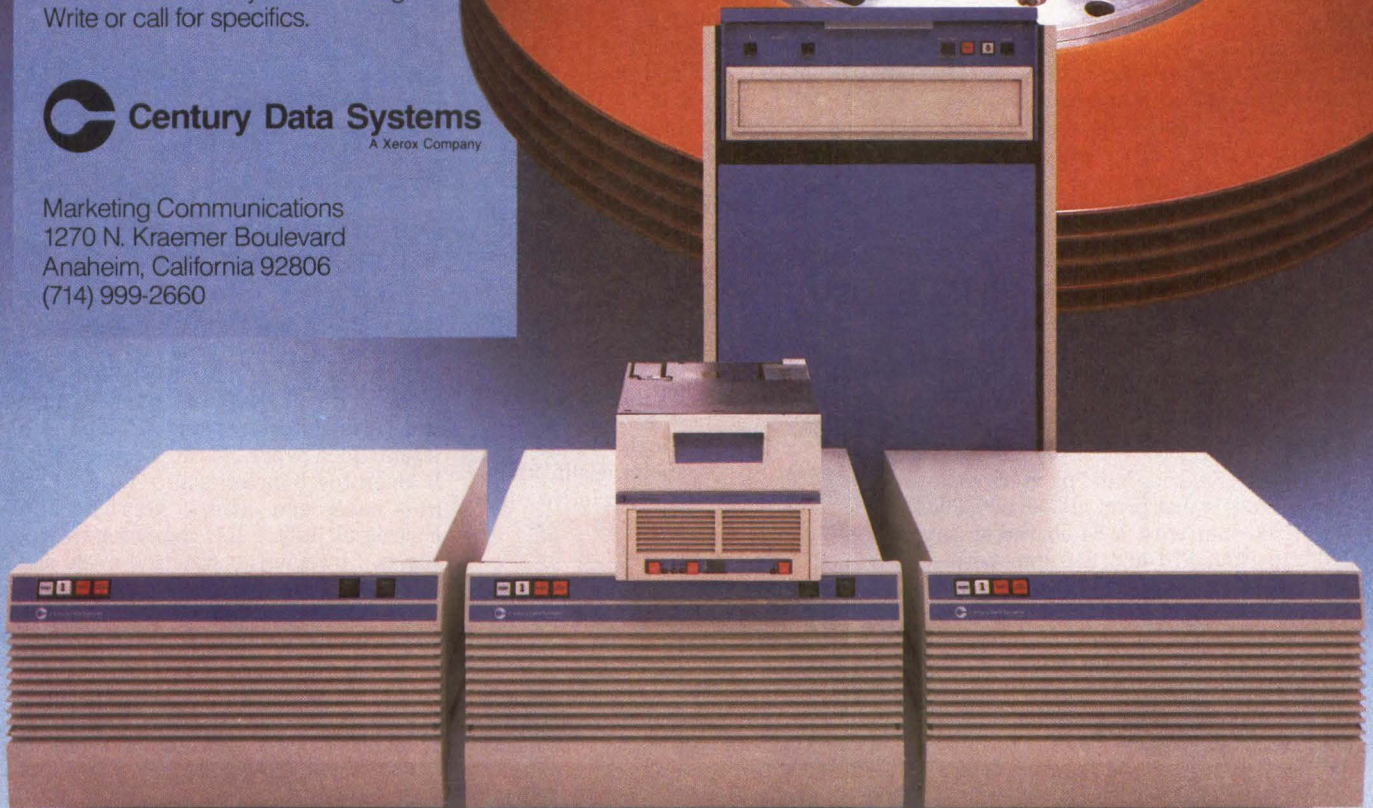
At Century Data Systems, we see quality as a pervasive, company-wide attitude. And our customers share this perspective.

Leading OEMs continue to rely on Century Data Systems disk memories for superb reliability, year after year. That's the real payoff from our total approach to quality.

At Century Data Systems, quality is much more than a memory. It's a living company commitment. And it can work to your advantage. Write or call for specifics.



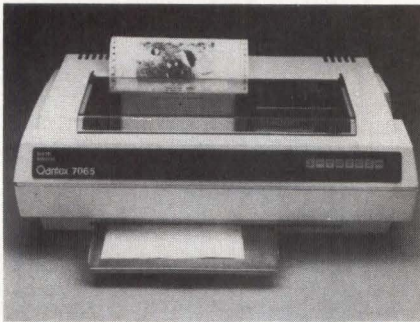
Marketing Communications
1270 N. Kraemer Boulevard
Anaheim, California 92806
(714) 999-2660



CIRCLE NO. 146 ON INQUIRY CARD

New Products

PRINTERS



Dot-matrix printer supplies graphics mode

The model 7065 dot-matrix printer operates at 300 cps in draft mode, 250 cps in compose mode, 125 cps in near-letter-quality mode and 65 cps in letter-quality mode for word processing. The graphics mode offers 144-by-144-dpi bit-mapped resolution at a repetition rate of 1,500 dps per activated needle. The printer also features down-loadable proportional spacing, right-margin justification, automatic underline, overprint and boldface fonts and an expandable 4.7K-byte input buffer. It can store as many as three letter-quality fonts on-line. A host computer can down-load printer parameters to the model 7065 using escape-code sequences. The unit is compatible with Anadex, Epson and DEC LA120 escape codes. A Centronics interface and an RS232 current-loop interface are standard. \$1,995. **North Atlantic Industries, Qantex Division**, 60 Plant Ave., Hauppauge, N.Y. 11788, (516) 582-6060 or (800) 645-5292. **Circle No 317**

Band printers feature 6,000-hour MTBF rating

The M304X series band printers come in four models that print at 300, 600, 900 and 1,200 lpm with a 64-character set and 210, 420, 670 and 910 lpm with a 96-character set. They automatically identify three standard print bands and one optional print band and automatically select the associated ROM. Operating noise level is 55 dB. The printers have 136 print positions and switchable 6- or 8-lpi vertical spacing. They accommodate one- to six-part forms from 3 to 17 inches wide and from 3 to 15 inches long. Each model is available with a Centronics, Dataproducts or RS232C interface. MTBF is 4,000 hours at 1,200 lpm and 6,000 hours at 600 lpm.

1,200-lpm model: approximately \$8,000 (OEM quantities). **Fujitsu America Inc.**, 3075 Oakmead Village Dr., Building 3, Santa Clara, Calif. 95051, (408) 988-8100. **Circle No 318**

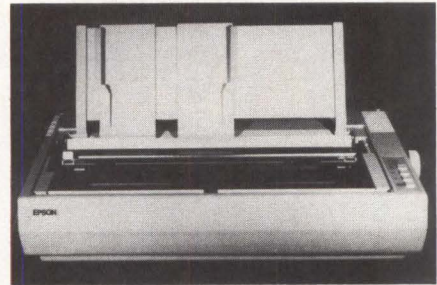


Printer provides quiet operation

The VersaPrint model 530 serial dot-matrix impact printer features color printing, cut-sheet feeding, continuous-form feeding, graphics, multiple speeds with selectable print-quality modes and quiet operation. Printing modes and speeds include a draft-quality mode using a 7-by-9 matrix at 180 cps, a memo-quality mode using a 14-by-9 matrix at 90 cps and a near-letter-quality mode using a 14-by-18 matrix at 45 cps. Character formats range from 135 columns at 10 pitch to 224 columns at 16.5 pitch. For international applications, the printer has 10 resident character sets including USASCII, UKASCII, French, German, Swedish, Finnish, Italian, Danish, Norwegian and Portuguese. Dot-addressable graphics resolutions are 72 by 72 dpi and 144 by 144 dpi. The printer comes with RS232C and parallel interfaces. The unit's operating noise level is less than 55 dB. \$2,495. **Lear Siegler Inc.**, 714 N. Brookhurst St., Anaheim, Calif. 92803, (714) 774-1010. **Circle No 319**

Matrix printer employs 24-pin head

With a 24-pin head and printing speeds of 200 cps for high-volume drafts and 60 cps for letter-quality correspondence, the LQ-1500 serial dot-matrix printer forms characters with matrices ranging from 9 by 17 dots to 37 by 17 dots. In graphics mode, resolution ranges from 60 to 240 dpi. The printer's built-in character sets provide 96 ASCII characters, 13 international character



sets and 96 italic characters. Printing is bidirectional with logic seeking. Centronics, RS232C and IEEE-488/GPIB interfaces are available; additional 2K-byte buffers are available with the RS232C and GPIB interfaces. MTBF is 6,300 hours at 25 percent duty cycle. \$1,200 to \$1,500. **Epson OEM Products Division**, 3415 Kashiwa St., Torrance, Calif. 90505, (213) 533-8277. **Circle No 320**



Dot-matrix units print 140, 120 or 100 cps

The D-300, D-200 and D-100 dot-matrix printers print at 140, 120 and 100 cps, respectively. Model D-300 has a 132-cpl column width at 10 pitch and comes with a 2K-byte buffer, parallel and serial interfaces and friction- and tractor-feed paper-handling capabilities. It operates bidirectionally with short-line seek and offers vertical and horizontal tabs. Its character-matrix size is 9 by 8 in the standard mode and 17 by 16 in near-letter-quality mode. Other features include six pitch sizes, emphasized or elongated print, proportional spacing, an italics character set and a 96-character ASCII set. The printer also has bit-image graphics capabilities with horizontal resolutions of 60, 72 and 120 dpi. Models D-200 and D-100 have 80-cpl column widths at 10 pitch. D-300: \$795, D-200: \$595. **Smith-Corona**, 65 Locust Ave., New Canaan, Conn. 06840, (203) 972-1471. **Circle No 321**



THE PRINTER TO PICK WHEN THE PACE QUICKENS.

It's happening all over the value-added world.

Your multi-user customers are getting hit with a ton of increased throughput requirements and they need more printer speed. A lot more.

They're also looking for more professional-looking presentations so they need better print quality. A lot better.

Where can you find the best of both worlds for them? And at the same time find some margins that'll look real good to you?

With Okidata's Pacemark 2350 and 2410 dot matrix printers.

Take throughput. The 2350 and 2410 can quickly get your customers out of the waiting game to where they're *really* cranking it out.

But wait. Cranking *what* out, you may ask? A single, restrictive printing mode? No way. The 2410 can give your customers DP, draft, and correspondence quality that truly rivals the daisy-wheel. And with flexibility, too: up to 5 pages per minute.

And the 2350 and 2410 can both

print at up to 350 cps. While producing 120 to 420 lines a minute for them.

With bidirectional printing and short line seeking logic. And both high speed and vertical slew.

SYSTEMS COMPATIBILITY. SOFTWARE COMPATIBILITY.

The 2350 and 2410 use industry standard interfaces making them hardware compatible with most mini and microsystems on the market today. In addition, they are supported on the menus of most of the important software being offered to microsystem users.

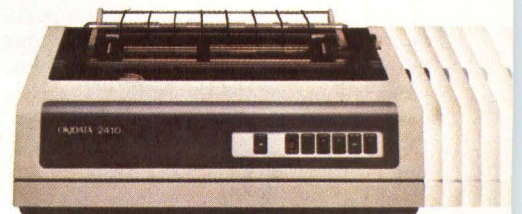
You also get an outstanding graphics capability with 144 x 144 dots per inch resolution.

Two color printing for highlighting. Down line loadable font sets for flexibility. Subscripts and superscripts so your scientific and technical usage won't bog down. Six-part forms handling. The capability to print 132 columns on eight-inch paper using 17.1 characters per inch to save paper costs and make

output easier to handle.

And—so that your customers can depend on getting all that good stuff, all the time—a mean time between failure of 2200 hours. A mean time to repair of only 30 minutes. An average print-head life of 200,000,000 characters. And an industry low warranty claim rate of less than 2%.

No doubt about it, the quicker the pace at your customers' place, the more you need Pacemark from our place. For more information, call toll free 1-800-OKIDATA. In New Jersey, 609-235-2600. Or write OKIDATA, Mt. Laurel, NJ 08054.



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We're keeping pace with your business.

CIRCLE NO. 147 ON INQUIRY CARD

New Products

SOFTWARE

Relational DBMS interfaces with Multiplan

The R:base Series 4000 relational database-management system provides a direct interface to Multiplan and dBase II and is compatible with Lotus 1-2-3, VisiCalc and WordStar. It features management of 40 files with 100 billion records; relation (file) and attribute (field) lists; teaching and branching to direct commands; customized screen forms for data entry, editing and reports; data validation; automatic identification and explanation of improperly entered syntax; and English-like prompts and commands. Information from any productivity program can be transferred to R:base for modification and storage. Relational access functions include join, intersect, project, subtract and union. An updated change command modifies selected values throughout all relations in the database. Priced at \$495, the R:base Series 4000 requires 265K bytes of memory and operates on personal computers that run PC-DOS, MS-DOS, CTOS, BTOS and UNIX. **Microrim Inc.**, 1750 112th Ave., N.E., Bellevue, Wash. 98004, (206) 453-6017.

Circle No 322

Tools form software facility

The Softool set of software tools for software management, development, maintenance and conversion operates on Hewlett-Packard Co.'s HP9000 computers running the HP-UX operating system. Softool is composed of two environments: the change and configuration control (CCC) environment and the programming environment (PE). The CCC environment allows software managers and programmers to track all software and documentation changes and versions automatically. It supports automatic reconstruction of previous versions, problem-tracking, difference reports, management reports, access control, archiving, compression, encryption and automatic recovery. It can handle programs in FORTRAN, C and Pascal. The PE environment allows a user to compose an application program from prefabricated code. Tools include shorthand language, structured languages, a source-code auditor, a source-code documenter, an interface documenter, error detectors, a code

generator and libraries of prefabricated code. PE supports FORTRAN only. CCC or PE: \$5,045 to \$20,180; CCC and PE: \$7,570 to \$30,270. **Softool Corp.**, 340 S. Kellogg Ave., Goleta, Calif. 93117, (805) 964-0560.

Circle No 323

Utility analyzes program performance

The Image Monitoring (IMON) utility for DEC VAX/VMS systems gathers samples from a running FORTRAN, BASIC, C, COBOL, PL/I, BLISS or MACRO program and produces a bar-graph display of the program's location. The display indicates routine names and program line numbers within those routines. IMON can also display the time a program spends in scheduling states and processor modes. Users can run IMON from any terminal on the VAX by specifying the process ID, the process name or the image name. A terminal-independent screen package supports non-standard terminals as well as VT100 compatibles. \$2,500. **MID-COM Corp.**, 1940 N. Tustin -117, Orange, Calif. 92665, (714) 998-6041.

Circle No 324

Software lets IBM PCs emulate HP terminals

PC 2622 emulation software enables IBM PC and IBM PC-compatible microcomputers to work and look like intelligent HP2622A terminals. The software matches the features of the 2622A and emulates some features of the HP2624, including security fields, two communications ports and space substitution of tabs. The package offers selectable data-transfer rates as high as 19.2K baud, a printer buffer that can be configured to store as much as 320K bytes, "type-ahead" with HP3000 host computers, a system for transferring files between the PC and an HP3000 minicomputer, support of parallel and serial printers and horizontal scrolling of lines as long as 10,000 characters. \$295. **Walker Richer & Quinn Inc.**, Lake Union Place, 1914 N. 34th St., Suite 201, Seattle, Wash. 98103, (206) 634-0503.

Circle No 325

Database-management system is easy to use

ASAP Five, a universal relational database-management system for IBM PC, PC XT and compatible computers, features variable-length fields and records. Users define data fields by identifying the item name, type (text, number, date, money or calculation) and length. The program automatically puts all data fields in the appropriate files and databases. The same screen can be modified to delete, add or change data items. With integrated word-processing functions such as header, automatic page numbering and automatic page breaks, users can generate mailing labels, form letters and custom-designed invoices. \$575. **ASAP Systems Inc.**, 2425 Porter St. Suite 14, Soquel, Calif. 95073, (408) 476-3935.

Circle No 326

Tool kit increases graphics capabilities

The GSS-Toolkit, a collection of subroutines and utilities for programming FORTRAN, Pascal, Compiler BASIC and C, aids software writers and system integrators in developing micro-computer graphics applications for MS-DOS machines. It comprises a plotting system, a kernel system and a window manager. The plotting system subroutine library enables programmers to create bar charts, pie charts and scatter plots by manipulating high-level graphics elements such as titles, axes and legends as well as attributes such as position, color shading, scale and line style. The kernel system programming library addresses lower-level graphics primitives. It incorporates the ANSI-standard Graphics Kernel System. When used with GSS-Drivers software, it permits graphics portability across MS-DOS machines. The window manager provides symbol-oriented commands that enable users to create and alter text and graphics and perform other operations by indicating appropriate symbols displayed on the screen using cursor keys, a mouse or a joystick. Prices depend on OEM licensing agreements. **Graphic Software Systems Inc.**, 25117 S.W. Parkway, Wilsonville, Ore. 97070, (503) 682-1606.

Circle No 327

More Room ... More Multibus® Cages.

ONLY FROM ELECTRONIC SOLUTIONS!

Word processor works with spelling corrector

WordPlus-PC for the IBM PC, TI Professional, DEC Rainbow and Victor 9000 features the built-in on-line spelling system (BOSS). The BOSS combines word processing with a system that checks and corrects spelling. During document editing, the BOSS locates and highlights misspelled words on-screen and displays as many as eight spelling suggestions in order of probable phonetic correctness. An auto-correct feature enables users to fix misspelled words directly in text with one keystroke. The BOSS relies on a standard dictionary of 90,000 words. WordPlus-PC features built-in mail merge, invoice generation and the ability to merge information from programs such as Lotus 1-2-3 and dBase II. Users can print bar graphs and other charts, move columns, scroll horizontally, execute global search and replace and print boiler-plate text and, on some printers, proportionally spaced text. \$495. **Professional Software Inc.**, 51 Fremont St., Needham, Mass. 02194, (617) 444-5224.

Circle No 328

CAD software speeds image construction

Plot 10 computer-aided drafting software enables users without extensive computer training to create engineering drawings, illustrations and presentation overheads. The software runs locally under the CP/M-86 operating system in Tektronix Local Programmability on Tektronix 4100 series display terminals. The tablet menu and English-language prompts aid beginners and experienced users. File utilities organize and archive drawings. The software allows users to enter text and geometry on-screen using thumb wheels and a cross-hair cursor. Users can specify as many as 250 levels on one drawing and use 15 pens for color assignment to various items. Individual drawing items or groups of items, defined as "worksheets," can be modified, rescaled, rotated or mirrored in one operation. \$1,600. **Tektronix Inc.**, P.O. Box 500, Beaverton, Ore. 97077, (503) 644-0161.

Circle No 329



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Fully Multibus Compatible,
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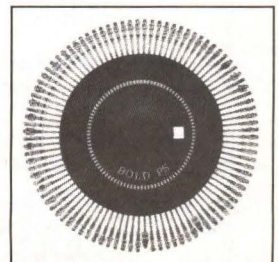
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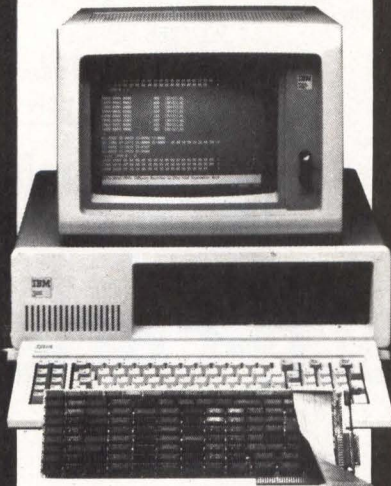


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New Products

TERMINALS



Terminals interface packet-switching networks

The Series TDV 2200S editing terminals are enhanced versions of the company's TDV 2200 series. The terminals feature business graphics, a 70-Hz refresh rate, extended character sets and an add-on communications controller that enables communications through packet-switched networks using the X.25 protocol. The terminals can be equipped with 56K bytes of memory. They transmit by character, page, block or line/field. A plug-in card turns the TDV 2200S into a bit-mapped raster screen display with 684-by-384-point resolution. This configuration emulates the Tektronix 4010 and 4014 terminals for vector drawing and point plotting. The character generator can store as many as 1,024 characters. Latin, Cyrillic and Greek alphabets and mathematical and semi-graphics symbols are available. Characters are displayed on a 15-inch green screen. \$1,875. **Tandberg Data Inc.**, Box 99, Labriola Court, Armonk, N.Y. 10504, (914) 273-6400.

Circle No 330

PBX merges telephony with personal computing

The AmbiSet two-line integrated voice/data PBX automates business-communications functions by combining telephone features with personal computing. Measuring 11 by 16 inches, the 6½-pound unit has a standard typewriter keyboard and an 8-by-80-character LCD screen. It uses an Intel 8088 microprocessor with 128K bytes of RAM for general-purpose messaging functions, 64K bytes of battery-backed

CMOS RAM that supports a 250-entry phone directory and 45K bytes of EPROM for custom-tailoring the terminal. By adding a CRT and a disk drive, the AmbiSet can run MS-DOS software. The unit has a 300-/1,200-baud modem and an RS232C port. Telephone features include automatic dialing, speakerphone, call forwarding, last-number retry and an electronic Rolodex. Approximately \$2,495. **AMBI Voice/Data Systems**, 2083 Landings Dr., Suite 25, Mountain View, Calif. 94043, (415) 968-3555.

Circle No 331

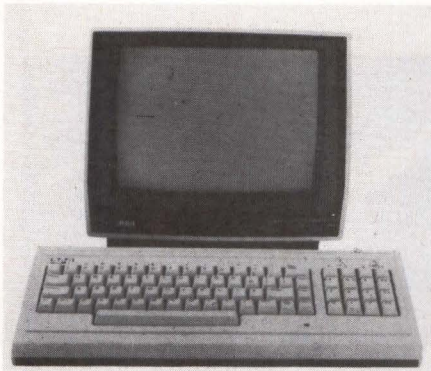
Display provides multiple emulations

The ESP 6310 video display terminal emulates the TeleVideo 925/910 Plus, ADDS Regent 25/Viewpoint, Hazeltine 1500, Lear Siegler ADM-3A and the vendor's Esprit II. On its tilt-and-swivel, 14-inch, non-glare green screen, it displays 7-by-11-matrix characters in an 80-column-by-24-line format with a 25th status/message line. The unit has line-drawing graphics and smooth scrolling. It offers 22 non-volatile, programmable function keys with an English-language setup, allowing for specialized functions. Its DIN standard keyboard contains a 14-key numeric pad. An RS232C/current-loop communication interface using x-on/x-off protocol is standard. \$695. **Esprit Systems Inc.**, 100 Marcus Dr., Melville, N.Y. 11747, (516) 293-5600.

Circle No 332

Display models boast user-friendly features

Aimed at multiple-database timesharing and dedicated, direct computer-connected applications, the APT series terminals provide programmability and menu-controlled operation. They feature a built-in, direct-connect, 300-baud modem, automatic dialing of as many as 26 stored telephone numbers and automatic log-on. With an optional 12-inch, non-glare, green phosphor display monitor, the terminals supply video output for an 80- or 40-character, 24-line display on a standard monitor or an RF output for a 40-character display on a television screen. Full-stroke and flexible-membrane keyboards are available. A 48-hour battery-less power backup furnishes non-volatile storage of the telephone directory, log-on sequenc-



es and communications parameters. A Centronics-type parallel printer port and an RS232C port are standard. Without monitor: \$399, with monitor: \$598. **RCA Microcomputer Products**, New Holland Avenue, Lancaster, Pa. 17604, (717) 397-7661. **Circle No 333**





Color graphics terminal is DEC-, Tektronix-compatible

The CIT-467 color graphics terminal allows simultaneous use of DEC alphanumeric software commands, the Tektronix 4027A color graphics command structure and the Tektronix 4010/4014 emulation mode. In addition to its DEC VT100 compatibility and ANSI X 3.64-standard control sequences, the terminal's Tektronix personality provides rectangle, polygon, circle, arc and pie command functions. The unit has a 572-by-480-dot resolution, an addressable 4,096-by-4,096-dot plot area, a cross-hair cursor, five vector variations, incremental and point plotting and 20-mA current-loop interfaces. Video features include a 7-by-9 character matrix, 80- or 132-column display, eight colors with 64 programmable combinations, variable-speed smooth scroll, split-screen operation and window erase. \$2,995. **CIE Terminals Inc.**, 2505 McCabe Way, Irvine, Calif. 92714, (714) 660-1421. **Circle No 334**

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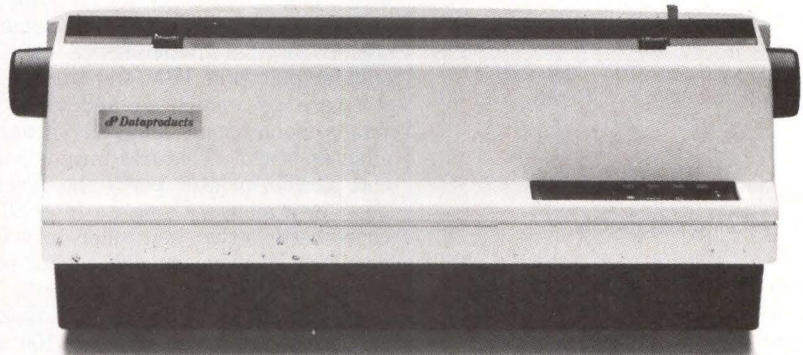
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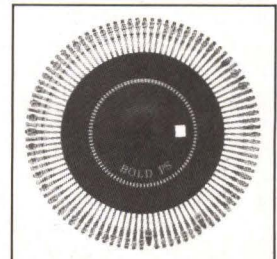
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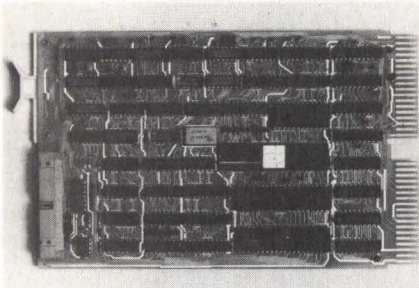


Dataproducts Daisywheel Printers

CIRCLE NO. 152 ON INQUIRY CARD

New Products

SUBASSEMBLIES



Synchronous serial board replaces DEC DUV-11

The model 315 single-channel serial I/O port interfaces DEC's Q-bus to synchronous serial data channels requiring Bell 201 synchronous modem compatibility. The product directly replaces DEC's DUV-11 and is compatible with software used by DEC to support the DUV-11. It is packaged on an 8.9-by-5.2-inch DEC-style dual-height board and is electrically and mechanically compatible with DEC's LSI-11, 11/2 and 11/23 microcomputers. The board consists of a synchronous transmitter and receiver in which operating modes are program-controlled. These modes include synchronous or isochronous character transmission and reception, character length, parity, sync character and half of full duplex. Model 315: \$695, DMA option: \$300. **Grant Technology Systems Corp.**, 11 Summer St., Chelmsford, Mass. 01824, (617) 256-8881.

Circle No 335

System enhances IBM PC graphics

Matrigraph, an interactive color graphics system for IBM PC and XT computers, furnishes a 16-color, bit-mapped, 640-by-400-pixel resolution display. A four-color display mode with color prioritization is also available. The system uses a NEC 7220 graphics display processor that handles all video display functions. Display memory consists of 128K bytes of RAM mapped into four color planes. Direct hardware support allows users to zoom, pan and scroll through display memory. An IBM-compatible serial interface permits connections with two RS232C devices such as graphics tablets, mice, plotters and printers. A resistive interface connects to devices such as mice,

joysticks and paddles. A light-pen input is also supplied. The system occupies one expansion slot. A library of 13 color graphics routines in ROM can be called from high-level languages such as BASIC. \$1,395. **Matrivation Inc.**, 26 Beacon St., P.O. Box 377, Burlington, Mass. 01803, (617) 272-7203.

Circle No 336

DMA controller employs multifunction channels

The two-channel model 316 universal DMA controller is a DEC Q-bus peripheral that provides data block transfer between memory and other peripherals. Packaged on an 8.9-by-5.2-inch DEC-style dual-height board, the product is electrically and mechanically compatible with DEC's LSI-11, 11/2 and 11/23 microcomputers. Each of the controller's two channels can also perform peripheral-to-peripheral and memory-to-memory transfers with byte or word data sizes. \$595. **Grant Technology Systems Corp.**, 11 Summer St., Chelmsford, Mass. 01824, (617) 256-8881.

Circle No 337

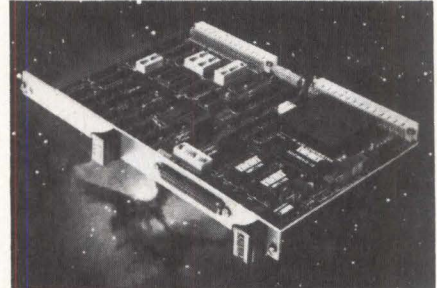
Graphics controller meets GKS standard

The Graphcard model 100 circuit board and utility software for IBM PC and PC XT microcomputers implements the ANSI GKS virtual-device interface standard. It runs IBM and third-party software by emulating and replacing IBM's monochrome and color graphics adapter boards. Features include serial and parallel printer ports and a serial port for a mouse. Using its Intel 80186 coprocessor, the controller provides graphics displays at 720-by-352-pixel resolution and an intensity level for highlighting. Through its multitasking operating system, Graphcard 100 outputs high-resolution text and graphics to dot-matrix printers while other applications functions are executing. \$1,250. **Concept Technologies Inc.**, P.O. Box 5277, Portland, Ore. 97208, (503) 684-3314 or (800) 547-4000.

Circle No 338

VME bus board handles 32 analog inputs

The MVP901 12-bit resolution, 32-channel analog input, two-channel analog output board is electrically and



mechanically compatible with and interfaces to the VMEbus. The analog-input section includes an analog multiplexer selectable for 32 single-ended or 16 differential channels, a resistor- or software-programmable amplifier, a sample/hold amplifier and a 12-bit A/D converter. An optional analog output section consists of two 12-bit D/A converters and control logic. Gains of 1 to 1000 V/V are software-selectable from the on-board programmable gain amplifier and can be stored in an on-board RAM. Analog-input signal ranges—jumper selectable for each channel—are +10 mV, +100 mV, +1V and +10V. Analog-output signal ranges are 0V to 5V, 0V to 10V, +/-2.5, and +/-10V at 5 mA. Prices start at \$1,495. **Burr-Brown**, Box 11400, Tucson, Ariz. 85734, (602) 746-1111.

Circle No 339

Graphics card colors IBM PC

The IDEAgraph color graphics card for the IBM PC is available in 28- and 40-MHz versions with 128K or 256K bytes of memory. It furnishes automatic line, circle, vector and space-filling functions; a hardware-controlled zoom factor of 1 to 16; and a software-controlled feature that can display blinking on a pixel-by-pixel basis. With 256K bytes of memory programmable to eight planes, the card offers 256 colors from a palette of 4,096. It can reach speeds of 80 nsec. per pixel and is programmable to a resolution of 1,024 by 1,024 pixels. At lower resolutions such as that of the IBM-standard PC monitor—640 by 200 pixels—the card can generate 16 colors. Each board comes with software, including IBM-compatible BIOS, IDE-extended BIOS and virtual-device interface to link with GSX. \$895 to \$1,895. **IDEAssociates Inc.**, 7 Oak Park Dr., Bedford, Mass. 01730, (617) 275-4430. **Circle No 340**

New Products

LITERATURE

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Folder describes video course

A collection of 20 half-hour videotapes for software engineers, showing how to cut the costs of software development and maintenance is described in a folder. Software engineers can use the course as an introduction to tools and techniques or as an introduction to modern programming practices. **W.L. Somervell Jr., Director, Engineering Renewal & Growth Program, Colorado State University, Fort Collins, Colo. 80523, (800) 525-4950.**

Circle No 341

Catalog describes Multibus products

This 200-page Multibus products catalog describes the company's line of more than 70 products, including single-board computers, memory modules, I/O extenders and peripheral controllers. The catalog briefly describes the IEEE STD 796 bus, iSBX bus and Multibus II specifications. **Symbicon Associates Inc., 89 Route 101A, Amherst, N.H. 03031, (603) 673-8898.**

Circle No 342

CAE workstation described in brochure

An eight-page brochure describes the DASH-1 (Design Aid Schematic Helpmate), a CAE workstation based on an IBM PC or XT. The brochure includes step-by-step illustrations of a schematic

being created on-screen. The brochure also describes available proprietary software as well as design parts and flowchart/project-plan symbol libraries. **FutureNet Corp., 21018 Osborne St., Canoga Park, Calif. 91304, (818) 700-0691.**

Circle No 343

Application note discusses data bus

This 12-page application note on the Manchester coding bus describes Manchester coding and its use. The note explains the differences between Manchester and NRZ coding. It discusses using Manchester coding in information transmission under MIL-STD-1553. It also describes coaxial- and transceivable Ethernet interfaces. The note concludes with the advantages of using Manchester coding for MIL-STD-1553

and Ethernet. Figures and tables illustrate various formats, architecture, interfaces and comparisons. **ILC Data Device Corp., 105 Wilbur Place, Bohemia, N.Y. 11716, (516) 567-5600.**

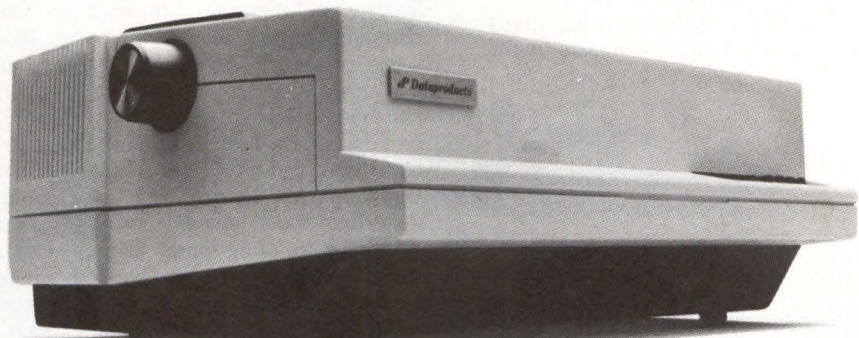
Circle No 344

Catalog covers datacomm equipment

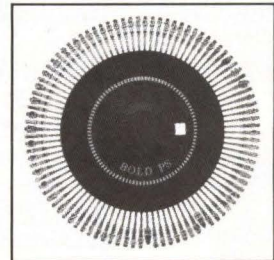
This 14-page, illustrated short-form catalog and price list covers the company's data-communications equipment. The booklet briefly describes local networking equipment, voice/data multiplexers, data concentrators, data PABXs, modems, multiplexers, miniature local datasets and protocol converters. It also provides information on prices and volume discounts. **Micom Systems Inc., 20151 Nordhoff St., Chatsworth, Calif. 91311, (213) 998-8844.**

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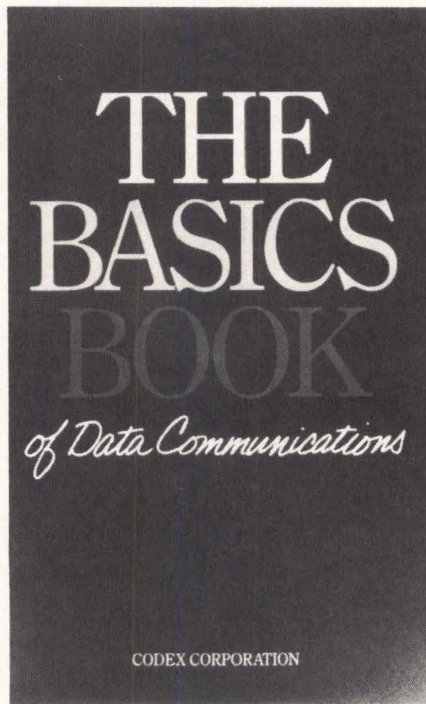
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New Products

LITERATURE



Reference explains data-comm concepts

The *Basics Book of Data Communications* explains basic data-communications concepts and terminology. Taking a humorous approach to the complexities of networking, the 100-page reference covers such topics as terminals (One Size Does Not Fit All), choosing a circuit (Wats My Line?), expanding a network (Playing Connect-the-Dots) and network control (When the Chips Are Down). The last chapter describes and solves various application problems (Configuring Things Out). \$14.95. **Codex Corp., Catalog Sales Program**, Department 713, Mail Stop 5-10, 20 Cabot Blvd., Mansfield, Mass. 02048, (617) 364-2000.

Circle No 346

Guidebook presents engineering techniques

Written for software developers, *Applying Software Engineering Principles* by David L. Marca, identifies the key engineering principles behind successful software design and describes how to apply these principles.

The 270-page book explains goal definition; the logic of classic software development; the concept of programs as models; how to develop software using only the basics of a given language; how to use and reuse tools and how to analyze, design and build table-driven software. The book also describes how to simplify software design and how to evaluate and optimize trade-offs. \$27. **Little, Brown and Co.**, 200 West St., Waltham, Mass. 02154, (617) 890-0250.

Circle No 347

Study forecasts low-end printer market

This two-volume, 403-page report analyzes and predicts the low-end computer output printer market in the United States. It focuses on general-purpose and 80-column printers that attach to microcomputers and retail for less than \$2,000. The market is forecast in unit shipments and dollars for serial dot-matrix printers, serial fully formed character printers and serial non-impact printers. The study provides in-depth profiles of 25 major vendors and describes their products, market thrust and competitive strategies. \$1,650. **Frost and Sullivan Inc.**, 106 Fulton St., New York, N.Y. 10038 (212) 233-1080.

Circle No 348

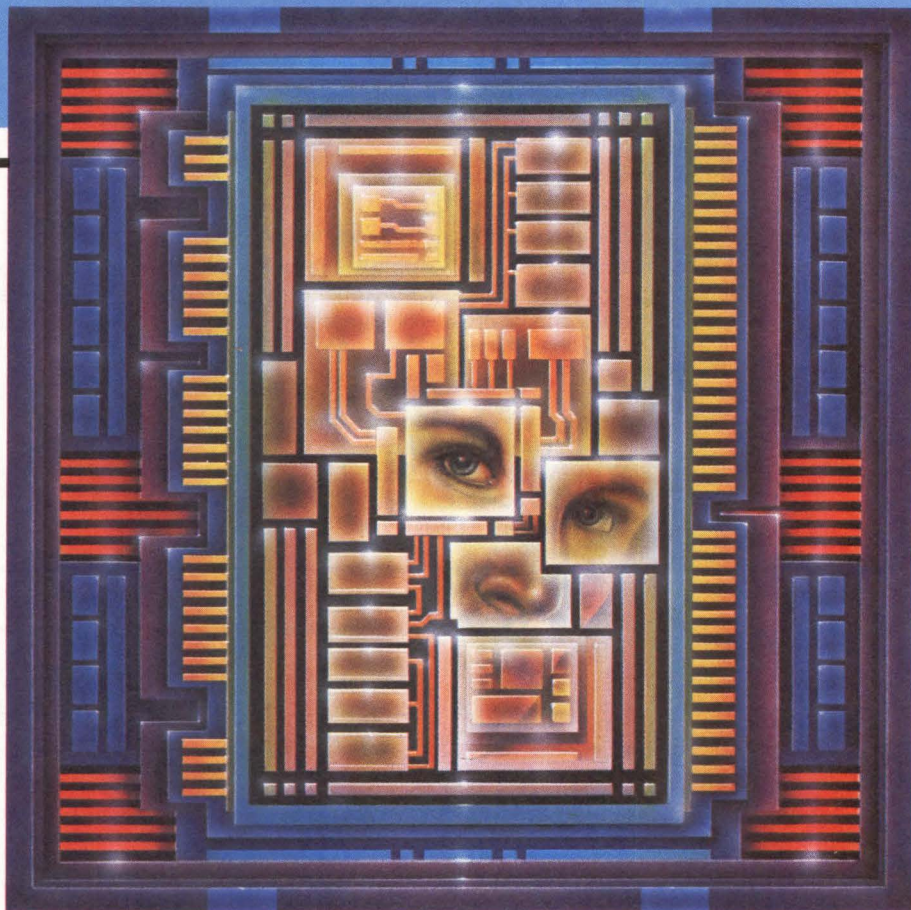
Guide helps entrepreneurs raise R&D funds

Forming R&D Partnerships: An Entrepreneur's Guidebook is the third in a series of guidebooks serving the computer, software, electronics, medical and biotechnology industries. The 112-page guidebook, prepared by Anthony P. Spohr and Leslie Wat, explains the general concepts behind partnerships, including how investors and partners can get tax deductions, what an R&D contract is, how to implement a successful R&D program and how to avoid common pitfalls. **High Technology Industry Group**, Deloitte Haskins & Sells Executive Office, 1114 Avenue of the Americas, New York, N.Y. 10036, (212) 790-0500.

Circle No 349

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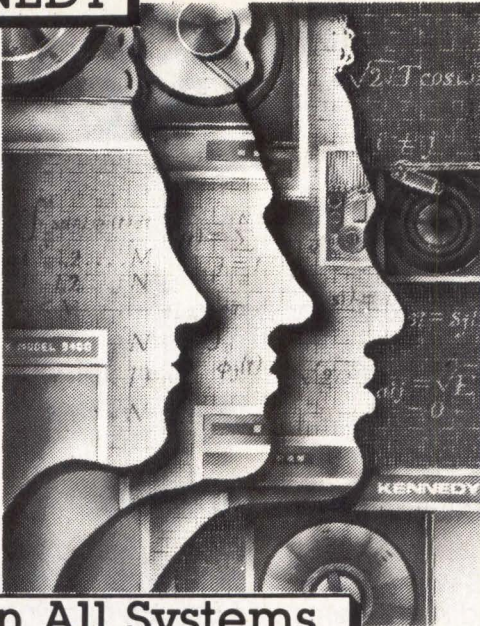
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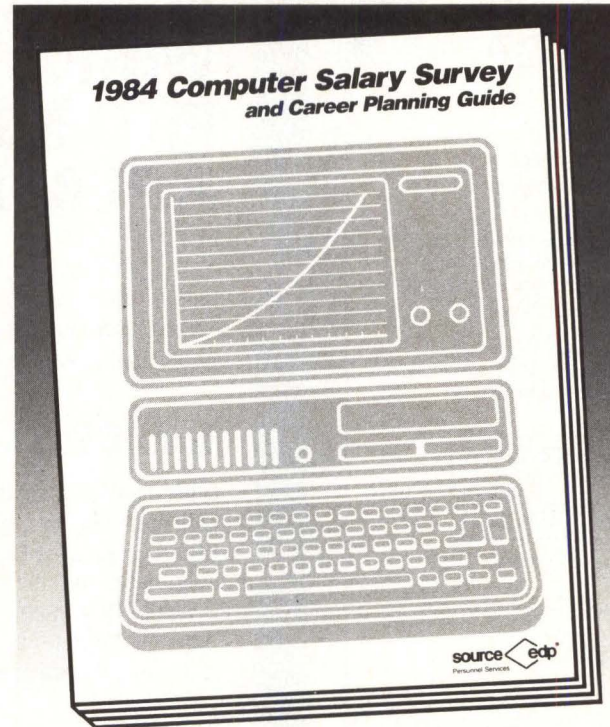
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- 5-18 "International Study Mission on Electronic Printing Technology,"** Tokyo, sponsored by Technology Transfer Institute (TTI) and Datek Information Services Inc. Contact: Hideaki Hashizume, General Manager, TTI, 1 Penn Plaza, Suite 1411, 250 W. 34th St., New York, N.Y. 10119, (212) 947-2648.
- 21-22 "Evaluating Decision Support Software: Personal Computer, Mainframe and Distributed Applications - A Managerial Perspective," Decision Support Systems (DSS) Conference,** The New York Hilton at Rockefeller Center, sponsored by Program Chairman C. Lawrence Meador, the New York Chapter of the Planning Executives Institute and Information Technology Institute. Contact: Donna A. Kacin, Conference Coordinator, DSS Conference, 215 First St., Cambridge, Mass. 02142, (617) 864-0900 or (617) 546-5061.
- 21-24 Boston Computer Showcase Expo,** Hynes Auditorium, Boston, produced by The Interface Group Inc. Contact: Linda M. Yogel or Peter B. Young, The Interface Group, 300 First Ave., Needham, Mass. 02194, (617) 449-6600 or (800) 325-3330.
- 22-25 COMDEX/Spring,** Georgia World Congress Center, Atlanta Apparel Mart and Atlanta Merchandise Mart, Atlanta, produced by The Interface Group Inc. Contact: Linda M. Yogel, Peter B. Young or Lori Robak, The Interface Group, 300 First Ave., Needham, Mass. 02194, (617) 449-6600 or (800) 325-3330.
- 24-27 Anaheim Computer Showcase Expo,** Anaheim Convention Center, Anaheim, Calif., produced by The Interface Group Inc. Contact: Linda M. Yogel or Peter B. Young, The Interface Group, 300 First Ave., Needham, Mass. 02194, (617) 449-6600 or (800) 325-3330.

MAY 31 - JUNE 2

"Personal Computer and STD Computer Interfacing for Scientific Instrument Automation" Workshop, Virginia Polytechnic Institute, Blacksburg, Va., sponsored by Virginia Polytechnic Institute and State University. Contact: Dr. Linda Leffel, CEC, Virginia Polytechnic Institute, Blacksburg, Va. 20461, (703) 961-4848. Also to be held Sept. 6-8 in Washington.

JUNE

- 6-8 Display Terminal Conference,** Newport Beach, Calif., sponsored by Dataquest Inc. Contact: Gail van Tubergen, Conference Coordinator, Dataquest, 1290 Ridder Park Drive, San Jose, Calif. 95131, (408) 971-9000.
- 12-14 Information Management Exposition & Conference for Software (INFO/Software),** McCormick Place, Chicago, managed by Clapp & Poliak. Contact: Clapp & Poliak, 708 Third Ave., New York, N.Y. 10017, (212) 661-8410.

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12-14 Advanced Manufacturing Systems Exposition & Conference (AMS '84), Chicago, managed by Clapp & Poliak. Contact: Clapp & Poliak, 708 Third Ave., New York, N.Y. 10017, (212) 661-8410.

12-15 Data Communications Course, Boston, sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888.

13-15 PC-World Exposition, McCormick Place West, Chicago, sponsored by Mitch Hall Associates. Contact: Paul Belikove, Operations Manager, Mitch Hall Associates, P.O. Box 860, Westwood, Mass. 02090, (617) 329-8090. Also to be held Oct. 3-5 at Market Hall, Dallas.

19-20 Office Automation Conference, New York, sponsored by The Yankee Group. Contact: Lisa Caruso, The Yankee Group, Seminar Director, 89 Broad St., Boston, Mass. 02110, (617) 542-0100. Also to be held June 26-27 in San Francisco.

19-21 Third Canadian CAD/CAM & Robotics Exhibition & Conference, International Centre of Commerce, Toronto, sponsored by the Canadian Institute of Metalworking (CIM), the Computer and Automated Systems Association and Robotics International. Contact: CIM, McMaster University, 1280 Main St. W., Hamilton, Ontario, (416) 528-2777.

19-21 Computerized Office Equipment Expo/Office Information Systems Conference (COEE/OIS '84), Rosemont, Ill., sponsored by Ruann International. Contact: Janet Schafer, Show Manager, Cahners Exposition Group, Cahners Plaza, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, Ill. 60018, (312) 299-9311.

19-22 "Implementing Local Area Networks" Seminar, Cherry Hill, N.J., sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888. Also to be held June 26-29 in San Diego.

20-22 "Non-Impact Printing Technologies" Database Access Meetings, Hilton International Wien, Vienna, Austria, sponsored by Advanced Technology Resources (ATR) Corp. Contact: Jack Jordan, ATR, 6256 Pleasant Valley Road, El Dorado, Calif. 95623, (916) 626-4104.

21-23 Great Southern Computer Shows, Jacksonville Veterans Memorial Coliseum, Jacksonville, Fla., sponsored by Great Southern Computer Shows. Contact: Great Southern Computer Shows, P.O. Box 655, Jacksonville, Fla. 32201, (904) 356-1044 or (904) 384-6440. Also to be held Aug. 2-4 in Charlotte, N.C., Oct. 11-13 in Orlando, Fla., and Dec. 6-8 in Tallahassee, Fla.

26-28 PCExpo, New York Coliseum, New York, produced by PCExpo. Contact: Steve Gross, Public Relations Manager, PCExpo, 33 Sylvan Ave., Englewood Cliffs, N.J. 07632, (201) 569-8542.

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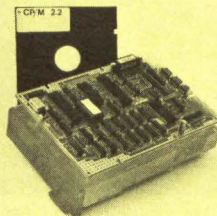
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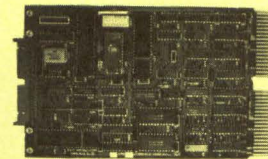
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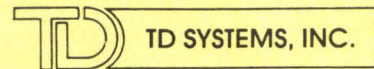


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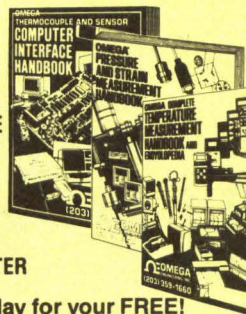
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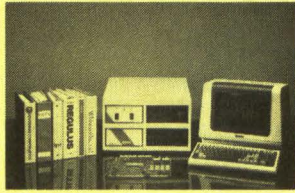
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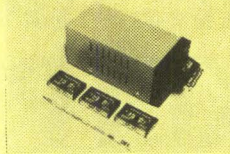
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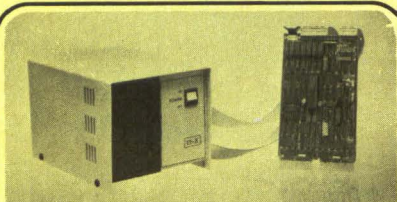
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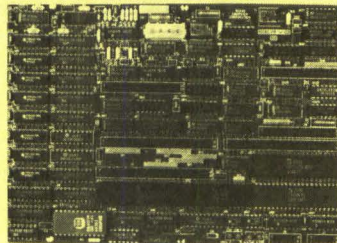
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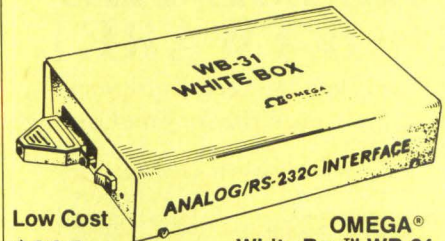
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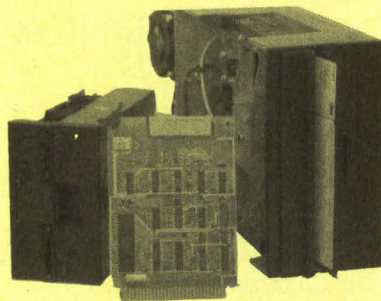
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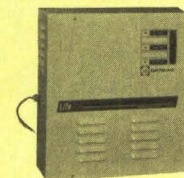
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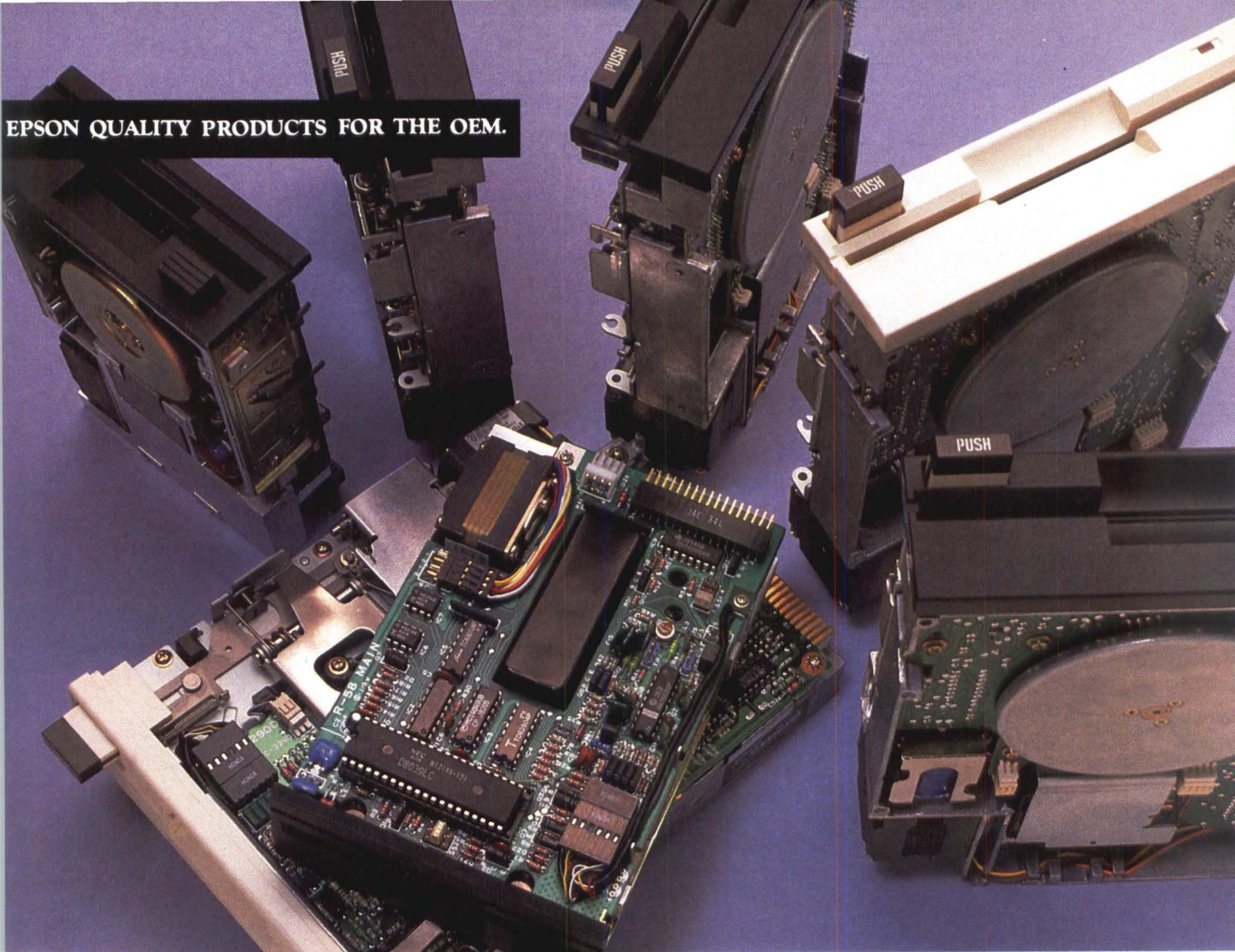
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