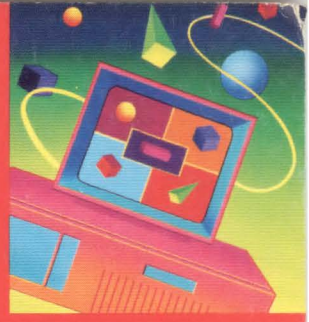
▲ **DEC'S 8800:** BIG SPLASH LITTLE NEWS

▲ **PLUS:** HC/WG LABS' RICHARD STEINCROSS ADDS A WINCHESTER TO THE MACINTOSH

StorAGE PAGE 15

TCP/IP: ALEN DARR MAKES THE CONNECTION



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MAY 15, 1988, VOL.8, NO.5 $3.00

REPORT 5 **INTERFACES AND CONTROLLERS** PAGE 40

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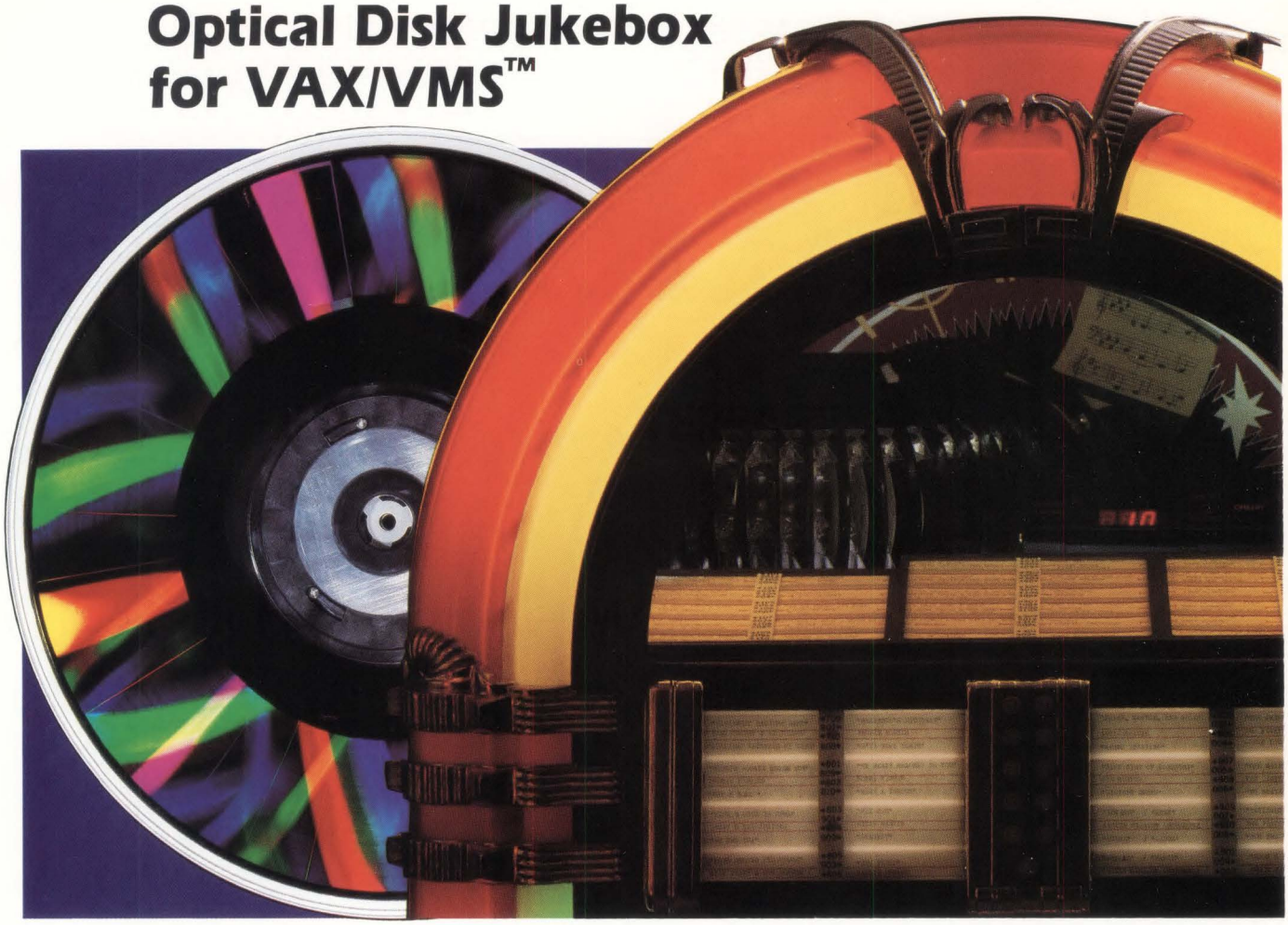

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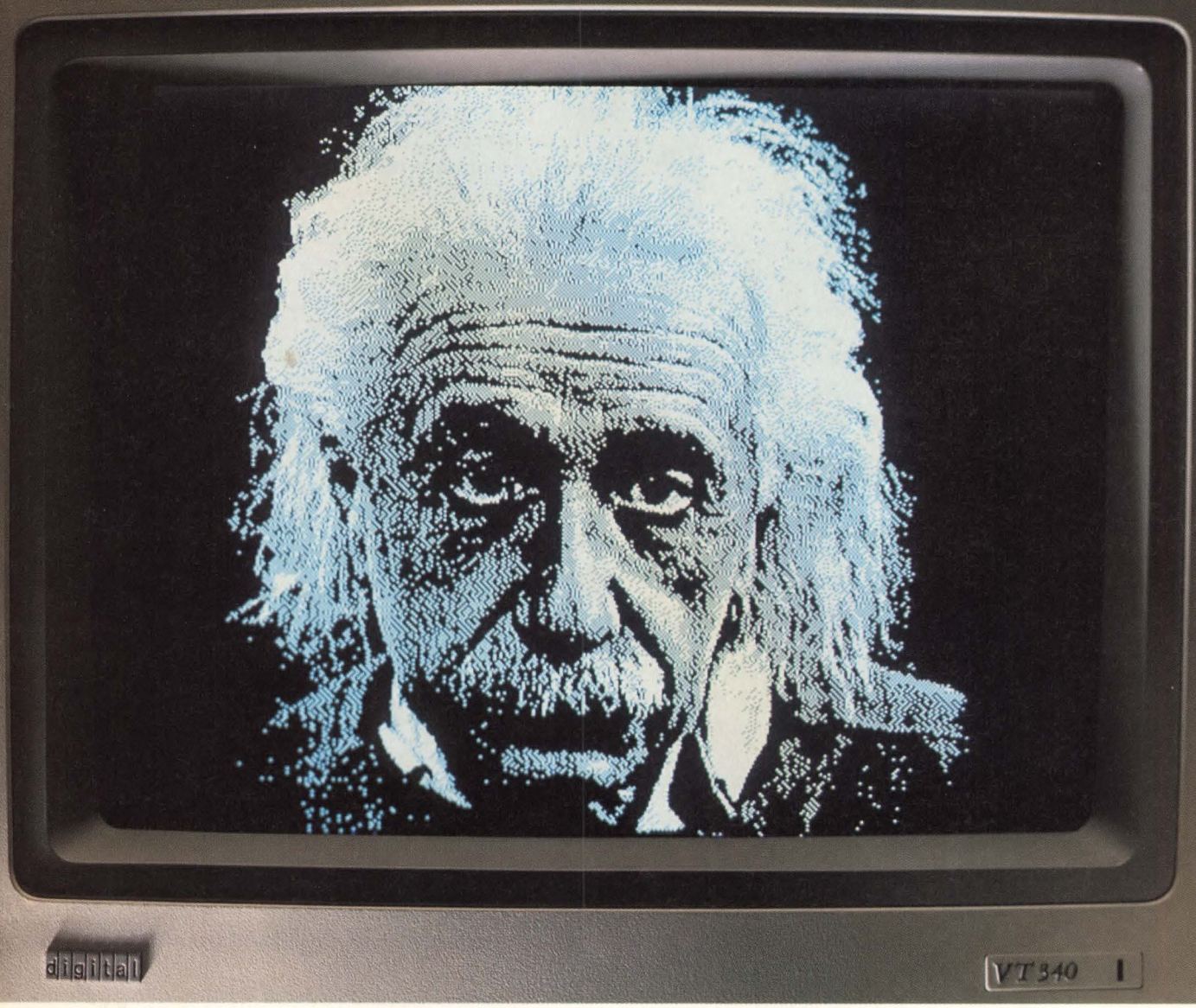

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CIRCLE 473 ON READER CARD

From The Blue Line

"Flummery, nothing but flummery," that's what my favorite paperback detective Nero Wolfe would call it. I say just plain phooey. The computer industry is indeed a bunch of crybabies. Two cases in point: disk drives and semiconductor memory—both of which are made in the Far East. Countries like Japan and Korea have taken leadership roles in fast, reliable production of these products. Not on their own initiative, mind you, but because we practically begged, and indeed subsidized, their enterprise. And in the course of establishing a manufacturing dominance, they took both industries away from American manufacturers. The disk drive makers started the trend by looking around for lower labor costs and moving manufacturing offshore. The result was that we lost the entire flexible disk market to Japan Inc., and virtually all high-volume manufacturing of rigid disks is done in Japan, Korea, or Hong-Kong.

Now, at the behest of the U.S. electronics industry, the Federal government has slapped heavy import duties on electronic components and devices made in the Far East. The idea, of course, is to encourage the purchase of U.S.-made goods. The only problem is there aren't any. The disk drive industry, which partly lobbied for the strong import measure, is now singing the blues.

Consequently, a consortium of disk drive manufacturers has been formed to lobby Congress into letting the "good guys" off the import hook. They argue that they shouldn't be responsible for extra duties since they are U.S. companies.

Come on guys. If you want to lobby for something that will do the industry some good, ask Congress for good tax incentives to bring full production back on shore. Norm Peterson, the CEO of Fujitsu America, is viewed as God in Oregon and Japan both. First he brought employment into what is an otherwise dank employment area, and made Fujitsu almost bulletproof against the onslaught of import duties. Good going Norm, wouldn't it be nice if everyone else followed suit.

But crying to Congress to get duties lifted isn't the end of the avaricious, or protectionist attitude of current high tech.

Now, companies are price gouging on the cost of semiconductor memory. It seems that if you're big enough, you can get a RAM supplier to forget about earlier and lower-cost contracts and supply you; conveniently forgetting about the other guy—the line being, if you want the RAM, you have to be willing to renegotiate the contract at the higher rate.

Those of you who are seeking out stores of RAM probably remember when DRAM prices were in the less-than-$1 range. A year ago, 256K DRAMs had a distribution selling price of $0.85 for 150 nsec and just a tad more than a buck for the fast 100 nsec. Prices were even less on spot markets. The Mbyte chips really weren't an issue since they were only sampling. Now they are shipping in quantity, and you do have to pay the going rate. The HC/WG Lab index of RAM prices shows a mean of $8.16 spot market for 120-nsec, 256K RAM and $37.88 for the 1M equivalent. The latter is the most legitimate since the big memory chips are in short supply and just now moving into the market stream.

If you're on the buying end of this cycle, you're probably screaming bloody murder—the seller surely isn't. And you can expect the price to take another leap before November.

Carl Warren
Editor In Chief

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PUBLISHER George R. Seldin
ASSOCIATE PUBLISHER Susan R. Francis

EDITOR IN CHIEF Carl Warren
MANAGING EDITOR Catherine Semar
MIDWEST EDITOR Brad Harrison, *500 W. Prospect, Ste. 11I, N. Aggie Village, Fort Collins, CO 80526, 303-491-8963*
EAST COAST EDITOR Lynn Haber, *6 Faneuil Hall Marketplace, Boston, MA 02109, 617-723-2477*
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SENIOR SCIENTIST AND LAB MANAGER Steve Bostwick
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SENIOR RESPONDENT—SOFTWARE Chris Serrano
RESPONDENTS Alen Darr, Mark Duvall, John Schimpf, Moses Sun

EXECUTIVE DESIGN DIRECTOR Roger L. Morrison
PRODUCTION MANAGER Dave Dalmas
ASSISTANT ART DIRECTOR Marianne Weldon

NATIONAL SALES MANAGER Cal James Franklin, *1061 S. Melrose Ave., Ste. D, Placentia, CA 92670-7180, 714-632- 6924*

CIRCULATION DIRECTOR Dianne Hoff
MARKETING MANAGER Renee P. Brown

ADMINISTRATIVE SERVICES Wendy R. May
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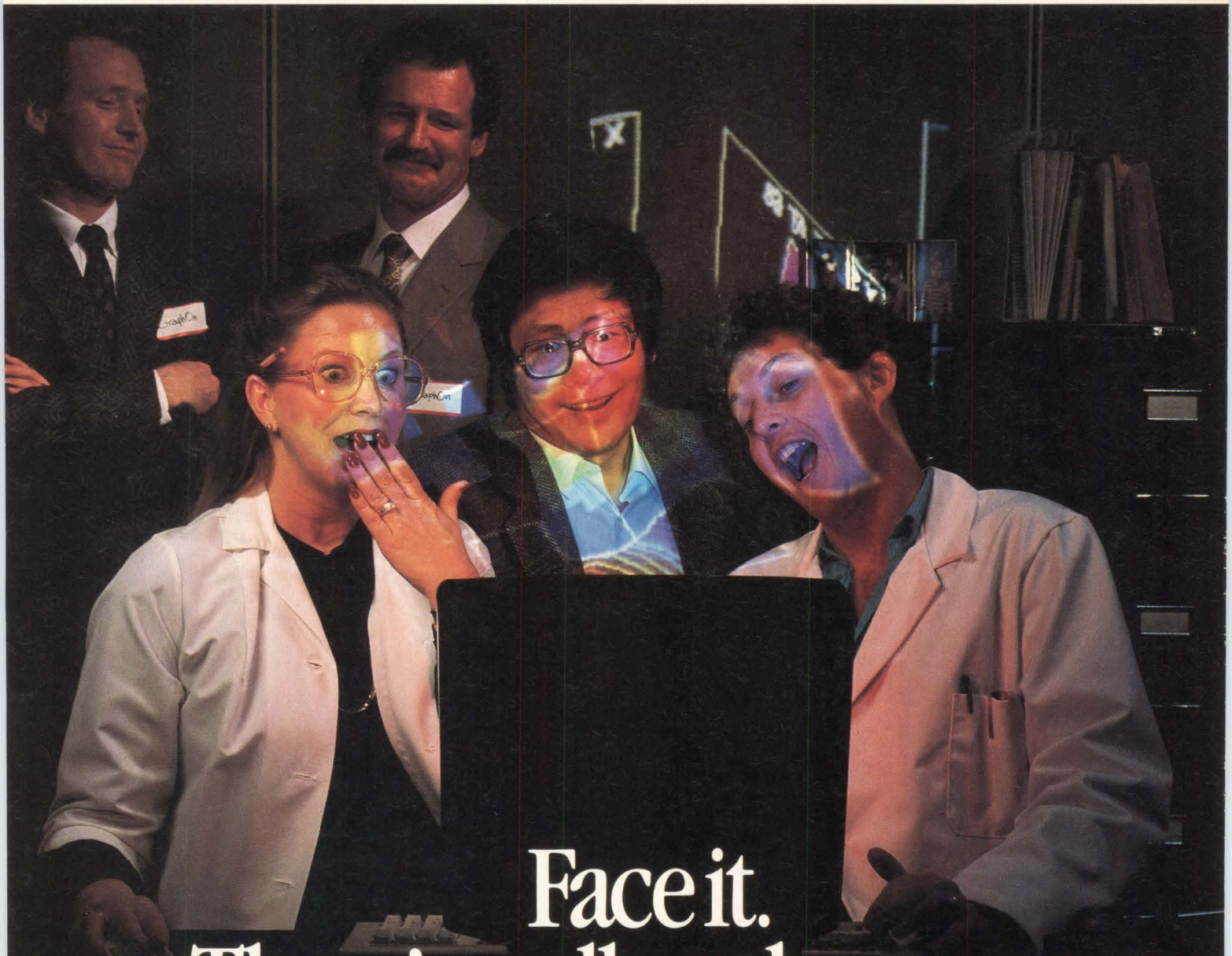

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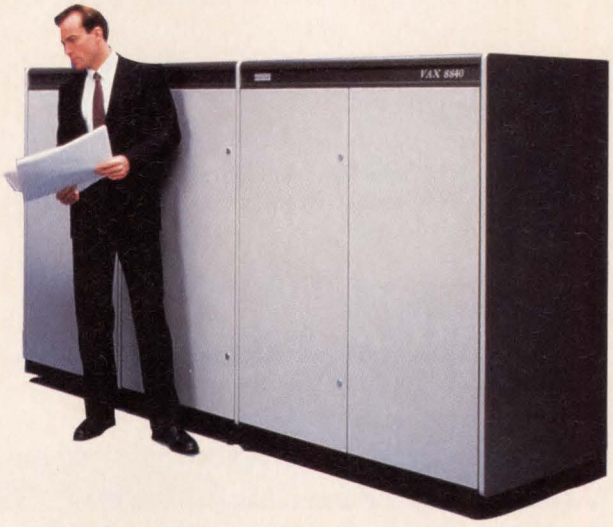

VAX 8800—a migration path for current customers who are running out of processing steam—page 24

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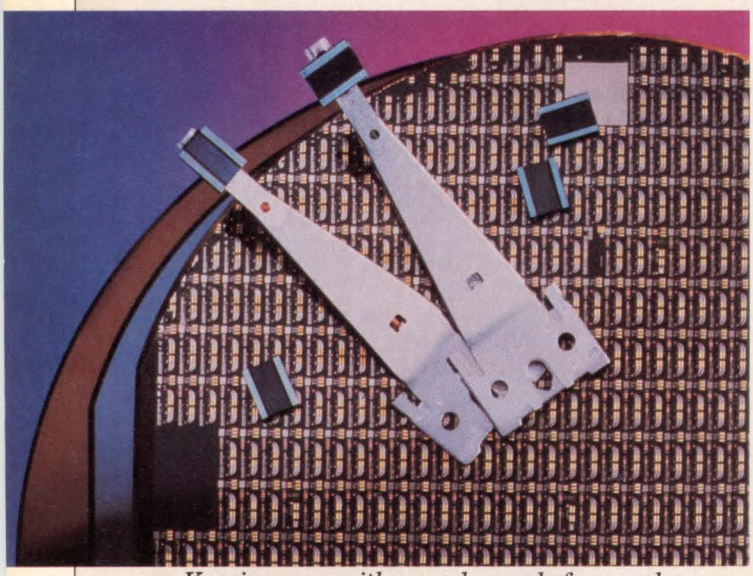

Keeping pace with your demands for speed, capacity, and reliability—StorAGE *page 8*

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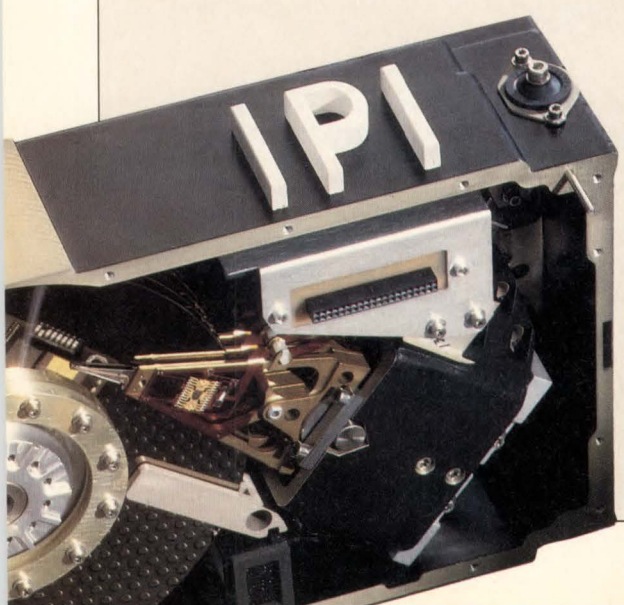

Peripheral controllers take on the role of information highway and traffic cop—page 40

Alen Darr makes the TCP/IP connection via Excelan's Ethernet system—page 96

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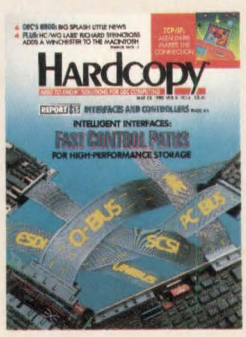

This cover, created by Ed Bright, Emulex marketing communications manager, depicts controllers taking on the role of an information highway that links CPUs with support storage devices. The notion is that "smart" interfaces ensure that performance is tuned to the applications at hand. (Photography by Frank Longford).

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Digital's VAXmate desktop computer with Digital LA75 companion printer

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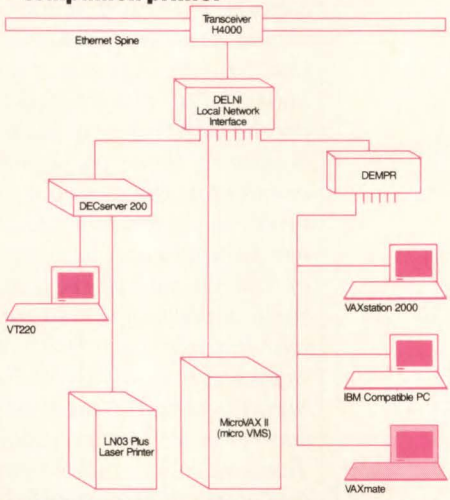
We are also a full service distributor. In addition to our networking expertise, MTI is your source for all computer and data communications equipment. We offer sales, leases, or rental plans, service contracts and supplies and accessories. Our prices are very, competitive, too. Call us today.



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If you have questions regarding *Hardcopy* editorial, feel free to contact the appropriate *Hardcopy* editor/author.

I. Dal Allan & Ken Hallam, I/O
ENDL Consulting
14426 Black Walnut Ct.
Saratoga, CA 95070
408-867-6630

Steve Bostwick, Senior Scientist
HC/WG Labs
1061 S. Melrose Ave., Ste. D
Placentia, CA 92670-7180
714-632-6924

Milton Campbell, RT-11
Talisman Systems
Drawer CP255
Manhattan Beach, CA 92503
213-318-2206

Steve Davis/Matthew Owen,
VAX/VMS Toolbox
Owen+Davis Systems
3100 Airway Ave. #116
Costa Mesa, CA 92626
714-540-8878

Phil Devin, Rotations
1290 Ridder Park Rd.
San Jose, CA 95131
408-437-8211

Tom Gardner, Magnetic Storage
14469 Manuella Rd.
Los Altos, CA 94022
415-941-5324

Robert Gezelter, RSX
27-42 168th St. #312
Flushing, NY 11358-1130
718-463-1079

Mark Hartman, RSTS
2404 E. Nutwood #E23
Fullerton, CA 92631
714-738-8300

George Langworthy,
Optical Storage
6025 Martway #111
Mission, KS 66202
913-268-8775

Robert Pap, Communications
Sheraton Office Center #A180
409 Chestnut St.
Chattanooga, TN 37402
615-267-5959

John Schimpf, UNIX
1061 S. Melrose Ave., Ste. D
Placentia, CA 92670-7180
714-632-6924

David Spencer, Review Support
2600 V St.
Sacramento, CA 95818
916-456-7000

Edward Teja, Graphics Notes
704 N.E. 61st Ave.
Portland, OR 97213
503-231-9914

LETTERS

AND THE MASS REPORTER ANSWERS . . .

"The Mass. Report," March, page 31, is a self-centered, whining, juvenile waste of two pages of an otherwise highly useful magazine. To quote: "Get with it, guys!" I can get this drivel from USENET.

Ken Barr
OEM Systems Manager
Calma Co.
Research & Development
525 Sycamore Dr.
Milpitas, CA 95035-7489

If what's bothering you is the apparent "sour grapes" note of the column, I can appreciate that: I should've indicated more strongly that I rarely approve of any *government "help," not just federal subsidies for the selection of a Texas site for Sematech. Some people see Big Government as the solution; I see it as the problem. As for juvenile, that's a word I apply to companies that pull on Uncle Sam's sleeve and whine instead of digging in and competing, which is what our economic system's supposed to be all about. I should also mention that Massachusetts, unlike several other states, responded to the Texas selection with congratulations and a privately supported program to bolster the technical content of our state's secondary education.*

I expected the column to generate some emotional replies, but it would help if that were not all they contained. In any case, I appreciate your taking the time to respond and your kind words about Hardcopy. *Keep those cards and letters coming, folks.*

CONSUMER REPORTS WE'RE NOT!

My concern about your HOW report program is that the manufacturer knows that the product is being delivered for test purposes. Obviously, this differs from *Consumer Reports,* which buys blind in the open market. I suppose I should place my orders in your name to ensure that I get the best!

Douglas Boynton Quine, Ph.D.
Illinois Natural History Survey
Wildlife Section 172 NRB
607 E. Peabody Dr.
Champaign, IL 61820

The goal of the HC/WG OEM Evaluation Program (HOW) is to provide you with enough test information so you can make an intelligent buying decision. After reading a HOW Review or Report, you will have enough ammunition to ask probing questions regarding a product's performance in your particular environment. Depending on the answers you receive, you *will make the final purchasing decision.*

Steve Bostwick
Senior Scientist
HC/WG Labs

SMOOTH, NO-WAX FORMULA

In reference to Edward Teja's "Graphics Notes" column (January, page 89), we appreciate the mention, but it seems that we haven't done a very good job of keeping you up to date with the technology. The paper used in our copiers is not treated or wax based. It is simply calendered to achieve a smooth, even surface for the adhesion of the wax-based ink from the doner [sic] sheet.

Cheryl Landman
Manager, Marketing Communications
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IT HAD TO END SOMETIME.

MegaTape Announ
Choice In The Ba

Sorry fellas.

We know how much you depend on us for disk backup systems that are idiot-simple and Old Faithful-reliable. For years, we've been making your life easy with "push the button and go home" backup of even the biggest disks.

But things have gotten more complicated. There are now major tradeoffs available between speed, capacity, and cost.

If your system is big, busy, and expensive, minimizing downtime is probably a major consideration. So you want the fastest backup possible.

On the other hand, smaller systems and networks may be able to get by nicely with a much less expensive but slower backup solution.

The point is that no single backup answer is right for everybody.

So now, MegaTape offers you a choice. The exceptional cost/capacity of 8mm. Or the "industrial-strength" performance of our proven cartridge technology—now dramatically upgraded.

You can still pick up the phone and order a MegaTape system for just about any minicomputer or workstation network.

But now you'll have to decide *which* MegaTape system to order.

NCES THE HARDEST CKUP BUSINESS.

NEW

MT-1500

CHOOSE BLINDING SPEED AND HIGH CAPACITY.

BI BUS Direct Attachment

When speed counts, nothing tops the new MT-1500. At maximum transfer rate, this rugged powerhouse backs up 1.2 gigabytes on a single cartridge in under 30 minutes. And it offers features you simply can't get anywhere else:

- ❑ Up to three plug-in interfaces: any combination of Pertec and SCSI. A front panel switch selects the CPU.
- ❑ Complete software compatibility. No need for special device drivers or backup utilities.
- ❑ Comprehensive local and remote diagnostics. A technician can easily troubleshoot the entire system from the front panel—or from across the continent, using a terminal and modem.

The MT-1500 comes in rackmount and tabletop configurations, and is designed for easy OEM customization. It's even read compatible with the previous generation of MegaTape systems.

NEW

GT-88

CHOOSE ROCK-BOTTOM COST AND EVEN HIGHER CAPACITY.

Even though the new 8mm data cartridges promise eye-popping capacity and unbeatable cost per megabyte, we saw a few problems. Unproven reliability, for one. Nonstandard interfaces, for another.

So our engineers made the problems go away. Presenting the remarkable new GT-88: the only 2 gigabyte, *Pertec-compatible* tape cartridge system you can buy. With an absolutely unique set of big-computer features:

- ❑ Works with existing software. No changes to device drivers or backup utilities are necessary.
- ❑ A full 1.25 MB of Cache, for burst-mode transfer rates up to 880K bytes per second.
- ❑ Optional switching between two different CPUs at the push of a button.

The GT-88—complete with AC power supply—is conveniently packaged as a tabletop unit or in 8″ form factor to fit standard enclosures. And it's format-compatible with other 8mm backup systems.

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THE GREAT LEAP FORWARD IN BACKUP.

CONTROLLER SOLUTIONS EXPAND THIRD-PARTY SUPPLIER VISTAS

Taking advantage of powerful interfacing technology, third-party vendors are offering more control capability on and off the DEC backplane

by **Brad Harrison,** *Midwest Editor*

Digital Equipment Corp. has fallen behind in controller technology. The company's bias toward its own custom Standard Drive Interface (SDI) and the sluggishness of its RA series drives are resulting in a lack of state-of-the-art storage solutions for VAXBI systems.

The same is true for smaller systems—DEC's focus on the dated ST-506 interface and disregard for blossoming Enhanced Small Device Interface (ESDI) and Small Computer Systems Interface (SCSI) standards are resulting in performance bottlenecks in MicroVAXes and MicroPDPs. DEC buys its ST-506 Winchesters (the RD32, 53 and 54) from Micropolis Corp. (Chatsworth, CA), Seagate Technology (Scotts Valley, CA), and Maxtor Corp. (San Jose, CA), even while these manufacturers are developing a whole new generation disk technology that provides greater capacities and faster access times than the older ST-506 product lines.

The most interesting developments in the DEC environment involve third-party activity on the Q-bus, suggests Phil Devin, senior storage analyst at Dataquest Inc. (San Jose, CA). He points out that DEC has traditionally been on the cutting edge of commercial technology, but that has changed. "Now they seem to be stagnant as far as innovative storage goes." Devin contends that this means there is probably more opportunity than ever before for third-party vendors, despite the fact that DEC exercises tight legal control over who supports its line of BI-based VAXes.

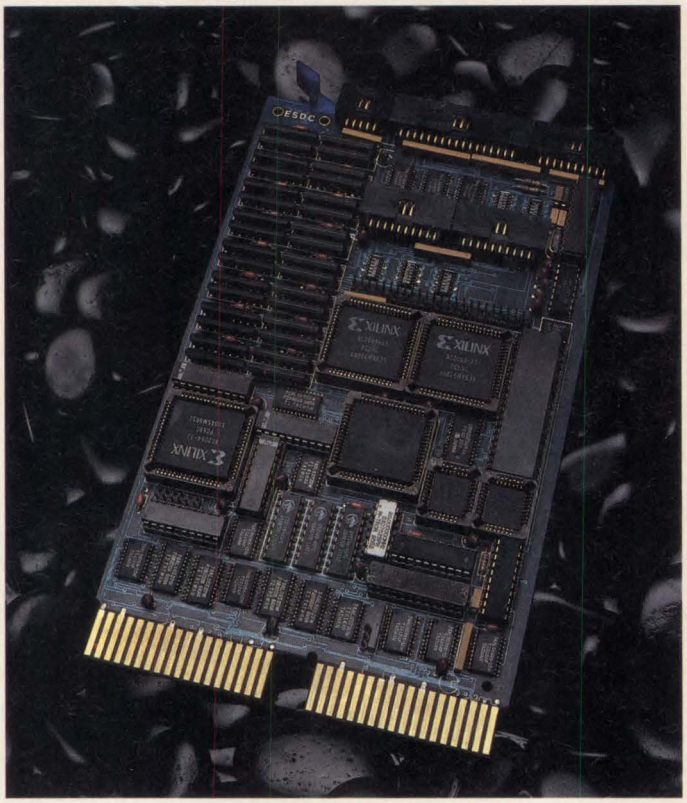

Figure 1—Andromeda Systems Inc.'s ESDC represents *the future of controllers. Packed with logic and a large 1-Mbyte cache that can be expanded to 16 Mbytes, the board uses programmable logic cell arrays that can be reprogrammed by the microcode. A variety of microcode levels and revisions are available for the board from Andromeda, and can be downloaded by calling Andromeda's support computer.*

Moving Away

It may be too late for DEC to woo some traditional DEC-compatible manufacturers back onto native DEC buses. The industry has taken DEC's not-so-subtle hints and is moving off of native DEC buses onto more-easily-supported bus architectures such as Multibus, NuBus, and VME. "Everyone is looking for other markets," says Jim Reynolds, president of Andromeda Systems Inc. Reynolds has been in the DEC-compatible market for eleven years. "The move toward other architectures is so rapid," claims Reynolds, "that even if DEC eased licensing restrictions today, the investments in time and money we've already made would still sweep us all away."

Real Problems

"There's a basic conflict within DEC between its marketing people and its engineers," says I. Dal Allan of ENDL Consulting (Saratoga, CA). "The marketing people want standards; the engineers want proprietary technology." The marketing people have gotten their way in communications, according to Allan, but the engineers continue to control the BI and mass storage options—a situation that could prove fatal.

"The marketing people need to be able to tell engineering that if they can't design and manufacture the product within a certain amount of time, then marketing is going to go outside the company to get it," says Allan. This important type of internal leveraging is critical to remaining competitive, according to Allan, and is one of the most remarkable and important characteristics of the widespread use of standards in the computer industry.

The situation developing with the BI and DEC's controller and subsystem offerings isn't surprising. Everyone except DEC, it seems, saw it coming. The company is going to have to introduce some pretty amazing new products—and soon—if it wants BI options to keep up with what's available industry-wide. Q-bus offerings are being kept state of the art by the third-party vendor, but surely this 16-bit bus has a life span of only a few more years, possibly ending with the MicroVAX III.

Spot Check

The trend toward intelligent interfaces started more than four years ago in the general industry and began finding its way in the DEC world more than a year ago (see "Evolving Disk Interface Standards Shaped by Digital Third Party," *Hardcopy,* page 40, April 1987). And, it is gaining momentum, as evidenced by several recent controller introductions. For example, TD Systems Inc.'s Viking/QDT and UDT SCSI controllers for the Q-bus and Unibus, respec-

continued on sector 18

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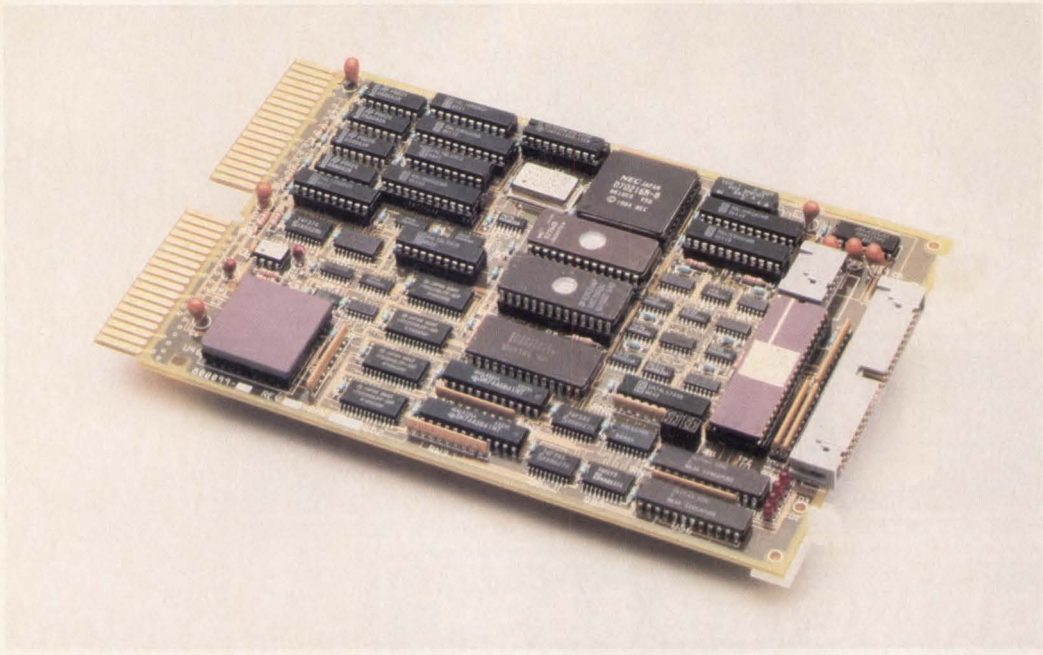

Figure 2—Qualogy Inc.'s QLC-1000 TMSCP controller for optical subsystems represents *a trend in optical storage controllers toward the controller handling all the special software requirements of the subsystem by plug-compatible support of standard DEC drivers. Previously, DEC-compatible optical subsystems required special driver software. Dedicated, special-function controllers of this type represent an important contribution third-party hardware manufacturers make within the DEC environment.*

continued from sector 16

tively, combine Mass Storage Control Protocol (MSCP) and Tape Mass Storage Control Protocol (TMSCP) to support sequential and random devices on the same SCSI bus. Additionally, Andromeda's ESDC ESDI controller (Figure 1) features the same capabilities of its earlier SMDC counterpart for Storage Module Drive (SMD) drives (including a 16-Mbyte cache and user-service port for monitoring cache activity and downloading microcode from Andromeda's dial-up support computer).

Two other introductions are Qualogy Inc.'s QLC-1000 TMSCP SCSI optical controller (Figure 2), which is tailored to support optical disks by combining SCSI and DEC's TMSCP tape protocol, and CMD Technology Inc.'s CQD-120 SCSI controller for the Q-bus (Figure 3). The CQD-120 is a SCSI subsystem that includes a miniature, on-board, 100-Mbyte Winchester. To keep pace with the growing demands of DEC customers, CMD is also offering SCSI controllers that support both MSCP and TMSCP. This capability is available on the CQD-120, but at a unit cost of almost $4,000.

Taking advantage of the storage holes left by DEC, Exsys Storage Systems (formed by a group of ex-System Industries employees) has announced a board that allows you to attach ESDI devices to DEC VAXclusters and BI-bus computers. The attachments are made via the DEC KDB-50 controller and HSC-50 and HSC-70 cluster controllers. The Exsys RACE (RA-Compatible ESDI) product fits between the SDI controller and an ESDI device, giving you the option of adding a wide variety of state-of-the-art, high-speed, high-capacity 5.25-in. Winchester ESDI disk drives. Emulex Corp. is also offering SDI-to-ESDI links, in addition to its SMDI SDI-to-SMD product that it's been selling since last year. These approaches do, however, add an extra component to the storage system. SDI interfaces are also available on the DEC UDA-50 and KDA-50 controller boards for the Unibus and Q-bus, respectively.

Link to the BI

The move toward support of DEC's BI systems via interconnect schemes like Exsys' is gaining momentum—they offer one of the few routes DEC-compatible controller and subsystem manufacturers can take—even though these products offer only moderate increases in performance over their DEC counterparts (tied, as they are, to DEC controllers).

System Industries claims to have found a healthy market for the "C" series of BI and VAXcluster subsystems using high-performance SMD drives.

System Industries is also in the process of cloning the BIIC—the proprietary BI interface chip that DEC sells only to its licensees. EMC Corp. continues to pick this lock, too. But in the nearly three years that the BI has been on the market, no one successfully challenged DEC on its rights to the bus.

Other companies, such as Distributed Logic Corp. and Micro Technology Inc., are looking at supporting the BI as well. DILOG is already offering "RA-compatible" (plug-compatible with SDI

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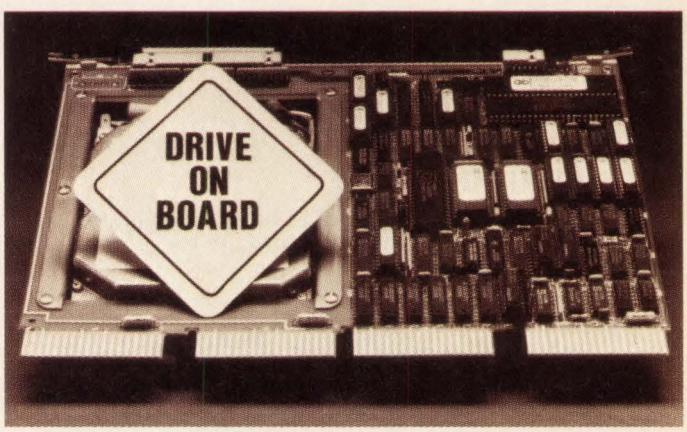

Figure 3—The CMD Technology Inc. CQD-120 SCSI subsystem on a quad board is *the latest in "hard card" support for the Q-bus. The subsystem functions as a standard SCSI host adapter, controlling up to seven devices, but supports a 100-Mbyte 3.25-in. Winchester as well. CMD offers a variety of other "hard cards" also.*

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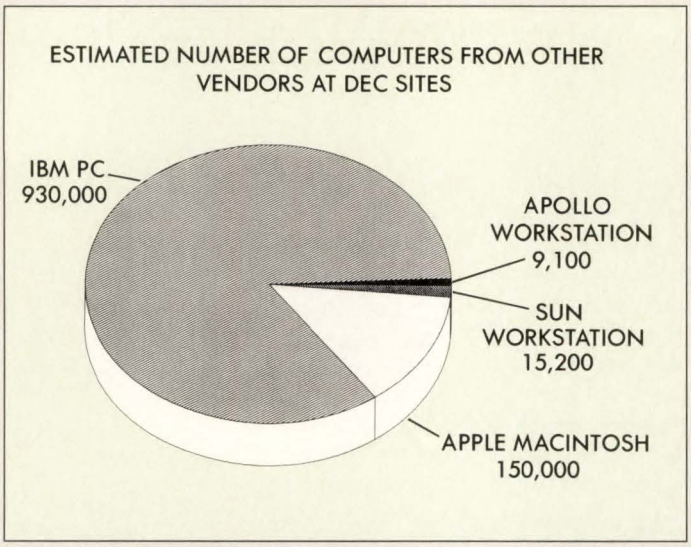

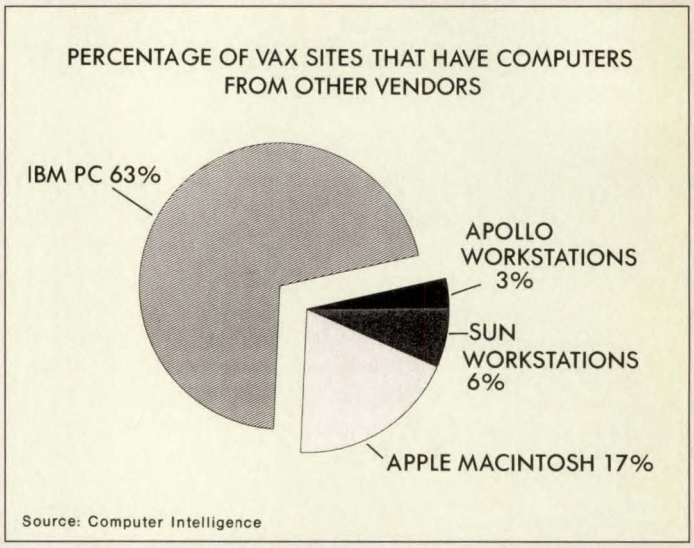

The number of personal computers and non-DEC workstations at VAX sites is *growing at an astounding rate. Computer Intelligence estimates that 23% of all DEC VT100 and VT200 terminals are actually PCs running emulation software. And many of the workstations, as well as PCs, are networked to the VAXes by Ethernet.*

continued from sector 18

controllers) SMD and ESDI subsystems, and Micro Technology is in the process of developing similar products. Spokesmen from both companies indicated that they are moving toward more of an "end-user support" orientation (as opposed to relying strictly on volume sales of controllers as mass-market commodity items). Especially in the case of DILOG, with its acquisition of Plessey Peripherals, the trend among the traditional DEC-compatible controller manufacturers is toward making more dollars in the subsystem business—and there are virtually no new players coming into either the controller or the subsystem businesses from outside the DEC environment.

Greener Pastures

The smart companies are seizing new opportunities. Emulex has a line of VME bus products, and the same is expected soon from DILOG. Scientific Micro Systems has decided to limit its DEC controller offerings to its multifunction controllers for the Q-bus, while focusing on also supplying VME and Macintosh products for the DEC environment.

VME activity in the DEC environment is racing along, and it's expected that VME-based workstations from Sun and Motorola could soon overwhelm the MicroVAX. Webster Computer Corp. has begun full-scale VME development efforts in Australia, and we'll soon be seeing Webster VME boards in the United States. In addition, a variety of products already exists for opening VAXes and PDPs to industry-standard bus structures (see "High-Performance Extensions Break Out of the DEC Cage," *Hardcopy,* page 34, March 1988).

This isn't happening by accident: Apple Computer Inc. and Sun Microsystems Inc., the two best examples, are opening their arms and their systems to DEC's traditional third party, recognizing all the potential there. Andromeda, for example, is considering developing a line of NuBus products.

Similarly, Trimarchi Associates Inc. (State College, PA) is finding new revenue by supporting Sun workstations. Trimarchi was once an all-DEC controller and subsystem shop, but now claims 10% of its business is Sun compatible.

Even with a growing demand for ESDI and SMD controllers for a variety of buses, SCSI may soon prove to be the universal peripheral connection. Currently, 8-bit SCSI is starting to be embedded into systems much like a serial port. But peripheral manufacturers are looking toward 16-bit SCSI-II for higher performance—a need that will most likely be filled by year end.

Additional information about the products or services described in this article can be obtained by contacting the company directly or circling the appropriate reader service number.

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32-BIT UNIX WORKSTATIONS: A GOOD BET ON WALL STREET

by Lynn Haber, *East Coast Editor*

Despite the stock market's nosedive, last October 19th, Wall Street securities firms are still banking on high-performance, 32-bit UNIX workstations as the desktop device of choice for their information-intensive trade.

And major computer vendors in the financial market, such as Apollo Computer Inc., Digital Equipment Corp., and Sun Microsystems Inc., anticipate an even greater worldwide sales opportunity this year and are eagerly rallying the support of third-party suppliers to round out their product offerings.

Allan Grody, president of Financial Integroup Holdings, a consulting company located in New York, estimates the market for financial market data services (including data feeds and desktop devices) will reach $10.4 billion worldwide by 1990, up from $2.3 billion in 1985.

With an ever-increasing amount of digital information, financial service and securities companies recognize the growing requirement to manipulate and manage data more efficiently.

Several companies already serving the trading community include Micrognosis Inc., QV Trading Systems Inc., Quotron Systems Inc., Rich Inc., and Transvik Inc.

Requirements Change

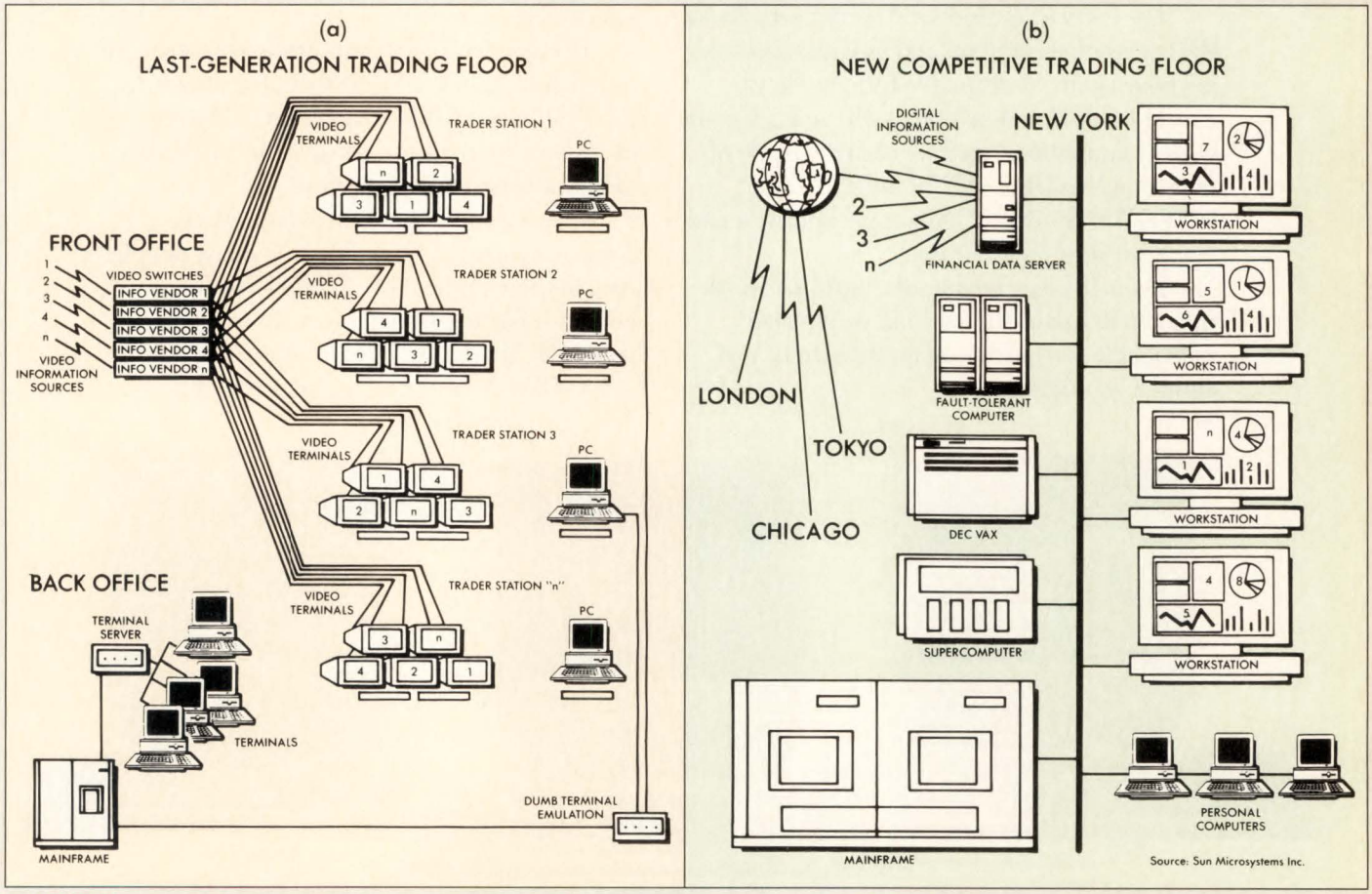
During the past few years, deregulation, globalization, and new arbitrage opportunities in the financial marketplace, combined with the availability of digital ticker feeds versus the conventional video means of transmission, changed the type and level of service that organizations could provide to their customers.

And, to maximize their competitive edge, many financial service companies recognized that faster, more versatile desktop computers were the key facilitator to achieving competitive advantage.

Craig Symons, vice president at the Gartner Group Inc., a consulting company located in Stamford, CT, says that 32-bit workstations allow traders working with real-time data to respond quickly to changing market conditions, for example.

Processing speed, sophisticated graphics, display management capabilities, and networking features--the same workstation characteristics originally required for scientific and engineering applications--filled a niche in the financial service market that, industry participants contend, even the promises of the second-generation personal computer cannot fulfill. Common applications include calculating mortgage-backed securities, fixed-income trading, risk arbitrage, and portfolio management.

Bush Karbal, vice president of advanced technology at Bear Stearns & Co. Inc., New York, notes that, for the same price as an IBM PS/2,



Sophisticated, *computerized trading floors allow financial-service companies to offer higher-level services to their clients.*

his organization can purchase UNIX-based workstations that he considers accomplished desktop devices.

"From the trader's point of view, you can get real-time information and manage and manipulate it quickly. And, from the development side, you can achieve faster and higher-quality results," he points out. During the past two years, Bear Stearns & Co. Inc. has installed between 100–200 Sun workstations that are used to develop front-end trading systems and generate software development. Such workstations are currently being considered for use by senior executives for office automation or sophisticated MIS applications as well, Karbal reports.

For such requirements, he contends, "The DOS operating system is a D-O-G."

Networking

In the fast-paced and rapidly changing financial service industry, traders seized new opportunities and spent millions on new computer systems while riding the bull market—often bypassing the kludge of the central processing organization.

"Many departments saw the possibilities of the new technology and abandoned central processing, and it soon became the norm to departmentalize," says Grody of Financial Integroup Holdings. The result of these independent buying sprees by departments, he contends, is that what was easy to cost justify during a bull market is not as easy to live with under the weight of a bear market.

As a result, system integration—networking workstation groups together as well as integrating front- and back-end systems—is today's priority for many organizations.

A typical computer configuration in a trading room consists of a minicomputer hooked to a ticker plant that receives data feeds in real time and sends the information to individual workstations. In the past, traders had anywhere from three to a dozen or more 9-in. video terminals stacked on their desks, feeding them financial data. A single workstation not only conserves real estate on the desktop, but it also allows for data reduction, enabling traders to receive only that information which they want. Then, depending on a department's requirements, the local workstation network may or may not be tied to an VAX or an IBM mainframe for more complex analytical or database work.

Several Wall Street trend setters, such as Morgan Stanley & Co. and Goldman, Sachs & Co., have, reportedly, installed minisupercomputers from such vendors as Alliant Computer Systems Corp. and Convex Computer Corp.

So, while many firms, early on, recognized the importance of system interoperability and open architectures, today, system expandability, integration, and local- and wide-area networking features take on even greater importance as financial institutions continue to streamline their operations for the bull/bear market. For this reason, many industry analysts believe that DEC is well positioned to maintain a strong foothold in the financial market industry.

"DEC's product solution may be more appealing to MIS because it can offer a package—applications, networking, a computing migration path, and an operating system that offers data integration and security," says Gartner's Symons.

Don Bracken, industry marketing manager, capital markets, at DEC, agrees that the company's strength lies in its networking capability. "While the workstation itself is important, the data links and infrastructure to deliver that data are critical," he says.

One of the earliest third-party vendors to develop a DEC-based trading-support system that utilizes the functionality of DEC's VAXstation capabilities is Transvik. The Transvik System, according to David Rosensaft, company president and CEO, is a turnkey securities transaction and execution system designed to provide automated trading facilities for both existing markets and emerging markets worldwide.

Rosensaft says that the company chose DEC equipment because the product was based on a distributed architecture. "Users can expand both vertically and horizontally with the VAX architecture while retaining operating system continuity, and DEC also offers a repertoire of interfaces to a variety of installed systems from other vendors," he explains. "Additionally, DEC is recognized worldwide."

Transvik announced its system last Fall and is currently installing its first system in Europe. This system consists of approximately 100 VAXstation 2000's tied to a network of MicroVAXes.

Last year, DEC was also awarded a $30 million contract from Citicorp for a worldwide trading platform.

The Battle Ahead

George Gardner, vice president of information systems at Arthur D. Little Inc., Cambridge, MA, contends that, while integrating the front- and back-room computing environments is a must for many financial service institutions, the task is a big one.

"I expect that things will keep churning around for a while as we're still seeing warfare among the entrenched suppliers of raw data and the newer workstation vendors," he explains. "Additionally, it's difficult to make heads or tails out of the myriad of available software."

Finally, Gardner notes that, before any single vendor can emerge on top in the financial services market, companies will have to develop expertise in application software that they currently lack.

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NEWEST HIGH-END VAX MIGRATES CUSTOMERS TO MORE POWER

by **Lynn Haber,** *East Coast Editor*

The ultimate benefit of Digital Equipment Corp.'s recently introduced VAX 8800 Series, which DEC claims is more than three times faster than the VAX 8700, is that it provides a migration path for current customers who are running out of processing steam.

"Although the announcement was primarily a software announcement," says Stephen Dube, senior vice president at Shearson Lehman Hutton, New York, "what it allows is for users to solve their upgrade problem."

The VAX 8800 Series—comprised of the VAX 8810, 8820, 8830, 8840, and 8842 (a turnkey cluster configuration)—is viewed as less of an attempt by DEC to attract IBM Corp. mainframe users than it is an attempt to dissuade DEC's current installed base from buying Big Blue's powerful mainframes.

The heart of the DEC announcement lies in the company's implementation of symmetric multiprocessing (SMP)—the ability to incorporate multiple processors in a single VAX machine—under the VMS operating system. Unlike DEC's existing clustered configurations, SMP presents a single-system image.

According to DEC, the new series technology is based on the VAX 8700—which was renamed the VAX 8810—and can incorporate up to four, tightly coupled VAX processors in a single system. By incorporating SMP in VMS, the system delivers balanced performance across applications. Additionally, VMS, with SMP support, manages system resources and, therefore, the user sees the same VMS interface as in a single-processor system.

***DEC's new VAX 8840 incorporates** four processors and 128 Mbytes of main memory.*

A Closer Look

DEC reports that all models are available in up to four processor configurations (see Chart) and are compatible with existing VAX application software and hardware.

The 8800 Series computers support up to 512 Mbytes of main memory—double the previous capacity—and up to six VAXBI buses, which increases the available I/O bandwidth for disk controllers, VAXcluster adapters, Ethernet adapters, parallel devices, local communication devices, and VAXBI options provided by licensed third-party vendors, according to DEC.

DEC also boosted customer support for the high-end VAX Series to include a one-year warranty on all DEC hardware and software; 24-hour, seven-day, on-site hardware service; a dedicated account support manager; and a performance reporting service.

The new machines are available now and include a fully supported advance release of VMS V. 5, which is scheduled for general release this summer.

Prices of the 8800 Series range from $592,000 to approximately $1.7 million, depending on configuration.

Two products for new VAXcluster installations—the Startup and Services Package and the High Data Availability Package—which, DEC says, optimize support for the VAX 8840 and 8842 systems, were also introduced.

Options For Users

While the VAX 8800 Series is good news for DEC customers because it allows for system expandability via enhanced product selection, the other side of that scenario is that it may also generate confusion, contends Norman Weizer, a senior consultant with Arthur D. Little, a consulting company in Cambridge, MA.

"I think that DEC will now have to rationalize its product line to customers and give them a better grasp as to which way to go with the VAX line," he says.

Nevertheless, Weizner believes that the greatest customer interest in the new machines will come from medium-to-large commercial organizations to meet their office automation needs. "The symmetrical multiprocessing capability of the Series 8800 is particularly valuable in instances where an organization has to run many jobs and they don't want the overhead associated with a VAXcluster," he says.

In a VAXcluster, each VAX computer runs a version of VMS, whereas only one version of VMS runs in the new VAX SMP configuration.

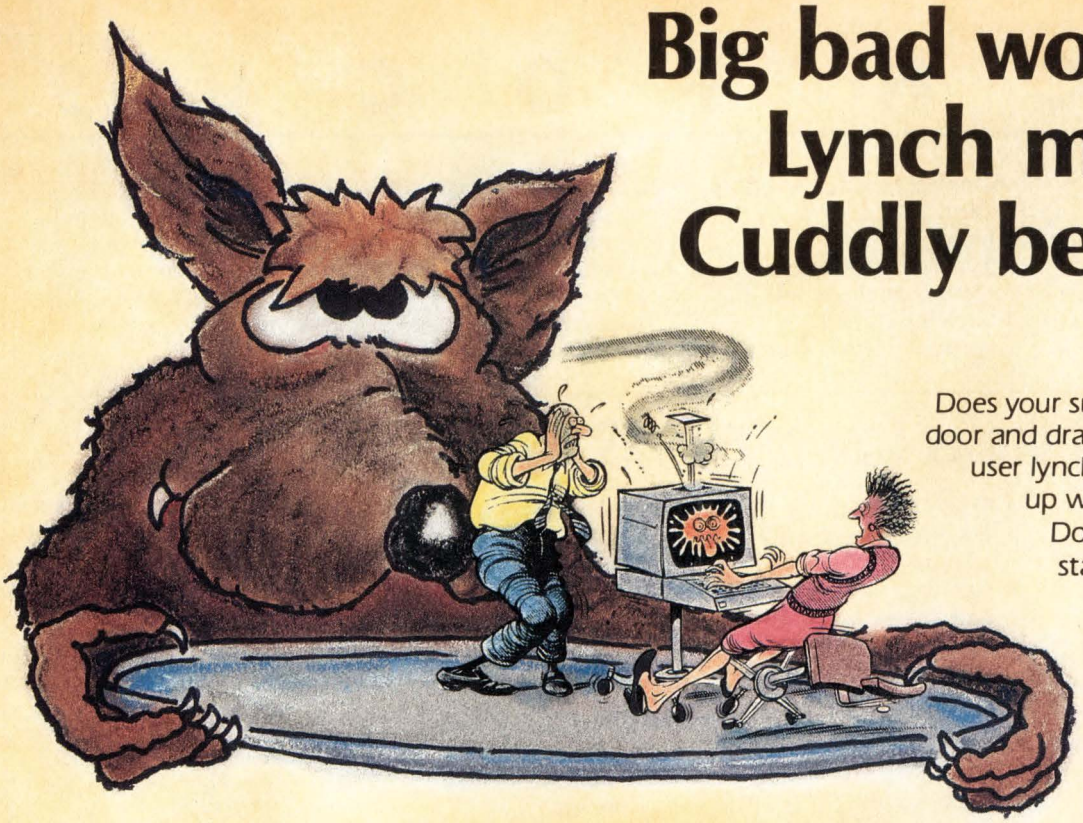
Shearson Lehman Hutton's Dube believes that both the commercial and the scientific markets will be interested in the VAX 8800 Series.

"For the majority of commercial applications, the benefit of the new machines is that they will run unaltered and users will see enhanced performance throughput," Dube says. "Some other applications, mainly scientific, will show significant improvement by rewriting them to maximize the machine's parallel processing capability."

Already, several third-

continued on sector 26

Big bad wolves? no. Lynch mobs? no. Cuddly bears? YES.



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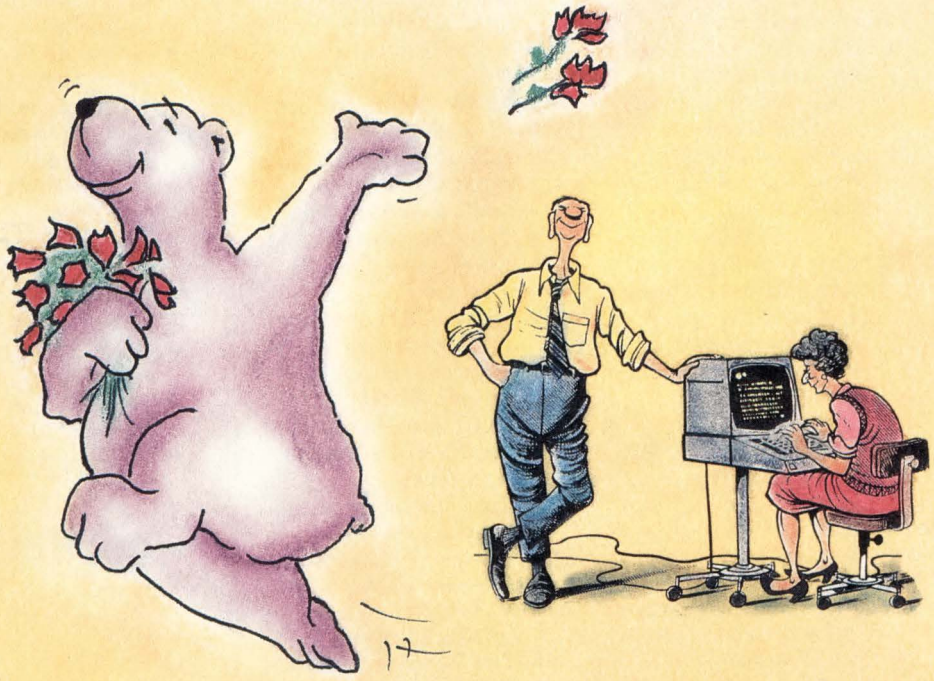

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continued from sector 24
party software developers have announced products that take advantage of the SMP architecture, including Intera-ECL (Denver, CO) with its Eclipse 300 Reservoir Simulator software and Structural Dynamics Research Corp. (Milford, OH) with its Integrated Design Engineering Analysis Software (I-DEAS) product.

Dataquest expects that DEC, over the next year, will also announce software refinements that utilize the VAX 8800 Series parallel processing capabilities.

In the final analysis, say industry consultants, while not earth shattering, DEC's announcement was significant in that it now puts the company in a computing-power range that will, ultimately, broaden its market potential.

A CLOSER LOOK AT THE VAX 8800 SERIES

Sample Configurations:

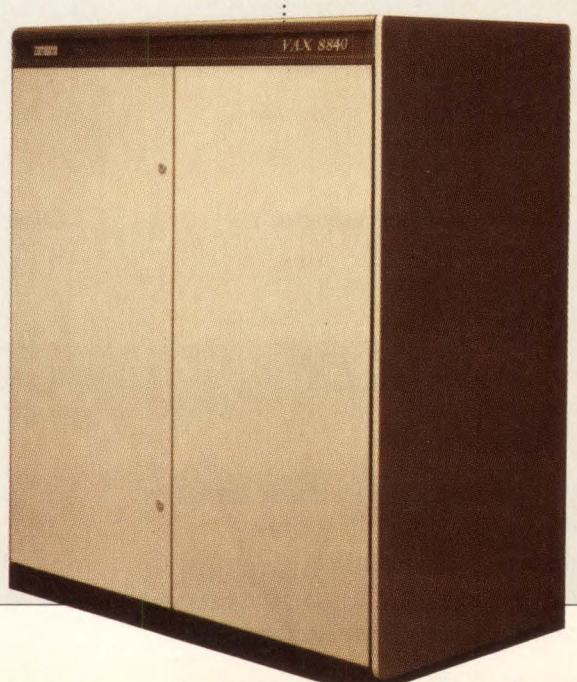
VAX 8810
- 60- x 74- x 30-in. cabinet occupies 15.5 square feet (1.44 square meters) of floor space
- One processor
- 48 Mbytes of main memory
- MicroPDP-11 console subsystem
- VMS operating system software license
- DECnet-VAX software end node license
- One Ethernet adapter
- One VAXBI bus
- One VAXcluster system adapter or one KDB50 local disk controller
- One-year DECservice hardware warranty including installation, 24-hour hardware telephone support, and on-site support during business hours
- Performance: Equivalent to VAX 8700
- Prices begin at $543,900

VAX 8820
- 60- x 106- x 30-in. cabinet occupies 22.2 square feet (2 square meters) of floor space
- Two processors
- 128 Mbytes of main memory
- MicroVAX II console subsystem with VT320 terminal, LA75 printer, 71-Mbyte RD53 fixed disk drive, and 95-Mbyte TK50 tape drive
- VMS operating system software license
- DECnet-VAX software end node license
- VAXcluster system software license
- One Ethernet adapter
- Two VAXBI buses
- One VAXcluster system adapter
- One-year hardware and software warranty, 24-hour/7-day on-site hardware service, account support manager, and Performance Reporting Service
- Performance: Up to 1.9 times the performance of VAX 8810
- Prices begin at $833,700

VAX 8830
- 60- x 106- x 30-in. cabinet occupies 22.2 square feet (2 square meters) of floor space
- Three processors
- 128 Mbytes of main memory
- MicroVAX II console subsystem with VT320 terminal and LA75 printer, 71-Mbyte RD53 fixed disk drive, and 95-Mbyte TK50 tape drive
- VMS operating system software license
- DECnet-VAX software end node license
- VAXcluster system software license
- Two Ethernet adapters
- Two VAXBI buses
- One VAXcluster system adapter
- One-year hardware and software warranty, 24-hour/seven-day on-site hardware service, account support manager, Performance Reporting Service, and six-month resident software engineer
- Performance: Up to 2.8 times the performance of VAX 8810
- Prices begin at $1,062,000

VAX 8840
- 60- x 106- x 30-in. cabinet occupies 22.2 square feet (2 square meters) of floor space
- Four processors
- 128 Mbytes of main memory
- 2.5 Gbytes of disk storage
- Intelligent storage controller
- MicroVAX II console subsystem with VT320 terminal and LA75 printer, 71-Mbyte RD53 fixed disk drive, and 95-Mbyte TK50 tape drive
- VMS operating system software license
- DECnet-VAX software end node license
- VAXcluster system software license
- Two Ethernet adapters
- Two VAXBI buses
- One VAXcluster system adapter
- One-year hardware and software warranty, 24-hour/seven-day on-site hardware service, account support manager, Performance Reporting Service, and six-month resident software engineer
- Performance: Up to 3.7 times the performance of VAX 8810
- Prices begin at $1,472,000

VAX 8842
- Two 8820 systems
- 2.5 Gbytes of disk storage
- Intelligent storage controller
- One-year hardware and software warranty, 24-hour/seven-day on-site hardware service, account support manager, Performance Reporting Service, and six-month resident software engineer
- Prices begin at $1,577,000



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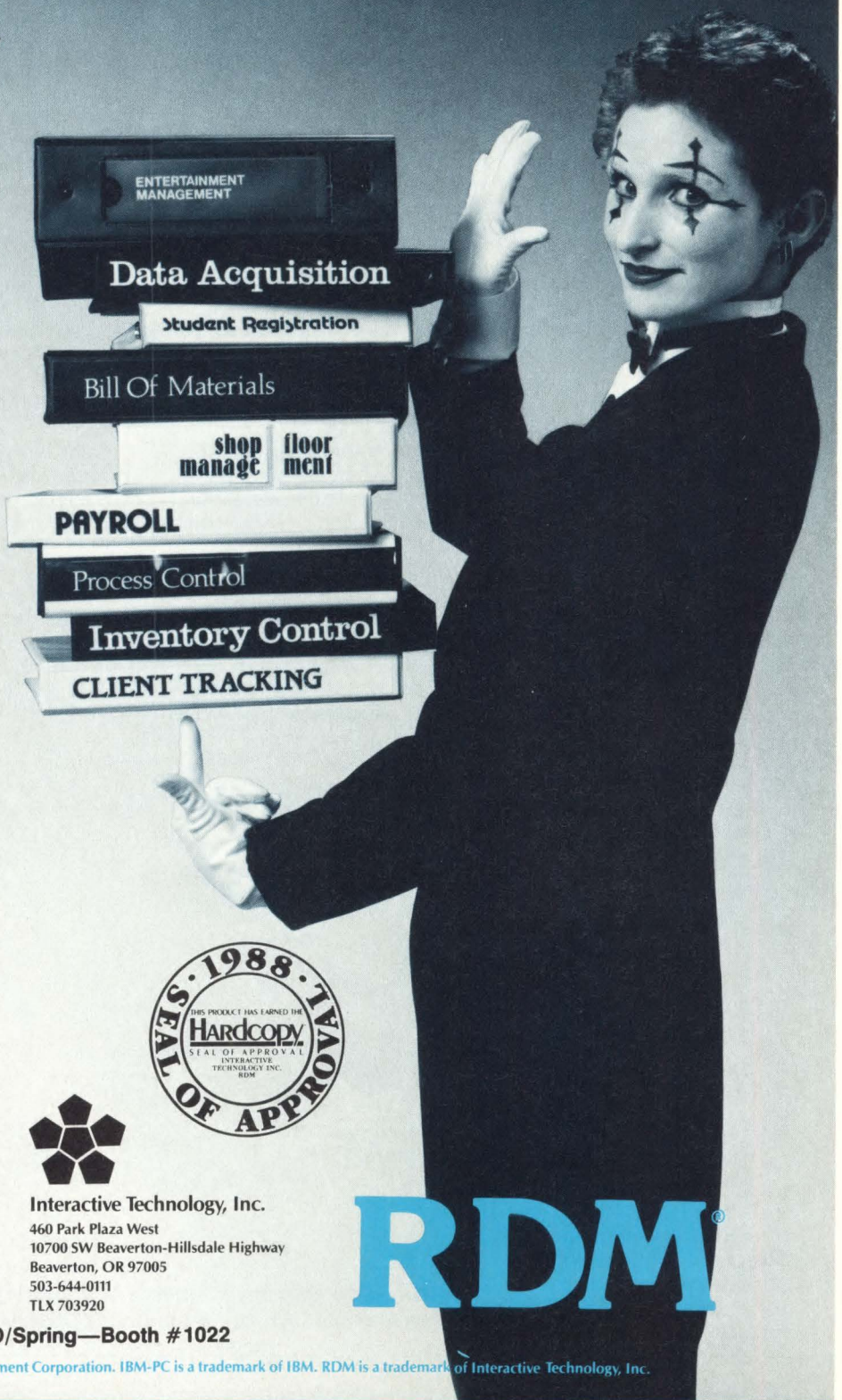

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First POSIX Standard Reflects DEC Input

by Edith Myers, *Senior Editor*

Digital Equipment Corp. may have been dragged, kicking and screaming, into the UNIX world, but it's there in a big way now.

DEC's a major player in the IEEE POSIX (portable operating systems environment) standards effort that, this month, may yield the first of what will ultimately be several standards. A considerable amount of DEC input is reflected in the first document and, undoubtedly, will be reflected in its successors also.

Call It UNIX

The official IEEE 1003 working groups are saddled with developing standards for portable operating systems environments, and the goal of the IEEE work is to come up with a set of standards for portability with which any O/S could be made to comply. However, UNIX comes closest to compliance as the standards are now evolving and the O/S most people think of in relation to POSIX.

Jim Isaak, formerly of Charles River Data (Framingham, MA), heads the overall IEEE POSIX efforts and chairs the 1003.1 working group, a group Isaak characterizes as being one of the hot ones. Besides serving as an IEEE chair, Isaak now heads up DEC's internal POSIX strategy as well. "At Digital, we are committed to POSIX and currently have 15 people actively working in this area," says Isaak.

Isaak's 1003.1 working group, charged with developing the full-use specification for a POSIX system interface, was the first of seven IEEE working groups to complete its work, thus permitting an IEEE ballot this past March and April. An IEEE consensus could result in an acceptable standard by mid-summer.

Meanwhile, at ISO

Even though domestic balloting is expected to be swift, the vote at the International Standards Organization (ISO) level "will take a little bit longer. Possibly ending in June or July," says Isaak. Acceptance by ISO is critical and will eventually lead to the specification's becoming a Draft Interface Standard, which will ultimately go before a full plenary session of the international organization.

Long Road to Go

Committee 1003.3, which is working on testing methods, will probably be next to get a document to IEEE ballot. Isaak expects this group's work to be complete sometime this fall. A 1000.0 committee, working on what he calls, "A Guide to the POSIX Open System, a description of the complete environment," should be complete by the end of the year.

Committee 1003.2, working on shells and tools, is 12 months away from completing its document, while committee 1003.4 on real-time extensions and 1003 on the Ada language should wind up work early in 1990. The final committee, 1003.6, on security issues, has no set time frame as yet.

POSIX vs. Ultrix

As these standards evolve, DEC undoubtedly will increase its commitment to both them and Ultrix—DEC's own UNIX-like operating system. A clear indication of this was DECwindows, which came out of an Ultrix environment and is now available for Ultrix systems, while a VMS version isn't due out until later this year.

"DEC's support staff for Ultrix has been equal to that of VMS for two years now," says Gig Graham, software management strategies program director for The Gartner Group (Stanford, CO). "DEC has been one of the top beneficiaries of the UNIX marketplace," he adds. "It [DEC] hasn't had UNIX at the core of its business strategy in the past, but that's changing."

Recently, the Integrated Office Systems (IOS) software marketplace belonged almost exclusively to proprietary vendors until independent UNIX software licenses began to make an impact. Figure 1 illustrates the installed base of IOS software in the United States at the end of 1986 by licenses (a) and users (b). DEC's share of these markets jumps from 11% of the licenses to a whopping 42% of the users. DEC is now trying to merge these two markets using its UNIX-based Ultrix operating system.

"A momentum is building. There are a lot of people, and I am one of them, who think UNIX works best in a VAX environment," says Graham.

Meanwhile, per Isaak, the National Bureau of Standards (NBS) adopted the 1003.1 document and announced it as an interim Federal Information Processing Standard. NBS developed a validation test suite for the interface and just about every computer vendor that offers a UNIX-like operating system, including DEC, will be a beta test site.

Isaak is of the opinion that DEC will announce a

continued on sector 30

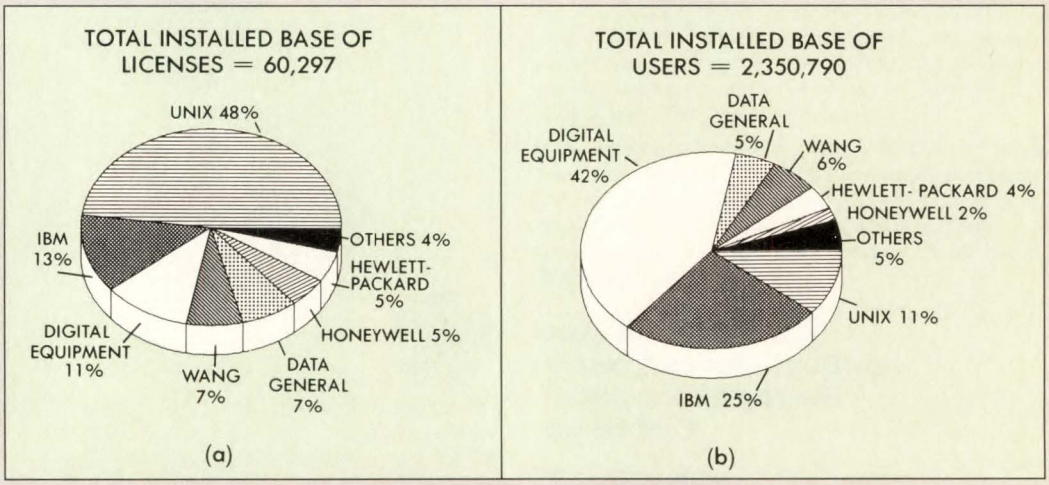

Figure 1—The installed base of Integrated Office Systems (IOS) software in the U.S., *as of March 1987, by licenses* (a) *and users* (b), *illustrates DEC's focus on the multiuser market.*

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continued from sector 28

new POSIX-compliant version of Ultrix sometime this summer. He believes IBM will do the same with AIX and adds that AT&T has announced that its System V, V. 4 UNIX will offer POSIX conformity.

Ties to OSI

Isaak explains that the POSIX interface standard, as it stands, is, "communications neutral, network neutral, and neutral to protocols," adding, "we have been after applications portability, and networking applications typically are not portable." Communications issues will be addressed as the Open Systems Interconnect (OSI) model comes along. "Our efforts are tightly coupled to OSI."

Communications capability is a key issue to many UNIX standards watchers. Michael Tilson, president of HCR Corp. (Toronto), a UNIX systems software developer, is an avowed supporter of POSIX but warns that it isn't addressing communications issues yet. Graham (of The Gartner Group) agrees, but believes it will happen: "DEC, IBM, and AT&T all have a vested interest in seeing that this happens."

HCR's Tilson worries there will be efforts, "in some corner of DEC, to sell the world on POSIX as if it were the true UNIX standard. Then we might never have a true UNIX standard." He calls POSIX "a subset of UNIX and a step forward," but feels that the closest thing today to a true, full UNIX specification is AT&T's System V Interface Definition (SVID).

Isaak says there is overlap between SVID and the interface specification his committee has devised. "We rejected about 30% (of what's in SVID) because it isn't generic enough, particularly for distributed computing or for secure environments. Ours is a subroutine-driven interface which addresses a wider range of environments," says Isaak.

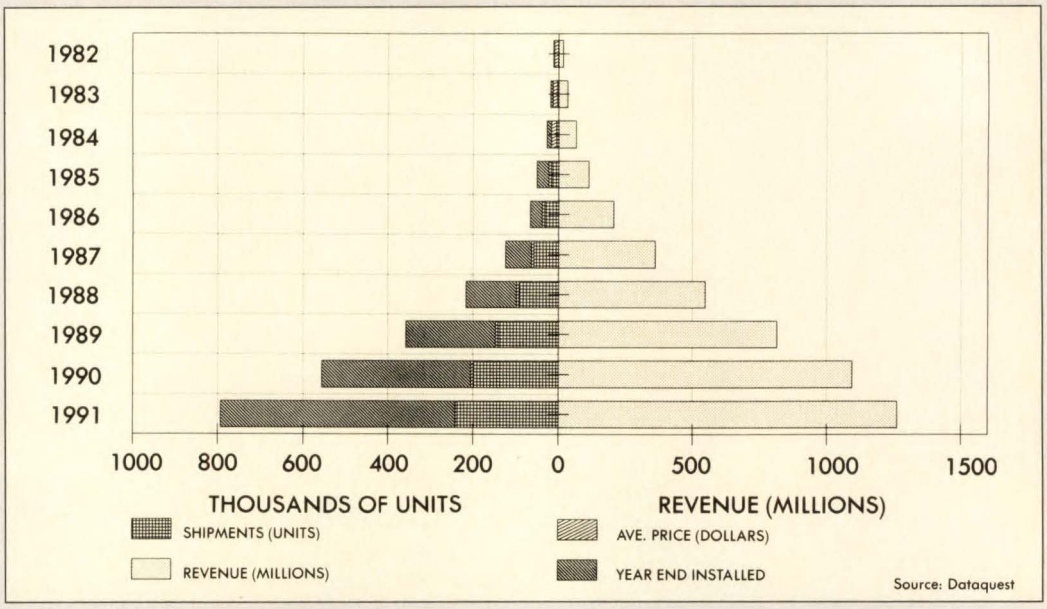

Figure 2—UNIX products from third-party suppliers are *expected to increase as software developers introduce UNIX versions of their proprietary products.*

Third Parties, Too

Third-party suppliers are beginning to recognize the importance of Ultrix. "Ultrix use is growing. More people are interested in it," says Jack Buell, vice president of Simpact Associates Inc. (San Diego, CA), which announced Ultrix support of communication interfaces for the VAXBI at UniForum last February in Dallas.

Per Simpact's Vice President of Data Communication Systems, Tom Stockey, "Native-mode VAXBI interfaces mean that Ultrix users can now take full advantage of the communications bandwidth of DEC's VAXBI bus." Simpact's new interfaces are based in a multi-port, single-slot ICP1632 front-end processor—the first DEC-licensed product for the VAXBI. Stockey feels that "it is especially important to offer this in light of the growing use of Ultrix and other flavors of UNIX on DEC's VAX machines."

UNIX products from third-party suppliers are making a significant impact that is expected to increase (Figure 2) as software developers introduce UNIX versions of their proprietary products.

Where Did UNIX Come From?

Since 1981, UNIX has been proliferating in the worlds outside of academia (after Bell Labs lowered what had been an exorbitant license fee). Digital Equipment Corp. hardware has been associated with the UNIX operating system although DEC didn't rush to embrace it.

First on a PDP-7

Not many remember that UNIX was developed on a DEC computer—a PDP-7 in Bell Labs. One of its developers, Ken Thompson, had become dissatisfied with the Lab's available computer facilities. He uncovered the little-used PDP-7 and set to work to create what he hoped would be a more hospitable environment. His work sparked the interest of co-developer Dennis Ritchie and together they moved UNIX up, first to an 11/20 and then to an 11/45.

The first company to offer a commercial UNIX product was Interactive Systems (Santa Monica, CA), which, today, is best known for its work for IBM on development of AIX. Interactive paid a hefty $20,000 license fee when it was founded in 1977 to offer a UNIX-based programmer's workbench based on the PDP-11.

DEC noticed that its customers were using UNIX and, in 1983, introduced Ultrix, based on the Berkeley 4.2 version of UNIX. Ultrix was for use only with the PDP-11 then. The VAX version of Ultrix came later, as DEC realized that even VAX users were buying and running various flavors of UNIX.

In its early days, Ultrix may have been something of a step-sibling to VMS—not any more.

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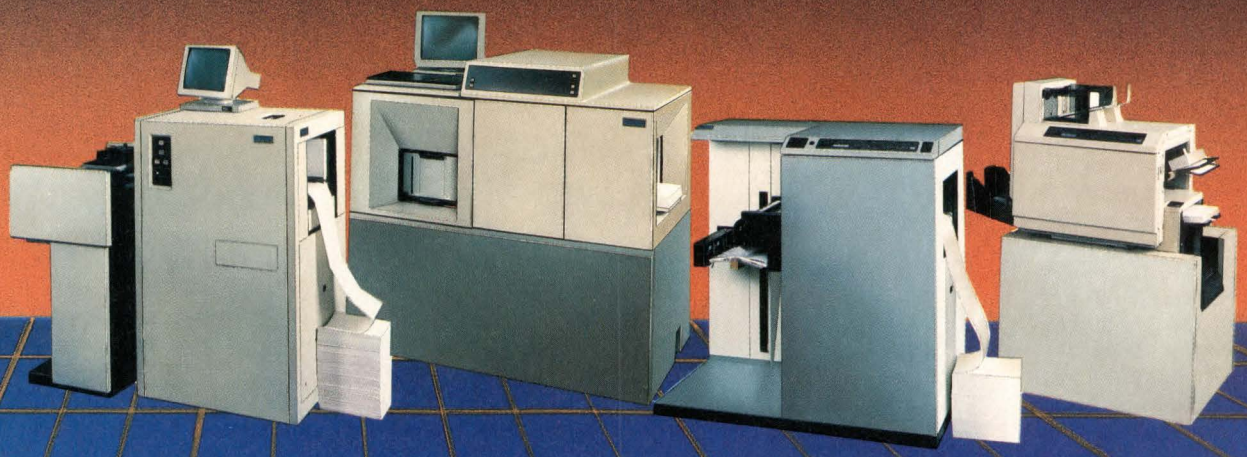

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CIRCLE 453 ON READER CARD

COLOR OUTPUT MAKES YOU LOOK GOOD

by Bonnie Brisson, *Senior Copy Editor*

With the low cost and general availability of color printers contributing to the growing popularity of color graphics output, you should be aware of the application software and output media necessary to achieve maximum benefit. You can't simply install the printer and continue with your projects—something must drive the printer to print blue here and red there. And, you won't want to simply photocopy your dynamic color graphics and prepare a run-of-the-mill black and white program of presentation overheads for your important meetings. These are but two of the "opportunities for innovation" that drive the PC and general workstation marketplaces.

Color-Ware on Tap

Desktop publishing is pushing the use of color technology. With a large and growing installed base of desktop publishing systems, developers of color publishing programs, and eventually hardware, have a waiting market.

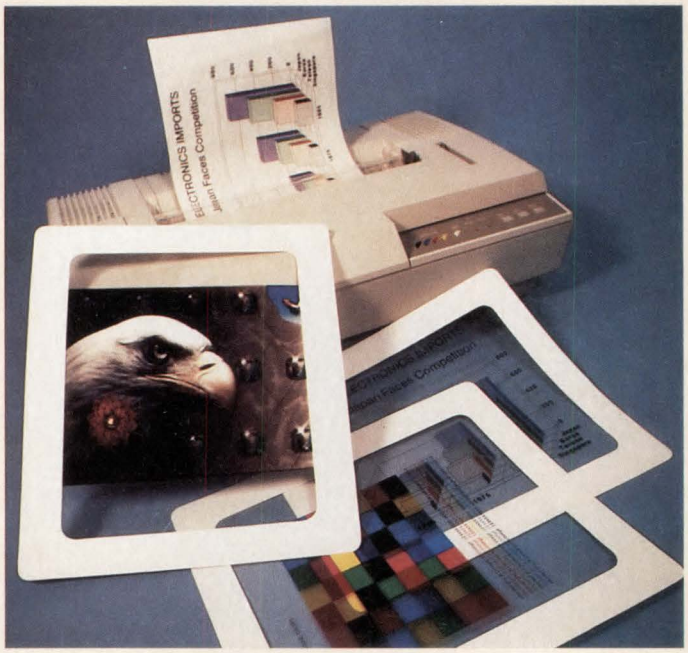
Current versions of Aldus Corp.'s PageMaker, Quark Inc.'s XPress, Apple Computer Inc.'s MacPublisher, and Xerox Corp.'s Ventura Publisher already include features for adding spot color. Although development of complete programs for economical, easy-to-use, four-color output from desktop publishing systems is in process, this facility is not yet available to the average PC user.

Overheads by Key

The general availability of sophisticated four-color graphics programs, as well as desktop publishing with spot color, brings up the need for being able to create four-color presentation overheads on your PC.

To put together a set of color transparencies, you can output directly to your color ink-jet printer onto projection/transparency film that accepts color ink. Arkwright Inc. offers a quick-drying, universal transparency film that accepts a full spectrum of colored inks. The surface of the film is engineered to reduce bleeding and promote consistent ink density. Such films are available for use with color-technology infrared reproduction and pen plotter applications, too.

The new, optically clear, polyester pen plotter transparency film for color output provides an ink-receiving surface that promotes rapid drying and higher resistance to smears and fingerprints. Arkwright markets its plotter transparency film in 8.5- x 11-in. and A4 sheet sizes as well as 13-in. x 50-ft. rolls.



Arkwright Inc.'s universal transparency film, *for use with inkjet printers from IBM, Tektronix, Canon, Xerox Corp./Diablo, and Digital Equipment Corp., is packaged in boxes of 50 sheets that retail for $49.95.*

Evolving Products

The industry's hardware and software design engineers have seen the "writing on the wall" and are working desperately to be the first with new PC-compatible graphics products, including color xerographic copiers, color laser printers, and desktop publishing software with complete four-color capability.

Both the copier and the laser printer have been "engineered" but have proved too complex and expensive to gain any acceptance into the PC marketplace. The application software is not of any value to the user until the peripheral hardware is successfully installed.

For instance, QMS Inc.'s new QMS printer employs a Mitsubishi thermal transfer print engine and integral QMS controller. However, this is not a laser printer, per se, and will cost approximately $25,000. For the past 18 months, Precision Image Corp. has been successfully marketing a color output printer/plotter device employing electrostatic technology (see "Helical-Scan Technology: A New Twist to Graphic Output," *Hardcopy,* page 94, January 1988), but again, the cost is significant—approximately $54,000.

Waiting for Tomorrow

Presently, Xerox (and the major Japanese vendors) is striving to perfect the plain-paper electrostatic copier so as to achieve four-color recognition and output at a reasonable price, and most major manufacturers of laser printers are working 'round the clock to offer a viable four-color alternative to their present product line.

Additional information about the products or services described in this article can be obtained by contacting the company directly or circling the appropriate reader service number.

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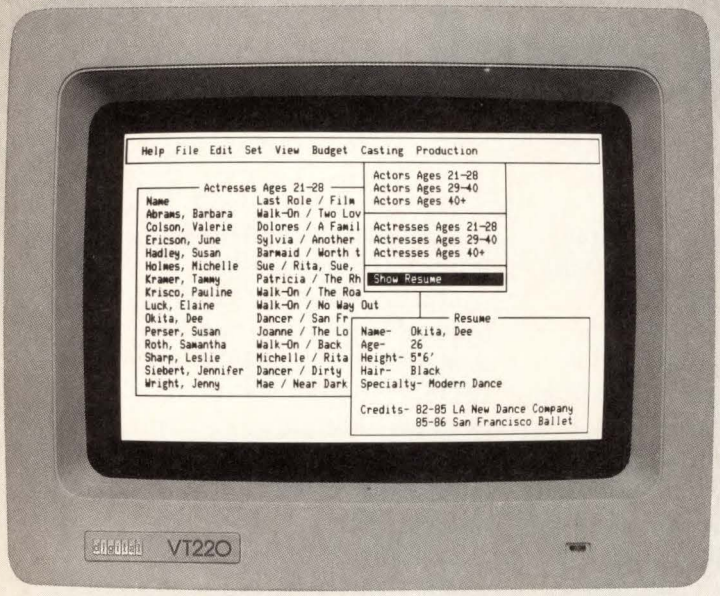

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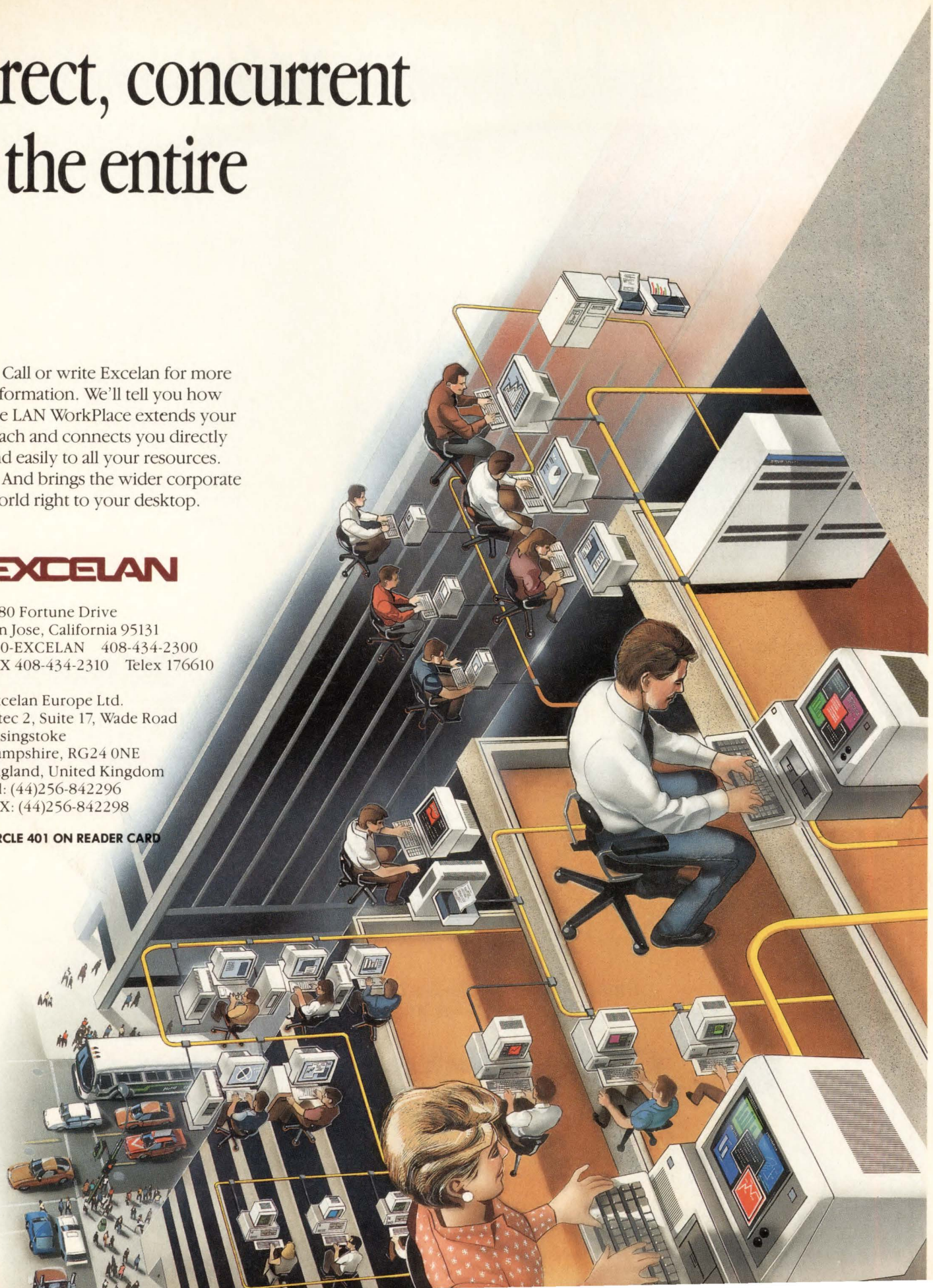

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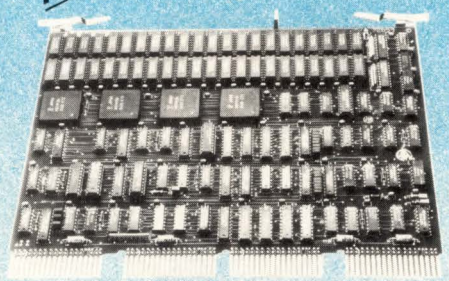

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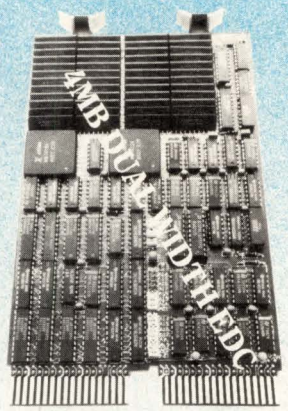

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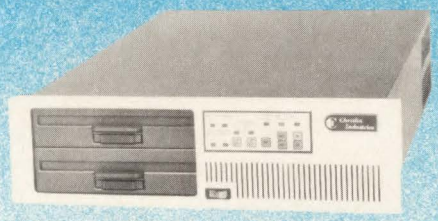

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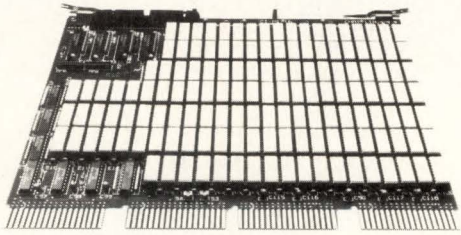

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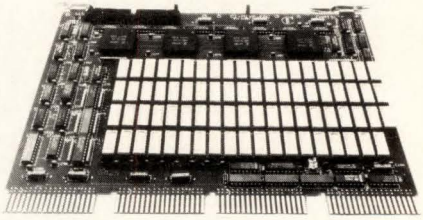

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THE MASS. REPORT

UNIX as an "open standard"

The recent agreements between AT&T, keeper of the UNIX flame, and Sun Microsystems, developer of the Scalable Processor Architecture (SPARC) Reduced Instruction Set Computer (RISC), have many competing computer firms up in arms. Competitors, including such heavy hitters as Apple, Apollo, Data General, Digital Equipment Corp., Hewlett-Packard, Honeywell-Bull, NCR, Prime, and Unisys, are concerned that AT&T's exclusive contract with Sun for Release 4 of UNIX System V will produce a UNIX optimized for the SPARC. Should this happen, say Sun's competitors, UNIX will cease to be an open standard, or at the least no longer remain a neutral battleground upon which to field their own UNIX platforms. These concerns were exacerbated by the January announcement of AT&T's intention to purchase 20% stake in Sun over the next three years.

UNIX, as most of us remember, has an unusual history full of contradictions. Characterized as a multiuser system, it was designed by Ken Thompson at AT&T's Bell Telephone Laboratories for internal use as a single-user system (hence its name, a revision of MULTICS, the multiuser system on which it was developed). Designed to run on DEC computers (the PDP-7 series), it was at first not accepted by DEC as an alternative O/S product for distribution to its customers. UNIX is now one of the most portable of operating systems (it's implemented entirely in the higher-level C language), but was originally written in machine-specific assembler code. And while UNIX has now attracted major commercial attention, it wasn't offered to end users until 1978, 19 years after its first implementation. That first offering came from Onyx Systems, not AT&T, and it was for Onyx', not DEC's, systems.

Today there are several AT&T versions of UNIX, more than a dozen major versions of UNIX developed under AT&T license (including DEC's Ultrix and Microsoft's XENIX), and at least that many unlicensed (by AT&T) "work-alike" systems (for instance, Charles River Data Systems' UNOS and Mark Williams Co.'s "Coherent"). It's no wonder that hackles are raised at the possibility that control of UNIX' development might tighten.

Ironically, past concerns have emphasized just the opposite aspect of UNIX as an "open standard"—the possibility that multiple versions would create an ambiguous "pseudo-standard." Significant enhancements to UNIX developed outside AT&T, notably in the late '70s at the University of California at Berkeley and subsequently adopted by other UNIX developers, threatened to dissipate UNIX' monolithic image. To prevent that, UNIX developers, including AT&T, organized a standard-setting committee in 1981 to establish, if not enforce conformance, at least "traceability" to a standard UNIX version. That version took the form of AT&T's UNIX System V announced in 1983, which incorporated many of the Berkeley enhancements. Similarly, forthcoming modifications (Release 4) are expected to conform to the IEEE POSIX standard for portability. (See "First POSIX Standard Reflects DEC Input," this issue, page 28.)

Real Issues and Possibilities

With that background, it's clear the current brouhaha about UNIX becoming something other than an "open standard" has less to do with "standard" issues than with "open" issues. And, of those issues, the two most relevant are "*Could* a 'standard' UNIX be optimized to a particular processor?" and "*If* it could be done, *would* it be done?" The first involves technical issues; the second, practical matters.

The technical issues could be debated forever, but on balance, the answer would have to be "Yes, UNIX could be optimized to a particular processor." In the "real world," that's done all the time. The simplest definition of any operating system is "software that makes the hardware run." An operating system without hardware is simply a collection of resource-management programs without resources, and hardware without an operating system is junk. Operating systems are developed *on* hardware *for* hardware. To the extent that UNIX remains an "open" standard, it must continue being minimally dependent on any "real" devices, including any particular processors. But make no mistake: its development must target *some* processor that may or may not be the same as the host processor on which it is developed.

The catch—or saving grace (depending on whether you're an end user or a systems manufacturer)—is that this targeted processor need not be real, but a "virtual" machine that exists only as a concept. Indeed, some complete systems have been designed in just that way, with the hardware developed to optimize pre-existing software. Western Digital's "P-machine," for example, was a processor optimized to Pascal. Most coprocessors also originated that way, as have complete systems specialized for communications, graphics, and database applications. Systems designers attempt to strike a balance between hardware and software, following the dictum that "any task implemented in software can be implemented in hardware, and vice versa."

More often, however, operating systems are targeted to existing computers and "ported" to others. This can be a herculean task if little similarity exists between the original and new computers. The good news is that it's *always* possible! For this users are indebted to Alan Turing, whose

work on finite-state machines (digital computers) guarantees us that even the simplest computer can perform the tasks of its more complex brethren. (You can prove this by programming your Commodore 64 to perform the same weather simulations running on Cray computers. Me? I've got a bus to catch.) So Sun may indeed target UNIX to the Sun SPARC, in which case that version of UNIX would be optimized to SPARC and unrecognizable as UNIX.

It also wouldn't surprise me to hear Sun argue that such a development would be a great contribution to the UNIX watershed. SPARC, because of its RISC architecture, resembles a virtual machine more than, say, an AT&T 3B2 computer, which will probably be the first real target for Release 4. I would also expect Sun to point out that SPARC is itself offered as a standard. Those would've been substantial arguments for UNIX, Version 0.000001; but for UNIX V/Rel. 4, they'd be nonsense.

All of which brings us to the practical matters, and my reasons for believing Sun will not/cannot seriously jeopardize UNIX' open-standard status. First, AT&T, regardless of its equity interest in Sun and any plans to adopt SPARC, also competes to some degree with Sun and doesn't need a SPARCed UNIX any more than does, for example, DEC. (Probably a lot less, considering that AT&T's use of a nonproprietary processor, coupled with its own unspectacular architecture, dependence on OEM peripherals, and a standard operating system, would leave little room for adding value.)

Second, for the reasons mentioned, even the **idea** of "optimizing" UNIX for one processor is ambiguous. An operating system—as implemented on a real computer—is an enormous collection of individual programs, of which only those at the highest, processor-independent level (the only level offered under AT&T license as UNIX) can be efficiently written in a higher-level language. Typically, tens of thousands of lines of additional nanosecond-stingy machine code are directed toward such intensely iterative device- and processor-specific functions as memory management and peripheral control. The job of writing that code is what constitutes the "porting" process, and that process will remain as distinct and difficult for SPARC-based machines as for any others.

Third, it's self-defeating for AT&T to allow Sun to tamper with any code that affected UNIX at the application (or device-and processor-specific) level. The rest of the industry has already indicated it won't stand for it, and AT&T would lose too much prestige and money if its version of UNIX became less acceptable as a standard. Everyone would lose.

Does all this mean that Sun's competitors should sit back and let AT&T and Sun go their merry way? Absolutely not! UNIX is too important to the industry to entrust its future into so few hands. Decisions must still be made and alternatives chosen. Everyone should have the opportunity to review and contribute. Sun could, for example, decide to build into Release 4 more dependence on a graphical interface. (What might Sun have in mind for its own UNIX ports? Wait, I'm getting a vision . . . four letters . . . NEWS, Sun's own graphic environment.) The entire industry should have a say in such decisions.

AT&T should support and encourage overview and guidance committees. It should welcome contributions, and by seriously considering them, might pare months from development. Everyone would benefit, as would the continued perception of UNIX as a truly open standard. On that point, there's one more action AT&T might take: coming down on Sun for prematurely promoting SPARC as a privileged UNIX machine. Motorola currently has more right to that claim. The first time I heard microprocessors so closely linked with UNIX was in the late '70s, when National Semiconductor announced its 32000 line. Until we have Release 4 both of those earlier claims have more substance.

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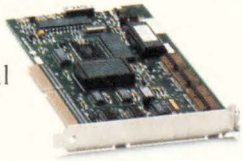

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REPORT 5

INTELLIGENT

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PERIPHERAL INTERFACES SUPPORT HIGH-PERFORMANCE, NETWORKED SYSTEMS

TAKING ON THE ROLE OF INFORMATION HIGHWAY AND TRAFFIC COP, PERIPHERAL CONTROLLERS LINK CPUs WITH SUPPORT STORAGE DEVICES, ENSURING THAT PERFORMANCE IS TUNED TO THE APPLICATION AT HAND

by the HC/WG Laboratory Staff

Although design extensions of the current device-level peripheral interfaces, such as Storage Module Device (SMD-E) and Enhanced Small Device Interface (ESDI), are proving capable of supporting larger data files and higher transmission speeds, they cannot provide the device intelligence necessary for high-level multitasking, multiuser operations. Intelligent interface standards, such as Small Computer Systems Interface (SCSI) and Intelligent Peripheral Interface (IPI), provide the capabilities needed by multiple-host and multiple-peripheral systems.

Intelligent interfaces, *such as the Enhanced Small Device Interface (ESDI), Intelligent Peripheral Interface (IPI), and Small Computer Systems Interface (SCSI), depicted here, are making it possible for storage devices to graduate to greater performance. This example of smart approaches to interfaces shows a Sabre 1230 8-in. Winchester disk drive with IPI. This artwork was created exclusively for* Hardcopy *by Control Data Corp., Data Storage Products Group. (Photography by Glen Sikler Studios, Minneapolis, MN).*

Unlike other board-level products that play a nominal role in today's high-performance computers, the peripheral interface board can often be the key ingredient to system performance.

In most applications, I/O controller performance is the key to high performance, not CPU speed. When data is transferred more quickly, more system bus bandwidth is available to handle demanding real-time applications. The slower the data transfer between a storage device and the CPU, the more "I/O bound" the system will be.

There are two broad categories of peripheral interface: the device-level interface and the intelligent interface.

Device-level interfaces are essentially "dumb," and the host CPU manages all peripheral tasks such as head positioning, diagnostics, and error management. Peripheral controllers with intelligent interfaces take over these tasks from the CPU, making the peripheral almost transparent to the host system.

Device-Level Interfaces

Device-level interfaces have traditionally delivered higher performance than intelligent interfaces due to the overhead that is introduced by an additional processor in the data path of the intelligent interfaces. However, with careful tuning of system and peripheral, the performance of intelligent interfaces comes very close to device-level performance. And, intelligent interfaces offer the advantage of being flexible enough to

Coordinated by Edward Teja, responded to by Bill Brent; I. Dal Allan, I/O Columnist; and Richard Steincross, Senior Respondent—Hardware.

meet performance levels of future peripheral products.

Device-level peripheral interfaces have served the computer industry well for many years. The slow, but sure, ST506/412 is still the most widely used disk interface in the industry (due mainly to its use in IBM PCs). QIC-36 and QIC-02 are the accepted tape drive interfaces. And the higher performance ESDI and SMD interfaces are still evolving to handle the ever-increasing number of higher-performance and higher-capacity disk drives—those with gigabyte capacities and transfer rates up to 3 Mbytes per second.

The SMD is presently the best known disk interface in high-performance systems, though ESDI is rapidly gaining acceptance. 5.25-in. ESDI drives with gigabyte storage capacities are expected from several vendors this year and will compete directly with the 8- and 14-in. SMD and SMD-E drives for the high-performance market.

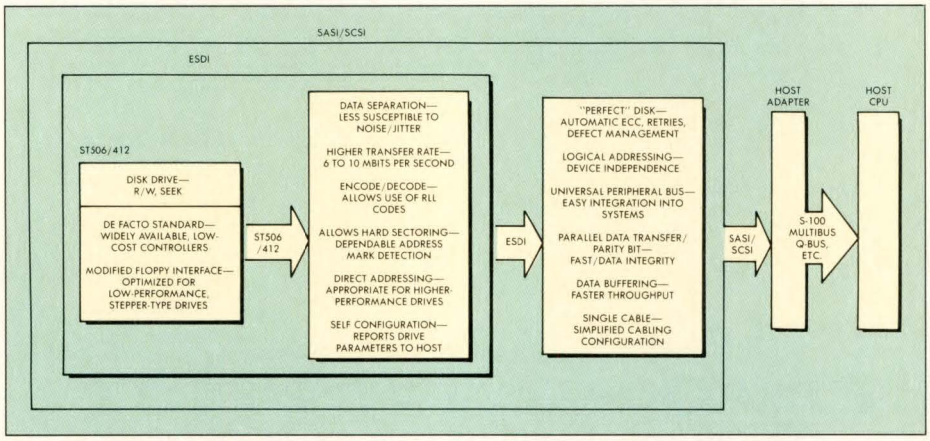
However, the demands for performance are rapidly outstripping the capabilities of both SMD and ESDI. The 3-Mbyte-per-second transfer rate limit of these interfaces will be too slow for the next generation of high-performance systems. And, as the number of high-performance peripheral devices proliferates, system integrators will be looking for interfaces that permit them to separate the device specifics from the system hardware and software—essentially making the peripheral transparent to the CPU. This device transparency allows integrators the flexibility to "plug-and-run" a wide variety of devices until the best mix for the application is found.

The bandwidth limitations of the device-level interfaces and the need for device transparency are probably the most compelling reasons for the development of intelligent interfaces.

Intelligent and Transparent

By decoupling the architecture of the peripheral device from the operating system, intelligent interfaces free system integrators from the necessity of modifying operating system software to accommodate differing peripheral devices.

Decoupling also frees the disk drive vendor to improve performance and increase capacity without any performance penalty from interface limitations on the CPU side.



The difference between device interfaces (such as ESDI) and bus-based interfaces (such as SCSI) lies *in the nature of the functions they provide the system with. It's all a matter of which functions you want in the peripheral, and which you want in the controller. Device interfaces are simpler and less versatile.*

Interface Assumes CPU Tasks

IPIs transfer many device-control functions from the system's CPU to the microprocessor of the controller, giving system integrators the device transparency they seek. Systems can achieve greater efficiency with intelligent interfaces because the CPU is freed from device-control tasks and can concentrate on what it does best—number crunching.

The intelligence provided in the interface can also relieve the operating system of tasks relating to data access optimization. Tasks such as queue processing, reconstituting fragmented files, and diagnostic functions can be handled by the controller. Defect management, error correction, and retries, all essential functions currently handled by the operating system, can be assumed by the controller.

Intelligent controllers can also assume such functions as matching transfer rates between the CPU and the peripheral. This allows a rate change of the CPU or the peripheral, or both, without redesign.

At the system level, optimized partitioning of functions among the intelligent controller, the I/O processor, and the system software that drives both, results in increased throughput.

As system integrators plug in more peripherals, and the number of processors accessing those peripherals increases, other optional attributes of intelligent interfaces come into play. Bus arbitration, multithreading, direct copy, and overlapping operations are features that may not be necessary in systems using only one or two peripherals. But, in configurations that include multiple-host systems and several storage devices, these features are essential.

With these features comes the ability to mix or match peripheral devices. Disk drives, tape drives, printers, scanners, and logic analyzers are mixed or matched to obtain the optimum combination of capacity and performance, and the ability to handle rapid-access or archival-storage devices with equal facility.

Whether SCSI will grow in acceptance and performance capabilities enough to displace IPI for design wins in high-end mainframe and minicomputer systems is hotly debated. Let's take a look at these two intelligent interfaces and see if we can fan the flames a bit.

For years, the SCSI standard bore the stigma of "small" in its title. Despite its built-in intelligence, system integrators have not taken SCSI's performance capabilities seriously, choosing to implement SCSI chiefly in low-end systems.

Additionally, in the early days of SCSI, each manufacturer interpreted the SCSI specs in his own way. This resulted in incompatibilities among host adapters, controllers, and drives. You could buy one SCSI host adapter and hang a couple of SCSI

continued on sector 44

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controllers on it, plus seven different SCSI peripherals on each controller. Even though they would all be SCSI technically, they still might be incompatible. This possibility slowed SCSI's acceptance.

Since then, however, a subgroup of the SCSI ANSI committee has developed a more realistic standard incorporating the Common Command Set (CCS). By selecting a common implementation of a subset of SCSI commands, CCS allows software and hardware developers to create products for a wide range of systems. The SCSI standard now enables peripheral vendors to design an assortment of products with strong prospects that they will work together as planned.

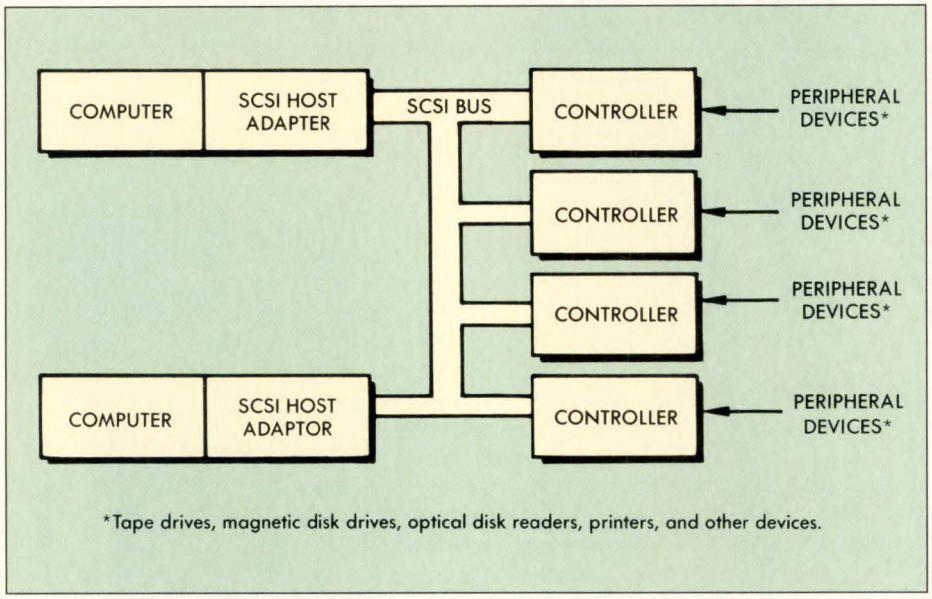

Figure 1—SCSI's disconnect/reconnect function makes *maximum use of multiple storage devices. A number of such devices can take commands from multiple hosts.*

SCSI's Features and Benefits

The SCSI standard includes many performance features, such as disconnect/reconnect, arbitration, multitasking, logical addressing, and command linking and queuing. Since the major contributor to system performance degradation is mechanical delays in the I/O, these features are specifically designed to eliminate as many of these delays as possible.

One of the key performance features, disconnect/reconnect, allows a controller to release use of the SCSI bus once a command is received. The controller can execute the command while disconnected from the bus, and reconnect when ready to transmit or receive data. The system can then initiate multiple jobs, allowing disk-seek times on different peripherals to overlap. Banks of SCSI storage devices can operate as file servers for a network of computers or a large multiprocessor system (Figure 1). This multitasking allows optimization of peripheral device operations.

SCSI provides for logical rather than physical addressing, which allows the system software to be independent of the particular peripheral device on the controller. Device sizes and types can be modified or added to SCSI systems with virtually no change in the system. The universality of the SCSI standard provides the flexibility to add new SCSI devices as they are introduced.

The SCSI standard provides two electrical specifications for the interface: a single-ended implementation that allows a maximum cable length of six meters, and a differential implementation that allows bus lengths of up to 25 meters—long enough to reach across most computer center floors. Some device vendors are now utilizing the differential implementation with its synchronous clocking to achieve transfer rates of 4 Mbytes per second.

The argument for implementing SCSI gains strength from the fact that SMD has run into problems achieving the 4-Mbyte-per-second transfer rates now being offered on synchronous SCSI devices.

In addition, a recent proposal on the committee level that would change the SCSI bus from an 8-bit to a 16- or 32-bit parallel interface, if implemented, also would put SCSI devices in the position to offer data transfer rates in the 8- to 16-Mbyte-per-second range. This would suit SCSI to large, performance-oriented systems, and make it competitive with IPI.

A proposal by Data Processing Technology, called SCSI-2, would add another set of cables and connectors, widening the SCSI data path. The second cable is at least 24 lines wide and works in parallel with the existing eight-line cable. The SCSI-2 could accommodate different word widths and host architectures with 8-, 16-, and 32-bit I/O buses on the same peripheral bus. Some manufacturers have initiated designs for implementing 16-bit SCSI interfaces.

The push for larger, faster machines has driven efforts to provide an interface with the potential for even more power and flexibility than SCSI. The result is IPI, a 16-bit parallel interface with multiple physical and logical levels. IPI is the only interface available that was designed to simplify the connection of multiple high-speed disk drives to high-performance superminicomputers and larger computers (perhaps because it was conceived by a committee made up of members from the mainframe world).

Simply defined, IPI is a high-performance, 16-bit, leveled interface capable of transfer rates of up to 10 Mbytes per second at distances up to 125 meters. The interface is defined in four levels:

- IPI-0 is the first level and defines a 16-bit (double-byte) parallel bus running at 5 MHz.
- IPI-1, level 2, defines a state machine and procedures for device selection, deselection, and polling to determine status.
- IPI-2, level 3, is a device-level interface that can be used directly between the host and its peripheral, or in combination with the next level—IPI-3.
- IPI-3, level 4, adds intelligence and provides the capability of sup-

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WHEN MORE IS LESS: TRADING PERFORMANCE FOR FUNCTIONALITY

BY I. DAL ALLAN, I/O Columnist

Intelligent interfaces, such as the Small Computer Systems Interface (SCSI) and Intelligent Peripheral Interface-3 (IPI-3), offer systems integrator the opportunity to incorporate an interface with a wealth of functionality. However, too often, the specifications demanded of a controller aren't in line with the ability of the operating system to take advantage of its features.

A case in point is command queueing. A feature of IPI-3 for several years, queueing multiple commands to the same address has recently been added as a new option in SCSI-2. It's a feature that intuitively appeals to most integrators.

IPI and SCSI approach the support of multiple hosts in different ways. IPI uses separate ports, one for each interface attachment. SCSI shares the same bus and has an arbitration scheme to determine which attached device will use it.

The simplest form of queueing occurs when the controller can accept more than one command for an attached peripheral, but not more than one per port (IPI) or one per initiator (SCSI). This ability is described in IPI as command stacking.

Command queueing is the host's ability to issue several commands for the same peripheral to the controller. This is appealing because it gives the controller enough visibility to optimize the sequence in which the commands should be executed. Thus, five commands can be received from two hosts as:

For Host B	READ	10	blocks at Address	473
For Host A	READ	5	blocks at Address	32,854
For Host B	WRITE	2	blocks at Address	468
For Host A	WRITE	3	blocks at Address	32,846
For Host B	READ	10	blocks at Address	483

If executed in the order received, there would be a long seek motion between each command. A much more efficient method would be to execute them by accepting the WRITE command for two blocks immediately because there is a buffer free. If the disk arm is toward the center of the disk, the most efficient sequence might be:

For Host A	WRITE	3	blocks at Address	32,846
For Host A	READ	5	blocks at Address	32,854
For Host B	WRITE	2	blocks at Address	468
For Host B	READ	10	blocks at Address	473
For Host B	READ	10	blocks at Address	483

A host can order within its own requests. But, in an environment in which the controller is shared among multiple hosts, command queueing can seem to be the most attractive way to boost performance. It can be, but rarely is.

Initially, the controller must have buffers allocated to hold multiple commands, and then it has to sort them. As each command is received, it must be ranked according to a controller algorithm of when to execute. Also, host-defined operatives, such as Priority, force the controller to adjust its algorithms.

The additional overhead for queue processing is masked if the host(s) can continue giving enough commands outboard to be executed. Here, the fallacy that queueing can improve performance creeps in.

Few operating systems are written to migrate the responsibility for command ordering outboard. In fact, as they've evolved, operating systems have been written and rewritten to optimize the sequence of commands issued to peripheral subsystems.

Slow response and low throughput results from combining a high-performance controller with command-queueing capability and an operating system that issues only one command per device address at a time.

Systems integration goes beyond the selection of a controller with the best "specifications" as perceived from the length of the options and features list supported. The sum of the parts can add burdens to processing overhead and lengthen I/O time.

It might appear that the world of mainframes is where command queueing can provide the greatest benefit, because of servicing hundreds of I/O requests per second. But, such is not the case. Mainframe operating systems were developed when peripherals were dumb, and their control came from the host software.

The "soft" in software has become a synonymous with concrete because of its rigidity and resistance to change. Improvements include complete compatibility with existing practice. If not, the customers' complaints are heard on high.

IBM introduced IPI-3 on its System 36, System 38, and 9370 processors in mid-1986. The IBM IPI-3 doesn't support command queueing, but it duplicates the practice of physical device selection in virtually the same manner as the Block Multiplexer Channel does. The biggest complaint since IPI-3's introduction has been that the paltry buffer size (4 Kbytes) severely limits its performance.

The OEM market prefers logical device selection, as seen in offerings from Control Data Corp., Fujitsu, Hitachi America Ltd., and NEC. The fastest of this group is the NEC offering developed by Siemens (Hauppauge, NY). Siemens is the largest

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porting many different types of peripherals simultaneously. In an IPI-3 implementation, the host needs no specific information about track size, gap timing, or other peripheral characteristics; all peripheral device operations are transparent to the host.

A full IPI-3 configuration can consist of one master, eight slaves, and up to 255 facilities or peripheral devices. At the most sophisticated level, the IPI-3 controller would manage almost all drive-related functions for the host, including logical-to-physical addressing, command queuing, data transfer multiplexing, and error handling.

IPI-3 furnishes a set of interface characteristics, called attributes, that you can specify to optimize host interface operation. Attributes can include data-transfer burst sizes, the capability to multiplex multiple data transfers at burst boundaries, and throttling of data transfers.

Communication in an IPI-3 implementation takes place via three types of "packets": command, response, and asynchronous. Command packets are sent by the host to the peripheral to invoke I/O activity. Response packets are sent by the peripheral back to the host after it has received and acted upon a command packet. Asynchronous packets are also sent by the peripheral to the host, to inform the host of unexpected changes in peripheral system status.

The IPI-3 specification provides a set of system-level commands, plus sets of command packets for disk, tape, and network communications subsystems. The commands are stacked before execution in one of two modes. In the Individual Stacking Mode, the controller stacks only one command for each of the (up to) eight drives. In Queued Stacking Mode, the controller stacks multiple commands

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seller of mainframes in Europe and one of the first companies to realize the benefits of IPI. Designed by ANSI as a migration vehicle from existing device interface I/O, IPI offered support to the existing software environment with no impact.

Siemens began development in 1984, before silicon use was established, and the standard was still under development. After an exhaustive evaluation of disk drives to attach to, the NEC D2366 disk (800 Mbytes/2.4 Mbytes/<15 = msec average seek time) was selected because of its combination of quality, performance, and capacity. Since initial selection, NEC has introduced the D2377 (1,400 Mbytes/3 Mbytes/<15 = msec average seek time). NEC was among the first of the disk drive vendors to offer an IPI-2-compatible disk.

IPI-3 is a buffered interface, comparable to SCSI, and IPI-2 is a timing-critical, unbuffered interface best compared to the Storage Module Drive (SMD) interface. IPI-2 is seen as the heir apparent to SMD for high-capacity, high-performance disk drives. It's a 16-bit parallel interface that removes the limitation on transfer rate that has haunted SMD. SMD tops out at 3 Mbytes at 50 feet, compared to IPI's 10 Mbytes at 50 meters.

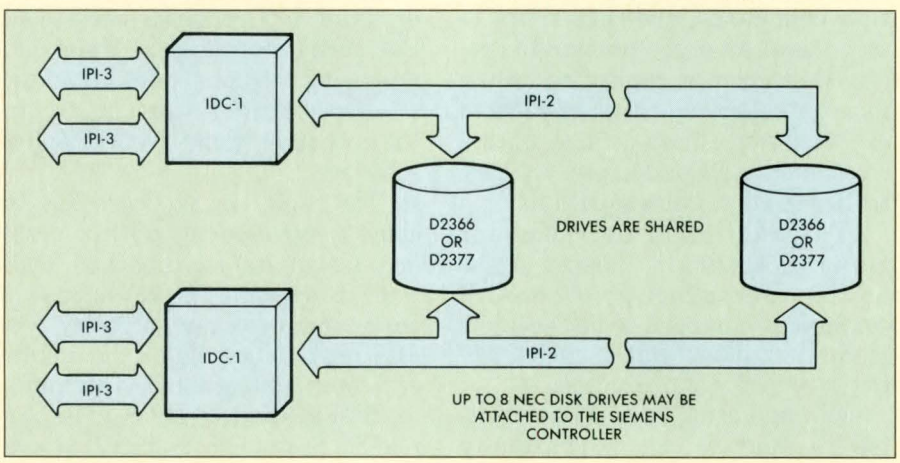

Figure 1—To optimize the use of peripheral devices, *banks of SCSI storage devices can operate as file servers for a network of computers or a large multiprocessor system.*

NEC knew an OEM market existed for a high-performance IPI-3 controller, and investigated developing its own. However, marketing would take a long time, and the performance of the Siemens controller so impressed NEC that discussions began. These talks resulted in a cabinet populated by Japanese-built disk drives and a German-built controller sold to the American OEM.

The Siemens controller is an impressive display of how to utilize silicon to conserve space and ingenuity in the repeated use of components. The same printed circuit board is used as the IPI-3 slave interface to the host and as IPI-2 master to the NEC disk drives.

There are three IPI ports: dual-port IPI-3 to the host, and a single port to the NEC disk drives. The NEC disks are dual ported also, connecting to a second controller. This combination provides four separate data paths to each disk.

Static Random Access Memory is used in the controller for its high speed. There are 128 Kbytes each for data buffers, and 32 Kwords (128 Kbytes) of executable microcode memory.

The package, including the AMD 29116 bit slice processor, and its support circuitry, fits on five boards in a self-contained drawer 9.3 x 4.4 x 23.5 inches. An alternative configuration holds two controllers in a standard 19-in. rack.

The package includes shielding. And, to illustrate the degree of detail in the SIEMENEC subsystem, the controller and disk drives qualify for use in Class B operation under FCC and VDE. A controller designed for a separate cabinet with disk drives passes the same emissions tests as personal computers.

Siemens designed its own silicon in which speed and performance were stressed, as the SIEMENEC competes with IBM 3880s and 3380s (which are attached to Siemens mainframes conforming to an OEM

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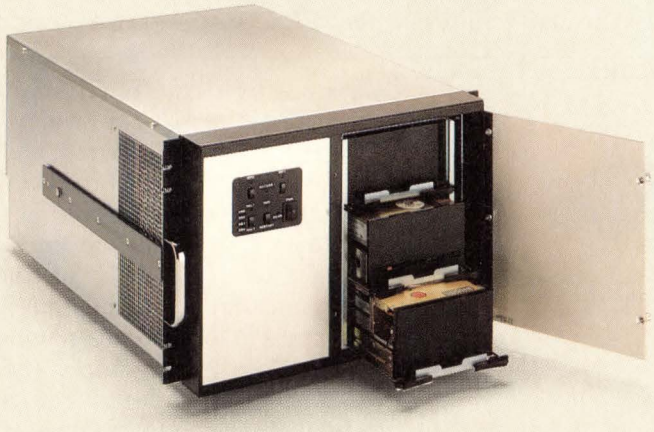

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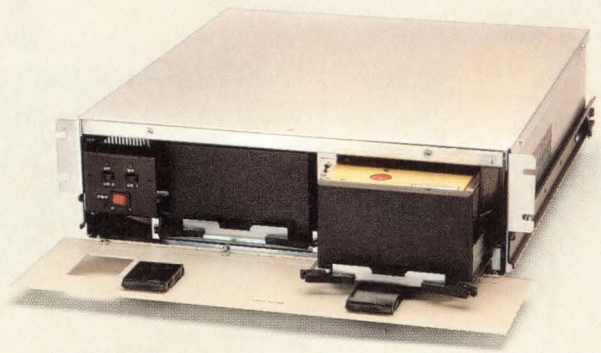

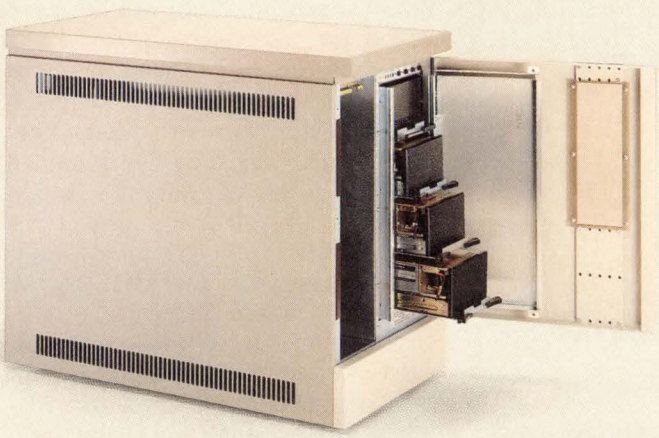

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for each device to optimize the use of each drive. To guarantee operational flexibility, however, the host can override the queue to demand sequential execution of commands.

SCSI vs. IPI

So, what are the major differences between SCSI and IPI, and how will these differences affect market acceptance?

One important feature that differentiates the two is bandwidth. As shown in Figure 2, IPI contains a 16-bit bus that can be operated bidirectionally. SCSI utilizes an 8-bit bus, which limits its bandwidth to half that of IPI. This makes IPI the only standard with sufficient designed-in bandwidth to support the next generation of peripherals with data transfer rates of 5 to 10 (or more) Mbytes per second. However, SCSI can already complete 4 Mbytes per second, which is the highest transfer rate of available devices. If the proposals to change SCSI to a 16- or 32-bit interface (mentioned previously) are implemented, SCSI-2 will become a viable competitor for future devices.

But perhaps the major difference between the two interfaces is the master/slave concept on which IPI is based, as contrasted with the peer relationship of SCSI. A master/slave-based interface must include a multichannel electronic switch for multiple CPUs (masters) to talk to a con-

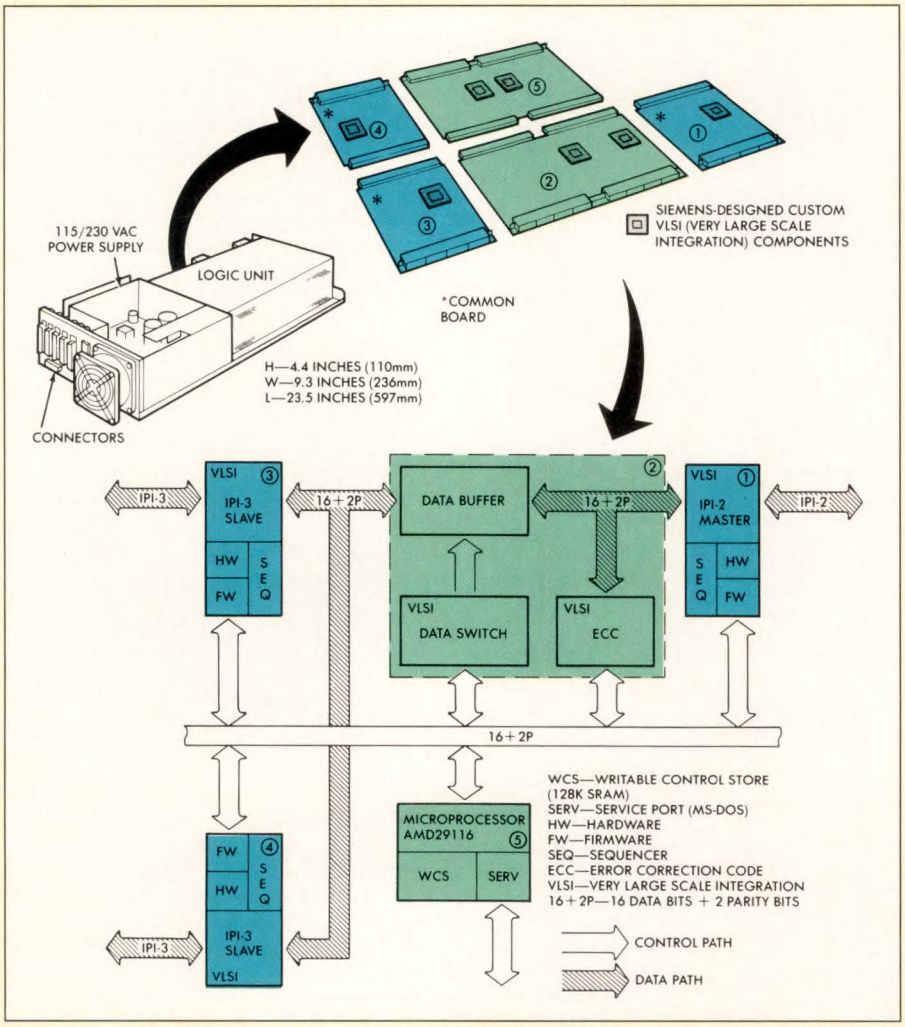

Figure 2—Custom VLSI components are *the heart of an IPI interface, with the protocol chip offering either IPI-2 or -3.*

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agreement with IBM).

A 3880 cabinet (containing two unbuffered controllers) is larger than two complete SIEMENEC subsystems. You can fit four Siemens controllers with eight ports, plus eight dual-ported NEC disk drives, in less space than one 3880 with no disk drives.

The 29116 was chosen because it represents the highest horsepower processor available in a chip. A general-purpose microprocessor, such as the Motorola 68000, would have been easier to program as many compilers and development tools were available; however, exhaustive studies proved the 29116 had superior speed.

As seen in Figure 2, there are three custom parts. The IPI protocol chip can act as master or slave for either IPI-2 or IPI-3 ports. The Error Correction Code chip is unique in that it provides correction data on the fly. Even if an error occurs in transfer from the disk, no time is lost in calculating polynomials after the data is in the controller memory.

The Data Switch chip is the key to fast routing of data through the controller. The data buffer is triple ported, one to each IPI interface. The register controls of the Data Switch increment and decrement according to the flow of data, and operate unhindered by outside processor intervention.

The data buffer is segmented so that data may be held or passed through for up to eight facilities. The storage use is dynamically assigned in 12K segments, with a maximum allocation to any one device of 72 Kbytes.

Less is more in the case of the Siemens IPI-3 controller. It's smaller and faster than any other alternative offering. The combination was the result of thorough design analysis and clear-cut objectives that resulted from a complete analysis of what was essential, rather than what looked attractive.

Decisions on controller features, such as command queueing, cannot be made in isolation. Presently, Siemens' IPI-3 doesn't incur the overhead associated with attempting to optimize a command queue of one per port. But the hooks are there. As changes are made to the operating systems so that they can take advantage of outboarding multiple commands per device, enhancing the controller will be relatively straightforward.

troller (slave). Because of the sophistication of the hardware and the number of drivers and connectors needed, it's expensive. In addition, it's difficult to reconfigure a controller when the number of available interfaces is changed. SCSI's peer-to-peer architecture, however, supplies an eight-channel switch free with every SCSI controller. This cost difference may become the deciding factor in the industry's acceptance of SCSI as a high-performance standard.

Table 1—Interface Profile For OEM Rigid Disk Drives

ST506/412	33%
SCSI	25%
SMD/ESMD	20%
ESDI	13%
IPI	3%
Other	6%

Sources: SCSI Source Guide, IPI/DLI Supplement

Table 2—SCSI Supplier Growth

	1984	1986	1987
Chips	4	5	10
Boards	20	54	60
Peripherals	34	60	72
Subsystems	6	29	59
Total	60	132	196

Table 3—IPI-3 Controller Suppliers

Company	Product
Acceleron	9635
CDC	9057
Hitachi	SC802
Fujitsu	M1060B
Siemens	IPI-2/3 Disk Controller

The challenge posed by the potential of SCSI-2 is very real to the advocates of IPI, though this may have more to do with the inertia in the IPI market than anything else. IPI is lagging about three years behind SCSI. In a recent study of more than 500 OEM rigid magnetic disk drives, Joe Molina, president of Technology Forums (Chanhassen, MN), found that only 3% were implemented with the IPI interface; 25% had implemented SCSI (Table 1). In the same study, the number of vendors supplying SCSI products—chips, boards, peripherals, and subsystems—was growing 50% per year (Table 2). Compare this with the handful of suppliers of IPI products (Table 3). The major concern among IPI advocates is that the low-cost SCSI interface is moving too fast in the marketplace to be caught by IPI.

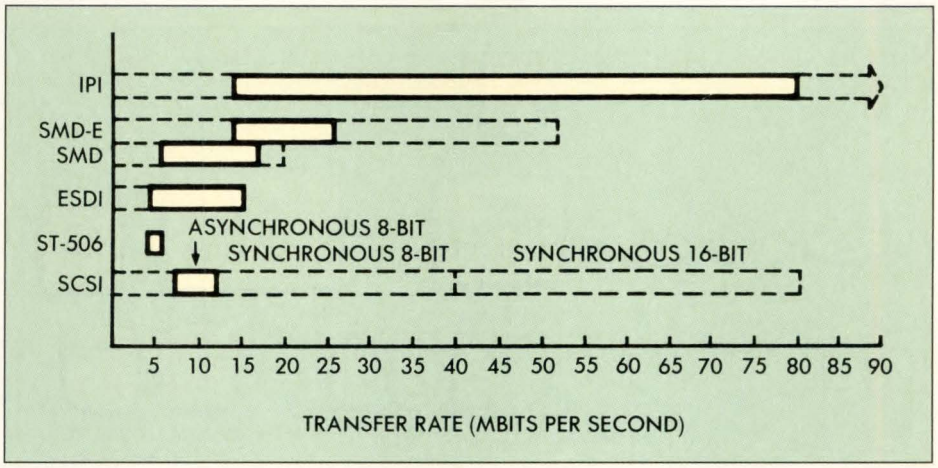

Figure 2—The bandwidth limitations of the various interfaces make *it clear that, in high-performance applications, the contest is between SCSI and IPI. As SCSI grows in bus width, IPI may have trouble matching its price/performance standards.*

Still, many vendors do not believe that SCSI, or even SCSI-2, has what it takes to compete in mainframe environments. One problem is that SCSI is limited in the number of devices it can control: eight controllers and eight devices at each controller for a total of 64. Some see this number as overly ambitious because of the judgmental conflicts between multiple targets and initiators in SCSI peer architecture. In contrast, IPI's master/slave configuration is intended for large "disk farm" environments.

Significance for DEC Users

Digital Equipment Corp. system integrators now have a choice of high-speed, high-capacity disk drives and controllers from which to choose for optimizing system performance. Manufacturers such as CMD Technology Inc., CMS Enhancements Inc., Distributed Logic Corp. (DILOG), Emulex Corp., and System Industries are providing peripheral controller boards with a variety of interfaces—ESDI, ST506/412, SMD, and Pertec—as well as SCSI host adapters that will link your DEC system to current high-performance devices.

Leading DEC controller suppliers, such as Emulex and DILOG, contend that their products are plug-and-run; no additional software drivers are necessary. Their boards emulate the Mass Storage Device Protocol and appear to the system to be DEC boards.

CMS has just introduced a new line of DEC-compatible controllers and disk drives. With this line, CMS plans to introduce low-cost devices normally only associated with PC peripherals to the DEC environment.

However, once again, DEC is limiting the choices available to DEC system integrators by adhering to a proprietary bus philosophy. Although controllers are available from outside vendors that will link high-performance peripherals to Q-bus and Unibus systems, DEC is keeping attachments to the BI backplane strictly in-house. However, it's rumored that System Industries is building a BI clone. It will be interesting to see what DEC does about that.

What Will the Future Bring?

The recent acquisition of Plessy Peripherals by DILOG may be signaling a consolidation of DEC suppliers, with a consequent shrinking of the market for third-party vendors. DEC suppliers that survive will be following the market trends at the

device level to keep pace with next-generation systems.

IPI-2 device-level controllers will, in all likelihood, come into general use much faster than the IPI-3 intelligent interfaces. There are only a handful of IPI product manufacturers at this time. But, IPI-2 is expected to replace SMD-E in the next generation of high-performance computers as the SMD interface runs out of steam.

Tape drives as we know them may very well go the way of the dinosaur

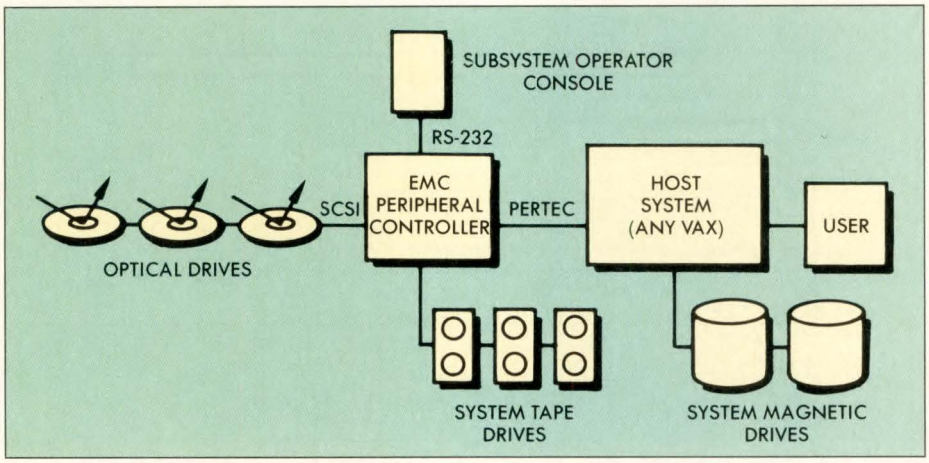

Figure 3—A SCSI interface connects *a controller to multiple optical disk drives to give the subsystem as much as 56 Gbytes of storage. The Pertec tape controller interface makes the entire subsystem appear as a tape drive.*

in the next couple of years as traditional reel-to-reel systems make way for the more compact, higher-capacity .5-in. and 8mm. tape cartridges, with gigabyte storage capacities.

Microcartridges in a 3.5-in. form factor are taking over the desktop systems market as 3.5-in. hard drives displace 5.25-in. drives in these systems. For example, the newly introduced Quantum Pro 2000 Series of 3.5-in. disk drives with embedded SCSI controllers offers:

- data access times of 19 msec;
- transfer rates of 2 Mbytes per second asynchronous, 4 Mbytes per second synchronous; and
- capacities of 42–168 Mbytes.

Apple is now using Quantum's 3.5-in. drives in its Macintosh SE and Macintosh II machines.

Disk drives aren't likely to be displaced, as are reel-to-reel systems, because their capacities continue to spiral upward while their physical size shrinks. Several manufacturers are expected to introduce 5.25-in. drives with gigabyte storage this year. And Very Large Scale Integration technology is making possible the engineering of complete IPI and SCSI controllers on chips. Simulex has introduced a chip set for IPI-2 implementation, and several manufacturers are embedding SCSI chips on their drives.

Optical drives are already increasingly present in archival backup systems. The Archeion subsystem from EMC Corp., for instance, stores 56 Gbytes. The subsystem uses a Pertec interface and emulates a tape drive. Internally (Figure 3), it connects the drives to the controller via a SCSI interface.

While write-once optical drives are limited by their inability to be erased and rewritten, there's little doubt that this will eventually be achieved—opening up another dimension in mass storage.

Solid-State Storage

Every couple of years, someone writes an article predicting the demise of rotating storage due to the advent of low-cost, high-capacity, solid-state storage. Comparisons of future solid-state capabilities are often made against rotating storage capabilities frozen in the present.

However, these predictions shouldn't be taken too lightly. IBM seems a strong driving force behind solid-state memory, seeing it as faster and more reliable than disk drives. In addition, IBM announced a 4-Mbyte DRAM chip at the 1987 Solid State Circuits Conference and is expected to introduce production of 4-Mbyte DRAMs this year.

And Memory Sciences Corp. (MSC) has introduced an all-electronic, high-performance peripheral storage system called Fastor. According to George Dill, president of MSC, "Fastor stores and retrieves data at microsecond speed. Access time is approximately 1 μsec on Fastor versus 38,000 μsec on disk. Data transfer rate is approximately 5.5 Mbytes per second. No formatting is required and, unlike disk, Fastor utilizes 100% of the storage media."

MSC has even run comparison tests on DEC's VAX equipment between DEC's RA-81 main disk drive and Fastor. These tests revealed that "... the maximum number of records that can be written from memory to the RA-81 by a VAX 6800 is approximately 30 per second, whereas we can write the same record to Fastor 1115 times per second."

So the newest interfaces, at their highest performance levels, are coming none too soon to help you take advantage of the latest breakthroughs in tape, disk, optical disk, and solid-state storage.

Additional information about the products or services described in this article can be obtained by contacting the company directly or circling the appropriate reader service number.

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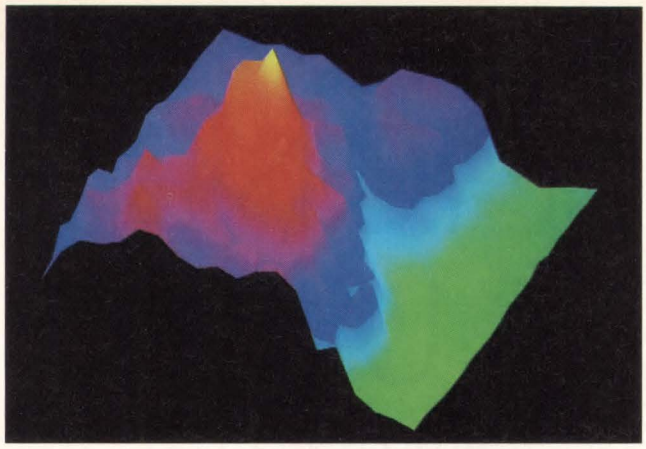
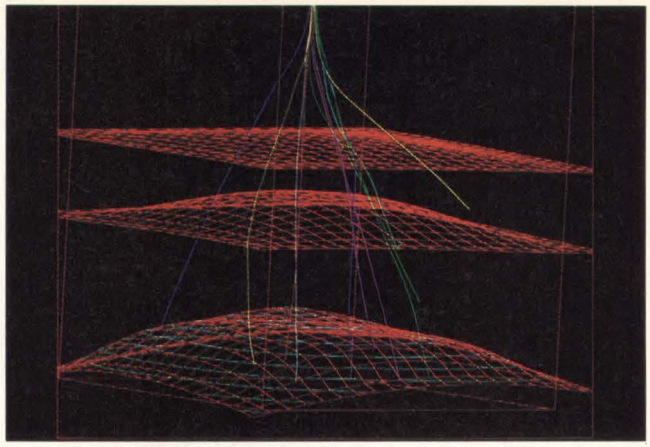
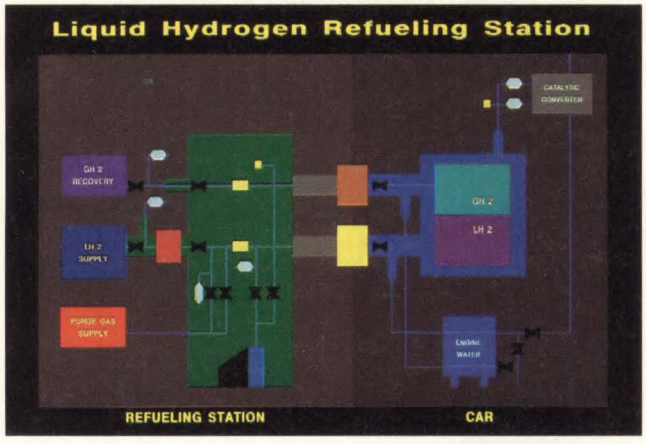


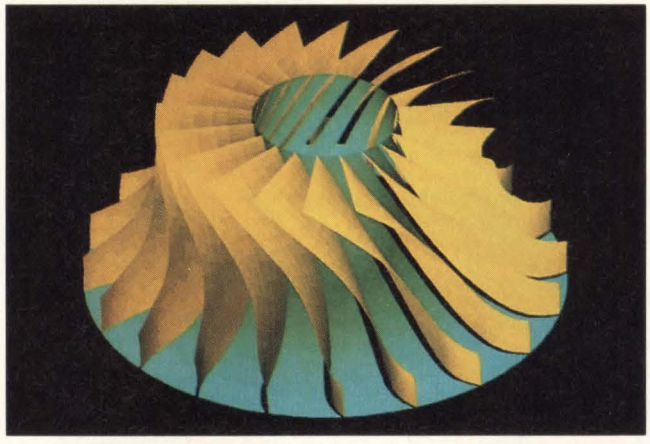
Local, interactive 3D manipulation of mapping data captured on a Tektronix 4129.



The 3D modeling capabilities of DI-3000 XPM are shown in this interactive drilling application.



The DI-3000 XPM graphics database excels at process modeling applications.



Using DI-3000 XPM, a turbine impeller is realistically rendered with local light source modeling.

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The Product

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The User

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DI-3000 XPM is machine and device independent, with initial support for the VAX/VMS environments. In the DEC environment, Precision Visuals' products install automatically as run-time shareable libraries, allowing run-time selection of device drivers and efficient use of machine resources. Over 100 graphics devices are supported, including graphics terminals and hardcopy devices from Tektronix, DEC, and HP, as well as PostScript-supported laser printers. Prices for DI-3000 XPM start at $5,500 on the DEC MicroVAX GPX; license fees scale up and down depending on CPU power.

The Features

DI-3000 XPM includes the entire DI-3000 2D/3D graphics subroutine library. For sophisticated development tasks, the XPM extension includes graphics data management based on the PHIGS output model, hidden line processing, and many extended primitives such as rectangles, ellipses, arcs, spheres, extruded polylines, extruded fill area sets, and solids of revolution. Graphics structures can be built, edited, and archived with or without images appearing on a graphics device. Output can also be displayed and rendered locally on Tektronix 41xx/42xx terminals by combining DI-3000 XPM with Precision Visuals' AddSys-3000™ software. DI-3000 XPM also supports a powerful name set filtering option for controlling the display and detectability of graphics picture components.

The Applications

DI-3000 XPM is a tool for programmers building design, simulation, process monitoring, and other applications including: ☐ Transportation or Communication Networks ☐ Simulation of Flow Phenomena ☐ Manufacturing Simulation ☐ Molecular Modeling ☐ 2D Layout ☐ Architectural Modeling ☐ Any Simulation Where 2D or 3D Objects Change Based on Events. Less complex applications can be fully addressed with the basic DI-3000 package.

The Story

To get the full story on DI-3000 XPM, including technical information and a complete list of supported systems and users,

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REPORT 4: MICRO TO VAX OPERATING SYSTEMS PART II

PICK, UNIX, AND VMS

MOVING BEYOND THE SINGLE USER

IN THIS SECOND PART OF THE OPERATING SYSTEMS ANALYSIS, THE HC/WG LAB STAFF GOES BEYOND SINGLE-USER MICROCOMPUTER ENVIRONMENTS AND EXPLORES ROBUST, MULTITASKING/MULTIUSER OPERATING SYSTEMS DESIGNED FOR POWERFUL VAX SYSTEMS

BY THE HC/WG LABORATORY STAFF

Our goal with Part II of this operating system series is to bridge from microprocessor-based operating systems and environments to PDP- and VAX-class machines. Pick serves as an ideal system transition tool since it offers a rich environment both at the VAX and at the PC level, which gives significance to its inclusion in this report.

Like UNIX, Pick isn't limited to microprocessors. Both have drifted from mainframe and minicomputer environments to the desktop system. Like their siblings, the desktop versions of these operating systems offer the same capabilities; the result is that microprocessor systems attached to a VAX can have a peer-to-peer relationship even at the operating system level.

The Pick operating system from Pick Systems Inc. is unique in that it's organized with a standalone database manager. The complete system allows multiple users to instantly update or retrieve information stored in on-line data files. Pick's unusual philosophy and organization have popularized it with business users of both minicomputers and microcomputers. Vendors of Pick systems claim that their products' high performance and fast response are made possible by the use of a unique, business-oriented, machine-independent assembly language that greatly reduces system overhead and program execution time.

Pick File Hierarchy

Pick files are organized in a hierarchical structure. Files at each level of the hierarchy point to multiple files at the next lower level. Pick defines four distinct file levels:

- System Dictionary—the highest level of file; contains user log-on names, passwords, security codes, and system privileges;
- User Master Dictionaries—one for each user account; includes information relevant to the user and data for customizing the user's environment;

- File Level Dictionaries—several for each user account; describe the structure of the associated data files; and
- Data Files—several for each user account; contain the actual data that may be stored in a 3D variable-length format.

Within a file, items are stored in a "pseudo-random" sequence. The sequence is determined using a "hashing" (randomizing) algorithm. The item ID and other predefined parameters for the file are used to produce a disk address called a Frame Identifier (FID). The FID identifies the physical location of the item on the disk. Items stored in a file may be accessed directly, using the item ID as a key, or sequentially in the pseudo-random sequence. If sorted sequences are required, Pick makes a preliminary pass through the data and produces an ordered list of item IDs. These lists can be used immediately or stored for future reference.

Picking the Utility

Pick communicates with the users through a simple command processor called Terminal Control Language (TCL). From TCL, the user can perform most of the expected file maintenance functions. Files may be created, deleted, and copied. In keeping with its database architecture, Pick also allows files to be cleared.

Pick Development Tools

Pick's power and appeal stem from its database architecture. Users can, using the built-in editor, perform on-line, interactive modifications to any item in the database. The editor can be used to create or modify programs, predefined sequences of TCL commands, data files, and dictionary files.

Pick also provides a query and report-generating language called Access. The Access language processes sentences that specify the desired data retrieval functions (Figure 1).

The syntax of Access is a limited form of English. The purpose of Access is to permit input sentences to be stated in the technical terminology of a given application. Access allows the user to make various types of listings, reports, and queries easily; it can also be used to select items from a file for use by other processors, too.

Pick is also supplied with a BASIC interpreter, Pick/BASIC, and a text output processor, Runoff. The BASIC used is a version of Dartmouth BASIC that has been extended to provide access to Pick files. Runoff is a limited text formatter that can produce justified documentation.

Pick provides an excellent solution to the business user with large and complicated databases. Its weaknesses in language support and transportability make it a less attractive choice for other uses.

Making the UNIX Move

You may not be overly enamored with application-specific operating environments such as Pick, however. To this end, other environments, equally robust but more general in operation, should be considered.

Figure 1—One of the features of Pick is *the ability to use the stored data for creation of business graphics, as shown here. The above data was retrieved using a simple Pick Access statement: SPLOT SALES BY DATE. . . . The data was then passed to Accusoft Enterprises' Accuplot business graphics management program—a program that creates graphics for output to virtually any printer, plotter, or graphics CRT.*

Specifically, UNIX offers a tried-and-true alternative that is well supported.

UNIX has grown in status from the somewhat obscure hackers' interface of 15 years ago to one of today's most widely used operating systems. Initially developed at AT&T to meet the requirements of in-house computer scientists, UNIX has moved into the mainstream—partly because of its technical sophistication and partly in spite of it.

The popularity of UNIX can be attributed to several factors. As mentioned earlier, the emergence of powerful microprocessors has paved the way for relatively inexpensive but highly flexible computing environments. UNIX has the advantage of being independent from any one processor or system, but is still capable of implementing the features that make these processors so desirable. It's written primarily in very portable C code and exists on systems as diverse as Cray supercomputers and ordinary PCs.

Putting Users to Work

UNIX is a multitasking, multiprocessing operating system—more than one user can run more than one program at a time. It's also easy to start programs running as background processes (simply place an ampersand after the command line invocation, and the problem will run in background), or have one program start another. UNIX also manages the system's access to real and virtual memory.

Another important UNIX feature is its ability to easily redirect program I/O. Output from a program can be directed away from the terminal (the default destination) and into a disk file, or even be used as input to other programs. The latter is accomplished via what's called a "pipe" and allows programs to be built in a modular fashion and run in parallel.

UNIX has its drawbacks as well. A major source of irritation is that there are two almost equally accepted versions of the operating system. One is the System V release, produced and maintained by AT&T. The BSD version that emanates from the University of California at Berkeley is the other. While alike in many ways, the two versions have continued to become increasingly dissimilar in recent years.

Another concern is the large size of a complete UNIX release. As much as 15–20 Mbytes of disk space may be required just for the system software. Although improvements to the user interface have been attempted, UNIX can be difficult for new or casual users.

Networking Support

Each version of UNIX provides a low-level mechanism for network support. In System V, this support is provided by the Streams facility.

BSD uses "sockets" to provide this functionality.

From the user perspective, two popular methods are used for allowing file access across a network. Both Network File Sharing (NFS) from Sun Microsystems and Remote File Sharing, supplied as part of the System V 3.0 release from AT&T, allow users to mount directories from other systems on the network and treat them as if they were their own. NFS even provides the ability to share files with non-UNIX-environment machines, such as VAXes running VMS or PCs running DOS.

In either case, the file-sharing mechanisms are implemented by layering several necessary parts, such as the socket or Streams layer, the protocol layer, and the device layer. In keeping with the UNIX philosophy, these layers fit together in a modular fashion. They do not require any one protocol or device interface, although some combinations fit together better than others. Examples of protocol and device layers are TCP/IP and Ethernet, respectively.

Directory Structure

The UNIX directory structure is similar to that of MS-DOS. The file system is characterized by a hierarchical directory tree. At the base of the tree is the root or "/" directory. All of the files, user and system, reside in directories and subdirectories below this level.

A directory entry consists only of a filename and an "inode" location. The inode, as described later in this article, contains all of the information associated with the file.

One file that does reside in the root directory is the UNIX program, also known as the kernel. This program is the interface between all other programs and the system hardware.

UNIX regards everything on the system, including peripheral devices, as a file or sequence of bytes. This is one of the most fundamental aspects of this operating system. Thus, the typical user and most programmers don't need to be aware of the low-level operation of the system. The kernel performs the task of turning the "sequence of bytes" into an appropriate command for the targeted device.

Vary the Block Size

The UNIX file system consists of a series of logical disk blocks. Typically 1024 bytes in length, logical blocks may vary in size in different systems depending on the particular implementation. First comes the boot or start-up block; it contains information used to initialize the system. The boot block is followed by the superblock containing general file-system information. Next comes a sequence of inode blocks followed by the actual data blocks.

The inode is the fundamental component of the UNIX file system. Allocated by the system administrator during the creation of the file system, the inode table contains a specified number of inode blocks that are subdivided into the inodes themselves.

A portion of the inode contains administrative information about the file, including its owner, permissions, size, and creation and modifi-

cation times. The remainder of the inode is a series of pointers to data blocks. Most of the pointers refer to data blocks that store the file's contents. However, several pointers are reserved to point to indirect data blocks that, in turn, target other data blocks and, possibly, other indirect data blocks.

A major reason for this method of chaining the inodes and data blocks is to allow files to grow as required without wasting disk space. Further, since many files are small enough to avoid indirect data-block allocation, accessing the files is a relatively efficient process. On the other hand, there's a small price to pay when accessing very large files.

The interface between the user and the kernel is accomplished through a program known as a shell. The shell interprets user commands and supports a high-level programming language. This language provides many standard programming features such as FOR and WHILE loops and IF-THEN-ELSE and CASE conditional statements. UNIX commands are available for use as well. Shell programs may be entered directly by the user or stored in a file and executed. The resulting programs are called shell scripts.

The two shell scripts shown in Listing 1 determine the number of processes a specified user has running. The first is a Bourne shell script and the second is a C shell script.

Although there is a variety of ways to use both C and Bourne shell scripts to do this, some of which may be faster, these were selected because they demonstrate a number of interesting capabilities including IF and FOR loops, shell commands (ps), shell utilities (awk), and pipes. Further, these examples help identify areas where the types of scripts do similar things with different sets of calls.

The ability to use shell scripts provides power and flexibility. For example, many of the system start-up programs are shell scripts that are easily customized to serve a particular site or user.

Just as there are two versions of UNIX, two versions of the UNIX shell exist. The Bourne shell is a standard part of both the System V and the BSD UNIX releases. The C shell, while commonly available for System V, is part of the BSD release and is

LISTING 1

```
# Bourne shell script
trap "exit" 1 2 3 12 15
trap "rm -f /tmp/temp.$$" 0
#
if [ $# -ne 1 ]
then
        echo Usage: Bprcnt '"user"'
        exit 1
else
        USER=$1
fi
```

```
# C shell script
if ($#argv 1= 1) then
        echo 'Usage: prcnt "user"'
        exit 1
else
        set USER="$1"
endif
```

most often associated with it.

Two notable features of the C shell give it a friendlier user interface: its history mechanism allows easy recall of recently issued commands, and its alias mechanism provides the ability to rename a complicated command line to a simpler (to type and remember) acronym. However, Bourne shell scripts are more portable since every UNIX system has that shell, and they generally use less memory and execute faster.

Standard UNIX software development utilities include C and FORTRAN-77 compilers, an assembler, a linker, and assembly and source debuggers. Additionally, the program link is provided to pass through the source code and detect problems before compiling. The make program, on the other hand, controls how a program's components are to be compiled and linked.

Another standard UNIX tool is its text-processing software, Documenter's Workbench (DWB). DWB provides the ability to specify tables, equations, and simple graphs, along with some rather sophisticated documentation layouts.

Obviously, more features and functions of UNIX exist than discussed here.

Interestingly, UNIX has, until recently, taken a back seat to mainstream operating systems. Due to standards efforts (see "First POSIX Standard Reflects DEC Input," page 28, this issue"), portability and user interface issues are being resolved. Moreover, Digital Equipment Corp. is moving toward more standardized implementations, drawing from AT&T's System V with Berkeley enhancements, eschewing the off-beat approach that characterized earlier versions of Ultrix.

VMS—DEC's Flagship

Even though DEC is supporting UNIX, VMS is still its flagship and will continue to be. As this report is being written, DEC is preparing to begin shipping VMS 5.0, which is a generational product. The new version is designed to take advantage of the new VAX 8800 series symmetric processing engines. Therefore, VMS 5.0 supports up to four parallel processors.

Extending the Functions

One feature that has made DEC's VMS popular is its ability to manage multiple tasks and users (Figure 2). In theory, any number of users can have access to any number of tasks or jobs. And, in the ideal environment, which VMS has proven to be for the most part, tasks can beget tasks, and other operating systems can be tasks within the VMS environment.

Other features that make VMS a good choice for your VAX system include:

- ideal software development environment offers a full range of tools that speed development time, and
- powerful system management facilities control all functions within the VAX environment.

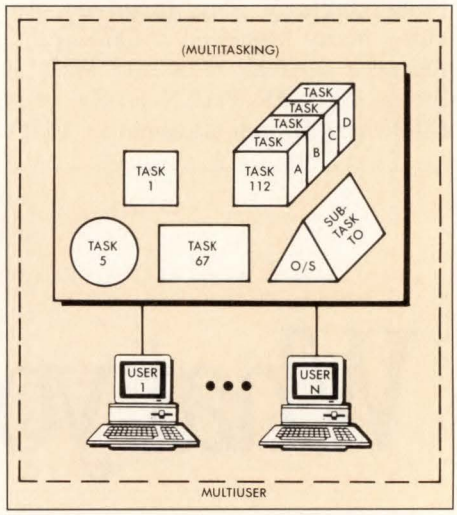

Figure 2—A multitasking environment can be simulated *by using a network to attach several single-tasking systems together. The basic notions are: any user on the network can utilize any network resource (e.g., printers, file servers, gateways); on most networks, such as an Excelan Ethernet, users can run tasks on other users' machines (resources)—a feature of OS/2 LAN Manager. Since the ability to use other resources exists at the network level, it is conceptually a multitasking, multiuser system when viewed as a whole, regardless of the capabilities of the operating systems running on the individual nodes.*

A Rich Environment

Making VMS a powerful development tool for software developers has been one of DEC's goals. As such,

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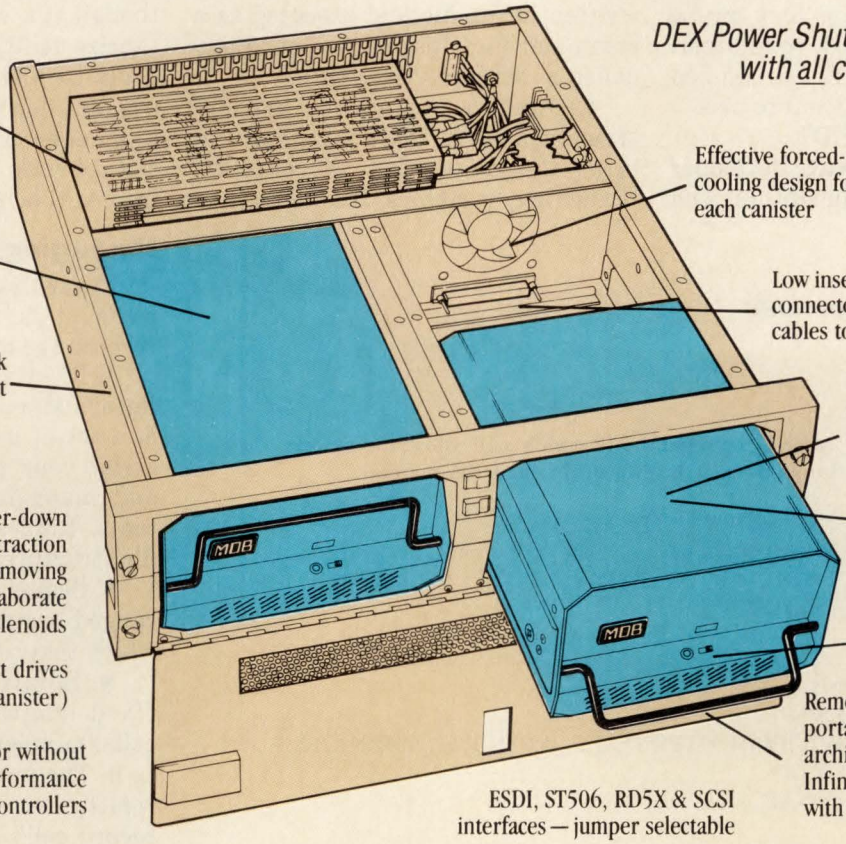

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VMS comes with two full-screen editors: DEC Editor (EDT) and Extensible VAX Editor (EVE). Both are full-function screen editors that allow you to create text files and programs. Quite a bonus considering that some operating systems come with only a line editor.

Although EDT has been available for almost eight years—and is both a line- and a screen-oriented editor—it does offer many features, such as a start-up command file that lets you tailor your EDT environment to suit your requirements. For example, you can create commonly used macros (a combination of commands) and keyboard definitions for automatic operation.

Additionally, EDT has the provision for a journal file to keep track of each entry, making recovery easy if work is unexpectedly interrupted. Other capabilities include a multi-buffer function and a large command set to facilitate editing.

EVE is an editing interface to the VAX Text Processing Utility (VAXTPU, or more commonly, TPU). TPU is a text-processing language, and EVE is written in this language. EVE has all the EDT abilities mentioned previously, but also has multiple windows to allow editing of two files on the same screen. Text can be moved from one window to another. When exiting from EVE, all modified buffers are written back out to disk—an improvement over EDT.

Of course, the software developer is looking for more than editors. And VMS does provide a powerful linker resource. The VMS linker combines individual modules (separately written and compiled) into a single executable image. (Image refers to a single program.) And, as can be expected, the linker supports all VMS programming languages and is able to support shareable images.

Because it's important for you to keep track of the code operation, the linker produces the necessary symbol and cross-referencing tables, can make use of various object modules, and serves as a powerful debugger.

VAX Control

Although there are other features of VMS that make it ideal for programming, including a wide variety of languages such as Ada, APL, BASIC, BLISS, C, COBOL, FORTRAN, LISP, Pascal, PL/I, and RPG II, the real features are at the user level.

One important control feature is the command language processor—the Digital Command Language (DCL). The DCL language, through which you communicate with the VMS operating system, is an extensive set of commands that allow you to do various tasks. You can use DCL interactively or in a batch mode. Moreover, DCL commands can be written into a file and executed as a command file (Listing 2)—normally called a command procedure.

Command procedures are extremely powerful. DCL is a programming language with subroutines, branching, variables, functions, and other components. Command procedures can perform backups, check modules in/out for program development, and compile/link programs.

VMS is a multiuser system—several users can share the processor's time. VMS provides the ability for multiple users of the same program to be using the same code. For example, user Steve and user Dave, or both, can use DECalc (a spreadsheet). The read-only portion of DECalc can be shared by both (or any number of) users. Let's say the read-only portion of DECalc is 120 Kbytes; the read-write portion 55 Kbytes. If the code were not shared, each user would require 175 Kbytes of virtual memory, or a total of 350 Kbytes. With the read-only code being shared, 120 + 55 + 55 = 230 Kbyte of virtual memory is needed—a savings of 120 Kbytes. The savings would be multiplied by the number of users sharing the program.

VMS provides multiuser capability with a utility called Authorize for managing user access to the system. Thus, you can restrict users by time of day, day of week, dial up over modem and across the network, as well as establish privilege levels, set usage of disk and physical memory space, and restrict program usage. Although it's worth knowing the Authorize utility, be aware that it's difficult to learn, and cumbersome to use. But don't be dismayed; there are a number of command procedures that obviate the need for you to get into Authorize.

LISTING 2

```
$ SET DEFAULT 'DEFDIR'
$ EXIT
$!
$SKIP_CNTRLY:
$!
$!  This is the new MENU command file which will allow the system
$!  manager to do things even if he has never read the manual.
$!
$ DEFDIR = F$ENVIRONMENT("DEFAULT")
$ SET DEFAULT SYS$MANAGER
$ ON CONTROL_Y THEN GOTO CNTRLY
$ SAY = "WRITE SYS$OUTPUT"
$ ESC[0,8] = 27
$ DASHES = "------------------------------------------------"
$ CRLF = F$FAO("!/")
$ CLS = ESC+"[H"+ESC+"[J"
$ IF .NOT.F$GETDVI("SYS$OUTPUT","TT_ANSICRT") THEN CLS =
  CRLF+DASHES+CRLF
$ GOTO MENU_NOWAIT
```

Managing the Records

Regardless of the operating environment being used, how files and records are managed is important.

Within the VMS environment, Record Management Services (RMS) is a set of generalized services that assist your programs in processing and managing files and their contents. RMS supports three types of file structures:

- Sequential Files—records arranged sequentially in the order in which they are stored in the file;
- Relative Files—a series of fixed-length record positions (or cells) numbered consecutively from 1 to n. The number, referred to as the relative record number, indicates the record cell's position relative to the

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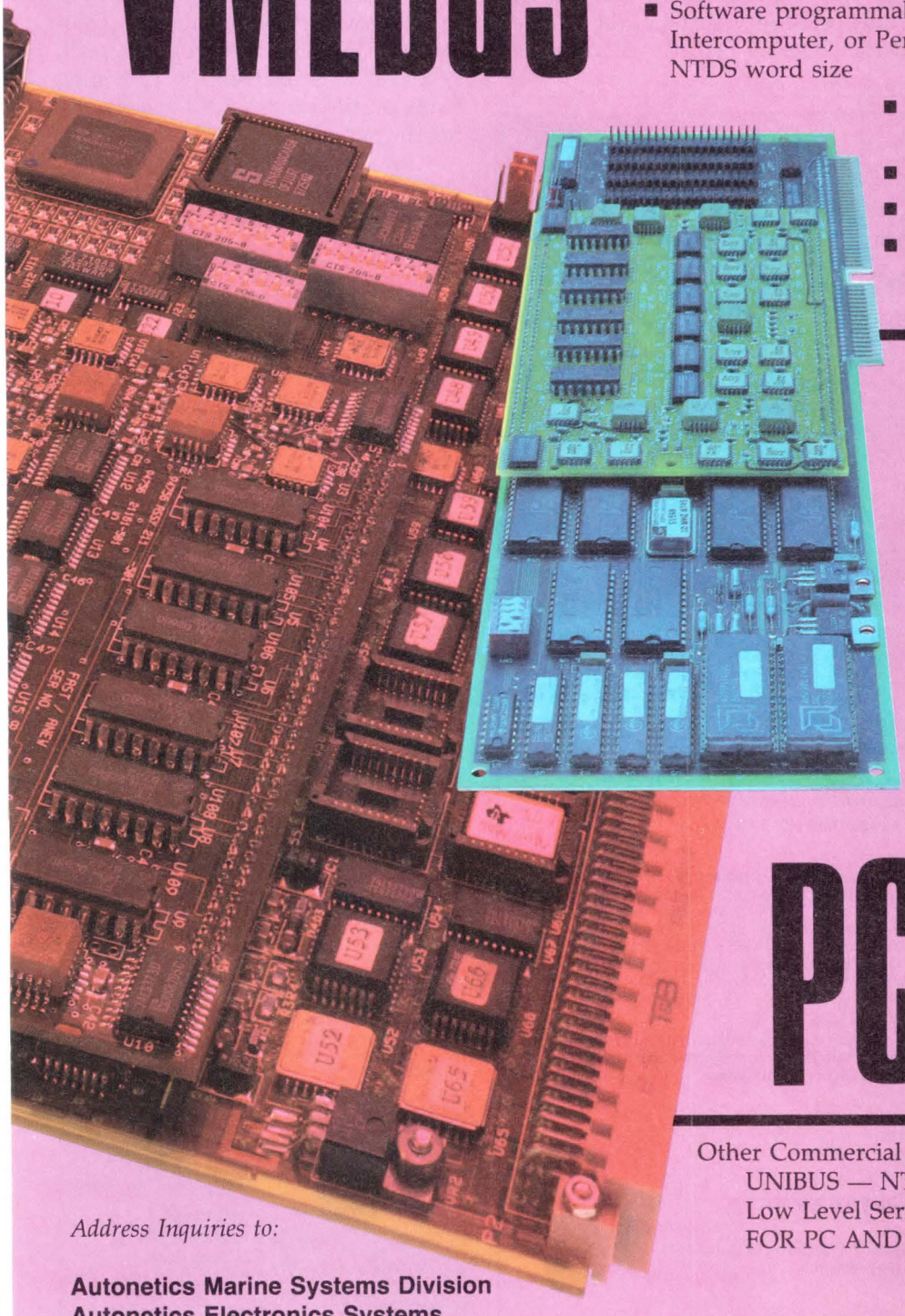

Features:

- FIFO buffering for increased data rates
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beginning of the file; and

- Indexed Files—allowing sequential and random access of records. This method is typically used in business applications.

Callable Sort/Merge facilities help manage the data within the VMS environment. Sort/Merge facilities can be incorporated into a user program or invoked as utilities. The extent and the flexibility of the routines are impressive. Collating sequences may be changed and multiple input and output files may be used, as well as record manipulation. For example, an input file with 20 fields may be sorted by any number of fields with the output file containing a subset of the original fields.

Handling the Storage

The most obvious job of an operating system is to handle the storage devices in the system; VMS provides that capability through its sophisticated Backup utility. VMS can perform and record both incremental and complete backups. Either an entire volume or a selected subset of files on the volume may be backed up. Backups may be performed to either tape, disk, or floppy drives.

There are some problems with backup in VMS versions prior to 5.0: it doesn't work across the network. What you need to do is back up on machine A, create a save-set, copy it to tape, and physically move it to machine B. VMS 5.0, however, reportedly solves this problem by providing backup utilities designed specifically for the network.

Unfortunately, VMS has no archive utility. In contrast to Backup, an archive utility allows you to physically remove data from the disk, but the file information remains; therefore, the system knows the file exists on some backup medium.

The Wire Connection

Because DEC emphasizes networking, and communications in general, you shouldn't be surprised to learn that VMS was built for networking, and the basic elements for networking are incorporated. However, a separate license, known as DECnet, is required to use networking. DECnet is extremely powerful because it supports virtual terminals, transparent file access, task-to-task communication, and routing. Just about everything that can be done to a file on a local machine can be performed transparently on a file residing on a remote machine.

Next month, HC/WG Lab staffers will look at PDP operating systems: RSTS, RSX, and RT-11.

For additional information about the products discussed in this article, please contact the company directly or circle the appropriate reader service number.

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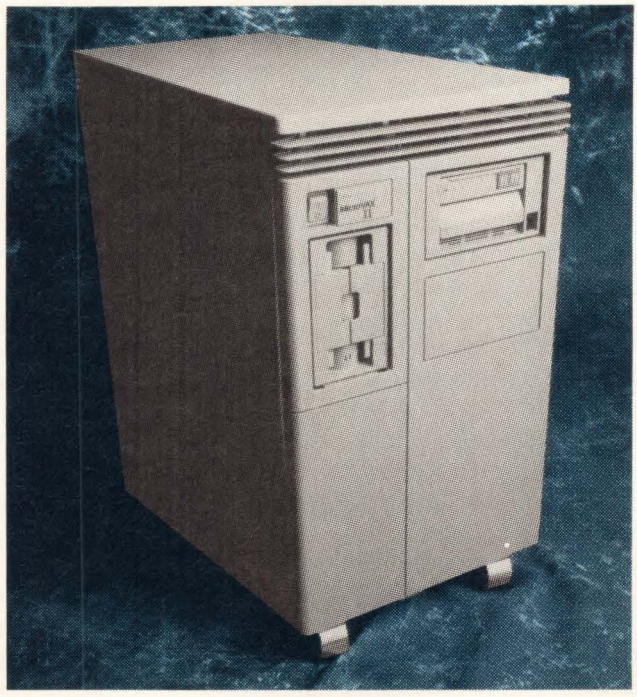

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PDP PERSPECTIVE . . . RSTS *by Mark Hartman*

Data communication with RSTS/E

RSTS has been treated by most communications vendors (including DEC) as something of a step-child/third-cousin. This is mainly caused by the fact that instructions for writing a device driver for RSTS to interface with an unusual communications gadget are not really documented. Thus, only brave souls with a masochistic hobby (like me) have ever written a device driver for RSTS to communicate with the outside world.

Several companies have produced third-party communications hardware/software packages that run under RSTS; I know of several, but I invite all of them to send me information (2404 E. Nutwood #E23, Fullerton, CA 92631). If there is sufficient response, we'll devote an entire column to third-party communications for RSTS.

DEC-supplied RSTS/E data communication typically falls into four categories:

- RS-232/422 (KB devices, keyboard ports),
- DMC-11/DMR-11 DDCMP ports (normally used for DECnet),
- 2780/3780 ports, and
- Ethernet (normally used for DECnet).

DMR-11/DMC-11 DDCMP Ports

The Digital Data Communications Message Protocol (DDCMP) is the transport layer for most existing DECnet installations.

Although smaller PDP-11 operating systems (such as RSX) implement DDCMP in the operating system so that DECnet can be run on a serial device such as a keyboard, RSTS developers chose to offload the protocol handling onto another processor.

This method of communication works rather well. There are, as always, good and bad points about it, however:

- speed—up to 1 Mbaud; and
- reliability—DDCMP ensures error-free transmissions, and the protocol handles retransmissions when necessary.
- expense—DMCs are relatively expensive on a cost-per-port basis;
- bus loading—at least one, and sometimes two or three, slots per port;
- programming—DMCs appear different to different programs, and allowances must be made by the programmer for the board; and
- compatibility—both ends must have not only the software but also the hardware.

Some of these points may be offset by your particular network configuration. For example, if you must have a very reliable, full-time network of RSTS machines, a network of DMCs might be a very good way to go.

2780/3780 Ports

DEC has been de-emphasizing communications between PDP-11s and IBM systems in general; this is evident by the current lack of significant support for the two existing 2780/3780 communications packages on RSTS. The veteran package, called RJ2780, is very old, and requires disabling some of the significant new features of RSTS to run. RJ2780 also requires that you use the older spooling system.

The newer, high-performance 2780/3780 system offloads the communications protocol overhead onto a KMC-11 processor. Just as the DDCMP protocol is offloaded to a DMC-11, the KMC-11 controls the transport aspects of the 2780/3780 protocol. RSTS has many internal structures to support this use, such as the II: (IBM interconnect) driver and bridge blocks, to enable the PDP-11 to communicate with and control the KMC-11.

Ethernet

Ethernet is the newest member of the RSTS communications family. Until recently, RSTS Ethernet was available only for DECnet. With the most recent release, however, Ethernet is directly available to user programs. Of course, Ethernet communication requires a lot of information that BASIC-Plus can't provide through its standard SPEC%( ) calls. So MACRO subroutines (generally through BASIC-Plus-2) are required if you are using Ethernet without DECnet.

Ethernet has the advantage of being a full two-way DMA communications method that permits many communications channels through a single medium. You don't have to "star" out to each network node, and the network is not dependent on each of its members remaining functional. Ethernet controllers are now available for most computers, and due to the rules set up by Intel, Xerox, and DEC (the owners of Ethernet), users must be compatible or they can't use Ethernet to describe their network.

Some third-party manufacturers have started to make specialized Ethernet equipment for DEC. To me, the best is the adapter that eliminates the big, bulky, expensive Ethernet cable and enables you to use cheap, reliable RG-58 coaxial cable end to end.

Part of a continuing series of Bomb Squad Field Updates

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- Because computer operators don't always remember to switch to daylight-saving time, and the wrong time means customers are billed at incorrect rates.
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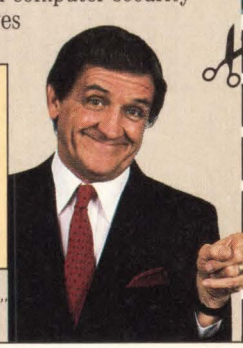
"I only act like 'Goober.' It's easy to see that Time Source technology can save more than just money."



George Lindsey, actor and businessman. Plays "Goober" on the Andy Griffith Show.

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CIRCLE 491 ON READER CARD

GRAPHICS NOTES *by Edward Teja*

Yes, sysop, there are graphics systems in your future

Many sysops think that they don't have to worry about graphics—that it isn't something needed in their application. Are they in for a shock—a future shock. Graphics applications might not be needed, but they will be used.

The greatest thing about writing about graphics today is that the subject doesn't need justification. Arguing against graphics (or better graphics) is like going to war against common sense. And everyone seems to be getting on the sensibility bandwagon.

For the record, the commonsense adage is: displayed images convey more information than alphanumeric, and color displays more than monochromatic. To the engineering and scientific community, graphic displays are essential for design, engineering, and analysis.

In the business community, graphics have always been perceived as . . . well, nice. But, in the business community, quality hasn't been much of an issue, with the term *business graphics* shorthand for low-quality graphics (poorly drawn pie charts, for instance) in much the same way that draft-quality output in printers has always represented the quality offered by a competitor's near letter quality printer. But, as the raw cost of graphics falls, business is finding reasons to believe graphics is important there, also. According to results from a Wharton Applied Research Center study, supplied to us by Project Software & Development Inc., visual aids used in presentations allowed the speaker to:

- be more effective,
- look more professional, and
- win consensus in 28% less time.

Figure 2—A Macintosh II running MGMStation CAD/CAM software provides *a powerful engineering workstation for a host system.*

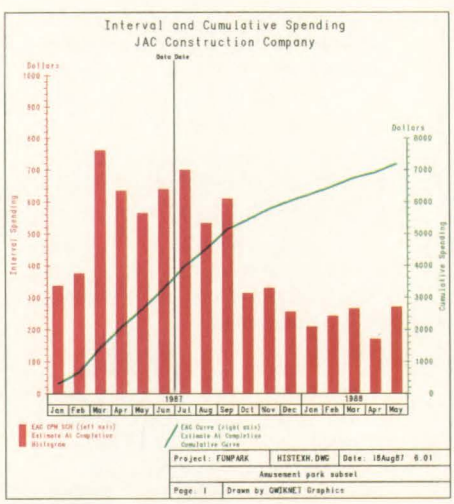

Figure 1—Because graphics can make your presentations more effective, *even business packages incorporate graphics output into their repertoire.*

This might not rock your MIS department to its foundations, but these facts convinced the folks at Project Software to add a graphics package to their project management plan. The new software allows users to produce histograms, network diagrams, and bar charts (in color), directly on transparencies. The software runs on PCs with MS/PC-DOS 3.0 or higher. The Qwiknet Graphics costs $645; the project management software costs $1,495.

Whether or not they have read the study, users have noticed the trend. According to a 1986 IDG Communications Research Department study of PC applications programs, business graphics ranked fifth in popularity after spreadsheets, word processing, communications, and database man-

agers. The deluge begins.

The meaning behind this declaration of the true desirability of graphics is that regardless of the nature of your application (unless you're still running back-room batch operations, in which case you had better update your resume anyway), you had better get up to speed on graphics. Users want (read, demand) graphics, and not only so they can play games—at least not entirely. It's necessary for you to understand that solutions to graphics needs come in many flavors.

Graphic workstations, designed for nothing more than display and manipulation, tend to be high-powered and specialized computers in their own right. They translate, rotate, and scale (the first-order transformations) images. These workstations are usually designed around high-performance silicon and are expensive—unless you need the display and manipulation functions, in which case they are not expensive but essential.

For less graphics-intense or graphics-critical applications, there are more general-purpose terminals that put graphics on your system without great effort. The classic "for instance" here is to make an Apple Macintosh do the graphics work. It has a simple user interface that's easy to learn and (as you read in "Making Computers Speak the Same Language: Networking Macintoshes With VAXes," *Hardcopy,* page 44, February, 1988) even the interconnection is relatively straightforward.

Macintosh-based terminals are not resigned to the lowest end of the application spectrum either. Manufacturing Design Systems is running MGMStation CAD/CAM software on the Macintosh II. The software includes an IGES translator that makes it easy to integrate with existing design stations. The complete subsystem (Macintosh and software) costs $8,950.

And, of course, if you cast your fates with IBM PCs, rather than Macintoshes, the third-party folks won't leave you stranded. Microsystems Engineering Corp. has introduced its MASS-11 Draw 5.0—an object-oriented graphics package that gives PCs Macintosh-type illustrating capability. The software requires an EGA or Hercules graphics card and supports freehand drawing, editing, scaling ability, and a tracing function that converts raster images to compressed vector images. This software costs $495.

Reader Interest Level

High	**Circle No. 263**
Medium	**Circle No. 264**
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Additional information about the products or services described in this article can be obtained by contacting the company directly or circling the appropriate reader service number.

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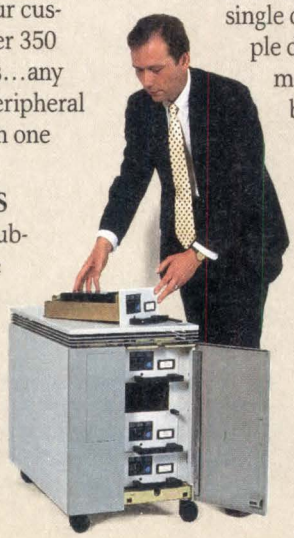

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CIRCLE 454 ON READER CARD

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StorAGE™

MASS STORAGE INDUSTRY FORUM

FROM THE PUBLISHERS OF
HARDCOPY MAGAZINE AND HC/WG LABS

MAY 15, 1988, VOL.1, NO.4

ANGLING FOR THE RIGHT TRACK

Getting to the data

located on tracks that range from 1.3 to 1.7 mils in width demands a precise method of stepping from track to track. One method uses a stepper motor attached to an arm carriage that supports the head/tree assembly. As depicted on this Seagate Technology (Scotts Valley, CA) Model 225, every 0.9 degrees of rotation of the capstan motor, located in the lower right-hand corner, equals one step (center of one track to the next). Notice that the radius of the step is greater than the capstan movement. Thus, a 0.9 angular change translates to either 1.3 or 1.7 mils of movement depending on the track density (600–800 tpi). To ensure accuracy of stepping, Seagate uses a so-called barber pole band that is tilted to the angle of movement. As the carriage moves in or out, one band on the pole unwinds while the other rewinds, giving the barber pole effect. The result being that the desired track is never clipped.

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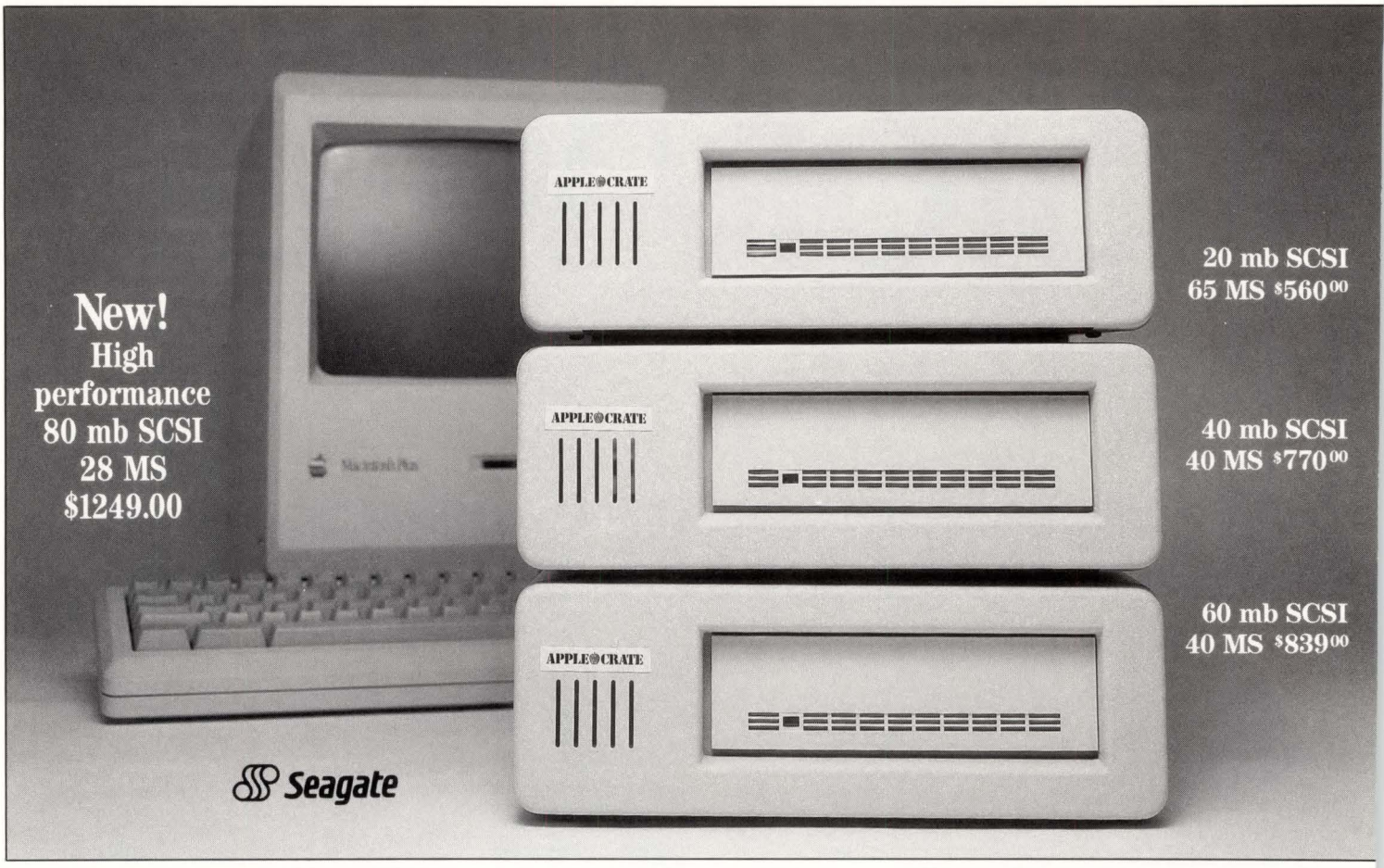

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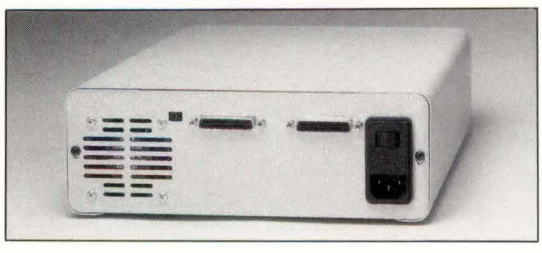

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CIRCLE 414 ON READER CARD

I. DAL ALLAN AND KEN HALLAM'S I/O UPDATE:

In last month's column (*StorAGE,* page 4), we briefly covered what ANSI, ASC, ISO, and IEEE stand for, but that is not the end of the strange acronyms used for identifying standards.

The Accredited Standards Committees (ASC) have their own numbering systems. X3 is the title of the committee responsible for "Information Processing." The committee responsible for host-to-host and host-to-peripheral computer interfaces is X3T9. Not surprisingly, it has the title "I/O Interfaces."

With so much activity in this area, several subcommittees operate under X3T9, and the following are the ones that you hear so much about.

- X3T9.2 is best known for the Small Computer Systems Interface (SCSI). Earlier work by this committee never came to fruition so, until SCSI, it was unknown. It is now responsible for the Flexible Disk (floppy) and the Enhanced Small Device Interface (ESDI) standards as well.
- X3T9.3 has generated the most standards, and both the X3T9.2 SCSI and ESDI efforts as well as X3T9.5 are spin-offs from projects within X3T9.3. When the workload in any one subcommittee gets too large, it is subdivided. Standards originally completed in X3T9.3 include the Rigid Disk Interface (RDI), Storage Module Drive (SMD), and Intelligent Peripheral Interface (IPI). There are several pieces to IPI: the Physical Interface, IPI-2 Device Specific command sets for disk and tape, and IPI-3 Device Generic command sets for disk, tape, optical disks, and communications. Current activities include the Enhanced Physical Interface, the High Speed Channel, and the Fiber IPI.
- X3T9.5 has focused on the longer distance interconnects known as the Local Distributed Data Interface (LDDI) and Fiber Distributed Data Interface (FDDI). Several pieces make up FDDI: the Physical Medium Dependent (PMD), Physical Layer Protocol (PHY), Medium Access Control (MAC), and Station Management (SMT). FDDI-2 is a follow on to FDDI that adds Hybrid Ring Control (HRC) for isochronous operation to allow mixed voice and data on the same fiber. A new project is underway to develop another PMD standard for single-mode fiber to cover longer distances than the multimode fiber presently defined.
- X3T9.6 is not presently active, but it developed the Streaming Cartridge Tape Device Interface (more commonly known as QIC02).

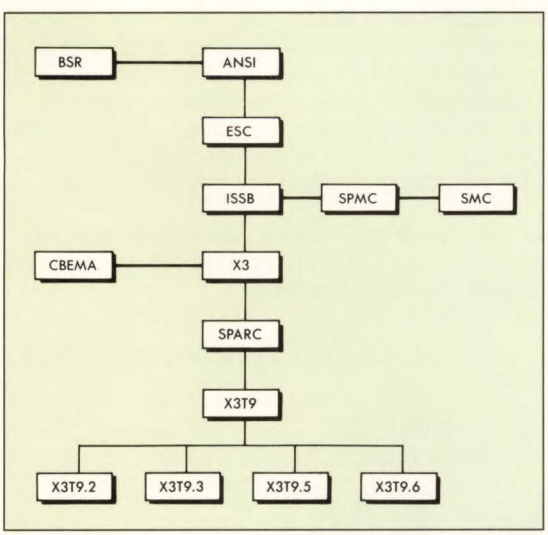
Future columns will describe most of the interfaces listed herein, but for the moment, we will stick to a description of the standards committee structure.

Interestingly enough, most of the technical work on standards is done in meetings that are untitled—the working groups. Every subcommittee has at least one working group, although several may be in progress at the same time. A working group can have from two to 50 participants dedicated to completing specific tasks.

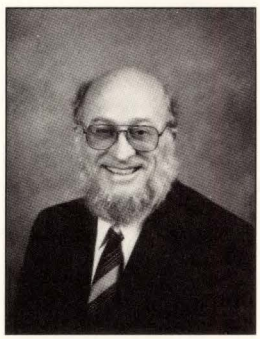
Figure 1 is an organization chart of the bureaucracy behind the technical committees.

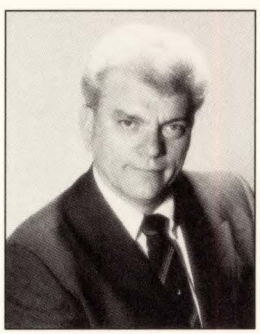
Are you impressed by the size of the organization, or dismayed by the strange acronyms you see?

The X3 line appears to run straight through to ANSI, but a few other groups are in the path. The Executive Standards Council (ESC), Standards Planning and Require-

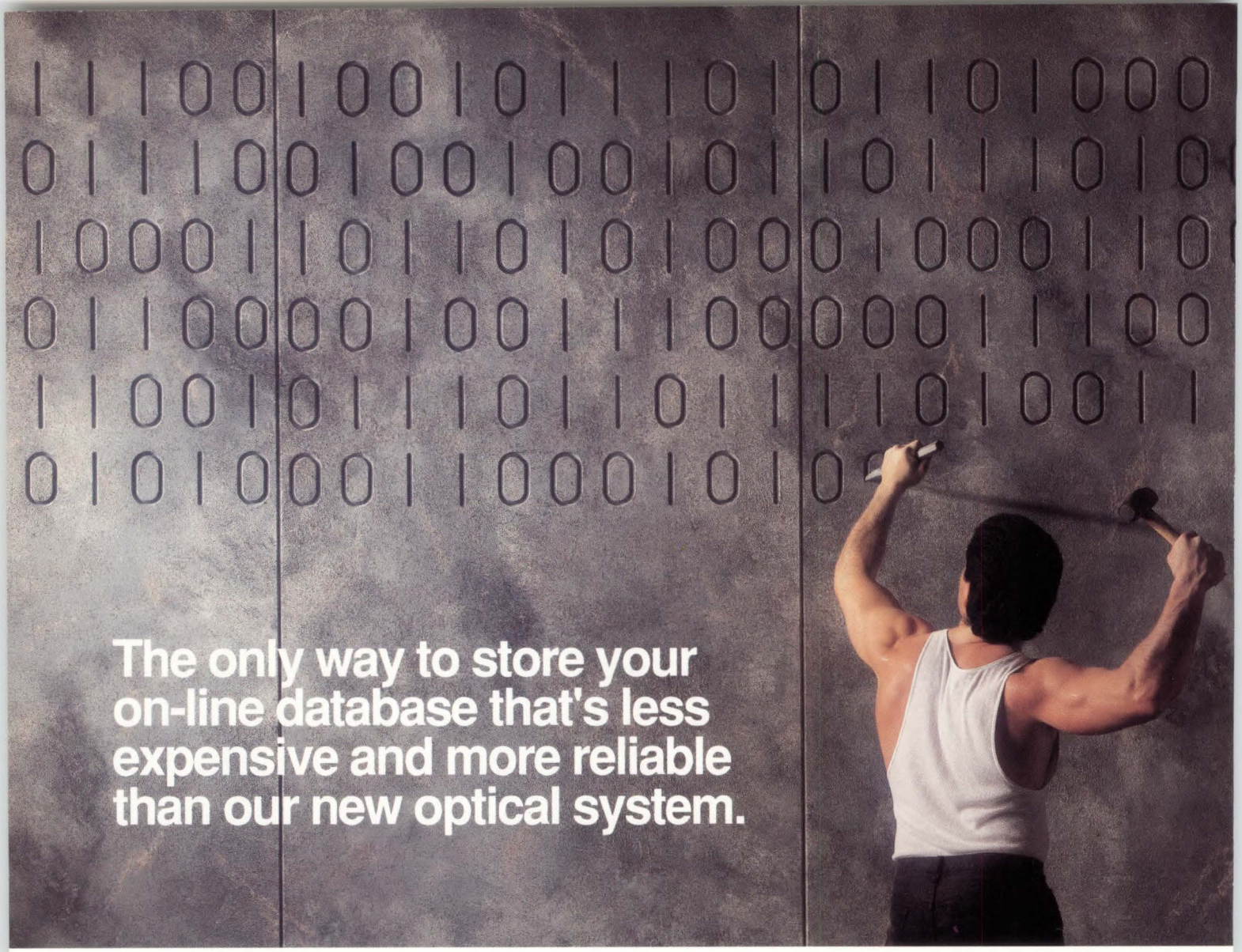


This is *a profile of where the standards fit in relationship to one another. The lowest level of technical working groups (X3T9.2 . . .) is supported by a bureaucracy that ensures the proper throughput of standards development.*





KEEPING TRACK OF COMMITTEES



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CIRCLE 382 ON READER CARD

ments Committee (SPARC), and the Standards Management Committee (SMC) are responsible for the functions their names describe.

Requests to work on interface projects are initiated in a subcommittee and are moved up the chain to SPARC, where they are perused and either recommended to X3 for approval or returned to the requesting committee.

Responsible for budgeting, approving officers, and developing operating procedures, SMC is the interface between X3 and the Secretariat. The SMC makes the rules by which the Technical Committees (TCs) operate, and the policy on the procedures to follow. The TC membership fees are set by the SMC, and are used as income to offset the cost of the Computer Business Equipment Manufacturers Association (CBEMA) services.

As with all management structures, SMC has been criticized for not understanding what the troops need to get their jobs done. This was more true in the past than at present. The SMC is now more responsive to the changing needs of the working committees.

When the Board of Standards Review (BSR) receives a document for approval to distribute for public review, it is assigned a number by ANSI by which it will eventually be known as a standard. Getting a proposed standard to this point is an uphill battle. Public review represents the beginning of the downhill run for the proposal to become a standard.

Even more important, the BSR verifies that the proposed standard was developed in an open and non-exclusive manner. It is important that ANSI standards represent the thoughts and opinions of all participants, and offer the opportunity for all interested parties to comment on the technical content. All types of legal implications and liabilities could result from a national standard that was developed otherwise.

To this end, ANSI has procedures that ensure consensus on the content of the standard. That does not mean unanimity must exist as that would enable any party that did not get exactly what it wanted in the standard to prevent the acceptance of the standard.

This is not to say that disagreement by any party is lightly regarded. Negative votes against a proposed standard are cause for concern, and every effort is made to resolve them. All correspondence relating to objections and responses from the committees are retained for review by the BSR, to ensure that everything possible was done to settle the reasons behind a negative vote.

Our first personal contact with the X3T9 standards activities came when it was a hotbed of political infighting over the attempted standardization of the IBM Block Multiplexer Channel. Fortunately, since then, no other serious problems of negative votes have caused concern to BSR on proposed X3T9 standards. They have all been forwarded with unanimous approval.

The charter of the Information Systems Standard Board (ISSB) is to manage the activities of several accredited standards organizations in information processing. It is the only point of interoperation between organizations such as IEEE, EIA, and other ASCs. As such, its primary task is to resolve conflicts and duplications in the standards arena.

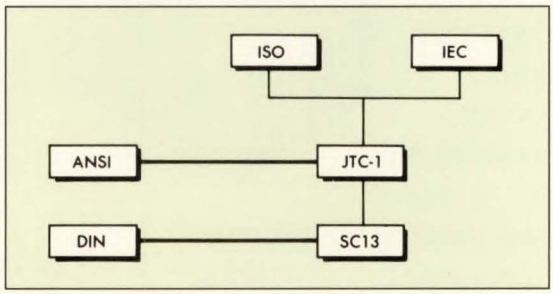
CBEMA is the Secretariat for the ANSI X3 committees. It levies the fees on members of the working committees to raise money for the administrative services that they perform for the committees. CBEMA issues all X3 documents for public review.

Keeping track of all the TC projects is a massive task because X3T9 is but one of the many X3 TCs. Dozens of others develop standards in different arenas.

The Standards Planning Management Committee (SPMC) is made up of member companies that belong to both X3 and CBEMA. It may be simplest to describe it as an adviser to CBEMA on matters covering the operation of the Secretariat.

So much for the American structure. There is another one for international standards as shown in Figure 2.

The equivalent to X3T9 in the Interna-



This represents *the hierarchy of the standards organization worldwide and to one another.*

"RESPONSIBLE FOR BUDGETING, APPROVING OFFICERS, AND DEVELOPING OPERATING PROCEDURES, SMC IS THE INTERFACE BETWEEN X3 AND THE SECRETARIAT."

"ANSI STANDARDS CAN BECOME ISO STANDARDS BY GOING THROUGH A PERIOD OF DEVELOPMENT SIMILAR TO THAT FOR AN ANSI STANDARD"

tional Organization for Standardization (ISO) is SC13, an abbreviation for Subcommittee 13. Deutsches Institut fur Normung (DIN) is the standards organization in Germany, and it operates as the Secretariat for SC13.

The equivalent to X3 used to be Technical Committee 97 (TC97) but due to recent changes, TC97 is no more; it has been rolled into Joint Technical Committee 1 (JTC-1), a joint committee of ISO and the International Electrotechnical Commission (IEC). The IEC is the international equivalent of the EIA. Presumably, standards approved by JTC-1 will be both ISO and IEC standards.

Activities in the international arena are by country, and ANSI is the U.S. member to IEC and ISO, as well as Secretariat of JTC-1. JTC-1 is in charge of standards projects for all information processing subcommittees, and covers the activities of IEEE and EIA as well as the X3T9.

Almost all activities in the X3T9 committees are projects within SC13. ANSI standards can become ISO standards by going through a period of development similar to that for an ANSI standard.

To avoid duplication of effort and expedite events, an alternative known as the Fast Track procedure has been introduced. Fast Track permits a national standard to begin the process of balloting by member countries without going through a development cycle. Experience to date with X3T9 standards is that Fast Track has yet to prove itself.

How does all of this affect the average user of interface standards?

Not at all. Most of this has no bearing or influence on those developing interfaces to ANSI and ISO standards. However, it does explain why sometimes the documentation you must order to obtain the latest copy has some strange numbering scheme.

All documentation in committee is given a number. Typically, this consists of the subcommittee number, the year, and a number assigned serially. As an example, the

working document for SCSI-2 is known as X3T9.2/86-109. Several copies of the working document are generated over the time that an interface standard is being developed. These are treated as revisions. The original SCSI documentation included 17 revisions before leaving X3T9.2 for the last time.

When a proposed standard is forwarded by a subcommittee to X3T9, the document is given a new number—X3T9/88-sss. This identity is in force until ANSI issues a new number such as BSR.yyy-19xx. The yyy is a number assigned serially and xx stands for the year in which it is approved.

A proposed standard can be known by several different document numbers at the same time. The following fictitious example might help:
X3T9.2/88-73 Rev 7A
X3T9/89-124
BSR X3.178-19xx
X3.178-1990

The confusion continues even after approval, and the interface becomes known officially as X3.178-1990. The process has taken so long that a popular, proposed standard is already well known by its original committee number. Unfortunately, the committee number is useless when it comes time to order a copy of the approved standard.

After ANSI accepts a proposed standard and the BSR number is assigned, it is referred to as a Draft Proposed American National Standard (dpANS), and copies are sold by Global Engineering Documents (800-854-7179 or 714-540-9870). In some cases (such as the current effort on SCSI-2), special arrangements make the draft working revisions also available from Global.

There it is. More than you ever needed or wanted to know about the structure of the standards committees.

As we review the status of interfaces in future columns, there will be references to procedures, committees, and acronyms that can be confusing. Hopefully, this column will give you a better understanding. SA

Reader Interest Level

High
Circle No. 267

Medium
Circle No. 269

Low
Circle No. 271

READ/WRITE HEAD ADVANCES

ENSURE RELIABLE HIGH-CAPACITY STORAGE

TINY ELECTRONIC TRANSDUCERS MOUNTED INSIDE YOUR WINCHESTER DISK DRIVE SENSE SUBTLE CHANGES IN MAGNETIC FLUX TO DENOTE THE PRESENCE OR ABSENCE OF STORED DATA AND ARE KEY ELEMENTS THAT HELP DRIVE DESIGNERS KEEP PACE WITH THE DEMANDS FOR SPEED, CAPACITY, AND RELIABILITY

BY PETER GOVE, Peripheral Components International

"IN-CREASING STORAGE CAPACITIES AND PER-FORMANCE ARE ACHIEVED BY IN-CREASING THE NUM-BER OF TRACKS PER INCH (TPI) AND THE NUMBER OF MAGNETIC REVERSALS PER INCH."

With a growing need for instant access to large volumes of information to satisfy the voracious appetite of the information age, manufacturers of storage devices are creating fast, reliable, high-capacity disk drives.

But, users are demanding more than exacting performance—lower costs per megabyte are equally important. But enhanced performance doesn't come cheaply. To this end, disk drive manufacturers are employing new methods and materials to meet the demands.

The Key Element

One of the pacing factors of disk drive performance, and recording technology in general, is the read/write transducer or head. This technology has been evolving for the past ten years, and even more rapidly in the past three.

How the read/write head is constructed influences, and has a direct correlation with, the industry's ability to tap increased recording density. In fact, the head is the single most important element in a disk drive.

Basic Drive Operation

To understand the importance of the heads, consider the basic mechanics of a disk drive. The head, or the read/write mechanism, is an electromagnet and rides on a cushion of air above the aluminum disk, which rotates at 3600 rpm. To record data, the head magnetizes a small section of the disk surface. Reversals in the direction of this magnetism establish a code of ones and zeros, recording the data. When the magnetized areas of the disk platter induce an electric current in the electromagnet, the head reads the stored data.

Disk drive technology isn't new. Thirty years ago, IBM introduced RAMAC, the first disk drive. This system was comprised of 50 disks, each 24 in. in diameter, stored in a 6-ft.-long cabinet. RAMAC had a storage capacity of 5 Mbytes—the equivalent of about 2000 double-spaced, typed pages.

RAMAC was a significant achievement for its time, but clearly a white elephant by today's standards.

Increasing storage capacities and performance are achieved by increasing the number of tracks per inch (tpi) and the number of magnetic reversals per inch. The latter boosts the number of bits per inch (bpi) recorded on each track.

For example, five years ago, 800 tpi and 15,000 bpi were considered state of the art. Today, storage densities have increased to 1400 tpi and 25,000 bpi, and are projected to

be as high as 2500 tpi and 35,000–40,000 bpi by 1990.

A Choice of Technology

There are three types of heads now in general use: monolithic, composite, and thin film. Each has unique characteristics, but no single one is best for all applications. Head construction is at the heart of the issue. Linear densities of the heads are limited by gap thickness, flying height, and media properties. The smaller the gap and the lower the flying height, the greater the recording density.

Monolithic heads represent where the industry has been. Thin-film heads point to the future. Composite heads are, in many ways, a transition between yesterday's monolithic heads and evolving thin-film heads.

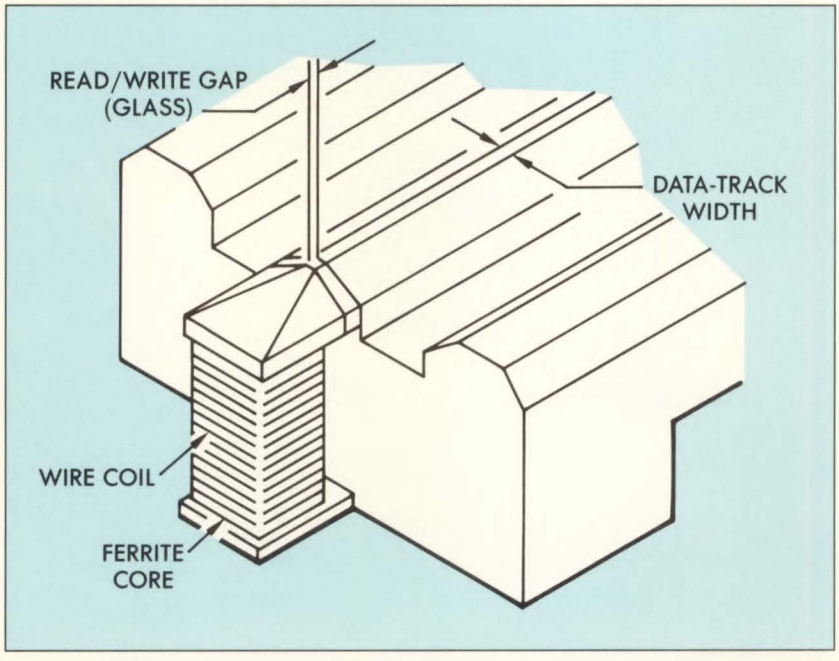
Technology in Threes

A monolithic head is made almost entirely of ferrite; the only non-ferrite parts are the wire coil and glass used in creating the gap, as well as the material used to bond the pieces together (Figure 1). The ferrite material is brittle and cannot be machined easily or economically to meet the precise tolerances required for higher track densities. The coils of the electromagnet-in-ferrite heads are wound by hand under a powerful microscope—a slow and expensive process. In many cases, ferrite heads have reached the limits of their capabilities.

A composite head (Figure 2) uses a smaller ferrite core than a monolithic head. The core is made separately, then glass-bonded into a hard, ceramic slider-housing. This technique protects the gap area with glass and ceramic material that allows for lower flying heights and, therefore, higher track densities. A composite head can handle narrower tracks than a monolithic head, but the brittleness of the ferrite and limited precision in final machining sharply restrict its potential for any substantial increases in density.

Thin-film-head gaps are created through sputtering, a vacuum deposition process that permits the creation of extremely small gaps (Figure 3). With this advanced process, the gap area is completely enclosed in the sputtered material and, therefore, protected. The core material in the heads is very thin. The major advantage of thin-film technology is that it can handle more tracks

Figure 1—When manufacturing a monolithic read/write head, *the techniques for melting and flowing glass, used to create the gap, impose limitations on the potential gap thickness. More importantly, the unprotected ferrite in the gap places severe restraints on reliable flying heights.*



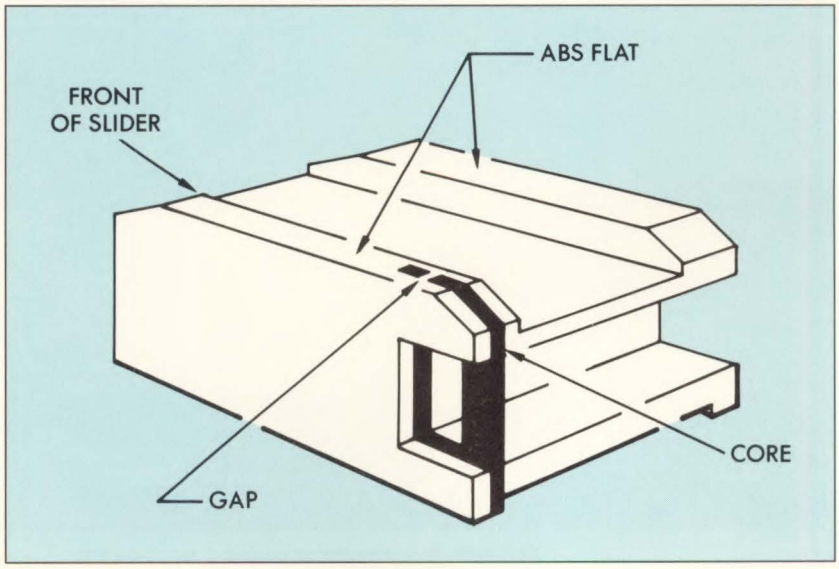
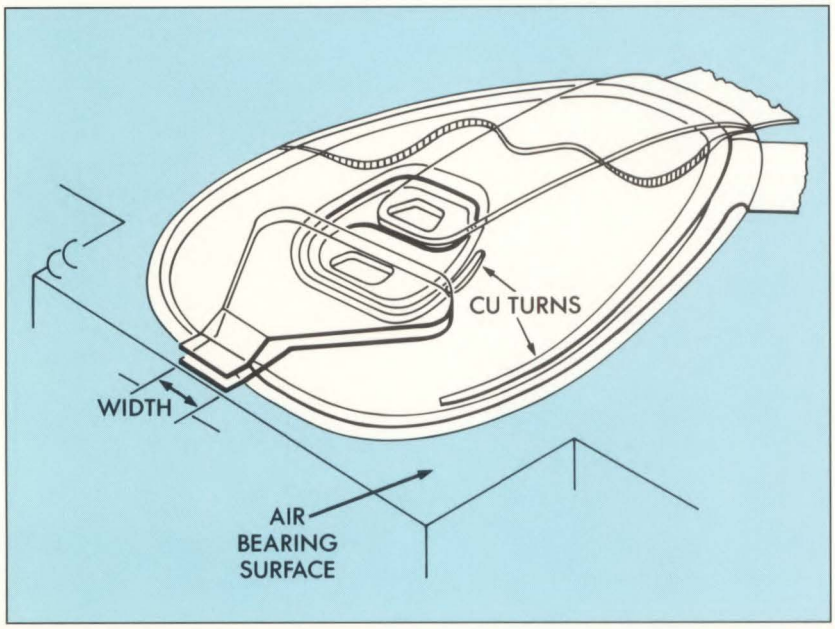


Figure 2—A composite read/write head is composed *of a magnetic core and ceramic slider. During manufacturing, the core is glass-bonded onto a hard, ceramic slider-housing.*

Figure 3—Inductive thin-film heads, *when viewed in cross-section, show the relationship of the gaps to the air-bearing surface of the media. The recording gap, that space shown between the two pole tips, is measured in millionths of an inch—the notion being the smaller the better.*



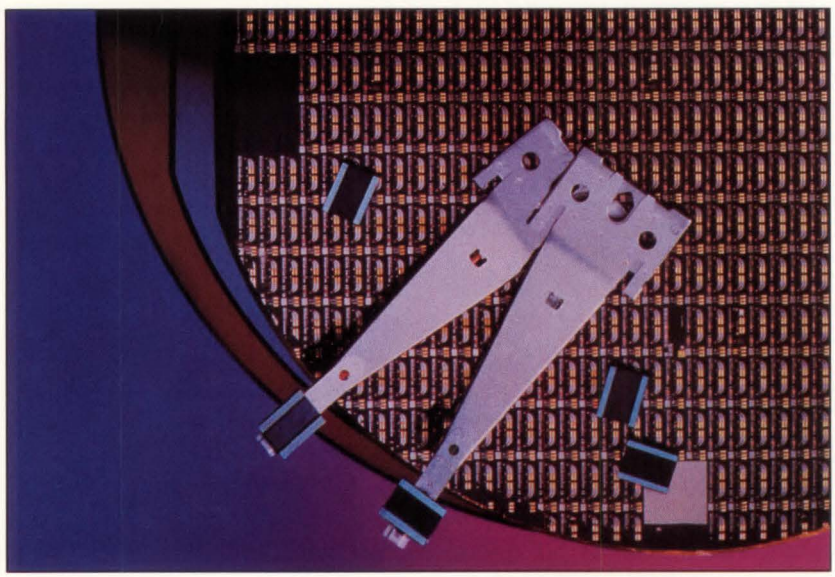


Figure 4—From masked wafer to partially completed head/gimbal assembly, *the thin-film-head manufacturing process requires a complete range of clean-room assembly operations and inspections.*

per inch than other types of heads, while allowing higher recording frequencies.

Benefits of Thin-Film

Thin-film heads provide better inductance, higher frequency response, and enhanced track width and signal amplitude control than conventional ferrite heads. However, yesterday's ferrite heads do offer a slight performance advantage on lower frequency response and are still less expensive. Thin-film heads offer better areal density, amplitude, resolution, window margin, and ruggedness.

Thin-film technology provides better overwrite capability, and the shorter gap of a thin-film head permits support of much higher read/write densities. In short, thin-film heads provide superior control over many of the critical physical dimensions and permit the use of smaller form factors than conventional ferrite heads.

Unlike ferrite heads that can vary greatly from production run to production run—and even within a single run—variation in the production of thin-film heads is nil. This means that greater reliability, with established parameters of performance, can be achieved. Thin-film technology allows the drive manufacturer to control track width with micron accuracy. The recording gap, the space between magnetic poles, can be measured in millionths of an inch, and it can be replicated throughout the production run.

How Thin-Film Heads Are Made

Many techniques used in the manufacture of thin-film heads have been adapted from the semiconductor industry. Disk manufacturers concerned with quality test incoming materials to be certain that only those materials meeting the company's standards are used. In fabrication of the wafer substrate, manufacturers employ a series of detailed and complex masking steps using photolithography with precision aligners to ensure that the various layers of fine tracings are properly aligned. Precision cutting equipment slices the 3-in. wafer into 32 bars; each bar can be made into head sliders for 13 thin-film heads (Figure 4).

To ensure a consistent quality, precise slider matching is employed. In this step, automated, high-precision slicing machines and computer-controlled lapping systems are employed. Several proprietary lapping

techniques are used to enhance the dimensional accuracy of critical mechanical parameters.

The head assembly process includes ultrasonic bonding of the leads to the transducer and adhesive attachment of the slider to the gimbal. Flying-height analyzers are used to test aerodynamic integrity and automated production testers are used to check electrical performance of the equipment.

Competitive manufacturers always institute rigorous quality control programs to ensure uniform quality—regardless of design or length of run. Statistical process controls (the use of an extensive database to collect and analyze product data) are used to track each part through the manufacturing process.

Each slider head is identified by its own serial number so that system and drive manufacturers can trace the manufacturing lot number, wafer number, and date of manufacture even after a head slider has been installed in the field and is in operation. This allows a quality control team to compare the interaction of process and performance design parameters to determine the effects of processing changes on the performance of the product.

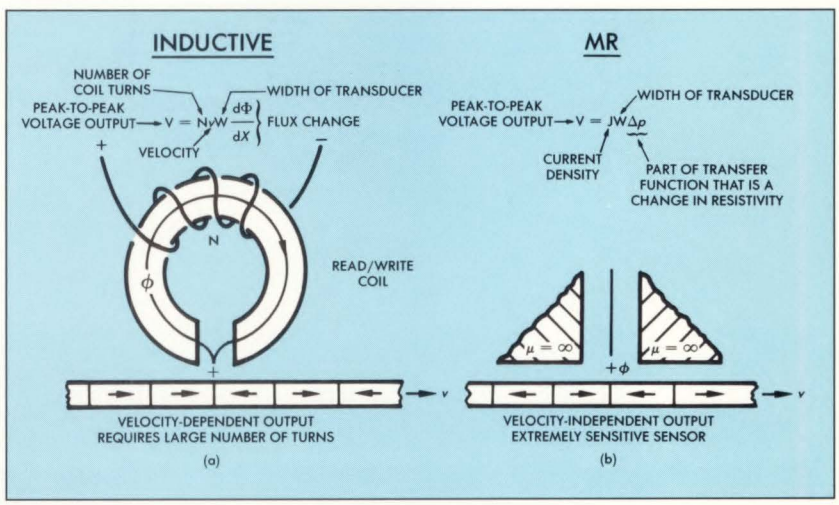
Magnetoresistive vs. Inductive

Currently, two types of thin-film technology are vying for attention: inductive and magnetoresistive (MR). MR heads have four terminals, while inductive heads have only two. The read and write functions in an MR head are two separate functions, making optimization possible—it writes wide and reads narrow. The read and write functions are combined in an inductive head and optimization is difficult since the read and write widths are identical. An MR head is two to five times as sensitive as the typical inductive head and its sensor is flux-velocity independent.

The MR head offers greater throughput, sharper readback pulse, and a more sensitive flux sensor; however, at the present stage of development, this type of head is sensitive to corrosion, stray fields, and discharge. Nonetheless, MR heads offer significant advantages—even over inductive heads.

The output noise in an MR head produces a low inductive pickup noise; the older inductive head has a high inductive pickup noise for a large number of turns (Figure 5).

Figure 5—Most disk drives use *some form of an inductive read/write element—head* (a). *This type of head, in order to sense flux changes in the media, is dependent on the movement of the media. The recorded bits moving past the inductive head induce, hence the name, a current in the coil of wire on the head. A magnetoresistive (MR) head* (b), *on the other hand, is independent of media movement and can indeed sense extremely subtle changes in the flux of stationary media. Rather than induce a current in the MR transducer the resistivity of between the poles changes, thus denoting a change in flux—a written bit.*



Input impedance is low in an MR head and it has a high data rate capability. The inductive head has a medium impedance rate and is capable of high data rates.

Be aware, however, MR heads aren't an off-the-shelf technology. It is, however, beginning to move from the engineering lab to the disk designer, where a number of sensory techniques are being evaluated. The results may be available within the next two to three years, permitting the design of 3.5-in. disk drives with capacities above 100 Mbytes. SA

Peter Gove is director of marketing for Peripheral Components International (PCI), a wholly owned subsidiary of Control Data, based in Minneapolis, MN. PCI designs, manufactures, and markets sophisticated recording heads, head/arm assemblies, media, and other disk drive components for the OEM market.

Konica
TECHNOLOGY INC

KT-510

10 MB Formatted 5.25 inch Floppy Disk Drive

Features:

- **10.7 MB formatted capacity**
- **Reads and writes data onto disk at 480 TPI**
- **Uses 5-1/4" floppy media with standard floppy jacket**
- **Read-compatible with IBM PC standards: reads 360 KB and 1.2 MB floppies**
- **Average access time:75 ms**
- **Embedded SCSI controller (Small Computer Systems Interface)**
- **Half-height 5-1/4" form factor**

The Konica KT-510 combines Winchester disk drive performance with the convenience and economy of floppy diskettes.

This advanced floppy disk drive stores 10.7 MBytes of formatted data on a standard 5-1/4" servo-written floppy diskette, and can read the 360 KB and 1.2 MB floppy diskettes used in today's popular personal computer systems. With a 75 ms average access time and an embedded SCSI controller, the Konica 5-1/4" half-height drive sets an evolutionary new standard in floppy disk drives.

The Konica KT-510 has the high capacity and Winchester-like performance to make it ideal for software distribution and data backup.

Konica Technology, Inc.
Main U.S. Office
777 North Pastoria Ave.
Sunnyvale, CA 94086-2918
Telephone: 408-773-9551
FAX: 408-720-9288

CIRCLE 455 ON READER CARD

GEORGE LANGWORTHY'S INSIGHTS TO OPTICAL STORAGE

CD-ROM: TAKING ITS FIRST STEPS OR PUTTING ON RUNNING SHOES?

The 120mm (4.75-in.) shiny plastic disk that plays up to 74 minutes of music is a high-technology "miracle." It is the media portion of a VLSI-chip-based, 660-million-byte, read-only computer system. Low-end audio versions now sell for as low as $100. In the volumes bought by record companies, the cost per disk (with label and packaging) is less than $2.

Since Compact Disc Read Only Memory (CD-ROM) technology is all-digital except for the digital-to-analog output conversion circuitry, general use by the computer world was logical. It began in November 1984 with the Comdex, Las Vegas, introduction of prototype CD-ROM drives from Phillips, Sony, and Hitachi, with 80–90% of the components identical to the audio versions.

A CD-ROM data format has two key elements: an 8-bit status byte designating which of 256 possible types of information is to follow, and up to 330,000, 2048-byte blocks of data. Although there is a lot of other information on the disk that is used for error correction and various audio purposes, only these two elements are required to grasp the concept of using CD-ROMs for computer storage.

What's It Good For?

Anything you can process and store on a digital computer system, you can process onto a CD-ROM. The first CD-ROM application uses large alphanumeric databases from centralized time-sharing systems, such as those from Dialog (Palo Alto, CA).

The most attractive market for conversion to CD-ROM today, however, is information stored on paper and microforms, which constitutes 98% of all mankind's recorded information. CD-ROM production costs are less than .1% that of unprinted paper; estimates are that this cost is even 1% or less that of microfilm or microfiche. Thus, cost makes CD-ROM a compelling storage media.

For an individual school district, a custom CD-ROM could be created to record every kindergarten-through-12th-grade-level (K–12) textbook plus key reference material such as dictionaries. Obviously, there are copyright and licensing issues that must be negotiated by book publishers and school administrators, but the potential for a student's self-directed study is too great to pass up.

What Took So Long?

With extremely low media and disk drive costs on an absolute and per-megabyte basis, immediate acceptance and production would seem to follow. Not so. It's more than three years since its introduction, and the first large-volume *personal* computer manufacturer, Apple Computer Inc., has just entered the market.

The Apple CD-SC is compatible with any current-production Macintosh machine, uses an Apple II SCSI interface card, and retails for $1,119. Grolier (Danbury, CT) announced the first consumer-oriented CD-ROM product—the Electronic Encyclopedia—in Chicago during the summer of 1985. Until the spring of 1988, only Digital Equipment Corp. had a CD-ROM drive available as part of an integrated hardware/software system. Apple has been working on its CD-ROM product for more than two years.

Enter the Heavy Hitters

The Apple HyperCard product and concept are well suited for use with CD-ROM data, image, and audio information retrieval. This first entry will undoubtedly be followed by other Apple CD-ROM-based products. Apple's penetration of school and individual education markets could be significant considering the use of CD-ROMs for K–12 classroom material.

Tandy Corp. (Dallas, TX) is distributing the Hitachi CD-R1503SUY CD-ROM drive, with Microsoft Corp. (Bellevue, WA) MS-DOS extensions, interface card, and cable, for $995. Tandy is on a 48-hour, order-to-delivery cycle, with the units centrally stocked. This is an important benefit to the MS-DOS system integrator. The CD-ROM add-on or the entire system can then be ordered, trained for, and serviced by the nearest of several hundred Radio Shack Computer Centers.

Egghead Software (Bothel, WA), the large discount software retailer, is selling CD-ROM hardware and software. Here is a major independent software provider willing

"INFORMATION PROVIDERS CAN NOW MASTER A SINGLE DISK THAT CAN BE READ BY THE VAX, MS-DOS, AND APPLE FAMILIES OF COMPUTERS."

to pioneer CD-ROM with a view toward longer-term, high-volume sales.

Multiuser Access

The low cost makes CD-ROM well suited to one-on-one access with a personal computer. Database searching is interactive and the "slow" access time (in tenths of seconds) is fine for specific users; however, some will want multiple terminals to access more than one CD-ROM drive. An expensive database—some cost up to $25,000 per year—need not be duplicated. Restriction for security purposes is another purpose of accessing through a multiuser sign-on procedure.

DEC was the pioneer in multiuser access to CD-ROM with several internal applications, one of which is SOFTbase, a central catalog and description of software product business solutions. DEC claims that this provides faster access to remote locations than delivery over a wide-area network. DEC offers a complete design, build, test, and produce package for CD-ROM databases should the user want a DEC-based, one-stop source.

Early in 1988, DEC extended its Network Applications Support facilities to the Macintosh, MS-DOS, and OS/2 operating systems and users. A CD-ROM drive attached to one of these PCs can be accessed by others on that network.

Meridian Data Inc. (Capitola, CA) is one of several companies recently introducing networked CD-ROM drives. Meridian's small- and medium-volume user system is called CD Net. One, two, or three drives are integrated using Ethernet, ARCNET, or token ring protocols and hardware. The larger user has CD Server, a network board with Intel 80286 or 80386 microprocessor, DRAM storage, software, and space for six half-height CD-ROM drives. Meridian Data originally established itself with CD Master, a computer, tape drive, and disk drive system designed especially to organize and format data for mastering and producing CD-ROMs.

CD-ROM Standard File Format

In March, Apple, DEC, and Microsoft announced plans to support the International Standards Organization (ISO) 9660 CD-ROM volume and file format standard. In early 1986, the USA-vendor-sponsored High Sierra group hammered out a volume and file description format standard so that one CD-ROM could be read by any system adhering to the standard. It was presented to the ISO, slightly modified, and is now supported as ISO 9660 by all CD-ROM drive manufacturers.

Information providers can now master a single disk that can be read by the VAX, MS-DOS, and Apple families of computers. Although this "standard" covers traditional forms of computer data, it doesn't fully address compressed image, audio, and full-motion video CD-ROM formats. Extensions to ISO 9660 and additional standards to address these areas are important to the expansion of CD-ROM applications.

Significant Installations

CD-ROM applications excel when they enable the user to do something that would otherwise be impossible.

For example, in December 1987, the U.S. Postal Service (USPS) installed 438 ZIP+4 CD-ROM address-retrieval systems in 200 locations. Each disk has compressed 109-million addresses blocked within 25-million range records. This allows automated equipment to sort down to the carrier route level and improves computer generation of forwarding-address labels.

The hardware is a Telex MS-DOS PC clone and Hitachi CD-ROM drive with keyboard and video display. This system was designed and installed by First Data Resources (Omaha, NE) under a competitive bid contract and replaces a central computer, telecommunications, and remote terminal system performing some of the same functions.

Both Arthur Andersen & Co. and Arthur Young & Co.—two of the "big eight" accounting firms—announced customized CD-ROM systems.

Arthur Andersen sends MS-DOS-based PCs along with its auditors to speed up responses to auditor and client questions.

Arthur Young's field personnel take Macintosh computers with them. The Arthur Young Reference Series uses the HyperCard in connection with a search engine developed by Knowledge Set. Included on the disk are Federal and State regulations, Arthur Young audit standards, and IRS and court decisions.

First Steps or Running Shoes?

CD-ROM is taking its first steps. It is a very healthy and fast-growing baby.

First steps? Yes, and they are steps of a Paul Bunyan in the making. SA

Reader Interest Level

High
Circle No. 307

Medium
Circle No. 309

Low
Circle No. 311

HC/WG LABS ADDS A

WINCHESTER TO YOUR MACINTOSH

THE FEBRUARY ISSUE OF *HARDCOPY* SHOWED YOU HOW TO ATTACH AN APPLE MACINTOSH TO YOUR VAX, BUT TO DO SO YOU HAVE TO MAKE SURE YOU HAVE ENOUGH LOCAL STORAGE TO CONTAIN ALL THE NECESSARY PROGRAMS. TO THIS END, WE DECIDED TO SHOW YOU HOW TO MAKE THE UPGRADE.

BY RICHARD STEINCROSS, Senior Respondent—Hardware

Whether you're planning on using your Apple Macintosh as a workstation attached to a larger system, or as a standalone unit, you need sufficient storage to take advantage of all the software tools available. And a fast Winchester disk drive is just the ticket.

You can, of course, purchase the Macintosh with a built-in drive, or buy the necessary add-on units from a number of vendors (Table 1).

You can also take advantage of any number of discount drives available; and, if you're an OEM or a value-added reseller, upgrade the Macintosh with your own add-in Winchester. This article is the result of such an exercise that we undertook at the HC/WG Labs.

There are two integration tasks that you have to face when you elect to add your own drive:

- mechanical and electrical attachments, and
- software drivers.

The latter element can be the toughest to resolve and is the most confusing.

Planning the Integration

Like any hardware or software task, preplanning will save you a great deal of time. For this project you will need the following items:

1. A soft surface to lay the Macintosh on
2. A 3.5-in. Winchester disk drive Small Computer Systems Interface (SCSI)
3. A resistor terminator for the SCSI port (see text)
4. A Torx-style T-15 screwdriver
5. Mounting hardware
6. An 8-in. SCSI data cable
7. DC power cable for drive
8. Driver software

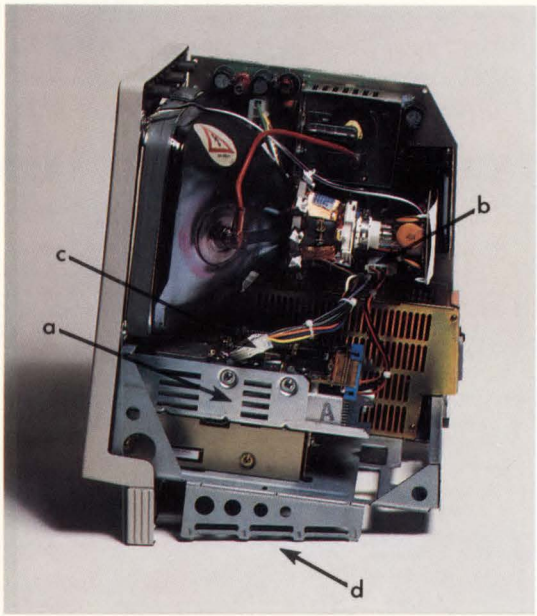


Figure 1—The configuration shown is *a Macintosh SE with an Apple hard disk* (a). *What you need to identify are the drive power connector* (b) *and cable harness for logic board power* (c). *Note that the logic board is normally located at point* (d).

What you are going to do is take advantage of the space inside the Macintosh chassis (Figure 1) to add a drive. Although it would appear that you can just "plop" the drive into the existing space, you do have to worry about proper mounting hardware.

Before we began mounting the drive, we determined what the necessary mounting bracket should be. Although there are commercial brackets, you may find (as we did) that they aren't available in small quantities, and you may want to create your own. Our choice was the latter, and we designed the necessary mounting plates for our drive (Figure 2).

The drive we used is a Conner Peripheral Inc. CP-340, and it should be mounted 0.2 in.

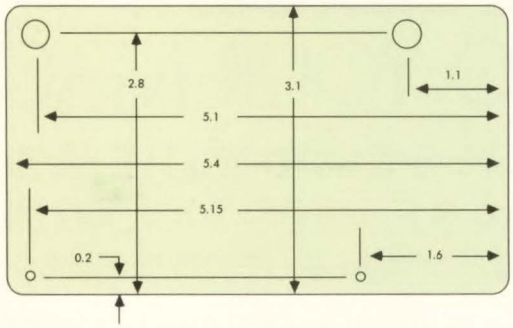


Figure 2—This template is *a replica, albeit smaller, of the mounting brackets we devised at HC/WG Labs. We found that MacDraw and a laser printer were sufficient tools for creating the desired mechanical.*

above the lower floppy drive. To copy our bracket, you will need two pieces of 0.030-weight aluminum, measuring at least 3.5 x 5.5 in. Notice in the drawing that we rounded the edges. We recommend this to avoid sharp corners and to achieve an easier fit.

Once you have machined two mounting brackets, set them aside for later use.

Beginning the Integration

To begin the integration process, you'll need a Torx-style T-15 screwdriver that is at least 6 in. long.

Remove the two silver screws located beneath the handle. Remove the two black screws located in the lower rear of the Macintosh (near the mouse and speaker connectors).

You are now ready to open the Macintosh case. This isn't easy. You will need a nonmarring, preferably soft plastic, lever to pry the front and rear halves apart. A burnishing tool used by graphic artists works quite well. Don't use a screwdriver as it will damage the case.

Table 1—Macintosh Storage Devices

Company	Product	Formatted Capacity	Media	Price
AlphaMicro Video Tech Div. P.O. Box 25059 Santa Ana, CA 92799 800-992-9779 or 800-821-0612 in CA **Circle No. 152**	Videotrax	80–240 Mbytes	Beta/VHS	$399 or $1,100 w/VCR
AppleCrate 6850 Vineland Ave. N. Hollywood, CA 91605 800-543-5808 or 800-323-9994 in CA **Circle No. 153**	AppleCrate	20–80 Mbytes	Fixed	$560–$1,249
CMS 1372 Valencia Ave. Tustin, CA 92680 714-259-9555 **Circle No. 154**	MacStack SD Series	20–140 Mbytes	External fixed	$795–$1,895
	ProSeries	20–300 Mbytes	Internal fixed	$695–$4,095
	Expandable Series	150 Mbytes to 1.2 Gbytes	Fixed w/opt. 60-Mbyte streaming tape	$4,695–$18,280
Cutting Edge Products P.O. Box 1259 97 S. Red Willow Rd. Evanston, WY 82930 800-443-5199 **Circle No. 156**	XL+ Series	30–70 Mbytes	Fixed	$729–$1,199
Jasmine Technologies Inc. 555 De Haro St. San Francisco, CA 94107 415-621-4339 **Circle No. 157**	MegaDrive	10 Mbyte/floppy	5.25-in. megafloppy	$999
	InnerDrive Series	40–160 Mbytes	Fixed	$999–$1,499
	DirectDrive	20–300 Mbytes	Fixed	$649–$3,995
	BackPack	40 Mbytes	Fixed	$1,299
Mass Micro Systems 550 Del Ray Ave. Sunnyvale, CA 94086-3528 800-522-7979 or 408-522-1200 **Circle No. 158**	DataPak Series	45 Mbytes	Removable fixed disk	$1,775
	Mass 20e–100e	23–102 Mbytes	Fixed	$649–$1,649
	Power2Expand!	23–102 Mbytes	Fixed	$489–$1,449
Microtech International Inc. 29 Business Park Dr. Branford, CT 06405 800-626-4276 **Circle No. 160**	Nova	20–120 Mbytes	Fixed	$789–$2,449
Mirror Technologies Inc. 2644 Patton Roseville, MN 55113 612-633-4450 **Circle No. 161**	ProStation 1024	300–900 Mbytes	Fixed w/40-Mbyte tape backup	$5,495–$21,395
NuData 4201 Burton Dr. Santa Clara, CA 95054 408-727-1049 **Circle No. 164**	Giga Cell	290–580 Mbytes	Fixed + tape backup	$6,295–$12,395
Personal Computer Peripherals Corp. 4710 Eisenhower Blvd. Bldg. A Tampa, FL 33634 800-622-2888 or 813-884-3092 in FL **Circle No. 164**	MacBottom HD21	21 Mbytes	External 3.5-in. fixed	$1,195
	MacBottom HD32	32 Mbytes	External 3.5-in. fixed	$1,395
	MacBottom HD45	45 Mbytes	External 3.5-in. fixed	$1,795
	MacBottom HD70	70 Mbytes	External 3.5-in. fixed	$2,195
	PCPC IHD144	144 Mbytes	Internal 5.25-in. fixed	$2,895
	PCPC Tape	2 Gbyte/tape	8mm tape	$4,495
Racet Computes Ltd. 31550 E. Birch St. Brea, CA 92621 714-579-1725 **Circle No. 165**	PCMS High Performance Series	150 Mbytes to 1.2 Gbytes	Fixed w/streaming tape backup (150-Mbyte, .25-in.)	$4,670–$18,420
Tallgrass Technologies 11100 W. 82nd Overland Park, KS 66214 800-228-3475 **Circle No. 167**	TG-4040	40 Mbyte/tape cartridge	Tape cartridge (w/opt. fixed disk)	$1,195 (or $2,595 w/opt. fixed disk)

We recommend that you begin prying the case loose above the CRT on the parting line. Put the burnishing tool in the groove between the front and rear case halves and gently twist—you only have to create about a ⅛-in. gap. Turn the Macintosh upside down and repeat the process.

Place a soft, folded towel or large piece of foam on your workbench and lay the Macintosh face down. Continue to pry around the periphery of the parting line. Make sure the Programmer's Switch has been removed from the left side; it is impossible to get the case apart without damaging the switch.

Once the case is loose, lift it gently off the Macintosh body, being careful not to damage the Radio Frequency Interface (RFI) shield. This part may come off with the case back, or stay on the frame around the main logic board. If it is still attached, note its orientation and gently lift the shield off and set it and the case aside.

At this time, it would be wise to discharge the high voltage on the CRT (or be extremely careful!). You may do this by connecting a clip lead to one of the CRT mounting screws and connecting the other end to a screwdriver, which you slide gently under the plastic high-voltage electrode cover on the side of the CRT. You will hear a loud crack when the CRT discharges.

Now you will need to remove the two flexible disk drives and attach the hard drive's mounting brackets. To do so, unplug both gray cables that connect to the main logic board by pulling them gently away from the board. These are the extent—power and data—of the electrical connections between the drives and the computer's electronics.

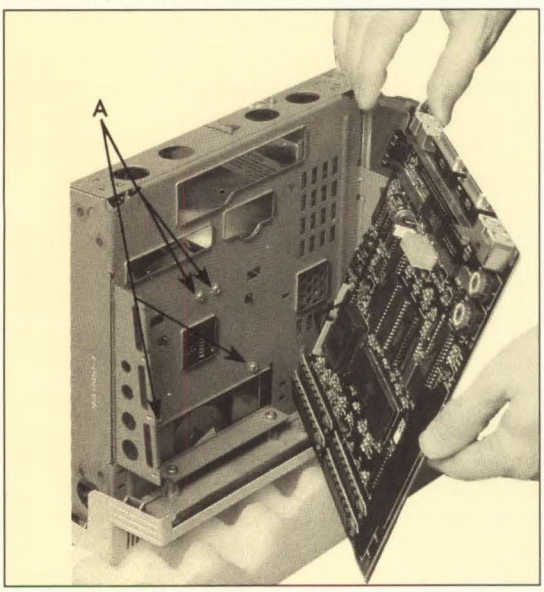


Figure 3—With the SE resting face down on a soft surface, *remove the logic board. This reveals the bottom base-plate of the chassis and the four Philips-head screws* (a). *These must be removed in order to remove the disk drive assembly.*

Next, remove the cable connecting the power supply to the main logic board. Reach down into the floor of the Macintosh case, squeeze gently on the release latch of the multi-pin connector, and extract the power cable.

Once you have disconnected the necessary cables, take the logic board by its connectors and slide the board rearward (upward if the computer is lying on its face) about .5 in. It is now possible to disengage the board from its card guides by pulling it gently away from the frame (Figure 3). Move the board away from the computer until you can see the speaker connector. Observe the connector orientation and disengage it. Set the board aside.

Setting Up the Drives

With the logic board out of the way, you can remove the flexible disk drives. To do so, you will need a medium Phillips-head screwdriver. The four screws holding the drives are located below the chassis. Take care while removing these screws that the drives don't fall out or damage the CRT.

You remove the drive assembly by gently tilting it forward and lifting away from the chassis. Disassemble the drives by removing the two screws from the rear of the assembly and the bracket holding the drives together. Set one drive aside.

At this point, retrieve the mounting brackets you made earlier. If your Macintosh has Sony flexible drives (some use YE Data), it will be necessary for you to remove the small metric screws holding the drive in its metal housing—take great care since these drives are fragile. Keep the screws to use in attaching your bracket. Actually, these screws are too short if you use the existing washers, so plan on attaching the bracket without extra hardware (Figure 4).

With the mounting brackets in place on the flexible disk drive, you can mount the Winchester disk drive. It is important with all hard drives to allow their built-in suspension system to shock-mount the Head Disk Assembly (HDA). On the Conner drive we

Figure 4—This shows *the new disk assembly as you put it together. Note the hard disk in the foreground and the flexible Sony drive in the background. In this picture we have already mounted the left bracket to both drives and are preparing to attach the right bracket.*

used, four large rubber bushings—similar to grommets—float the HDA about 1/16 in. above the drive frame. You need to mount the drive so nothing comes in contact with, or prevents movement of, the HDA. To do so, we have made spacers (they aren't really very good shock mounts) out of grommets and aluminum or brass tubing. The spacers ensure that no part of the mounting bracket will come in contact with the HDA.

To mount the Winchester in the brackets, turn it upside down and lower it between the brackets until the mounting holes line up. Use #6 Phillips-head screws of 3/8-in. length. You want to mount the drive in this configuration to avoid having a twist in the data cable. In addition, this approach permits ready access to the device address jumpers on the drive Personal Computer (PC) board.

Since the Conner drive is a SCSI device, you need to establish a device address—we chose to call it device 4.

Now you can physically mount the drive assembly into the SE. The remounting is just the reverse of disassembly discussed earlier; slip it into place and reinsert the four screws through the base plate. Remount the Mac's main logic board and remember to connect the speaker cable. Reconnect the floppy drive cable to the main logic board. Install the SCSI data cable between the drive and the logic board. Brace the PC board from behind when plugging in connectors to lessen stress on the board. Connect a DC power cable to the hard drive and into one of the conveniently provided sockets on the Mac's power supply (video) board. Reconnect the Mac's main power cable to the logic board, bracing as before. Put the silver RFI shield in place, covering the logic board, and replace the case—it's a lot easier than taking it off. Replace the four Torx screws—the silver ones go under the handle.

Since the Conner drive does not have terminators for the SCSI bus, we decided to plug our terminator into the DB25 connector on the rear of the computer. This connector is generally meant for connection of an external hard drive, but since it parallels the internal 50-pin connector, a terminator here will do the job. We fashioned our terminator from two resistor packs—they were soldered to the back of a DB25 connector. A DB25 shell was used to cover the wiring, and the assembly was potted with hot, melted glue.

The Software Connection

Now that you have the hardware portion of the integration under control, all that is left is to mate the Apple operating system and the drive.

What we chose to do was employ a software driver from Diversified I/O Inc. This driver is designed to match the Macintosh with 40 different Winchester disk drives. Besides supporting a variety of disk drives, the software, priced at $75, also works with an equally impressive number of controllers—including advanced Run-Length-Limited (RLL) versions.

Once it was mounted in the SE, the Conner drive was linked to the Macintosh operating system by following the simple instructions in Diversified's software. Since the Conner SCSI controller is built to operate only with the drive on which it is mounted, it does not have as many options as other controllers.

We set the drive jumpers to SCSI address four. Any but seven would be acceptable—it is reserved for the Mac. Usually a Mac hard disk is set to SCSI address one, but we were setting up tests where multiple drives would be attached at the same time.

When the Diversified software is started, it recognizes the Conner controller by its unique signature and identifies the SCSI address that it's using. The user need only select the FORMAT DRIVE option to initialize the disk drive and make it bootable. On the Conner, this takes just a few seconds. After exiting the program and ejecting the floppy diskette, the computer can be booted directly from the hard disk.

The list of drives and controllers supported is quite lengthy—especially when you consider all the combinations. The program we used has been expanded since our initial work with it. We didn't allow enough time to properly review the improved version prior to deadline.

Those wanting to build tape backup systems should contact Diversified, too, as a similar software package for SCSI tape drives is being offered. SA

Additional information about the products mentioned in this article can be obtained by contacting the companies directly or circling the appropriate reader service number.

Adaptec Inc.
580 Cottonwood Dr.
Milpitas, CA 95035
408-946-8600
Circle No. 148

Conner Peripheral Inc.
2221 Old Oakland Rd.
San Jose, CA 95131
408-433-3340
Circle No. 149

Diversified I/O Inc.
1008 Stewart Dr.
Sunnyvale, CA 94086
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Microscience International Corp.
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Data Shuttle 2000

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- Low Insertion Force Connectors; No cables to disconnect!
- Automatic individual turn-off of DC power to disk and head parking when removing canister
- Available with or without disk controllers
- Can be attached to almost any computer system
- Disk drives can have ESDI, ST506, RD5X, or SCSI interface
- Interconnection cable connects to a single rear mounted 50-pin sub-miniature "D" connector for one or both drives
- Disks with capacities up to 760 Mbytes unformatted can be installed in canister (over 1.5 Gigabytes total)
- Canister resident Write Protect switch

Data Shuttle Variations:

MDB-DS2000-ES21

A version of the Data Shuttle 2000 chassis that has a self contained SCSI to ESDI converter module to allow direct connection to computers/workstations that have embedded SCSI controllers, such as Sun Microsystems.

MDB-DS2000-SP-CHASSIS

A version of the Data Shuttle 2000 chassis that will allow each of the canisters to be controlled by two different computers.

Specifications:

Electrical

Input Power	115VAC or 230VAC, 47 to 400 Hz Both at 230 Watts

Mechanical

Depth	20.70" overall, 19.25" into rack
Width	17.00", 19.00" overall
Height	5.25"
Weight	35 Lbs With 2 canisters installed

Options

Slides (MDB-DS2-SMO)
Mounting Rails (MLSI-RMO)

Disk Chassis or Subsystem?

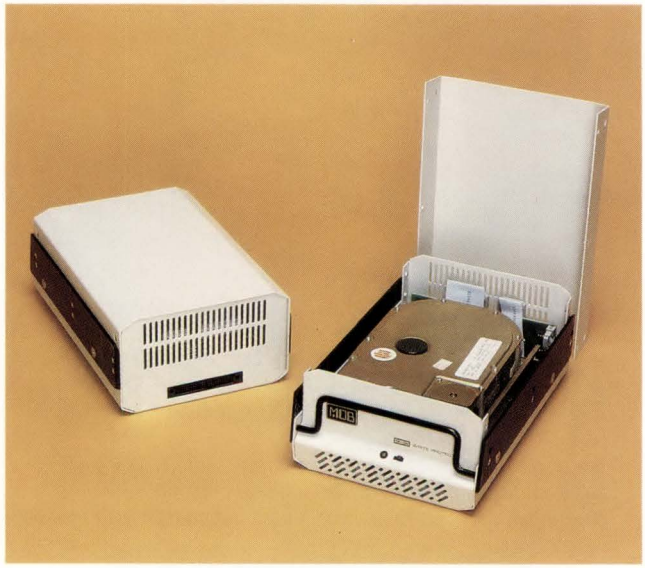
The Data Shuttle 2000 can be provided as a Disk Chassis or as a Disk Subsystem. The disk chassis includes one or two disk drives but does not include a disk controller or cables. It is computer manufacturer independent and can be connected to a variety of computers that have the appropriate disk controller.

The Data Shuttle can also be purchased without drives. For this configuration, basic chassis and empty canister kits are supplied.

Disk Canister:

Each canister contains interface specific (ST506, ESDI, SCSI) internal cabling between the disk I/O signal and power leads and the low insertion force connector. A Write Protect switch and indicator is located on the front of each canister.

The left canister is typically Drive 0 and the right canister is Drive 1. Two DIP switches in the chassis, one for each canister, can be used to change drive addresses. This is particularly useful when the Data Shuttle is used with controllers that support more than two drives.



Canister for Data Shuttle 2000

CIRCLE 478 ON READER CARD

PHIL DEVIN'S ROTATIONS

The 3.5-in. hard disk market brought out the best in conservative market forecasting. The computer industry appeared at a loss as to how to package these little drives, and production economies were slow to meet the costs associated with 5.25-in. products. Even the history of this poor, little waif has proven to be controversial, and may require court judgment to resolve its origins.

Who Invented What?

The first mention of a 3.5-in.-diameter disk drive was in a Sony Corp. paper presented at Dataquest's Computer Storage conference in October 1981. This paper, "The Emerging 3.5-in. Floppy Market," by Sony's Mr. Kikuchi, was the first announcement of Sony's 3.5-in. floppy disk drive and media design—now the industry standard. Sony's forecasts included 3.5-in. rigid drives with shipments beginning in 1983. Capacities revealed ranged from 3 to 100 Mbytes. Market researchers have strived to be as accurate as this man proved to be!

Actually, Rodime Inc. announced and shipped first production volumes of such a product in 1983. Control Data Corp. (CDC) announced its 3.5-in. Cricket drive in 1983, but its chirps were never heard by the public. It took Quantum Corp.'s (Santa Rosa, CA) subsidiary, Plus Development, to make a market for these small drives.

Plus introduced the 10-Mbyte Hardcard in 1985 and was promptly upstaged by Mountain Computer Inc., which, overnight, produced a 20-Mbyte card. These Drive-On-A-Card (DOAC) devices were offered with twice the capacity and at lower retail prices than Plus. It took two years to recover, but Plus now owns with the DOAC market.

Primary sales of the 3.5-in. drives in 1986 were into the DOAC market, but then the Apple Macintosh paved the way for system use of these small drives. Compaq stuffed a Rodime drive into a 5.25-in. ruggedized frame, and laptop computers offered a promising application. But it took IBM's April 1987 announcement of PS/2 Models 30 and 50 with 20-Mbyte drives to bring them into the real world of rotating storage.

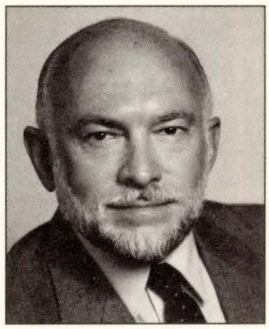
Forecast Revelations

In June 1987, Dataquest estimated that demand for 3.5-in. drives would accelerate slowly. IBM's desktop PS/2 configurations were the first indication that the OEM world would turn toward the 3.5-in. rigid dimensions. Currently, little indication still exists of dealers stocking desktop computers with 3.5-in. rigid drives—high-end laptops and PS/2s (and clones) are the only ones.

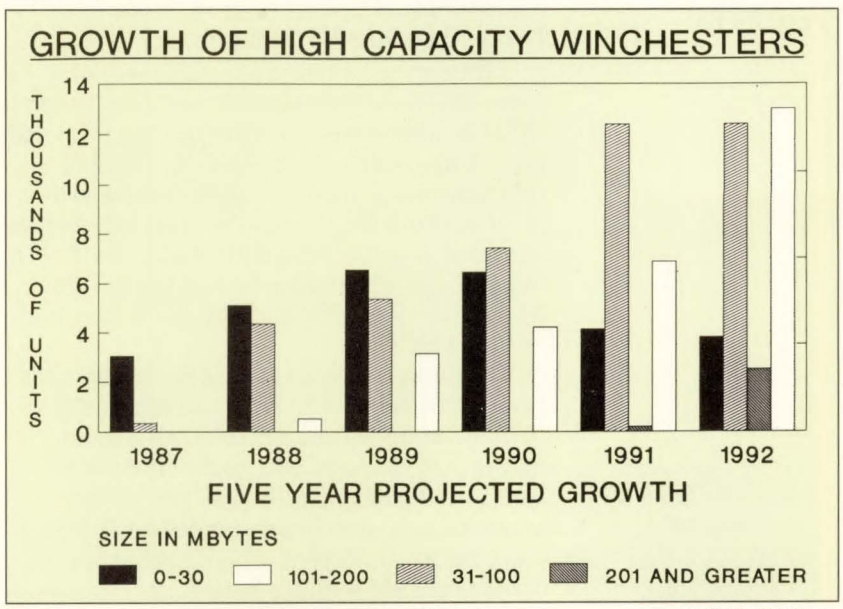
Miniscribe's leadership is still unchallenged. IBM's factory at Fujisawa, Japan, may be the first to approach Miniscribe's output. JVC's low-power drive found its way into early laptops, and the Western Digital/Tandon drives often found their way onto retail shelves as DOAC devices. Along with Plus, these companies were the only ones to sell high quantities of 3.5-in. drives in 1987.

Dataquest's latest forecast for 3.5-in. drives by capacity are sales estimates that include resale and captive production.

The average capacity of the overall 3.5-in. family in 1988 will be 35 Mbytes due to the rapid movement away from the 20-Mbyte



THE MOUSE IS ABOUT TO ROAR



SOURCE: DATAQUEST

Dataquest research indicates *that the low-capacity, 20–25-Mbyte drives will dominate worldwide sales through 1989 due to their popularity in laptop computers and low-cost desktop PS/2 imitators.*

"IBM'S FAST MOVES TOWARD SMALLER FORM-FACTOR PRODUCTS HAVE MADE THE 3.5-IN. HARD DISK BUSINESS THE FASTEST-RISING STAR IN THE HISTORY OF STORAGE FIRMAMENT."

standard and the availability of 40-Mbyte drives from multiple sources. The use of run-length-limited data encoding and variable-zone, bit-density recording techniques that increase recording capacities by 50% has become standard.

Dataquest research indicates that the low-capacity, 20–25-Mbyte, drives will dominate worldwide sales through 1989 due to their popularity in laptop computers and the low-cost desktop PS/2 imitators. The 31–100-Mbyte-capacity category has been pioneered by Conner Peripherals and copied by most of the new entrants. Quantum is the only announced producer with better performance specs and a chance at taking a substantial market share.

The more-than-100-Mbyte category is only beginning to take off. The original estimates of 300,000 unit sales in 1988 may have been optimistic, and management at Conner Peripherals agrees. If CDC and Maxtor Corp. start volume shipments to their established OEM customer base in 1988, there might be a windfall change in forecasts. Frankly, I don't look for the 100+-Mbyte market to materialize until 1989, delaying the 200-Mbyte drives until 1991.

Where Do We Put Our Money?

Let's take a brief look at the suppliers of 3.5-in. drives and their potential to become leaders in this newest of growth markets. Today, there are 34 producers.

Miniscribe has been the volume leader since 1986 and is destined to keep its leadership because of high production capacity and experience in the 3.5-in. field. Solid OEM relationships—such as Apple Computer for its Macintosh SE drives—provide Miniscribe with consistent profitability and growth. It's estimated that Miniscribe sold one million 3.5-in. drives in 1987 and will likely do 1.5 million this year.

IBM may become the largest producer of 3.5-in. drives in 1988. The Fujisawa factory turned out an estimated 750K 20-Mbyte drives last year and will probably double that in 1988. Seagate, the sleeper in this market, has recently announced an IBM contract for 3.5-in. drives, which probably indicates that IBM will not have higher-capacity products for another year. An intelligent interface 50-Mbyte drive with a sub-30-msec access time would fit IBM's plans perfectly.

Conner Peripherals is slowly breaking out of its role as Compaq's drive house. Production shipments of the 100-Mbyte drive and the new, low-power, 20-Mbyte product will supplement the strong 40-Mbyte offering. Dataquest looks for Conner to approach the 1.5 million production market in 1988.

The most promising new contender is an old favorite, too long out of the position of leadership: Quantum. Capitalizing on the Plus relationship with Matsushita Kotobuki, Quantum will build 40- and 80-Mbyte drives in the same Japanese factory. Intelligent, zone bit-density caching decreases access times to 13 msec. A 50,000-hour mean-time between failure will catch the attention of OEM buyers. Quantum is definitely back!

CDC's announcements at Comdex 1987 may have been premature. It's unlikely that we will see high-capacity 3.5-in. drives from CDC in 1988. Maxtor Corp.'s 170-Mbyte project was scrapped in favor of a higher-capacity drive and a more cohesive marketing plan. Maxtor will ship some high-capacity 3.5-inchers in 1988.

Kalok is the new kid on the block this year. A family of very inexpensive drives has been designed by the folks that gave us the Seagate ST-225 and the Lapine Spartan drives. Oriental Precision is building the drives in Korea with a goal of selling its 20-Mbyte products in the range of $150 for very high quantities in the United States.

Bigger Than Hula Hoops?

IBM's fast moves toward smaller form-factor products have made the 3.5-in. hard disk business the fastest-rising star in the history of the storage firmament. Faced with an industry over-capacity situation in late 1988, actual sales will climb to 9.8 million drives, an increase of about 190% over 1987 sales.

With PS/2 compatibles being announced hourly, there is no doubt that these forecasts will hold up. To make profits and retain the necessary quality for OEM relationships, any vendor must provide:

- capacities of 40 Mbytes and greater,
- access times of less than 30 msec,
- less than 9 watts of power consumption,
- ship-to-stock reliability programs, and
- competitive prices.

Since we don't live in a perfect world, I fear some disappointments are in store, but there is little doubt that this market is a rocket on its way up. SA

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Medium
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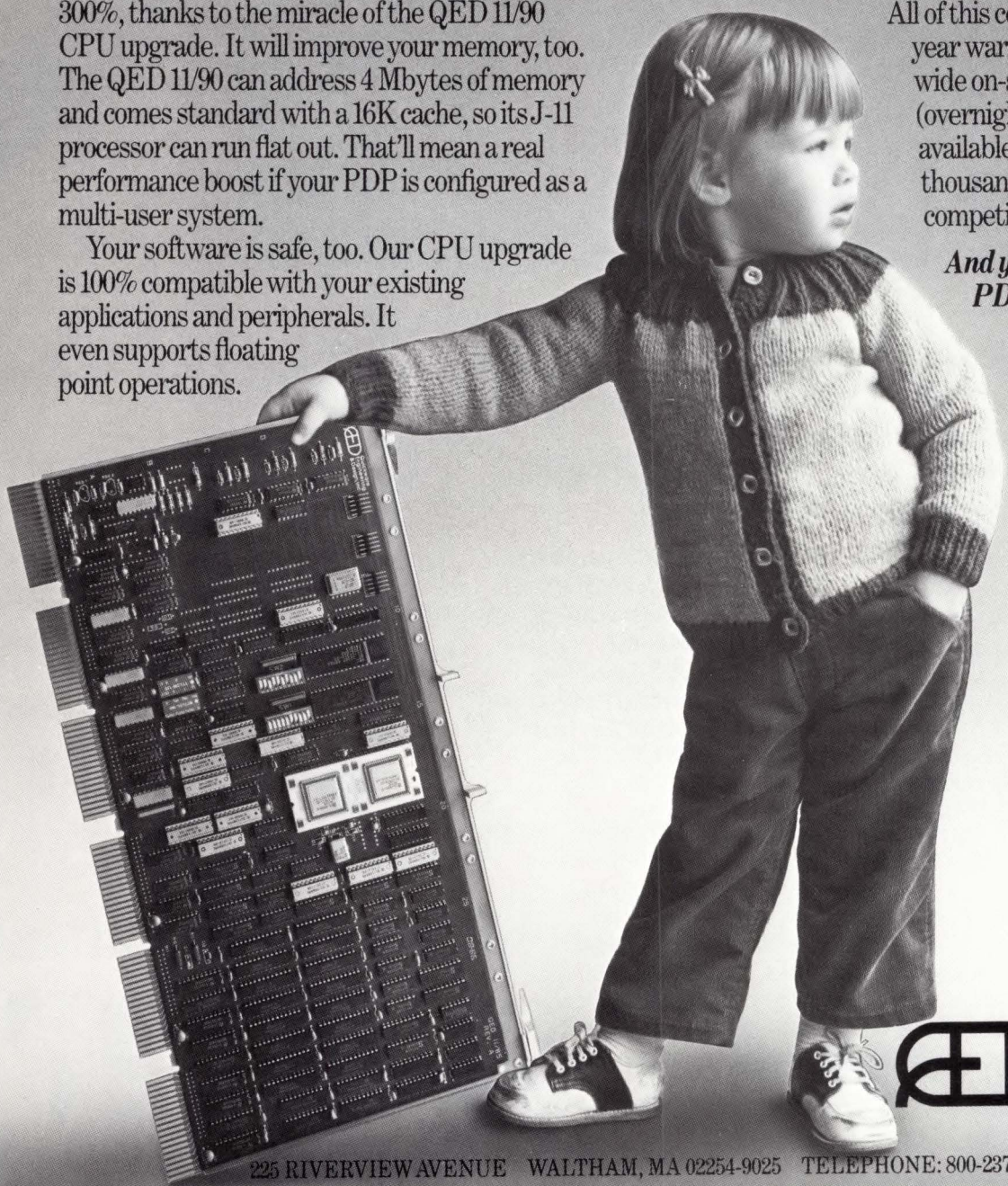

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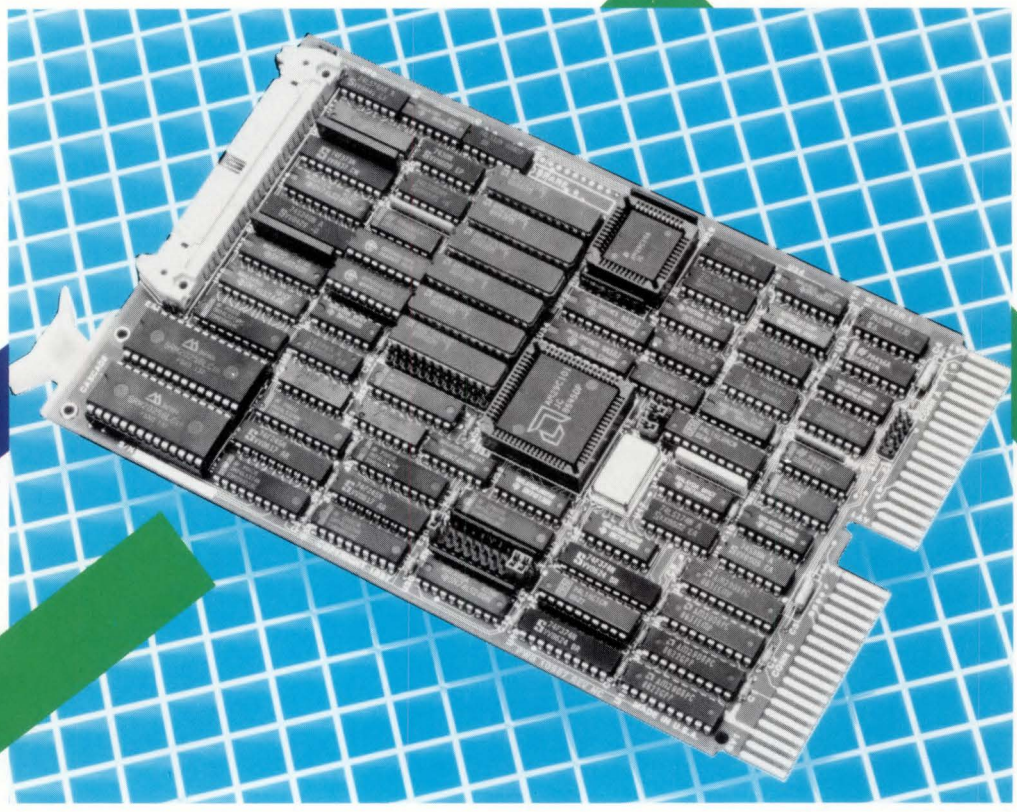

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VAX/VMS TOOLBOX *by Steve Davis and Matthew Owen*

Creating complex reports with the tools at hand

Toolbox departs from Digital Command Language (DCL) this month to bring you a handy tool for creating complex reports. Related subjects that need elaboration include the allocation of virtual memory via the system services LIB$GET_VM and LIB$FREE_VM, the use of the MESSAGE facility, and the MACRO assembler.

The module, dubbed PAGER, provides a mechanism for programmers to create a virtual report page, place data on that page, and then retrieve the page's contents for output.

Report programs tend to be written on a line-by-line basis. Each report line is assembled and then output to a print device or a file. This works well in most cases. However, a report sometimes requires more complicated manipulation of the input data; that is, rather than having similar lines written in succession, it might require information from several different databases.

For example, an invoice form would, typically, have spaces reserved for ship-to address, bill-to address, invoice number, terms, etc. To illustrate the problem, let's look at the ship-to and bill-to addresses. They are usually two separate boxes on the form in a parallel position. When printing the form, the company name for the ship-to and bill-to address must be printed on the same line, the address lines follow.

PAGER allows the programmer to define a page as an array of lines and columns. This page then becomes a canvas where data may be placed—in the same way that direct cursor addressing allows data to be positioned anywhere on the screen. After the page is assembled (that is, data has been written to complete the entire report page), PAGER will return report lines to be output to a printer or file.

The Ins and Outs of PAGER

PAGER is written in VAX MACRO and has several entry points. Each is discussed in the order normally invoked. Some special-purpose entry points are discussed for more advanced applications.

- **ODS$PAGER_INIT**

ODS$PAGER_INIT is called to initialize the PAGER environment. This is usually called once during the use of the PAGER. It has two arguments, returns a completion status, and is called as follows:

```
ret_status = ODS$PAGER_INIT( rpt_lines, rpt_columns )
```

rpt_lines: a longword passed by reference; indicates the number of lines on the virtual report page.
rpt_columns: a longword passed by reference; indicates the number of columns on the virtual report page.
ret_status: a longword returned indicating completion status. Typical values returned might be:
SS$_NORMAL: Successful completion.
PAG$_INVARG: Invalid number of arguments.
PAG$_RANGE: Line or column out of range. Both line and column are limited to a maximum of 255.
PAG$_ACTIVE: PAGER environment is already active. This indicates that ODS$PAGER_INIT has been called previously without ODS$PAGER_END being called.

- **ODS$PAGER_PUT**

ODS$PAGER_PUT is called to place data on the virtual report page at a specified line and column. This would be called many times to write the lines of the report. This entry point has three arguments and returns a completion status, and is called as follows:

```
ret_status = ODS$PAGER_PUT( line, column, field )
```

line: a longword passed by reference; indicates the line on the virtual report page.
column: a longword passed by reference; indicates the column on the virtual report page.
field: a string passed by descriptor; contains the data to place on the report.
ret_status: a longword returned indicating completion status. Typical values returned:
SS$_NORMAL: Successful completion.
PAG$_INVARG: Invalid number of arguments.
PAG$_NOTINIT: ODS$PAGER_INIT has not been called to initialize the virtual report page.
PAG$_RANGE: Line or column out of range. Both line and column are limited to a maximum of 255.

- **ODS$PAGER_LINE**

ODS$PAGER_LINE is called to return a line of the report page. It's used in a loop, with the call returning the specified line number until all lines of the report are retrieved. Trailing spaces are trimmed from the returned line if the variable passed to receive the data is a dynamic string. This entry has two arguments, returns a completion status, and is called as follows:

```
ret_status = ODS$PAGER_LINE( rpt_line, line )
```

rpt_line: a string passed by descriptor and upon return contains the report line.

line: a longword passed by reference; indicates the line on the virtual report page to return.
ret_status: a longword returned indicating completion status. Typical values returned include:
SS$_NORMAL: Successful completion.
STR$_TRU: String truncation warning. The fixed-length destination string could not contain all of the characters copied from the report line.
PAG$_INVARG: Invalid number of arguments.
PAG$_NOTINIT: ODS$PAGER_INIT hasn't been called to initialize the virtual report page.
PAG$_RANGE: Line specified is greater than 255.

- **ODS$PAGER_END**

ODS$PAGER_END ends use of PAGER and releases any resources allocated. This call would be made once, usually at the end of execution. It has no arguments, returns a completion status, and is called as follows:

```
ret_status = ODS$PAGER_END
```

ret_status: a longword returned indicating completion status. Typical values returned are:
SS$_NORMAL: Successful completion.
STR$_TRU: String truncation warning. The fixed-length destination string couldn't contain all of the characters copied from the report line.
PAG$_INVARG: Invalid number of arguments.

A program making use of PAGER would have the basic structure shown in Listing 1.

More for Your Money

Some additional features of PAGER are necessary for obvious reasons. It's uncommon for a report to be only one page, as the previous example shows. After the lines on a page are returned, the virtual report page is still intact. Thus, it must be cleared to start a new page. One could use ODS$PAGER_PUT using a rpt_field filled with spaces the width of the report columns, looping for each line on the report—not very convenient. Neither is having to retrieve all 66 lines when only the first 60 lines contain data. There are two routines to address these issues.

- **ODS$PAGER_CLEAR**

ODS$PAGER_CLEAR is called to re-initialize (blank) the virtual report page. It includes two arguments, returns a completion status, and is called as follows:

```
ret_status = ODS$PAGER_CLEAR( begin_line, end_line )
```

begin_line: a longword passed by reference indicating the starting line of the virtual report page to blank.
end_line: a longword passed by reference; indicates the ending line of the virtual report page to blank.
ret_status: a longword returned indicating completion status. Typical values returned are:
SS$_NORMAL: Successful completion.
PAG$_INVARG: Invalid number of arguments.
PAG$_NOTINIT: ODS$PAGER_INIT hasn't been called to initialize the virtual report page.

LISTING 1

```
ret_status := ODS$PAGER_INIT( 66, 132 )
!
! declare a page of 66 lines by 132 columns
!
if ret_status .ne. SS$_NORMAL then
   call LIB$STOP( ret_status by value )
else
   begin

      ret_status := ODS$PAGER_PUT( 10, 10, "report data" )
      if ret_status .ne. SS$_NORMAL then
         call LIB$STOP( ret_status by value )

      ret_status := ODS$PAGER_PUT( 11, 11, "report data" )
      if ret_status .ne. SS$_NORMAL then
         call LIB$STOP( ret_status by value )

      ret_status := ODS$PAGER_PUT( 12, 12, "report data" )
      if ret_status .ne. SS$_NORMAL then
         call LIB$STOP( ret_status by value )

      loop for line = 1 to 66

         ret_status := ODS$PAGER_LINE( rpt_line, line )
         if ret_status .ne. SS$_NORMAL then
            call LIB$STOP( ret_status by value )
         else
            print to report_device( rpt_line )
         end_if

       end_loop

   end

end_if

ret_status := ODS$PAGER_END

end_program
```

LISTING 2

```
ret_status := ODS$PAGER_INIT( 66, 132 )
!
! declare a page of 66 lines by 132 columns
!
if ret_status .ne. SS$_NORMAL then
   call LIB$STOP( ret_status by value )
else

   loop for all_pages

      begin

         ret_status := ODS$PAGER_PUT( 10, 10, "report data" )
         if ret_status .ne. SS$_NORMAL then
            call LIB$STOP( ret_status by value )

         ret_status := ODS$PAGER_PUT( 25, 25, "report data" )
         if ret_status .ne. SS$_NORMAL then
            call LIB$STOP( ret_status by value )

         ret_status := ODS$PAGER_PUT( 40, 40, "report data" )
         if ret_status .ne. SS$_NORMAL then
            call LIB$STOP( ret_status by value )

         ret_status = ODS$HIGH_LINE( high_line )
         if ret_status .ne. SS$_NORMAL then
            call LIB$STOP( ret_status by value )

         loop for line = 1 to high_line

            ret_status := ODS$PAGER_LINE( rpt_line, line )
            if ret_status .ne. SS$_NORMAL then
               call LIB$STOP( ret_status by value )
            else
               print to report_device( rpt_line )
            end_if

         end_loop

         ret_status := ODS$PAGER_CLEAR( 1, high_line )
         if ret_status .ne. SS$_NORMAL then
            call LIB$STOP( ret_status by value )

      end

   end_loop

end_if

ret_status := ODS$PAGER_END

end_program
```

PAG$_RANGE: Starting or ending line specified is greater than 255.

- **ODS$PAGER_HIGH_LINE**

ODS$PAGER_HIGH_LINE is called to return the highest line number on the virtual report page that holds data. This entry point includes two arguments, returns a completion status, and is called as follows:

```
ret_status = ODS$PAGER_HIGH_LINE( high_line )
```

high_line: a longword passed by reference; on return, contains the highest line number that holds data.
ret_status: a longword returned indicating completion status. Typical values returned are:
SS$_NORMAL: Successful completion.
PAG$_INVARG: Invalid number of arguments.
PAG$_NOTINIT: ODS$PAGER_INIT hasn't been called to initialize the virtual report page.

The basic structure has now been changed to incorporate two new calls—ODS$PAGER_CLEAR and ODS$PAGER_HIGH_LINE (Listing 2).

Installation and Linking

Now that we know how to use PAGER, let's review its construction and integration. PAGER is made up of two source files: PAGER.MAR, the MACRO source; and PAGERR.MSG, the PAGER error codes and associated messages. To assemble PAGER.MAR:

```
$ MACRO PAGER
```

To create an object module for PAGERR.MSG:

```
$ MESSAGE PAGERR
```

To include PAGER in with your code:

```
$ LINK your_module_here+PAGER+PAGERR
```

PAGER may also be a shareable image. A shareable image is a previously linked image not intended to be executed by itself. To execute, it must be included as input in a linking operation that produces an executable image. This allows many programs to use PAGER without the PAGER code and messages being included in each program. To link PAGER as a shareable image:

```
$ LINK PAGER+PAGERR/SHARE
$ RENAME PAGER.EXE SYS$LIBRARY:
```

PAGER.EXE is moved to SYS$LIBRARY where the linker expects to find shareable images. To link

PAGER.EXE in with your program:

```
$ LINK your_module_here,SYS$INPUT/OPT
SYS$LIBRARY:PAGER/SHARE ^Z
```

The SYS$INPUT/OPT notifies the linker that an option file is to be read from SYS$INPUT, which normally would be your terminal. After typing in SYS$LIBRARY:PAGER/SHARE followed by a RETURN, type a control-Z. This indicates end of file for option file.

Internals

For those who are curious about the internal workings of PAGER, we'll touch upon the more interesting topics.

When the call ODS$PAGER_INIT (Listing 3) is made, an area in the process virtual space must be set aside to hold the virtual report page. This is done using the RTL routine LIB$GET_VM. The total number of lines and columns are multiplied to calculate the bytes needed to store a virtual report page.

```
rpt_lines * rpt_columns = bytes_needed
```

LIB$GET_VM is called with bytes_needed and it returns the base_address in memory where those bytes are located. This area of memory can then viewed as an array (l,c), when l is rpt_lines and c is rpt_columns. In MACRO,

LISTING 4

```
.SBTTL  ODS$PAGER_PUT - put field on virtual report page

put_line = 4
put_column = 8
put_field = 12

        .TRANSFER       ODS$PAGER_PUT
        .MASK           ODS$PAGER_PUT
        BRW     ODS$PAGER_PUT+2

        .ENTRY  ODS$PAGER_PUT,^M<R10>

        MOVL    #PAG$_INVARG,R0         ;assume error
        CMPB    #3,(AP)                 ;are there three arguments?
        BNEQ    50$                     ;branch if not

        MOVL    #PAG$_NOTINIT,R0        ;assume error
        TSTB    active                  ;are we in business?
        BEQL    50$                     ;branch if not

        MOVL    #PAG$_RANGE,R0          ;assume error

        MOVL    @put_line(AP),R4        ;R4 = line number
        BLEQ    50$                     ;line number too small
        CMPL    R4,max_lines            ;within range?
        BGTR    50$                     ;out of range, go away

        MOVL    @put_column(AP),R3      ;R3 = column number
        BLEQ    50$                     ;line number too small
        CMPL    R3,max_columns          ;within range?
        BGTR    50$                     ;out of range, go away

        JSB     MAKE_POINTER            ;go make the pointer
;
; R3 -> first position on page
;
        MOVL    put_field(AP),R10       ;pointer to string header
        MOVZWL  (R10),R2                ;R2 = length of string
        BEQL    40$                     ;no length, no string, exit
        SUBL3   R3,end_addr,R1          ;R1 = length left in buffer
        CMPL    R2,R1                   ;will buffer overflow, R1 < R2
        BLEQ    10$                     ;no, go ahead
        MOVL    R1,R2                   ; else truncate passed string

10$:    MOVL    R2,R0                   ;number of bytes to start
        MOVL    4(R10),R1               ;address of string
20$:    LOCC    #0,R0,(R1)              ;any nulls here?
        BEQL    30$                     ;no nulls, continue on
        MOVB    #^A" ",(R1)             ;change to space
        BRB     20$                     ;try for another

30$:    MOVC3   R2,@4(R10),(R3)         ;copy string into buffer

40$:    MOVL    #SS$_NORMAL,R0          ;okay finish

50$:    RET                             ;back to caller
```

LISTING 3

```
.SBTTL  ODS$PAGER_INIT - initialize virtual page

page_lines = 4
page_columns = 8

        .TRANSFER       ODS$PAGER_INIT
        .MASK           ODS$PAGER_INIT
        BRW     ODS$PAGER_INIT+2

        .ENTRY  ODS$PAGER_INIT,^M<R10,R11>

        MOVL    #PAG$_ACTIVE,R0         ;assume error
        TSTB    active                  ;are we active already?
        BNEQ    5$                      ;yes, that's no good

        MOVL    #PAG$_INVARG,R0         ;assume error
        CMPB    #2,(AP)                 ;are there two arguments?
        BEQL    10$                     ;branch if okay
5$:     RET                             ;back to caller on error

10$:    MOVL    #PAG$_RANGE,R0          ;assume error

        MOVL    @page_lines(AP),max_lines ;get number of lines
        BLEQ    20$                     ;line number too small
        CMPL    max_lines,#range_lines  ;within range?
        BGTR    20$                     ;out of range, go away

        MOVL    @page_columns(AP),max_columns ;get number of columns
        BLEQ    20$                     ;line number too small
        CMPL    max_columns,#range_columns ;within range?
        BGTR    20$                     ;out of range, go away

        MULL3   max_lines,max_columns,max_bytes
                                        ;max_bytes = # of bytes needed for page
        PUSHAB  base_addr               ;return base address here
        PUSHAB  max_bytes               ;number of bytes to snag
        CALLS   #2,G^LIB$GET_VM         ;go get virtual memory
        BLBC    R0,20$                  ;oops! some kind of error

        ADDL3   max_bytes,base_addr,end_addr
                                        ;calculate the end addr for boundary
                                        ; checking
        MOVC5   #0, #0, #^A" ", max_bytes, @base_addr
                                        ;fill the block with spaces
        MOVL    #SS$_NORMAL,R0          ;okay finish
        DECB    active                  ;turn on okay flag for other calls
20$:    RET                             ;back to caller, R0 = status
```

The code for PAGER is quite lengthy, consisting of more than 200 lines of code. If you're interested in using PAGER, it will be available June 15 on the Digital Village to valid Hardcopy *subscribers. Full access details will be printed in the June issue.*

it is more appropriate to view it as a string that is bytes_needed long starting at memory location base_address.

When ODS$PAGER_END is called, a call is made to LIB$FREE_VM to return the allocated virtual memory that is no longer needed.

When ODS$PAGER_PUT (Listing 4) is called to place field data on the virtual report page, a simple calculation determines the starting offset from the base_address to begin placing the data. In the code, this is done by the MAKE_POINTER (Listing 5) routine. For your convenience, we view the first position on the report as line 1, column 1. However, for our calculation, we must view the first position as line 0, column 0, since the first byte of the virtual page begins at base_address, which is offset 0. So the passed line and column must be adjusted in the formula:

```
offset = ((line - 1) * max_columns) + (column - 1)
```

This means that base_address (offset) is the first byte to begin placing data, and the field data length is important now. If base_address + offset + length is greater than end_address (the end of the virtual report page allocated), the field data must be truncated so we do not write into hyperspace; that is, memory not allocated for this purpose.

The error codes mentioned above PAG$_various are defined in the source file PAGERR.MSG. The MESSAGE facility under VMS provides a mechanism to associate returned completion status codes with a message. When a status code is passed to the RTL routine LIB$STOP, the data structure created by MESSAGE is scanned, the code is matched, and the error is signaled. The error is then displayed in the fashion shown below:

```
%PAGER-E-NOTINIT, ODS$PAGER_INIT has not been called
%PAGER-E-RANGE, Line or column out of range
%PAGER-F-INVARG, Invalid number of arguments
```

As always, we love to hear about variations and ideas from readers, so keep those cards and letters coming.

LISTING 5

```
.SBTTL  make_pointer - make pointer into buffer
;+
; pass R4 = line, R3 = column
;
; on return, R3 = pointer

make_pointer:

        DECL    R3              ;prepare for zero based math
        DECL    R4              ;prepare for zero based math
        MULL2   max_columns,R4  ;R4 + R3 = offset into page buffer
        ADDL2   R4,R3           ;R3 = offset into page buffer
        ADDL2   base_addr,R3    ;R3 -> into page buffer at line and col
        RSB                     ;back to the caller

.END
```

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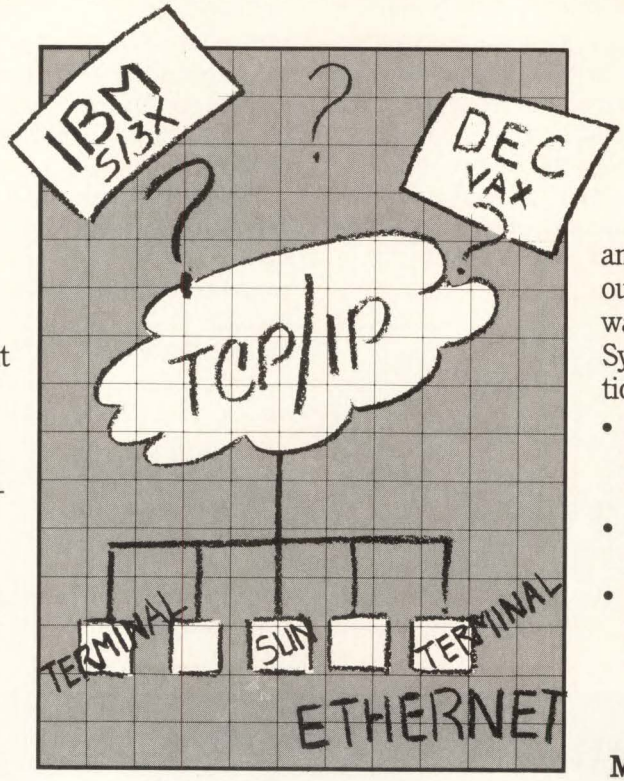

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Linking the LAN for the Best Connection

As part of our ongoing series of making actual connections of systems via networks, we've asked Price Waterhouse's Alen Darr to perform the TCP/IP connection for us via the Excelan Ethernet system

by Alen Darr, *Price Waterhouse*

After completing the integration of the Apple network with our MicroVAX II Local-Area Network (LAN) (see "HC/WG Labs Evaluates Alisa Systems' AlisaTalk, Part 1," *Hardcopy,* page 38, February 1988, and "HC/WG Labs Evaluates Alisa Systems' AlisaTalk, Part II: Making the Final Connection," *Hardcopy,* page 54, April 1988), I was asked to install and integrate a PC-based LAN into the MicroVAX network. After some initial resistance on my part, I agreed to the project, but only on the basis that it would have to be more than just another PC-based LAN. What I received from *Hardcopy* exceeded my expectations—a complete Excelan PC networking system consisting of two PC LAN boards (which support both thin-wire and thick-wire Ethernet connections) and a complete Transmission Control Protocol/Internet Protocol (TCP/IP) implementation for both the MicroVAX II and the PC.

The Excelan networking boards are capable of: 1) creating a PC-to-PC network using one PC as a network file server, and 2) allowing a PC to become part of an Ethernet network (see Figure). If you are using PCs as development workstations, this product may be your connection to the network.

There's a lot to integrating a network. Before we get into the details of implementing the Excelan products, you may need to understand more of the basics of networking (see sidebar, "Why Network at All?).

Although step-by-step details for implementing the physical network connection are beyond the scope of this article, I would like to comment on the quality and quantity (measured in linear feet) of the documentation included with Excelan's product. The manuals are well prepared, easy to follow, and allow you to easily integrate the software and hardware. Briefly, the following steps are required to integrate an IBM PC/AT into an existing MicroVAX II/Macintosh network.

The first step is to install the EXOS 205T Intelligent Ethernet Controller into a 16-bit slot of the PC/AT.

Next, install the LAN WorkPlace network access software for PC-DOS on the PC/AT. Although this process is usually uneventful, it can involve the shuffling of about 15 disks in and out of the PC/AT.

You then make the physical connection of the PC/AT to the existing Ethernet network. This is a simple process of tapping onto the existing thin-wire with a T-connector and connecting to the Ethernet controller.

As mentioned previously, both thick-wire and thin-wire connections are supported on Excelan's Ethernet controller—most manu-

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Product: LAN Workplace HostAccess
Price: $150

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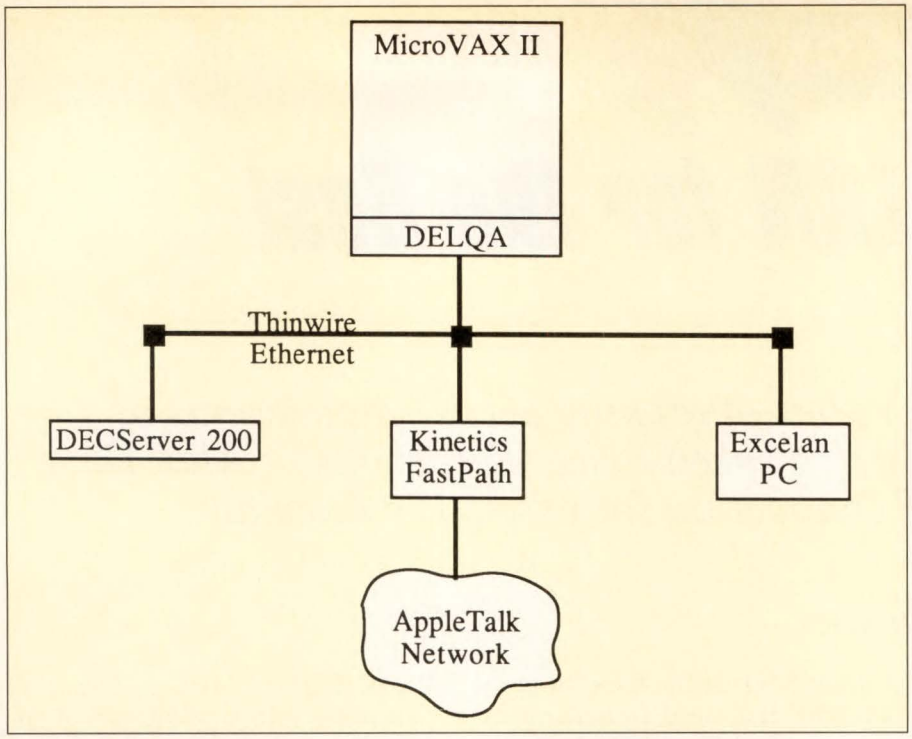


Figure—This figure shows *our test configuration of the Excelan PC network. The Excelan network boards can also be connected to the network via thick-wire through a DELNI or through the Excelan EXOS 1130 Fan-Out Unit.*

facturers have separate controllers for thick-wire and thin-wire.

Next, you must install the TCP/IP software for VMS onto the MicroVAX II.

Finally, you need to define the host names and Ethernet and Internet addresses on both nodes to allow the Ethernet devices to talk to each other.

The complete installation will entail approximately six hours.

The Excelan TCP/IP implementation, along with the EXOS 205T Ethernet controller, allows the PC/AT to become a peer member of an Ethernet network with a complete implementation of the Department of Defense standard DARPA TCP/IP protocols.

The TCP/IP software is downloaded to, and executes on, the EXOS Ethernet board. The Excelan TCP/IP software implements the following Department of Defense Internet protocols:

continued on sector 104

Why Network at All?

This question is rarely asked. Many Local Area Networks (LANs) are implemented when a modem or direct connection to a host will suffice. LANs are particularly useful when you must share files or hardware devices (such as expensive printers) with users on multiple computer systems. A LAN is a high-speed connection that allows computers operating independently to share resources in an organized manner.

LANs can be differentiated from Wide Area Networks (WANs) in that LAN communications are usually confined to a relatively moderate-sized geography—typically a 5-10-mile area. More frequently, however, a LAN may be confined to a building, warehouse, or campus.

LANs consist of more than just the hardware needed to interconnect the communicating devices; the heart of the system is the software, or protocols, that links the systems together logically. Network protocols are the procedures and message formats that allow two or more systems to communicate over the same medium (Ethernet, coaxial cable, etc.).

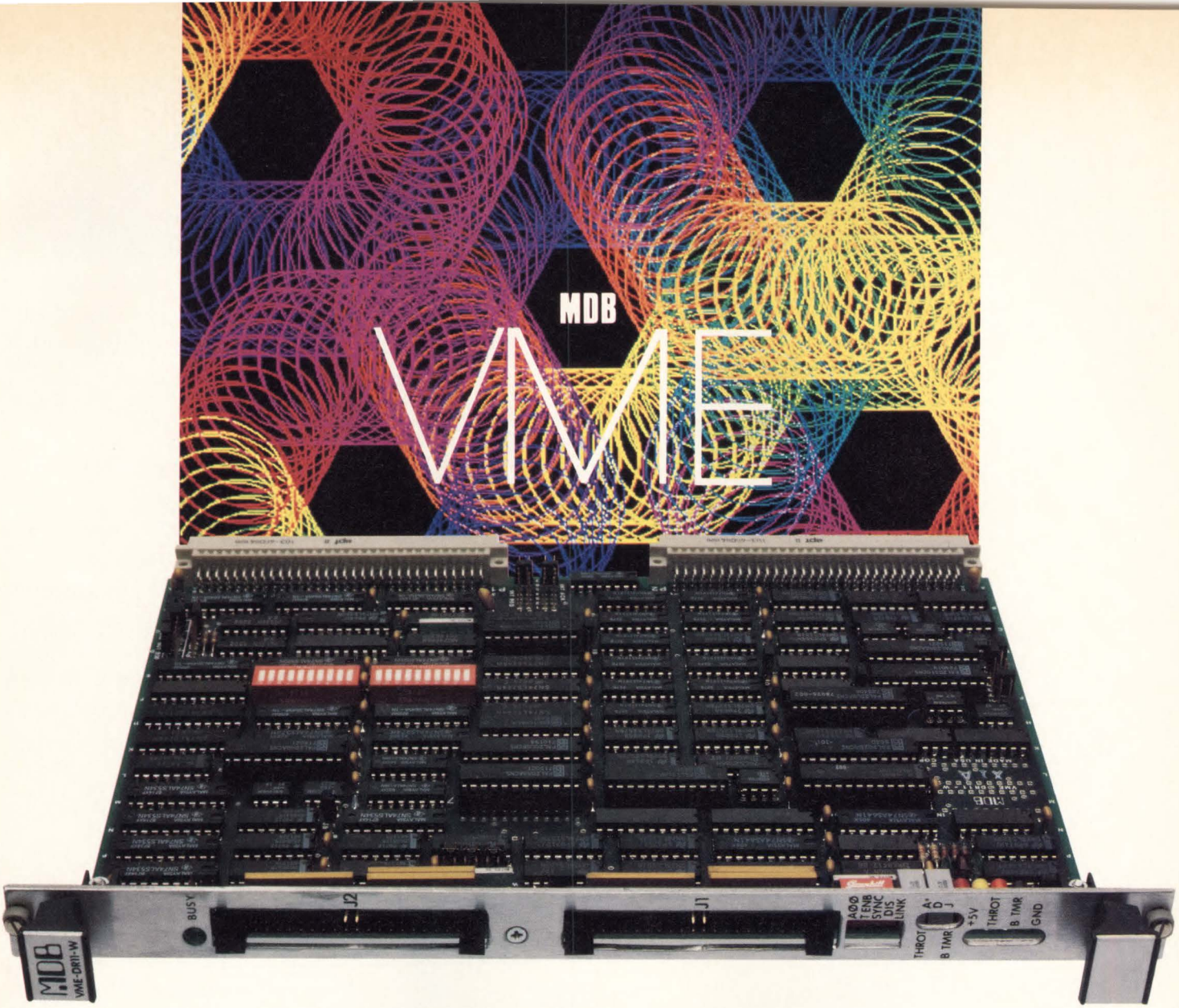
Standard Protocols

Standard protocols for LANs have been slow to develop. In the early '70s, the Department of Defense (DoD) Advanced Research Projects Agency (DARPA) provided grants for the development of a communications protocol over its ARPAnet packet-switched WAN. With DARPA grants, several organizations, including Stanford University and the University of California at Berkeley, used Transmission Control Protocol/Internet Protocol (TCP/IP) to develop UNIX-based systems. As a result of this research, the DoD adopted TCP/IP as its standard communication protocol, and it is now mandatory in most federal government and defense-related networks. With the dynamic growth of the computer industry since the '70s, computer vendors and users demand LAN protocol standards that exceed those capabilities originally provided by TCP/IP. The International Standards Organization (ISO), after working with computer vendors and users, has developed a seven-layer reference model for Open Systems Interconnect (OSI).

The OSI reference model, developed by members of the computer industry, provides a common standard for the interconnection of computer devices to the LAN. The IEEE developed standards for the physical and data link layers of the ISO model. Standards for the following three models that have been accepted are:

IEEE 802.3—Ethernet
IEEE 802.4—Token Passing Bus Networks
IEEE 802.5—Token Ring Network

continued on sector 101



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Now that you've entered the VME world, it's good to know the leader in connectivity is already on-board.

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continued from sector 98

The Protocol Library

Despite the efforts of ISO in developing a set of standard protocols for LANs, a commercial product has not yet been developed that meets the OSI standards, although all major vendors in the market have agreed to implement the standard.

Without a commercially available product, TCP/IP, SNA, XNS, and DECnet have become the de facto industry standards. Each protocol meets varying portions of the OSI standards. A brief overview of each of these protocols follows:

- TCP/IP was developed with a DARPA grant as a wide area networking protocol and is used as a de facto standard by most workstation vendors utilizing the UNIX operating system and by the DoD.
- SNA was developed by IBM as its protocol architecture for wide area networking and is supported by vendors desiring IBM connectivity.
- XNS was developed by Xerox and is designed as a high-performance, office automation protocol. XNS hasn't been accepted as rapidly as other protocols since Xerox has only published XNS standards through the transport level, with the higher levels still being retained by Xerox as proprietary.
- DECnet was developed by Digital Equipment Corp. as a high-performance protocol to connect DEC computers in both LANs and WANs.

According to the 1986 International Data Corp. report on the number of terminal-based LANs, the previously mentioned protocols represent more than 90% of the implemented LAN protocols.

The Physical Connection

Most DEC-based LANs are physically connected through Ethernet (primarily because of DEC's involvement with Ethernet). Ethernet is the preferred medium for LANs, because of its

continued on sector 102

continued from sector 101

relatively low cost and high speed.

In 1980, DEC, Xerox, and Intel joined together to create the specifications for Ethernet. This specification was issued to encourage a standardized approach to the design of LANs and maximize communication between a variety of equipment available from many manufacturers.

The access control method utilized by Ethernet is called the Carrier Sense Multiple Access with Collision Detection (CSMA/CD). The multiple access feature of CSMA/CD allows any node to send a message immediately upon receiving the signal that the channel is free of traffic. This, in turn, permits a substantial portion of the waiting time for token access methods to be eliminated. Carrier sense is the ability of each node to determine that there's no traffic on the channel. However, because of the time it takes a signal to travel across the network, it is possible for two nodes to determine that the channel is free at exactly, or close to, the same time. In such a situation, a collision between the messages occurs. This collision changes the energy level on the channel, allowing the collision detect mechanism of each node to stop transmitting the message, wait a random interval, and then retransmit the message. The fewer collisions on the channel, the more efficient the network. Since there is no predetermined order of access by nodes in CSMA/CD, no guarantee of a maximum wait time is given before getting access to the channel.

Ethernet Wiring Alternatives

Although there's more than one standard access method to the LAN (such as Ethernet, token ring, or token bus), the physical wiring methods for LANs are the same. The following types of wiring options are available:

- twisted pair;
- fiber optic cable;
- broadband coax (allowing multiple channels for video and voice, in addition to digital data), more commonly called thick-wire; and
- baseband coax, more commonly called thin-wire.

Your selection of wiring media depends on your specific environmental factors—such as:

The data to be transmitted. If voice or video is to be transmitted along with digital data, a broadband coax or fiber optic cable is usually required.

Broadband coax is capable of transmitting three concurrent 6-MHz channels, with fiber optic cable recently being implemented to transmit additional channels.

The length of cable required. Each of the Ethernet media have maximum cabling requirements between repeaters, with twisted pair being the shortest, followed by baseband coax, broadband coax, and fiber optic cable. The maximum distance can range from 500 ft. to more than a mile.

The number of nodes allowed on the cable is a function of the length of the cable and the mandatory spacing requirement of 3 meters between nodes. Therefore, in congested areas, it may be appropriate to use broadband cable and multi-port repeaters to allow additional node connections.

Security options must be considered. If unauthorized access to the cable must be detected, then fiber optic cable may be required because it's very difficult to tap or monitor, and unauthorized access can easily be detected and pinpointed.

Redundant cable paths are required. To minimize network downtime in the event of failure, broadband coax is a more suitable cable; broadband coax allows redundant data paths to be configured for maximum network availability.

A Short History of TCP/IP

Transmission Control Protocol/Internet Protocol (TCP/IP) is a highly specific set of network communications protocols derived from the Department of Defense (DoD) Advanced Research Projects Agency (DARPA) project, ARPAnet. TCP/IP was developed to allow the diverse networks of DARPA contractors to communicate seamlessly with the DoD and networks of other DARPA contractors. TCP/IP was designed to allow communication between any two networks that transmit and receive data.

The universal adaptability of the TCP/IP protocol was achievable only with the extensive resources of DARPA. TCP/IP is the protocol of choice for the DoD and defense contractors; as such, the marketplace for TCP/IP will continue to grow with the size of government budgets. However, it is the use of TCP/IP in the commercial field that is of greatest interest. The ability of TCP/IP to interconnect diverse computer systems and its connectivity to a wide range of transport medias—ranging from the Hyperchannel to T1 lines—have allowed TCP/IP to penetrate many business and technical environments.

The definition of TCP and IP protocols is so comprehensive that it has allowed many vendors to implement them on a wide range of dissimilar computer systems yet satisfy many varied communications environments. TCP/IP is used with X.25, and numerous vendors have layered higher-level protocols on top of it, including IBM NETBIOS, the X.400 Message Exchange Standard, Sun Microsystems' TOPS, and Excelan's EXOS. TCP/IP is an integral part of the UNIX operating system.

TCP/IP has gained acceptance from a cost and performance standpoint due to the availability of dense, integrated circuits that allow the complex TCP/IP protocol to be implemented. As more and more companies demand the connection of dissimilar computer systems, TCP/IP will continue to grow in acceptance. The major remaining obstacle for TCP/IP is its acceptance over the International Standards Organization's (ISO's) model that is slowly being implemented on other systems—especially the ISO Transport Protocol, which is well specified with less associated overhead than TCP.

When comparing TCP/IP to the Open System Interconnect (OSI) standard by the ISO (see Figure), TCP/IP consists of the Network Layer's Transport (Level 3) and Network (Level 4). IP provides the equivalent of the ISO Level 3 Network Layer. IP handles all the routine of information and is responsible for providing a network-wide system-naming standard, hiding the naming conventions of the individual subnets from the higher levels. The IP manages the availability and status of the individual subnets and their respective hosts to provide availability and failure information.

TCP implements the ISO Level 4 Network Layer. TCP provides the end-to-end connectivity of the network and simulates a virtual circuit, hiding the underlying network architecture from the user levels. This allows TCP/IP to be used on a wide variety of media (such as T1, Hyperchannel, Ethernet, and StarLAN).

OSI/ISO Network Model

		ISO	Excelan EXOS
User Interface	7	Application	File Transfer Protocol (FTP), Remote Shell (RSH), Simple Main Transfer Protocol (SMTP), TELNET
	6	Presentation	
	5	Session	
Network	4	Transport	Transmission Control Protocol (TCP), User Datagram Protocol (UDP)
	3	Network	Internet Protocol (IP), Internet Control Message Protocol (ICMP)
Physical	2	Datalink	I.E.E.E. 802.3 Ethernet and StarLan
	1	Physical	Thinwire Coax Thickwire Coax

Figure—This depicts *the implementation of Transmission Control Protocol/Internet Protocol (TCP/IP) compared to the Open System Interconnect Standard (OSI) by the International Standards Organization (ISO).*

HARDCOPY POINTERS IBM PC/DEC PRINTER CABLE CONNECTIONS

The following pin outs were used to connect the IBM asynchronous communication serial port to the standard RS-232 connector of the LN03. The same pin outs can also be used to connect the IBM PC to the RS-232 connector of the LA210. With the exception of the new cable, no additional hardware is needed, provided the IBM PC has been configured with a serial port (optional on the PC, standard on the XT).

MEANING	IBM	TO	LN03	MEANING
Ground	1		1	Ground
Trans Data	2		3	Rcv Data
Rcv Data	3		2	Trans Data
Req to Send	4		4	Req to Send
Clear to Send	5		11	Sec Req to Send
Data Set Ready	6		20	Data Term Ready
Data Term Ready	20		6	Data Set Ready

The LN03 printer settings should be:

SWITCH #	SETTING	
1-1	OFF	Serial Input
2	ON	
3	OFF	9600 Baud
4	ON	
5	OFF	8 Data Bits
6	OFF	Parity Disabled
2-1	OFF	
2	OFF	LN03 Device ID
3	OFF	
4	OFF	Auto Wrap Off
5	ON	Restraint
6	ON	Restraint Inverted

The LA210 printer settings should be:

SWITCH #	SETTING	
A-1	OFF	Restraint
2	OFF	No Modem Control
3/4	OFF/OFF	No Action on Paper Fault
5	ON	EOT Disconnect
6	ON	XON/XOFF Enabled
7	OFF	Print Error Default Character
8	OFF	NVR Storage Switch
B-1	ON	
2	OFF	
3	ON	9600 Baud
4	ON	
5	OFF	
6/7	OFF/OFF	Space, No Parity
8	ON	8 Data Bits

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continued from sector 98

- Internet Protocol (IP)—IP provides packet routing, fragmentation, and reassembly of information though the data link layer of the OSI model.
- Address Resolution Protocol (ARP)—ARP is used to translate the Internet address utilized by TCP/IP into the hardware-specific address used by Ethernet devices.
- Internet Control Message Protocol (ICMP)—ICMP is used, in conjunction with IP, to convey control and error information.
- Transmission Control Protocol (TCP)—TCP provides full-duplex, application-to-application data stream connections and IP as its inter-network service. TCP adds reliability, flow control, and multiplexing protocols to each connection.
- User Datagram Protocol (UDP)—UDP provides simple IP-based datagram services; adds checksum and additional application-to-application addressing information to each packet.

Is This Product for You?

TCP/IP is most beneficial to users with UNIX networks that are currently utilizing TCP/IP. For these users, TCP/IP on the PC is a natural extension of the network. For VAX/VMS installations, TCP/IP does not provide a "seamless" network for PC users. These users will have to learn a new syntax for file transfer, remote host login, and print serving. For those of you wishing to utilize the VAX as a remote file-server, this product doesn't provide that support. Instead, the VMS Services for MS-DOS would be a more appropriate product for you.

Next month, we will be monitoring the performance of the Ethernet network utilizing Excelan's LANalyzer 5500. I look forward to measuring the impact of adding the AppleTalk and TCP/IP components to the network.

Alen Darr is a management consulting services manager in the Sacramento office of Price Waterhouse.

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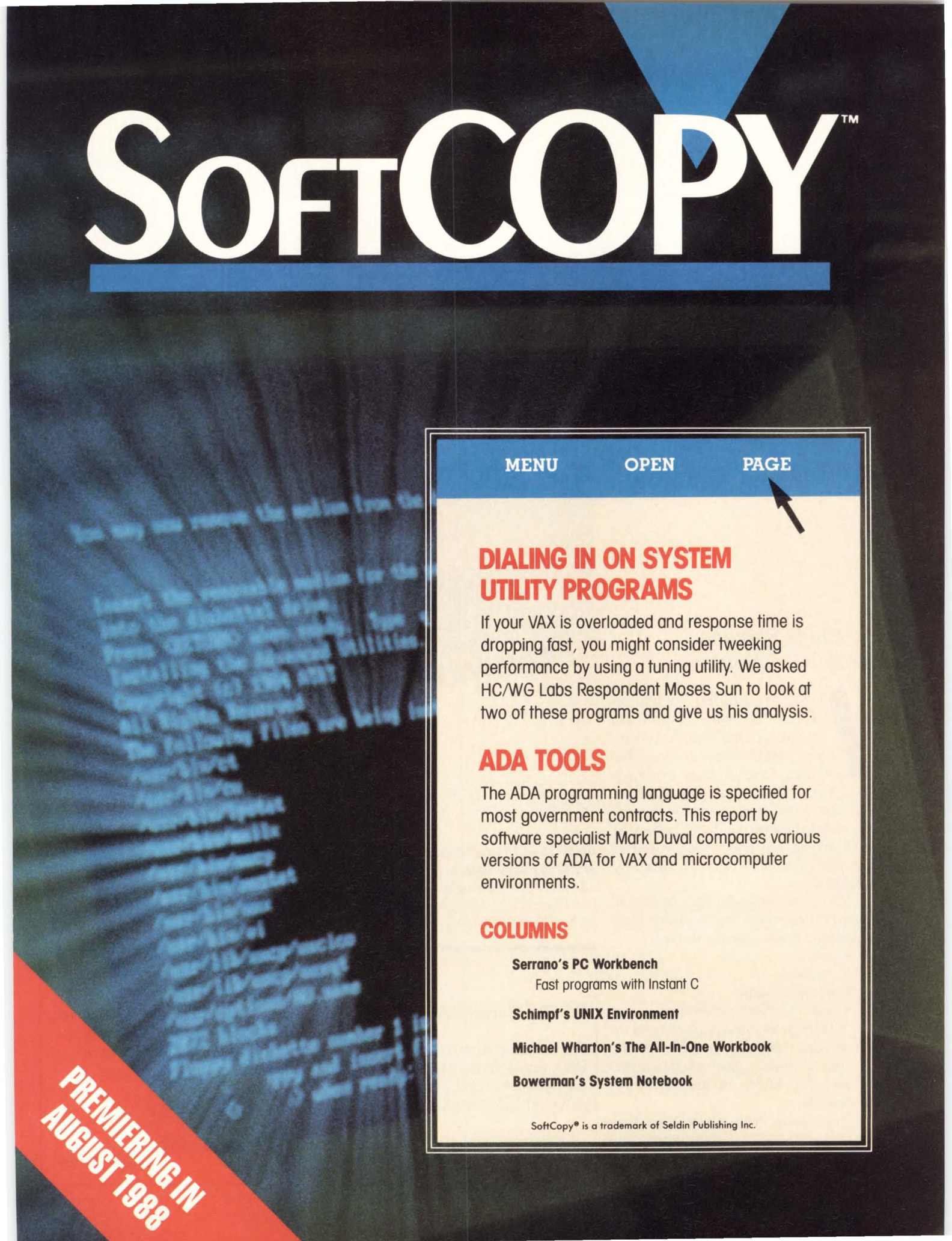

MENU OPEN PAGE

DIALING IN ON SYSTEM UTILITY PROGRAMS

If your VAX is overloaded and response time is dropping fast, you might consider tweeking performance by using a tuning utility. We asked HC/WG Labs Respondent Moses Sun to look at two of these programs and give us his analysis.

ADA TOOLS

The ADA programming language is specified for most government contracts. This report by software specialist Mark Duval compares various versions of ADA for VAX and microcomputer environments.

COLUMNS

Serrano's PC Workbench
Fast programs with Instant C

Schimpf's UNIX Environment

Michael Wharton's The All-In-One Workbook

Bowerman's System Notebook

PREMIERING IN AUGUST 1988

HC/WG LABS HOW REVIEW

HC/WG Labs Reviews Data Technology's TakeTen High-Capacity Cartridge Disk Drive

by Chris Serrano, Senior Respondent

If you are looking for add-on storage for your Macintosh, PC, or VAXmate workstation, you might want to consider Data Technology Corp.'s TakeTen subsystem. The 5.25-in. storage subsystem provides a reasonable alternative to Winchester disk drives, but as we discovered at the labs, the use may be limited by application.

There are four factors of major importance when you consider purchasing a mass storage device:

- size,
- speed,
- security, and
- use as a back-up device.

Although manufacturers tend to claim that their disk or tape drives do indeed meet these needs, most devices fall short in one or more categories.

The Data Technology TakeTen cartridge disk subsystem, however, appears to adequately address all four needs.

Using 10-Mbyte (formatted) flexible media with a pre-written servo track encased in a protective hard shell, *the Data Technology Corp. TakeTen storage subsystem is an adequate alternative to Winchester disk drives. The 5.25-in. drive accommodates a track density of 333 tpi and an average seek time of 65 msec. The drive is easily attached to any system via SCSI.*

HARD FACTS:

TakeTen Storage Subsystem

Price: External unit (single-drive) $995, (dual-drive) $1,695; internal unit (single-drive) $795, (dual-drive) $1,545; cartridges $39.95 each

- Average seek time: 65 msec
- Track density: 333 tpi
- Capacity: 10 Mbytes formatted and 12.75 Mbytes unformatted
- Back-EZ Backup Software included

Data Technology Corp.
2551 Walsh Ave.
Santa Clara, CA 95051
408-727-8899 **Circle No. 256**

Multiple Capability

TakeTen is available as either an internal or an external, 10-Mbyte, removable-cartridge disk drive system. The initial market is for IBM PCs and similar systems. However, the drive isn't limited to one market segment but fits nicely into any workstation environment due to the small computer system interface (SCSI).

The system supplied to HC/WG Labs includes the TakeTen drive in its own external case with power supply, the cable, and the interface card that plugs into the IBM bus. Also included are documentation, software utilities, and Back-EZ software by EZ-Logic (Los Altos, CA) to perform hard disk backup or mass file transfer. Currently, this is the only software supplied with the system. OEMs are expected to supply the necessary drivers and support software for other systems such as the MicroVAX.

Easy to Integrate

As supplied, TakeTen is aimed at the end user and the documentation supplied supports this orientation. The 94-page, spiral-bound users guide, for example, contains clear, complete instructions for the step-by-step software installation and use. Hardware installation instructions, contained in an appendix, are simple and straightforward.

One disk of utilities contains programs to set up and to use with the TakeTen system. A shell program that surrounds DOS is included to make running the utilities simple.

A SCSI Device

TakeTen is a SCSI device. Thus, a SCSI host adapter is needed to match the drive to the computer. Data Technology supplied us with an IBM PC/AT host adapter. We also connected the drive to a MicroVAX using the TD Systems Inc. (Lowell, MA) QTO. Additionally, we attached the drive to an Apple Computer Inc. (Cupertino, CA) Macintosh SE by plugging directly into the computer's SCSI port—no other modifications were necessary.

Even though SCSI does ease integration pangs, there still seems to be a need to have selectable configuration jumpers on the interface card supplied by Data Technology. The configuration jumpers are grouped into two areas and arranged in groups of eight and four.

Data Technology does make some basic assumptions about your system. It assumes that it's an IBM PC/XT, AT, or similar system. Thus, the jumpers on the interface card are preset to reflect the necessary interrupt line (INT 13) and address space as well as alternate ROM address. Alternate DMA/INT addresses can be jumper selected.

Unfortunately, all jumpers may need to be changed when you install the host adapter in your PC—it depends greatly on what other devices you may have installed. We used a basic PC/AT consisting of a Winchester, a floppy drive, and an EGA video adapter. Thus, TakeTen was easily integrated with the standard factory settings on the host adapter. Should you find it necessary to change the jumpers, the manual does give detailed instructions. For the TD card in the MicroVAX, we changed nothing and, essentially, plugged in the drive. Interfacing to the Apple Macintosh was equally simple and required no changes.

Making the System Talk

A device driver is required to allow the PC system access to the TakeTen drives. The Macintosh SE, using Apple's HyperCard, handled the drive with no other modifications.

The PC-compatible software utilities provided are a format program, a diagnostic program, and a copy program. These specialized programs are necessary since the actual media within the TakeTen cartridges have a pre-written servo track. By use of this servo track, the alignment accuracy required to reliably read and write 78-sector/333-track-per-inch media can be achieved. Because of the pre-written servo, these cartridges may not

The Test Environment

The HC/WG Labs tested the Data Technology Corp. TakeTen storage subsystem in the following environment:

Equipment

- 16-MHz 386 system equipped with 12 Mbytes of RAM memory; two 40-Mbyte Winchesters; one 360-Kbyte, 5.25-in., flexible disk drive; one 1.2-Mbyte, 5.25-in., flexible disk drive; and an EGA video adapter
- MicroVAX II running VMS V. 4.0
- Apple Computer Inc. Macintosh SE with 1 Mbyte of memory

Software

- Apple's HyperCard
- Ashton-Tate's dBase III
- HC/WG Labs modified hard disk test program

Tests

1. Shared volume test of 40 Mbytes of records across six cartridge volumes
2. Seek and transfer tests
3. Multiple cartridge insertions and point seek test

be bulk erased or formatted using standard format programs as both destroy the servo track.

To this end, Data Technology's format program, DFORMAT, validates track location and establishes logical sectors within the limits of the pre-established track data controlled by the servo. Similarly, the copy program, DTCXCOPY, supplied by Data Technology takes advantage of the capabilities of the drive. DTCXCOPY also provides a menu-driven user interface to guide you through the copy process.

Although Data Technology recommends the use of the software it supplies, any copy program that can read or write to a DOS device works with TakeTen. The only exceptions you might have to consider are those programs that bypass the operating system and access the drive directly though the BIOs ROM. Typically, this method is used for performance testing and we don't expect it to be a problem.

Compatible Operation

Within the PC environment, the TakeTen device driver is loaded into the computer's configuration file (CONFIG.SYS), which reads the information on the SCSI host-adapter ROM. Once booted, TakeTen works as a normal DOS device with all standard commands: COPY, COMPARE, CHKDSK, DIR, and so forth.

One utility not used is FORMAT. The TakeTen cartridges are pre-formatted and the DFORMAT program supplied by Data Technology is used to initialize them. DFORMAT takes less than 30 seconds (22.6 seconds average by our measurements of 25 formats) to prepare a disk. When finished, DFORMAT reboots the computer. This is not a problem on most machines. However, on the HC/WG Labs 386 PC, which is configured with 12 Mbytes of memory, the reboot takes several minutes—just to count memory. This can become annoying if several disks need to be prepared.

Data Technology claims an average seek time of 65 msec for this drive; this is comparable or slightly faster than the PC/XT drive. In using TakeTen at HC/WG Labs, we found the performance to be comparable to the PC/XT drive when doing large file copies (see Table).

Extensible Storage

Ten Mbytes was the size of the original PC/XT hard disk and has proven to be adequate for many users. Obviously, the amount of data accessible on a TakeTen removable-media drive is limitless—10 Mbytes at a time, spread over multiple volumes/cartridges.

A 20-Mbyte, dual-drive TakeTen system, for example, indeed offers unlimited storage possibilities, depending on how your files are arranged. This concept is important since it does imply some careful planning, especially if it's necessary to cross over volume boundaries in a database.

To test the viability of crossing volume boundaries, we moved a 40-Mbyte database from our host VAX to the 386 PC, in comma delimited format. The names were ported into a list management application written in Ashton-Tate's (Torrance, CA) dBase III. Ten-Mbyte segments were created based on alpha criteria for logical breaks. The final files (six total) were then moved to six TakeTen cartridges.

Normally, the dBase application expects to find all the records on one volume or within logical volumes linked in some relational manner—not on removable media. With the dual-drive system, logical JOINs—linking of database files—could be accomplished as long as the two online volumes were indeed linked (e.g., Volume 1 in Drive D covers A–D, Volume 2 covers E–H, etc.). The burden, of course, is on you to properly manage the cartridges. The single-drive system becomes more manageable since you need only to insert the next logical cartridge. To make this work, it is necessary to create dBase command files that recognize the end of real data and prompt for a new cartridge.

The Right Fit

Although TakeTen provides extensible storage, it isn't ideal for managing large databases. However, it does fit in environments where many users have their own databases and a minimum storage system—one TakeTen.

Within this context, users can have their own individual cartridges that boot up the system in their preferred configuration. Unsophisticated users may have only one, or a menu of, applications while others can have a totally different selection and environment. Users have sole access to their data, providing security from accident and inadvertent disclosure.

Speed, Security, and Backup

In regard to speed and single disk size, TakeTen is just your average drive. But it has the very large advantage of providing two more attributes: backup and remounting. TakeTen is its own backup device. A simple disk copy, (DTC)xcopy, or backup provides an exact, usable duplicate. The advantage of providing backup on the working device is tremendous. Tape drives are often used to back up hard disks. The large disadvantage is that an expensive device is infrequently used and that it occupies space and bus slots that might be better used. A backup on TakeTen is immediately available where a tape backup may not be accessible for some time because it must be re-installed.

Table—Comparative Transfer Times

	360-Kbyte Floppy	10-Mbyte DTC TakeTen	40-Mbyte Hard Disk
Average random access	200 msec	65 msec	29 msec
Data rate	250 Kbit/sec.	275 Kbyte/sec.	5 Mbit/sec.

Note: Measurements were made using 1000 random seeks and 1000 seeks from track 0 to track 100 on all devices. Transfer rates were measured using 1-Kbyte block size.

Everyone recognizes the advantages of hard disks for mass storage. Very few give forethought to security and backup. In many environments where security and security clearances are traditional, removable hard disks and large (10-Mbyte) flexible disk cartridges such as the TakeTen are popular. Most business applications fail to properly consider the value of the data stored on their mass storage devices.

Security and portability are often two sides of the same coin. As the media is removable (portable), it is securable in conventional security devices (safes). In applications where the data is classified or proprietary, it can be quickly and easily removed and secured.

Tape cartridges are commonly used to transport data from one hard disk to another. Similarly, a disk cartridge is easily taken to another machine to transport data or to continue operations suspended due to other hardware failure. Time is often a priceless commodity and TakeTen provides instant security, portability, and recovery.

TakeTen can help provide a high-security environment. Most users would not notice any difference in speed of operation if their existing hard disk was replaced by a TakeTen. This makes TakeTen a very good mass storage device in high-security work environments where it is necessary to secure data in a safe. Putting a .25-in cartridge in the safe is a lot easier than storing your whole computer in the safe. Many government contractors live daily with this requirement.

Checking the Reliability

To some extent, TakeTen can be viewed as just another disk drive. Indeed, it's like the 3.5-in. drives now popular in PCs and Macintosh computers—only bigger. The cartridges are .23-in. thick and have a sliding metal guard over the head access port. This guard is opened only when the cartridge is inserted in the drive and the drive lock button depressed to protect the media.

Two write-protect tabs are built onto each disk. One is meant to protect the first 2 Mbytes on the disk cartridge; the other the remaining 8 Mbytes. This is a nice feature that is not found on any other flexible or cartridge disk system and it is supposed to allow you to conveniently protect part of a disk. Unfortunately, Data Technology chose not to implement this unique feature, instead allowing either one of the write-protect tabs to protect the entire disk.

One difficulty in using a cartridge-type system is the centering hub on the cartridge. The TakeTen cartridge has a locking centering hub similar to that used on 3.5-in.-type disk cartridges. Data Technology claims that this, in concert with the embedded servo, ensures a registration repeatability of the hub/spindle within 200 microinches. It's a claim we can't dispute. We tested the drive with 100 insertion/removals and rewrites and erasures of cylinder 150, alternating between an ASCII A and Q, with no detected errors.

Supporting Software

Another item supplied with the TakeTen system is Back-EZ, a software utility to back up a hard disk or one DOS device to any other DOS device. Back-EZ moves complete copies or selective files from a hard disk to any DOS device. It writes DOS-readable files, unlike some backup software. Back-EZ will copy an entire disk or a directory (including or excluding subdirectories), selecting files by archive status, date, or size.

The natural comparison when using Back-EZ is to the backup and restore programs provided with DOS. One other program supplied with DOS has many of the same functions. XCOPY has been supplied with DOS since V. 3.2. It allows file copying, including subdirectories, by archive bit status, time, and date.

Back-EZ is designed to work with removable-media disks of any size. Should you have files larger than 10 Mbytes, Back-EZ can split them onto multiple disks. Both command-line and menu-driven operation are available with Back-EZ and the command-line syntax is compatible with DOS BACKUP, allowing easy conversion of existing batch files.

Back-EZ, DOS BACKUP, and DOS XCOPY were all used to transfer 9,879,552 bytes from a fast, hard disk to the TakeTen removable-disk cartridge system. XCOPY writes normal DOS-readable files and completed our test transfer in 15.5 minutes. BACKUP was able to finish in less than 12 minutes. Back-EZ did the job in only 7.5 minutes—clearly the fastest of the three.

Many conditions affect the speed obtained during file transfer. The type and basic speed of the machine (8-bit PC/XT or 16-bit PC/AT) and hard disk are significant. These tests were done on a PC/XT with a 28-msec drive.

We agree strongly with the preference for saving data in exactly the same logical form and functionality, especially when used with TakeTen, which saves data on physically identical media. Back-EZ provides desirable speed and convenience of operation to augment the benefits found in the TakeTen system.

The only reservation we have about using Back-EZ is its use of memory. The amount of memory used by Back-EZ depends on the size of the two storage devices being backed up (i.e., a 360-Kbyte drive vs. the 10-Mbyte TakeTen) and the number of files and directories involved. Since Back-EZ may fail at any time due to an increase in the number of files or directories in use, even with 640K of memory, there is no security. Hard disks are getting larger and the software (or DOS versions of it) to support larger volume sizes is here. Until Back-EZ supports paged memory to disk or expanded/extended memory, it is sufficient only for fast backup of reasonably sized systems. All gigabyters will have to look elsewhere for backup software.

ENDL REVIEW

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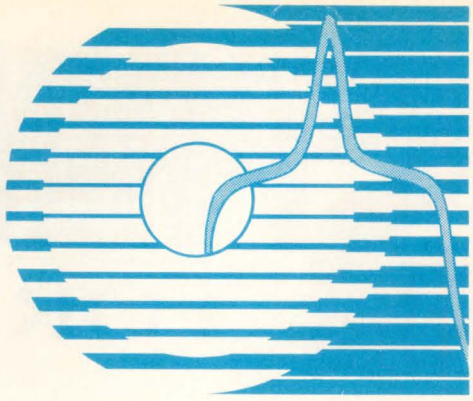

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Time is of the Essence to Your VAX

Does your VAX have the precise time? The National Bureau of Standards (NBS), the nation's official timekeeping organization, does and you can tap into the NBS broadcasts of Coordinated Universal Time—the replacement for Greenwich Mean Time—with the Time Source from Precision Standard Time Inc. The Time Source receives, decodes, and converts the radio signal into a digital format.

The Time Source isn't a clock, however. Rather, it is an auto-adjusting combination precision radio receiver and digital processing unit.

Due to the signal-locking circuitry of the Time Source, drift and accuracy degradation are avoided. The company claims accuracy within 10 msec of the world standard. The Time Source also serves the function of a clock, showing time on the built-in display.

Why a Time Clock?

The Time Source is not just another gimmick add-on clock, rather, it serves the very real purpose of providing any accurate system time stamp.

Computers, standalone or networked, need a continual synchronization reference to ensure a proper operational control. For example, an accurate clock reference for network timing avoids degradation. To illustrate, data files in a networked database are partially identified by a time stamp showing when they were stored. When nonsynchronized computers on a network attempt backup or deletion functions, the wrong files can be deleted due to date and time mismatches. The Time Source prevents this by synchronizing the file time stamps across the entire network, preventing inadvertent data loss.

Precision Standard Time Inc. recently announced *software that permits a DEC VAX computer equipped with a Time Source unit to operate as a network time server, synchronizing DECnet nodes to a standard time signal.*

Craig Fredericks, vice president of marketing and sales, SBE Inc. (Concord, CA), a company that deals in real time, explains: "By accurately time-stamping data, an event can be played back." Fredericks says one of the problems in simulations is accurately time-stamping the data sets. "Ideally, you want to capture data in real time and play it back the same way," says Fredericks.

How It Works

To minimize reception difficulties, NBS broadcasts the world standard time on five radio frequencies from Ft. Collins, CO, and Kauai, HI. Precision's Time Source continually scans all five. Then, using Digital Signal Processing and sophisticated comparison algorithms, the frequency with the best data content is selected, ensuring accuracy of the received timing beat.

Once the Time Source receives and decodes the NBS signal, it converts the signal into an 8-bit analog format that is compatible with computers or instrumentation, via standard interfaces, such as RS-232 or 8-bit parallel.

The Time Source also makes use of the received timing data to keep its own internal, battery-backed-up system clock accurate—an important factor since it is the accuracy of this clock that sets the heartbeat for the entire system. Should power fail, this battery-backed-up clock allows resynchronization with NBS once power is restored.

Self-adjusting capabilities of the Time Source automatically set time changes: time zones, daylight savings, and leap year, including seconds. It records year, month, day, hour, minute, second, and tenths-, hundredths-, and thousandths-of-seconds.

Locking Onto Time

The main constituents of the Time Source family are the VAX Time Source, the Modular Time Source, and the Integrated Time Source.

The VAX Time Source includes a complete unit to set, update, and continually monitor the calendar clock on a DEC VAX. Installing VAX Time Sources on networked computers synchronizes processors, improving systems operations.

The Modular Time Source is suitable for integration into instruments, controllers, and other products. Interfaces are provided to computers, peripheral digital equipment, visual displays, and audio speakers.

Precision's Integrated Time Source, a complete time-receiver system, has an integral display, speaker, and power supply with battery backup.

HARD FACTS:

The Time Source Family

Price: $695-$1,495+ (Quantity 1)

- Continuous time reference: time and data information for activities demanding synchronized, accurate time
- Unattended operation: sets itself when power is applied; adjusts for time zone (user selective), daylight-savings time, leap year, and leap seconds
- Accurate to within 10 msec of UTC

Precision Standard Time Inc.
105 Fourier Ave.
Fremont, CA 94539
415-656-4447
Circle No. 137

PRODUCT NEWS

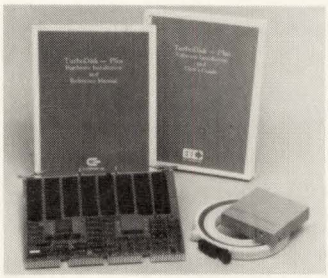
Instant Relief for I/O-Bound VMS Systems

A powerful new version of the TurboDisk-Plus—the Model II—consists of Clearpoint Inc.'s 16-Mbyte QED/16 memory board and EEC Systems Inc.'s TurboDisk-Plus Software V. 2.2. You can install the single, quadwide QED/16 module into the Q-bus backplane of your VMS-controlled MicroVAX II or MicroVAX 3000 and configure RAM disks of up to 256 Mbytes.

By partitioning main memory into two parts—one VME-controlled and one TurboDisk-controlled—you can create a virtual RAM disk. The TurboDisk software dedicates a portion of the main memory to be accessed as an I/O device (up to 256 Mbytes in increments of 16 Mbytes). This RAM disk, of course, has access times comparable to main memory, which is several orders of magnitude faster than a true disk.

Clearpoint Inc.
99 South St.
Hopkinton, MA 01748
617-435-5395 **Circle No. 251**

EEC Systems Inc.
327 Boston Post Rd., Ste. E
Sudbury, MA 01776
617-443-5106 **Circle No. 252**



Clearpoint's QED/16 board utilizes *reliable 1-Mbit ZIP DRAMs and features the reliability of on-board error-detection code.*

Compact 600-lpm Line Printer Allows Mainframe Performance from Your PC

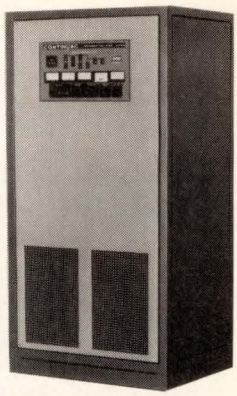
MIS personnel in the PC and mini/mainframe worlds might want to consider Output Technology Corp.'s (OTC) Model 2161 compact 600-line-per-minute (lpm) matrix printer for heavy-duty and networking environments. The OTC 2161 features an open architecture, modular design, and a unique two-line-per-pass printing technique that is able to deliver output at a consistent 600-lpm speed while printing upper- and lower-case characters using OTC's proven Tri-Matrix three-headed print mechanism. Two complete lines of text are delivered with a single pass of the print mechanism, using the OTC proprietary, two-line-per-pass printing technique.

Standard features of the OTC 2161 include two expansion slots for user-installable option cards, dot-addressable graphics, built-in bar codes, downloadable fonts and font cartridge capabilities, and both Centronics and Dataproducts interfaces.

Output Technology Corp.
E. 9922 Montgomery, Ste. 6
Spokane, WA 99206
509-926-3855 **Circle No. 253**

The rugged construction, *compact styling, and light weight (80 lb.) of the OTC 2161 allow for heavy-duty, yet reliable, service.*

80-kVA UPS With 20-Year Money-Back Performance Guarantee

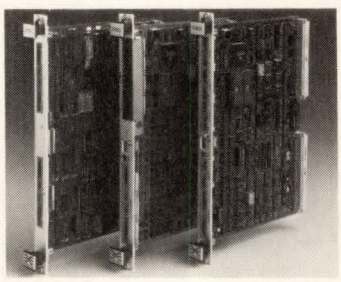


LorTec's 80-kVA UPS system can support *all types of loads, including nonlinear and high-crest-factor loads as well as loads with power factors from 0.8 leading to 0.8 lagging (without correction).*

The new 80-kVA UPS system from LorTec Power Systems Inc. ideally suits large minicomputers and small mainframes so popular today. This unit, however, is half the size of previous designs of equivalent capacity and can handle both three-phase and single-phase loads simultaneously. The system incorporates fewer, larger inverter modules, reducing the overall footprint to 60 x 30 x 80 in., without diminishing system reliability.

The LorTec Model 603CRK UPS delivers 80 kVA at temperatures as high as 40°C (104°F) or even in environments with ambient temperatures up to 50°C (122°F). The system's delta-regulated inverter can handle 100% unbalanced loads as well as extended system overloads. Designed for use with an external standby battery plant, the new 80-kVA UPS includes a solid-state inverter, battery charger/rectifier, and a solid-state, automatic static switch.

LorTec Power Systems Inc.
145 Keep Court
Elyria, OH 44035
216-327-5050 **Circle No. 254**



Emulex Corp. entered *the VME-compatible market with five new products for data storage and data communications. Shown here* (left to right) *are the VT01 tape controller, and the VM31 and VM21 disk controllers.*

Emulex Jumps Onto the VME Bus

Well known for producing high-performance controllers and subsystems for use on DEC, IBM PC, and SCSI buses, Emulex Corp. has undertaken plans to offer the VME user its proven controller technology. New VME-compatible products from Emulex include:

- VM21 and VM31 disk controllers with the highest transfer rates available—20–24 MHz,
- VT01 VME Pertec-compatible tape controller,
- VH01 SCSI-to-VME host adapter that incorporates Emulex' ESP chip, and
- VS02 VME 16-line asynchronous communications multiplexer.

Emulex Corp.
3545 Harbor Blvd.
P.O. Box 6725
Costa Mesa, CA 92626
714-662-5600
Circle No. 255

DEC-Compatible Systems

386-Based AT-Compatible System

SMS 3000 Model 40; high-performance, single- or multi-user computer utilizes the Intel 80386 motherboard and CPU, runs all UNIX and MS-DOS applications, and is functionally compatible with an IBM PC/AT; designed for the factory floor and can withstand the vibration, high temperatures, and electromagnetic interface typical of industrial applications.

The SMS 3000 Model 40 contains a high-capacity 250W power supply and two cooling fans; all peripherals are shock-mounted and the card guides and supports ensure reliable seating of components; optional memory boards for a total of 16 Mbytes of RAM can be added; $4,500–$7,900; available second quarter 1988.

Scientific Micro Systems, 339 N. Bernardo Ave., Mountain View, CA 94043, 415-964-5700. **Circle No. 279**

Storage Devices

Quad Density Tape Drives

9610/9612; quad density hybrid streaming, start/stop .5-in. tape drives are 8.75-in. high; 9610 has an industry-standard (Pertec) interface; 9612 has a SCSI interface; both drives include a 50-ips start/stop tape speed, a streaming speed of 100 ips, 800/1600/3200/6250 bpi densities, automatic speed control, 100% data verification on-the-fly, up to 270 Mbytes capacity, self diagnostics, and a maximum reposition time of 43.5 msec; both drives also feature an auto threading and loading system with front tape insertion that loads small or large reels with no failures.

9612 features a 256-Kbyte cache SCSI controller for continuous streaming, single-ended or differential drivers for wide applications, and operates in asynchronous/synchronous modes matching system performance.

Kennedy Co., 1600 Shamrock Ave., Monrovia, CA 91016-4247, 818-357-8831. **Circle No. 281**

Floppy Disk Drives

Model SA310, Model SA310-16; 3.5-in. micro floppy disk drives have capacities of 1.0 Mbytes and 1.0/1.6 Mbytes, respectively; both list track density of 135 tracks per inch; SA310 has a recording density of 8717 bits per inch (bpi) and a data transfer rate of 250 Kbits per second; SA310-16 has a recording density of 8717/14,184 bpi and a data transfer rate of 250/500 Kbits per second.

Both drives feature lead screw activating head movement and accurate track positioning by a PM-type stepping motor; high-precision rotation is achieved using a direct-drive system with a brushless DC motor; custom CMOS gate arrays are incorporated.

Shugart Corp., 9292 Jeronimo, Irvine, CA 92718, 714-770-1100. **Circle No. 283**

Q-bus ESDI Disk Controller

ESV22; disk controller will interface most ESDI disk drives to the Q-bus using DEC MSCP emulation; supported under TSX-Plus and many versions of UNIX; available with a DEC RM03 and/or RM05 emulation; packaged on a single quad-height Q-bus printed circuit module; can handle disk drives with data rates up to 20 Mbits per second; implements seek optimization techniques and dynamic bad-

block replacement.

Unique proprietary double-buffering technique allows the ESV22 to operate at high data rates and store data without an interleave on most ESDI drives; $950.

Genroco Inc., 205 Kettle Moraine Dr. N., Slinger, WI 53086-9407, 414-644-8700.

Circle No. 284

Data Input and Display Devices

Data Acquisition Peripheral

IDAC/1000; data acquisition peripheral works with VAX computers over a standard RS-232 port at speeds up to 19.2 Kbytes; has a 32-Kbyte firmware operating system and will capture eight channels of single-ended or four channels of differential analog input; up to 16 channels of digital I/O are jumper-selectable for input or output in groups of eight; offers 12-bit analog/digital resolution and a maximum sampling rate of 3600 conversions per second (aggregate) within voltage ranges of ±10, ±5, ±2.5, 0-10, and 0-5 volts.

The IDAC/1000 supports Type J, K, and T thermocouples and has standard screw terminals for connecting field signals; mounting facilities provide for passive signal conditioning components; options are available to tailor the device to specific application requirements; $995.

International Data Acquisition + Control Inc., Four Limbo Ln., P.O. Box 397, Amherst, NH 03031, 603-673-0765. **Circle No. 285**

Bilingual VT220-Compatible Terminal

B3022; bilingual (Arabic/Latin) VT220-compatible terminal conforms to British standards BS5750 and 6204 and IEC standards IEC 435 and 950; provides all features offered by the DEC VT220/

100/52 terminals plus many extra features that enhance operation and improve performance; provides full ANSI X3.64, AMSO 449, and SASO 429 compatibility; has 14-in. amber or green screen with tilt and swivel and a height-adjuster option.

B3022 supports a wide range of printers such as Epson, Citizen, Star, and Brother, with on-board, downloadable Arabic Character Set; additional printers are supported.

Rocketfield Computer Systems, 86 Birch Hall Ln., Manchester M13 0XZ, U.K., 061-224-4032.

Circle No. 286

Manufacturing/ Industrial Control

TK50 Tape Duplication

ImageMaker; tape duplication system supports Digital Equipment Corp.'s TK50 .5-in. cartridge tape drive; in .5-in formats, it supports 800, 1600, 3200, and 6250 (GCR) formats; in .25-in. formats, it supports most quarter-inch compatibility formats; can be used with a SCSI host adapter for duplication of SCSI-compatible tape or optical drives; copies and verifies information in a single operation using simultaneous bit-map verification techniques; proprietary bus transport network allows high-speed parallel operation.

ImageMaker features powerful menu-driven software; proprietary utilities speed routine production tasks, while continuously updated displays let the user monitor copy production and drive status; with four TK50 drives and expanded hard disk drive storage $83,000; available 30 days ARO.

Applied Data Communications Inc., 14272 Chambers Rd., Tustin, CA 92680-6998, 714-731-9000. **Circle No. 287**

Robotic Disk Handler

CopyMaker Plus; multifunction robotic disk handler

for duplicating, printing, and labeling 3.5-in. diskettes is targeted at any volume diskette duplication application where a custom-printed and automatically applied label is required for each diskette; provides a way to support Macintosh and PS/2 computers that aren't directly connected to a VAX or VAXcluster; for double-sided, double-density Mac diskettes, the average throughput rate is 64 seconds with complete memory test and verification of copied data; without verification, throughput time is 31 seconds per diskette; average throughput rate for single-sided disks is 36 seconds with memory test and verification and 19 seconds without.

CopyMaker Plus interfaces to any Macintosh Plus/SE/II, IBM PS/2, and ADC DataLink high-speed duplication system; for printing labels, it uses an internal nine-pin dot-matrix printer capable of printing 15 lines by 23 characters per line of ASCII text; Macintosh-style wrap-around labels or flat labels can be used; labeler capacity is 1000 wrap-around labels or 1600 flat labels; $15,590.

Applied Data Communications Inc., 14272 Chambers Rd., Tustin, CA 92680-6998, 714-731-9000. **Circle No. 288**

Data Communications And Interconnects

Long Distance Line Printing

RDS100T, RDS110R; allow placement of high-speed line printers 1000 feet from the line printer driving device, with no modifications to existing hardware or software; compatible with all Dataproducts parallel I/O and Centronics parallel I/O printers and use standard cabling.

Remote Data Systems, 589 Pearl Harbor St., Bridgeport, CT 06610, 203-384-0553.

Circle No. 289

Network CD ROM Drives

CD Net, CD Server; enable multiple CD ROM drives and databases to be integrated into a LAN; both products can be configured for token ring, Ethernet, and ARCNET, and support Novell and MS Net software.

CD Net is for small-to-medium-sized LANs and features three half-height 5.25-in. slots, a network board with an 8088 microprocessor, integration/operation software, and a power supply all integrated into one cabinet; software is downloaded from PROM; each storage device appears as a logical drive on the network; by installing hard disk storage, end users benefit from improved performance, a by-product of the system's caching software; seven CD Nets can be daisy-chained in a single LAN configuration.

CD Server is for medium-to-large-sized LANs and LAN environments that require Winchester-like access to CD ROM databases; combines the same features in CD Net with additional computing capabilities; can process incoming data from all sources on the LAN; includes six half-height 5.25-in. slots, a network board with a 286 or 386 microprocessor, integration/operation software, and

a power supply; one slot must hold a floppy disk drive because software is downloaded from floppy disks; can be configured with up to 2.4 Gbytes of hard disk space; CD Net $2,995; CD Server (with 40 Mbytes of hard disk space) $5,995.

Meridian Data Inc., 4450 Capitola Rd., Ste. 101, Capitola, CA 95010, 408-476-5858.

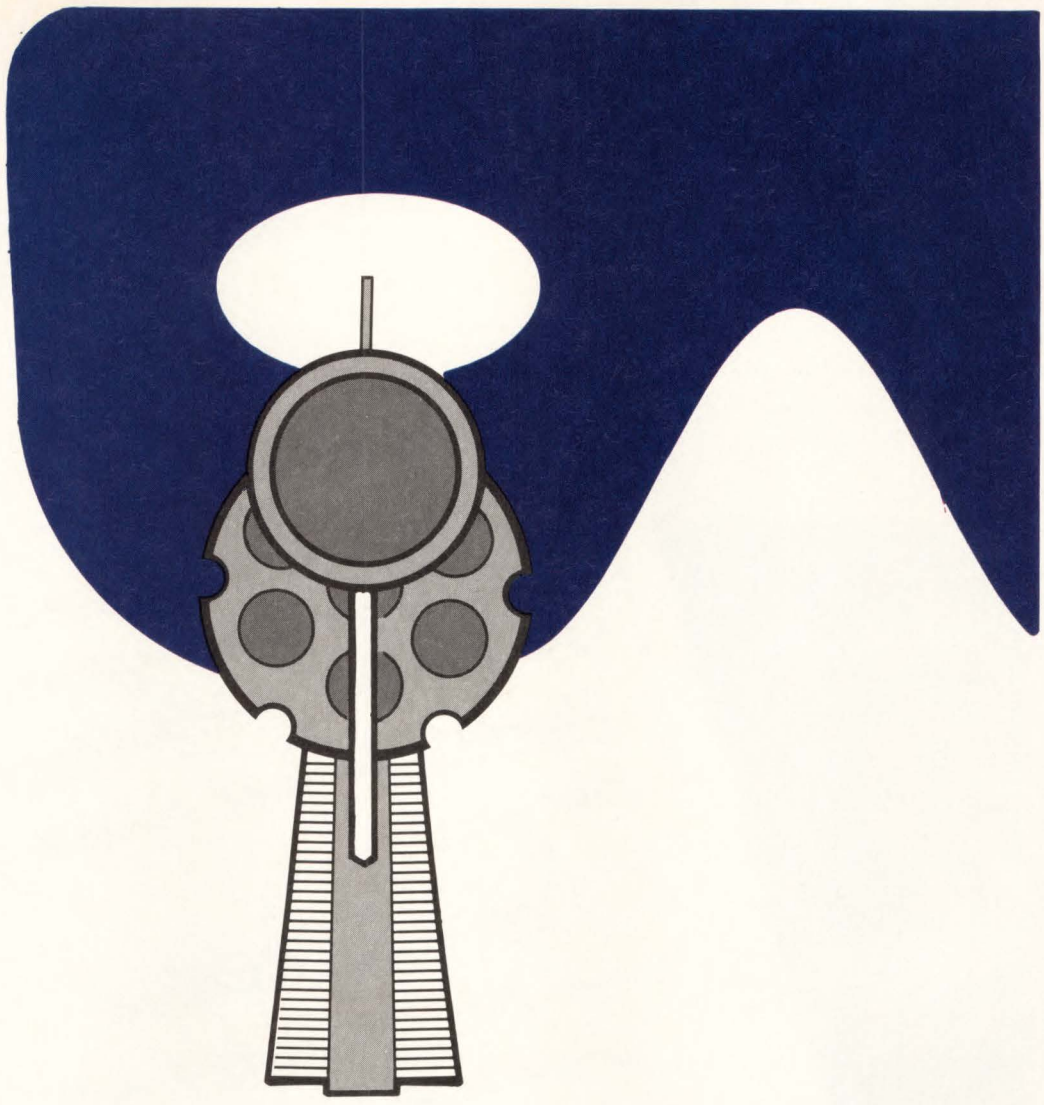
Circle No. 290

Out-Dial/Dial Backup Device

EM-2410; extended capability version of the EM-2400 Integrated Modem/Pad provides synchronous X.25 out-dial/dial backup capability; acts as an X.32 synchronous autodial modem that is compatible with any V.22, Bell 212A, and V.22 bis modem and meets CCITT X.25, X.32, X.28, X.29, and X.3 standards; can connect to the backup network port of an X.25 Pad.

If the primary lease line

VMS SOFTWARE DEVELOPERS



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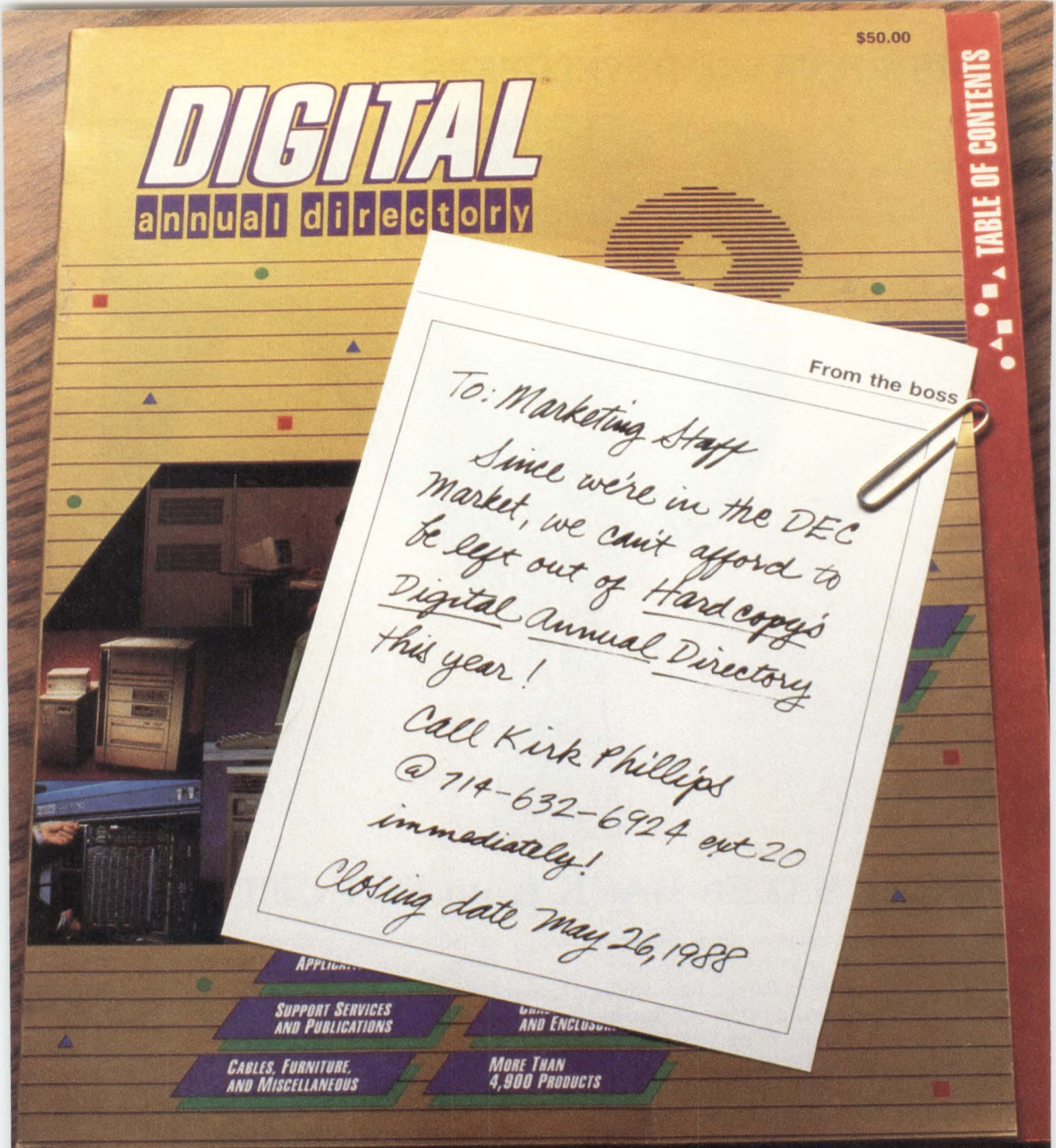
CIRCLE 396 ON READER CARD



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connection fails, the EM-2400 is immediately kicked into action by the next call request from the Pad, and then a dial connection is established and data transfer takes place over the dial backup line; no operator intervention is required and the operation is completely transparent to the connected users; in a packet switched data network environment, it provides out-dial capability, wherein, on receipt of the call, the EM-2410 automatically dials out to the remote user and establishes an X.25 session; $845; available now.

Emucom Inc., 25 Industrial Ave., Chelmsford, MA 01824, 617-256-9871.

Circle No. 291

Fiber Optic Channel Extenders

FL2000 (up to 2000 meters), FL5000 (up to 5000 meters); fiber optic channel extenders attach control units, switching units, and channel-to-channel adapters to byte and block multiplexer channels of IBM and IBM plug-compatible processors; both units come in two models: Standard Performance (SP) model features approximately 43 Kbytes per second at a distance of two kilometers and 60 Kbytes per second at one kilometer, and High-Performance (HP) model features 1.4 Mbytes per second (11.2 Mbps); $17,500–$44,500.

Network Systems Corp., 7600 Boone Ave. N., Minneapolis, MN 55428, 612-424-4888. **Circle No. 292**

Multibus for UNIX System V. 3

NP322; Multibus network protocol processor for the UNIX System V. 3 environment provides a full set of tools for TCP/IP processing; comprised of an 80136 microprocessor, 82586 LAN coprocessor, and 512 Kbytes of resident RAM on a single-slot Multibus I interface card; acts as an intelligent, high-performance front-end processor by incorporating all of the TCP/IP functions on the card.

NP322 fully supports Streams and AT&T's Remote File Sharing features for UNIX System V. 3, as well as Telnet, FTP, and R-utilities network services; includes a C-callable socket interface library that allows users to port and develop network applications under Berkeley 4.2; $2,190; available now.

Micom-Interlan, 155 Swanson Rd., Boxborough, MA 01719, 617-263-9929.

Circle No. 293

Statistical Multiplexer Networking

SPL Hub; allows multiple SPL multiplexers to share a single communications line and is available in two-, four-, and six-port versions; remote "Hub" sites can be star or in-line configurations; synchronous or asynchronous modems can be used on the tail circuits behind the remote Hub; remote setup of SPL multiplexers is supported through remote Hub locations; $1,095.

Data Comm for Business, 807 Pioneer, Champaign, IL 61820, 800-637-1127 or 217-352-3207 in IL.

Circle No. 294

Graphics

Graphics Software

Adobe Illustrator 88; PostScript-based product assists both the professional and the novice artist in producing high-quality drawings; features a free-hand drawing tool; new features include color, a blending (or interpolation) tool, resolution-independent pattern fills, and masking; creates on-screen color images and color separations for output to a PostScript typesetter.

The Adobe Illustrator 88 blending tool allows the user to dynamically create effects such as highlighting, contouring, airbrushing, and shading, and can also be used to blend (or interpolate) shapes and line weights; pattern-fill feature provides the user with the ability to create PostScript patterns; masking tool enables the user to create

a window of any desired shape and whatever design is behind it will show through; $495; available now.

Adobe Systems Inc., P.O. Box 7900, Mountain View, CA 94039, 415-961-4400.
Circle No. 295

Systems Security, Power Conditioners/Supplies

Power Protection Equipment

PurePowrII, PowrTap, FerroPowr, PowrShield, SuperShield, PowrShare, PowrWatch, PowrConverter; PurePowrII is a solid-state power line conditioner that offers ±1% regulation over a +10 to -20% input range of nominal output with 97% efficiency; power ratings range from 5 to 50 kVA, single phase, and 7.5 to 1000 kVA, three phase, at all standard line voltages to 600 volts; features easily adjustable output voltages.

PowrTap is a solid-state power line conditioner that offers high speed, high efficiency, and low distortion for applications that don't require regulation any tighter than 5%—3% accuracy is available as an option.

FerroPowr is a line of ferroresonant power conditioners; PowrShield and SuperShield are shielded isolation transformers for applications where noise reduction is more important than regulation; PowrShare is a line of power distribution centers; PowrWatch is a comprehensive power center system status monitor and PowrConverter is a line of solid-state 400/415 Hz frequency converters.

Rapid Power Technologies Inc., Graysbridge Rd., Brookfield, CT 06804. 203-775-0411. **Circle No. 296**

Track User Access

Box Office; tracks the number of people using a software application program and prevents user access beyond a predetermined limit set by the software developer; is an external subroutine that works with any programming language supported by VMS: continues to operate correctly even if the program being protected crashes or is interrupted; is totally transparent to the user and can be easily incorporated into existing programs; controls program access across a VAXcluster network.

Box Office eliminates cluster piracy by preventing software from being copied repeatedly to the various CPUs on the cluster; addresses problem of collecting upgrade fees when users advance to larger CPUs because software developers can charge users only for software used; $695.

Owen+Davis Systems, 3100 Airway Ave., Ste. 116, Costa Mesa, CA 92626, 714-540-8878. **Circle No. 297**

Failed H7100 Trade-Ins Accepted

Marway will accept failed DEC H7100 VAX 11/780 power supplies as trade-ins on its MPS 7100 replacement supply; substantial price reduction is available; 7100s are available now.

Marway Products Inc., 311 N. Clara St., Santa Ana, CA 92703. **Circle No. 298**

UPS for Multiple Microcomputers

Lifeline II; uninterruptible power system (UPS) features pulse width modulated technology for a quiet, reliable, efficient UPS; provides battery back-up for up to 25 minutes and has a built-in power conditioner delivering filtered, regulated AC sine wave power at all times—

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POWER IV			
STANDARD SYSTEM	380 MEGABYTES	9 MEGABYTES	16
EXPANDED SYSTEM	1.52 GIGABYTES	17 MEGABYTES	64
POWER VI			
STANDARD SYSTEM	720 MEGABYTES	17 MEGABYTES	32
EXPANDED SYSTEM	2.88 GIGABYTES	17 MEGABYTES	64

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- ☐ Emulex, Dilog & Spectralogic Controllers

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VIDEO TERMINALS • ADD-IN MEMORY • PRINTERS • LASER PRINTERS

CIRCLE 467 ON READER CARD

Lifeline II is always on-line; capacity is 1000W.

Lifeline II features battery charge status and output power status displays and alarms; internal batteries are maintenance free; additional exterior batteries provide longer run times; 28 x 10 x 22 in.; $2,780.

ICS Inc., Electro-Pac Division, 520 Interstate Rd., Addison, IL 60101, 312-543-6200.

Circle No. 299

Systems Software

Language Family

Microsoft C Optimizing Compiler V. 5.1, Macro Assembler V. 5.1, BASIC Compiler V. 6.0, FORTRAN Optimizing Compiler V. 4.1, and Pascal Compiler V. 4.0; include the Microsoft Editor, CodeView, data browsing, and math libraries; support inter-language calling and very large program development in OS/2 environments.

C Optimizing Compiler V. 5.1 supports creation of dynamic link libraries and multi-thread, multiprocess applications under OS/2; includes in-line code generation for commonly used functions, removal of invariant code from loops, automatic register allocation within loops, and constant folding.

Macro Assembler V. 5.1 is 15% faster than V. 5.0; fully supports the 80386/387 instruction set and 80386 segmentation; interface to high-level languages has been simplified.

BASIC Compiler V. 6.0 offers customizable runtime libraries, selective runtime library linking, user-defined event trapping, and inter-module error handling.

FORTRAN Optimizing Compiler V. 4.1 is GSA-certified as being an error-free implementation of ANSI 77 FORTRAN; offers full OS/2 support, code optimization identical to that of Microsoft C, inter-language calling, and memory model support.

Pascal Compiler V. 4.0 features full OS/2 support, very large program support, and built-in utilities.

C Optimizing Compiler V. 5.1 $450; Macro Assembler V. 5.1 $150; BASIC Compiler V. 6.0 $295; FORTRAN Optimizing Compiler V. 4.1 $450; Pascal Compiler V. 4.0 $300; all available now.

Microsoft Corp., 16011 N.E. 36th Way, P.O. Box 97017, Redmond, WA 98073-9717, 206-882-8080.

Circle No. 258

Disk Defragmenter For VAXstation 8000

Diskeeper; on-line disk defragmenter keeps VAXstation 8000 disks from becoming fragmented and impacting processing capabilities; eliminates the fragmentation of files to allow data to be read at maximum speed while also grouping free space at the front of the disk for efficient and contiguous creation of new files; $249–$3,250.

Executive Software Inc., 3131 Foothill Blvd., Ste. F, La Crescenta, CA 91214-2699, 800-346-4707 or 818-249-4707 in CA.

Circle No. 301

File Compression/Expansion

FCX V. 1.0; file compression/expansion utility for use in VAX/VMS environments streamlines file-transfer operations; can substantially

reduce the time and cost normally required to transfer files over local and wide area networks, as well as save disk space; permits one or more files of any type or size to be compressed into a single file, with space savings ranging from 30–70%; files can then be selectively expanded from the compressed format file to their original size; file transfers can be accomplished faster and at less cost by compressing at the sending node, transferring the compressed format file, and then expanding at the receiving node; multiple file transfers can be accomplished in a single transfer operation, resulting in reduced network traffic.

FCX supports compression and expansion of directories and directory trees, file selection by type and date, preservation of file characteristics and protection information, and full use of wild cards; available now.

Innovative Computer Systems Inc., 72 Crooked Ln., Cherry Hill, NJ 08034, 609-779-1422. **Circle No. 302**

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Clear for dBase, V. 1.0; produces high-quality system documentation and clarifies the logic of dBase programs and applications; reads the source code of any dBase application and instantly produces the system tree chart, program flow charts, and formatted source listings; flow and tree charts can be output to a printer, screen, or file; automatically calculates the spacing, number of pages (or screens) required, and the placement of symbols for the flow chart; output to the screen uses a WYSIWYG approach; flow chart screen output is interactive.

Clear for dBase, V. 1.0 features powerful hardcopy controls, including background printing and optional HP LaserJet printing capabilities, and an option to run any DOS command; $99.95+.

Clear Software Inc., 637 Washington St., Ste. 204,

Brookline, MA 02146, 617-232-4720. **Circle No. 303**

IBM/DEC Connectivity

System/370 Linked to VAX

Enhanced FastPath; control unit can now connect an IBM System/370 simultaneously to a TCP/IP network, as well as to either a DEC VAX, a MAP/OSI network, a custom Ethernet network, or ASCII devices; connection to the VAX is through the high-speed DR11W/DRB32W interface; $35,000–$90,000.

Intel Corp., 3065 Bowers Ave., P.O. Box 58065, Santa Clara, CA 95052-8065.

Circle No. 304

Software Links VAX/MicroVAX To IBM DOS/VSE/Power

ezSNA/RJE; provides IBM 3777-4 SNA/RJE workstations functionality to VAX and MicroVAX systems; is a complete RJE subsystem for the VAX; uses standard DEC interface hardware; can operate on a single VAX system or, with its RJEnet option, provide RJE and file/transfer services to several VAX systems in a DECnet network and/or on a VAXcluster; MicroVAX 3000 and VAX $7,500; MicroVAX II $3,750.

Datanex Inc., P.O. Box 1728, Eugene, OR 97440, 503-687-2520. **Circle No. 305**

Enhanced CommUnity-DOS

CommUnity-DOS V. 3; allows users to share computer resources, applications software, data, and peripherals on a DECnet Phase IV Ethernet network; enhancements include compatibility with DEC's VAX/VMS Services, File Access Listener (FAL), and support for Ultrix and RSX-11M computers on a DECnet Ethernet network; package including CommUnity-DOS software, media, and documentation, and an intelligent Ethernet controller is priced less than $1,000.

Technology Concepts Inc., 40 Tall Pine Dr., Sudbury, MA 01776, 617-443-7311.

Circle No. 306

IN THE QUEUE

The following products have been received by *Hardcopy* for review or HOW evaluation.

Access Technology Inc.
South Natick, MA
Product: 20/20
Status: At review

Adobe Systems Inc.
Mountain View, CA
Products: Adobe Type Library for IBM (1—Palatino, 9—ITC Garamond, 15—Trump Mediaeval); Adobe Type Library for Macintosh (Newsletters, Publishing Pack 1); Adobe Illustrator for Macintosh
Status: In HC/WG Lab

Aldus Corp.
Seattle, WA
Product: Pagemaker for Mac
Status: In HC/WG Lab

CIE Systems
Irvine, CA
Product: CI-2500 Dot-Matrix Printer
Status: At review

Data Technology Corp.
Santa Clara, CA
Product: Crystall Print VIII
Status: At review

Golden Bow Systems
San Diego, CA
Product: Vopt Disk Orgainzer
Status: At review

Jyacc Inc.
New York, NY
Product: Jam V. 3.1 Development Environment
Status: At review

Lightgate
Oakland, CA
Products: Felix; Post-mouse
Status: At review

Meridian Software Systems Inc.
Laguna Hills, CA
Product: AdaVantage Compiler
Status: At review

Microsoft Corp.
Redmond, WA
Products: Microsoft Works for IBM PC; Microsoft Pageview
Status: At review

Modgraph Inc.
Burlington, MA
Product: GX-2000 Graphics Terminal
Status: At review

Monolithic Systems Inc.
Englewood, CO
Products: 386 Motherboard; Memory board; Multiport board
Status: In HC/WG Lab

Procyon Computer Systems
Torrance, CA
Product: Star Draw for VAX
Status: In HC/WG Lab

Rational Systems Inc.
Natick, MA
Product: Instant C/16m for IBM PC
Status: At review

The Santa Cruz Operation
Santa Cruz, CA
Product: SCO Xenix OS
Status: At review

Soricon Corp.
Boulder, CO
Product: Datasweep 1 PC Scanner
Status: At review

Techpower Inc.
Santa Ana, CA
Products: Everex System; System 1800
Status: In HC/WG Lab

Traveling Software
Bothell, WA
Products: LapLink Plus; Desklink Communication Software
Status: At review

VM Personal Computing
Danbury, CT
Products: Beyond.BAT; Relay Gold
Status: At review

White Crane Systems
Norcross, GA
Product: The Brooklyn Bridge Communications Program
Status: At review

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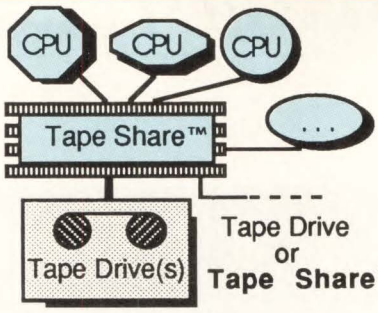

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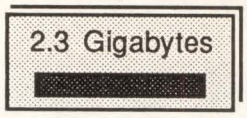

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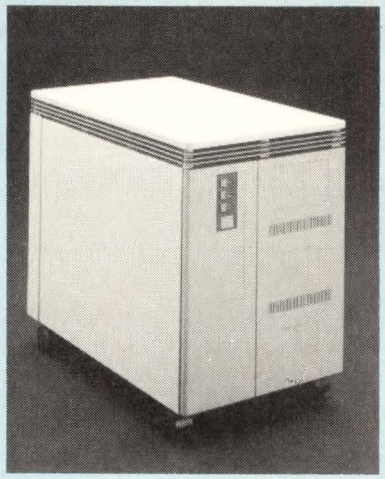

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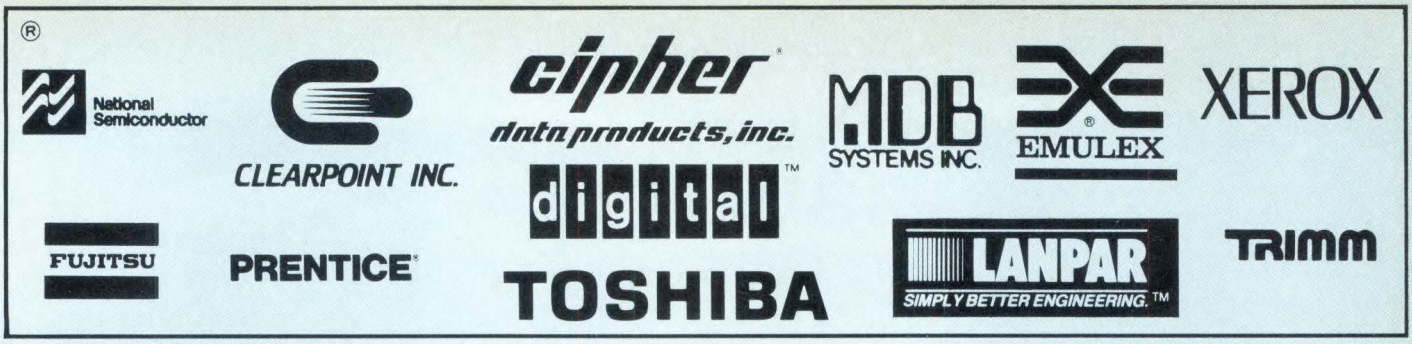

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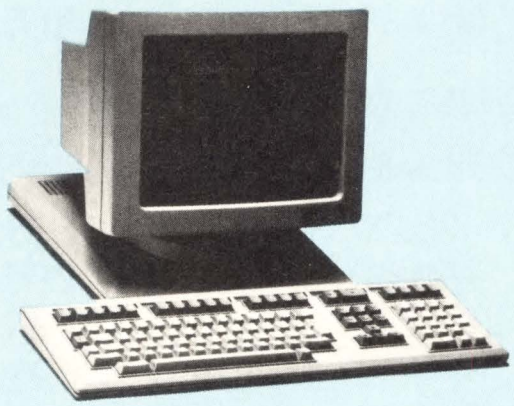

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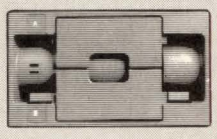

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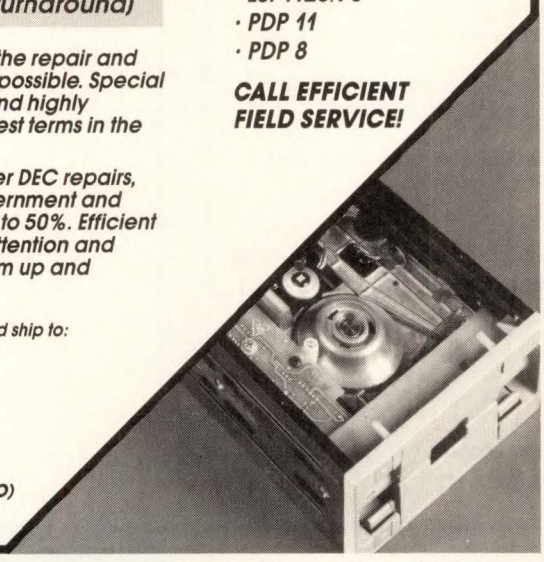

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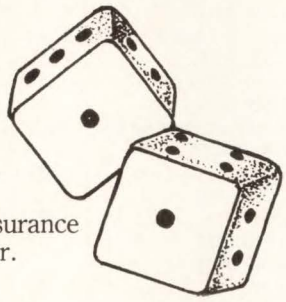

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CALENDAR

BY KIMBERLY SCHULZE, Associate Editor

IN THE SPOTLIGHT

A half-day workshop covering the security aspects of VAX-to-Macintosh networking is one of the highlights of Computer Security Institute's "Two Computer Security Conferences in One" for DEC and IBM users. It is being held June 13–15 at the Marriott Crystal Gateway in Arlington, VA.

The conference addresses the security concerns of three groups—users of DEC systems, users of IBM systems, and users of *both* DEC and IBM systems. A heavy emphasis will be placed on network security, including a session featuring a live demonstration of new Ethernet enhancements. Other highlights include sessions on comparing and integrating security in DEC and IBM systems; workshops on security for UNIX, XENIX, VAX/VMS, MVS, and VM systems; DEC's TEMPEST program (for controlling electromagnetic emanations); "mandatory security controls" as defined by the Department of Defense; and the security and audit experiences of Bankers Trust Co., the financial world's largest DEC user.

You can choose six workshops—any two from the 13 offered each day. Every workshop is given twice, so you shouldn't have too much trouble with the struggle over which seminars to attend. Because so many companies have multi-vendor installations, you will have unlimited crossover privileges between the IBM-specific, DEC-specific, and IBM/DEC hybrid workshops. Optional full-day security seminars will be offered Sunday, June 12th, and Thursday, June 16. And on Monday, you can even take a ($28) twilight champagne tour of Washington.

JUNE

1–3—Data Communications Network Design and Optimization; Detroit; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590; also June 20–22 in San Francisco.

1–3—Using a Data Base in a Distributed Processing Environment; San Francisco; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590; also June 13–15 in New York.

5–8—Expert Communication 88; San Jose, CA; contact the Graphic Communications Association, 1730 N. Lynn St., Ste. 604, Arlington, VA 22209-2085, 703-841-8160.

6–8—Evaluating and Implementing Local Area Networks; Los Angeles; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590; also June 27–29 in Atlanta.

6–8—Voice/Data Integration and ISDN; Denver; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590; also June 20–22 in San Francisco.

6–10—Strategic Planning for Database/Logical and Physical Design for RDBMS Featuring DB2 Case Studies; Toronto; contact Digital Consulting Inc., 6 Windsor St., Andover, MA 01810, 617-470-3880.

7–9—Information Engineering: Disciplines for Building Data Sharing Systems; Boston; contact Digital Consulting Inc., 6 Windsor St., Andover, MA 01810, 617-470-3880.

8–10—SNA—IBM's Systems Network Architecture; New York; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590; also June 27–29 in San Francisco.

9–10—Connectivity for Personal Computers; Los Angeles; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590; also June 30–July 1 in Atlanta.

13–15—Micro-to-Mainframe Links, PC Networks and Connectivity; Chicago; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590; also June 29–July 1 in Minneapolis/St. Paul.

13–15—Relational Data Base Management Systems: A Comparative Analysis; Washington, DC; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590.

13–15—Two Computer Security Conferences in One; Arlington, VA; contact the Computer Security Institute, 360 Church St., Northborough, MA 01532, 617-393-2600.

14–17—Data Communications: Components, Systems, and Networks; Chicago; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590; also June 28–July 1 in Pittsburgh.

15–17—Building Expert Systems—Applied Artificial Intelligence; Chicago; contact The Institute for Professional Education, P.O. Box 756, Arlington, VA 22216, 703-527-8702.

15–17—Data Communications and Information Systems Security; Atlanta; contact the Institute for Advanced Technology, Registrar (ETCIAT), 1450 Energy Park Dr., St. Paul, MN 55108-5299, 800-638-6590.

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23–24—Systems Application Architecture; Boston; contact Digital Consulting Inc., 6 Windsor St., Andover, MA 01810, 617-470-3880.

Bus Stop

MAKING EVERYTHING FIT

Software vendor Computer Associates International Inc. (Garden City, NY) is on a marketing blitz announcing its commitment to the DEC marketplace. Coupled with the introduction of Masterpiece/ABS (Advanced Business Software), a modular line of financial software for VAX/VMS systems, the 12-year-old company outlined a multiple-level strategy that focuses on distinct levels of user sophistication, avoiding what Robert W. Mendyk, the company's national marketing manager for DEC VAX application products, calls a one-size-fits-all approach used by other software vendors. And, what the heck, we like their television ads. . . .

CABLING FOR FUN AND PROFIT

Everyone talks about the idea of having a homogenous method of integrating diverse network cables, but very few do anything about it. One company, Cabletron Systems Inc. (Rochester, NH), has come across with a good idea that it calls the Multi-Media Access (MMA) Center. This nifty box has from two to eight card slots that can support unshielded twisted pair, fiber optic, RG-58 coax, and standard AUI transceiver cable connections. The nice thing about the MMA is that it can be configured as a wiring closet . . . that may make your wiring stand a little taller or at least vertical.

COGNOS TAKES A POWERFUL LEAP INTO THE PC ARENA

If you've grown to know and love PowerHouse, Cognos Inc.'s (Ottawa, Ontario) fourth-generation language, brace yourself. The power of PowerHouse is now at your disposal on an IBM PC/AT or compatible 286/386 machine. The introduction of PowerHouse PC catapults Cognos into the PC workstation market. But can PowerHouse PC live up to the reputation established by its minicomputer-only big brother? Cognos thinks so. The company claims that PowerHouse PC includes all the standard PowerHouse modules and more: data dictionary, dictionary reporter, screen design and data input program, volume transactions processor, and report writer. The company also claims that PowerHouse PC lets you use your PC to run more time-consuming operations. This means freeing up the more expensive CPU cycles on mid-range machines. Sounds impressive. Move over big brother.

PLUGGABLE OBSCENITIES

Just when we thought we had covered the landscape of pluggable disk drives (see "Quick-Disconnect Subsystems: The New-Generation Disk Packs, *StorAGE,* page 8, April 1988), IBM announced its Model 6156, available this June. The Portable Disk Drive is for attachment to certain models of the PC/RT. The 6156 Model 001 can receive one IBM 114-Mbyte (formatted) module while the Model 003 accommodates two modules. Both models have internal universal power supplies; their operator interface includes a power on/off switch, a module latching mechanism, and a drive-ready indicator. Pricing seems almost obscene, however. The Model 6156 is $4,595 and the Model 003 is $5,095, which includes one 114-Mbyte module. Additional modules are available at $3,895. An $850 adapter card, functionally equivalent to an enhanced small device interface adapter, attaches the subsystem to the RT.

IBM thus joins the several manufacturers offering the advantages of removability by making a Winchester drive pluggable. The product is rumored to be the same basic mechanism as the 115-Mbyte disk drive sold with the PS/2 Models 60 and 80.

IT EVEN DOES ENVELOPES

Dataproducts validated the ad hoc standard status of PostScript, the page description language from Adobe Systems (Palo Alto, CA) when it rolled out its newest, fastest laser printer, the LZR 1260. In its roll-out of the 12-page-per-minute printer, Dataproducts touted its speed and the fact that it offers "true" PostScript, not one of the clone products that have been popping up in increasing numbers, noting that Adobe invented PostScript and that clones can't match it in quality. Hewlett-Packard LaserJet+ emulation is available for printing non-PostScript software. Its triple interface—RS-232, AppleTalk, and Centronics—makes the printer useable with virtually any computer. A particularly attractive feature for its targeted office and commercial markets is an optional, high-capacity envelope feeder.

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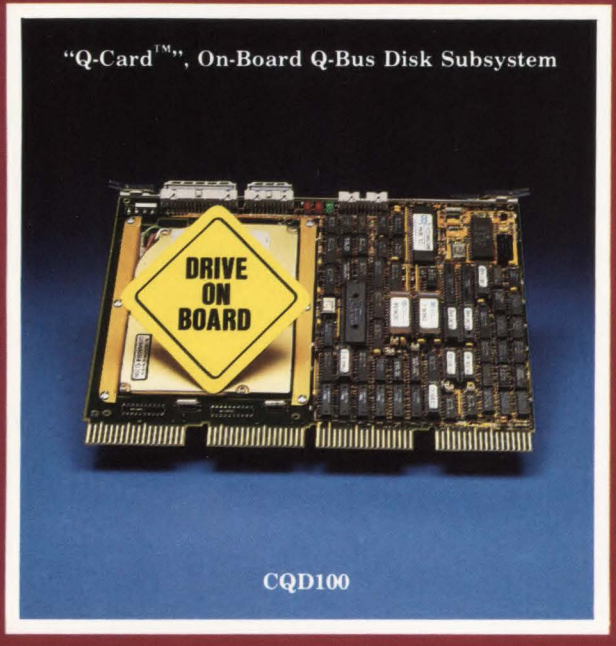

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