JUNE 1986

Mini-Micro Systems

THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

A CAHNERS PUBLICATION

State-of-the-Market Report

- Market overview
- Local area networks/OSI
- Personal computers
- Mass storage

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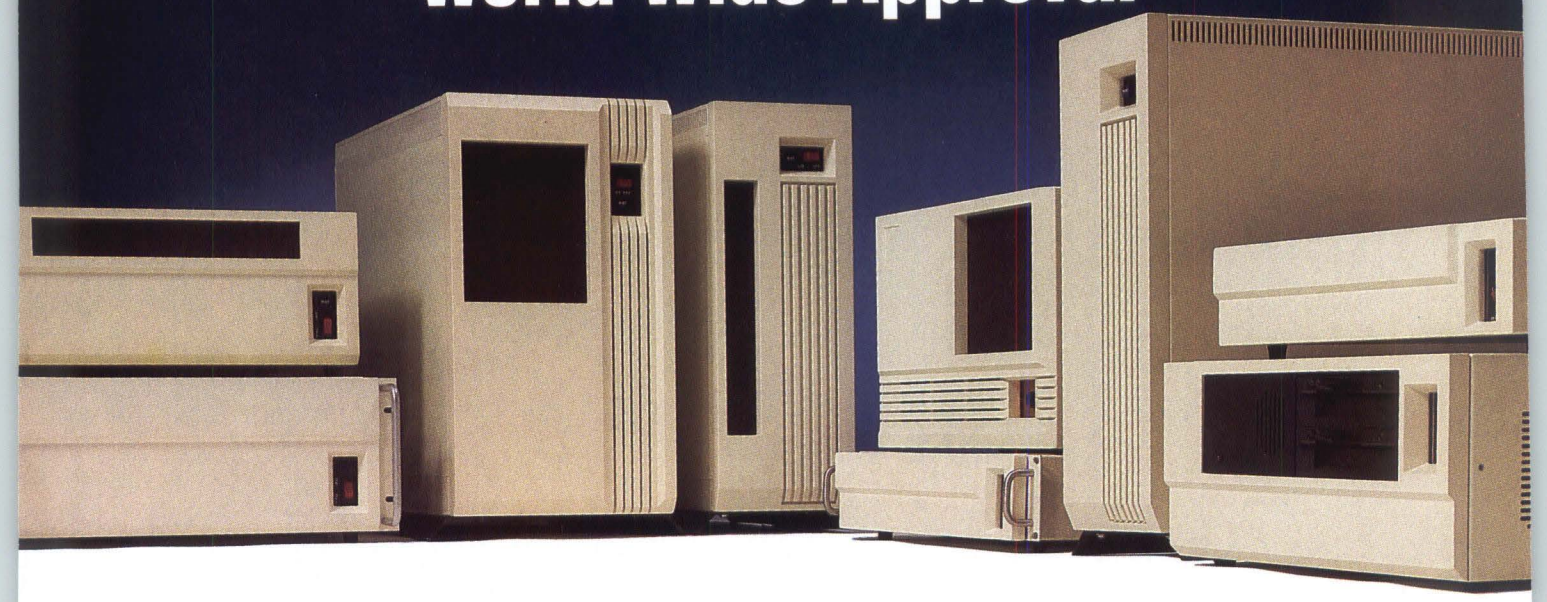

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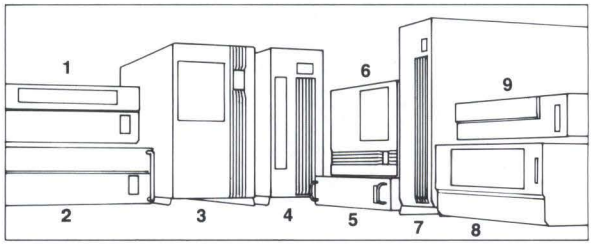

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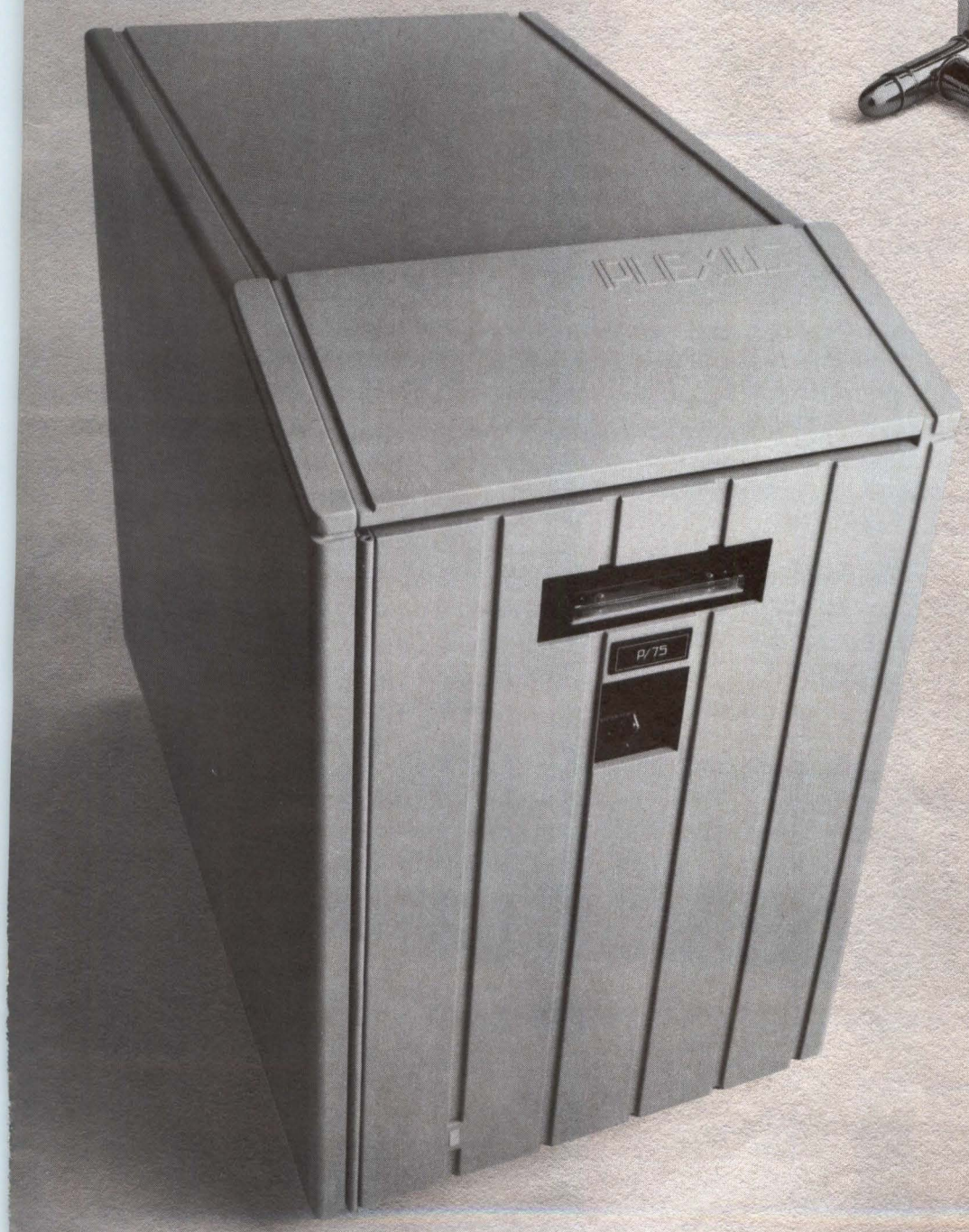

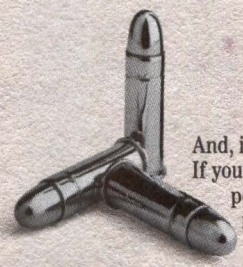

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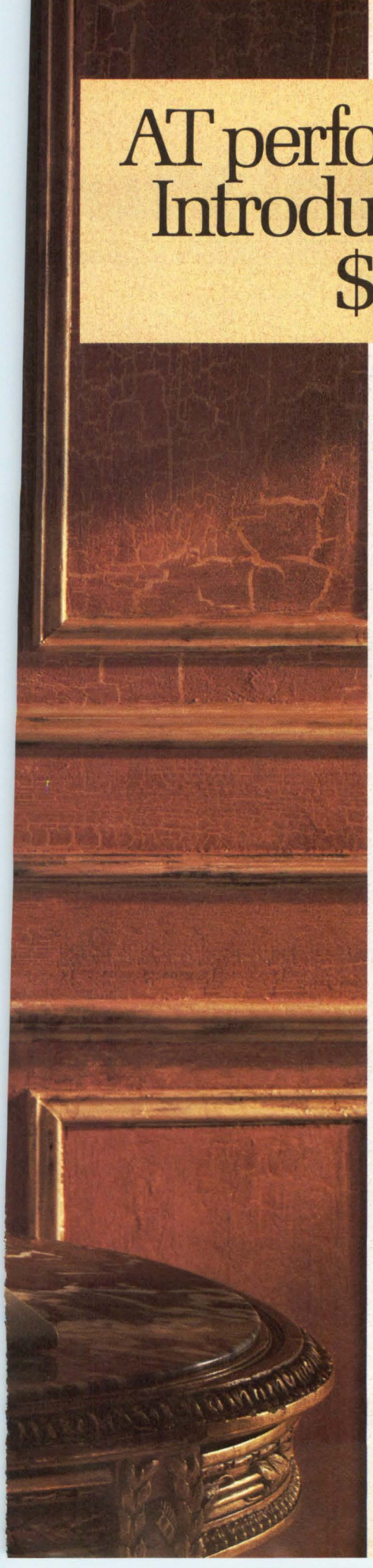

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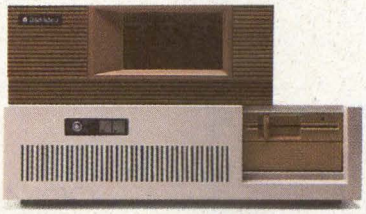

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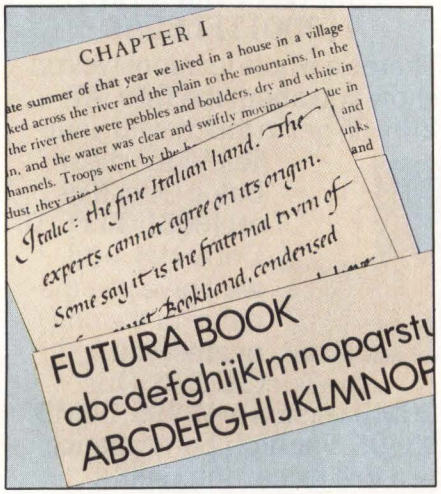

p. 149 . . . . Building your own library

NEWS/INTERPRETER

Vendors rallying around DGIS graphics interface 27
A new PC graphics standard could slash program-development time

Will success spoil the Corporation for Open Systems? 29
COS may already be too popular to accomplish its goals

VMEbus specs: Will industry back private lab? 32
VMElaboratories has a remedy for integrators' mix-and-match headaches

Trans-Atlantic standards promise common e-mail 34
The X.400 protocols are opening European doors for American companies

Competition, not technology, fuels the drive for ISDN 39
Does the telecom industry really have users' interests at heart?

* DEC DIRECTIONS

* (begins opposite Page 112)

MicroVAX II fills a DEC gap, wins market acceptance D1
The story of a supermicro's success

New Products D4

*Appearing in issues of subscribers who have indicated having DEC computers

COMPUTER/SOFTWARE HANDBOOK

Cover 143
Table of contents 145

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INTEGRATION

FEATURES

STATE-OF-THE-MARKET REPORT

Feature Highlights 49

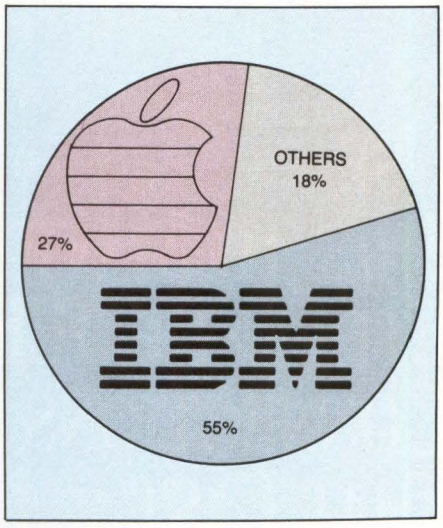
Computer vendors consolidate resources 54
Manufacturers worldwide team up for shared R&D, mergers and consortia to protect their turf as competition heats up in a maturing market

OSI standards spur product profusion 67
As OSI standards earn approval, a blitz of OSI products and customers poised to buy foreshadow a burgeoning industry

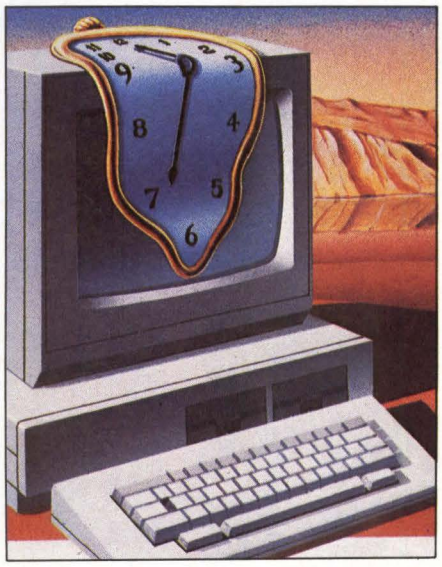
Small businesses bolster PC sales 85
A survey of U.S. companies reveals that small businesses represent a potentially lucrative market for personal computer manufacturers and value-added resellers

Software tools slash development time 95
Libraries of subroutines and functions that developers can incorporate into their own products dramatically reduce software development time and cost

Mass storage market stages a comeback 103
After a two-year slump, the mass storage industry is back on track with new standards, interfaces and product categories



p. 85 . . . . . A lucrative market



p. 95 . PC tools cut development time

DEPARTMENTS

Editorial Staff. 6
Editorial 9
Letters 13
Breakpoints. 17
New Products 117
Mini-Micro Marketplace 138
Classified Advertising 187
Index to Advertisers. 188
Career Opportunities 189
Mini-Micro Marketplace(Handbook) 190

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George V. Kotelly

Managing Editor
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Product and Market Consultant
Raymond C. Freeman Jr.
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Dix Hills, N.Y.
(516) 667-7278
Washington, D.C.: **Stephen J. Shaw**
(202) 387-8666
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Editorial Offices

Boston: 275 Washington St., Newton, MA 02158, (617)964-3030. **Irvine:** 2041 Business Center Dr., Suite 109, Irvine, CA 92715. **Los Angeles:** 12233 W. Olympic Blvd., Los Angeles, CA 90064. **San Jose:** 3031 Tisch Way, San Jose, CA 95128. **London:** P.O. Box 37E, Worcester Park, Surrey, KT4 8RQ, England.

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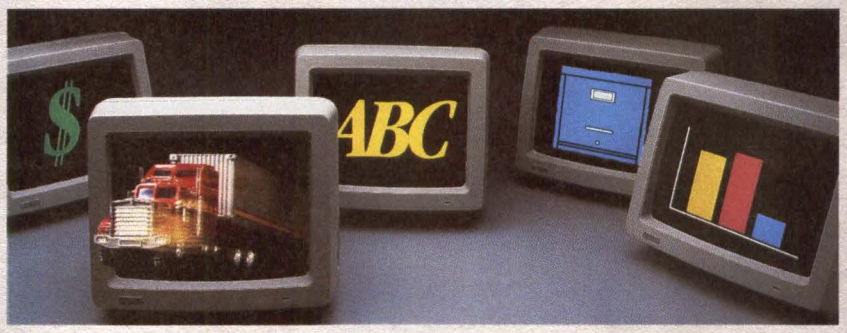

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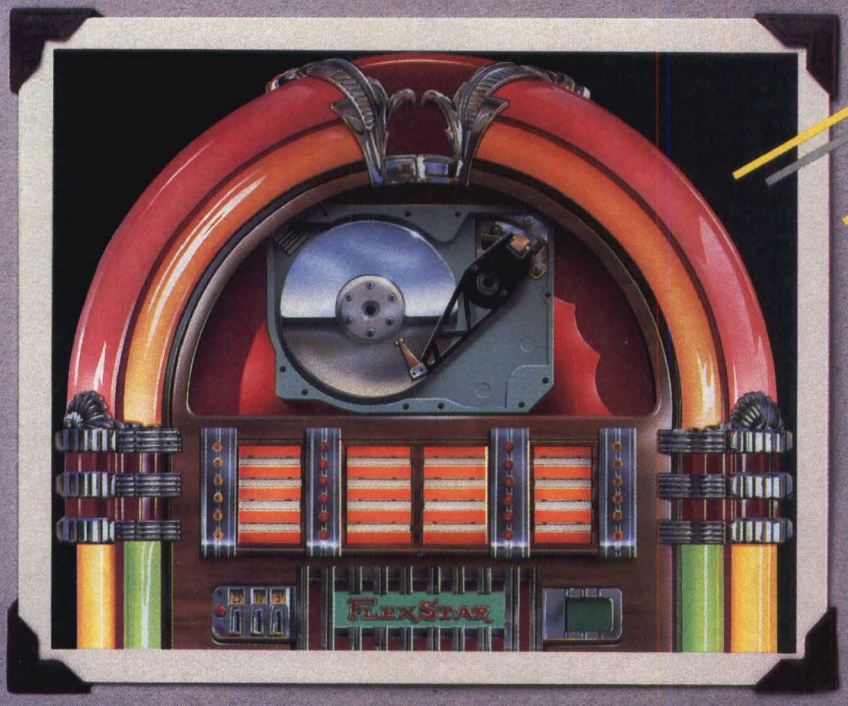

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PUBLISHER'S LETTER

SYSTEMS INTEGRATORS, VALUE-ADDED RESELLERS AND VARs

Since 1968 with the first issue of this publication, then called *Modern Data,* we have directed our editorial efforts toward the complete-systems approach to computer solutions. In fact, our first series of articles during 1968 was titled, "Integral Hardware/Software Design." Although it may sound far-fetched today, in those days it was common practice to have one team develop the hardware, independent of another team developing the software. This series of articles demonstrated that substantial economies and improvements in performance can be accomplished by intelligent trade-off of functions between hardware and software.

Indeed, the primary objective of this publication was to give the new "systems personnel" information on classes of hardware and software from which to make an optimum selection and to make intelligent trade-offs. This focus continues today in *Mini-Micro Systems.*

The late 60s and early 70s saw the beginning of the minicomputer revolution, and, for the first time, a computer was purchased for the sole purpose of reselling it. And, the people doing it, we then called system integrators and also value-added resellers. Would you believe it, way back then you, our readers, were value-added resellers long before there were Apples and long before the market went bananas with new acronyms and buzzwords. Well, today, we still define our readers' function as system integration and define all our readers as system integrators. Our readers are either system integrators who add value (hardware or software or both) and resell a complete solution-driven system, or our readers are system integrators at large user firms implementing solution-driven systems for in-house use.

Some of our readers who are value-added resellers have made a commitment to one computer vendor, and these resellers have become today's VARs. Not too many though. From the latest reported figures, IBM Corp. has about 1,000 VARs and Digital Equipment Corp. has less than 900. So it would appear that most value-added resellers are multivendor resellers or, in any case, have not made formal commitment to one vendor. Thus, most value-added resellers do not get counted as VARs by those who claim to count VARs.

I believe it is safe to conclude that many more computer systems are resold through the multivendor and/or non-committed value-added resellers than through so-called VARs.

Also, many of our readers are at large industrial concerns that resell minicomputers or microcomputers by incorporating them into non-computer capital equipment such as process- and numerical-control systems, testing systems, medical instrumentation, etc. They could fall under the definition of a value-added reseller.

In summary, system integration still remains as the best overall term to describe the valuable function our readers perform. Some of you resell and some don't, and some are committed to one vendor and some are not, and some of you are old and some of you are young, some of you are tall and some of you are short, etc., etc., etc.

Now, that clears that up! But probably not; the computer market seems to thrive on confusion.

We'll keep trying.

S. Henry Sacks

S. Henry Sacks
Vice President/Publisher

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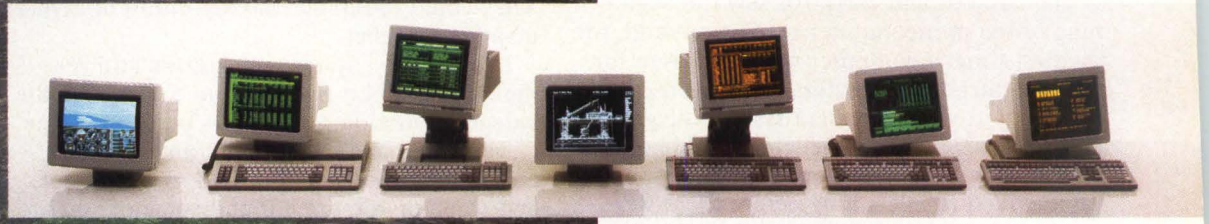

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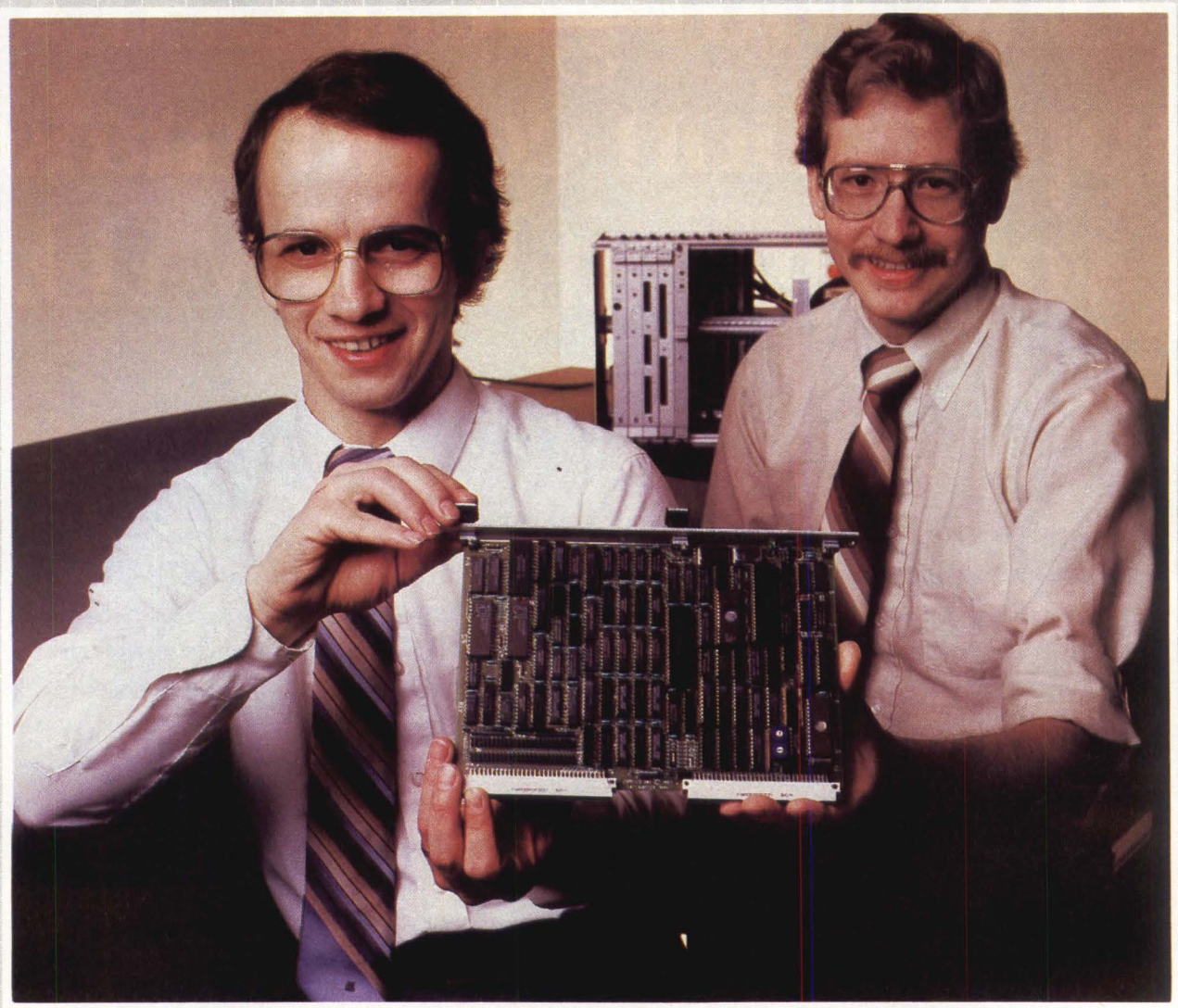

Tapemaster 3000 design engineers Bob Simning and Larry Hull

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LOSS OF CONTEXT

To the editor:

In your December 1985 article on binary compatibility (Page 31), I am quoted with a modest but significant loss of context. The "half truth" of (Intel Corp.) 80286-80386 compatibility is the one-way nature of the relationship—(that is,) code written for use with the 386's capabilities won't move down to the 286.

The 286 is one of the very few processors where integers and printers make sense as different-size objects. This is the "nasty" side of the 286. For binary portability, the integer and printer sizes need to be constant and probably the same size.

The real misleading element is the concept that one vendor's binary compatibility somehow provides that to the entire UNIX domain. Digital Equipment Corp., Motorola Inc. and other vendors have had binary compatibility between products within the same family (DEC VAX and Motorola MC680XX families), but that does not mean binary code can be moved between a VAX and a 68000. The Intel family is another internally compatible, single-vendor family—with less actual binary compatibility than either the VAX or 68000 lines.

Jim Isaak
Director of Product Planning
Charles River Data Systems Inc.
Framingham, Mass. 01701

FAIR TRADE

To the editor:

I share your concern for the declining U.S. trade surplus for computer equipment and support your recommendations (MMS, February, Page 5). For more than a year, the United States has been reduced to being a net debtor nation. If we can't maintain a trade surplus in such an important high-technology area as computers, how can we hope to maintain our once pre-eminent economic strength?

I believe there are factors other than price and sociopolitical considerations that have contributed to the significant penetration of the U.S. OEM disk-drive industry by foreign suppliers.

1. Marketing by foreign companies has often excelled the best the United States has to offer. Fujitsu (Microelectronics Inc.) is one example.

2. Reliability and performance of imported disk drives have also topped U.S. counterparts. Fujitsu's 10½-inch Eagle is one example at the high end, and Rodime (Plc.)'s 3½-inch fixed drive is an example at the low end.

3. U.S. companies that have had the economic and technological clout to combat the foreigh suppliers have not met the challenge successfully. For example, Control Data (Corp.)'s leadership is waning, if not gone. It has focused too long on removability and big disks, products that are either dying or vulnerable. Its foray into the low end with its 3½-inch Cricket was a technological debacle.

Entrepreneurs and venture capitalists must also share the blame. Was it greed or poor business planning that caused more disk-drive companies to be spawned than the market could support? Wouldn't our industry be in better shape if there had been fewer but better-financed and better-managed disk-drive start-ups?

In short, we brought a lot of it upon ourselves. Foreign suppliers have simply done a better job in many instances and capitalized on our weaknesses.

Joe Molina
President
Technology Forum
Pomona, Calif. 91768

COMMUNICATIONS HANDBOOK UPDATE

The following company did not appear in the Communications Handbook

NETWORKING SOFTWARE

TOUCHSTONE SOFTWARE CORP.
909 Electric Ave., Seal Beach, CA 90740, (213) 598-7746

Company Package name	Network	Network hardware interface	Computer/operating system compatibility	Required additional software	Price $	Function
MACLINE		asynch modem		UniHost	145	allows a Macintosh to communicate over asynch lines to UNIX, VAX/VMS or other hosts; permits transfer of text and binary files using an end-user-oriented menu system
PCworks	3Bnet, ISN connectables	ISN, asynch modem, PC interface	IBM PC/MS-DOS	UniHost	195	allows personal computer to communicate over asynch lines to UNIX, VAX/VMS or other hosts; permits transfer of text and binary files using an end-user-oriented system
UniHost	machine-dependent	asynch port (3Bnet for 3B2 computers)	Berkeley UNIX Version 7 (XENIX, VENIX, UNOS)	PCworks, MACLINE	295-795	allows UNIX or look-alike machine to communicate over asynch lines or Ethernet to personal computers and Macintoshes; permits transfer of text and binary files

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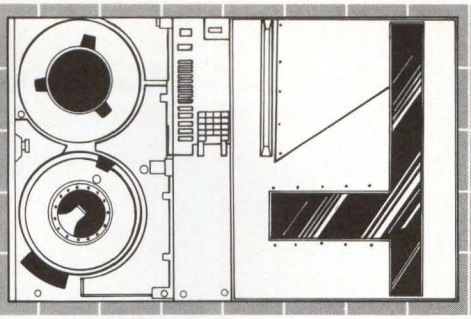

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AT A GLANCE

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- *Convenient Auto-Threading*
- *Integrated Formatter/Controller*
- *Service Panel with Alpha/Numeric Display*
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- *Host-optimized Data Transfer Rates*

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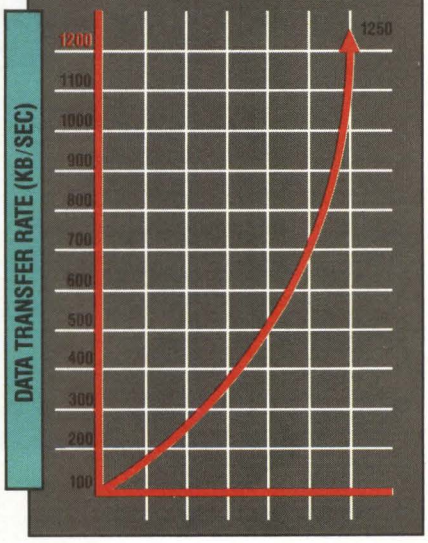

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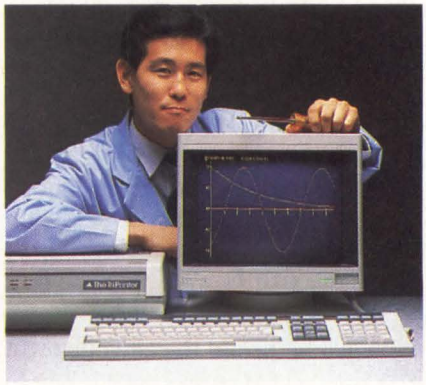

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BREAKPOINTS

HP OFFERS RISC MACHINE FOR MANUFACTURING, DESIGN

With little fanfare, Hewlett-Packard Co., Palo Alto, Calif., announced the latest reduced instruction set computer (RISC) in its Spectrum program. The new Series 800 is the top end of HP's 9000 line and is aimed at manufacturing and design markets. The first model in that series, the 840, uses the same processor technology HP introduced in its first RISC machine earlier this year. Rated at 4.5 million instructions per second and priced at $113,500, the 840 comes with a floating point coprocessor, 8M bytes of memory, a six-channel multiplexer and a 16-user license for HP-UX, the company's UNIX-like operating system. Expect deliveries in the fourth quarter.—*Mike Seither*

FCC ACTS TO ENFORCE LABEL LAW

Small labels have suddenly become a big issue. Those labels, located by law on the back of most personal computers and peripherals, indicate that the device has been certified as meeting radio-frequency emission standards established by the Federal Communications Commission (FCC) and that the equipment does not interfere with other electrical or electronic devices, such as radios, television or public-safety communications systems. But, according to an FCC Public Notice, many companies are selling peripherals without having them separately certified and labelled. As part of an FCC crackdown on unlabelled devices, a commission task force "ticketed" as many as 2,500 computer products at the Comdex/Spring '86 computer show as a visible reminder that manufacturers who do not comply with the FCC's certification rules face fines of up to $2,000 for each violation.—*Stephen Shaw*

IBM WORD-RECOGNITION SYSTEM GETS FOUR TIMES MORE WORDS

IBM Corp.'s Thomas J. Watson Research Center, Yorktown Heights, N.Y., is testing a 20,000-word version of its PC/AT-based, 5,000-word, speech-recognition system that it recently demonstrated at the Massachusetts Institute of Technology. The 5,000-word system uses two three-board subsystems based on proprietary digital signal-processing chips for acoustic and language modelling. The 20,000-word "Tangora," named after the fastest typist in the Guinness Book of World Records, uses 12 boards in an expansion box and has a 94.2 percent overall accuracy rate, compared to the 90.7 percent rate for the 5,000-word version. The Research Center is fine-tuning the Tangora's human interface and beginning work on continuous-speech input.
—*Jesse Victor*

TI ANNOUNCES FIRST LASER PRINTERS

Saying its offerings are aimed at "shared-resource" environments, Texas Instruments Inc. has joined the ranks of laser-printer makers with the Omni-Laser Series 2000. The three models in the series are built around a heavy-

duty laser print engine from Ricoh Corp. The printers, which range in price from $5,995 to $7,995, buck the current trend toward low-cost (less than $2,000) laser printers. But TI's Peripheral Products Division, Temple, Texas, hopes good numbers in duty cycle and machine life will put the machines in offices where up to 10 desktop computers share a single printer. The $5,995 2108 has a duty cycle of 10,000 pages a month and a machine life of 600,000 prints. The numbers for the top-of-the-series 2015 and 2115 are 25,000 pages a month and 1.5 million prints.—*James F. Donohue*

EUROPE LOOKS FOR EVIDENCE OF CHIP DUMPING

U.S. semiconductor makers' concerns that Japanese competitors are dumping chips—selling them in the United States at prices lower than in Japan—has spread to Europe. The European Electronic Component Manufacturers Association (EECA), Brussels, has established a working party to look for evidence of dumping in Europe. EECA secretary general Neville Lyons says that the organization is working closely with the European Commission, which is negotiating with the United States and Japan to ensure that any antidumping accord is a worldwide agreement, not one between just the United States and Japan.—*Keith Jones*

HARRIS TARGETS DEC WITH MCX SYSTEMS

The new MCX family of supermicrocomputers from Harris Corp., Fort Lauderdale, Fla., based on Motorola Inc.'s MC68020 microprocessor and the UNIX operating system, is aimed at markets for computer aided design, manufacturing (CAD/CAM) and software engineering (CASE). Meant expressly to compete with Digital Equipment Corp. offerings, the MCX line ranges from the $18,700 MCX-30 model 40 to the $73,000, four-processor MCX-5 model 70, which supports up to 64 users.—*Michael Tucker*

FROM FUJITSU: EMBEDDED IPI AND PARALLEL-TRANSFER DRIVES

Fujitsu America Inc. is taking aim at real-time image-processing applications with the introduction of a parallel-transfer drive. Now available in evaluation units, the 689M-byte Fujitsu Eagle can simultaneously read and send data over five channels. The Eagle uses a modified storage module device interface, has a transfer rate of 12.29M bytes per second and an access time of 18 msec. The San Jose, Calif., company has also unveiled an 8-inch, 337M-byte drive with an imbedded intelligent peripheral interface (IPI). Evaluation units of the M2333P IPI drive, which has a transfer rate of 2.6M bytes per second, are expected in the third quarter.—*Mike Seither*

PARALLEL LOWERS THE PRICE FOR FAULT TOLERANCE

Look for a full line of computers later this summer from Parallel Computers Inc., Santa Cruz, Calif., that will provide fault tolerance for as little as $21,000. The low-end system, housed in a deskside pedestal, is built around Motorola Inc.'s MC68010 16-bit processor. It can have up to 4M bytes of memory, 200M bytes of mass storage and 16 I/O ports. That system can be

3200 USERS:

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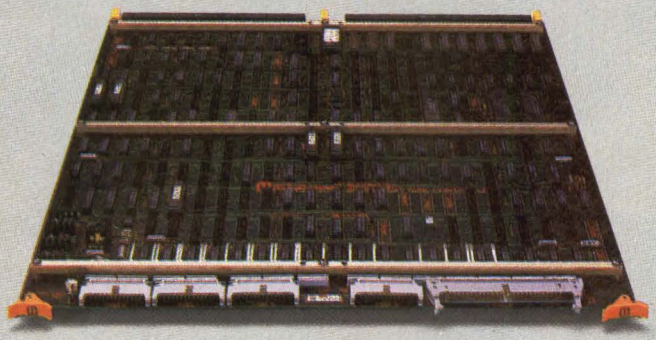

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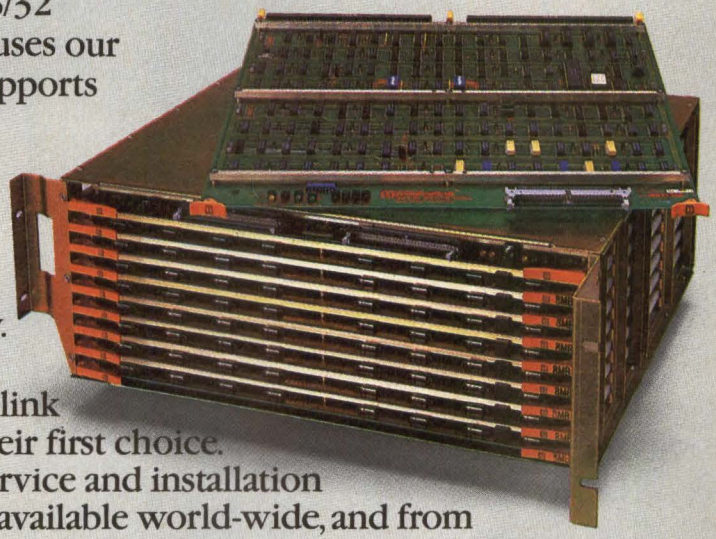

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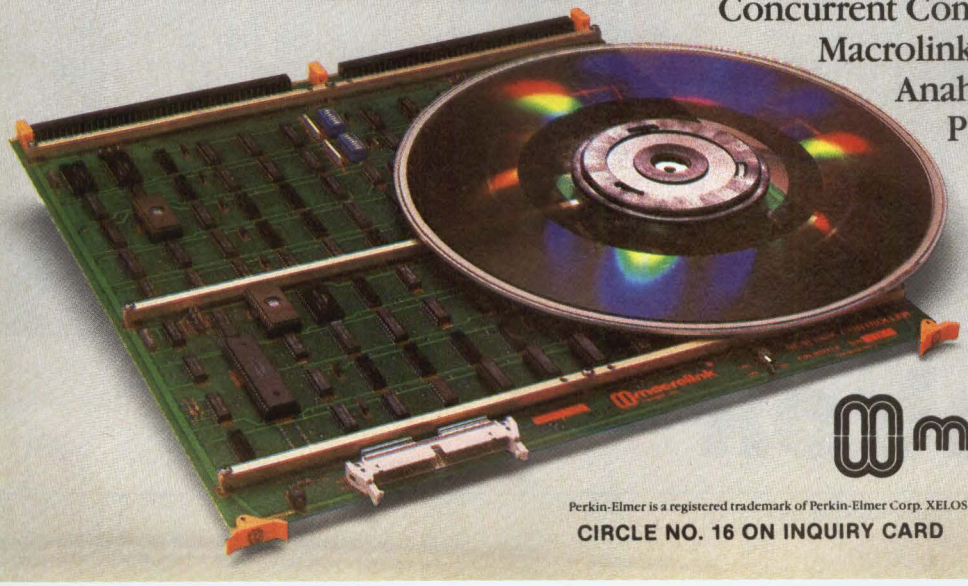

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Matrox now offers two new intelligent color graphics boards for the Q-Bus. The QG-1280 and QG-640 provide the speed and resolution necessary to upgrade DEC's MicroVAX and PDP computers into Professional Graphics workstations.

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upgraded in the field to handle the 32-bit 68020 CPU and up to 24 ports. Parallel also plans a $70,000, 68020-based, single-bay system with as much as 8M bytes of memory, 3G bytes of disk-drive capacity and 256 ports. Parallel plans a 68020 upgrade for its present product, the 300XR.—*Mike Seither*

SOFTCLONE OFFERS SOLUTION TO PC-INCOMPATIBILITY

Personal computer makers whose machines are incompatible with IBM Corp. PCs are turning to Control-C Software Inc., Portland, Ore. Control-C offers Softclone, a program that changes the device-driver and ROM-basic input/output system instructions of an IBM PC application, such as Lotus Development Corp. 1-2-3, to those of the host. It allows incompatible machines to run the most popular PC application packages. British personal computer makers like Apricot Inc., International Computers Ltd. and Research Machines Ltd. appear to be the first to adopt Softclone for their machines. Look this month for Softclone on Apricot's XEN.—*Keith Jones*

PCs, MACINTOSH RUN ON NEW KOWIN COMPUTERS

Kowin Computer Corp. of Montebello, Calif., is shipping a new family of office computers that feature both voice and data communications. The UNIX-based multiuser Kowin Office, a group of graphics computers, file servers and executive workstations, is bundled with 10 application packages that include spreadsheet, word-processing and calendaring facilities. Messaging software works with built-in telephones. Kowin aims the systems at resellers, who can add their vertical software, and claims the IBM Corp. PC and Apple Computer Inc. Macintosh can be connected as full-fledged workstations. An eight-user system costs $20,900 and includes 2M bytes of RAM, speaker phone, a 20M-byte rigid disk drive and Kowin's Office software.—*Mike Seither*

ISKRA VMEBUS BOARD EXECUTES PDP-11 INSTRUCTIONS

Touted as the first J11 processor board optimized for the Digital Equipment Corp. RSK-11M operating system, VMEx J11 from Iskra Technologies, Farmingdale, N.Y., executes the entire extended PDP-11 instruction set. The $2,395 double-height board combines an on-board VMEbus requester and interrupt handler with a 15-MHz DEC J11 processor, up to 512K bytes of dynamic RAM with parity, memory management, RS232 and Centronics parallel ports, real-time clock and programmable timers.—*Jesse Victor*

VISA GETS SMART WITH CREDIT CARDS

Visa USA, San Mateo, Calif., says it will be the first credit-card agency to use a new generation of "smart" credit cards that will authorize transactions within themselves without the need for a terminal. The company is expected to take delivery this month of 100 prototype cards developed by SmartCard International Inc., New York, the exclusive licensee of French smart-card patents. The production version of the card will include a proprietary 64K electrically eraseable programmable ROM (EEPROM), magnetic stripe, touch-sensitive keyboard and a display screen. Features include accessing credit and banking accounts, tracking purchases, a personal notepad and a calculator. — *Stephen Shaw*

TECH FILES: A QUICK LOOK AT NEW PRODUCTS AND TECHNOLOGY

Tektronix Inc., Beaverton, Ore., has introduced the $1,795 4696 color ink-jet printer, which produces paper copies or transparencies at a resolution of 120 dots per inch in about 2½ minutes. For $6,995, the printer can be configured with Tek's 4510A rasterizer to create presentation-quality copies. Tek is aiming the printer at OEMs for computer aided design, mapping and data-analysis applications.—*Mike Seither*

A flexible disk copying machine that transfers IBM Corp. PC application software from 5¼-inch media to 3½-inch media is available from **Media Systems Inc.**, Irvine, Calif. The model 7350 copier duplicates 128 disks per hour and costs $29,350; the $24,150 model 6350 copies 82 disks per hour. — *Mike Seither*

Near-letter quality (NLQ) is now available on **Output Technology Corp.'s** family of high-speed dot-matrix printers. The $2,095 OT-700n prints 200 lines per minute in draft mode and 35 to 51 NLQ characters per second in 10-pitch Helvetica and includes dual-mode dot-addressable graphics and front and bottom paper feed. Epson FX and DEC LA-120 emulation and serial and parallel interfaces are standard. NLQ factory upgrades for Output's OT-700e are available for $395. The Spokane, Wash., company has added IBM Corp. 5224/5 or 5256 printer emulation to its OT-777 model.—*Bruce MacDonald*

The new 1500 series of full-height, 5¼-inch Winchester disk drives from **Micropolis Corp.**, Chatsworth, Calif., has an unformatted capacity of 383M bytes, an 18-msec average access time and connects to the host via the enhanced small device interface (ESDI). The drives use thin-film media, allowing them to operate with 2,7 run-length limited (RLL) controllers. The company expects to ship evaluation units of the $1,900 drives in August, with full production scheduled in the first quarter of next year.—*Carl Warren*

NOTES FROM OVERSEAS: West German electrical and electronic equipment maker, **AEG AG**, Frankfurt, is bidding to buy the rest of high-performance minicomputer manufacturer **Modcomp Inc.**, Fort Lauderdale, Fla., of which it already owns 19 percent. It's offering $42 million, or $9 a share. AEG hopes to capitalize on Modcomp's strong sales in Europe, which a spokesman says are expanding much faster than sales in the United States. Europe accounted for one-third of Modcomp's $70 million sales in 1985.—*Keith Jones*

European software implementing the graphical kernel system standard (GKS) on different computers is now available in the United States from the Template division of **Megatek Corp.**, San Diego. Template will market GKS-GRAL and GKSGRAL-3D from **GTS-GRAL GmbH** of Darmstadt, West Germany. The two products implement the 2-D and 3-D versions of GKS, respectively. Template expects the new products to complement its own graphics software offerings. They include Figaro, said to be the first-delivered implementation of the draft standard Programmers Hierarchical Interactive Graphics System (PHIGS).—*Keith Jones*

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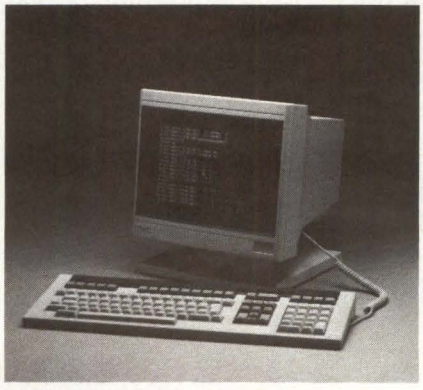

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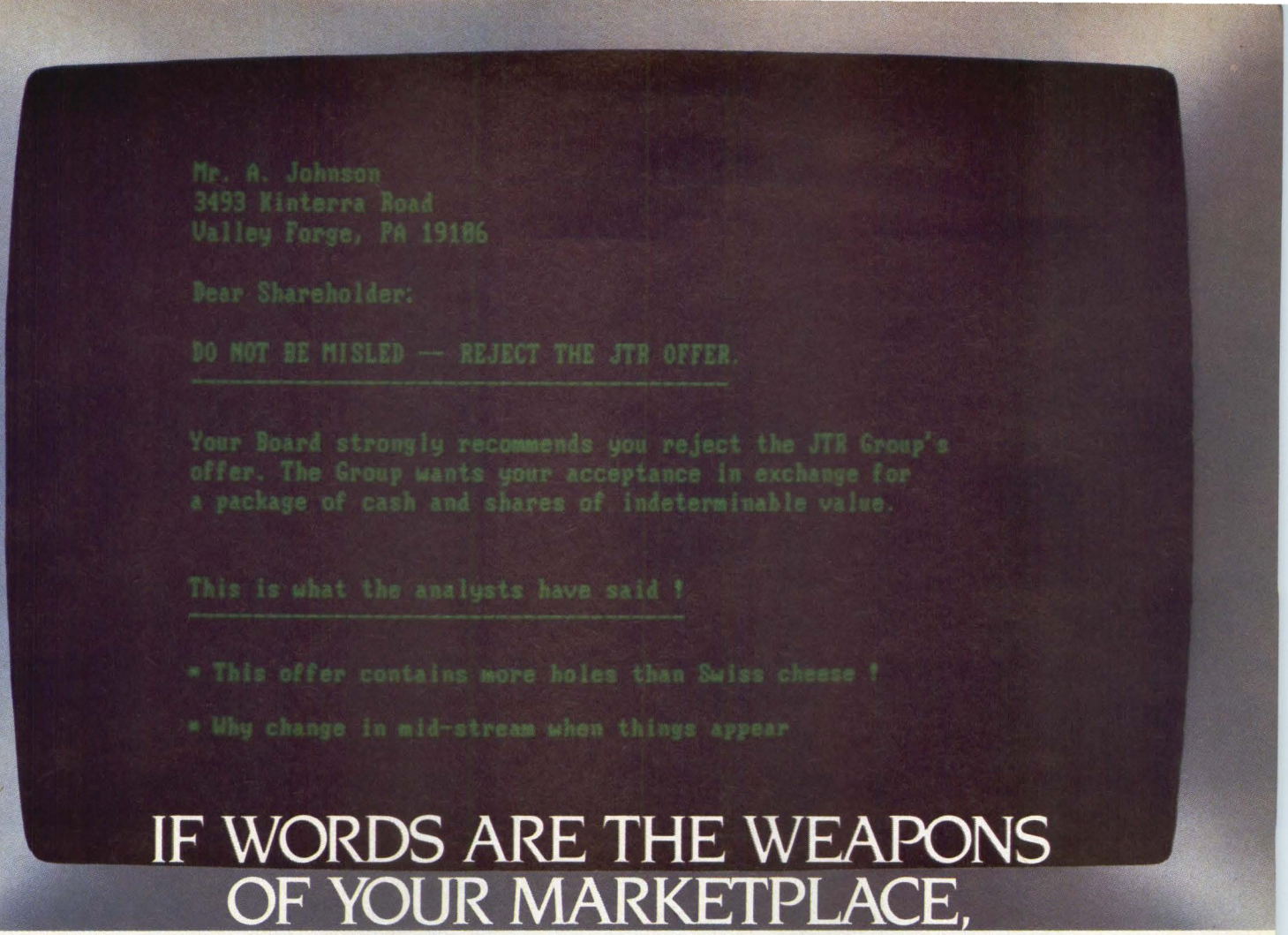

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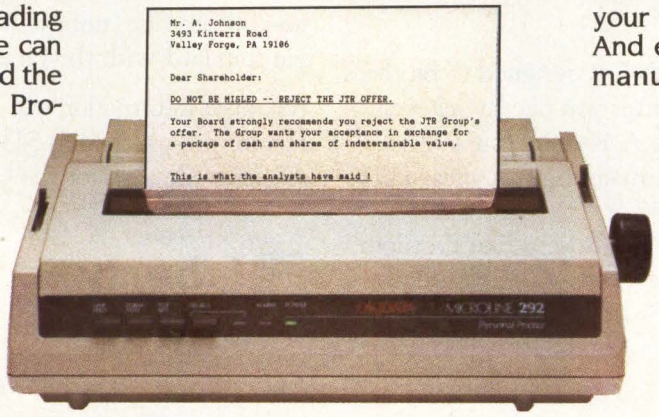

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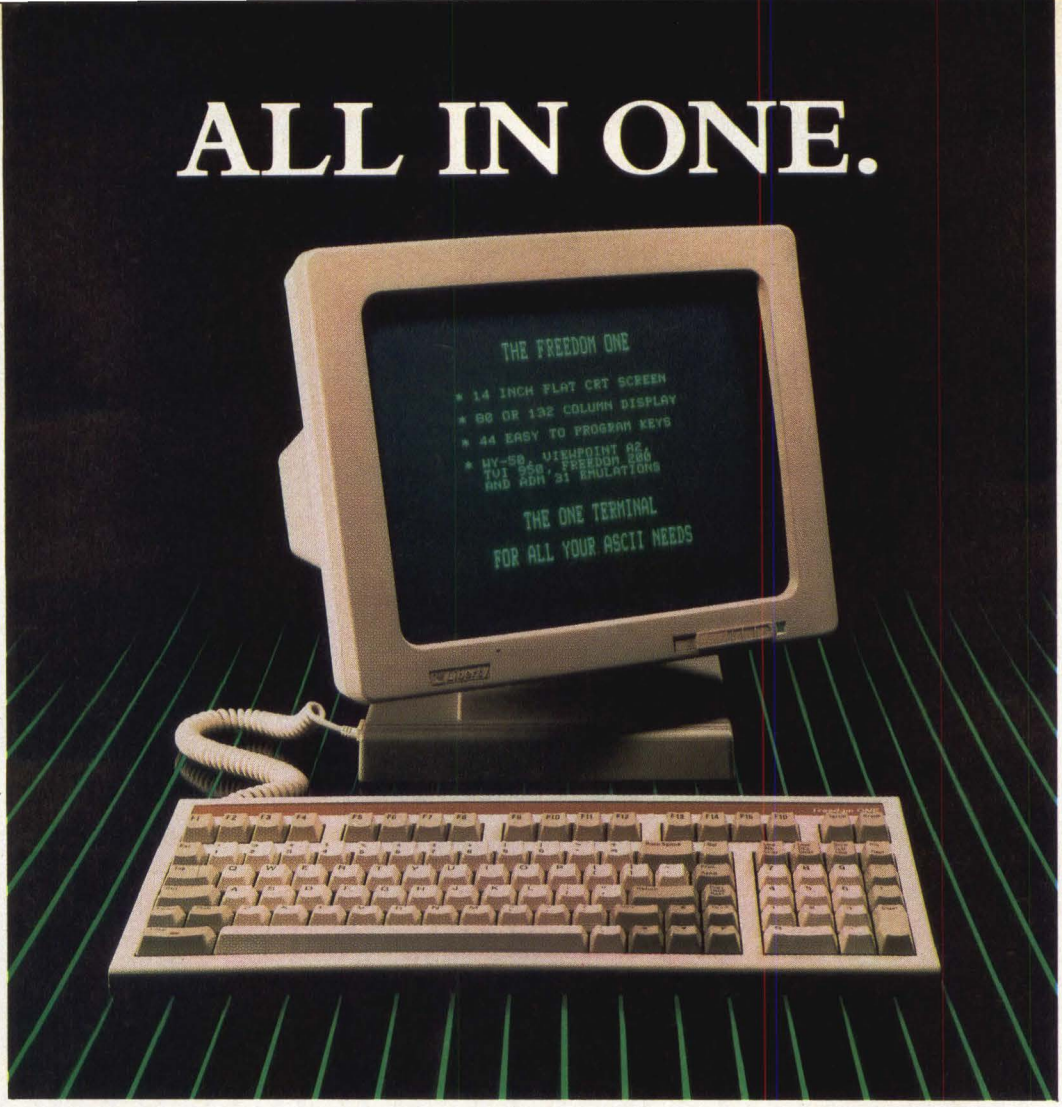

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CIRCLE NO. 21 ON INQUIRY CARD

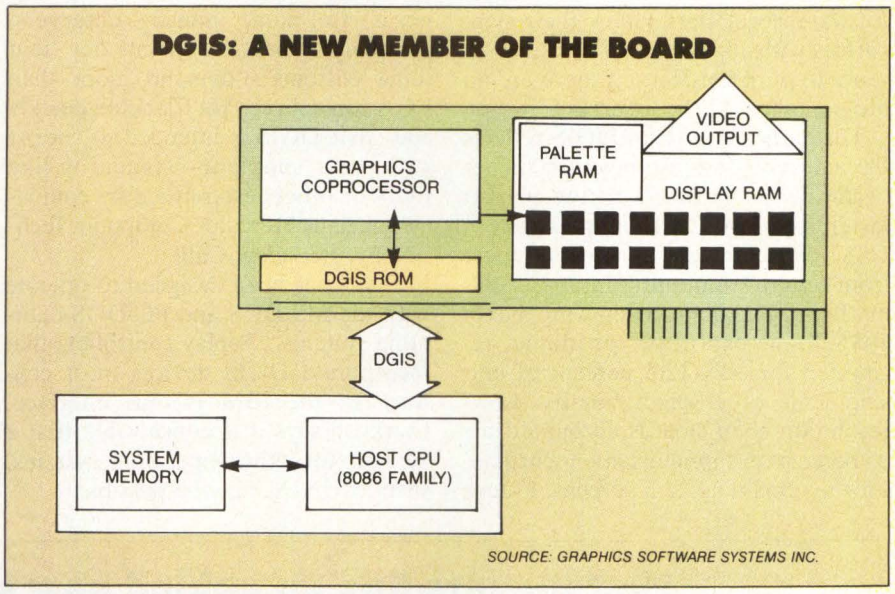
Vendors rally around DGIS graphics interface

Mike Seither
Associate Western Editor

Semiconductor, software and board manufacturers are beginning to throw their support behind a new standard for personal computer graphics that advocates claim will drastically reduce program-development time and usher in a new era of high-performance graphics applications.

The proposed standard, called the Direct Graphics Interface Specification (DGIS), is the creation of Graphic Software Systems Inc. of Beaverton, Ore. GSS wrote the original version of the specification, then farmed it out for comment to a broad base of companies that supply graphics products. The response resulted in a recent agreement on an open standard for a board-level interface that resides in ROM. DGIS provides for a closely coupled hardware link between the chip-based graphics subroutines and the intelligent graphics processors. According to some supporters of the idea, DGIS could offer, depending on the hardware configuration, from three to five times the speed of current graphics boards, such as IBM Corp.'s enhanced graphics adapter (EGA) for the IBM PC.

The ROM-based interface contains an extensive collection of software subroutines to produce on-screen graphics and text. These DGIS calls—there are more than 100 of them for such graphics primitives as circles, lines and windows—can be invoked by either the application program or the operating system. Backers claim that DGIS is not encumbered by the hardware dependencies of a particular display controller. DGIS, they declare, is hardware independent. As a result, software developers can write applications without having to learn the intricacies of a processor chip's instruction set.



DGIS is a board-level *interface that resides in ROM and works with a graphics coprocessor in IBM PCs and compatibles.*

Saved from the graveyard?

"What DGIS will do is specify primitives in a single, standard manner. To the software developer, it really doesn't matter how the hardware underneath accomplishes that," says Robert Carr, chief technologist for Ashton-Tate, the Torrance, Calif., software giant. Carr believes that DGIS, among other things, will offer a way to speed up graphics applications for Intel Corp. 8088-based PCs. "A lot of people agree they don't work as fast as they might," says Carr. "This might save them from the graveyard."

Ashton-Tate is only one of more than a dozen companies to publicly express support for DGIS. Other software heavyweights have also signed up, including Borland International Inc., Lotus Development Corp. and Software Publishing Corp. Semiconductor makers also support the specification. Prominent on the list are Texas Instruments Inc. and Hitachi America Ltd., though neither has mentioned specific product plans. On the other hand, Intel, Hillsboro, Ore., plans to introduce a major DGIS-related product in the second quarter of 1986, according to Garth Wilson, general manager of Intel's graphics components operation.

Other manufacturers are at once enthusiastic and reserved. "DGIS is a standard that would eliminate the Tower of Babel that exists as [a result of the speed at which] hardware changes," says Larry Finch, president of Paradise Systems Inc. of South San

Francisco, Calif. Paradise sells graphics chip sets and complete graphics boards to OEMs. One of the problems now, says Finch, is that, when hardware comes out for a higher resolution monitor, software that a developer already has written for a previous display controller usually won't run with the new device. The developer has to rewrite for the new hardware. Finch says that Paradise backs DGIS but that the standard won't go anywhere unless software developers follow their sympathies with applications. "It makes no sense to burn hardware if there are no programs for it," he asserts.

The early support for DGIS reflects the industry's interest in getting higher performance hardware to the market faster, says Tom Clarkson, president of GSS. Clarkson cites a recent report from Future Computing Inc., a Dallas market-research outfit, showing that in 1985 high-resolution products accounted for only 12.5 percent of unit shipments of graphics boards. Low-resolution color boards accounted for 65 percent of shipments; monochrome, for the remaining 22.5 percent. Future Computing forecasts that, by 1990, 88 percent of unit shipments will be high-resolution color graphics boards. The researchers expect most of these to be based on the lower-cost EGA, despite DGIS' speed advantages.

Foreign protocols offer new paths

EGA is considered a de facto graphics standard for the PC. It reproduces 16 colors on the screen (out of a palette of 64) at a resolution of 640 by 350 pixels. But some industry observers, including Clarkson, point out that some customers demand more than EGA can deliver. Yet Clarkson quickly adds that DGIS is intended to coexist with—not supplant—standards like EGA or others established by companies such as Hercules Computer Technology, Berkeley, Calif.

DGIS has been designed to operate with the MS-DOS and PC-DOS operating systems. Display controllers that incorporate DGIS devices must conform to the IBM PC-bus interface. Clarkson says it is conceivable that a version for other operating systems, such as UNIX, may be possible.

It is also conceivable that manufacturers may implement one or more graphics standards on a single board as a way of making their product support as many existing applications as possible. According to the DGIS specification, manufacturers can use "foreign protocols," which are simply descriptions of other graphics standards. These protocols would provide various paths to the graphics hardware. One path to the screen, for example, could be through EGA silicon. Another path, using DGIS, could provide higher resolution, off-screen memory or a larger color table. "The exact capabilities of the DGIS path would be determined by the advanced-graphics-display processor and [by the] additional memory on board," the specification says.

GSS plans to license DGIS code to board manufacturers. They can use the the GSS ROM kits to program their own DGIS chips. GSS is also actively working with semiconductor firms like Intel and Texas Instruments to modify their graphics processors to accommodate DGIS. □

First players line up behind new graphics spec

When the initial public announcement of the Direct Graphics Interface Specification (DGIS) was made recently, 16 vendors expressed support for the standard. The prime mover behind the specification, Graphic Software Systems Inc. (GSS), Beaverton, Ore., expects more vendors to support DGIS, once products hit the market.

The first DGIS-based applications and hardware are expected to be available late this year, according to GSS president Tom Clarkson. Companies aren't talking yet about unannounced products, but here are some of the first players to announce their support for DGIS and what kinds of products may appear from them.

Company	Likely products
Ashton-Tate Torrance, Calif.	icon-based operating environment
AST Research Inc. Irvine, Calif.	boards
Borland International Inc. Scotts Valley, Calif.	application programs
Chips & Technologies Inc. Milpitas, Calif.	chip sets
Hitachi America Ltd. San Jose, Calif.	processors
Intel Corp. Hillsboro, Ore.	processors
Lotus Development Corp. Cambridge, Mass.	application programs
Microfield Graphics Inc. Beaverton, Ore.	boards
NCR Corp. Dayton, Ohio	chip sets
Number Nine Computer Corp. Cambridge, Mass.	boards
Paradise Systems Inc. South San Francisco, Calif.	boards, chips
Software Publishing Corp. Mountain View, Calif.	application programs
Tecmar Inc. Solon, Ohio	boards
Texas Instruments Inc. Dallas, Texas	processors
Western Digital Corp. Irvine, Calif.	chip sets

Will success spoil the Corporation for Open Systems?

Bruce J. MacDonald
Assistant Managing Editor

It has been called the most significant industry development in the last five years but chastised as having made mistake after mistake. Smaller companies won't survive without it, say analysts—who add in the same breath that it is already too big to accomplish its goals.

Is it? Has the Corporation for Open Systems (COS) grown more unmanageable with every new member?

From almost every angle, COS looks like a roaring success. Since its formation in January, 45 companies have joined the non-profit organization. That includes IBM Corp., whose growing power is said to have prompted the founding of COS. The membership list includes manufacturers, OEMs and end users and grows almost weekly. Its annual budget already stands at approximately $5 million, and it recently hired Lincoln Faurer, former director of the National Security Agency, as its first president.

But, many wonder if that momentum means it will miss its chance to redirect the computer and communications industries.

Its goals are simple enough. It seeks to promote U.S. support of such proposed international standards as the International Standards Organization's open systems interconnection (OSI) model and the Integrated Services Digital Network (ISDN) so that different brands of computers can talk to one another, and to establish a single, consistent set of tests and certification methods to ensure that they do. Thomas Chun, COS chairman and corporate projects vice president at Tandem Computers Inc., Cupertino, Calif., says the group plans to have test beds for file-transfer and electronic-mail software "up and running" by early next year.

Few people underestimate the size of those tasks, and COS has suffered its share of skeptics. Some industry analysts and trade press writers predicted COS would fail because the biggest computer vendors wouldn't commit themselves seriously to it, and that it wouldn't attract those vendors' top technical staffs. Then, critics said that it wouldn't be able to circumvent antitrust laws; that it needed to, but wasn't, considering European and Japanese standards work; and that IBM

Where COS should focus—one analyst's view

The Corporation for Open Systems (COS) has ambitious plans—too ambitious, says George Colony of Forrester Research Inc., Cambridge, Mass. But he maintains it might succeed if it is willing to narrow its focus.

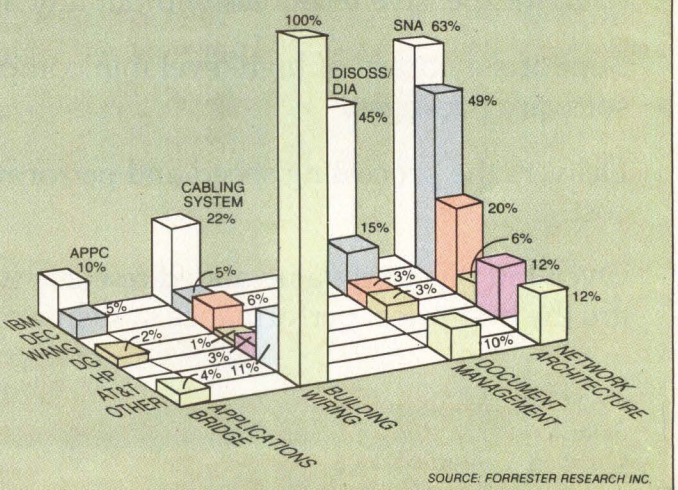
If the group can concentrate specifically on promoting the top layers of the open systems interconnection (OSI) model—rather than the entire seven levels—to ensure that different systems' applications can be interconnected, interoperability might be achieved more simply and quickly. IBM Corp.'s market penetration of the application-to-application level, where it has placed the Advanced Program-to-Program Communications (APPC) facility of its Systems Network Architecture (SNA), is limited.

"COS should not waste its time battling embedded IBM protocols and the non-critical areas like building wiring and document management," he advises. Smart vendors should not only support COS, i.e. OSI, application bridges, he says, but also build their own proprietary networks to solve their customers' immediate problems and commit resources to IBM compatibility.

One need look only at Data General Corp., a COS founding member, to see that Colony's formula is already popular—and that pragmatism sells computers. Recently the company announced both XTS/SNA Backbone, a software package that permits DG's computers to communicate transparently over SNA, and SNA Suspend Manager, which allows users to suspend and re-enter up to three IBM 3278 terminal sessions, DG's Office Automation and CEO software, and user-integrated applications.

IBM CONTROLS THE LION'S SHARE OF NETWORKS

(Percentage of Fortune 1000 companies currently using these products)



SOURCE: FORRESTER RESEARCH INC.

wouldn't join.

Those concerns were nonsense, says a source close to COS. What industry observers overlooked, or didn't know, he says, was that a handful of major computer vendors began laying the groundwork for COS as long ago as 1984. Those companies include AT&T Co., Burroughs Corp., Digital Equipment Corp., Northern Telecom Inc. and Sperry Corp.

Their motivating concern was IBM and its ever-stronger grip on the market, according to the source. "Those guys were really scared," the source recalls. "There is a perception that even AT&T was going to have its clock punched, and when a company like AT&T is having that much trouble, how much was a smaller firm going to have?"

The ground breakers contacted the CEOs of the biggest companies in the industry, and by late last year, COS had become a main topic of conversation at the boardroom level. Although COS was not formally set up until January, the top technical people of what became the 17 founding companies had begun meeting a year earlier.

To avoid antitrust problems, company lawyers have been carefully monitoring every step of the process. And although COS limits membership to North American companies, the group has taken European and Japanese companies into consideration from the beginning, says the source. They will be allowed to join, "probably within the next year."

IBM's decision to join COS came as a surprise to many, although some observers think it had no choice but to sign up. They feel IBM's commitment to OSI has been half-hearted at best, driven only by the need to sell its products in Europe, where demand for OSI-compatible products is strong. If nothing else, joining COS was a way for IBM to prevent competitors from ganging up on it, say some analysts. For its part, IBM says it supports OSI.

COS executives categorically deny that the group was formed to counteract IBM's increasing domination of the computer industry. Analysts, however, will tell you IBM power did inspire COS' founding. One such is Jack Biddle. His father is A.G.W. Biddle, president of the Computer and Communications Industry Association, the trade group that spearheaded COS. A market analyst with The Gartner Group Inc., Stamford, Conn., Jack Biddle stresses that, without COS, IBM's revenue and profit trends will continue, leaving smaller firms to flounder. "You really have to wonder where the R&D money is going to come from for the competitors to stay current," he says. "I mean, they're making 60 percent of revenues and less than 30 percent of profits [compared to the boom years of the early '80s]. You've got to make profits to stay current, both in manu-

facturing and technology."

"The margins involved, if you're able to sell a proprietary system, are higher," he adds, "and IBM is in an increasingly powerful position to control where and when in a computer system profits can be earned. If you project that trend out, [other companies] don't really have a choice."

But will COS fly? Gartner's Biddle, for one, believes so. "I think there will continue to be mid-level infighting in the development groups, but there's someone standing over their shoulders now." He explains that if an engineer tries to gain a competitive edge for his company through COS' development committees—a common concern among COS critics—it will be made obvious to all. "There are going to be people watching these guys, and that's a big change," he adds.

"It's a matter of survival; COS has to happen," echoes William Johnson, vice president of systems and communications engineering at DEC. If it doesn't, he explains, "you would see major customers getting together around given industries and defining what it is they needed, and if you wanted to sell to them you'd have to implement that." He cites General Motor Corp.'s Manufacturers' Automation Protocol (MAP) as an example.

The role for integrators

If COS can eventually ensure that different vendors' machines will communicate with one another without the various and often convoluted gateways and interfaces that are necessary today, where will it leave all those smaller companies who make a living off those products? Venture capitalists have invested heavily in such multivendor products, says Jack Biddle. If widespread adoption of international standards permits large manufacturers to tie their machines together themselves, COS may indeed reshape the industry—though into greater, not lesser, consolidation.

Vendors are emphatic about COS' benefits for system integrators, however, and some see numerous opportunities for the smaller hardware and software makers as well. "More than anything else," says Don Street, manager of networks and communications for Intel Corp.'s Systems Group and a delegate to COS' Strategy Forum, "COS will introduce the opportunity for the smaller guys to focus on true added-value applications. COS is going to open up whole new industries because it's going to open up opportunities for the little guy to build a product he knows can conform to a standard, and he knows he's got a market he can attack." He names expert-system software development as one potential market.

Other analysts think COS has already missed the boat. Andrew Allison

of Los Altos Hills, Calif., believes that with so many members, the number of competing interests will be too great to produce a useful specification.

Allison says Parkinson's famous law would indicate, "The maximum number of people who can belong to a committee that will do anything useful is 21," and adds, "I think it's true."

Calling COS a fallback position for those vendors who already offer complete system solutions, Allison argues that they have joined only to assuage their nagging concern that proprietary architectures may not prove the route to success. He adds that those vendors will participate only to the extent that they can influence COS to their best advantage.

"That's where you run into the problem of the number of participants," he explains, adding, "Good things happen when one company or one very small group has a good idea and implements it, and then a lot of people recognize it and jump on the wagon."

To be effective, he continues, COS will have to move fast. With so many members, the group will have to quickly settle on a set of protocols, do a limited amount of tweaking and resist the urge to make any proposed open architecture look like proprietary systems already on the market. "It will probably be clear in two or three months whether COS is capable of picking a target and going after it," he maintains, "or whether it's going to flounder around until a standard appears by accident."

George Colony of Forrester Research Inc., Cambridge, Mass., is even more skeptical. "You don't let IBM into this sort of thing," he says emphatically. "That was the dumbest move they could have made. They had the right idea, the right concept and the right people—CEOs, not technoweinies. It was a complete business decision to do it, a very smart idea. However, from that point on they made mistake after mistake. They said, 'We're going to be a standards organization; we're going to go public; we're going to try to get IBM involved; we're trying to expand membership.' Those moves were antithetical to the original purpose of the group."

COS suffers from three major problems, he explains. IBM's installed base of communications will prevent the group from imposing standards in some areas; vendors' competing interests will result in stalemate because they won't let their installed customer base be endangered; and COS is driven by OSI, whose standards are being specified, particularly at the upper layers, at a slow pace. Customers need answers now, he stresses; they can't wait for COS.

The cost of trying to solve those problems will not be cheap. COS executives anticipate an annual operating budget of approximately $10 million, paid for by membership fees. Regular membership costs $25,000 a year; research membership, for companies with annual revenues of more than $25 million, costs $50,000 for the first year and $25,000 thereafter; and senior research membership, for companies with more than $150 million in revenue, will cost $375,000 for the first year and $175,000 annually after that. More than a third of the budget will be spent on research and development, but critics wonder if that will be enough. Last year IBM spent $4.7 billion on R&D.

COS will succeed if it can keep to its goal of establishing file-transfer and electronic-mail standards and testbeds by early next year, says Jack Biddle. "If COS can get some stuff out there and it works, and it starts to get some of the press that MAP's got—that this is for real . . . they can do the same thing that some large vendors do—issue statements of intent to unfreeze markets."

And if it can't?

"Something will bubble up," says Allison. "Probably IBM." □

VMEbus specs: Will industry back private lab?

Mike Seither
Associate Western Editor

This month VMElaboratories, a new, independent testing company located in Denton, Texas, will begin a major marketing effort to sell manufacturers a service that certifies that their components comply with the tight rules of the VMEbus specification.

The novel inspiration behind VMElaboratories is one that most industry participants—manufacturers and system integrators—will readily applaud. For manufacturers, VMElabs offers impartial testing, and certification, which assures users that the company's products conform to the rigorous mechanical and electrical specifications of the VMEbus. In the competitive VMEbus industry, a company with certified products could have a marketing advantage over others who don't.

For system integrators, VMElabs' seal of approval may offer them the assurance that certified products from different vendors will work together. Both manufacturers and system integrators agree that mixing VMEbus products from different vendors is often a trying job because many boards aren't designed according to the VMEbus specs. One of the major problems that results from this is inconsistent timing among boards.

Whether VMElabs will help to eliminate this situation and succeed as a business may well depend as much on the demands of the user community for a disinterested testing organization as it does on the support of manufacturers, who must foot the bill for testing. For a company with a broad product line, that could mean a considerable investment. The cost of certifying a board will cost about $7,000. Testing other products based on a design already certified by VMElabs will run about $1,000, according to the company.

David Allen, president of VMElabs, is optimistic that the idea will catch on. Much of his confidence stems from John Black, VMElab's "spearhead of

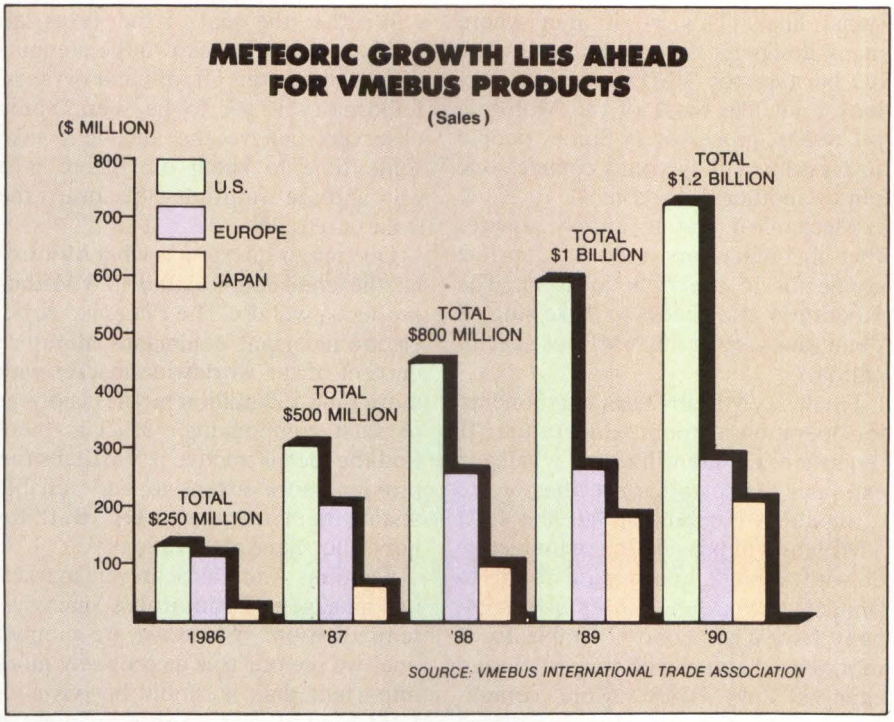
credibility," without whom the company would not have even tried to get off the ground. Black is VMElab's technical consultant who designed the test procedures for certification. Black is a former Motorola Inc. engineer and one of the primary authors of the VMEbus specification. Now an independent consultant based in Tempe, Ariz., Black is considered one of the most knowledgeable VMEbus experts in the field.

As part of its strategy, VMElabs also hopes to attract new vendors entering the market for VMEbus products. The lab hopes to convince these vendors that certification will lend credibility to their equipment. "Half a dozen manufacturers on board will pretty much guarantee our success," Allen reasons.

There are plenty of manufacturers for VMElabs to woo. In its latest vendor directory, the VMEbus International Trade Association (VITA), Scottsdale, Ariz., identifies about 200 companies worldwide. Together they produce more than 1,000 components for the high-performance VMEbus, including everything from 32-bit CPU, memory and disk drive controller boards to backplanes and card cages. These companies are vying for part of the exploding market for VMEbus products, a market that VITA estimates will grow to $1.2 billion by the end of 1990. That's a fivefold increase from this year's $250 million (see chart).

In theory, products from these vendors should work in concert, largely because the VMEbus specification is so comprehensive. But it's a rare system integrator who hasn't run into problems mixing and matching products from different manufacturers. The reasons, according to Black, vary: rushing products to market without adequate testing, misunderstanding the specification, not adequately supporting some features. "It's becoming a very competitive market," he says.

The ones getting stuck with the mistakes are system integrators. "I could name you a long list of commerical [VMEbus] board manufacturers who violate the spec," says Jeremy Rosenblatt, a senior program manager



with Integrated Automation, an Alameda, Calif., company that builds image-document-management systems.

"Their design errors show up as subtle system failures," says Rosenblatt. He says that some board manufacturers design later products around earlier boards that did not originally conform to the spec. "If you stick with one vendor, everything is fine. But you can't do that all the time," he says. The result is that system integrators have to make modifications to the boards.

Stating assumptions

What VMElabs hopes to offer is assurance that all certified products will operate correctly at the bus-interface level—that is, as the specification tells users the products will behave. The lab will check for conformance against Revision C.1, the latest version of the VMEbus spec. That specification, one of the most comprehensive for any bus, is broken down into four sets of design guidelines: rules, recommendations, suggestions and observations. VMElabs will test for minimum conformance with the rules, says Black.

VMElabs is aware that some rules are open to interpretation, depending on the kind of equipment used in a system. For example, the rule covering the design of power-failure modules does not define what a power failure is—it could be a brownout or complete loss of power. Throw in yet another variable: some systems use AC, others DC. The rule is to inform other parts of the system that power is going down so that necessary housekeeping can take place, such as saving data. For VMElabs to test for compliance with rules like that, it will rely on the manufacturer's stated assumption of what constitutes a power failure.

To help manufacturers understand the certification test, VMElabs has published a 500-page document that outlines the conformance procedure in detail. It costs $40, but that charge can later be deducted from test fees. "The procedure gives you a pretty clear understanding whether or not you'll pass before submitting your design," says Black.

VMElabs will test for conformance in three areas: electrical, mechanical and temperature. A two-phase electrical test covers correct characteristics of line drivers and receivers. This is done through analysis of schematics of printed circuits. Then, VMElabs uses its own test equipment to verify the proper use and timing of VMEbus

signal lines. This is an area where many designers have gotten into trouble because the VMEbus signal lines look a lot like those of the Motorola MC68000 processor. "Some people just assumed they could connect one pin to another," says Black.

Mechanical testing simply assures that manufacturers used the correct connector in the right location. The laboratory also checks to make sure all dimensions meet the VMEbus specification.

Finally, VMElabs tests components for operation at room temperature. If requested, the lab will test at whatever extremes the customer specifies.

Should a component fail the test, VMElabs will provide the manufacturer with enough information for it to simulate the problem in its own company lab. Where only a simple fix is required, the lab will suggest design changes, says Black. More complicated redesigns can be negotiated through VMElab's consulting service.

Once a component passes tests, manufacturers will be allowed to use the lab's "Conformance Certified" seal on its products or literature. VMElabs retains possession of all boards it certifies as a hedge against manufacturers who may alter a design later without having those changes certified. "If someone begins to fudge or spins off designs, we'll have components in stock to determine what is and what is not certified," says VMElabs' Allen.

Will Motorola bite?

During testing, VMElabs will release no information on a manufacturer's product, or whether it is even being tested, without approval of the customer, says Allen. However, when a product is certified, the lab will make the information available to potential customers. Parties interested in learning whether a product is certified can call VMElabs toll free at (800) 654-5227.

To remain as objective as possible, VMElabs will neither market nor endorse any VMEbus products. The company says its selection of any product could be construed as an endorsement.

Whether the seal of the Texas lab will become as familiar to the computer industry as the UL of Underwriters' Laboratory is yet to be seen. Some observers believe the idea may take some time to catch on. There is a wait-and-see attitude because the stakes are high.

One major question is what Motorola, the undisputed leader in VMEbus products, will do. The Phoenix, Ariz., electronics giant commands about 25 percent of the worldwide market with more than $30 million in sales last year of such components. Officials there find the idea attractive if VMElabs can provide more extensive and reliable testing than manufacturers. But, for now, they have reservations.

Cautions Andreas Schreyer, marketing manager of Motorola's microsystems division: "Since we are number one, we see our role as probably more important than it should be [vis-a-vis VMElabs]. If we stepped in now, it would be like forcing the entire community to do so. We'd rather let the industry decide whether this is a good service, rather than having Motorola force it down everyone else's throat."

Smaller manufacturers of VMEbus products, like Mizar Inc., St. Paul, Minn., find the notion of impartial certification alluring, but they are also keeping an eye on the bottom line. Says Mizar president Steven Darnauser: "We have 40 different designs. It would cost us a quarter of a million dollars to have them all certified." He notes that, for a $5 million company, that's a lot of money.

Meanwhile, VMElabs' president Allen is sure he's on the right track. The company polled 1,500 users recently and got an overwhelming response in favor of impartial testing, he claims. "Once system integrators specify certified products, the pressure will be on manufacturers to get it done." □

Trans-Atlantic standards promise common e-mail

Keith Jones, European Editor

As a prelude to its members developing X.400-compliant electronic-mail software, the Corporation for Open Systems (COS) is expected to adopt soon a set of standards based on X.400 protocols. It will mean, says Joseph St. Amand of Wang Laboratories Inc., a wide, new market for COS members who sell systems on both sides of the Atlantic. St. Amand represents Wang, of Lowell, Mass., on the COS executive committee.

The X.400 standards began life in Europe as recommendations from the Comité Consultatif Internationale Téléphonique et Télégraphique. COS has been established to promote the Open Systems Interconnection (OSI) model and other proposed international standards such as the Integrated Services Digital Network (see "Will success spoil the Corporation for Open Systems," Page 29). ISDN also originated with the CCITT. The X.400 recommendations are being adopted by the International Standards Organization as part of its extensive set of OSI proposals. X.400 fits into the seven-layer OSI model at the top, or Application, layer. The X.400 proposals will be the first OSI Application-Layer standards to be implemented worldwide.

Proprietary e-mail standards are already available from some computer systems vendors. But X.400 is intended to facilitate e-mail traffic among different vendors' computers and among different e-mail networks, referred to in X.400 terminology as "domains." They can be public or private, national or international.

According to St. Amand, the X.400 standards backed by COS will be the same as those just adopted by the U.S. National Bureau of Standards. NBS has collaborated closely with computer vendors and standards-making bodies

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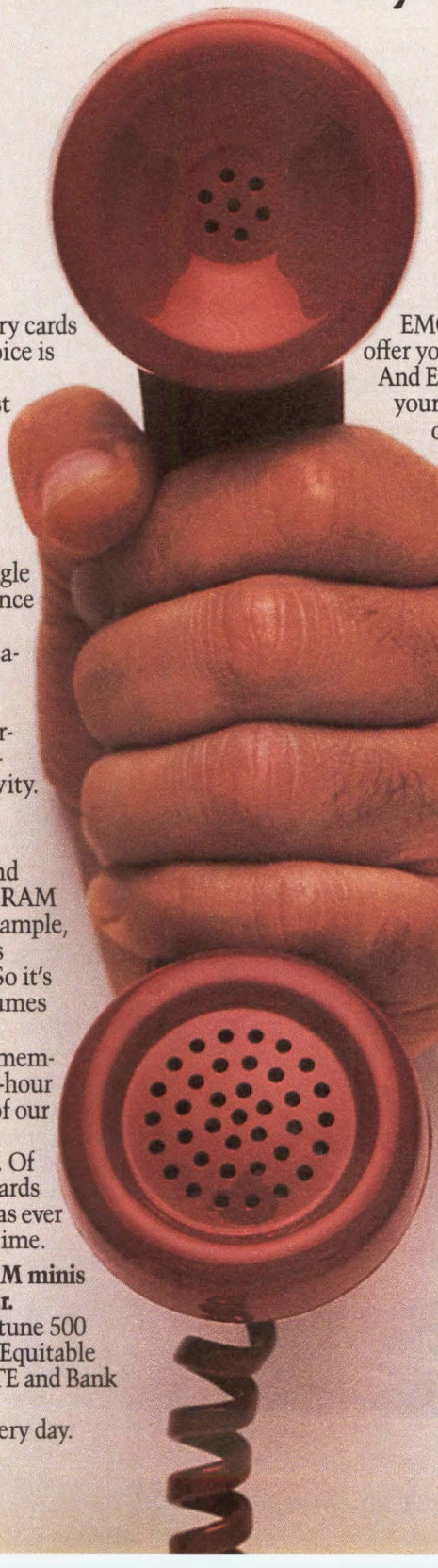

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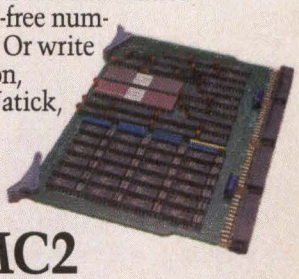

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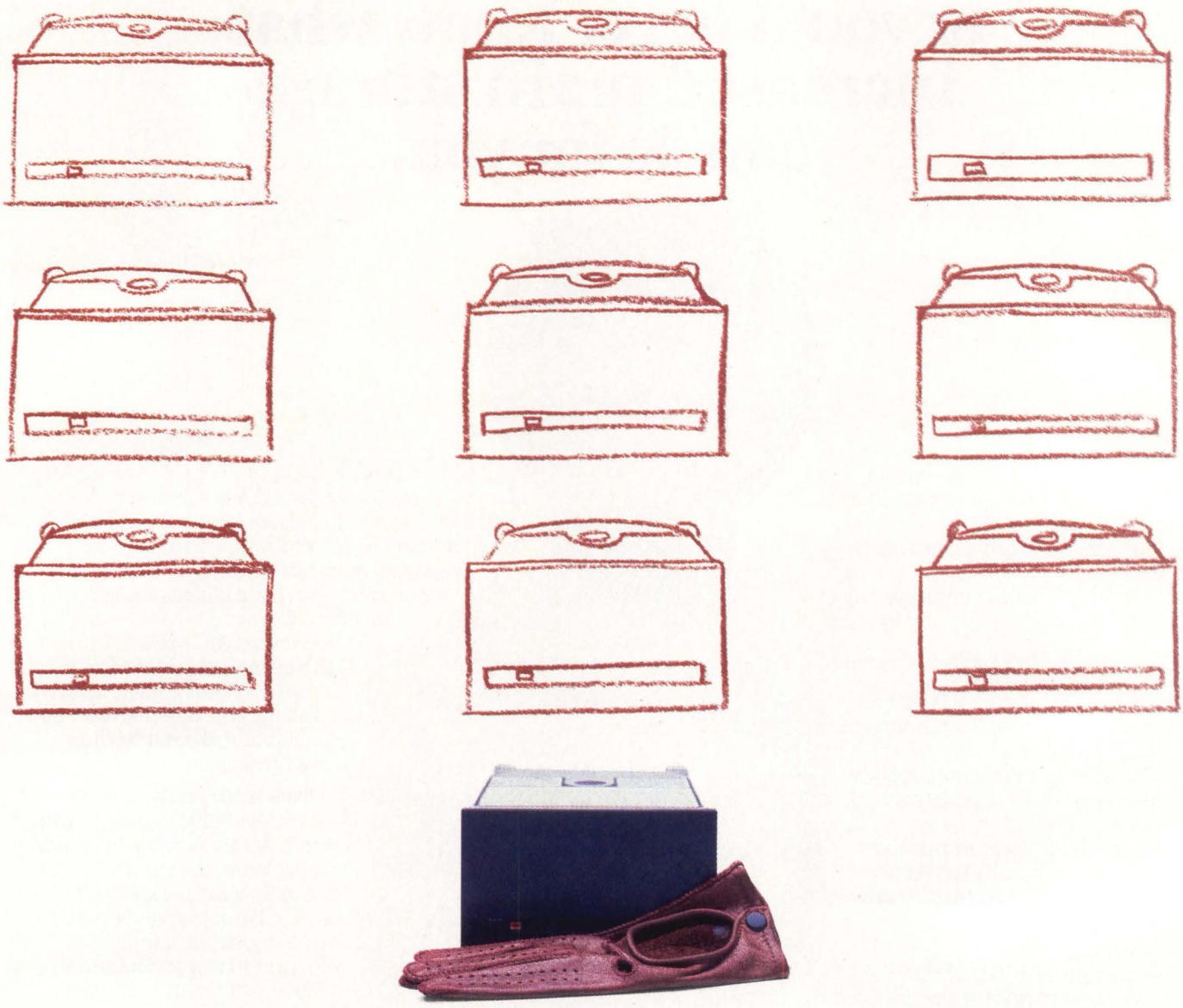

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in Europe, where X.400 is being promoted more enthusiastically than in the United States, he adds.

One of the strongest European proponents of X.400 is International Computers Ltd. (ICL) of London. Steve Dooley, manager of mail and messaging at ICL's office-business center in Bracknell, England, explains that the X.400 standards being adopted by computer vendors in Europe and the United States are functional standards, or profiles. These profiles are more precise than both the ISO X.400 standard set and the CCITT recommendations. They give exact values to such parameters as the length of information fields needed to send an e-mail message. This information includes the time, date and subject, and the names and addresses of both sender and recipient.

In Europe those profiles have been formally ratified by two closely collaborating standards bodies, Centre Européen de Normalisation (CEN) and Centre Européen de Normalisation Electrotechnique (Cenelec), both of Brussels. Together they formulate European information technology standards for the European Commission. "The X.400 profiles adopted by NBS have been harmonized with CEN/Cenelec, so there will be very few differences," promises St. Amand.

Europe leads the way

COS wants standards it promotes in the United States to conform to those promoted in Europe, says St. Amand. The European Standards Promotion and Awareness Group (SPAG) is carrying out a similar task. SPAG comprises a dozen leading European computer makers and was set up more than three years ago by the European Commission to campaign for OSI standards. It has worked closely with CEN/Cenelec on the X.400 profiles.

"Europe has taken the initiative with X.400, and SPAG has led the way," observes Julian Patterson, an analyst with the European office, in Watford, England, of The Yankee Group of Boston. St. Amand concurs, but he attributes Europe's lead not only to SPAG's activities but also to the strong support for X.400 coming from Europe's powerful telephone companies, most of which are government-owned and enjoy a monopoly or near-monopoly in their countries. Those carriers are establishing public X.400-based e-mail networks that will be used to link private X.400 domains operated by major computer users.

Incentive to 'stop the rot'

The real goal in this work is to establish X.400 as the dominant worldwide e-mail standard before IBM Corp. can establish a proprietary e-mail standard with its Document Content Architecture/Document Interchange Architecture. DCA/DIA forms part of IBM's Systems Network Architecture (SNA)—its proprietary equivalent to the OSI model. Leone Pease, an office-automation analyst with Venture Development Corp., Natick, Mass., sees Europe's common carriers as the standard bearers in the fight: "Europe's common carriers are much stronger than those in the United States and are making IBM come into the X.400 fold."

St. Amand is confident that IBM will not inhibit the commercial adoption of X.400 in the United States. He points out that IBM is active in both COS and the NBS X.400 working group and predicts that the company will provide products for both SNA and OSI. The Yankee Group's Patterson adds that, while acceptance of SNA has been more widespread in the United States, IBM's U.S. competitors are now desperate to "stop the rot" by promoting X.400 and other OSI standards through initiatives such as COS.

Just how acquiescent is IBM to all of this? Fairly, it would appear to those in Europe. At this year's Cebit exhibition in Hannover, West Germany, IBM participated in a demonstration of X.400-based e-mail transfer among different vendors' systems. IBM 4300 series mainframes and VAX minicomputers from Digital Equipment Corp. were the only U.S. machines in the SPAG-organized demonstration. Other participating vendors included Groupe Bull, Paris; ICL; Nixdorf Computer AG, Paderborn, West Germany; and Siemens AG, Munich. Connected to the Cebit e-mail circuit by a DEC VAX-11/750 was the West German data-processing research institute, Gesellschaft für Mathematik und Datenverarbeitung mbH., of Bonn. West German interest in X.400 is such that the government is funding several X.400 software-development initiatives as part of a program to establish a network linking West German universities and research institutes.

Additionally, X.400 implementations for the UNIX System V and Berkeley UNIX Version 4.2 operating systems are being prepared by software house Danet GmbH of Darmstadt. And West German universities and institutes with DEC VAX computers running VMS will use X.400 software now being prepared by DEC's worldwide networking, communications and office-automation software-development center in Reading, England.

Even though the X.400 profiles from NBS and CEN/Cenelec are suitable for implementation on current computers, some important facilities extending the capabilities of X.400 have yet to be added. There is a need to implement X.400 software on single-user personal computers. Two new protocols called P3+ and P7 should permit that.

CCITT is defining P3+, while the European Computer Manufacturers Association defines P7. ECMA concentrates more on forming standards than on promoting them. ECMA developed additions to the original CCITT X.400 recommendations, which have been included in the profiles being adopted by CEN/Cenelec and NBS. St. Amand believes that NBS will have profiles for P3+ and P7, at least in draft form, by late this year or early next.

X.400 will not rest there. According to St. Amand, upcoming developments for the recommendation include incorporating the NBS X.400 profiles in the next version of the Technical and Office Protocol by the TOP user group. Even more important, a resolution will be sought for the differences between the NBS and CEN/Cenelec profiles and those X.400 profiles drawn up in Japan by a group of companies led by Nippon Telegraph and Telephone Corp. of Tokyo. □

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Competition, not technology, fuels the drive for ISDN

Lynn Haber, Associate Editor

Ultimately, it will be end users who benefit from the much talked about Integrated Services Digital Network. But the current push for ISDN stems more from competition among telecommunication providers than from any desire on their part to make innovative services available to customers.

ISDN represents the ultimate architectural concept in a digital highway: a telephone network designed to carry voice, data, message, video and image traffic from a local area network to a wide area network.

To attempt to understand the hoopla surrounding this utopian, global, end-to-end digital internetworking scheme, one must disentangle the voices promoting it. Each of them, not unnaturally, pontificates for his own interests.

Those interests are directly related to industry projections for anticipated sales of ISDN-related products—which some analysts view as the next frontier for industry revenue. According to International Resource Development Inc., a market-research and consulting company in Norwalk, Conn., the value of shipments of ISDN-related equipment will grow from an estimated $45 million this year to more than $11 billion by 1991.

ISDN suppliers include a host of participants: long-distance telephone companies; Bell operating companies (BOCs); central office switch manufacturers; customer-premise equipment and private branch exchange manufacturers; data-communication equipment manufacturers; semiconductor companies; and computer equipment companies.

Digital transmission promoted

The ISDN concept becomes tangible as the protocols that define the network's interfaces unfold. These standards, known as the I-series of recommendations, are published by the European-based Comité Consultatif Internationale Téléphonique et Télégraphique. Both U.S. and European industries sit on its various standards committees.

The idea of ISDN originated in Europe in the late 1960s. It was an attempt to standardize data communication transmission between different nations with incompatible public telephone networks. In the United States, ISDN has been driven by the competitive telecommunication environment that resulted from the deregulation and divestiture of AT&T Co., in addition to the expanding telecommunication requirements of multinational companies.

When AT&T stood essentially alone in telecommunications, the monolithic corporation's field of vision was virtually unimpeded by competition. Divestiture changed that. AT&T Communications (ATTCOMM) found itself competing for customers not only with the BOCs but also with other long-distance telephone companies, such as MCI Corp. and U.S. Telecom Inc.

While ISDN holds promise for end users in terms of economy and enhanced services, industry analysts agree that ISDN is primarily a banner under which ATTCOMM and the BOCs can modernize their networks from analog transmission to digital. "The long-distance telephone market is big, but it's not a rapidly growing market," says Kim Myhre, director of communications and office-automation research at International Data Corp., Framingham, Mass. "And the way to generate additional revenue," says Myhre, "is to offer enhanced telecommunication services—but that requires that the networks be updated."

The BOCs depend on businesses, which constitute a small percentage of their overall customers but generate the bulk of their revenue. They need to maintain these customers by offering them the sophisticated communication networks they demand. Although the BOCs are legally limited in what they can offer in terms of enhanced services, industry watchers expect the parameters of the regulated-versus-deregulated telecommunication business to change over the next five years.

To this end, according to Jean Buffham, research analyst at IRD, the BOCs are attempting to bring back Centrex services—private enhanced networks—and integrate the enhanced Centrex services with ISDN services, when they become available. "This would put the BOCs in a competitive position to offer something that nobody else does," she notes.

Filling in the pieces

The theory behind ISDN is this: If there is a universal set of rules or guidelines that manufacturers can adhere to, compatibility among a myriad of equipment—telecommunications and data communications, hardware and software—will exist. The ISDN vision will have to become a reality.

But the computer industry hardly matured under the guidance of a benevolent communal spirit. Computer companies touted proprietary systems and software, and users today find themselves with incompatible vendor equipment and islands of networks. On top of that, the breakup of Ma Bell promoted, for good and for bad, further product diversity.

Manufacturers are virtually operating in the dark because ISDN standards are presently either nebulous or nonexistent. ISDN standards are based upon the International Standards Organization's seven-layer model for open systems interconnection (OSI). The CCITT publishes its recommendations every four years—the last report was published in 1984 and the next is expected in 1988. The 1988 report will fill out the standards recommendations, but that doesn't imply that the recommendations will be complete. Additionally, recommendations to date have only addressed the bottom three layers of the model. And, as IRD's Buffham contends, "Standards or no standards, vendors must design ISDN products now."

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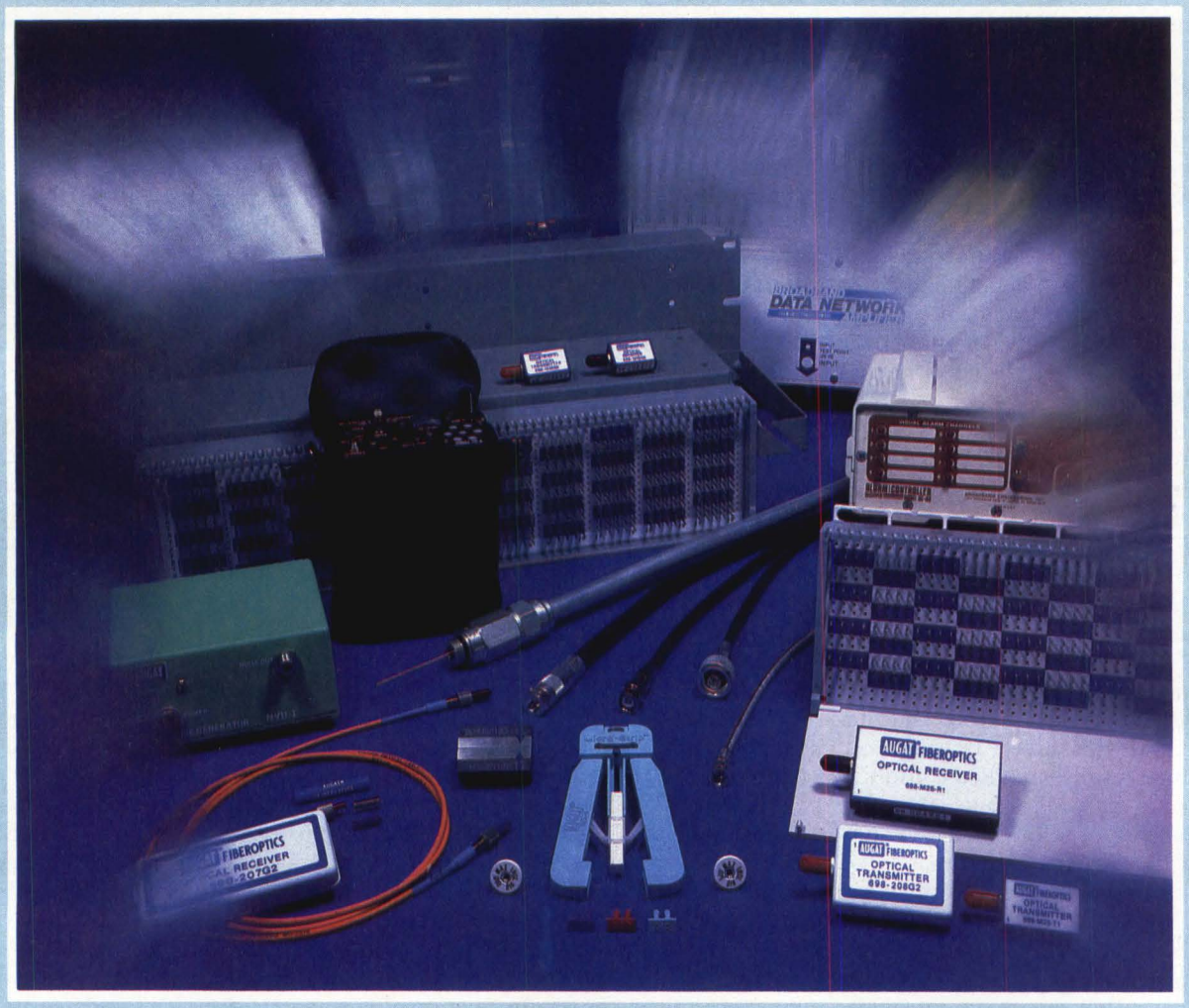

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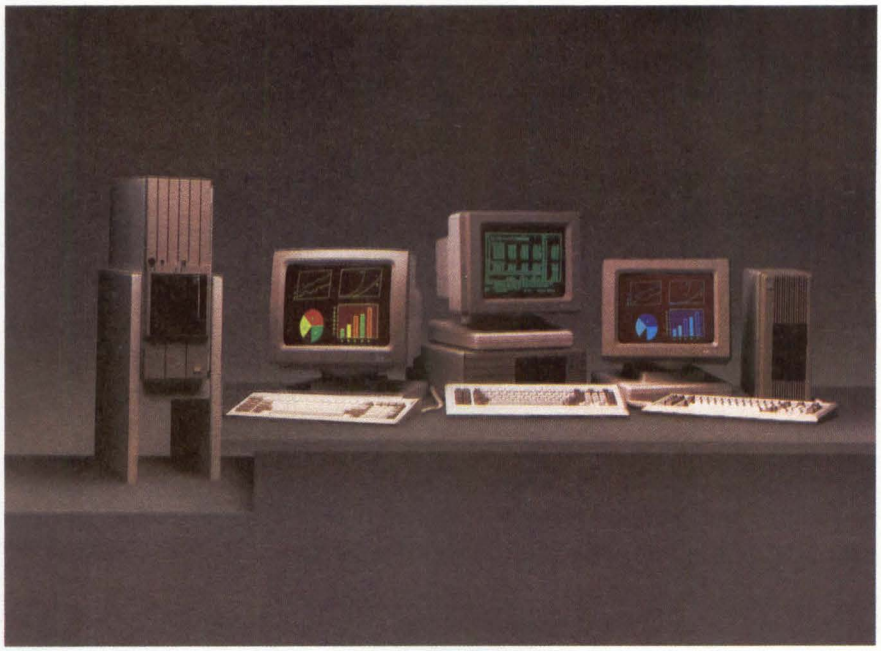

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T	1010000000	NEW YORK	APEXINC	33333888899	KL234	87654	200	10/02/85	NWPHILIDE	NEW YORK	ACMETRS	
SON	1022277754	BOSTON	ZINCINC	33388990044	KL234	50987	007	12/01/85	CENTRALLA	BOSTON	AJAXAIR	
	1000000456	CHICAGO	AASEWER	98750372378	KL230	90867	999	ONHOLD	WOODLAWN	CHICAGO	DUMAIR	
N	1038657363	ATLANTA	TVSINC	77493887549	KL239	99999	808	11/19/85	ATLANTANW	AUGUSTA	EWFRT	
Y	1087584948	MINNIAP	XYZCORP					/07/85	MINNSTPAUL	MINNIAP	TRUCKER	
T	1089558488	SANFRAN	JAKINC					/28/86	SANJOSESE	SANMATEO	SHORTAIR	
TT	1066574637	SANJOSE	ACDCORP					/08/85	SACRAMENTO	SANJOSE	EZHAULER	
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Screen Color	Green or Amber	Green Only	Amber Only
Optional Graphics model	Yes	No	No
Dynamically allocated non-volatile function key memory	512	128	140
Maximum non-volatile bytes per function key	256	4	64
High contrast super dark Matsushita screen	Yes	No	No
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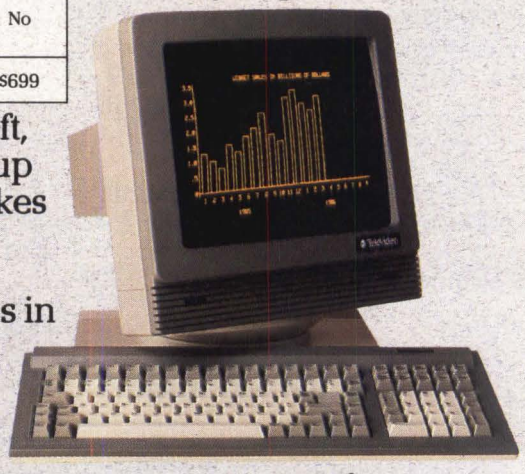

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Data communications equipment companies such as Racal-Milgo, Sunrise, Fla., and Codex Corp., Mansfield, Mass., while actively engaging in ISDN research and product development, see themselves in a transition period. While ISDN creates a host of new business opportunities for data communications manufacturers, the interim period will be one in which new product development conflicts with the traditional product line that these companies offer. These are primarily devices that convert the digital world to analog, says IDC's Myhre.

Howard Krauss, director of new business development at the electronics division of Racal-Milgo, says that, while the company does not reveal R&D figures, the allotment for ISDN-related research is substantial. "ISDN is a fundamental technology that will not only change the type of products we produce but will also change the way customers view and use telecommunications."

According to IDC's Myhre, communications is the new frontier in chip development. "ISDN consolidation in chip technology will provide ISDN-related cost savings."

Buffham agrees. "The ISDN chip market is generating a lot of interest among semiconductor companies, who see it as a new niche-market opportunity."

But companies such as Advanced Micro Devices Inc., Harris Corp., Intel Corp., Motorola Corp. and Siemens AG face an uphill battle to maintain momentum in the face of evolving standards. VLSI chips are expected to aid in the transition to ISDN as it matures, by providing an upgrade path for existing equipment while keeping pace with the ISDN technology. But the design standards are not in place yet. "These companies are walking on eggshells," says Buffham, "but they can't afford to do nothing."

Companies such as Intel, Phoenix, Ariz., are currently working on product development for the proposed interface standards, though Graham Alcott, marketing manager for telecommunication products doesn't expect to see "complete building blocks" for another four to five years. □

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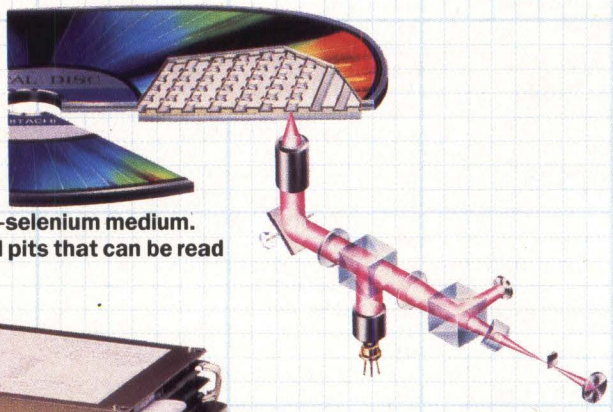
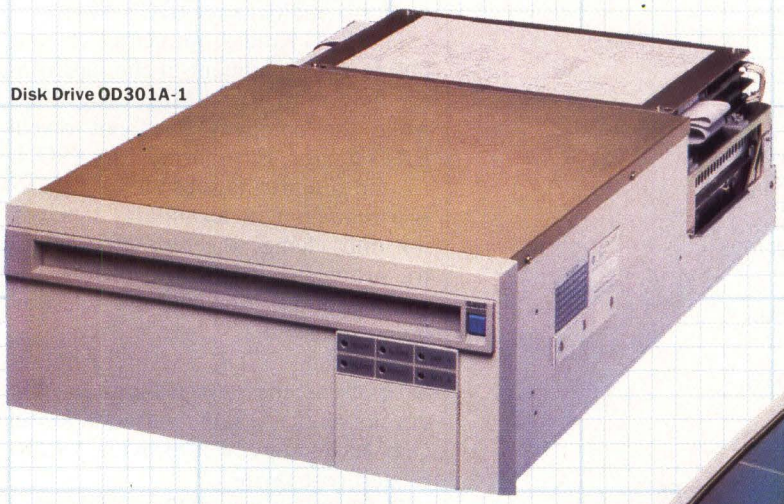
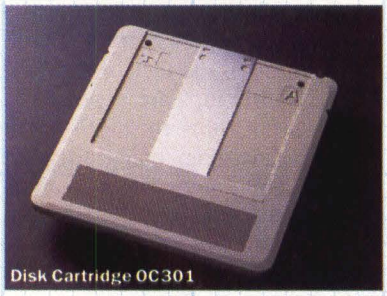




Disk Drive OD301A-1

The 301 Series drive automatically checks each data bit after it is written and also records error-correcting bits. The combined use of read-after-write checking and error-correction codes reduces expected read errors to 10^{-12}, allowing storage of both image and encoded data.

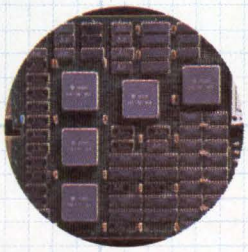


Disk Cartridge OC301

To assure data retention, the 301's disks are sealed in a glass envelope and then encased in an easy-to-handle plastic cartridge. The predicted data life of the doubly sealed disk is more than 10 years.

■ The 301's formatter/controller implements either the industry-standard SCSI interface or a GP-IB (IEEE-488) interface, which enables the disk subsystem to be used with a wide range of computers. The unit includes its own memory buffer to speed data transfer between a host computer and the disk drive, which has a 250 millisecond average access time.

Formatter Controller OF301S-1/2



Hitachi Developed
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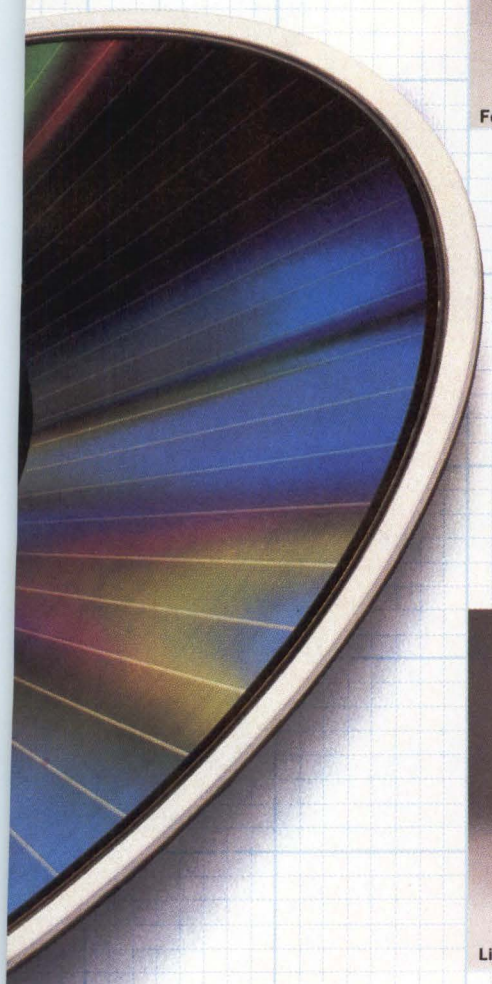
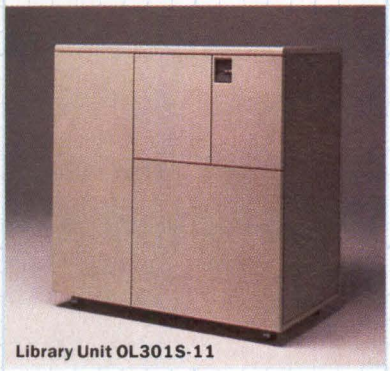


This 12-inch optical disk can store 2.6 gigabytes of images or encoded data.



Library Unit OL301S-11

■ The 301 Series library unit provides as much as 83 gigabytes of on-line storage capacity. It incorporates a formatter/controller, one or two disk units, and an automatic changer for as many as 32 disk cartridges.

How Hitachi's 301 Series Facilitate Information Storage and Retrieval

With the introduction of its 301 Series optical disk system, Hitachi has taken a giant step forward in speeding information access. Unlike conventional disk units, which record information magnetically, the model 301 stores data optically—by using a laser to inscribe microscopic pits on a specially coated disk surface and subsequently read them.

The results: a big leap in storage capacity per disk. A 301 Series system can store 2.6 gigabytes of information on a 12-inch disk. The 301 Series library unit, which combines an automatic disk changer with one or two drives, can store and retrieve 83 gigabytes of information—yet occupies no more space in an office than would a large filing cabinet.

The ability to record so much information so compactly opens vast new applications for on-line information storage and retrieval. For example, with the 301 Series, it becomes economically feasible to create extremely compact electronic archives for storing and retireving copies of medical records, engineering drawings, and other documents, much faster than with conventional microfilm or magnetic tape storage. Other applications include electronic publishing and backup of volatile databases in large-scale information processing systems. For more information, contact:

Hitachi America, Ltd.

Computer Division
Peripheral Systems Marketing Department
950 Elm Avenue, San Bruno, CA 94066
Tel: 415/872-1902
or: 313 Speen Street, Natick, MA 01760
Tel: 617/655-5501

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KODAK
3.3 MB
Flexible 5¼"
Disk Drive.

KODAK
Intelligent
12 MB
Cartridge
Disk Drive.

For years, choosing a high-capacity drive was a hard decision...a hard disk decision. But the hard disk monopoly on high capacity has just been shattered. Introducing 3.3 MB and 6.6 MB flexible drives and 12 MB intelligent cartridge disk drives from Kodak.

Now you can move up in performance without sacrificing security and reliability.

Advanced servo-embedded technology gives Kodak's 3.3 MB and 6.6 MB units capacity and performance unprecedented in flexible drives. Specially preformatted Verbatim media tells the head exactly which track it's over. This accurate track positioning lets us increase track density and still get reliable data transfer. In fact, this is the *only* reliable way of getting multi-megabytes of data storage from a flexible disk drive.

Kodak drives give you new levels of speed, too. The 3.3 and 6.6 units access and transfer 3 to 6 MB of data in the same time that conventional flexible drives handle only 1 MB. Both drives offer 3 ms track-to-track access and dynamic ramp stepping for fast random access and a transfer rate of 500 Kbit/sec.

Downward read capability puts these drives in a league by themselves. They automatically read any files that have been recorded on standard PC- or AT-type 5¼-inch media. That means there's no need for expensive overhauls of existing software or files.

CAPACITY A HARD DECISION.

KODAK
6.6 MB
Flexible 5¼"
Disk Drive.

The intelligent 12 MB cartridge disk drive completes Kodak's powerful family. This advanced peripheral delivers hard disk performance with the convenience of media removability.

It features reliable servo-embedded technology, fast 75 ms average access time, and an embedded controller with SCSI interface. These built-in extras let you eliminate expensive and time-consuming testing and integrating of individual components.

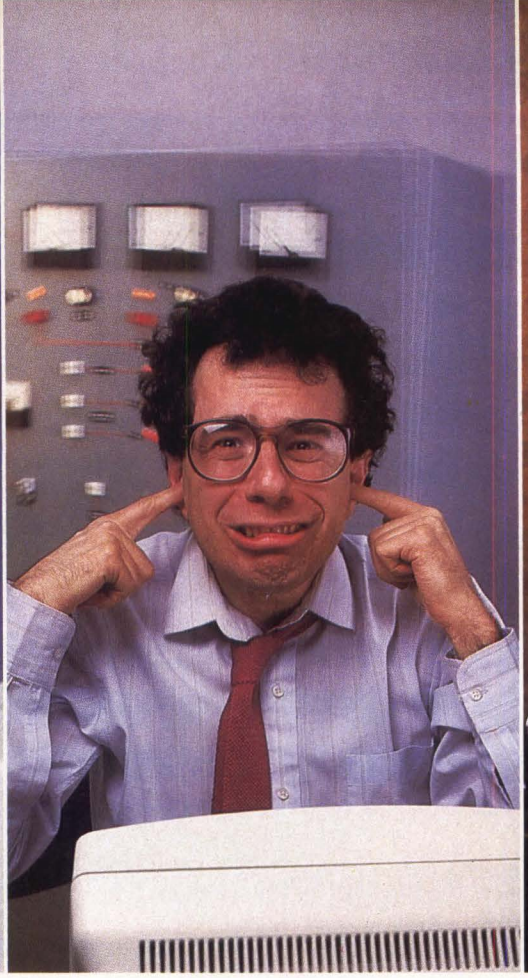
And the 12 MB 5¼-inch media comes in a shock-resistant hard cartridge that protects precious data while it's out of the drive.

But the most surprising thing about Kodak disk drives is that they squeeze all their capacity and performance into a half-height, 5¼-inch format.

So if you're ready to move up, remember high capacity doesn't have to be a hard decision anymore. Now you can grow with powerful 3.3, 6.6, and 12 MB disk drives from Kodak.

If you'd like more information about Kodak's advanced disk drives, call 1-716-724-5887 or write to Peripheral Systems Products, Dept. MMS, Mass Memory Division, Eastman Kodak Company, 343 State Street, Rochester, New York 14650.

Kodak



Too big. **Too noisy.** **Too much.**

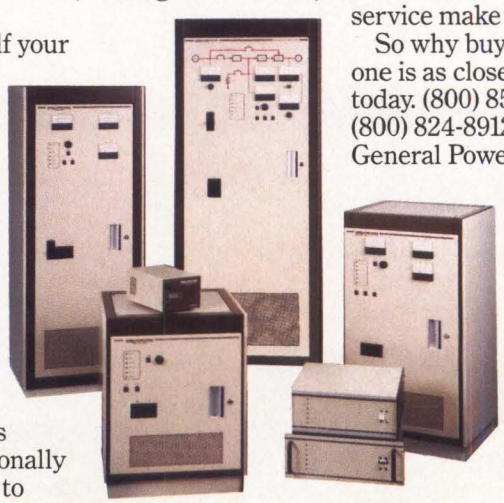
How to keep from buying the wrong UPS.

If you've been told a big, noisy, expensive uninterruptible power supply is the only way to really protect your power-based system from error or disaster, look again.

Yes, you do need a UPS.

But a UPS doesn't have to hog half your computer room, or put your staff—or your treasurer—into shock. Not when the UPS is from General Power Systems.

GPS is the pioneer in transistor-based UPSs with all the benefits that implies—small, quiet, cool, reliable, efficient. In fact, a GPS system is often half the size of another supply of comparable power. And because GPS manufactures the most complete line of UPSs on the market, we have what you need—on-line models from 500VA to 50KVA, and exceptionally small standby systems from 200VA to 2000VA with transition times as low as 2ms.



GPS systems have a low initial cost with many features, which are traditionally optional, included free. Plus, our extraordinary reliability, ease of use and service make the cost of ownership low.

So why buy the wrong UPS when the right one is as close as your telephone. Call GPS today. (800) 854-3469, in California (800) 824-8912, (714) 956-9321, Telex 182283. General Power Systems, 1400 North Baxter St., Anaheim, CA 92806-1201.

Now, UL Listed models 1KVA–10KVA.

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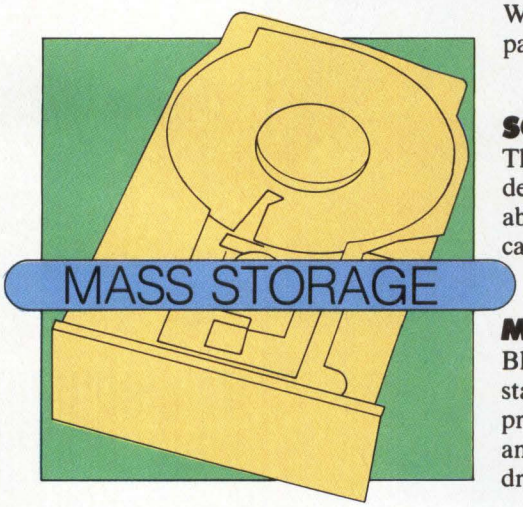
CIRCLE NO. 99 ON INQUIRY CARD

FEATURE HIGHLIGHTS

p. 54 . . . . . Teaming up



p. 103 . . . . . Back on track

INDUSTRY OVERVIEW: COMPUTER VENDORS CONSOLIDATE RESOURCES 54

In the face of increasing competition and a prolonged industry slump, manufacturers are banding together in a variety of joint efforts including mergers, strategic alliances, R&D sharing and government-sponsored and private consortia. This consolidation and cooperation is worldwide but doesn't necessarily cross national borders.

OSI STANDARDS SPUR PRODUCT PROFUSION 67

Promising plug-compatibility for polyglot computers, the International Standards Organization's open systems interconnection (OSI) networking protocols are finally being backed up with products. This article is the first in a three-part series and focuses on the lower layers of the seven-layer OSI model. The second and third articles, which examine the upper layers, will appear in July and September.

SMALL BUSINESSES BOLSTER PC SALES. 85

Many market-research concerns report only on how many units of a commodity have been and will be purchased. Focus Research Systems' ongoing personal computer surveys track the specific buying plans of U.S. companies: What brands are small businesses planning to buy—and which ones will they pass up—in the next 12 months.

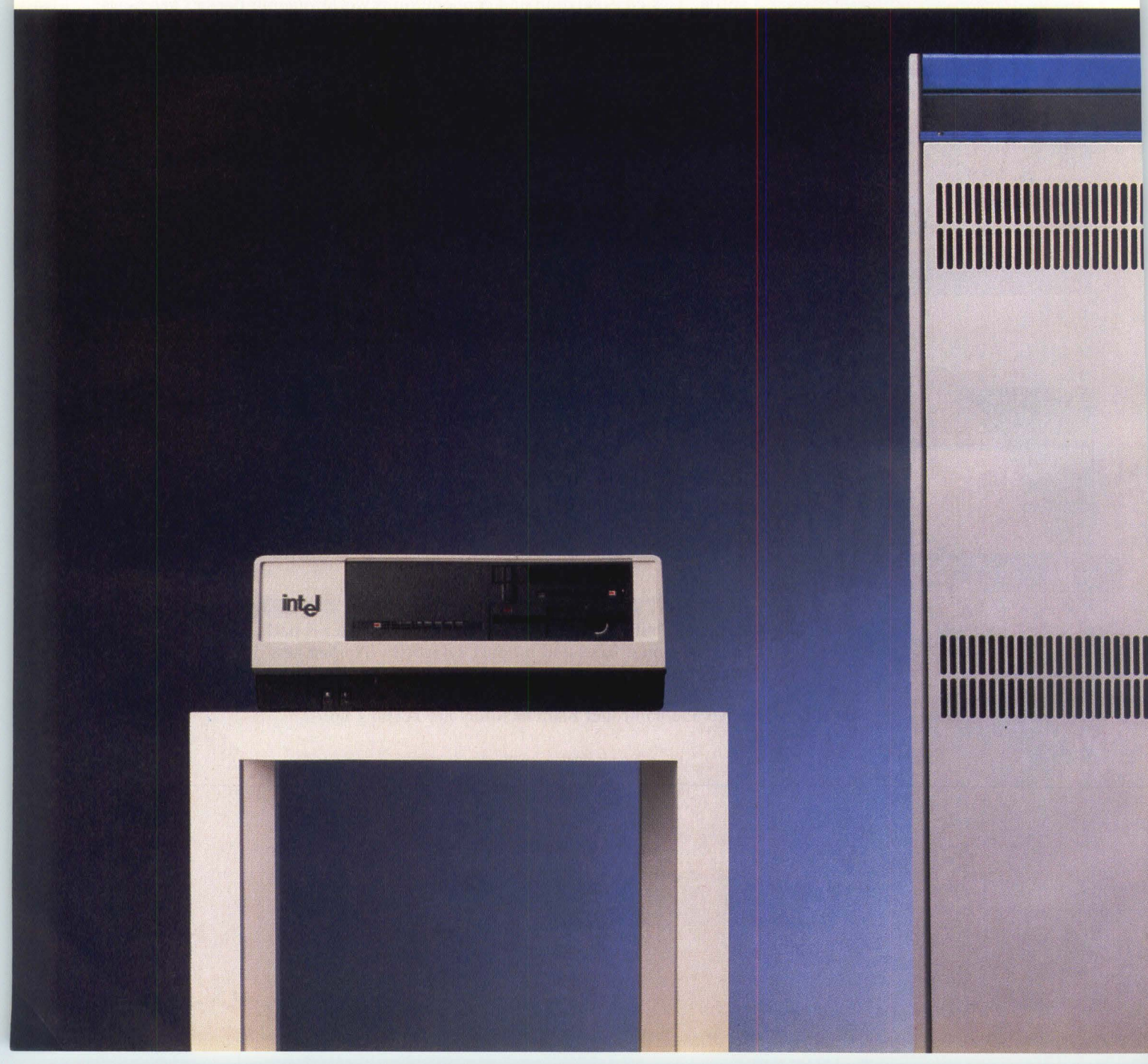
SOFTWARE TOOLS SLASH DEVELOPMENT TIME. 95

The nemesis of all programmers is time. Fortunately, a variety of software-development tools—such as libraries of subroutines and functions—are available to assist programmers in quickly creating customized packages for vertical-market applications.

MASS-STORAGE MARKET STAGES A COMEBACK. 103

Bloodied, but not beaten, the mass-storage market is back on track with new standards, interfaces and product categories. Among new developments are a proliferation of drives in the 3½-inch form factor, a rapid emergence of SCSI and ESDI interfaces and refinements in optical-disk technology. And tape-drive and controller manufacturers are keeping up.

OUR 310 AP HAS RATHER ORDINARY PERFORMANCE COMPARED TO MOST MINICOMPUTERS.



Its CPU performance is only marginally faster than the VAX*-11/780 shown on the right, for example.

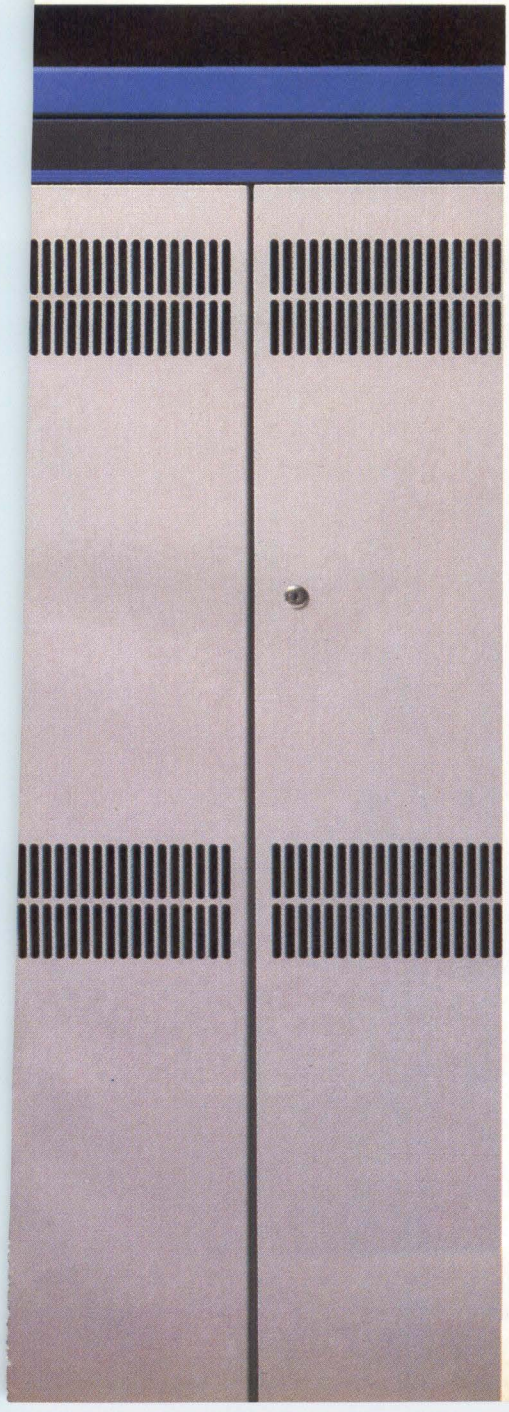
And even with a couple additional high-performance application boards slugged in, it can't quite keep up with a Wang VS 300.

But this parity changes to a powerful competitive edge when another number is considered.

Cost.

Our new 310 AP gives you over 1 MIP of CPU performance for under $20,000. (A fifth the price of a mini.) And you can add up to three additional CPU boards to provide up to 5 MIPS of performance, for under $50,000.

Which makes this either one of the most ordinary minis around, or the most extraordinary supermicro.



But what's in a name? Performance is performance, whatever name it goes by. And with this expandable system you can cost-effectively deliver the performance your customers need.

An expandable open system like this allows you to avoid obsolescence by making future upgrades of performance and/or functionality without having to buy a new system.

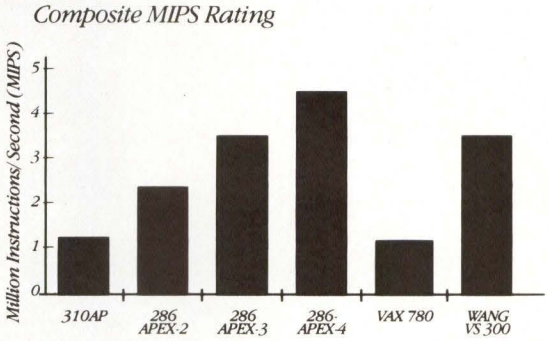
But there are open systems and there are open systems.

The starting point for any open system that really is an open system is, of course, standards.

We support more standards than anybody. So we can offer a *complete* open system, and a complete open product line—from operating systems to applications software to networking—all based on standards.

And because the 310 is a truly open system, you can have more than 50 independent software packages. More memory if you want it. Or additional Winchester drives.

And all our systems are supported fully by our worldwide customer service organization.



When new technology comes along our systems don't get obsolete and replaced, they get upgraded.

Just ask the people who bought our first ones four years ago.

For further information call toll-free (800) 548-4725. Or write Intel Corporation, Lit. Dept. W286, 3065 Bowers Ave., Santa Clara, CA 95051.

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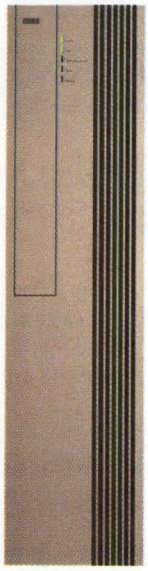
THIS
END UP

PICK, PICK, PICK. SHIP, SHIP, SHIP.

At NCR, quality and quantity have a cause and effect relationship. We ship *lots* of Towers because OEMs know and trust NCR quality.

Our reliability fanatics know how to pick a nit. Our OEMs know how to pick a hit.

NCR's unique combination of research and development programs, quality assurance procedures, and massive production capabilities allows us to deliver the highest quality products, in volume. On time.



NCR spends over a quarter of a billion dollars every year on research and development. More than many computer companies gross.

Then, once a design is accepted for production, we unleash our nit-picking reliability fanatics. They subject every Tower® product to a gauntlet of excruciating tests, culminating in a final burn-in: three full days of flawless performance.

The result of all this concentrated effort is a Tower you can build upon with certainty. A system nucleus with dependability engineered in every step of the way. And that means fewer service calls—higher customer satisfaction—from your accounts.

Equally important as delivering a product that lives up to your expectations is delivering that product *when* you expect it. And here's where all our nit-picking pays off, for you. Aided by our R&D and quality assurance efforts, our production lines fill orders for two or two thousand Towers, without missing a beat.

We've designed an unparalleled program at the NCR OEM Systems Division to say just one thing to ambitious OEMs: Go! Go! Go!

THE TOWERS. BUILT FOR SYSTEMS BUILDERS BY NIT-PICKING FANATICS.

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CIRCLE NO. 28 ON INQUIRY CARD

COMPUTER VENDORS CONSOLIDATE RESOURCES

Manufacturers worldwide team up for shared R&D, mergers and consortia to protect their turf as competition heats up in a maturing marketplace

Andrew Allison
Contributing Editor

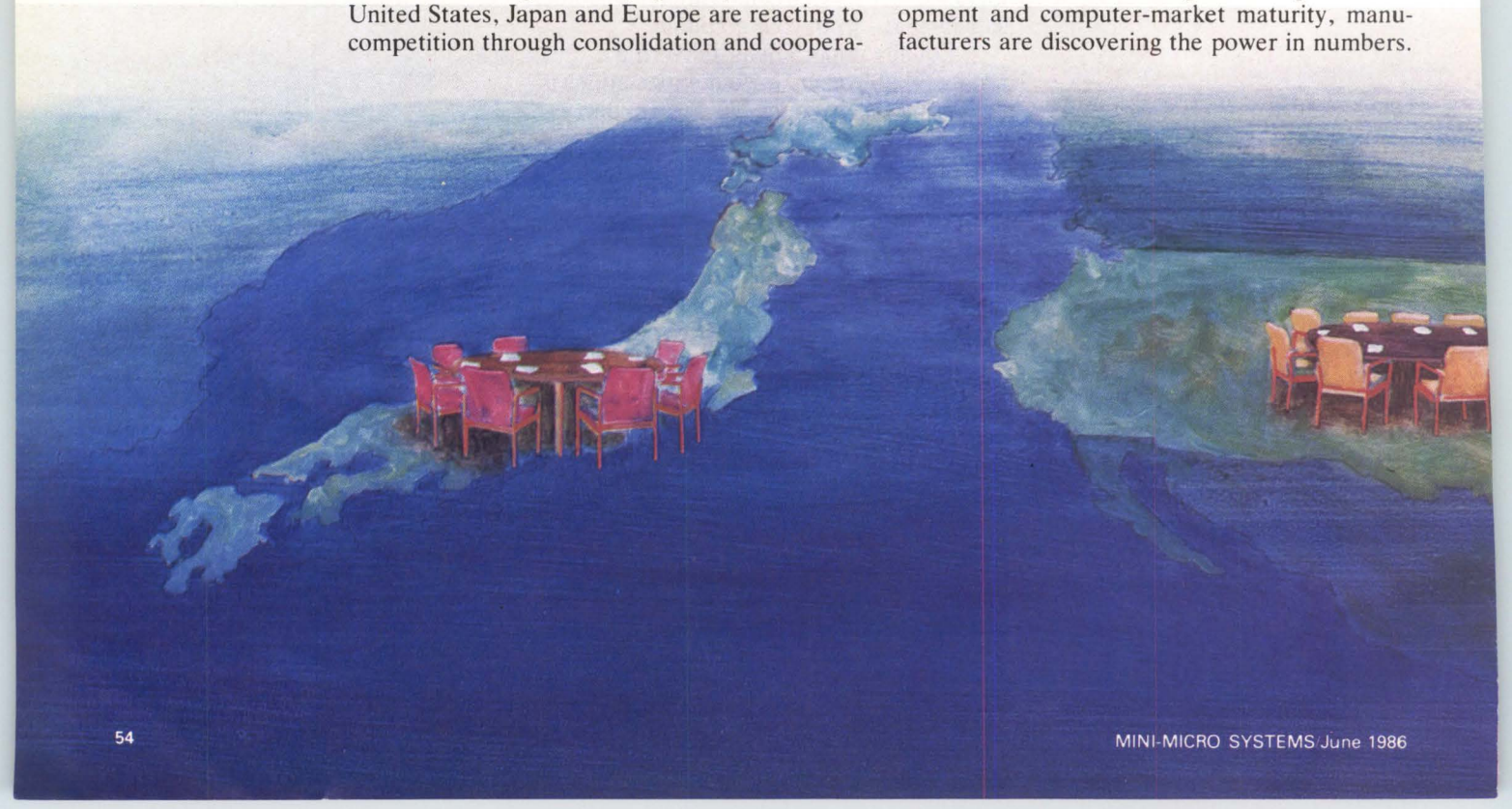
The computer industry exhibits all the signs of marketplace maturity—including the salient one of domination by only a few suppliers. The rapid pace of market development, its segmentation and the continuing preoccupation with IBM Corp.'s dominant role within the industry tend, however, to mask this maturity. And, what's more, the positions of established suppliers in a mature market can change dramatically when one or more vendors fail to respond to technological or market shifts.

Hence leading industry participants in the United States, Japan and Europe are reacting to competition through consolidation and cooperation. These efforts range from strategic alliances between individual suppliers to industry-wide consortia, both public (i.e., government sponsored) and private.

The sort of consolidation that took place within the mainframe industry during the 1960s was mirrored in the minicomputer industry during the 1970s. Just 15 years ago, 70 participants competed in the minicomputer market. But, 10 years later, three suppliers accounted for over two-thirds of revenues. The same thing is happening in the personal computer industry today.

Consolidate and cooperate

In the face of accelerating technological development and computer-market maturity, manufacturers are discovering the power in numbers.



In Japan, the Ministry of International Trade and Industry (MITI) remains the model for such industrial consensus-building, acting as an effective coordinator of technological development. Similarly, the Alvey Directorate in the United Kingdom also looks promising.

The response to MITI in the United States has ranged from radical improvements in semiconductor product quality to the establishment of a variety of cooperative research and development efforts. Perhaps the most far-reaching result has been U.S. government encouragement of cooperative R&D among large American corporations. Last year, Congress provided legislative relief from the antitrust implications of such joint development efforts by passing the National Cooperative Research Act and, by year end, 38 cooperative projects, ranging from steel making to telecommunications, came into being.

Such cooperative efforts in the United States are not without antecedent. The first major cooperative semiconductor R&D effort was the Department of Defense's VHSIC (Very High Speed Integrated Circuit) program, designed to improve military systems performance through better IC design and fabrication. Although the VHSIC projects are military-application specific, the contractors are all active in the commercial marketplace. Another significant DOD-funded program likely to benefit the commercial market is the long-standing DARPA (Defense Advanced Research Project Agency) research into artificial intelligence.

A more recent trend is the development of university-based "Centers of Excellence" such as the Center for Integrated Systems (CIS) at Stanford, Calif., a partnership of Stanford University, the DOD and 20 industrial sponsors. CIS seeks to integrate solid-state research, fabrication and applications.

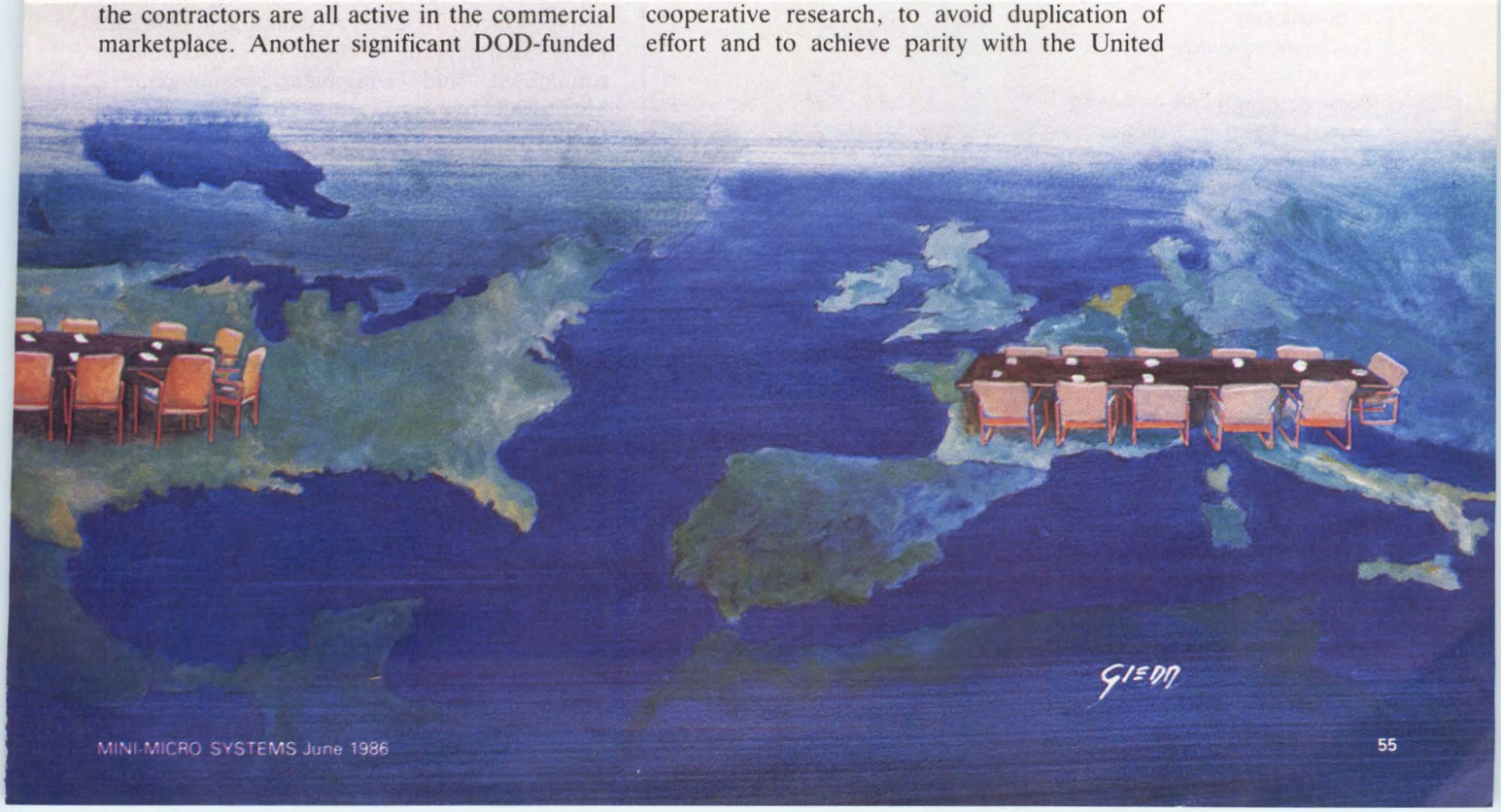
Europeans react to U.S., Japan

In Europe, the threat of Japanese domination has invoked national and multinational responses. The Common Market has established two major projects. One, the European Program for Strategic Research in Information Technology (ESPRIT), is the successor to the 1983 Market-funded IT (information technology) program. ESPRIT focuses on software, advanced information processing, office automation, computer-integrated manufacturing and advanced microelectronics.

This roughly $1.25 billion, 10-year program, half funded by Market grants, was launched in February 1984. Its objectives are to encourage cooperative research, to avoid duplication of effort and to achieve parity with the United

Leading industry participants in the United States, Japan and Europe react to competition through consolidation and cooperation.

Illustration by Richard Giedd



States and Japan. Three quarters of the funding is devoted to finding "system-driven" solutions to existing problems; the remainder goes to more speculative projects. The first group of 270 participants garnered 104 grants, totaling about $126 million. Of these, 27 grants were in advanced microelectronics. Participants in eight of the grants included the European affiliates of IBM, AT&T International Inc., Digital Equipment Corp. and ITT Corp.

A second major pan-European program is more recent. In mid-1985, Europe's four largest electronics companies—Cie Générale d'Electricité (CGE), N.V. Philips, Siemens AG and Thomson S.A.—prepared a plan for an advanced-technology project. They concentrate on R&D for large data-processing and complex, decision-oriented systems. Dubbed Eureka, the resulting program has been underway since last November. Eureka has encouraged Common Market members to cooperate on high-technology projects. Like all such multinational programs, Eureka is susceptible to political squabbling, uncertain funding and diffuse objectives.

Certain European countries have established their own government-supported activities. France, for example, helped in the formation of a major telecommunications company through the combination of CGE and Thomson-Brant, another French company. A similar result is hoped for in the reorganization of the French computer industry around Groupe Bull. Also, France is nationalizing its electronics industry, though this may be tempered or reversed by the new administration.

In the UK, the government-sponsored Alvey Directorate—a nationwide R&D effort—has identified four major areas for government-industry collaboration: VLSI; software engineering (based on UNIX); man-machine interfaces; and intelligent knowledge-based systems. The government has committed $600 million for up to 50 percent funding of industry R&D projects. Similarly, the government of West Germany has established a $1 billion, matching-fund, electronics R&D program with heavy emphasis on submicron ICs.

U.S. R&D CONSORTIUM PARTICIPANTS

Company	VHSIC	SRC	MCC	CIS	COS
AT&T Information Systems					✓
AT&T Technologies Systems	✓				
Advanced Micro Devices		✓	✓		
Allied-Signal Corp.			✓		
Amdahl Corp.					✓
Bell Communications Research					✓
Burroughs Corp.		✓			✓
Concurrent Computer					✓
Control Data Corp.	✓	✓	✓		✓
Digital Equipment Corp.		✓	✓	✓	✓
E.I. du Pont de Nemours & Co.		✓			
E-Systems		✓			
Eastman Kodak Corp.		✓			
Eaton Corp.		✓			
Fairchild Semiconductor				✓	
GCA Corp.		✓			
General Electric Co.		✓		✓	
General Instrument Corp.		✓			
General Motors Corp.		✓			
Goodyear Aerospace Corp.		✓			
*Gould/AMI Semiconductors Inc.				✓	
GTE Laboratories Inc.		✓		✓	
Harris Corp.	✓	✓	✓		✓
Hewlett-Packard Co.		✓		✓	✓
*Honeywell Inc./3M	✓	✓	✓	✓	✓
*Hughes Aircraft Co. Inc./Union Carbide	✓				
*IBM Corp./Northrup	✓	✓		✓	

*Indicates team leader/partner on VHSIC only; other memberships refer only to first company listed. For example, Honeywell is team leader, 3M the partner on VHSIC; Honeywell alone is a member of the four other consortia.

Industry pools its chips

In addition to the VHSIC and various DARPA-funded R&D projects, two private corporations have been set up in the United States to encourage semiconductor and systems R&D. The first, the Semiconductor Research Corp. (SRC), was established as a subsidiary of the Semiconductor Industry Association in February 1982. Membership is open to semiconductor component and equipment manufacturers. SRC's objective is to extend knowledge in semiconductor-related areas by funding university research.

SRC's goals are to plan, promote, coordinate, sponsor and conduct research that will result in: new knowledge of semiconductor materials and phenomena, and of related scientific and engineering subjects required for the useful application of semiconductors; the development of new and more efficient design and manufacturing technologies for semiconductor devices; and an increase in the number of scientists and engineers that are proficient in research, development and manufacture of semiconductor devices. It has also been suggested that SRC might run a fully automated, government-owned, contractor-operated facility to produce a 4M-bit CMOS RAM. The corporation hopes to have developed the technology to produce such devices by the end of 1987.

The second major domestic, private-sector activity is the Microelectronics and Computer

Corp. (MCC). In contrast with SRC, which is encouraging device-oriented basic research within the university environment, MCC has been (since 1982) a systems-oriented applied R&D co-op funded by industry members. MCC intends to separately channel the results of its activities to the companies that fund the individual programs. After three years of exclusive use by those who paid for particular technological developments, MCC hopes to license them to others as an additional source of revenue. The applied-research activities of MCC are well-suited to utilizing the fruits of the basic-research labors of VHSIC and SRC.

Four separate 6-to-10-year programs have been established by MCC in the fields of advanced computer architecture, computer aided design and manufacturing, packaging and interconnection and software technology.

A third U.S. industrial consortium is the Corporation for Open Systems (COS), a non-profit group formed to develop standards based on the International Standards Organization's open systems interconnection (ISO/OSI) model. COS was founded in January 1985 by 16 manufacturers of computers and communications equipment in response to a perceived threat presented by a technical committee of the European Computer Manufacturers Association (ECMA). It was rumored that ECMA would accept IBM's Systems Network Architecture (SNA) Logical Unit 6.2 as the standard for the upper two layers of the seven-layer OSI model; in February, however, the ECMA formally rejected it.

The composition and objectives of COS make it clear that it represents an organized effort to counter the increasing presence of SNA in interconnection. Note also COS' data-processing and office-automation orientation and the belated participation of IBM, which joined only when it became clear that its participation was vital.

In Europe, 1984 saw Philips and Siemens announce a five-year, $470 million joint research project for the development of a sub-micron CMOS process and 1M- and 4M-byte dynamic RAMs that are expected to be ready for the commercial marketplace by 1989 (still about two years behind Japanese schedules). This venture is interesting in that it brings together suppliers of the two leading microprocessor families.

Choosing partners: mergers

Another notable trend is the formation of what are frequently referred to as "strategic alliances" among or between companies for the development of technology. Most of these arrangements are, in reality, marriages of convenience that usually fail to develop the mutual interests necessary for a long-term relationship. Nevertheless they have an impact on the market.

For instance, new entrants in the mid-range computer market show a pronounced tendency toward joint marketing. Notable among them are Stratus Computer Inc.'s agreements with Italian office-equipment manufacturer Olivetti SpA and with IBM. (IBM markets Stratus' fault-tolerant system as the System/88.) Other fairly typical arrangements are those of Sequent Computer Systems with Matsushita Electric Co. and Siemens; Pyramid Technology Corp. with Nixdorf Computer Corp. and Sharp Electronics Corp.; and Ridge Computers with Groupe Bull.

As to marketing scientific/engineering computers, Alliant Computer Systems Corp. has entered into a joint agreement with Apollo Computer Inc., and both Alliant and Convex Corp. have joint technology and market-development arrangements with Sun Microsystems Inc. In January, AT&T Information Systems' (ATTIS) Components and Electronic Systems Division invested in Counterpoint and Omnicad.

U.S. R&D CONSORTIUM PARTICIPANTS

Company	VHSIC	SRC	MCC	CIS	COS
ITT Corp.				✓	
Intel Corp.		✓		✓	
LSI Logic Corp.		✓			
Monolithic Memories Inc.		✓			
Monsanto Co.		✓		✓	
Motorola Inc.	✓	✓	✓	✓	
NCR Corp.			✓		
National Semiconductor Corp.	✓	✓	✓		✓
Northern Telecom Inc.					✓
Northrup Corp.				✓	
Perkin-Elmer Corp.		✓			
*Philips Research/Signetics Corp.				✓	
RCA Corp.	✓	✓	✓		
Rockwell International Corp.		✓		✓	
Silicon Systems Inc.		✓			
Sperry Corp.	✓	✓	✓		✓
Tektronix Inc.				✓	
Telex Computer Products Inc.					✓
Texas Instruments	✓	✓		✓	
*TRW/Motorola Inc./Sperry Corp.	✓			✓	
Union Carbide Corp.		✓			
United Technologies Communications			✓	✓	
Varian Associates Inc.		✓			
Wang Laboratories Inc.					✓
Westinghouse Electric Corp.	✓	✓			
Xerox Corp.		✓		✓	✓

*Indicates team leader/partner on VHSIC only; other memberships refer only to first company listed. For example, Honeywell is team leader, 3M the partner on VHSIC; Honeywell alone is a member of the four other consortia.

IBM ASCII terminals:

The case in black and white.

Introducing a somewhat more colorful member of the family.

Meet the IBM 3164 ASCII Color Display Station.

It gives you eight foreground and eight background colors. On a 14″ screen.

And because of its 8 x 16 character matrix, the 3164 gives you clear, crisp characters in color.

But is color any reason to buy IBM's 3164? It is, according to studies that indicate the use of color increases productivity, decreases errors and promotes user satisfaction.

Color, of course, is far from the sole reason for choosing the 3164. To appreciate the others, you should get to know the rest of our ASCII family.

Emulation. Another side of the family.

Our ASCII terminals are designed to fit into existing systems. Even if the systems aren't ours.

Emulation Capability	
3161	IBM 3101 Model 881 ADDS Viewpoint* Hazeltine 1500* Lear Siegler ADM-3A* Lear Siegler ADM-5* TeleVideo 910*
3163	IBM 3101 Model 881 DEC VT 52* DEC VT 100* TeleVideo 950*
3164	IBM 3101 Model 881

For example, our basic ASCII Display Station, the IBM 3161, emulates up to six terminals. And the advanced-function 3163 emulates a number of higher level ASCII data streams.

Features	3161	3163	3164
Screen size	12″	12″	14″
Lines x characters	25x80	25x80	25x80
Character matrix	8x16	8x16	8x16
Double-sized characters	No	Yes	Yes
Line drawing characters	24	24	24
Vertical scroll	Jump	Jump/ Smooth	Jump/ Smooth
Definable function keys	24	24	24
Windowing	No	Yes	Yes
Partitioning	Horiz.	Vert./ Horiz.	Vert./ Horiz.
Characters in buffer	1920	7680	7680

What's more, every one of our ASCII terminals can operate in its own function-rich native mode.

Our family is flexible.

Our unique plug-in cartridges allow for considerable flexibility in your operation. For example, simply by switching cartridges you can shift a terminal from one data stream to another.

And, in many countries cartridges are also available that go beyond emulation to let you operate your ASCII terminals in several foreign languages. Appropriate foreign language keyboards are also offered.

Enhanced ergonomics. Another family trait.

All our ASCII terminal keyboards have 102 keys. But that's not all they have in common. Every keyboard also has a low profile, gentle contour and typewriter touch.

And our keyboards have programmable function and editing keys so they can be custom-tailored to fit your application needs. The 3163 and 3164 models also have redefinable and recappable keys.

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The case in color.

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Counterpoint, a spinoff from Convergent Technologies Inc., makes engineering and scientific workstations. It had been working with Omnicad to develop CAD software. This trend appears likely to accelerate.

The merger mania of the past few years has also had its impact on the electronics industry. U.S. companies that have recently made significant new investments in the industry include General Motors Corp., with its purchase of EDS and investments in several software and computer-vision developers; and General Electric Co., with the addition of RCA to its previous acquisition of semiconductor manufacturer Intersil.

Another case in point is that of AT&T Co., which in December 1983 purchased for $260 million a 25 percent interest in Olivetti. The agreement, which represents the biggest minority stake ever acquired by a U.S. company in a foreign corporation, gives AT&T the right to raise its share to 40 percent within four years. It gives Olivetti exclusive rights to market ATTIS' 3B computer series in Europe. ATTIS resells Olivetti's IBM-compatible personal computers in the United States.

IBM plots strategies

IBM participated in the merger mania with its acquisition of 12 percent (since increased to 19 percent) of Intel Corp. in December 1982 and of 15 percent (now 100 percent) of Rolm Corp. in June 1983. Industrial sponsors seeking to establish or improve strategic positioning in the electronic field may well become a significant source of financing for established participants and start-ups.

How, then, is IBM responding to all this flux? Certainly, one of IBM's declared objectives is to become the low-cost producer in each area in which it competes. Regardless of whether or not this is a feasible objective, the attempt to do so will create opportunities for subassembly suppliers like SCI Systems, which has risen to the ranks of the Fortune 500 on the success of the IBM PC.

During the first half of the 1980s, IBM concentrated on development, especially of high-end minicomputers, mainframe processors and software, and on establishing SNA as a de facto communications standard for IBM products. The fact that the IBM PC came to dominate its market segment during this period was purely fortuitous. The company's performance in the minicomputer market has been less impressive, despite the aggressive price/performance characteristics of its 4300 Series. And, until early this year, IBM had no presence in the burgeoning workstation market, an omission it has rectified with the introduction of the RT PC, based on reduced instruction set computer (RISC) technology.

During the second half of the decade, IBM can be expected to strengthen its presence in the minicomputer market. The RT PC targets the scientific-engineering segment, and IBM will address commercial needs with a replacement for the overpriced and under-powered System/36. IBM's focus will be on applications rather than products, especially in the office-automation and communications areas, in which the competition has been making significant inroads, and in the industrial market. There will also be a steady increase in the proprietary component of the PC family in order to keep profit margins up.

The future of computing

The United States and Europe appear to have organized effective responses to the Japanese challenge and, assuming reasonable success for the various programs, it does not seem likely that any single bloc will dominate semiconductor or systems technology. The competition, though, should accelerate certain inevitable developments. For example, the worldwide emphasis on microtechnology will make 4M-bit dynamic RAMs available in production quantities by the end of 1987 and logic circuits of a similar level of complexity available 12 to 18 months later.

Microprocessors and the associated peripheral-support circuits will be early beneficiaries of advances in semiconductor fabrication and packaging, leading to ever more powerful and lower cost configurations of microcomputers and

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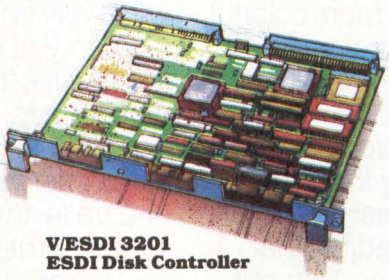

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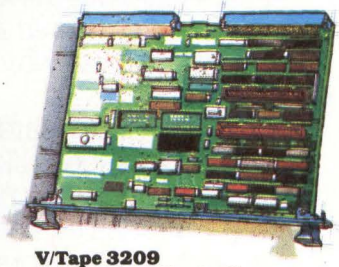

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supermicrocomputers. Without a major change in the way that semiconductor components are marketed, the products will be offered by many suppliers. This, in turn, will increase both the opportunities for new participants and the challenges for established suppliers.

IBM's decision to utilize its proprietary RISC microprocessor instead of the Intel 80386 for its supermicrocomputer line should, at least in the short term, benefit the Motorola Inc. family. However, the benefits associated with RISC will lead to considerable development in this area, with consequent risk for some established participants and opportunities for others. The other major decision made by IBM was essentially to modify UNIX into AIX—for Advanced Interactive Executive—as a proprietary version for the RT PC. This obviously has the objective of trying to prevent ATTIS from controlling the UNIX standard. Industry participants would do well to follow the example of COS, in response to the SNA threat, and unite behind System V.

At the high end, superminicomputer suppliers will continue to pursue the high performance that has been the mainstay of the segment, goaded by the increasing performance of the specialized number-crunchers being developed by several new market entrants.

At the low end, the IBM PC family and its clones will become even more ubiquitous than at present, spreading from its dominance in the professional application area to industrial and instrument applications. But because the basic hardware and software are fixed, and readily available to all, the scope for innovation is restricted to performance enhancement, cost reduction and reconfiguration for specific applications. This, however, is little different from what hundreds of OEMs have been doing with DEC's PDP-11 and other popular minicomputers for the past 15 years. The biggest hurdle faced by low-end computer vendors is gaining access to channels of distribution. Nevertheless, opportunities still abound. As in any commodity-oriented market, control of costs and knowledge of the marketplace are the only prerequisites. □

Interest Quotient (Circle One)
High 727 Medium 728 Low 729

Andrew Allison is an independent product planning and market development consultant based in Los Altos Hills, Calif., and a contributing editor of *Mini-Micro Systems*. He was formerly with Digital Equipment Corp., Rolm Corp. and Advanced Micro Devices.

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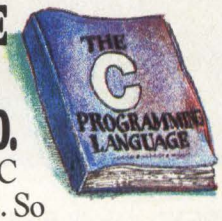

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OSI STANDARDS SPUR PRODUCT PROFUSION

As OSI standards earn approval, a blitz of OSI products and customers poised to buy foreshadow a burgeoning industry

Wendy Rauch-Hindin
Special Features Editor

Just a year ago, computer and peripheral companies considered the International Standards Organization's open systems interconnection (OSI) protocols, which promise plug-compatibility among polyglot computers as well as vendor independence, meritorious but lacking in clout.

Now, however, after several years of development, OSI standards have become commercial realities. In fact, six OSI protocols have been approved as international standards. These are ISO's Network, Transport and Session protocols; the IEEE 802.3 and 802.4 local area network protocols; and one graphical-image protocol. Several others, dealing with file transfer and access, virtual terminals, database access and integrity, office document handling, information presentation and common application service elements, are nearing final standardization (see "How the OSI layers stack up," Page 68).

With these standards approved, products—VLSI, board-level and software—have become available off the shelf. Many companies are even merging their proprietary networks with these standards. Moreover, the Department of Defense (DOD) is migrating to OSI from Transmission Control Protocol/Internet Protocol (TCP/IP) and doubts the long-term future of TCP/IP.

This is the first of a three-part series schduled to appear in Mini-Micro Systems *on OSI standards. The second article will appear in July; the third, in September.*

Commercial implementations also stepped into the limelight this year. General Motors Corp. and Boeing Computer Services are, respectively, leading the way among large-scale users in implementing OSI—on the factory floor with the Manufacturing Automation Protocol (MAP) and in business and engineering offices with the Technical and Office Protocol (TOP). (See "How OSI, MAP and TOP differ," Page 71.)

OSI faces obstacles

OSI will not succeed overnight: Two major problems remain. The first centers on converting existing installed systems to OSI. Several companies are tackling this problem by designing gateways, routers and bridges between proprietary and OSI protocols. Some companies intend to gradually migrate to OSI. The second problem involves the need for better testing procedures to ensure interoperability. The National Bureau of Standards and Industrial Technology Inc., Ann Arbor, Mich., are working to rectify the problem. Problems notwithstanding, there seems to be no doubt that ratification of, and massive compliance with, the OSI protocols is imminent.

By the early 1990s, GM will be a major OSI protocol user. Gabriel Tiberio, executive director of advanced manufacturing engineering at GM, has committed the company to implementing OSI, particularly in the form of the MAP protocols.

OSI's ability to integrate and transfer information between the factory and the office is also attractive to Boeing. Looking toward the TOP options in OSI, Robert Dryden, president of Boeing Computer Services, Vienna, Va., says,

"We have informed all our computer suppliers that, in the future, purchasing preference will be given only to those companies that are prepared to sell us TOP-compatible equipment."

An informal survey by Hewlett-Packard of 38 Fortune 1000 discrete- and process-manufacturing companies provides a more comprehensive vision of the technology's future in those environments. The survey indicates that at least 39 MAP networks with a total of 1,040 nodes will be operational in 1986 (not counting those implemented by GM, the largest user). Next year, according to the survey, the number of MAP networks should swell to 316 and contain 10,809 nodes. The companies polled further indicated that these networks will be connected via gateways, bridges or routers to PBXes and to networks based on 802.3 baseband protocols, IBM

How the OSI layers stack up

The International Standards Organization's open systems interconnection's seven layers of specifications reflect various networking requirements:

APPLICATION LAYER

Common Application Service Elements (CASE)

- Handles remote log-in
- Sets up associations to named peers and agrees on the semantics of the information to be exchanged
- Handles Commitment, Concurrency and Recovery (CCR)

Specific Application Service Elements (SASE)

- File Transfer, Access and Management (FTAM)
- Basic Class Virtual Terminal (BCVT)
- Forms class virtual terminal
- Message handling
- Editable text and document exchange
- Job Transfer and Manipulation (JTM)
- Directory service
- Database access and update
- Editable graphics exchange
- Operating system command and response language
- Industry protocols developed by special-interest groups, e.g., for banking, invoice, real-time process-control and inventory

PRESENTATION LAYER

- Negotiates concrete transfer syntax (bit-encodings) for character sets, text strings, images and other data types to be exchanged
- Specifies syntaxes for transfer
- Handles session services pass-through (passing Session services to the Application Layer after transfer syntax is negotiated)

SESSION LAYER

- Maps addresses to names (users retain same name if they move)
- Connection establishment and termination
- Data transfer
- Dialogue control (who speaks when, how long, half- or full-duplex)
- Synchronization between end-user tasks
- Graceful and abrupt closure
- Breaks up dialogue into different activities handled on one session connection

TRANSPORT LAYER

- Reliable end-to-end bit pipes (transport connections)
- Multiplexes end-user addresses onto network
- Handles end-to-end error detection and recovery
- Flow control
- Monitors quality of service
- May disassemble and reassemble session messages

NETWORK LAYER

- Sets up routes for packets to travel (establishes a virtual circuit)
- Addresses network machines on the route through which the packets travel
- May disassemble transport messages into packets and reassemble them at the destination
- Sends control messages to peer layers about own status
- Congestion control (regulates flooding within the network)
- Recognizes message priorities and sends messages in proper order
- Handles internetworking (both connection-oriented and connectionless)

DATA LINK LAYER

- Ensures reliable transfer of data across a single link
- Adds flags to indicate beginning and end of messages
- Adds error-checking algorithms
- Makes sure data is not mistaken for flags (transparency mechanism)
- Provides access methods for local-area networks

PHYSICAL LAYER

- Handles voltages and electrical pulses
- Handles cables, connectors and components (interfaces to media)
- Handles collision detection for CSMA/CD access method

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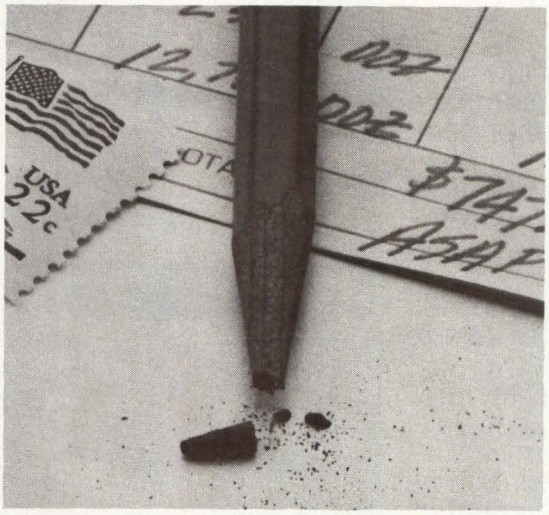

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Corp.'s Systems Network Architecture and Digital Equipment Corp.'s DECnet.

It's a switch that major users, rather than dominant suppliers, lay down the rules for standards. But, with this kind of pressure, and with large numbers of Fortune 1000 and military buyers in the United States and overseas, IBM was one of the first suppliers to get OSI protocols up and running. This disproves any notion that, for fear of losing face, IBM would never implement OSI, staying exclusively with its own SNA. Apparently, IBM is more concerned with losing market share.

Vendors line up

DEC also has begun replacing its proprietary Digital Network Architecture with OSI-standard communications protocols. Meanwhile, Gould Inc. has gone so far as to discontinue its proprietary Modway network in favor of MAP/OSI. In addition, Advanced Computer Communications, Industrial Networking Inc., Intel Corp., Motorola Inc. and Ungermann-Bass Inc. already have OSI-based board-level and software products for the factory and/or office. What's more, Allen-Bradley Co., Charles River Data Systems Inc., Concord Data Systems Inc., Control Data Corp., General Electric Co., Honeywell Inc., Sperry Corp., Stratus Computers Inc. and Sun Microsystems Inc. are only some of the companies that offer box-level systems and software to execute OSI protocols. Yet another company, Northern Telecom Inc., has begun to provide OSI in its PBXes.

Commercial OSI product development is continuing at a fast pace. Within the year, OSI products will be forthcoming from most large computer manufacturers, network vendors and

How OSI, MAP and TOP differ

The open systems interconnection (OSI), Manufacturing Automation Protocol (MAP) and Technical and Office Protocol (TOP) are based on a seven-layer model, defined by the International Standards Organization. The protocols specify the rules, functions and services for machine access and communications across the network.

The two lowest layers (Physical and Data Link) deal with physical connections, recognition of messages and some reliability chores. The five upper layers (Network, Transport, Session, Presentation and Application) handle internetworking, reliability, connection management, presentation of information and meaning of information exchanged. Normally, each layer on a system uses the services of the layer beneath it and communicates with the corresponding (peer) layer on another system.

The three lower layers are specific to each type of network, while the top three layers are network-independent. Situated between them, the Transport Layer resolves the differences among physical networks.

Unlike the OSI protocols, the MAP and TOP standards are not intended to define new protocols. Rather, they are recommendations and descriptions of existing and proposed standards and of options within these standards.

MAP and TOP primarily specify OSI protocols. However, portions of their specifications are based on protocols defined by ANSI, IEEE, Comité Consultatif Internationale Téléphonique et Télégraphique (CCITT), the Electronics Industries Association, the National Bureau of Standards and the Instrument Society of America. Where standards are still emerging, or do not exist, they are being defined for MAP and TOP on an accelerated, custom basis in order to provide required functionality that can be implemented immediately. Many of these standards will eventually be proposed as OSI standards.

A comparison of MAP and TOP reveals that they both specify the same OSI protocols at layers 2, 3, 4 and 5. These are IEEE's 802.2 logical-link protocol, Connectionless Network protocol (for message-routing and internetworking), Class 4 Transport protocol (for end-to-end data reliability) and Session kernel (for name and address translation and synchronization).

MAP and TOP diverge, however, in their choice of other OSI options at the bottom two layers. Oriented toward the factory floor, MAP specifies OSI broadband coaxial cable as the physical (layer 1) backbone media and the 802.4 (token bus) protocol's access methods and electrical and mechanical specifications for interfacing devices to a network. In contrast, TOP specifies baseband and 802.3 carrier sense multiple access with collision detection (CSMA/CD)—commonly used in office environments.

OSI, MAP and TOP also differ in their messaging protocols. CCITT's X.400 store-and-forward messaging protocol, which forms the basis of OSI office document protocols, is the messaging protocol of choice for TOP's office environments. Because storing or forwarding mail for robots in a factory environment is not applicable, MAP defines its own real-time messaging protocol.

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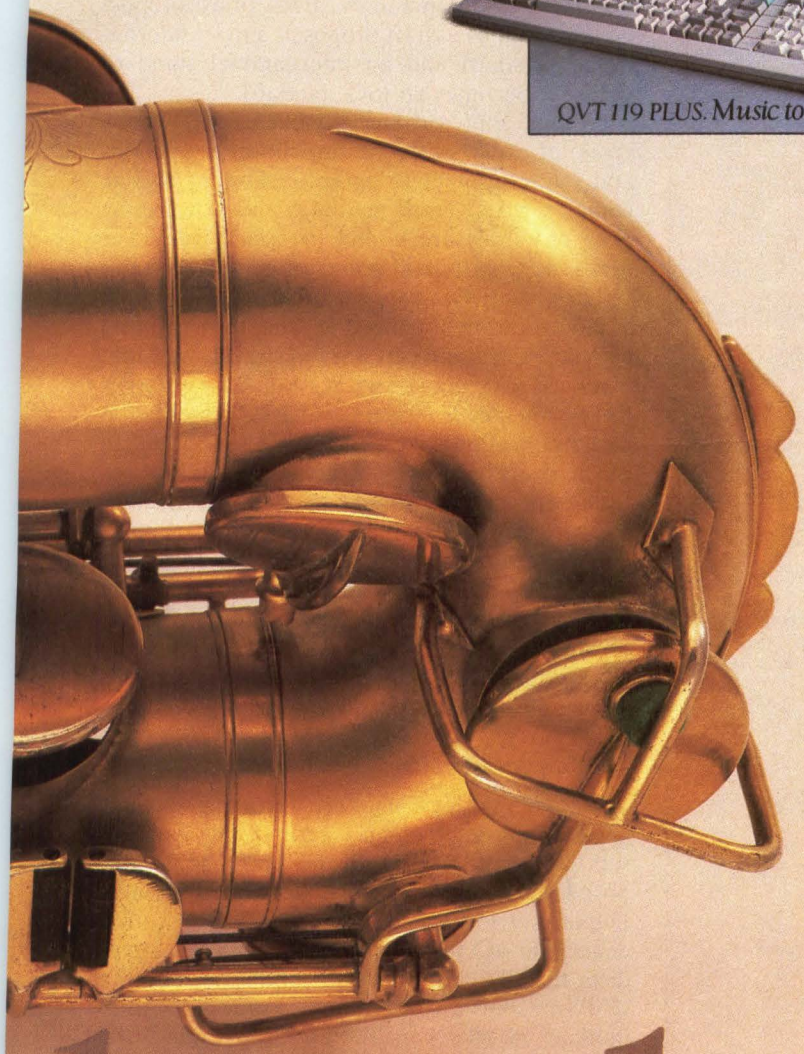

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communications companies (see Table). Many of these products are expected to run under UNIX. In addition, 41 companies (the total at press time), including IBM, have formed the Corporation for Open Systems (COS), a non-profit consortium, to accelerate the delivery of OSI products and to devise methods to ensure interoperability. The COS is under the umbrella of the Computer Communication Industries Association.

OSI PROTOCOL IMPLEMENTATIONS MULTIPLY

Company	When available: By first half 1986	Second half 1986	1987
Advanced Computer Communications 720 Santa Barbara St. Santa Barbara, Calif. 93101 (805) 963-9431 **Circle 377**	network, transport, session, presentation, FTAM, CASE, 802.4		
Allen-Bradley Co. 747 Alpha Drive Highland Heights, Ohio 44143 (216) 449-6700 **Circle 338**	network, transport, session, CASE, FTAM		
AT&T Information Systems 1 Speedwell Ave. Morristown, N.J. 07960 (201) 898-3278 **Circle 339**		network, transport, session, FTAM, CASE, directory, 802.3, 802.4	
Bridge Communications Inc. 2081 Stierling Road Mountain View, Calif. 94043 (415) 969-4400 **Circle 340**	network, transport	session, virtual terminal	
Burroughs Corp. 1 Burroughs Place Detroit, Mich. 48232 (313) 972-7000 **Circle 341**		802.3	network, transport, session, FTAM, X.400
Charles River Data Systems Inc. 983 Concord St. Framingham, Mass. 01701 (617) 626-1000 **Circle 342**	network, transport, session, FTAM, CASE, directory		
Codex Corp. 20 Cabot Blvd. Mansfield, Mass. 02048 (617) 364-2000 **Circle 343**		network, transport, 802.2	
Concord Data Systems Inc. 303 Bear Hill Road Waltham, Mass. 02154 (617) 890-1394 **Circle 344**	network; transport, classes 2 and 4; session; 802.2; 802.4	CASE, FTAM, directory	
Concurrent Computer Corp. 2 Crescent Place Oceanport, N.J. 07757 (201) 870-4500 **Circle 345**	network; transport, class 3		
Control Data Corp. 8100 34th Ave., S. Minneapolis, Minn. 55440 (612) 931-3131 **Circle 346**	network		

Even though a large sponsoring consortium of protocol adopters with market clout is essential to the success of an OSI standard, it's been the development and approval of the protocols that have paced its progress. The seven layers of OSI protocols are specified and approved by numerous countries, computer manufacturers, network vendors and communications carriers participating in the ISO community. Each protocol must be approved as a draft proposal, a draft international standard and an international standard before it becomes an ISO standard.

Getting approval hasn't been easy. When a group of experts representing different opinions and interests meet to agree on how to change complex rules, teeth gnashing and skirmishing over proposals are bound to occur. But, over time, the experts find points of compromise.

Thus, many OSI proposals for layers 1 through 5 have become finalized in the form of ISO standards. These layers are Physical, Data Link, Network, Transport and Session. Many upper-level protocols for layers 6 and 7 (Presentation and Application) have reached, or are about to reach, draft international standard status.

But the closer the end appears, the farther away it gets. Several reasons exist for this apparent contradiction. First, standardization in one area tends to breed a taste for standardization in other areas. For example, the National Bureau of Standards is spearheading a recently formed working group to specify spreadsheet formats for communications purposes.

The impact of ISDN

Second, major changes are occurring in communications technologies and in the network services they deliver. Prominent among proposed technologes is ISDN (Integrated Services Digital Network), and Robert Blackshaw, senior consultant at Omnicom Inc., Vienna, Va., predicts that ISO may have to redo or extend the OSI Transport Layer protocol in order to accommodate ISDN's capabilities. Applicable from local to internationally scaled wide-area networks (WAN), ISDN is the network system design that promises universal interfaces for all kinds of digital communications with the flexibility to accommodate new equipment types and applications.

Whether ISDN will eventually replace all other communications technologies, or whether it can ever be achieved at all, is not yet clear. However, many large corporate buyers in Europe and in the United States (not just the

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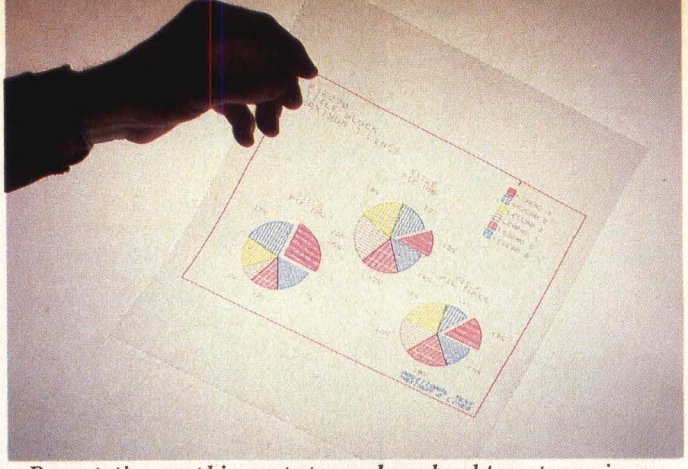

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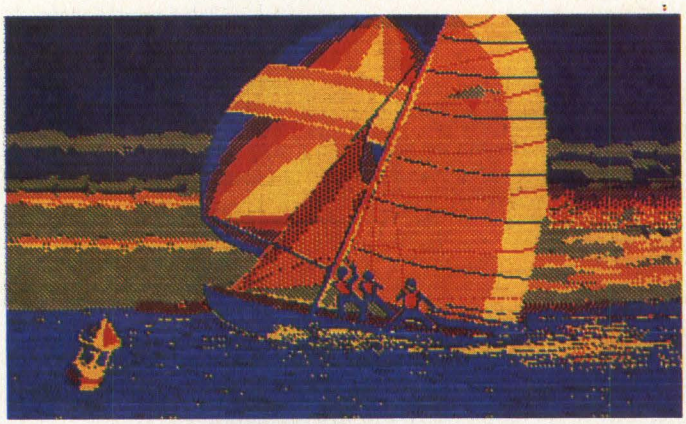

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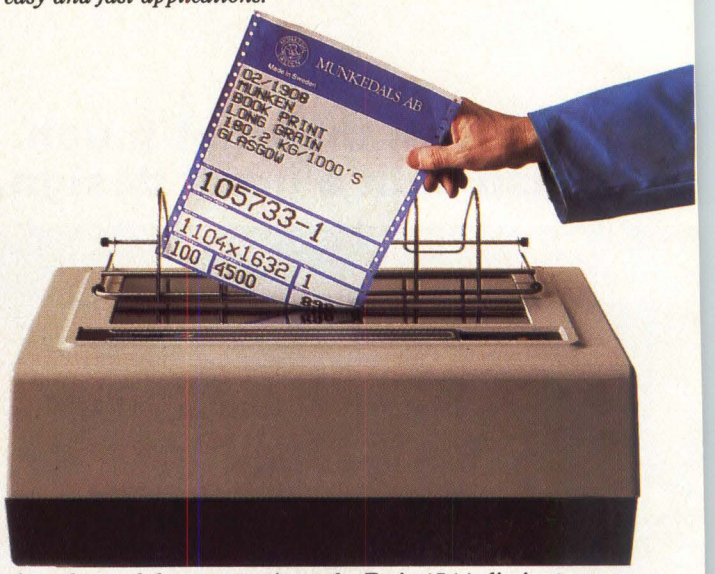

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telephone companies) have begun planning for ISDN and purchasing new equipment based on these plans. Again, when major customers seem to be determining standards, it is important for OEMs and value-added resellers to consider the divergences between ISDN and OSI when planning products.

OSI's internetworking activities in the last year already reflect ISDN's impact. OSI provides two different methods of interconnection in the Network Layer. One method, the so-called area networking protocol approach, is typically used to link LANs. The other method enhances or modifies all interconnected subnetworks, so that they all offer exactly the same service, and then connects them so they appear as a single homogeneous network.

ISO previously focused most of its internetworking emphasis on the area networking protocol approach. In the wake of the ensuing protocol development, interconnected MAP-type networks became the hot items for product development and user planning.

Anticipating circuit-switched ISDN capabilities and the new generation of microprocessor-controlled high-speed switches that handle both packet-switched and circuit-switched networks, attention has shifted to integrating LANs with packet-switched and circuit-switched networks. For example, ISO revised the internal organization of the Network Layer (ISO 8648). This layer allows system integrators to more easily understand how to use the protocol and to achieve homogeneous networking service over several different underlying technologies.

In addition, several mixing and matching network protocols have been proposed or ironed out. Such schemes specify, for example, how to use Comité Consultatif Internationale Téléphonique et Télégraphique (CCITT) X.25 packet-switching protocols on top of LANs, coupling X.25 with the OSI Network Layer and reliably transmitting from WANs to local networks. Still missing, however, is a protocol that handles reliable transmission in the other direction—from local networks to WANs.

Unfortunately, the problem of how to handle reliable internetworking between LANs and WANs has plagued ISO. The functions involved are part of the Network (commonly called "Internet") and Transport protocols. These protocols provide two diverse networking techniques: the connection-oriented or virtual-circuit approach and the connectionless or datagram mode. What's more, the choice of a technique has economic and political implications.

On the one side, AT&T Co., the European network providers and IBM are vigorously lobbying for the connection-oriented mode because their economic and/or political interests are at stake. On the other side, almost all computer manufacturers and network vendors have an

OSI PROTOCOL IMPLEMENTATIONS MULTIPLY

Company	When available: By first half 1986	Second half 1986	1987
Data General Corp. 4400 Computer Drive Westboro, Mass. 01580 (617) 366-8911 **Circle 347**	802.3	network, transport	session, FTAM, X.400, 802.4, 802.5
Digital Equipment Corp. 146 Main St. Maynard, Mass. 01754 (617) 897-5111 **Circle 348**	network, transport, 802.3	session, FTAM, CASE, X.400, 802.4	
Excelan Inc. 2180 Fortune Drive San Jose, Calif. 95131 (408) 434-2300 **Circle 349**		network, transport, session, FTAM, CASE, X.400, 802.3, 802.4	
General Electric Co. Data and Information Systems Division 12020 Sunset Hills Road Reston, Va. 22095 (703) 478-6000 **Circle 350**	transport, session, CASE	network, FTAM, directory	
Gould Inc. Information Systems Section 6901 W. Sunrise Blvd. Fort Lauderdale, Fla. 33310 (305) 587-2900 **Circle 351**	network, transport, session, FTAM, CASE		
Hewlett-Packard Co. 8020 Foothills Roseville, Calif. 95678 (800) 367-4772 **Circle 352**	network, transport, session, FTAM, CASE, X.400, 802.2, 802.3, 802.4		
Honeywell Information Systems Inc. Honeywell Plaza Minneapolis, Minn. 55408 (612) 870-5200 **Circle 353**	custom network, transport, session, FTAM		network, transport, session, FTAM
IBM Corp. 1133 Westchester Ave. White Plains, N.Y. 10604 (914) 765-1900 **Circle 354**	on Series/1: network, transport, session, FTAM, CASE, directory; on 370s-in Europe only: transport, session		
Industrial Networking Inc. 3990 Freedom Circle Santa Clara, Calif. 95052 (408) 496-0111 **Circle 355**	network, transport, session, FTAM, CASE, 802.4		
Intel Corp. 3065 Bowers Ave. Santa Clara, Calif. 95051 (408) 987-8080 **Circle 356**	network, transport, session, FTAM, CASE, directory		

economic interest in insisting on the connectionless approach. And the DOD has its own reasons, including security and communications survivability, for favoring the connectionless mode.

OSI PROTOCOL IMPLEMENTATIONS MULTIPLY

Company	When available: By first half 1986	Second half 1986	1987
LISP Machine Inc. Suite 900 6033 W. Country Blvd. Los Angeles, Calif. 90045 (213) 642-1116 **Circle 357**	network, transport, session, FTAM, CASE, directory		
McDonnell Douglas Computer Systems Co. P.O. Box 19501 Irvine, Calif. 92713 (714) 250-1000 **Circle 358**	virtual terminal	network, transport, session, FTAM, CASE	
Motorola Inc. Communications Sector Systems Division 1301 E. Algonquin Road Schaumburg, Ill. 60196 (312) 397-1000 **Circle 359**	network, transport, 802.4	session, FTAM, CASE, directory	802.3
National Semiconductor Corp. 675 Almanor St. Sunnyvale, Calif. 95051 (408) 737-5000 **Circle 491**	802.3		
NCR Corp. 1700 S. Patterson Blvd. Dayton, Ohio 45479 (513) 445-5000 **Circle 360**	network, transport, session, FTAM	X.400	
Northern Telecom Inc. 2100 Lakeside Blvd. Richardson, Texas 75081 (800) 328-8800, Ext. 498 **Circle 361**	X.400 (standalone)		X.400 (interconnected)
Prime Computer Inc. Prime Park, Mail Stop 15-26 Natick, Mass. 01760 (617) 655-8000 **Circle 362**			802.3
Siemens Energy & Automation Inc. Programmable Controls Division 10 Technology Drive Centennial Park Peabody, Mass. 01960 (800) 322-7224 **Circle 363**		network, transport, session, FTAM, CASE, directory	
Sperry Corp. Information Systems Group P.O. Box 500 Mail Station B-700 Blue Bell, Pa. 19424 (215) 542-4011 **Circle 364**	custom network, transport, session		X.400
Stratus Computer Inc. 55 Fairbanks Road Marlborough, Mass. 01752 (617) 460-2000 **Circle 365**	network; transport, class 4; session, BCS; FTAM; CASE; directory	transport, classes 0-3; session, BAS and BSF; X.400	

So, to understand how OSI networks and subsystems evolve, you need to understand some details both about the two OSI networking techniques and about the economic and political ramifications involved in adopting either.

Connection-oriented networking determines and establishes in advance the links between geographically distant machines. All transmitted data flow over these paths as sequential data packets. Overly large data packets are divided into smaller ones for transmission and then reassembled, using packet-sequence numbers at the network's receiving end.

The connection-oriented service does not include specific internetworking or routing capabilities. It has traditionally been provided by European network carriers and many WANs and value-added networks in the United States.

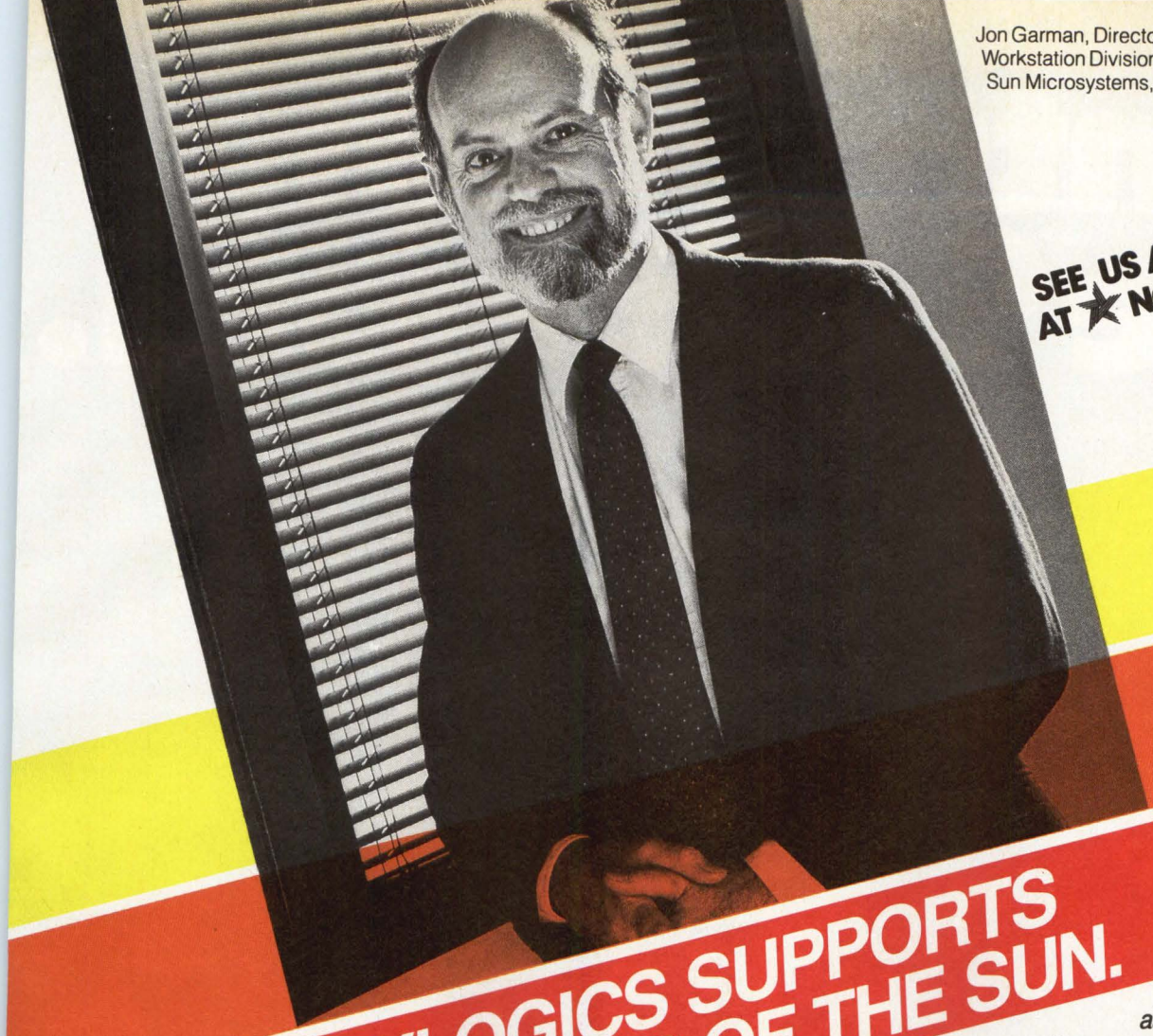
In contrast, the connectionless-mode service sends single data packets, unsequenced and unrelated to previously or subsequently transmitted packets. It interests local-network system designers and integrators because local networks transmit single, independent data packets.

Sequence numbers and other reliability controls provided by connection-oriented networks are not needed for many internetwork communications because local networks, such as Ethernets, have inherently low error rates. But, as such controls are needed for internetworking, local-network vendors want those controls added at the Transport Layer.

To accommodate diverse WANs and LANs, the final compromised version of the Transport Layer standard offers five classes of transport service (classes 0 through 4) that provide minimum to maximum reliability functions. Implementors can choose transport classes based on their needs and on whether they already have reliability controls at another layer. However, without special facilities, networks that use different transport classes can communicate with each other only at the lowest common denominator of reliability.

For the DOD, communications survivability, particularly during military crises, is the overriding network requirement. The DOD feels that this requirement is best provided by the connectionless transmission service, for several reasons. The connectionless service supports adaptive routing. And network operation is simpler because most bookkeeping and message-integrity controls are performed at the terminal ends rather than in the network. In addition, connection-oriented networks entail a large amount of overhead, which increases network complexity and, therefore, the chance for failure.

Only after the ISO specified connectionless-



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mode—in addition to connection-oriented—protocols could the DOD consider adopting OSI protocols. The connectionless internetworking protocols and network service definitions have been approved as international standards. Now, the DOD must resolve its quandry about whether its networking future lies with OSI or TCP/IP.

On the one hand, the DOD would like to use commercial standards, wherever possible, to gain the price, training and development economies supported by off-the-shelf products. Facilitating a migration to OSI is the fact that the OSI Network and Transport protocols also are very similar to the DOD's TCP/IP.

On the other hand, "similar" is not "same." For example, the OSI and DOD internet protocols differ in their addressing schemes. However, the DOD admits that its internet protocol addressing scheme is more limited than the newer OSI scheme and says it will modify its addressing scheme to be consistent with OSI. In addition, although the OSI Transport protocol provides the same services as the DOD's TCP, it provides them in a different manner.

Last year, to help figure out what to do about TCP/IP versus the ISO Transport and Network protocols, the National Academy of Sciences chartered a committee to study the issues and make recommendations. The committee recommended that DOD drop TCP/IP and migrate as quickly as possible to the ISO protocols, without jeopardizing national security, even in the face of potentially high conversion costs.

"The DOD is in agreement with the report," says Martin Thompson, associate director for interoperability and standards at the Defense Communications Agency, the executive agency for DOD protocol development. "We are moving as quickly as we can toward use of the OSI standards."

Thompson explains that the DOD is now in agreement with CCITT's X.25 and OSI's Internet and class 4 Transport protocols. It is currently working with the National Bureau of Standards to incorporate some of its unique requirements, such as security, into the higher layers.

"We intend to have a dual standard for a couple of years and migrate completely to the international standard in five or six years," Thompson says. "We want to let the procurements specify either OSI or TCP/IP. It then would be the vendor's choice as to what to bid, but the user's choice as to what to procure. We hope the user would procure the protocols that were most cost-effective, and we expect that these would be the OSI protocols, because they are the ones used most in industry." Thompson adds: "I think TCP/IP, 10 years out, will be gone."

A new draft proposal specifies the use of X.25

OSI PROTOCOL IMPLEMENTATIONS MULTIPLY

Company	When available: By first half 1986	Second half 1986	1987
Sun Microsystems Inc. 2500 Garcia Ave. Mountain View, Calif. 94043 (415) 960-1300 **Circle 366**	network, transport, session, FTAM, 802.2, 802.3	CASE, directory, 802.4	
Syros Inc. 1050 E. Southern Tempe, Ariz. 85282 (602) 897-2399 **Circle 367**	network, transport, session, FTAM, CASE		
Tandem Computers Inc. 19333 Valleo Parkway Cupertino, Calif. 95014-2599 (408) 725-6000 **Circle 368**	transport, classes 0-3	network; transport, class 4; session, BCS and BAS; FTAM; CASE; directory	
Texas Instruments P.O. Box 225012 Mail Station 57 Dallas, Texas 75265 (214) 995-2011 **Circle 369**	traditional computers: network, transport, session, CASE, 802.2, 802.4		for artificial intelligence: network, transport, session, FTAM, CASE
3Com Corp. 1365 Shorebird Way P.O. Box 7390 Mountain View, Calif. 94039 (415) 961-9602 **Circle 370**	transport, class 0; session; 802.3; 802.5; X.400	network; transport, class 4	
Touch Communications Inc. 10 Victor Square Scotts Valley, Calif. 95066 (408) 438-4800 **Circle 371**		TOP-oriented: network, transport, session, presentation (context management subset), FTAM (full OSI version)	
Ungermann-Bass Inc. 2560 Mission College Blvd. Santa Clara, Calif. 95050 (408) 496-0111 **Circle 372**	network, transport, session, FTAM, CASE, 802.5		
Wang Laboratories Inc. 1 Industrial Ave. Mail Stop 1307B Lowell, Mass. 01851 (617) 459-5000 **Circle 373**			network; transport, classes 0, 3, and 4; session, BCS and BAS; FTAM; X.400
The Wollongong Group 1129 San Antonio Road Palo Alto, Calif. 94303 (415) 962-7200 **Circle 374**	network; transport, class 4	FTAM, CASE	session, presentation, TOP applications
Xerox Corp. 800 Long Ridge Road P.O. Box 1600 Stamford, Conn. 06904 (203) 329-8700 **Circle 375**	802.3	X.400	network, transport, session, 802.2

Lack of agreement on addressing and routing protocols has stalled the completion of the specification for internetworking techniques.

on top of LANs. AT&T is its strongest advocate, which is not surprising considering the connection-oriented, WAN-based telecommunications sources of its revenue. In an attempt to keep the traffic on the phone wires, AT&T has been trying to persuade GM to go with an X.25 connection-oriented approach to networking their plants.

This campaign has been moderately successful, according to AT&T and IBM salespeople. But even this success might not have been possible if AT&T had not picked up support from such big players in computerization as IBM and Electronic Data Systems (EDS), the system integration/data processing group within GM.

IBM advocates a connection-oriented approach because its existing networking systems are connection-oriented. EDS supports the same approach because its thinking is often IBM-oriented. Because an AT&T-IBM combination is tough to beat, a number of other computer manufacturers are banding together to avoid being crushed by the juggernaut.

Addressing and routing lack agreement

Lack of agreement on addressing and routing protocols has stalled the completion of the specification of internetworking techniques. Clearly, transmitted computer data needs to know where to go before finding out how to get there. Therefore, standards designers felt they could not specify a routing protocol until they first got together on addressing. After a slow start, agreements on addressing zipped to a conclusion, and a Network-Layer addressing scheme was recently approved as an international standard.

Specification of an addressing protocol was slow-going because many compromises were required. For example, routing in Europe is done by public data networks using geographical addressing schemes recommended by the CCITT. However, large, multinational corporations and organizations, such as GM, IBM, Chase Manhattan Bank and NATO, did not wish to be subsumed under public networks. CCITT's three incompatible addressing schemes posed a futher complication.

The OSI finally agreed on a hierarchical scheme that is not geographically oriented. It subsumes different addressing schemes under a top-level addressing structure. The top-level structure indicates the type of address, such as X.121 (the X.25 public data numbering), X.69 (used in Telex), E163 (used in public telephone networks) and ISO 6523 (used for private, multinational organizations).

CCITT's incompatibility problem was solved by assigning CCITT three top-level addresses to accommodate X.121, E164 (used for public-switched telephone networks), and E165 (for use in ISDN networks). The ISO 6523 private-identification scheme allows multinational organizations, once identified, to escape into proprietary addressing methods.

Specifying routing standards presents a more highly charged situation than addressing did, and it will take more time to work out, because "routing is where the money is," says David Oran, network architect at DEC. Oran is a member of the ANSI X353 and X353.3 committees on Data Communications and on the Network Layer. How routing is done affects the purse of every country, telecommunication carrier, computer manufacturer and user. Customer charges are related to the time and amount of data on a network, and money available for equipment purchases is related to ongoing costs.

To simplify the specification process, the United States has proposed that the routing problem be tackled in two parts. One part would specify how end systems, such as telephones or terminals, talk to intermediate systems, such as PBXes, for routing purposes. The second would resolve how the intermediate systems communicate.

A U.S. proposal for solving the first part of the routing problem has been accepted as a working draft. It doesn't provide a complete picture of how to perform routing in a global environment, but it does specify how end systems should locate and identify themselves to the intermediate systems or gateways necessary to take data from a local to a remote point. ANSI is now working on the second part of the puzzle: the intermediate system, or relay-to-relay, protocol.

Still needed for interoperability are the upper level protocols that establish a connection and handle the presentation and meaning of information exchanged over a network. ISO has approved many of these. Others are nearing approval.

Several key questions remain unanswered. For example, can the ISO keep mediating everyone's differences so that all the protocols are approved? What upper level protocols are needed for different applications? Will the networks really operate together when the protocols are implemented and the machines plugged in?

The answers will determine whether products conforming to OSI protocols will consitute a profitable industry for years to come. □

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SMALL BUSINESSES BOLSTER PC SALES

A survey of U.S. companies reveals that small businesses represent a potentially lucrative market for personal computer manufacturers and value-added resellers

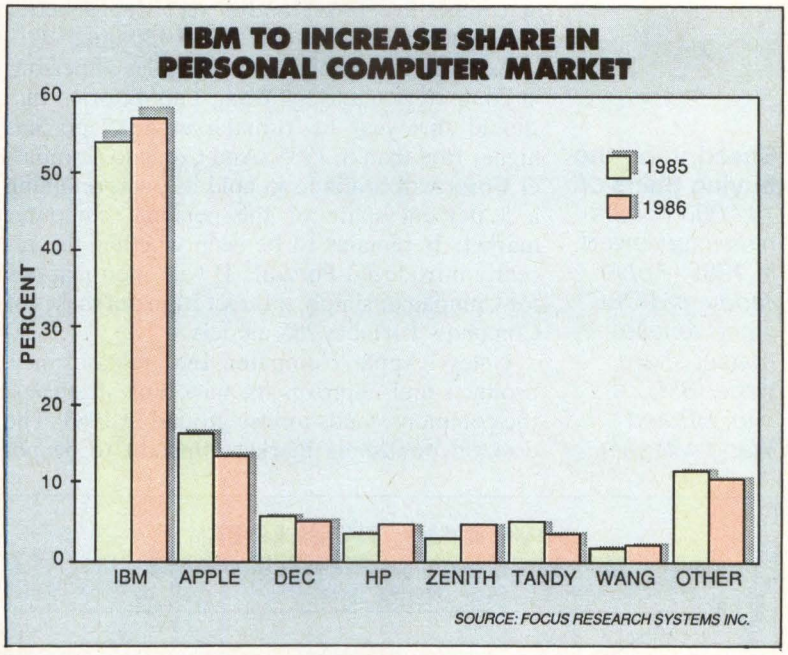
Gene R. Talsky
Contributing Editor

If corporate America buys the computers it says it plans to, the installed base of personal computers (i.e., single-user microcomputers) could grow 30 to 40 percent this year.

Although large and mid-size companies employ mainframes and minicomputers as their primary business computers, they use microcomputers and personal computers for departmental and application-specific tasks. Therefore, these companies' buying plans significantly affect the PC market. However, sales to small businesses account for more than half of the total dollar value of the microcomputer market.

A continuing survey of buying plans bears this out. So far, more than 147,000 interviews with small businesses—classified here as those with more than 10 employees and whose primary computers, if any, are microcomputers or personal computers—have been conducted by Focus Research Systems Inc., West Hartford, Conn. Their ongoing research in office automation reveals that less than 60,000 (40 percent) of the interviewed small businesses had computers in 1985. However, more than 21,000 companies of the entire survey field said they planned to buy computers in the next 12 months. In fact, their budgeted expenditure for computers exceeds $575 million, with 80 percent of the spending intended by companies with under 100 employees. Extrapolating these actual small-business plans indicates that as much as $6 billion or more may be spent on computers by small businesses nationwide.

Although larger corporations once bought personal computers by the thousands, their planned purchases for the coming year average just over 24 units. Still, the dominance of this market segment by IBM Corp. continues to grow. In businesses of all size, IBM personal computers represent more than 64 percent of planned personal computer purchases. That would increase IBM's overall personal computer



IBM continues to dominate *the personal computer market and is expected to control 57 percent by the end of this year. Zenith has gained significant market share primarily by virtue of IRS and Air Force contracts.*

market share to almost 58 percent. IBM has been only slightly less successful at penetrating just the small-business segment, with less than a 43 percent share last year, but they are expected to increase their share to 57 percent this year.

Here's to the winners

As a result of continually improving their personal computer product lines, Zenith Data Systems and Hewlett-Packard Co., after IBM, will earn the most significant increases in market share, if companies follow through with buying intentions. Zenith continues to dominate governmental personal computer sales, especially to federal agencies. Their recent contracts with the Internal Revenue Service for as many as 18,000 portable personal computers and with the Air Force for up to 90,000 personal computers represent potential revenue in excess of $600 million. HP's Vectra line of IBM PC/AT-compatible personal computers offers impressive performance at competitive prices and is receiving a better reception than did its earlier HP 150 line.

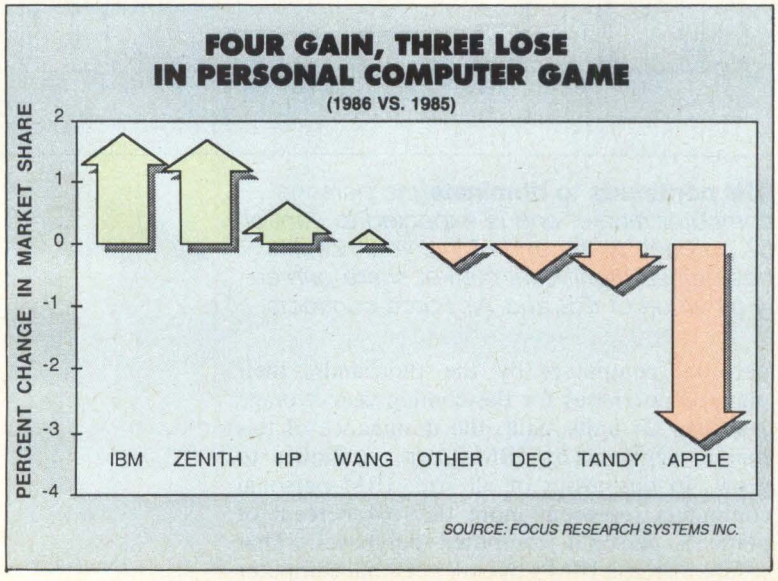
According to Focus Research, sales of personal computers made by Wang Laboratories Inc. should this year be running at a 25 percent higher rate than in 1985. And Compaq Computer Corp. will continue to hold its own, retaining a 3 percent share of the personal computer market. It remains to be seen whether the recently introduced Portable II will open markets for Compaq or simply subtract from purchases of Compaq's Portable 286 models.

Unless Apple Computer Inc. releases new products and improves its marketing strategies, the company stands to lose ground in 1986. The desktop publishing market—thought to be potentially lucrative for Apple's popular LaserWriter printer and Macintosh computer—is not developing fast enough. This lag gives competitors time to develop MS-DOS-based systems to challenge the Apple-DOS-based early entrants. In fact, ClickArt "personal publisher" from T/Maker Co., Mountain View, Calif., provides IBM-compatible systems desktop-publishing capabilities equal to those of the Macintosh.

Tandy Corp. may also lose ground this year, from its 3 percent market share in 1985. However, its belated recognition of the MS-DOS standard (seen in the Intel Corp. 8088-based 1000 and 1200 models and the 80286-based 3000) coupled with aggressive pricing and promotion may turn it around.

Other major players whose share is slipping to IBM include TeleVideo Systems Inc., Texas Instruments and Xerox Corp. TeleVideo's primary products, terminals, are under increasingly competitive price pressure, and the company has not been promoting its personal computer products as vigorously as last year. Texas Instruments continues to stress engineering over marketing, creating good products that haven't sold well. Having had limited success at the low end, TI is betting on the introduction of its new 1500 series of 32-bit, multiuser systems. For its part, Xerox has restructured its sales organization and introduced several new products—including a desktop publishing system with a low-cost laser printer—in efforts to reverse the decline. Finally, Digital Equipment Corp. should slip slightly in sales of its Rainbow and Professional series of personal computers.

Based upon the buying plans *of 147,000 companies interviewed in 1985, Apple, Tandy and DEC stand to lose market share, while IBM, Zenith, HP and Wang will gain.*



AT off to a slow start

A number of factors contribute to the failure of PC/AT to dominate the personal computer market as expected: lack of 100 percent software compatibility with the PC and the PC/XT; the availability of higher performance, cheaper AT clones; and buyers' anticipation of a higher performance AT from IBM, which was announced in April.

In any case, planned purchases of XTs were outnumbering ATs by more than 2-to-1 at the end of last year. This preference shows in all corporate-market segments. What's more, competitive AT-compatible systems sport faster processors and better displays than does the AT, and most of these clones are more software-compatible and lower priced than before, thereby limiting IBM's success. IBM's recent AT price reductions are an effort to arrest this erosion.

Not surprisingly, in larger corporations which use personal computers, according to Focus Research, spreadsheets are the most widely used

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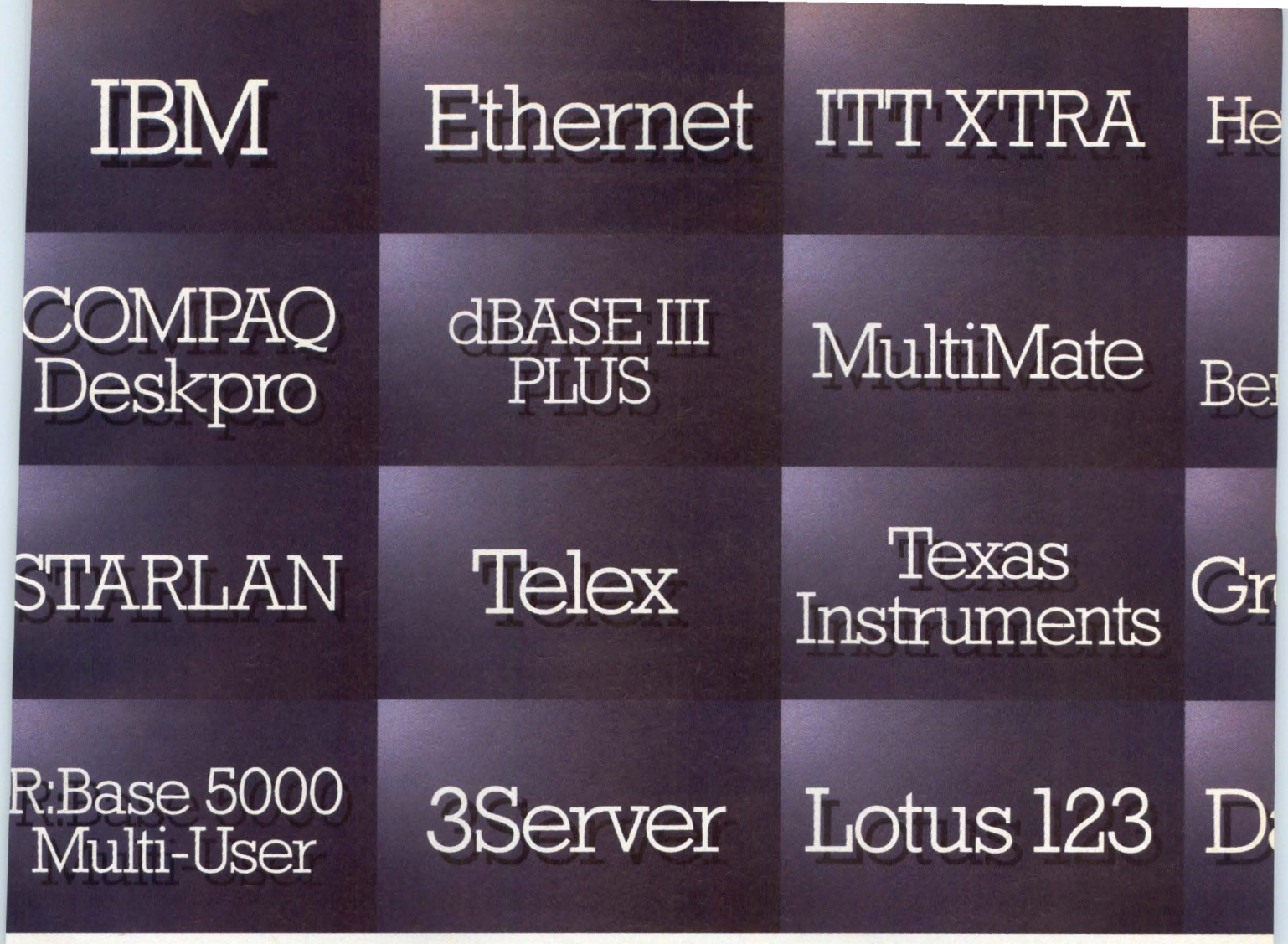

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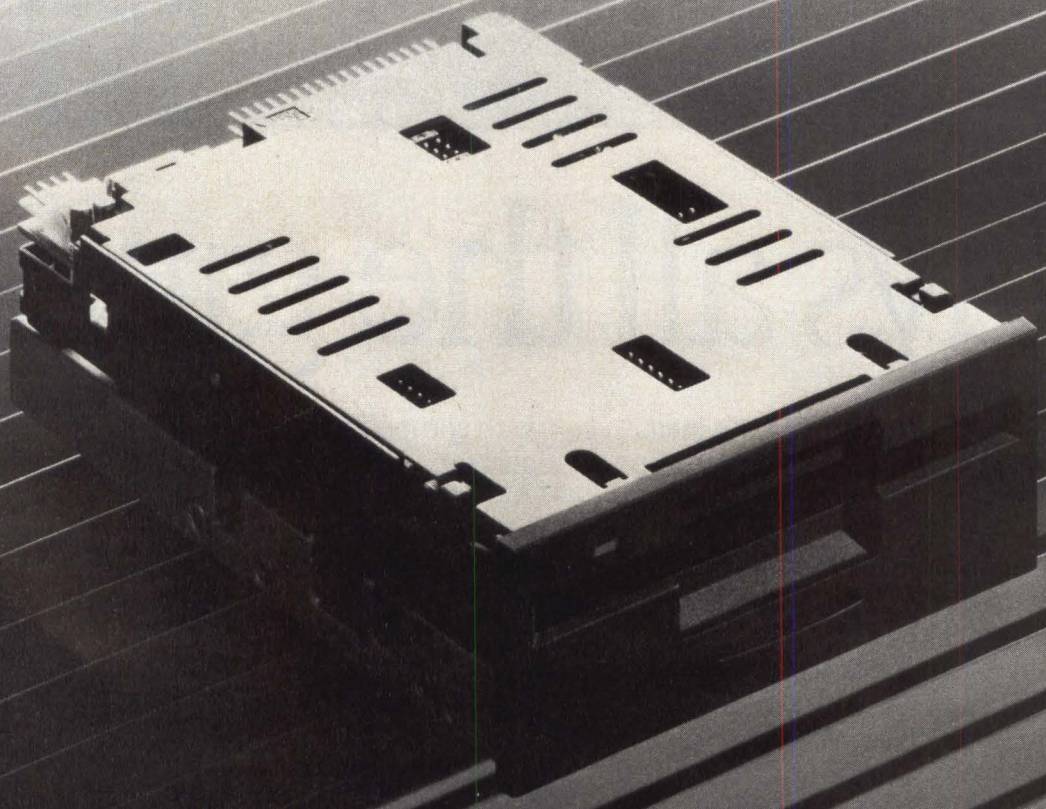

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personal computer application, with more than 70 percent of them using Lotus Development Corp.'s 1-2-3. Word processing is the next most widely used application, still dominated by Micropro International Corp.'s WordStar, which outnumbers IBM's own Displaywriter by more than 2-to-1.

Less than one-fourth of larger corporations use a database management system, with Ashton-Tate's dBASE systems accounting for more than one half of those users. Less than one-fifth of larger businesses use graphics applications. Those that do produce half of their graphics with Lotus 1-2-3, which does not generate presentation-quality output. Decision Resources' Chartmaster, with 3.7 percent of the market, is the only standalone graphics package that has made any measurable inroads into the graphics market for small businesses.

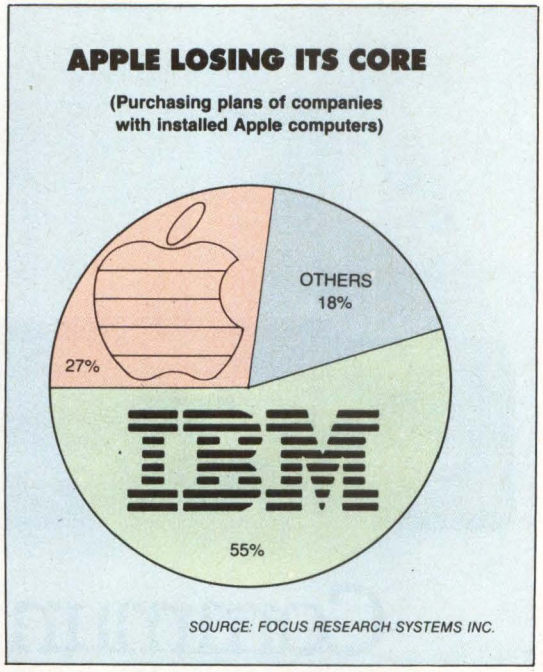
Unquestionably, graphics usage patterns offer evidence that the real potential of this market is elusive, at least at present. One problem lies in the difficulty of using such software, which needs to be simple to learn but must offer complex layout and design features.

Additionally, while many hardware and software vendors promote graphics for monitor display, many users want presentation-quality 35mm slides and overhead transparencies, which require a high-resolution color printer or plotter. Unfortunately, there are no standard software driver interfaces for these devices. So, each separate software package requires output drivers for each device. Putting together compatible microcomputers, graphics software, monitors, printers and plotters is a challenge even for resellers and experienced users, let alone the average business user. However, new systems such as ClickArt and Harvard Business Graphics from Software Publishing Corp., Mountain View, Calif., are significantly easier to use than are most graphics packages, yet they're sufficiently powerful.

VARs address small businesses

Manufacturers and larger resellers typically structure their sales efforts toward larger corporations, those with the potential to buy large quantities of hardware and software. Unquestionably, because of their large combined base of installed machines and their volume purchases, major corporations still represent the greatest potential for personal computer, peripheral, support-service and follow-up sales. Naturally, the competition for this business is the most intense in the industry.

However, small businesses account for more than half of the anticipated expenditures for microcomputers and personal computers combined. Smaller companies have completely different priorities than do large corporations. Usually, they use computers to fulfill one or more specific accounting tasks, in much the same way they once purchased bookkeeping machines to record their general ledger, inventory or accounts payable entries.



The purchasing plans *of companies with installed Apple computers indicate that 55 percent plan to buy IBM machines in the next 12 months while only 27 percent plan to stick with Apple.*

Currently, accounts receivable is the No. 1 application in smaller companies. It is used by more than one-third of these companies. More than 20 percent use their machines for accounts payable, the next most widely used applications. Less than 20 percent perform word processing, and only 4 percent produce spreadsheets. It seems clear that small businesses use personal computers primarily for accounting.

Small companies, categorized by number of employees, plan annual computer expenditures that average from $18,600 to $43,600 per company. These projections should send strong signals to third parties who have been questioning the profitability of selling to and supporting small businesses. It also explains the recent, intense interest by manufacturers in value-added resellers who have successfully addressed these markets since the late 1960s.

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So, typically, these customers obtain discounts greater than those offered to even the largest "official" VAR.

Most manufacturers have national-account sales organizations selling directly or via telemarketing to these companies. That way, they are better positioned to successfully work their way through the corporations' lengthy and tedious product-evaluation and approval process.

Distributors often compete for these major accounts against both the manufacturers they represent and the dealers to whom they resell. In fact, it has become very difficult for dealers to compete in this highly charged marketplace. So, while some corporate accounts value the support and service provided by local dealers, others have developed in-house support groups and their own maintenance capabilities. Because of the nature of the large corporate purchases, their primary selection criteria for computers are price and delivery.

A number of companies with national-account sales organizations also try to protect their approved resellers. Compaq, for instance, involves the appropriate resellers in most major sales. Zenith includes its authorized dealers in most of its direct sales, except in some of its large government contracts. In any case, both companies retain large, loyal reseller networks.

With large corporate accounts effectively closed to them, retail dealers (including the local outlets of national chains and franchises) try to profitably meet the needs of small business. But, while most dealers have strong product expertise, few have the breadth of business experience required to deal with the typical small-business owner or manager who, for example, wants to know how a particular computer and software package gets him current inventory information from his two tire warehouses and seven retail tire stores.

These dealers' ability to demonstrate and operate specific software products is important but secondary to small-business buyers who want to talk to someone who understands their specific needs. Therefore, this niche has historically been addressed by vertically oriented systems houses, value-added dealers and VARs.

Retail dealers too often try to fit all buyers with loaded personal computers and off-the-shelf software packages, which might represent a total sale of $7,500, but which probably won't satisfy the demands of even small businesses. And, with the profits earned on those $7,500 sales, dealers can't afford to provide buyers much education, training, conversion assistance and ongoing support. In short, these retail dealers need to develop specialized vertical-industry knowledge to service small-business customers.

Outlook is strong

Despite promising projected sales, the computer industry had a dismaying first quarter when many corporate buyers, facing their own budget crunches, withheld funds for their planned purchases. The main challenge for manufacturers and resellers today is to survive within a market increasingly dominated by IBM, and with fierce competition swooping down at the remains.

Fortunately, other external and industry factors bode well for the remainder of 1986. For example, the value of the American dollar is on the decline, which should help U.S. manufacturers brave the flood of less expensive Japanese and Korean imports. In fact, some U.S. manufacturers are even announcing higher prices, despite pressure from the press and from predatory competitors to lower them. □

Interest Quotient (Circle One)
High 733 Medium 734 Low 735

Gene Talsky is president of Professional Marketing Management Inc. (PROMARK), Old Lyme, Conn., which provides strategic planning, business development and marketing planning services to computer-industry vendors and resellers.

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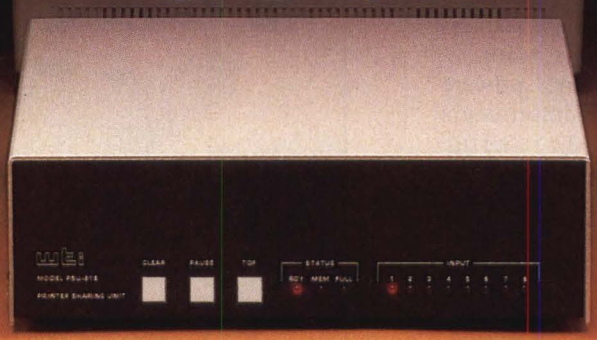

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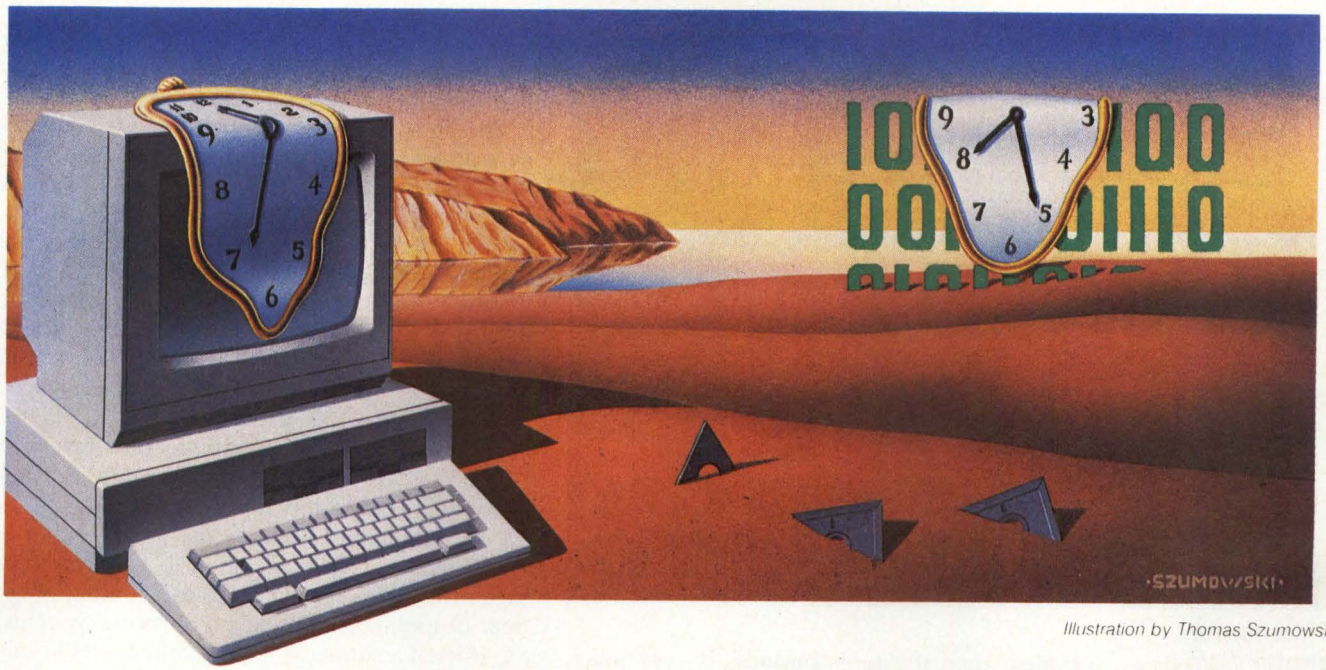


Illustration by Thomas Szumowski

SOFTWARE TOOLS SLASH DEVELOPMENT TIME

Libraries of subroutines and functions that developers can incorporate into their own products dramatically reduce software development time and cost

Michael Tucker, Associate Editor

Personal computer software developers are taking a cue from mainframe programmers and investing heavily in subroutine and function libraries. Less than a decade ago such software "tools" for the IBM Corp. PC and compatibles were almost unknown or were so crude that most programmers wouldn't touch them.

Now, there is an entire industry devoted to making the PC software developer's life a little easier. Programmers can take advantage of libraries containing everything from simple keyboard-control subroutines to complete application kits that they can quickly modify for vertical markets.

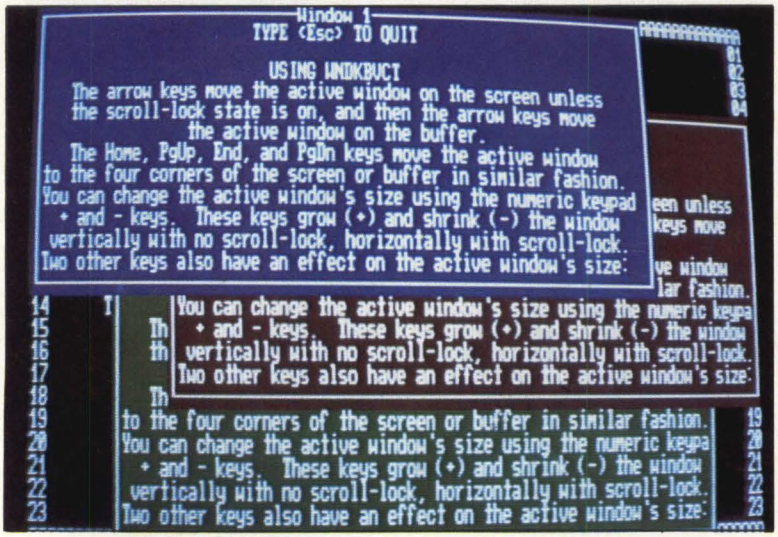
Software libraries are now available for several different languages and for many different compilers. They are relatively inexpensive, come with complete source code and usually may be compiled and resold in binary form without royalty fees. In fact, where libraries once were something of a joke among PC programmers, now—in a dramatic reversal—they've become so useful that few developers will work without them.

Some observers are even speculating that eventually libraries will merge with fourth-generation languages (4GLs). However, other observers warn that becoming overly dependent on libraries can be dangerous to vendors' financial health, because it might lead to inflexibility in a market where versatility is key.

Tools float to C-level

The PC-tools business is so new that even the meaning of the word "tools" is still debated. There are two types of programmers' tools sold today. The first, and by far the most common, comprises source code libraries of subroutines and functions that developers can incorporate into their own software. The second is of programs that assist a developer in the writing, management and maintenance of code (see "Shaping tools to the task," Page 96).

If, however, you define tools as source code



This screen shot *is from a demonstration program written using Pforce, Phoenix Computer Product's software-development tool kit for users of the C programming language.*

libraries, then the tools business is very much like the hardware-component trade. Vendors maintain collections of subroutines for jobs such as screen handling, mathematical operations, database-search methods and graphics and string functions that address common programming tasks. Developers can purchase them in source code—so that they can be modified and further specialized—and resold as part of a complete application, usually without royalties. In other words, libraries make programmers look a bit like system integrators.

The library business is booming. One company that specializes in marketing such tools, The Programmer's Shop of Hanover, Mass., carries more than 700 products. Its president, Bruce Lynch, notes, "The function-library business has become suddenly crowded. In just the ISAM [indexed sequential access method] market, for instance, we've seen incredible growth. Right now, there are over 15 ISAM [a database search method] products on the market. A year ago, there were only four or five."

Most source code libraries are written in BASIC or C—with C slowly pulling ahead because of its portability and relative maturity. A lot of C compilers already exist.

C is particularly well-suited to taking advantage of libraries. Explains Louis Lepiene, president of toolmaker Entelekon Software Systems, "C is itself a simple language, and it uses libraries to get sophisticated and specialized. The whole idea of C is to have a simple core and then to add on functions indefinitely." This is, of course, one of the reasons C is so portable. The core of the language can be quickly and easily transferred to nearly any machine or application and then specialized afterwards with additional coding.

To this end, Entelekon markets a series of tool kits, among them the Foundation Library with

Shaping tools to the task

Some programmers take the word "tools" to mean software that facilitates programming tasks but is not itself incorporated in individual programs. For example, Phoenix Computer Products Corp. (PCP), a spinoff of Phoenix Software Associates Ltd., markets a broad line of programming tools in the microcomputer-based MS-DOS world. It was, in fact, one of the first companies to take programming tools into the retail channel.

PCP's current offerings include Pmate, a programmer's editor; Pre-C, a C program analyzer for the MS-DOS environment; Plink, a linking editor; Plib, a library manager; Pfix, a high-level debugger; and Pfinish, a program which allows user to identify inefficient areas of code.

A particularly unusual programmer's tool, Pfinish allows MS-DOS programmers to find problem areas, not only in application programs, but also in their compilers and operating systems.

The success of this kind of tool, however, may lie outside of programming, falling more in the software maintenance arena. Polytron Corp., for instance, has sold several different C functions. Their $99 C Library package includes 65 functions for the Lattice Inc. C compiler. But Polytron also markets a very broad line of programming aids—such as PolyMake, which the company describes as "an intelligent program builder and maintenance tool."

Essentially, PolyMake is an MS-DOS version of a utility in the UNIX operating system known as "make." If a programmer makes in one module of code a change that requires other modules to be likewise modified, PolyMate will automatically go through the program and update the files that have to be changed. It costs $99 and is particularly useful in long-term software management.

"We've found we have to target managers of programmers as much as programmers," notes Doug Root, Polytron's director of marketing. "More and more, people are doing large programming tasks on gangs of PCs, and managing that effort can be difficult. Increasingly, we're selling to managers, librarians, systems administrators and software technicians—non-programmers, in short, whose job it is to keep track of those kinds of efforts."

some 325 subroutines, or "functions" as they are called in C. For $129.95, the library provides functions for cursor control, data entry, time-and-date display, printer control, keyboard handling and so forth. Entelekon also sells the C Power Windows library, also priced at $129.95, which gives MS-DOS pop-up windows for such items as menus, overlays, help screens, messages and alarms. Like most such collections, Foundation Library and C Power Windows can be reproduced and sold in developers' compiled products without payment of royalties to Entelekon.

Another company heavily involved in the C-function business is Greenleaf Software, which offers a library of over 200 functions called The Greenleaf Functions. For $185, the package is available for popular C compilers and provides features like graphics interfaces, MS-DOS file managers and string manipulation, keyboard, printer and video functions.

Greenleaf's library is particularly well-suited to the IBM PC and compatibles. "There are a lot of capabilities unique to the PC," says Donald Killen, Greenleaf's president, "and if you're going to take advantage of those unique features you're either going to buy one of the commercial libraries already on the market—like ours—or you're going to spend hundreds, even thousands, of hours pouring over the documentation for the PC to discover how to exploit them, or even what they are."

Like most C-library vendors, Greenleaf is scrambling to stay ahead in what has become a volatile industry. Notes Killen, "The library market is one that is largely user-driven. Right now, users are telling us they want increasingly sophisticated functions. They're saying they want very good graphics, the ability to be in control right down at the system level, and so on."

A C-library vendor with a similar marketing philosophy, though targeting a slightly different group of end users, is Software Horizons Inc. One of the first C-function vendors, and still one of the leading names in the business, Software Horizons offers "C Power Packs."

"Our customers range all the way from IBM to the federal government, to scores of start-ups," says Ramal Murali, Software Horizon's director of software. "They use our products because software development is rather like doing a jigsaw puzzle. The C language provides a big puzzle of 1,000 pieces or so. We concentrate those 1,000 pieces into a smaller, simpler puzzle of 100 pieces or so."

Traditionally, C-function libraries have consisted of relatively small chunks of code—sometimes little more than a few lines. However, that's changing as tools grow more sophisticated. Increasingly, C-function libraries have come to resemble entire C-language development environments.

Lattice Inc., for example, is one of the premier names in personal computer C programming. The company's C compiler claims more than 30,000 users worldwide. Lattice also makes a very powerful product known as Panel, a C-function library combined with a development environment. According to Lattice, some of its value added resellers are writing English-language front-ends to Panel and marketing the result as a 4GL.

Another company marketing a development-environment type of library is also one of the best known names in MS-DOS-related programming—Phoenix Computer Products Corp., a spinoff of Phoenix Software Associates Ltd. PCP has marketed a line of programming tools since 1984. In 1986, it entered the library business with Pforce, a collection of approximately 400 functions for $395. Pforce comes with both low-level functions—directory management, monitor control, keyboard control—and high-level functions, such as a database system management and windowing. Programming with Pforce is relatively simple. The developer writes C software that includes calls to the appropriate functions in Pforce, uses a text editor to enter the program as source code, compiles and links the resulting

HOW A FEW LIBRARIES STACK UP

Company	Product	Language	No. of functions	Price ($)
Blaise	Turbo Power Tools	Pascal	greater than 100	99.95
Borland	Turbo Toolboxes	Pascal	N/A	54.95-69.95
Entelekon	Function Library	C	greater than 325	125.95
Greenleaf	Greenleaf Functions	C	greater than 200	185
Lattice	Panel	C	N/A	295
Phoenix	Pforce	C	greater than 400	395
Software Horizons	Power Packs	C	over 1,000 combined	99-399

Source: Mini-Micro Systems

CUG circulates C tools

Looking for C-tools on a tight budget? Consider the C Users' Group.

CUG describes itself as "an information exchange facilitating noncommercial distribution of public-domain software." Members donate to a mutual library of such software as compilers, editors, text formatters and UNIX-like tools. Individual "volumes" are available for just $8.

Write: C Users Group, Box 97, McPherson, Kan., 67460, (316) 241-1065.

binary code and, finally, produces an executable file that has subroutines from Pforce, the compiler library and the programmer's own private collection of tools.

However, what makes Pforce more like an environment than like a library is not the functions, but their organization. Pforce comes complete with a pop-up directory, Phelp, that allows the developer to search the library for functions while programming. As a result, in the hands of a clever—but not necessarily experienced—programmer, Pforce can perform like a 4GL. The programmer decides which functions should go where and then writes a little C-code between them.

Pascal blazes a trail

If C is the emerging lingua franca of the library business, other tongues are vying for attention. BASIC continues to attract many programmers, and there is already a small, but vigorous, library business in personal computer FORTRAN. Both of these languages are hampered by their lack of standards. There are also some assembly language libraries on the market, but programmers have proved somewhat reluctant to work in that difficult tongue.

Two relatively new languages—Pascal and Modula-2—share C's advantages of standardization and ability to capitalize on tools. Both languages were developed by Swiss computer scientist Niklaus Wirth. In the late 1960s, Wirth wrote Pascal as a language embodying the principles of structured programming. Pascal eventually proved extremely popular, particularly at U.S. universities. In the early 1980s it became the de facto 'teaching language in American public schools.

Despite Pascal's popularity, Wirth grew dissatisfied with his creation in the late 1970s. Ultimately, he developed Modula-2 (from MODUlar LAnguage) as Pascal's replacement. It has advantages over Pascal: Notably, programmers can compile small modules of code, which enable them to modify programs without recompiling the entire application.

But, whatever the relative merits of Modula-2, it's Pascal that has an installed base of users and compilers. Already, several companies offer Pascal libraries. For instance, Blaise Computing Inc. markets libraries for C and Turbo Pascal from Borland International Inc. The Turbo Pascal package includes subroutines for string functions, screen handling, graphics interfaces and MS-DOS file handling.

Essentially, the Pascal packages give developers the same capabilities already available in C-library and subroutine packages. In fact, Blaise's president, Richard Levaro, says that, no matter what the language, all the players look alike. "Functionality isn't a distinguishing characteristic in this business," he says. "There are a lot of libraries out there, and they all do pretty much the same thing. And cost isn't a distinguishing feature either. In the end, most of the packages vary by only $30 or so. What is a distinguishing feature, though, is the sort of support and documentation the company offers after the sale." This, he explains, might include regular updates of the software, a support hotline and newsletters.

Blaise Computing is not, however, in the Modula-2 business. Explains Levaro, "We're not in a position where we can make markets. And

Toolkit plays an OS tune

One of the more interesting personal computer tool kits is the O/S Toolbox from Wendin Inc. of Cheney, Wash. It allows you to design your own personalized operating system.

"Basically, we provide you with a kernel that contains much of the functionality of [Digital Equipment Corp.'s] VMS, [AT&T Co.'s] UNIX and [Microsoft Corp.'s] MS-DOS," says Stephen Jones, Wendin's director of computer systems. "Then, you tailor it. You write the shell to give you whatever feel you like. It's all source code, and there's no royalty unless you resell that source."

Wendin has used O/S Toolbox to write PCUNIX, a UNIX work-alike that runs on the IBM Corp. PC and compatibles, and PCVMS, a VMS work-alike. With a cheeriness that ought to strike terror in the hearts of operating system vendors everywhere, Jones notes, "We plan to sell them in bookstores." At the moment, though, you can purchase O/S Toolbox, PCUNIX and PCVMS through the mail from Wendin or from resellers. Wendin's customers include several aerospace companies and federal laboratories.

Regardless of the long-term future of O/S Toolbox, Wendin has its place in history. It's a small company: The president and founder is Wendell Jones, the coauthors of the company's software are his sons, Stephen and Greg. But Wendin, already, is dominant in one field. Originally in the music business, it is still the largest producer of double reeds for woodwind instruments in the world.

right now, Modula-2 isn't a market for us. It has some nice features, but few people use it." In fact, both Pascal and Modula-2 have severe critics. Greenleaf's Killen, for instance, says bluntly, "I think Pascal is on the decline. It's being used less and less. You'll notice no one's written a new Pascal compiler for a long time. And, as for Modula-2, I don't think that's a real language yet...though, if someone like Borland were to do a Modula-2 compiler, then yes, it could become a popular language."

In fact, Borland is planning to enter the Modula-2 market in a big way. According to company president Spencer Leyton, Borland will introduce a Modula-2 compiler soon. "And we'll also have on tap a number of toolboxes for Modula-2."

Among programmers, Borland is known primarily as a maker of compilers, particularly the powerful Turbo Pascal compiler. But, perhaps due to its background in large software systems, Borland takes a different approach to the tools business. Rather than market libraries of subroutines, the company sells what are nearly complete applications that can be specialized by individual programmers. These software kits, known as "toolboxes," come with complete source code.

Borland uses the toolboxes to open markets that might otherwise be closed to it. "They're a means by which we can address vertical markets," says Leyton. "Rather than put out some vertical application costing $200 or $300, we can market just a toolbox for under $100. Then, value-added resellers or sophisticated end users can perform their own modifications."

Currently, Borland sells four toolboxes, each for Turbo Pascal. These include the Turbo Database Toolbox, $54.95, a database management system that can be modified for specific markets; the Turbo Graphix Toolbox, $54.95, a set of graphics applications; the Turbo Editor Toolbox, $69.95, a tailorable word processor or programmer's editor; and Turbo Gameworks, $69.95, a game developer's environment. Leyton says that more toolboxes for Pascal, and for other languages—including Modula-2 and an upcoming Borland Prolog implementation—are coming soon.

For the critics of Pascal and Modula-2, Leyton has this answer: "I think the advantages of Pascal and Modula-2, particularly the clarity with which they allow you to write, make them superb development environments. The fact is, we sell more Pascal every month."

'The whole idea of C is to have a simple core and then to add on functions indefinitely.'

Ada is a sleeping beauty

However, the one language that might someday provide the most fruitful library business is Ada. Developed to the specifications of the Department of Defense in the late 1970s for military and commercial applications, Ada may be the most standardized language in the world. The government has reserved all rights to Ada, and to market an "Ada" compiler that does not meet exacting federal requirements is to risk prosecution under the law. As a result, Ada is so standardized that binary code produced from one company's compiler should look exactly the same as binary code generated by another company's compiler.

Accordingly, if Ada ever becomes a popular commercial language—and Ada compilers for IBM PCs and compatibles have recently appeared—it could lend itself to a library market larger than anything yet envisioned. For in-

Companies mentioned in this article

Blaise Computing Inc.
2034 Blake St.
Berkeley, Calif. 94704
(415) 540-5441
Circle 376

Borland International Inc.
4585 Scotts Valley Drive
Scotts Valley, Calif. 95066
(408) 438-8400
Circle 377

Entelekon Software Systems
12118 Kimberley
Houston, Texas 77024
(713) 468-4412
Circle 378

Greenleaf Software Inc.
2101 Hickory Drive
Carrollton, Texas 75006
(214) 446-8641
Circle 379

Lattice Inc.
P.O. Box 3072
Glen Ellyn, Ill. 60138
(312) 858-7950
Circle 380

Phoenix Computer Products Corp.
320 Norwood Park S.
Norwood, Mass. 02062
(617) 762-5030
Circle 381

Polytron Corp.
P.O. Box 787
Hillsboro, Ore. 97123
(503) 648-8598
Circle 382

The Programmer's Shop
128 Rockland St.
Hanover, Mass. 02339-2223
(800) 421-8006
Circle 383

Software Horizons Inc.
165 Bedford St.
Burlington, Mass. 01803
(617) 273-4711
Circle 384

'We think Ada will have an incredible components market.'

stance, developers might someday produce large libraries and subroutine packages that resemble complete applications packages, compile them and sell them to software integrators who could resell them as part of their own products.

One company that has recently introduced an Ada compiler for the IBM PC is Alsys Inc., Waltham, Mass. Alsys' president is Jean Ichbiah, the man who headed the original design effort that produced Ada. Ichbiah formed Alsys partly in anticipation of an Ada components market. Explains Charles Patrick, Alsys' executive vice president, "We think Ada will have an incredible components market. The promise is that a piece of compiled software could be advertised in a catalog and sold as a black box. You could even have a warranty on it. You can't warranty source code because you can never tell what sort of bugs the end user is going to introduce."

Real programmers do use tools

At the moment, however, Ada users are a small group, and the binary Ada components business remains something for the future. Furthermore, those companies that have gotten into the Ada library business have done so in the standard way—by selling source code.

One factor that could hamper the trade in tools is their image. Some developers, particularly those working on end-user products for retail outlets, continue to shy away from libraries, partly on the principle that "real programmers don't use tools." But the main reason is that tools have a history of being somewhat crude. In popular PC applications, software becomes a consumer product and users simply won't buy anything that fails to deliver the highest possible functionality. The feeling has been that developers have had to write nearly everything themselves—or lose shelf space to someone who does. Thus, when Ashton-Tate wrote its integrated package, Framework, it wrote everything, right down to the last line of code.

However, Framework targets a general market, where competition is brutal and profits hard to discover. For most vertical applications, the tool kits are now so sophisticated that they meet most of a programmer's requirements without sacrificing elegance.

"Real programmers don't use tools? You hear that from programmers who don't get their projects done on time," says Entelekon's Lepiene. "You can save incredible amounts of time with libraries. I don't think you'll find too many people who don't use them."

Greenleaf's Killen agrees: "I've been around this business for a long while, and there aren't many people left who don't use tool kits. We just did a survey of 400 customers and literally all of them said, 'Well, yeah, there wasn't anything in the package which I couldn't have written myself, but why bother?' "

On the other hand, even some vendors caution against using the libraries uncritically. "If you're writing a commercial application," says Blaise Computer's Levano, "then, to rely on a vendor's library—somebody else's black box that you can't alter yourself—would be suicidal."

In general, then, libraries have finally become sufficiently refined so that few programmers can realistically object to them on purely technical terms. Indeed, the libraries save so much time and effort that no software developer—excepting those working in demanding environments—can afford to do without them. Someday they may even take on the traditional roles of 4GLs and application generators. □

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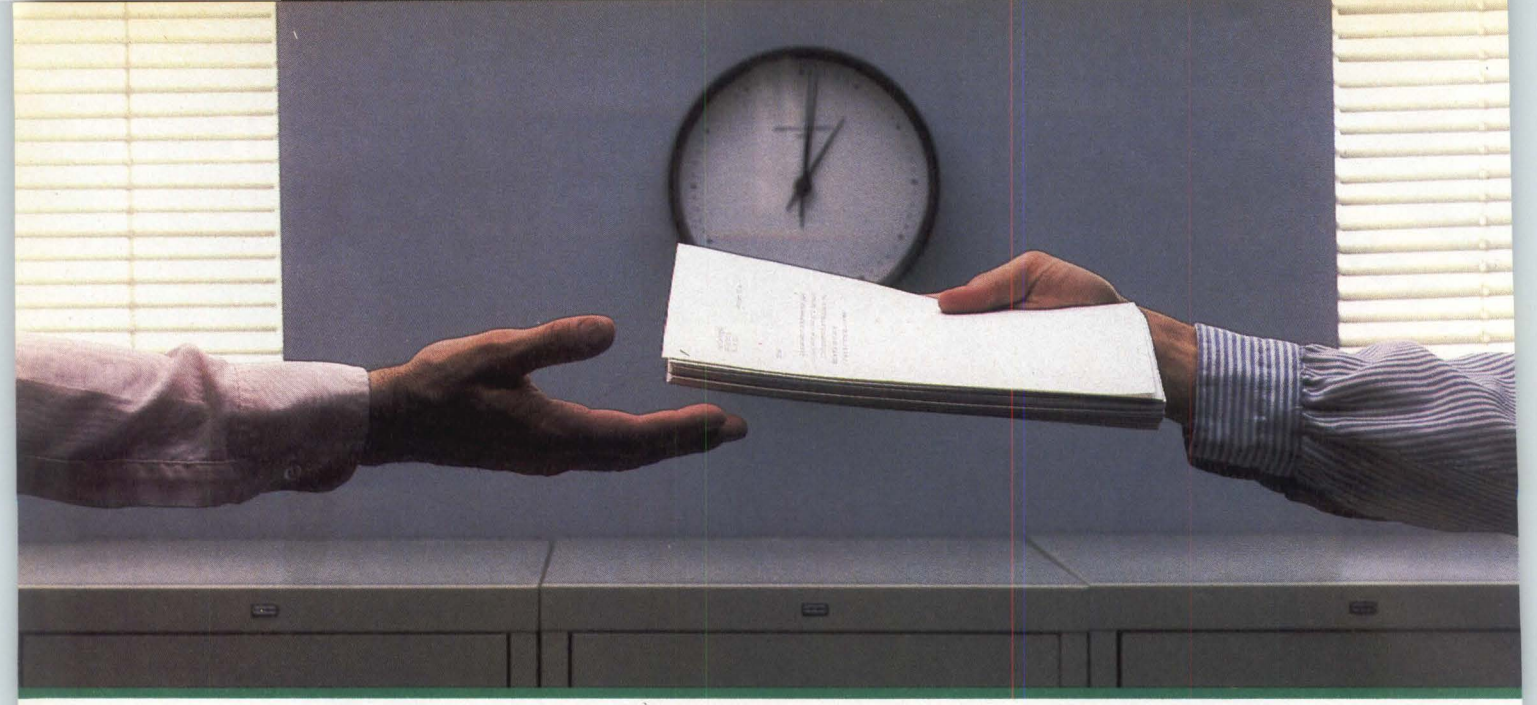

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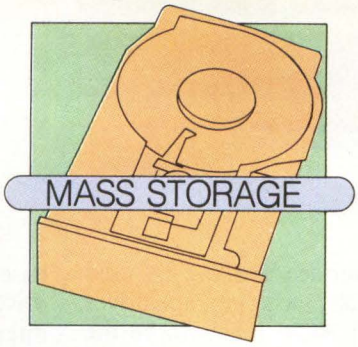


MASS STORAGE MARKET STAGES A COMEBACK

After a two-year slump, the mass storage industry is back on track with new standards, interfaces and product categories

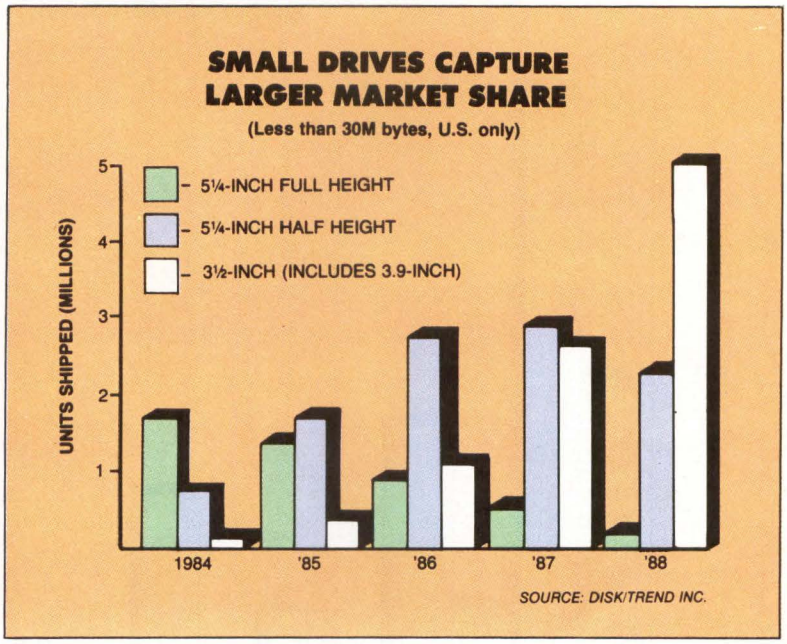
Joe Jaworski, Peripheral Concepts Inc.

During 1984 and 1985, the sluggish computer industry paced a mass storage market experiencing only marginal growth. Disk drive and controller sales were stalled by obsolete interfaces, little technological change and IBM Corp.'s massive—but unpredictable—buying patterns.

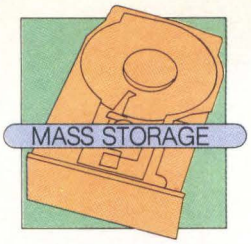
But, during this uncertain period, the industry worked out some of its problems, particularly those concerning interface standards and new technologies. Now on the road to recovery, the mass storage industry boasts intelligent-interface standards, 150M-byte-plus 5¼-inch Winchesters, optical disk drives and half-inch tape cartridge drives, many of which are making their production debuts in 1986.

Probably the hottest issue over the past year has been the battle for a new interface standard, particularly for small Winchester disk drives. System integrators had to choose from a list that was too long to even begin to analyze. Fortunately, at least for system integrators, many so-called standard interfaces have either fallen into niche markets or have disappeared altogether.

The two winners in the standards battle are the small computer systems interface (SCSI) and the enhanced small disk interface (ESDI). SCSI is one of the fastest growing buses on the market (MMS, February, Page 71). Its main feature is a data-transfer rate of 1.5M bytes per second in asynchronous mode and 4M bytes per second in synchronous mode. SCSI is a "generic," or



The dominant trend *in small Winchester disk drives is toward higher capacities in smaller form factors. As shipments of full-height 5¼-inch drives decline, shipments of 3½-inch units—which began in 1984—should top 5 million by 1988.*



device-independent, interface that can be used by a variety of peripherals, including tape drives and disk drives. In fact, SCSI seems to be the only bridge between two contending tape technologies; both half-inch and quarter-inch tape drives use SCSI.

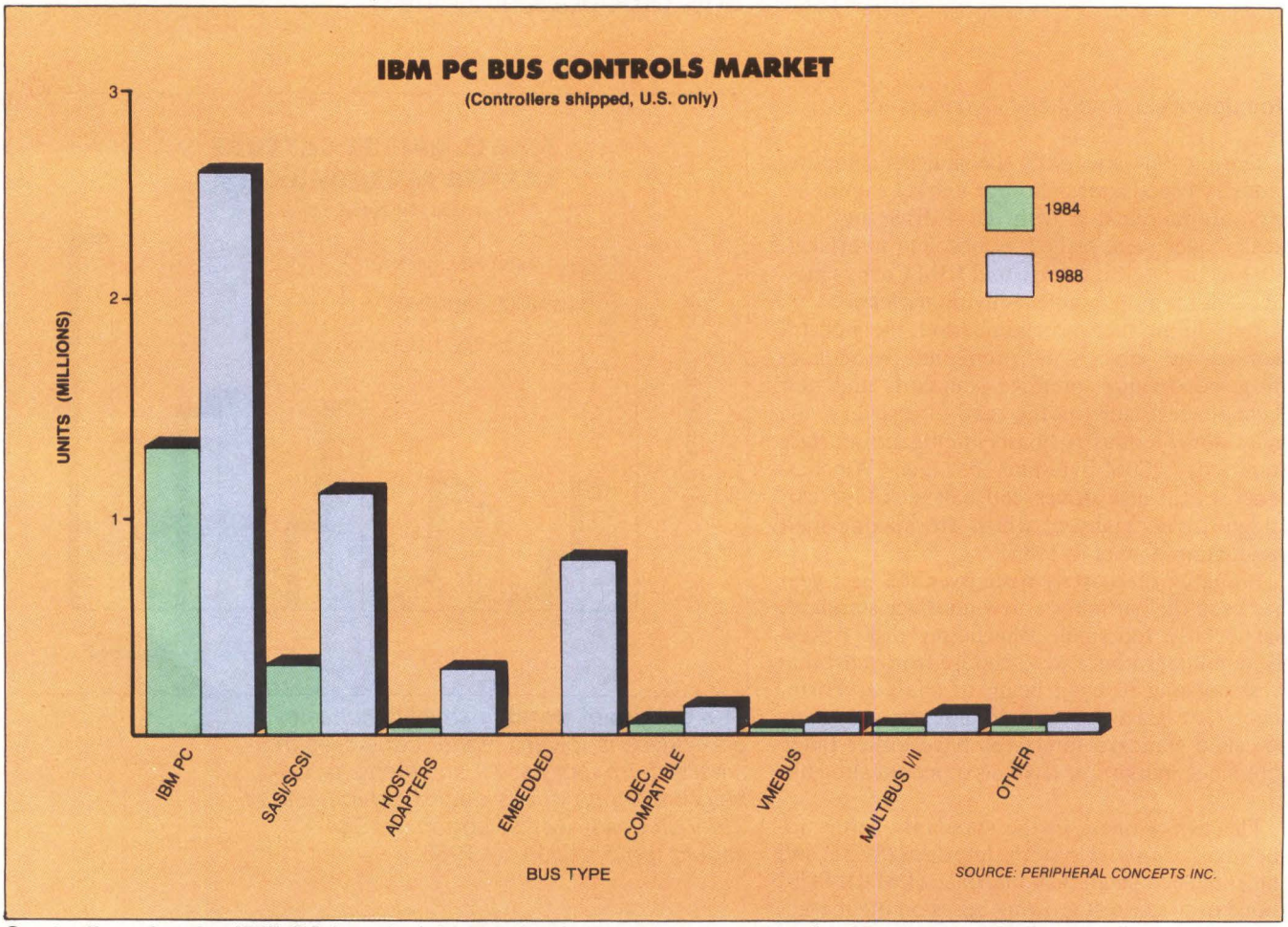
System integrators and OEMs can implement SCSI at various performance levels. The specification allows flexibility to configure the interface as a simple 8-bit bus, or as a powerful I/O system with multiple hosts and targets communicating via a high-level protocol.

On the other hand, ESDI, which began as an upgrade to the ST506 interface for small Winchester disk drives, is also a popular standard for high-capacity, 5¼-inch disk drives (MMS, February, Page 83). In addition, some tape drives, such as half-inch units from Electronic Processors Inc. and Fujitsu America Inc., use ESDI. Furthermore, manufacturers of tape drives based on IBM's 3480 half-inch tape cartridge drive are considering standardizing on the ESDI interface, which would spur further growth of ESDI in the tape world.

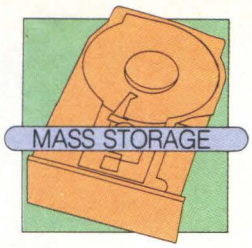
ESDI is a serial interface capable of transferring data in excess of 10M bits per second. Most disk drives with capacities in excess of 85M bytes are now available with both ESDI and ST506 interfaces, but it's clear that ESDI will dominate, particularly as disk capacities approach 500M bytes, primarily because of its higher transfer rate and the lack of need for a data separator.

Winchesters get smaller

It's no surprise that higher capacities in smaller form factors is the continuing trend in rigid disk drives. What is surprising, though, is the rapid rate in which this is occurring. For example, full-height 5¼-inch disk drives peaked in 1984, and half-height drives accounted for over



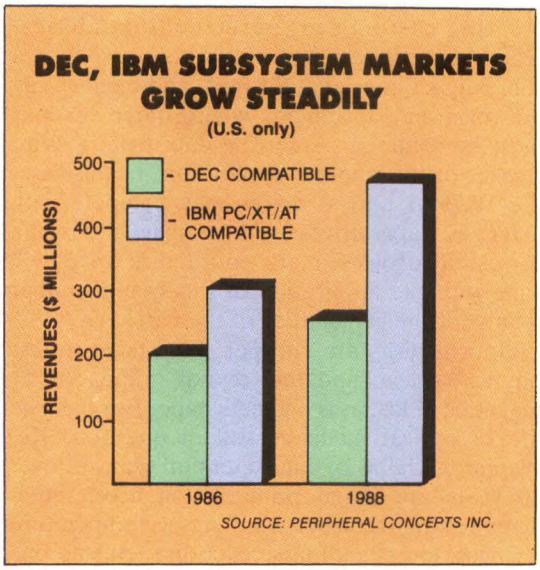
Controllers for the IBM PC bus *led the market last year, accounting for 37 percent of all controller revenues, or roughly $216 million.*



50 percent of last year's shipments, according to Disk/Trend Inc., Mountain View, Calif.

IBM—the largest customer for OEM disk drives in the world—has begun to satisfy its drive requirements with internally manufactured products. Although this reduces the potential volume of OEM disk sales, it does open up new possibilities for innovation as the market shifts to meet the needs of a number of smaller OEMs, instead of one company.

Manufacturers of 3½-inch Winchesters—such as market leader Rodime Inc., MiniScribe Corp. and a host of Japanese companies—got off to a slow start, but are now catching everyone's attention, including IBM's. It is estimated that IBM will begin production of its own 3½-inch drive for use in its personal computer family this year. If and when this happens, the market will explode with many new products and configurations.



DEC-compatible subsystem *sales should reach $198 million this year, excluding DEC's captive-market shipments. Add-on subsystems sales for IBM PCs and compatibles is expected to reach $310 million.*

Optical drives expand storage

Despite the rapid growth in Winchester disk capacities, today's supermicrocomputers and minicomputers can still quickly exhaust even the highest capacity drives. Ever-growing databases and operating systems and increased numbers of users all contribute to the inevitable inadequacy of current capacities.

Optical disk technology (MMS, December 1985, Page 68) holds great promise to solve these capacity problems, particularly in applications using large databases. Not only do optical disks take a giant leap in storage capacity, but they do so with a lower price tag and a smaller physical size than conventional magnetic disks.

Like any new technology, optical disks have their problems. The most significant is that many of the initial product offerings do not have the ability to erase previously recorded data. These "write-once" optical disks go against the grain of just about every operating system and storage architecture used today. That is, most operating systems and all applications software access normal read/write devices. The inability to erase and rewrite will hamper the growth of optical products until appropriate software becomes available.

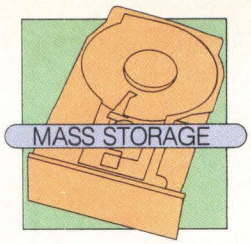
The most prominent example of widespread use of optical technology is in the consumer market: compact-disk audio players. Here, the read-only technology uses a prefabricated, prerecorded disk that cannot be altered or written to in any way. A major advantage with this type of optical disk is its low manufacturing costs. The thin metallic media are literally "stamped-out" by the millions. In contrast, reproduction of data on magnetic media requires that each individual bit be recorded in real time, a much slower and costlier approach.

Digital compact disks are called CDROMs (compact disk ROM). They offer up to 500M bytes in a 5¼-inch package. Unfortunately, all CDROM drives are extremely slow. With an average access time of 1.5 seconds, CDROM optical drives are about 40 times slower than Winchesters.

Many of the speed problems are related to the poor raw-error rates found on all optical disks (about 1×10^3, or one error in every 1,000 bits of information), which must be compensated for by error-correction techniques. But CDROMs may be attractive for applications that rely on static databases, such as dictionaries, inventory and parts catalogs, banking transactions, etc. Prices of 500M-byte CDROM disks (after mastering) range from $30 to $200, depending upon quantity.

Another class of optical disk drive is the write once read many (WORM) drive, which has been announced by several suppliers, including Information Storage Inc., Optimem and Optotech Inc. Simply stated, this technology allows the user to write data to the optical disk only one time, and read it back an infinite number of times. The reason why multiple writes cannot take place is that this technology actually destroys a portion of the disk during the writing process.

Obviously, WORM and CDROM optical drives serve different applications. With the WORM process, the end user has control in



creating customized, permanent databases. Good examples are financial histories, such as a company's financial audit trail, and engineering drawings and documents where older versions must be retained. Archiving data from a Winchester disk is another application. In this case, the WORM optical drives may compete with magnetic tape drives. Unlike magnetic-media drives, the choices among optical disk drives will vary with the application of the system, rather than with the capabilities of the CPU.

Optical disks are cheaper, they take up less physical space, and they're not influenced by magnetic fields, as is magnetic tape. But the true life of optical media is still in question. Researchers' claims of data-retention spans of over 10 years are based primarily on accelerated-aging testing through such things as temperature changes, stress and harsh exposure. But no one really knows for sure how long the media will last. Because of this, critical archiving applications will probably not take off until more reliable life-span information is available.

The future of optical disk drives clearly depends on erasability. The ability to read/write thousands of megabytes will push optical products into stiff competition with Winchesters. That future is not very far away. In Japan and in the United States, many companies are actively developing various erasable technologies, and some even have working prototypes. But commercially viable drives won't hit the market until mid-1987.

Controllers meet the challenge

With the changing mix of peripherals, controllers are finding their way into non-traditional places. Typically, a rigid disk controller resides on a separate board, either mounted on the disk drive or buried in the system enclosure. But today, these traditional board-level functions are being integrated or embedded within the disk drive itself as part of the drive electronics. Likewise, new VLSI circuits present strong competition to many older controller boards. But board-level controllers are far from obsolete.

The IBM PC segment accounted for 37 percent, or $216 million, of all controller revenues

Companies mentioned in this article

Digital Equipment Corp.
146 Main St.
Maynard, Mass. 01754
(617) 897-5111
Circle 386

Distributed Logic Corp. (Dilog)
1555 S. Sinclair St.
P.O. Box 6270
Anaheim, Calif. 92806
(714) 937-5700
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Dual Systems Corp.
2530 San Pablo Ave.
Berkeley, Calif. 94702
(415) 549-3854
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Electronic Processors Inc.
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(303) 761-8540
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Emulex Corp.
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Circle 390

Fujitsu America Ltd.
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San Jose, Calif. 95134
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Circle 391

IBM Corp.
Old Orchard Road
Armonk, N.Y. 10504
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Circle 392

Information Storage Inc.
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MiniScribe Corp.
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Mountain Computer Inc.
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Optimem
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Xylogics Inc.
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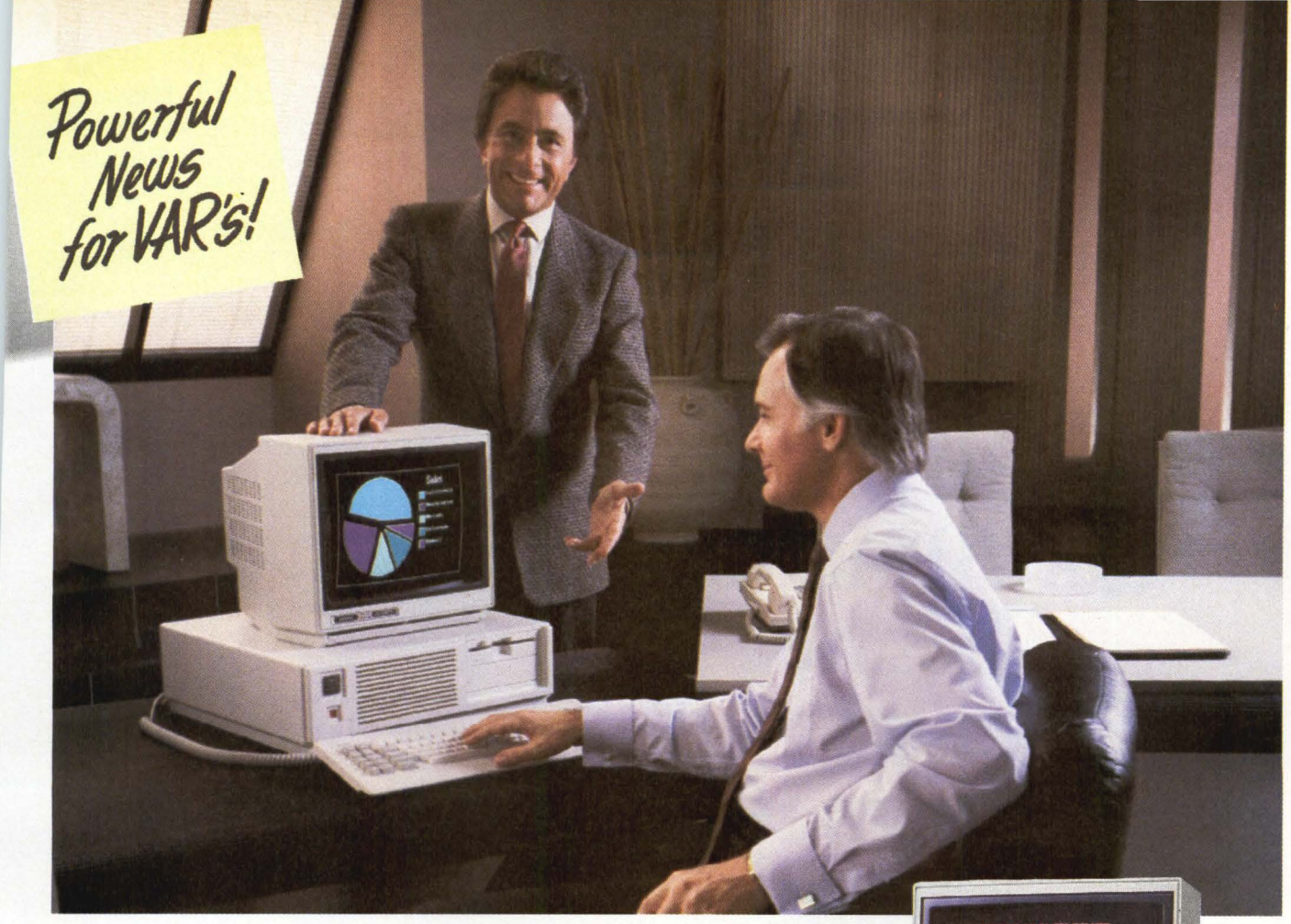
Circle 403



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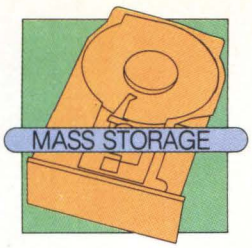


generated in 1985. The second strongest market was chip-level controllers at 19 percent, followed by Shugart Associates system interface (SASI) and SCSI board-level controllers, which actually declined from 15 percent to 14 percent in overall revenue share from 1984 to 1985. The decline was primarily due to the strong growth of the IBM and chip-level controller shipments. Actual SASI and SCSI controller revenues increased from $77 million to $84 million during that period.

Two significant growth areas in the controller market are host adapters and the SASI/SCSI products. Host adapters will experience a strong compound annual revenue growth of 69 percent, but the total market will be relatively small, remaining below $50 million in 1988. SASI/SCSI products will grow at a compound annual rate of 21 percent to reach a projected $163 million in 1988.

The compound growth rate for all chip-level controllers is expected to be 17 percent, from $90 million in 1984 to $168 million in 1988. Approximately 63 percent of 1984's chip revenues came from shipments of flexible disk controller devices. By 1988, only 52 percent of revenues will be derived from this source. Nevertheless, over 11 million flexible-disk controller chips were shipped last year.

The embedded controller market is a new segment for the industry. The demand for embedding is driven by increasing capacities of Winchester disk drives. However, the quality of the media used in these drives has not kept up with their capacities. The flawed areas, or "bad spots," on the disk's surface increase in both frequency and size as capacities increase. Although a combined effort of controller and host I/O firmware handles these bad spots today, at some point they will become unmanageable. In a multiuser environment, for example, defect management devotes precious CPU time to both manage and search the disk for alternate sectors and/or tracks. Embedding the controller with the drive electronics allows for greater internal management of these flawed spots, thus improving overall system performance. This market, with virtually no shipments in 1984, is expected to increase to a whopping 817,000 units by 1988. Revenues (which are on an "if-sold" basis, because the product is really shipped within a disk or tape drive) are expected to be $33 million by 1988, primarily from purchases by drive manufacturers of chip sets.

At the "high-end," or supermicrocomputer and minicomputer market, Digital Equipment Corp.-compatible controllers accounted for 49 percent of all revenues generated in 1984, or roughly $74 million. Multibus controller manufacturers claimed 31 percent of sales, with revenues of $47 million. The emerging VMEbus market accounted for only 4 percent: $6 million in revenues.

By 1988, revenues from DEC-compatible controllers from companies such as Emulex Corp. and Distributed Logic Corp. (Dilog) will reach $132 million, but market share will drop slightly to 45 percent. Combined Multibus I and Multibus II sales, led by controller manufacturer Xylogics Inc., will maintain its number two position but with a decreased 27 percent market share. VMEbus controllers will exhibit dramatic growth, capturing 18 percent of the total market, or $52 million. Recent entries in the VMEbus controller arena include VMEbus-ESDI controllers from Xylogics, Dual Systems Corp. and Interphase Corp. The market share of non-DEC minicomputer-level controllers will decline to 10 percent in 1988. It is important to note that each category will register a net growth in revenues for the 1984-88 period.

The VMEbus controller market is clearly the fastest growing category, with a compound annual growth in revenues of 75 percent. Explosive growth projections for supermicrocomputers, fueled by the workstation and computer aided design/computer aided manufacturing markets, will contribute most to this dramatic upswing in VMEbus controller revenues.

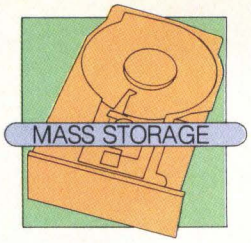
A shift toward smaller, Q-bus-based DEC computers will result in lower average selling prices for compatible controllers. Consequently, revenue share for DEC controllers will decline slightly, but the growth in shipments will remain strong. A severe decline in revenues for Texas Instruments Inc. controllers and a greater move toward captive controllers will shrink the market share of non-DEC minicomputer compatible controllers. Competing buses, particularly the VMEbus, will slow the growth rate of the Multibus I controller market in the future.

The VMEbus controller market is clearly the fastest growing category, with a compound annual growth in revenues of 75 percent.

Subsystems put it all together

Mass storage subsystems have become a significant market segment. In recent years, the availability of low-cost, high-capacity Winchesters has made subsystems extremely attractive. Likewise, high-capacity subsystems have expanded the applications range of existing systems.

Although most aftermarket subsystems are prepackaged "boxes" containing the disk or tape



drive, a controller and a power source, there are some new variations. The "disk-on-a-card" concept now available for IBM PC systems is one of them. These are essentially add-in subsystems that draw power from the computer and do not require the traditional enclosed power supply. Early producers include Mountain Computer Inc., Plus Development Corp. and Western Digital Corp.

Add-on subsystems are popular at the high- and low-end computer markets. DEC-compatible minicomputer subsystems dominate the high end, whereas IBM PC-compatible products make up the majority of low-end subsystems.

DEC-compatible subsystems will generate a revenue base of $198 million in 1986. This projection covers subsystems for both Q-bus- and Unibus-based minicomputers but excludes DEC's captive-market shipments. The add-on subsystems market for IBM PC and compatible machines is expected to reach $310 million this year. This market has 2-to-3 times more manufacturers than the high end (excluding retailers who privately label existing subsystems or do limited site integration). The fastest growing segment, the "hardcard," or disk-on-a-card, configuration, will make up 29 percent of the IBM PC subsystems market in 1986. A year ago, this class of product was virtually non-existent. □

Joe Jaworski is president of Peripheral Concepts Inc. of Irvine, Calif., a management-consulting and market-research company specializing in the mass storage industries.

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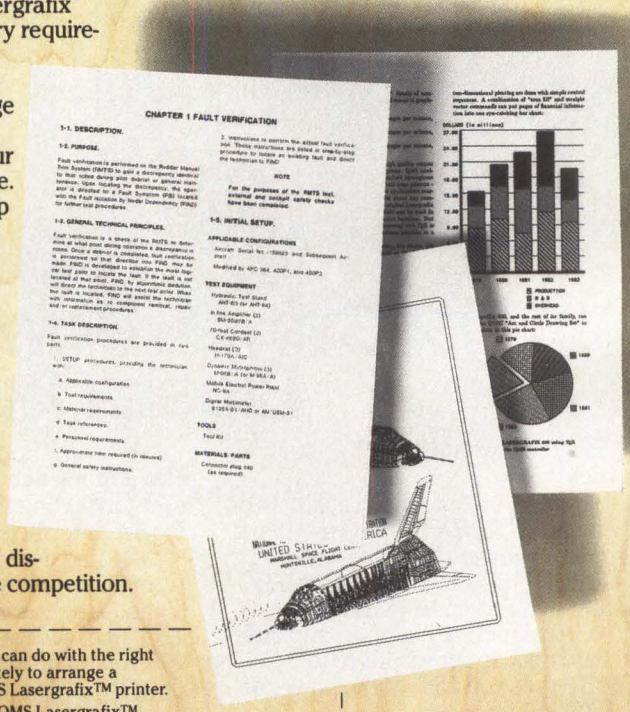

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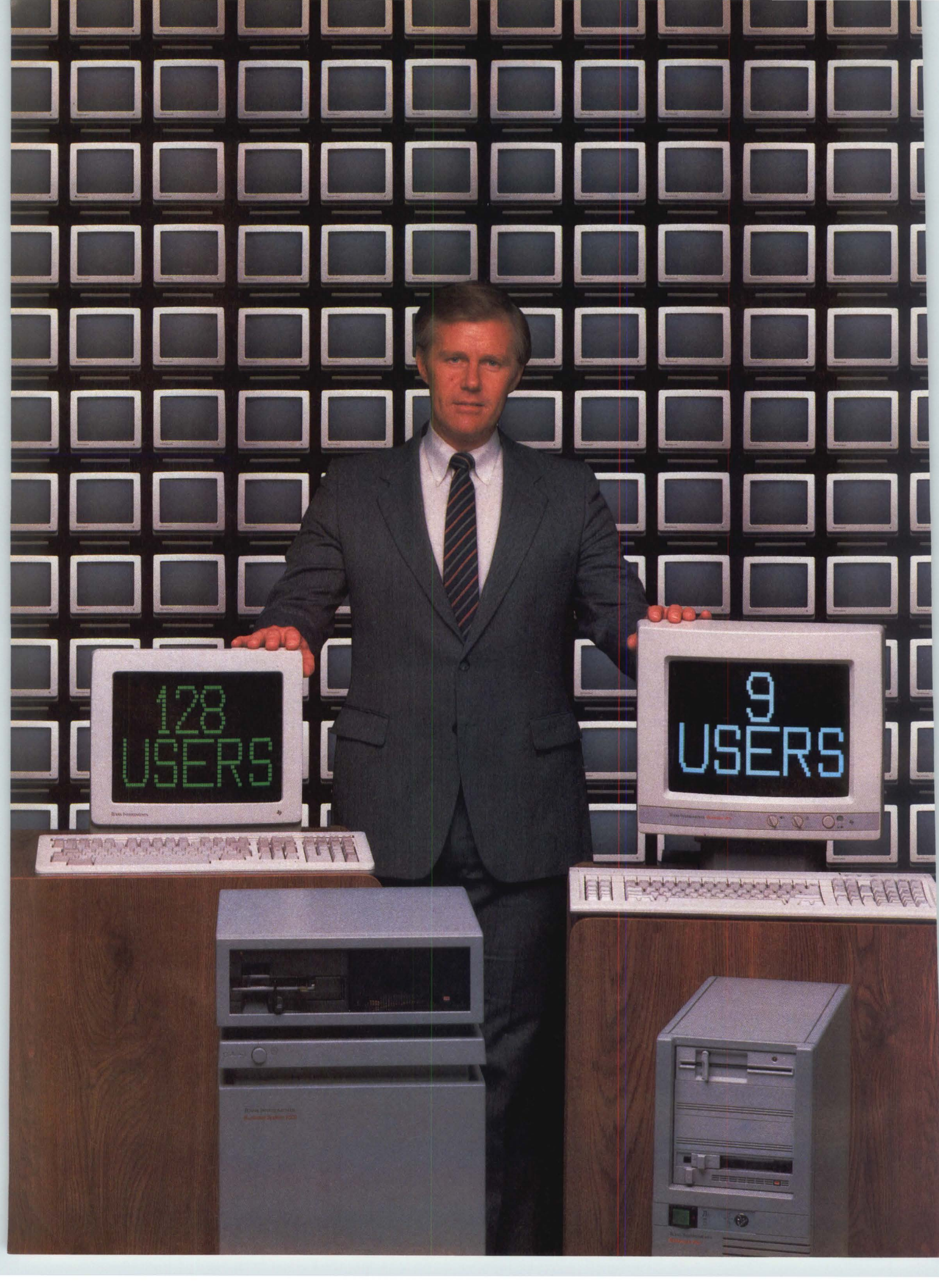
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- 25 lines

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Circle 452

Terminal emulates Honeywell VIP

- 80 or 132 columns
- DEC compatible
- 14-inch screen

The 20-7813 terminal emulates Honeywell's VIP 7813/7823 and 7305. It provides DEC VT100 compatibility. Display format is 24 lines of 80 columns or 132 columns on a 14-inch green or amber screen. RS232C and RS422 interfaces are standard. Up to 1,080 characters of non-volatile memory are used in 16 programmable functions. A second bidirectional port interfaces to a printer or an alternate host. It supports Tektronix 4010, 4014 and compatible graphics. $1,595. **Teleray,** P.O. Box 24064, Minneapolis, Minn. 55424, (612) 941-3300.

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Circle 454

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DISK/TAPE

Disk subsystem stores 20M bytes

The 4100 Small Disk is a 3½-inch Winchester disk subsystem. The unit stores 20M bytes and is ruggedized for military and commercial environments. Software programs and data bases can be distributed among various processors. An SCSI interface is supplied. $11,500. **Rolm Mil-Spec Computers,** One River Oaks Place, San Jose, Calif. 95134, (408) 942-8000.

Circle 460

Tape drive emulates rigid disk drive

A 40M-byte tape drive for the IBM PC/XT, /AT and compatibles, the TD440 emulates a rigid disk drive. The file-addressable unit responds to all DOS 2.0, 3.0 and higher commands. A sector-by-sector utility backs up a 10M-byte rigid disk in 10 minutes. $1,490. **Advanced Digital Information Corp.,** P.O. Box 2996, 10201 Willows Road, Redmond, Wash. 98073-2996, (206) 881-8004.

Circle 461

Winchester drive resides on card

A 30M-byte card-level hard disk, Drivecard 30 combines two 3½-inch disks with controller electronics. The unit is compatible with the IBM PC/XT and /AT and operates under IBM DOS and XENIX. It is equivalent in capacity to 87 double-sided, double-density flexible disks. Rigid disk software is stored on two EPROMs that contain DOS BIOS programming. The internal device requires one card-cage slot on the PC/XT and one and one-half slots on other models. $1,449. **Mountain Computer Inc.,** 360 El Pueblo Road, Scotts Valley, Calif. 95066, (415) 534-1717.

Circle 462

Tape drives supply streamer technology

- 64K-byte data buffer
- 12.5 to 75 ips
- 1,600 bpi

Consisting of five moving parts, the Series 2000 cache tape drives combine streamer technology and semiconductor data-buffering. All models provide a 64K-byte data buffer and selectable block sizes of 8K, 16K, 24K and 32K bytes with error handling through automatic read-and-write retry. Model 2110 emulates start/stop tape speeds of 12.5 to 75 ips and has a transfer rate of 20 to 120K bytes. It records data at 1,600 bpi. Model 2120 achieves a dual-density recording rate of 1,600 to 3,200 bpi, allowing up to 138M bytes of unformatted capacity per reel. Units 2112 and 2122 offer transfer rates of 72 to 384K bytes. They emulate start/stop speeds of 45 to 240 ips. Access times are 1 to 8 msec. $2,850 to $3,695. **Digi-Data Corp.,** 8580 Dorsey Run Road, Jessup, Md. 20794, (301) 498-0200.

Circle 463

There's a difference between making news and making drives.

While others are announcing high-capacity SCSI drives, Maxtor is shipping them.

That should come as no surprise. Because our new SCSI drives are based on the same proven technology as the tens of thousands of ST506/412 and ESDI drives we've already shipped.

They're called the XT-3000™ Series. The difference is they feature an embedded SCSI controller with an extensive command set.

And the fact that they come with capacities up to 280 megabytes really isn't news at all.

Once you consider the source.

Maxtor Corporation, 150 River Oaks Parkway, San Jose, CA 95134, (408) 942-1700. TELEX 171074.
Regional Sales Offices: Austin (512) 345-2742, Boston (617) 872-8556, Orange County (714) 859-3100, San Jose (408) 435-7884.

Maxtor

CIRCLE NO. 101 ON INQUIRY CARD

The Convergent Principle Applied:

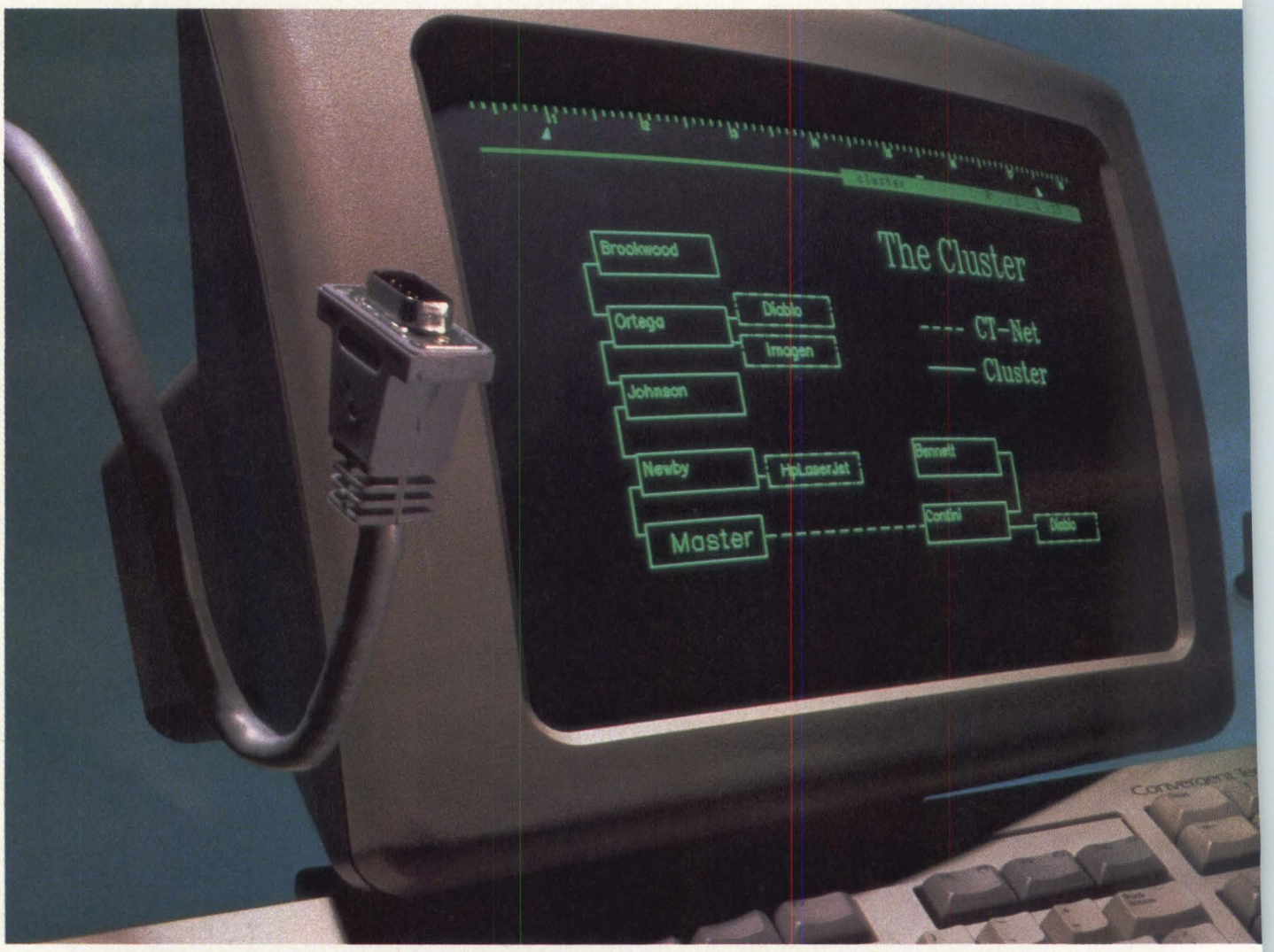
Our networks let you share

For a business to succeed, great ideas must be shared throughout the company. But a single network can't connect all the different kinds of computers you find in business today. That's why we offer a choice of networks that let you link workstations, PCs, minicomputers and mainframes in the specific arrangement that best suits your needs.

THE BUILT-IN NETWORK

For simplicity of networking, we built the Convergent Cluster™ into every NGEN® workstation. This inherent network eliminates specification and installation problems. All you do is connect the cables. And with CT-Net,™ you can link Clusters together as easily as you connect workstations, so that your networks can grow as your organization grows.

Through the Cluster, workstations share databases, modems, printers, files, programs and communication resources. Because the network operates invisibly, people can use the Cluster without changing the way they normally work.



great ideas with others.

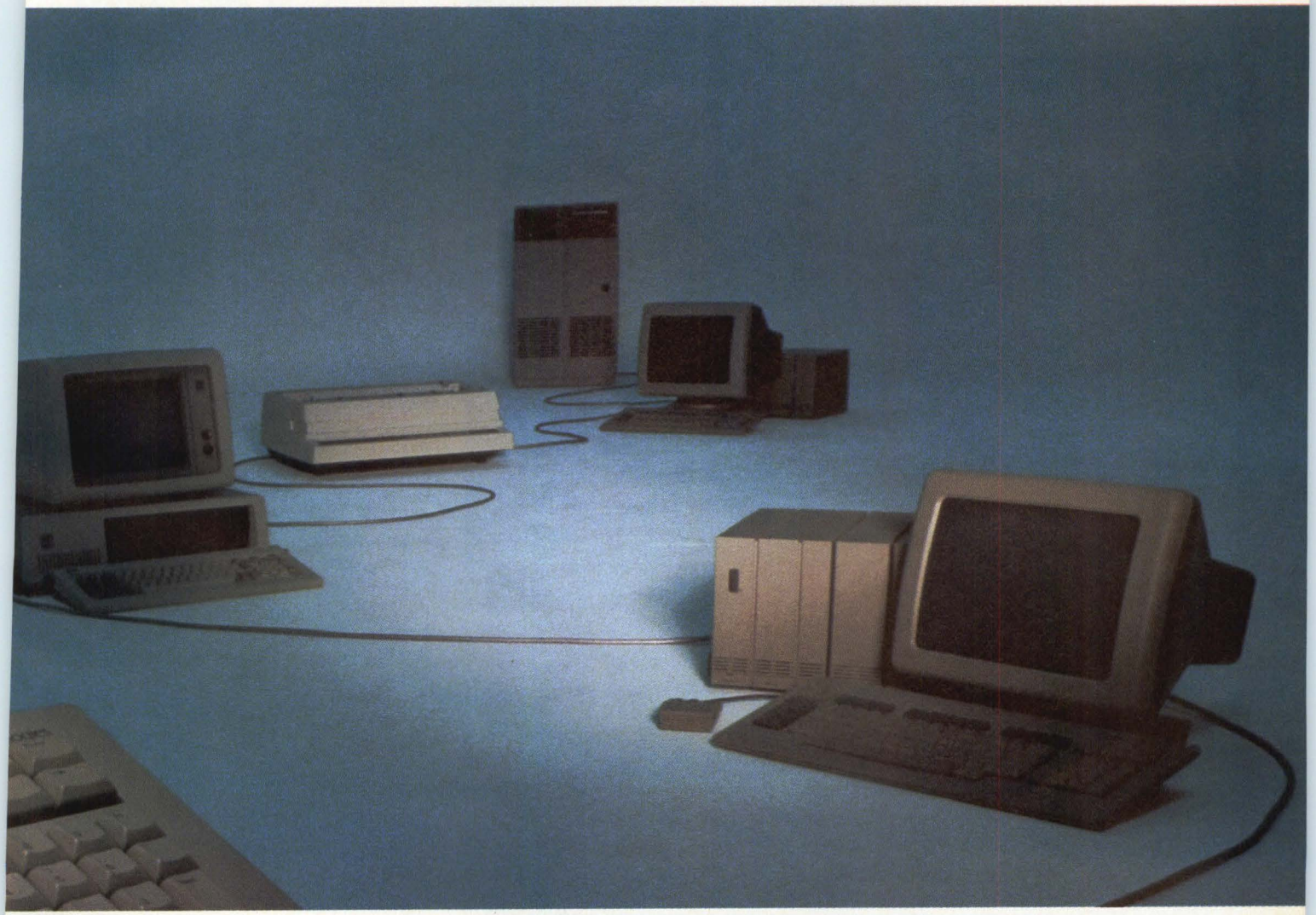
THE EXTENDED NETWORKS

Obviously, not all computers are designed for the Cluster. So we offer SNA or X.25 communication packages that link workstations to large mainframes or public data bases.

All our networks are backed by Convergent's commitment to excellence in engineering, craftsmanship in manufacturing and fast turn-around in high-volume production.

We'd like to show you how this convergence of thinking can work for you. Call us for more information at 800-538-8157, ext. 951 (in California call 800-672-3470, ext. 951; in Europe call 44-2404-4433). Or write us: Convergent Technologies, 2700 North First Street, P.O. Box 6685, San Jose, CA 95150-6685, Attention: Mail Stop 10-015.

That is, if great computers and total networking sound like good ideas to you.



Convergent

When great ideas converge, great products emerge.

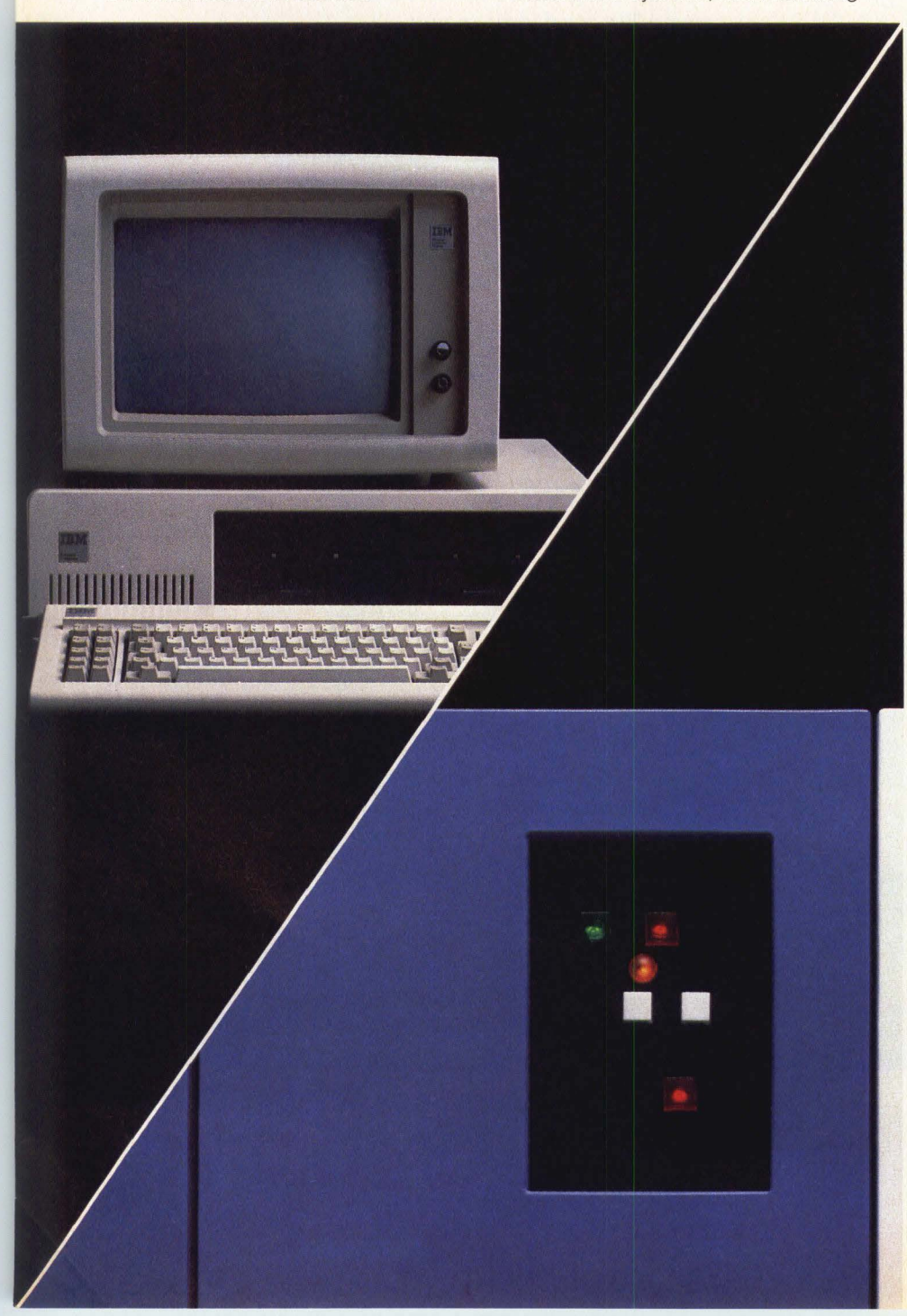
YOU CAN OFFLOAD YOUR PC COMMUNICATIONS JUST LIKE YOU WOULD A MAINFRAME.

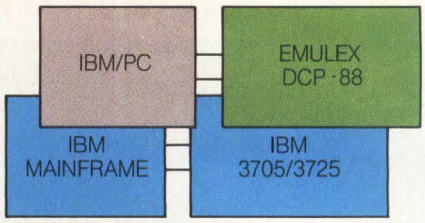
DCP-88/VM, THE PLUG-IN FRONT END.

If communications overhead is wearing your system down, simply use our new DCP-88/VM Front End Communications Processor.

ALMOST ENDLESS APPLICATIONS.

The DCP-88/VM is ideal for integrating workstations, like RJE, on-line reservation systems, manufacturing automation and financial banking applications, It's equally recommended for protocol converters, instrumentation, process control, off loading printer control, or virtually any other application that involves communications processing on a PC.





PLUG-IN ADVANCED FEATURES.

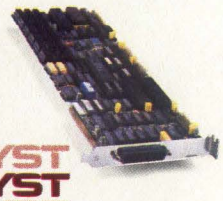
Get up to 512 KB RAM, four multi-protocol serial ports, a high speed parallel printer port—all on one board. Naturally, we support ASYNC, SYNC, BISYNC, SDLC and HDLC (X.25) protocols. And thanks to shared memory architecture, data and control information move at memory speeds.

PLENTY OF POWERFUL SOFTWARE.

Emulex fully supports the DCP-88/VM with a wide variety of software. This includes Real-Time Executive. Plus PC/3780, PC/HASP, PC 3270 BISYNC, PC/3270 SNA and PC/X.25.

With so much to offer, it's no wonder we're fast becoming an industry leader.

So offload your PC with the DCP-88/VM, the plug-in front end from Emulex. Call toll free 1-800-EMULEX3. In California, (714) 662-5600. Or write: Persyst Products, Emulex Corporation, 3545 Harbor Boulevard, P.O. Box 6725, Costa Mesa, CA 92626.



EMULEX PERSYST PERSYST PERSYST

U.S. Regional Offices: Anaheim, CA (714) 385-1695; Reston, VA (703) 471-1001; Schaumburg, IL (312) 490-0050; Roswell, GA (404) 587-3610; Nashua, NH (603) 882-6269. **International Offices:** Australia, Eastwood, N.S.W. (02) 858-4833; Canada, Mississauga, Ontario (416) 673-1211; France, Montrouge (1) 735-7070; United Kingdom, Bracknell, Berkshire (334) 484234; West Germany, Munich (089) 304051.

CIRCLE NO. 67 ON INQUIRY CARD

Daisywheel printer runs at 40 cps

- 197 columns
- Three interfaces
- 3K-byte buffer

Geared towards small-to-medium size offices, the EXP800 daisywheel, letter-quality printer operates at 40 cps. The unit provides a 15-inch carriage and parallel, serial and IEEE-488 interfaces. It prints 197 columns on paper as wide as 17 inches. An expandable 3K-byte buffer frees the computer or word processor for other jobs during printing time. Character pitches include 10, 12, 15 and proportional. $895. **Silver-Reed America Inc.,** 19600 S. Vermont Ave., Torrance, Calif. 90502, (213) 516-7008.

Circle 464

Laser printer blazes at 26 ppm

- 300 dpi
- IBM, DEC compatible
- 1,500 lpm

Achieving 26 ppm and 1,500 lpm, the LaserPrint 2670 runs three times as fast as most laser printers. The unit, geared towards OEMs, is plug-compatible with DEC, IBM and Wang systems. The printer has a 300-dpi resolution and a bar code and bit-mapped graphics capability. It emulates Calcomp, Diablo, Epson, NEC and Xerox printers. Features include a dual-input feeder, a 2,000-page paper-input capacity and a 55 dB(a) noise-level. $11,400. **Advanced Technologies International Inc.,** 2041 Mission College Blvd., Santa Clara, Calif. 95054, (408) 748-1688.

Circle 465

ANSWERS TO MAY'S PUZZLE

O	U	T	P	U	T		U	P	D	A	T	E
C	T		I		I		S	U	P	E	R	
T		C	P	M		A	R	M		R	U	B
	T	O		A	B			A	M	I	G	A
V	A	L		S	I	V	A		O			L
	T	E	C	H	N	O	S	T	R	E	S	S
S	A	C	O		A	L	P		A	R	E	A
P	R	O	P	O	R	T	I	O	N	A	L	
I			A		Y	A	R	D		S	A	G
K	O	A	L	A			E	O		E	H	
E	L	M		B	I	T		R	N	D		B
	G	O	A	L	S		M		E		O	Y
T	A	N	D	E	M		E	N	C	O	R	E

Desktop printer targets OEMs

- 8 ppm
- 128K-byte memory buffer
- Four type fonts

Aimed at the OEM market, the LC-800, 8-ppm desktop printer provides a 128K-byte memory buffer, 250-sheet input and output bins, an LCD operator panel, four resident type fonts and a dual, serial/parallel interface. A dual-cartridge printing system permits separate replacement of toner and photoconductor. Options include a 1.3M-byte memory board, four font cartridges and paper handlers. $2,995. **NEC Information Systems Inc.,** 1414 Massachusetts Ave., Boxborough, Mass. 01719, (617) 264-8000.

Circle 466

DATACOM

Gateway allows IBM 3270 emulation

The DNA Gateway provides a 3270 communications link between an installed DNA local area network and SNA hosts. Using one personal computer card slot, the device requires no additional programming. It supports from eight to 32 concurrent users. An RS232C modem connection is standard. $3,995 to 4,995. **Network Development Corp.,** P.O. Box 1785, West Chester, Pa. 19380, (215) 296-7420.

Circle 467

Communications box cuts line costs

A communications box, the Micom Box Type 2 cuts telephone line costs and adapts to different environments. Plug-in firmware modules such as data concentrators and statistical multiplexers are provided; hardware modules tailor the device for the number of asynchronous channels required. A base configuration supports four asynchronous terminals or computer ports, a composite interface and a Command Port. $1,290 and up. **Micom Systems Inc.,** 4100 Los Angeles Ave., P.O. Box 8100, Simi Valley, Calif. 93062-8100, (805) 583-8600.

Circle 468

Tool links PCs to databases

A network productivity tool, Multiplex links personal computers to databases on multiuser systems. The product uses Lotus 1-2-3, dBASE and other personal computer software to automatically format data. File transfer, network file management and terminal emulation are provided. $695. **Network Innovations Corp.,** 20863 Stevens Creek Blvd., Cupertino, Calif. 95014, (408) 257-6800.

Circle 469

LAN uses existing wires

A LAN without cables, GridNet uses existing AC wiring to link microcomputers. Error-free data is transmitted and received on electrical circuits without interference. System throughput is 23,040 bps. Full duplex operation and ASCII and binary information transfer is supported. $449 to $799. **GridComm Inc.,** 20 Old Ridge Road, Danbury, Conn. 06810, (203) 790-9077.

Circle 470

Board suits IBM PC/XT, /AT

An SDLC communications board for the IBM PC/XT and /AT, Adaptcom operates at speeds of up to 19.2K bps. It provides solutions for PC-to-host and PC-to-PC communications applications. The unit has one configurable interrupt level and allows users to configure the I/O base address. $245. **Network Software Associates Inc.,** 22982 Mill Creek, Laguna Hills, Calif. 92653, (714) 748-4013.

Circle 471

SBC uses Intel 8097 microcontroller

- 32 I/O lines
- 16-bit processor
- Two serial ports

A single-board computer for data-acquisition and process-control applications, the FX-97 uses the Intel 8097 microcontroller to provide 48K bytes of RAM, EPROM or EEPROM. The device connects directly to a terminal and power supply and may be used as a standalone system. It offers two serial ports, eight analog inputs with 10-bit resolution and 32 parallel I/O lines. The unit's 16-bit processor runs at 12 MHz. $425. **Allen Systems,** 2151 Fairfax Road, Columbia, Ohio 43221, (614) 488-7122.

Circle 472

I/O system provides data acquisition

- 16 I/O lines
- 300 to 9.6K bps
- RS232C, RS423 interfaces

Eliminating the need for bus interfacing, the SL-800E intelligent data acquisition I/O system communicates with host computers or terminal via an RS232C or RS423 interface. The unit operates at baud rates ranging from 300 to 9.6K bps. Sixteen digital I/O lines are configured as eight TTL-level inputs and eight outputs. The A/D resolution is 12 bits. Up to 90 systems can be daisy-chained on one RS232C/RS423 line. $995 to $1,895. **Syntest,** 40 Locke Drive, Marlboro, Mass. 01752, (617) 481-7827.

Circle 473

SBC mounts on disk drive

- IBM compatible
- Two serial ports
- 8088 CPU

An IBM PC/XT-compatible single-board computer, the Quark/PC, mounts on a 5¼-inch flexible disk drive. The board supplies 256K bytes of DRAM, an 8088 CPU running at 4.77 MHz, two serial ports, a parallel printer port and a flexible disk controller. A color graphics monitor and a BIOS are provided. Options include a bus expansion module and board, a 9.5-MHz speed-up mode and an additional 256K bytes of DRAM. $495. **Megatel Computer Technologies,** 150 Turbine Drive, Weston, Ontario, M9L 2S2, Canada, (416) 745-7214.

Circle 474

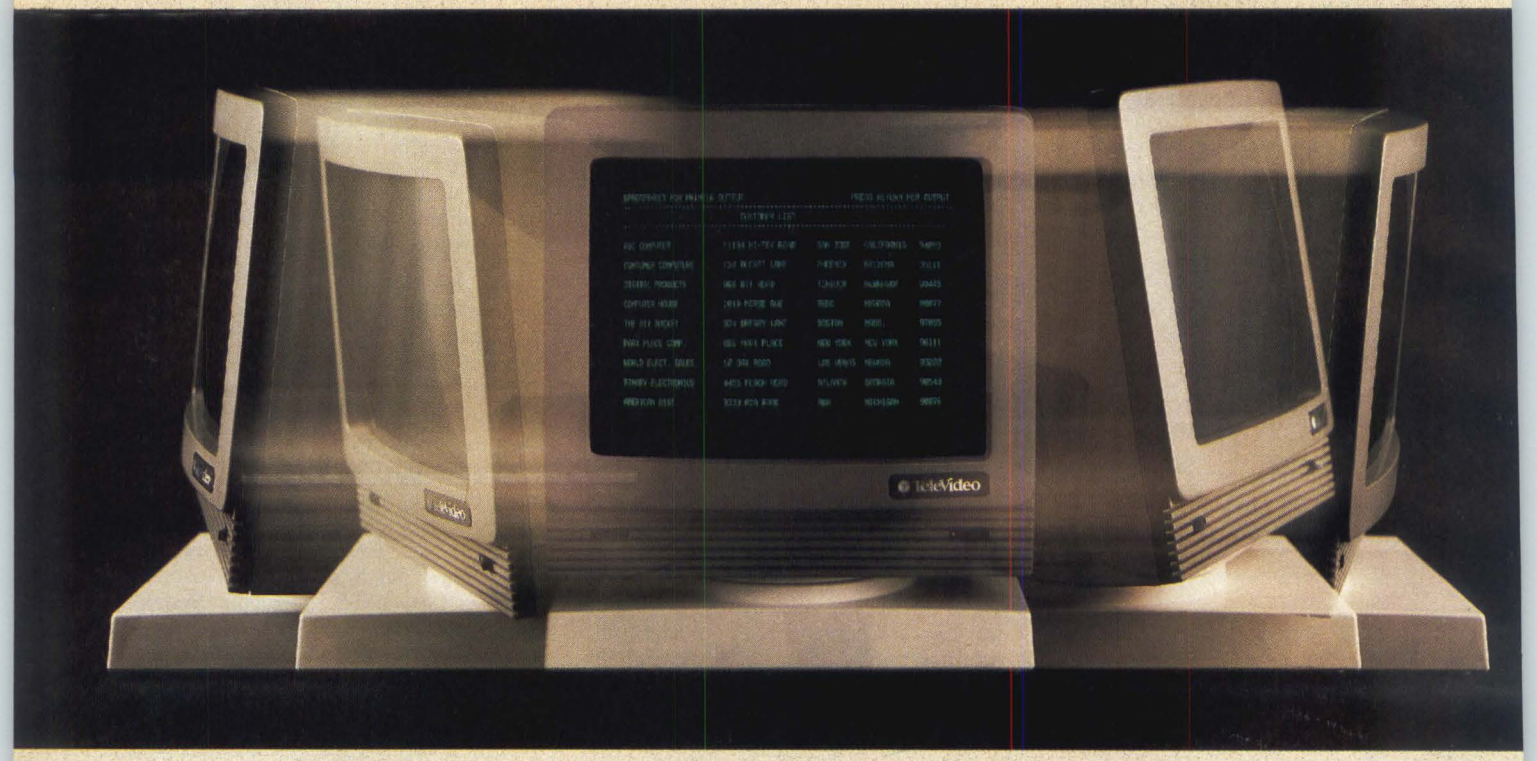
CPU card targets STDbus

- Hardware/software
- 120 commands
- Z80A processor

The 890 Multifunction CPU card works with the STDbus. It utilizes STD BASIC and application programs to talk to any STDbus peripheral card. Of the 120 commands, 44 speak to control systems on bit, BCD, 8-bit or 16-bit levels. The unit incorporates a 4-MHz Z80A processor, dual independent RS232C serial ports and four 8-bit counter/timer channels. Memory consists of 64K bytes of RAM and EPROM. An additional 64K bytes of RAM can be addressed on the STDbus. $385. **Octagon Systems Corp.,** 6501 W. 91st St., Westminster, Colo. 80030, (303) 426-8540.

Circle 475

The TeleVideo 905 terminal. What a difference $10 makes.



Let's face it; there are a lot of $399 terminals being sold these days. You get a basic box, a few tacked-on bells and whistles, and not a whole lot more.

But now there's the TeleVideo® 905. At $409,

TELEVIDEO 905 VS. WYSE WY-30		
FEATURES	TELEVIDEO 905	WYSE WY-30
Individual programmable function keys	16	4
Tilt and swivel standard	Yes	No
High contrast super dark Matsushita screen	Yes	No
WordStar® mode	Yes	No
Full-size keyboard	Yes	No

it has a feature set so powerful, your customers will think they're sitting at an expensive workstation.

For example, there's a sleekly designed monitor case with full tilt and swivel.

A full-size keyboard with sculptured keycaps for smooth, comfortable typing. Sixteen non-volatile, programmable function keys. Key-switches that have been tested to 100,000,000 strokes. Even an enhanced numeric keypad.

There's also a buffered printer port. And, of course, compatibility with the TeleVideo 925 command set, the most popular and widely emulated ASCII command set in the world.

The TeleVideo 905. What a difference $10 makes.

TeleVideo®
Settle for more.

TeleVideo Systems, Inc., 1170 Morse Avenue, Sunnyvale, CA 94088-3568, (408) 745-7760
AMSTERDAM: 31.2503.35444, PARIS: 33.1.4687.34.40, LONDON: 44.9905.6464

NEW PRODUCTS

LITERATURE

Pamphlet describes VMEbus products

This VMEbus brochure summarizes over 30 hardware and software products. Among other things, it describes and illustrates a single-enclosure development system; 16-bit, single-board CPUs with speeds up to 12.5 MHz; and memory boards with parity checking or EDC data security. Segments on I/O and graphic controllers, rigid- and flexible-disk units, backplanes and power supplies are included. Free. **Plessey Microsystems,** 1 Blue Hill Plaza, Pearl River, N.Y. 10965-8541, (914) 735-4661.

Circle 476

Brochure details datacom devices

The 34-page "Datacom Cookbook" deals with data communications networks and multiuser computer systems. Catagories include short-haul modems, interface converters, test equipment and multiplexers. Information is supplied for port-sharing devices, cables, lightning protection and for obtaining datacomm books. Free. **Telebyte Technology Inc.,** 270 E. Pulaski Road, Greenlawn, N.Y. 11740, (800) 835-3298.

Circle 477

Book examines LAN topics

The expanded *LOCALNetter Designer's Handbook* lists buyers, vendors and designers of local networks and network products. This 496-page fourth edition contains 14 articles on LAN-related topics as well as specific information on LAN systems and products. A listing of international distributors and sales offices is provided. $102. **Architecture Technology Corp.,** P.O. Box 24344, Minneapolis, Minn. 55424, (612) 935-2035.

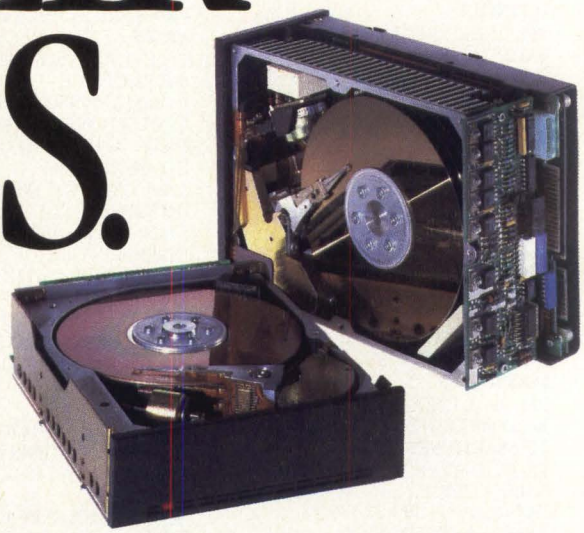
Circle 478

Guide tabulates systems products

The second annual *Kierulff Systems Designers Guide* supplies information on the computer products and systems, peripherals, data communications equipment and software of more than 25 manufacturers. The 320-page volume reviews technology in specific product areas. Free. **Kierulff Distribution Professionals,** 10824 Hope St., Cypress, Calif. 90630, (800) 367-7767.

Circle 479

FASTEST OF THEIR SPECIES.

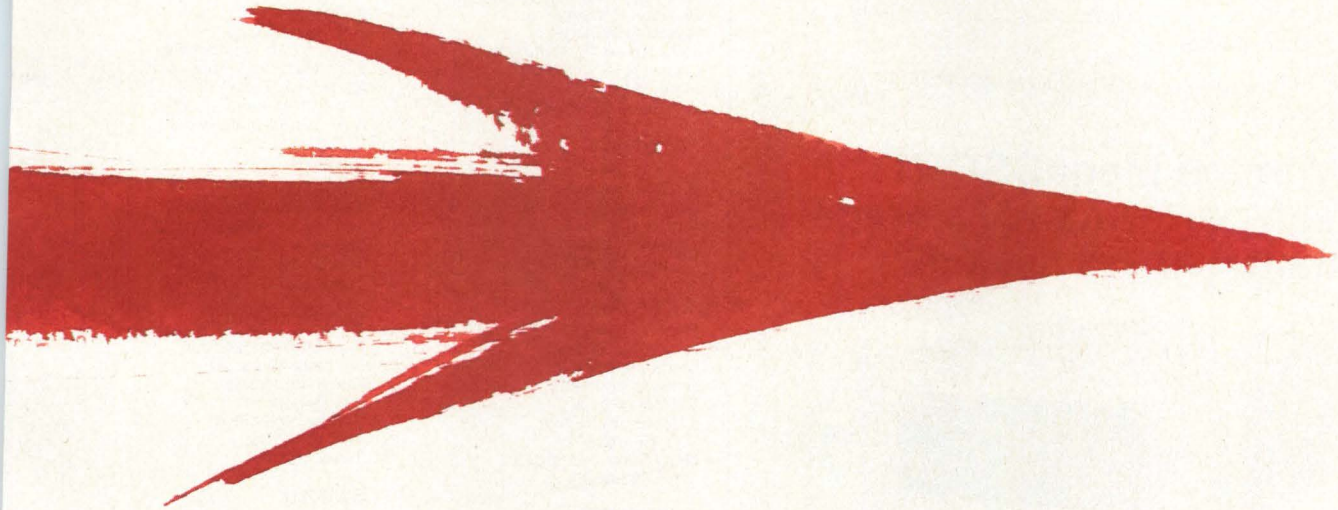


Announcing the Wren™ II Half-Height and Wren III 5¼" drives.

Two high performance, high capacity drives that represent not only the fastest of their species, but the best engineered, best designed drives in the world.

The Wren II Half-Height has 51 MB of unformatted storage, (40 MB formatted), with a typical seek time of 28 ms. The fastest in its category.

The Wren III is the fastest high capacity unit available anywhere. It stores up to 182 MB with a typical seek time of 16.4 ms.



Both have 20,000-hour MTBF and require no preventative maintenance. And both are covered by the best support services in the industry.

The Wren family offers a variety of industry standard interfaces, including ST506 on the Wren II Half-Height. The Wren III offers ESDI and SCSI.

No one in the world has sold more 5¼" high performance, high capacity drives than Control Data. A sure sign of satisfied customers.

For more information, call 1-800-828-8001 ext. 82. (In Minnesota, call 612-921-4400 ext. 82.) Or call your local Arrow or Kierulff distributor.

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CIRCLE NO. 71 ON INQUIRY CARD

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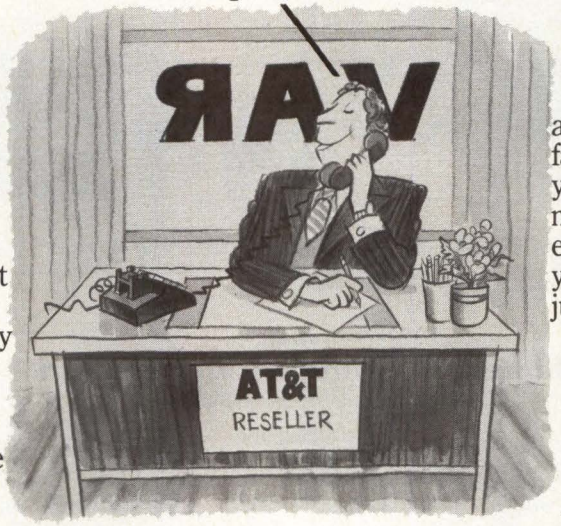
Sherri Gronli
Group Manager

Promise them AT&T. Then call Ducommun Data Systems.

"Let me get this straight. You need fifty of the AT&T PC 6300 Pluses with internal tape drives by Monday Morning? No problem."



Of course, by calling Ducommun Data Systems first, you'll be absolutely sure of keeping the promises you make your customers.

DDS, after all, is the largest national master value added AT&T distributor. In fact, nobody stocks as many AT&T products as we do. Systems like the UNIX-based 3B family including the new 3B2/310 and 3B2/400. The UNIX* PC, too! Plus MS-DOS based products like the PC 6300 and the all new PC 6300 Plus.

Also, only DDS can build you special configurations like the PC 6300 with internal tape and 40 MB storage or 40 MB UNIX PCs.

DDS even offers you the AT&T Teletype line, AT&T co-labeled software and authorized AT&T service. Whew! What could be more promising?

But there's more. DDS handles the widest range of peripherals and software from leading manufacturers. In other words, when you need printers, or data base management programs, or whatever, get it through DDS. We're your one single reliable source for just about everything.

And we're your best source for service and support. DDS people work hard. DDS people know your business. We're ready to integrate equipment and software into progressive systems you can sell with confidence.

That's our promise to you. Count on it. And call us. We'll send you our new catalogue. Ducommun Data Systems, 10824 Hope Street, Cypress, CA 90630. **1-800-FOR VARS.**

*UNIX is a trademark of AT&T Bell Laboratories.

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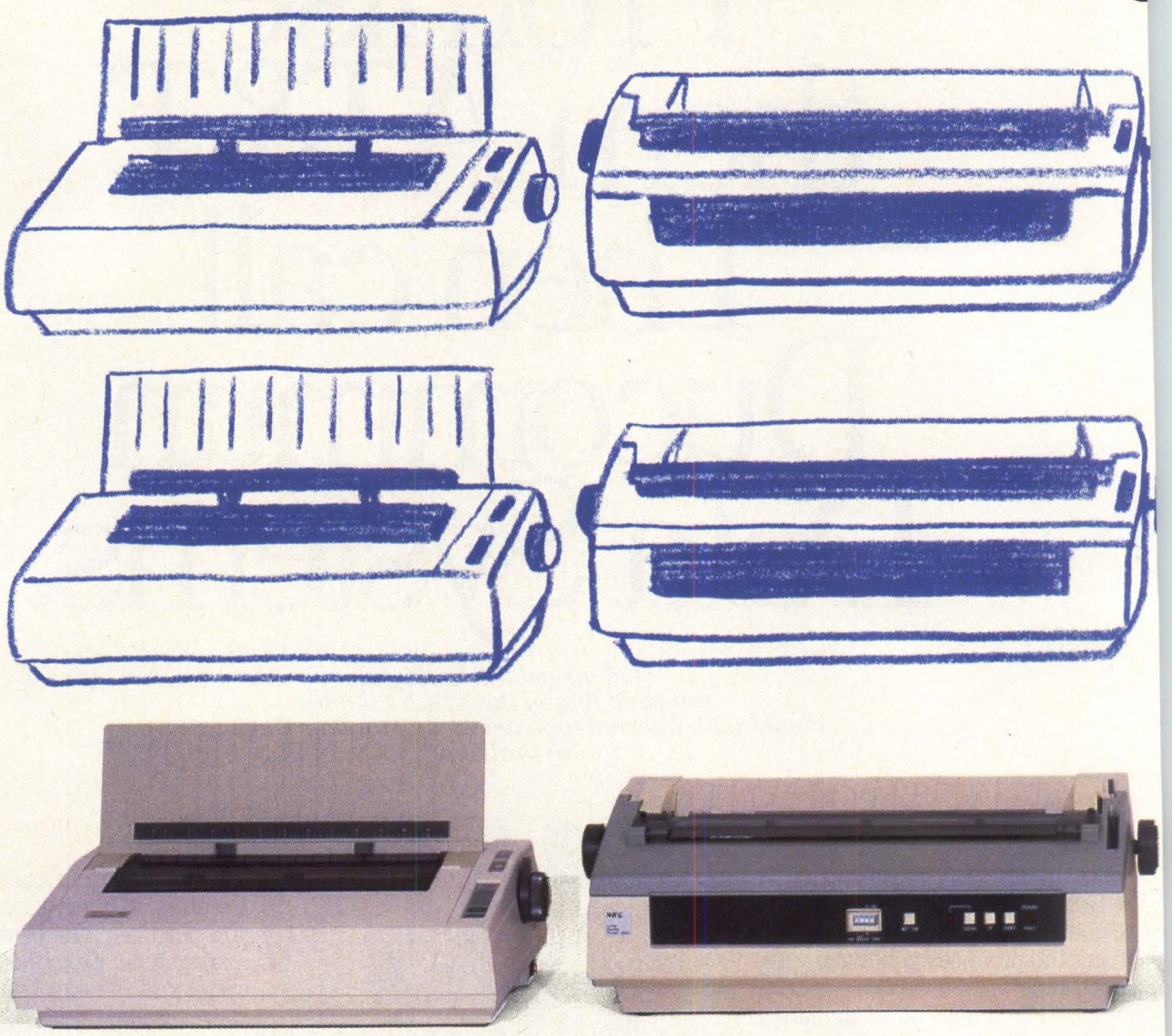
AT&T · AT&T Teletype · Ashton-Tate · Alloy · CDC · Convergent · Data Technology Corporation · Dataproducts · DEC · FIS · HANDLE · Lear Siegler · 3-M · NEC · Quadratron · Qume · Sola · Tandon · Televideo · Thesys · TI · Touchstone · Unify · Western Digital · WYSE

CIRCLE NO. 11 ON INQUIRY CARD

The perfect way to accent Bi



The IBM-compatible NEC printers from Hall-Mark.

You've got an IBM or compatible personal computer. And you're looking for a flexible printer that can deliver the quality you want at an affordable price. Your search is over. NEC makes your printer, and Hall-Mark has it in stock.

Maybe you need the letter-quality performance of the Spinwriter 3500 or 8800 Series with its famous print thimble and over 70 type fonts to choose from.

Or perhaps the Spinwriter e•l•f 300 Series printer would suit your needs. It's a good, reliable, letter-quality printer for medium-usage environments at a remarkably low price.

Looking for versatility? Then the Pinwriter P2 and P3 dot matrix printers are for you. From 180 cps

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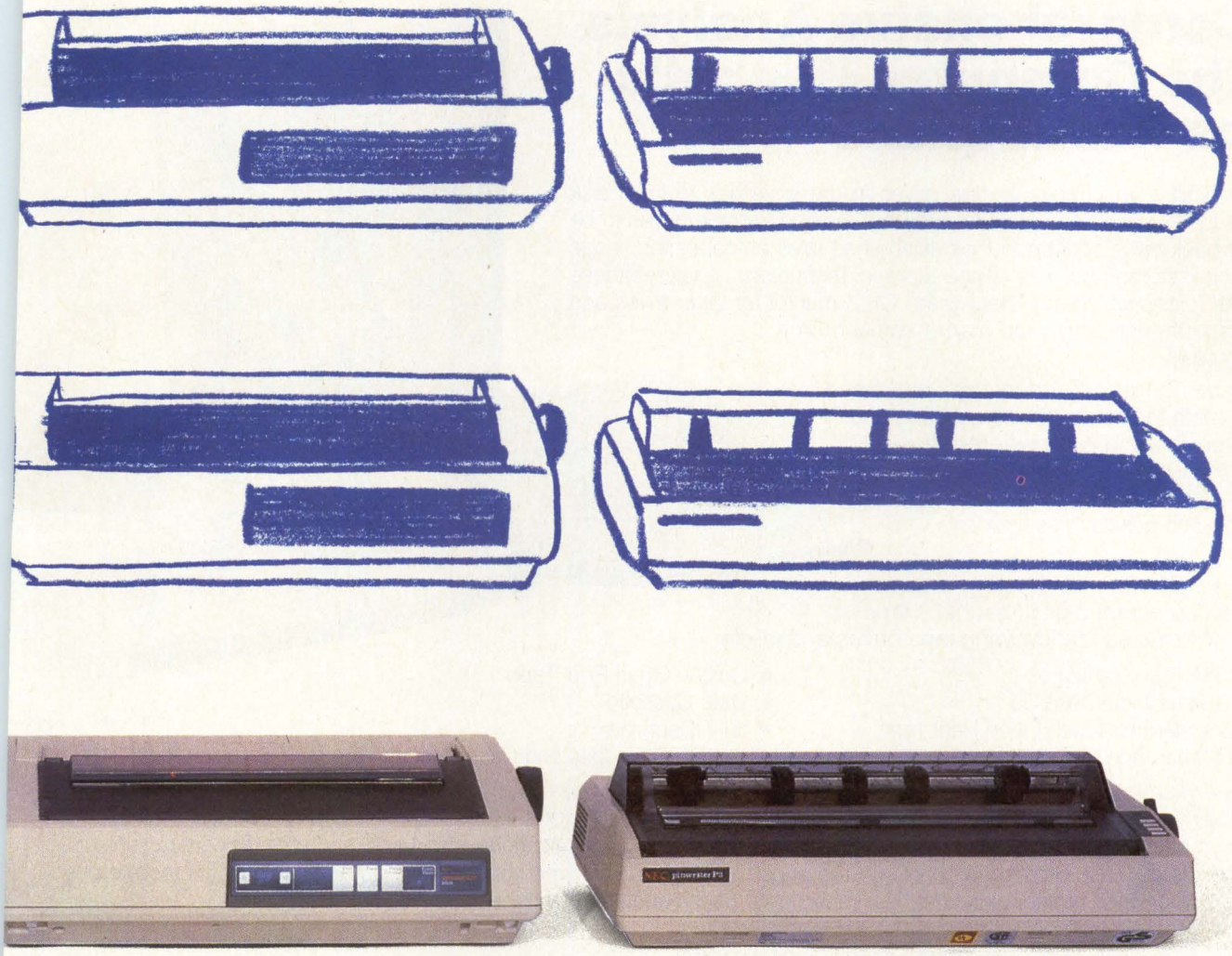

high-speed data processing to 90 cps high density to 30 cps near letter quality, it has the print modes for all your applications.

Need the highest performance levels available? The Pinwriter P5 is the fastest, quietest 24-wire dot matrix on the market today. It has nine built-in character fonts with eight more plug-in fonts available. Speeds range from 100 cps near letter quality to 290 cps data processing. The Pinwriter P5 is a printer that can grow with you.

Hall-Mark has all these NEC printers and their accessories in stock right now, ready for delivery. So call today. Hall-Mark has the products you need and the service you require because we care about your success.

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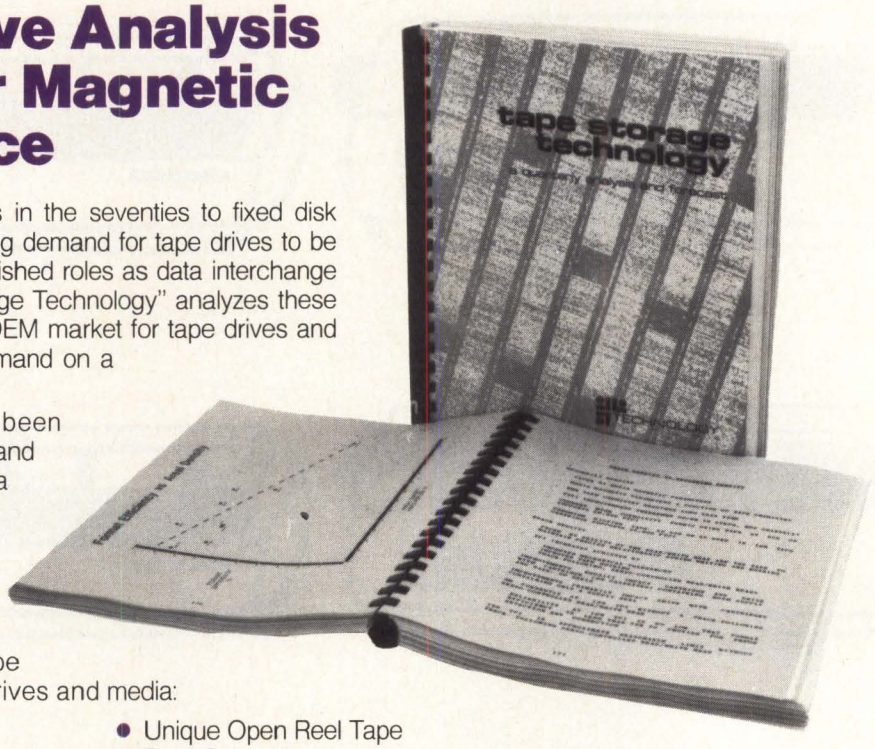
CIRCLE NO. 74 ON INQUIRY CARD

TECHNOLOGY
FORUMS

A Comprehensive Analysis of the Computer Magnetic Tape Marketplace



The shift from removable disk drives in the seventies to fixed disk drives in the eighties has created a growing demand for tape drives to be used for back-up in addition to their established roles as data interchange and archival storage devices. "Tape Storage Technology" analyzes these and other forces which are shaping the OEM market for tape drives and forecasts both technology and market demand on a quarterly basis.

"Tape Storage Technology" has been prepared with the needs of both suppliers and integrators carefully considered. It is a comprehensive yet focused planning tool for product planning, engineering, marketing, and general management personnel.

"Tape Storage Technology" covers all computer digital magnetic tape products, including the following tape drives and media:

- IBM Tape Cartridge
- Quarter Inch Cartridge
- Standard Half Inch Open Reel Tape
- Quarter Inch Mini-Cartridge
- Unique Open Reel Tape
- Data Cassette
- Mini-Cartridge
- Unique Cartridges and Cassettes

The dynamics of the peripheral storage marketplace often rener annual reports on magnetic tape drives out-of-date well before their next publication date. By updating and publishing quarterly, clients who subscribe to "Tape Storage Technology" will always have access to the latest data on technology, forecasts, specifications, standards, and other important subjects. Single copies of "Tape Storage Technology" are priced at $995. Clients who subscribe on an annual basis will receive one current copy for each quarter of their annual subscription period at an annual price of $2495.

Disk Storage *Technology Seminars*
Tape Storage *Technology Seminars*

Three-hour seminars are given periodically by industry experts on both magnetic disk and tape. These seminars are held on the same day to facilitate attendance at both. Some of the subjects covered are Technology, Standards, Forecasts, Market Trends and New Products.

I would like to receive the "Tape Storage Technology" Report. Please send me:

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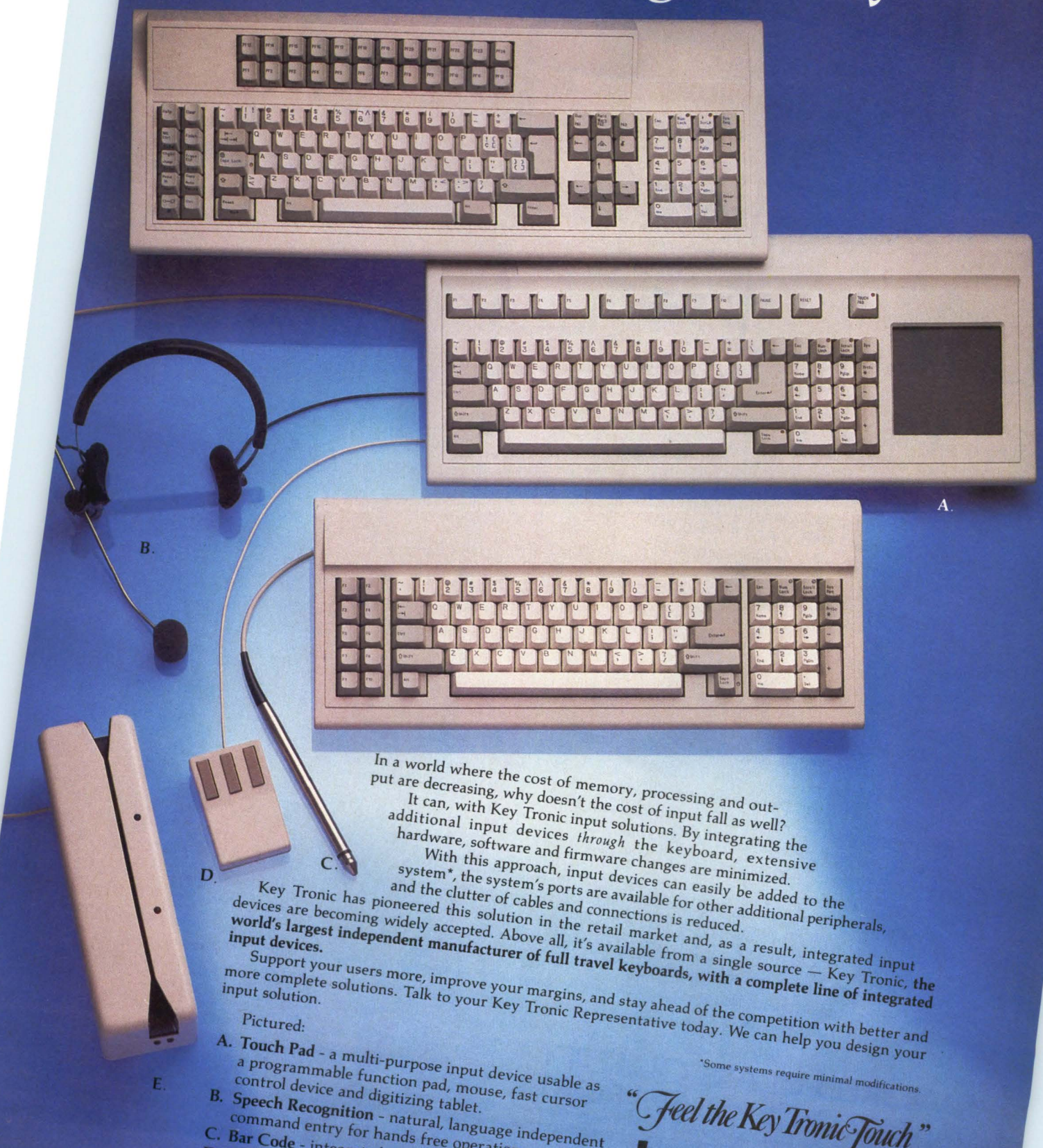
CIRCLE NO. 75 ON INQUIRY CARD

Input Devices -
The Solution is Through the Keyboard



In a world where the cost of memory, processing and output are decreasing, why doesn't the cost of input fall as well?

It can, with Key Tronic input solutions. By integrating the additional input devices *through* the keyboard, extensive hardware, software and firmware changes are minimized.

With this approach, input devices can easily be added to the system*, the system's ports are available for other additional peripherals, and the clutter of cables and connections is reduced.

Key Tronic has pioneered this solution in the retail market and, as a result, integrated input devices are becoming widely accepted. Above all, it's available from a single source — Key Tronic, **the world's largest independent manufacturer of full travel keyboards, with a complete line of integrated input devices.**

Support your users more, improve your margins, and stay ahead of the competition with better and more complete solutions. Talk to your Key Tronic Representative today. We can help you design your input solution.

*Some systems require minimal modifications.

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A fraction of the size.
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The higher capacity is made possible by the use of 8 disks and 15 heads. Yet the drive still fits in the industry-standard form factor. So you can put 2 gigabytes in a standard rack-mount drawer. Or 1 gigabyte in a half-height drawer.

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Both models in the new MK-280FC Series feature 18ms average access time, the high-speed SMD interface, and a center-stack servo for the last word in data reliability.

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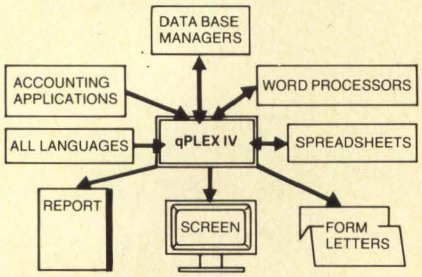

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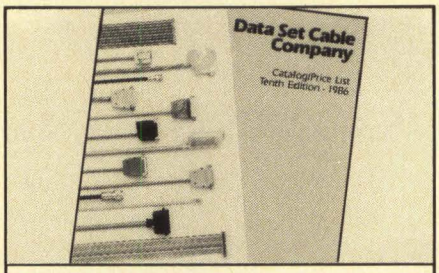

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July 9-11, 1986

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If you buy or influence the purchase, management or implementation of PC-compatible systems, hardware, software and services or if you are a dealer, distributor or other "value adding" reseller, then you can't afford to miss this year's only opportunity to see what's new and what works in the PC-compatible industry.

PC EXPO is Big,
Five New York City square blocks of PC-compatible exhibits all come under one roof at the stunning new Jacob K. Javits Convention Center of New York this July! Meet more than 400 principal vendors who are waiting to talk to you "face-to-face" about your PC-compatible needs and purchases. PC EXPO exhibitors are prepared to provide you with everything you need to know in order to make informed buying decisions.

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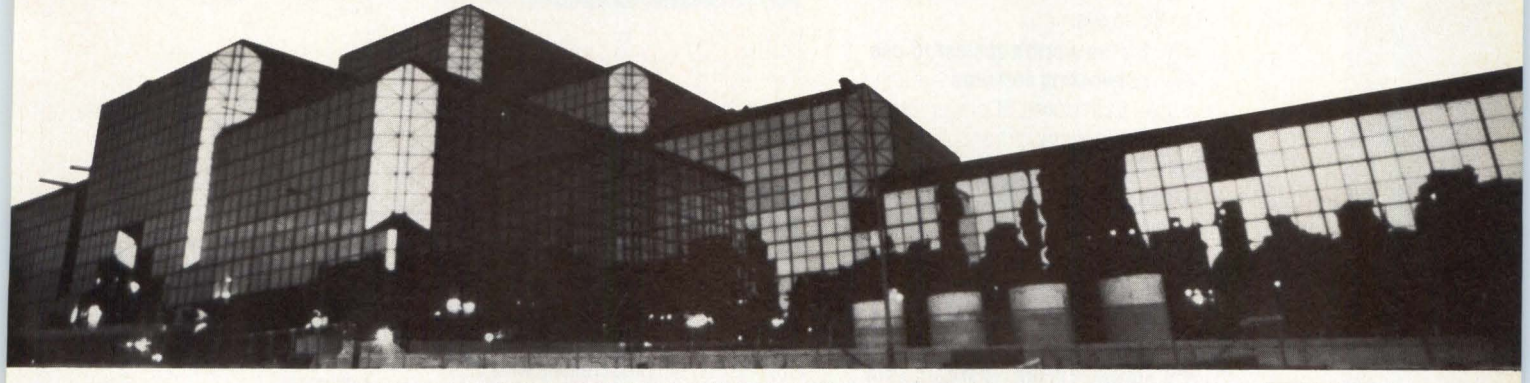

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E ☐ Construction/Architects
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HH ☐ Engineer (all)
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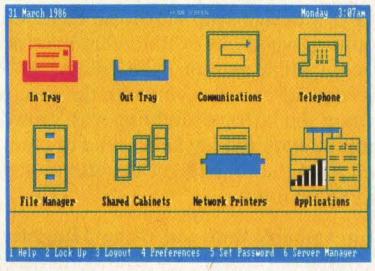
CIRCLE NO. 78 ON INQUIRY CARD

A remarkable breakthrough for LANs—one that's easy to use: Tapestry

No matter what local area network hardware you choose—your next choice should be Tapestry network operating software from Torus Systems. Here are 6 reasons why.

1 IBM chose Tapestry, for its overseas market, and it quickly became the hottest LAN system in Europe.



This is the friendly screen that caught Big Blue's eye.

2 It's the world's easiest-to-use networking software—much simpler than Novell, 3Com, or IBM because Tapestry is managed with icons. To use it, you just point to graphic symbols: the "in-tray" to get mail, the "cabinet" to access files, and so on.

You even use icons to configure the system, so almost anyone can set up a Tapestry network—and keep it running smoothly.

3 Tapestry is the most complete LAN software money can buy.

The basic system gives you:

• Advanced electronic mail

Compose memos with the Torus text editor. Send them to any person or group on the network, just by pointing to names. Track the mail you've sent. Get messages instantly.

• Cost-effective sharing of hard disks, printers and modems

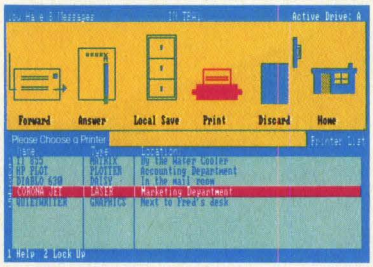
You can have up to 100 Tapestry workstation/servers and access any one of them by touching the right icon. Since all Tapestry servers are undedicated, each station is free for business as usual. You don't have to invest in specialized hardware, or sacrifice your valuable PCs.

• Advanced communications capabilities

Need information from the company mainframe or an outside service? Just point to the desired Service icon. Torus offers a family of network gateways* that automatically make the connection and speed your information through.

• And there's more!

Tapestry also provides central storage of all your applications so they too can be accessed with icons. Automatic file locking so you can safely run single-user applications not originally designed for networks. File Manager icons that let you manipulate files without using DOS commands. And a Telephone Manager that places your calls and maintains a personal electronic rolodex.



What good is a network if your people don't know how to use it? Tapestry's screens are so easy to understand, anyone can net great results without special skills or training.

4 Tapestry supports all the standards, like IBM Token-Ring, PC Network and 3Com hardware. Like PC-DOS 3.1 and NETBIOS. So you can choose the LAN hardware that's best for you, and you won't have to worry if your software will run.**

5 Tapestry is proven and reliable. Thousands of Tapestry stations have been installed in both large and small companies in the U.S. and around the world. Customers include: Proctor & Gamble, EDS, the White House, the IRS, Prime Computer, TRW, NBC News, Shell Oil, Exxon and Citicorp.

6 With this coupon you get a FREE Network Manager AND a money back guarantee!

Usually, Tapestry costs $495 for your first workstation (the Network Manager) and $295 for each additional station.† BUT NOW YOU CAN GET A TAPESTRY STARTER PACK (BOTH THE MANAGER AND THE SECOND STATION) FOR ONLY $295!

And we're so confident you'll love Tapestry, we'll let you return it—for any reason—within 30 days of shipment and we'll gladly refund your purchase price (less $50.00 restocking fee).

So send this coupon to us, take it to your Torus Dealer, or call in your order today, and start networking the easy way.

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System Requirements: Station 1: IBM PC, XT, AT or compatible 384K, 10MB hard disk. Station 2: IBM PC, XT, AT or compatible 320K. Plus suitable networking hardware.

Notes: *ASYNC is standard, while VT100, 3270 SNA, and Remote Access are purchased separately. **Tested applications include: dBase III Plus, MultiMate Advantage, Open Systems Accounting, Displaywrite 3, WordPerfect, MS Word, Lotus 1-2-3, AutoCAD.

†6 Station Pack—$1495, 24 Station Pack—$3995.

CIRCLE NO. 79 ON INQUIRY CARD

GO FOR IT

The Supermini Real-Time Benchmark Challenge

Take your best shot

We're throwing down the gauntlet and challenging you to challenge the best. If you're evaluating high performance supermini systems, **demand a benchmark**. Try the parallel processing power and awesome real-time efficiency of our 3280 MPS against the other guys. Read on and we'll tell you how to set it up today. But first, take a look at what they'll be up against.

The 3280 has:

- As low as $26K per MIP
- Easy expansion
- Up to 33 MIPS
- Growth without replacement
- High availability
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- 64 MB/sec. bandwidth

And if that doesn't impress you, check out these High-End Supermini price performance numbers:

	Concurrent Computer Corporation 3280MPS	DEC 8600	DEC 8650	DEC 8800
Entry-Level System Price	**$250,000 to $860,000**	**$350,000**	**$475,000**	**$650,000**
Performance in MIPS*	**6 to 33.8**	**4.7**	**6.9**	**11.3**
$K/MIP	**$40.7K to $25.5K**	**$74K**	**$68.8K**	**$57.5K**

List prices are for processor only or entry-level configurations.
*Single precision whetstones.

The truth is the proof

We're putting the test of real-time on the line.

All you have to do is fill out the coupon or call. We'll put you in touch with one of our worldwide benchmark centers. They'll show you how the 3280 MPS is making real-time performance history by meeting the toughest real world challenges.

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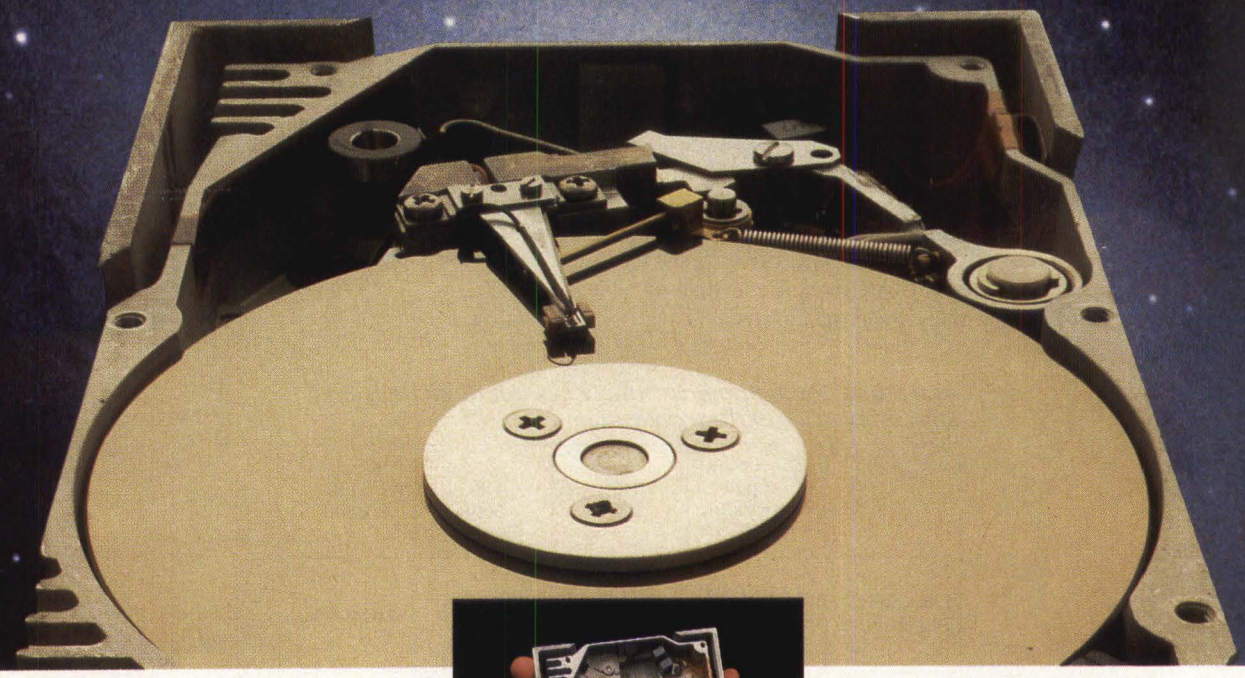
CIRCLE NO. 80 ON INQUIRY CARD

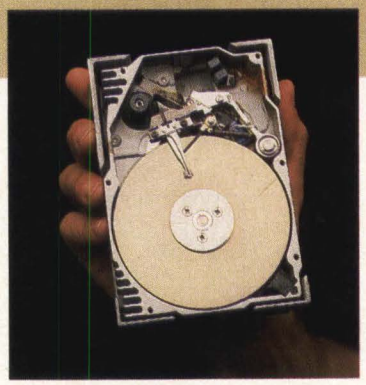
THERE'S A REASON WHY THEY DON'T PARK PLANES ON THE RUNWAY.



Parking violations.
Most Winchester manufacturers "park" the read/write heads on the media. That's where the trouble starts. Like stiction between the heads and media causing drive failure on start-up. Or shock and vibration causing the heads and media to slap together, which can mean errors, lost data, head crashes.

Heads-up technology.
That's why all Titan™ 3.5-inch 20 Mbyte Winchesters have LaPine's patented head lifters. To hold the heads off the media during power-down. So there are no take-offs and landings. Not only do the heads never "park on the runway," they never touch the media at all.

Top flight performance.
Because the heads don't rest on the media, LaPine's Titan drives are virtually shockproof, built to withstand 60 G's shock and 2.5 G's vibration. And at 5°C to 55°C, the operating thermal range is the widest around. To speed system throughput, track-to-track access time is just 15 MS, with an average access time of 65 MS.



Shockproof 3.5-inch 20-Mbyte Winchesters that eliminate head-disk wear and stiction — completely.

LaPine means reliability.
Only LaPine eliminates the three main causes of Winchester failure:

- *Eliminates stiction.*
  Heads don't touch or park on media, so they can't adhere.
- *Prevents head/media wear.*
  Heads never contact disks, even during power down.
- *Ends head-slap.*
  Shock and vibration can't damage the heads or media.

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For your customers, this means reliability, durability and data dependability. In even the most demanding applications. And now they're backed by the only two year warranty in the industry.

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To compete in today's systems markets, you need the most reliable Winchester storage there is. You need LaPine. Affordable quality you and your customers can't afford to be without.

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182 Topaz Street
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408-262-7077
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*Patent pending.