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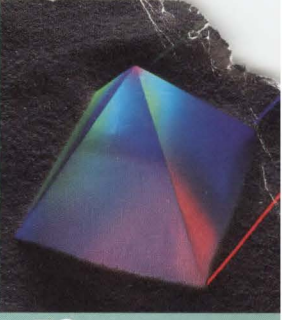

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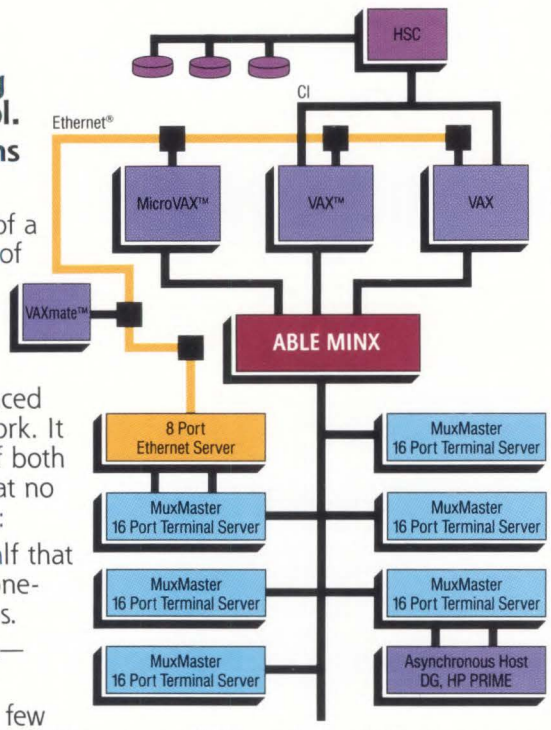

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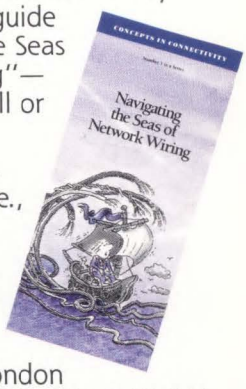

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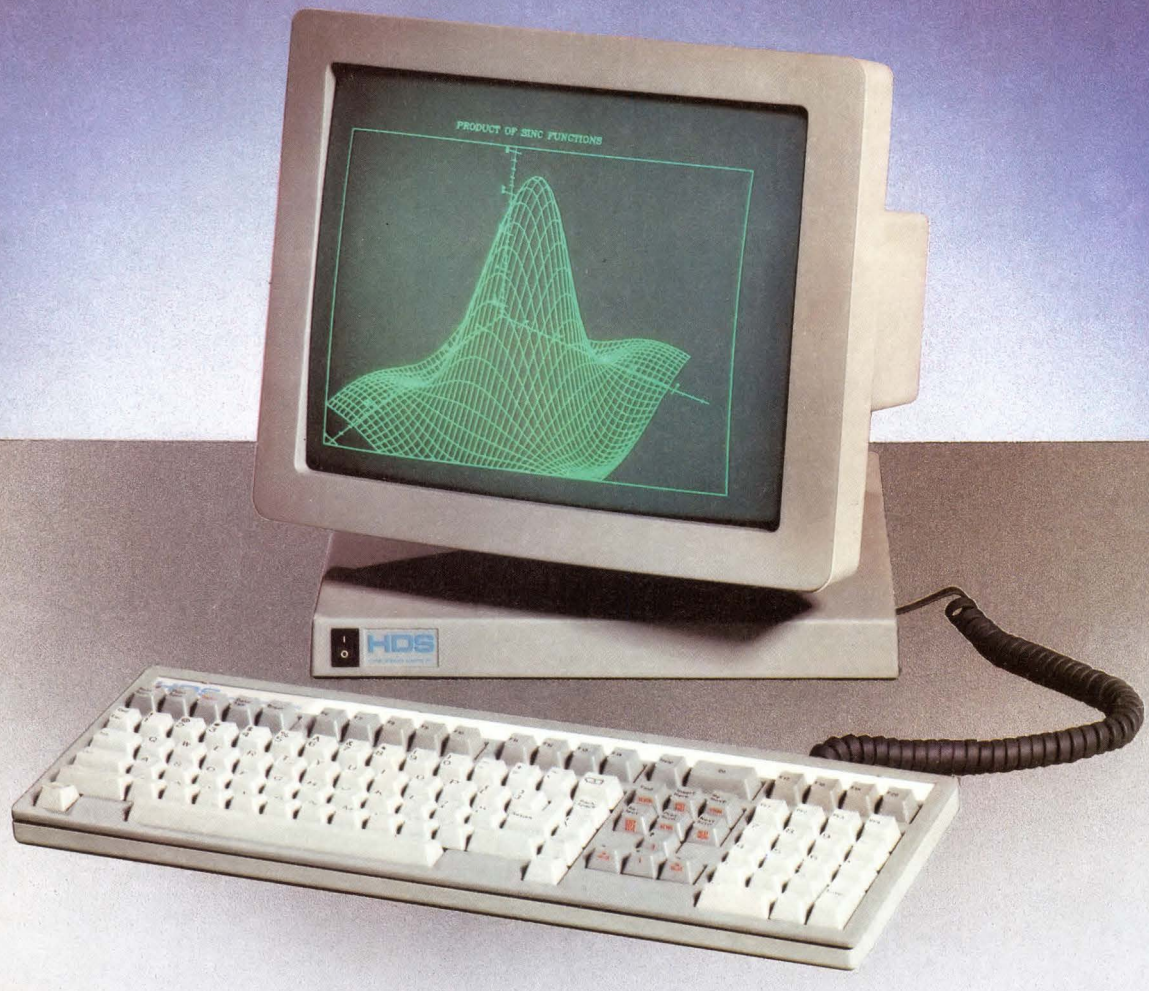

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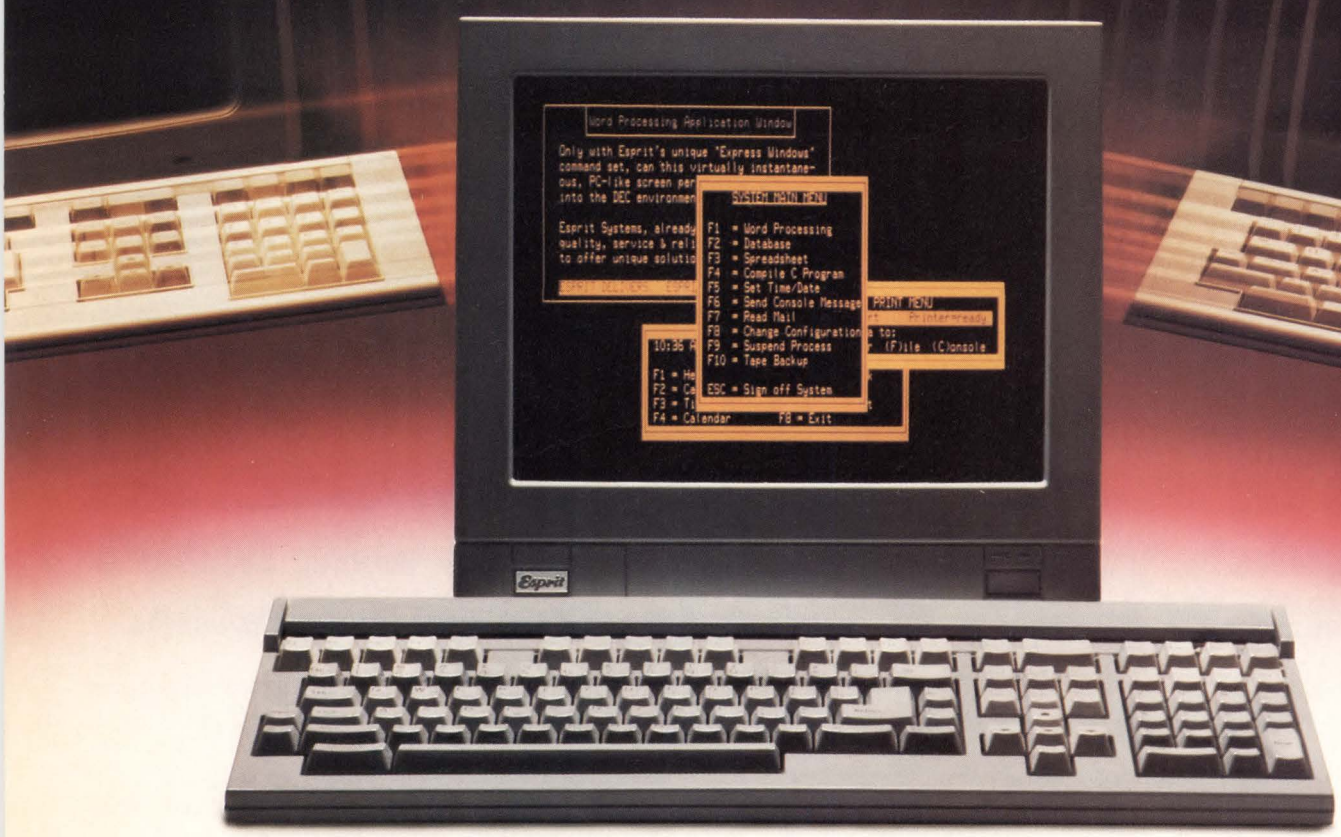

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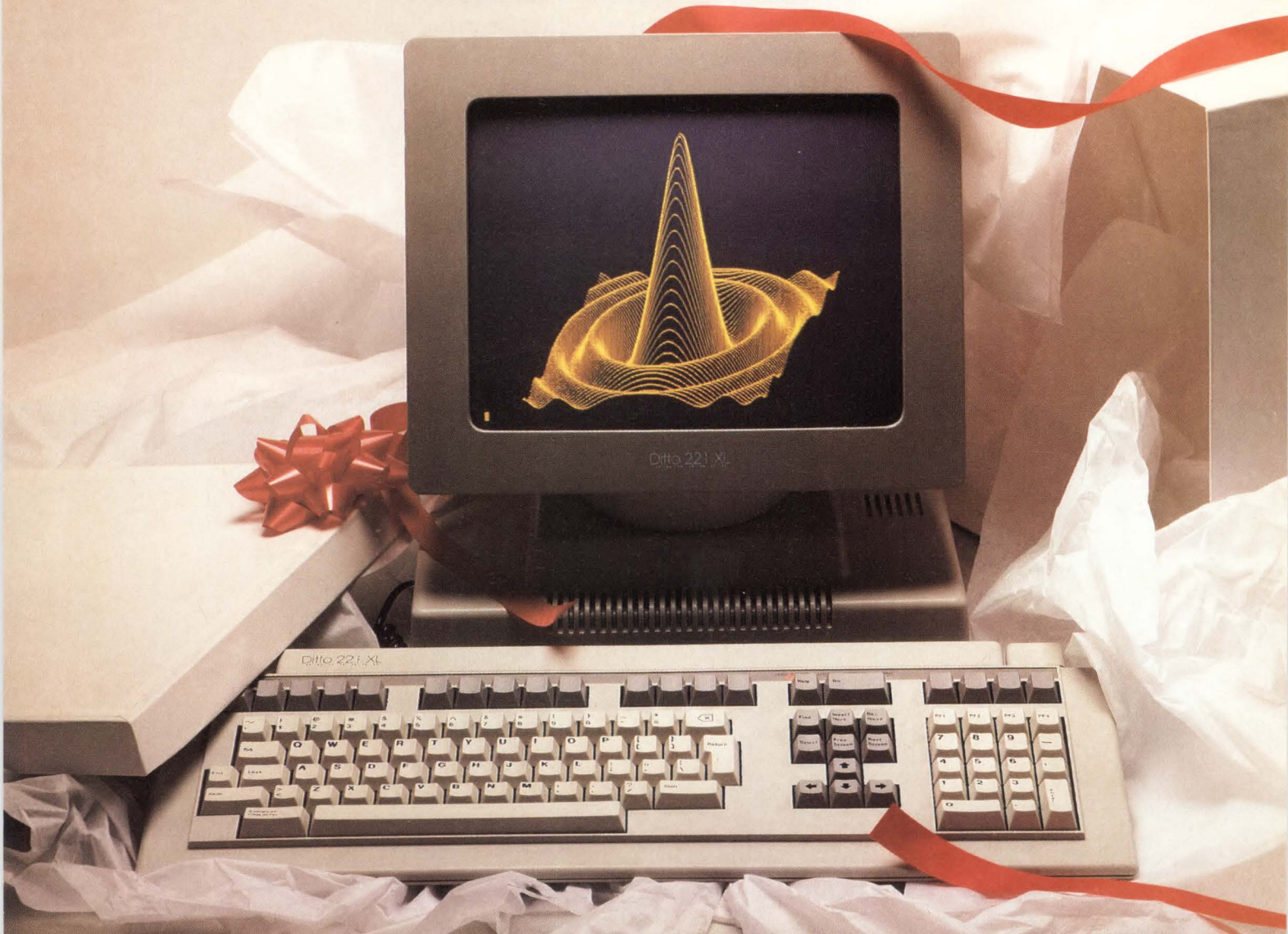

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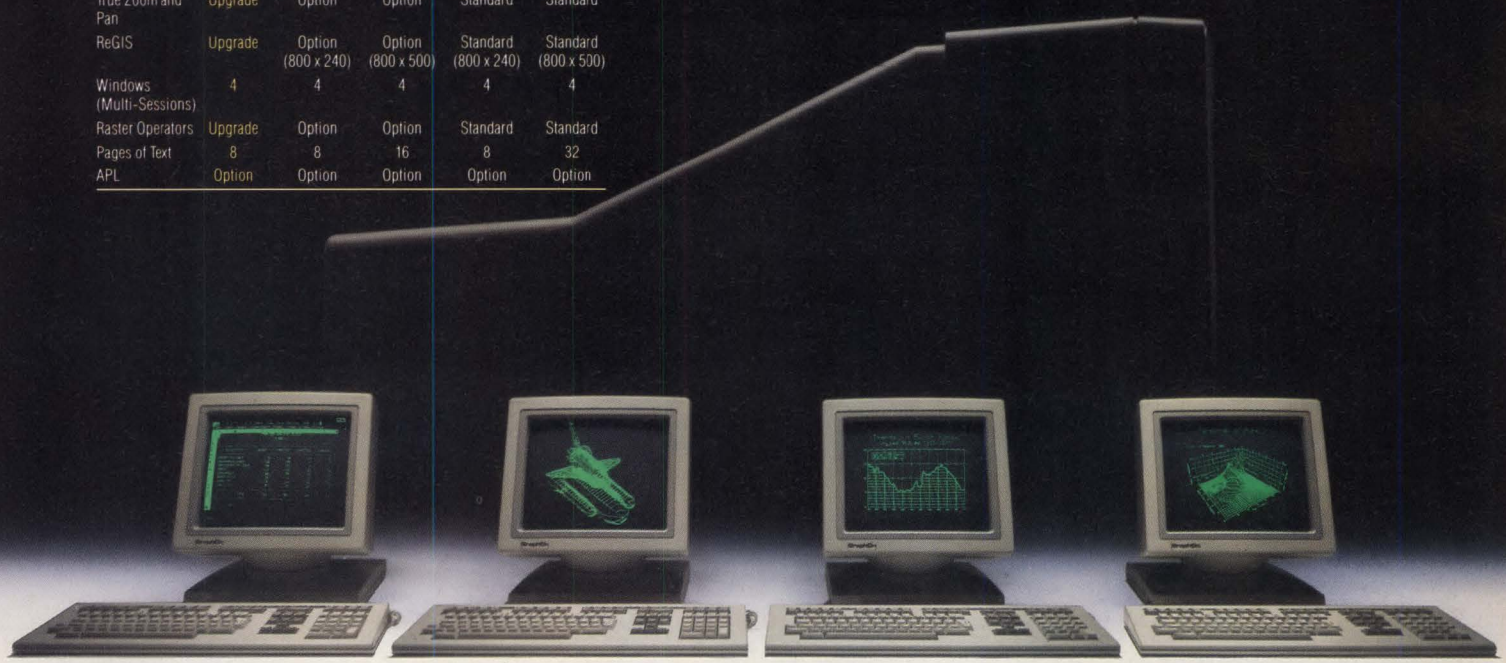

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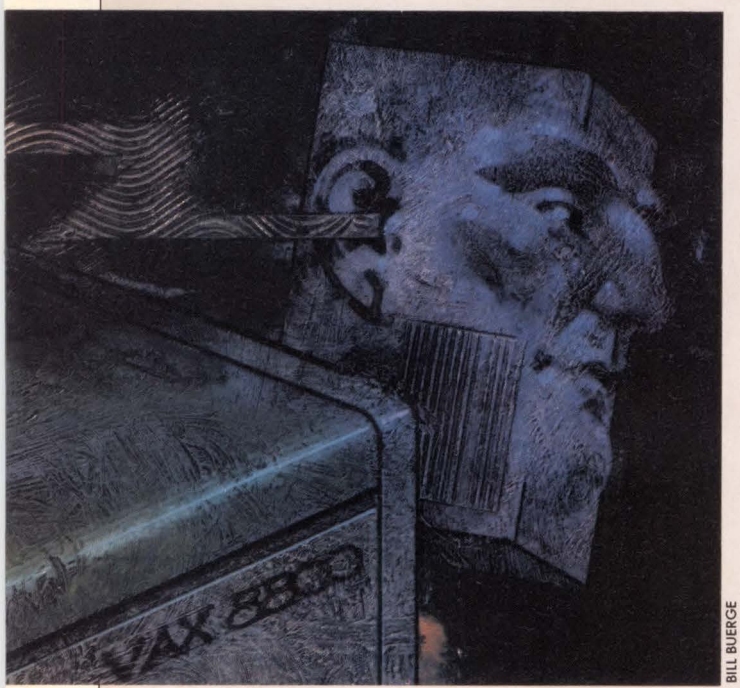

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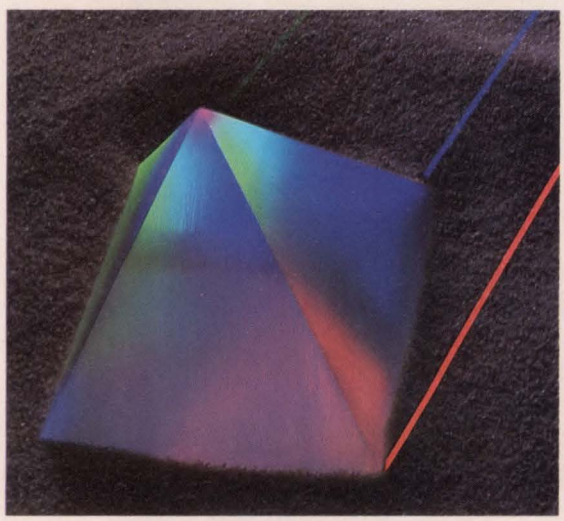

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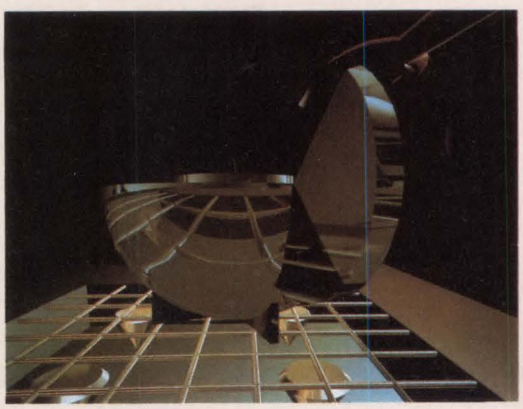

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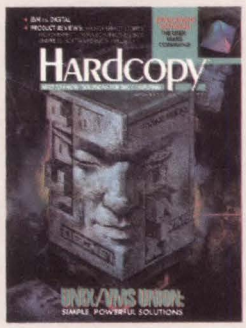

This month's cover, the work of Southern Calif.-based artist Bill Buerge, illustrates the quiet coexistence of multiple industry standards possible in the Digital environment using third party solutions.

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Why Digital Should Acknowledge The Mac

The Macintosh is making serious headway into Digital Equipment Corp.'s major computing sites. Thus far, the driving force behind Mac-to-VAX connectivity has been either Apple's third party or startups, but some of the manufacturers from the Digital industry—such as Technology Concepts and Excelan—are active as well.

The growing legion of these communications hardware and software producers have developed bidirectional file transfer capabilities, virtual disk functionality, and VT terminal emulation programs for the Mac, and gateways that allow AppleTalk networks to connect with Ethernet. The Mac can now participate as a node on implementations of DECnet. The market has been bombarded with more than a dozen new companies offering Mac-to-VAX solutions.

Much of the momentum for the trend has been the growing acceptance of the Mac by engineers. The Mac is one of the application development machines of choice for many designers. Macs and VAXes are already online together on the huge Ethernets at GTE, Hughes Aircraft Co., McDonnell Douglas, and Lawrence Livermore Labs. A division at DuPont is tossing its VT100s and VT240s in favor of the Mac. The U.S. Navy, historically a strong Digital user, has placed a large order for Macs, and will integrate them into its Digital environment. Government agencies are also high-quantity buyers of Macs.

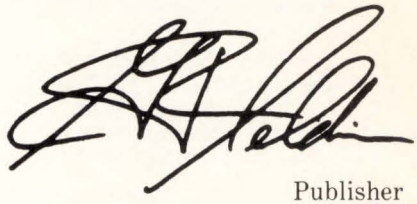
The inclusion of the Macintosh into Ethernet systems makes these Digital environments that much stronger. It's an integration of systems that make sense together. Each is the most accepted solution in its area of the industry. If a systems designer prefers front-ending his VAX computing with a Mac, he now has the freedom to make that choice.

Nevertheless, Digital is aware that the relationship could result in competition with Apple. Not only is the Mac an alternative to Digital terminals, but it could eventually replace VAXstations and MicroVAX 2000s.

This should not be the primary concern, however. In the long run, it will be to Digital's advantage to support the union of these two snowballing technologies. Apple is supportive. At Mac World in Boston last month, Apple's Peter Hirschberg said that the Mac is a fabulous device to work into a DECnet. He also said that Apple has thrown more marketing into Digital connectivity than IBM connectivity.

Without question, the Apple third party, which has a close relationship with Apple, would like to get some form of support or stamp of approval from Digital as well. There are indications that an official statement is coming soon from Digital, acknowledging that the VAX/Mac marriage is a viable alternative. At its ACT in Atlanta, for instance, Digital uses a Macintosh as part of its Ethernet office simulation.

Digital's track record is good. It made a very valid commitment at the microcomputer level to running MS-DOS programs in VAX environments via the VAXmate and Digital Services for MS-DOS. But now we'll learn how open Digital has become, based on whether it accepts Apple's participation, or refuses to make marketing agreements to support it.



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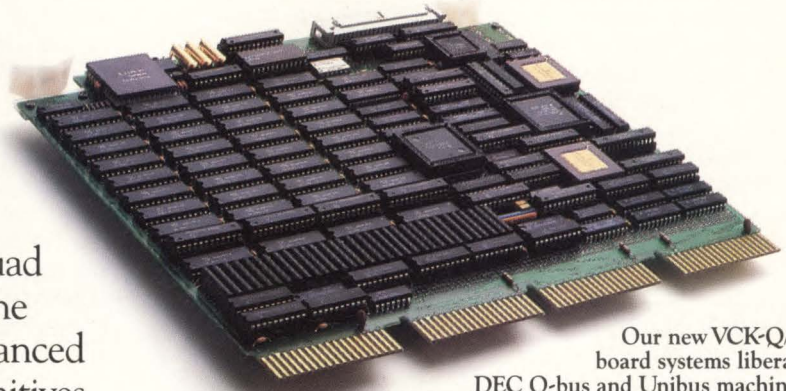

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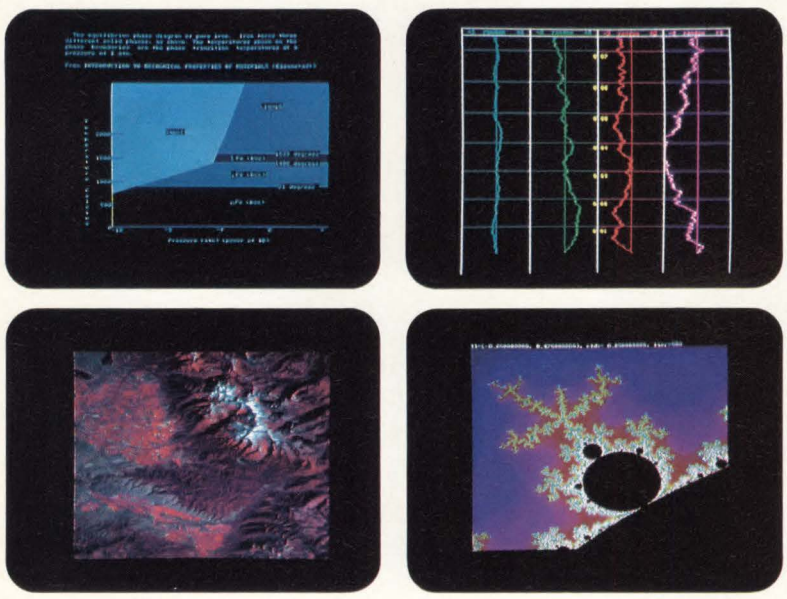

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UNIX Challenge To VMS

In February, DEC introduced the VAXstation 2000. In June, it reduced the price of the new workstation from $10,500 to $5,400, a decrease of almost 50%. This bold move was DEC's way of making a statement: Above all else, DEC is a networking company, and networking works best under VMS/DECnet. (See "Workgroup Computing: Digital's Philosophy Reflecting The Way You Really Work," *Hardcopy*, p. 54, June 1987.)

These powerful inexpensive workstations have sent the industry reeling. As has happened many times before, a redefinition of computing tools is taking place. What exactly is a workstation and how does it differ from a personal computer? Is the conventional computer terminal doomed? Will users no longer upgrade their main processors (minicomputers), electing instead to simply add workstations?

Overnight, Sun and Apollo have become increasingly important in the DEC environment as users grapple to understand the concept of a workstation and what it can do for them. (See "Workstation Applications: Visions Of Your Future," *Hardcopy*, p. 40, July 1987.)

Sun and Apollo workstations are both UNIX based, which means that networking them to VAXes (under TCP/IP or DECnet) offers limited capabilities. (See "Clustering Carries Digital To New Heights: Will Anyone Stop DEC Now?" *Hardcopy*, p. 36, August 1987.) As the situation now stands, if you want to cluster, you buy from DEC.

This isn't necessarily bad: The one architecture, one operating system approach that DEC is challenging IBM with allows for a close coupling that many claim cannot be challenged in functionality by any multivendor or shared environment. DEC has gone to great pains to develop its powerful, comprehensive, seamlessly networkable VAX/VMS line of computers, and users should benefit from all the advantages this environment offers.

But UNIX is gaining momentum, and DEC is reacting. Ultrix-32 V. 2.0 runs on every 32-bit system DEC sells, and DEC supports X Windows and Sun's Network File System (NFS) as well. (See "Digital Users Accept UNIX," this issue, p. 72) NFS brings to UNIX/Ultrix much of the functionality available in VAXclusters. And Ultrix-32 supports both DECnet and TCP/IP, and includes a VAX C compiler.

DEC has been perfecting VMS for more than 10 yrs. now, but UNIX has had a good deal of support as well, and is finding even more. Along with third party activity, DEC will soon bring complete clustering functionality to mixed operating system networks. The heavy compute power on the networks will still be provided by the VAX, but the operating system software and some of the workstation hardware will be the result of a combination of DEC and third party contributions. By openly embracing shared standards and recognizing the value of efficient networking technology, Digital and its third party continue to offer the strongest computing environment available.

Editor

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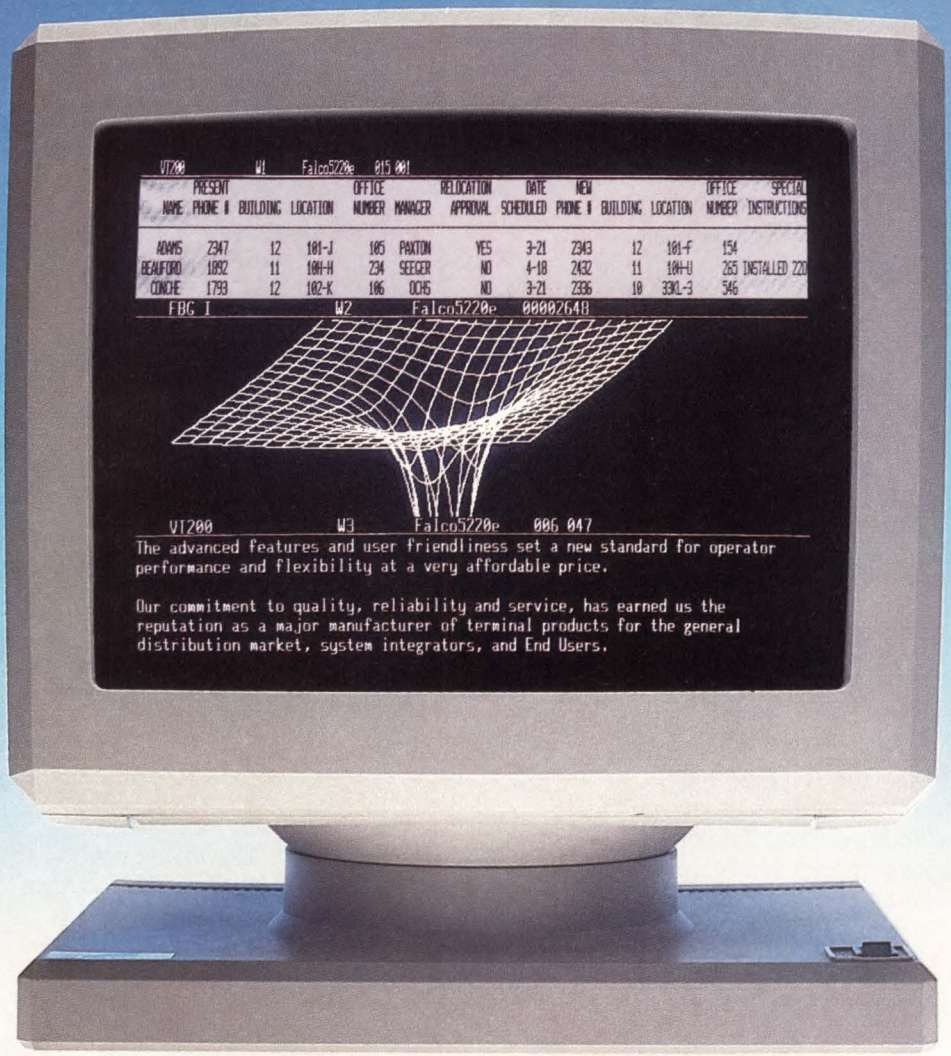

1. What connections! You get ASCII, ANSI, PC-AT in any combination.

6. More places to connect to! Four ports for printers, scanners, mouse—even 4 different hosts.

ACTUAL UNRETOUCHED PHOTO OF VIRTUAL TERMINAL SESSION

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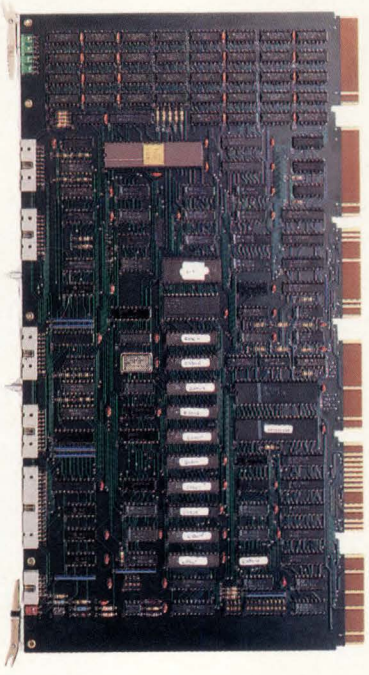

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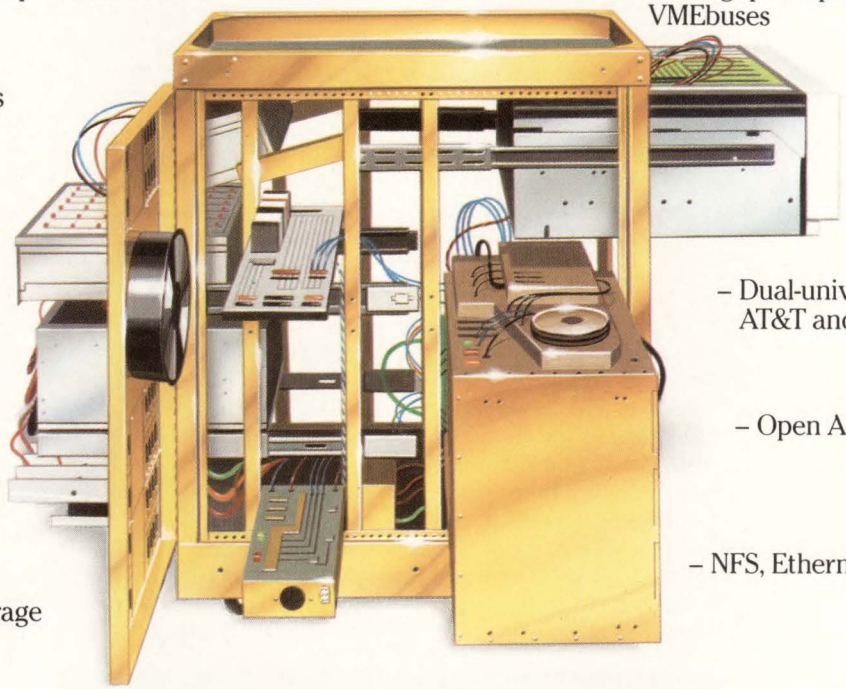

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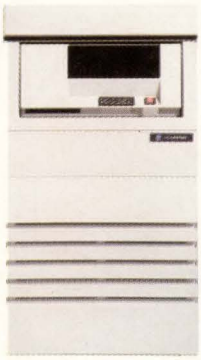

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DIGITAL PROMOTING AI

How did you spend your summer vacation? The people from Digital Equipment Corp.'s Artificial Intelligence Technology Center spent their summer vacations on the road, participating in and sponsoring AI exhibitions around the world, and introducing new expert systems software packages. Digital participated in the American Association of Artificial Intelligence (AAAI '87) Conference in Seattle, Wash., and helped sponsor the bi-annual International Joint Conference on Artificial Intelligence (IJCAI) in Milan, Italy.

Digital's new products are VAX LISP V. 2.2, which is reportedly a significantly enhanced release of VAX LISP, Digital's AI programming language, and Nexpert Object, an expert systems development tool for VAXes. Just 1 yr. ago, it cost more than $50,000 to begin a VAX AI development system, according to Digital. Today, a full-blown VAX with a graphics-based AI development environment can be purchased for less than $15,000.

In addition, Digital's Educational Services developed an AI curriculum that includes eight new courses in expert systems, ranging from introductory and management courses to in-depth technical courses for advanced programmers. The topics are: Introduction to AI, Manager's Seminar in Artificial Intelligence, Computing Techniques in AI, Symbolic Programming in VAX LISP, Building and Prototyping Expert Systems, Advanced AI Languages and their Applications, Programming in VAX OPS5, and the San Marco LISP Explorer, an interactive tutorial designed to teach LISP.

VAX LISP 2.2 has significantly improved performance and "garbage collecting" according to Digital. VAX LISP, which is VMS and Ultrix-32 compatible, was designed for "rapid prototyping and exploratory programming as well as the delivery of working systems," says Digital. The new version improves performance by 20% over V. 2.1, and allows users to write VAX LISP applications that act like applications designed with more conventional languages. The applications can then be distributed without having to purchase separate runtime licenses.

Most significantly, a System Build utility has been added allowing designers to build smaller, more efficient programs. The programmer only has to write code specific to the applications, and not worry about writing debuggers, compilers, or editors.

For Ultrix users, V. 2.2 provides access to the Ultrix-32 Graphics Library, Digital's implementation of X Windows.

Neuron Data's Nexpert Object, available through Digital as a Digital Distributed Software (DDS) package, is a graphics-oriented tool that can be used to design expert systems. Written in C, it is already being used on VAXes ranging from the VAXstation to VAX 8000s. It can reportedly integrate with VMS and relational databases such as Rdb, Oracle, and dBase III, other conventional software packages, and a few networks.

The program's inference engine can process rules forward or backward, and is considered flexible enough to tackle a wide range of problems. A special Browsing Network, provided during development and runtime, is a visual representation that graphically depicts the links between the program's concepts and rules, and allows the user to monitor his progress.

Other cooperatively marketed products available through Digital include S.I, an expert system development tool designed specifically for VAXes; Intellect, an Rdb/VMS interface; and Quintus PROLOG, an advanced PROLOG development system for VMS or Ultrix-32.

Digital also has several other little-known AI-related programs. VAX OPS5 is a knowledge management system that is ideally implemented on Digital's AI VAXstation, a VAXstation 2000 that is specially configured with additional memory and graphics capabilities. Written in Bliss-32, OPS5 can call out and be called from routines written in FORTRAN, C, Pascal, BASIC, or Bliss-32.

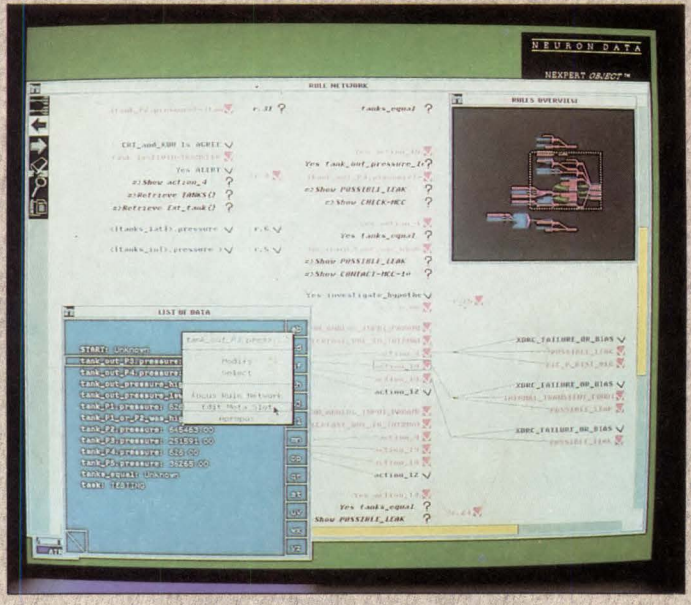
At the AAAI Conference in July, Digital demonstrated an integrated expert system of VAX OPS5 and Ada code known as KNOMES that diagnosed faults in a robot arm of the space shuttle.

Digital reports that it is using six different AI applications internally, including: XCON for sales orders, XSEL to assist salespersons in selecting the right components, XFL to help XSEL users layout computer rooms, Dispatcher to speed decisions in a manufacturing plant, CDS as a source for parts orders, and Spear for customer support. Specifically, Spear is used to remotely locate problems in TU50 tape drives. The company estimates that Spear alone saves $50 million annually.

The company now claims to have implemented expert systems in the financial, aerospace, petrochemical, manufacturing, and process control industries.

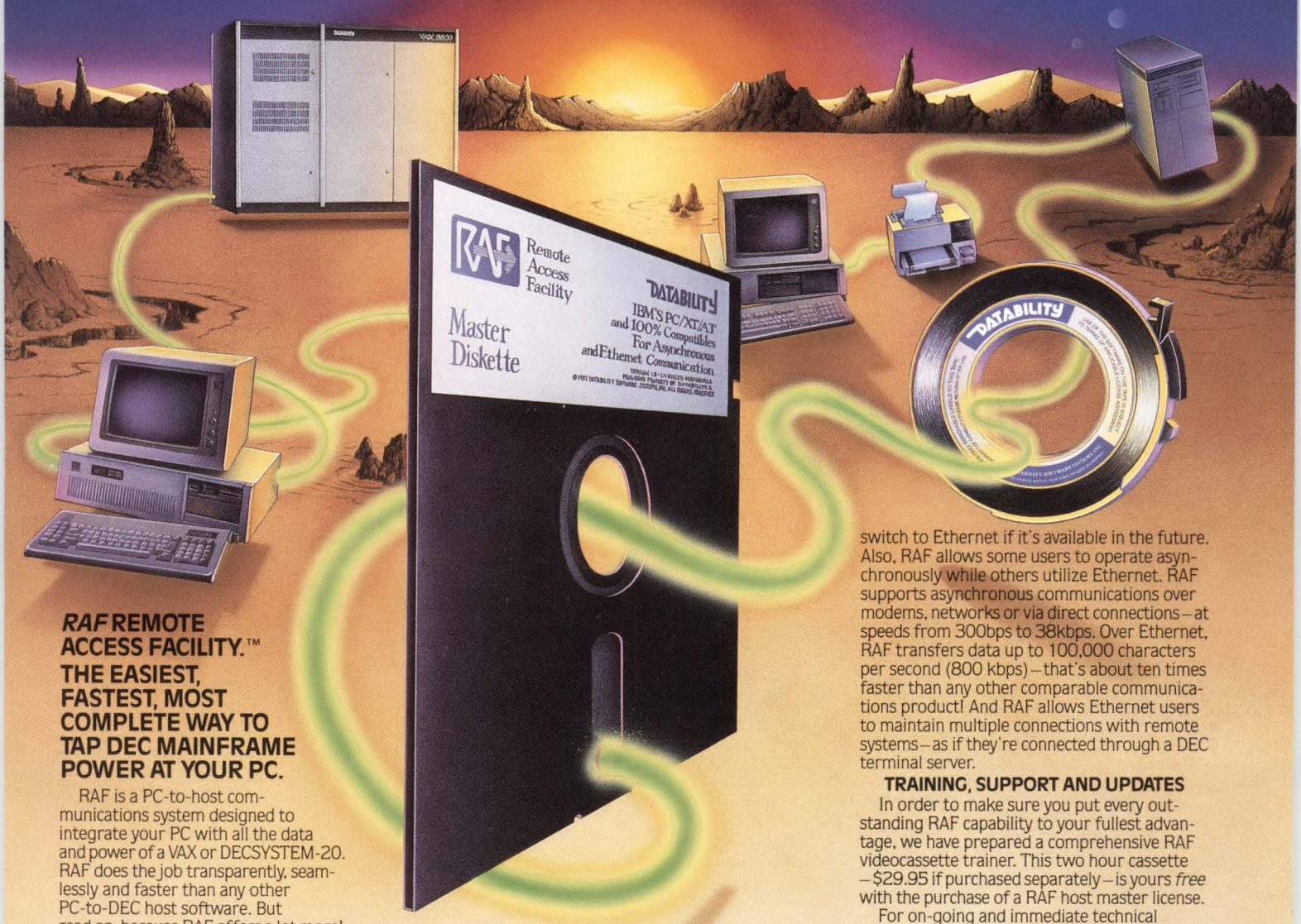
Enter No. 131

—Evan Birkhead



Neuron Data's expert system building tool, Nexpert Object, uses the VAXstation's windowing capability for a graphic display of rules.

RAF. THE MAINLINE TO YOUR MAINFRAME.



RAF REMOTE ACCESS FACILITY.™ THE EASIEST, FASTEST, MOST COMPLETE WAY TO TAP DEC MAINFRAME POWER AT YOUR PC.

RAF is a PC-to-host communications system designed to integrate your PC with all the data and power of a VAX or DECSYSTEM-20. RAF does the job transparently, seamlessly and faster than any other PC-to-DEC host software. But read on, because RAF offers a lot more!

EASY ACCESS TO REMOTE DATA

RAF fools the PC into "thinking" that remote files are local. So you can utilize your regular PC software to access data stored on a remote system. It's as if the data were stored locally on your PC! Use WordPerfect, MASS-11 and other PC editors to create or edit files stored on a remote VAX. And use PC spreadsheet programs like Lotus 1-2-3 to manipulate remotely stored spreadsheets.

SHARE REMOTE SYSTEM PRINTERS

Why dedicate a printer to a PC when RAF allows PC's to share remote system printers transparently? With RAF, PC software thinks your PC is equipped with its own local printer! And RAF lets you define all remote printer options. With RAF, you decide which remote printer to use or which forms to utilize.

COMPLETE ACCESS OF REMOTE COMPUTERS

RAF delivers automatic access to remote computers through a scripting mechanism that allows you to define each step of an automatic login. Or complete VT100 and VT220 terminal emulators unlike any other software system. RAF's VT100 and VT220 support allows for instant switching between PC and VAX applications.

ASYNCHRONOUS AND ETHERNET SUPPORT

You can use RAF to communicate asynchronously or over Ethernet. A single copy supports both, so you can install RAF asynchronously now and switch to Ethernet if it's available in the future. Also, RAF allows some users to operate asynchronously while others utilize Ethernet. RAF supports asynchronous communications over modems, networks or via direct connections—at speeds from 300bps to 38kbps. Over Ethernet, RAF transfers data up to 100,000 characters per second (800 kbps)—that's about ten times faster than any other comparable communications product! And RAF allows Ethernet users to maintain multiple connections with remote systems—as if they're connected through a DEC terminal server.

TRAINING, SUPPORT AND UPDATES

In order to make sure you put every outstanding RAF capability to your fullest advantage, we have prepared a comprehensive RAF videocassette trainer. This two hour cassette —$29.95 if purchased separately—is yours *free* with the purchase of a RAF host master license.

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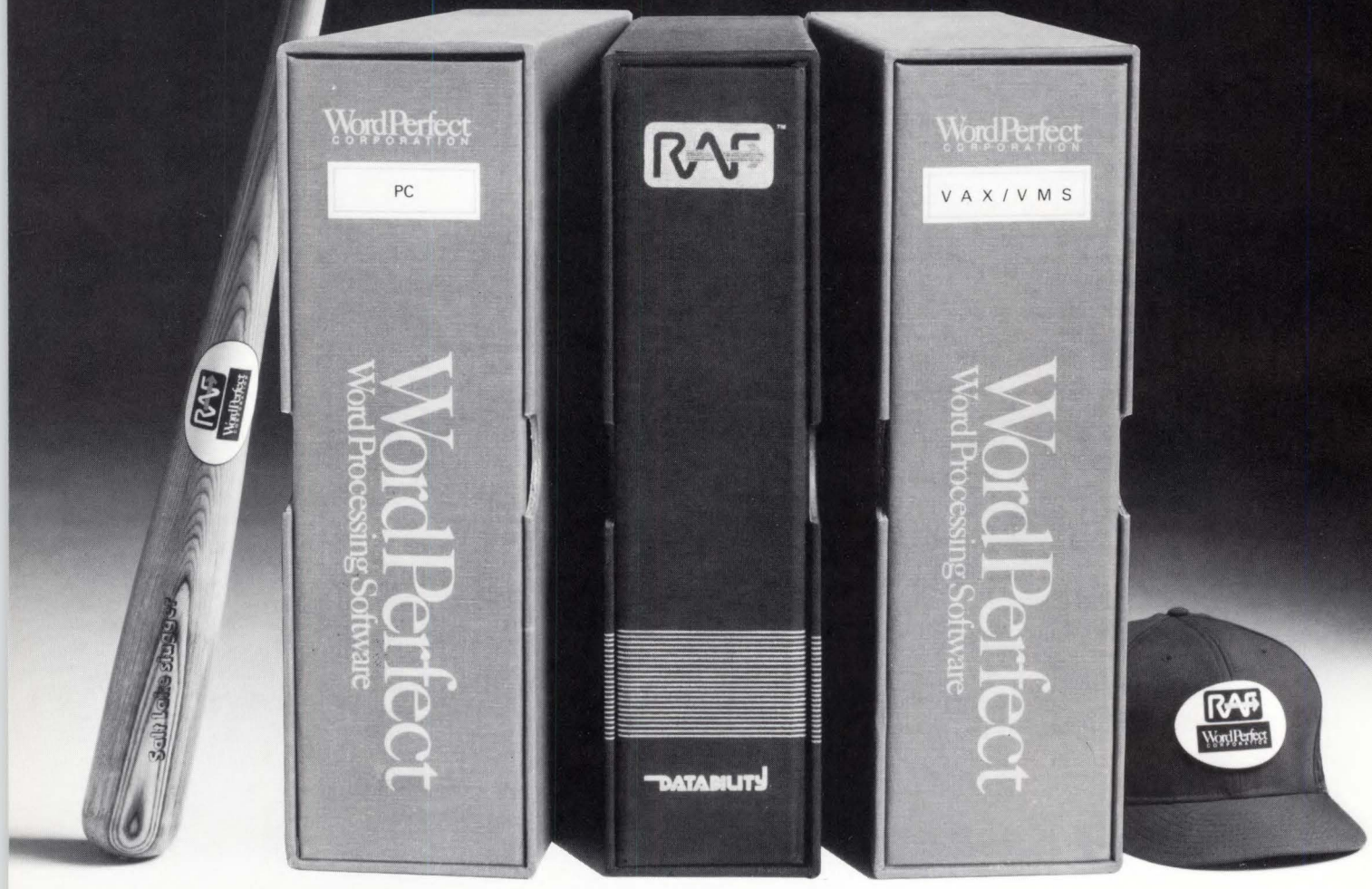

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Committed To Solutions

The Digital Equipment Corp. philosophy of providing customers with integrated solutions and services was truly demonstrated at the 1987 Design Automation Conference, June 28–July 1 (Miami Beach, Fla.).

"Integrating the business of engineering" was the theme of Digital's booth. Together, Digital and 21 of its System Cooperative Marketing Program (SCMP) and Cooperative Marketing Program (CMP) participants demonstrated solutions for each stage of the electronic design cycle.

A network of computers in simulated engineering environments, using simple interface capabilities, provided transparent resource sharing among multiple engineering applications. The network demonstrated the different stages of the PCB development process from initial design concept to distribution on the manufacturing shop floor. Digital's solutions integrated VAXstation platforms and leading edge applications.

Each software package passed data from one phase to the next, linking together workgroups in engineering and manufacturing. Applications from Endot Inc., Cadre Technologies Inc., Valid Logic Systems Inc., Scientific Calculations Inc., Matra Datavision, Interleaf, and Digital were integrated together on a Local Area VAXcluster system.

"The trend toward high performance workstations reinforces the importance of a seamless computing environment that includes the high end," comments

The new, 32-bit color VAXstation 2000 workstation, featuring a 15-in. color monitor, is priced at $7,900.

The monochrome VAXstation 2000 workstation offers CPU performance equal to a MicroVAX II system, but fits easily on a desk.

Don McInnis, Digital's vice president of engineering systems. "Digital's single computing environment enables multiple paths, multiple jobs, and multiple tasks to be executed on a higher system throughput basis than with single clock rate CPUs. In addition, Local Area VAXcluster systems provide load balancing capability, a single point of system management, distributed file management, and distributed batch queues across multiple workstations—all for up to 28 nodes."

In addition to the design demonstration, there were six solution centers that focused on aspects of the design process, enabling visitors to explore specific solutions designed to increase productivity in the engineering design environment. The centers demonstrated solutions in Engineering and Manufacturing, IC Design Using Ultrix, Hardware and Software Development, Large Systems Design and Test, IC Design Using VMS, and Software Engineering. The workstations in these areas were end-user nodes on a network, where communications and data flowed freely among teams working together on design projects.

"Digital sells completely integrated solutions to customers who desire them via our Solutions Systems programs," explains McInnis. "We intend to use our large software and support service resources to solve our customers' integration problems."

Along with integrated solutions, two new product announcements were made. Digital's newest workstation, the color VAXstation 2000, designed for the electronics market where a standard, desktop, low cost workstation is required, had its first public demonstration. Five of the color 32-bit workstations were used in different areas of the booth, illustrating Digital's ability to provide a total range of compatible computing systems for the engineering environment.

Also announced was a VAXstation 2000 workstation featuring a 15-in. monochrome monitor. The system fits easily on a desk and is priced at $4,600, placing it in competition with conventional workstation manufacturers.

Enter No. 128

—Renee P. Brown

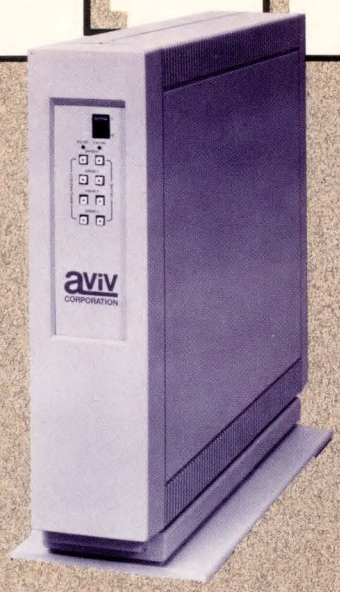
NEWSLINE

Up To 3 Gbytes Of ESDI Disk Storage

A new high capacity 5¼-in. disk subsystem from Aviv Corp. (Woburn, Mass.) has entered the MicroVAX and MicroPDP-11 markets. The DFS 904-X760 disk storage system, a member of Aviv's APEX family of products, is comprised of Aviv's DFC 904 enhanced small device interface (ESDI) disk controller and Maxtor's XT8760E disk drive. It has an unformatted capacity ranging from 180 Mbytes, for a single drive configuration, to more than 3 Gbytes when configured with four 760-Mbyte disk drives.

The XT8760E is a high speed ESDI disk drive with a data transfer rate ranging from 1.2 to 1.8 Mbyte/sec. and an average seek time of 16–18 Mbyte/sec. The DFC 904 disk controller can support up to four drives of different capacities, and includes a 1-Mbyte cache memory for fast data access.

"The DFS 904-X760 disk storage system is a natural progression in the APEX family," says Jim Frantzreb, central regional sales manager for Aviv. "For many MicroVAX users, there is a constant need for greater storage capacity, but physical, environmental, and power constraints dictate that this storage must be put in the smallest possible package. The APEX family answers this need."



Aviv Corp.'s DFS 904-X760 is a high capacity, ESDI disk system for MicroVAX and MicroPDP-11 systems.

The APEX subsystem family is compatible with all Digital Equipment Corp. operating systems that support Mass Storage Control Protocol (MSCP) and DU driver. The subsystem is available in either add-in or add-on configurations and can be mounted in a 19-in. rack or in a MicroVAX look-alike pedestal. In either configuration, the APEX family just may be one of the highest performance 5¼-in. disk subsystems available to date.

Enter No. 126

—Renee P. Brown

SCSI Q-Bus Host Adapter

The host adapter market has a new addition with the announcement of the CQD-200 from CMD Technology (Santa Ana, Calif.). The intelligent, dual-wide Q-bus host adapter, priced at $1,250 and currently available, uses the small computer systems interface (SCSI) and is fully compatible with Digital Equipment Corp. Mass Storage Control Protocol (MSCP) drivers.

The CQD-200 supports 18- or 22-bit Q-bus addressing, block mode DMA transfer, 16-Kbyte sector buffers, disconnect/reconnect, command queueing, and seek optimization. SCSI support includes all required commands and standard bus arbitration, and up to seven SCSI target devices (magnetic or optical) can be connected with a data transfer rate of 2 Mbyte/sec.

"Dramatic improvements in the SCSI chip have resulted in SCSI becoming a more popular interface," comments Ivan C. Hwang, national sales manager for CMD. "With our host adapter, users can daisy-chain optical disks, hard disks, and tape drives, eliminating the need for multiple controllers."

The CQD is equipped with an on-board utility allowing users to configure and format drives, scan bad blocks, and replace them automatically. The drive configuration is stored in an on-board nonvolatile RAM. Also included is a user-selectable automatic bootstrap option that can boot the system on power-up.

Compatible with LSI-11, MicroPDP-11, and MicroVAX II CPUs, the CQD supports RT-11, TSX+, RSX, RSTS, MicroVMS, and other operating systems that use the DU driver.

Enter No. 198

—Renee P. Brown

BASIC Plus Programs Migrate To UNIX

Universe BASIC, developed by Datavision Limited (Hartford, Wis.), offers PDP-11 users running BASIC Plus and Plus II applications software a simple, quick, and effective migration to UNIX.

Simply, Universe BASIC is a BASIC interpreter and compiler that allows programs written in BASIC Plus to be translated to run as binary code on any UNIX system. This capability increases the range of hardware options available to PDP-11 users who wish to upgrade, and also provides access to the VAX via Ultrix.

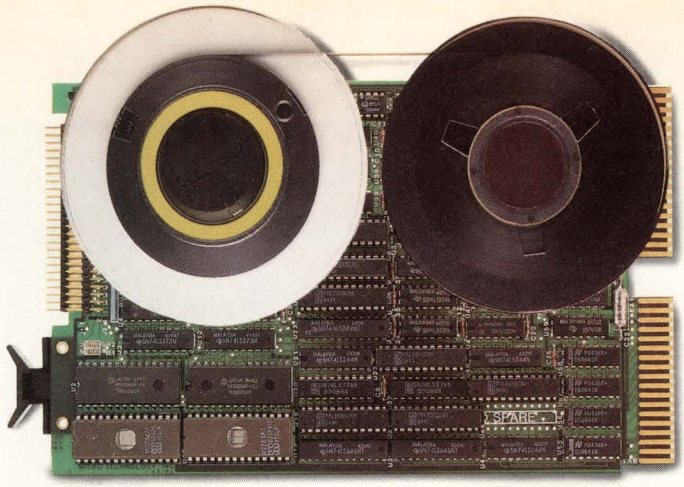
The product includes four main elements: interpreter, translator, compiler, and executive library, making it suitable for both software development and translation. The interpreter provides a standard BASIC interface and is primarily intended for software development. It supplies full support for the BASIC Plus language and syntax, and produces BASIC Plus source code.

The translator optionally translates BASIC Plus source code into C, retaining the author's original construct and narrative for easy maintenance. The compiler produces native object code from a C source program. Both the interpreter and compiler use the executive library, which is responsible for the interface between Universe BASIC and UNIX.

Universe BASIC represents a solution for PDP-11 users who want to upgrade their systems without discarding their existing applications. It provides a bridge from the world of BASIC Plus programming to the rapidly developing worlds of UNIX and Ultrix computer systems.

Enter No. 580

—Renee P. Brown

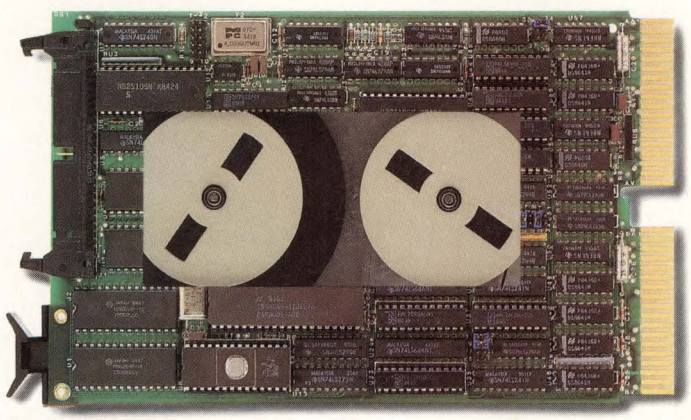


INTRODUCING THE FIRST Q-BUS DUAL-WIDE ½" TAPE COUPLER.

It's called the MSV15. The first serious alternative to quad-wide ½" tape couplers.

Consider: a dual-wide design that frees up backplane slot space. Virtually unmatched low cost. And DEC TS11/TSV05 emulation so true, it even runs DEC diagnostics.

Best of all, the MSV15 is available right now for use in all popular Q-Bus based systems, including DEC's LSI-11 series and of course, the MicroVAX I and II.



THE ORIGINAL Q-BUS ¼" STREAMING TAPE COUPLER.

The MSV05 is the most widely used Q-Bus ¼" streaming tape coupler today.

It's also the most imitated.

Yet no one's matched its impeccable field reliability. Its excellent cost to performance ratio. Nor its true DEC emulation.

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A 'Personal Mainframe'

A standard IBM PC/AT or compatible can be transformed into a high performance workstation or a multiuser host by the addition of Opus Systems' (Cupertino, Calif.) Series 300 Personal Mainframes (PM). The products provide a total system upgrade for the PC at a cost less than comparable standard workstations.

The Series 300PM has two models, the 350PM operating at 30 MHz and the 340PM at 25 MHz. The 32-bit UNIX systems, based on Fairchild Semiconductor's Clipper technology, use the PC as an I/O processor and subsystem. They provide 4–5 millions of instructions per sec. (MIPS) of computing power and 4–16 Mbytes of physical memory in a full 4-Gbyte virtual address space at OEM prices of less than $3,700 each.

According to Glenn Patterson, Opus president, "Our Clipper technology brings the performance of a mainframe to a personal computer at the cost of a microcomputer system. The product provides high performance workstation capabilities for an extended number of applications and is available for a wider range of users than the larger, more costly minicomputer and mainframe alternatives."

The Opus Systems' Series 300 Personal Mainframes transform a standard IBM PC/AT or compatible into a high performance workstation or a multiuser host.

The 300PM features a port of UNIX System V Release 3.0. Standard software tools include C and FORTRAN77 and support for Berkeley 4.2 utilities, COBOL, Common LISP, and BASTOC (BASIC to C translator) is also available.

The Series provides compatibility with the Network File System (NFS), Remote File Sharing (RFS), and transmission control protocol/internet protocol (TCP/IP) network access software standards. This capability allows 300PM-based systems to communicate with a wide variety of host computers, peripheral devices, and databases.

Enter No. 127

—Renee P Brown

Digital Establishes ACT In IBM Territory

The christening of a New York Applications Center for Technology (ACT) in late June was Digital Equipment Corp.'s best publicized and most costly opening of a new facility to date. The ACT, located in midtown Manhattan at 53rd and Madison, was built where it could be easily accessed by Digital's Fortune 100 corporate and financial services customers, according to Digital spokespersons.

The multimillion dollar facility, which houses an 8974 VAXcluster in addition to an Ethernet network, is staffed by a team of experts from the commercial and retail banking industries, the trading business, and the MIS area. Without question, the ACT is Digital's boldest statement toward expressing its commitment to the financial market.

Roland Hevey, the vice president for New York area sales says he expects 1000 major customers to visit the ACT every year. Each customer will be able to experience firsthand what Digital calls "solutions in action" in any of several private demonstration areas or conference rooms.

The extensive hardware, software, and networking capabilities of the Center are intended to give customers and potential customers a better understanding of what Digital can offer. The various approaches of several third party software packages can also be evaluated and compared.

"They can see everything from trading workstations, to branch automation capabilities, to connections to IBM," explains Claude Thomas, the director of Digital's financial industry marketing group. The IBM interconnections used in the ACT's Ethernet system were reportedly designed using equipment commonly used by financial institutions running Ethernet/DECnet.

According to Digital, the New York ACT is one of 17 hands-on facilities that will be built around the world in the next few years. Like the financial ACT, each is expected to be built near the commercial center of its targeted industry.

—Evan Birkhead

Freedom for VAXcluster and BI users means more than just freedom to choose a storage alternative to DEC's SA482. It also means more freedom in configurations, and the freedom to add more capacity per drive without giving up full Digital Storage Architecture functionality and compatibility.

Free yourself from DEC's RA-series drives.

Even DEC's largest RA subsystem locks you into drives with lower capacities and slower access than readily available industry standard drives provide. You take what you can get from DEC in reliability and cost too.

60% more capacity.

Emulex's SMDI (SMD-Interconnect) subsystems offer the freedom to choose between the best new SMD and SMD-E drives as they become available from the best industry sources. Then freedom to choose from up to 36 configurations, using high performance drives with seek times of less than 15msec and capacities to over 1 gigabyte per drive—60% more than DEC's.

More for less.

SMDI can give your budget a break too, with prices two-thirds of DEC's. Or choose 50% more capacity for the same price.

Now that you've been guaranteed freedom of choice again, enjoy it. Call (800) EMULEX3 or (714) 662-5600 in California. Emulex Corporation, 3545 Harbor Blvd., Costa Mesa, CA 92626.

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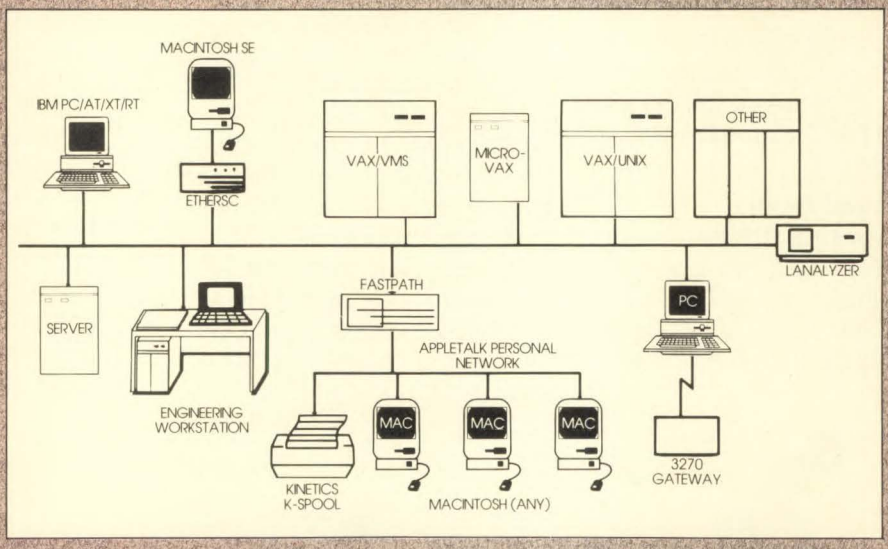
ENTER 669 ON READER CARD

Excelan To Acquire Kinetics: Gets BI License

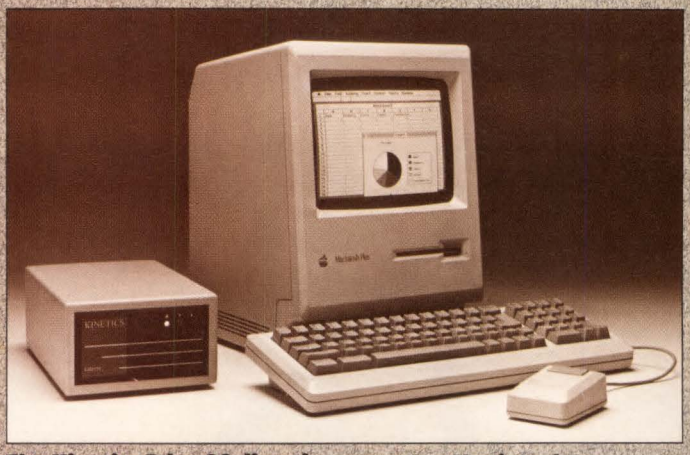
Excelan Inc. (San Jose, Calif.) continues to expand its line of transmission control protocol/internet protocol (TCP/IP) networking products. Strategically standardizing its product line on the combination of TCP/IP on Ethernet in 1983, the company has developed hardware/software solutions for the interconnectivity of many dissimilar computers, and now intends to add the complete line of Apple Macintosh computers as well as Digital Equipment Corp. VAXBI machines.

Through the planned acquisition of Kinetics Inc. (Walnut Creek, Calif.), Excelan will acquire the capability to bring individual Macintosh computers as well as entire AppleTalk networks into the TCP/IP-Ethernet environment. Kinetics has been an extremely successful and innovative small company that recognized early the power of the Macintosh. Though it has to date only filed a letter of intent to purchase Kinetics, Excelan hopes to acquire the company by the end of the year.

With support from Apple, Kinetics has developed products such as FastPath, EtherSC, and FastPath/Q. FastPath, Kinetics' best-known product, is an AppleTalk (Apple's LAN) to Ethernet gateway that has been used by many third party companies to integrate the Apple and Digital environments. EtherSC places Macintosh directly on Ethernet via the small computer systems interface (SCSI) port on the Mac. FastPath/Q is an AppleTalk controller board for the Digital Q-bus.



Excelan's interconnect possibilities using TCP/IP on Ethernet provide comprehensive networking solutions.



The Kinetics EtherSC directly connects a Macintosh to Ethernet.

The Kinetics FastPath AppleTalk-Ethernet gateway establishes a bridge between Apple and Digital LANs.

Combining the new capabilities with its existing ones, Excelan will be one step closer to its ultimate goal of a true distributed file system that works across all types of computers—PCs, minis, and mainframes. According to Subhash Bal, vice president of marketing for the company, it is Excelan's intent to treat the Macintosh family "just like the PC," bringing it transparently into the existing fold of supported computing devices. He is confident that even the one main existing technical problem—true file sharing (no conversions) with the VAX or Macintosh files stored on the VAX—will be overcome.

Being awarded a VAXBI development license is another boon for Excelan, enabling it to "continue to offer a complete family of top price/performance solutions for Digital users," says Bal. "The BI is very important to Digital's long-term strategy, so it's very important to us." Bal points out that, as a company that seeks to support industry standards, Excelan works with software architectures that are independent of the bus-level hardware, so it will be a simple migration for Excelan customers to move from Q-bus and Unibus machines to the VAXBI.

TCP/IP has proven to be a widely accepted, rugged industry standard. Add to this the fact that it can coexist with DECnet on Ethernet, and it becomes increasingly clear that it will remain an industry standard for the long-term. Industry standards are kept alive and strong by companies like Excelan, and this type of third party activity shows how technology can flourish even in the midst of massive marketing of proprietary standards by industry giants. It is to Digital's credit that it recognizes this and stimulates activity with VAXBI licensing to the appropriate companies.

Enter No. 565

—Brad Harrison

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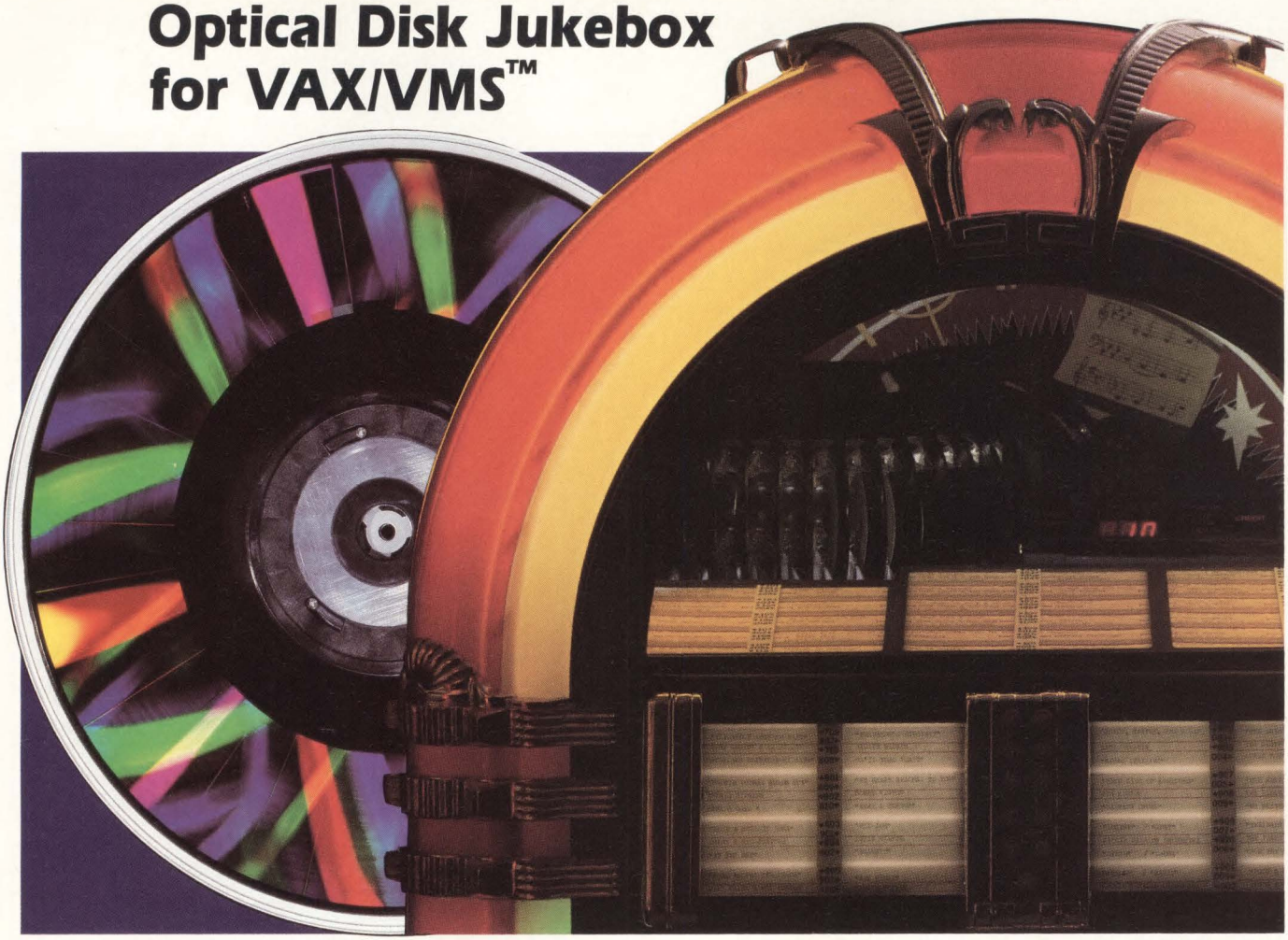

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New Options For PDP-11 Users

Conscious of criticism that its support for PDP-11s may be dwindling, Digital Equipment Corp. recently made a few additions to the venerable computer line while adding options for some configurations and reducing prices for others. The new systems include the PDP-11/84E series, the MicroPDP-11/53 Plus, and the A-to-Z Business System that is a MicroPDP-11/53 bundled with various A-to-Z software packages.

The 11/84E is basically an 11/84 with a 9-slot processor backplane and a few new packaging options, such as a 5¼ x 19 in. rack-mount (with prices starting at $16,000) or a 10½ x 19 in. rack-mount ($20,000 at the entry level). The 10½-in. box has a 27-slot capacity, "more watts and slots than any previous 10½-in. PDP-11 computer box-level design," according to Digital.

Two enhanced system-level packaging designs, both based on the 10½-in. box, complement the PDP-11 series building block approach by permitting the integration of a variety of peripheral and device options.

The basic setup of every PDP-11/84E will be a PDP-11/84 board set, a J-11-based CPU with a floating point coprocessor, 2 or 4 Mbytes of error-correcting memory, and a Unibus adapter. Prices for these configurations will range from $23,000 to $26,000. The introduction of the PDP-11/84E was accompanied by a 40% decrease in the monthly service charge for all PDP-11/84s.

Chip Charlot, product manager for the PDP-11/84, said that the new features should "extend the PDP-11/84 systems to reach a wider range of market needs. Our strategy is to provide a smooth and cost-effective migration for our Unibus PDP-11 system customers."

In addition, Digital announced price reductions from 5 to 15% on all configurations (standard systems and system building blocks) of MicroPDP-11/83s, and introduced proprietary storage upgrades and a communication device for the MicroPDP-11/73 and 11/83.

Digital reports that the cost of a basic 11/83, including the CPU, a floating point accelerator chip, eight asynchronous lines, a 2-Mbyte private memory interconnect (PMI), is now approximately $13,400. The price of the MicroPDP-11/83's operating system was reduced by 57%.

The new storage options are the RX33 and RD32 disk drives. Designed to replace the RX50, the RX33 is a 1.2-Mbyte, half-height floppy drive. The RD32, which replaces the RD52, is a 42-Mbyte, half-height Winchester drive.

The DHQ11, a communications controller for the Q-bus, is backward compatible with the DHV11. Digital says that the controller provides eight asynchronous DMA communication lines from a dual-sized module, and improves reliability and reduces power consumption. It is also available in configurations for the MicroPDP-11/53 Plus.

The MicroPDP-11/53 Plus, available at prices ranging from $14,500 to $17,800 (less than the MicroPDP-11/53) has 1.5 Mbytes of memory, 1 Mbyte more than the 11/53, and offers a 25% improvement in performance. The system also includes an extra card-cage slot, and support for full-height 5¼-in. storage devices.

The A-to-Z system is comprised of layered VAX/VMS applications. A network between the A-to-Z Business System and other computers can be established using DECnet. The basic package, currently available in four variations, consists of 2.5 Mbytes of main memory, a 5¼-in. floppy drive, six asynchronous serial lines, and four software modules: the A-to-Z base system, A-to-Z word processing, A-to-Z E-mail, and A-to-Z Supercomp 20. The four configurations range in price from $14,788 to $19,765.

Enter No. 133

—Evan Birkhead

IT*OS Goes UNIX

In a continuing effort to offer its customers freedom in the word processing environment, Intermation Corp. (Pasadena, Calif.) announces a UNIX version of IT*OS, its document management system for Digital Equipment Corp. and IBM PC computers. Development is currently on UNIX System V, but since Intermation also follows the X/OPEN protocol, versions for Ultrix-11 and Ultrix-32 will be released shortly.

IT*OS is an advanced word processing system designed to increase productivity in the office automation environment. It is an easy-to-use, menu-driven system that supports VMS, RSX, P/OS, RSTS, TSX+, and RT-11 Digital operating systems.

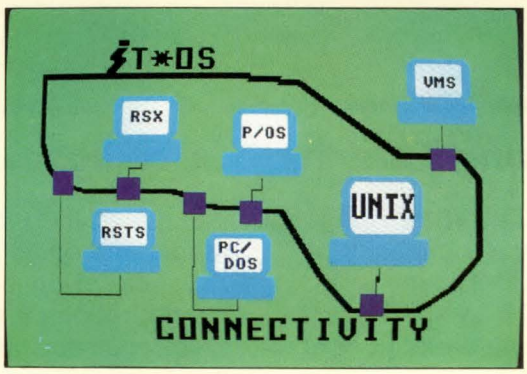
"Word processing has evolved far beyond 'cut and paste' and the bolding and underlining of text. It is simply not enough to be able to avoid retyping," explains Darlene H. Wills, president of Intermation. "ASCII files, scanned input, other word processing files, database files, graphic files, mail messages, telex copy, and spreadsheet cells are just a few of the items that are pulled into IT*OS on a daily basis."

"The significance of adding UNIX to our list of operating systems is like X/OPEN," explains Dan Perkins, Intermation's National marketing director. "Intermation is working toward freedom of choice, portability, and a common applications environment.

"By adding UNIX Systems V, IT*OS creates a link between many operating systems, releasing the user from any reliance on one system or investment. As the business grows and requirements change, the user's initial investment in IT*OS is protected by its portability and flexibility between systems and hardware," says Perkins.

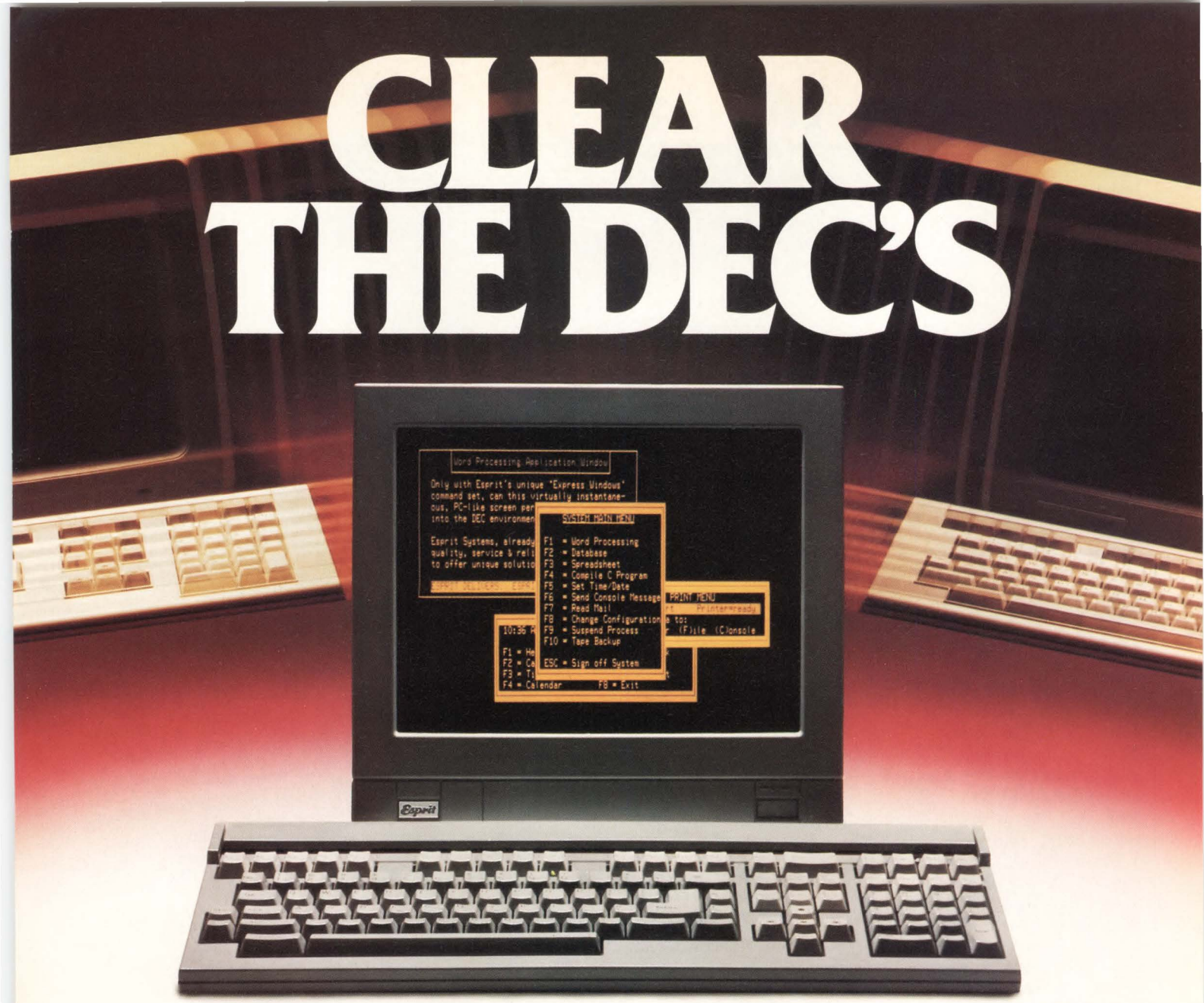
Enter No. 125

—Renee P. Brown



IT*OS creates a link between many operating systems, releasing the user from any reliance on one system or investment.

CLEAR THE DEC'S



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ENTER 724 ON READER CARD

Dual Sessioning In CIT310

Some of the capabilities of Digital Equipment Corp.'s VT300 series terminals are starting to creep into third party products. Though no one has claimed to produce a VT300 emulator yet, several companies are reportedly moving closer to the goal. The next generation of alphanumeric terminals is expected to be unleashed this Fall in a flurry of third party activity.

One of the first of the new generation is the CIT310, a $749 VT224 emulator from CIE Terminals Inc., a subsidiary of C.Itoh Electronics Inc. (Torrance, Calif.). CIE claims that the terminal provides what its customers indicate is needed from the next generation: greater connectivity, more function keys, increased local memory, and a high resolution flat screen display.

The most impressive feature of the CIT310 is dual-sessioning, a capability usually found in workstations, but also found in the VT300s. This allows the terminal to be connected to two hosts simultaneously. By punching the Mode/Session key, the user can toggle between the two environments. The screen can also be horizontally split with a dividing status line that allows the user to easily regulate the amount of screen space devoted to each session.

The connection is established by two cables, rather than by software, increasing the types of computers that can be connected to the terminal. Internally, the CIT310 consists of, in effect, two CIT224 terminals. This architecture is evident from the function keys, screen memory, and set-up menus.

The terminal stores four pages of screen information or 100 lines locally, which can either be allocated for one session or split for two. In dual-session mode, one host can't accidentally access memory assigned to the other. Viewports allow the user to display small sections of memory.

One Kbyte of nonvolatile memory is available per session, enough for 180 programmable functions that can be accessed with 45 function keys. The function keys can have a separate function for each host, and switch over automatically when the Mode/Session key is hit. The CIT310 also has separate set-up screens and nonvolatile memories for each session.

Improved ergonomics in the new terminal include a larger, 14-in. flat-screen display, available in either white, amber, or green phosphors. In 80-column mode, the characters are 9 x 15 formed inside a 10 x 16 cell.

Following the announcement, CIE reduced the price of its CIT224, formerly $749, to $649. The CIE 101XL, a VT100 emulator, was reduced from $699 to $645, and the CIT50+, an ASCII terminal with support for VT100/ANSI, was reduced from $649 to $595.

Enter No. 132

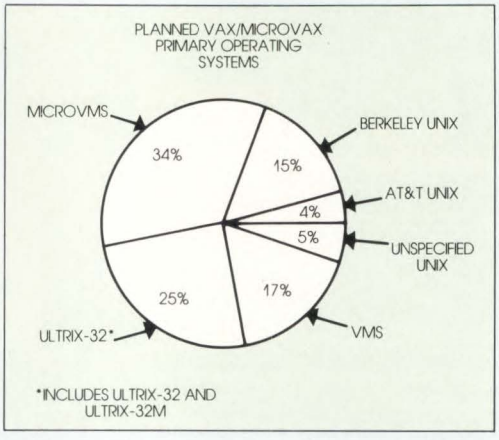
—Evan Birkhead

For VAX Users, UNIX Is Trendier Than VMS

A new study by Computer Intelligence (La Jolla, Calif.) has determined that a number of VAX sites are choosing to run under UNIX and UNIX look-alike operating systems rather than VAX/VMS. The study concludes that UNIX and Ultrix-32 are gaining on VMS in the VAX marketplace. The results are based on interviews with VAX users and CI's Computer Installation Data File.

VMS, the operating system that is most often sold with VAXes, has a much wider selection of software available in the marketplace than either UNIX or Ultrix. It is generally considered to be ideal for timesharing and production applications, and is often praised for its flexibility.

Some VAX users appreciate UNIX, however, because it allows them to port applications between different brands of hardware with little modification. CI reports that some users who prefer UNIX use it because it allows them to use the hardware that is best suited for a given application.



Sites based primarily on VMS are gravitating toward UNIX systems.

The Figure illustrates that these sites, based primarily on VMS, are gravitating toward the UNIX systems. The total for future VMS-like systems (41%) is less than the total for UNIX systems (49%).

But CI's statistics also show that VMS currently holds a commanding lead at VAX sites that use the three major classes of VAX CPUs: MicroVAX IIs, VAX-11/700s, and VAX 8000s. Of all MicroVAX II sites, for example, 87% use MicroVMS as the primary operating system. Twelve percent use UNIX-like systems: 9% have Ultrix-32m, and 3% run UNIX, which includes both AT&T System V and Berkeley V. 4.2.

The remaining 1% use VAXELN, but CI explains that the numbers on VAXELN are deceptive because VAXELN requires VMS as its development environment. Since the statistics only reveal the primary operating system at each site, many VAXELN users are hidden among the large number of MicroVMS users.

VMS is the primary operating system in 90% of VAX-11/700 series environments, while UNIX is second with 9%, and Ultrix-32 third with 1%. In VAX 8000 installations, VMS has 95%, UNIX 3%, and Ultrix-32 lags behind with 2%. Inexplicably, Digital Equipment Corp.'s Ultrix-32m, the MicroVAX II version of Ultrix, leads the pure versions of UNIX at MicroVAX II sites, while Ultrix trails UNIX in the large VAX sites.

—Evan Birkhead

Visions Of Supercomputers

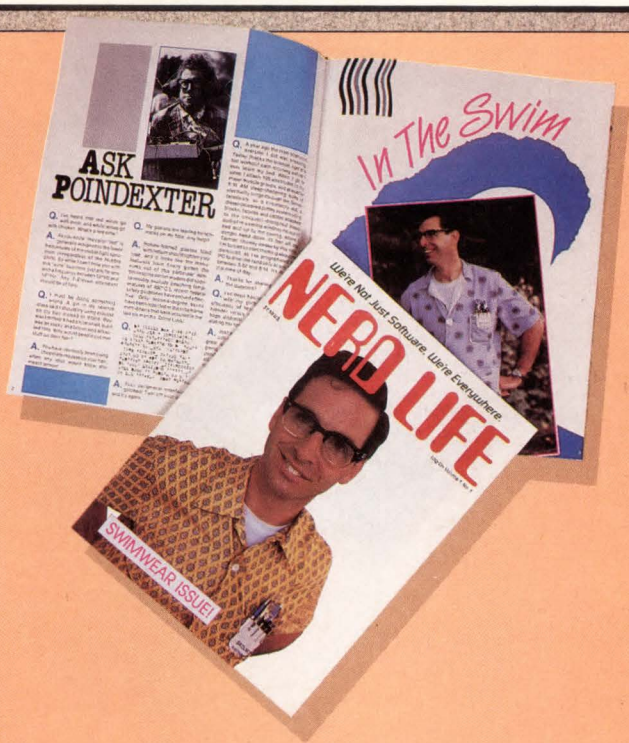
Elxsi (San Jose, Calif.) reports accelerating sales of its System 6400 supercomputer. With recently announced capabilities such as add-on vector processors (in addition to the 1–12 scalar processors systems it can be configured with) and automatic detection of and migration away from failing processors, the company appears to be on a roll.

The 6400 addresses all applications where either extremely high millions of instructions per sec. (MIPS) or instantaneous realtime response is required—or both. Surprisingly, the 6400 is capable of handling realtime and number-crunching (including multiuser number-crunching) environments simultaneously. Add to that the fact that the machine can run its four operating systems—UNIX System V and 4BSD, EMS, and EMBOS—all at the same time and across any combination of processors, and the simultaneous support of the multiple environments becomes even more impressive. (Realtime support is available under all operating systems, and does in fact provide response in supercomputer realtime via a unique interrupt structure that goes right to the hardware, avoiding operating system overhead.)

How can VAX users take advantage of the 6400? The EMS operating system is a VMS look-alike, and VMS FORTRAN applications can be recompiled to run on the machine. The code can be altered manually for execution in parallel across multiple scalar and/or vector processors, providing, the company claims, execution speeds up to 144 MIPS across the 12 scalar processors. Bringing VMS scientific applications to the 6400 has sold many of the machines for Elxsi, and the company is planning on selling a lot more into the Digital Equipment Corp. environment. DECnet is supported on the 6400, as well as transmission control protocol/internet protocol (TCP/IP), and Elxsi plans to offer additional features that will make the 6400 even more network/software compatible with the Digital environment (including attaching directly to the VAXBI over the 6400's extension VMEbus).

The 6400's 64-bit system bus is synchronous and capable of reaching an amazing 320 Mbyte/sec. throughput rate. System configurations typically contain substantial amounts of memory (a maximum of 2 Gbytes is possible) in order to take advantage of this throughput—if a process has to go to disk, the bus is dragged down to only a few Mbyte/sec., and the advantages to the supercomputer are lost. The current processor iteration is the 6420; it's approximately twice as fast as its forerunner, the 6410, and the 6430 is being designed. It's important to note that when upgrading, users don't replace processors and memory—they add.

Elxsi sees its machine as providing the best price/performance in the range somewhere higher than the VAX 8800 and somewhere lower than computers from Cray. Tremendous compute power is available for a relatively small amount of money.



Would you buy a computer from this man? *Nerd Life* is the magazine every self-respecting nerd wants to read. Feature articles include: "Scratch a Yuppie . . . Find a Nerd," "The Nerd Dollar: Where Does It Go?" and "In The Swim," where our *Nerd Life* fashion-plates model the latest and greatest in pool and beach attire. (*Nerd Life* was created as a promotion piece for the movie, *Revenge of the Nerds II*, from 20th Century Fox.)

Is the 6400 a sign of computers to come? Flexible, parallel, extremely fast, and able to keep users satisfied with never-ending additions of state-of-the-art hardware, the 6400 is certainly one of the leading-edge computers of the '80s. But what if memory chips don't continue to show the amazing drops in cost/Mbyte of storage, and denser integration of custom chips doesn't provide for the further dramatic increases in condensed, fast processor architectures? Surely there will be a tapering off in these breakthroughs that gave Silicon Valley (where Elxsi is located) its early phenomenal growth rate—making Digital's clustering capabilities and well-supported (though comparatively slow) buses as important as ever.

But Elxsi claims that it isn't competing with Digital—it's complementing it. Elxsi is offering a solid, well-backed machine that supports a variety of industry standard environments with supercomputer power at a reasonable price. As such, the 6400 will continue its present, strong rate of growth. But innovative machines from manufacturers like Elxsi won't begin to threaten Digital until the next wave of computer technology—superconductors?—once again returns the industry to the hectic, nonstop innovation it saw when the chip first arrived.

Enter No. 129

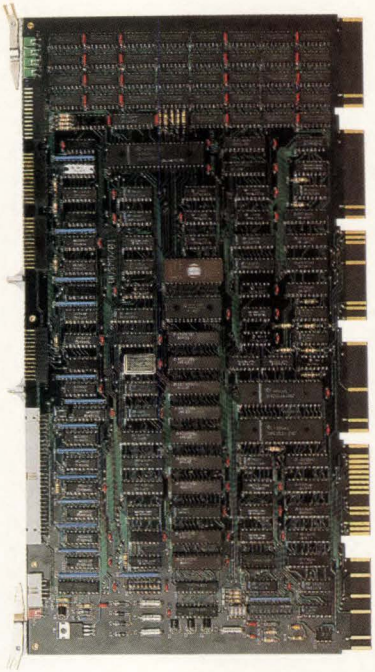
—Brad Harrison

Two Australians you're sure to know

. . . And one it will pay you to meet

THE WOMBAT, Vombatus hirsutus
The Wombat's territory ranges over the hilly and heavily timbered coastal regions of south-eastern Australia. Their ability to burrow long tunnels and bulldoze their way into the undergrowth has brought them into disfavour with farmers, yet they are inoffensive animals running for cover if disturbed. The young leave the pouch at four months.

WOMBAT is also an acronym for Webster Omnipotent Mass-storage Builder And Tester, a set of interactive, formatting and diagnostic utilities developed by Webster Computer Corporation and totally contained within firmware ROMS on Webster disc controller products.



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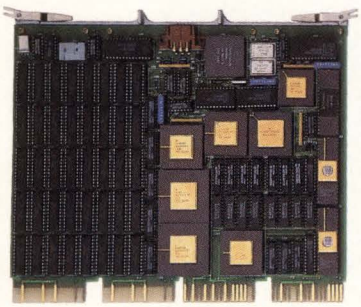

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ENTER 685 ON READER CARD

And The Winners Are. . . .

The culmination of one of the world's largest computer graphics art competitions occured on July 28 at Siggraph '87, as hundreds of invited guests gathered at an awards ceremony in the Anaheim Hilton, honoring the 25 winners of the Truevision-Raster Tech Image contest.

The contest, sponsored by AT&T's Truevision Division (Indianapolis, Ind.), Island Graphics Corp. (San Rafael, Calif.), and Raster Technologies (Westford, Mass.), received both national and international entries with subjects ranging from high tech robots to tropical ocean scenes.

AT&T's Truevision computer graphics products allow personal computer users to capture and display full color images from a video source in realtime. Island Graphics is a developer of computer graphics software and Raster Technologies develops and supplies high performance computer graphics systems.

The entries were created solely on computer equipment ranging from the common personal computer to large systems such as the Cray supercomputer. The images were divided into two types: fine art and commercial art. Winners were awarded for each type in two categories: art produced using AT&T Truevision graphics boards and art produced using other computer graphics products. Judging was on originality, composition, and creative use of graphics products.

"This year's contest attracted some of the most stunning examples of computer imagery I've seen," says Rand Schulman, vice president of corporate development for Island Graphics. "The artists who entered this contest are taking computer graphics to the creative limits."

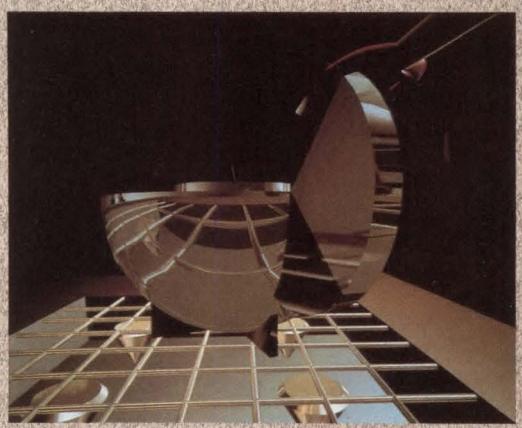
First, second, and third place winners received $2,000, $1,000, and $500, respectively. Honorable mention winners received $250. The four first prize winners were: "Cop" by Jim Hillin, "The Pour" by Alan Waxenberg, "Bubble's Beach Diner" by Cherry Simpson, and "Teapot" by Shelley Lake.

"Teapot" won first prize for fine art using any computer product. Using proprietary software along with a VAX-11/782 connected to a Cray supercomputer, Shelley Lake designed her award-winning image. All object creation and building was performed on the VAX.

Lake, a self-employed artist who holds an M.S. in Visual Studies from MIT, says she found the VAX to be "a great machine that was very reliable."

The winning entries for the contest are on display July 30 through September 30, 1987, at the California Museum of Science and Industry (CMSI) in Los Angeles. "It seems fitting that the country's largest and most popular computer graphics art contest should be featured at one of the country's most popular science museums," says Don M. Muchmore, executive director of CMSI. "One of the objectives of computer art is to make computers more accessible to a wider range of people. What better way to do it than to display this work to the thousands of people who attend CMSI every day?"

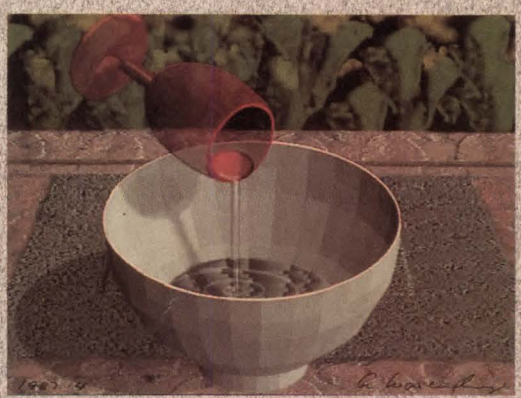
—Renee P. Brown



1st Place—Fine art using other graphics products—"Teapot" by Shelley Lake

2nd Place—Fine art using Truevision graphics products—"Roots" by Keith Ohlfs

2nd Place—Fine art using other graphics products—"South Sea Moon" by Jim Thompson



1st Place—Fine art using Truevision graphics products—"The Pour" by Alan Waxenberg

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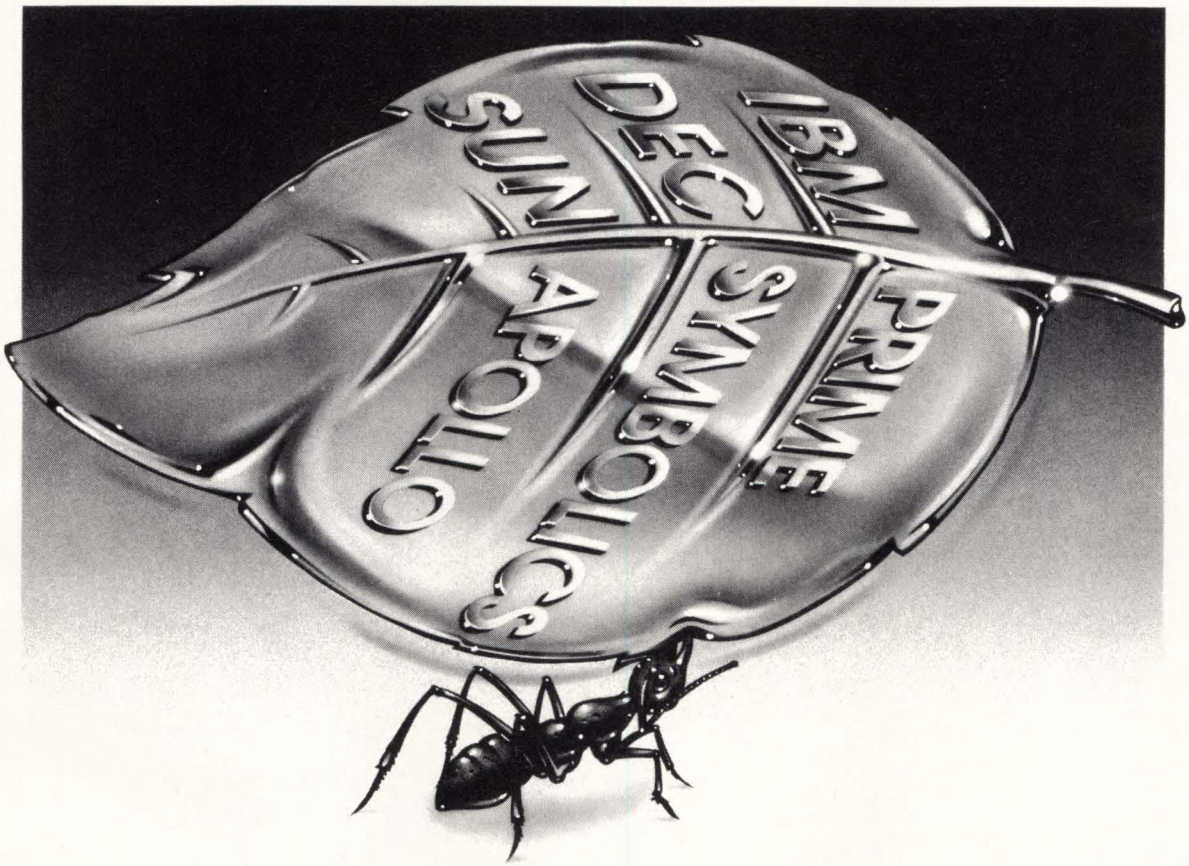

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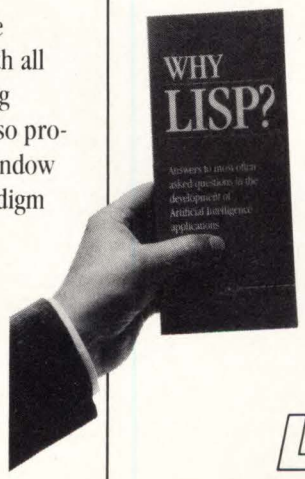

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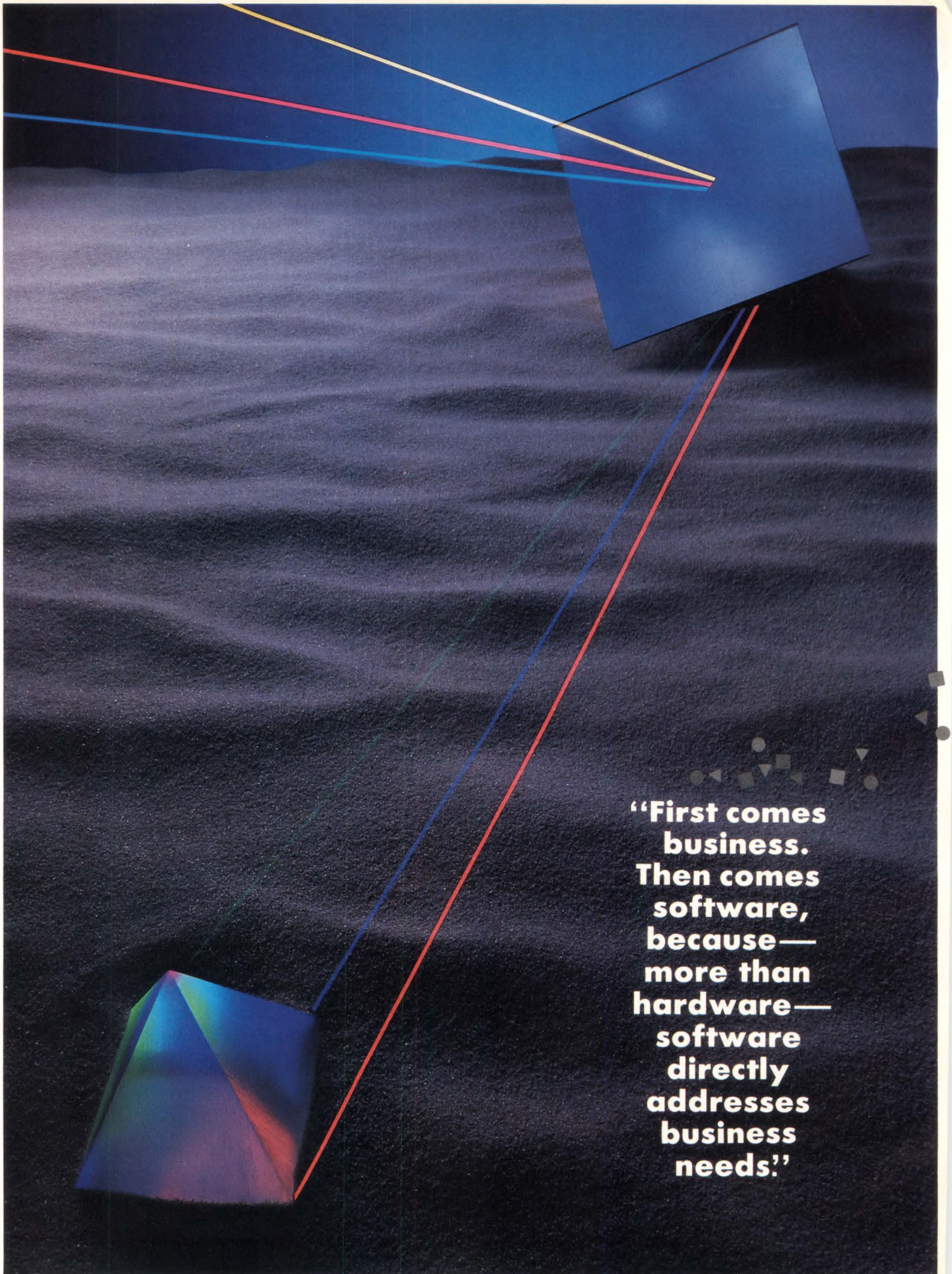

"First comes business. Then comes software, because— more than hardware— software directly addresses business needs."

CHANGING CONCEPTS IN APPLICATIONS SOFTWARE:

THE USER TAKES COMMAND

USERS REFUSE TO ALLOW THEIR APPLICATIONS SOFTWARE TO DICTATE HOW THEY DO THEIR WORK

BY JIM MEADE

NANCY FRENCH PHOTOGRAPH

Atlas Powder Corp. of Dallas is a company of 1500 employees, and the largest commercial explosives manufacturer in the country. In recent years, the onetime DuPont division has found itself growing quickly—so quickly that the IBM computer system it had in place simply could not keep pace.

Even explosives manufacturers don't like to "bite the bullet," but Atlas chose to do so in the case of its hardware and software programs. That is, Atlas opted to remove the system already in place, start from scratch, and install a new system that it hoped would never, like the old system, be unable to keep pace with business needs.

While Digital Equipment Corp. proponents might choose to make a great deal out of the fact that Atlas removed its IBM mainframes and moved to clustered Digital computers, the change in hardware wasn't as basic as the change in philosophy that led to the change in hardware.

"We went through an exhaustive planning phase," says Darwin Wolfe, director of information services. "Our planning committee was made up of all users, and our objective was to plan only what they needed." What did they need? Solutions to business problems, not solutions to data processing problems. "Atlas' computer system is a business system," Wolfe emphasizes, "not a data processing system."

To provide business solutions instead of "raw MIPS," Atlas "let the software selection be our driving force," as Wolfe puts it.

The Atlas experience reflects a major trend. First comes business. Then comes software, because—more than hardware—software directly addresses business needs. Then, dependent on the others, comes "iron." If there was a time when the sequence was the other way around—first hardware, then software, then business applications—that time has passed.

COMPLEX CHOICES

Business end users, aided by Management Information Services departments, are taking control of software decision-making. Even though they are familiar with the business problems they need to solve, the problem they face in selecting the software to solve those problems is complex. They face a multitude of choices:

- "Should we buy off-the-shelf software, or should we build our own applications?"
- "If we buy off-the-shelf, how do we decide which vendors and packages to use?"
- "If we build our own, what language do we use?"
- "Whether we build or buy, how do we maintain the programs once in place?"
- "Do we use applications generators, or do we write lines of code the old-fashioned way?"
- And of course, the final question (formerly often the first question) is: "What iron do we choose for running our software?"

In response to these needs, flexibility-conscious vendors offer both off-the-shelf and build-your-own software. They support the traditional languages like COBOL, but are developing modern fourth-generation language (4GL) alternatives, too. They offer service and support, while looking to make it easier for users to service themselves. They offer computer-aided software engineering (CASE) as an option, while providing traditional programming as well. CASE is a relatively new technology for the automation of applications development. It attempts to computerize the system analysts job, as well as provide hooks to the actual generation of code.

While most vendors debate over

whose route to "flexibility" is the best, they tend to agree that flexibility is the ideal. Business users, they agree, should decide for themselves what they need in software, rather than having software houses decide for them. The software they buy should be flexible enough to allow them to decide for themselves, and should not, as in the old days, dictate how they will do business.

DIGITAL

As prominent as anyone developing flexible software in the Digital marketplace is Digital itself. Digital's philosophy has long been "Digital sells solutions," and not "Digital sells hardware." As "solutions" comes more and more to mean "software," Digital's emphasis on software is increasing. "Digital is a software company," Digital President Ken Olsen said recently, in remarks echoed in June by Basil Harris, manager of software product managers for the company.

Considering that software is only 6.6% of total revenues for the multibillion dollar company, the statement that "Digital is a software company" may seem surprising at first. Digital insists that the remark is anything but surprising, though. Digital is "in" software.

Hardware costs are dropping quickly, Harris observes, noting that, for example, the price of a VAXstation 2000 recently dropped from $9,600 to $4,600. Prices are falling so fast, says Harris, that the hardware itself is, in effect, free to the users in comparison with software.

"The value of a computer system is in the software," Harris says. He concludes, "Digital's future is hitched to the software it produces."

Given its emphasis on software, how does a company like Digital create flexible software that will meet business needs both now and in the future? By setting firm standards, on one hand, and, on the other, allowing users freedom in building their own applications into those standards. Also, Digital can encourage outside developers to work with its standards, and is doing so with its Cooperative Marketing Program (CMP) and Systems Cooperative Marketing Program (SCMP).

Digital's firm standard is, of course, its commitment across the board to running VMS on its VAX systems. The VAX Information Architecture means

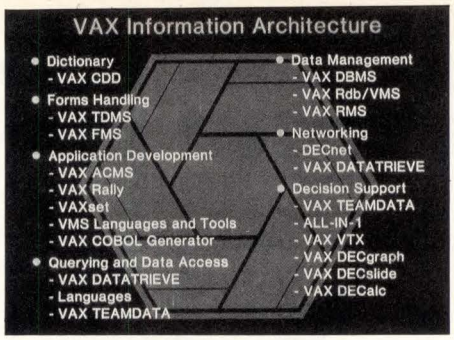


***Figure 1**—The VAX Information Architecture unifies the Digital application environment.*

that software for data management, networking, applications development, and forms handling all fit together with a data dictionary into a unified architecture (Figure 1).

On the basis of the uniform architecture comes flexibility. Users can pick the pieces of the architecture they wish to use and the software development tools they prefer. In software development, for instance, users can opt for traditional languages, 4GLs, or CASE. As CASE Product Manager Donna Slattery puts it, "All of our VAX software development tools run on all the VAXes, from the VAXstation 2000 to the largest 8000 series computers . . . Applications developed on any VAX can be run on any other VAX."

INSULATION

Other software developers, like Digital, look to combine firm standards, with adaptability to change. Cincom Systems Inc.—developers of financial software, and a Digital CMP—is one of the companies Atlas Powder's user committee selected. "We provided Atlas the migration capability it needed for the future," says Cincom's Ron Hank. "We've eliminated that barrier to change."

Originally developing for the IBM environment, Cincom, in 1975, decided to develop for the Digital environment, as well. "In 1975, our competition laughed at us," says Hank. "They said, 'DEC is a bunch of engineers. They couldn't care less about financial applications. They couldn't care less about business.' "

What Digital cared about, though, was its consistent architecture, and now that approach is reaping dividends. Cincom provides flexibility through a modular architecture of its own that provides users what Cincom terms "insulation." A company might begin by installing a financial module, and later, when it adds a manufacturing module, the two fit. Updates to one are automatically reflected in the other.

Doing all it can to remain hardware-independent, Cincom offers an application development language (MANTIS) that aims to be independent of the unique requirements of particular hardware. If someone chooses to move Cincom software from one hardware product to another (IBM-to-Digital, or Digital-to-IBM, for example), the applications level of the code remains the same. Only the machine-specific portion of the code changes.

MACHINE-INDEPENDENT CODE

Like Digital and Cincom, another developer of financial software, ISI-Interactive Systems Inc./Fasbe, takes flexibility as its guiding principle. Says Fasbe engineer Gary Neidhardt, "When someone purchases an application, 95% of the code should be just the application itself. The code shouldn't have anything to do with how or where data is stored.

"On our system, you could start with a MicroVAX and run our executables. When you upgrade to an 8200, everything runs the same. Just pick up the disk pack from one machine and move it over to the next."

Because of its flexibility, Fasbe software is another product adopted at Atlas. When Atlas decided to move from IBM hardware to Digital, it didn't have the luxury of moving its applications software with it. It had to start from scratch. Now, says Fasbe spokesman Bill Cardani, that shouldn't happen again. By changing, at most, 5% of the code, a Fasbe user on an IBM system should be able to become a Fasbe user on a Digital system.

Fasbe builds in flexibility in other ways, besides building machine-independent code. Its software is modular. You can begin with Accounts Payable, then add Accounts Receivable, then add General Ledger, and have all the modules work together. Much of the system is user-defined. The executive with no technical background can use the report writer.

Fasbe users believe they profit from the flexibility. Tom McCormack of Offshore Navigation (Harahan, La.) isn't a computer expert. He knows the financial world, and he knows oil. When he wanted to write reports with the new Fasbe system, he says, he could do it easily. Service to vendors improved so much overall under the system, he says, that he believes the software helped improve vendor relations and helped the company's bottom line.

Fasbe, unlike Cincom, isn't a Digital marketing partner yet. But it has submitted its application and is hoping to gain that status.

The theory, again, is that the CMP agreement benefits vendors and, ultimately, the customer. It becomes easier for the user to find compatible software that will fill his business needs.

Within its own software, meeting business needs is Fasbe's priority. "Our software lets you run your business the way you want to, not the way some software house thinks you want to," says Cardani.

McCormack and Dodge originally developed software for IBM computers, and now specializes in moving applications between IBM and Digital. "From the functional point of view," says John Birch, corporate vice president, "exactly the same thing happens whether you are working in the IBM or DEC environment." The software looks the same to the user.

Many departments are insisting on having their independent systems, Birch points out. Using McCormack and Dodge software, they can work on a VAX at the departmental level, then ship files for consolidation on an IBM at the corporate level.

DEBATE CONTINUES

Meeting business needs, then, is now becoming the clear-cut purpose of software. Rather than attempting to anticipate all needs, vendors are looking to provide users with the flexibility and modularity to meet needs as they arise.

Digital itself, while building in as much flexibility as it can from its own side, is also building marketing agreements with other vendors who can increase the options open to the marketplace.

Sound ideal? It may, indeed, sound ideal, and almost everyone seems to agree on flexibility as an objective. Not everyone, however, agrees with Digital on the best way to achieve the objective. In that arena, the debate goes on.

Digital's CMPs may sound like the way to increase customer options, for instance. But there are those who insist they are, in fact, a dead sure way to limit those options.

Microsystems Engineering Corp. (MEC), for instance, worked under a marketing agreement with Digital until several years ago. Then MEC's idea of flexibility came into conflict with Digital's. "DEC's philosophy is parochial," says MEC president Everett Karels. "DEC hates PCs. It doesn't want anything done on IBM PCs."

In many cases, though, the finest software and hardware for specific applications work not on the VAX but on the PC. As Figure 2 shows, Mass-11 looks to integrate the best of those products with one another and with the VAX. "I think we are the only one who can pull in a Macintosh file, edit it in our word processing, and send it out to a Postscript, Hewlett-Packard Laserjet, Epson FX, and any of the other leading printers," Karels emphasizes.

To be able to implement its own philosophy of maximum flexibility for its users, MEC had to break away from an agreement with Digital that it found restrictive.

UNIX

Cooperative marketing agreements, then, may not be the way to offer maximum flexibility to the user. Competing vendors challenge the Digital approach in other ways as well. Even VMS itself, the basis for Digital's VAX Information Architecture, doesn't seem to all software developers to be the best basis for offering the greatest number of options to users.

Syntactics Corp. felt that a UNIX-based system offered power and custom tailoring capabilities unavailable from VMS. The two standard, nonproprietary operating systems, points out Syntactics President Erwin Morton, are DOS and UNIX. As a high speed, multiuser system, UNIX offers distinct advantages to software developers and users.

Also, he adds, many UNIX-based systems go through value added reseller (VAR) channels, where the VARs build their applications into the larger applications. "You can't do that unless you give the resellers applications that are modular," he continues. "We built in that kind of functionality early," he says of the Syntactics CrystalWriter word processing software.

Digital's version of flexibility, then, isn't always the third party developer's version of flexibility. Nor, it turns out, is the vendor's description of flexibility what the user will necessarily discover when he puts a software application to use.

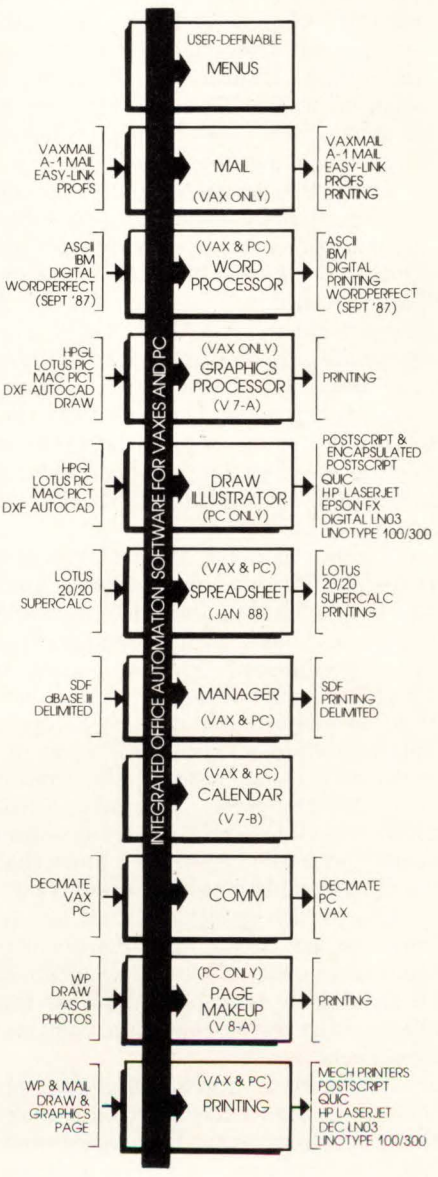
Carol Julian is a financial programmer at the *Daily News* in Los Angeles, which has McCormack and Dodge financial software in place. The company moved from its VAX-based system to an IBM-based system back to the VAX. Since McCormack and Dodge software is designed to make it easy to move from an IBM system to a VAX and vice versa, the transfers should have been easy.

But that was not altogether the case. "The McCormack and Dodge people who customized the software for DEC were IBM people, not that knowledgeable about DEC," Julian says. Some of the job control procedures suitable for IBM do not work well for Digital, for instance. "We don't allow our operators [running software on the VAX originally designed for the IBM] to submit McCormack and Dodge jobs," says Julian, "because they would tie up their terminals."

USER PROGRAMMING

Overall, then, it still may not be as easy as software vendors say it is to move from IBM to Digital and back, or,

***Figure 2**—Unlike Digital's applications product line, the Mass-11 family of applications stress the PC as strongly as the VAX.*



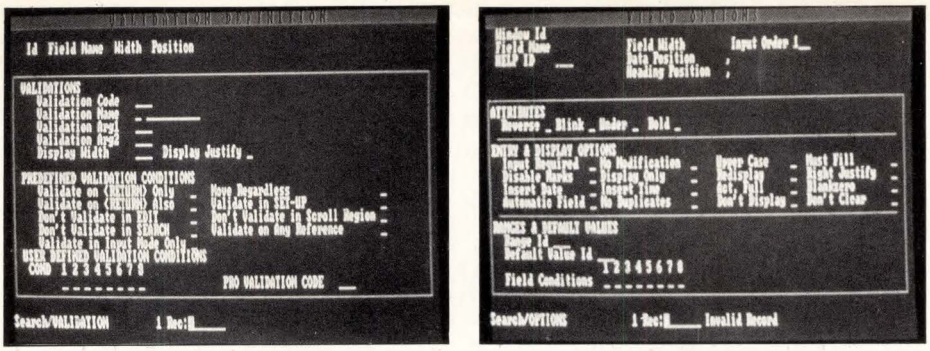


Figure 3—*RDM's user interface uses a nonlanguage "fill-in-the-forms" approach.*

for that matter, from any operating system to any other or from any hardware system to any other.

'Flexibility' may not be all, in practice, that vendors say it is. 'User-defined programming,' another form of flexibility offered by Digital and others, may not altogether live up to vendor billing. Digital, for instance, is proud of its new VAX COBOL generator that allows users to create COBOL programs by manipulating icons.

There are users who are pleased with the COBOL generator. Dick Bailey, manager of computer information services for Great Northern Paper in Maine, wanted to allow users to do more for themselves. The COBOL generator has proven to do that successfully in situations where the MIS department didn't have time to help. For example, the security department needed a program to track license plates, and successfully wrote the program it needed.

Another popular applications generator, RDM from Interactive Technology Inc., addresses basically the same application, but with a nonlanguage 4GL development tool. According to President Roger Brown, RDM's fill-in-the-forms approach (Figure 3) opens applications generation technology to a wider user base without dominating computer resources: "You have to look at the results in relative terms—time saved using this type of tool more than offsets any additional resources used.

Brown also points out that the generic nature of applications development technology allows applications to be seamlessly transported across machines. With RDM, the actual code is of no concern to users.

But modern applications development tools aren't necessarily a panacea for programming needs. Programmers like those at Fasbe insist "We write our programs the old-fashioned way." CASE, say critics, is guaranteed to ease software development and, at the same time, use all of your computer resources. "We do it in COBOL" is the righteous slogan of a generation of programmers, who insist they can write prototypes in COBOL just as quickly as others might write them in a 4GL. Once written, they insist, their old-fashioned programs use computer resources efficiently, where the generated applications don't.

While almost everyone agrees that 'flexibility' and 'modularity' are requirements in modern software, then, everyone disagrees on how to reach the objectives.

VMS is Digital's standard, but advocates of UNIX and DOS say that it isn't the best standard, so all developers don't begin at the same baseline as Digital.

The cooperative Marketing Programs, says Digital, is the ideal way to expand the range of Digital marketing offerings compatible with VMS. But CMPs, say critics, put unnecessary restraints on the marketing partners, who are free to offer only what Digital doesn't want to offer. (And, the critics continue, the partners only have the unfettered opportunity to offer it until Digital itself has had the chance to develop a competing product.)

Additionally, 4GLs, which some say free users from the need for programming, may, in fact, eat up valuable computer resources and provide solutions for only the simplest applications.

Even the decision by Digital to become truly a "software company" may not bring true solutions to many of the buyers in the Digital marketplace. Arthur Martin, president of Computer Covenant Corp. had a blunt answer when asked what applications software from Digital was useful to him. "We don't look at DEC," he says. "They're difficult to deal with. And software on the VAX is very expensive. We don't use DEC applications software."

No single solution, not even from Digital, appeals to all users. Nevertheless, the history of software development is that, one way or another, vendors respond to the needs of the marketplace. Now that the marketplace is agreeing on the objective—providing business solutions with software that is flexible—it is increasingly developing software that truly is flexible and meets user needs.

Vendors of applications software are finding their individual ways to create flexible software that meets business needs. Because they have a common objective, the vendors are finding themselves with more in common, in spite of themselves.

Smart buyers, like Atlas Powder, may still not find all the flexibility they want. But they are finding more than they did in their previous software systems. The new systems may not be so flexible that they will never become obsolete, but they promise to be much more flexible than the old systems that said, "Do it our way, or do it manually."

Jim Meade is a Hardcopy *contributing author.*

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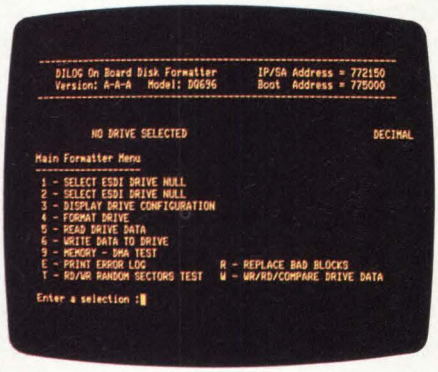

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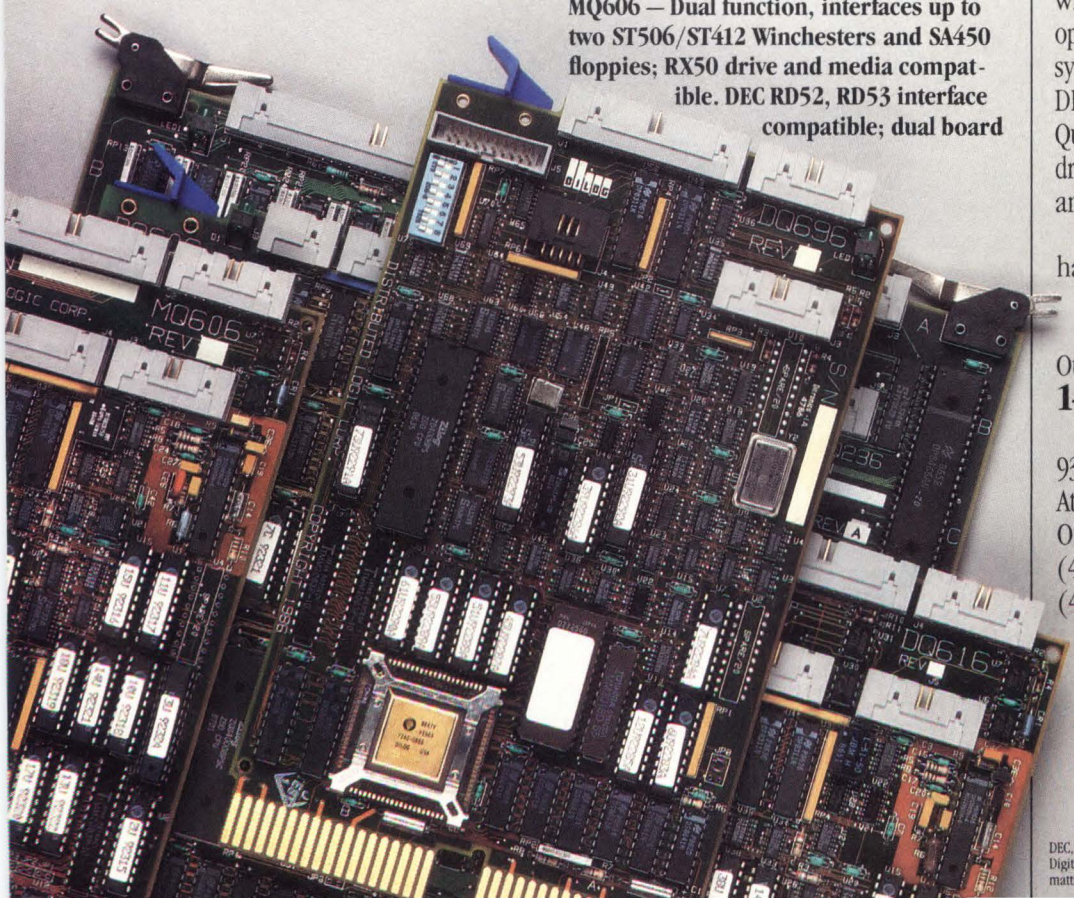

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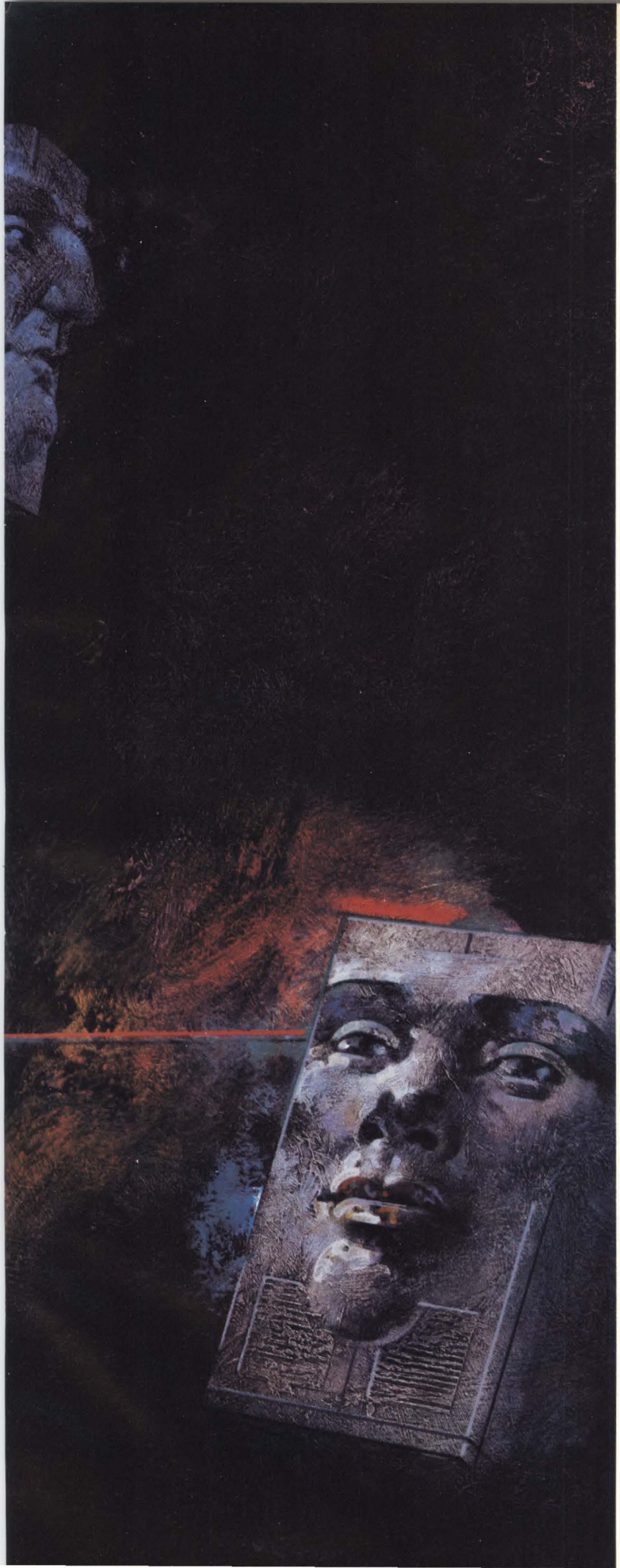

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BY DAN LADERMANN
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The best solution is a combined system that offers both VMS and UNIX compatibility for application software, and is supported by complete and transparent connectivity between Digital and UNIX systems. Unfortunately, Digital has been fairly slow to support such 2-tier interoperability. But third party vendors have been steadily filling the void, and organizations in today's computing environment can find a variety of products to help them connect VMS to UNIX systems in a wide range of configurations to support their par-

Dan Ladermann is vice president of advanced products for the Wollongong Group Inc.

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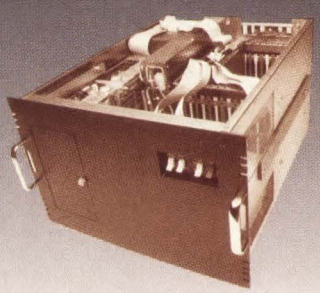
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ticular business objectives and strategic requirements.

THE IMPORTANCE OF UNIX

There are three main reasons for the increasing importance of UNIX-based products to organizations primarily built on VMS-based systems.

First, UNIX is widely acknowledged as one of the most powerful development systems available. Second, many of the newest and most powerful workstations require a UNIX environment, and yet reach their full potential for the organization only when connected to existing VMS resources. Third, the networking protocols common in UNIX provide the most practical approach to communications between heterogeneous hosts, and appear likely to provide the easiest and best migration path to international standards now on the horizon.

The advantages of UNIX for application development are widely recognized and acknowledged. The operating system offers unmatched capabilities for rapid prototyping, modification, source code control, completion of applications, and full portability of completed applications and data files as hardware requirements evolve.

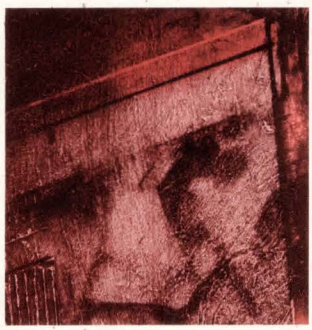
Organizations with expanding needs for processing power tend to be very attracted to the concept of portable applications. This is because application portability like that of UNIX supports relatively simple migration to larger, faster, and more powerful computer systems, with no need to sacrifice the heavy investment in established and functional software.

As a kind of corollary, its power as a development environment means that UNIX-based workstations tend to offer the advanced capabilities that organizations want most, and it's the one non-Digital operating system they must support if they wish to remain competitive through advanced automation capabilities.

Many of the most exciting and important new tools—from CAD/CAM terminals to parallel processing architectures—become available first in UNIX-based systems. Although much of the early work in CAD/CAM was done on VAXes, today's most powerful graphics workstations, for example, are based on UNIX. UNIX is the operating system of choice for today's most advanced fourth-generation languages (4GLs), and for artificial intelligence and expert systems shells and applications. Organizations that insist on remaining single-vendor shops fall further behind the cutting edge of sophisticated and powerful automated support of essential business activities.

NETWORKING ACROSS VENDOR LINES

The critical reason UNIX has become virtually indispensable, and will probably become more so in the near future, is its standardization on transmission control protocol/interrupt protocol (TCP/IP) networking protocols, which are currently the closest to an international nonproprietary networking standard. In terms of pure connectivity, UNIX is beginning to outdistance other operating systems in long, rapid strides. With off-the-shelf products, UNIX has the power to provide immediate data communications and networking among a wide variety of heterogeneous processors.



"The best solution is a combined system that offers both VMS and UNIX compatibility...."

The newest versions of UNIX are more attractive than ever because they contain some important and highly useful advanced features. For example, certain UNIX implementations contain a powerful concept called Distributed File Systems (DFS). Simply stated, DFS provides transparent file system interoperability, even among heterogeneous hosts. It will allow files, sub-directories, and other resources attached to one host on a network (or an interconnection of many separate networks) to be utilized by other hosts exactly as though they were local resources.

In the UNIX world, there are currently two major standards for DFS implementations: Network File System (NFS) from Sun Microsystems Inc. and Remote File System (RFS) from AT&T used in UNIX System V Release 3.

DFS is now available for the VAX/VMS environment in the NFS form. With this implementation, a UNIX-based workstation using NFS can access files on a remote VAX as easily as those on its own hard disk. This is considerably more convenient and powerful than either copying a VMS file to a UNIX disk manually or using the UNIX workstation to log on to the VAX to access a file, which also requires the user to work within VMS rather than UNIX.

As currently implemented, NFS makes it possible for several different hosts on a combined UNIX-to-VMS network to share a file system as though the disk drive were directly connected to each of the remote hosts accessing it. The NFS connection is established by "exporting" the file system to the network and "mounting" it to a remote host. If parts of a directory tree are exported, the various sub-directories can be mounted anywhere in the network. Because the applications or end users needn't know the resource is in another building or another city, the networking considerations become totally transparent. At one stroke, DFS greatly simplifies distributed file systems and makes networking less of a headache for applications developers.

Under NFS, the UNIX workstations can access the same files on the VAX, transforming the VAX into an effective file server and paving the way for transparent networking for currently standalone applications.

The power of the DFS concept and other advanced UNIX-to-VMS connectivity features rest on the networking protocols most commonly used with UNIX.

INTERNATIONAL STANDARDS

By far the dominant networking protocol in UNIX is TCP/IP, a suite of communications protocols and interface standards first developed more than a decade ago and strictly maintained as a public domain standard by the U.S. Department of Defense, the National Science Foundation, and others.

TCP/IP is currently supported by more than 100 vendors, and is utilized in countless products running on virtually every size and type of hardware, from Cray supercomputers through VAXes and MicroVAXes to PCs and portables. In all these products, however, TCP/IP presents the same basic user interface, responds to the same control sequences, and offers the same suite of services: remote log on (TELNET), file transfer with automatic translations as necessary (FTP), and electronic mail (SMTP).

The constancy and simplicity of

TCP/IP reflect its maturity, and mean that users, network administrators, system integrators, and application developers working in UNIX or VMS can count on TCP/IP for a uniform and stable set of standards and interfaces among products for the widest possible range of heterogeneous hardware, operating systems, and link levels.

Normally, a VMS/DECnet system is limited to communications with other VMS/DECnet hosts, while hosts using other protocols may communicate with each other, but not with DECnet hosts. The effect is as if VMS/DECnet systems are physically separated from hosts using other protocols. But with the addition of TCP/IP, all hosts can be integrated into a single internet, and communicate with each other as though linked on a single cable, even though they may be physically connected to separate networks.

Already a mainstay of today's multivendor communications networks, the layered nature of the TCP/IP protocol suite and its status as the leading nonproprietary protocol in the world seem likely to combine to make this the best vehicle for adapting VMS/DECnet systems both to UNIX in the near term and to emerging international networking requirements and standards in the longer term. The two connectivity issues go hand in hand.

One must acknowledge that the current proposals and drafts for the International Standards Organization's Open Standards Interconnect model (ISO/OSI) will certainly settle into a set of standards stable enough for vendors to develop products for the market. As that occurs, organizations that have already established UNIX-to-VMS communications using TCP/IP as the backbone protocol will be in much the best position to migrate to the new international standards.

VMS CONTINUES STRONG

Despite all the reasons UNIX is enjoying an increasingly important role in today's networking picture, VMS and DECnet cannot and should not be abandoned. Proprietary protocols with hooks into the native operating system are almost always able to offer richer functionality and a greater range of features than a necessarily more generic nonproprietary communications method. Thus, among Digital systems, VMS and DECnet will continue for some time to outperform UNIX and TCP/IP in certain critical areas.

One example of where VMS excels is in time-sensitive applications. VMS is well-suited to realtime control of machines and manufacturing processes, an area where UNIX is intrinsically weak because of its architecture and design. Coupled with this difference are a great many third party packages for direct numerical control of machines doing milling, for example, with virtually no comparable applications available in UNIX.

Another area of VMS pre-eminence is scientific and research-oriented applications. Here users can find numerous applications packages under VMS supporting symbolic arithmetic and other important functions for physicists working with particles, for example, while UNIX offers a very limited selection of such application packages.

"One of the most powerful methods of achieving UNIX-to-VMS connectivity is the meta-port approach...."

Digital-intensive installations like the one at the Stanford Linear Accelerator Center have only microseconds to collect vast quantities of experimental data. Scientists there and in many research installations generally prefer to work under VMS, which supports data acquisition packages capable of gathering megabytes of information generated within a very short time frame. Although the same work can theoretically be accomplished with custom software developed under UNIX, the practical aspects of research designs, time pressures, and budgetary constraints makes VMS a much more desirable laboratory environment.

A third applications area of great practical interest to user organizations centers around financial functions. This includes everything from accounts receivable and payable to ordinary payroll and cash management systems. Applications such as these, necessary for the day to day operations of any large organization, can be chosen from a much broader selection under VMS than under UNIX.

But even in financial functions, the desire for a simple, reliable link between UNIX and VMS quite frequently arises. Most often, users want UNIX because it provides a very good set of tools for financial analysis and management. UNIX-based workstations can create the full range of reports, charts, and graphs that managers want much easier than most VMS workstations. But to do so, they need access to the database in the Digital environment. One commonly finds an organization using VAXes, DECnet, and specific VMS applications to control a factory, for example, but wanting special-purpose UNIX workstations to share the corporate data and centralized resources.

For all these reasons, connectivity between VMS and UNIX remains a vitally important issue for thousands of Digital shops in all types and sizes of organizations.

DEC ATTEMPTS AT CONNECTIVITY

Surprisingly, Digital has accomplished relatively little in support of general connectivity between VMS and UNIX, despite taking several different approaches to this area of user concern.

First, Digital offers a set of tools for VMS systems, called VNX. These tools don't actually run under the UNIX operating system. But they provide a small group of UNIX and UNIX-like utilities that users can apply within their VMS environments. VNX includes a C-compiler, a utility similar to *make*, and a series of source code control utilities.

One problem with VNX is that its availability tends to confuse the market. The tools it contains are close enough emulations of UNIX for many people to think VNX provides or requires UNIX in a Digital hardware environment. Actually, VNX merely emulates UNIX tools within VMS, and doesn't provide real connectivity between VMS and UNIX. Its main advantage is to make some of the more popular UNIX toolset capabilities available to VMS users.

A second and better-known Digital approach to UNIX-to-VMS connectivity is to support its proprietary DECnet controls under Ultrix. Ultrix is Digital's proprietary native-port offering of a UNIX operating system for Digital machines. It's a native-port because it's

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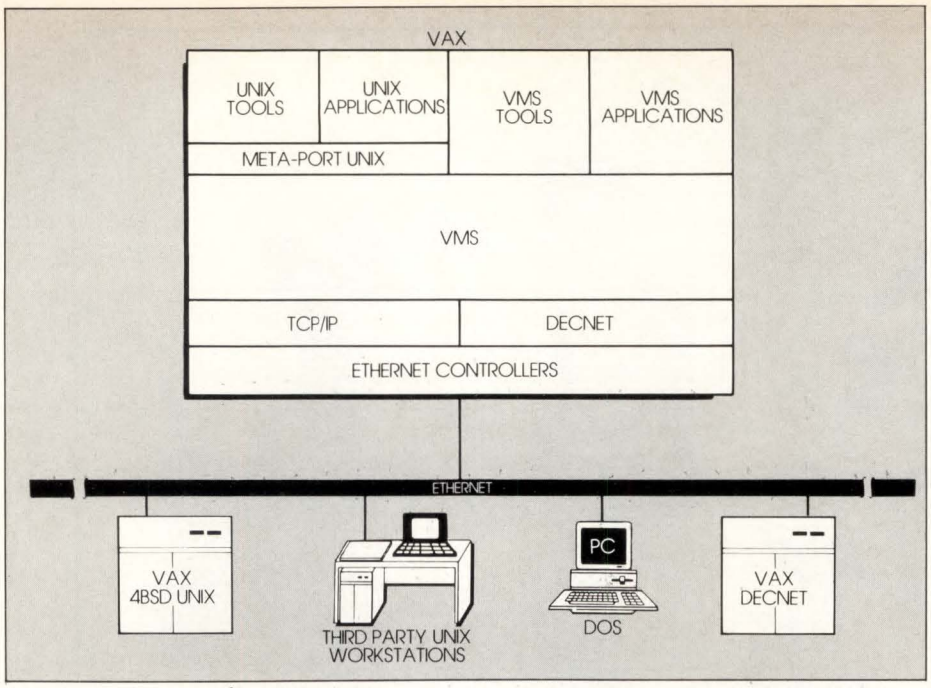

Support of multiple industry standards—*Running concurrent UNIX, VMS, TCP/IP, and DECnet provides the VAX with full communications/distributed processing capabilities.*

intended to work directly with the hardware environment, as a full alternative to VMS.

Mistakenly perceived by a great many user organizations as a pure native-port of UNIX BSD 4.2, Ultrix actually contains a number of important features that are compatible only with Digital hardware. This approach to UNIX-to-VMS connectivity, in effect, limits rather than expands the possibilities for sharing data and resources, because the differences between Digital's Ultrix and other vendors' versions of UNIX mean that VMS can communicate only with Ultrix, not the UNIX community at large.

The only way to make a connection between VMS/DECnet and generic UNIX using TCP/IP, in fact, is to go outside the family of Digital offerings and install third party products specifically designed for that job.

Digital's third approach to UNIX-to-VMS connectivity is to market a third party product (WIN/TCP, developed by The Wollongong Group) that provides UNIX-to-VMS connectivity by adding the TCP/IP protocols to Digital's standard VMS. Once WIN/TCP is installed, users can employ TCP/IP to tie VMS, Ultrix, and nonDigital standard UNIX hosts together over any one of several DECnet compatible networking links.

THIRD PARTY ALTERNATIVES

But many VMS/DECnet user organizations remain dissatisfied with the limitations of Ultrix and with Digital's approach to UNIX-to-VMS connectivity. As a result, they are turning more often to third party vendors that are heavily committed to TCP/IP. In many cases, they are discovering these vendors offer a variety of ways to better share the power and resources of UNIX and VMS facilities.

For example, one class of third party products provides VMS/DECnet systems the full power of the UNIX standard protocol (TCP/IP) without compromising existing DECnet communications. Such products can co-exist with DECnet and share such important hardware resources as the DEUNA and the DELUA on Unibus machines, and the DEBNT on VAXBI machines.

Implementing the TCP/IP suite of networking protocols on Digital hardware within VMS immediately provides important UNIX-to-VMS connectivity benefits to user organizations. For example, standard DECnet applications and resources can communicate with such popular UNIX-based CAD/CAM and software development tools as Sun and Apollo Computer Inc. workstations.

Such third party, TCP/IP-based networking products permit Digital systems to communicate with Data General, Cray, Control Data, Cybers, Pyramid, and a great many other UNIX machines. The result is a virtual "internet" that permits user-to-user and user-to-application connectivity between any of the Digital or nonDigital hosts linked by this method—capabilities that Digital couldn't previously provide through either VMS- or Ultrix-based DECnet.

At NASA-Ames (Mountain View, Calif.), for example, a variety of DECnets and nonDigital Ethernet LANs are connected by means of TCP/IP into a unified internet that permits users on any of the Ethernet-supported workstations to communicate transparently across the DECnets to TCP/IP users on other networks. The linkage is accomplished transparently by software that encodes the TCP/IP packets in standard DECnet packets at the entry gateways, and transmits them normally to the appropriate exit gateways, where complementary software strips off the DECnet headers and routes the packets onward across TCP/IP networks to their final destinations.

NEWEST DEVELOPMENTS

Because of the widespread support for the TCP/IP standards, networks with thousands of heterogeneous nodes are well-established and fully functional. But the vitality of the third party market keeps leading to new and more powerful UNIX-to-VMS communications capabilities.

The most important change in this area is the addition of domain addressing to TCP/IP networks. Under this addition to the protocol, "name servers" within each logical domain contain all routing information for dozens of other hosts. The name servers provide something akin to directory services, so users outside the domain can address E-mail or other messages to a user without knowing a physical or host address. The network automatically takes care of message routing.

META-PORT UNIX

One of the most powerful methods of achieving UNIX-to-VMS connectivity is the meta-port approach to implementing UNIX on VMS systems.

This approach is different from the Ultrix native-port approach, which installs a version of UNIX as the native operating system of the hardware. Instead, the meta-port installs UNIX within existing VMS, and maps all UNIX system calls directly into the unmodified VMS kernel. For example, when users issue the UNIX OPEN command to reach a file, the resident meta-port software automatically translates this call to the analogous VMS service QIO.

The meta-port approach to implementing UNIX on Digital hardware makes all the power and flexibility of UNIX available to VAX/VMS users without any need for installing extra

hardware or supporting excessive overhead processing.

A significant advantage of a UNIX meta-port is the availability of the unmodified VMS, which ensures continuous support for all Digital devices currently installed, and should also support new installations planned for the future. For example, the full power of VMS remains available to support clusters of Digital processors, and can be used to provide the realtime machine control that so many user organizations require. No native-port UNIX, such as Ultrix, is able to support clusters, and, in fact, no such capability is currently planned for UNIX or anticipated.

Organizations heavily invested in Digital systems are rapidly recognizing the need for a broad-based approach to connectivity. Simple connectivity has long been available within DECnet and VMS, but organizations seeking to use external resources and facilities realize they must now find new ways to transcend these limits and obtain the best of both worlds.

The meta-port provides one of two very useful approaches to expanding the limits of connectivity, while retaining the strengths of the VMS system. By adding UNIX via the meta-port technology, existing Digital resources in a single host can support UNIX applications and utilities. For example, software developers can work within the meta-port and make use of the UNIX program and document development system, a valuable facility for simplified programming and interface consistency, while still having all the VMS tools and facilities available when they want them.

The combination of meta-port and TCP/IP supports a truly broad-based connectivity environment for both users and computers. Communications with a variety of other processors become relatively easy because users of systems with both the meta-port and TCP/IP can capture or access the files they want on any VMS or UNIX remote host. In addition, applications using either of the two operating systems can send information whenever necessary from UNIX to VMS processors, or vice versa, across the network or within a single host.

A combined system such as this supports communications and common applications with virtually every other host in the organization, using either VMS or UNIX, TCP/IP or DECnet, as necessary. It can support powerful UNIX-to-VMS connectivity, and it simplifies operations and enhances the organization's use of VMS and UNIX resources, without sacrificing the power and continuity of VMS and DECnet.

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AVOIDING BUSINESS DISRUPTIONS CAN OUTWEIGH NEW TECHNOLOGY BENEFITS

DON'T TRADE IN THAT DECSYSTEM ...YET!

BY EVAN BIRKHEAD

While DECsystem-10/20s are no longer the leading-edge mainframes they once were, they continue to be attractive for many time-sharing applications. A recent survey conducted for CompuServe Data Technologies—a division of CompuServe (Columbus, Ohio)—shows that almost 50% of DECsystem sites plan to keep their hardware active for at least 3 yrs.; 25% of these sites plan to keep their hardware active for more than 5 yrs.

Deciding whether to stick with these machines or switch is difficult. Hardware costs are low, but maintenance costs are rising—and Digital Equipment Corp. plans to phase out maintenance at some point. Often, the ultimate decision is influenced more by investments in software than by standard measures of performance.

THE 36-BIT BOOM

The DECsystem line originated with Digital's first 36-bit system, the PDP-6, introduced in 1964. This 36-bit architecture (see Figure) was situated to gain market share from IBM, which was phasing out its 36-bit machines. The mid-60s also saw the leading edge of the baby-boom generation enter college, which plays an important role in DECsystem history.

The PDP-6 was created to fill the need for a long word length machine for scientific applications left by the demise of IBM's 7094. Digital was set on word lengths that were multiples of 6 bits: the 18-bit PDP-4, and the 12-bit PDP-5 minicomputers. The 36-bit architecture, besides being a logical next step, was well-adapted to FORTRAN and the LISP symbolic processing language.

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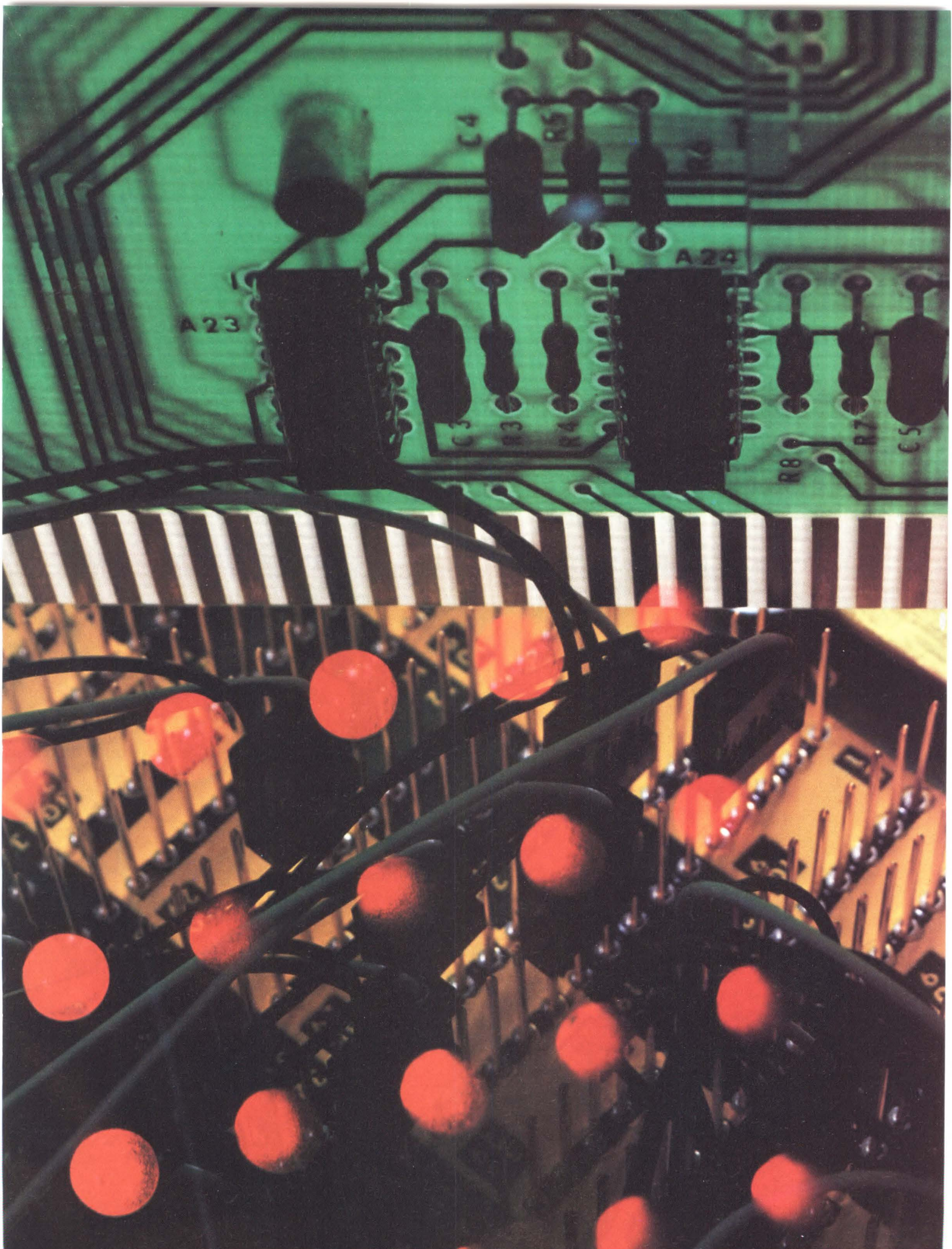
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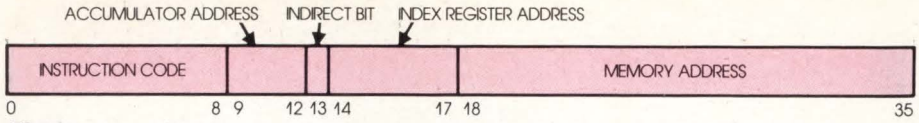

***Figure**—The DECsystem 36-bit instruction format is simple and consistant.*

Only 23 PDP-6s were actually sold, but they led to the "10" series of 36-bit processors. The KA-10, three times faster, was introduced 3 yrs. later, followed at approximately 3-yr. intervals by the KI, KL, and KS processors. Tens span a wide range of sizes: the KL-10 is a 100-user system up to 30 ft. long; the KS-10, typically a 6- to 10-user system, is the size of a refrigerator.

The DECsystem-10 is a "10" with the TOPS-10 time-sharing operating system, which evolved directly from the PDP-6's original monitor. The DECsystem-20, a virtual memory system, uses TOPS-20, originally called Tenex (TEN EXtended). Digital acquired the rights to Tenex from its developers, the Cambridge, Mass. firm of Bolt, Beranek, and Neuman, and continued its evolution to TOPS-20.

Estimates of the number of DECsystem processors installed range upward from Digital's official estimate of 1103. Complete systems sold for more than $1 million. The KL-10 processor alone sold for upwards of $750,000.

Because of their suitability for scientific research and multiuser timesharing, DECsystems were (and still are) used in college and university computing centers. Countless numbers of students received their first taste of online computing with Digital hardware. Not coincidentally, many of these young men and women are the MIS managers and senior programmers of today.

It was against this backdrop that Digital made its now-infamous announcement abandoning 36-bit architecture. In 1983, Digital cancelled work on "Jupiter," a proposed 10 millions of instructions per sec. (MIPS) successor to the KL. The company announced decisions to stop developing 36-bit software in 1988 and to stop supporting 36-bit equipment in 1993.

Digital decided to concentrate on the 32-bit architecture used in its VAX line, introduced in 1978. "We didn't want two architectures," says a former DECsystem salesman who is now selling VAXes at Digital. "The market and the sales force were confused, it was hard to educate users, and the 1-2 yr. sales cycle for DECsystems was seen as inefficient and risky." Digital began to promote integrating DECsystems with VAXes, and eventual total migration.

FALLOUT FROM 'JUPITER'

Since Jupiter's cancellation, the assets of the DECsystem hardware have become more sharply visible, even within Digital itself. At a user panel on converting from TOPS-10/20 to VAX/VMS presented at the Fall 1983 DECUS meeting in Las Vegas, panelist Dave Doxey of DEC Information Services (Digital's internal MIS group) described his experiences transferring DECsystem applications to VAXes: "We have some processes that were written on the 10s and 20s that aren't the most efficient in terms of coding and systems design. But they've been getting by because of the compute power of the large machines. When they're done the same way on the VAX, [inefficiencies] become a lot more obvious. A lot of times, CPU firepower can just overwhelm bad code."

CompuServe, one of the world's largest information utilities with more than 360,000 subscribers, has an exceptional investment in DECsystems, with 43 of them running in two centers. Sixteen of CompuServe's systems are KI-10s; the remainder are KL-10s originally sold as 2060s, but running under CompuServe's proprietary TOPS-like operating system CSMS.

***DECsystems galore**—Compuserve hardware includes 43 DECsystems and one Systems Concepts mainframe.*

Alexander (Sandy) Trevor, CompuServe executive vice president, support services, has overall responsibility for CompuServe's mainframes. "Someday," he says, "retaining DECsystems will not be cost-effective." However, for the next several years he actually expects to purchase additional KL-10s in the secondary market.

DECsystem software vendors report a growing user base. For example, many applications are written in CompuServe Data Technologies' System 1022—by far the most popular database program for DECsystems. System 1022 was written in DECsystem macro assembler for the TOPS environments and is 13 yrs. old; the most recent release occurred in June 1987. Yet, since Digital's 1983 announcement, the number of DECsystems running System 1022 has increased 47%.

Some of these software installations were only recently acquired systems, according to Dennis Lynch, president of Merida Trading Inc., a supplier to the Digital secondary equipment market. "Why not?" he asks. "You'd have to get a VAX 8600 for almost $500,000 versus $100,000 for a full-blown 10 that'll do the same job. And there's lots of that equipment out there."

BEYOND PRICE/ PERFORMANCE

For the DECsystem site trying to decide whether to switch, price/performance measurements inevitably must be addressed. Unfortunately, though easily quantified, price/performance doesn't turn out to be the deciding factor for most organizations.

Price comparisons are usually made against VAX, which is the most commonly mentioned hardware alternative. The cancellation of the DECsystem product line created a large secondary market whose prices favor the DECsystem: $50,000-$70,000 for a complete reconditioned DECsystem-2065, against more than $400,000 for a new VAX 8600. Used KL-10 processors are available for less than $5,000, and used KS-10 processors have sold for $500.

The comparison is reversed for maintenance, if you buy it from Digital. Currently, maintenance for a DECsystem typically runs 25-35% more than

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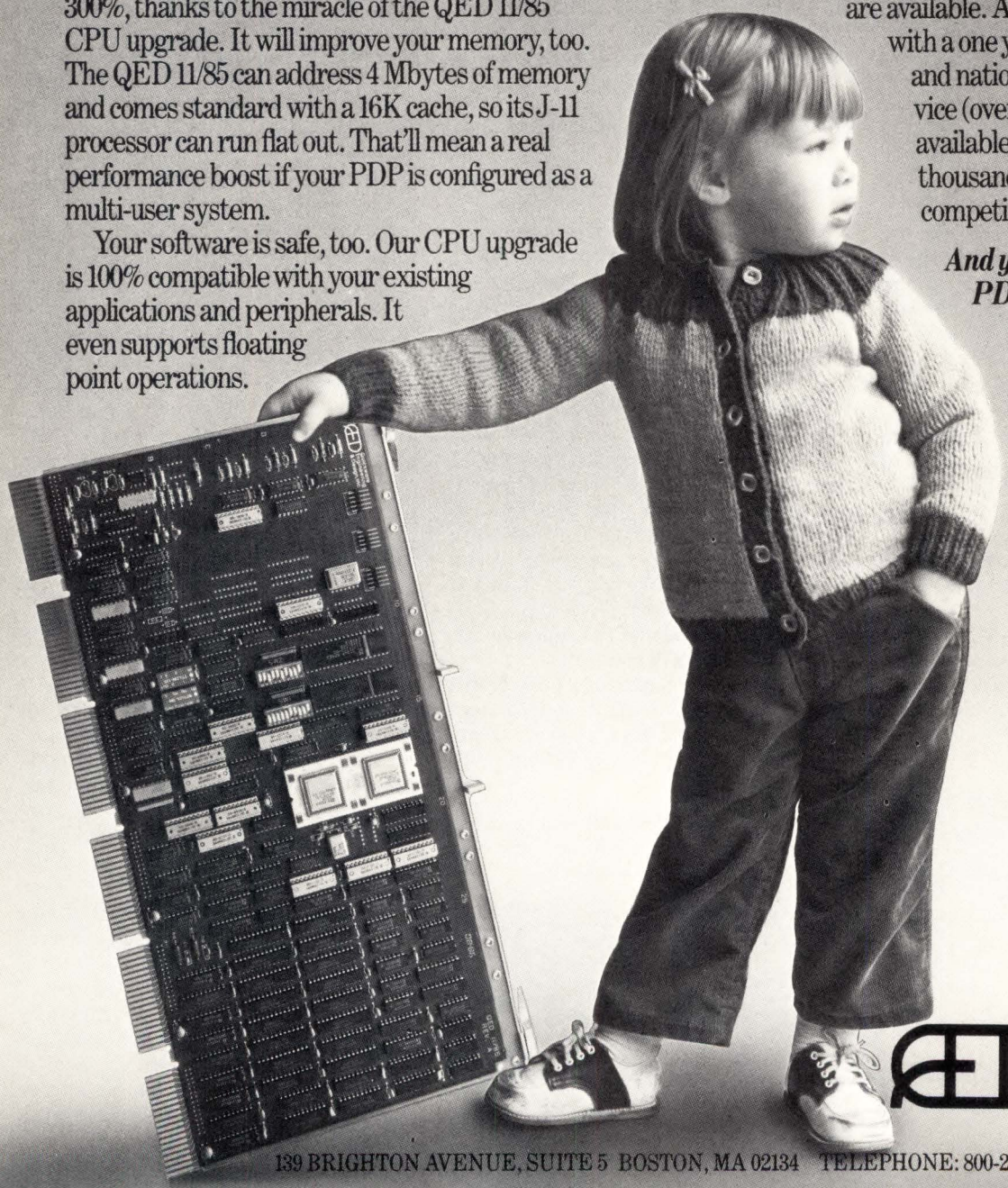

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VAX. But Merida's Lynch points out that third party maintenance is generally available at prices 15% less than Digital's.

At the CompuServe DECsystem site, maintenance is handled completely in-house for even greater savings. Moreover, the company enhances the hardware, often to the point of upgrading it beyond what might be expected from a newer, different system. These enhancements can be made available to other DECsystem users.

For example, CompuServe developed various channel adapters and interfaces to IBM and other nonDigital peripherals that, in some cases, increase DECsystem I/O performance 3-4X. CompuServe also replaced the power supply on KL-10 processors with a more modern modified linear supply. The replacement unit not only halves the cost of electricity required by the processor but, by reducing heat generated, also saves on air-conditioning.

Standard measures of performance, the second part of the price/performance ratio, are available but less useful. Where the DECsystem-2065 cranks out 1.8 MIPS, the VAX 8600 provides 4.75. Standard language benchmarks, like Whetstone, give the VAX a significant edge, as much as 4:1 in single-user tests. However, DECsystem users contest the real-world applicability of these measures. (Some quip that MIPS stands for "Meaningless Index of Processing Speed.") "MIPS doesn't really mean beans," says Paul Treece of SOHIO, at the 1983 Fall DECUS. "The 2060 is only a 1 MIPS machine. Why do I get seven times the performance on it than I do on a 780, which is also a 1 MIPS machine?"

Experienced DECsystem managers don't minimize the value of the price/performance ratio. They just add in some price factors that may be less obvious. CompuServe's Trevor says that price/performance is exceptionally important, but he points out that the equation must include software development, and investments in software typically grow faster than investments in hardware. Because of CompuServe's enormous investment in existing software, "It would be less effort today to build our own DECsystem-like hardware than to re-do our software for a new machine," says Trevor.

Based on this judgement, Trevor already has on site a KL-10 clone called the SC-30, from Systems Concepts Inc. If the SC-30 works out, it could extend the life of CompuServe's 36-bit applications indefinitely.

PROGRAMMING PREFERENCES

Comfort with DECsystem software—both systems software and custom applications—is the reason most often cited for sticking with the hardware. "The hardware may make them dinosaurs," says the former DECsystems salesman, "but the software makes them friendly."

Consultant Mark Crispin has been involved with DECsystems for more than 14 yrs., and for the past 18 mths. has had one installed in his home. As a systems designer and programmer, his achievements include a major role in developing MM, a proprietary DECsystem-20 mail system. "The KL offers a delightful program environment," he says, "one that's even fun to program in." Specific features cited by Crispin include the KL's symmetric machine instruction set, the programmer's ability to use the DECsystems' entire address space, and the DECsystems' user interface—particularly its editing

tools like EMACS (Editor MACros). "Only now is VMS offering what TOPS users have had for years," he adds.

Many programmers favor TOPS over any other Digital operating system. Tom Knight was a 10-yr. Digital employee and member of the VAX 8600 design team, and today is an engineering group leader at EMC Corp., a manufacturer of expansion products for IBM, Prime, Hewlett-Packard, Wang, and Digital minicomputers. "I cut my teeth on TOPS-20 and for friendliness it leaves VMS and UNIX in the dust," he says.

SOFTWARE SATISFACTION

A survey of more than 100 DECsystem sites was recently conducted for CompuServe Data Technologies. Of those respondents planning to keep their hardware for at least 3 yrs., more than 50% report that they plan active software development or maintenance.

So major third party software companies continue to develop and support their DECsystem-compatible products almost as if nothing has changed. "It would be a poor business decision not to continue development," says Lorraine Schulz, vice president of NCP Co. The company's NCP Calc was the first DECsystem-10/20 spreadsheet, introduced in 1982 and now in its eighth version. In the 18 mths. following the DECsystem cancellation, NCP developed three new releases of NCP Calc, "proving we are serious, that there is still a market," says Schulz. Recent add-ons provide financial modeling and graphics capabilities.

DECsystem users reap the benefit of the software vendors' continued support. The latest version of System 1022 DBMS supports variable-length text fields, provides a link to popular PC packages like Lotus 1-2-3, and expands data set size from 262,000 records to 134 million records—a number unthinkable in the early days of DECsystem hardware.

IF NOT NOW, WHEN?

Does switching from a dependable, fully amortized environment ever make sense? Chad Hansen, responsible for technical support at 3M's internal time-sharing center in St. Paul, Minn., currently watches over 19 DECsystem-20s, the last purchased 2 yrs. ago. Since then, he has bought mostly VAXes and PCs. He has no plans to buy more DECsystems, and expects to dispose of those he has. He is experimenting with converting System 1022 database applications to its VAX sister product, System

1032 DBMS/4GL.

Rather than centralizing computer operations, 3M encourages its internally competitive research groups to experiment with their own unique approaches. Hansen supports systems as varied as standalone PCs and workstations, local resource-sharing on departmental processors, mixed-vendor LANs, and micro-to-mainframe links. Consequently, Hansen's mission is to "stay light on his feet," striving for flexibility rather than stability.

For managers like Hansen (to whom nothing is stable), no system is likely to remain in place for more than a few years. But 3M and Hansen are hardly typical. For DECsystem users whose applications are more stable, he says, "Stay with the DECsystems."

A good number of DECsystem sites agree. They find no urgent need to change what already works well. On the horizon are white knights like Systems Concepts hardware clones. Packaged software suppliers like NCP's Schulz feel that "there's still money to be made" among the users that remain.

And there's that unquantifiable affection that a generation of programmers has for the venerable DECsystem. As one cheerfully predicted, "This machine will see the tick of the new century."

Evan Birkhead is Hardcopy *East Coast editor.*

Was the information in this article helpful to you in the performance of your assigned responsibilities?

Very helpful	**Enter No. 532**
Somewhat helpful	**Enter No. 534**
Not very helpful	**Enter No. 536**

The following vendors were mentioned in this article

CompuServe Data Technologies
(formerly Software House)
1000 Massachusetts Ave.
Cambridge, MA 02138
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EMC Corp.
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Hopkinton, MA 01748
617-435-2541
Enter No. 101

Merida Trading Inc.
P.O. Box 3067
Woburn, MA 01888
617-933-6790
Enter No. 102

NCP Co.
694 Portofino
Foster City, CA 94404
415-572-2490
Enter No. 103

Systems Concepts Inc.
55 Francisco St.
San Francisco, CA 94133
415-984-1000
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3M
3M Center Bldg. 220-9E-02
St. Paul, MN 55144
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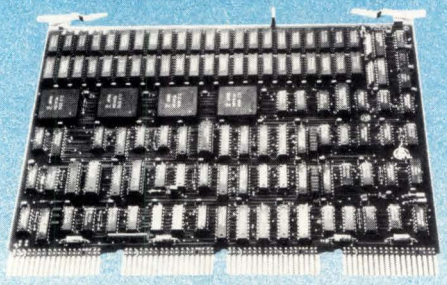

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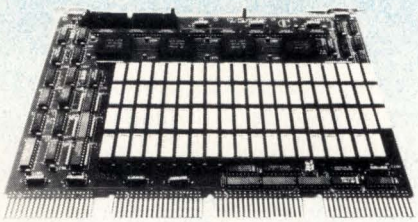

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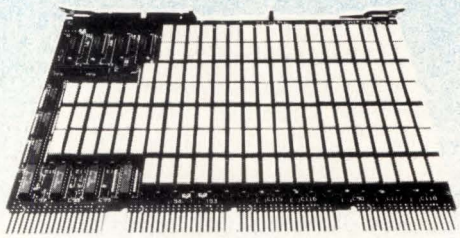

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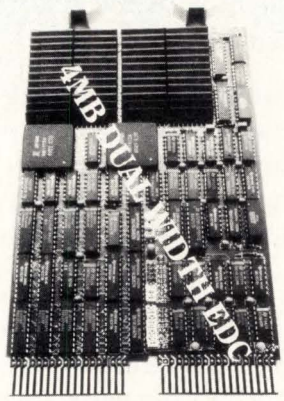

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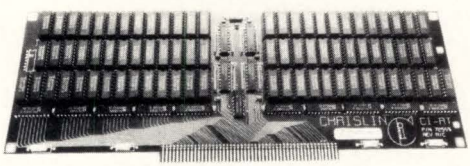

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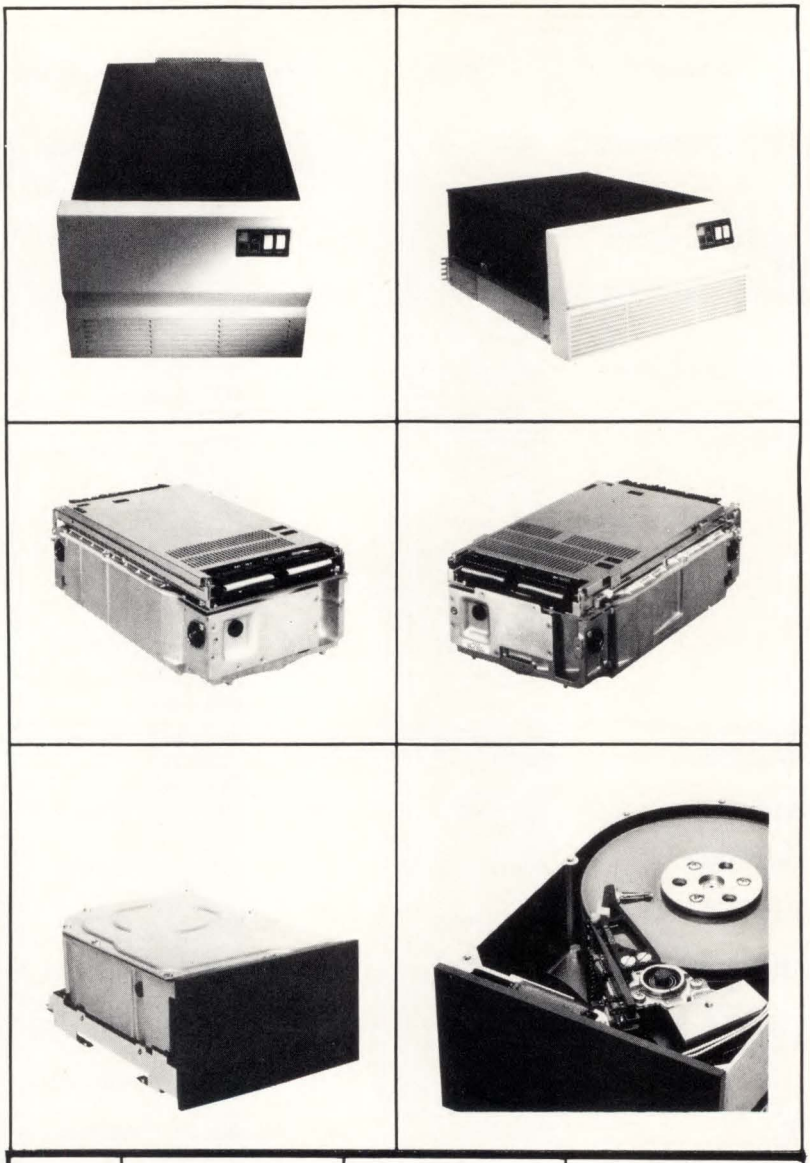
PDP AND VAX DATABASE MANAGEMENT SYSTEMS

Company	Product	Price	Operating System(s)	Data Model	Query Language	File Structure Characteristics (Maximums)			
						Characters/ Field	Fields/ Record	Records/ File	Files/ Database
ADVANCED DATA MANAGEMENT INC.	DRS	$12,000-$72,000	VMS	Hybrid with both relational and network modes	QML (proprietary)	4000	1000	100 million	64
AFFORDABLE TECHNOLOGY GROUP	EZbase	$3,500	VMS	ISAM	Proprietary	256	No limit	No limit	No limit
APPLIED INFORMATION SYSTEMS INC.	EasyEntry (data entry/ data management system)	$500-$10,000	VMS, RSX, RSTS	RMS indexed files	Proprietary or Datatrieve	Screen width (80 or 132)	1200	No limit	No limit
AUTOMATED SYSTEMS INC.	Easy Base II	$695-$2,990	VMS, TSX, UNIX, System V, Ultrix	ISAM	INP	30	108	No limit	No limit
BRITTON LEE INC.	BL300 Series	$22,950-$124,950	VMS, UNIX System V, UNIX 4BSD, Ultrix	Relational	SQL, IDL (QUEL)	255	254	No limit	32,768
	BL700 Series	$164,950-$239,950	VAX/VMS, UNIX System V, UNIX 4BSD, Ultrix	Relational	SQL, IDL, (QUEL)	255	254	No limit	32,768
	BL8000 Series	$395,000-$674,000	VAX/VMS, UNIX System V, UNIX 4BSD, Ultrix	Relational	SQL, IDL (QUEL)	255	254	No limit	32,768
BRS INFORMATION TECHNOLOGIES	BRS/Search Full-Text Retrieval	$20,000-$80,000	VMS, UNIX System V, UNIX 4BSD	Inverted	Proprietary	No limit	No limit	No limit	No limit
CANALTA	Lazer DBMS	$3,470-$18,000	VMS	Network	Interactive DML utility	65,016	65,535	1 billion	128
CINCOM SYSTEMS	Ultra Relational DBMS	$20,000-$99,000	VMS	Relational	Spectra (proprietary)	4090	4088	No limit	1024
COGNOS	PowerHouse	POR	VMS	Relational, ISAM	Proprietary	2048	1024	No limit	No limit
COMMAND BUSINESS SYSTEMS INC.	Structure/4	$19,700	VMS	Relational	Proprietary (SQL-like)	32,000	1000	No limit	No limit
COMPUSERVE/DATA TECHNOLOGIES	System 1022	$16,000-$72,000	TOPS-10/20	Relational-like	PL1022 (proprietary)	5000	3000	134,000,000	64-80
	System 1032	$8,000-$115,000	VMS	Relational-like	Proprietary	32,767	3000+	2,147,483,647	32
CRI INC.	Relate/DB	POR	VMS	Relational	Proprietary (SQL-like)	256	127	No limit	No limit
CULLINET SOFTWARE INC.	IDMS/SQL	$3,000-$140,000	VMS	Relational	SQL	3992	255	No limit	No limit
DATA ACCESS CORP.	Dataflex	$695-$1,800	VMS, UNIX System V	Relational	Proprietary	255	255	16,777,215	250
DATA LANGUAGE	Progress	$695-$19,500	VMS, Ultrix	Relational	Progress (proprietary)	2000	2000	No limit	1000
DATA RETRIEVAL CORP.	TextDBMS	$32,200-$155,000	VMS	ISAM, sequential	Proprietary	230 characters/ line	65,000 lines/ document	2 billion documents/ database	
DB/ACCESS INC.	Enhansys	$9,000-$49,000	VMS	Relational	Proprietary, SQL	130	300	No limit	100
ESCA Corp.	Habitat	$12,500-$110,000	VMS	Hierarchical, relational	None	INP	INP	INP	INP
GEMSTONE COMPUTER SERVICE	Ledgr	$200	RT-11	Proprietary	Proprietary	80	20	999	No limit
HENCO SOFTWARE INC.	Info-DB+	$15,000-$75,000	VMS	Relational	SQL, Intuitive Query Language - IQL (proprietary)	32,767 for nontext fields, no limit for text fields	32,767	No limit	50
INFORMATION ACCESS SYSTEMS INC.	Intelligent Text Management System (ITMS)	$7,500-$125,000+	VMS, UNIX System V, UNIX 4BSD, Ultrix	Combination of B-tree, inverted, keyword, proprietary AI-based associative index	Natural language	No limit	No limit	No limit	No limit

The Smart Buyer's Guide to Quality Disk Drives



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PDP AND VAX DATABASE MANAGEMENT SYSTEMS

Company	Product	Price	Operating System(s)	Data Model	Query Language	File Structure Characteristics (Maximums)			
						Characters/ Field	Fields/ Record	Records/ File	Files/ Database
INFORMATION BUILDERS INC.	Focus	$6,800-$88,500	VMS, UNIX System V	Shared relational	INP	256	No limit	No limit	No limit
INFORMATION DIMENSIONS INC.	DM	$15,000+	VMS	Relational	Proprietary	16,100	500	2 billion	4000
INFORMATION STRUCTURES INC.	Base/OE	$13,500-$36,000	VMS, RSX	Relational, ISAM, hierarchical	Proprietary	255	255	2 million	No limit
INFORMIX SOFTWARE INC.	Informix-ESQL/C	$595	VMS, UNIX System V, Ultrix	Relational	SQL	32,000	No limit	No limit	No limit
	Informix-SQL	$795	VMS, UNIX System V, Ultrix	Relational	SQL	32,000	No limit	No limit	No limit
	Informix-4GL	$995	VMS, UNIX System V, Ultrix	Relational	SQL	32,000	No limit	No limit	No limit
	C-ISAM	$225	UNIX System V, Ultrix	ISAM	INP	32,000	No limit	No limit	No limit
INMAGIC INC.	Inmagic	$13,500	VMS, RSTS, RSX	Flat file	Boolean	No limit	75	No limit	No limit
INTEGRATED PLANNING INC.	Stratagem	$20,000-$115,000	VMS	Relational, multi-dimensional	Proprietary, SQL	No limit	No limit	No limit	No limit
INTERACTIVE SOFTWARE SYSTEMS	User Data Management System (UDMS)	$5,000-$17,000	VMS	Relational, Indexed, Relative, Sequential	Proprietary	255	256	No limit	No limit
INTERACTIVE TECHNOLOGY INC.	RDM: The Application Developer	$895-$39,000	VMS, RSX, RSTS, TSX, RT-11	Relational	Nonlanguage Query by forms, processes and reports	255	220 or 2048 bytes/record	16 million+	No limit
INTERBASE SOFTWARE CORP.	InterBase	$2,000-$75,000	VMS, Ultrix	Relational	SQL, GDML (Datatrieve-like)	32,000	16,000	No limit	16,000
LANDMARK SOFTWARE SYSTEMS INC.	X-ample	$20,000-$60,000	VMS	Relational	Menu-driven, proprietary, SQL	80	1000	No limit	10,000
LOGICAL SOFTWARE INC.	Logix	$2,000-$15,000	UNIX System V, UNIX 4BSD, Ultrix	Relational	Q (proprietary)	128	60	No limit	No limit
MICRO DATA BASE SYSTEMS INC.	KnowledgeMan/2	$3,995+	VMS, Ultrix	Relational	SQL-like (proprietary)	65,534	255	2 billion+	No limit
	MDBS III	$7,000+	VMS, Ultrix	Extended Network	Proprietary	65,535	No limit	No limit	N/A
	Guru	$17,000-$60,000	VMS, Ultrix	Relational	SQL-like (proprietary)	65,535	No limit	2 billion	No limit
MICROSYSTEMS ENGINEERING CORP.	Mass-11 Manager	$5,750-$8,625	VMS	Relational	Proprietary	1000	256	65,000	10
NATIONAL INFORMATION SYSTEMS	Accent R	$12,000-$99,500	VMS, TOPS-10/20	Relational	Proprietary	30,000	12,000	No limit	No limit
OFFICE SMITHS INC.	The Officesmith	POR	UNIX System V, Ultrix	Hierarchical with relational links	Proprietary	No limit	No limit	No limit	No limit
ORACLE CORP.	Oracle	$6,000-$100,000	VMS, Ultrix	Relational	SQL	240	255	No limit	No limit
PREVAIL SYSTEMS INC.	Prevail	$3,600-$12,000	UNIX 4BSD, Ultrix	Relational, hierarchical	Proprietary, SQL	5000	No limit	No limit	No limit
RELATIONAL TECHNOLOGY INC.	Ingres	$900-$140,000	VMS, Ultrix	Relational	SQL, QUEL	2000	127	No limit	No limit
RHODNIUS INC.	Empress/32 & M-Builder	$4,000-$100,000	VMS, UNIX System V, UNIX 4BSD, Ultrix	Relational	SQL	2,147,483,647	9999	2,147,483,647	9999

POR—price on request; INP—information not provided.

PDP AND VAX DATABASE MANAGEMENT SYSTEMS

Company	Product	Price	Operating System(s)	Data Model	Query Language	File Structure Characteristics (Maximums)			
						Characters/ Field	Fields/ Record	Records/ File	Files/ Database
RIM TECHNOLOGY INC.	RTIRIM	$2,000-$7,000	VMS, UNIX System V, UNIX 4BSD, Ultrix	Relational	Same as public domain RIM-5, some proprietary features	1000	100	No limit	No limit
ROSS SYSTEMS	Maps/DB	$15,000+	VMS	ISAM	Proprietary	132	97	8,338,607	No limit
RUF CORP.	IMPRS	INP	VMS	Relational	Proprietary	255	200	No limit	No limit
SATURN SYSTEMS INC.	Saturn-Base	$1,850-$14,000	VMS, TSX, RSX	Relational	Report Generator Language - RGL (proprietary); also provides menu-driven query utility	132	Maximum of 10,000 characters/ record	500,000	No limit
SEED SOFTWARE CORP.	Seed DBMS	$12,000-$113,000	VMS	Network	Proprietary	254	3000	INP	INP
SIGNAL TECHNOLOGY INC.	Smartstar/BL	$5,000-$55,000	VMS	Relational	SQL	255	250	2,000,000	32,000
	Smartstar	$3,500-$50,000	VMS	Relational	SQL	255	32,000	2,000,000	32,000
SIR - A DIVISION OF ISI	SIR/DBMS	$3,000-$80,000	VMS, Ultrix	Relational, hierarchical, network	SQL, PQL (proprietary)	255	4095	2 billion	32,767
SOFTWARE AG	ADABAS	$25,000-$105,000	VMS	Relational, inverted list	Natural, Supernatural, AdaSQL (all proprietary)	253	500	16.7 million	255
SOLUTIONS UNLIMITED	Giant/8	$295	COS-310	Relational, flat file	Fill-in-the-blanks menu panels	50 alpha, 15 decimal, 24 key	99	99,999	No limit
	Giant/8W	$780	COS-310	Relational, flat file	Fill-in-the-blanks menu panels	50 alpha, 15 decimal, 24 key	99	99,999	No limit
SYBASE	Sybase	$10,000-$100,000	VMS	Relational	SQL	255	250	No limit	2 billion
THOROUGHBRED SOFTWARE	Thoroughbred Idol-II	$2,895	VMS	Relational	Proprietary	255	99	8,000,000	No limit
3CI INC.	Infocen	$4,995-$69,900	VMS	Relational	ISQL (proprietary)	70 bytes fixed, 70,000 bytes variable	No limit	No limit	No limit
TIMELINE INC.	Digibase	$3,000-$9,000	VMS, RSTS	ISAM	Proprietary	512	128	No limit	N/A
TOUCH TECHNOLOGIES	Intouch	$1,500-$40,000	VMS	All	Guided Query Language (proprietary)	16,384	1000	No limit	99
UNIFY CORP.	Accell Integrated Development System	$4,500-$39,000	UNIX System V, Ultrix	Relational	SQL	No limit	256	2 billion records/ database	256 tables/ database
	Accel/CP	$5,500-$45,000	UNIX System V, Ultrix	Relational	SQL	No limit	256	2 billion records/ database	256 tables/ database
	Unify RDBMS	$3,000-$30,000	UNIX System V, UNIX 4BSD, Ultrix	Relational	SQL	No limit	256	2 billion/ database	256 tables/ database
UNIPRESS SOFTWARE INC.	Unipress ZIM	POR	UNIX System V, UNIX 4BSD, Ultrix	Entity-relationship	Proprietary, SQL	No limit	No limit	No limit	No limit
USERWARE INTERNATIONAL	Userbase	$7,500-$60,000	VMS	Relational, ISAM	IDML (proprietary)	32,767	32,767	No limit	No limit
	User-11	$7,500-$15,000	RSTS	Relational	Proprietary	1024	255	2,000,000	No limit
	Gemini	$7,500-$90,000	VMS	Relational	SQL	65,535	No limit	No limit	No limit
Zanthe Information Inc.	ZIM	$3,110-$47,370	VMS, UNIX System V	Entity-relationship	SQL, ZIM 4GL (proprietary)	32,000	16,000	No limit	No limit

The vendors listed in this buyers guide responded to a survey conducted by Hardcopy. *To be included in the* Hardcopy *PDP and VAX DBMS database, please contact Cindy Grant-Thurman at: 714-632-6924.*

ADVANCED DATA MANAGEMENT INC.
15 Main St.
Kingston, NJ 08528
609-799-4600 **Enter No. 136**

AFFORDABLE TECHNOLOGY GROUP
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San Diego, CA 92121
619-450-0833 **Enter No. 137**

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500 Eastowne Dr. #207
Chapel Hill, NC 27514
919-942-7801 **Enter No. 138**

AUTOMATED SYSTEMS INC.
3900 W. 12th
Sioux Falls, SD 57107
605-335-3636 **Enter No. 139**

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408-378-7000 **Enter No. 140**

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800-235-1209 **Enter No. 141**

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403-236-6100 **Enter No. 142**

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513-662-2300 **Enter No. 143**

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617-535-1328 **Enter No. 144**

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714-259-7351 **Enter No. 145**

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617-661-9440 **Enter No. 146**

CRI INC.
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408-980-9898 **Enter No. 147**

CULLINET SOFTWARE INC.
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Westwood, MA 02090
617-329-7700 **Enter No. 148**

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Miami, FL 33186
305-238-0012 **Enter No. 149**

DATA LANGUAGE
47 Manning Rd.
Billerica, MA 01821
617-663-5000 **Enter No. 150**

DATA RETRIEVAL CORP.
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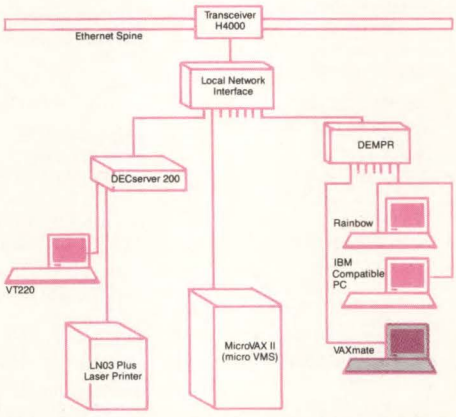

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VAXmate Engineering Team's Challenges And Resolutions

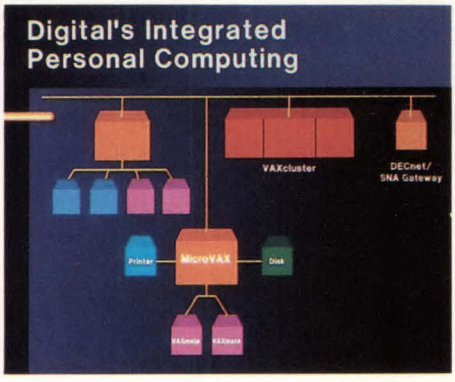
Designing an MS-DOS device that truly integrates/by Tony Troppito [Digital Equipment Corp.]

In late '84 and early '85, Digital Equipment Corp.'s top management wrestled with the question of how to integrate office desktops into the VAX/VMS DECnet environment. VAX/VMS and DECnet had made Digital number one in midrange computing and the vendor of choice in technical markets.

But the office desktop was the domain of the IBM PC architecture. With LANs looming as a major force in the future of office automation, Digital was poised to be the leader in networking individuals with each other and with the computers in their back room. A major obstacle to this was running the applications desktop computer users wanted. And, in 1985, it was clear these applications ran on IBM PCs or compatibles.

Digital concluded that creating a strict IBM PC clone wasn't sufficient for its existing customers. These users wanted a seamless integration of the desktop computer into their corporate computing environments. Digital customers wanted to run VAX/VMS applications from the same terminal or workstation that ran IBM PC applications. After all, who wants two monitors and two keyboards—one for the VAX and one for the PC? Besides, they wanted that nice Digital keyboard. They liked being able to move files from one computer system to another with a simple copy command. They loved their electronic mail. And, of course, they wanted all this and more while they were using Lotus 1-2-3 or dBase.

All of this meant designing a way to integrate IBM PC application support with VAX/VMS, DECnet, and VT200 family terminals in a manner that didn't drive a user bonkers trying to determine what keys to strike. To accomplish these desktop integration decisions, the VAXmate design team focused on several key areas of desktop and VAX/VMS computing including running off-the-shelf PC applications, the user interface into PC and VAX/VMS environments, system management, networking, and terminal emulation. Terminal emulation provides desktop computer users their closest and most obvious interaction with the VAX/VMS environment. Terminal emulation also provided or factored into the major design challenges faced by the VAXmate engineering team; challenges centered around integrating the desktop computer into the VAX/VMS systems environment. This article describes these challenges and their resolution.



Typical configuration—*With a VAX or MicroVAX as the server, users can tap into the full capabilities of a network and supporting hardware, VAXclusters, DECnet/SNA gateways, LAN Bridge 100s, and more.*

The VAXmate Personal Computer

The VAXmate is more than a standalone personal computer. It's a computing environment that allows the user to interact with Digital's VAX/VMS and DECnet distributed computing systems from within many popular applications and Microsoft Corp.'s MS-DOS and MS-Windows environments.

The VAXmate is a desktop computer that integrates Intel's 80286 CPU chip in the same package with a built-in, high resolution monitor, 10-Mbit Ethernet network port, 1.2-Mbyte floppy disk drive, 1 Mbyte of RAM memory, an RS-232 compatible serial port, a Digital serial printer port, dedicated slots for options such as a Hayes compatible 300/1200/2400 modem, 2 Mbytes of additional memory, and an extended ROM BIOS that includes emulation of the IBM PC/AT. In addition to all this, the system is completed with an extended version of Digital's VT200 family keyboard, a mouse, an optional expansion box that houses a hard disk, and two IBM PC/AT compatible expansion slots.

The hardware system is a compatible superset of the standard IBM PC/AT personal computer. The VAXmate is designed to provide a user with a powerful interface into Digital's distributed computing environment and to closely integrate personal computer applications with the VAX/VMS file system and system management features.

Tony Troppito was one of the design engineers at Digital Equipment Corp. during the development of the VAXmate.

Figure 1—*MS-Windows provides an easy-to-learn and easy-to-use environment for new and experienced users alike.*

The basic software environment of the VAXmate consists of an operating system based on, and fully compatible with, Microsoft's MS-DOS, a customized version of Microsoft's MS-Windows user interface and operating environment, and Digital's DECnet-DOS networking software. Layered on the DECnet-DOS network software is an implementation of Microsoft Networks, which allows access to the VMS file system from the MS-DOS system and allows all MS-DOS data to reside on the VAX. An emulation of Digital's VT220 terminal runs within the MS-Windows user interface. And an emulation of Digital's VT240 terminal runs on top of the MS-DOS operating system and can be initiated from within the MS-Windows user interface.

Through the terminal emulators and the DECnet software, the VAXmate user has virtually transparent access to a variety of large system networked services. These services include electronic mail, relatively unlimited disk storage, shared data between individual users and applications, centralized system management, centralized backup of files, and use of local and mainframe applications and utilities for accomplishing the task at hand.

The VAXmate Design

Melding personal computing architectures and Digital's VAX/VMS and DECnet architectures into a single system required addressing a number of challenges.

The first concern was to run applications designed to execute on the IBM PC/AT under the IBM PC-DOS operating system. This meant correctly running most off-the-shelf software designed for the IBM PC family of desktop computers. No VAXmate-specific software yet existed; consequently this yet-to-be-developed software could be written to compensate for shortcomings found in the PC architecture. Therefore, whenever a choice was made between looking like an IBM PC/AT or looking like a Digital system, the default was to look like the IBM system and add the Digital extension in a manner that could be turned on later under user or software control.

To accomplish this, the underlying IBM hardware, ROM BIOS, and character set architectures were emulated. The VAXmate development team accomplished this by paying close attention to IBM's published definitions of compatibility in the design of the VAXmate hardware and ROM BIOS, being careful not to infringe on IBM's patents or copyrights. When the VAXmate system first powers on and loads the MS-DOS operating system, it appears to the software to be an IBM PC/AT clone. The extensions in the area of memory, keyboard, video resolution, and character sets are available for use by software written to take advantage of them. But they don't interfere with the execution of standard PC applications.

User Interface

Another challenge was to create a user interface that provided an easy-to-learn and easy-to-use environment for new and experienced personal computer users alike (Figure 1). This user interface had to support the use of the system as a standard IBM PC/AT and as a terminal into the VAX/VMS environment. Further, Digital users wanted access to both environments simultaneously. To compound the issue, windowing environments were the wave of the future and a new workstation that didn't support a windowing environment wasn't going to elicit much excitement from the user community. The MS-Windows operating environment was selected as the cornerstone of this user interface. This environment was extended with the addition of enhanced keyboard support, 640 pixel wide x 400 pixel high video resolution, use of Digital's 3-button mouse as a pointing device, and a close integration of the Windows' printing services, serial communication line, and file system with the DECnet network.

The choice of MS-Windows as the standard user interface also allowed the VAXmate development team to design the Online User Information System, which provides extensive information about using the VAXmate. It runs as an MS-Windows application and uses standard MS-Windows conventions. This unique "help" system allows users to view information on a topic in one window when they have encountered a problem in another. For instance, if you are running the VT220 emulator on the VAXmate and encounter a question, you can pull up the Online User Information System in another window for the answer. This system is menu driven for easy access, and an MIS staff can customize its contents for particular applications.

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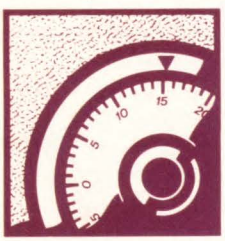

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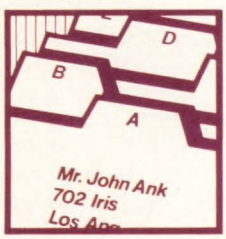

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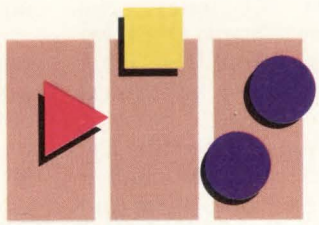

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VAX/VMS And DECnet Integration

A third challenge was providing close integration of the VAXmate system into the VAX/VMS and DECnet environments. VAXmate system users needed access to the powerful application set and system management functions of VAX/VMS. VAXmate system users and VAX/VMS users located on the same network needed to share data and information.

To tie the VAXmate workstation into the VAX/VMS DECnet network meant integrating Ethernet, DECnet-DOS, and Microsoft's MS-Network in the same system. The Ethernet network hardware port and controller are built into the VAXmate. The Ethernet device drivers and the hardware-specific layers of DECnet are in the VAXmate's ROM BIOS. Microsoft's MS-Network is actually a thin layer of interface code that uses Digital's DECnet-DOS to provide network services to MS-Network compatible applications. Digital applications including network management tools use DECnet-DOS directly. A version of Digital's Local Area Transport (LAT) can be invoked as an MS-DOS terminate and stay resident program. The LAT software allows the VT220/240 terminal emulator applications to communicate with VAX/VMS applications using the Ethernet in place of a serial communication line.

Network Performance And Memory

The addition of many unique features to the VAXmate presented another challenge to the VAXmate development team—performance. When an MS-DOS machine draws so many resources from the network, decreased performance can be a serious issue.

One way the development team increased the VAXmate's network performance was in designing its own Ethernet controller. By including the Digital proprietary LANCE chip on the controller, the design team achieved higher efficiency. The LANCE chip alone controls all Ethernet protocol, avoiding the need for multiple chips and additional software.

The LANCE chip architecture also provides a unique feature not found in many other Ethernet controllers and boards available on the market today. That is LANCE allows the user multiple buffers for reception and transmission of data onto the Ethernet wire. Most packet transmissions come in bursts (that is, several back to back), because the VAX sends data to the VAXmate faster than the VAXmate can receive and process the data. The multiple buffering of the LANCE allows the VAXmate to receive these back-to-back packets.

What this means to the user is when your VAX sends data to the VAXmate in one of these packet bursts, the LANCE can effectively buffer all segments of the message until the PC has time to handle the data. This multiple buffering means fewer retransmissions from the VAX, and thus leads to improved performance over single buffer architecture.

The buffer space used by the LANCE results from a buffer pool in system memory that is more than the industry standard address space (more than the 640-Kbyte DOS memory limit). Therefore, MS-DOS applications aren't affected by having extra memory buffers allocated for the VAXmate's high performance network. To further reduce the impact of the network's software upon MS-DOS application memory space, a portion of the Ethernet and DECnet software was placed in system ROM.

VT220/240 Terminal Emulations

This level of networking and transparency allows VAXmate users more functionality than traditional MS-DOS personal computing, but if they want to run VAX/VMS applications they need terminal capabilities. The VT220/240 terminal emulators are closely integrated into MS-DOS, MS-Windows, and the Ethernet network environments. They provide almost complete compatibility with the actual VT220/240 terminals. To use the terminals, the VAXmate keyboard was designed to fully emulate the LK201 keyboard found on all of Digital's VT200 family of terminals and VAXstation products.

The VAXmate user interacts directly with the VAX/VMS operating system and its application using one of two terminal emulators. The VT220 terminal emulator executes under the MS-Windows user interface and emulates the character cell VT220 terminal. The VT240 terminal emulator can be started from MS-Windows but executes in the nonWindows MS-DOS environment. The existence of two terminal emulators is the result of one of those design decisions necessary when integrating two disparate architectures.

The IBM PC video and, subsequently, the MS-Windows video environments are designed around video bit map resolutions of 640 pixels x 200 pixels. There are other standard PC video resolutions, but this is the standard around which the VAXmate is designed. If you create a circle using the 640 x 240 resolution of the IBM PC and then move that exact same circle bit for bit to Digital's 800 x 250 resolution, it no longer looks like a circle. This problem is called aspect ratio.

So, to execute VAX/VMS graphics applications using the VAXmate as a graphics terminal, required that the video control and monitor be designed to have an 800 x 240 mode of operation. It turns out the VAXmate video actually has an 800 x 250 mode of operation. But this minor difference doesn't noticeably affect the shape of circles (Figure 2).

But, to be able to execute IBM PC graphics applications, required the VAXmate also have a 640 x 200 mode of operation. When in this mode of operation, the monitor actually paints 640 pixels x 400 pixels. The video controller repeats each horizontal line of pixels a second time. Thus fooling software and the eye into believing a 640 x 200 video system is present.

So, why 640 x 400? Why not just 640 x 200? Well, most PC users complain about how difficult it is to use a 640 x 200 graphics mode video resolution for reading text. And MS-Windows uses graphics mode to operate. The VAXmate version of windows operates the monitor in true 640 x 400 mode. That is to say the controller doesn't double each horizontal line. When a windows application wishes to write text to the screen, it uses one of the fonts designed for this 640 x 400 mode of operation. This allows the MS-Windows software to paint clean crisp characters on the screen that don't strain your eyes. The windowing software actually writes the double horizontal lines when an MS-Windows graphics applications is executing.

Why two terminal emulators? Well, the VT220 emulator executes only under MS-Windows. With it the user gets an almost complete VT220

Figure 2—*To execute VAX/VMS graphics applications using the VAXmate as a graphics terminal required the video control and monitor be designed to have an 800 x 240 mode of operation. The VAXmate video actually has an 800 x 250 mode of operation.*

terminal with all the power and ease of use provided by MS-Windows. With the LAT software comes an additional benefit of being able to actually execute multiple VT220 emulations, each in its own window, each logged in to the same or different VAX/VMS hosts. The reason this emulator is the text-only VT220 and not the graphics VT240 is because of the 640 x 400 video mode MS-Windows uses to provide IBM PC video resolution compatibility, so, VAX/VMS graphics applications cannot be run through windows. The VT240 doesn't execute in a window. When it is being used, and a VAX/VMS graphics application is started, the VT240 uses the 800 x 250 video mode of the VAXmate.

The VT240 emulator is a class of application that directly manipulates the hardware resources; it changes video modes. When such an application is started, MS-Windows temporarily steps aside and allows the application to take control of the VAXmate. When the application exits, Windows regains control of the VAXmate and reinstates the VAXmate's user interface and operating environment. This is exactly what happens when the VT240 emulator is started from within the MS-Windows environment.

The VT220/240 terminal emulators support two methods of communicating with a VAX/VMS host. The first is serial communications using the RS-232 compatible 25-pin serial communication port that extends out of the back of the VAXmate. This port is logically referred to as COMM1 in the MS-DOS and MS-Windows environments. The user configures the baud rate, parity, etc. of this port using MS-DOS and MS-Windows utilities. A VAX/VMS host communicating with a VAXmate over this medium views the terminal emulator as a standard VT200 family device.

The second form of communication is Digital's LAT. This communication medium uses the ThinWire Ethernet network port located on the back of the VAXmate. LAT is the same protocol spoken by Digital's DECserver 100/200 LAT terminal servers. Each terminal emulation is actually communicating with the VAX/VMS system over the same ThinWire Ethernet cable used by DECnet and MS-Network for file sharing. The user can simultaneously be accessing directories and files and conducting one or more terminal sessions with VAX/VMS systems. This eliminates the need for a separate serial communication terminal line back to the host.

The LAT software running on the VAX/VMS system emulates standard terminal ports for the application services layers of VMS. A VAX/VMS application runs without change whether communicating with a VT220 or 240 terminal using a serial line or one of the VAXmate terminal emulators using the Ethernet.

Running the VT220 terminal emulation under MS-Windows affords the user the convenience of a standard Windows application. The user can size the window, set the emulation aside, or make it an icon, all without terminating the VAX/VMS terminal session. By using the LAT Ethernet protocol, the user can run multiple terminal sessions into the host. These sessions appear exactly as though the user is logged on to multiple terminals. Further, the user can connect multiple terminal emulations to the same host or each terminal emulation to a different host. In the context of Digital's distributed architecture, the user is actually connecting to the same LAT service or multiple named LAT services. Another benefit to the LAT protocol under MS-Windows is the transparency the user perceives between VMS and MS-DOS. Using standard MS-Windows menus, users can cut data from a VMS file in a VT220 emulation window, and paste this data directly into an MS-DOS file—without document conversion.

Through the VT220's SETUP screen, the user specifies the LAT service to connect with for each running of the terminal emulator. In most installations, the LAT service's name is the DECnet node name or the VAXcluster's name. VAX/VMS systems managers determine the service names and the VAX nodes they run on. The LAT protocol software on the VAXmate actually listens for LAT servers to broadcast their names and locations. The broadcast names are saved in an LAT service table that is read by the terminal emulator. The user is provided the available LAT service names through SETUP. In addition, SETUP allows the user to specify a default service name to connect upon initiation of the emulator.

The default VAXmate LAT service table holds the first 10 LAT service names that are received by the VAXmate. This default size minimizes memory wasted on empty table entries for VAXmates networked with a small number of VAXes. For large VAX networks, the VAXmate system

manager can configure the VAXmate network initialization file to extend the LAT service table to hold more than 10 names.

When using the standard serial communication port, the VT220 emulator uses the MS-Windows serial communication port drivers to provide the handshaking protocol. This is either the "XON/XOFF" restraining protocol, or a data lead form of restraint. MS-Windows drivers are used to control access to the serial port. Windows will now allow more than one application to use the serial port at any one time. This protects two communications applications from stepping on each other's data.

MS-Windows also provides an LAT protocol network interface for applications running within the environment. Using MS-Windows' control panel, the user can redirect to the network all serial communication targeted for the COMM1 or COMM2 serial ports. Thus a Window application can communicate with a host system using the serial communication port or the Ethernet. This allows existing personal computer applications to be insulated from the underlying communication mechanism. By redirecting serial communications over the Ethernet, the ThinWire Ethernet cable can replace the serial communication cable for many applications.

The VT240 terminal emulator implements all serial and network communication capabilities available in the VT220; additionally, the VT240 provides a ReGIS graphics emulator. Further, non-MS-Windows users can run the VT240 emulator directly from MS-DOS.

While the VT220 emulator is a true MS-Windows application allowing the user to change its window size and to be set aside while maintaining communication with the host, the VT240 emulator is not a true MS-Windows application. The VT240 emulator can be started from Windows, however, it cannot be sized into a smaller window. Unlike the VT220, it can not be set aside while still monitoring communications with the host. The reason for this lies in the underlying video requirements for emulating ReGIS graphics. When creating ReGIS images, the VT240 emulator places the VAXmate's video into a mode of 800 pixels x 250 pixels. This provides the correct aspect ratio for ReGIS images designed to be seen on a VT240 terminal. The 800 x 250 mode is also used for displaying 132-column-wide text. This allows high quality international characters to be generated on the screen in 132-column mode.

The VAXmate's VT220/240 terminal emulators, together with its network and user interface software, provide a user with a powerful environment that integrates IBM personal computing with Digital's VAX/VMS distributed computing architecture. This integration not only enhances today's desktop applications, it provides a platform for developers to build a new generation of distributed applications.

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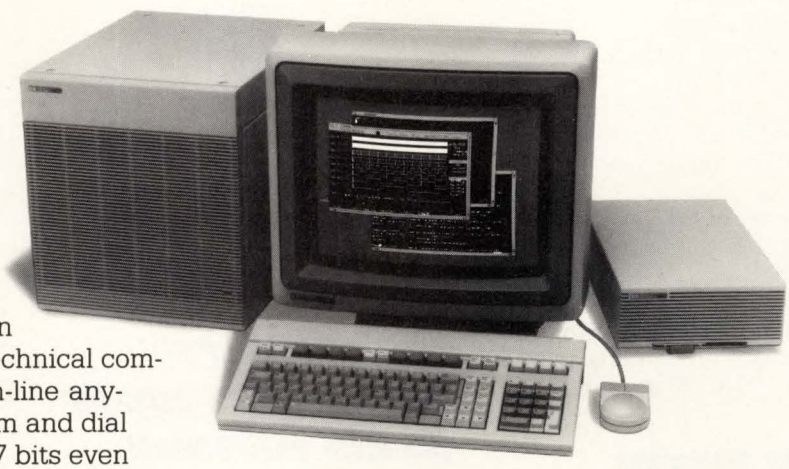

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Digital Users Accept UNIX

As UNIX penetrates environments containing Digital hardware, the opportunities for UNIX-based applications increase/by Jim Brunet

UNIX continues to be an increasingly important operating environment. According to a Digital Equipment Corp. spokesman, as many as 20% of all VAXes sold this year will use UNIX. UNIX has found favor in facilities concerned with technical applications such as software development, and is widely used in installations requiring software portability and interoperability among heterogeneous systems.

UNIX is available on hardware across the entire Digital product line. Outside of Digital, UNIX has made its greatest impact in the workstation, supermicro-, and minisupercomputer (such as Convex or Alliant) markets (see sidebar, "The Many Flavors of UNIX").

Windows And Networking

Two functions that have seen a flurry of recent progress under UNIX are windowing and networking. The development of a windowing standard will, in conjunction with the development of workstation hardware, spark a new generation of graphics applications. Developments in networking, meanwhile, will spur development of sophisticated distributed applications that make use of resources spread over an entire network instead of restricted to a single processor or locality.

The windowing activity has centered around the X Windows standard, developed at MIT and actively supported by Digital, and the Network extensible Windowing System (NeWS), developed by Sun Microsystems Inc. NeWS uses a screen description technique modeled closely on the Postscript page description language that has become a standard in desktop publishing.

Alan Nemeth, a consultant for Prime Computer Inc., and president of Usenix, the professional and technical UNIX association, sees the two windowing standards complementing each other. "NeWS seems superior in describing the contents of a screen, while the X mechanism of controlling data input and the real estate of a screen is very good," says Nemeth. He expects that eventually some sort of joint windowing standard will evolve—a view

"A large number of applications now exist for the UNIX environment, including editors, database programs, networking systems, and office automation products."

MARITTA TAPANAINEN

shared by several other experts consulted for this article. One development supporting this contention is the recent announcement by Sun in support of the X Windows standard in addition to its own NeWS.

Sun has been a key player in the networking arena as its Network File System (NFS) is accepted by an ever increasing number of vendors. At a recent UNIX trade show, computers from 30 different vendors were linked together with NFS.

NFS allows users on one system to transparently access files or other resources anywhere else on the network as if they were a part of the user's local system.

X Windows, NeWS, and NFS are three of the most important developments that will have immediate impact on end users in any segment of the computer community. The fact that these advances are taking place in the UNIX environment further underscores the importance of UNIX.

Digital/UNIX

Digital offers UNIX through its Ultrix product line, with its most recent product being Ultrix-32, V. 2. Ultrix is based on the Berkeley Standard Distribution (BSD) UNIX, but contains features of the System V Interface Definition (SVID). Compared to the previous release (V. 1.2), this latest version extends Ultrix to the 8800 series VAX, so now Ultrix spans the entire VAX product line from MicroVAX to top-of-the-line BI bus machines.

Other new features, in addition to the usual collection of bug fixes and cleanups, include Sun's NFS and a VAX C compiler, designed to provide source code compatibility between VMS and Ultrix environments.

Ultrix-32w is what Digital calls a layered product, designed to run in conjunction with Ultrix-32 to provide windowing and graphics capability on the VAXstation II. The windowing capability, called DECwindows, uses the X Windows system as its base. The Digital product also includes a toolkit for building graphics applications.

Digital Strategy

Digital's incorporation of NFS is just one manifestation of the company's commitment to integrating Ultrix with industry standards, according to Gary Oden, group manager for Ultrix product management.

"We adopted NFS because of its widespread use and superior networking capability," says Oden. "We expect it to be incorporated at some point as a formal standard in the legitimate standards arena."

Similarly, Digital's support of X Windows is based on the view that it, too, will become an industry standard. When comparing X Windows to Sun's NeWS, Oden says, "X Windows was developed independent of any one vendor; we prefer standards that are industry driven, not vendor driven." To promote the X Windows standard, Digital is contributing X Windows toolkit features to the public domain via the X Windows activity at MIT.

Digital believes the future includes the evolving Posix (a pseudo acronym for a portable operating system for computer environments) standard. "As Posix standards are adopted, we're committed to incorporating them into Ultrix," says Oden. He indicates that Digital's strategy is to identify standards and then to incorporate them into the Digital environment, while preserving the original character or "flavor" of the standard.

"For the immediate future, UNIX seems as if it will be marked by increasing adherence to standards that will narrow the range of UNIX implementations."

Digital is also committed to the development of worksystems, with an emphasis on graphics products integrated into both Ultrix and VMS environments, providing local processing with significant flexibility.

"The Digital style of distributed computing is for a very heterogeneous environment," says Oden. A typical profile would include an Ultrix-based workstation, an Ultrix- or VMS-based departmental computer, and a VMS-based corporate computer.

UNIX Alternatives

There are several alternatives to Ultrix for UNIX in the Digital environment.

One alternative, called MORE/bsd, comes from mt. XINU. MORE/bsd is a BSD-based product that includes additional networking capabilities and is often custom-tailored to a customer's specific needs. Customizing can include optimizing the kernel to meet customer requirements.

It's mt. XINU's view that the operating system business has become the environment business. "People are interested in solving the problem of hooking together hardware from different manufacturers together in varying configurations that meet their specific needs," says Dick Wrenn, vice president of sales at mt. XINU. He cites an example of an environment containing a large VAX, Sun workstations, Macintoshes, and PCs, where everyone needs access to the same files.

Wrenn sees an inevitable conflict between standards and high performance. "Business needs a stable operating environment for running applications; research and development outfits need the cutting edge of technology. There always will be a divergence between the two poles," says Wrenn.

Mt. XINU began shipping NFS as part of its product 2 yrs. ago and has had UNIX record locking for years, observes Wrenn; he says the company has made an effort to be out in front implementing new technical developments. One such development is XINET, a networking package that connects PCs, Macs, MicroVAXes, and VAXes on the same network.

A Uniq Solution

Just as there are installations that prefer a pure BSD UNIX, others may desire to run pure System V. Uniq Digital Technologies offers System V for the VAX.

Uniq ports every AT&T UNIX release to the VAX, including System V, V. 3. A key feature of UNIX V. 3 is Remote File Sharing (RFS), which is roughly equivalent in function to Sun's NFS. "Compared to NFS, RFS has better message handling and security features," says Chuck Richter, president of Uniq.

Also featured in System V. 3 is the Streams networking mechanism, an alternative to the socket method of interprocess communication employed by BSD UNIX. Streams provides network protocol and media independence to the systems on which it runs.

Like many other companies, Uniq sees the future growth of UNIX intertwined with the development of networking. "Open systems [implementation of the OSI networking protocols] are necessary to the growth of the industry, providing international and

intervendor interoperability," says Richter.

UNIX Emulation

An alternative to running UNIX in the Digital environment is to emulate UNIX under VMS. Eunice, from the Wollongong Group Inc. (TWG), is one such emulation.

Eunice runs by providing a translation module, REX, that stands between VMS and UNIX utilities and applications. Each UNIX command of an application is translated by REX into a VMS command that duplicates the same function. A key advantage of Eunice is that it allows both VMS and UNIX environments to co-exist on the same computer, allowing users their environment and applications of choice.

Emulations traditionally have a reputation for making a system crawl, but Art Prichard, product line manager for TWG, hopes that Eunice 4.3, the latest version, will change that notion. Recent benchmarks performed by AIM Technology showed that for 10 users running Eunice 4.3 on a VAX, Eunice ran about ⅓ slower than the same

The Many Flavors Of UNIX

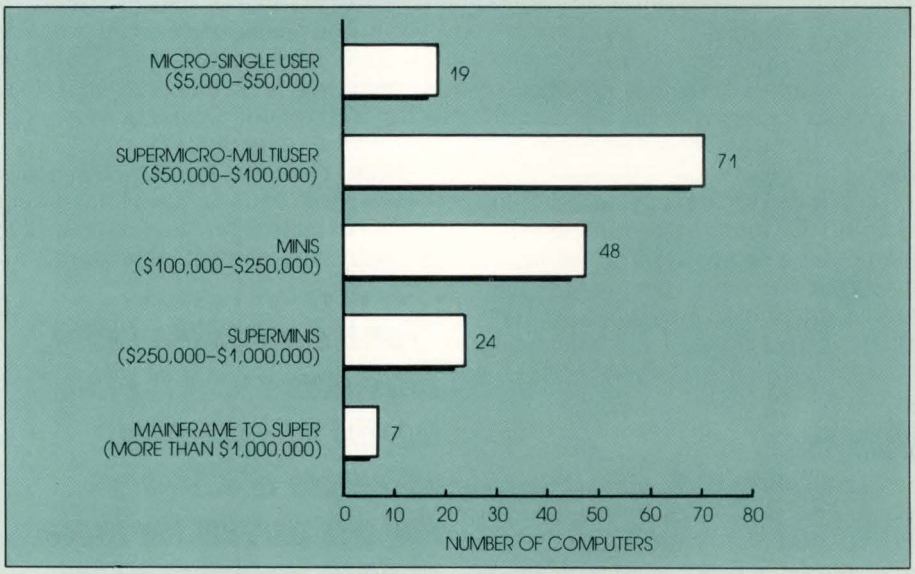
by Jim Geers
AIM Technology

How's this for heresy: Computer Architecture is not important to most users! What is important is application software that fits needs, runs efficiently, and adapts to changing requirements.

In an ideal world, you could select the appropriate software and install it on the most reasonable cost-effective hardware system meeting your requirements. For reasonable changes in the number of users or applications, the initial system could be easily modified to accommodate these changes. When the requirements changed significantly, the software could be migrated to a more powerful hardware system or to other systems apropriate for the task(s).

It is this hope, or perhaps illusion, that has drawn many to UNIX. After all, there are only four other "world class" operating environments that could potentially meet this ideal scenario. MS-DOS is too limited in operating system capabilities to be considered a serious candidate for migration potential to large hardware configurations. IBM's MVS and VM, and Digital Equipment Corp.'s VMS all possess the capability to handle serious computing requirements, but their capability to implement them on a wide variety of hardware systems is severely constrained.

The position of UNIX as the "only" choice for software migration is not likely to change in the near future, and the originators of the other operating environments are not likely to give their competitors an opportunity to penetrate their proprietary market shares.



Figure—*Some 150 computers manufactured in the United States run UNIX.*

At last count, more than 150 different computers that ran UNIX—from PCs to Crays—were identified in the United States alone. The Figure shows the distribution of the performance range of these models based on value. The UNIX operating system is reputed to be capable of expanding to service "legions" of users with an "infinite" variety of programs! So if UNIX is so great, why hasn't it taken over the computer world as some had predicted?

Why The UNIX Problem?

The multiple UNIX versions and manufacturer modifications have provided a major obstacle to third party software vendors and an annoyance to users. UNIX's reputation for portability has been earned due to the relative ease of moving the operating system from one hardware environment to another. This type of portability is impressive from a manufacturer's viewpoint, but doesn't guarantee the ability to effectively migrate application software, which is the primary goal of the user.

The guarantee of application portability is limited by the lack of a common hardware architectural environment. UNIX has been ported to systems utilizing the Intel IAPX family (8086, 80286, 80386), the Motorola family (68000, 68010, 68020), VAX, 370 architecture, Cray, and practically every other computer architecture available in the world today.

However, this lack of a common hardware architectural environment isn't the major obstacle that limits application migration. After all, source has been used to effectively migrate application software over a wide range of architectures for years. The major culprit is the wide variety of UNIX implementations that exist.

Jim Geers, chairman/CEO of AIM Technology, is a 27-yr. veteran of the computer industry, having spent the past 7 yrs. as executive director of a computer marketing research firm.

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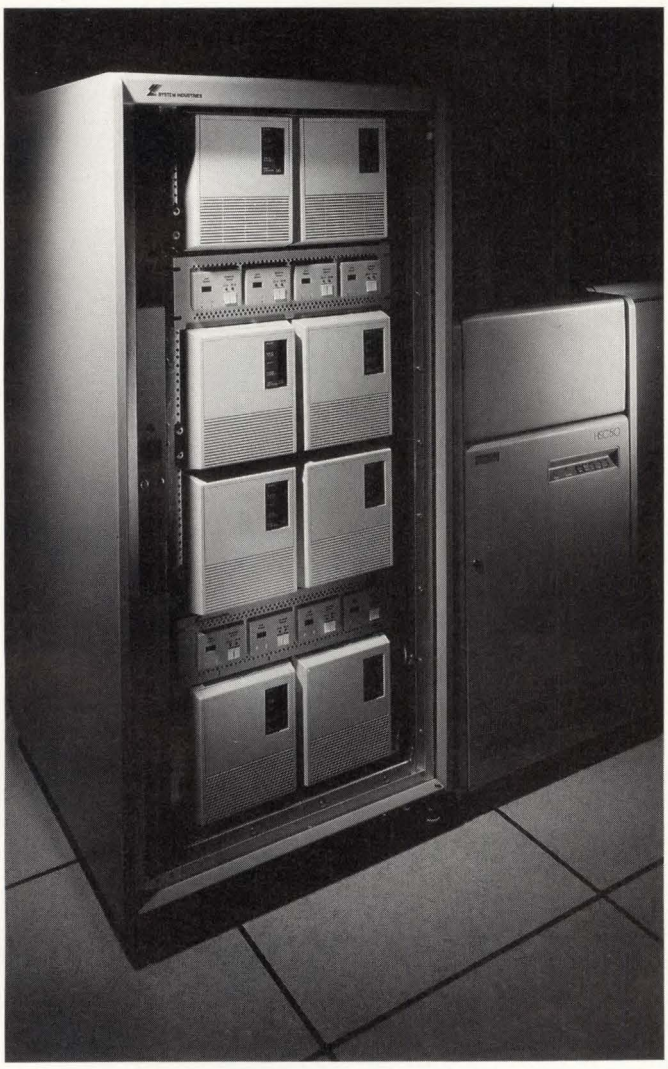

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benchmark run under BSD 4.3 UNIX. "We hope that you agree that Eunice may be slower, but not slow," says Prichard.

Comparing speeds between Eunice and UNIX is tricky, however. Some Eunice functions take advantage of VMS proprietary features and actually run faster under Eunice; compiles are one such example. Other functions, such as those that require a "translation" between VMS and UNIX file types, run much slower. The trade-off is one of speed versus flexibility. Still, Prichard notes that each successive release of Eunice has run proportionally faster than its predecessor when compared to contemporary releases of UNIX.

Though Eunice is an emulation of UNIX, not every UNIX function is emulated. System management functions are performed by VMS, as UNIX utilities such as bad block counts, disk formatting, and device assignment aren't available under Eunice.

TWG is exploring ways to implement UNIX-like database capabilities under Eunice. While VMS has the ability to lock down a sector or block, it lacks UNIX's ability to lock down a byte. Be-

At first glance, most of the UNIX world appears to be divided between two standards: System V from AT&T, and Berkeley 4.2 BSD, originated by the University of California at Berkeley. This is an oversimplification, however. Different System V and BSD versions exist. To complicate matters further, many manufacturers mix several of the versions and create hybrids or perhaps mutations. It's safe to say that practically every manufacturer's UNIX offering contains variations both in the manner in which it's implemented and the features that are included.

For example, Digital President Ken Olsen recently described Ultrix as "the Berkeley version, and we're doing many features that System V has in it." Combining standards is not the way to implement a standard, especially when each manufacturer combines the various standards in a different way. It is a safe bet that Digital does not change VMS so casually.

Why So Many UNIX Versions?

The market forces that have allowed this situation to develop are really not so difficult to understand. Probably most important is the fact that UNIX lacks the dominant market leadership that is provided for the other major operating environments. MS-DOS, VM/MVS, and VMS all derive structure and control as standards from IBM/Microsoft, IBM, and Digital. AT&T has clearly been a follower, not a leader, in providing UNIX to the marketplace. It has also failed to provide any significant strategic relationships that could provide UNIX with some structure. AT&T waited to join efforts such as X/Open and 386/Xenix until after these products gained market acceptance.

Although AT&T has released new versions of UNIX, it always seems to lag market demand. This has caused manufacturers to take an interest in BSD. In the past, the Berkeley versions have had more advanced features and functions for technically demanding applications than the then current version from AT&T. With the System V.3 release, many of the advanced features have been implemented. There is no longer a clear performance or functional difference between the two. The Berkeley version, however, lacks the structure and market image of a standard. This leads manufacturers to such activities as calling their offerings a System V, but using the BSD file structure.

Lacking such market leadership, manufacturers are left to implement UNIX for their systems more or less as they see fit. If this were a less sophisticated operating system, such as

"If third party developers cannot achieve portability, end users will not be able to benefit from low cost, comprehensive software...."

MS-DOS, the results might not be so different. There are not as many potential variations in implementing MS-DOS on an Intel IAPX microprocessor-based system as there are in porting UNIX to the wide variety of hardware architectures available. Even when the same hardware architecture is used, such as a Motorola 68020 microprocessor, the UNIX implementations turn out differently. This results for one of three reasons:

- Given the number of variables in a porting effort, the probability is high that not everyone will make the same implementation decisions.
- Marketing forces want a "competitive edge"— the implementation of features the competition doesn't have.
- Engineering NIH (not-invented-here) will include several changes to "improve" the port.

C compiler differences also have an affect. There's no universal standard or primary source for C compilers. Many of the compilers are implemented differently and contribute to the problem of portability at the source level.

Multiple Version Problems

Reasonable applications portability is important in order to allow users to move software to new systems and locations. It is also important for compatibility in interconnected environments. To date, in spite of its installation success, UNIX has failed to fulfill its potential for application portability.

An indication of this failure is the problem UNIX has had in developing a third party software industry to rival those available for other operating environments. If third party developers cannot achieve portability, end users will not be able to benefit from low cost, comprehensive software similar to that available in the other major operating system environments.

Standardization Efforts

The problem of the lack of UNIX standards is being recognized, and significant standardization efforts are underway. In general, these efforts fall into two categories: standards and consortiums advocating positions on standards.

The best and most comprehensive standard is the System V Interface Definition (SVID). Developed by AT&T, it's used as the base for the X/Open, Posix, Sigma, and 380/Xenix standards efforts.

Although BSD has a reputation for incorporating the latest technology into its operating systems, it's more of a pseudo standard. It's not so much a specification as a specific

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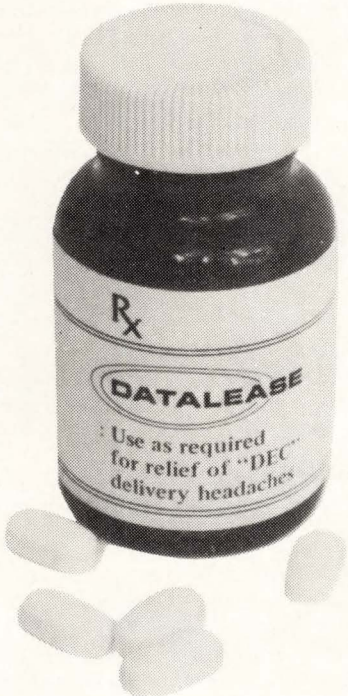

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cause of this, record locking is currently not supported.

UNIX Applications

A large number of applications now exist for the UNIX environment, including editors, database programs, networking systems, and office automation products. Following is a brief description of a sample of these applications.

Informix-4GL, from Informix Software Inc., is billed as a fourth-generation database product. It offers users the ability to build customized database applications written entirely within the database management program. Functions such as IF_THEN_ELSE can be incorporated into the application without having to resort to subroutines written in a third-level language such as C.

Informix-4GL is intended for programmers, applications developers, MIS departments, and others who can make use of its sophisticated application-building features.

Laura King, co-founder and vice president of marketing for Informix, sees databases becoming the cornerstone of software integration. Distributed processing, such as that possible with Sun's NFS, will lead to an integration of spreadsheets and word processors with database managers, she believes. "Databases will be able to store worksheets, pictures, and text," says King. "And they will offer ways to manipulate these different kinds of objects."

PC Interface, from Locus Computing Corp., allows PC users to use the VAX as a massive hard drive system. The product allows users to issue UNIX commands from the DOS prompt without going into terminal emulation mode, as well as accessing DOS applications such as a word processor or spreadsheet that are stored as the contents of a UNIX file on the VAX. PC Interface also comes with utilities that

implementation.

Posix, pseudo acronym for a portable operating system for computer environments, is being developed by the IEEE, with initial availability planned for the end of this year. Although the availability of this standard will be a step forward, it's viewed by many as a minimal subset. Posix doesn't currently cover the user interface, shell commands, network, graphics, performance monitoring, or database management interfaces. Additional efforts are underway that should lead to future standards in some of these areas.

The Posix standard will be a subset of System V functionality and will initially address only the operating system interfaces at the programmatic level (e.g., a minimum set of system calls). Its limitations are further illustrated by the goal of being able to allow vendors to modify their proprietary operating systems to adhere to Posix.

European computer manufacturers have shown their intent to support standards by the formation and support of X/Open. Several U.S. manufacturers (Digital, Hewlett-Packard, Unisys, and AT&T) have joined X/Open.

X/Open isn't a standards-making organization. The interfaces it has adopted are either existing standards or interfaces to products that are considered as de facto industry standards. X/Open has published interface definitions based on SVID. It has also announced endorsement of the Posix effort, and the commitment to work for the convergence of Posix and its SVID-based interface definition.

Sigma is a consortium sponsored by the Japanese Ministry of International Trade and Industry (MITI) to encourage software development. More than 150 companies are participating in an effort to share hardware independent software development tools. Ground rules are such that these tools will be written in C and be designed to run in a standardized UNIX environment.

Standardization of a software workstation environment has also centered around UNIX. System V has been adopted as the standard SIGMA operating system interface. However, many of the Japanese manufacturers have added various BSD and other options and enhancements.

Xenix/386 is a consortium formed by Microsoft, The Santa Cruz Operation Inc., Interactive Systems Corp., and most recently, AT&T. Its goals are twofold: one, to migrate System V and Xenix into a common standard; and two, to provide a common UNIX optimized for 386 environments.

Manufacturer Standardization Compliance

Users want portability. Software developers want portability. Unfortunately, manufacturers have not recognized sufficient incentive to comply with the standards. This situation is likely to change. Worldwide computer supply exceeds demand and will continue to do so. This allows users to be more selective, and forces manufacturers to be more responsive to user's needs.

Perhaps the most "influential" force that will provide standards compliance is emerging from the Pacific Basin. Japanese manufacturers have proven that they can successfully supply cost effective hardware computing environments worldwide. Korean and Taiwanese manufacturers would like to provide more powerful systems than their successful "PC clones." All have indicated their willingness and ability to comply with standards.

In the future, noncompliant manufacturers will not only face increasing competitive pressure, but will also have compatibility problems in networking systems. We can look for Digital and IBM to "drag their feet" in the support of standards. End user vendor independence is not a high priority for them. Even they, however, with time will be forced to conform. Manufacturers such as Sun Microsystems, which claim to use UNIX only as a vehicle for vertical applications, are also finding it in their best interests to support the standards.

Increased pressure for standards compliance is needed in system procurements. If you are buying UNIX for its functional capabilities alone, any version, including Ultrix will suffice. But, if you are a software developer or an end user anticipating migration, beware.

The new "war-cry" of those using UNIX computers should be: "If you sell it as a UNIX system, it had better adhere to the standard!"

Even with all of the problems, UNIX is still the only operating environment that provides near-term hope for a significant level of application portability from multiple suppliers. Users should continually evaluate potential suppliers' compliance with standards. Using the procurement cycle to draw attention to standards compliance is the best way to achieve results.

allow the PC user to view and manipulate raw UNIX-based files just as if they were DOS files. Terminal emulation and print-server features are also available.

Connections between PC and VAX can be made via Ethernet card, direct connection, or modem. PC Interface occupies approximately 40K of memory on the PC, plus 180K for code and data in the DOS-UNIX translation facility on the VAX.

AIM Technology offers a line of performance-enhancement software for UNIX systems.

The Disk Tuner monitors disk usage. Based on the profile of that usage, the Disk Tuner generates an algorithm that dynamically rewrites the disk to optimize performance. Jim Geers, president of AIM, cites 15-20% improvement in disk performance.

The Job Scheduler performs a series of functions: it tells what programs are being run, identifies processing bottlenecks, and then sets limitations on certain system activities. As an example, compilation runs or nroff text processing might be given limited access between the hours of 10 a.m. to 3 p.m.

The Job Accounting package keeps track of log ins and CPU and disk usage. Reports are generated indicating use of resources by individual, accounting group, charge code, or the system as a whole.

A great many other applications are available as well for UNIX systems. Covering them adequately would require several articles devoted to nothing else. The most important point about UNIX applications, though, is that after years of being promised they have arrived as use of UNIX has increased.

UNIX Moves Forward

For the immediate future, UNIX seems as if it will be marked by increasing adherence to standards that will narrow the range of UNIX implementations. At the same time, new standards, particularly in graphics and networking, will in some ways redefine UNIX.

Digital's commitment to Ultrix seems strong; the continuation of that commitment should spur the development of new applications as software developers take advantage of the stability.

Jim Brunet is a Hardcopy *contributing author.*

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Informix Software Inc.
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Locus Computing Corp.
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Sun Microsystems Inc.
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Uniq Digital Technologies
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Product Review: WordPerfect Corp.'s WordPerfect

VAX and micro users alike can reap the rewards of fast, efficient, and elegant word processing through the union of the VAX and WordPerfect/by Donald R. Goss

This is a marriage of great significance—the wedding of WordPerfect, currently one of the world's best-selling word processors (approximately 30% share of the market), and the VAX, the world's best and most popular minicomputer.

A review of this marriage must necessarily address two distinct audiences. One audience is the large number of microcomputer users who use WordPerfect in its standalone mode and who, perhaps, work in a company with a VAX environment. This group is most concerned about how WordPerfect fares in a VAX environment and whether all their favorite features are intact in this new version. The other audience is system managers, MIS staff, and other readers of *Hardcopy* who are experts in VAX systems and might not be familiar with WordPerfect. This group will want to know what benefits they can derive from running WordPerfect on their VAXes.

Full-featured word processor—

If you need a word processor that runs equally well on your mini or mainframe and on your PC, then you should look closer at WordPerfect.

To Experienced Users

Micro users familiar with WordPerfect can relax—almost all of WordPerfect's features for micros are available on the VAX version. And what isn't available is on the way. The 4.08 version currently being shipped (as of this writing) lacks the SORT utility, PARALLEL COLUMNS, and several other minor functions. All of these are in the process of being developed and are scheduled to be included within a few months. The SHELL function, reported as being absent, is available in the VAX version. The user can exit WordPerfect to issue DCL commands at any point.

The only adaptation to be made by experienced WordPerfect personal computer (PC) users is a rearrangement of the function keys. Because of the design of Digital Equipment Corp. keyboards, which run the VAX version of WordPerfect, all of the functions are shuffled. It doesn't take long to readjust, however, and templates can be obtained from WordPerfect to ease the transition. Rainbow users will also find their function keys scrambled. However, the newest update of 4.2 for the Rainbow includes a program that uses the same function key layout as the VAX version. Incidentally, Rainbow WordPerfect 4.2 users should send $20 ($35 if you need to upgrade from 4.1) to WordPerfect Corp. for the newest upgrade. The company has eliminated the screen flicker that was so irritating on earlier versions, and the difference in speed is amazing.

PC WordPerfect users who have access to their corporate VAXes will find excellent uses for the connection. Given a good communication program, it's possible for the PC user to configure virtual drives on the VAX to enlarge storage and to facilitate file transfers. File compatibility is absolute—a document created on the VAX has the same structure as a document created on the PC.

For Those Unfamiliar With WordPerfect

For the second audience, VAX experts who might not be familiar with WordPerfect, the product is a What You See Is What You Get (WYSIWYG) word processor with a full-screen editor. The program, which has been on the market 8 yrs., is a comfortable word processor. First-time users are somewhat taken aback when, upon invoking the program, the

screen appears to go blank. The only information on the initial screen is a small line on the lower-right corner of the screen that says: Doc 1 Pg 1 Ln 1 Pos 10. This informs the user that he is on document 1, page 1, line 1, and column 10 of a new blank document. All information to be printed on the page is displayed on screen, except justification and super and subscripts. Codes and instructions that the user inserts in the document are invisible unless he invokes the "reveal codes" key, which causes the codes to become visible. This makes the novice user a bit nervous until experience proves that the codes work—even if you can't see them.

Installation

WordPerfect is available on either 1600, 6250, or 800 bits per in. (bpi) tape, TK50 cartridge, or RX50 diskette. It contains a straightforward VMSINSTAL procedure that is explained in a well-written installation manual. The program takes a few minutes to install and offers no particular surprises.

Documentation

WordPerfect documentation, as you might expect from such a mature product, is superb. A large (more than 450 pps.) loose-leaf binder contains a brief "Getting Started" section (13 pps.), a superb tutorial that covers all the basic features of the program (230 pps.), a thorough reference section that addresses the features in alphabetical order (207 pps.), and a complete index and glossary. The tone of the documentation is light and, although technically correct and complete, is easy to understand. Out of curiosity, I did a Gunning "Fog Index" (which is a quick-and-dirty readability formula) on parts of the documentation and came up with an average of 10. This means that a person with a 10th grade reading level or higher should have no trouble understanding the explanations. In comparison, the Digital LN03 Programmer Reference Manual averages a reading level of 15. A person with less than 3 yrs. of college would struggle a bit in understanding it. As with other "how-to" instructions, most computer documentation is written by engineers or programmers so familiar with the product they don't remember a time when they didn't understand it. WordPerfect documentation is written with the user in mind.

Program Features

There isn't enough room in this review to describe the entire program, so here's a listing of some of the features:

- *Table of contents/index generation*—This is an excellent tool for anyone putting together manuals or larger documents.
- *Speller*—115,000 words are online at all times. The feature offers phonetic choices for those of us who are hopeless spellers. Users may create personal dictionaries and add words. A nice extra is a word-counting feature.
- *Thesaurus*—This is online and never leaves you at a loss for words. It includes antonyms as well as synonyms.
- *Macros*—This allows you to store keystrokes and commands in a single key or by longer names—a very powerful feature.
- *Multiple documents*—Users may switch back and forth between two documents with a single keystroke. The cut-and-paste feature will exchange information easily between the two documents.
- *Split screen*—This is a variable-sized window across the bottom of the screen that allows the user to view two documents at once.
- *Outline*—This is another feature that will benefit the writer of large documents or manuals. The user may customize up to seven levels of automatic outline numbering.
- *Columns*—Up to five variable-sized newspaper columns (snaking columns) are easy to manipulate.
- *Footnotes/endnotes*—This allows you to create and edit footnotes or endnotes.
- *Help*—Online help is available from inside any of the program's features.
- *Math*—WordPerfect offers 5-function math across or down columns.
- *Other features*—WordPerfect offers the same functions you expect in any word processor: insert and overtype modes, versatile cut-and-paste ability, control of all printer functions, variable spacing, etc.

Printer Drivers

WordPerfect is equipped with printer drivers for all popular printers. It also comes with a separate program, "Printer," that allows you to modify an existing driver or to write your own, provided you have access to a printer manual that gives the control sequences.

File Compatibility

One outstanding feature that may provide some answers for VAX system managers is the total file compatibility between WordPerfect on different machines. The program is currently available on the IBM PC and compatibles, Rainbow, Apple II (E, C, and GS models), Amiga, and Data General machines. Versions are planned for the Macintosh, Atari ST, and IBM 370. The file structure is such that any WordPerfect file can be created on any of these machines and, if it can be moved through communication to any other, will run the same as if it were created on that machine. This may prove invaluable to system managers trying to integrate PCs with mini and mainframe structures.

Support

WordPerfect supplies excellent free telephone support. I have called this support service several times and have found the personnel polite, helpful, and genuinely interested in helping me solve whatever problem I bring to them.

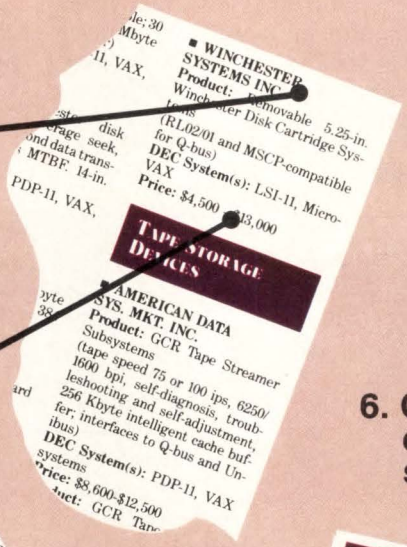
Any fixes for bugs that occur in the product will be supplied free to all users. Update service is 10% of the purchase price/yr. This service provides all updates of the program and documentation. Early purchasers of the program will be delighted to learn that an even faster version of 4.08 has been developed. Tests on a VAX 8200 indicate that I/O speed is improved more than 700% and CPU usage has been reduced by about 300%. Purchasers will receive this update automatically—they don't have to request it.

Relationship To All-In-1

An important question to VAX/VMS managers is whether a program can integrate with All-In-1. At DEXPO South '87, held in Nashville, Tenn. in late April, WordPerfect demonstrated its newest version of WordPerfect 4.08 for the VAX. This program can be used as an alternate word processor under All-In-1. It can exchange files with All-In-1 using the SAVE and RETRIEVE functions, and interrupting WordPerfect returns the user to All-In-1 at the level it was left. Tom Mallory, director of development

Here's What You'll Get In The *ONLY* Comprehensive DEC* Directory

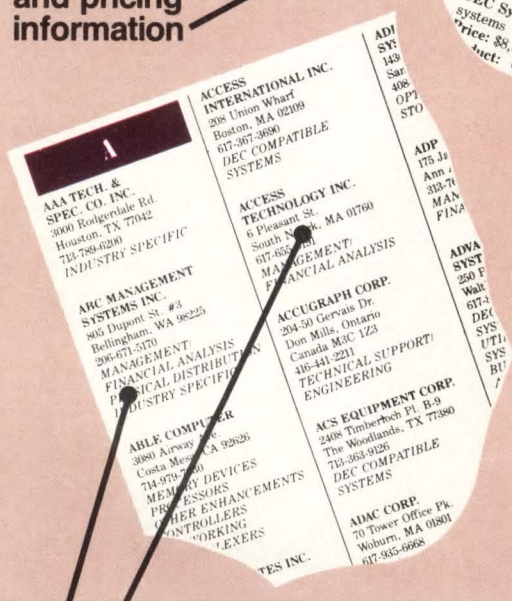
1. More than 10,000 listings of the Digital-related products available on the market today



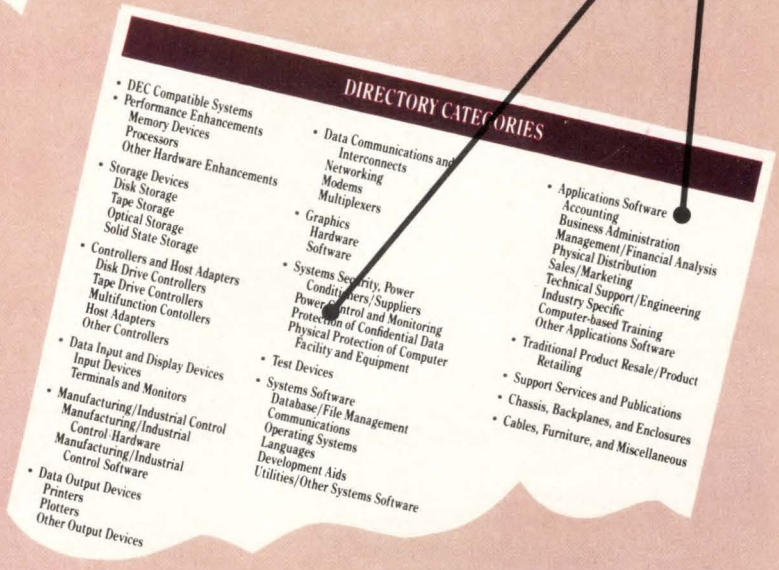
2. Each listing includes a general product description, CPU compatibility, and pricing information

5. Divided into 17 major product categories that cover the entire spectrum... from systems to services

6. Over 48 sub-categories designed to help you locate specific products and vendors



3. A list of over 1,000 companies with addresses and phone numbers



4. Each company listing provides an overview of what product categories they appear in for cross-reference

DIGITAL™
annual directory

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in the minicomputer division of WordPerfect, states that all of the functionality of the 4.2 version will be available on the VAX version before COMDEX this Fall. The SORT function, table-of-authorities, and PARALLEL COLUMNS function are currently in beta test and will be available by mid-summer.

With a new VAX product like this, the question of commitment to the VAX market inevitably arises. Is the company really committed to the product or is it just "testing the water?" I put this question to Dr. Alan C. Ashton, president of WordPerfect. "I am excited about the future of WordPerfect on the VAX. It is a strategic product for us and will receive our full support and on-going enhancement. Our goal is to have WordPerfect and our office automation products running on all major computers, integrated with other existing office systems," he replied.

What's the bottom line on this program? Should you buy it? As with most software, it depends on whether or not it meets your own particular needs. If your operation only needs to produce 1-pg. letters and memos, almost any word processor will meet that need. If you need a full-featured word processor that runs equally well on your mini or mainframe and on your PCs, then you should look closer at WordPerfect. The main difference in the program is that it is a writer's program. Comparisons with WPS are inevitable; the ubiquitous WPS is a good middle-of-the-road office word processor. WordPerfect is for the person who writes manuals, outlines, books, ad copy, and other tasks that require fast, efficient, and elegant processing of words.

Donald R. Goss is the Division Chairman of Humanities at Volunteer State Community College in Gallaton, Tenn.

Product: WordPerfect 4.08
Price: $1,000 (VAXstation); $8,000 (VAX-11/750-785); $29,000 (VAX 8978)
DEC System: all VAX/VMS
Company: WordPerfect Corp.
288 W. Center St.
Orem, UT 84057
801-227-5500 **Enter No. 497**

WordPerfect Library and Executive

WordPerfect Corp. has two additional programs that should be considered by personal computer (PC) users. One is Library, a well-designed shell that manages the user interface. Just as All-In-1 serves as a useful interface on the VAX, Library provides system managers with a simple-to-learn interface for the PC.

When it is loaded into the AUTOEXEC.BAT file, the program will boot automatically and confront the user with a simple chart of choices on screen. Applications can be loaded with a single keystroke, and the operating system will return to the shell upon exiting that application.

Library comes preconfigured to load WordPerfect or MathPlan and several useful utilities including: an appointment calendar (allowing you to do a thorough job of scheduling your days, weeks, or months), a calculator program (one of the best I've seen—it has scientific, programmer, financial, and statistical capability, and a constant tape that can be printed), a macro editor (a very useful addition to WordPerfect), a file manager (the same excellent part of the WordPerfect program that allows you to copy, delete, rename, and otherwise manipulate files among directories), a notebook (an address book and file card program with autodial capability), and a program editor (an ASCII editor identical to WordPerfect but with fewer functions). It also includes a graphics game called "Beast" (for those times when the office is slow and the boss isn't looking) and an MS-DOS command that allows you to exit to the operating system to perform a single command. There is also a handy "clipboard" function that allows you to select/cut-and-paste information from one program and carry it to another application.

Library is available for the IBM PC and for the VAX. This program is definitely worth your consideration, particularly if you are already running WordPerfect. The consistency of command functions from one utility to another and the ease of reconfiguring Library make it a powerful but simple tool.

Executive is the second new addition to WordPerfect's product line, having been introduced at COMDEX in June. The best way to describe Executive is that it's a scrunched-together version of all the company's products. Although it will run on any PC, it is obviously designed to simplify the life of portable computer users. Although it comes with both 5¼- and 3½-in. disks, it works best with 720-Kbyte 3½-in. drives such as the PC Convertible, Toshiba, and other lap-top clones. With a 360-Kbyte 5¼-in. drive, you will find yourself doing too much disk swapping. The program contains the best and strongest features of WordPerfect, MathPlan, and Library. To enable it to fit into one 720-Kbyte disk, some features obviously had to be deleted.

The Library shell has the essential features of the appointment calendar, the calculator, the file manager, and the notebook utilities. These are somewhat reduced in function, but are still powerful. The versions of the spreadsheet and the word processor are familiar and comfortable for the WordPerfect user and only leave out the most advanced functions. The word processor, for example, lacks multicolumn and footnoting capabilities. But, given the way most of us use lap-top computers, do we really need multicolumns and footnoting when we are sitting at an airport terminal with the computer balanced on our knees?

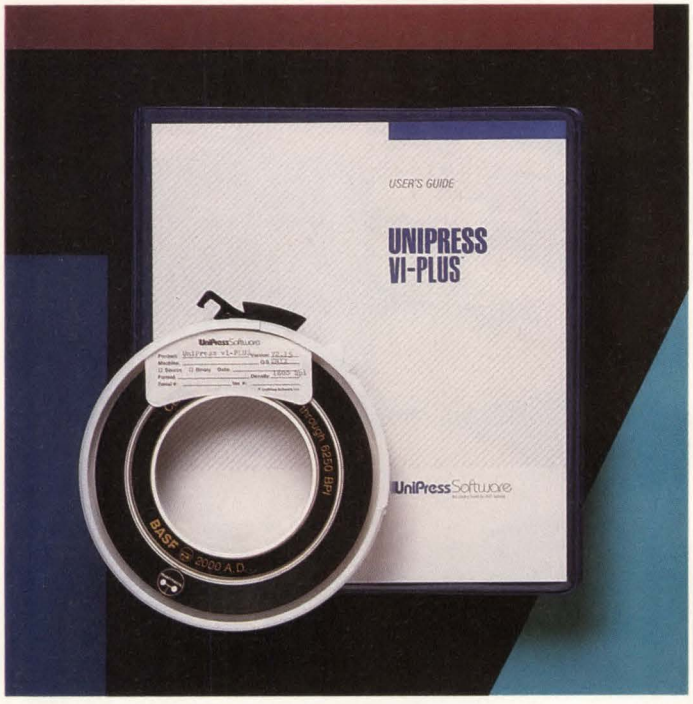
The Executive is not without flaws. Some bright young mind at WordPerfect decided to deviate from the company's usual packaging style (sturdy notebook in a slipcover), by putting the program in a box with a cover that cannot be fastened down. The manuals are three well-written pamphlets, but the box must be left on its back, since putting it upright in a bookcase causes the contents to spill out. The program also includes some very simple-minded macros to produce forms for letters, itineraries, etc. These flaws do not diminish the real value of the package. As a dedicated user of lap-top computers, I find it to be the most useful addition to lap-tops since the invention of rechargeable batteries.

—*D.R.G.*

Product Review: UniPress Software Inc.'s viPlus

Instead of trying to decide which UNIX/Ultrix editor is best for you, use both/by Walter Zintz

HARDCOPY PRODUCT REVIEW



EMACS + vi = viPlus—*Using the built-in MLISP programming language in its existing EMACS product, UniPress added the vi editor to create its viPlus product.*

There's a squabble simmering among UNIX system users as to which screen editor is best: vi or EMACS. A clear victory for either just isn't in the cards; they're so different that the choice between them depends more on the user's philosophy of life than on technical pros and cons.

And yet here comes UniPress Software with a package that claims to combine the features of both editors into a single integrated tool. This may sound as likely as crossing a dog with a cat, but it's a better idea than it first seems, because the divergent capabilities of the two editors naturally supplement each other. UniPress' product lives up to most of the idea's potential, for the right sort of user: a vi veteran who mainly works with vi's visual editing tools.

UniPress has long been marketing James Gosling's version of EMACS, and viPlus is built on top of Gosling EMACS. One of the strongest features of UniPress' EMACS, far outclassing vi in this respect, is its extensibility and modifiability through its own built-in programming language, MLISP. It's a real programming language (a cut down version of LISP), and it's an order of magnitude more powerful than the corresponding vi tools—map and source. UniPress programmers simply rewrote vi from scratch in MLISP.

A user enters viPlus much the same way he'd enter vi, and finds himself in an environment very much like vi's visual mode. About 85% of true vi's visual command set is there, and the missing visual mode commands are almost always the ones that aren't often used. At times, a command won't do what the same command true vi does, because it isn't feasible to write an identical copy in the different environment of EMACS.

More often a visual mode command will accomplish more in viPlus than in vi, because it parallels an EMACS command that's more powerful and UniPress' programmers have slipped the extra functionality in as an extension of the vi syntax. For example, the u command performs everything a vi user expects, but combining it with the spacebar allows the user to undo everything back as far as the start of the editor session, one command at a time.

The extra power added to many vi commands is only the tip of the iceberg—for a viPlus user, complete Gos-

ling EMACS is only a pair of keystrokes away. Just as typing a : lets a user execute an ex mode command (exactly as in true vi), so typing :: turns the ensuing command line directly over to EMACS for execution. This power is tightly integrated with the pseudo vi, so the viPlus user is rather like a surgeon operating with a different scalpel in each hand.

The most welcomed EMACS feature is complete windowing. It's possible to have several windows on your screen, opening into different files, or different parts of the same file, and/or to other UNIX utilities via shell escapes. It's fast and easy to open and close windows, expand and reduce their sizes, connect and disconnect documents and processes to/from specific windows, switch your editing focus from one window to another, and move text between different windows. Even mouse support is there. It's a whale of an improvement over vi's stodgy named buffers.

EMACS (and, therefore, viPlus) has simple text formatting power, such as line filling and justification. It has modes for editing C programs as well as LISP (the Berkeley campus UNIX researchers really ought to blush with embarrassment over their fiasco in writing vi with a LISP mode but no C mode), and can take an error output file from a program like *make* and bring you, in turn, to each error spot in the source file, simultaneously displaying the associated error message in another window. (To write a similar function for vi—without the windowing, of course— I had to strain the editor to its limits, and still my function wasn't as useful and convenient as the one built into viPlus.)

Myriad other small matters are handled better in EMACS than in vi; a good example is capitalization. In vi, you can change the capitalization of individual letters in visual mode via the ~ command, or you can make more complex capitalization changes by tedious jury-rig work with the *ex substitute* command, its g flag, and the &, \(, \), \U, \L, \E, \u, and \1 metacharacters. EMACS does all this with ease—four keystrokes are all you need to capitalize just the first letter of each of the next 10 words. It also handles capitalization work that vi just can't do except manually. A particularly splashy example comes with the EMACS abbreviation facility, which starts out similar to :se ab in vi. If you've told EMACS that sc is to be the abbreviation for state capitol, then EMACS automatically makes SC stand for State Capitol, Sc for State capitol, and sC for state Capitol.

Rather than grind through a list of every little EMACS-based advantage of viPlus, I'll add that if you don't like the way a particular vi feature is simulated (UniPress programmers went so far as to put in several vi bugs, which they thought were undocumented features), or you think one of the obscure vi commands that was not included is essential to your own editing, you can easily take care of it yourself. The MLISP source code for the vi additions is included with viPlus, and MLISP is not difficult for a high level language programmer to learn—nothing like the cranky modification features of vi. And if you just don't like some of the decisions that went into original vi, its easy to change those in viPlus, too.

But there are drawbacks to viPlus.

The first one most users notice is that vi and EMACS syntax are noticeably different, so you must constantly switch contexts mentally as you move between pseudo-vi and straight EMACS. Its about like a user in true vi switching between visual and ex commands, but now there's a third context to be remembered. The differences extend right down to as basic a business as giving counts to commands; often the count needed with an EMACS command is one less than would be needed with the corresponding vi command.

Next, you'll notice that EMACS doesn't run as fast as vi, and the pseudo-vi of viPlus is slower still. UniPress has done quite a bit to speed it up, but the speed difference still is large enough that it's noticeable when you're just typing in text; screen refreshes easily fall behind with viPlus. This probably won't cause problems if you edit on a technical workstation, but if you have a PC or a terminal on an already-overloaded multiuser system, this needs to be taken into account.

The biggest drawback shows up later: viPlus has implemented relatively little of the ex mode of vi. Most of the environment setting is there, and the majority of the commands that parallel visual-mode commands, but the features that make ex mode so powerful for global editing, such as global commands, the source command, and many advanced features of the substitute command, just aren't there. This is a Catch 22 situation: EMACS isn't oriented toward this sort of editing, which makes these commands difficult or impossible to simulate with MLISP, but that's exactly why they are the most desirable commands in a pseudo-vi that's integrated with EMACS. This factor alone is enough to make viPlus of little interest to present EMACS users. Why should they learn the alien (to them) syntax of vi when they won't be able to do much in viPlus that they can't already do in EMACS.

But for current vi users, viPlus can be a very attractive package. Most vi users rarely go beyond visual mode editing. They'll find the extended power of EMACS as refreshing as the first day of spring, and won't often miss the rest of ex mode. When they need it, they can always return to true vi.

Documentation is more than adequate. There are better than 150 pps., 8.5 x 11 in., in a ring binder (but without divider tabs). Coverage is thorough enough for most end users, explanations are generally clear, and the mistakes I've found are few in number and rarely major. The software has a 30-day warranty, and subsequent maintenance is available by contract. UniPress was quite helpful with my questions, and seemed genuinely interested in my bug reports and criticisms.

For ordinary users working with vi now, this is a worthwhile step up. There's no competition to compare it to, because no one else is advertising vi integrated with any other major editor.

Walter Zintz is a Hardcopy *UNIX specialist.*

Product: viPlus
Price: $645 (PC/VAXmate), $1,590 (VAX), $3,995 (VAX supermini)
DEC System: Ultrix, any version of UNIX
Company: UniPress Software Inc.
2025 Lincoln Hwy., Ste. 209
Edison, NJ 08817
201-985-8000 **Enter No. 499**

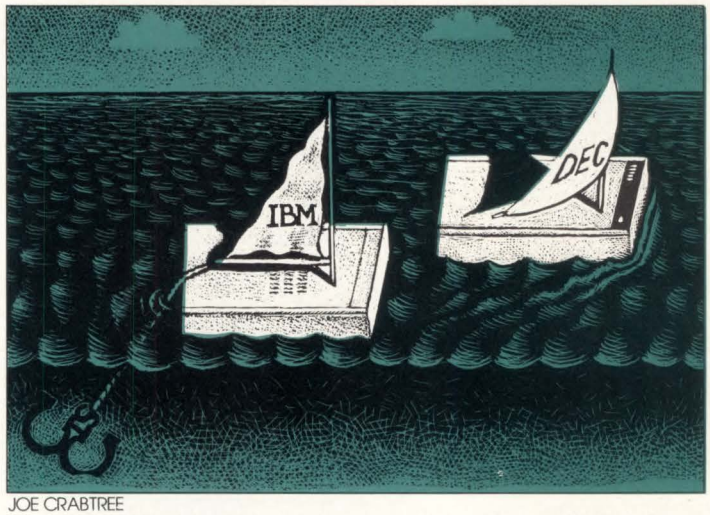
IBM Vs. Digital

IBM's inability to effectively support the online environment heralds Digital's fortune/by Gary Neidhardt [ISI/Fasbe]

It was 1975. Thirty data processing professionals were assigned to the combined tasks of converting COBOL application programs from one IBM operating system to another, centralizing seven regional mainframes into one headquarter's mainframe, and keeping the users serviced without interruption. The conversion took 30+ man yrs. spread over a period of 13 mos.; it provided a classic example of many of Murphy's laws.

Very little had actually been accomplished, other than the gain of a very impressive computer room. Nothing had changed in the "real" world—the information systems hadn't changed at all; only the technique of how to run them had. The conversion of the operating system was, after all, unrelated to the real problem at hand, which was to improve the information that was available to the real decision makers.

It was then that I learned the curse word of the applications software world: conversion. I also learned that if a computer company could design an operating system for all its hardware that would minimize, if not eliminate, conversions when the hardware changed, that company would become the long-term, economical solution to manage the majority of information systems that real decision makers need.



JOE CRABTREE

"CICS is an anchor dragging behind the IBM boat."

The VAX/VMS Solution

Digital Equipment Corp. is almost always described in nontrade newspaper articles as the computer hardware company that markets to scientists and engineers. This is inaccurate and defines most of the current marketing of the UNIX community, rather than the marketing strategy of Digital. Digital is really marketing to the heart of the general business community.

When it was first introduced, Digital's VAX/VMS was thought of as unsuitable for business applications. This point of view was essentially correct at that time. The VAX originally was a 32-bit replacement for the 16-bit PDP-11; it mainly provided virtual memory for environments with minimum disk activity: reading instruments, slicing time, and performing analog-to-digital operations. General business application software lives and dies by accessibility to large disk, and the original VAXes didn't do that very well.

The same newspaper articles also classified Digital as a "minicomputer" company. This description is also inaccurate. One way to show the difference between a microcomputer, a minicomputer, and a mainframe is to answer the following question: How much money has been spent on disk storage? VAX "minicomputers" can now dedicate 100 times more memory to a job than IBM mainframes of the mid-'70s could. The average IBM PC has 10 times more memory, on the average, than that old IBM mainframe allowed. Therefore, the amount of memory on a computer may not be an accurate way to determine what kind of computer it is. The following definitions are often more accurate:

- If the computer has a floppy disk or small Winchester disk, chances are it's a microcomputer.
- If the system uses large multi-platter disk drives, and these drives are managed by your CPU, chances are it's a minicomputer.
- If there is a separate "box" (or boxes) from the CPU that controls disk activity, chances are it's a mainframe.

Judged by these criteria, Digital is ahead of its competition because it can provide one VAX/VMS operating system as a solution for all three types of computers. Digital does "have it now," as its advertising claims. VAX/VMS is paving Digital's road to success, at least as much as its advertised hardware. Because of VAX/VMS, Digital can provide the widest range of hardware that shares one compatible and robust operating system—something that IBM must wish it had now.

Competitive IBM Solutions

With regard to "future solutions on the drawing board" rumored about IBM, please note these words of com-

Gary Neidhardt, product development director for ISI/Fasbe (Lowell, Mass.), holds a B.A. in mathematics from Wesleyan University. He has more than 15 yrs. professional experience in application design in both the IBM and Digital environments.

mon sense from Joe Gallagher of 4GL Solutions:

"No software arrives in the marketplace bug-free and in final working form. Many problems surface only after extended use. The vendor provides fixes and adds functions and features—enhancements—when its developers complete them. This 'maturing' process proceeds unpredictably. Prudent users, therefore, don't count on capabilities that are not in hand."

Even if IBM introduces a new mainframe operating system or alters one to make it their new standard, many years will pass before IBM can achieve what Digital has now. Digital has pioneered electronic mail, which remains foreign to IBM's Customer Information Control System (CICS). A VAX doesn't require system programmers to keep the mainframe operational. Batch programs can update files, while online programs, which share the same files, remain operative; CICS environments commonly prohibit this practice. New Digital terminals allow two separate programs to share the same video display terminal (VDT) concurrently. The VAX represents a less complex, more economical technology to use when compared to traditional mainframe alternatives.

The maturity of VAX/VMS is its outstanding characteristic. Only after a company makes a very large investment in a computer operating system can it begin to make another very large investment to make it mature. Digital has done it! References to an IBM single operating system solution comparable to Digital's remain speculative. Consequently, to minimize future large software conversions, IBM mainframe shops should strongly consider offloading appropriate software applications to VAX "conversion-free" environments; the initial expense to acquire VAX computers has the potential of a rather quick payback. The question becomes not *if* IBM mainframes should be offloaded, but *when*.

The IBM Hierarchy

Disk management is only the first example of IBM's hierarchical design. If you want to use an IBM mainframe to create a permanent indexed disk to use for production, be prepared to prove why and get approval from Operations. IBM's most common operating system design requires that the file be catalogued, which means that the average analyst can't do it without approval.

Hierarchy has virtually permeated IBM mainframe environments. The widely used CICS and Systems Network Architecture (SNA) of IBM are hierarchical. If you talk with an IBM mainframe veteran, he may almost think hierarchically. Hierarchies of people are required to manage the large and complicated mainframes. Consequently, the needs of individual decision makers are quite often secondary to the needs of the hierarchy.

Batch processing has always been the strength of IBM's mainframe architecture. IBM's design favors the processing of large amounts of keypunched data sent once a day from data entry departments and processed throughout the evening by computer operators. The evolution of VDTs forced IBM to design data entry software for the mainframe after its basic operating system and disk management architecture were already established and entrenched. This pre-VDT IBM information architecture may be the most significant factor in the emergence of strong IBM competitors like Digital (who don't have the overhead expenses of a mainframe management hierarchy). Digital didn't copy IBM's design, as have some other computer manufacturers. For example, NEC copied the IBM mainframe design and now offers "world class mainframes." However, rather than another Japanese success story, NEC mainframes remain a significant market force only within Japan.

Such developments strongly suggest that mainframe technology has already passed through its strong growth curve and that new markets demanding online entry want other solutions.

The Keypunch

IBM's online solution is CICS, which is actually the old keypunch in disguise. IBM users either keypunch input cards on their own VDTs or fill out an input form and send it to keypunching. A more modern synonym for a keypunch machine has become a "block mode terminal." Block mode terminals can be thought of as the data card without the cardboard. Whether you call an IBM VDT a block mode terminal or a keypunch, the results are the same: No computerized intelligence exists to assist the user while data is being entered.

The computer resources provided for online entry on an IBM mainframe don't amount to much. Each keypuncher may be allowed less than 1/10th of the memory provided to a user of an old IBM PC. Would you choose a CICS terminal or a VAX if you had to do the data entry yourself? The answer is obvious: You'd choose the friendlier way.

Because all IBM keypunchers must work through the same CICS hierarchy on the mainframe, the actual CICS software quickly becomes very complex and cumbersome the more keypunching there is to do.

When a CICS screen first appears, a rigid input card format is displayed in full on the VDT. No variety of fields that might be dependent upon specific data not yet entered by the user is permitted. To achieve any variety of screen appearance, the user must use another CICS screen. Because of the rigidity of the input card formats used in CICS, many more screens are required by IBM to accomplish the same thing than are required by Digital.

After keypunching the entire card on a VDT, you send the card to the IBM mainframe. Only then can the card be validated and either accepted or rejected as a whole. If an error is detected, the entire card is returned to be fixed. Not very friendly, is it?

IBM's advertising tends to disguise the weakness of its online design. It emphasizes that information is available "at the push of a button." However, there isn't much attention paid to the mechanics of how data is entered. Data entry, rather than data display, is a far better way to judge online technologies.

The market is now demanding friendlier interfaces to a variety of computers. Just as blue collar jobs are diminishing in number, so are straight keypunch jobs and their related software. The market's expectations of how to communicate with computers is evolving toward direct entry by many more nonkeypunchers, such as salesmen and various managers at all levels. These new users demand friendlier tools that outdate IBM's online mainframe economics and technology.

The VDT Terminal

Digital, like other originators of the time-sharing industry, designed its original input device to be the old Western Union teletype, which was the forerunner of the VDT and the personal computer. The typing of individual words and immediate recognition of them are premises of Digital's online design. The user doesn't have to wait until the IBM data card is completely typed to receive results or advice.

As characters and/or words are typed on a VAX terminal, they can be immediately validated. A variety of information can either be displayed or requested, depending on what has been typed so far. Friendly help procedures can provide online documentation of the entry screen in use. Demo, ISI's FASBE financial software designed for

the VAX, versus a CICS alternative. You'll quickly see the advantages of "conversational computing" on the VAX.

An example of the superiority of a VAX-based software design over an IBM design is illustrated by ISI's multilingual capability within the FASBE product. ISI's financial software "speaks" any language that reads left-to-right and that has fewer than 256 characters in the alphabet. FASBE can be translated at one site and then distributed, or translated by remote sites when the software is received. Anything that appears on a VDT screen, including the commands used to instruct the computer what to do, can be translated at the discretion of the individual. The exact same software can be economically maintained worldwide and at the same time, it can provide unprecedented friendliness, such as local dialects, within a language (e.g., Canadian versus Parisian French). Don't expect an IBM computer to work that way.

The demand for friendlier human/computer interfaces makes IBM's CICS no longer competitive. Unless IBM has something up its sleeve to provide conversational computing, the introduction of the IBM 9370 "VAX killer" doesn't change this equation much at all. CICS is an anchor dragging behind the IBM boat. And it's not the only one.

Disk Filing

The techniques of filing information on a disk are fundamental differences between Digital and IBM. IBM disk management methods were designed without directories, which is the most common disk management technique used in VAX computers and also in other, newer disk software technologies.

Directories operate like folders in a filing cabinet. When you open the "drawer" of a VAX disk, there are many separate folders to choose from. When you withdraw a folder from the filing cabinet and open it, you find that the folder contains many files that you have named yourself. If you want, nobody else can open your folders; thus, their contents can be yours and yours alone.

However, IBM doesn't store information this way. When you open the "drawer" of an IBM disk, you find no folders, only files. You cannot name the file yourself; that must be decided by Operations through the centralized Job Control Language (JCL) process that IBM requires. You must inform Operations who is going to use the filing cabinet, so it can make sure somebody else's file is not used inadvertently. Because there are no folders, Operations must perform the secretarial function of filing.

Digital has recognized the importance of efficient file organization. A subset of VAX/VMS, the Record Management System (RMS), provides the tools necessary for robust disk performance and supplies efficient file management as well. RMS has an online editor named EDIT/FDL that provides a variety of helpful ways to improve disk performance. It's difficult to overstate the significance of disk filing. The UNIX community has directories similar to those of VAX/VMS. However, UNIX disk filing efficiency remains very questionable. Despite mainframe companies such as Amdahl that offer it, UNIX hasn't significantly penetrated the market of general business ap-

continued on page 132

THE DECOMMUNICATOR *by Tim DePrima*

Planning for high speed digital networking, part II

There are two primary components to most high speed digital networks: circuits and/or services contracted from one of the common carriers, and customer premises equipment (CPE) required to multiplex, transmit, receive, de-multiplex, and manage data (including digitized voice) over these circuits. In the July issue, The DECommunicator examined trends in the telecommunications industry affecting the services offered. This month, let's turn to the nature of the CPE being offered, and provide some guidelines for strategic decisions with respect to planning a high speed digital network.

Nature Of High Speed Digital Networks

The communications industry is mimicking a trend seen in the computer industry during the past several years: that of moving toward distributed intelligence rather than centralized control. The cost and power of the new generation networking equipment has shifted network control from the carriers to users. Users are becoming more sophisticated, and enhanced management is permitting dynamic use of T1 circuits, including the ability to access other networking solutions.

The cost of network management and control was formerly bundled with transmission costs. But now, with the new generation of digital networking products, not only have users been placed in the network management seat, but the distinction has been emphasized between network management and transmission costs. Transmission (versus equipment) costs are being exposed as the biggest expense in high speed digital networks. The natural trend for users will be increased emphasis on replacing recurring line costs with one-time equipment expense. The Regional Holding Companies (RHCs) and other carriers are at least partially countering this trend by developing and offering the potential for "hybrid" networks, combining access to multiple services and types of facilities. Gateways to value-added networks (VANs) or evolving integrated services digital network (ISDN) type services, for example, can offer more flexibility and improved cost performance, but are potentially complex to manage.

A merging of these seemingly opposing trends is likely. Customers will embrace new carrier offerings, but will still prefer to own the equipment required to take advantage of them, if possible. Today's T1 multiplexers will emerge as multifaceted, high speed network controllers, supporting voice, data, and multiple network protocols. Efficient use of bandwidth will continue to be emphasized, but not at the expense of compatibility. A 64 Kbit per sec. (Kbps) standard channel access to digital access cross-connect system (DACS) or evolving ISDN, for example, is likely to be respected. While this may seem like an expensive amount of bandwidth for access to a particular application in today's market, as the price of bandwidth falls, this will be less of a concern.

Manager Strategies

First off, in which applications will high speed digital networking pay off? The answer depends on your unique trade-offs, but the obvious trend is toward integrated voice and data networks. It may take this type of integration strategy for your company to develop the capacity required to justify transmission costs, and the new generation of CPE is now providing the capability to effectively manage such diversity. Historically, high speed digital networks have been primarily either voice or data. For example, a network has been cost-justified to carry voice, with some small percentage of its capacity dedicated to carrying data for "free." In determining the cost justification for a T1 line, make sure you're comparing apples to apples. Many arguments against cost-effectiveness in voice applications, for example, may be based on the 64 Kbps voice quantization rate of pulse code modulation (PCM). Other forms of voice quantization (see "A Primer for T1 in 1987," in the May The DECommunicator) are fitting up to 90 voice frequency channels on a single T1 span, potentially making it cost-effective at any distance.

In keeping with the premise of replacing recurring transmission costs with one-time equipment costs, it seems reasonable to plot a strategy whereby you will purchase transmission/management equipment wherever possible. Strategic plans should also plot telecommunications industry factors. Any guesses on what a coast-to-coast T1 circuit will cost in 5 yrs.? A dramatic drop in the price of bandwidth will put cost/efficiency tradeoffs into an entirely new framework. Also, as Telco services become more complex, so will pricing plans. They will be more unbundled, with more variables. It may be cost-effective to employ the services of firms specializing in the interpretation of voluminous tariff data.

In terms of vendor selection, keep in mind you're looking to get married, rather than just have a fling. Your vendor should offer a software-intensive product line to be able to provide integration tools and support open systems. There are many start-up companies that will be trying to sell the same feature set as established products for a lower price. Some serious caution in vendor selection during the next years is warranted. Pay attention to vendors who focus on customer service.

Finally, you must also stay abreast of transmission technology and Telecom industry developments. For example, extended superframe format (ESF) formatting is a relatively new development (being implemented by AT&T during the past 2 yrs.) that permits maintenance or troubleshooting of T1 circuits without first having to take them out of service, as was previously required. While there is some benefit to the user either way, to take full advantage, your equipment must be ESF compatible. There are undoubtedly other such developments coming our way in the next several years.

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TCP/IP Solves Network Interconnect Problems

Networking provides a standardized well-supported method of computer interconnection/by Nancy Conner [FTP Software Inc.]

Network access is a useful and sometimes necessary tool in most environments today. Digital Equipment Corp. has responded to this need by creating DECnet and DECnet-DOS (its own local network software for personal computers [PCs] and Digital computers running standard Digital operating systems) and, by offering Transmission Control Protocol/Internet Protocol (TCP/IP) support as an integral part of some of its computer systems. TCP/IP support is included in Ultrix and offered as an option in VMS.

DECnet And DECnet-DOS

DECnet is a Digital proprietary network system, running primarily on Digital computers with Digital operating systems. DECnet is available on the Rainbow, VAXmate, MicroVAX, VAX, and DECsystem-10/20 computer systems, and an implementation is also available for the IBM PC, called DECnet-DOS. Several transcontinental DECnet networks have been established, and the number of sites that are attached to these networks is constantly growing. The implementation of DECnet in department- or building-wide networks is also widespread, as VAXclusters and local Ethernets are prevalent in many workplaces.

The DECnet protocol was designed to link all Digital systems at a given site, and to share resources between remote sites. It was designed to work over a variety of network technologies, including IEEE 802.3 Ethernet, synchronous and asynchronous serial lines, and satellite links. Translating gateways also exist for X.25 and IBM Systems Network Architecture (SNA) links. DECnet is the name for both the Digital protocol suite and the software that's sold to the user. The DECnet protocol is a host-to-host network protocol, Local Area Transport (LAT) is a secondary protocol that works with DECnet to provide a more efficient serial peripheral to host protocols, and Digital Data Communications Message Protocol (DDCMP) is also a secondary protocol that provides point-to-point network communications.

For a site that uses Digital equipment and operating systems, DECnet has the advantage of being easy to learn, with a small number of new commands and an easily recognizable host naming convention. However, it has the disadvantage that if you have nonDigital equipment, or if you are using non-Digital operating systems such as Berkeley UNIX, you will not be able to use DECnet on these hosts, and you will not be able to talk to any network provided on these hosts without a translating gateway that will interpret the protocols.

At present, DECnet networking includes a large number of hosts, but these hosts are not listed in any central registry. In order to connect to a DECnet node, you need to know its nodename in advance, and your computer then consults its host table, which must contain that host's nodename. This host table must contain the area and nodenumber for each nodename. This can cause problems if you want to communicate with a new node on the network, and your computer's host table doesn't contain information for it yet.

Unlike DECnet, TCP/IP uses a domain naming system that allows you to locate the address of hosts for which you don't already know the address. This requires only that your computer know the addresses of a few domain name servers. (The address of one domain name server would be sufficient if computers never crashed.) After that, everything happens automatically. If you ask for a service such as File Transport Protocol (FTP) or mail service from a host that your computer doesn't know, it will look up the name from name server. If the name server doesn't know the address of the host that you are requesting the service from, it will pass the request to the name server for the appropriate domain.

For example, if you were sending mail to a user on vax.ftp.com, your computer would query the com server which may know the address of vax.ftp.com, but it will know the address of the ftp.com name server and will pass the request there, if necessary. All you need to know is the user and his computer's name.

Nancy Connor, manager of documentation at FTP Software Inc. (Boston, Mass.), holds a B.A. in computer science/mathematics from Towson State University (Baltimore, Md.).

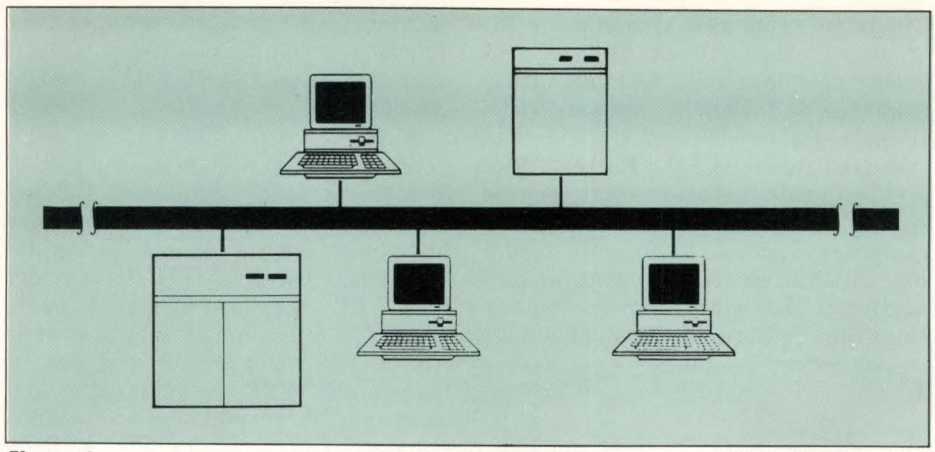


***Figure 1**—A typical basic TCP/IP network consists of PCs and minis on an Ethernet.*

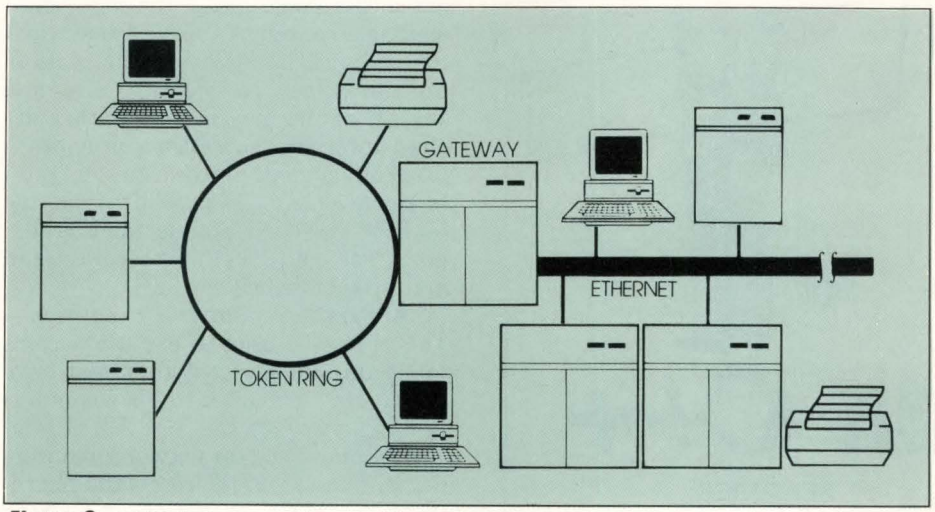


***Figure 2**—TCP/IP networks usually include more than one type of network, and thus gateways.*

TCP/IP

There are many computing environments to consider when discussing networking: the office environment, where standard computer systems are PCs such as the VAXmate, IBM PC, and Macintosh; the engineering environment, where a variety of computers, such as Sun and Apollo workstations, VAXstations, MicroVAXes, and computer-aided engineering (CAE) workstations are in use; and the research or academic environment, where there's usually a large number of time-sharing computers with some workstations, and occasional special-purpose machines, such as LISP.

In most workplaces, these groups all want to share resources, which poses the problem of how these different computers communicate with each other. Usually, the PCs are networked together on a LAN, but since the LAN protocols for PCs are rarely the same as those on the larger computers, the PCs usually use a slow serial line to reach the larger machines. Clearly, another solution is needed to enable the LANs to communicate with the rest of the computer world.

Most larger computers, especially those in the engineering, research, and academic environments, include TCP/IP support as part of their operating system, and require only a network interface to create a network link. On the other hand, most smaller computers do not include any network support, and therefore require hard decisions regarding which LAN software and network interface to buy, and how to integrate your PC LAN with your other computers. Since the larger computers already have TCP/IP support built in, it seems logical to provide TCP/IP support for the PC. This eliminates the need for gateways or other cumbersome solutions to the interconnection problem.

TCP/IP was developed during the 1970s as a research project sponsored by the Advanced Research Projects Agency (ARPA) of the Department of Defense. Part of the research project consisted of an experimental, packet-switched computer network called the ARPANET, which linked together many types of computers. These computers were either directly connected to each other using X.25 and 1822 links, or via many types of LAN technologies. The TCP/IP protocols were designed and tested in this environment, linking many different kinds of networks and computers.

The TCP/IP protocols were designed to run over different types of network interfaces, and to bridge different networks. TCP/IP implementations are available for many network architectures such as IEEE 802.3 Ethernet, IEEE 802.5 token ring, Proteon ProNET-10 and ProNET-80 token ring, StarLAN, asynchronous and synchronous serial lines, satellite links, and X.25 links.

Implementations of the TCP/IP protocol family exist for almost all major mainframes and micros, and TCP/IP is supported by more than 150 vendors. Some of the computer systems that support TCP/IP include Digital's VAXes, VAXmates, PDP-11s, and DECsystem-20s, as well as Control Data Corp.—CDC Cybers, Data General computers, Cray supercomputers, Apollo and Sun Microsystems workstations, Hewlett-Packard 9000s, Prime computers, and IBM mainframes, minis, and PCs.

DECnet Versus TCP/IP

DECnet and TCP/IP both provide similar services, but these services are best used in different environments. DECnet works best where Digital equipment is used exclusively, while TCP/IP works best where a hybrid environment requires computers from many different vendors. TCP/IP should be treated as an addition to the repertoire of available DECnet services, which allows you to expand the area that your existing network can reach.

DECnet and TCP/IP provide the same categories of services. DARPA has standardized a number of the services available in the TCP/IP family. The University of California at Berkeley and other institutions have added a number of new services to the family in

its 4BSD UNIX distributions, and some of these new services have become de facto standards in their own right (and are thus included with other versions of UNIX that are derived from 4BSD, such as Sun's operating system and Ultrix). This rating as standards is due to both the quality of the new services and the number of vendors supporting it. The most important network services include:

- *Remote log in*—This allows one computer to act as a terminal for another over the network. DECnet provides a network virtual terminal utility using the SET HOST command. TCP/IP provides versions of the DARPA-standard Telnet and the Berkeley Rlogin protocol. An often-implemented special version of Telnet allows the computer to act as a 3270-family terminal, which is especially useful for connecting to IBM mainframe computers. Note that *Telnet* and *the Telenet* have nothing to do with one another. *The Telenet* is a commercial computer network service sold by GTE that doesn't use TCP/IP.
- *File transfer*—This allows users to transfer files of the same or different formats between computers. DECnet uses the COPY command, with options to change formats for various Digital operating systems. TCP/IP provides the DARPA-standard FTP protocol, in which files in various formats, such as ASCII, EBCDIC, and binary, can be transferred. FTP automatically converts text file formats between different operating systems. The TCP/IP family also provides the DARPA TFTP, and Berkeley Rcp protocols.
- *Electronic mail*—This allows users to exchange electronic mail. Mail messages consist of a set of headers and the body of the message. The headers tell the sender, recipient(s), date, and subject of the message, and other desired information. DECnet provides a proprietary mail protocol to send mail to remote hosts. TCP/IP provides the DARPA-standard Simple Mail Transport Protocol (SMTP) protocol to send mail to remote hosts.
- *Remote command execution*—This allows a user to execute a command on another computer and have the results sent back to his computer. DECnet provides the SET EXEC and TELL commands for network monitoring, and the SUBMIT command for remote command execution, via batch queues. There are no interactive command execution utilities available with DECnet. TCP/IP provides the Berkeley Rexec and Rsh protocols for interactive remote command execution.
- *Printer spooling*—This allows files to be spooled and queued for printing on another computer on the network. DECnet provides the PRINT command, where providing the queue name or the printer name is sufficient for spooling the file on any printer in the network. TCP/IP provides the Berkeley Lpr protocol, and sometimes proprietary protocols, such as the Imagen printer protocol for Imagen printers on the Ethernet.
- *Filesystem access*—This allows computers to share the filesystem over the network. DECnet provides a virtual disk utility for DECnet-DOS to keep remote disks on a larger system. DECnet also provides a data access protocol for larger systems to keep remote file access transparent to the user. TCP/IP provides the Network File system (NFS) protocol, designed and imple-

mented by Sun Microsystems for its UNIX-based workstation, although many vendors are currently supporting it. NFS has become a de facto standard because of the number of vendors who are supporting or promising to support it.

- *Realtime user communications*—This allows users to send messages, or even converse, across hosts in the network. DECnet provides the PHONE utility for a visual communications connection to another user. TCP/IP provides an equivalent of PHONE, created by Berkeley, called Talk. The TCP/IP family also provides Send, which is part of the SMTP protocol, to send short messages across hosts.

Setting Up A TCP/IP Network

After the network manager determines what network services must be available at his site, he must determine where and how they will run. Any given computer on the network can either provide or request any subset of the available services.

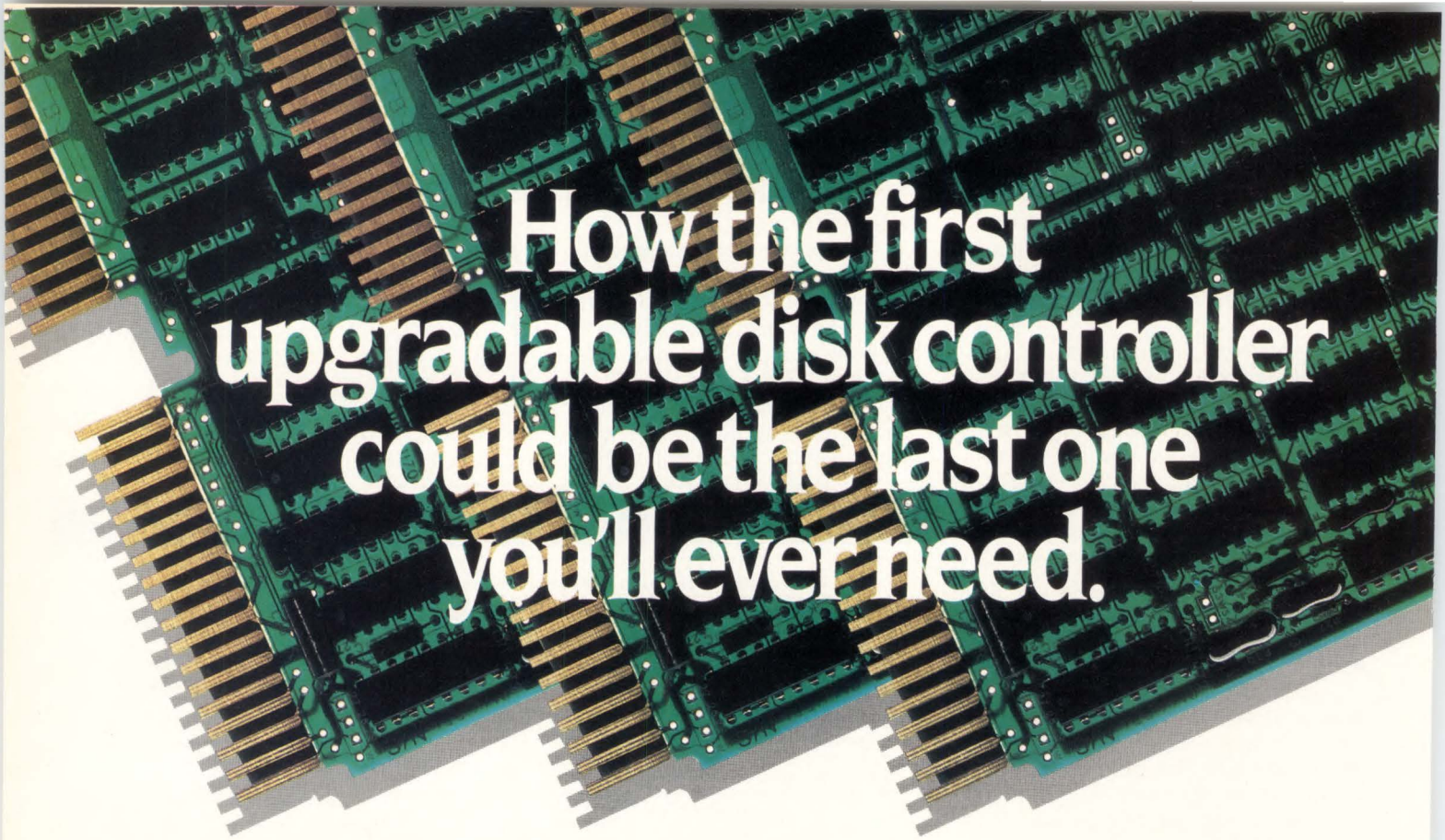
A computer can play one or more of several roles on a TCP/IP network—host, server, and/or router. A host is a computer that requests services, normally a user workstation or a time-sharing system. A server is a computer that provides services, such as file transfer and remote log in. Some TCP/IP networks have computers that are explicitly dedicated as servers, but most servers reside on time-sharing systems that are also hosts.

Routers are the components of the network that interconnect LANs at the physical level. In TCP/IP terminology, a router is also called a gateway. A translating gateway connects two networks that use different protocols. For instance, a router would connect an Ethernet with a token ring network, but a translating gateway would connect a DECnet network with a TCP/IP network. Computers are usually both hosts and servers, and sometimes also routers or bridges.

A simple TCP/IP network could consist of several hosts (which might be UNIX systems, PCs, or large mainframes) on a single LAN, often an Ethernet (Figure 1). All the hosts that timeshare can also act as servers, and some can act as routers. The services most commonly supported on these networks are file transfer, remote log in, and mail. If the host did not provide these services, it would be unable to receive mail, allow users on other hosts to log in over the network, or accept file transfer requests. However, it could still request all these services of another computer.

A more common configuration for a TCP/IP network is an internetwork, or combination of networks connected by bridges and/or routers (Figure 2). Each of these smaller networks might use the same type of media, or they might be of different types. For instance, there may be an internetwork made up of a collection of Ethernets and token ring networks with routers between them.

In order to provide a router between the DECnet community and other hosts that communicate via TCP/IP, a DECnet LAN might use a MicroVAX running Ultrix, or a PC running MS/DOS with a combination of TCP/IP and DECnet. With the widespread use of TCP/IP today, you could easily be left behind if there were no TCP/IP hosts available to you.



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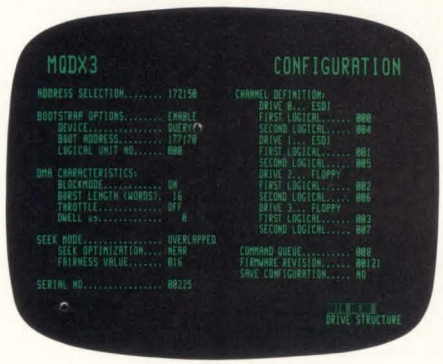

Sample MENTOR screen.

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Micro Technology, Inc.

Product Review: Trimarchi Inc.'s E-Z Box

The E-Z Box provides removable disk drives with improved security, transportability, interchangeability, and reliability/by Scott Taylor

HARDCOPY PRODUCT REVIEW

A new concept in storage—*Representative of the new removable disk subsystems entering the mass storage market, Trimarchi's E-Z Box is rugged yet attractive, and supports a variety of configurations.*

The E-Z Box evaluation unit consisted of the chassis, a Distributed Logic Corp.—DILOG (Anaheim, Calif.) disk controller, and one Control Data Corp.—CDC (Bloomington, Minn.) Wren III disk drive (151 Mbytes formatted capacity). Cables, manuals, and power cord were all included. During installation, a quick reference to the manuals was made to confirm the switch settings (boot on/off, boot address), and which connector was for drive 0.

With the controller at the default address, the DU driver supplied with RT-11 was ready to use. Opening the shipping carton to booting the drive took about 10 min. (the drive had been previously formatted and RT-11 installed). Formatting time depends on the controller and drive used (Trimarchi offers a variety of configurations); the DILOG/CDC combination takes about 15 min.

The E-Z Box chassis is a solid, well-built, white aluminum box, or chassis, 17-in. wide, 16-in. deep, and 5¼-in. tall (add ½-in. for tabletop feet), about the size of a thick briefcase. The front has two openings that allow metal drawers to be inserted, with AC power and controller cable connections on the rear. Rack-mounting or a chassis having four drawers in a roll-around floor unit are options. Each drawer, the size of a shoe box and weighing 10 lbs., can hold one full-sized or two half-sized disk drives. The next revision of the E-Z Box will add position independence, enabling any drawer (with the correct interface) to be inserted into either opening. Both the power and disk controller connectors to the drawer are mounted on the rear so connection is automatic when it's inserted. The front of each drawer has a power and access light,

plus a write protect switch for drives supporting write protect.

To exchange one or more drawers, switch off the front panel power switch, loosen the thumb screw with your fingers, pull the drawer out by the handle mounted on the front, insert the new drawer, finger-tighten the thumb screw, and power-on again. Total time to swap up to 1.5 Gbytes of storage (currently 640 Mbytes) is less than 1 min.

The E-Z Box has two separate cooling fans. Even if one fan should fail, the remaining fan will keep the unit cool indefinitely (until the service man arrives). The E-Z Box power supply is rated at 20A at 5 V and 5.5A (10A peak) at 12 V. Two Wren III drives require 2A at 5 V and 4.6A at 12 V. With the 5 V supply loaded only to about 10% capacity, spare power is available to the 12 V supply.

Secure Data Storage

When data security or archiving are required, several choices are available: removable optical or magnetic disk packs, tape backup, or removable disk drives in a drawer. Using removable disk packs, contamination and damage are a problem, requiring untrained personnel to wait for trained personnel to change packs. Tape backup requires considerable system resources during disk-to-tape copy operations, and if security is an issue, the disk must then be erased to ensure all data has been removed. The tape system will either be expensive or slow (or both), possibly requiring several tapes to back up a large disk. Further, when the tape drive is not in use, it's a wasted resource.

Removable disk drives in a drawer offer backup and archiving without the disadvantages of disk packs or tape. The data is always on the drive, so the system doesn't waste time with copy operations and the drawer can be removed and locked in a vault for security. Since the drives used are generally the hermetically sealed type (though removable media types are available), contamination or damage isn't a problem. Any person who can turn off a switch and loosen a thumb screw can change the drawer, since all connections are made automatically when the drawer is inserted into the E-Z Box chassis.

Trimarchi makes the E-Z Box available from an "empty box" to a complete disk subsystem. An empty box includes the power supply, front panel switches, two empty drawers, cables (if interface type is known when ordering), and cooling fans. Disk drives and controllers ordered with the E-Z Box are installed and tested prior to shipping. Controllers from DILOG; Micro Technology Inc. (Placentia, Calif.); Andromeda Systems Inc. (Canoga Park, Calif.); Sigma Sales Inc. (Anaheim, Calif.); and Webster Computer Corp. (Sunnyvale, Calif.) are available. Disk drives can use ST506, enhanced small device interface (ESDI), small computer systems interface (SCSI), and other interfaces. New drives of up to 780 Mbytes have been announced by manufacturers and will be offered as they become available. Currently available drive capacity is up to 320 Mbytes/drive.

The E-Z Box owner's manual includes directions for mounting a drive in a drawer, allowing a user two upgrade paths: replace a drive in an existing drawer with a faster or higher capacity drive, or add additional drawers. This also enables MicroVAX users (or their field service people) to remove the internal RD-53/54 drive that comes with a MicroVAX and install it in an E-Z Box drawer. Adding a second "exact same" RD-53/54 drive from Trimarchi (at half the Digital price) will double the storage capacity of a MicroVAX, while adding removable security and archiving capabilities.

"Future additions to the Trimarchi line include the Liberty board and a solid state disk called Hypercache."

The E-Z Box is available for use with minicomputers or home computers. Files and data can be loaded onto a disk in the E-Z Box, then removed and inserted into another system. By selecting drives and controllers supporting the ANSI standard SCSI interface, drives can be moved between different types of systems. Since the drive format is determined by the drive and not the controller, data will be readable, even when controllers from different manufacturers are used (file structure compatibility will need to be handled in software). This is one of the advantages of SCSI that the other currently available interfaces—ESDI, SMD, and Digital's proprietary interfaces—don't offer.

Future additions to the Trimarchi line include the Liberty board and a solid state disk called Hypercache. The Liberty board is a Q-bus multifunction, multiemulation controller capable of handling 56 disk drives and 57 serial ports, and boasts a controller to Q-bus memory DMA transfer rate of more than 5 Mbyte/sec. Tape support and floppy disk support are planned additions. The Hypercache will appear to a disk controller to be a standard disk drive with no rotational latency or track-to-track access delays. The Hypercache drive to disk controller transfer rate will be a continuous 5 Mbyte/sec. Capacity will be 1–32 Mbytes. The drive will have the footprint of a 5¼-in. disk so that it can be mounted in the E-Z Box.

The overall impression of the E-Z Box was good, providing a practical solution to the problem of ever-increasing data storage requirements and data security. The system was complete and easy to install. The drawers were rugged, and inserted without difficulty. The people at Trimarchi were helpful and willing to assist with special applications.

Government security requirements have been the recent push in removable drawer media development, but developers have stopped one step short. Drawer compatibility between the different manufacturers is an area needing improvement. Without pressure from users, these types of standards are slow to evolve. By changing to a standardized size and mount now, costly problems and changes due to noninterchangability can be avoided in the future. If need be, two easily adaptable standards could be selected to allow both a high and low end market.

Scott Taylor is a Hardcopy *contributing author.*

Product: E-Z Box
Price: $2,495 (quantity 1);
$1,250 (quantity 1000)
DEC System: All
Company: Trimarchi Inc.
P.O. Box 560
State College, PA 16804
814-234-5659 **Enter No. 507**

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PERIPHERAL VISION *by Carl Warren*

Disk restructuring software optimizes disk performance

An operating system, whether on a mainframe, VAX 8800, or IBM PC, is usually equated with a random access data storage device.

Operating systems, of course, have other chores such as managing memory and I/O and, in some cases (such as in the UNIX operating environment) managing the data storage device is secondary.

Because storage devices are treated as second cousins in the system hierarchy, the operating system frequently isn't as frugal as it should be in how the data surface is managed. A Winchester disk drive formatted for 10 Mbytes of storage only has so many slots to use for data. Of the 10 Mbytes, only about 7.5–8.2 Mbytes are really used for data—the rest is for overhead of headers, sync bytes, and other logical functions required to store and locate files and records.

In the Digital Equipment Corp. environment, operating systems such as VMS, RSTS, and RSX tend to exacerbate the problem even more by forcing fragmentation on files. UNIX takes it a step further and moves the files around, creating even more discontinuity (UNIX likes to tuck file fragments into any available slot).

Part of the fragmentation problem arises from the notion that files are by nature contiguous and have finite boundaries. This may be true if a file is static, is written once, and never expected to grow. Moreover, operating systems such as RSX, UNIX, and VMS are optimized for writing to tape. Magnetic tape is considered the medium of exchange and is physically linear. Thus, files are put on tape, block after block, under the assumption that nothing changes. Indeed, tape utilities are designed to locate all member blocks of a file and write it in a serial fashion.

Random storage devices such as Winchester disk drives are more efficient when all the blocks of a file are contiguous. However, once a file is changed and rewritten, a problem can occur. If the newly written file is bigger than the original, part of the file is written in the old space, and new data stored at some other location. If the drive is bare of other data, there's no problem—the next location is the next available data block.

The more changes made to files on the disk drive, the greater the fragmentation. And most operating systems are willy nilly about maximizing file allocation on the drive.

There are several consequences to fragmentation:

- Performance is reduced by several factors including: the number of physical moves the read/write head must make, the number of rotations that take place during that period, and the size of the blocks transferred.
- Storage efficiency—the amount of usable surface is reduced by as much as 10–20%. This reduction occurs due to the necessity of providing more pointer detail and failure of the operating system to reclaim unused space.

Reclaiming space and improving performance is possible by using a powerful utility. Demac Software Ltd., for example, offers Squeezpak for Digital systems using RSX and VMS. This utility, which is priced by CPU and ranges in price from $945 to $2,495, is run online and is "designed to run in batch mode at file maintenance time," says Demac programmer Alan Macewen.

Macewen explains that, in operation, Squeezpak builds a block table that sets all the locations of the files and associated blocks. The disk is then rebuilt using either single or multiple passes, and excess space is squeezed out, thus reclaiming deleted file space and ensuring the contiguous nature of the files.

Digital users who want a full set of utilities might want to consider Diskit, from Software Techniques Inc. With a price range of $995–$2,995, the Diskit utility set provides a series of tools for data compression and full disk management operating under VMS. The tools include: Frag, which is a disk analysis utility that maps the disk and tells you the number of free blocks and how they are organized; and Disk Structuring Utility (DSU), which is like Squeezpak in that it optimizes the file organization, and also includes a detailed report on disk operation and file structure.

Besides the above, Diskit provides an extended directory function (XDIR) and a process utility that displays all the current information about all running processes.

Carl Warren is the principal designer at the Warren Group, a company specializing in system-level architecture, firmware, device drivers, and words.

The following vendors were mentioned in this article

Product: Squeezepak
DEC System: VMS, RSX
Company: Demac Software Inc.
1260 Old Innes Rd.
Ottawa, Ontario
Canada K1B 3V3
613-748-0209 **Enter No. 134**

Product: Diskit
DEC System: VMS, RSTS
Company: Software Techniques Inc.
6600 Katella Ave.
Cypress, CA 90630
714-895-1633 **Enter No. 135**

Additional disk restructuring software products

Product: Juicer
DEC System: VMS
Company: DECUS International
Program Library
219 Boston Post Rd.
Marlboro, MA 01752
617-480-3418 **Enter No. 194**

Product: Diskeeper
DEC System: VMS
Company: Executive Software Inc.
5132 Ocean View Blvd.
La Canada, CA 91011-1240
818-249-4707 **Enter No. 195**

Product: Defrag
DEC System: VMS
Company: H & E Concepts
1255 S. Federal Blvd., Ste. 045
Denver, CO 80219
303-628-7145 **Enter No. 196**

Product: Rabbit-5
DEC System: VMS, RSTS

Company: Raxco
1370 Piccard Dr.
Rockville, MD 20850
301-258-2620 **Enter No. 197**

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

Fall DECUS is mandatory for data processing professionals on the move

September is upon us and the Digital Equipment Computer Users Society (DECUS) Symposium is right around the corner. Managers unfamiliar with DECUS want to know what it's all about.

Twice a year DECUS, a volunteer organization, sponsors a gathering of Digital Equipment Corp. users. These sessions usually alternate between the western and eastern regions of the country.

This time it's back in the West, in Southern California. Five years ago, before the Anaheim DECUS Symposium, a customer called the company we were working for and said: "We're thinking of sending some of our employees to DECUS. Is it worthwhile or is it just an excuse to miss work?" Our response was then as it is now: attendance is more than worthwhile—it's important. Naturally the manager on the other end wanted to know why.

Readers of this column work with Digital computers. Their jobs require knowledge of Digital's approach to computing. Most command a higher than average salary due in part to an understanding of modern computing.

Ah, but the beast is dynamic in nature, and in order to remain knowledgeable about computers, the educational process must be continual. Put in more practical terms, it's getting near version 5—do you know where your operating system is headed?

Just as in 1984, this year a whole new version of VMS lurks around the corner. New features are in the cards. Support for new hardware innovations will be included. It's important for professionals who use Digital computers to know what these changes are and how they will affect the way people do business.

New hardware announcements are always interesting. Users may be interested in seeing if Digital will display a new 3½-in. Winchester disk drive. MicroVAX users may be interested in the new half-height disk and tape combinations.

A new generation of terminals is now in the picture. It may now be inefficient to have staff members tied to a terminal that allows them to do only one thing at a time. VAXes now start at $5,500. It may be time to consider these new solutions in the corporate data processing strategy.

Besides changes in VMS to support new hardware directions, expect some new software innovations as well. New ways to make computers work together are looming on the horizon. In the networking race, IBM is trying to catch up, but what will Digital's next lead be? What is symmetrical processing? Why is it important?

Digital is rumored to be adding distributed processing support to its high level languages, making a difficult programming concept as easy as calling an external subroutine. Imagine the power of several VAX processors sharing a common workload.

These are some examples of subject matter that is important to a company. Take a look at the information scheduled to be presented at the DECUS symposium. From DCL to Macro, from artificial intelligence to realtime simulation, DECUS is a conduit for vital information on subjects pertaining to myriad industries and disciplines.

Particularly note the sessions featuring Digital software developers. These sessions provide more than hot news flashes for the attendees. Digital uses DECUS as an interface between its developers and its users.

The operating system may need to evolve in a particular direction to better meet users' needs. This is the forum for expressing needs and discussing directions with developers. Anyone who feels the need to influence the development of system software and layered products should attend these sessions.

Concurrent with the DECUS symposium is the DEXPO trade show. This is where third party vendors display their DEC compatible wares. Ever wonder if those miraculous claims could possibly be true? This is the place to see it work. Software utilities and applications, tape drives, disk drives—all designed to work with Digital machines.

DEXPO attendees will see the latest write once read many (WORM) technology optical laser drives actually store and retrieve information. Or even a whole bank of optical disks in a mechanical jukebox, 100 Gbytes of archived data just 12 sec. away. These are just examples of what DEXPO has to offer.

Besides seeing professional presentations and exhibits directly relating to Digital, the DECUS symposium offers an unparalleled opportunity to meet and share ideas with industry peers. Campgrounds are established where people with common interests can meet informally and discuss ideas. Bulletin boards abound where users post problems and others respond.

Managers are often concerned with bringing the value of such conventions back to the workplace. Will the attendee suffering from jet lag take adequate notes? To assist in preserving the value of the experience, DECUS makes available an extensive set of audio cassette recordings of the sessions. These are valuable for reviewing and sharing information.

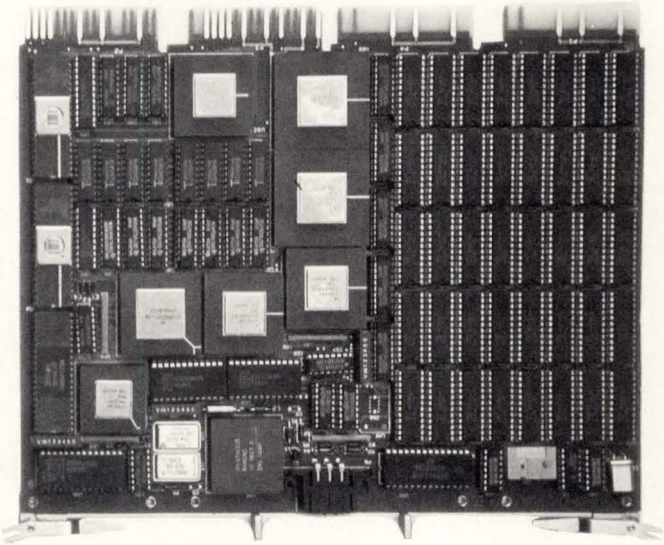
It isn't mandatory to stay abreast of the direction computing is taking. It usually isn't mandatory to automate at all. The whole idea of automated information management is to improve efficiency and increase capabilities for meeting the challenges of doing business.

To register or for more information about the DECUS symposium call 617-480-3283.

Steve Davis is a senior systems analyst whose credits include: extensively modifying operating systems for various new hardware devices, writing the original RSTS/E Disk Structuring Utility, as well as creating and implementing a directory structure for the new generation of write once laser disk drives. Matthew Owen is a programmer who has worked with Davis since 1978.

The Incredible Shrinking Graphics System

ASICs spawn the next generation of interactive graphics controllers—smaller, less expensive, and more powerful than their predecessors/by Bill Stronge and Matthew Reiner [CalComp]



***An integrated graphics controller**—Extensive logic is packed onto a single circuit board for use with MicroVAX II systems.*

Don't look now, but the world of computer graphics is getting smaller. The world of computer graphics hardware, that is. Thanks to the design advances made possible by application specific integrated circuits (ASICs), the era of bulky and expensive dedicated graphics controllers is drawing to a close. A new class of controllers, capable of being integrated with a workstation platform, is replacing these standalone machines.

High performance, high resolution interactive graphics subsystems traditionally have consisted of a standalone graphics controller with a monitor, keyboard, and a cursor control device, such as a data tablet. Via the controller, the graphics subsystem was connected to a computer though a serial (RS-232) port or a high speed parallel interface. With Digital Equipment Corp.'s VAX series products, this interface was accomplished using the DR11-W.

With the development of the engineering workstation, the requirement for high performance interactive graphics and for workstations has become synonymous. The user expects the standard workstation capabilities of local processing, networking, and consistent response. He also demands graphics standards—Computer Graphics Interface (CGI), Graphical Kernel System (GKS), Programmers Hierarchical Interactive Graphics Standard (PHIGS)—and a quality image with rapid display updating. In addition, the price must be consistent with the processing capability. The graphics performance on an engineering workstation must significantly exceed that of a personal computer (PC); this performance difference should be comparable to the cost difference between the PC and the workstation.

With the independent graphics subsystem no longer sufficient as a peripheral, it became necessary to integrate it, both physically and logically, into the CPU platform.

The integrated graphics subsystems must produce increased performance using minimum CPU platform resources such as bus load, processing, system memory, physical space, and power. In addition, the cost of the controller must be a fraction of current standalone controllers in order to be competitive with CPU platforms such as the MicroVAX II. Requirements of the controller can be summarized as:

- high performance graphics engine with excellent vector and raster capabilities,
- single printed circuit board in order to use minimum space in the CPU platform and to allow insertion of multiple graphics controllers,
- minimal power consumption,
- screen presentation in excess of 1024 x 1024 resolution,
- significant increase in graphics performance over currently available standalone controllers,
- cost proportional to that of the platform,
- fully integrated with the CPU's operating system, and
- adherence to software standards enabling the porting of application software to other workstations and next-generation products.

To demonstrate how these requirements can be met, a comparison was made between a proven standalone con-

troller and an integrated controller, both from CalComp (Anaheim, Calif.).

Both are high resolution, high performance graphics subsystems. Functionally, the two systems are quite similar. Each uses the MicroVAX as the CPU platform. Their resolutions are 1280 x 1024 at 60 Hz, and their pixel depths are 8 bits/pixel, enabling images of 256 colors. The standalone controller handles local peripherals and has a local display list built on a proprietary software package. The integrated controller also handles peripherals locally and has a local display list; however, it's built on the CGI standard.

Although functionally similar, both systems are physically quite different. Standalone controllers usually are packaged in a desk-side tower and connect to the MicroVAX DR11-W parallel port via cables. The integrated controller is a single-quad Q-bus card that plugs directly into the backplane of the MicroVAX.

The two controllers are almost identical in graphics functions, but advances in technology and in printed circuit board fabrication have made it possible to replicate the tower functionality into a single board.

In printed circuit card fabrication, more layers, etches routed closer, and surface-mounting of components on both sides of the board have enabled more parts to be put on a single card.

Integrated circuit (IC) memory has dramatically increased in density. In 4 yrs., the standard dynamic RAM (DRAM) has grown from 64 Kbits to 256 Kbits and then to 1 Mbit. In the integrated controller, the display list memory uses 1-Mbit DRAMs, an eight-to-one savings in space over the 64-Kbit DRAMs. This results in space savings, particularly in graphics systems that have a high memory content.

The increase of silicon density also allows increased functionality on a single chip such as integrated video chips. A 120-pin device of 2.3 sq. in. takes the place of more than ½ of a standalone controller board, or approximately 54 sq. in.

The real space savings is realized in the form of ASICs, which are essentially boards on a chip. Sometimes, an off-the-shelf part can fit into a design precisely, such as the video chip mentioned previously. Often, however, there are no off-the-shelf parts that fit, in which case the circuitry must be built from small scale integration (SSI) or medium scale integration (MSI) components. In the case of the integrated controller, an ASIC part was used with an off-the-shelf single-chip digital signal

Bill Stronge, an engineering manager at CalComp's Display Products Division (Hudson, N.H.), holds a B.S.E.E. from Rensselaer Polytechnic Institute, and currently is pursuing graduate studies in computer science at Boston University. He has 8 yrs. of experience in the design of high performance graphics systems. Matthew Reiner, a product line manager in charge of interactive graphics systems at CalComp's Display Products Division, holds a B.A. in mathematics from St. Michael's College and has completed graduate studies at the University of Florida, Rensselaer Polytechnic Institute, Worcester Polytechnic Institute in Computer Sciences. He has more than 20 yrs. of experience in the graphics display area.

processor to replace a complete board.

In total, there are six ASIC parts on the integrated controller. These custom chips eliminate all but a handful of MSI and SSI parts.

The reduction of the physical size of a design has an interesting effect. To a certain point, reductions in the size make further reductions possible. A case in point is the combining of two or more boards in a system into one board. Each of the original boards requires logic duplicated on the other, such as an interface. When a reduction in circuitry allows the combining of two boards, the space savings includes eliminating duplicated circuitry. This snowball effect becomes an avalanche when all the standalone controller boards are reduced to the single integrated controller board.

With the current technology, this was about as far as the circuitry could be reduced. However, once the circuitry was put on a single card, that card could be plugged into a MicroVAX card slot. This allowed all the support mechanics for the circuitry, such as power supply, backplane, card cage, fans, and package, to be eliminated, along with their associated costs.

The reduction in circuitry also causes parallel reductions in power consumption and cost requirements. As duplicate circuitry is removed, the power used and the costs incurred are eliminated. The space reductions from the use of ASICs and increased silicon density parts also result in power and cost savings. Power is saved because much of the power a chip uses is spent driving its signals outside the chip, across the board, to other chips. If the functions of several chips are combined onto the same piece of silicon, less power is required to drive the signals across the silicon.

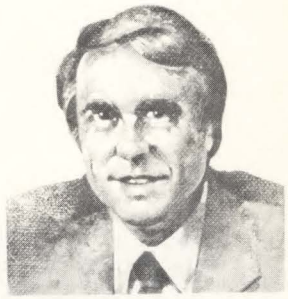
Cost is saved in several ways: Most of the cost of a chip, particularly memory, SSI and MSI, is determined by the physical package. If fewer packages are used, less cost is incurred. Fewer packages also means lower manufacturing costs, due to reduced inventories and simplified assembly.

What has occurred in taking the standalone controller to the integrated controller can be summed up in one word: "synergism." Synergy was created when the IC technology of higher density parts and ASICs combined with the new PC layout and manufacturing techniques to drastically reduce the circuitry area through higher circuit density and elimination of duplicate circuitry. Power was saved by making more interconnections across silicon instead of across the PC board. Cost was reduced by the lesser number of parts.

The savings in space, power, and cost combined to allow the graphics controller to be placed inside the MicroVAX. This, synergistically, allowed the shedding of the mechanical support packaging and software load device, resulting in more savings of space, power, and cost. This was accomplished with only minimal use of CPU platform resources.

As popularity of ASIC broadens, the trend is clearly toward the size reduction of interactive graphics controllers to a single board or limited board set. The result is a graphics controller package offering configuration simplicity, ease of system integration, and—most importantly—higher graphics performance at less cost.

THE CAD/CAM ACCOUNT *by Daniel Bowman*



Macintosh CAD/CAM in the Digital environment

Because of the Macintosh, many companies have been introduced to an affordable in-house electronic publishing system. With laser printer support, newsletters, brochures, pamphlets, and other publications that require the integration of text and graphics are easily composed.

In February of this year, Apple introduced the Macintosh II. Through a combination of features, including a 68020 microprocessor, 68881 floating-point coprocessor, 1 Mbyte of RAM (expandable to 8 Mbytes), 256-Kbyte ROM, and enhanced small computer systems interface (SCSI) throughput, the Macintosh II delivers a new level of performance. The 68020 microprocessor from Motorola is a full 32-bit databus operating at 16 MHz. A key feature of the new computer is an open architecture that provides six expansion slots, and the end result is an ideal engineering workstation at an affordable price. Configured for CAD use, including a video card and color monitor, the Macintosh will cost approximately $7,100, which is close to the cost of a 386-based personal computer (PC), and less than that of an entry-level workstation.

Prior to the introduction of the Macintosh II, Machinery Alternative (Laguna Hills, Calif.), the official distributor of MGM-Station CAD/CAM software for Macintosh, received an advance unit from Apple for beta testing. And it was with great satisfaction that Machinery Alternative found that it was the only CAD/CAM VAR invited to the Macintosh II introductory program.

Since obtaining a premiere position in the Macintosh CAD/CAM world, Machinery Alternative is looking forward to a connection to the VAX. Thus, the company figures that it will have the best of both worlds, CAD/CAM on a Mac and, via the Macintosh, a connection to Digital Equipment Corp. According to Monty Feyen, national sales manager of the MGM-Station CAD/CAM product line, MGM-Station has an Initial Graphics Exchange Specification (IGES) translator, and through appropriate software, the Macintosh could serve as a 2D workstation for a Digital mainframe.

Already there are VAX-to-Macintosh products, such as AlisaTalk from Alisa Systems Inc. (Pasadena, Calif.). In its most common form, AlisaTalk uses a standard Digital Ethernet port, Ethernet cable, and one or more Kinetics Inc. (Walnut Creek, Calif.) FastPath bridge units to provide the Macintosh-to-VAX link.

"A key feature of the new computer is an open architecture that provides six expansion slots, and the end result is an ideal engineering workstation."

Whatever the resulting connection, the prospect of having CAD on a Mac in a Digital environment is most intriguing.

MGM-Station CAD/CAM software is sophisticated CAD/CAM software developed for the Macintosh computer. While coupled with the Macintosh II, it makes the ideal engineering workstation; MGM-Station works equally well with the other Macintosh models, such as the SE and Plus. The system includes self-definable libraries for template storage, layering, and geometric calculations such as area, perimeter, center of gravity, and moments of inertia. It has an IGES translator allowing the exchange of files with other mainframe, mini, and PC-based CAD systems.

On the CAM side, it's quick, easy to use, and extremely flexible. Features like auto speeds and feeds, roughing cycles, complex milling routines, and even hand moves are available to the operator. Two-, 2½-, and 3-axis output for a variety of mills, lathes, EDM, flame cutters, and lasers give shop owners power only dreamed of in systems costing $30,000 or more.

An added feature enables 3D simulation and an interactive editor so the machinist can monitor the cutter path in any of nine perspective views. Time studies by operation run in realtime during simulation, and changes to the program are instantly animated in the simulator. The price of the MGM-Station CAD/CAM software package lists at $7,000.

What makes Machinery Alternative different from other CAD/CAM software houses is that the company was founded in 1981 by Kim Karpowitz and Mike Costello as a distributor of machine tools. They were quick to see that many of their machine tool clients were in need of CAD/CAM systems and, as a result, became the official distributor of MGM-Station CAD/CAM software. While they are still a distributor of machine tools, their CAD/CAM operation is expanding so rapidly that it is now a separate division.

Daniel Bowman, a licensed professional engineer, is a marketing consultant to the high tech industry. He holds B.S.M.E. and M.B.A. degrees.

Inexpensive Frame Grabbers Herald The Automated Factory Of The Future

Sophisticated MicroVAX II image processing hardware/software provides advanced automation to almost all industries/by Dr. Robert J. Porter and John Molinari [Data Translation]

Plug-in boards called frame grabbers that capture and display images from a video signal are becoming widely available. With real-world images converted to digital form, number-crunching programs can give a general-purpose machine like the MicroVAX II the power to discern patterns in images and to make decisions based on visual information. On the manufacturing floor, MicroVAX II-based vision systems are assuming the roles of trained inspectors, and vision-guided robots are at work in assembly. In these areas, image processing can automate tedious and repetitive tasks. In many application areas, image processing can actually provide greater accuracy and sophistication than a human.

It's not necessary to incorporate sophisticated intelligence (artificial or otherwise) for an image processing system to be useful. Applications success can be achieved using popular processing algorithms and inexpensive plug-in boards, beginning with frame grabbers and ranging upward to dedicated processors.

This article reviews some image processing fundamentals, with a focus on machine vision and surveillance applications.

A Misconception

A common misconception is that image processing requires an extremely powerful host computer system. This misconception has its basis in early image processing work in which even operations performed on low resolution images required huge amounts of system memory and extremely fast processing by the host CPU.

"On the manufacturing floor, MicroVAX II-based vision systems are assuming the roles of trained inspectors, and vision-guided robots are at work in assembly."

Consider, for example, the conversion of a single image from a monochrome video signal. The analog image consists of 525 horizontal lines, and each line varies in intensity along its length. Each line is produced in about 53 msec, with the entire image frame being refreshed at a rate of 30 frames/sec. In order to preserve a resolution fine enough to satisfy the eye, a single frame may have to be represented in a computer by a set of more than 256,000 binary values or picture elements (pixels). Each pixel represents an intensity or gray level in a stored array of 512 lines x 512 pixels/line. Even if image frames are not digitized, stored, processed, and displayed one after the other in realtime (30 frames/sec.), the 10 MHz data rates and processing requirements are enormous. Less than a decade ago, these requirements could

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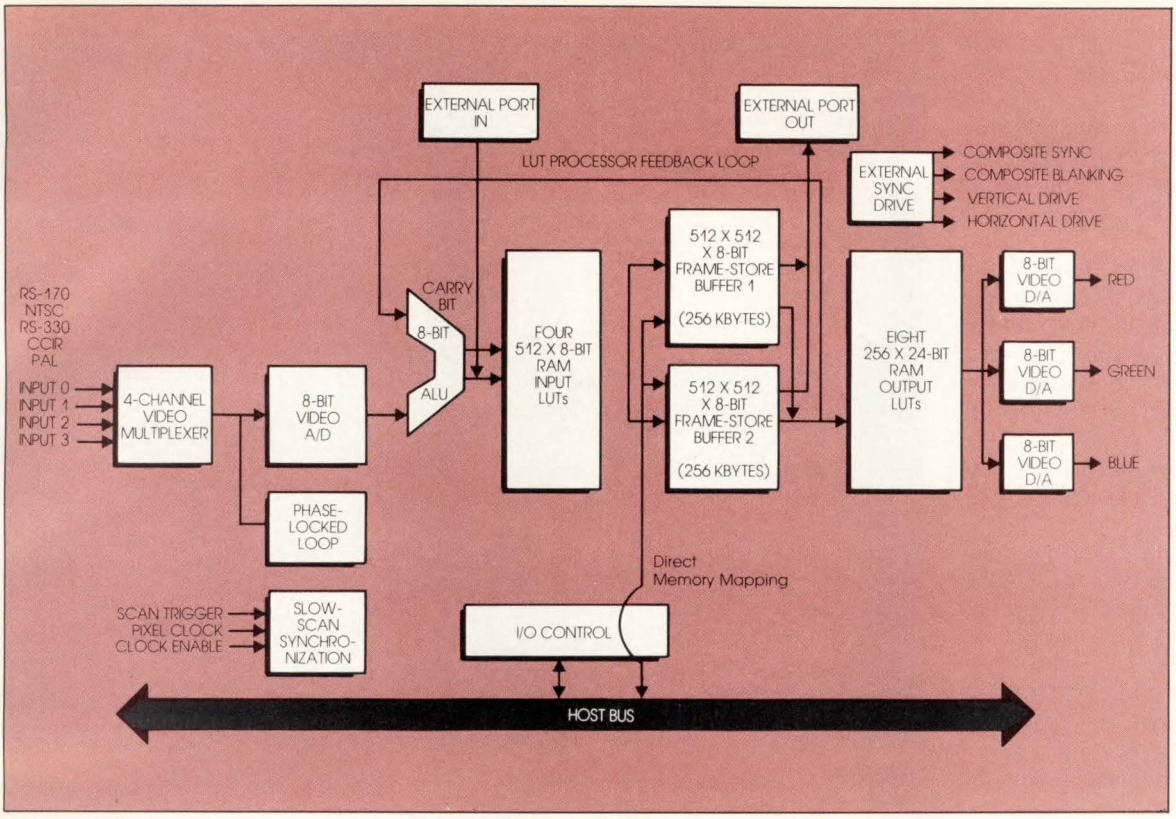


***Figure 1**—A high resolution frame grabber consists of four basic components: A/D converter, LUTs, frame-store RAM, and D/A converter.*

only be met by expensive, dedicated image processing systems costing hundreds of thousands of dollars.

Today, even a powerful machine like the MicroVAX II cannot, on its own, handle the 10 MHz data transfer rates required just to move images in and out of memory for display. Within the past few years, however, advances in memory and processor chip technologies, together with innovative engineering, have led to the development of plug-in boards for capturing, processing, and displaying images from video cameras, VCRs, medical diagnostic devices, scanning electron microscopes, and a wide range of other real-world image sources. These plug-ins provide the MicroVAX II with the specialized image capture, storage, and processing capabilities that previously required dedicated systems-level hardware.

Frame Grabbers

Before the MicroVAX II can be used to process real-world data, including images from a VCR, video camera, or CAT scanner, the data must be made available to the computer. A frame grabber is a plug-in board that digitizes a video signal, stores one or more images in on-board memory, and displays the images at a rate of 30 image frames/sec. (realtime). Advanced frame grabbers can also process images at this rate. Typical realtime processing includes adding or subtracting images, offsetting images, performing logic operations on images, or attributing false color to gray-level regions in images. More sophisticated processing, usually possible in near-realtime, includes edge enhancement and noise removal filtering, and also histogram generation. All frame grabbers contain the same basic system components (Figure 1).

- A flash analog-to-digital (A/D) converter digitizes the video signal into pixel values. The possible range of values or gray levels for a given pixel is determined by the resolution of the A/D converter: an 8-bit A/D converter produces a range of 256 possible gray-level values; a 6-bit A/D produces 64.
- A phase-locked loop (PLL) circuit aligns the timing of the incoming signal to the timing of the frame grabber. Video signals, besides containing video or visual information, contain sync pulses to mark the beginning and end of lines, and the beginning and end of frames; the PLL uses these sync pulses to control the timing of the board.
- RAM look-up tables (LUTs) are used typically for realtime image processing; LUTs can be used for a variety of image processing operations like adding or subtracting images, or attributing false color to specified gray-level regions in images.
- Of crucial importance to a frame grabber, an on-board memory called a frame-store memory stores image frames: digitizer boards that don't have frame-store memory for at least one complete frame cannot capture and display images in realtime; frame grabber boards with highly advanced memory architectures may feature more than one complete frame-store for the parallel processing of multiple image frames.
- Finally, on the output, D/A converters re-convert the digital pixel values to an analog video signal; this is usually an RS-170 signal for display on a monitor. Frame grabbers with false color output require three D/A converters, one each for red, green, and blue.

Beyond The Hardware

Hardware advances themselves don't guarantee the usefulness of image processing in machine vision. Images not only must be "grabbed," but also interpreted to be useful. This second requirement is the source of another misconception about image processing: namely, that it has to be very complex to be useful.

This misconception comes from studies of human vision that show we can identify objects and interpret them

in spite of wide variation in viewing conditions. For example, our brain can recognize a friend, even if he is in the distance, jogging with several other men, at dusk, and wearing a new jogging outfit; his image is moving up and down, as well as rapidly across our field of view.

Many years of effort have yet to produce image processing that can provide anything remotely close to this performance. But what many potential machine vision users don't realize, is that it isn't necessary to emulate the complexity of human vision in inspection, quality control, and security/surveillance applications. This is because mechanical and lighting structures can be constructed to limit viewing conditions, simplifying the demands placed on the vision system. Thus, image processing is not employed to create a vision system that, like a human vision system, can "see" or "identify" a wide range of objects; rather, the vision system is built to fit particular circumstances for viewing a specific scene.

Applications

Some examples of important, yet simple, functions that can be performed using a frame grabber include:

- detection of missing components on a printed circuit board (PCB), incorrect part orientation, or movement or change in surveillance image;
- monitoring of object areas, average object size or density, or homogeneity of color; and
- aiding in sorting and counting, manual measurement, or image documentation for long-term quality control.

These applications make use of the fact that in most practical cases, the objects to be viewed, detected, sorted, inspected, or otherwise identified are few in number, relatively consistent in features, and pass before a video camera (image sensor) with relatively little variation in distance, orientation, or speed.

Where viewing circumstances are variable, additional planning and the use of more complex algorithms can further exploit frame grabber and auxiliary frame processor hardware. Such systems can, for example, identify and sort parts; inspect for missing, broken, or disoriented components; monitor conformity in average size or color; detect movement; and/or provide permanent records of inspections for later review or comparison.

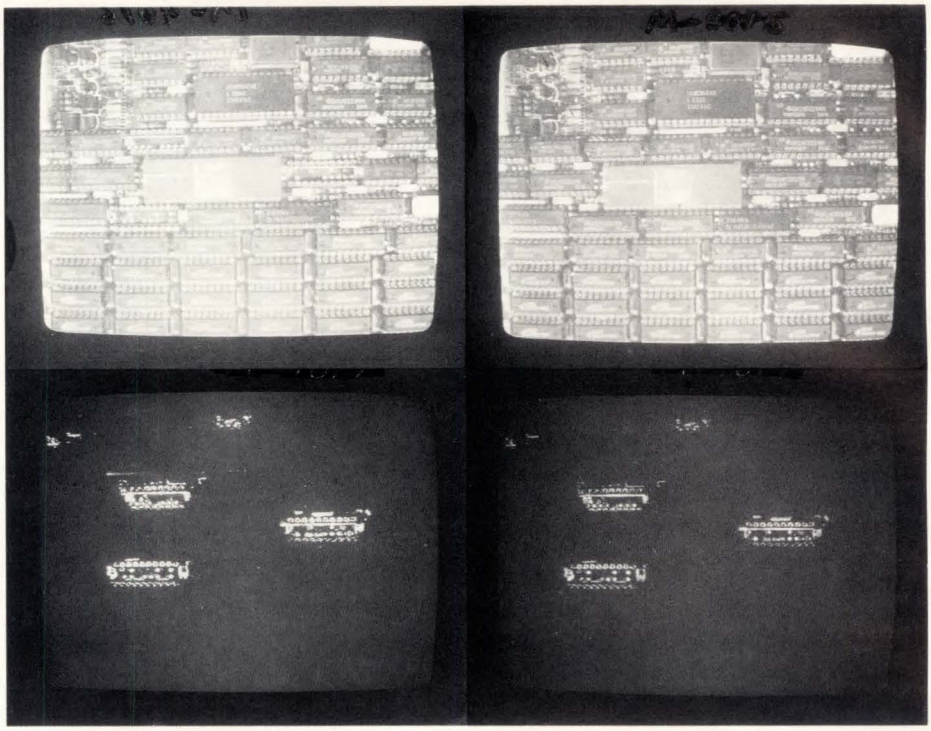


***Figure 2**—Using image processing for PCB inspection involves first scanning the board* (a), *then subtracting its template image* (b) *from it; missing chips are then identified* (c) *and highlighted* (d).

Inspection

Most machine vision inspection involves determining if image data falls within specified acceptance ranges. Image data that may be received and interpreted for inspection purposes can represent object size, shape, orientation, and intensity. Relatively simple image processing algorithms that can be implemented using a frame grabber can provide measures of these visual properties.

In general, two phases of processing are required. The first stage pre-processes an image to isolate objects in it; the second stage interprets the isolated objects to obtain information about them.

In the pre-processing phase, the entire image is analyzed in such a way as to clearly distinguish objects of interest from the background. Here, careful mechanical and lighting design can greatly simplify the work to be performed by the frame grabber vision system. For example, objects to be inspected can be presented in single file in such a way that individual objects don't touch or overlap. In addition, the background can be made distinct from the objects. And viewing parameters like camera-to-object distance can be constant.

In cases where objects are moving (for example, on a conveyer belt), movement can be slow to preclude blurring, or a strobe light can be used to "freeze" fast-moving objects. In addition to blurring, signal noise can degrade image clarity to the point where precision measurements are difficult or impossible. Even expensive video cameras and cabling can introduce 2–4 bits of noise.

Frame averaging by the frame grabber can reduce signal noise at roughly a rate of $N^{-1/2}$ where N is the number of averaged frames. Thus, if several frames of the to-be-inspected part can be acquired and averaged, poor image clarity can be dramatically improved. Although frame averaging can be accomplished using the computational power of the host, with board-level advances, frame averaging can be performed on board the frame grabber in realtime using LUTs and an on-board ALU.

Careful planning allows images to be acquired for analysis; the images contain low noise views of well-separated objects lying on a distinct background. In the simplest case, an object such as a PCB can be presented in some pre-specified orientation. In other cases, objects may vary in size, number, and/or orientation. In any case, simple, whole-image pre-processing can enhance the objects.

For example, if the background has a small range of intensity levels, and they are different from that of the objects of interest in the image, a pre-processing algorithm can set all background pixels to one value, say 255 (white), and all object pixels to another value, say 0 (black), creating the effect of a silhouette. This process of reducing the number of gray levels in an image is called thresholding, and, again, can be implemented in realtime on the frame grabber. Note that in addition to creating sharp contrasts, thresholding greatly reduces the memory required to store an image by reducing the number of bits required to store individual pixels. Eight bits are required to store a pixel that can represent 256 gray levels; only 1 bit is required to store a pixel representing only black or white.

Template Matching

A second-stage algorithm can count the number of 0-value object pixels in the threshold image to determine object area. Note that this type of image processing doesn't require an identification of the objects in the image per se. For example, two cameras could provide end-views and top-views of dowels as they moved along a production line, and the pixel-counting algorithm could calculate end areas and dowel widths to ensure production uniformity.

Area measures may be sufficient for many inspection situations. In addition, the shape of objects and their orientations may be important. In these instances, a somewhat different, yet still straightforward, form of processing is required. One form of image processing is image subtraction. In image subtraction, an acquired image is compared with (subtracted from) a prestored image called a template, with known shape, orientation, and intensity characteristics. The subtraction of the acquired image from the template yields a difference that can be analyzed. A large difference, for example, may indicate that a part is missing, or a defect has been found.

As an example, a simple pattern (e.g., a PCB) may be stored in the four different orientations (90° rotations) that approximate the likely positions in which boards can be expected to be found when they pass before an inspection point on an assembly line. By grabbing images of PCBs as they come down the line, and subtracting each from each of the four stored template images, the results of the differences can be compared to best determine PCB orientation (Figure 2).

Note that the template subtraction procedure works efficiently when the number of possible templates is relatively small and where subtraction differences are uniquely small for the correct template match and large for incorrect matches. Whether these criteria are met is an empirical issue to be addressed for each new application. As previously noted, careful attention to structuring the inspection area is particularly important in order to maximize differences among templates and among subtraction differences.

Monitoring And Security

Monitoring for process control and security has the obvious advantage of allowing viewing and inspection at sites that might otherwise be inaccessible (e.g., inside a furnace) or undesirable (e.g., next to a loud stamping machine). Applying video cameras has, therefore, been a component of manufacturing since television cameras and monitors first became available. Frame grabbers can enhance the usefulness of such video monitoring by automating detection processes.

Frame grabber-based inspectors can locate, measure, and sort based upon image data. Exploitation of image enhancement features of frame grabbers and processors can also be used to highlight objects, aid in the computation of areas and distances, help detect product variations, and store images for later analysis or review.

An example of a computer aided monitoring capability is change detection. In its simplest form, change detection involves the subtraction of successive frames, followed by a summation of the difference between the frames. Difference totals exceeding a pre-determined level are presumed to reflect a change in the image, and a human observer can be directed to the source of the change in the image. This process finds applications in surveillance and security situations such as motion detection in a secured parking lot at night.

With state-of-the-art frame grabbers, LUTs can be set up from software control—and several different tables can be set up in advance—for highlighting points in the image area and representing movement with color. In this way, security personnel can see even faint movements in brilliant color.

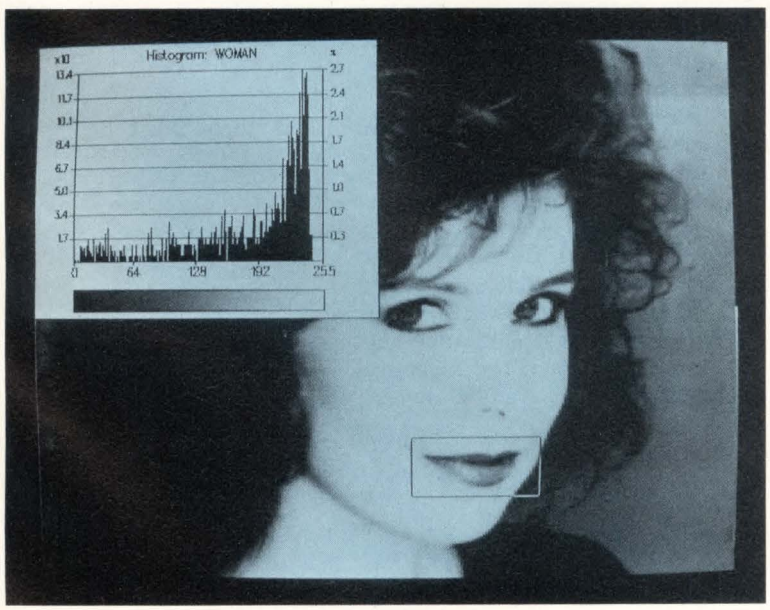


Figure 3— *Histograms are generated to analyze image contrast.*

Histograms

Somewhat more sophisticated frame processing involves histogramming and/or summing pixel information. Histogramming is a process of generating a frequency distribution of pixel gray-level values in all or part of an image (Figure 3). The histogram can show if an image is dark, light, or well-balanced, and can be the basis for adjusting image contrast.

By averaging frames over time, and performing histograms, a time-average histogram of pixel values can be determined to show long-term changes in image composition. This process can be used, for example, to monitor changes in the composition of materials moving by on a conveyer belt. The range of frame grabber use can be extended by

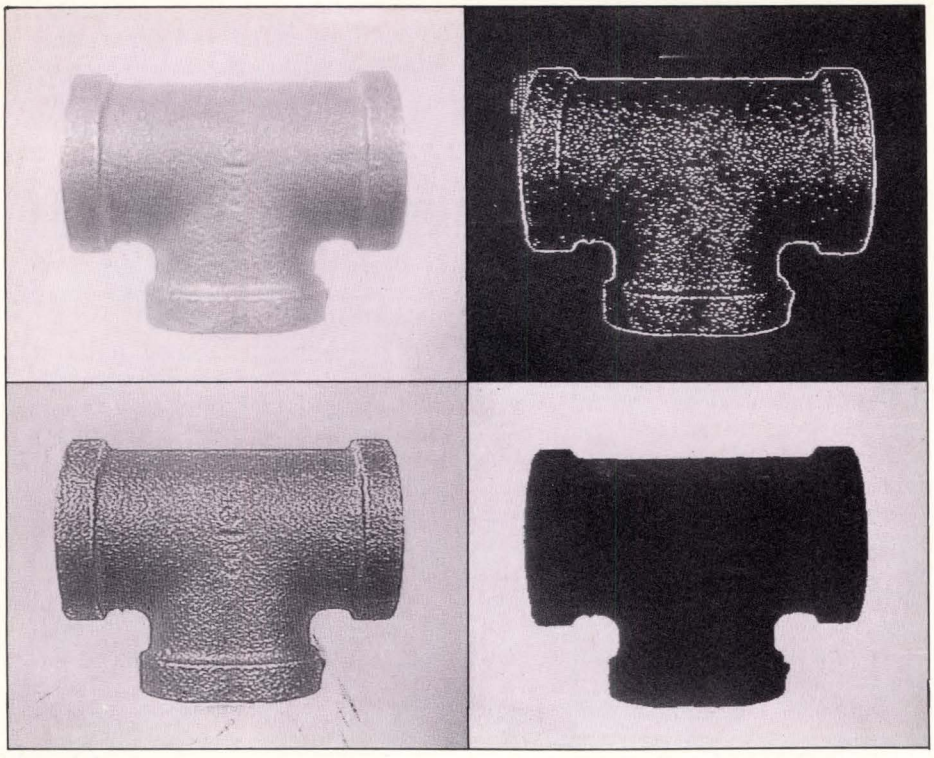


***Figure 4**—A 512 x 512 x 8-bit digitized image* (a) *can be altered with 3 x 3 Laplacian filtering* (b), *a 3 x 3 high pass filter* (c), *or binary thresholding* (d), *as the application requires.*

using different sensors (cameras).

Infrared cameras, for example, can be used to monitor temperature. Combined with the capacity of some frame grabbers to switch between different video sources for digitizing images, temperature image data can be displayed from different sources in different quadrants on a display monitor by the frame grabber. By making adjustments to lighting, and using color filters, an ordinary video camera can be made selectively sensitive to particular wavelengths. Use of such a camera, together with histogramming and averaging, is useful in quality control of color in foods or in the detection in color variations in pharmaceuticals or enameled surfaces.

Filtering Images

More complex image processing involves creating a modified image by analyzing groups of pixels at a time to produce a single new output pixel. This type of group processing is used for filtering images to enhance edges or smooth image details.

The spatial convolution algorithm is popular for group processing. Convolution involves calculating a weighted average of pixel intensities around and including a single pixel. Repeating this operation for every pixel in an image produces a convolved or filtered image.

The group of pixels operated upon by a spatial convolution operation is called a kernel. The kernel is usually a square- (N x N) or rectangular-shaped (N x M) array of pixels. A 3 x 3 kernel is typical. Each time one group or kernel of pixels is processed, only one output pixel value is produced. This new pixel value is usually placed at the same spatial location in the output image as the central target pixel in the kernel.

For example, in a 3 x 3 convolution, the kernel consists of a 9-pixel array (3 pixels high x 3 pixels wide) with the target pixel at the center of the array. To begin the convolution, each of the 9 pixels in the kernel is multiplied by one of nine coefficients comprising a coefficient mask. The resulting nine products are added to produce a single output pixel. Because for a 3 x 3 convolution every pixel in the output image is actually produced by as many multiplications and additions as there are pixels in the kernel, spatial convolutions are extremely arithmetic-intensive. And the larger the convolution kernel, the more arithmetic-intensive and time-consuming the entire operation.

To perform convolutions in real-time, or close to realtime, some frame grabbers can optionally plug directly into auxiliary frame processor boards. Without an auxiliary processor board, convolutions take seconds and minutes to execute on the host CPU.

Several types of image filtering can be performed using the convolution. Laplacian filtering, for example, reduces low frequency information from images, and accentuates high spatial frequencies, giving prominence to edges and details (Figure 4).

Laplacian filtering is especially good at locating boundaries (i.e., edges) between objects and is, thus, a useful image pre-processor for highlighting objects with uneven or soft edges.

Auxiliary Frame Processors

As previously noted, auxiliary frame processor boards are available that can speed up the vast amount of required processing. Convolutions, in particular, place enormous demands on processing hardware, and can be slow to perform unless specialized hardware is provided. A 3 x 3 convolution, for example, requires nine multiplications and nine additions for each pixel in the frame. For a 512 x 512 image, a 3 x 3 convolution requires 2,359,296 multiplications and 2,359,296 additions.

An auxiliary frame processor board with built-in, dedicated image processing circuitry, 16-bit internal accuracy, sufficient frame-store memory for storing one image, and the ability to handle more than one pixel value at a time (pipelined architecture) greatly speeds convolutions, histograms, and increases the accuracy of successively averaging large numbers of frames. Some frame processing hardware supports only fixed convolution kernel sizes, like the popular 3 x 3 convolution. More flexible designs support N x M convolutions in which the kernel dimensions can be any size or shape, even rectangular or star-shaped.

This article has reviewed some of the fundamentals of image processing, particularly as they apply to frame grabber implementations. Applications in digital image processing are fast apace. This is due in large part to the fact that picture processing costs are down: for the price of a MicroVAX II, a $2,000-$3,000 frame grabber, and a video camera, the scientific, industrial, and engineering masses have access to systems-level digital image processing power.

Using 'state-of-the-market' technology for more flexible manufacturing

In Japan, 40% of all computer numerically controlled (CNC) machines go to small- and medium-sized companies, according to a recent assessment by Harvard Business School Professor Ramchandran Jaikumar. A number of these firms lease automated machine tools and robots, and also take advantage of low interest government loans.

Things are considerably different in the United States, where it's industry giants such as General Motors that typically opt for factory-of-the-future technology—and often with less-than-sterling results. In a recent *Christian Science Monitor* article, *Modern Machine Shop* Editor Ken Gettelman estimated that only 1% of the 100,000 or so small jobs shops in the United States utilize CNC. That has to change—if America is to be globally competitive, and it will change—if Chad Frost has anything to say about it.

Convinced that flexible manufacturing "is not an end in itself, but a tool that will help companies achieve their business plans—and more effectively," Frost founded Amprotech, a 1-yr.-old firm that specializes in developing companywide automation systems for small-to-medium-sized firms. If Frost is bullish on flexible manufacturing systems (FMS) for less-than-leviathan companies, it's based on his own successful experience at Frost Inc., where he is president and CEO.

Frost Inc. is a privately held family business in Grand Rapids, Mich., with 110 employees and annual sales of $15–$20 million. It was "a solid-growth company" in the 1970s, according to Frost. For several years, the firm made conveyor and automation components and sold them to systems houses, but by the latter half of the decade, "we could see that we were going to come to the end of our marketing niche," he says. Attempts to diversify into agricultural machine parts and other assemblies "failed miserably" and led to a study of "why we had failed."

The reason, Frost and his colleagues concluded, was a lack of flexibility. "We had become an unbelievable cash machine in our standard product but lacked the ability to do much of anything else—starting from the element of sales all the way through to the element of packaging the product. We weren't equipped to handle change," says Frost.

Corrective measures included a shift from 11 to four layers of management to speed up information exchange and decision making, and a quest for flexible automation tooling—"but in those days, there was no such beast," recalls Frost. "If you said automation in 1981, everybody's mind's eye went to speeding up the conveyor." Yet, *Megatrends* author John Naisbitt and other business pundits were proclaiming that customers of the future would demand plenty of models. In other words, high volume production would become medium-volume, and medium-volume would become small-volume.

"If you said automation in 1981, everybody's mind's eye went to speeding up the conveyor."

Amprotech grew out of Frost's frustration when "we couldn't find anybody in the field who could give us flexible automation and we couldn't find anybody who was interested in doing it to a business plan—instead of for its own sake. Their idea of doing a project was to put a lathe and a robot together, make them work, and leave. But we wanted a group of people to come in and stay with us for about 3 yrs., see the entire process through, and measure themselves according to our success."

Frost Inc. wound up borrowing $5.1 million to buy flexible work cells, including robotics for machine loading and unloading, and CNC lathes that could be adjusted to cut round shapes of virtually any dimension. Today the company can turn out a range of axles, bearing rings, and other metal parts—often within seconds of each other—for aerospace, automotive, and a host of other industries. Productivity and sales per person has doubled, Frost says, "and the quality performance increase is absolutely enormous."

His advice to small companies in search of flexible systems is to stay away from elegance, look for technology that is being downsized in the industry, and choose a solution that will pay for itself in 36 mths. or less. Choosing 2D CAD in lieu of 3D, for instance, can amount to a two-to-one cost differential. If the market shows a 5% need for a 5-axis machine, a small company should consider buying its 5-axis machining outside and restrict its in-house milling to 4-axis machines.

By shunning costly state-of-the-art technology and concentrating instead on state of the market, a small company can garner good aftermarket support from well-established suppliers. "That way," says Frost, "you can be reasonably sure of who's going to stay around in the business."

Dr. Robert J. Schlesinger, a registered professional engineer, teaches courses in operations research, manufacturing, and automated production at San Diego State University. Sylvia Tiersten is a business writer.

Extending PDP/MicroVAX Functionality

A wealth of products available for the VME and Multibus environments provides Q-bus users an effective alternative to traditional expansion avenues/by Don Turrell [Performance Technologies Inc.]

The Digital Equipment Corp. user has several options to choose from when extending the basic function of a Digital system. The traditional means of adding to Digital architectures has been through board-level modules (from both Digital and third party suppliers). These modules generally interface directly to Digital's internal system bus and perform a specific function or provide a selected interface to the external world. Another widely used link to/from a Digital system has been through the standard DR11-W port.

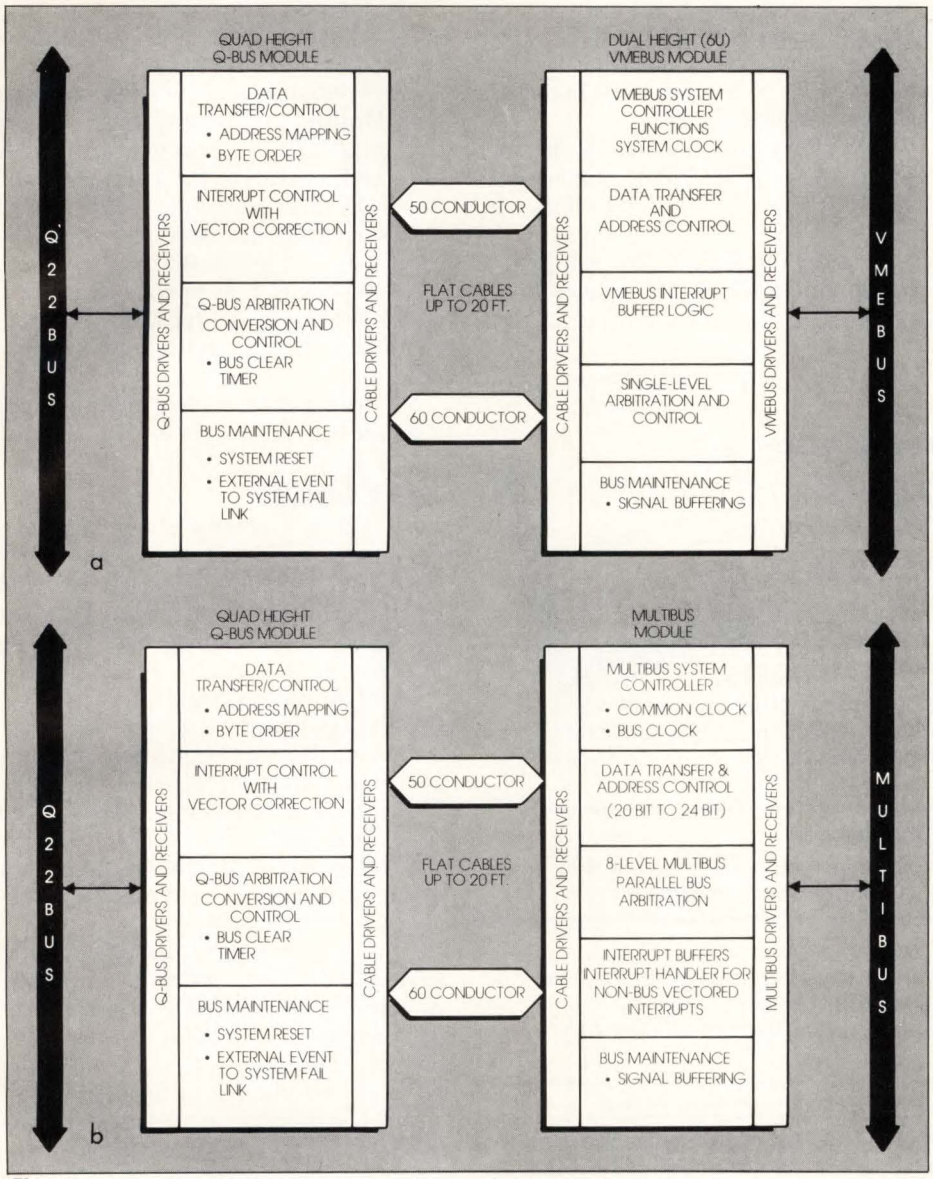
Alternatives

While a wide range of DEC compatible hardware has been— and continues to be—developed for extending the capability of Digital systems, an effective alternative to the traditional expansion avenues is now available. Outside the Digital environment, there has been a proliferation of board-level computer products that interface to the Intel-inspired Multibus I standard and the Motorola-promoted VMEbus standard. These two popular bus standards now boast of more than 5000 board-level computer products that perform a variety of functions over a broad range of price and performance. Through bus-to-bus adapters, a direct means is available to use Multibus or VMEbus modules as part of the 22-bit Q-bus found in LSI-11 or MicroVAX systems from Digital. These bus-to-bus adapters perform all necessary bus signal translations, allowing VMEbus or Multibus modules to architecturally appear as though they were actually plugged into the 22-bit Q-bus.

Because VME and Multibus have been actively promoted as "open" architectures to encourage the use of silicon produced by Motorola and Intel, the variety and capability of board-level modules from third party manufacturers continues to grow at an increasing rate. In addition, the high performance nature of the 32-bit VMEbus has encouraged the development of complete subsystem functions that are not currently available on other bus structures. For a Digital user to take advantage of these "alternative bus" products has traditionally required embracing a completely new software

Don Turrell, product manager at Performance Technologies Inc. (East Rochester, N.Y.), holds a B.S.E.E. from Pennsylvania State University and an MBA from University of Wisconsin. He has worked as an applications engineer for 15 yrs.

"Because VME and Multibus have been actively promoted as 'open' architectures to encourage the use of silicon produced by Motorola and Intel, the variety and capability of board-level modules from third party manufacturers continues to grow at an increasing rate."



***Figure**—Q-bus to VMEbus hardware* (a) *and Q-bus to Multibus hardware* (b) *allows the buses to be separated by a distance as great as 20 ft.*

environment typically based on Motorola or Intel processors. In many instances, this barrier has been impractical to overcome from a time and knowledge investment, ultimately preventing the Digital user from taking advantage of the many unique hardware functions available on Multibus or VMEbus. Bus adapter products have been specifically designed to provide an effective link to these alternative bus architectures, while still allowing the Digital user to operate in a familiar MicroVAX or LSI-11 software/hardware environment.

Applications

Since Q-bus adapters have become available, they have found their way into a number of unique applications. In general, however, the application of these bus-to-bus adapters can be divided into three categories:

- *Realtime environments*—These environments integrate VMEbus or Multibus subsystems with a Digital system, to take advantage of the modularity and realtime control orientation of alternative bus products, while retaining the Digital software base. The advent of the more contemporary "downsized" MicroVAX has encouraged use of Digital engines in many isolated shop floor and realtime control environments. Coupling the MicroVAX with VME or Multibus can provide the system architect a means to logically segment system functions, maximizing the overall capability. Using a Digital engine also allows a convenient ready-made connection into Digital network hardware/software that may be in use throughout a facility.
- *Special VME hardware*—This category includes the use of high performance subsystems such as the vision and imaging hardware that are being built with direct interfaces to the VMEbus. The new VME-based systems from a number of manufacturers have very impressive price/performance advantages.
- *Migration*—This includes migrating between bus structures during the development phase. The bridge provided between the Digital environment and VME or Multibus environments allows for this transition to occur in convenient steps, using previously developed hardware or software in the transition.

Operation Of The Adapters

Q-bus adapters allow VMEbus or Multibus modules to functionally appear as extensions to the MicroVAX or LSI-11 22-bit Q-bus (see Figure). The interface cables between the different bus modules are fully buffered and terminated, allowing for cable lengths to 20 ft.

The operation of the adapters is at the bus level. Most bus-to-bus transition functions are accomplished in adapter hardware and tend to be transparent to the user. Software drivers necessary to use the bus adapter have minimal complexity, serving only to initialize the Q-bus adapter module and set up the adapter's mapping and byte-ordering registers. If a MicroVAX is being used, the paging and address mapping must be configured to operate with the adapter under VMS. Appropriate software drivers for modules that reside on the VME or Multibus side of the adapter are still required, and will need to function under the Digital operating system that is being used.

In general, the similarities of the Q-bus, VMEbus, and Multibus structures assist in minimizing the complexity of the bus-to-bus adapter hardware. The basic bus translation requirements that arise when interfacing the Q-bus to VMEbus are:

- buffering of the signals between the Q-bus loading specification and the VMEbus specification,
- mapping of the 22-bit, 4-Mbyte Q-bus memory to 24-bit, 16-Mbyte VME

memory space,

- compensation for the "byte ordering" differences between the Digital and VME worlds,
- mapping of the 4-level Q-bus interrupt structure into the 7-level VMEbus interrupt structure with hardware conversion of the interrupt vector interpretation,
- translation of bus maintenance signals (such as system reset and system clock on VME), and
- translation of bus arbitration to allow the VMEbus to be arbitrated as an extension of the Q-bus.

The basic bus translation requirements that arise when interfacing the Q-bus to Multibus I are:

- buffering of the signals between the Q-bus and Multibus expansion to allow for use of a full Multibus card cage,
- mapping of the 22-bit, 4-Mbyte Q-bus to either the 24-bit, or older 20-bit, Multibus memory space,
- compensation for the byte-read vs. word-read modes between Multibus and Q-bus,
- flexible interconnection of Q-bus and Multibus interrupts with support for vectored or nonvectored Multibus interrupt operation (as with the Q-bus-to-VME, the interrupt vector differences are fully hardware-corrected between the two bus structures),
- translation of bus arbitration to allow the Q-bus arbiter to provide this function to the Multibus subsystem, and
- translation of bus maintenance signals.

Digital Engines

A number of specific applications demonstrate the capability and flexibility that the bus-to-bus links provide when users are able to migrate between the Q-bus environment and VME or Multibus.

- JHK and Associates (Norcross, Ga.) has designed a traffic control system around a communication and preprocessing subsystem based on VME. This is linked via a Q-bus-VME adapter to a MicroVAX. The VMEbus subsystem provides the interface with sensors and control hardware at specific intersections and traffic control points throughout a geographic area. This subsystem collects and transmits data, in addition to providing selected preprocessing (i.e., traffic counts). The data is then transferred through the VME-Q-bus adapter to the MicroVAX, which has dynamic models of the traffic flow mechanisms in a specific area. These models can be modified and controlled by municipal or Metropolitan traffic engineering personnel. The MicroVAX analyzes the traffic situation in realtime, and is able to direct traffic signals, etc., via the VME subsystem, smoothing traffic flow and reducing bottlenecks. This system configuration, using two different bus structures, allows segmentation of functions, along with optimization of specific hardware and software capabilities on each bus structure. The performance and modularity of VME and the familiar and comprehensive Digital-based software are ideal combinations for this application.
- Another application involves a national laboratory that has designed a similar Digital VME system configuration using VME modules in a preprocessing configuration for handling an intensive data acquisition require-

ment. The bandwidth of the VME system provides sufficient performance to handle the data rates. The information is then passed to an LSI-11 for further reduction and manipulation. The software environment of the LSI-11 is familiar to the user and provides a comprehensive foundation to process and archive the collected information. The Q-bus-to-VME hardware allows a bus-level link between the systems, with sufficient bandwidth to efficiently transfer the incoming data bursts.

- A number of sophisticated vision applications are under development using a MicroVAX engine with a VME-based vision and imaging subsystem built by such companies as Datacube (Peabody, Mass.). The Q-bus-to-VME link provides the necessary interconnect between the Digital system and VME-based imaging hardware. This general system configuration is being applied in a number of diverse end uses. These include such applications as actual digitizing of image data relating to an athlete's activities during practice or competition. This digital image data can be analyzed to improve the athletes form, style, and endurance. Other applications involve more traditional machine vision for positioning, part recognition, and pick and place. The MicroVAX software environment coupled to high performance/high bandwidth VME-based vision components, makes an ideal system architecture for these applications.

"Through bus-to-bus adapters, a direct means is available to use Multibus or VMEbus modules as part of the 22-bit Q-bus found in LSI-11 or MicroVAX systems from Digital."

- In a final application note, a developer of sophisticated military silicon is testing and refining a proprietary CRT and graphics chip set on a Multibus I foundation. The Q-bus-to-Multibus hardware has provided a ready-made link to develop software and further test the silicon in a Digital environment.

There is a large and impressive installed base of Q-bus equipment throughout the world. This has created a large and knowledgeable pool of hardware/software individuals who are both comfortable and competent with Digital systems. Outside the "DEC World," another phenomenon has been running its course, with the development of thousands of board-level computer products on the VME and Multibus standards. The Q-bus-to-VME or Multibus hardware allows the Digital user to take advantage of the growing selection of board-level functions on these two buses. This can be accomplished without making the substantial investment that's often required to relearn a different CPU and software environment associated with VME or Multibus systems.

Was the information in this article helpful to you in the performance of your assigned responsibilities?

Very helpful	**Enter No. 508**
Somewhat helpful	**Enter No. 510**
Not very helpful	**Enter No. 512**

PRODUCT NEWS

Compact Desktop Terminal Stand

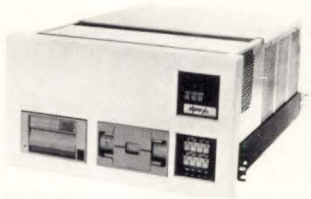
Keyport; makes economical use of desk space for computer users who have terminals, workstations, or personal computers with detached keyboards on their desks; provides a raised platform for the monitor and thus creates a recess below that provides storage space for even the widest of keyboards; when the user slides his keyboard under the Keyport, he recovers as much as a square foot of his desk for noncomputer-related work.

The Keyport is 24 in. wide, 12 in. deep, and has 2.5 in. of clearance beneath the shelf for the keyboard; the shelf will support up to 80 lbs.; is compatible with most terminals, personal computers, and workstations; retails for $39.95.

Gold Key Electronics Inc., 11 Cote Ave., P.O. Box 186, Goffstown, NH 03045, 603-625-8518. **Enter No. 558**

BA123 Compatible Enclosure

SE105; an enclosure that provides a 12-slot backplane, 750 W of power, mounting for four 5¼-in. peripherals (fifth drive optional), and will support either MicroVAX II or MicroPDP-11 processors and memory; designed to accommodate Digital snap-in style guides used on the TK50, RD50 series, and RX50 disk and tape drives; optional peripheral interconnect panel allows the use of Digital RQDX disk controllers to support an RX50 floppy and two RD50 series hard disks or up to four RD50 series hard disks in a single enclosure.



Built-in thermal monitoring assures cool and quiet operation over a wide range of ambient temperatures by varying airflow (up to 335 CFM when required) and shuts off the power supply if temperature specifications are exceeded; power supply is switch-selectable to either 115 V, 60 Hz or 230 V, 50 Hz; $2,745 for a basic 4-drive unit.

Dyna Five Corp., 3421 W. Segerstrom Ave., Santa Ana, CA 92704 714-751-0133. **Enter No. 559**

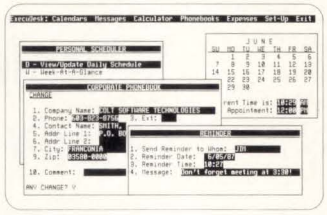
Replacement Backplane For VAXstation II/RC

H9278-BP; quad-width backplane assembly that is form, fit, and function compatible with the original Digital backplane; provides usable connectors for all eight slots in the Digital BA23 chassis; can be installed in a few minutes with a screwdriver; $269.

Zoltech Corp., 7023 Valjean Ave., Van Nuys, CA 91406, 818-780-1800. **Enter No. 560**

Executive Desk Organizer

ExecuDesk; designed for the multiuser VMS environment; provides sophisticated corporate and personal calendars, an executive expense analyzer, corporate and personal phone directories, a business calculator, and a message-sender/reminder system; is primarily intended as an office automation product; provides a general corporate phone directory with alphanumeric look-up capability by company name and contact; a personal phone directory provides both contact and corporate name look-up for each individual user; mailing labels may be generated by authorized persons on either phone directory; reminders with date, time, and message may be sent to one's self or to other users; messages also may be sent to the user's VAX mailbox.

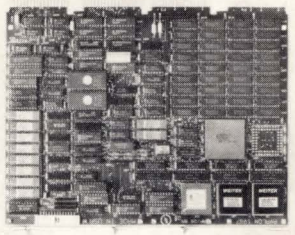


ExecuDesk provides a comprehensive business calculator with onscreen tape display with print capability on a local printer attached to the user terminal; up to eight decimal places and memory storage are screen-selectable; tapes may be saved at the end of the session and printed later; the executive expense analyzer provides a file for definition of up to 256 expense types and then provides detail and summary expense reporting along with the employee's personal calendar print-out; all calendar schedules may be printed for any date range and then placed in a binder for daily scheduling and expense reporting; available for all VAX computers using the VMS operating system.

Colt Software Technologies Inc., P.O. Box 8716, Red Bank, NJ 07701-8716, 201-308-4404. **Enter No. 561**

Processor Increases VAX Speed

AP/20; increases the processing speed of the VAX by running CPU-bound programs on the Attached Processor instead of the host CPU; offloading computationally intense programs from the VAX to the AP/20 board is the product's major advantage; runs at 3.5–4 million instructions per sec. (MIPS) and is not affected by the load on the VAX; floating point multiply time is 437 nsec; it is compatible with any Q-bus VAX; several AP/20 boards can be added to a single VAX; available with C, FORTRAN, and Pascal compilers; has its own memory and operating system kernel; all user mode instructions and many of the operating system functions execute completely on the AP/20 with no transfers over the bus or loads on the VAX; the VAX interface is only used for program loading, I/O, and for system call processing.



A 1-Gbyte protected virtual address space is provided; 4 million bytes of real memory are standard; high speed floating point is optionally available; $10,000; delivery 30 days ARO.

Avalon Computer Systems, 425 E. Colorado Blvd #710, Glendale, CA 91205, 818-247-2216. **Enter No. 562**

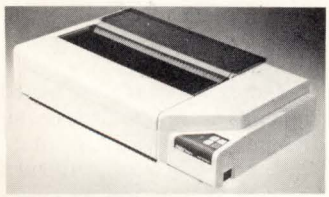
End-User Data Communications Modem

Performance 1000/14.4; a 14.4 Kbps full-duplex leased line modem with a full feature set, constructed with fewer components, and in a smaller package; provides menu-driven operation through a 16-character LCD; no straps or switches used in

configuring the device; the user configures and tests the unit from the front panel by selecting between English language commands displayed; the remote Performance 1000 may also be configured and tested through the local modem's front panel without operator intervention at the far end; part of that configuring may command the Performance 1000 to automatically adjust its speed up or down according to line conditions.

The Performance 1000/14.4 uses trellis-coded modulation for improved throughput compared to CCITT V. 29 compatible 9600 bps modems; trellis coding gives at least a 100 times lower error rate for comparable line speeds, enabling the Performance 1000/14.4 to operate reliably over a wide range of conditioned and unconditioned lines; features a footprint of 8½ x 11 in. and a height of less than 2½ in.; $1,795.

Emulex Corp., 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626, 714-662-5600 (in Calif.), 800-EMULEX3 (outside Calif.). **Enter No. 563**



Dot-Matrix Printer With Networking

TriMatrix 850 PrintNet; dot-matrix printer featuring built-in networking capabilities; up to five networking users can connect directly to the 850 PrintNet through resident serial ports; any device capable of serial communication, such as computers, printers, and modems, can be connected to the 850 PrintNet, and exchange data in RS-232C or RS-422 formats, at speeds up to 19.2 Kbaud.

With a throughput of 240 lines per min., PrintNet

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meets the printing requirements of multiple users; for special printing applications, additional printers (of any type) can be networked through any of the five dedicated serial ports; internal memory of 256 Kbytes allows users to store large jobs while freeing up their computers for other activities; $2,995.

Output Technology Corp., E. 9922 Montgomery, Ste. #6, Spokane, WA 99206, 509-926-3855. **Enter No. 509**

Performance Enhancements

MicroVAX II Computations

MicroMSP-4; a single-board solution for the MicroVAX II backplane that accomplishes realtime and numerically intensive signal and image processing at 20 millions of floating point operations per sec. (MFLOPS); the VMS compatible board uses three processors to achieve the fast processing time: a vector processor, a host interface, and a 68020 control processor; the three sections share a multiport memory that consists of a 256-Kbyte data memory, expandable to 4 Mbytes; the array processor performs a 1024-point complex Fast Fourier Transform (FFT) in 4 msec, and a 512 x 512 complex 2D FFT in 2½ sec.

Other software on board includes an image processing library, a FORTRAN interface, and a scientific library for real vector, complex vector, matrix, and signal processing operations; $5,950.

Computer Design & Applications Inc., 411 Waverly Oaks Rd., Waltham, MA 02154, 617-647-1900.
Enter No. 511

Memory For High End VAXes

16-Mbyte memory arrays; third party memory for high end VAX series; 1-Mbyte dynamic RAM (DRAM) modules allow users to implement their original VAX backplane without having to install a

new backplane with wider memory slots; they run on the memory interconnect (MI) bus used on the high end VAXes; end users have the option to upgrade to future memory add-ons through EMC's memory trade-up program.

EMC Corp., 128 South St., Hopkinton, MA 01748, 617-435-2541. **Enter No. 513**

ECC PMI Memory For Q-bus

CI-PMIEDC; memory for Q-bus-based systems; offers 4 Mbytes of memory with error detection and correction; supports the full implementation of Digital's private memory interconnect BUS; is hardware and software compatible with Q-bus system; has a lifetime parts and labor warranty and a 24-hr. repair/replacement policy.

Chrislin Industries Caribe Inc., RD 188, KM 0.8, Industrial San Isidro, P.O. Box 1657, Canovanas, Puerto Rico 00629-1657, 809-876-5205. **Enter No. 514**

Accelerate VAX-11/750

IVAC 750; speeds up the processor of a VAX-11/750 15–25%; system speed is improved by a new clock that pulses variably, according to the exact time required for each instruction, rather than a fixed pulse that is standard on the VAX 750s; this results in significantly reduced processing time; it has an on/off toggle switch for returning the CPU to its standard, slower clock; comes ready to install and conserves space by plugging into the back of the backplane of the 11/750.

Iverson Inc., 850 Auburn Ct., Fremont, CA 94539, 415-659-1660. **Enter No. 515**

Storage Devices

Disk Subsystem For LSI-11

A 5¼-in. Winchester disk subsystem; can be added to enhance storage capabilities of early model Digital 11/23 with RL01 or RL02 systems; the product is desktop standalone with internal power supply and attractive enclosure; formatted capacities up to 159 Mbytes; ability to be removed and secured in remote vaults and cabinets; dual-height Q-bus to industry standard ST506 interface disk controller with MSCP emulation can control up to two drives per module.

The product supports block mode DMA; offline formatting and diagnostic utilities; hardware and software compatible with all LSI-11 series, MicroPDP-11, MicroVAX I and II CPU configurations; custom cabling is available.

JTF Enterprises, 1240 North Rd., P.O. Box 274, Divide, CO 80814, 303-687-3818. **Enter No. 517**

MasterDisk Systems Available For Unibus

MasterDisk; Unibus disk storage system; available in configurations ranging from 152 to 607 Mbytes; average access time of 7.6 msec and a data transfer rate of 24 Mbit per sec.; achieved by the use

of Winchester drives, coupled to the controller, which incorporates 1 Mbyte of cache; ADD-ON system comes complete with its own housing in a DEC BA23 floor stand, tabletop cabinet, or rack-mount package.

American Digital Systems Inc., 75 Union Ave., Sudbury, MA 01776, 617-443-7711.

Enter No. 516

Controllers And Host Adapters

Controller Connects Digital And IBM

CPC-220; a multitasking controller that offers VT220 terminal emulation, multiple sessions, and windowing for IBM PC/XT/AT; provides a direct connection between the IBM PC (or compatible) and VAX or MicroVAX systems; consists of an add-on PC card, an RS-232 port mounting bracket for both VT220 ports, system software, software utilities, and user manual; the VT220 RS-232 ports can be connected either to two different ports on a host or to two different host systems; each port performs error-free data transfer up to 19.2 Kbaud.

Other features include user-definable keyboard mapping to allow the PC user to emulate the VT220 keyboard and a setup menu, an automatic setup, which allows the user to toggle between the standalone PC and CPC-220 terminal emulation.

Camintonn, 2121 Alton Ave., Irvine, CA 92714, 714-553-0247. **Enter No. 518**

SCSI To Q-bus Host Adapter

SDC-HA11; SCSI bus to Q-bus host adapter with 22-bit addressing; plugs directly into any contiguous dual Q-bus slot and presents one load to the bus; up to eight SCSI bus devices can be easily daisy-chained to the SDC-HA11; one device is selected at a time for processing on the Q-bus; the SCSI bus device can request up to 10 command bytes before executing the command from the host.

Three modes of operation are possible: Slave, Direct Memory Access (DMA), and Interrupt; provides switch-selectable base address selection from 160000 to 177760 (octal) and interrupt vector selection from 000 to 374 (octal); parity enable/disable and interrupt priority selection (4, 5, 6, or 7) are jumper-selectable; $417.

Sigma Information Systems, 3401 E. La Palma Ave., Anaheim, CA 92806, 714-630-6553. **Enter No. 519**

Disk Controller With MSCP Emulation

WUESD; designed to link Enhanced Small Device Interface (ESDI) disk drives for upgrading the storage of Unibus PDP-11 and VAX minicomputers; includes 1 Mbyte of cache memory, effective data access time of 2–4 msec, and emulates Digital's Mass Storage Control Protocol (MSCP); a solution with up to several gigabytes of extra fixed storage per controller and a 20 Mbit per sec. data transfer rate.

Couples up to 4 ESDI disk drives of various sizes and data rates to all Digital standard operating systems without software modification; compatible with PDP-11/84, 44, 34, 24, VAX 11/750/780/785/8600; $2,800.

Webster Computer Corp., 1037 N. Fair Oaks Ave., Sunnyvale, CA 94089-2183, 408-745-0660. **Enter No. 520**

Data Output Devices

Intelligent Printer Switch

SWITCHmate II; an intelligent printer switch that reduces printer and printer-related costs by allowing up to six systems share the use of one or two printers; designed specifically for compatibility with Digital printers and systems; IBM PCs, as well as other nonDigital systems and printers, are supported; allows the user to access their selected printer without concern for the printing activity of other sharing systems.

Print requests are handled automatically and transparently so that the user may issue print requests in exactly the same manner as in using a dedicated printer; if the printer is currently busy, the system's print data is queued to print as soon as the printer is available.

Gold Key Electronics Inc., P.O. Box 186, Goffstown, NH 03045, 603-625-8518.
Enter No. 521

Graphics

Graphics Subsystem For MicroVAX II

CGS-4600; a high performance, high resolution interactive graphics subsystem that plugs directly into the Q-bus of a MicroVAX II to create a standalone graphics workstation; the product is available as either a complete graphics subsystem, which includes color monitor, keyboard, mouse, and digitizer, or as a graphics engine alone; built around proprietary very large scale integration (VLSI) components, the graphics engine card, installed in a MicroVAX II, performs the complex graphics processing tasks that previously required a dedicated controller.

A complete CGS-4600 subsystem is equipped with a full set of peripheral devices and all the necessary cables and panels.

CalComp, 2411 W. La Palma Ave., Anaheim, CA 92803, 714-821-2541. **Enter No. 522**

Plotting Software For VAX/MicroVAX

Versaplot Random Enhanced 2.1 and Versaplot 9.3; integrated plotting software packages for VAX and MicroVAX computers; features include the ability to plot 2048 line colors and 2048 area fill colors per plot; users can utilize the 256 pre-defined colors or re-define the default colors; allows definition of a pixel array with a color associated with each pixel; enables the data to be suitable for image scan and improves the visual quality of the output; raster data from various sources can also be merged;

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the software is designed for integration into Ultrix operating systems.

Versaplot 9.3 software for Versatec's Versacolor thermal transfer color plotters outputs raster data; is designed for easy and simple installation on VAX and MicroVAX computers running under VMS operating systems; $2,000–$5,500; available 30–90 days ARO.

Versatec, 2710 Walsh Ave., Santa Clara, CA 95051, 800-538-6477; in Calif. 800-341-6080. **Enter No. 523**

CAE Design System For VAX/MicroVAX

Vanguard Stellar CAE Design System; CAE software that provides windowed operating environment that allows complete design file compatibility, file sharing, and portability universally across industry standard hardware platforms; within the system graphical shell, it integrates a complete CAE tool set, including a Schematic Design System, Symbol Editor, Layout Editor, Autorouter, Design Rule Checker, Electrical Rule Checker, Analog and Digital Simulators, and a Document Editor all around a common ASCII database; on Sun and Digital MicroVAX platforms, the Stellar Design System runs within the existing window system, and allows the user to select both CASE and non-CASE overlapping windows.

System interface provides both keyboard and pop-up command selection; in addition, the command structure has been simplified to shorten the learning curve for the first-time user; from $14,900 to $49,900.

Case Technology Inc., 2141 Landings Dr., Mountain View, CA 94043, 415-962-1440. **Enter No. 524**

Facilities Engineering Software

PALETTE Computer-Aided Facilities Engineering Software; a system designed to help large manufacturers design, construct, and manage modern plants and facilities; operates on Apollo DOMAIN 32-bit workstations and Digital VAX, VAXstation, and MicroVAX II computers; features integrate CAD, facilities engineering, and local database functions that can be linked via networks with larger relational databases on IBM and VAX computers, and with other Apollo workstation databases via the DOMAIN network.

PALETTE is a multipurpose graphics software system integrating 2D and 3D computer-aided drafting, standard and user-definable facilities engineering drawing symbols, materials/quantities/cost estimating, a total plant database plus a special drawing management system, and documentation preparation; users direct the system via mouse-driven pop-up menus, tablet menus, and keyboard commands; can tailor PALETTE by adding your own on-screen menus, symbols, macros, and control features; $7,900/workstation.

Palette Systems Inc., Two Burlington Woods Park, Burlington, MA 01803, 617-273-5660. **Enter No. 525**

CAE Tools Ported To VAX Workstation

Workview VAX; CAE software products that run on the VAX workstation; takes full advantage of VMS and VAXstation graphical capabilities; features include schematic entry, waveform processing, simulation, data management, and other engineering workday functions; VAXstation-based Workview facilities can run simultaneously under a multitasking environment; multiwindowing environment allows simulations to run simultaneously with other Workview capabilities; currently runs under the VMS operating system, but will soon run under UNIX and Ultrix; $20,000.

Viewlogic Systems Inc., 275 Boston Post Rd. W., Marlboro, MA 01752, 617-480-0881. **Enter No. 526**

For additional product information, please write the appropriate reader service number on the Reader Inquiry Card.

Two-In-One Graphics Workstation

Colorscan/2; a 2-in-1 workstation that combines the capabilities of an IBM Personal System/2, or PC/XT/AT compatible computer with the communications and graphics capabilities of Digital's VT240 terminal; features parallel operation in the VAX and MS-DOS environments, which allows the user to switch between them with a single keystroke; designed as a platform for online information access and desktop business computing where timely access to several sources of information is essential.

The product enables users to access more sources of information, while continuing to utilize existing bases of Digital and IBM PC applications; $2,000.

Datamedia Corp., 11 Trafalgar Sq., Nashua, NH 03063, 603-886-1570. **Enter No. 527**

Architecture Design Tool For VAXstation

ValidCOMPOSE; an IC design environment for developing chip architectures; designers can use pre-defined cells from standard cell libraries, compiled cells, or handcrafted custom cells to construct new chips; operates on symbolic representations of cells and produces design rule-correct output, freeing designers from the details of cell geometries; shares a common database with the ValidGED schematic editor and ValidLED IC layout editor; reads the schematic, accesses symbolic representations of the geometric cells from its cell library, and displays their connectivity.

The symbols appear as bounding boxes that define the relative sizes and shapes of the cells and their connection points; runs on the Sun 3/100 and 3/200 series of engineering workstations and on VAXstations; $20,000.

Valid Logic Systems, 2820 Orchard Pkwy., San Jose, CA 95134, 408-432-9400.

Enter No. 528

Systems Security, Power Conditioners/Supplies

Three Enhancements To UPS

FERRUPS 1000 and 1500VA; 1000 and 1500VA units available in 19-in. rackmount cabinets, measuring 10 x 16.2 x 21 in.; units include keypad, LCD display, internal battery, and RS-232 port; 10 new 50 Hz models, ranging from 500 VA to 15 KVA; these units meet requirements for all overseas applications, including commercial, government, and military; internal bypass switches have been added to the 7.5 KVA to 15 KVA models as a standard feature.

FERRUPS ranges in capacity from 250 VA to 15 KVA, and provides two functions for computers and other electronic and electrical devices: instant continuous computer grade power in case of blackouts or deep, protracted brownouts; complete line conditioning and filtering, protecting against virtually all other line power problems.

Best Power Technology Inc., P.O. Box 280, Necedah, WI 54646, 800-356-5794, 608-565-7200 (in Wisconsin).

Enter No. 529

Test Devices

Pulse/ Frequency Counter

Model 4604OPI; offers five general-purpose 16-bit counters on a convenient compact module for IBM PC/XT/AT, MicroVAX, and PDP-11 systems; can be used as a general-purpose timer, a counter, a frequency meter, a watchdog timer, and a pulse totalizer; with eight optocoupled inputs to a VLSI chip and hardware/software gating of each of the five counters; is programmable for up or down counting in both binary and BCD formats; a system timing controller permits gating times from 1 msec to 2000 sec., using the crystal clock or any of

the 10 source or gate inputs to the STC.

Load registers are preset automatically and up to four of the counters can generate a bus interrupt; provides start-stop flip flop or level gating; a hold register permits the count to be read at any time without disturbing the counting process; modules start at $450.

ADAC Corp., 70 Tower Office Pk., Woburn, MA 01801, 617-935-6668. **Enter No. 530**

Systems Software

Diskeeper For VAXstation 2000

Diskeeper Online Disk Defragmenter for the VAXstation 2000; can maximize disk performance and keep Digital's new workstations running efficiently without users even being aware that the disks are being maintained; swapping floppies to backup/restore disks on a VAXstation 2000 (in order to defragment the disks) is eliminated.

Diskeeper eliminates the fragmentation of files to allow data to be read from the disk at maximum speed while also grouping free space at the front of the disk for efficient and contiguous creation of files; $375.

Executive Software Inc., 3131 Foothill Blvd., Ste. F, La Crescenta, CA 91214-2699. **Enter No. 531**

Linking Software For VAX

Q-ARC-CX: and Q-ARC-CX:/ARP; for linking VAX/VMS to ARCNET LANs; when used with Q-bus compatible Q-ARC-01 board, this ARCNET compatible software package provides systems engineers with a basic VAX/VMS compatible device driver foundation for supporting higher level LAN software development and applications; software is offered at two separate levels.

Q-ARC-CX is suited for specialized, speed critical applications, such as realtime control networks; and the Q-ARC-CX:/ACP contains the CX, the ACP supplies higher level channel control and a messaging mechanism; the Q-ARC-CX: device driver starts at $750; a copy of the Q-ARC-CX:/ACP software is as low as $1,100 (MicroVAX II).

C&C/Comendec Ltd., P.O. Box 280, 708 Mandrake Dr., Batavia, IL 60510, 312-879-7003. **Enter No. 533**

VAX Connectivity For PC/Macintosh Users

pcLINK; provides high speed Macintosh and PC to VAX integration over Ethernet; consists of configurations that enable users of these microcomputers to take advantage of the full range of pcLINK functionality over an Ethernet connection to VAX systems running VMS; includes features for moving data between the DOS and Macintosh environments and provides high speed VAX Ethernet connectivity for both the Macintosh and the IBM PC.

With the new pcLINK configurations, the physical connection between the Mac-

For additional product information, please write the appropriate reader service number on the Reader Inquiry Card.

intosh (512, 512e, Plus, SE, or II model) and the VAX is accomplished using either the Kinetics FastPath AppleTalk/Ethernet hardware bridge or the Kinetics EtherSC, a direct SCSI/Ethernet connection for the Macintosh; pricing is server based, starting at $2,000/VAX.

Pacer Software Inc., 7911 Herschell Ave., Ste. 402, La Jolla, CA 92037, 619-454-0565. **Enter No. 535**

Optical System Software Utility For VMS

Optical System Software (OSS); a software utility and set of callable software routines that allow the VMS operating system to communicate with the write once read many (WORM) optical disk; OSS is a VMS utility and a set of callable routines that manage the optical disk file structure; the write once disk structure is similar to the standard VMS ODS-2 file structure; the home block, file-header, filenames, filename extensions, versions, dates, and characteristics are the same as those of any ODS-2 device.

Additional features of OSS include virtual volume support, triple redundant file headers, optical disk initialization command, copy command, and file structure verification; $2,000.

Scientific Micro Systems Inc., 339 N. Bernardo Ave., Mountain View, CA 94043, 415-964-5700 **Enter No. 537**

Black Box Router For VAX

Black box router; created specifically for MS-DOS compatible PCB CAD systems, VAX and Sun; is capable of autorouting with simple X,Y (Gerber-formatted) data; needs only the location, size, shape, and layer of all component pads, and the starting and ending point of all unrouted lines (links) of a board design; features include: gridless routing, region routing, multilayer routing on up to 20 layers simultaneously, re-entrant routing, and multipass routing that allows up to six user-defined passes.

Since the route is not tied to net list order, the shortest point-to-point connections are assured; the black box router is also capable of handling SMD routing; $5,500.

Academ Systems Inc., 2418 Armstrong St., Livermore, CA 94550, 415-449-3294. **Enter No. 538**

Expert System Development Tool

RuleMaster 2; extended version of the RuleMaster software package; used to solve knowledge-based problems in a variety of fields, including medicine, agriculture, machine diagnostics, hazardous material handling, weather prediction, and insurance underwriting; retains the features of RuleMaster; new features include: end-user interface with pull-down menus and windows; screen design toolkit enables the developer to design custom end-user screens quickly and easily; an ASCII file import facility allows the developer to incorporate tabular information from a database or spreadsheet into the knowledge base; includes two versions for the personal computer: RuleMaster 2/PC and RuleMaster 2/PCX.

Both versions offer all the capabilities of the original RuleMaster software package, as well as all the new features; RuleMaster 2/PCX allows very large expert systems to be built on a PC; RuleMaster 2/PC ($495), RuleMaster 2/PCX ($1,895).

Radian Corp., 8501 MoPac Blvd., P.O. Box 9948, Austin, TX 78766, 512-454-4797. **Enter No. 539**

VT220 Terminal Emulation Software

HyperACCESS V. 3.22; features emulation of the VT220 terminal with support for a wide range of VT220 features and offers higher data transmission speed than the VT220; features supported include ASCII, multinational,

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graphics, British, French-Canadian, and German character sets, alternate keypad modes, 7- and 8-bit modes, auto-wrap, host-definable top and bottom margins, host-definable tabs, insert and replace mode, select graphic rendition, auto print mode, printer controller mode, print cursor line mode, and print screen mode; supports 57,600 baud transmission rate; $149.

Hilgraeve Inc., P.O. Box 941, Monroe, MI 48161, 313-243-0576. **Enter No. 540**

SmarTerm Adds VT240 Color Graphics Emulation

SmarTerm 240 V. 2.0; includes emulation of the VT241 color graphics terminal and support for Enhanced Graphics Adapters (EGA) when displaying ReGIS graphics images; SmarTerm 240 is software that allows an IBM PC or 100% compatible computer to communicate with minicomputer and mainframe hosts and emulate the display and keyboard characteristics of a wide range of Digital and Tektronix graphics and text terminals; VT241 emulation using an EGA card will allow PC users to take full advantage of powerful Digital host business graphics software, such as DECgraph and DECslide.

The ReGIS image generated in EGA mode will be similar in quality to that of the VT241 terminal, despite the limitations of personal computer display hardware; the full-screen image will be dynamically maintained; in addition, full VT241 resolution of any portion of a picture also can be shown and dynamically maintained; the image will be painted on the display at virtually the same speed as the VT241 terminal, or faster, depending on PC hardware; will support four on-screen colors at a time; $345, upgrade is available for $75.

Persoft Inc., UW Research Park, 465 Science Dr., Madison, WI 53711, 608-273-6000. **Enter No. 541**

Gateway To IBM For DECnet And VAXclusters

RJEnet; option to complement both Datanex HASP+ and ezSNA/RJE communication software products; allows VAX and MicroVAX users on DECnet nodes and VAXclusters to use HASP+ or ezSNA/RJE software on any VAX or MicroVAX in the network; jobs and files can be submitted over the network to the HASP+ or ezSNA/RJE input queue with job output or files returned to the submitting VAX system, having their arrival announced to the user via VAXmail; remote users can obtain status information about their jobs by issuing status and queue query commands.

They can also issue console commands through RJEnet to any host mainframe connected to the VAX running HASP+ or ezSNA/RJE; $1,000+.

Datanex Inc., P.O. Box 1728, Eugene, OR 97440, 503-687-2520. **Enter No. 542**

Automatic Charting Tool For VAX

ProMod/SC; an automatic structure charting option for the ProMod computer aided software engineering (CASE) environment; ProMod/SC creates highly detailed graphic structure charts representing software design data developed during the modular design phase of ProMod; diagrams produced represent the Modular Network connections, the Function Network at the module, subsystem, or system level, and the Function Structure Chart of the system following Yourdon/Constantine notation.

ProMod/SC prepares charts in single-page format from the information contained in the database, displays the charts on-screen for positional editing if desired, and then outputs the charts to a pen plotter or laser printer; $1,000 VAX; $500 PC.

Promod Inc., 23685 Birtcher Dr., Lake Forest, CA 92630, 714-855-3046.

Enter No. 543

Operations Monitor For VAX

Opmon; allows a properly authorized user to monitor batch queues, print queues, or users on the VAX system or node; in addition, a Macintosh-like interface has been integrated into the program to implement the pull-down menu system; major features include: monitoring batch queues, print queues, or users on the system or node; uses little system CPU time during execution; has pull-down menus to activate commands.

The product spawns a subprocess to issue DCL commands; saves 10 DCL commands for execution from within the program; terminates other processes from within monitor; handy calculator, alarm clock, calendar, and notepad; online help facility; and traps and displays broadcast messages.

Data Center Software, 447 Old Boston Rd., Topsfield, MA 01983, 617-887-3656.

Enter No. 544

VT220 Emulation Software

Reflection 2 and Reflection 2 PLUS; users with DECnet-DOS can communicate with VAX/VMS over an Ethernet network, using Digital's LAT protocol; offers both VT102 and VT220 emulation; offers DECnet-DOS users more convenient connectivity and PC-to-VAX data transmission speeds up to 19.2 Kbaud; Reflection 2 PLUS offers VT220 terminal emulation and file transfer to VMS and UNIX hosts, and supports Kermit and Xmodem; Reflection 2 ($199); Reflection 2 PLUS ($249).

Walker Richer & Quinn Inc., 2825 Eastlake Ave. E., Seattle, WA 98102, 206-324-0350. **Enter No. 545**

New Poly-STAR Releases With Networking

Poly-STAR/220; provides accurate emulation of Digital's VT52/102/220 text terminals, seamless file transfer capabilities, pop-up window menus, "hot key" switching, international keyboard support, "smart" modem support, and pre-written communications language programs for automated log on, file transfer, disk backup, and mail delivery; Poly-STAR/240 has all of the features of poly-STAR/220 plus color graphics emulation of Digital's VT125 and VT240/241 graphics terminals; the new releases (V. 1.1) add multiple session support, enhanced scripting features, an improved user-interface, keyboard remapping capabilities, and additional remote control features.

Network Support Options (NSOs) allow users of various types of networks to access VAX systems from any PC on the network; the initial release supports Digital's Local Area Terminal (LAT) Ethernet protocol; primary benefits are increased speed and easier connectivity; permits the transfer of large files in a fraction of the time required asynchronously; poly-STAR/220 ($200); /240 ($300); Ethernet/LAT NSO ($69).

Polygon Inc., 1024 Executive Pkwy., St. Louis, MO 63141, 314-576-7709.

Enter No. 546

ASIC Design Environment For VAX

Plessey Design Software 2 (PDS 2); combines capabilities previously found in Plessey's semicustom CAE system and Plessey MEGACELL standard cell CAD system, with several new features that will offer new capability and flexibility to circuit designers; provides engineers with a complete set of easy-to-use tools for designing advanced electronic components in their own facilities; an engineer can now design and layout integrated circuits from a common library of circuit cells for processing and implementation as a gate array or standard cell in silicon.

This merger of capabilities permits engineers to segment their designs into several logic subsystems, implement a solution for each subsystem in a manner that is most cost-effective and then merge all subsystems onto a single piece of silicon offering the quickest time to market; runs in a VAX/VMS environment on any Digital system or equivalent hardware.

Plessey Semiconductors, 9 Parker, Irvine, CA 92718-2892, 714-472-0303.

Enter No. 547

Network Connection To DEC VAX and DECnet

10CAD Plus; a network connection to Digital systems; is designed specifically for CAD/CAM/CAE; the network allows CAD/CAM/CAE workstations to share disk drives, drawing and part files, laser printers, and plotters; offers a bidirectional link option between CAD/CAM workstations running DOS, and VAX/VMS workstations; with this option, VAX workstations and IBM PCs can share data files, programs, disk drives, plotters, and printers; offers a direct link to DOS for VAX users; with links to DOS, VMS, and AppleTalk, it provides connectivity for CAD/CAM installations; the bridge to DECnet allows desktop CAD/CAM workstations to directly access the power of

PRODUCT NEWS

VAX mainframes.

The 10CAD Plus Network also includes Electronic Mail, Electronic Messaging, Workgroup Scheduling, and shared printers; DOS 3.x file and record locks are supported for programs like dBase II Plus and Rbase 5000; dedicated fileservers are not required, but may be added to increase storage and performance; is $995/PC workstation.

ACS Telecom, 25825 Eshelman Ave., Lomita, CA 90717, 213-325-3055.

Enter No. 548

VT220-Layout Keyboard And Emulation Software

PowerStation-220; a VT220-layout keyboard and VT220 emulation software for PC/XT/AT-class systems; the keyboard, which plugs into most PC/XT/ATs, is an exact replica of a Digital VT220 layout; when used with the PowerStation VT220 emulation software, the PC functions as an enhanced VT220 terminal with full functionality including true double-high/double-wide characters, smooth scrolling, and true 132-columns on many adapters; extensions include mapping of character attributes (such as bold, blink, and underline) to color, full keyboard SOFTKEY/MACRO script language, and ASCII, Kermit, and Xmodem file transfers.

The keyboard works with all DOS applications, as no special software is required; the Standard PowerStation-220 (keyboard and VT220 emulation software) lists for $289, the Gold Key model lists for $319.

KEA Systems Ltd., #412-2150 W. Broadway, Vancouver, B.C., Canada V6K 4L9, 800-663-8702. **Enter No. 549**

Network-Management Capabilities For ATTACH

Resource Manager; combined with ATTACH, is similar to LANs in that it provides port contention, dynamic load balancing, and

multisessions; unlike LANs, however, ATTACH with the Resource Manager provides a queuing function that gives users the option of waiting for a resource; provides centralized network management and security; via a resource-management terminal, a designated network manager can selectively limit access to resources through classes of service assigned on a per-port or per-group basis; the network manager may also restrict access to resources through passwords, individual privileges, and designated days and hours.

Software is completely self-contained in the Resource Manager module that resides in the ATTACH enclosure; available for all Digital computer systems; baseline ATTACH system with the Resource Manager, 64 server ports, and two, 128-port front-end processors is $18,000; the product is available 60 days ARO.

Able Computer, 3080 Airway Ave., Costa Mesa, CA 92626, 714-979-7030.

Enter No. 550

WORD-11/All-In-1 Interface Option

WORD-11 interface option; an interface linking WORD-11 with All-In-1; is added to All-In-1's Main Menu so that documents may be created using the powerful features that WORD-11 users appreciate, then stored in a local format within an All-In-1 "file cabinet"; all formatting characteristics are left intact during this conversion—bolding, underlining, headers, footers, etc. are all stored in the All-In-1 file.

Such documents are then available for interface with the other All-In-1 applications, including Electronic Messaging; All-In-1 documents may also be pulled into WORD-11 (formatting characteristics intact) for editing sessions, combining with other WORD-11 documents, and printing; $2,000.

Data Processing Design Inc., 1400 N. Brasher St., Anaheim, CA 92807, 714-970-1515 **Enter No. 551**

Applications Software

PostScript For VAX Version of MASS-11

MASS-11 V. 7-A; word processing software for the VAX line of computers; major enhancement is the support of 43 PostScript fonts in an unlimited range of point sizes; gives PostScript users the freedom to change typefaces and point sizes repeatedly anywhere within a document; fonts can also be printed in outline form or in various shades from black to white; MASS-11 documents integrated with graphics can also be output to PostScript printers.

New features include: DCA Conversion Program, Hot Print, Spreadsheet Integration, Text and Graphics Integration, Change Bars, Directory Phrase Search, and the Hyphenation Dictionary; $5,750–$17,250.

Microsystems Engineering Corp., 2400 W. Hassell Rd., Ste. 400, Hoffman Estates, IL 60195, 312-882-0111. **Enter No. 552**

Defense Contract Management System

Compass Contract; a fully integrated manufacturing, financial, and contract management software system designed to assist aerospace and defense contractors manage estimating, bidding, planning, and production processes, along with most aspects of cost accounting, quality/configuration control, and government reporting requirements; enables government contractors to adhere to new DoD regulations and more stringent enforcement of existing regulations.

For VAX equipment, Compass Contract runs under VMS and uses the RMS file management system; includes an optional, integrated journaling facility that can be used for rollforward disaster recovery of a database; requires only VMS and COBOL to install on VAX hardware; $100,000 (MicroVAX) ranging to $400,000 (VAX 8800).

Western Data Systems, 22120 Clarendon St., Woodland Hills, CA 91367-6395; 818-340-4041. **Enter No. 553**

Sales Management System For VAX

OMNITRAC; a database program developed to manage data involved in the sale of services and products; improves the productivity and efficiency of a sales or marketing operation by placing all client information in a centralized database; previous conversations, future contact dates, and personal callbacks can be viewed at a glance; sales management can automatically generate reports such as Sales Forecasting, Territory Analysis, etc.; runs on the IBM PC/XT/AT and compatibles, as well as LANs and Digital VAX/VMS; $5,000–$8,000.

Cincom Systems, 2300 Montana Ave., Cincinnati, OH 45211-3899, 513-662-2300. **Enter No. 554**

Chassis, Backplanes, And Enclosures

Rugged OEM Chassis For Q-bus

Trilobyte IV-B; rugged system chassis that provides 14 quad Q-bus (on 0.6-in. centers), 12 multibus, or 9 double-high VME slots; four full-high 5¼-in. drives and 750 W power supply are cushioned by Aeroflex Helicoil shock/vibration isolators on an internal platform; platform space accommodates two re-

SYSTEMS AND SOFTWARE
—IBM Vs. Digital

continued from page 90

plications yet. Trade newspapers are filled with news about IBM software-application vendors announcing new disk-dependent VAX/VMS products, while UNIX receives much less attention.

Digital's UNIX hardware competitors advertise by promoting their CPU's mainly on the basis of MIPS (millions of instructions per sec.) or RISC (reduced instruction set computing). One UNIX vendor claims more MIPS per dollar than a VAX. Another vendor advertises a RISC operating system, which is supposed to be more efficient than VAX/VMS. Disk performance is rarely mentioned in the same advertisement. The UNIX hardware vendors, unlike Digital, don't often develop disk filing systems, such as RMS. Instead, this software must be purchased from a separate vendor. Since the general business software market knows that MIPS and RISC aren't adequate terms to prove much by themselves, ISI makes this recommendation to the UNIX hardware suppliers competing with IBM or Digital—buy a disk filing system, improve its throughput to the maximum (even if the techniques are proprietary), benchmark your results until you're sure they're competitive, and then publicize a full business solution to the hilt.

Memory generally operates no less than a thousand times faster than disk filing on almost every computer. To make a general business application run faster, there is no particular secret about how to do it: cut down the disk filing to a minimum, and when you must disk file, do it as quickly as possible. Digital's VAX/VMS provides numerous choices for optimizing results. As George Dyer, manager of business systems for Gallaudet University and chairman of the Digital Equipment Corp. Users Society (DECUS) Business Application Special Interest Group (SIG) remarks, a VAX/VMS program "can work so fast, you think it's broken."

Faster VAX/VMS program execution does require more memory per program. However, in this day of cheaper memory, larger user programs that are more intelligent and communicative than their predecessors seem to be a natural, if not inevitable, part of software evolution. The market is just beginning to realize the full implications of this change.

IBM has been so successful that some people think IBM is synonomous with "computer." No matter how successful Digital becomes, IBM mainframes are here to stay. However, mainframes will, most likely, play a diminished (although still significant) role in the future because fewer people will use them to enter data. The mainframe will become less visible and simply process sequential data as it was originally designed to do. Other kinds of computers will be used more often to feed data to the mainframe, and many of those will be VAXes.

A common IBM mainframe technique was to reserve three to six entire disk packs for just the temporary work files that can result from sorting large sets of data. The presence of many large disks, foreign to any VAX site that I know of today, will continue to have their place, just as an 18-wheel truck that carries heavy cargo. However, the emerging markets of conversational data entry and remote access to decentralized databases most often leave IBM as the high cost, labor-intensive alternative.

Was the information in this article helpful to you in the performance of your assigned responsibilities?

Very helpful	**Enter No. 501**
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movable drive units or front service units; the fully wired OEM chassis with power supply and backplane occupies 12¼ in. of rack space and weighs in less than 70 lbs.

With every Trilobyte IV-B comes the System Sentry, an 8085-based diagnostic monitor and controller, that constantly monitors operating parameters (line and DC voltages, temperature, airflow, and system status) to provide logging, diagnostic, alarm, Battle Short, and emergency shutdown functions; $12,150 in quantities of 10–24, integrated MicroVAX II systems $34,800.

Trilobyte Computer Corp., 801 W. Grand Ave., Oakland, CA 94607, 415-839-1100
Enter No. 555

Expansion System For VAXmate

DM310; network expansion system that allows the VAXmate user, who is on the network for tape and disk storage, to add local enhancements such as EMS, EGA, communications, and other AT compatible functions; consists of an integrated external cabinet complete with power, quiet cooling and bus extension subsystems, card cage, and necessary installation and operation documentation; mounts underneath the VAXmate and simply plugs-in to provide local AT compatible enhancements for the end user.

The DM310 has a system master on/off switch on the front panel that provides conditioned power to the entire system with surge/EMI suppression; the cooling system has a fan installed that can be enabled or disabled depending upon the environment and the configuration of the subsystem; the card cage has four 16-bit AT compatible expansion board slots (three long and one short) that provide capability to add needed local enhancements while on the network; available 30 days ARO.

dmi, 27635 Forbes Rd., Ste. H, Laguna Niguel, CA 92677, 714-955-2422 or 714-582-3118. **Enter No. 556**

Four Sigma Chassis

SA-H165, SA-H158, SA-H161Q, and SA-H160; SA-H165 expansion enclosure supports Fujitsu 2300 or Toshiba MK-280 series Winchester drives; includes a 350 W heavy-duty power supply, all internal drive cables, and a front switch/display panel, including control switches and status indicator LEDs; $1,270.

SA-H158 is a tower enclosure designed for mounting two 8-in. Fujitsu 2300 series Winchester drives; includes heavy-duty 350 W power supply, two fans, a bulkhead connector panel for the drive controller interface, and all drive cabling for power, front panel status, and control/data lines; $1,458.

SA-H161Q is an IBM PC/AT look-alike system enclosure for the LSI-11; supports two 5¼-in. Winchesters, plus a removable device such as a floppy drive or tape cartridge drive; includes an 8-slot dual-wide backplane with selectable 18- or 22-bit addressing, and a 240 W power supply with power fail sequencing and front control panel interface logic; $1,041.

SA-H160 is a replacement for Digital's BA123 (World Box); includes a 700 W power supply, a rear panel with configurations for "A," "B," and "C" I/O panels, slide-in, snap-on drive assemblies, snap-on front bezel, rack-mount slides, and modular design components for convenient serviceability; $2,737.

Sigma Information Systems, 3401 E. La Palma Ave., Anaheim, CA 92806, 714-630-6553. **Enter No. 557**

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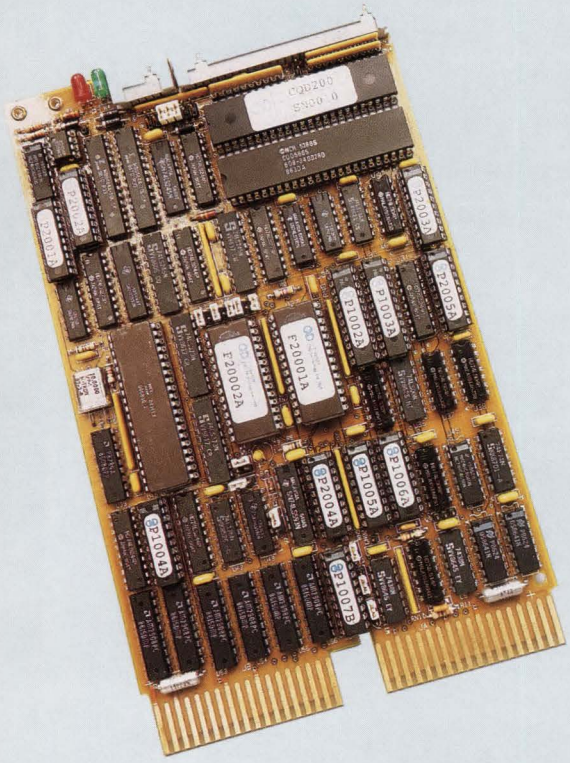

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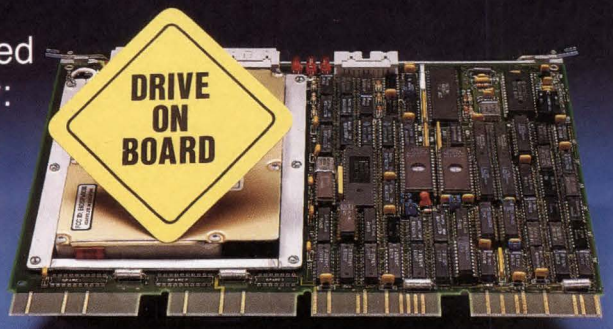

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