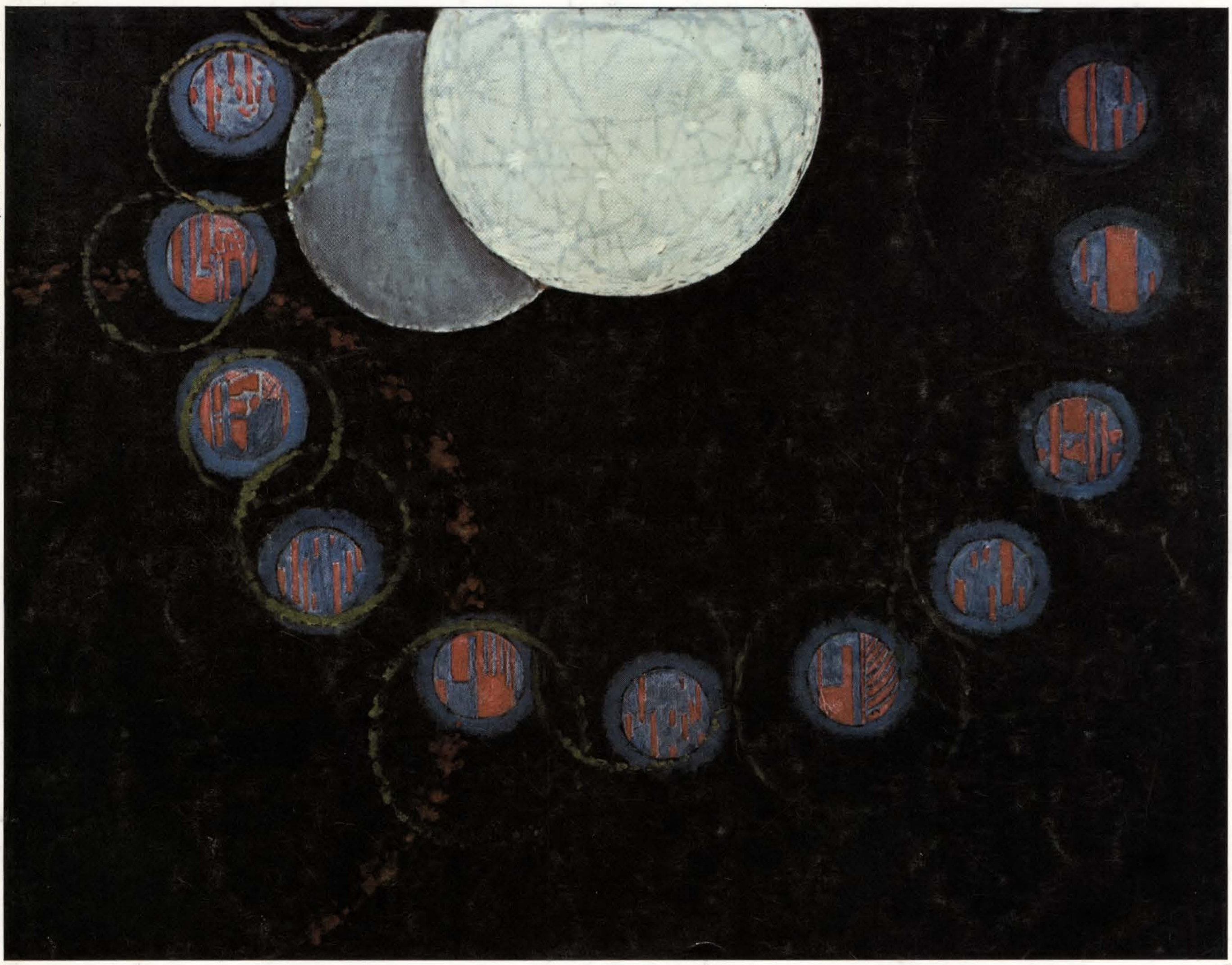
AUGUST ▪ 1986 VOL. 5, NO. 8 ▪ $4.00

SOFTWARE
MACSnVAX

DEC PROFESSIONAL

- Interfacing programmable printers
- The MicroVAX II grows up
- Breaking the disk performance barrier



Detail from *The First Step*, 1910-13?, by Frantisek Kupka

A galaxy of add-ons and connections

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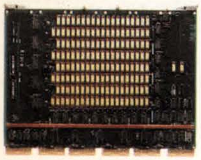
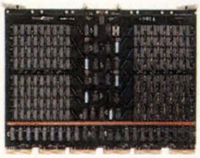
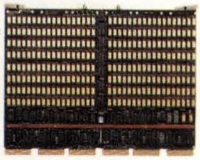
STANDARD MEMORIES' add-ins for DEC:



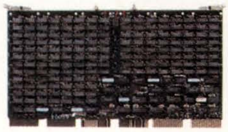
PINCOMM 780SX 1MB or 4MB for VAX-11/780,/785



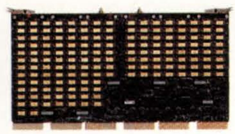
PINCOMM 780S 256KB for VAX-11/780,/785



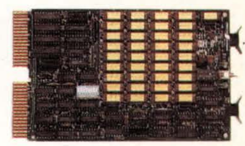
PINCOMM 780S+ 1MB or 2MB for VAX-11/780,/782



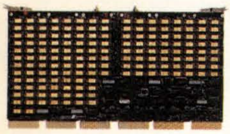
PINCOMM 750S 256KB for VAX-11/750



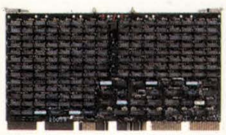
PINCOMM 730S 1MB for VAX-11/730



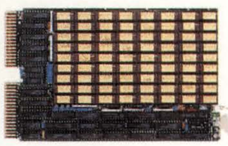
PINCOMM 23S 256KB for PDP-11/23, LSI-11/23...



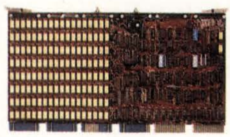
PINCOMM 750S+ 1MB for VAX-11/750-CA



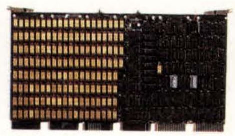
PINCOMM 70S 256KB for PDP-11/70



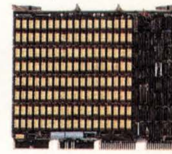
PINCOMM 23SX Up to 2MB for Q-Bus Computers



PINCOMM 24S 1MB for PDP-11/24 Parity Checking



PINCOMM 44S 1MB for PDP-11/44 ECC

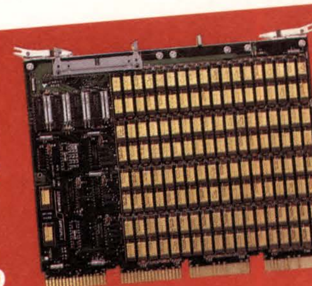


PINCOMM 73S Up to 4MB for PDP-11/73, MicroVAX 1...

(all covered by our ten year "5 Plus 5" Warranty)

And look what's here now! One for the MicroVAX II:

PINCOMM 630S...
AVAILABLE NOW IN 4MB AND 2MB ON A QUAD BOARD



We know that when you put a memory from STANDARD MEMORIES into your computer, you're putting your trust in us. We've worked over 19 years to earn that trust, and to maintain it. From our first core-type memory modules to our current 256K RAM technology, we've used the talents and experience of our design engineers to develop memories of the highest quality. We've built efficiency into our plant so that we can offer add-in memories that are unsurpassed for cost-effectiveness and reliability. (Every board we deliver is brand new—not a recycled exchange.)

One result of this effort is our new ten year "5 Plus 5" Warranty—evidence of a confidence in our products that you can share. Another result is our latest product—the Pincomm 630S for the MicroVAX II, delivering 2MB and 4MB on a board—and delivering it now.

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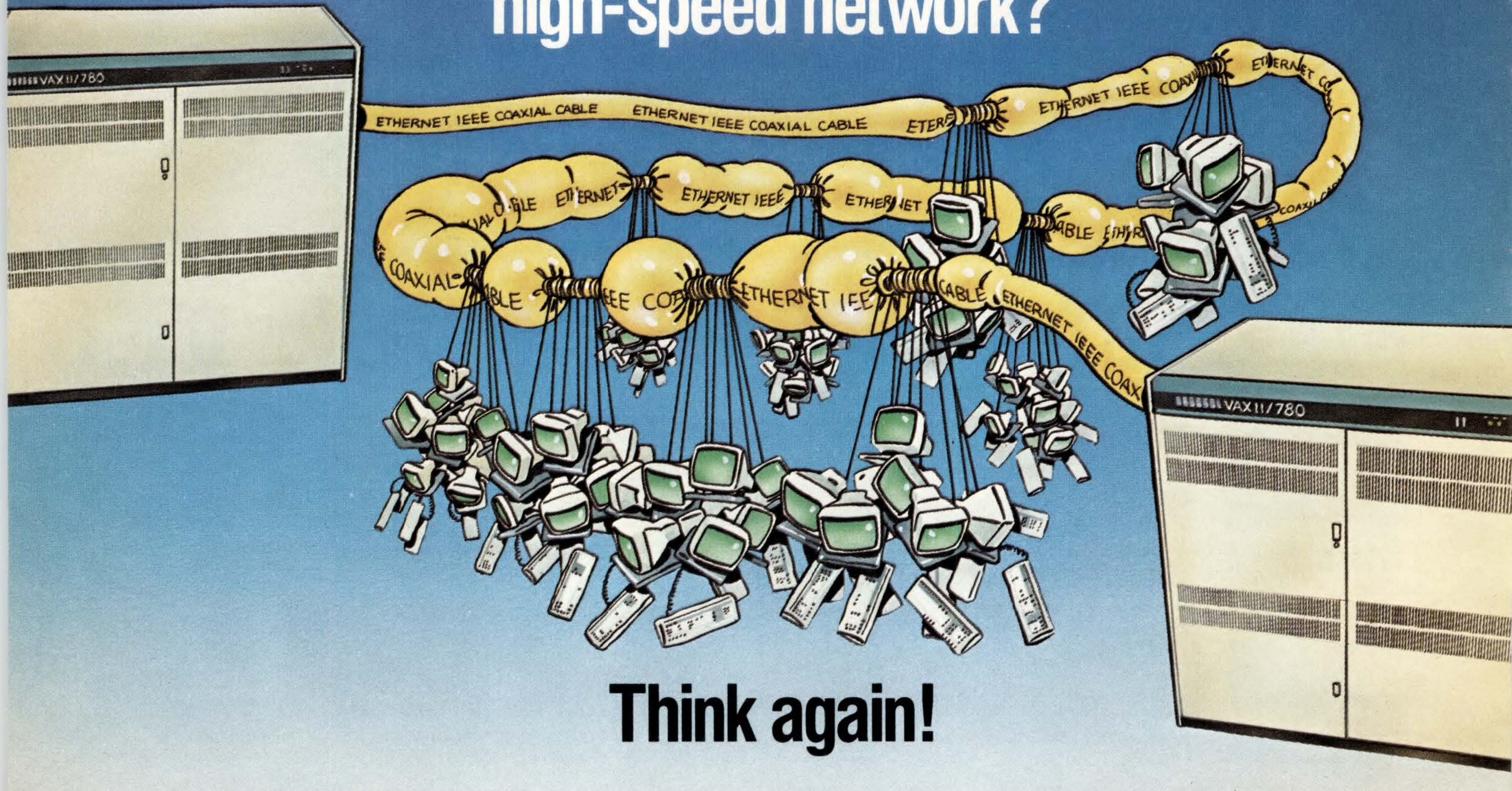
Thinking of tying low-speed terminals onto a high-speed network?



Think again!

A high-speed LAN is ideal for file transfer, distributed processing and CPU-to-CPU communications.

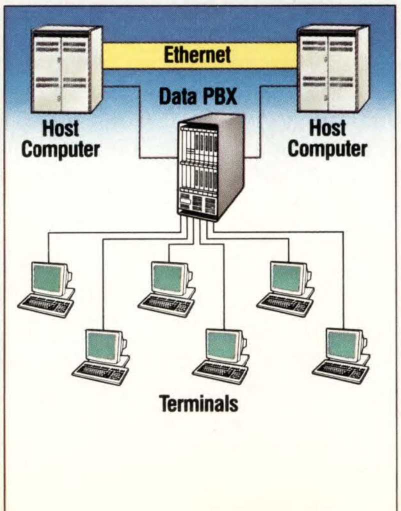
But using it for terminal traffic can cause problems.

You may be tying up bandwidth. Low-speed terminal traffic on a high-speed network can rob bandwidth where it's needed most. That means slow file transfers and sluggish response for all network users. The protocol overhead required for a terminal to send small data packets across an Ethernet® link can mean that only 10% of the 10 Mbps bandwidth is available.

By connecting your terminals through an Equinox® Data PBX and connecting your computers together with Ethernet, your LAN runs at top efficiency. An Equinox Data PBX dedicates a full 12 Mbps to terminal data traffic. More than 1300 devices can run continuous 9600 bps data at the same time, providing the best possible response through the network.

You'll tie up about $500 per terminal. When you consider the cost of Ethernet Terminal Servers, Taps, and Cable, Ethernet can cost between $300 and $800 per terminal. An equivalent solution using an Equinox Data PBX with our 8-channel Terminal Servers and twisted pair wiring is about $100 per terminal.

You could tie up your computer. Some Ethernet LANs handle terminal switching by running special software in your computer. So adding terminal traffic means your computer spends more time running the network and less time running applications. An Equinox Data PBX requires no special software and handles all terminal network processing without disturbing the host. It even allows you to monitor the network load and provides additional security for access control.



We won't tie you down. Putting your terminals on an Equinox Data PBX provides more terminal switching features for less money with greater efficiency, so you can get the most out of your LAN. And because it works with all types of computers and terminals you're not tied to a one-vendor solution.

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Miami, FL 33186-6108

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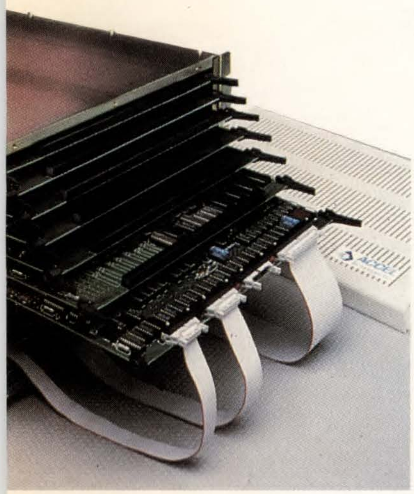

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ON THE COVER:
The First Step,
Frantisek Kupka,
1910-13?
Dated on painting 1909.
Oil on canvas, 32¾"x51".
Collection, The Museum of Modern Art, New York.
Hillman Periodicals Fund.
Photograph © 1986.
The Museum of Modern Art, New York.

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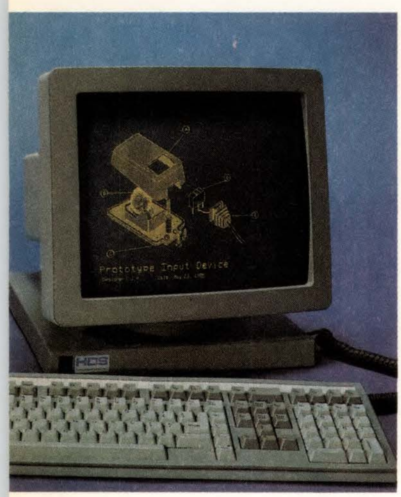

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SPECIAL PUBLICATIONS EDITOR Lonni Wright
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CONTRIBUTING EDITORS Kevin G. Barkes, Bill Brindley, Victor J. Chorney, John C. Dvorak, Bill Hancock, Rex Jaeschke, James A. McGlinchey, Lori Snyder, Ralph Stamerjohn
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BPA

DIGITAL DEALERS ASSOCIATION

PUBLISHER

Carl Marbach

Is DEC Hot? And How!

It's a hot table!! Gamblers know it: When the table is going your way its time to put it all on the line. Today's generation says "go for it." Advertisements tell us, "when it's right you'll know it." Well, the time for DEC is NOW and it should pull out some stops and go full speed.

IBM is experiencing problems in connecting its mainframes, minis and micros, because they each have a different design. The emphasis is on networks and the IBM gear just doesn't lend itself to this type of computing. Last year IBM spent $4.7 BILLION on research and $3 BILLION on factory automation which promoted President John F. Akers to say, "I don't care who you are in this industry. No one can compete with the IBM Company." Hogwash! Smokescreen! Nonsense! If that were true, why does DEC have demonstrably better hardware and networking capability NOW!

An old television series, Maverick, had a saying from Pappy Maverick: "You can fool some of the people all of the time, and all of the people some of the time — and those are pretty good odds." Well Mr. Akers, you can fool computer people for only so long and then . . .

DEC has a product line that won't quit. From the MICROVAX II workstations to the clustered 8800s, you can support from one to many thousands of users with ONE architecture, and tie them all together with networking products that work well and are available NOW!

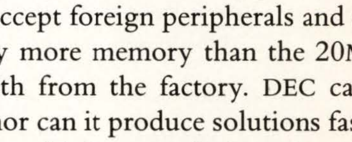
You might spend more money Mr. IBM, but you don't have the product. For DEC the time is now. First, spend lots of money on production facilities so that you can produce enough product to satisfy demand without some of those horrendous backlogs and shipping delays that plagued the company some years ago. The new 8000 series of VAX computers can be produced very quickly compared to the older 780s. Production must be increased to take advantage of market conditions. A gambler will tell you to bet on a hot table. The market is hot for DEC NOW.

Second, DEC must increase its distribution channels. The direct sales force is too small and too weak to challenge Big Blue seriously all by itself; it must have help. There are plenty of OEM/VARs who would love to sell DEC solutions, but they need more incentives. DEC must increase the discounts and start treating its OEMs like partners rather than competitors. The stories about DEC salespeople going after certain OEMs' customers has got to stop. OEM/VARs are DEC's friends, and its ticket to going after IBM.

Third, DEC has to open the architecture. Part of DEC's success up until now has been the availability of third party hardware and software. Much of this has been due to the UNIBUS and Q-bus architecture which has allowed many devices and peripherals to be attached, greatly enhancing the value of DEC computers. With the recent addition of the BI bus, DEC has served notice that it no longer will permit easy attachment to its computers. The VAX 8500 can exist without any UNIBUS at all, with only BI peripherals effectively producing a machine that cannot accept foreign peripherals and doesn't have room for any more memory than the 20MB it comes packaged with from the factory. DEC can't think of everything, nor can it produce solutions fast enough; it needs to have third-party devices that enhance the capability of its machines.

Since most of DEC's sales will come from its "loyal installed base," it follows that the larger the installed base, the more sales DEC can expect. NOW is the time to greatly expand the installed base and move rapidly toward IBM.

History will record that this was a time of opportunity for DEC. It will also tell us if DEC took advantage of it.



Publisher

DATELINE DEC

GRANT COMPUTERIZES AAUW EDUCATIONAL FOUNDATION

VAX To Increase Mobilization Of Member Network

A new "funding partnership" between the American Association of University Women (AAUW) and DEC recently was announced at a luncheon at AAUW's national office.

DEC has awarded the AAUW Educational Foundation a grant of $205,000 toward the purchase of a VAX 11/780 system valued at $475,000.

Computerization will dramatically increase AAUW's ability to mobilize its national network of members by providing a unique database on women active in educational equity and other advocacy programs in 1,950 communities across the country.

NEW INCENTIVE OFFERED TO INCREASE MEMORY ON 8600, 8650

Program Includes Price Reductions

A three-pronged program is now available to enable VAX 8600 and 8650 users to enhance productivity by increasing their memory configuration more easily and more inexpensively than ever before. DEC's program includes price reductions on the 16-MB memory array, a trade-up program for 4-MB memory arrays, and free on-site service for add-on memory covered by Digital on-site service.

The amount of the price reduction varies from 11 percent to 40 percent, depending on the quantity of total memory purchased on an annual planned basis using the Digital memory Volume Discount Agreement.

Under the memory trade-up program, DEC allows a $10,000 credit on all DEC 4-MB memory boards traded in for the new 16-MB boards. Complete pricing and other details of the Digital memory program are available from any Digital sales representative.

OLSEN RECEIVES IEEE AWARD

First Computer Entrepreneur

The Institute of Electrical and Electronics Engineers (IEEE) Computer Society recently presented the 1986 Computer Entrepreneur Award to Kenneth H. Olsen, president of DEC.

The award, presented this year for the first time, was established to "recognize and honor technical managers whose outstanding leadership developed the growth of some segment of the computer industry."

Olsen was chosen to be the recipient of the first Computer Entrepreneur Award for "having pioneered the development of small computers, and for his foresight in the founding of Digital Equipment Corporation, which began with three individuals in 1957, and has grown to become the world's leading manufacturer of networked computer systems."

QUANTITY DISCOUNTS AVAILABLE TO USER GROUPS

Hardware 'Specials' Also Offered

DEC has provided another good reason to join a user group: a new program that provides quantity discount purchasing power to user groups.

Jim Butler, manager of the Workstation Software Group, said, "Individuals who own personal computers should have the opportunity to purchase software at the discount prices granted to volume purchasers."

This was expanded further by Joe Thomas, product manager of the Personal Computer Software Group: "Digital wants the owner of personal computers — Rainbows, DECmates, and PROs — to know that they have not been forgotten."

With this program, discounts ranging from 20 to 50 percent, depending on the type and quantity of software, will be available on purchases made by user groups. Moreover, hardware "specials" also will be available (contingent on the volume of software purchases).

The program works as follows: Software is divided into two categories. Category A software, which includes all Digital Classified Software except *Lotus 1-2-3*, *Symphony*, *dBASE III*, *WPS-Plus* and *WPS*, has a discount program based on the following:

Quantity	Discount
10—24	40%
25—49	45%
50 and over	50%

Category B software, which includes all Digital Classified Software and *Lotus 1-2-3*, *Symphony*, *dBASE III*, *WPS-Plus* and *WPS*, has a discount program based on the following:

Quantity	Discount
10—24	20%
25—49	25%
50 and over	30%

Quantities from both categories may be combined to take advantage of the highest discount.

In addition, each quarter, specific hardware items will be available at significant discounts when at least 10 software products are offered.

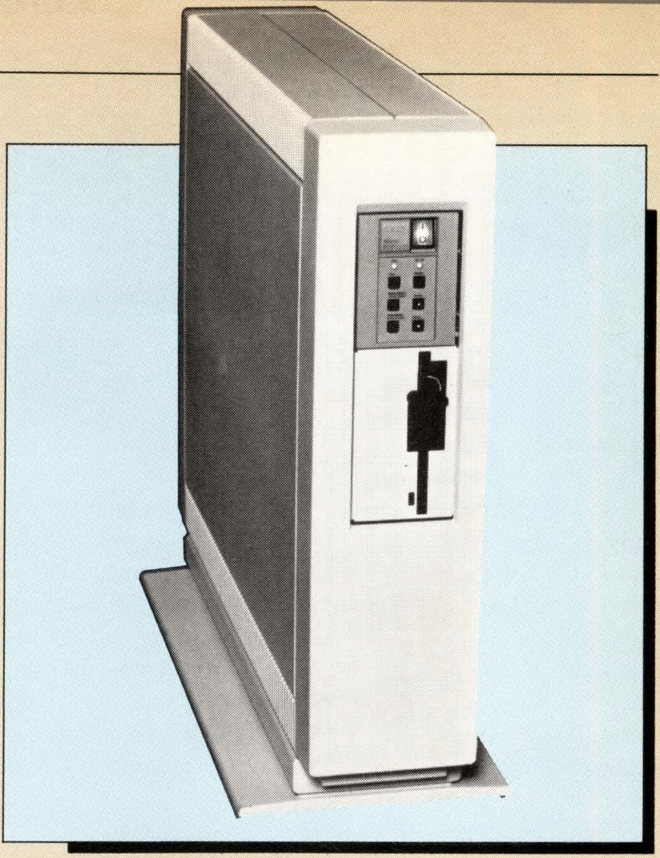
Detailed information about the program and how to place orders is being sent to the president of each user group. If you have not received such information, call (603) 884-1160.

SYSTEM DESIGNERS, DEC TO SHARE ADA TECHNOLOGIES

Family of Cross-Compilers To Be Developed

DEC and Systems Designers, headquartered in Camberley, UK, have signed a joint development agreement to share their Ada technologies and jointly build a family of cross-compilers based on DEC's VAX Ada programming language, to support the MIL-STD 1750A, Motorola 68000 and Intel iAPX86.

Under the agreement, engineers from both companies will work to combine DEC's state-of-the-art VAX Ada Compiler with Systems Designers' sophisticated host-target technology.



MicroPDP-11/53 system offers approximately twice the performance of the previous low-end system at roughly the same price.

NEW MicroPDP-11/53 HANDLES EIGHT USERS

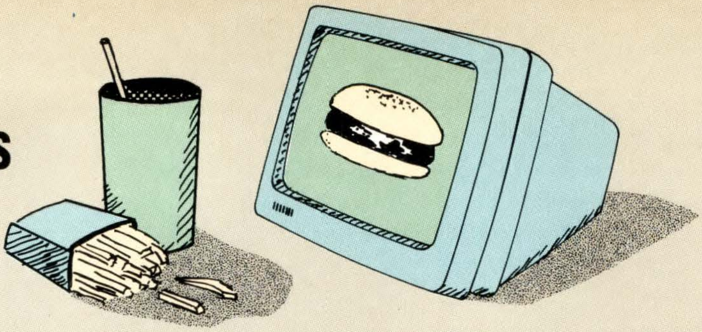
Doubles Performance, Maintains Price

DEC has announced a new low-end member of its PDP-11 family with more than twice the performance of its previous entry-level MicroPDP-11/23 system, at approximately the same price. The new MicroPDP-11/53 handles up to eight users simultaneously, twice as many as possible with the MicroPDP-11/23.

The new system is available in both pedestal and rack-mount versions and is an ideal unit both for end users and OEMs. The new system is fully software compatible with other members of the PDP-11 computer family. It can take full advantage of more than 2000 application programs, preserving software investments in the more than half-million PDP-11 systems delivered to date.

Markets for the new system include real-time process control, small business, science, communications, and government. System prices are from $9,270, with deliveries beginning this month.

VAXs LINK HARDEE'S OFFICES, RESTAURANTS



Users Connected Through poly-COM/220

A network of eight VAX-11/750 superminicomputers links Hardee's Food Systems, Inc.'s area offices and 875 company-owned restaurants. Hardee's keeps its personal computer users connected to its VAX-based database through Polygon Associates, Inc.'s *poly-COMM/220* terminal emulation and file transfer package.

Two of Hardee's VAX-11750 systems are located at corporate headquarters. One is dedicated to the systems development group, the other handles office automation functions using DEC's *All-in-1* software. The six remaining VAXs, located in area offices around the country, are connected with DECnet software. Every evening, each area VAX polls the point-of-sale devices (cash registers) of that region's restaurants.

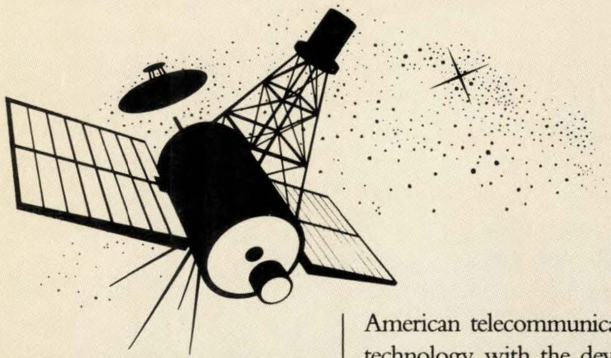
When logging on, whether using VT220s, IBM PCs, or portable computers, a communications switch lets users choose the appropriate system for the application they want to run. Corporate officers, for example, can send electronic mail messages from their IBM PCs to VAX users, and field technicians can transfer maintenance reports to their area VAX through COMPAQ portable computers.

USTTI, DEC LAUNCH TELECOMMUNICATIONS TRAINING COURSE

DEC To Be Host

In conjunction with the U.S. Telecommunications Training Institute (USTTI), DEC recently launched a two-week training course entitled "Telecommunications and Networking in the New Information Age" for telecommunications professionals from several developing countries.

This training course is designed to help participants better understand how computer technology complements telecommunications capabilities. DEC will host the training course at its Merrimack, New Hampshire, facility.



Established to share American telecommunications technology with the developing world, USTTI is a non-profit training organization sponsored by 33 corporations and four federal agencies and departments.

APTEC, CENTURY SIGN MARKETING AGREEMENTS

Joint Sales To Be Shared With DEC

Aptec Computer Systems of Portland, Oregon, and Century Computing, Inc., of Laurel, Maryland, have signed marketing agreements with DEC.

Aptec and DEC have signed a Cooperative Marketing Agreement that establishes guidelines for the two companies to market their respective products. Aptec manufacturers a special-purpose I/O computer for VAX computers running VMS. The I/O computer manages data flow between high-speed peripherals on the VAX system, enabling it to provide supercomputing capabilities and support real-time applications.

The agreement calls for the companies to share nonproprietary sales, marketing, technical and user information, as well as coordinate joint sales activities and product training seminars.

DEC and Century Computing have signed a marketing agreement that calls for the companies jointly to market DEC hardware and Century's Comm100 Link software to help users connect different vendors' systems to VAX computers running VMS.

DEC will sell and support the hardware component, which is priced at $12,500. Century Computing will sell and support the software, priced at $8,500 for quantities of over six.

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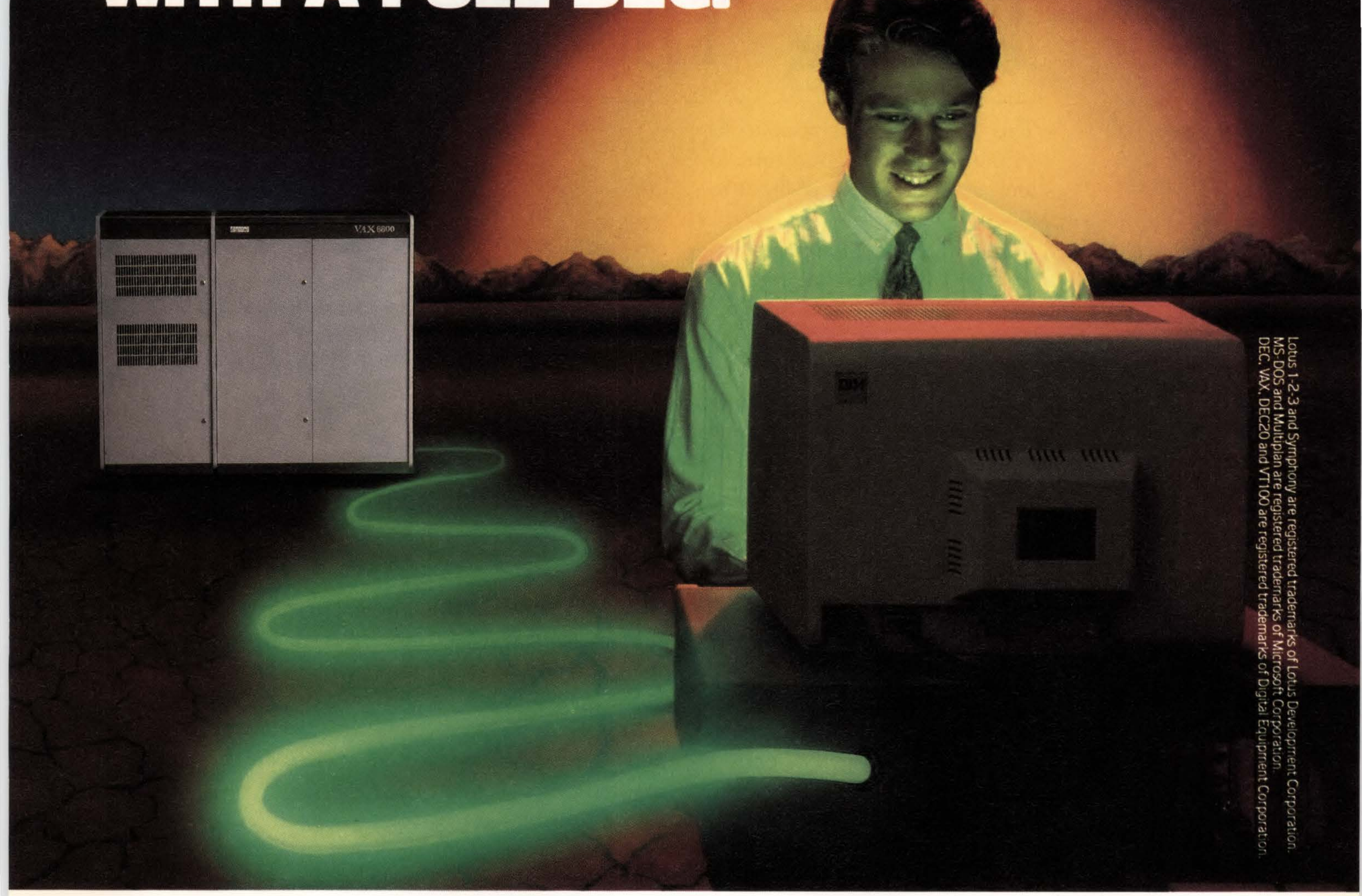

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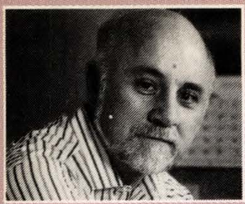


EDITORIAL

Dave Mallery

BIting The Bus

This is our annual peripherals edition, and it's a good time to look at an issue that is about to explode in our faces.

DEC has "closed" its new BI-based architecture. This means that only *selected* third-party vendors can have access to the BI interface chips and the associated manufacturing information necessary to actually build a card that will plug into a BI backplane and run. You can become a selected vendor only if you make something that DEC is not interested in making right now (like attached processors and other low-volume specialized items). Memory makers, disk controller and communications (DHU, etc.) makers need not apply.

I already have presented the emotional arguments against this tactic. Here are some not-so-emotional ones:

A closed architecture violates a 20-year trust with the customer. The alternate sources always have "pushed" the state of the art. Small firms with sharp ideas could get them into silicon and into the market, and we all benefited. The stagnation and profit-margin protection that always hung over IBM never managed to pollute the DEC market. DEC and the customer base won in the end.

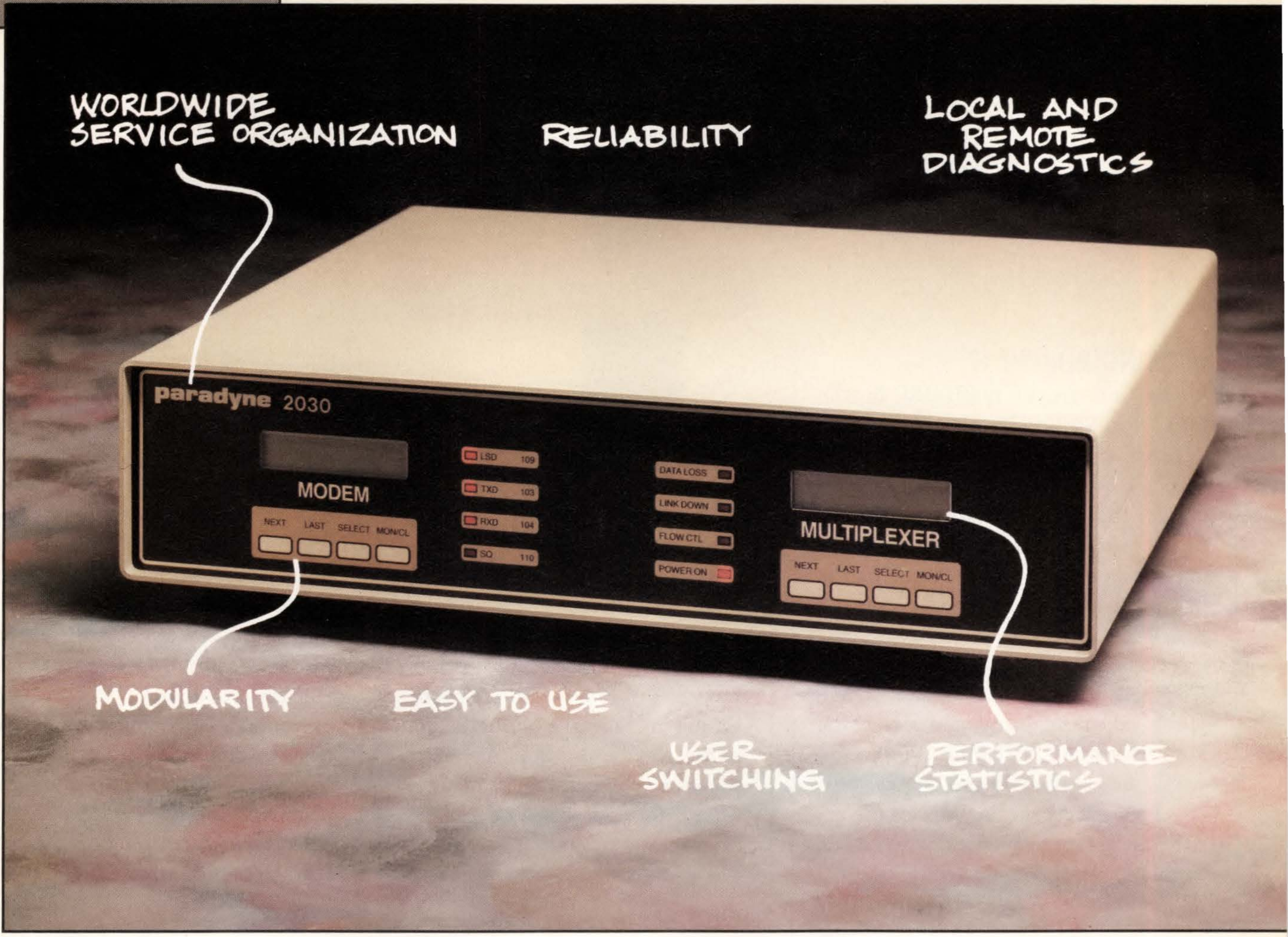
"The stagnation and profit-margin protection that always hung over IBM never managed to pollute the DEC market."

The DEC market has been a free market. If you had the guts (and it used to take real guts), you could cut your cost per MB of either memory or disk and stay in the fight. The option always was there. You could use the foreign vendors as simple price leverage against DEC and force them down to more realistic deals. All the free market forces were at play.

A fully closed architecture ends all this. The players will walk away from the table and look for action elsewhere.

I would welcome comments from either side of this argument. This is an issue that will not go away.

Editorial Director



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LETTERS

MISSING BRACKET?

In re: the article published in the *DEC PROFESSIONAL*, May 1986, "Getting to Know Your VR201 Monitor," by Anthony J. Novacky, I noticed that there was an error in every BASIC statement in the article; i.e., the left-bracket ("[") was left out of the quoted string to be printed.

While a programmer who has some experience with both BASIC and ANSI terminals like the VT100 and VT200 would take note, shrug, and correct the bug, there are certainly those who would be confused by this omission.

Fortunately, in the bulk of the article, the escape sequences, when given explicitly, are given correctly.

Russell L. Morrison, II
Brea, California

Anthony Novacky replies:

The left-bracket ("[") is actually provided within the portion of the basic statement: CHR$(155).

This code, as with any between decimal 128 and 159, provides the device being addressed with a combination of <ESC> and the respective characters between decimal 64 and 95. In other words, CHR$(155) will send <ESC> + "[".

An obvious caveat is that this code will only work on eight-bit devices. The user addressing a seven-bit device must substitute, as an example, PRINT CHR$(27)"[1m" for PRINT CHR$(155)"1m" to switch to on-screen bolding, if provided by that device.

I would like to apologize to the readers for the apparent similarity between a one "1" and the letter "l" on the print wheel I used in preparing the Options Chart that accompanied my article. This resulted in three typographical errors in both columns of that chart. The commands requiring correction are under SCREEN WIDTH, BACKGROUND, and SCROLLING. In each case, the letter "l" should be used as opposed to the number "1".

Address letters to the editor to the *DEC PROFESSIONAL* magazine, P. O. Box 503, Spring House, PA 19477-0503. Letters should include the writer's full name, address and daytime telephone number. Letters may be edited for purposes of clarity or space.

DECUS DOINGS

The March editorial column by Carl Marbach about DECUS irritated me, because I attended the Anaheim Symposium held in December 1985. In contrast to Mr. Marbach's attitude, I did NOT find it to be a "DEC promotional show." Instead, it was very much the "educational meeting it was intended to be." I returned to my job with a lot of very useful information, as well as the business cards of several fellow DECUS members who are willing to answer questions that may arise as I implement this new knowledge.

In the April issue, Mr. Marbach tells us that DECWORLD was a wonderful show, but it's too bad DEC did not invite its customers. Well, I didn't attend that show, but I WAS invited by my Digital account representative. Furthermore, at a meeting of the San Diego DECUS LUG prior to DECWORLD, everyone in attendance was told of the exposition and invited.

Mr. Marbach seems to have a very negative attitude. Perhaps he finds it easier to write critical, sarcastic columns than to be objective.

Katy Moore
San Diego, California

Mr. Marbach hit it right on the head with his comments on DECUS.

Brian Garfield
New York, New York

MISSED THE POINT

Michael Fallon's article, "DEC PCs in The Office," in the April issue of the *DEC PROFESSIONAL* indicated that "DEC has a good chance of becoming the number two player in personal computers." I think he missed the point that even though Apple has been weak in the office automation market as a whole, they are strong on human interface, which is a strong factor in office automation expansion. He also missed the fact that there is a current drive from many areas to make the Macintosh a

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**Dataquest 1985 mid-year terminal shipment update.*

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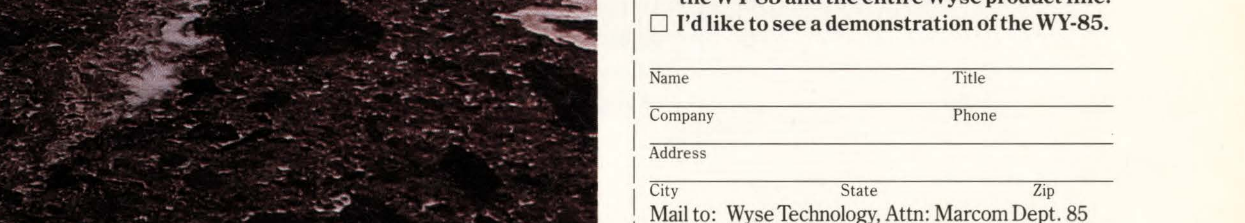

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viable workstation to interact with DEC equipment, thus eliminating DEC's need to produce a personal computer.

As an information specialist familiar with VAX equipment and many microcomputer models (IBM PC, DEC Rainbow, Macintosh, etc.) I would much rather work on a Macintosh than on a Rainbow hooked to the VAX. There are so many things I can do on the Macintosh with so little effort; the productivity is very high.

For example, programs like MacMoney, by Survivor Software Ltd., which is a financial record keeper and financial planner, provide great organization.

I think overall, DEC has quite a way to go before overtaking Apple in the personal computer field.

Kathy Farmer
Inglewood, California

SECOND THOUGHTS

I was going over some back issues of the *DEC PROFESSIONAL* recently, and R.D. Mallery's editorial from April 1985 (Vol. 4, No. 4) jumped out at me. It knocked the IBM PC/AT as another instance of IBM's "sell[ing] bigger and faster machines to run inefficient software at acceptable speeds."

Well, it's a year later. One of my clients is very seriously thinking of upgrading his VAX-11/750s so that they can run the same software they used to run easily under V3.x, under VMS V4.x. In one case, there was just too much retraining of his (noncomputer) personnel involved to allow them to run what looked like a totally different operating system. The other found that his users were complaining bitterly about the falloff in performance.

Has the past year's experience with DEC given you any second thoughts about that editorial? I think they'd be worth another look.

I'd also like some follow-up on why Cluster-11 isn't on the market (*DEC PROFESSIONAL*, May 1985). That device would have provided a solution to another of my clients who's run out of RSTS steam on a PDP-11/70 (up to 56 jobs running) and who dares not even think about RSTS 9.

Phil Anthony
Philadelphia, Pennsylvania

There's no free lunch. Version 4 buys you better security and other improvements, but you pay by executing more code. RSTS V9 is supposed to be like a VAX, but the DCL is too different!

Cluster-11 went public, got its money, and is alive and well. The product slipped about six months.

THANKS

As a Rainbow 100 owner, I want to express my thanks and appreciation for the excellent coverage in the May '86 issue. I especially appreciated the review of *WordPerfect* 4.1 and the helpful information on the VR201 screen.

Bob Wendel
La Puente, California

NOTICE

Shortly after publication of my review, "Rainbow Clock Boards," on page 66 of the June 1986 issue (DEC PROFESSIONAL, Vol. 5, No.6), the pre-production evaluation version E87 Clock Board experienced a loss of battery backup clock function. The 8087 and memory expansion function were not affected. The clock board was returned to the manufacturer for analysis. According to Rainbow Data Systems, this evaluation unit experienced premature battery depletion, a potential problem which has been remedied prior to the issue of final production boards.

—R.B. Trelease, Ph.D.

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PERIPHERALS

SORT

By Raymond J. Schnorr, Jr.

Performance Advantages of Peripheral Hardware Sort/Merge.

Sorting data is a mundane, but commonly required, task that consumes CPU and I/O resources, severely degrading system performance for all interactive processes. Many of the performance problems associated with database management, transaction processing, CAD/CAM/CAE and text processing relate to the sorting bottleneck.

Recently introduced specialized hardware now enables sort-intensive tasks to be off-loaded from the host. Here we will review the relative performance benefits of peripheral hardware sorting, with specific benchmark results against the DEC Sort/Merge utility in VMS operating system, version 4.2.

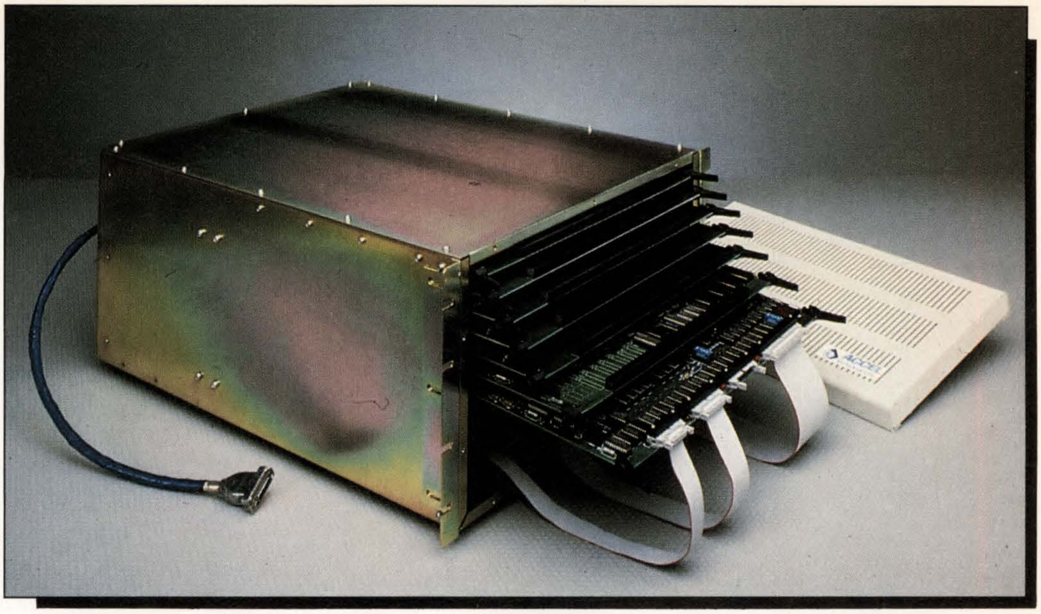
SORT. It is indeed a four-letter word in the vocabulary of data processing professionals. The task of putting data in an orderly fashion is a relatively simple one, comparing one byte to the next, storing away the result. Yet, in practice, this job quickly will consume enormous chunks of CPU, memory, and I/O resources, degrading system performance not only for the requesting culprit, but all other interactive users as well.

Practically all work goes faster, from interpreting scientific experiments to cutting payroll checks, if the pertinent information is represented in meaningful order. The poor performance of most software sort programs often can override the benefit of having ordered data. Therefore, avoidance of sorting, particularly during the day, is sought at all costs. Elaborate indexing schemes are used to avoid sorting, with a price paid to maintain those indices during transaction processing.

A dozen years ago, computer scientist Donald Knuth noted in his book, *The Art of Computer Programming, Vol. 3: Sorting and Searching* (Addison-Wesley Publishing Co., Reading, Massachusetts, 1973), that an average computer spends 25 to 50 percent of its cycles rearranging data. An individual with considerable data processing experience once told me that he never sorted; rather, he used the "order by" facility in SQL. Of course, the system sorts when performing the "order by," as it does when building indices, creating a relational join or projection, inverting a matrix equation, and generating data for a plotter.

The potential benefits of speeding up the sort are great, both in freeing up the host computer for other, perhaps more important, work and in terms of the actual wall clock time it takes to complete a task. In database processing, an improved sort capability means faster loading of databases, modifications of tables, reconstruction of indices and, of course, quicker sorting for queries and reports.

SOFTWARE PROGRAMS THAT SORT data are offered as utilities in the operating system, as separate packages available from third-party vendors, or as proprietary programs running



The DBA 1000 Database Accelerator is enclosed in a 10.5-inch rack-mountable chassis, with all circuit cards accessible from the front.

beneath applications such as database management systems. The best sorting algorithms sort data in N LogN operations for quantities of data that can be contained in main memory, and approach N^2 operations when work strings are written to disk and subsequently merged.

The Sort/Merge utility typically is a shareable resource, performing multiple sorts concurrently. A wide variety of features usually is supported, including sorts on multiple keys, numerous data types, ascending/descending sorts, record or file interfaces, and sort statistics, to name a few. Most sorts require one to two times the file size in disk capacity for scratch space.

The performance of the software sort as measured in CPU time is dependent on the number of items being sorted and the instruction speed of the host. Wall clock performance, on the other hand, depends on a wider range of circumstances: the number of users on the system, the fragmentation of the host disks, the allotted working set size, the process' priority, and so on. Software sorting normally is I/O bound.

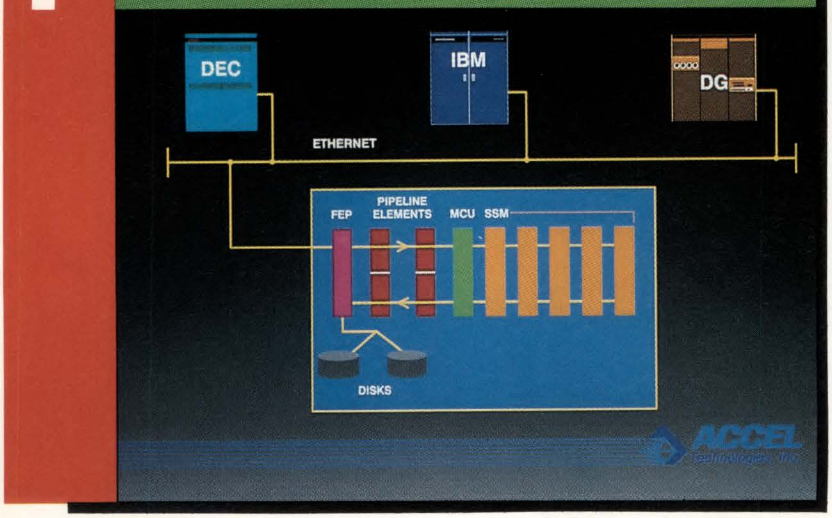
The hardware sorting engine is a combination of logic elements and memory (both RAM and scratch disk) dedicated to data ordering. Taking the approach that all cycles are not created equal, specialized hardware running tailored microcode can attain tremendous performance results at relatively low cost. The floating point accelerator provides a good commercial example of a specialized peripheral processor. (See Figure 1.)

The hardware sorting engine performs a zero time sort, ordering data with input and output so that total time is relative to the number of bytes being processed. With sorting time linear and proportional to N, the performance advantage over software sorting becomes much greater as files grow larger. (See Figure 2.)

Interface software on the host is designed to be transparent to the user and his data processing application by redirecting calls intended for the Sort/Merge utility, sending them instead to the sorting engine. The peripheral either completes the task, or if unable to do so, calls back upon the host Sort/Merge function. If the database application calls an internal sort, a proprietary interface to the hardware is required.

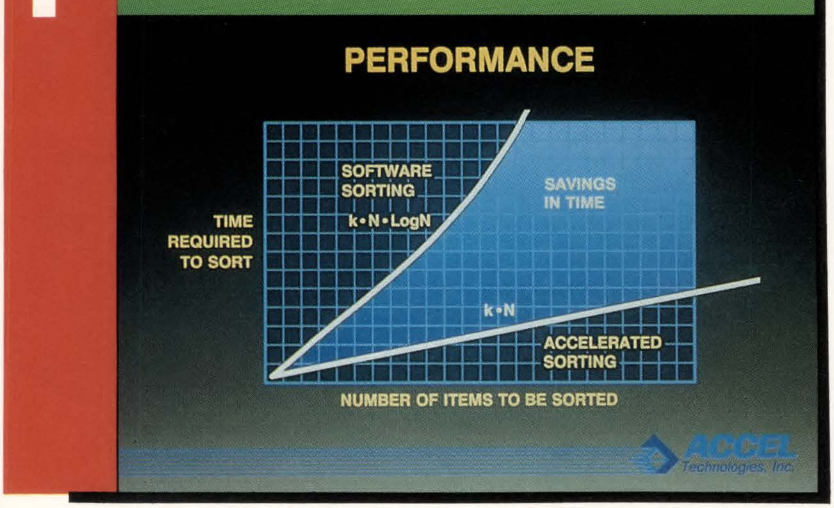
With its fast processing capability, the performance of the hardware sorting coprocessor is governed by how fast data is delivered from the host, and by how much

FIGURE 1.



The DBA 1000 Database Accelerator is depicted here attached to an Ethernet that someday could include VAXs, DGs and IBM mainframes, all sharing the accelerator's capabilities. Inside the DBA 1000 are the FEP (Front-End Processor), the MCU (Memory Control Unit) and up to five SSM (Self-Sorting-Memory) modules. Additional capabilities are possible with the addition of Pipeline Processors, now under development.

FIGURE 2.



For software sorts that can be contained in memory, time is proportional to N Log N operations. If scratch strings are written to disk, the curve becomes much steeper. A hardware sorter allows sorting time relative to N, so that 10 times as much data takes just 10 times longer.

preprocessing is required to translate the records into a byte stream that the special logic compares.

THE SOFTWARE SORT/MERGE utility typically is a collection of modules that perform the following tasks:
A. Read a file (or get a record from a program).
B. Sort the data in memory, write work strings to disk.
C. Read work strings from disk and merge.
D. Write sorted file (or return a record to a program).

These functions correspond almost directly to the VAX Sort/Merge entry points of SOR$BEGIN_SORT,SOR$PASS_FILES, etc.

The hardware sorting alternative performs as follows:
A. Read a file (or get a record from a program).
B. Pass data to the sort engine.
C. Receive data from the sort engine.
D. Write sorted file (or return a record to a program).

Since the use of a peripheral coprocessor for sorting still requires obtaining the original data and passing back the sorted result, the performance gains are made by having a faster processor performing fewer comparisons and by eliminating intermediate I/O to host disks. Again, the scratch space for the hardware sorter is contained within the peripheral system unit.

To measure the relative performance benefits of sorting in hardware versus software, a series of benchmarks was conducted at a university in California. Random data was sorted on a VAX 11/780 with 8 MB of RAM and over a GB of disk. The shared image version of the DEC-supplied Sort/Merge utility running under the VMS operating system, Version 4.2, was used to obtain the software sort statistics.

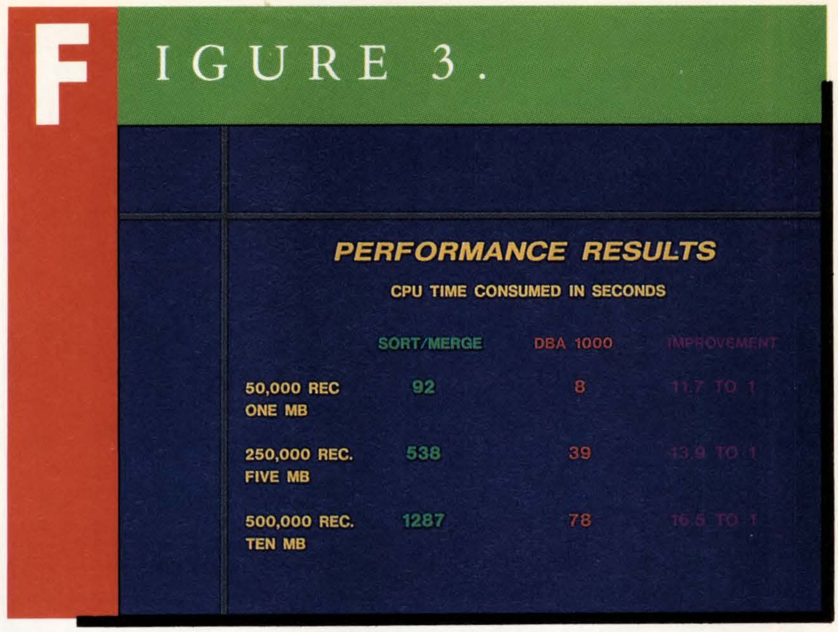
> The DBA 1000 was configured with 3 MB of "self sorting RAM" . . .

THE PERIPHERAL HARDWARE sorting engine used was the DBA 1000 Database Accelerator manufactured and sold by Accel Technologies, Inc., of San Diego, California. The DBA 1000 was configured with 3 MB of "self sorting RAM" and 108 MB of "extended sorting disk memory," which the sorter uses for scratch space. The hardware connection between the DBA 1000 and the host computer, which again was the same VAX 11/780, was via the Ethernet local area network.

For CPU time, the DBA 1000 ran from 11.7 to 16.5 times faster than VAX Sort/Merge, indicating that 91 to 94 percent of the cycles previously spent sorting were eliminated with the peripheral sorting engine. (See Figure 3.) The standard deviation between the samplings was relatively small for CPU time as compared with wall clock time.

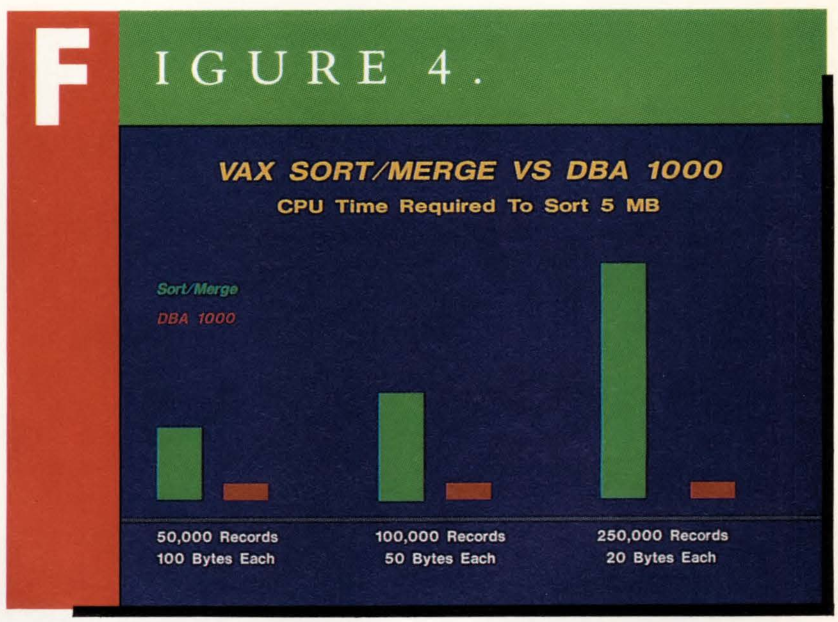
Measuring the relative performance of two sorting techniques with respect to how much wall time they take, is dependent on a wide variety of circumstances, as noted above. For this test the user load was varied from two (almost unloaded) to 25, and the working set was varied for Sort/Merge from 400 to 2000 blocks. Record sizes varied from 20 to 100 bytes, and file sizes ranged from 10,000 to 500,000 records. Under these conditions, the DBA 1000 averaged 2.2 to 7.3 times faster than VAX Sort/Merge.

The effect of record size and the number of records sorted is exhibited in Figure 4. For 5 MB of data, the DBA 1000 consumed nearly identical CPU time, regardless of record length. This is because the performance of the sort engine is bound by I/O, or how data can be delivered. The performance of Sort/Merge, on the other hand, is bound by how many comparisons it must perform, or the number of records to be sorted. The shorter the



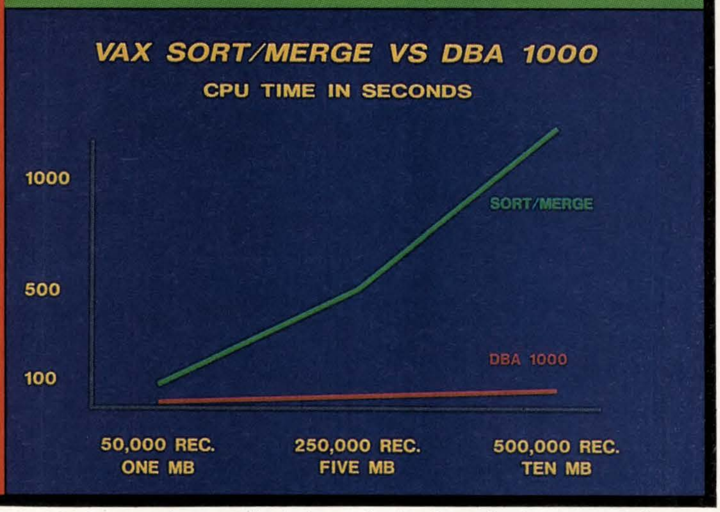
	SORT/MERGE	DBA 1000	IMPROVEMENT
50,000 REC ONE MB	92	8	11.7 TO 1
250,000 REC. FIVE MB	538	39	13.9 TO 1
500,000 REC. TEN MB	1287	78	16.5 TO 1

The DBA 1000 frees 91 to 94 percent of the VAX cycles that would have been spent sorting.



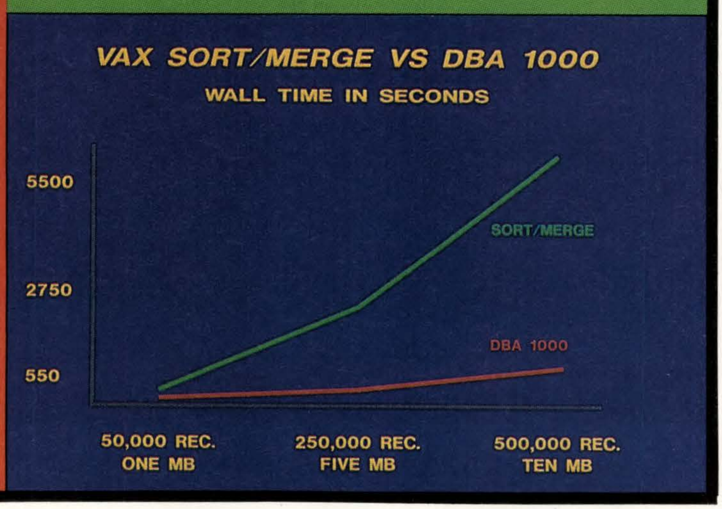
The CPU time required to sort in software is relative to the number of records processed, whereas with the hardware sorter, CPU time is relative to the number of bytes processed.

FIGURE 5.



The DBA 1000 can substantially lighten the load on the host CPU for sort-related data processing tasks.

FIGURE 6.



As the file size grows, so does the advantage of the DBA 1000 over traditional sorting.

records, and thus the greater their number, the longer VAX Sort/Merge takes. Accordingly, the relative benefit of the sort engine is more apparent with shorter record lengths.

The trends for the relative performance advantages over various file sizes for CPU time and wall clock time are displayed in Figures 5 and 6 respectively.

The benchmarks provided were intended to support the thesis that a specialized high performance and relatively low-cost peripheral effectively could offload the host of its sorting burden. To that extent, the tests are conclusive, though more research is needed.

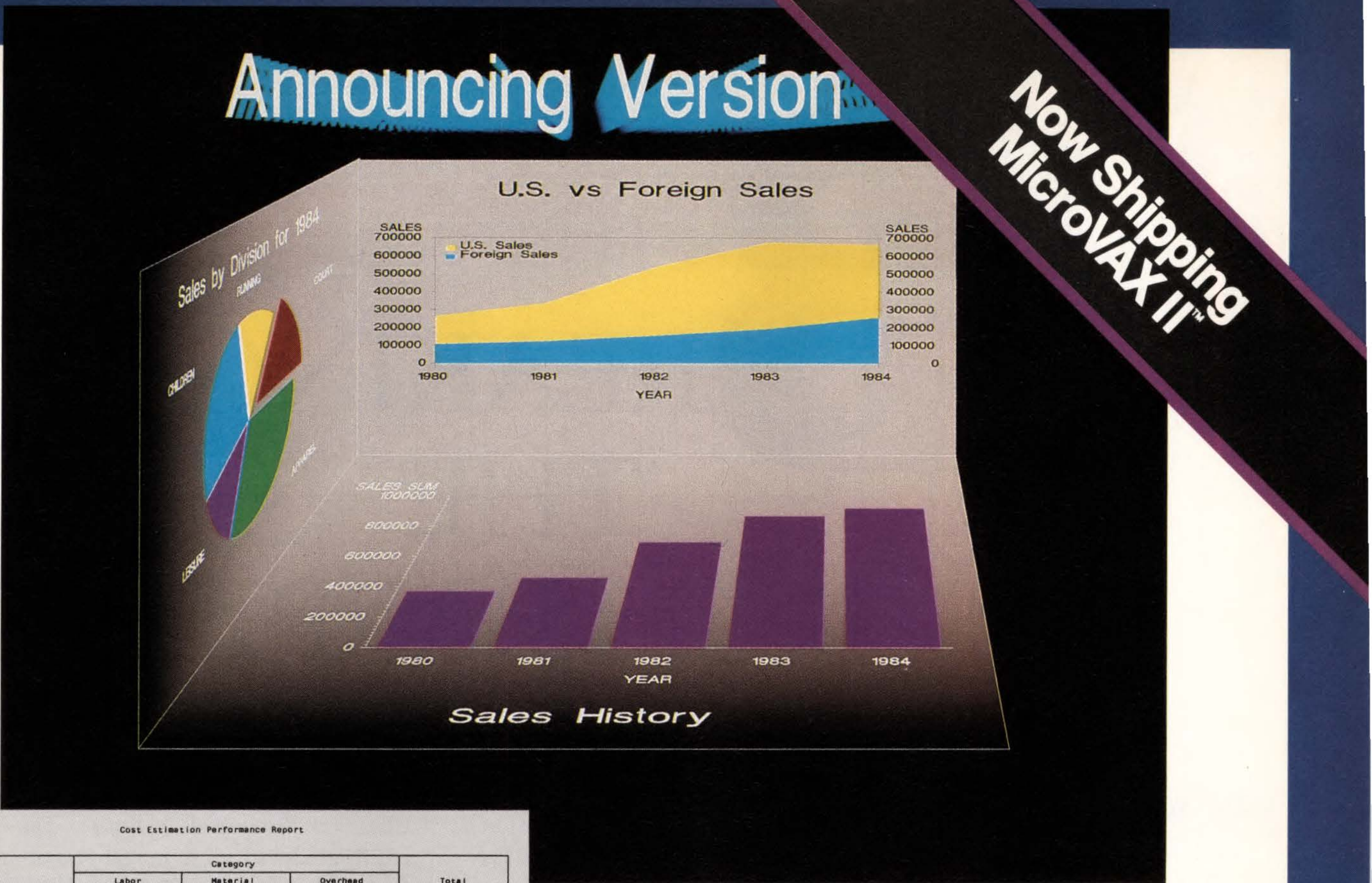
Any test conducted on a multiuser, multitasking machine like the VAX is likely to be difficult to evaluate unless it is a completely unloaded machine. Yet, there are very few single user VAX 11/780s out in the real world, and fewer still completely dedicated to sorting. The advantage of a peripheral coprocessor is greatest when there is a multitude of demands placed on the host CPU.

The wall clock time advantages of the peripheral sorter allow the data processing professional to discontinue the practice of sort avoidance at all costs. The design and use of databases easily can be changed to take the greatest advantage of this new tool.

The CPU savings that the sorter provides could allow the use of a much smaller host machine to handle jobs that previously were placed on mainframe class machines.

The peripheral coprocessor sorting engine joins its predecessors — floating point accelerators and specialized simulation engines — as a cost effective answer to solving data processing's performance bottlenecks.

Ray Schnorr is vice president of marketing for Accel Technologies, Inc., San Diego, California.



Cost Estimation Performance Report

Estimator	Job	Labor Estimate in $1,000s	Labor Cost in $1,000s	Material Estimate in $1,000s	Material Cost in $1,000s	Overhead Estimate in $1,000s	Overhead Cost in $1,000s	Total Estimate in $1,000s	Total Cost in $1,000s
Barbour	2618	549	538	715	763	101	103	1,365	1,404
	2635	619	624	312	298	82	81	1,013	1,003
	2645	589	581	425	423	86	85	1,100	1,089
	2695	119	124	98	103	18	19	235	246
	All Jobs	1,876	1,867	1,550	1,587	287	288	3,713	3,742
Murphy	2647	149	144	267	254	32	30	448	428
	2651	748	727	538	523	109	106	1,395	1,356
	2665	836	794	345	353	106	102	1,287	1,249
	All Jobs	1,733	1,665	1,150	1,130	247	238	3,130	3,033
Richards	2620	459	483	635	663	87	91	1,181	1,237
	2630	272	246	547	536	62	59	881	841
	2640	632	601	741	698	111	105	1,484	1,404
	2670	239	227	394	347	49	45	682	619
	2680	317	322	296	201	50	45	663	568
	All Jobs	1,919	1,879	2,613	2,445	359	345	4,891	4,669
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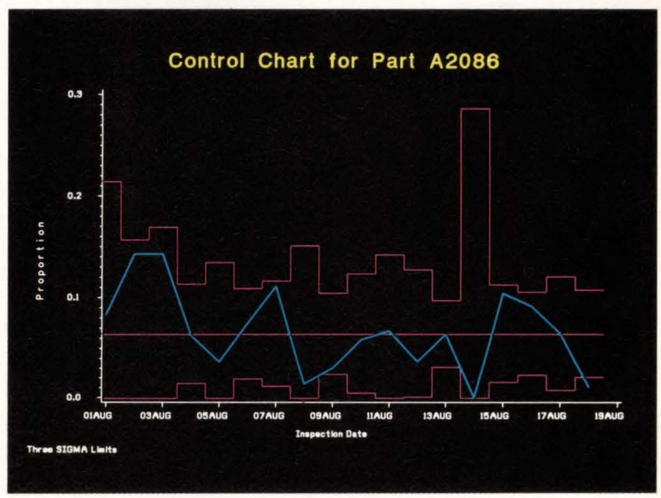

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PERIPHERALS

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By Mike Presbyndowski

Using System Industries' Disk Cache Processor.

The Wilbur Ellis Company's Northwest Division has just run out of resources again. Having purchased a second VAX 11/750 CPU and DECnet Ethernet, system growth has caught up with and passed the current capabilities of the configuration. Users had been complaining of poor response even though they had a dedicated 11/750 configured to run their online applications and all the in-house processing had been moved to the second 11/750. Then, System Industries (SI), the Milpitas, California-based company broke through the disk performance barrier with the Disk Cache Processor.

Wilbur Ellis' Northwest division is one of the largest agricultural retailers in the world. Its chemicals, feed products, fertilizers and worldwide commodity trading provide complete support for the agricultural industry. Some of the most highly trained and respected people in the field are employed by the company to assure the proper use of the products offered.

AUTOMATING THIS COMPANY presented quite a challenge. The central accounting office is located in Seattle, Washington, with online branches located in four Northwest states and total branches covering seven states. Twenty-five remote locations are connected through 47 terminals to a multiplexed leased-line network. A dedicated VAX 11/750 runs a custom order entry, inventory and reporting package that was developed in-house. The VAX is configured with eight megabytes of memory, four Able VMZ 32s (that supply connection for a total of 48 terminals), two System Industries 9900 controllers and three 9722 Fujitsu 160-MB disk drives. All in-house accounting such as AR, AP, GL, financial reporting and Digicalc, takes place on the second 11/750 equipped with a System Industries 9766 300-MB removable disk drive and a 472-MB Fujitsu Eagle. Thirty-two terminals can be attached through three Able VMZ 32 terminal controllers, and the computers communicate using DEC DEUNA Ethernet interfaces and DECnet. Batch jobs execute every night to move the day's sales information from VAX 1 to VAX 2 for completion of the accounting cycle.

The data processing problem Wilbur Ellis faced was the direct result of underestimating the impact of automation on a company that had no previous experience with online computers. While the Northwest division was ramping up the project, projections were made to have no more than two terminals in every branch. The initial plan simply was to replace the current in-house IBM System 34 that assisted the office personnel in their accounting, with a total automated online accounting system that would speed the flow of information from sales through the billing process. Quickly, it became apparent that the rule of two terminals per branch would be broken. Once the branch users caught on to the idea, the DP department was swamped with requests to expand the system concept and incorporate much more sophisticated concepts, such as customer tracking and sales reports that involved heavy database activity. The VAX CPU quickly became an overworked database processor.

THE STANDARD RULES of system expansion had been followed: Add lots of memory, create as many data paths to the databases as possible, use the most efficient peripherals as can be acquired, and tune the software to assist the hardware whenever possible. While DEC had introduced its much-touted HSC50 series of disk drives, the cost of replacing all of our current disk equipment was astronomical, reports of reliability problems plagued this expensive subsystem, and performance reports were conflicting at best. System Industries had been our disk supplier since the first stage of expansion two years earlier and we had a good feel for their reliability and support. They knew we had the classic case of disk bottleneck and were quite eager for us to install their new product, the Disk Cache Processor. Having had quite a bit of experience with microcomputers and the caching found in some of the small operating systems, I knew the benefits to be gained through such a device. We had tuned our VAXs to perform quite well using the built-in caching of the VMS operating system. We easily could measure the efficiency of the system cache through the monitor utility and by analyzing the active system and observing the requests queued up to the disk drives.

Wilbur Ellis' business is seasonal due to its agricultural market. During the height of the busy season, branches literally could enter over 1,000 orders a day; but, in the winter months, there may not be more than a dozen sales per week. While an 11/780 might solve that problem during the busy season, it would be overkill for a company the size of Wilbur Ellis. The monitor utility clearly indicated we

We were incurring overhead from some source that wasn't easily visible to us.

had more than enough CPU capacity, but we simply couldn't satisfy our users' requests for data fast enough.

VMS documentation (the familiar diagram from page 1-10 in the *Guide to Performance Management*) indicated what we already had suspected. We were at the part of the curve where we were getting diminishing returns for our tuning efforts. Clearly the VAX by itself could not help us get more performance. We had reduced paging and swapping to the point where the system simply was timesharing, increased the VMS caching capacity to maximum values, and had the database activity spread across two high-speed disk drives on separate controllers. Secondary paging and swap files were implemented along the RMS global buffering of major files. The database files were optimized nightly to minimize access time. The application was installed shareably along with other less significant tuning changes. On paper we easily should have been able to support our users with our hardware and software, but we obviously had overlooked one important factor: We were incurring overhead from some source that wasn't easily visible to us. The first clue was an exceptionally high instance of kernel mode processing. Other indicators showed processes waiting for disk I/O requests to complete, and not much CPU time spent in user mode, but a high degree of null processing.

Enter the Disk Cache Processor (DCP). The disk drives we had were considered to be some of the fastest on the market, with 24 millesecond average access times, but the DCP promised an increase of disk speed by a factor

FIGURE 1.

	With DCP	Without DCP	Improvement
SEQUENTIAL file write test			
1024 byte records	00:00:16	00:00:17	5.9%
512 byte records	00:00:03	00:00:03	0%
256 byte records	00:00:03	00:00:04	25.0%
SEQUENTIAL file read test			
1024 byte records	00:00:05	00:00:08	37.5%
512 byte records	00:00:02	00:00:03	33.3%
256 byte records	00:00:01	00:00:02	50.0%
RELATIVE file write test			
1024 byte records	00:02:31	00:02:31	0.0%
512 byte records	00:01:11	00:02:08	44.5%
256 byte records	00:00:48	00:01:22	66.2%
RELATIVE file read test			
1024 byte records	00:00:25	00:00:35	28.6%
512 byte records	00:00:12	00:00:33	63.6%
256 byte records	00:00:11	00:00:25	56.0%
INDEXED file write test			
1024 byte records	00:02:28	00:03:24	27.5%
512 byte records	00:02:30	00:03:22	25.7%
256 byte records	00:02:55	00:04:16	31.6%
INDEXED file read test			
1024 byte records	00:00:26	00:00:37	29.7%
512 byte records	00:00:37	00:01:03	41.3%
256 byte records	00:00:25	00:00:46	45.7%
INDEXED file modify test			
1024 byte records	00:05:04	00:06:42	24.4%
512 byte records	00:03:48	00:06:42	43.3%
256 byte records	00:04:25	00:08:15	46.5%

These tests were performed individually on a VMS system tuned to optimize disk operations without a DCP, and then on a system without VMS caching, but with a disk cache processor.

of 10. We received the DCP directly from California and informed the local office of its presence. The next day a group of SI personnel gave us a visit to install the circuit board in our disk controller. The system was offline for about 40 minutes and, when the computer system was returned to service, the DCP monitor immediately began to show caching activity. After several days of monitoring system performance, we observed cache "hit" rates of 30 to 60 percent and average disk access times (as perceived by the host VAX CPU), of 10 to 17 milleseconds. While these figures indicated much better disk performance, they were not up to the predicted rates documented by SI. We then started to suspect some unfavorable reaction between the DCP and the VMS operating system as it was presently tuned. The decision was made to return to a base-line version of VMS straight out of the box, as released by DEC, and start collecting performance data. The result was a significant increase in disk performance. The system ran so well that we theorized that VMS software caching was reducing the effectiveness of the DCP, so the next suggestion was to mount the DCP-affected disk drives with the VMS caching parameter turned off. The direct effect was a very efficient cache with 60 to 85 percent hit rates and effective disk access times of two to eight milleseconds. These results were more in line with the published figures from SI.

Other than the immediately noticeable results gained from adding the DCP, the VAX actually showed increased performance due to the reduced overhead of not having to administer such a large internal cache and reduced system memory requirements for internal caching which, in turn, increased the available memory to users. The system still had a normal operating system disk on its own dedicated controller and VMS caching to support it.

Since the operating system pages itself to disk and there are repeated requests to load and run images that are part of VMS, and considering that VMS still hasn't grown beyond two MB in size, it was thought that the addition of a second DCP to the system disk controller probably would improve performance further. SI has published a paper discussing possible avenues system tuners may want to explore when optimizing the VAX to run with a Disk Cache Processor. One particularly interesting discussion addresses paging and VMS: the idea that thrashing due to excessive page faults may not be such a bad situation if the DCP is assisting the drive that has the page file. Many VAX system managers will find this radical concept hard to accept.

DEVELOPMENT OF THE CP at System Industries revolves around Steve Adams. About five years ago, Adams developed the concept and implemented it on the PDP-11/05 minicomputer from DEC, but, at the time, the product was not marketable and SI put it on the shelf indefinitely. Adams kept his invention alive until microprocessor technology caught up with his concept. When the Motorola 68000 microprocessor came on the market, he redesigned his caching concept to be a super

FIGURE 2a.

	With DCP	Without DCP	Advantage
Single User Emulation	00:01:38	00:03:15	52.9%
Multiple User Emulation	00:09:39	00:19:07	50.48%
(10 users)	00:09:31	00:19:23	49.10%
	00:10:17	00:19:18	53.28%
	00:09:47	00:19:49	49.37%
	00:08:56	00:20:21	43.90%
	00:09:34	00:20:04	47.67%
	00:09:54	00:20:05	49.29%
	00:09:44	00:19:49	49.12%
	00:09:53	00:19:47	49.96%
	00:09:30	00:19:32	48.63%
Average	00:09:40	00:19:43	49.05%

FIGURE 2b.

	With DCP	Without DCP	Advantage
Multiple User Emulation	00:19:21	00:30:38	63.17%
(20 users)	00:21:41	00:36:06	60.06%
	00:20:03	00:36.00	55.69%
	00:20.22	00:35:58	56.63%
	00:18:37	00:35:49	51.98%
	00:20:02	00:35:48	55.96%
	00:19:18	00:35:49	53.89%
	00:19:09	00:35:43	53.62%
	00:18:59	00:35:32	53.42%
	00:19:09	00:35:22	54.15%
	00:18:40	00:35:10	53.08%
	00:21:03	00:31:08	67.61%
	00:18:53	00:34:57	54.03%
	00:18:45	00:34:17	54.69%
	00:18:43	00:34:29	54.28%
	00:20:15	00:34:54	58.02%
	00:19:45	00:36:24	54.26%
	00:19:30	00:36:25	53.55%
	00:21:11	00:36:33	57.96%
	00:20:12	00:36:19	55.62%
Average	00:19:21	00:35:10	55.97%

FIGURE 2c.

	With DCP	Without DCP	Advantage
Multiple User Emulation (30 users)	00:18:24	00:45:30	40.44%
	00:31:11	00:53:01	58.82%
	00:25:29	00:53.17	47.83%
	00:31:55	00:53.22	59.81%
	00:27.39	00:53:05	57.95%
	00:31:02	00:53:33	57.95%
	00:32:17	00:53:17	60.59%
	00:30:33	00:53:06	57.53%
	00:32:39	00:53:15	61.31%
	00:31:58	00:53.11	60.11%
	00:30:44	00:52:55	58.08%
	00:17:37	00:47:15	37.28%
	00:29:54	00:53:00	56.42%
	00:32:13	00:52:52	60.94%
	00:31:58	00:52:45	60.60%
	00:30:47	00:52:29	58:65%
	00:30:52	00:52:21	58:96%
	00:32:17	00:52:06	61.96%
	00:30:56	00:51:53	59.62%
	00:32:09	00:51:33	62.37%
	00:31:57	00:51:16	62.32%
	00:30:37	00:51:02	59.99%
	00:30:44	00:48:18	63.63%
	00:31:56	00:50:51	62.80%
	00:30:38	00:49:43	61.62%
	00:31:03	00:51:32	60.25%
	00:31:01	00:51:32	60.19%
	00:29:49	00:52:24	56.90%
	00:31:44	00:52:28	60.48%
	00:31:46	00:53:05	59.84%
Average	00:31:19	00:51:39	60.63%

microcomputer dedicated to disk caching. He developed the control program in FORTH, a very compact threaded programming language that really is almost as efficient as assembly language on microprocessors like the 68000. It also allowed him to write certain routines of the control program in assembly language for increased speed. It's interesting that the entire FORTH language kernel resides on the DCP in a 128-KB ROM control store. The original design would have had to be built into a box larger than the 9900 controller it was supposed to support. The current design is on a single circuit board that fits easily into the 9900 controller box without any modifications.

The optional but highly recommended Cache Monitor is the only giveaway to the presence of a DCP installation. It has six readouts that monitor cache performance. Each readout has two types of display: instantaneous performance shown by vertical LED bar graphs, and running average given by LED digital readouts. Categories are:

1. Cache Hit Rate—Measures the frequency of an I/O request found in the cache performance ranging from 0 to 100 percent.
2. Disk Service Time—The I/O response speed of the disk drives connected to the cache as perceived by the host CPU.
3. CPU Speed—Measured in disk requests per second.
4. Write Load—Represented by the formula: (write requests / total requests) * 100. A representation of the percentage of requests that are written to the disk out of the total number requests made by the CPU.
5. Request Length—The number of sectors per disk request.
6. Seek Distance—The number of cylinders the head is requested to move from the last request.

Now VAX system managers can tune their VAXs and their disk cache processors. The performance monitor not only displays the cache's activity, but, through a standard RS-232 terminal connected to the rear of the monitor, menus can be displayed that allow many parameters that affect the DCP's performance to be altered. A system manager who has varying system loads can organize the type of jobs to be run so that he can tune the DCP for optimum performance in different environments. Disk intensive batch jobs could be grouped together during off hours and program development and interactive application processing during normal working hours. These groups each could operate with different DCP parameter values. Adjusting the DCP's parameters does not require rebooting the host CPU for the changes to take effect. It's easy to experiment with the DCP and observe the effects and reverse them quickly if detrimental to system performance. Theoretically, a detached process running on the host com-

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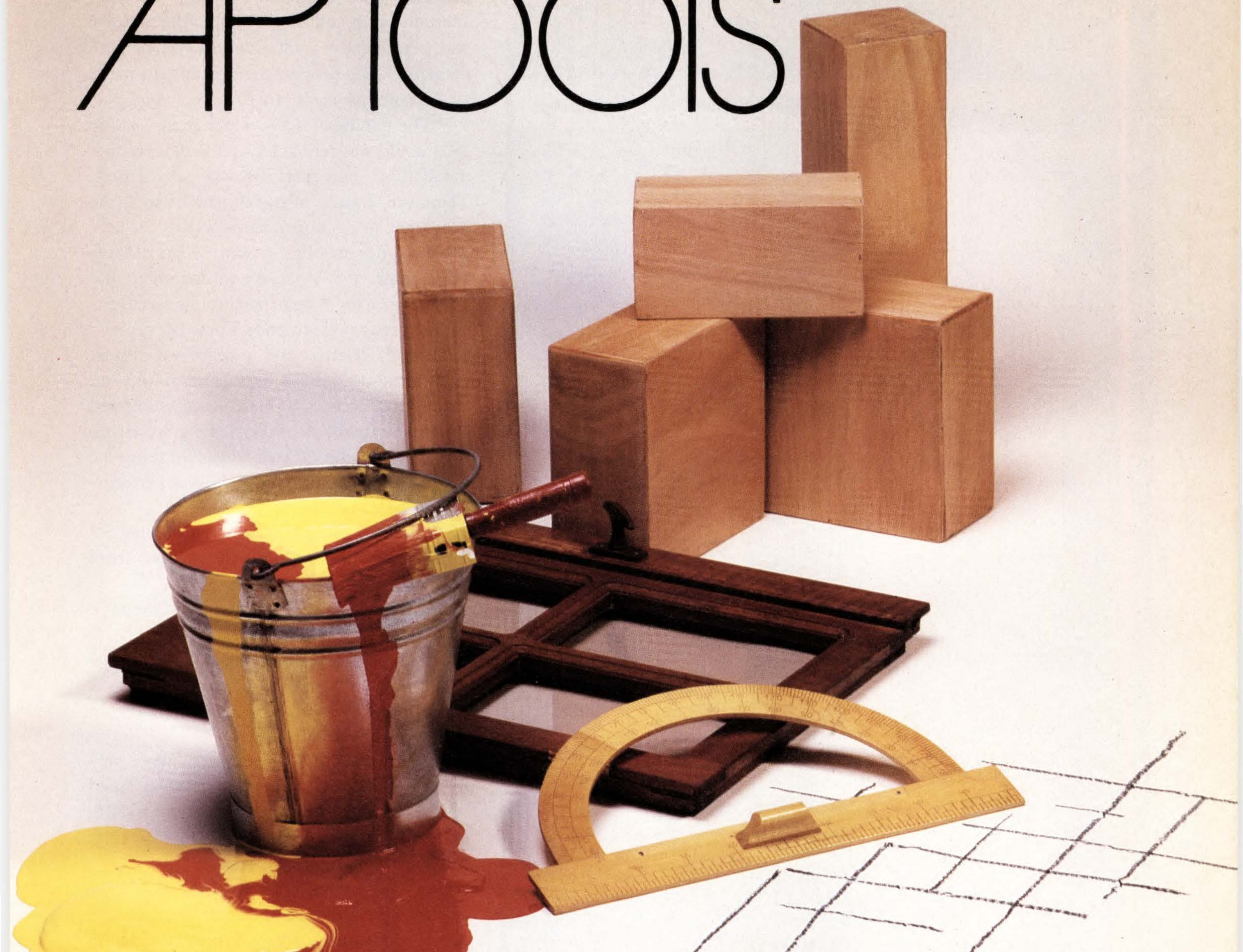

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FIGURE 2d.

	With DCP	Without DCP	Advantage
Multiple User Emulation (40 users)	00:41:20	01:13:51	55.97%
	00:39:04	01:13:52	52.89%
	00:46:15	01:13:13	63.17%
	00:45:52	01:14:26	61.62%
	00:46:50	01:13:53	63.39%
	00:46:27	01:05:40	70.74%
	00:45:13	01:14:30	60.69%
	00:45:00	01:14:06	60.73%
	00:47:23	01:14:06	63.95%
	00:44:19	01:14:29	59.50%
	00:46:37	01:15:26	61.80%
	00:40:50	01:13:34	55.51%
	00:45:51	01:15:26	60.78%
	00:43:05	01:15:29	57.08%
	00:46:40	01:15:53	61.50%
	00:46:47	01:15:26	62.02%
	00:45:19	01:15:38	59.92%
	00:45:58	01:15:40	60.75%
	00:46:16	01:15:06	61.61%
	00:44:53	01:15:23	59.54%
	00:46:24	01:15:34	61.40%
	00:45:25	01:15:20	60.29%
	00:44:16	01:13:58	59.85%
	00:44:21	01:15:15	58.94%
	00:44:02	01:15:37	58.23%
	00:47:05	01:15:27	62.40%
	00:46:24	01:15:23	61.55%
	00:46:33	01:15:33	61.61%
	00:46:05	01:15:27	61.08%
	00:45:25	01:15:28	60.18%
	00:44:59	01:15:37	59.49%
	00:46:26	01:15:51	61.22%
	00:44:54	01:15:26	59.52%
	00:41:26	01:13:33	56.33%
	00:45:11	01:15:19	59.99%
	00:42:23	01:13:57	57.31%
	00:40:57	01:13:57	55.38%
	00:38:38	01:13:53	52.29%
	00:44:29	01:14:19	59.86%
	00:42:56	01:14:28	57.65%
Average	00:44:42	01:14:37	59.92%

puter could be used to control a DCP through a terminal port connected to the cache monitor and periodically could sample system performance. The process then could adjust the DCP to provide optimum system throughput.

The purchase of a product as new as the DCP could not rely solely on verbal recommendations and performance speculation. Therefore, a suite of benchmarks had to be developed to document the worth of the new device. Since the file system of the VAX is directly affected, it is easy to document any performance improvements through basic tests of file system performance. Three file types—sequential, relative and indexed—are most commonly used. Read, write and modify are the types of access that data files are subjected to. Three categories of disk testing were performed to quantify the advantage of using the disk cache processor to improve disk performance. The categories were:

1. Sequential file access (read and write)
2. Relative (or random) file access (read and write)
3. Indexed file access (read, write and modify).

Each category implemented the same program, but with 1024-byte records, 512-byte records or 256-byte records. Variable record length files were not tested.

The tests shown in Figure 1 were performed individually on a VMS system tuned to optimize disk operations without a DCP, and then on a system without VMS caching, but with a disk cache processor.

A FINAL TEST was developed that simulated the actual application activity. Typical user action is described as follows: The user requests a customer number from the customer file, scans forward several records then enters the next module of the program to select items from the stock file with parallel access to the product master file, and scans forward again for several more records to the item desired. The item selection process is repeated until several products are found. This is a fairly typical point-of-sale process. The completed transaction is stored in data file keyed by invoice number. A program was written that performs the test described above and a command procedure was developed to set up the environment and execute the test. The user emulation then can be run concurrently to observe any performance gains the DCP might add to concurrent database access. See Figures 2a through 2e.

Testing became impossible at numbers higher than 50 due to the capacity of the 11/750. It was tuned to work optimally with 48 users. VMS began to swap processes and page excessively to the point where the DCP was of no advantage. A fellow DECUS member and friend who was operations manager of a large VAX installation with two 11/780s and one 11/785 clustered with an HSC50 and several RA81 disk drives, expressed interest in our test and wanted to see how his system would perform running the benchmarks. We ran the tests for 40 users and the average time was 18 minutes. This was very surprising. We suspected the performance would be comparable, but not 40 percent faster. The times for 50 and 60 users did not increase. On the surface, the 780 and HSC combination would seem to be much more efficient, but the real performance advantage seems to be in the increased capacity of the CPU to handle many processes; i.e., context switching. This is the real limit to the VAX 11/750.

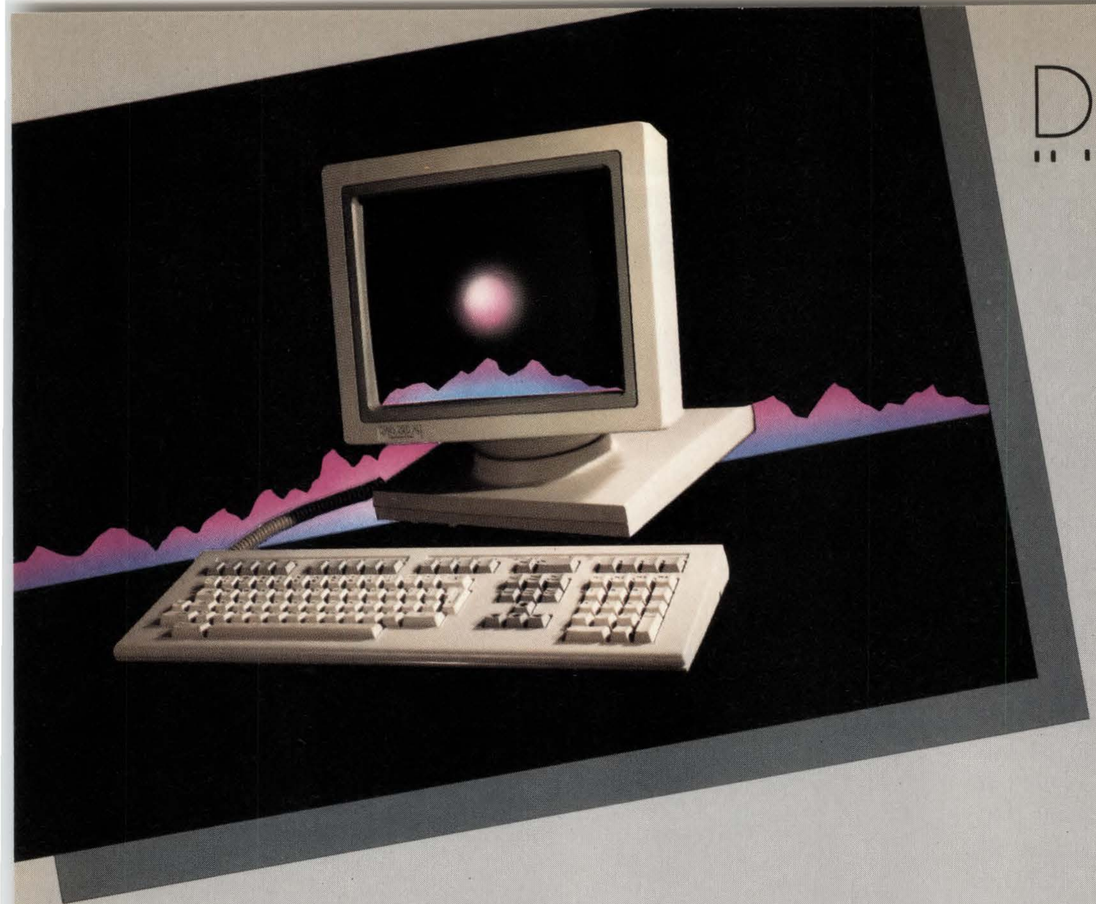
Proper system configuration can assure computing performance, and tuning must be used to get the most efficiency from a VAX; but in the cases where heavy database activity is the primary function, the DCP, as shown, can offer the highest increase in throughput available.

The Disk Cache Processor has opened new possibilities for DEC minicomputers. But System Industries is planning for the future, with DCP memory expansion to eight megabytes and support for MICROVAXs. It will assist the already popular SIMACS disk sharing product, making it perform more efficiently. The much-rumored SI-LINK clustering product should benefit greatly from the improved disk speed and efficiency made possible with the DCP.

Mike Presbyndowski is a systems analyst at Boeing Computer Services, Seattle, Washington.

FIGURE 2e.

	With DCP	Without DCP	Advantage
Multiple User Emulation (50 users)	00:36:17	02:03:17	29.4%
	00:46:57	02:14:24	34.9%
	00:51:25	02:17:58	37.3%
	00:51:08	02:14:39	38.0%
	00:55:04	02:17:34	40.0%
	00:55:47	02:18:49	40.2%
	00:52:43	02:17:41	38.3%
	00:56:17	02:18:44	40.6%
	00:57:23	02:15:40	42.3%
	00:57:26	02:13:48	42.9%
	00:56:50	02:14:06	42.4%
	01:47:49	02:06:54	85.0%
	00:55:18	02:15:20	40.9%
	00:55:40	02:17:31	40.5%
	00:56:15	02:15:00	41.7%
	00:54:12	02:16:36	39.7%
	00:53:27	02:17:38	38.8%
	00:55:42	02:16:57	40.7%
	00:54:57	02:16:33	40.2%
	00:56:32	02:16:22	41.5%
	00:55:55	02:16:58	40.8%
	00:55:09	02:14:24	41.0%
	00:47:18	02:13:53	35.3%
	00:55:32	02:16:49	40.6%
	00:55:53	02:16:48	40.9%
	00:56:15	01:16:52	41.1%
	00:56:12	02:17:39	40.8%
	00:54:59	01:16:49	40.2%
	00:56:35	02:15:19	41.8%
	00:55:28	02:17:31	40.3%
	00:54:28	02:16:14	40.0%
	00:56:04	02:16:25	41.1%
	00:56:17	02:17:31	40.9%
	00:52:02	02:20:10	37.1%
	00:55:45	02:17:39	40.5%
	00:56:15	02:16:07	41.3%
	00:55:23	02:16:42	40.5%
	00:54:49	02:16:22	40.2%
	00:55:26	02:16:22	40.7%
	00:55:01	02:16:17	40.4%
	00:53:22	02:17:36	38.8%
	00:54:58	02:16:18	40.3%
	00:55:03	02:16:14	40.4%
	00:54:48	02:16:55	40.0%
	00:49:18	02:14:48	36.6%
	00:55:39	02:16:41	40.7%
	00:42:51	02:15:01	31.7%
	00:56:34	02:14:19	42.1%
	00:55:15	02:15:39	40.7%
	00:58:21	02:16:33	42.7%
Average	00:55:17	02:15:58	40.7%



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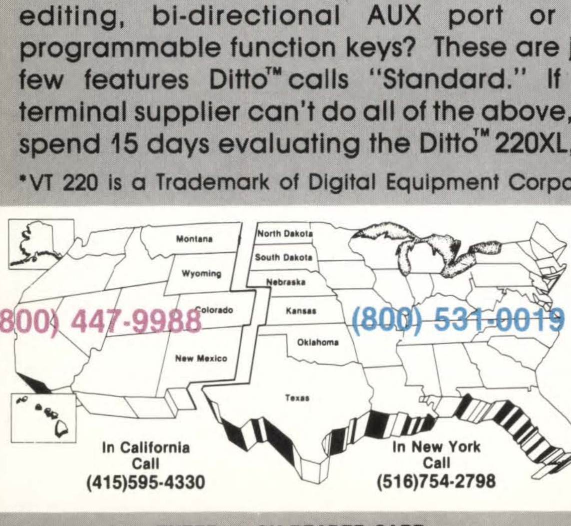

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By Joseph P. Dallatore

A New Fast Food Sandwich? No — An Inexpensive Macintosh File Server for the VAX.

Ever since Apple first sold a Macintosh to a VAX user, there has been enthusiastic interest in integrating the Mac into the VAX/VMS environment. One of Apple's first software products for the Mac was MacTerminal, which was, and still is, among the best VT-100 emulators available for the Mac. For those who require the additional features of a VT-125 or VT-240, MAC-240, by White Pine Software, is one of more recent entries to consider.

The next step on the road to full integration with the VMS environment is the sharing of data between these two very different worlds. Once either machine can use files produced or modified by the other, the Macintosh can serve as a VMS workstation.

The benefits of this arrangement are many and immediate. Busy VMS facilities can offload many routine, but resource intensive, tasks that now burden the system, and the users can perform more tasks in the superior working environment that the Macintosh provides.

CONSIDER THE SINGLE EXAMPLE of text processing. The displaying and editing of text files is a major component of interactive computing. Activities as diverse as program development, document preparation, preparation of input and review of results for many scientific, engineering and statistical packages, word processing, electronic mail, information broadcasting, and many others, are, in essence, on-line text processing. Removing this ordinary activity from a VAX leaves more VAX-power available to do the extraordinary things that VAXs do so well.

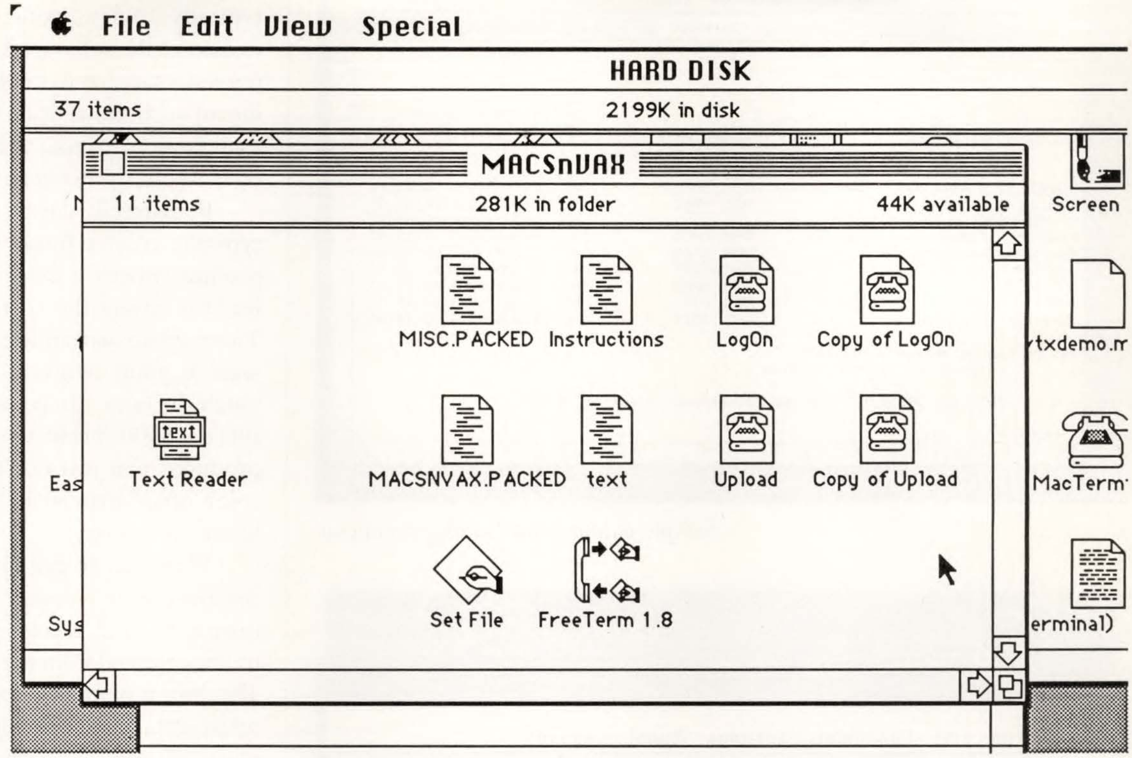
Unfortunately, DEC never has demonstrated much interest in this particular marriage of convenience, directing its efforts instead to the integration of the IBM-PC and clones into the DEC environment. This is clearly demonstrated by DEC's newest product offering to the handmaidens of Big Blue: DECnet-DOS is software that runs on the PC and enables it to join DECnet networks as a nonrouting node.

The fact that DEC now sells software for an IBM product is not too surprising since DEC also sells PCs that run the MS-DOS operating system. And, yes, there are a lot of IBM-PCs out there in corporate America—many in DEC shops. There are a lot of Macs out there too, and their enthusiasts certainly are more eager to bridge the gap to the VMS world than most of the IBM-PC folks ever will be. But, so far, DEC hasn't seemed to notice.

To fill this void, creative Mackers are developing utilities that provide varying levels of integration between Macs and VAXs. Many of their programs are free for the asking in the public domain and can be obtained from the DECUS library or the Macintosh Apple Users Group (MAUG), while a few are being sold as commercial products.

A program called *MACX*, which is on the Spring and Fall 1985 DECUS VAX SIG tapes, is the copyrighted (but free for noncommercial use) predecessor of a product called *MACSnVAX*, written by Daniel P. B. Smith

FIGURE 1.



Contents of MACSnVAX *disk.*

of the Eye Research Institute of Retina Foundation (20 Staniford Street, Boston, Massachusetts, 02114, (617) 742-3140).

MACSnVAX is a VAX program that runs under VMS 4.0 or later. When you use *MACSnVAX* to transfer files, the VAX looks to your Mac like another Mac performing a standard *MacTerminal* file transfer.

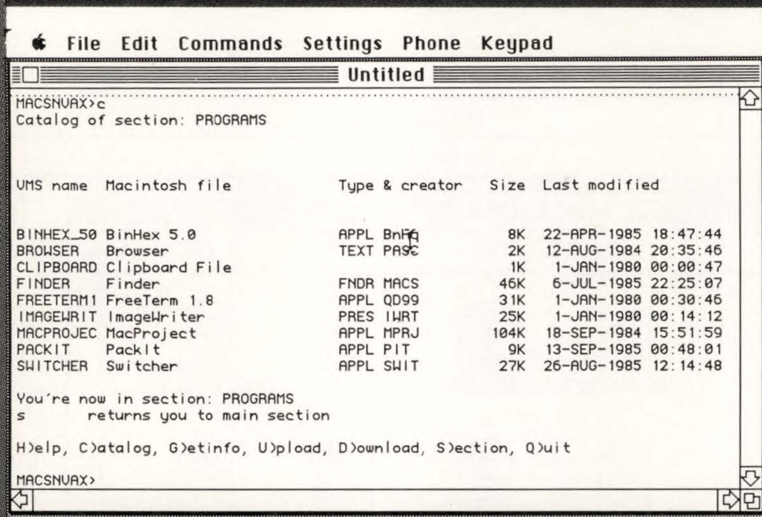
Any Mac can send and receive files from the VAX in exactly the same way that it would with any other Mac, using the typical Mac to Mac file transfer procedures to move files (including binary files!) back and forth between the VAX and the Mac. A Macintosh can receive programs or data files from the VAX, modify them, and send them back to the VAX, where they can be retrieved later by the same or any other Mac.

When using *MACSnVAX* this way, a VAX acts as a "slow" file server for the Macs. It takes about four minutes to transfer this article at 1200 baud. Since *MACSnVAX* accommodates Macintosh binary files, a VAX also can function as a library from which Macs can retrieve software and "live" application data files, like spreadsheet and database files.

A SIGNIFICANT BENEFIT of sharing files in this way is that all those important files previously stored only on rarely backed-up hard disks, now will be backed up as part of your routine VMS data preservation procedures. This ability to store and distribute programs and data, even might eliminate the need for an expensive hard disk in (or under) every Mac in your organization.

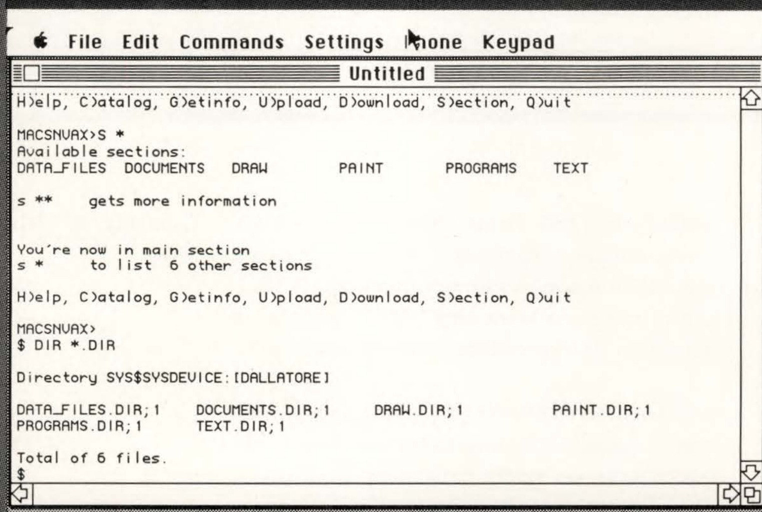
The *MACSnVAX* software is distributed on a single Macintosh disk as "shareware," meaning that while the software isn't free, you can obtain a copy from anyone who has it, for

FIGURE 2.



Sample output from Catalog command.

FIGURE 3.



Comparison of MACSnVAX *"Sections" and the corresponding VMS Directory.*

purposes of evaluation. The specific conditions under which permission to distribute copies of *MACSnVAX* is granted are described in the documentation.

Beyond the evaluation period, typically 30 days, you are asked either to discard the software if you don't find it satisfactory, or to "register" it if you intend to continue using it. You register your copy by paying a fee to the developer, typically between $29 and $99.

Registered users of shareware typically receive future updates of the product either for free or for a nominal fee that covers the cost of the media. There are no warranties; you use shareware at your own risk. This is pretty much the same disclaimer you find inside the $500 shrink-wrapped software products, you just don't get the four-color offset manual in the fancy ring binder-in-a-box.

What you do get, in this case, is the complete source code, extensive documentation, and a collection of related utilities gleaned from the public domain. This "try it before you buy it" method, while popular in the micro world, is a novel distribution technique for VAX software. A *MACSnVAX* license is expensive for shareware, at $150 for a single node, or $300 for a network or a cluster, but when you consider the number of Macs that can benefit from a single copy, the per-Mac price is nominal to many organizations.

The contents of the *MACSnVAX* disk is shown in Figure 1. The only essential file on the disk is MACSNVAX.PACKED which contains the text of a DCL command procedure also called by the same name. You can transfer this text file to a VAX using *MacTerminal*'s SENDFILE TO . . . option, or any other method you may have for transferring text to a VAX.

WHEN EXECUTED, the command procedure creates several VMS files containing FORTRAN source code, data tables, and DCL command procedures,

> The *MACSnVAX* command environment includes a fairly complete on-line help library that is accessed using the traditional command, HELP.

including one to compile and link the source code (which means that you must have a FORTRAN compiler in order to complete the installation).

An example command procedure is supplied that installs MACSnVAX.EXE in SYS$SYSTEM as a privileged image, but not as a shared image. Perhaps this is an oversight. If you anticipate a lot of *MACSnVAX* users on your system, you should consider installing it as a shared image. If you install it on a cluster, I suggest you disregard the example procedure and install it in SYS$COMMON, which is where it belongs.

The procedure MACSTRY.COM sets up a VMS user to run *MACSnVAX* on a system that has not installed it. It defines the command and the command help library to the DCL Command Language Interpreter, and defines a few logical names that the utility depends upon.

Installation took about 15 minutes on a 4-MB VAX 11/750, over a 1200-baud line. Sending the software is a little tricky since you must set the VAX terminal attributes to /NOECHO before you start, in order to avoid data overruns. This is because there is no handshaking in *MacTerminal* TEXT transfers. While your Mac is sending MACSNVAX.PACKED, only a single line on the Mac shows any activity, since each line sent overwrites the one sent before it. When nothing seems to be happening anymore, you simply assume that the transfer is finished.

It would be more reassuring if the last line in MACSNVAX.PACKED were something like

```
$!—THIS IS THE LAST LINE OF
MACSNVAX.PACKED.—
```

so an installer would know for sure that the entire file was transferred. Next, the installer must set the terminal attribute back to /ECHO, then enter the command @MACSNVAX.PACKED to continue the installation. When it finishes, *MACSnVAX* is ready for use. The *MACSnVAX* disk includes several *MacTerminal* V1.1 documents with the correct settings for each step of the installation, but since we were using version 2.0, we were unable to use them. The documentation adequately explains the required settings, and anyone familiar with the DCL SET TERMINAL command will have no trouble loading MACSNVAX. PACKED onto his system.

MACSnVAX stores Mac files, in Mac format, in one or more "sections." A section corresponds to a VMS subdirectory. In this article, we refer to a collection of related sections as a "library." Section directories only can be created or deleted using DCL commands, but a *MACSnVAX* user need not know anything about DCL or directories to use an existing *MACSnVAX* library.

Commands operate on the "current" section, which is, in fact, the user's default directory. By setting the default to different "library" directories before starting a *MACSnVAX* session, a user can access many different *MACSnVAX* libraries. You could, for example, maintain libraries containing files that relate to a particular project or working group; others for public domain software, database files, "live" spreadsheets, and so on. VMS file access control features can be used to limit access to libraries and their contents.

THE PROGRAM IS INVOKED by the DCL command $MACSNVAX. Thereafter, *MACSnVAX* commands are used to obtain information about existing sections, to receive a file set from a Mac and store it in a section, to send a file from a section to a waiting Mac, and, in the case of TEXT files, to view or print the contents of a Macintosh file directly to DEC terminals and printers.

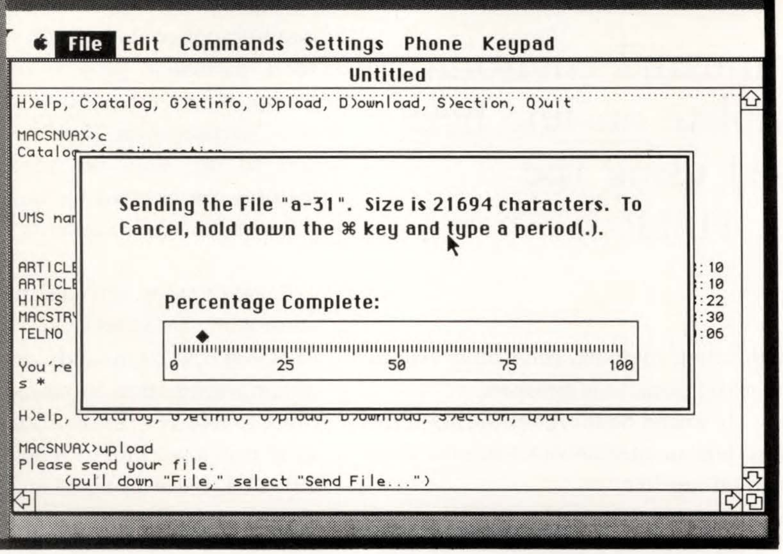
Be forewarned, though: Starting *MACSnVAX* from the wrong default directory could be a heart-stopper.

If your default isn't set to a top-level section directory when you start, *MACSnVAX* appears to have lost the entire library. This isn't a bug, but it sure is a surprise the first time you discover that all those files you KNEW were there have vanished.

The *MACSnVAX* command environment includes a fairly complete on-line help library that is accessed using the traditional command, HELP. Unlike VMS help, though, it doesn't handle more than one word at a time, so you'll have to suffer through the initial help screen every time you need help on a specific command.

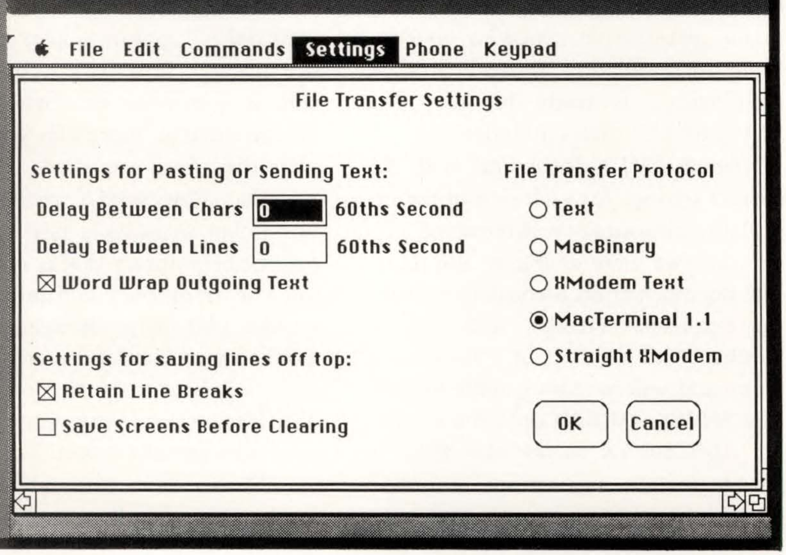
The SECTION command is the primary means of finding your way around in *MACSnVAX*. It is supposed to insulate Mac users who are unfamiliar with DCL, from the complexities of VMS directories and the SET DEFAULT

FIGURE 4.



Example of UPLOAD in progress.

FIGURE 5.



MacTerminal *V2.0 file transfer settings menu.*

command. Unfortunately, the SECTION command itself is complicated and, worse, is annoying to users who are familiar with DCL. Although *MACSnVAX* relies on the DCL Command Language Interpreter to parse its commands, and even has / qualifier options in some cases, the syntax is not consistent with DCL, and the terminology employed often is neither Mac nor VAX.

For example, the command SECTION resets your current section to MAIN (a sort of SET DEFAULT SYS$LOGIN), while SECTION * produces a list of available sections (a sort of DIRECTORY/BRIEF *.DIR), and SECTION ** produces the same display as SECTION * plus the contents of an "annotation" file for each section. The Macintosh term for "sections" is "folders." More compatible command verbs would be terms like OPEN (open folder [folder-name]) and SHOW (show folders, show contents). Fluent DCL speakers would feel more at home with DIRECTORY, DIRECTORY/FULL and SET DEFAULT.

The CATALOG command displays a list of all the files in the current section, including a "type" identifier that tells you what Mac application produced the file.

A related command, GETINFO, displays the same information as CATALOG, plus any existing "description" text stored for each file. If the "type" of a file is TEXT, you can examine the file using the VIEW command. This reads a Macintosh text file stored in a section and displays the contents on any ASCII terminal, real or emulated.

The related commands, IMPORT and EXPORT provide text file conversions from each format to the other, and recognize special qualifiers that control the insertion or removal of carriage returns and linefeeds based on the kind of VMS text file being converted.

These options are necessary because Macintosh text files do not contain a <carriage return/line feed> at the end of every line. With the appropriate qualifier, even RUNOFF source files can be moved back and forth with ease! Imported VMS files are inserted into the current section, and exported Mac files will be found in the VMS default directory as filename.MAC. Since these two places actually are the SAME directory and the file name remains the same, the file type is the key to a file's format.

Things can get very confusing if you don't choose your file types carefully. Assembly Language programmers must be very careful not to confuse these .MAC files with their Macro Definition files.

Macintosh text files can be printed on any system print queue using the PRINT command. MACSnVAX>PRINT converts the contents of a .MAC file to VMS format, and submits the result to a printer queue, all in one step.

THE HEART OF *MACSnVAX* is a FORTRAN program that "speaks" two languages; The *MACSnVAX* command language, and the file transfer protocol that *MacTerminal* uses (an Apple-specific variation of the *XModem* protocol). Transferring files is accomplished using the UPLOAD and DOWNLOAD commands. When you enter one of these commands, *MACSnVAX* stops speaking the command language and begins speaking *MacTerminal* V1.1, so your VMS session now looks to your Mac like just another Mac running *MacTerminal*. When the file transfer completes, *MACSnVAX* shifts back to command mode automatically.

From the Mac side, using *MacTerminal*, files are transferred by clicking either the SEND FILE or the RECEIVE FILE option on the FILE menu. Depending on how you set up the *MacTerminal*'s file transfer options, files are transferred in ASCII or binary form in one of the several incompatible variations of *XModem*.

The VAX side of the file transfer operation, however, is rather unforgiving of errors and is not nearly as simple. The primary problem is terminology. To initiate the VAX end of a transfer operation, the command UPLOAD or DOWNLOAD is given at the MACSnVAX> prompt. Next, you click on the appropriate Mac option to send

> The Macintosh world is very egalitarian; there is no up or down. One Mac sends, the other one receives...

or receive the file. So, which Mac menu choice corresponds to which *MACSnVAX* command? *MACSnVAX* considers a Mac to be down-line from the VAX, so DOWNLOAD means "send-file-to-a-Mac" and UPLOAD means "receive-file-from-a-Mac." Once you enter the command, you are told which option is appropriate, but if the VAX actually was another Mac, as it is pretending to be, there simply wouldn't be any of this "DOWNLOAD is for receive, UPLOAD is for send" confusion.

THE MACINTOSH WORLD is very egalitarian; there is no up or down. One Mac sends, the other one receives, and those are the choices on the menu. Most users can figure out that it takes one of each to move stuff from here to there. So, why give them commands like UPLOAD and DOWNLOAD? Why not use the corresponding terms and avoid all the confusion?

The UPLOAD command, once invoked, proved extremely stubborn. Although the documentation says that 10 Ctrl-Xs will interrupt an upload in progress, it didn't work for me in many cases. Even the ultimate interrupt, a Ctrl-Y, didn't work. Hanging up the modem worked. This was especially annoying because *MACSnVAX* encourages you to use single letter abbreviations for commands and it is far too easy for a fumble-fingered user to strike U (update) while going for I (import), and get trapped in an unintended transfer.

I eventually discovered that I get trapped most often when the protocol settings are mismatched. In several cases, I found a MACSNVAX.LOG file containing a thousand repetitions of the highly informative message: inside ttyin, N = 1. Log files aren't even mentioned in the documentation! If you plan to install *MACSnVAX*, make sure that anyone using it is subject to disk quota, or you may find that some patient user, or one who doesn't have a modem to hang-up, has filled your disk with one enormous MACSNVAX.LOG file of mystery messages.

If you send a file to *MACSnVAX* using the same name as a file that is already in the section, the old file is overwritten with the new one without any warning or error message! Since there is no DELETE command, this may be a "feature," but I prefer to receive a warning when about to replace an existing file. If you UPLOAD a file in the wrong section, there is no simple way, using *MACSnVAX* commands, to move it to a different section. A DCL RENAME of the .MAC file works fine, though. Obselete files can be deleted using DCL.

DOWNLOAD was troublesome, too. The system at Computer Methods Corporation defines logical names for certain files that we use often. For example:

```
$DEFINE/SYSTEM PHONELIST
  SYS$PUBLIC:PHONELIST.DAT.
```

allows the use of PHONELIST in place of the actual file specification for any VMS commands that require a file specification.

For example, $TYPEPHONELIST displays the right file, no matter what the current default directory happens to be. The *MACSnVAX* command IMPORT PHONELIST.DAT was used to put a copy of this file into the current section. *MACSnVAX* converted the file to Macintosh format and stored the result in a PHONELIST.MAC.

NEXT, WE TRIED to send the file to a Mac using the command MACSNVAX> DOWNLOAD PHONELIST. The DOWNLOAD command syntax requires that only the name portion of the VMS file PHONELIST.MAC be supplied. Even though PHONELIST.MAC is in the current section, *MACSnVAX* tries to send SYS$SYSTEM:PHONELIST.DAT, and fails spectacularly because the file is not in the expected format; it isn't the right file! VIEW, PRINT and EXPORT experience the same problem.

We hope this will be corrected in a future version. But when using version 4.1, beware of logical names!

Adding a qualifier to the UPLOAD and DOWNLOAD commands simplifies multienvironment text file sharing by avoiding "sections" altogether. UPLOAD/TEXT writes a Mac text file directly to a VMS text file in one operation, and the corresponding DOWNLOAD/TEXT does the reverse, sending a VMS text file directly to the Mac, performing the format conversion step immediately.

Another qualifier, mentioned only in the *MACSnVAX* help files, makes it possible to transfer VAX executable image files to and from a Mac. In essence, a Mac can be a store and forward agent for VMS executable image files. They

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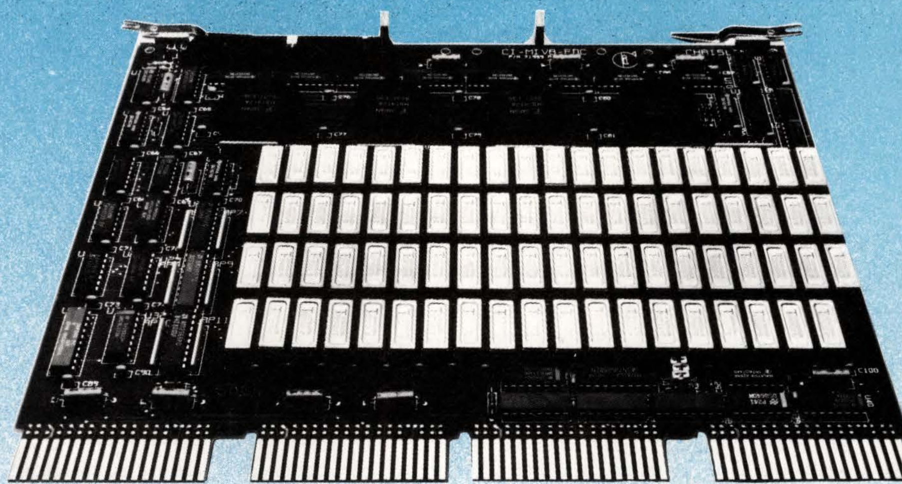

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ENTER 12 ON READER CARD

Maybe someday, DEC or someone clever enough to get DEC's permission will give us the Mac equivalent of DECnet-DOS.

better be *very* small executable image files unless you have a *big* disk in your Mac! This could have some utility if you have to transfer a small binary data file between two VAXs that don't have any other communications link between them, and it certainly would be faster and cheaper than express-shipping a tape containing a one-block data file—a 12-line command procedure that contained escape sequences.

We didn't actually try this option, though, since most VAX installations, including our own, have better and easier ways to do this.

Each of the protocol options is discussed in great detail in the *MACSnVAX* documentation. In fact, there are 26 pages on transfer protocols and terminal emulation programs! Also included is a brief review of the features and limitations of *MacTerminal* V1.1 and V2.0, *Red Ryder* V6.2, *VersaTerm* V2.0, and *Q&D* VT52. Although *FreeTerm* V1.8 is included on the *MACSnVAX* disk and is mentioned in an example discussion in the documentation, it is not included in this feature-by-feature review!

The issues surrounding a choice of protocol are complicated by the fact that Apple currently supports several incompatible variations on *XModem*, and standard *XModem*, too!

There are specific reasons for each variation, and Smith does a good job of explaining the tangled topic to those who care to read all about it. In brief, Apple modified the *XModem* protocol for use in *MacTerminal* V1.1, and calls the result "*MacTerminal* Protocol." But *MacTerminal* also supports the standard *XModem* for binary file transfers, probably because Apple recognized that a lot of bulletin boards did, and would continue to, use it. This is the protocol used when you select "MacBinary" on the file transfer setup menu.

TO FURTHER COMPLICATE matters, Apple modified *MacTerminal* Protocol for *MacTerminal* V2.0, adding Cyclic Redundance Checking (CRC). CRC improves the accuracy of binary file transfers, but also increases the complexity of the operation. But, since there are many existing application programs, including *MACSnVAX*, that use *MacTerminal* V1.1 protocol, Apple couldn't simply replace it in V2.0. So, now, there are three! Any terminal emulator that uses *MacTerminal* V1.1 protocol can swap files with a VAX running *MACSnVAX*.

I am disappointed with the terminology of the command language. With two sets of terminology already established, I don't see the wisdom of yet a third. The *MACSnVAX* command language, while not similar enough to either environment to feel "right," is just similar enough to be confusing. And a command such as SJ** is cryptic computer jargon at its worst! Metacharacters are not user friendly, and what is a Macintosh if not user friendly?

While there are some rough edges, most notably in the handling of logical names, *MACSnVAX* still is a useful tool for bridging the gap between the Mac and the VAX because it does provide an effective method for users who are not familiar with the VMS environment to transport text files between these two systems. Once you learn the ropes, *MACSnVAX* makes it easy to practice cross-system information processing. You can make changes to text files produced by a Mac editor (*MacWrite*, *WORD*) or your favorite VMS editor, simply by converting a text file to the other format, in a single step.

BY FAR the greatest benefit of *MACSnVAX* is in providing a simple means for doing an otherwise difficult task—using a VAX as a librarian/file server for Macintosh binary files. With it, the management and distribution of Macintosh programs and data can be accomplished from within the VMS environment, while Mac users can access the files using procedures that aren't too much more complicated than a standard Mac to Mac file transfer.

Maybe someday, DEC or someone clever enough to get DEC's permission will give us the Mac equivalent of DECnet-DOS. But if you can't wait until then, *MACSnVAX* provides a bargain basement way to bring your Macs and VAXs together in ways that go well beyond mere terminal emulation. You can use your Mac as a workstation for some VMS text processing tasks, and you can use your VAXs to store and distribute Macintosh programs and data. In addition, you can do all of this today! While it isn't the "DECnet for the Macintosh" so many Mac owners dream about, *MACSnVAX* can make the wait a little less frustrating. And, right now, it looks like it's going to be a LONG wait!

Joseph P. Dallatore is a senior software engineer with Computer Methods Corporation, Marlton, New Jersey.

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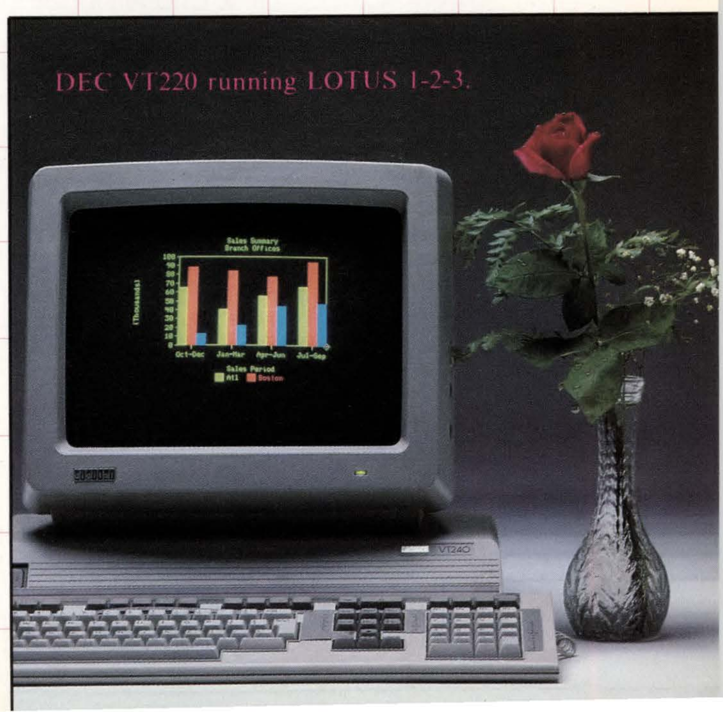


VAX

HOW'S YOUR FORM?

By David B. Alford

Interfacing Programmable Printers And Forms Control Using VMS 4.X.

The latest release of VMS includes an abundant amount of new control mechanisms for interfacing programmable printers and setting up multiple forms controls for the printer queues. The latter was available prior to this release, but now has been expanded to ease the user interface. The ability to program a printer from the system has been enhanced through the addition of a device control file that has been added to the SYS$LIBRARY area called SYSDEVCTL.TLB. This file contains the actual control information to set up the programmable characteristics of a printer.

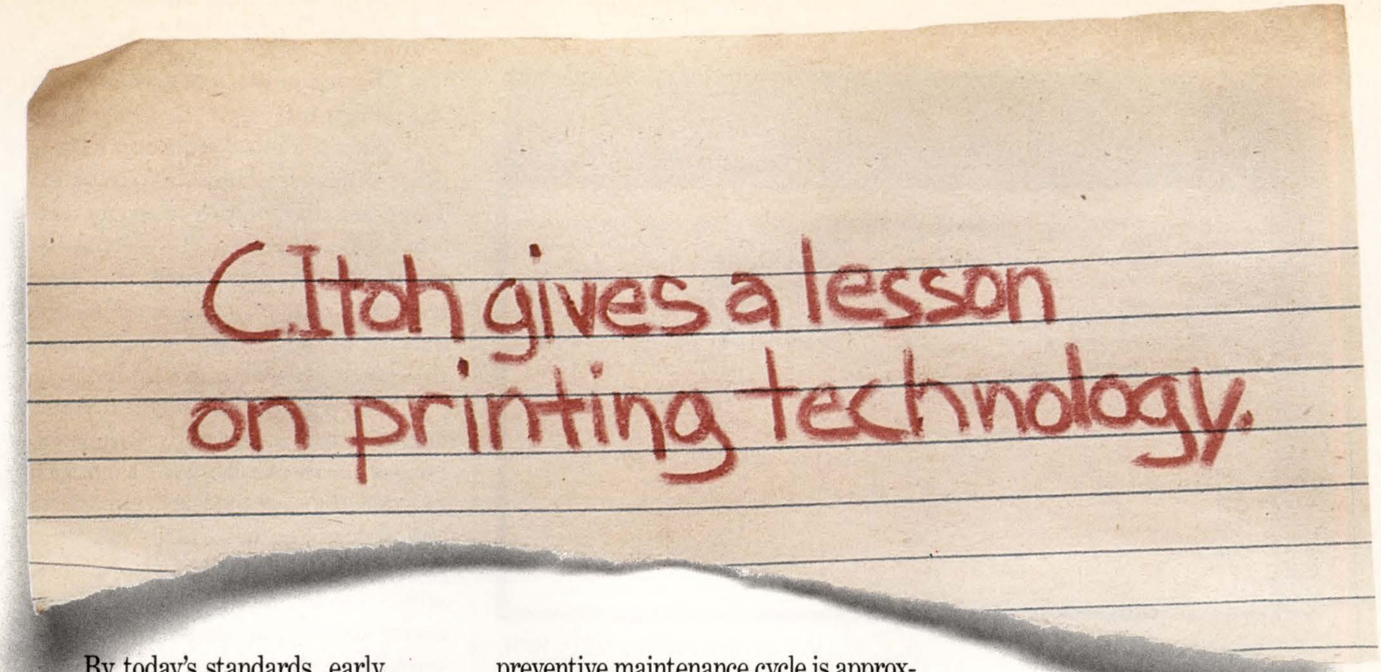
The trend in the dot matrix printer industry, today, is the ability to program different capabilities into a printer. These characteristics include setting the lines and characters per inch, changing the actual character size, as well as having several modes, such as draft and letter quality, to name only a few. Underlining and bolding also may be accomplished in a single pass, instead of using multiple overstriking as a letter quality printer does. If you are looking at purchasing such a printer, or already have one, take heart, these characteristics may be downloaded from the system using the forms library as well as the new device control table.

Setting up printer queues to take advantage of the programmable characteristics is not straightforward, but by explaining a few of the concepts before we plunge ahead, the implementation will be much smoother.

There is not much documentation about how to go about setting up a system device control library. Most of what I found in the way of documentation was that it resided in the SYS$LIBRARY area and was named SYSDEVCTL.TLB. The control library is basically a standard VMS library file built with the LIBRARY command.

I was interfacing a C.ITOH 300 printer using a serial terminal port. The C.ITOH printer had four different lines-per-inch modes, as well as four characters-per-inch modes. Draft and letter quality modes are also programmable for the printer. To begin the library, I constructed a series of text files using EDT, that contained the actual escape sequences for the programmable attributes that I wanted in the library. I also set up a default mode that contained the default number of lines and characters-per-inch sequences, as well as the draft mode sequence. This default module is used for resetting the printer any time a special programmable setup is downloaded to the printer. The mechanism for implementing this reset is described below in the section on the VMS printer queues.

In all, 11 different text files were constructed, each with a name that corresponded to the programmable characteristic it contained, such as LPI6 or CPI17 or LQ. The default module had several embedded escape sequences for resetting the printer. Once these files were set up, the library utility was invoked to build the SYSDEVCTL.TLB file. This set up 11 extractable device characteristics that are referenced by name in the SYS$LIBRARY area.



By today's standards, early computer printers were slow-moving dinosaurs. But then, so were computers.

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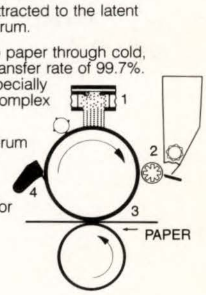

C.ITOH
Ion Deposition Printers

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FIGURE 1.

```
Directory of TEXT library SYS$LIBRARY:SYSDEVCTL.TLB;1 on 24-JUL-1985 15:48:50
Creation date:   6-JUN-1985 14:14:44          Creator:  VAX-11 Librarian V04-00
Revision date:   6-JUN-1985 19:21:17          Library format:   3.0
Number of modules:     11                     Max. key length:  39
Other entries:          0                     Preallocated index blocks:     11
Recoverable deleted blocks:        5          Total index blocks used:        1
Max. Number history records:      20          Library history records:        9

CPI10
CPI12
CPI13
CPI17
DEFAULT
DRAFT
LPI3
LPI4
LPI6
LPI8
LQ
```

The system device table.

FIGURE 2.

```
            Form name                        Number      Description

            CPI10                            4           CPI10
/LENGTH=66 /MARGIN=(BOTTOM=6) /SETUP=(CPI10) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
            CPI12                            6           CPI12
/LENGTH=66 /MARGIN=(BOTTOM=6) /SETUP=(CPI12) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
            CPI13                            7           CPI13
/LENGTH=66 /MARGIN=(BOTTOM=6) /SETUP=(CPI13) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
            CPI17                            8           CPI17
/LENGTH=66 /MARGIN=(BOTTOM=6) /SETUP=(CPI17) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
            DEFAULT                          0         System-defined  default

/LENGTH=66 /STOCK=DEFAULT /WIDTH=132
            DEFAULT1                         2           Default1
/LENGTH=66 /MARGIN=(TOP=6,BOTTOM=6) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
            LPI3                             4           LPI3
/LENGTH=66 /MARGIN=(BOTTOM=6) /SETUP=(LPI13) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
            LPI4                             6           LPI4
/LENGTH=66 /MARGIN=(BOTTOM=6) /SETUP=(LPI14) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
            LP16                             7           LPI6
/LENGTH=66 /MARGIN=(BOTTOM=6) /SETUP=(LPI6) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
            LP18                             8           LPI8
/LENGTH=66 /MARGIN=(BOTTOM=6) /SETUP=(LPI8) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
            LQ                               5           LQ
/LENGTH=66 /MARGIN=(BOTTOM=6) /SETUP=(LQ) /STOCK=DEFAULT /TRUNCATE /WIDTH=132
```

Forms may be viewed from VMS. The system will return a table like this.

The printer that you may be trying to interface may use escape sequences, or it may use control sequences to program different printer characteristics. There are many more programmable sequences available for the C.ITOH 300 printer than the ones I used, but I have kept the SYSDEVCTL.TLB small for the purpose of this article. Figure 1 shows the contents of the system device table.

VMS typically uses physical device queues as well as logical device queues. Logical queues usually have a name such as SYS$PRINT: or SYS$LETTER:. These logical device queues actually feed print jobs into the physical device queues, which connect directly to the physical device via the print symbiont. The print symbiont is the software driver for the printer. The printer and the printer queue may have the same name, such as LPAO:, but you are able to assign the physical device queue to another device, such as a terminal line (for example, TTAO:). This allows the use of serial printer devices.

Interfacing a programmable printer to a physical device queue may be done in serial or parallel. To program such a printer requires embedding special characters or character sequences in the stream of information that is your print file. These special control sequences usually are prefaced with an escape or control character to signal to the printer that the next characters are not printed but are used for programming printer characteristics. VMS offers several ways to download these special characters through the print symbiont. This may be accomplished using the /SETUP = parameter to the print command, or by assigning a setup to a particular queue form. DEC recommends the latter method as more reliable, and I have experienced problems with using only the PRINT/SETUP = (module name) command.

AMONG THE INTERESTING new features about VMS 4.X, are the enhancements made to the SET and SHOW PRINTER

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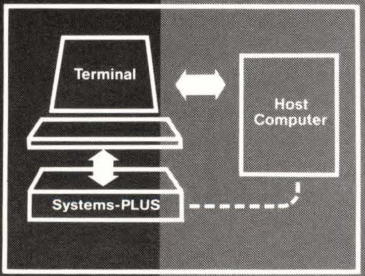

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. . . you should set the printer for /PASSALL.

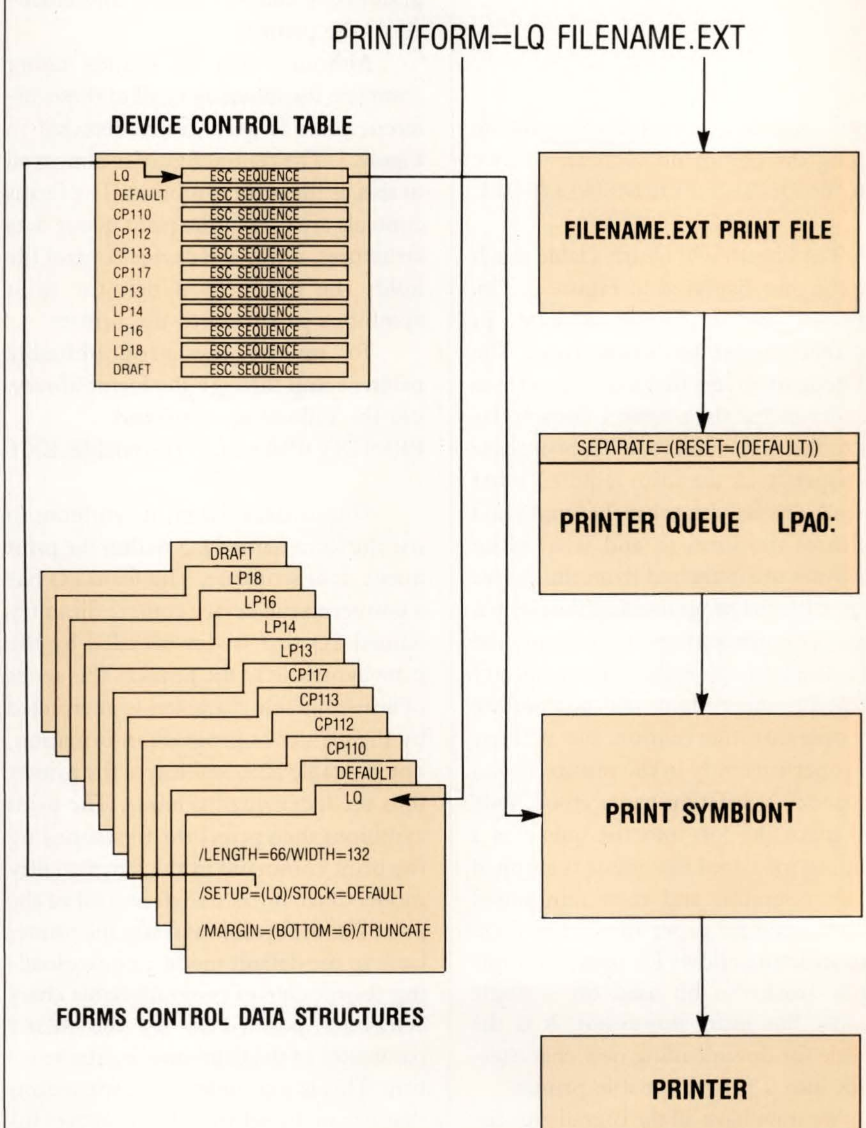
commands. If you plan to implement any of the control capabilities discussed using the device table, you should set the printer for /PASSALL. This will set the print symbiont to pass on to the printer, any escape or control sequences it might otherwise strip out of the print file it is downloading to the physical device. If you are using a terminal line for interfacing to a serial printer, you must allocate the terminal line before you assign it to the print symbiont, and set the line for /PASSALL using the SET TERMINAL /PASSALL/PERMANENT TTXX: command. After you deallocate the terminal line, you then assign the LPA0: queue to the terminal port TTXX. This will set up the print symbiont for passing the escape or control sequences to program the printer.

Another feature that is useful for setting up the printer queue is the SET QUEUE/SEPERATE = (RESET = (module[, . . .])). This specifies modules within the device control library for resetting the print queue back to a default condition when a /FORMS = or /SETUP = parameter is used with the print command. This will ensure that any of the setup features used on a particular job will not be assigned to the next print job in the queue.

CONTROL STRUCTURES called "forms" are assigned to printer queues. The forms are set up using the DEFINE/FORM command. The pointer to the device control table in the form is a parameter called SETUP. These

FIGURE 3.

PROGRAMMABLE PRINTER CHARACTERISTICS



. . . a good manual on the printer will be essential.

forms may be viewed from VMS by issuing the command such as:
SHOW QUEUE/FORMS/ALL/FULL

The system will return a table much like the one displayed in Figure 2. The table of queue forms is kept in alphabetic order by forms name. The different attributes that make up a form actually define the physical characteristics to the print symbiont. These include the paper stock the form requires, what the margins will be, what the length and width of the form is, and what setup attributes are extracted from the device setup table for programming the printer. One very interesting point about the STOCK parameter is that, if you specify DEFAULT, the system will not require any operator intervention, but will use the paper currently in the printer. If you do specify a different paper stock, VMS will place the job into the queue as a pending job, until the queue is stopped by an operator, and then remounted with the correct paper stock. The form data structure allows for many multiple paper stocks to be used on a single printer, but more important, it is the vehicle for downloading new characteristics into a programmable printer.

We now have all the ingredients for sending the necessary programming characteristics to a printer. The device control table holds the actual escape sequences or control sequences for setting up the programmable conditions, the forms data structures hold the pointers to the device control table, as well as other information that may be pertinent. The print queue has a library of forms controls that may be used for downloading the printer characteristics. It also contains a pointer to a reset control sequence to return the printer to a default condition after a forms control or programmable characteristic is downloaded to the printer.

Although this all sounds rather complex, the interplay of all of these different parts is graphically depicted in Figure 3. The central figure to almost all of this, is the print symbiont. The forms controls are part of the print queue data structures, while the device control file holds the information that the print symbiont passes on to the printer.

To invoke the programmable printer setup through the forms library, use the following command:
PRINT/FORM = LQ FILENAME.EXT

This invokes the print symbiont to use the form named LQ within the print queue data structure. The form LQ has a pointer to the device control file entry named LQ that is downloaded by the print symbiont to the printer. This series of non-printable characters is interpreted by the printer as program information, not printable text, and forces the printer into the letter quality mode. The print symbiont then prints the file named by the print command in the letter quality mode. Once it has transferred all of the print file, the symbiont resets the printer back to the default mode by downloading the module of programmable characteristics pointed to by the RESET parameter of the print queue data structure. This is a complex series of actions that occurs by setting up the correct information into the right data structures.

You may bypass the use of the forms data structure by using the following command:
PRINT/SETUP = LQ FILENAME.EXT

THERE IS A WARNING against using this within the written documentation, as well as the on-line help for the PRINT command. Apparently, using the print command and accessing the setup instructions in the device control library directly is not as reliable as linking to the information through the forms control. There is not much information given as to why there is a warning, but when I was setting up the forms and device control library, I did notice that using the FORMS parameter always worked properly, while when using the SETUP parameter, the print symbiont sometimes swallowed the escape character and sent only the programming characters. When the escape character was not sent, the printer would not recognize the programming characters and would print them directly. I experienced no trouble at all when the /FORM = parameter was used with the print command. The command even will allow you to use both of the parameters for invoking multiple programming sequences, but keep in mind the possible problems with the direct use of the /SETUP parameter.

To build a device control library, you must have a good working knowledge of the programmable characteristics of your printer, and what series of characters invoke or program these characteristics. If you don't, a good manual on the printer will be essential. DEC has provided an excellent vehicle for forms management, as well as specialized characteristic control of programmable printers. To take advantage of this vehicle requires knowledge and understanding of the inner workings of the print symbiont as well as the print queue. This article was written to give a better insight into these integral parts of VMS.

David B. Alford is computer systems manager at Crystal Semiconductor Corp., Austin, Texas.

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BRINGING UP BABY

By Brian Edwards

MICROVAX II Grows Up to Challenge VAX-11/780, and At Least One Third-Party Vendor is Adding to the Family.

The MICROVAX II is the least expensive VAX. It is also the smallest. But it has the heart of a VAX-11/780 and, given the right peripherals, the speed to equal one in nearly every respect. The MICROVAX II may be a microcomputer in name, size and cost — but not in performance!

And, with the addition of controllers, the MICROVAX II offers enough mass storage performance to compete head to head with the VAX-11/780. But what sounds good in a sales presentation and looks promising on a specification sheet, doesn't always hold true in the real world. Can a MICROVAX II, at a fraction of the size and cost of a VAX-11/780, really deliver comparable performance?

Emulex Corporation in Costa Mesa, California, asked independent university researchers to put together a series of benchmark performance tests pitting a MICROVAX II equipped with Emulex controllers and widely available hard disk drives, against a VAX-11/780 using DEC's top-of-the-line UDA50 controller and RA81 hard disk drive.

AS DELIVERED BY DEC, the MICROVAX II is flawed as a low-cost alternative to the VAX-11/780. DEC attempted to position the MICROVAX II merely as a replacement for the low-end VAX-11/730. This was reinforced when DEC failed to give the MICROVAX II clustering capability and equipped it with peripherals barely above personal computer performance levels.

While DECnet can serve as an adequate alternative to clustering in many installations, the poor controller and disk performance is a more serious problem. The RQDX2 controller and its companion 71-MB RD53 hard disk were unable to deliver enough performance or capacity to put the MICROVAX II on a par with the VAX-11/780. DEC's most recent effort, the RQDX3, is a marginal improvement at best. Many who purchased a MICROVAX II expecting VAX-11/780 performance have found CPU horsepower to spare; the limiting factor is disk performance.

Late last year, DEC finally announced the MICROVAX II version 5, using high capacity RAXX drives, which gives it the big system peripherals it was lacking. The problem is that it also caries a big system price that significantly lowers the MICROVAX II's favorable price-performance ratio. Also, DEC has failed to address adequately the upgrade needs of the 15,000 to 20,000 existing MICROVAX II users, many of whom have run into the limits of the RQDX2 or RQDX3.

DEC's reasons for limiting the performance of MICROVAX II peripherals came to light with the introduction of the VAX 8200 and VAX 8300 early this year. These machines, which use the new 32-bit VAXBI bus architecture, are targeted as the replacements for the VAX-11/780 and 11/785, with the MICROVAX II filling the low-end market.

Yet, even with pricing about half that of the computers they replace, the VAX 8200 and 8300 still aren't able to match the price/performance of the MICROVAX II. And, the new

FIGURE 1.

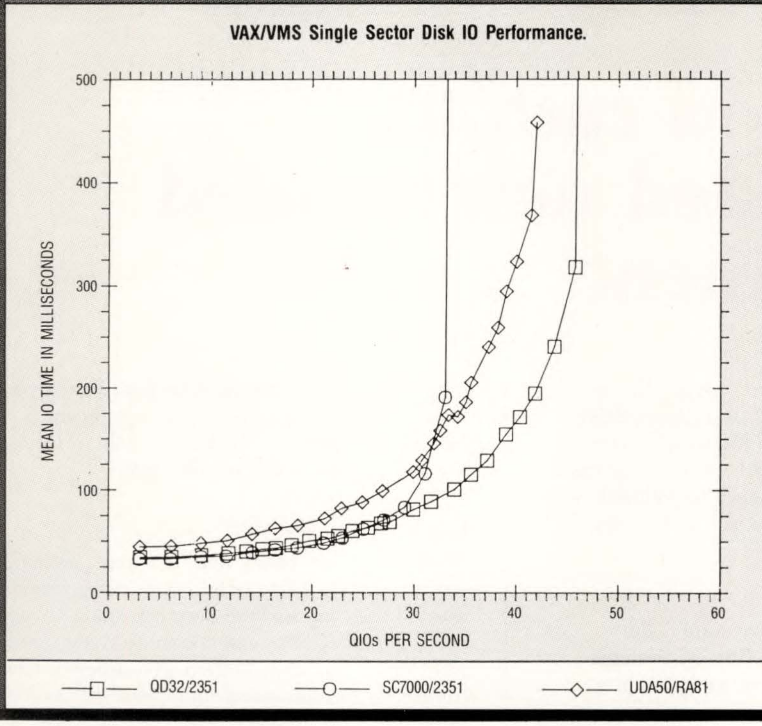
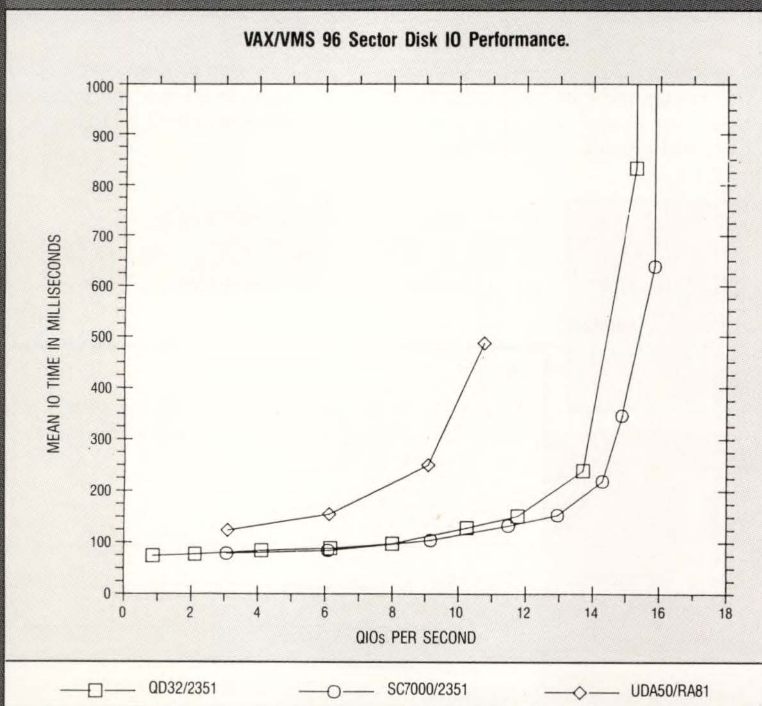


FIGURE 2.



mid-range VAXs use a bus architecture that is closed to third-party vendors, which means users are locked into buying only DEC peripherals at prices established by DEC. When all factors are considered, the MICROVAX II remains one of the best values in computing today.

AN IMPORTANT ADVANTAGE to the end user of a healthy DEC-compatible industry is the simple provision of an alternative. Unfettered by marketing and other restrictions, third-party manufacturers are able to concentrate primarily on extracting the most performance from the MICROVAX II, while providing a significantly greater range of options.

Among the controllers on the market that offer a choice of industry standard interfaces are Emulex's QD32 with an SMD interface; QD21 with an ESDI interface; and QD01/D with an ST506 interface, each with dozens of drives to choose from.

To the DEC operating system, these controllers appear to be standard DEC controllers, since all implement DEC's sophisticated Mass Storage Control Protocol (MSCP). The controllers provide additional enhancements, including noninterleaved sectors, adaptive DMA and nonvolatile RAM memory for storing disk drive information.

The Intel 8031 microprocessor used on the Emulex family of controllers, for example, is capable of simultaneously accessing and transferring data between disk and memory to allow a straight 1-1 interleaving factor. The advantage of 1-1, or noninterleaving, comes when transferring large amounts of data from contiguous sectors.

Adaptive Direct Memory Access (DMA) is a feature that enhances overall system performance, rather than just disk performance. It allows the controller to release the bus to other DMA devices with a lower priority, based upon the bus requests, thereby improving multiple I/O operations and throughput.

. . . there is no substitute for larger capacity . . .

Because of the huge selection of disk drives on the market, some of these controllers are supplied with an interactive program that makes storing configuration information about different drives in the controller's NOVRAM a straightforward process. Users can alter the configuration data through the console terminal as needed.

To better use the MICROVAX II's limited Q-bus slots, some controllers are contained on a single dual-wide card and are capable of supporting two physical or four logical drives each. The small size is achieved through the use of a custom VLSI host adapter chip that contains more than 50 percent of the Q-bus interface circuitry.

WHEN THE GOAL is peak performance, there is no substitute for larger capacity and higher transfer rates. The SMD and ESDI interfaces offer both. An established industry standard for large disks, SMD drives are abundant and available from numerous manufacturers in a wide range of capacities. They typically are less expensive than comparable DEC units with the popular Fujitsu 2351 Eagle, for example, priced at around $12,000 compared to $19,000 for DEC's RA81.

The only drawback to using SMD drives with the MICROVAX II in either the BA23 tower or BA123 world box configuration, is aesthetics. The drives easily are hooked up to the CPU via a cable, but require an external 40-inch

FIGURE 3.

Performance of Disk Systems Under "VAX-MIX" Load.

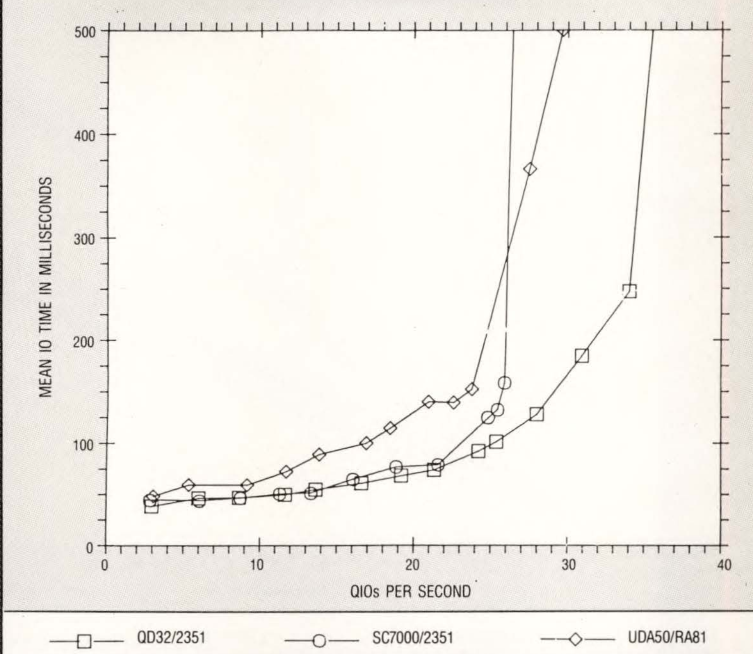


FIGURE 4.

Performance of Two Drive Systems.

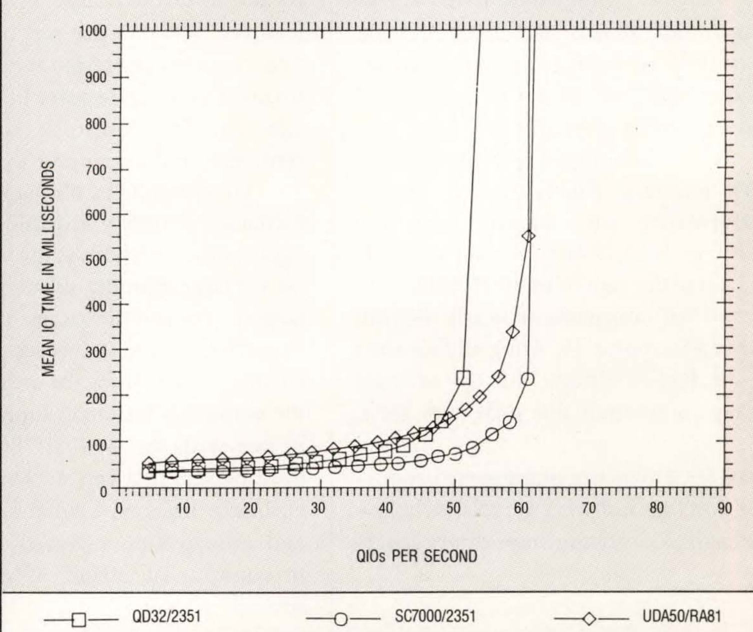
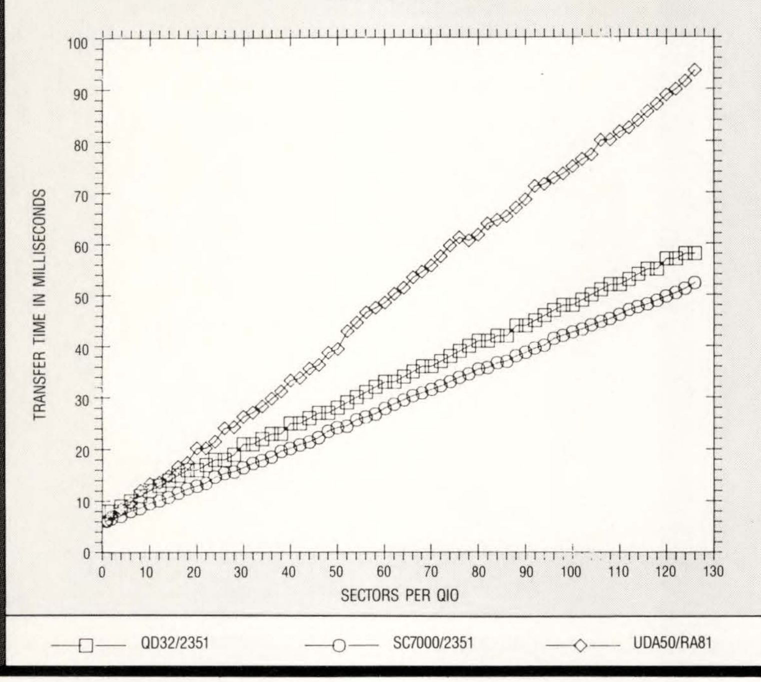


FIGURE 5.



Disk Transfer Rate.

cabinet that can be larger than the computer itself.

Depending upon the final destination, an external cabinet may not be desirable. One alternative is to modify the BA123 configuration to accept 8-inch SMD drives, which are starting to rival the performance of larger drives, with transfer rates of 2.4 MB per second and capacities of nearly 500 MB.

The other option is to go with the ESDI interface which features greater performance and capacity than the ST506 in the 5.25-inch format. ESDI offers a transfer rate of up to 10 Mbits per second with capacities of nearly 400 MB starting to appear. By using all four slots in the BA123 chassis, 1.5 GB of mass storage is an attainable goal with ESDI.

WITH MASS STORAGE of gigabyte proportions on tap, and with the relatively low performance cartridge tape drives standard on the MICROVAX II, tape backup becomes a problem. Emulex's alternative is the TC03 tape coupler for use with the industry standard Pertec tape interface to provide performance comparable to that of a large VAX. The TC03 features 900-KB-per-second transfer rate to permit operation with high performance tape transports up to 6250 at 125 IPS. The controller can support start-stop and streaming drives.

The MICROVAX II's big system performance is nearly worthless in many applications, without some way to connect a large number of terminals. The largest communications multiplexer from DEC for the Q-bus supports an inadequate eight lines. In order to bring the number of terminals supported more in line with the VAX-11/780, there are multiplexers that can support 64 asynchronous lines on a quad-sized board, and emulate DEC's DHV11, but with a throughput of 50,000 characters per second.

As a general purpose computer, the key to the success of the MICROVAX II is flexibility. The same machine can handle a broad range of users and provide a growth path as the need for more performance develops. For smaller applications that don't yet require 11/780 performance, Emulex offers the QD01/D with support for the ST506 disk interface and the QT12 tape controller for inexpensive cartridge tape drives using the QIC-02 interface.

Putting a MICROVAX II on a serious weight-gain program is much simpler than a similar program would be on a full size VAX. Controllers and drives usually can be installed with little more than a screwdriver to remove side covers.

CLEARLY, THERE ARE enough third-party options available to transform a mild-mannered MICROVAX II into a real performer with nearly 1 MIPS CPU performance, 16 MB of main memory, 2 GB or more of mass storage capacity, a high performance .5-inch streaming or start/stop tape drive and 64 communications lines.

The only real question in the minds of most people about the MICROVAX II is the performance of mass storage peripherals and controllers on the Q-bus. And, in the VAX/VMS environment, disk performance is of real concern because of the impact on overall system performance.

To determine top performing controller/disk combinations, the team of Richard Wrenn and Mark Freeman from the Washington University School of Medicine in St. Louis, Missouri, has spent considerable time researching disk system latency in VAX/VMS. Originally conducted on VAX-11/780 class machines, they recently have expanded their work to include the MICROVAX II. ("MICROVAX Disk System Latency," paper presented at the Fall DECUS U.S.

> In most VMS systems, the modified page writer is responsible for most large QIOs.

Symposium, December, 1985, Anaheim, California.)

Because of their expertise, Wrenn and Freeman seemed the ideal choice to put together a series of disk system benchmarks comparing the MICROVAX II with the VAX-11/780, the recognized standard for minicomputer performance. The MICROVAX II was to be equipped with a QD32 SMD controller and a 474-MB Fujitsu 2351 Eagle. The VAX-11/780 would feature the best performing controller/drive combination DEC has to offer, the UDA50 controller and 456-MB RA81 drive. For comparison purposes, the 11/780 also was tested with an Emulex SC7000 controller and the 2351.

After the smoke had cleared, the results showed conclusively that the MICROVAX II equipped with large disks can compete well with the VAX-11/780!

The performance benchmarks developed by Wrenn and Freeman are based on the issuing of Queue I/O Request (QIO) operations in a variety of combinations over time. This type of test measures the performance of the QIO mechanism, class and port drivers, I/O buses, controllers and disk drives — in short, the entire mass storage subsystem.

Wrenn and Freeman evaluated the response time of a system by issuing QIOs at a controlled rate and recording the time it takes for each request to complete. In order to determine the impact of load on performance, as in the real world, they varied the rate at which the QIOs are issued. This resulted in graphs showing the mean I/O completion time versus the number of QIOs issued each second.

As the load or number of QIOs per second increases, response time typically slows until reaching a point where the system is unable to cope with additional QIOs within a second. On the graphs, this is the point where the curve stops.

To isolate various performance aspects of a disk system, Wrenn and Freeman also varied the number of sectors or bytes that are transferred by each QIO. For example, if each QIO transfers a single sector, the test emphasizes seek performance, while if each request transfers numerous sectors, the results are a better indicator of transfer rates.

Figure 1 shows comparative results among the three controller/disk combinations tested, with each QIO transferring a single sector. Because of the fast seek performance of the Fujitsu 2351 and the seek ordering capability of the QU32, the MICROVAX II provided the best performance by a fairly wide margin.

Single sector disk I/O performance is an important factor in real world performance. Extensive studies of heavily loaded VAXs conducted by Wrenn and Freeman show that more than 60 percent of the QIOs transferred a single sector.

In Figure 2, each QIO transfers 96 sectors of data from disk to memory, instead of one. Both the QD32 and the SC7000 are substantially faster than the UDA50, which Wrenn attributes to the Emulex controller's high transfer rate.

IN MOST VMS SYSTEMS, the modified page writer is responsible for most large QIOs. Since it defaults to 96 sectors, this test reflects strongly on real-world performance under VAX/VMS, according to Wrenn.

Since the QD32/2351 on the MICROVAX II provides superior performance at the two extremes of the QIO byte count spectrum, it stands to reason that the combinations should also be the top performer under the more varied load shown in Figure 3. The "VAX-MIX" consists of 90 percent exponentially distributed byte count QIOs with a mean of four sectors, and 10 percent 96-sector QIOs. Database applications typically issue QIOs with exponentially distributed byte counts with a mean of four sectors.

To put these results in perspective, a user issuing 30 QIOs per second under a "VAX-MIX" type of load would be unable to run an application on a VAX-11/780 equipped with a single disk, but easily could on the MICROVAX II. In all cases, except with small sector counts, the MICROVAX II is able to handle a larger load with better performance than the 11/780. In fact, the only time the MICROVAX II starts to slow down is when a second drive is added to the system, though performance still remains competitive. Figure 4 shows the performance of two drive systems under a load similar to the "VAX-MIX," but without the 96-sector QIOs. The drop-off can be attributed to the fact that Emulex does not implement Rotational Position Sensing (RPS) on the QD32. Implementing RPS would have required quite a bit more circuitry and necessitated going to a quad-wide board. RPS only has an impact on performance when a second drive is hooked to a controller.

Remember that these tests push the disk subsystem to the limit. On most VAX-11/780s and 750s the number of QIOs issued rarely exceeds 35 QIOs per second, regardless of the number of disk drives on the system, according to Wrenn and Freeman. The MICROVAX II equipped with a QD32 and two Eagles would handle a load like this with a wide cushion.

One final test measures the rate at which data is transferred between disk and host memory by issuing a large number of QIOs at a low rate and recording the minimum of their completion times. The graph shown in Figure 5 is obtained by increasing the QIO byte count. Since only the byte count changes, the slope of each line indicates the rate at which data is transferred from disk to main memory.

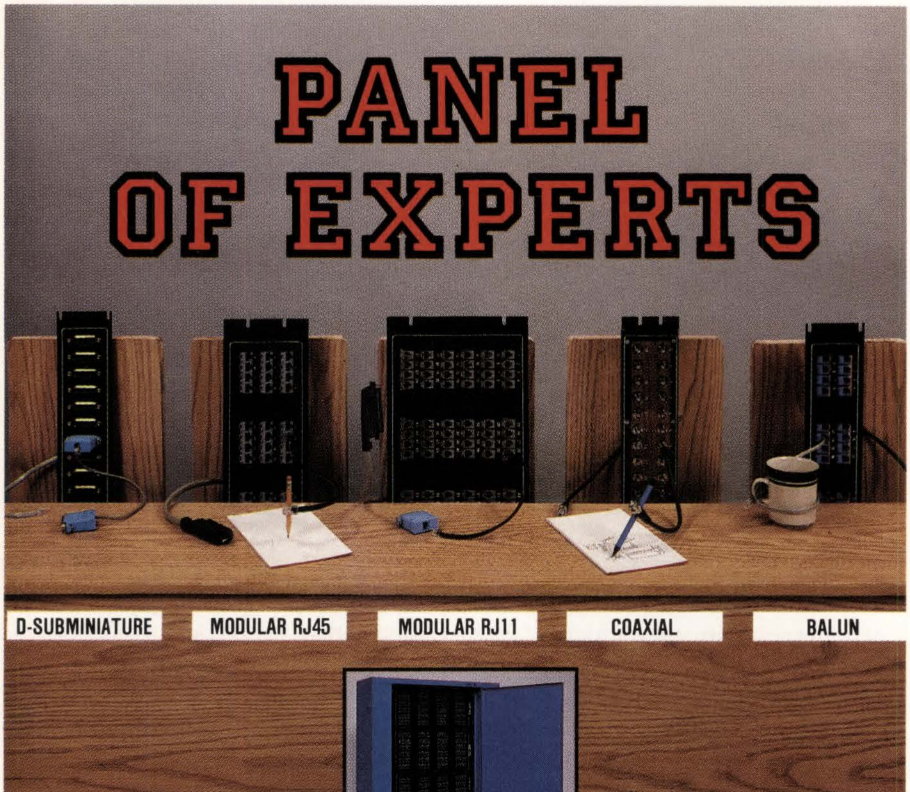
In both cases, the Fujitsu 2351 coupled with the Emulex controllers raced past the slower RA81 and UDA50, with the SC7000 on the VAX-11/780 coming out on top by a small margin. The SC7000/2351 transferred 1,388 KB per second, with the QD32/2351 close behind at 1,270 KB per second. Then, UDA50/RA81 had about half the transfer rate of the others at 689 KB per second.

WHERE PERFORMANCE comparisons between the MICROVAX II and the VAX-11/780 end, price comparisons begin — and here there is no contest. A complete MICROVAX II system costs approximately $60,000, while a similar VAX-11/780 system rings up a hefty $180,000 to $200,000 tab.

Besides a higher initial cost, the 11/780 keeps on costing more. Memory expansion modules, controllers and other hardware upgrades are more expensive. Likewise, software licenses typically are more costly for the 11/780 than for the MICROVAX II. And, there are hidden costs to be considered, like the greater power consumption of the larger system, coupled with its need for a special computer room. Because it uses older technology, the 11/780 typically requires service more frequently than the MICROVAX II.

After adding everything up, there is little wonder that DEC was worried about the MICROVAX II infringing upon 11/780 sales. A MICROVAX II equipped with special controllers and large capacity disk drives easily is enough to send the 11/780 into retirement.

Brian Edwards is a California-based freelance writer.

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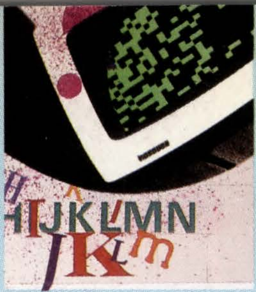

HARDWARE

The HDS2200

By Victor J. Chorney

A New Terminal That's Worth A Look.

The HDS2200 is one of six members of the new HDS2000 series of DEC and Tektronix terminals. Three of the six terminals are APL counterparts for the three "standard" configurations:

1. HDS2200, a VT220 emulating terminal.
2. HDS2200G, a medium-resolution terminal having the HDS2200's capabilities plus 1024 x 390 resolution and supporting simultaneous text and graphics display.
3. HDS2200GX, a high-resolution graphics terminal having 1024 x 780 resolution, in addition to VT220 emulation.

The 15-inch display, housed in a 13¾-inch wide by 13½-inch high by 13-inch deep case, is available in amber, green, or white and provides an 80-square inch display area (400 scan lines). The format of the display can be set to 80 or 132 columns with 24 text lines and one message line. Characters are formed by a 9 x 16 dot cell and this, combined with the large display area, provides a character display that is well defined and larger than that of the "standard" terminal.

BRIGHTNESS AND CONTRAST controls are inset at the rear of the display. The screen is mounted on a ball-joint, permiting a wide range of swivel and tilt positioning. There is no column to speak of; that is, the screen sits atop the swivel, which is attached directly to the pedestal. With a one-foot square footprint, the pedestal is one of the smallest around. In addition, it is 1½ inches high so that the overall height of the terminal (considering the larger screen) is not out of proportion.

All connectors are on the pedestal with the power switch on the front edge on the left-hand side and a "power" LED on the upper right corner of the keyboard. The interface connectors are on the left rear of the pedestal (as you face it). There are two standard RS-232 connectors with an optional third port. Also, a 20mA current loop port is available as an option. On the right side of the pedestal (as viewed from the front) are two modular plug connectors — one for a joystick and one for the keyboard. (An incorrect connection, by the way, simply causes the keyboard to be inoperative.)

The keyboard itself is small: 18 inches wide by ½ inch high by 6½ inches deep, which results in the key groups being close together. It is also very light, although rubber feet do prevent its moving about when being used by typists with heavy hands. Inasmuch as I learned to type on a keypunch, I include myself among the "heavy hitters" when it comes to pounding on a keyboard. As a result, I was aware of the difference in the weight of the keyboard, compared to Digital's, for instance, but this is a matter of personal taste.

There are several position changes, the most notable of which places the Escape key below the Hold Screen key, the Compose Character key at the left-front corner, the Return key enlarged (and shaped like a backwards "L"), and the Caps Lock key to the right of the space bar.

I want to bring special attention to the very effective use of LEDs, imbedding them in the keys where their "active" state may be well noted: Hold Screen, Compose Character, and Caps Lock have received this treatment.

TERMINAL SETUP is initiated by pressing the Set-Up key and then pressing the appropriate key in the cursor keypad group. Options are presented in a list, grouped by functional area. Instructions for changing values appear at the upper left of the display while the functional area being affected is displayed at the upper right. The functional areas are:

1. General—including clear and reset
2. User preference—covering display characteristics
3. Communications
4. User defined keys
5. Keyboard—covering keyboard characteristics (excluding function keys).

The documentation is comprehensive, though lacking an index. The Table of Contents, on the other hand, pretty well can direct you to the appropriate section. Among the subjects covered are:

1. How to use the manual
2. Terminal set-up—both physical and electronic
3. Communications
4. User defined keys
5. Graphics operation
6. Maintenance
7. Appendices covering programming/command information.

The unit I tested, the HDS2200G medium-resolution terminal, is the same externally as both its predecessor — the HDS220 — and any of its siblings in the HDS2200 family.

This one had an amber monitor (which I prefer) and, by adjusting the brightness and contrast controls, I was able to set the display to a comfortable level. This was a particularly critical test because I was sitting in a room with overhead fluorescent lighting, and the positioning of the terminal added or detracted from my efficiency. The results were quite satisfactory and there was a minimal amount of glare noticeable on the display from the office lighting.

The HD2200G, the medium-resolution version of the HDS2000 Series, features 1024x390 resolution, 15-inch bit mapped display, simultaneous text and graphics display, DEC VT220 emulation and more.

THE GRAPHICS DISPLAY was satisfactory; images used consisted of a variety of shapes and curves. There was nothing especially noteworthy except the clarity and large size of the images. One minor drawback did show up as a result of the larger display: Since the pixels were farther apart, the curves were not quite as smooth as would appear on a smaller screen. For those to whom graphics is important, I think the HDS high-resolution unit probably would be more suitable.

I like the HDS2200. The unit performs well, is well-constructed, and is economical. If for no other reason than the size and clarity of its display, it's well worth your time to evaluate.

Victor J. Chorney is an independent consultant from Overbrook Hills, Pennsylvania.

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DBMS

INGRES

By Bill Hancock

Relating Better Than Ever.

I'm not easily impressed. As a result, I place the "Bill's Stamp of Approval" on very few products and only after I have had the chance to put them through my own brand of software torture. As relational databases go, I like *INGRES*. I didn't always feel this way. I first ran into *INGRES* a few years back when evaluating relational databases for a large distributed database project. Back then, *INGRES* didn't make the cut. It does now, however, and actually may be one of the better relational database products on the market.

INGRES is a relational database software product that evolved from the computing caves of the University of California at Berkeley. Originally, it was implemented in C on UNIX-based PDP-11s with the parsing mechanism originally implemented in the UNIX utility YACC (Yet Another Compiler-Compiler). The original parser, which has evolved but still is in use, is a language called QUEL. QUEL also has a sister product called EQUEL (Embedded QUEL) that is used with *INGRES* in program development.

Though austere compared to today's relational database market (including the current version of *INGRES*), the product was revolutionary at the time, and the main authors, Drs. Eugene Wong, Lawrence Rowe, and Michael Stonebraker, decided in 1979 to take *INGRES* to the commercial marketplace.

Through their work and that of two professional businessmen, Jon Nackerud and current President Gary Morgenthaler, the entrepreneurs organized a company, Relational Technology Inc., prepared a business plan and secured funding from a venture capital organization. Following the initial funding, the small company went "underground" into Nackerud's basement and began to make *INGRES* a commercially viable product.

THE REST IS HISTORY. *INGRES* has been ported to a variety of processors and operating system environments (See Figure 1) and has evolved from a university project to a robust, commercially attractive relational database product.

The *INGRES* product set consists of several components (See Figure 2). The list is somewhat misleading, however, because it does not adequately explain the actual products involved with the different set items. *INGRES*/Forms, for instance, includes not only a forms-generating tool, but also a Query-by-Forms tool that allows neophytes to access database information in a screen-oriented fashion without regard to QUEL or SQL syntax or query methodologies.

A product called *VIGRAPH* allows users to pull information directly from the database and display it on high-quality color graphics devices (for slides, overheads, and general application information). Don't let the list fool you — there's more to it than meets the eye.

The general concept of *INGRES* emphasizes the ability to use any or all supplied tools in a cohesive, cooperative method. This ability is realized through RTI's concept of "visual programming" — the use of visually-oriented tools to provide access to

INGRES has been ported to a variety of processors . . .

database resources and data. While the current mechanism of visual access involves the use of sophisticated forms mechanisms, there were hints at the recent *INGRES* Users Association meeting in Minneapolis that the potential for icon-based graphics and mouse-oriented graphics is quite real and an attractive addition to the *INGRES* suite of products.

I'm of the school that views benchmarks as somewhat misleading. When I test products, I concentrate on what makes the product useful, how much faster I can get done what I set out to do, and how hard a product is to use. As a result, I will briefly discuss some testing that was done with the *INGRES* product set, but am going to refrain from publication of actual numbers since they most likely will vary in your environment.

I had the benefit of extensively testing most of the *INGRES* V4.0 product set recently, and also the opportunity to examine it closely in the VAX/VMS environment. In all, *INGRES* was tested in three different environments: an 8600-based VAXcluster, a standalone 11/780, and a MICROVAX II. On the cluster and on the 780, *INGRES* was placed on RA81s (HSC50 on the cluster and UDA50 on the 780) and on an RD53 on the MICROVAX II. In all testing, the systems were idle except for *INGRES* tasks, and all systems were tested utilizing out-of-the-box SYSGEN parameters as well as tuned parameters.

For the most part, *INGRES* V4.0 performed well in all three environments. I did notice, however, that the MICROVAX II was slower than the 780 in some respects, which I was able to narrow down to string manipulations and searches. I can attribute this to the use of string functions within *INGRES* which most likely call on emulation mode instructions on the MICROVAX II. These are substantially slower than native mode instructions. Other than that, the product performed well in all three environments.

I also took the time to make some adjustments to SYSGEN parameters and found that increasing TBSKIPWSL, adjusting various RMS parameters,

FIGURE 1.

INGRES Product Set	
INGRES Database	Available for various operating environments
INGRES/Applications	Tools for developing INGRES applications
INGRES/Forms	Screen building and graphics tools
INGRES/Net	A distributed database linking mechanism
INGRES/Report	Report generator and report writer-language
INGRES/EQUEL	RTI's own database query language and pre-compilers
INGRES/SQL	An ANSI-complaint SQL parser and pre-compilers
INGRES/PCLINK	A PC-to-host query parsing and linkage mechanism

FIGURE 2.

INGRES Versions	
VAX/VMS	All VAX Processors
UNIX	
(Directly sold)	VAX (4.2/4.2 bsd, System V, ULTRIX)
	AMDAHL (UTS/V, UTS/U370)
	Hewlett Packard (HP/UX)
	Pyramid Technology Corp. (OSx 2.5)
	Computer Consoles, Inc. (4.2 bsd)
	Data General (DG/UX)
	Sequent Computers (Dynix)
	Alliant Computers (4.2 bsd)
UNIX	
(OEMs)	AT&T Burroughs
	NCR
	Sun Microsystems
	Gould
	ELXSI
IBM	VM/CMS (V3.0 of INGRES with V4.0 coming)
	PCLINK (to allow OCs to connect to INGRES on larger hosts)

QUANTUM, and modifying list sizes for better memory utilization resulted in increased *INGRES* performance. Modification of user working set quotas (WSMAX, WSQUOTA, WSEXTENT) to allow greater use of memory had the most profound affect on *INGRES*' performance.

NO PRODUCT IS PERFECT and *INGRES* is no exception. For all its flexibility, *INGRES* is a resource and memory hog. I found that process page faults were excessive and did not get down to a reasonable level until I jacked up my working set size to 1024. Even then page faulting was high (I got the page faulting to a reasonable level at 1790 pages of working set). I also found that by tuning various SYSGEN parameters and adjusting disk cluster sizes, I was able to affect *INGRES* performance positively, and provide better throughput.

In addition to VMS items that could affect performance, *INGRES* has a variety of buffer parameters and other parameters that can be adjusted to provide faster throughput at the expense of memory utilization. *INGRES* also performs numerous process activations that cause overhead problems and degrade performance.

These observations were confirmed by other users of *INGRES* at the User Association meeting in Minneapolis, but in RTI's defense, it has been working diligently on performance enhancements and the V4.0 product is purported to be substantially faster than the previous versions (I did not have the previous version available for cross-testing, so I could not verify the claim).

Gary Morgenthaler also has publicly stated that the goal of RTI is to improve the performance of *INGRES* by at least 40 percent in each future release. Preliminary reports on V5.0 tend to substantiate that claim, but it still is too early to tell. Version 5.0 is interesting, however, in that it is a maintenance release of *INGRES* with no functionality enhancements but considerable performance enhancements.

My other complaint with *INGRES*

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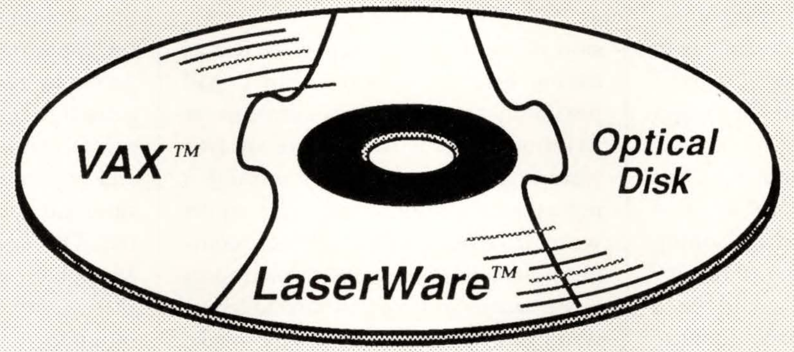

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is the documentation. While there is a lot of it, some of it is confusing (even for technical people) and mistitled — which tends to mislead. A document that accompanies the kit is titled "The *INGRES* Project Management Application Release 4.0." On the cover, it would seem to contain information on a project management application that comes with *INGRES*. While some of the functionality of such a system is included, the real reason for the document is to show how to use various *INGRES* components, not to provide for project management.

A more minor complaint, but something that can be critical to some applications, is the bulk data loading facility (COPY). Formatting a file for bulk loading potentially could be a maximum pain, so be prepared to write some small pieces of code to load difficult-to-format files.

The first application I wrote was a call book routine to keep track of phone calls and also to maintain a mailing list database. I first tried to write the application without reading the documentation and managed to get a functional version up and running in about two hours. To write the same application in C took me about three hours (not using *INGRES*).

As far as actual execution speed goes, my program beat the *INGRES* application hands down, but it was not nearly as flexible. Once the program was written, ad hoc queries were out of the question, as was flexible report writing and other desirable features.

THE END RESULT is that while creation time for the application in C was reasonable (also consider that I know C pretty well), the overall flexibility overwhelmingly was in favor of *INGRES*. It was during this time that I discovered one of the most powerful features of *INGRES* — the report writer.

Most relational products have a report writer, and most of them aren't very good. I remember the earlier version of the *INGRES* report writer as having been troublesome, but it had possibilities. Apparently, someone at RTI thought so as well. There are two ways to generate a report — through a report generator or through the report writer language. For the hard core computing types, go straight to the report writer language. If you are new to report writing, however, you may want to take a shot at the form-driven report writer before becoming familiar with the report writer commands.

> ... prototypes can end up *being* the system ...

For comparison, I wrote C code to format four-across stickers for my mailing list; it took the use of an array or two and some I/O patience (C is not the greatest at I/O formatting). I was able to do the same in *INGRES* in about 15 lines of *INGRES* report writer code and produced a very nice report in a short amount of time (two minutes). The same report took me about 30 minutes to write in C.

When working on my little call book application, I found another nifty feature of *INGRES* — its ability to handle an incredible variety of DATE data types. General categories include absolute dates (mm/dd/yy, dd-mmm-yy, dd-mmm-yyyy, yy.mm.dd, mmddyy, mm/dd, mm-dd, "today", "now"), absolute times (hh:mm:ss, hh:mm:ss cst, hh:mm), absolute date and time, date intervals, and time intervals. Most databases handle only one date/time format, so it was a pleasant surprise to see the variety of date support given. This feature is very useful in financial planning, where cash flow and interest rates are extremely date dependent and of an international nature.

To make a simple application even more powerful, I decided to write a form-driven access method which also would allow me not only to search and maintain my call list, but to keep a mailing list and reference list in the same database.

This capability was handled easily by the Applications-By-Forms (ABF) facility and the use of a specification language for ABF called Operation Specification Language (OSL). OSL gives the application designer a great deal of power by allowing the prototyping approach to programming: Program segments can be built, tested, debugged, and implemented in a short amount of time and later enhanced for production use. Through the use of ABF and OSL, an applications writer can specify forms, menus, and actions to take, based upon input and/or control sequences entered in the course of information input or retrieval.

To assist in the creation of forms, *INGRES* includes a Visual Forms Editor (VIFRED) which is useful, but takes some practice to master, since it is not as intuitive as the documentation would lead you to believe. I found that by using ABF, OSL and VIFRED I was able to create a very sophisticated call book application in an hour or so, once I became proficient with OSL and figured out how to use VIFRED properly.

ONE OF THE ATTRACTIVE things about relational databases is the ability to use the query language to access information quickly, in an ad-hoc manner, without regard to how the retrieval is made. *INGRES* has not one but two (Yes, two!) query languages that allow the user to access information in the database.

The first language is QUEL, the original query language developed for *INGRES*. The second is an ANSI-compliant SQL parser that supposedly is also compatible with IBM's DB2 product. I spent considerable time and maintained an open mind to learn QUEL so I could query the database and extract the information I had placed there.

While the language is solid and functional, I found QUEL not "intuitively obvious" and found myself frequently looking in the documentation or asking *INGRES* for help (which is plentiful) when I got lost (which was often). Once mastered, however, QUEL is reasonable to use and gets the job done. My language of choice, however, is the SQL parser, for multiple reasons.

First, SQL is the parser of choice for most popular relational database products on a variety of machine architectures, so, if I am going through the effort of learning a query language, I might as well learn something that I can use on other systems as well.

I also prefer SQL because it tends to be more intuitive to the query process than QUEL. I'll admit a prejudice to SQL — I've been using it for a considerable amount of time on various database products and prefer it since I am more familiar with it.

This is both good and bad. When using the SQL parser on *INGRES*, I found that I had developed dependencies on other SQL implementations which are not in the ANSI specification. I sorely missed them. This was the bad side. On a more positive note, I found that I was productive almost immediately with *INGRES*. The nuances that caused me trouble soon were overcome and I was merrily hacking along. To my pleasure, the implementation of SQL on *INGRES* is not treated as the wayward child. SQL is a fully supported and full-featured parser and may be used *instead* of QUEL in all applications I attempted. This was a bit of a shock since most implementations of parsers on databases tend to favor one type of parsing mechanism, usually the initial parser developed for the product. Secondary parsing mechanisms suffer. Hence, if you wish to use QUEL, fine; if you wish to use SQL, fine. Either works well and both are fully supported in *INGRES* and its utilities.

THERE IS ONE CAUTION: When considering *INGRES* for applications, be aware that the method of program development in the *INGRES* environment differs *greatly* from the standard program development cycle. *INGRES* lends itself very well to the quick prototype and test application as well as to the creation of "quick-and-dirty" access methods to get problems solved. This makes users happy in a big hurry, but it's also a major problem. *INGRES*, for its flexibility, easily lulls the program writer into sloppy development habits and the tendency to develop "piecemeal" applications that later become difficult to manage and maintain.

While this is not an *INGRES* problem per se, it still is a major consideration in selection of *INGRES* as a program development tool since additional time and caution must be expended to keep bad habits and methods from creeping into otherwise good procedures and coding methods. I mention this because I have spent lots of time over the last two or so years straightening out shops that implemented systems using sophisticated tools like *INGRES*. These sites allowed themselves to be seduced by the ease of programming and application development that full-featured packages offer.

I, too, once fell into the trap. It is hard to get out of the habit once it starts. When using *INGRES* for applications or system development, remember that prototypes can end up *being* the system if safeguards and procedures are not implemented up front. Application generation with *INGRES* is not like the classic programming environment and requires different procedures and programming direction from those used in classic applications design and implementation.

A feature included in *INGRES* is a facility called INGRES/Net. This allows a user on a supported node to access an *INGRES* database on another node as if the database were located on the user's own node. This can be a very useful feature for companies with the need for distributed database requirements or for those who subscribe to "Bill's First Law of Solving Large Application Problems" — DIVIDE AND CONQUER!!

While it is true that the VAX series of processors often is not capable of competing with large IBM mainframe transaction processing systems (although the 8800 will give that statement a run for its money), use of the divide-and-conquer philosophy can help distribute applications to where the work is being done and still allow updating and sharing of information through the use of network technology. (Do that on a mainframe!)

A MAJOR FACTOR to consider in the selection of distributed database technology is the concept of a two-stage COMMIT function. There are some relational database vendors who claim to have a distributed database capability. And, yes, they do allow one to connect to a database located on a remote system. And, yes, they do allow querying of the remote database by another system. The two-stage COMMIT, however, insures that database integrity is maintained on both ends of the communication link.

Basically, a two-stage COMMIT means that once the user on the host node has committed his changes to the database, the host node accepts the commit and the remote node tells the host that the commit also was successful on the remote node. This insures that the information on both sides of the communications link is the same and that the database maintains concurrency across node boundaries.

As networks become an increasing force in the computing arena and with the implementation of PC networks and other LAN technologies, the use of distributed database access will become


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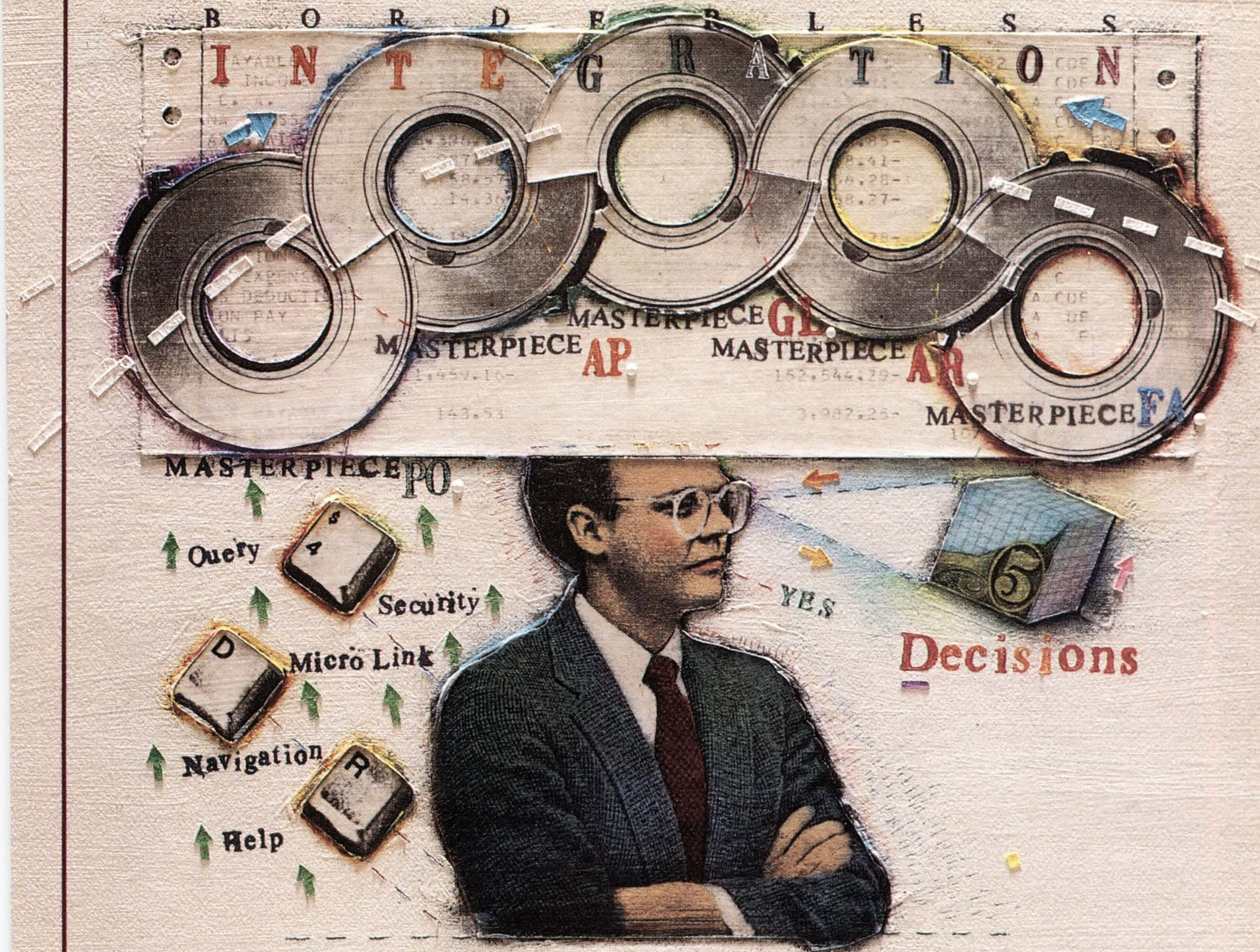

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increasingly important, and the solidarity of data on both ends of the communication link will become increasingly critical. At present, INGRES/Net supports DECnet on VAX systems and TCP/IP on UNIX systems, with other network technologies in development.

I would like to see INGRES/Net expanded to handle more than one database on more than one node at the same time, but this capability is beyond the scope of the current product set, and beyond the scope of practically every database on the market. To handle such a capability would require the use of distributed database index structures, name services, and other volatile structures to handle database transparency. While there is a lot of talk in the industry on this, it still will be a while before anyone, including the forward thinking people at RTI, gets around to implementing a full-featured distributed database capability.

Whenever considering a relational database product, it is useful not only to consider what a company has accomplished, but also what it plans to accomplish with the products it develops. When I asked Peter Tierney, RTI's vice president of Sales, and Gary Morgenthaler, RTI's president, about what to expect from RTI and *INGRES* in the future, they intentionally were vague. (Most companies tend to be that way, so not to worry). However, I did manage to glean the following from them and from discussions with other knowledgeable *INGRES* users and programmers:

1. A great deal of emphasis is being placed on improving *INGRES*' performance and to make the product a mainframe-class database product that will be capable of supporting mainframe-class applications (like transaction processing).
2. RTI is spending a lot of research time in graphics and human interfaces for *INGRES* to expand into other areas of use, not currently penetrated by relational database technology.
3. *INGRES* already uses some artificial intelligence techniques in its query optimizer, and it is logical to expect that AI extensions will play a significant role in *INGRES*' future.
4. Various users felt a strong need for the integration of document management, electronic mail, and other technologies such as voice and graphics storage within *INGRES*. RTI would not comment, but some of the engineering folks I talked to mentioned that such ideas were being looked into, and some were beyond the talking stage.
5. Strong hints were dropped about a PC version of *INGRES* at various meetings I have attended. When it will be available was not said, but often the remark was "soon."
6. RTI has set a corporate goal to get *INGRES* working in most of the major computing environments.

WHAT IMPRESSED ME the most about *INGRES* was not so much the product as the people at RTI. They were very attentive to my questions, even the tough ones, and when I asked them to let me alone to terrorize the product, they did. When I needed help (which was rare), their technical support personnel were very attentive and helpful. I also talked to other *INGRES* users about their experiences with RTI and what they thought about the product. Here is some of the general feedback I received:

1. Until V4.0, there were some serious complaints about performance. Most users now are satisfied and pleased that RTI is committing to *INGRES* performance enhancements on its major releases.
2. Technical support and phone assistance is good, but I was cautioned to specify the problem carefully so that I would get help faster. Apparently, the better the problem definition, the easier it is for the tech support people to figure out who to get hold of to help fix it.
3. There were some concerns that RTI may be growing too fast. While they subscribe to the "lean and mean" approach, some customers complained that at times there were inordinate delays on requests for information, distribution kits, and other items. Most customers said that the situation is getting better, but expect the problems to remain for a while.
4. Almost without exception, *INGRES* users liked the product very much. Those sites utilizing other database products in addition to *INGRES*, preferred to use *INGRES* in their applications due to better support and more flexibility in application creation.

In summary, I found *INGRES* to be flexible, powerful, and useful. It is full-featured and user friendly in most situations calling for a relational database. Caution should be exercised in the development cycle, however, to insure that good development habits don't die and that developed applications are supportable, expandable, and useful. There are situations where *INGRES* may not be as useful in some environments as some other relational (or quasi-relational) database, but only proper definition of the application will dictate which product to use.

Bottom line: Would I use *INGRES*? You bet.

Editor's Note: As we go to press, we have learned that RTI has announced INGRES/STAR, a heterogeneous distributed database.

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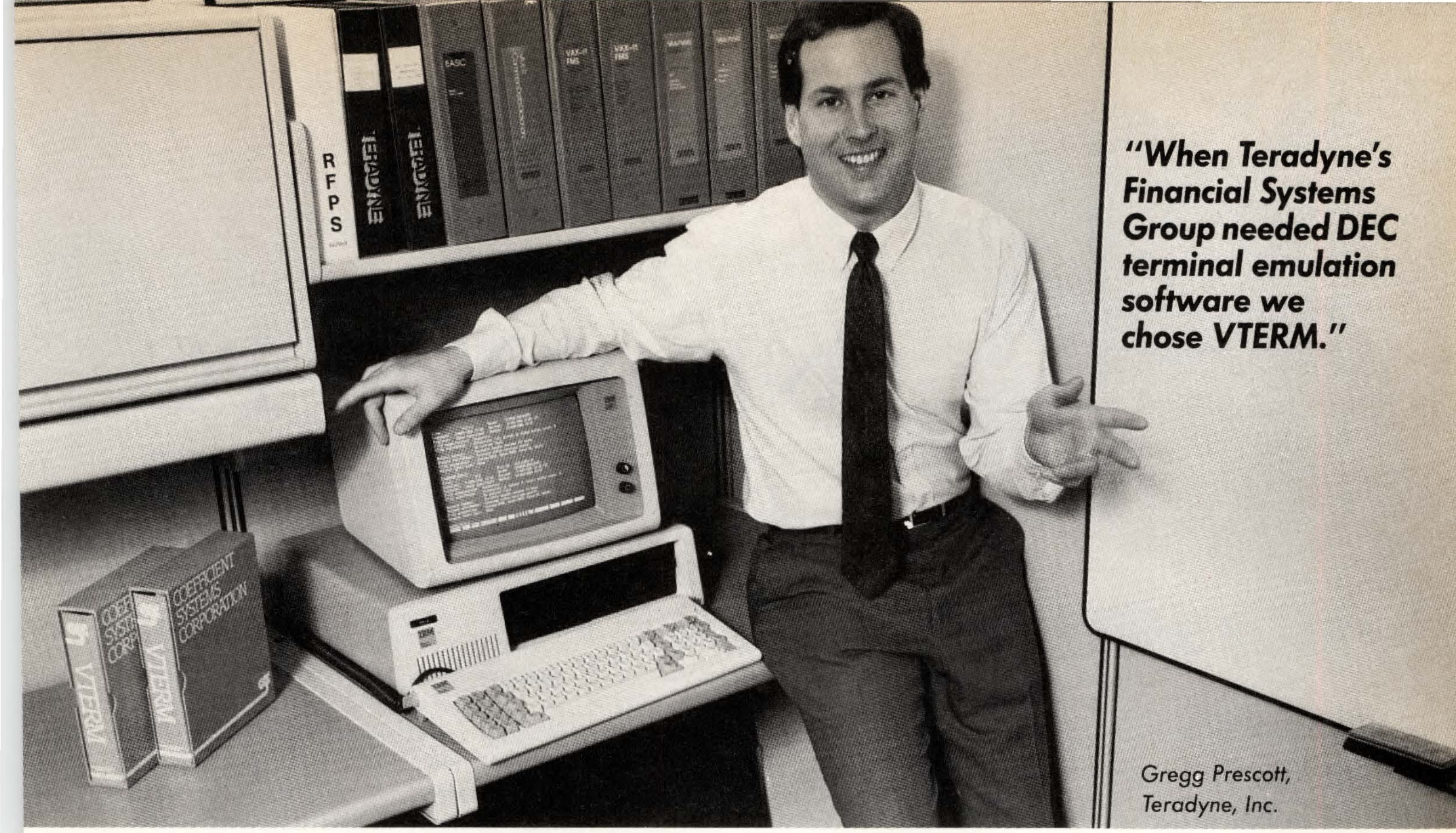

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PCs

LINK YOUR PC TO THE VAX

By Carl Marbach

***RAF* provides networking capability from the VAX to either IBM PCs and compatibles or DEC Rainbows.**

RAF, Remote Access Facility, from Datability Software Systems, Inc., provides your PC (or Rainbow) with multiple functionality when connected to a VAX. *RAF* turns the PC into a VT100 terminal, including mapping of the IBM keyboard to VT100 function keys; provides the MS-DOS user with complete access to the VMS file structure on the VAX; offers a "conversation" language that allows the MS-DOS user to construct automatic sequences that can be passed to the VAX (automatic LOGINs, for example); contains a facility to build an MS-DOS program that automatically will execute a DCL set of instructions on the VAX and return the result to the PC users screen; and provides subroutines that allow an experienced programmer to call VAX subroutines from an MS-DOS program. Phew . . !

Installing *RAF*

RAF is distributed on two floppy disks written at 48 TPI, which means that the same media can be used for both Rainbow and IBM PC (or compatible) distribution. The first diskette contains INSTALL, the PC installation program that senses which computer you are INSTALLing on, and uses the correct files. The second diskette contains sample conversation files, subroutines and other utilities. The program is copy protected and INSTALL can be run only twice. The procedure requires that you specify the default communications speed and the communications port to be used for communication with the VAX. The Rainbow always will use the COMM port, but you can use one of several with the IBM. The INSTALL program also is used to alter other standard settings within *RAF*, or to de-INSTALL *RAF*. *RAF* is always "on" when it is installed, and is automatically enabled at PC boot time.

The VAX installation, like the PC side, is simple and fast. The installation tape uses VMSINSTAL and needs about 5000 blocks temporarily, and 1600 permanently. *RAF* will create its own directory SYS$COMMON:[RAFPC] unless you choose to override this default. The system manager also will have to add RAFSTARTUP in the system startup file.

VT100 Emulation

As mentioned earlier, *RAF* can make your PC into a VT100. To begin emulation, just type <cntl><shift>D and your PC becomes a terminal communicating through the communications port. If you are connected to a VAX directly, a RETURN will elicit the USERNAME: prompt. Although the emulation is VT100, the VT200 keys on the keyboard are active, a definite plus over the Rainbow's normal emulation mode. If you are connected to a smart modem, you can give commands directly to the modem. To return to MS-DOS, type <cntl><shift>D again and you are back at MS-DOS. The VAX screen is saved in memory as is the MS-DOS screen so that you can toggle back and forth between the two operating systems and not lose anything that was displayed.

The emulation worked for us without any problems. We used EDT, several word pro-

FIGURE 1.

```
! Here when we were directly connected or when we have dialed a remote VAX   !
! and have been connected — in the latter case wait 1 sec before starting    !

Allset:   Sleep 1                                        ! Give the modem a rest
Direct:   Echo On                                        ! Let input show
          Ask %User /Please enter your account: /
          Echo Off                                       ! No more echo of input
          Ask %Password/Please enter the password for username %User:/
          Send/<13><13>/                                 ! Wake the VAX up with 2 <CR>s
          Timer 10                                       ! And set a maximum time to wait for
          Wait /Username:/                               ! The system prompt for "username."
          If TIMEOUT Goto Novax                          ! Trap a time out error
          Sender /%User/                                 ! Send the account name
          Wait /Password:/ /$/                           ! And wait for the next prompt
          If 2 Goto Runraf                               ! No password required . . .
          If TIMEOUT Goto Novax                          ! Check if the system didn't respond
          Sender /%Password/                             ! Send the password
          Timer 120                                      ! Allow 120 seconds to log in
          Wait /$ / /User authorization failure/
          If 1 Goto Runraf                               ! If "$" we're logged in
          If TIMEOUT Goto Novax                          ! Another problem not responding?
```

An RAF *conversion file.*

cessors, our own programs and VAX utilities. At 9600 baud, the emulator ran at about 80 percent as fast as the Rainbow's built-in emulator. The IBM PC version at a higher clock speed ran at full speed. Even on the Rainbow, the slower emulation speed was never a problem and was noticeable only when painting a full screen.

VMS File Access

VMS file access is where *RAF* separates itself from other similar products. While other packages use "virtual" floppy disks on the VAX, *RAF* uses the whole VAX native file structure, transparently to the MS-DOS user. While the virtual floppy concept means that you must use a VAX utility to move files to and from the virtual floppy, *RAF* gives you your entire VMS directory, along with other VMS directories or subdirectories to work with directly. No utilities are necessary to move files. When you do a DIR on an *RAF* device that is combined with a VAX account, you will see all of the VMS files in that account displayed the same way in which MS-DOS directories are displayed.

To use the file serving capability of *RAF*, it's necessary to use terminal mode to log in on the VAX, and then run the file serving utility RAFPC. Then exit (<cntl><shift>D) back to the PC and you will have access to the VMS directory via a regular MS-DOS disk name. The device name depends on your PC configuration, but it will follow the highest letter drive and include up to 16 *RAF* devices. If drives A: and B: are floppies, and drive E: is a Winchester, drive F: will be your first *RAF* device. To access the VMS file structure, simply access drive F: as a normal MS-DOS drive. You can COPY to it, get a DIRectory for it, store data on it, or run programs from it. Any VMS file in your directory can be read or written from MS-DOS directly.

Using the MS-DOS CD (change directory) command, you even can access subdirectories in your VMS user area. If you want to access different accounts on the VAX, it is easy to set up direct relations with multiple *RAF* devices:

A> CD F:[CARL.PC]
A> CD G:[TRACKING]
A> CD H:[SYS$MANAGER]

These MS-DOS commands would set up drive F: for the [CARL.PC] account, drive G: for the [TRACKING] account, and drive H: for the system manager's account. *RAF* will not violate any VAX security, so you have to have the proper privileges from the account running RAFPC on the VAX.

Backing up a hard disk on your PC is easy. Just set up an account on the VAX with an extension .BACKUP, set up a drive to point to it (CD J:[MARBACH.PC.BACKUP]) and then copy all the hard disk files to it:

```
A> COPY E:** J:
```

Make sure that you copy all the subdirectories on drive E: to a corresponding subdirectory on *RAF* drive J:.

I have found that PCs rarely are backed up often enough to ensure that data will not be lost in the event of a hardware or operator error. Some of this is due to the hardship of working with floppies, and part due to a casual attitude from PC users. With *RAF* it is easy to set up a very automated backup procedure that would copy all of your hard disk files to the VAX (where they should be safe because professionals are handling backup).

Using Terminal Mode

While the file server is running, you can enter VT100 emulation mode by typing <cntl><shift>S. This command will suspend RAFPC and log you into the same account RAFPC was running in, leaving you in terminal mode. When you are finished with your VT100 session and you have used SUSPENDED mode, logging out causes RAFPC to be run and you automatically are switched back to MS-DOS.

When you enter terminal mode by <cntl><shift>D and RAFPC is not running, it is called DIRECT terminal mode. When you enter terminal mode with a <cntl><shift>S and RAFPC is running, it is called SUSPENDED terminal mode. When you are in MS-DOS and RAFPC is running, you are in COMBINED mode. And, finally, when you are in MS-DOS and RAFPC is not running, you are in isolated mode.

The four modes are:

ISOLATED	JUST MS-DOS RUNNING
COMBINED	MS-DOS WITH RAFPC FILE SERVER RUNNING
DIRECT	VT100 MODE
SUSPENDED	VT100 MODE WITH RAFPC SUSPENDED

Executing Remote Programs

It is possible to have *RAF* execute a program on the VAX and return the results of running that program to your MS-DOS screen. A utility program called REMOTE is provided by *RAF* to accomplish this. Here is how it is used:

```
A> REMOTE BATCHQ "SHOW
  QUE/BATCH/FULL"
A>
```

This causes REMOTE to build an MS-DOS .EXE file, called BATCHQ.EXE, which when run will generate a batch queue display while you are in MS-DOS. *RAF* must be running on the VAX; i.e., you must be in COMBINED mode for this to work. The REMOTE program allows the "?" character to be substituted for at execution time:

```
A> REMOTE SHOW "SHOW ?"
A>
```

would generate a program allowing:

```
A> SHOW USERS
```

to generate a list of users on the VAX, to be displayed on the MS-DOS screen.

Using this facility, MS-DOS users could create and submit batch jobs for execution or run VAX programs directly from MS-DOS.

Conversation Files

The procedure of entering commands to the remote computer, and then acting on its responses, can be programmed by using *RAF*'s conversation file language. Using this language, you define commands to be sent to the VAX or to a modem, identify all the possible responses and take appropriate action. A conversation file mimics the commands you would type yourself.

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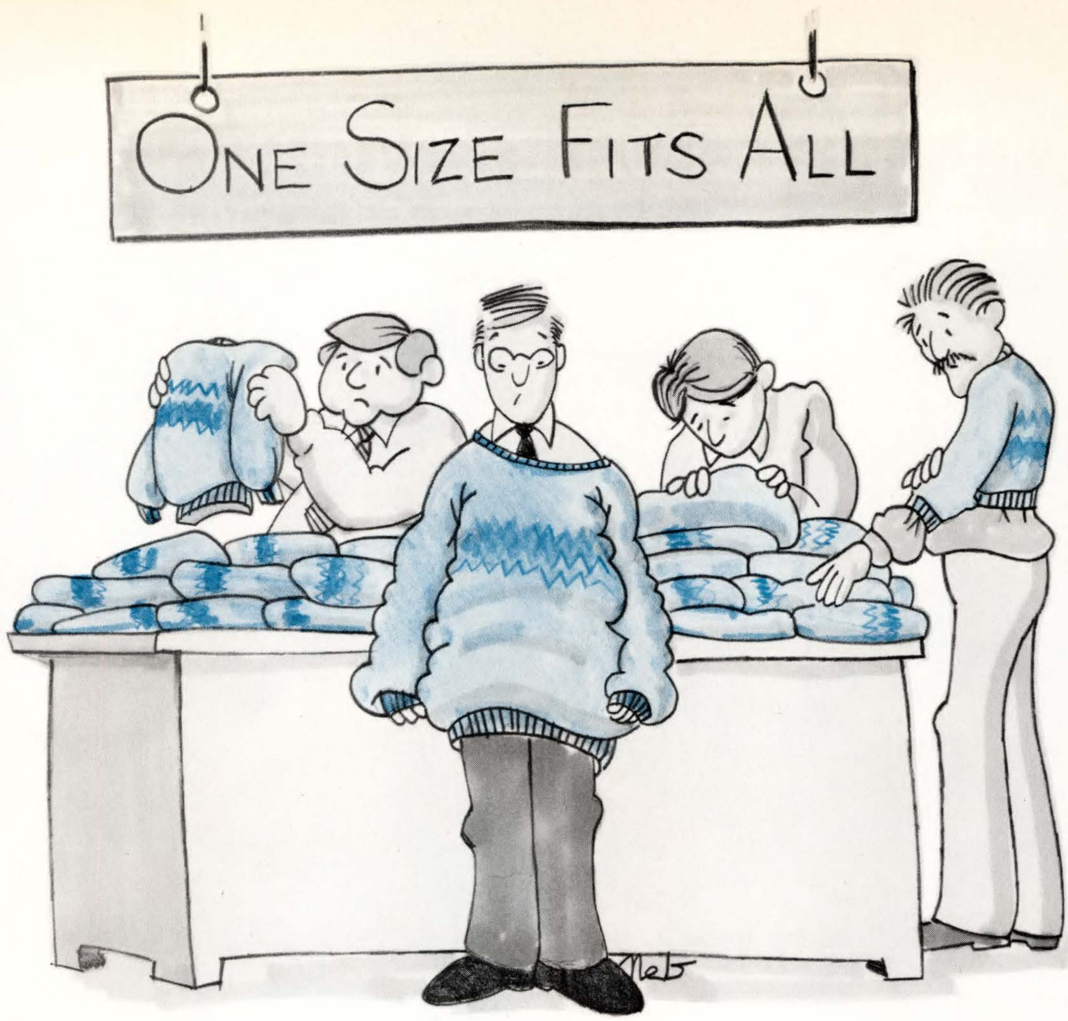

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Parameters, such as accounts or passwords, do not need to be hard coded into the conversation file, but can be prompted for when the file is executed.

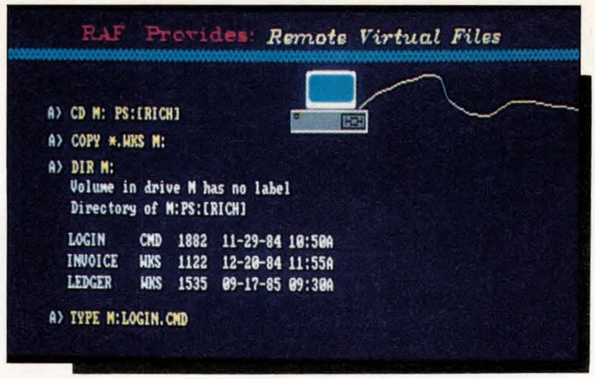
Several sample conversation files are included on the utility diskette and include RAFVAX.CNV, which automatically will log onto a VAX either with a Hayes modem or via a direct connect link prompting for account and password. The conversation command syntax is simple to use and allows you to program almost any interactive session with a remote computer or modem. Conversation files could be used with computer services like CompuServe or the SOURCE and could include complete autodial instructions for a modem.

RAF provides many standard subroutines that allow you, under program control, to do most of what you could do in conversation files. RAFLOGOUT, for instance, will stop RAFPC on the VAX and log you out. RAFLOGIN accomplishes the opposite: RAFLABEL invokes the execution of a conversation file, and there are many others. Almost all of the *RAF* capabilities are available from within your own MS-DOS programs.

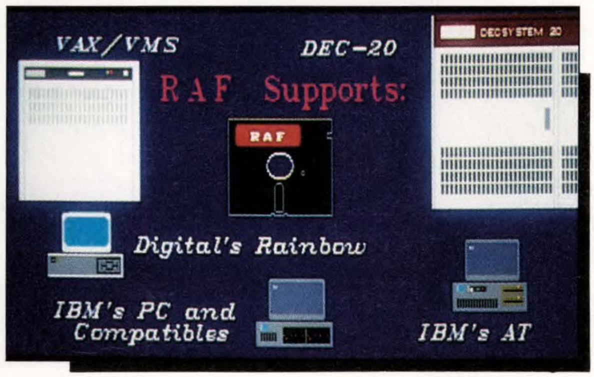
Experienced programmers can use *RAF*'s facilities to create their own MS-DOS programs in FORTRAN, PASCAL, BASIC and C that "CALL" subroutines that exist on the VAX instead of the PC. Your programs also can access data through an *RAF* device, but the idea of being able to have subroutines executed on the VAX is exciting.

If you have a database running on the VAX, a PASCAL program executing on the PC in MS-DOS could call a database subroutine on the VAX to access data in the VAX database. Other VAX programs are equally accessible using the subroutine calling capability.

What *RAF* does to make this work is straightforward. If you write a FORTRAN program that has the statement:
CALL GETDATA(A,B)



Commands keyed in on the PC manipulate the remote VAX. The last command, "type," can be used to print out the remote files specified.



RAF *supports a variety of hardware.*

using a utility called RAFSL, you create an *RAF* local (to MS-DOS) subroutine called GETDATA and a remote (on the VAX) subroutine that will be logically connected to GETDATA. For example:
LINK MAIN + GETDATA,DEF,,RAFLIB;

LINK is told to load your MAIN program, and subroutine GETDATA, as well as the library RAFLIB, and then to name the executable module DEF.EXE.

On the VAX you must create an executable program that contains all the subroutines you will be calling from the MS-DOS environment.

What happens is this: When you call a subroutine from the PC, *RAF* acts as a server to service that call. In turn, it will cause the VAX RAFPC program to call the proper subroutine, get the arguments (data) back, and then pass them to the *RAF* program on the PC. While the program thinks that it has called just one subroutine, in fact, *RAF* has passed the request to the VAX and then passed the data back to the PC program. Very neat.

Datability has provided a complete package allowing you to fully integrate your PCs and your VAX. You can access VMS directly or under program control. The MS-DOS user can be an experienced VAX user or, using pre-written conversation files, he can be a complete novice. VAX programs can be invoked from within MS-DOS and the results returned to the PC. File transfers are fast and error free, and things like backing up hard disks or sharing *LOTUS* spreadsheets are trivial.

There are things we can do with *RAF* that haven't been thought of yet. The mark of a good tool is that it exceeds its creator's expectations. *RAF* is good enough to do just that.

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Where Did All The Bits Go?

Ralph Stamerjohn

In 1971, the PDP-11's 16-bit address space seemed large enough for all but the most complex programming problems. Fifteen years later, the same PDP-11 16-bit address space seems barely enough for even the simplest programs. Where did all the bits go?

Major consumers of address space are the new functions that make our jobs as programmers much simpler. In 1971, our MACRO-11 programs issued their own direct QIOs to disk. Screen management consisted of double line feeds, so the last line was visible above the LA30 print head. Today's programmer uses FORTRAN, BASIC, COBOL, PASCAL, and C. Standard packages such as RMS and FMS eliminate the hassles of index file management and screen layout. Each new software layer makes our jobs as application programmers easier, but each also eats away at the 16-bit address space.

PDP-11s also physically can handle more data than the 1971 model. A large disk in 1971 was the RK05, which held 2.4 million bytes. An RK05 is one quarter the size of today's smallest Winchester disk. The J-11 processor is an order of magnitude faster and can handle 64 times the physical memory of the original PDP-11/20 model. Problems impractical 15 years ago now are easily within the capacity of the hardware.

Only the 16-bit virtual address space has remained constant. Fortunately, RSX provides many techniques to make the 16-bits stretch well beyond the original design. I have discussed these techniques in previous columns: In the June 1986 column, we looked at task builder features that let user code and software packages share the same virtual address space. Last month's column covered the Program Logical Address Space (PLAS) Directives. These RSX executive directives give a program complete control of its virtual address space. This article completes the three-part series by looking at a subroutine package that manages a region using 32-bit addresses and how the package has been used for two different applications.

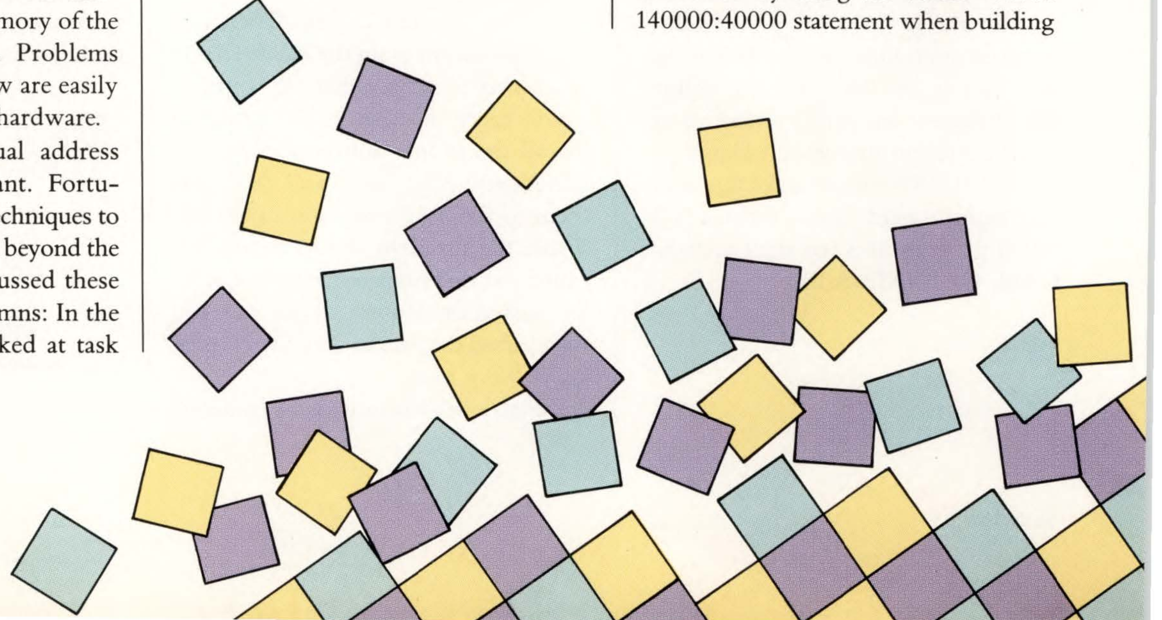
> ***Each new software layer makes our jobs as application programmers easier, but each also eats away at the 16-bit address space.***

THE PLAS32 PACKAGE consists of a set of FORTRAN-callable subroutines that create a dynamic region and move a window within the region (see Program 1). The package uses INTEGER*4 variables to hold addresses within the region. The first byte in the region is address 0. The size of the region, and thus maximum address, is set when the region is created. The region may be directly addressed or used as a dynamically allocated pool.

FORTRAN routines can gain direct access to data in the region by using a named common area and the task builder VSECT option. For example, an 8-KW common area window is declared using the following statement:

```
COMMON /VIEW/DATA(8192)
INTEGER*2 DATA
```

The common area VIEW now can be mapped to virtual addresses 140000 to 177777 by using the VSECT=VIEW: 140000:40000 statement when building



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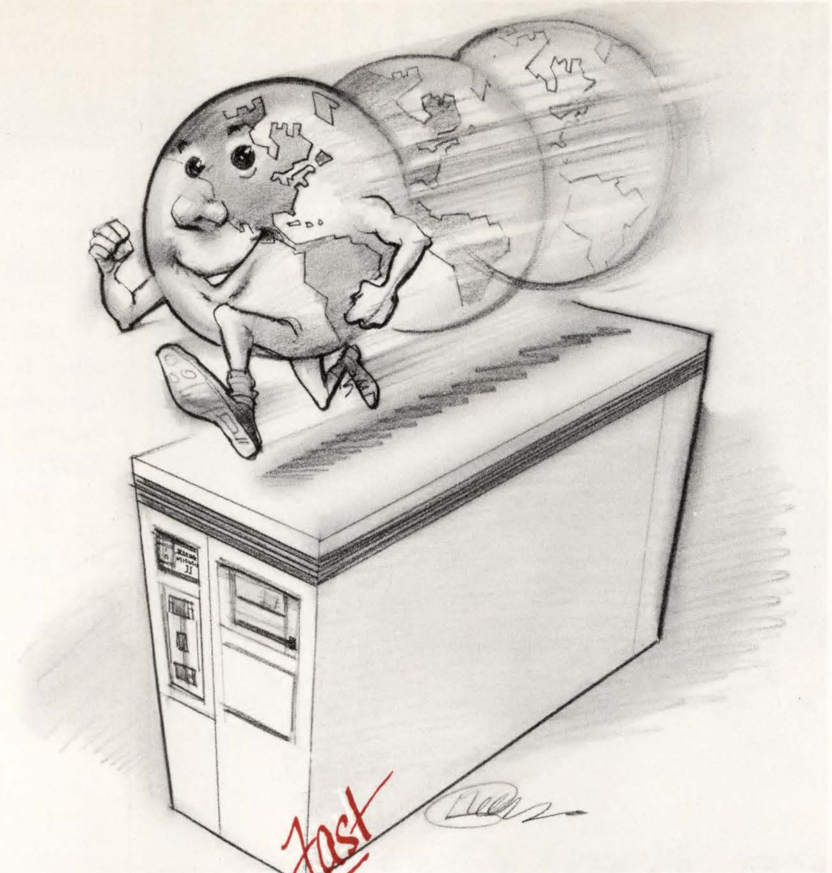

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Both PDP-11 and VAX versions of the packages use extended virtual memory features to greatly outperform systems with task space or run-time imposed limitations. The PDP-11 version uses a self-reorganizing ISAM management and the VAX version used DEC's standard RMS to further aid in system performance.

For VAX systems, you don't even need run-time software. The packages run in native mode under both VMS and Micro-VMS (Version 4.0 or later).

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the task. The region size, window, and window size then are passed to the *PLAS32* package when the dynamic region is initialized. Note the region size is in 32-word units so the following statement creates a 64-KW region that will be accessed through the previous common:

```
status=INITDR(2048,DATA,8192*2)
```

INITDR (see Program 2) can be called as either a subroutine or a function. As a function, INITDR returns a value of 1 for success and a negative directive status code for failure.

The features of the PLAS32 package are best shown by two examples. The first application is a control system that uses several different types of dynamic data records. The following code segment shows how one type of new record was created and added to the front of a list:

```
INTEGER*4 NEXT
INTEGER*2 RECORD(100)
EQUIVALENCE (NEXT,DATA(1)),
 (RECORD(1),DATA(3))

INTEGER*4 ADDR,HEAD
CALL ALOCDR(ADDR,204)
CALL MAPDR(ADDR,204)
NEXT = HEAD
HEAD = ADDR
```

THE ALOCDR SUBROUTINE (see Program 3) allocates a 204-byte section of the region and returns its 32-bit address to ADDR (see Program 4). The MAPDR subroutine (see Program 5) positions the mapping window such that the first element of DATA addresses the first word in the allocated segment. By using the EQUIVALENCE statement to map different variables to the common area VIEW, we now have direct access to the desired record. Note the PLAS directives can move windows within only a

32-word granularity. The addresses returned by ALOCDR always will fall on a 32-word boundary. MAPDR also will round the supplied address down to a 32-word boundary.

The other technique to use PLAS32 is to address directly the dynamic region. An example of this technique is a sort. In this case, the sort package operates on elements that are 15 words long. The sort element INDEX is accessed by the following code segment:

```
COMMON /VIEW/DATA(8192)
INTEGER DATA

INTEGER*4 ADDR
INTEGER*2 I,INDEX
PARAMETER (ISIZE = 15*2)

ADDR = INDEX * ISIZE
I = IDXDR(ADDR,ISIZE)
DATA(I+0) = . . .
DATA(I+1) = . . .
```

The IDXDR function (see Program 6) returns the FORTRAN INTEGER*2 array index to the start of the specified 32-bit address. The window is only remapped if the specified address is outside the current window (see Program 7). The mechanism can be somewhat faster than the MAPDR call which always forces a mapping call.

There are several possible extensions to the PLAS32 package that are not shown, in order to present a simple, clean package. PLAS32 could be modified to use multiple windows so separate sets of data can view at once. Similarly, multiple regions could be supported. A different initialization routine could access an existing region. This would allow one task to pass a region to another task using the send-by-reference directives. Finally, the fast mapping feature of RSX-11M-PLUS V3.0 greatly would increase execution speed.

Ralph Stamerjohn is principal engineer at Meridian Technology Corporation, St. Louis, Missouri.

PROGRAMS FOLLOW:

PROGRAM 1.

```
        .TITLE  PLAS32 - 32-Bit PLAS Region
        .SBTTL  PLAS32 - Title Page
        .IDENT  /V01.00/
;
; Fortran-callable routines to create dynamic region and manage using
; 32-bit address (I*4). The functions allow direct address or dynamic
; allocation.
;
; Author:       R.W. Stamerjohn         Meridian Technology Corporation
;
; Macro Library Calls:
;
        .MCALL  CRRG$S                  ;Create region
        .MCALL  CRAW$S                  ;Create address window
        .MCALL  MAP$S                   ;Map address to region
        .MCALL  RDBBK$                  ;Define region descriptor
        .MCALL  WDBBK$                  ;Define window descriptor
;
INCSIZ  = 77                            ;Allocation increment

REGION: RDBBK$                          ;Define region descriptor
WINDOW: WDBBK$                          ;Define window descriptor
```

PROGRAM 2.

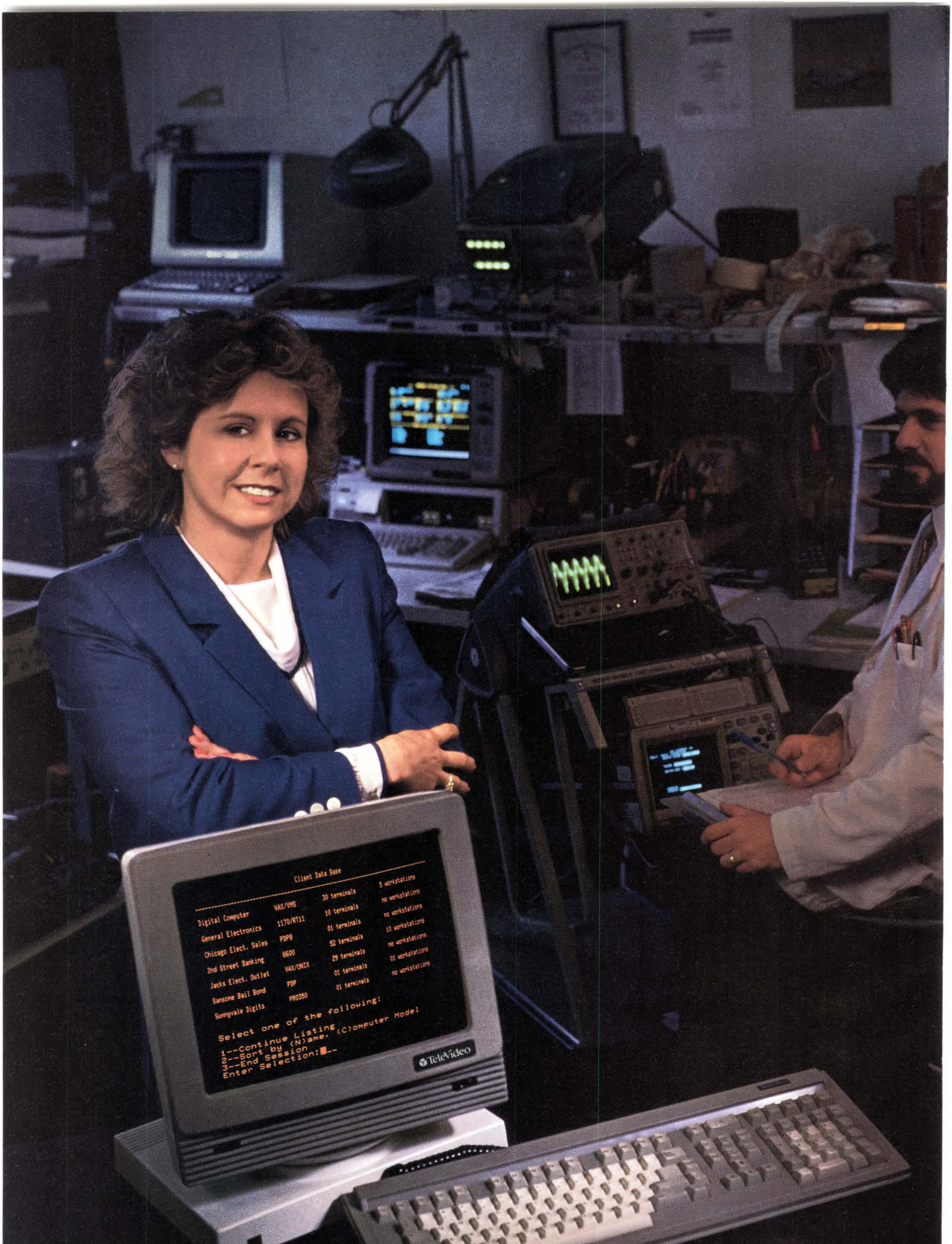
```
        .SBTTL  INITDR * Initialize Region
;
;+
; Create the dynamic region and initialize for dynamic allocation.
;
; Call with:    status = INITDR(size,virt,len)
;
;               size    -> Integer region size (32 word chunks)
;               virt    -> Starting address of virtual section
;               len     -> Length of virtual section (bytes)
;
; Exit with:    Returns integer status set to success (1) or the Directive
;               Status error code (negative).
;-
;
INITDR::                                ;Ref. label
;
; Get size of region to create.
;
        MOV     @2(R5),REGION+R.GSIZ    ;Store size of region to create
;
; Set initial status bits and create the region.
;
        MOV     #RS.MDL!RS.ATT!RS.WRT!RS.RED,REGION+R.GSTS
        CRRG$S  #REGION                 ;Create the region
        BCS     9999$                   ; If CS - error, exit
;
; Setup window block to map the first part of the region.
;
        MOV     #IE.ALG,$DSW            ;Preset error code
        MOV     4(R5),R0                ;Get virtual address
        BIT     #017777,R0              ;Is it on correct boundary
        BNE     9999$                   ; If NE - no, error

        ASH     #-13.,R0                ;Shift APR address
        BIC     #177770,R0              ;Clear any garbage
        MOVB    R0,WINDOW+W.NAPR        ;Store the APR number
        MOV     @6(R5),R0               ;Get size of window
        ASH     #-6,R0                  ;Convert to blocks
        BIC     #176000,R0              ;Clear extraneous bits
        MOV     R0,WINDOW+W.NSIZ        ;Store size of window
        MOV     REGION,WINDOW+W.NRID    ;Store region ID
        CLR     WINDOW+W.NOFF           ;Clear starting address to map
        CLR     WINDOW+W.NLEN           ;Clear size to map
        MOV     #WS.MAP!WS.WRT!WS.64B,WINDOW+W.NSTS
```

```
;
; Map window into first part of region.
;
        CRAW$S  #WINDOW                 ;Create address window and map
        BCS     9999$                   ; If CS - error, exit
;
; Map window into first part of region.
;
        MAP$S   #WINDOW                 ;Create address window and map
        BCS     9999$                   ; If CS - error, exit
;
; Create initial pool space as needed by pool type. Return with R4,R5 set to
; top of allocated pool space and R3 to pool cell allocation increment.
;
        MOV     #INCSIZ+1,R0            ;Set minumum allocation size
;
; Create pool header cell and link to cell with rest of allocated pool.
;
        CLR     R1                      ;Get starting pool cell
        CLR     R2                      ; ... at VM_address = 0
        CALL    MAPWDW                  ;Map pool header
        ADD     R0,R2                   ;Get address of first free cell
        MOV     R1,(R3)+                ;Store link in header cell
        MOV     R2,(R3)+                ; ... as a double word pointer
        CLR     (R3)+                   ;Mark header cell of size 0
        CLR     (R3)+                   ; ... in double precsision

        CALL    MAPWDW                  ;Map free cell header
        CLR     (R3)+                   ;Set end of free list
        CLR     (R3)+                   ; ... as a double word pointer

        MOV     REGION+R.GSIZ,R1        ;Get size of region to create
        DEC     R1                      ; as size minus header
        CLR     R0                      ;Set actual size of region
        ASHC    #6,R0                   ; ... as 32-bit number
        MOV     R0,(R3)+                ;Store free space size
        MOV     R1,(R3)+                ; ... as 32-bit number

9999$:  MOV     $DSW,R0                 ;Get error status
        RETURN                          ;Return to caller
```

PROGRAM 2. cont'd

```
        .SBTTL  ALOCDR * Allocate Buffer
;
;+
; Allocate buffer (32-bit address) from  region pool.  This routine
; allocates a VM buffer by searching the free list for an available
; buffer.  The  allocation  is  by first fit from the bottom of the
; available buffer space.
;
; Call with:    CALL ALOCDR(addr,size)
;
;               size    -> Size to allocate in bytes (I*2 value)
;
; Exit with:    If no buffer space is available, addr is set to zero.
;
;               addr    -> Allocate buffer address (I*4 variable)
;-
ALOCDR::                                ;Ref. label
        MOV     2(R5),R0                ;Get return variable
        CLR     (R0)+                   ;Preset allocation failure
        CLR     (R0)+                   ; ...
;
; Process allocation size and set allocation increment for mapping use.
```

PROGRAM 3.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General Electronics 1170/RT11 10 terminals no workstations
Chicago Elect. Sales PDP8 01 terminals no workstations
2nd Street Banking 8600 52 terminals 10 workstations
Jacks Elect. Outlet VAX/UNIX 29 terminals no workstations
Sansone Bail Bond PDP 01 terminals 01 workstations
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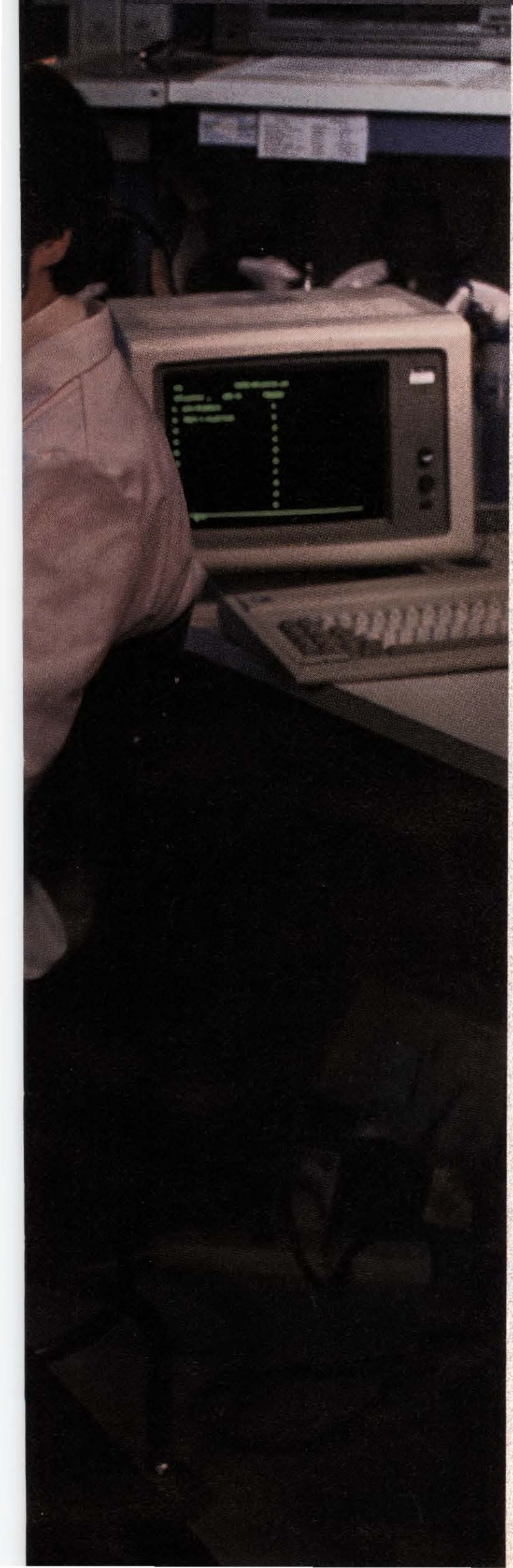

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ENTER 259 ON READER CARD

PROGRAM 3. cont'd

```
;
        MOV     @4(R5),R0               ;Get requested size.
        MOV     R0,R4                   ;Copy requested size
        MOV     #INCSIZ,R0              ;Get incremental buffer size
        ADD     R0,R4                   ;Round allocation size to
        BIC     R0,R4                   ; boundary of pool
        INC     R0                      ;Get mapping size
;
; Initialize starting VM address to header cell.
;
        CLR     R1                      ;Initialize VM address
        CLR     R2                      ; ... to header cell
        CLR     -(SP)                   ;Save space on stack for previous
        CLR     -(SP)                   ; ... free cell pointer
;
; Map current cell and check if sufficient space for allocation.
;
1000$:  CALL    MAPWDW                  ;Map the current cell
        TST     4(R3)                   ;Is cell large enough?
        BNE     2000$                   ; If NE - yes, continue
        CMP     6(R3),R4                ;Is cell large enough?
        BHIS    2000$                   ; If HIS - yes, continue
;
; Test for another free buffer and if none, attempt to allocate more pool.
;
1100$:  TST     (R3)                    ;Is there another free buffer?
        BNE     1200$                   ; If NE - yes, continue
        TST     2(R3)                   ;Is there another free buffer?
        BEQ     9999$                   ; If EQ - no, all done
;
; Advance to next cell in free list and loop.
;
1200$:  MOV     R2,2(SP)                ;Copy address of this cell
        MOV     R1,(SP)                 ; ... in case we must relink
        MOV     (R3)+,R1                ;Get next cell address
        MOV     (R3)+,R2                ; ... in free pool list
        BR      1000$                   ; And retry allocation
;
; Allocate cell and update free list pointers.
;
2000$:  SUB     R4,6(R3)                ;Subtract allocated space from
        SBC     4(R3)                   ; ... size of current cell

        ADD     6(R3),R2                ;Get virtual address of the
        ADC     R1                      ; ... new allocated buffer
        ADD     4(R3),R1                ; ... from end of free buffer
        MOV     2(R5),R4                ;Get the return address
        MOV     R2,(R4)+                ;Return allocated VM address
        MOV     R1,(R4)+                ; ... for return to caller

        TST     4(R3)                   ;Is there still space in free buffer?
        BNE     9999$                   ; If NE - still some space left
        TST     6(R3)                   ;Check low word for space?
        BNE     9999$                   ; If NE - yes, continue on
;
; Used up a free buffer entirely, map next free buffer into previous one.
;
        MOV     (R3)+,-(SP)             ;Save address of next free buffer
        MOV     (R3)+,-(SP)             ; ... for later restore
        MOV     4(SP),R1                ;Get address of previous buffer
        MOV     6(SP),R2                ; ...
        CALL    MAPWDW                  ;Map this buffer
        MOV     (SP)+,2(R3)             ;Store address of new VM free
        MOV     (SP)+,0(R3)             ; ... pool in previous buffer
;
; Exit routine.
;
9999$:  ADD     #4,SP                   ;Clean the stack
        RETURN                          ;Return to caller
```

PROGRAM 4.

```
        .SBTTL  DEACDR * Deallocate Buffer
;
;+
; Deallocate buffer (32-bit address) to region pool.
;
; Call with:    CALL DEACDR(addr,size)
;
;               addr    -> Allocate buffer address (I*4 variable)
;               size    -> Size to allocate in bytes (I*2 value)
;
; Exit with:    Buffer returned to pool. No check is made for a bad
;               deallocation.
;-

DEACDR::                                ;Ref. label
;
; Process deallocation size and set cell allocation increment for mapping.
;
        MOV     @4(R5),R0               ;Get the return size
        MOV     R0,R4                   ;Copy requested size
        MOV     #INCSIZ,R0              ;Get incremental buffer size
        ADD     R0,R4                   ;Round allocation size to
        BIC     R0,R4                   ; boundary of pool
        INC     R0                      ;Get mapping size
;
; Save virtual address of buffer we should return.
;
        MOV     2(R5),R3                ;Get address of address
        MOV     (R3)+,R2                ;Get the return address
        MOV     (R3)+,R1                ; ... and the high part
        MOV     R2,-(SP)                ;Save virtual address we
        MOV     R1,-(SP)                ; ... are returning to pool
;
; Initialize starting VM address to header cell.
;
        CLR     R1                      ;Initialize VM address
        CLR     R2                      ; ... to header cell
;
; Map current cell and check if allocate space belongs here.
;
1000$:  CALL    MAPWDW                  ;Map current cell

        TST     (R3)                    ;Is this end of list
        BNE     1100$                   ; If NE - no, skip
        TST     2(R3)                   ;Is this end of list
        BEQ     2000$                   ; If EQ - yes, insert

1100$:  CMP     (SP),(R3)               ;Check high part of next address
        BHI     1200$                   ; If HI - buffer does not fit
        BLO     2000$                   ; If LO - buffer fits in here
        CMP     2(SP),2(R3)             ;Check low part of address
        BLO     2000$                   ; If LO - buffer fits in here
;
; Advance to next buffer in free list and repeat check.
;
1200$:  MOV     (R3)+,R1                ;Get next virtual address
        MOV     (R3)+,R2                ; ... in free pool list
        BR      1000$                   ;And loop
;
; Found place to return buffer. First check if buffer falls at end of
; current buffer. If so, update size of current buffer.
;
2000$:  SUB     6(R3),2(SP)             ;Back up returning buffer
        SBC     (SP)                    ; ... in double precsision
        SUB     4(R3),(SP)              ; ... to check if new buffer is at end
        CMP     R1,(SP)                 ;Does the new buffer append to current?
        BNE     2100$                   ; If NE - no, continue
        CMP     R2,2(SP)                ;Check low part of address
        BNE     2100$                   ; If NE - no, continue
        ADD     R4,6(R3)                ;Add returning size to current buffer
        ADC     4(R3)                   ; ... in double precision
```

PROGRAM 4. cont'd

```
        BR      2200$                   ;And continue
;
; Buffer is non-contiguous to current, store pointer to new buffer and
; map new buffer to next free slot. First restore virtual address.
;
2100$:  ADD     6(R3),2(SP)             ;Get actual VM address back
        ADC     (SP)                    ; ... by reversving process
        ADD     4(R3),(SP)              ; ... in double precsision
        MOV     (R3)+,-(SP)             ;Save virtual address of next
        MOV     (R3)+,-(SP)             ; ... free buffer
        MOV     6(SP),-(R3)             ;Store virtual address of
        MOV     4(SP),-(R3)             ; ... new free buffer
        MOV     (R3)+,R1                ;Copy virtual address of
        MOV     (R3)+,R2                ; ... new free buffer
        CALL    MAPWDW                  ;Map this address
        MOV     (SP)+,2(R3)             ;Link in address of next buffer
        MOV     (SP)+,0(R3)             ; ... in free list
        CLR     4(R3)                   ;Store size of deallocated buffer
        MOV     R4,6(R3)                ;Store size of deallocated buffer
;
; Check if new buffer is directly in front of next buffer in free list.
; If so, make one allocation from the two.
;
2200$:  MOV     R2,-(SP)                ;Copy current buffer address
        MOV     R1,-(SP)                ; ... as double word address
        ADD     6(R3),R2                ;Get end of current buffer
        ADC     R1                      ; ... by adding in size of buffer
        ADD     4(R3),R1                ; ... in double precision
        CMP     R1,(R3)+                ;Does next link abut this segment?
        BNE     2210$                   ; If NE - no, continue
        CMP     R2,(R3)+                ;Does next link abut this segment?
        BNE     2210$                   ; If NE - no, continue
        MOV     -(R3),R2                ;Get address of next segment
        MOV     -(R3),R1                ; ... as a double word
        CALL    MAPWDW                  ;Map this address
        ADD     #10,R3                  ;Advance to bottom
        MOV     -(R3),-(SP)             ;Save size of next segment
        MOV     -(R3),-(SP)             ; ... as a double word
        MOV     -(R3),-(SP)             ;Save link to next segment
        MOV     -(R3),-(SP)             ; ... as a double word
        MOV     10(SP),R1               ;Get old segment address back again
        MOV     12(SP),R2               ; ... as a double word
        CALL    MAPWDW                  ;Map old address back
        MOV     (SP)+,(R3)+             ;Store link to next free cell
        MOV     (SP)+,(R3)+             ; ... as a double word
        ADD     (SP)+,(R3)+             ;Update size of this cell
        ADD     (SP)+,(R3)              ; ... add in low part of size
        ADC     -(R3)                   ; ... in double precision
2210$:  ADD     #4,SP                   ;Clean stack
;
; Exit routine.
;
9999$:  ADD     #4,SP                   ;Clean stack
        RETURN                          ;Return to caller
```

PROGRAM 5.

```
        .SBTTL  MAPDR * Map 32-Bit Address to Window Beginning
;
;+
; Map the 32-bit address to a 16-bit address within the window,
;
; Call with:    CALL MAPDR(addr,size)
;
;               addr    -> 32-bit address to map (I*4 variable)
;               size    -> Size of area to map   (I*2 variable)
```

```
;
; Exit with:    Beginning of window positioned to 32-bit address
;-

MAPDR::                                     ;Ref. label
        MOV     2(R5),R0                    ;Get buffer address
        MOV     (R0)+,R2                    ;Get the address (low)
        MOV     (R0)+,R1                    ;Get the address (high)
        MOV     @4(R5),R0                   ;Get the size to map
        MOV     #-1,WINDOW+W.NOFF           ;Force a remapping
        CALL    MAPWDW                      ;Map the virtual address
        RETURN                              ;Return to caller
```

PROGRAM 5. cont'd

```
        .SBTTL  IDXDR * Map 32-Bit Address to Window Offset
;
;+
; Map the 32-bit address to a 16-bit address within the window, return
; a window offset as a Fortran I*2 array index.
;
; Call with:    index = IDXDR(addr,size)
;
;               addr    -> 32-bit address to map (I*4 variable)
;               size    -> Size of area to map   (I*2 variable)
;
; Exit with:    Specific area mapped, index return to 'addr' position.
;-

IDXDR::                                     ;Ref. label
        MOV     2(R5),R0                    ;Get buffer address
        MOV     (R0)+,R2                    ;Get the address (low)
        MOV     (R0)+,R1                    ;Get the address (high)
        MOV     @4(R5),R0                   ;Get the size to map
        CALL    MAPWDW                      ;Map the virtual address

        MOV     R3,R0                       ;Copy the virtual address
        SUB     WINDOW+W.NBAS,R0            ;Get offset in window (byte)
        ASR     R0                          ;Get offset in window (word)
        INC     R0                          ;Get offset in window (FORTRAN)
        RETURN                              ;Return to caller
```

PROGRAM 6.

```
        .SBTTL  MAPWDW * MAP VM BUFFER
;
;+
; Call with:    JSR     PC,MAPWDW
;
;               R1,R2   -> Buffer address
;               R0      -> Buffer size
;
; Exit with:    R3      -> Mapped buffer address
;
;               Caller expects R0-R2,R4-R5 to be saved.
;-
MAPWDW:                                     ;Ref label
;
; Correctly position calling arguments.
;
        MOV     R1,-(SP)                    ;Save high address
        MOV     R2,-(SP)                    ;Save low address
        MOV     R0,-(SP)                    ;Save size to map
        MOV     R1,R0                       ;Copy virtual address
        MOV     R2,R1                       ; ...
        MOV     (SP),R2                     ;Get size to map
;
; See if requested buffer is mapped by current window?
;
```

PROGRAM 7.

PROGRAM 7. cont'd

```
        MOV     WINDOW+W.NOFF,R3        ;Get start of current window
        ASHC    #-6,R0                  ;Get start of buffer in 32-word blocks
        CMP     R1,R3                   ;Is start of buffer mapped?
        BLO     1000$                   ; If LO - no, map buffer
        ADD     #INCSIZ,R2              ;Round size to next 32-word block
        ASH     #-6,R2                  ;Get size in 32-word blocks
        ADD     R1,R2                   ;Get end of buffer in 32-word blocks
        ADD     WINDOW+W.NLEN,R3        ;Get end of current window
        CMP     R2,R3                   ;Is end of buffer mapped?
        BLOS    2000$                   ; If LO - yes, continue
;
; Map wanted buffer to current window.
;
1000$:  MOV     R1,WINDOW+W.NOFF        ;Set new start of buffer
        CLR     WINDOW+W.NLEN           ;Set to map as much as possible
        MAP$S   #WINDOW                 ;Map window to buffer
;
; Get offset in window to desired buffer.
;
2000$:  MOV     WINDOW+W.NOFF,R1        ;Get current offset into window
        ASH     #6,R1                   ; as low part of 32-bit address
        MOV     2(SP),R3                ;Get virtual address we want
        SUB     R1,R3                   ;Get offset into region
        ADD     WINDOW+W.NBAS,R3        ;Get virtual address in window
        MOV     (SP)+,R0                ;Restore size
        MOV     (SP)+,R2                ; ...
        MOV     (SP)+,R1                ; ...
        RETURN                          ;Return to caller

        .END
```

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LET'S C NOW

The Run-Time Library — Part III

By Rex Jaeschke

Strictly speaking, **stdio.h** must be inluded whenever a program calls any of the run-time library I/O functions. Consider the following example, similar to the first program listed in K&R:

```
main()
{
        printf("Hi there.\n");
}
```

This program should run without error on most C implementations. However, it would be *more* correct if it had contained **#include <stdio.h>** at the beginning. (In fact, according to the proposed ANSI Standard, this is necessary to make the program a conforming one.) One of the primary reasons for including standard headers is to declare the return type of each contained function. Since **printf** has a return type of **int**, the default return type, it need not be explicitly declared. However, doing so is a recommended practice, particularly since ANSI-conforming versions of **stdio.h** WILL contain a prototype for **printf** (as well as all other I/O functions that return type **int**).

Often, **stdio.h** is used to contain a number of declarations and macro definitions. The most interesting ones will be covered in detail.

The File Table

Each C program built to run on a hosted system (one with an operating system) typically will have the ability to open some number of files for input, output or both. While the number of files that simultaneously can be open is implementation-defined, the format of the table used to keep track of the status of each open file is fairly similar across implementations. A typical **stdio.h** might contain something like the following (inspect the version that is supplied with your compiler):

```
struct _filebuf {
        char *_bufptr;   /* current buffer pointer */
        int _count;      /* current byte count */
        char *_base;     /* base address of I/O buffer */
        char _flags;     /* control flags */
        char _fileno;    /* file number */
        /* ... */
};

#define _MAXFILE  20
extern struct _filebuf _iob[_MAXFILE];
typedef struct _filebuf FILE;
```

In this example, the maximum number of simultaneously open files is 20, as defined by **_MAXFILE**. Each of these files has a current context which includes such things as location of buffer, size of the buffer, current position within that buffer, type of buffering, etc. Each file context is defined by the structure **_filebuf** which may contain members other than those shown here. The array **_iob** is declared to be an array of 20 structures of type **_filebuf**, where each array element corresponds to one of the 20 possible files.

Note that **_iob** is declared, NOT defined. That is, the **extern** class is used to declare that the space for this array has been defined elsewhere and that we only are declaring that fact in **stdio.h**. Actually, the table is defined in an object module which is linked in with an application program. On some systems, this startup module must explicitly be named on the linker command-line. On others, it is automatically loaded from an object library. In any case, the important thing to realize is that as the programmer, you cannot change the size of this table even though you can change the value of **_MAXFILE**. For example, if you wanted 30 open files, changing **_MAXFILE** to 30 would not work. Therefore, you are limited to that maximum number provided for by the compiler, unless you are supplied with the source to this startup code.

> *Editor's note:* This month Mr. Jaeschke completes his three-part series on the C Run-Time Library. In particular, he discusses some of the functions in **stdio.h** and **FILE** pointers.

FILE Pointers

Each element in the array **_iob** contains the current context of a file and, by using **typedef struct _filebuf FILE;**, we have invented a synonym for this context, namely **FILE**. That is, the type **FILE** is the type of any entry in the file table. As the exact type and size of a file's context data varies from one implementation to the next, programmers always should access files using the type

FILE rather than a type such as **struct _filebuf**.

Since **FILE** is the type of a file's context (or simply, the type of a file), then **FILE *** is a declaration of a pointer to a file. For example:

```
#include <stdio.h>

main()

{
        FILE *output;

        output = fopen("test.dat","w");
        if (output == NULL) {
                printf("error opening file test.dat\n");
                exit(1);
        }

        if (fputs("this is a record", output) != 0) {
                printf("error writing file test.dat\n");
                exit(1);
        }

        if (fclose(output) != 0) {
                printf("error closing file test.dat\n");
                exit(1);
        }
}
```

The variable **output** is a file pointer that is the type returned by the **fopen** function. It also is the type of the second argument to **fputs** and the lone argument to **fclose**. (Note that the return value of **fputs** denoting success may vary. It may be zero, **!EOF**, or some other value. ANSI requires zero.)

Standard File Pointers

Three special file pointers, **stdin**, **stdout** and **stderr**, represent standard input (typically the keyboard), standard output (typically the screen or printer), and standard error (also typically directed to the screen or printer). On UNIX, MS-DOS and some other systems, these special files are opened by the operating system whenever a program is run. On other systems, these files are opened by the program startup code added at link-time. These files typically are declared using something like:

```
#define  stdin    (&_iob[0])
#define  stdout   (&_iob[1])
#define  stderr   (&_iob[2])
```

Since **_iob[i]** has type **struct _filebuf** (and hence type **FILE**), taking the address of **_iob[i]** produces a pointer to **FILE**. Therefore, **stdin**, **stdout**, and **stderr** have type **FILE ***. These names are merely synonyms for these three file pointers; they are NOT variables. In particular, they are not lvalues. Therefore, they can never be the destination of an assignment statement such as:

```
stdin = (expression);
```

Since the address of the table entry **_iob[0]** is fixed at compile-time, it cannot be changed just as the name of an array is not an lvalue.

In many implementations, the standard files occupy entries 0, 1 and 2 of the file table leaving **(_MAXFILE-3)** entries for user-opened files.

Since the standard file pointers and **output** point to entries in the table of structures, the members within those entries can be accessed directly, and this is precisely what some of the library functions do. While it is recommended that applications not rely on the format and contents of this table or any entry within it, it can be useful to understand just how library routines do so.

The FILE Flags Field

The **_flags** field typically contains a number of values that indicate the file's open mode, buffering type, whether the previous I/O action resulted in an error or end-of-file, and other properties. Some of the bits within **_flags** may be defined in **stdio.h** as:

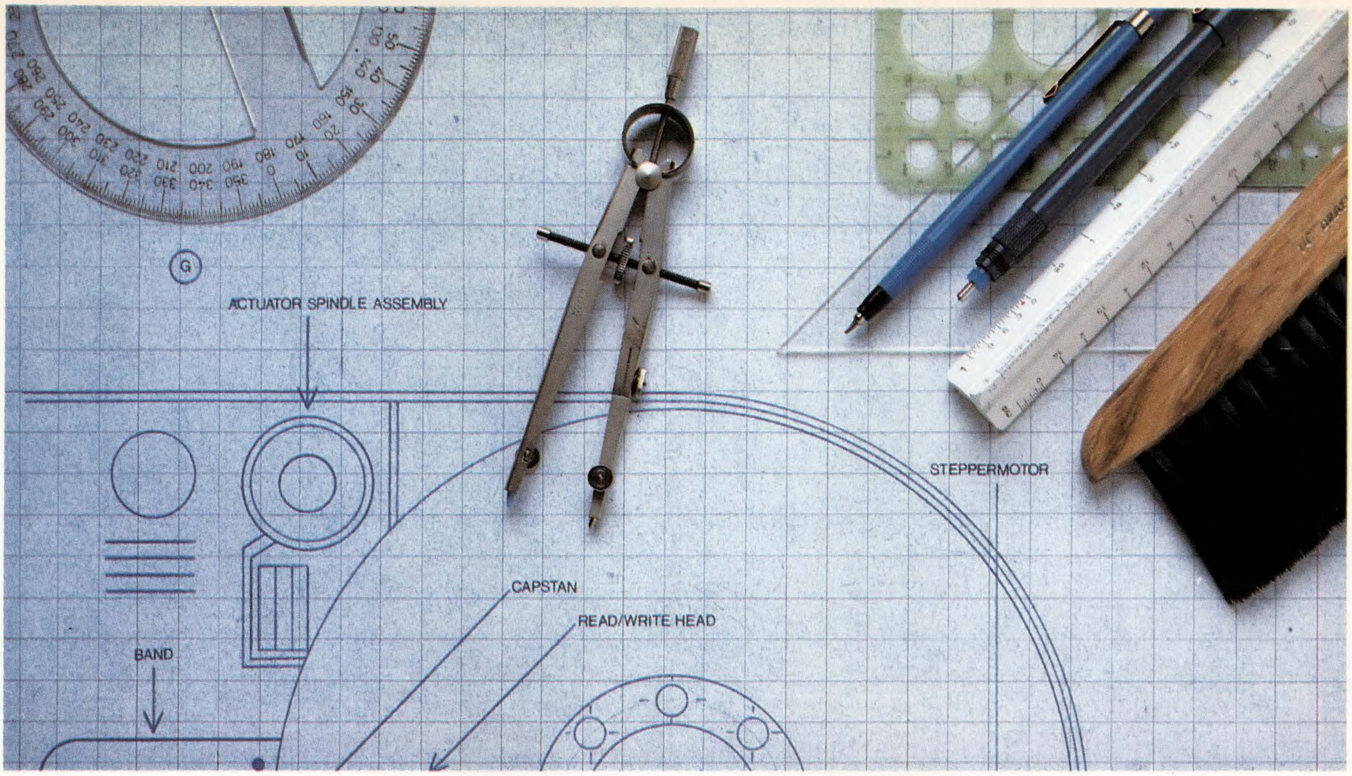
```
/* bit flags within the control flags field _flags */

#define _IOREAD      0x01    /* read flag */
#define _IOWRT       0x02    /* write flag */
#define _IONBF       0x04    /* non-buffered flag */
#define _IOMYBUF     0x08    /* private buffer flag */
#define _IOEOF       0x10    /* end-of-file flag */
#define _IOERR       0x20    /* error flag */
#define _IOSTRG      0x40
#define _IORW        0x80    /* read-write (update) flag */
```

Note that it appears that these flags could have been defined as bit fields using something like:

```
struct _filebuf {
        char *_bufptr;   /* current buffer pointer */
        int _count;      /* current byte count */
        char *_base;     /* base address of I/O buffer */
        struct {
            unsigned _IOREAD      :1;
            unsigned _IOWRT       :1;
            unsigned _IONBF       :1;
            unsigned _IOMYBUF     :1;
            unsigned _IOEOF       :1;
            unsigned _IOERR       :1;
            unsigned _IOSTRG      :1;
            unsigned _IORW        :1;
        } _flags;        /* control flags */
        char _fileno;    /* file number */
        /* ... */
};
```

However, the problem is that on many implementations, bit fields are packed into **ints**, which on most machines are bigger than **chars**. So, the bit field version takes up more storage. However, this method still would



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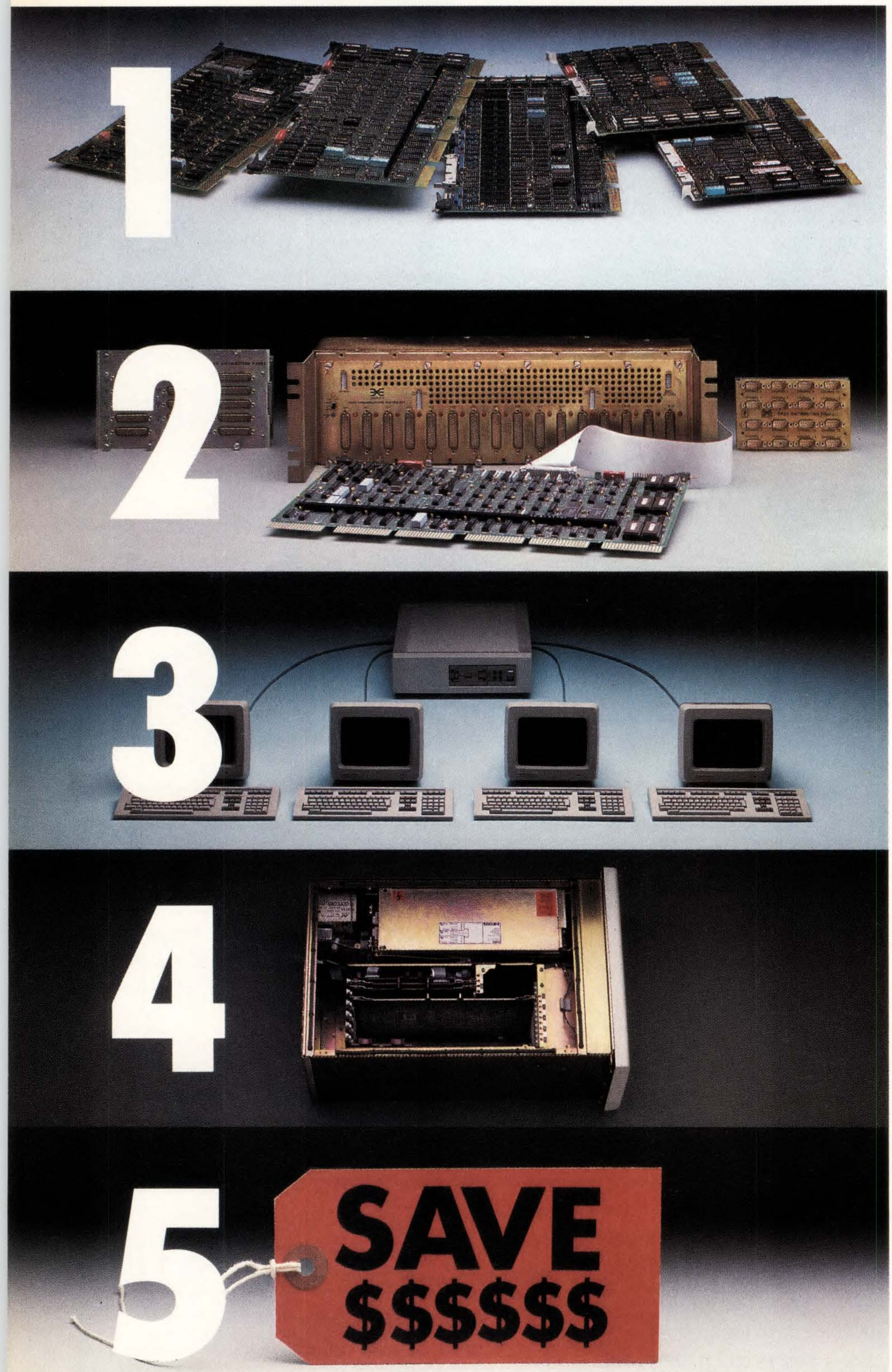

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work, provided all affected library routines were compiled using the same file table declaration.

Let's assume that if the **_IOEOF** and **_IOERR** bits are set, the file is respectively at end-of-file and in an error condition. Likewise for **_IOREAD** and **_IOWRT** recording, whether the file was opened for read or write. To inspect the flags for an open file using the **stdio.h** above, the following code will suffice:

```
#include <stdio.h>

main()
{
        FILE *output;

        output = fopen("test.dat","w");

        printf("flags field is 0x%02x\n",output->_flags);
        printf("read  bit is %d\n",output->_flags & _IOREAD ? 1 : 0);
        printf("write bit is %d\n",output->_flags & _IOWRT  ? 1 : 0);
        printf("eof   bit is %d\n",output->_flags & _IOEOF  ? 1 : 0);
        printf("err   bit is %d\n",output->_flags & _IOERR  ? 1 : 0);

        fclose(output);
}

flags field is 0x02
read  bit is 0
write bit is 1
eof   bit is 0
err   bit is 0
```

Flag Manipulation Functions

Since the file table can be read AND modified by a user program and most of the library I/O functions rely on that table being correct, it is suggested you refrain from accessing this table directly. The library functions that test and possibly set flags in the file table include **feof**, **ferror** and **clearerr**. Versions of these functions using the above definition of **stdio.h** follow.

```
/* feof returns zero if not eof, else non-zero */

#include <stdio.h>

int feof(fileptr)
FILE *fileptr;
{
        return (fileptr->_flags & _IOEOF);
}

/* ferror returns zero if not error, else non-zero */

#include <stdio.h>

int ferror(fileptr)
FILE *fileptr;
{
        return (fileptr->_flags & _IOERR);
}

/* clearerr clears ERR flag */

#include <stdio.h>

void clearerr(fileptr)
FILE *fileptr;
{
        fileptr->_flags &= !_IOERR;
}
```

(Note that some versions of **clearerr** clear the end-of-file flag as well.)

These functions are trivial and could even be implemented as macros as follows:

```
#define feof(fileptr) (((fileptr)->_flags & _IOEOF) != 0)
#define ferror(fileptr) (((fileptr)->_flags & _IOERR) != 0)
#define clearerr(fileptr) ((fileptr)->_flags &=!_IOERR)
```

Either way, they do relieve the user program from having to know just exactly what a file table entry looks like.

Buffered Character I/O

Often, the character get and put functions are implemented as macros as follows:

```
#define  getc(fileptr)  (--(fileptr)->_count >= 0 ?      \
                        0xff & *(fileptr)->_bufptr++ :  \
                        _filbuf(fileptr))

#define  putc(c,f)      (--(fileptr)->_count >= 0 ?              \
                        0xff & (*(fileptr)->_bufptr++ = (c)) :  \
                        _flsbuf((c),(f)))

#define  getchar()      getc(stdin)
#define  putchar(c)     putc((c),stdout)
```

Here, **getc** and **putc** are buffered and only read from or write to the disk if the file buffer is respectively empty or full. The functions **_filbuf** and **_flsbuf** fill and flush the buffer respectively. These macros are rather complicated and their full meaning is left as a reader exercise.

Typically, **getc** and **putc** are used to perform character I/O on disk files, so it is reasonable to buffer them. However, **getchar** and **putchar** read from standard input and write to standard output and, unless these are redirected to disk files at the command-line level, they really use the keyboard and screen (or printer). In the latter case, it is preferable that they be unbuffered. That is, if you want to get a character from the keyboard immediately as it is pressed, you require **getchar** to be unbuffered. Likewise for **putchar** if you want to put a character immediately to the output display. If these are buffered (as they are if the above #**defines** are used), then a RETURN must be entered after the character on input, and it must follow the character on output. Whether or not **getchar** and **putchar** are buffered is implementation-defined. Unbuffered **getchar** and **putchar** are unsuitable for use in data entry primitive functions.

Some implementations allow the buffering of a file to be specified using the **setbuf** or **setvbuf** functions. These allow buffering for a recently opened file that has not yet been accessed to be set to unbuffered, character buffered, or line buffered.

The End-of-File Indicator

Just as the definition of **FILE** is implementation-defined, so is the definition of the end-of-file condition. However, this definition typically is as follows:

```
#define EOF (-1)
```

An example of the use of **EOF** is:

```
#include <stdio.h>

main()
{
        int c;

        while ((c = getchar()) != EOF)
                putchar(tolower(c));
}
```

By redirecting **stdin** and **stdout** at the command-line level, we have a filter program that converts all upper-case input to lower.

Opening Files

The **fopen** function can be used to open a text or a binary file for input, output or both. The open mode is determined by the contents of the string used as the second argument as follows:

```
file-pointer = fopen(file-name, mode);
```

where **mode** is any one of the following:

```
"r"     open text file in read mode
"w"     create text file in write mode
"a"     open text file for append or create for write
"rb"    open binary file in read mode
"wb"    create binary file in write mode
"ab"    open binary file for append or create for write
"r+"    open text file in update mode
"w+"    create text file in update mode
"a+"    open text file for append or create for update
"r+b"   open binary file in update mode
"w+b"   create binary file in update mode
"a+b"   open binary file for append or create for update
```

Other characters may follow these on a per-implementation basis. The **freopen** function allows a currently open file to be closed and its file pointer to be reused to open another file. The calling format is:

```
file-pointer = freopen(file-name, mode, file-pointer);
```

This function can be used to redirect **stdin**, **stdout** and **stderr** from within a program rather than at the command-line level.

File Handling Errors

Each of the file manipulation routines has the ability to indicate whether or not an error has occurred. However, identifying the specific cause of the error is very much implementation-defined.

For example, when an error occurs, the following functions return a **NULL** pointer: **fopen**, **freopen**, **tmpfile**, **fgets**, **gets**. The following functions return a non-zero value: **fclose**, **fflush**, **remove**, **rename**, **fputs**. The following functions return a negative value: **fprintf**, **printf**. The following functions cause the error indicator to be set: **fgetc**, **fputc**, **getc**, **putc**, **getchar**, **putchar**.

Determining if **fread** and **fwrite** produced I/O errors can be even more difficult.

Because there are different methods used to detect I/O errors, it is not possible to write a general purpose file error handler. Also, different implementations have different possible reasons for failing on I/O. A file may not open because the "user has insufficient privilege," "the file does not exist," "there is no such directory or device," "the device is not mounted or the device driver is not loaded," "the open mode is invalid," "the filename is illegal," or any one of many other possibilities.

VAX C uses the global error indicator **errno** to help identify error causes. If **errno** is equal to a macro defined within one of VAX C's headers, then the user must check **vmsc$errno** for a VMS-specific error value. The ability to pinpoint causes of I/O errors varies widely from messy and comprehensive to simple and restricted. (For a discussion of the detection and handling or I/O errors from the **printf** and **scanf** family of routines, refer to the May and June 1985 columns.)

Random File Positioning

The **fseek** and **rewind** functions can be used to position within a file; **ftell** returns a file's current position. One common problem occurs with **fseek**, whose second argument is the byte offset to be used for positioning. This offset MUST be a **long int**, in which case, on 16-bit machines, **0** and **0L** are quite different. (An offset of zero often is used to position at the beginning of a file.)

The string.h Header

This is a relatively new header and it contains all of the library functions that have names like **str*** and **mem***. One particularly interesting thing is the **typedef**ed type **size_t**, which is the type of the result of the **sizeof** operator. This also is the type of the value returned from **strlen**. (Refer to the May 1986 column for details.)

Many compilers still place the **str*** function declarations in **stdio.h** so existing programs for these compilers will have to be changed when a Standard-conforming version is released.

The ctype.h Header

The header **ctype.h** declares several mechanisms useful for testing and mapping characters. These include **isalnum**, **isalpha**, **isdigit**, **islower**, **isupper**, **tolower**, and **toupper**.

These mechanisms can be implemented in one of two ways: as real functions or as macros. The function approach is quite straightforward. It simply requires that each routine be written and placed in the run-time library. In this case, **ctype.h** will just contain the return type declaration for each of these functions (they are, in fact, the default type, **int**). (For examples of the code for these functions, refer to the November 1984 column.)

The macro form can be implemented in two ways: one as straight in-line macro expansions which are totally self-contained (similar to the code used by the function versions), the other by using some predefined lookup table (often called **_ctype_** or something similar). The former approach uses something like:

```
#define islower(c) ((c) >= 'a' && (c) <= 'z')
```

while the latter uses:

```
#define islower(c) ((_ctype_[(c) + 1]) & _LOWER)
```

The latter approach is much faster because it uses a table lookup rather than a block of test code. The table **_ctype_** is a predefined list indexed by character set internal values such that, for the ASCII character set, the expression **_ctype_[65 + 1]** contains status information about the character "A". This table is defined in the startup module, which is linked in with a user program, and each of its elements contains flags that indicate such things as whether the corresponding character is upper or lower case, if it is a decimal (or hexadecimal) digit, or if it is a space or a punctuation character. The flags might be defined something like:

```
extern unsigned char _ctype_[];

/* flag values for each character */

#define _UPPER      0x1     /* upper case letter */
#define _LOWER      0x2     /* lower case letter */
#define _DIGIT      0x4     /* digit[0-9] */
#define _SPACE      0x8     /* tab, carriage return, new line,
                             * vertical tab or form feed */
#define _PUNCT      0x10    /* punctuation character */
#define _CONTROL    0x20    /* control character */
#define _BLANK      0x40    /* space char */
#define _HEX        0x80    /* hexadecimal digit */
```

By using this static table and a set of macros such as **_LOWER** (the lower case flag), the various character comparisons and conversions can be done simply with a logical AND or OR, or combination thereof, as shown in the definition of the **islower** macro above.

Next issue I'll complete my 26-part tutorial series by addressing several of the lesser used or known parts of C. These include enumerated data types and the comma operator. In subsequent issues, I'll be addressing topics suggested by readers' mail and other miscellany including the VAX C compiler. Readers are encouraged to submit any C-related comments and suggestions to Rex Jaeschke, 2051 Swans Neck Way, Reston, VA, 22091.

Rex Jaeschke is editor of "The C Journal" and the author of numerous articles on the C language. He is a member of the ANSI X3J-11 standards committee for C.

A compilation of Rex Jaeschke's first 13 "Let's C Now" articles, in updated form, is now available. *See the ordering information on page 154.*

THE NETWORKING EDITOR

An SNA Primer: What Has IBM Wrought?

By Bill Hancock

We who work in the world of Digital frequently try to forget that there is another computer company that grows at the rate of one Digital per year — International Business Machines Corporation (IBM), also known as "Infernal Blue Machines," "Itty Bitty Machines Company," "I've Been Moved," and many other disparaging things. As a result, we DEC-users tend to get somewhat smug when it comes to discussing things about DECnet or VAXs and we have a tendency to throw rocks at "the other company" on a regular basis. While it's true that I am a DEC hack, I got my start in the IBM world and am still very proficient with many IBM products, mostly out of self-defense. So, while I prefer to work on DEC products, I am equally comfortable on IBM products — in the network environment, you have to be able to talk to any vendor at any time.

IBM has a networking product in which it has invested a great deal of time and money. It is somewhat expensive, difficult to configure and difficult to change, but it DOES work and has some interesting and useful features.

Before you start vigorously waving your rubber chicken or burning old JCL decks in effigy, open your mind for a little while. This article is on Systems Network Architecture (SNA) — some of the basics, and why DEC users need to be concerned with it.

SNA BEGAN IN 1974 as a way to extend the host architecture of IBM mainframe systems. In 1978, it underwent a fairly drastic revamp to allow true networking capabilities and again was overhauled in 1984 to allow what IBM calls "a system of networks." A "system of networks" is basically the allowance of smaller, private networks (such as token ring LANs, terminal networks, etc.), based upon differing technologies, to be interconnected into a larger, more distributed network. IBM tends to view the overall network topology as a large distributed system, hence the term a "system of networks."

> "*... do not be misled into thinking that SNA is similar, overall, to DNA ...*"

Digital apparently has started to see the same situation, as evidenced by its latest battle cry of "The Network as the System." So, whether DEC is following IBM's terminology lead, or whether DEC marketeers are trying to take advantage of IBM's pre-education of IBM customers, is anyone's guess. The important point, however, is that the largest two computer companies in the world are calling networks the "system" and, as such, it is a vital part of the overall strategy for any company that will be using computing technologies now and in the future.

Those of you who have been following my ravings for the last few years, will understand when I say, "I told you so . . . "

Anyway, back to SNA. While your local DEC salesperson may be quick to point out the benefits of DNA and the Digital networking style and tell you why SNA and other networking technologies aren't worthy of your carefully spent networking dollar, beware of comparisons. SNA is a networking architecture, yes. There *are* some similarities to Digital Networking Architecture (DNA) and Digital networking style, yes. *However,* do *not* be misled into thinking that SNA is similar, overall, to DNA; you will be grossly misguided. There are some very basic factors that need to be identified to understand where DNA and SNA are alike and where they aren't.

As you probably know, DEC likes to compare the DNA to the Open Systems Interconnect (OSI) Reference Model on a regular basis. Also, DEC supports multiple technologies at layers 1 and 2 of the model (such as Computer Interconnect (CI), Ethernet (NI), DDCMP (async & sync), X.25, and others), which utilize multiple base protocols. For instance, CI uses the SCS protocol to communicate; Ethernet uses various protocols such as MOP, LAT, CTERM and others. The issue at hand is that there is not one singular protocol at layer 2 that DEC specifically claims to be "the" protocol for use on all processors. This is because DEC wants to support multiple protocols at all networking levels, encourage networking of dissimilar machines, and use the latest network technology, where reasonable.

Well, IBM has a somewhat different view of the computing and network world. While SNA is implemented in

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layers, such as OSI, they do not represent the same meanings as the OSI labels except for layers 1 and 2. Regardless of the layer 1 hardware, at layer 2 the preferred protocol considered to be "the" protocol in the IBM world is SDLC, or Synchronous Data Link Control protocol. This means that if you want to talk to most SNA supported devices, you better be able to speak SDLC. IBM views this as a feature since it provides a single, uniform line discipline that is predictable, stable, and implemented on a wide variety of processors. And IBM can get away with it. When you own 70 percent of the computing marketplace, it's fairly straightforward to dictate how conformance will be handled. So, DNA looks at being able to support multiple lower-level technologies and protocols. SNA supports SDLC as the primary protocol and is starting to allow connection of other network technologies, such as the token ring, but still supports SDLC as the main access protocol at layer 2.

AT THE HOST LEVEL, the DNA architecture differs from the SNA world in a somewhat radical way. In DNA, there is no "master" node — all nodes are equals in the eyes of the network. If a node goes down, for whatever reason, it does not necessarily "kill" the network or cause a catastrophic condition on the network. Even in the Ethernet environment, if the only router on the segment (which also would happen to be the Designated Router) were to die a miserable death, the end nodes still would continue to communicate without the use of the router. SNA is philosophically different. A central point of control (called a Systems Service Control Point — SSCP) in a group of nodes (called a DOMAIN) controls all connection requests and network flow. SSCP services typically are provided by mainframe-resident access services. Upon establishing the SSCP in a domain, all control to nodes in the domain then is hierarchical — every critical transaction to the communications process must be controlled by the SSCP.

The most common mainframe-resident SNA access method is called VTAM or Virtual Telecommunications Access Method. An older access method called TCAM (Telecommunications Access Method) is still around on some nodes, but IBM doesn't push its sale, and it requires an extremely technical and competent staff to manage it because it is difficult to configure, maintain, and use. VTAM provides a means for host-resident programs, queues, etc., to gain access to remote facilities on an SNA network in a manner similar to the way that DECnet allows user programs and utilities to access other nodes and resources. The similarities stop there, however. VTAM controls the access from unit-to-unit in a domain. It has to know who is where, what services they provide, etc., through system generation and parameter tables that are located in various parts of VTAM and in 37x5 network controllers. The end result is that if the mainframe that has VTAM running on it were to die for any reason, new connections might not be able to be made, and other networking functions would suffer. In the DECnet environment, connections to other nodes continue unabated (unless the node that dies is a routing node, but that will cause problems in both networking technologies).

IBM, realizing the weakness of host-resident network control, is coming out with a new version of Network Control Program (NCP) software for the 37x5 series of network controllers called NCP/VS. NCP/VS's main purpose will be to provide mini-SSCP services for some connection requests and to offload some of the SSCP functions that a host typically has to make down to the network controller level. This will reduce connection dependency on the host and also speed up some of the connection access time between entities on the network that wish to connect with each other.

SNA views entities in the network space as Network Addressable Units (NAUs). A NAU is nothing more than an IBM term that means that all items capable of working together in a networking environment — both at the physical and virtual levels — have a method of being selected for access. To do this, SNA assigns designators to functions that physical devices or programs provide. A Physical Unit, or PU, provides physical connectivity between devices. Every node on an SNA network contains a PU and can be accessed by the SSCP for the domain in which the PU lives. Programs, as a rule, do not establish connections to PUs because they provide level 1 and level 2 network capabilities that are of interest only to the networking system (i.e., SSCP or another PU wishing to downline-load a PU). PUs (and all other NAUs) are characterized by "what" they are capable of doing through the use of PU TYPE designators, as follows:

PU Type 5 — Physical unit in a subarea node with SSCP (VTAM or TCAM node).

PU Type 4 — Contained in a subarea node without SSCP (37x5 controller).

PU Type 3 — Not defined.

PU Type 2 — Peripheral node PU, such as a remote system, terminal, etc.

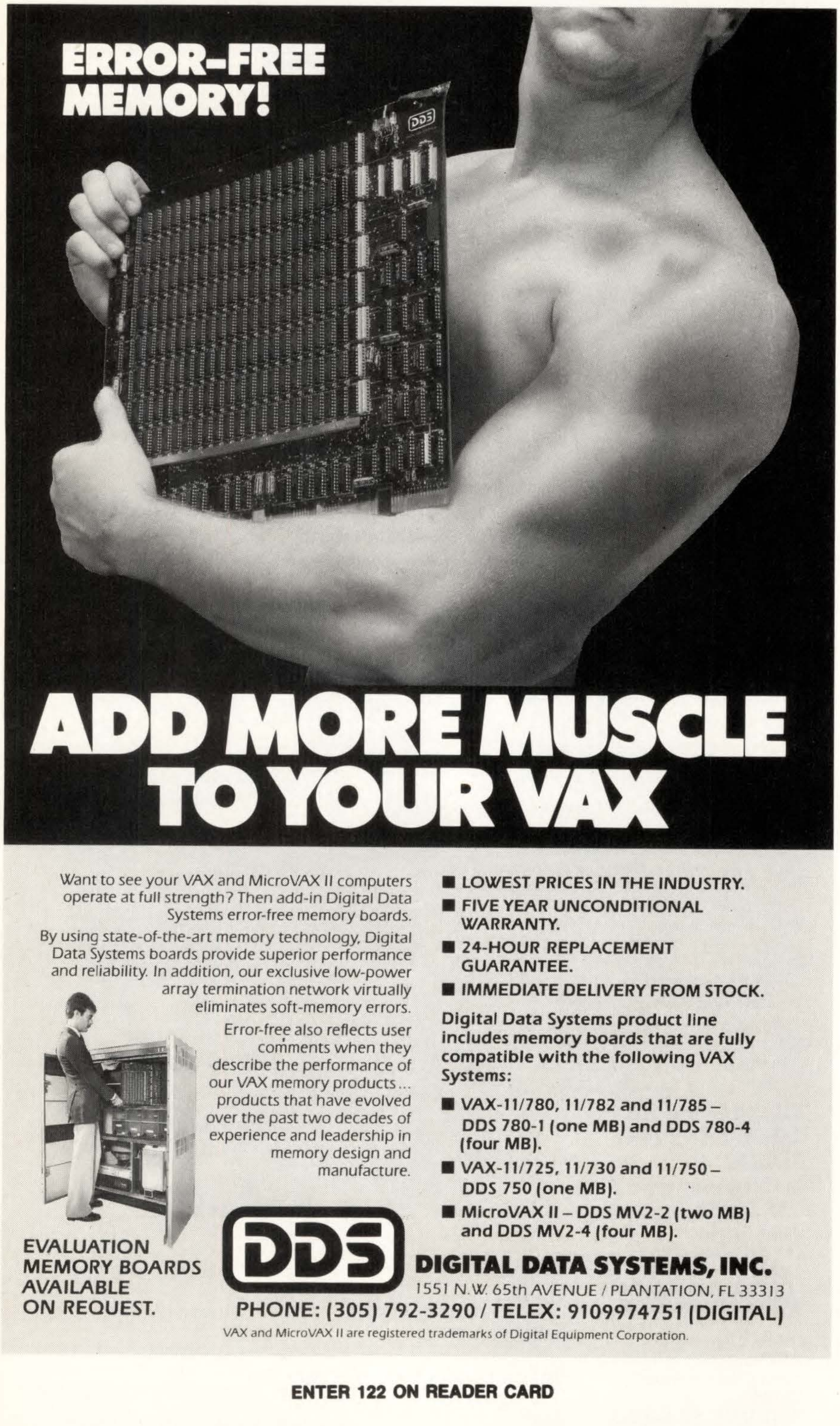
PU Type 2.1 — Enhanced PU Type 2 which will supersede PU T1 and PU T2.

PU Type 1 — Support in a 37x5 to support single terminals such as 3767.

Through the use of PU TYPEs, network management services quickly can determine whether the connection being requested to the PU is legal, whether it is capable of doing the job desired, and who has control over the PU, all critical items in a hierarchical network. This also allows for quite a bit of flexibility; it doesn't matter what the physical hardware looks like or how old or how modern it is, only that it conforms to the rules of being a certain PU TYPE and can connect into the SNA network.

AT THE VIRTUAL LEVEL, sessions (connections) are established to NAUs called Logical Units (LU). A Logical Unit is used to connect end-users (such as program to program or program to network service, etc.); an end-user, in IBM terms, could be a program, terminal, terminal controller, or other "smart" entity. How a session will be run is established at the time the session is created and a BIND command is sent to the SSCP. The BIND command is very important in the SNA environment because it defines how the session will be handled, what services will be used, security issues (such as cryptographic services), etc. A BIND command, in its fullest form, can contain over 30 parameters that must be provided for the session to be properly set up. LUs issue connection requests and, upon approval by the SSCP, a BIND command is issued and the session is underway. Just as with PUs, however, LUs are subject to TYPE restrictions and have their own TYPEs:

> ***"The BIND command is very important in the SNA environment because it defines how the session will be handled..."***



LU Type 0 — Defined by the implementation (can be creatively used).

LU Type 1 — Application programs-to-device communications to access non-display types of devices such as printers, hardcopy terminals, SNA character streams, etc.

LU Type 2 — Application program communications to 3270 display terminals.

LU Type 3 — Application program communications to printers utilizing a subset of the 3270 data stream.

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LU Type 4 — Application program communications similar to the services provided by LU T1.

LU Type 6 & 6.1 — Interprogram (program to program) communication that is SNA defined and part of the new distributed operating system function.

LU Type 6.2 — Usually called "Advanced Program-to-Program Communication" (APPC). This is basically a generalized task-to-task interface for general purpose data transfer and communication.

LU Type 7 — Application program communications to 5250 display terminals.

There are three types of LUs: non-SNA specified (LU0), terminal access LUs (LU types 1, 2, 3, 4 and 7), and program-to-program LUs (types 6, 6.1, and 6.2). To complicate things even more, LUs have "qualifiers" that are imposed at the BIND command that determine how data is represented to the destination LU, what kind of presentation services will be provided, and what kind of transmission subsystem profile may be used. These features can be very useful when moving applications from one display class to another because it will allow porting of applications from one LU type to another with minimal modifications, if the application is coded carefully to start with. As a result, the use of the data stream "qualifiers" to LU connectivity can be a real help in the high-transaction, large-terminal environments that mainframe systems usually are involved with (2000+ terminals on-line simultaneously).

Topologically, an SNA network does not look much different from a DNA network, but traffic-wise, there are substantial differences. IBM utilizes the "divide and conquer" approach quite well, and provides "smart" clusters of terminals or network concentrators as cooperating entities in the SNA environment. This means that smart terminals that are smart can be directly connected to; dumb terminals can have a terminal concentrator hooked up to them and the concentrator can be connected to SNA. For optimization of line use and traffic flow, network controllers can be used to connect multiple terminal clusters or other network controllers together, providing flexible networking configurations that can be changed as growth requires without necessarily replacing existing hardware. Also, since all nodes on the network can be addressed by "names," the reconfiguration of a network, properly done, does not affect application programs that have been written for the SNA environment. Application programs still call the service by "name" and it magically happens as long as the proper VTAM tables and NCP tables have been updated to reflect whatever network changes have taken place.

SNA networks are not limited to a single domain, either. SSCPs can provide session connections across domain boundaries ("cross-domain" session) to requesting LUs, effectively providing large network connectivity with segmented network management facilities. This requires flow control, path control, and many other network features. SNA provides these and much more, making it a very sophisticated technology with the capability of providing additional functionality at incremental expansions.

Probably the two most glaring differences between DEC networking products and IBM SNA products are one DEC strength and one IBM strength: DEC's is that it provides connectivity to a wide variety of technologies and processor architectures; SNA is fairly limited in scope and capabilities and requires a great deal of manual intervention. IBM's strength is that the SNA product set provides very powerful network management tools (such as Network Communications Control Facility (NCCF), and Network Problem Determination Application (NPDA), etc.), performance analyzers (VTAM Performance Analysis and Reporting System — VTAMPARS), cryptographic facilities, processing management, change management, and other features. DEC has few and they are marginally useful in many situations.

WHAT WILL IBM DO with SNA and why do DEC users care? Well, the general consensus in the networking world is that, after the dust settles, there will be two main networking architectures: OSI and SNA. SNA currently is undergoing changes, and IBM is heavily involved in the OSI space as well (mostly to satisfy European customers who require OSI in their networks), so expect to see IBM continue to push SNA and, when available on IBM systems, OSI. Also, since IBM has to provide services to its customers, such as banks, and those customers will want to provide services on the Integrated Services Digital Network (ISDN), such as bank-at home, shop-at-home, etc., for IBM to maintain market leverage in the mainframe area it will have to provide ISDN connectivity, which means OSI communications capability.

Consideration should be given to the contributions IBM is making to the OSI product set, the involvement with ISO and contributions to the ISDN. IBM is there; so is DEC. But IBM is IBM and DEC is not.

Another important reason to watch SNA is IBM's push into the office automation space. IBM issues things called "Statements of Direction" that are essential to pay heed to if you're planning to keep up with developments at IBM. In the area of office automation, the statement was made that "All IBM Office Systems will be integrated." This is a fairly strong statement that has communications implications galore. With IBM's Distributed Office Support

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System (DISOSS) product set, the use of communications between systems is critical and getting more attention.

When consideration also is given to two document standards on the market DIA (Document Interchange Architecture — a method by which document formats, protocols, etc., are defined to communicate between end-users) and DCA (Document Content Architecture — a document representation methodology), the fact that PU2.1 recently was created with the need to connect items such as the *Displaywriter* and the *Scanmaster 1* to an SNA network, and the fact that IBM firmly recognizes the need to provide multifunction support in the office, means that SNA will have to expand in scope and use and eventually will become a favored method to connect office environments of IBM customers.

Another major reason for SNA-watching is the IBM Systems Network Interconnect program (SNI). SNI provides for interconnection, protocol conversion, and gateways to other architectures and systems. While SNI is still somewhat new, it bears watching. IBM is like a large dragon. You can call it names, throw rocks, and poke at it until it decides to move. When it does decide to move, however, look out!

> ***". . . when your network breaks and all you have are DECnet counters and a TDR, don't be surprised to find the IBM guys giggling down the hall."***

The next time you bring up your DECnet network, be glad it's pretty much self-contained and self-sufficient. Revel in the ease of use and the capability to connect multiple technologies. But, when your network breaks and all you have are DECnet counters and a TDR, don't be surprised to find the IBM guys giggling down the hall. They've got tools to fix theirs. And when your boss asks for historical information on network performance and throughput capabilities to justify the add-ons you've requested, don't bother asking the IBM people how they do it — they just print off the report.

Bill Hancock is an independent systems and network consultant based in Garland, Texas.

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FROM THE LAB

The Midnight Monitor

By Dave Mallery

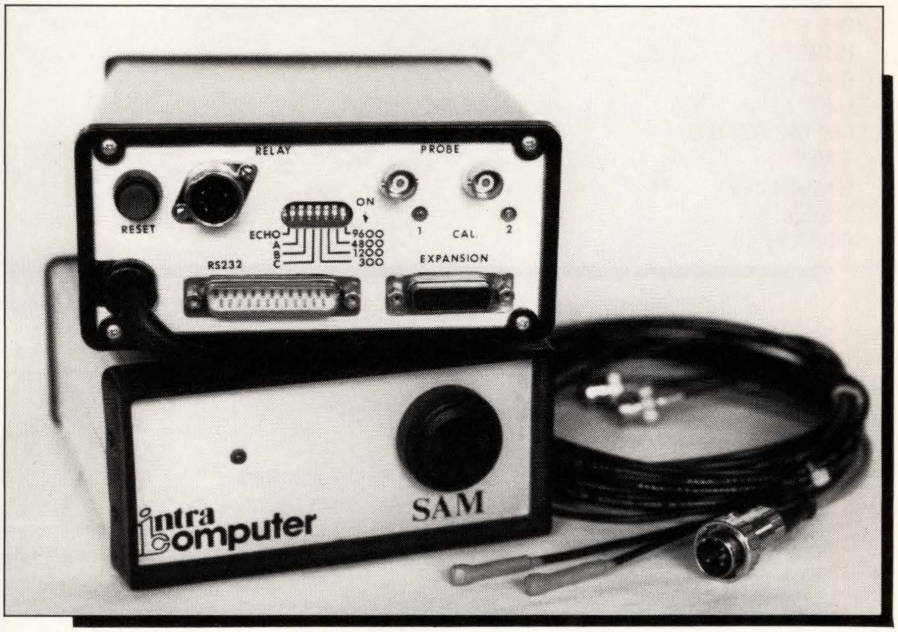
SAM (Smart Ambient Monitor) from Intra Computer is a classic niche product. It is a simple application of proven technologies to a universal problem.

Only large firms can afford 24-hour coverage in their computer facilities, and even then, how can you count on a mere human to really worry about your hardware? Enter *SAM*.

SAM is a micro obsessed with constantly monitoring two temperature probes and a variety of other devices (humidity, smoke, water, power line). *SAM* worries about these devices and checks that all measurements lie within pre-assigned limits.

Unlike simpler devices that only monitor, *SAM* can take action. *SAM* is queried and commanded through a simple RS-232 port. The author of the software should get a medal for using simple English commands terminating in <cr> instead of cryptic escape sequences. Second, *SAM* actually can do something about an impending meltdown or flood. *SAM* comes with a cable that plugs into the power controller of your system and actually is able to "pull the plug" when certain conditions are met.

As the finishing touch, Intra Computer has supplied DCL procedures that control and monitor *SAM*'s world. When *SAM* is queried (every 10 minutes, normally) and reports temperatures or other parameters out of range, the procedure goes to a two minute cycle. Should conditions continue to



deteriorate, all users are notified of an impending shutdown. *SAM* is ordered to power down in eight minutes and the SHUTDOWN.COM is executed for a five-minute shut. Elegant.

There is an additional procedure for querying *SAM* about the conditions in the computer room.

I had this product out of the box and connected to my terminal in about three minutes. A simple null modem cable is all that is required. Baud rate and echo are set via dip switches on the back. You can put it through all its paces without connecting up to the computer. This helps your confidence greatly.

The software consists of two main procedures: *SAM*VMSx.com (x = 3 or 4), which does the monitoring and shutdowns, and *SAM*UTILx.COM (x = 3 or 4). The UTIL procedure is a VT100/200 screen monitor program that displays the *SAM* status and allows the manager to modify the critical parameters. There was a small error in the installation instructions: the copy command should be:

copy msa0:[ ]*.* [ ]

but that should not stop anyone.

To install *SAM*, you need a port to be dedicated to the monitor. That could be a problem on some systems, but it's the price of poker.

I found I had to calibrate the thermometer probes that arrived with *SAM*. One was about 10 degrees high. The CALIB command will return the measured values every second while you diddle with the calibration ports on the back of the unit. Simple. This should be done prior to installation or, if necessary afterwards, via the simple expedient of "set host/dce txan:", provided that the *SAM* software is terminated.

```
sysmgr> set host/dte txa8:

Connection established, type ^ \ to exit
Control returned to node SYS$NODE
sysmgr> set host/dte txa7

PLEASE ENTER COMMANDed, type ^ \ to exit
TEMP 1
067 F
TEMP 2
069 F
HUMID
049 %
HIST
060 068 062 069
TIME
000:03:14:46
THRESH
84 88 84 88
```

FIGURE 1. Issuing commands to the SAMbox.

```
                    SAM INTERFACE UTILITY

0- Exit                          6- Monitor SAM Parameters
1- Stop SYS$TEMP Queue           <Stops SAM Batch Queue>
2- Start SYS$TEMP Queue
3- Display SYS$TEMP Status
4- Type TEMPHIST.LOG File
5- Type TEMPWARN.LOG File        99- Refresh Screen

Enter Your Choice:

DON'T FORGET TO RESTART SYS$TEMP QUEUE BEFORE EXITING
```

FIGURE 2. The SAM utility main menu.

```
                    SAM INTERFACE UTILITY
            Sensor 1                    Sensor 2
Temperature.................. 064  F  ............................064 F
Low Temp..................... 060     ...........................062
High Temp.................... 068     ...........................068
Alarm On.....................  84     .............................84
Power Off....................  88     .............................88
Humidity..................... 043 %

0- Main Menu                         6- Clear Hi/Lo Temp
1- Update all values                 7- Reset SAM
2- Set Alarm 1 Limit
3- Set Alarm 2 Limit
4- Set Power Off 1 Limit
5- Set Power Off 2 Limit             99-Refresh Screen

              SYS$TEMP QUEUE HAS BEEN STOPPED
Enter the corresponding number to update values:
```

FIGURE 3. By choosing number 6 on the main menu, SAM reads your computer room conditions and issues a full report.

The other point to remember in installation is to turn off the echo dip switch before you try to use the *SAM*UTIL procedure. If you don't, you will get the echoes of the commands all over the nice screen display.

During the process of installation, it is necessary to modify both the DCL procedures to indicate the port that you actually used to install the unit. The procedures use "TTA7", so just use EDT to find and change the single occurrence in each procedure.

" . . . a relatively inexpensive way for systems managers to sleep at night. "

Another factor to remember in planning is that not all power controllers in a given machine are tied together. I have found that as a machine ages and is serviced repeatedly, the power controllers tend to get disconnected from each other. In our case, the power controllers in the System Industries disk cabinets have never been connected to each other, nor to the 750. If you want to shut them off, they have to be connected to each other.

In summary: Here is a relatively inexpensive way for systems managers to sleep at night.

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By Jim McGlinchey

I will try to respond to interesting questions that are applicable to the general RSX user. Please mail your questions to: RSX Clinic, DEC PROFESSIONAL, P.O. Box 503, Spring House, PA 19477-0503, or leave them in the suggestion box on ARIS. Dial (215) 542-9458.

RETROFITTING UTILITIES

QUESTION: We are running RSX-11M Version 3.2. We can not upgrade to a new release because we have added our own modifications to the executive to implement a semaphore mechanism and other special features. We have other systems running the RSX-11M Version 4.1, soon to be upgraded to 4.2. We want to use some of the utilities from 4.1 such as BRU and EDT. Is it possible to take the BRU and EDT from the new release and install them on the old one?

REPLY: *The only way to answer your question is: try it, and good luck. You can take the Object Libraries and the Task Build files for the utilities you mention and rebuild them on your 3.2 system. I would not try to retrofit them to any earlier release, as the executive facilities they need probably wouldn't be there. BRU has an object library named BRU.OLB and its Task Build files are named BRUBLD.CMD and BRUBLD.ODL. Find them on your release kit, then copy them to your old system. Look at the BRUBLD.CMD file and set up the UIC and pseudo devices the way it expects to find them. Next, issue a "TKB @BRUBLD" command to Task Build BRU. Test carefully the utility you've just built, using a disk you don't mind losing.*

I wonder whether making modifications to the RSX Executive is worth the long-term price to be paid. You've locked yourself into an old release, and have incurred the additional burden of doing your own support and continuing development of that modified system. Now you are further modifying your system, at considerable risk. It is rarely necessary to modify the RSX Executive source code. You should try to find a way — any way—to solve your problem before having at the Exec. The semaphore mechanism you mention, for example, has two solutions: one described in "The Resource Executive" column in the October 1985 DEC PROFESSIONAL, *and the other a set of semaphore directives that reside in the DECUS library.* ■

DCL DIALOGUE

A Look At Version 4.4

By Kevin G. Barkes

VMS Version 4.4 is a major upgrade to the VAX/VMS operating system, containing significant enhancements and improvements to DCL and various utilities.

Because 4.4 was distributed only a short time before going to press, it was not possible to review the software on a "live" system, or to gather data on the minor bugs and glitches that accompany most major system upgrades. However, a review of DEC's release notes reveals changes that should quicken the hearts of most DCL programmers.

While the much-desired DCL compiler remains in the realm of vaporware, "structured" DCL programming is now possible with the subroutine functions provided by the new GOSUB and RETURN commands. Other powerful additions include the CALL, SUBROUTINE and ENDSUBROUTINE commands, which permit grouping procedures in a single .COM file.

THESE ENHANCEMENTS will free DCL programmers from using redundant code and complex dynamic label renaming schemes to simulate the sub-procedure capabilities of "traditional" high-level languages. There undoubtedly will be a great deal of command procedure rewriting by hardcore DCLers in the next few months.

DEC also has provided a new mechanism for coping with the problem of conflicting symbol assignments in nested command procedures. The SET SYMBOL/SCOPE command permits local and global symbols to be "turned on and off" without deleting them from their respective symbol tables.

Welcome to the premier issue of DCL Dialogue. *Kevin G. Barkes is a specialist in VAX systems software, management, tuning and training, whose expertise will help VAX/VMS users exploit the capabilities of Digital Command Language.*

In order to make this a true "dialogue," Mr. Barkes welcomes your suggestions. Please send your comments and questions to the author at 4107 Overlook St., Library, PA 15129; contact him via CompuServe Easyplex, user i.d. 72067,341; write in care of the DEC PROFESSIONAL, P. O. Box 503, Spring House, PA 19477; or leave a message in the ARIS suggestion box, (215) 542-9458.

A new item to the F$ENVIRONMENT lexical function, SYMBOL_SCOPE, returns the state of symbol scoping within a procedure, permitting the original symbol assignments to be restored prior to exiting from a nested .COM file.

Hyphens are now permitted in VMS file name, type and directory fields and in unpunctuated file specification logical names. Users are warned not to end their file names with a hyphen; DCL may misinterpret it as the command line continuation character.

The SHOW DEFAULT command now issues a warning message if the default has been set to a nonexistent device and directory, unlike the current flavor of the command which will cheerfully deposit you into oblivion if you so request. Logical name search lists are now supported by the SET DEFAULT command.

Other changes include:

VMS utilities and layered products using screen management software can now recall the last 20 commands using the Ctrl-B and up and down arrow keys, a feature previously restricted primarily to commands issued from the DCL prompt. Affected utilities include EDT, DEBUG, SDA, SHOW CLUSTER, MAIL and VAXTPU. The VAX C run-time library now supports command line recall capability.

MAJOR CHANGES were made to the VAX Text Processing Utility (VAXTPU), which requires all section files to be recompiled. Changes in the default section file type specification, EVE interface procedures, the callable interface, and various built-in procedures also have been made. The ability to remap key definitions quickly is provided by new KEY_MAP procedures. TPU section files are also now installable as shared images, with a resultant increase in performance.

DECnet changes include the ability to identify a VAXcluster as a single node by using an "alias," the sharing of files in the permanent database by VAXcluster nodes, and other system management enhancements.

The SHOW CLUSTER utility contains 11 new features. The /REPORT qualifier is now unsupported.

A new DCL command, SET_RIGHTS_LIST, and a new attribute, DYNAMIC, have been added to VMS' security features.

BATCH and PRINT queue operations have been improved with five new qualifiers and keywords to various queue management commands.

Changes to the AUTHORIZE utility include a new [NO]DYNAMIC keyword to the /ATTRIBUTES qualifier for permitting or inhibiting unprivileged users from modifying the process rights list; enhancement of the /ACCESS qualifier syntax string; the addition of the [NO]ALL keywords to the /DEFPRIVILEGES and /PRIVILEGES qualifiers; modification of the secondary password feature so that it must be initially activated by the system manager for each user; and a new /AUTOLOGIN flag which makes accounts so specified accessible only via the autologin mechanism.

Modifications to the MONITOR utility adding a CLUSTER class, a /NODE command qualifier, and changing the sampling rate of the I/O Request Queue

"BATCH and PRINT queue operations have been improved with five new qualifiers and keywords to various queue management commands."

Length item for the DISK class, have been implemented. The format of MONITOR recording files has been changed; a CONVERT command which processes files created on earlier MONITOR versions is also included.

Alterations were also made to RMS; layered product access on VAXclusters; SYSGEN; MOUNT; AUTOGEN; DEBUG; ANALYZE/RMS_FILE; ANALYZE/ERROR_LOG; SORT/MERGE; print symbionts; VAX/VMS System Services; Run-Time Library; Terminal Driver Support; logical name association with mailboxes and mounted volumes; VAX BASIC; SDA; CSMA/CD Data Link Drivers; TS11/RSX-11; XADRIVER and PADRIVER.

The VMS documentation set has been completely reorganized, with several manuals added and/or replaced.

Over 50 pages of problems, restrictions and notes also are included in the release document. As usual, detailed step-by-step installation instructions are provided.

Join us next month, when I'll offer some DCL Debugging Tips. ■

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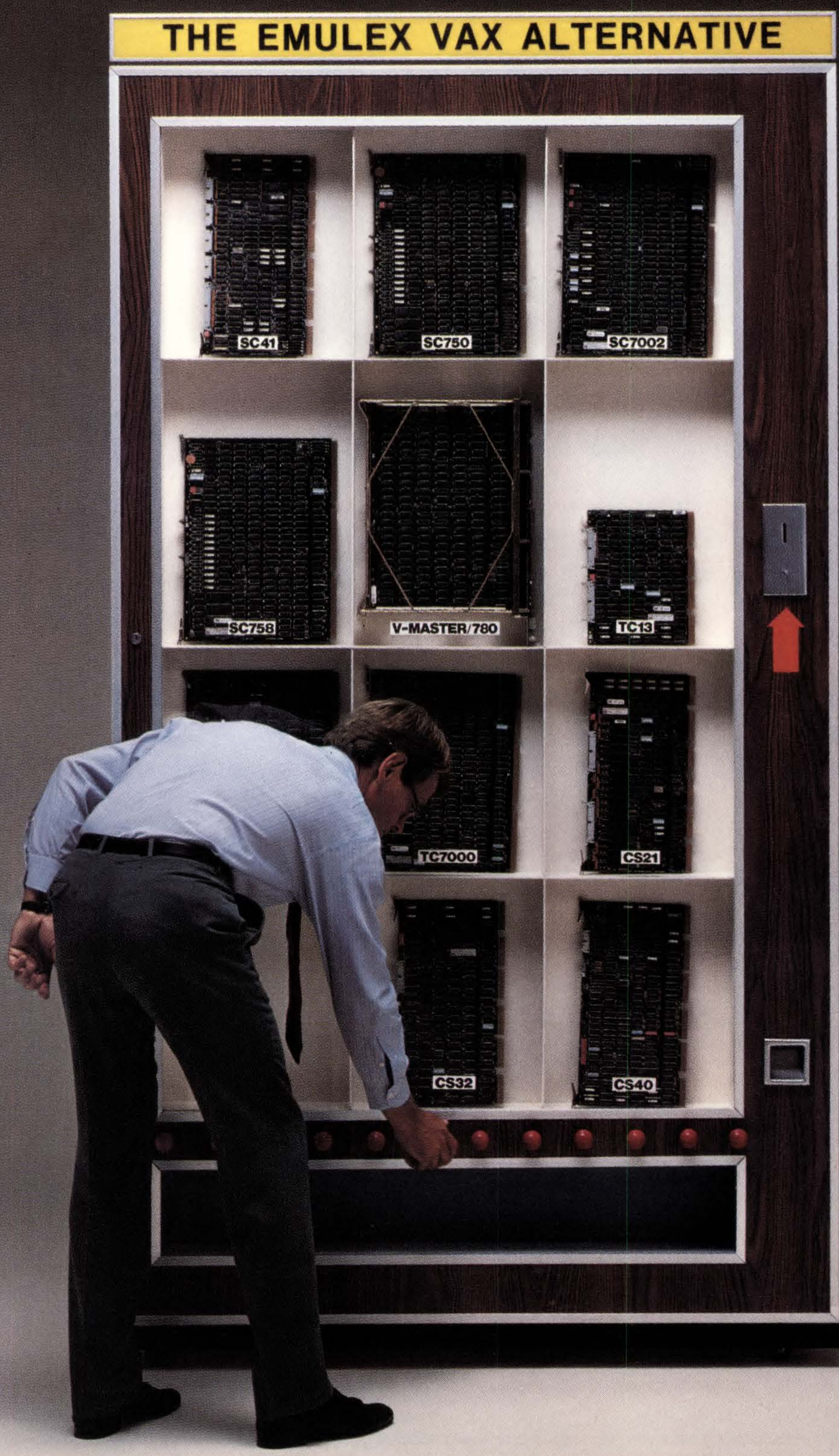

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DECUS

'First-Timer' Tips

By Bill Brindley

DECUS is an intense experience, the level of which is directly proportional to the level of involvement. The primary function of DECUS is to enhance technical and product information transfer among users, and between users and Digital. This charter is similar to that used by many other professional societies, including IBM user groups such as Share and Guide. Part of the information transfer includes influencing the manufacturer; i.e., Digital. DECUS exerts a powerful influence in this area, but it requires a lot of planning, administration, coordination, and management, through both personal and organizational effort.

DECUS is a volunteer, user-managed organization. Part of the management is elected and part is appointed by those currently in office. In future articles, I will describe some of the various positions and their responsibilities. Some are very technical and some are mainly administrative. Some DECUS jobs require little or no travel, while others require several weeks each year.

The Fall 86 DECUS Symposium will be held in San Francisco, October 5 through 10. At each Symposium, approximately half of those in attendance are "first timers." This is at least in part because of the constantly growing population of DEC technology and product users. You'll only be a first timer once, but you can be sure you'll have plenty of company in San Francisco.

A week of attendance at DECUS is the best training investment on the market. A variety of sessions is presented all week long. Technical and product support people from DEC—those typically not available outside of Massachusetts—abound. And, many organizations, from small companies to large national laboratories, send their technical and managerial staff members to DECUS. They come for the same reasons you do: exposure to Digital personnel and contact with other users.

> This is the first in a series of articles discussing the Digital Equipment Computer Users Society — DECUS. Over the next few months, this series will tell you how you will benefit both individually and organizationally from continuing participation in DECUS.
>
> Bill Brindley is a systems analyst in the Washington, D.C., area who has been actively involved in DECUS for more than 10 years, both as a general member, as meetings planner for the Fall 81 Symposium, and currently as chairman of the Networks SIG, chair of the Budget Committee of the SIG Council and vice chair of the Pre-Symposia Seminar Committee.
>
> Please send your comments directly to the author at 118 Pepperidge Place, Sterling, VA 22170, or in care of the *DEC PROFESSIONAL*, P.O. Box 503, Spring House, PA 19477.

In order to receive literature on DECUS, first verify that you are a member in good standing. If you haven't yet joined, call DECUS at (617)480-3659 and request the forms for your *free* membership. Most of the information about the Symposium will come to you in the Preliminary Program, which contains the fee schedule, a the list of seminars offered, instructor information, hotels available, air fare, etc.

Advanced planning will go a long way toward ensuring a profitable experience. Because sessions vary from the advanced technical to the novice user levels, you may want to "mix 'n match" your schedule; i.e., you may want to attend advanced sessions on one topic, and intermediate or beginner level sessions on another.

The Official Program, which you will receive at the symposium registration, contains abstracts of all the sessions presented. Reading the abstracts, which are keyed to identify session categories; i.e., general, managerial, technical, advanced, etc., gives you a better idea of what actually will be covered. (I don't recommend that you rely solely on the "short titles" initially received in your Preliminary Program.) When initially selecting your sessions, be sure to indicate a second choice. That way, if your first pick turns out to be different from what you expected, you can go on to your next choice.

Be sure to attend the "First Timers' Meeting" on Sunday evening. This is where you'll pick up plenty of valuable survival tips. Also, plan to attend the "Roadmap Session" of your choice. Each special interest group—VAX, Networks, Artificial Intelligence, etc.—presents an overview session on Monday morning.

With the tips from your First Timers' Meeting and Roadmap Session, you'll be equipped to enjoy the DECUS Symposium to the fullest. Enjoy!

For more information on DECUS, circle Number 279 on the Reader Service Card.

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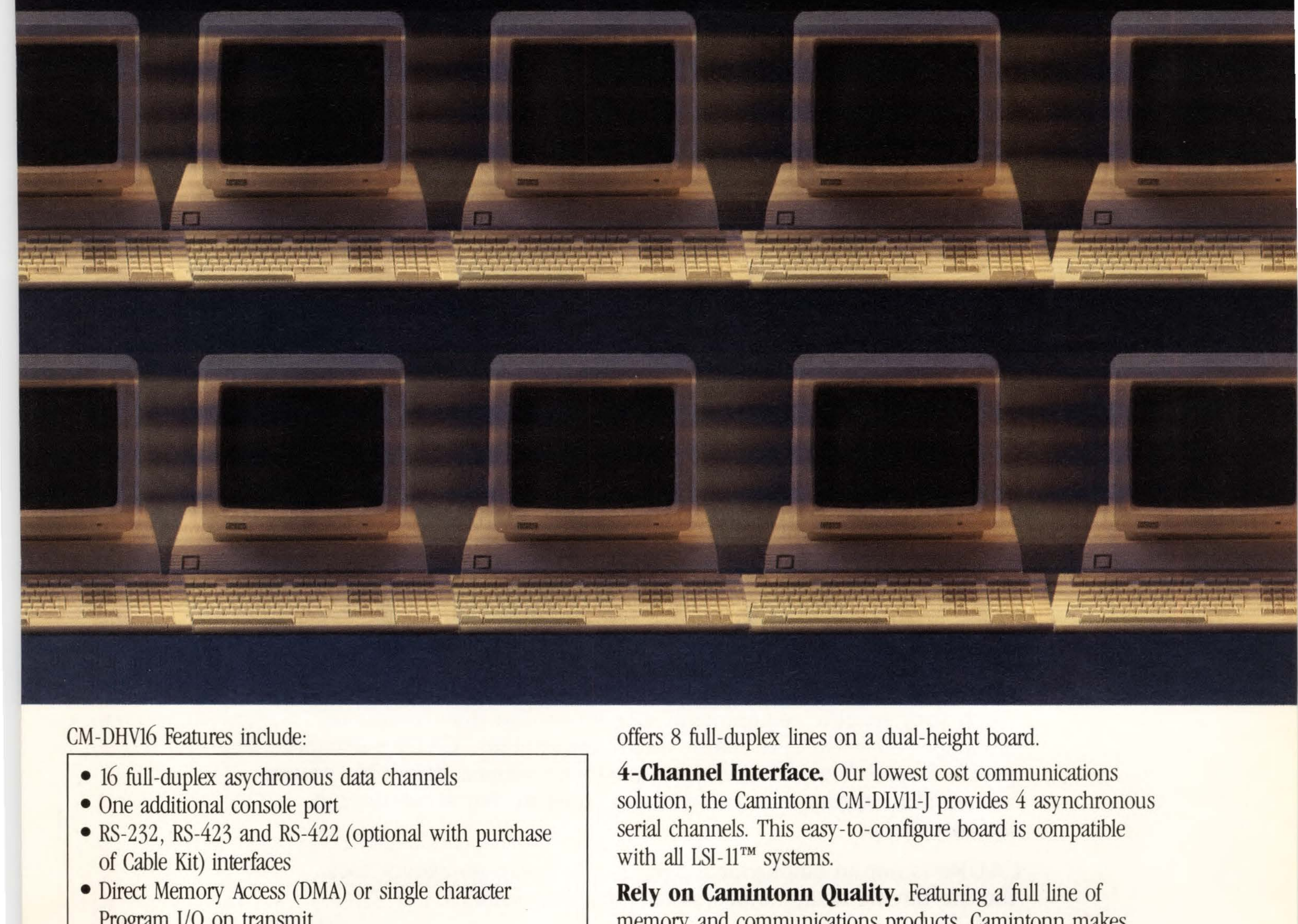

CM-DHV16 Features include:

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ARISTALK

How To Use ARIS

If you are a subscriber to the *DEC PROFESSIONAL*, you can call up our VAX and log into ARIS, our **A**utomated **R**eader **I**nformation **S**ervice. In ARIS, you can download programs from our publications, communicate with our editors, request a change of address, find additional information about advertisers, order books and back issues, check the guidelines for submitting articles, and take a peak at our editorial calendar for the year.

In addition, ARIS has a message center for communicating with other DEC users. There is no charge beyond that of the call, and many *DEC PRO* readers already are getting excellent advice. Each month, we will select and publish some of the most interesting queries and replies.

To log in, you'll need your subscriber number (it's on your mailing label). Then, just set your terminal to 7 bits, 1 stop, no space parity, and dial (215) 542-9458.

DEC'S LCP01 COLOR PRINTERS

QUERY:

Keith Fowler: Has anyone out there used (or better yet, owned) DEC's LCP01 Color Printer? We use Datatrieve and DECgraph for business graphics, which produce sixel and ReGIS protocol. We want hardcopy color output of professional quality, with true area-filling. The only device we have come across that will understand these protocols and produce the quality we are looking for, is the LCP01. The maintenance costs are extremely high, however, and we are afraid of being stuck with a dinosaur that will be a maintenance nightmare.

Any information as to MTBF (Mean Time Between Failures), or simply personal experiences, will be greatly appreciated.

P.S. What is everyone else doing for business graphics/hard copy color output for VAX/VMS?

REPLIES:

Curtis Snyder: We have not used the DEC printer you refer to. For our color output we have been using a Tektronix color printer attached to the terminal — pretty good copy (a little choppy) and very few failures. The problem is that it must be connected to the terminal. I am sure a driver could be built to connect it to the 11/780, but that would be a pain. We also use some of the HP plotter beds. They have excellent copy quality, but you have to wait a while. Again, a special driver would be needed for DTR output. Normally, we process through RS/1 which has all the necessary drivers for the output device.

John Ferriby: We have not had many maintenance problems with the LCP01, but I'd advise having plenty of the "Maintenance Fluid" cartridges on hand. In 14 months we have had no maintenance other than preventive.

As for personal preference, the LCP01 is great for the shading. Be sure, though, that if you send a graph to the device it has a white background—colored backgrounds are default and use ink resources heavily. For shear quality, get a demo graph and compare it to one from a bed plotter. The differences lie in the line quality for the bed plotter, while the LCP01 has better shading qualities.

As for the maintenance cost, I have an idea that DEC has someone building the product for them. (I think the LN01 is like this too.) This seems to drive up maintenance costs.

CALL FOR PDP/ORACLE USERS

QUERY:

Rodney J. Sampson: I wish to contact other PDP/ORACLE users. I need to find PDP/ORACLE development tools and an ORACLE-based accounting system.

Also, I need to find PDP/RSX11M + C language.

Thanks.

REPLIES:

Bill Mayhew: The two dominant sources of C for RSX family systems are Whitesmiths, Ltd., Concord, MA 01742, (617) 369-8499, which offers C for all major DEC operating systems; and DECUS, which has a version of C that is reliable and costs next to nothing, but has minimal RMS support. We added our own RMS support to the DECUS package and have been using it for commercial products for a year. The biggest advantage to this approach is that you have source code for the compiler and the runtime library. Can't help you with ORACLE, as we have our own proprietary relational DBMS.

Phil Anthony: You might want to look at the DECUS tapes; they have two implementations of C that run under RSX. The earlier (1980) version is the one I'm familiar with. It's lacking the " + " (update) modes for fopen( ), and it doesn't support floats or doubles, but other than that does a darn good job. (I use it in emulation mode on the VAX, too.) There's a later version that I understand at least partly corrects these shortcomings — somebody else may have more information on that.

Second, Whitesmiths puts out an RSX C. The problem with it is that the standard library doesn't look anything like anybody else's in the world. They do provide a somewhat UNIX-compatible library, but the last I heard, it was a little buggy. Still, you might find it worth looking into. Good luck!

Ted Bardsuch: I can't help you with the ORACLE stuff, but there are a couple of sources for C on M+. Cheapest are the DECUS tapes, which have an acceptable C for RSX. Much better (in my opinion) is Whitesmiths' C, for only $600 or so. We are using Whitesmiths' for the VAX as well, and it works fine. Just a couple of slightly annoying bugs in the UNIX V7 library include files (easy to fix).

PRINTERS FOR THE PRO 350

QUERY:

Edmund P. Morgan: I have been investigating the world of printers and there is a variety that exist. What printer on the market can be used with the PRO 350 besides the DEC LA210, LA100 and LA50? Would there be any incompatibility problems with cabling, baud rates, parity, horizontal pitch selections, vertical pitch selections and other functions used with non-DEC printers? If needed, what interface would accomplish my needs? Please advise on this matter. Thank you.

REPLIES:

Bill Mayhew: From a hardware standpoint, most any printer with a serial interface that can run at 4800 baud and has XON/XOFF (Ctrl-S/Ctrl-Q) handshak-

SEMIANNUAL CUMULATIVE INDEX

The *DEC PROFESSIONAL* **Semiannual Cumulative Index** is available on ARIS. All published articles—Volume 1, Number 1 (July 1982), through Volume 5, Number 5 (May 1986) — are available by title and author.

Dial (215) 542-9458, and have your magazine label handy. You'll need your subscriber number to access ARIS.

ing support can be used with the PRO. Beyond this, the problem is software compatibility. DEC printers use escape sequences to activate and deactivate features like bolding, underlining, etc., that often are not supported by other printer manufacturers, especially low-end ones.

Thus, DEC or third-party software that uses these features may have problems. The same also may apply to things like setting left, right, top and bottom margins. I would suggest that you use the hardware guidelines I mentioned at the outset of this note to screen initial candidates, and then arrange to check out your favorites, on-line, with a PRO and the software you are planning to use; and, of course, factor into your decision the possibility of future software acquisitions.

David E. Geary: I currently have an HP Thinkjet printer hooked up to my PRO 350. It works as well as any I have tried. It accepts the standard printer cable and can be used by setting printer type to "Other" in the Print Services routine. I also have hooked up a Brother daisy wheel printer to the same system. I did have some problems with this printer until I created a special convertor block to hook to the cable. Did you have a specific printer in mind? If you continue to have problems with interfacing a printer to your PRO 350, please feel free to contact me at the phone number above or by mail at: KLM Data Systems, Inc. ATTN: David E. Geary, 26 N. Trooper Rd. Norristown, PA 19403-3048.

VMS-TO-UNIX ETHERNET SOFTWARE

QUERY:

Patrick Wolfe: Does anyone currently use a software package that allows VMS and UNIX to communicate across the same Ethernet that DECnet and DECservers work on? I know about Process Software's FTP program, and Wollongong's WIN/VX (also known as IP/TCP), but don't know anyone who uses them on a shared Ethernet. WIN/VX sounds absolutely great, but it's price is way out of line ($15,000). FTP's price ($995 for RT-11, $1495 for RSX, and $1995 for VMS) is reasonable, but the software is limited in function.

Are there any other options out there? Can anyone rate these packages?

REPLIES:

Bill Mayhew: Have you looked at DECnet/ULTRIX? I don't know how compatible it is with UNIX versions other than ULTRIX (I don't think you mentioned which UNIX you are using), but it is DEC's answer for UNIX-to-VMS communications. I can't particularly comment on it other than noting that it exists (or has been announced).

Patrick Wolfe: Thanks, but the UNIX flavor we are running is DYNIX on a Sequent Balance 8000; totally incompatible with DECnet/ULTRIX.

Ted Bardsuch: I believe Tektronix (Beaverton, OR) has done this, but I don't know if they have it commercially available. I'd suggest contacting the folks at ACC about their XNS product (Futurenet or something like that).

CONTROLLING DEVICES VIA TERMINAL PT

QUERY:

Jim Agnew: I have a situation where we need to control a Mennen medical ICU monitor via a terminal port. The thing uses an ENQ message from the VAX/PDP to start a data stream ending with an EOT. No carriage return is involved. What would be the best way to do it — using ASTs, a simple QIO, or, RMS?

REPLY:

Curtis Snyder: I have done something similar for a scintillation counter we use for pharmacological studies. I used a QIOW call and specified a length for automatic return (very handy when no <cr> is passed). You may wish to use a size of one character and simply check for EOT as you scroll through the data transmission. If you would like my code for this (PASCAL) I can send you a hardcopy (it's very short) that would show you my method. However, if you already know what a QIO is, it's probably not worth it. (714) 752-4760. ■

ATTENTION VENDORS

The *DEC PROFESSIONAL* magazine will consider DEC-specific hardware and software products for review. We do not endorse or guarantee any products reviewed or discussed.

For further information contact:
The Editorial Department, Professional Press,
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After comparing and evaluating specifications, you settled on a DEC™ VAX™ computer as your best choice. Simply speaking, the VAX is the most technically advanced minicomputer on the market.

The logical next step, then, would be to choose DEC VT™220 terminals. Logical, but not necessarily right. Because the VT220 may not take full advantage of the potential of the VAX and its applications.

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Unlike the VT220 or any other compatible, VISION II has a multi-page memory system that can store up to 220 lines of text locally. This text can be configured into eight independent pages of varying length and width, and any page can be displayed instantly – without disturbing the host – using a function key. VISION II can even display command menus or receive system messages with its non-destructive six-line message window.

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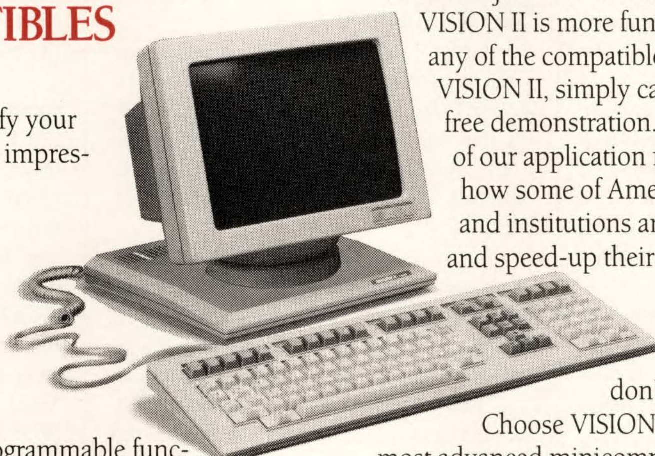
It's very difficult to turn the VT220 or most compatibles into graphics terminals. But with VISION II, all you do is insert our proprietary graphics board, and you've got a high-performance, 68000-based, Tektronix™ 4010/4014-compatible graphics terminal that can even pan and zoom on the fly!



These are just a few of the reasons why the affordable VISION II is more functional than the VT220 or any of the compatibles. To find out more about VISION II, simply call 1-800-387-4205 for your free demonstration. We'll also send you a free set of our application notes that explain in detail how some of America's largest corporations and institutions are using VISION II to simplify and speed-up their everyday computing tasks.

When you're choosing terminals for your VAX, don't make a terminal mistake. Choose VISION II. Because the world's most advanced minicomputer deserves the world's most functional terminal.

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MARKETPLACE

Sigma Announces New Disk Controller

Sigma Information Systems' new quad-height Q-bus SMD disk controller, SDC-RQD11-SC, is designed to interface two physical SMD-type disk drives to the Q-bus via DEC's MSCP protocol. These drives may be of mixed capacities and transfer rates with either fixed or removable media, allowing almost any combination of drives to be attached to the controller.

The SDC-RQD11-SC has a multitude of features including the ability to handle up to 3-MB transfer rates, one megabyte of cache memory, no sector interleaving (1.1 transfer rate), automatic overlapped seek, and complete controller and drive off-line testing.

The SDC-RQD11-SC includes an Out-Loaded Terminal Communication Program (OUTALK) and on-board diagnostics and utilities. The controller supports all appropriate bus functions such as multilevel interrupts, Block-Mode or non-Block-Mode DMA, 22-bit addressing, jumper-selectable alternate addresses and programmable vector.

The SDC-RQ11-SC is software-compatible with all DEC operating systems supporting MSCP, including VMS, RSX11-M, RSX11M+, RSTS-E, DSM, RT11, TSX+, and UNIX. It is hardware-compatible with the MicroVAX II, LSI-11/73 and LSI-11/23.

The list price is $1,850. Quantity discounts are available.

For more information, contact Sigma Sales, 3401 E. La Palma Avenue, Anaheim, CA 92806; (714) 630-6553. Telex 298607 SGMA.

Enter 901 on reader card

AST/Camintonn Offers Serial Interface Card

The CM-DHV16 16-channel asynchronous serial interface card from Camintonn, an AST Research, Inc. company, is a quad-size module that replaces DEC's DHV11 asynchronous multiplexer board in MicroVAX, MicroVAX II, LSI-11 and Micro/PDP-11 computers.

The CM-DHV16 doubles the number of modem channels available to DHV11 system users. It increases the operating speed of DHV11 protocol-based systems by 1½ to two times the current benchmarked rates.

The CM-DHV16 is based on a 2901 bit-slice microprocessor, which results in the board's fast operating speed, high system reliability and compact quad-size package. It includes a serial port for connection to DEC-compatible peripherals.

Price for the interface card is $1,350. For more information, contact AST Research at 2121 Alton Avenue, Irvine, CA 92714; (714) 863-1333.

Enter 902 on reader card

New Product Bridges VAX With IBM PC/AT

Virtual Microsystems, Inc.'s newest Bridge product, called the AT/BRIDGE, provides VAX users with IBM PC/AT compatibility.

The product offers a convenient PC/AT bus interface for connection to a wide variety of IBM PC option cards, such as expansion memory, and controller cards for floppy disks, hard disks and network interfaces.

The essential elements of an IBM PC/AT have been compressed onto a board that can be plugged into the bus of the VAX, allowing any user on the system to run a broad base of PC/AT application software (including Lotus 1-2-3, dBASE III and others) directly from any terminal.

The board's INTEL 8-mHz 80286 microprocessor provides a fast, high performance engine for the VAX in addition to IBM PC/AT hardware compatibility. Its IBM PC 8250 UART serial interface controller gives you the ability to run off-the-shelf communications packages such as Crosstalk.

Each AT board includes the microprocessor, one megabyte of RAM, one IBM-compatible RS-232 port, an optional 80287 floating point processor, and an IBM PC/AT Bus Interface. The AT/BRIDGE currently works with UNIBUS, running VMS. It's priced at $7500 and is available now.

For more information, contact Virtual Microsystems, Inc. at 2150 Shattuck Avenue, Suite 300, Berkeley, CA 94704; (415) 841-9594.

Enter 903 on reader card

BASELINE Software Goes Hollywood

A comprehensive information service for the entertainment industry, BASELINE, recently made its debut from BASELINE, Inc.

BASELINE provides information on 34,000 films, television shows and theatrical productions, plus data on more than 200,000 people involved in making them — from actors and directors to key grips and make-up artists. Information on films currently goes back to 1970 and information on television programs goes back to 1934.

BASELINE offers Cinemascore, which charts audience statistics and gives demographic breakdowns of opening-night reac-

Desktop Printer Cuts Copy Time In Half

Tektronix Information Display Group's (IDG) new 4696 Color Ink-Jet Printer is a low-cost, desktop personal printer that reduces the time required to generate high-quality graphics output. It can produce a copy in approximately 2.5 minutes, nearly half the time required by IDG's 4695 Color Graphics Copier, which the 4696 replaces.

Priced at $1795, including start-up supplies and interface cable, the new printer is designed for fast screen copy and presentation output on paper and transparency media.

For more information, write on company letterhead to Tektronix, Inc., P.O. Box 1700, Beaverton, OR 97075.

Enter 900 on reader card

tions for all major releases since 1979. Another service lists literary properties for which film rights are available, with story synopsis, author, agent and publisher.

BASELINE can be accessed through personal computers equipped with a modem or through a small portable Minitel receiver leased from BASELINE. Additionally, subscribers can use the phone-in service where BASELINE researchers help get quick answers to queries.

For more information, contact BASELINE, Inc. at 80 East 11th Street, New York, NY 10003; (212) 254-8235.

Enter 904 on reader card

Masterpiece Now Runs On VAX Computers

Software International Corporation's Masterpiece Series VAX is the company's new family of online accounting and business-management application software products for VAX computers. Masterpiece VAX operates on all VAX systems, from the MicroVAX II through the 8600 series.

Masterpiece VAX is built with an Intelligent Architecture design that is modular and that fosters borderless product integration. The Masterpiece Series VAX includes account-management applications, VAX MasterQuery, VAX MasterSecurity, Online Help, and VAX Navigation.

Prices for the software products range from $16,000 to $42,000. All purchasers of the company's existing family of VAX applications will receive upgrade rights to the Masterpiece Series VAX at no charge. Only the VAX MasterQuery and PC link products are priced as separate modules. VAX MasterQuery is priced at $10,000, and PC Link is $5,000 (for copies one through five).

For more information, contact Software International Corp. at One Tech Drive, Andover, MA 01810-2497; (617) 685-1400.

Enter 905 on reader card

Graphics Board Displays 16 Million Colors

Peritek's new color graphics board for DEC computers is the first single board able to create images 24 planes deep — with an independent alphanumeric overlay. The VCX-A/U board will display any of 16 million different colors at any moment, giving the user immediate access to virtually all hues discernible to the human eye. The board is a quad-height size configurable for either Q-bus or Unibus computers.

Principal applications are sophisticated imaging, process control, simulation, and presentation graphics. The graphics display consists of 512 X 512 pixels.

Price of the VCX-A/U board is $5895. Delivery is 30 days ARO.

For more information, contact Peritek, Inc., 5550 Redwood Road, Oakland, CA 94619; (415) 531-6500.

Enter 906 on reader card

VOX Joins Software Family

SOLVEware Systems, Inc. has added VOX, an office exchange software product, to its product line of office automation software products, which includes 20/20, developed by Access Technology, and WordMARC, developed by MARC Software International. SOLVEware Systems has entered into a distribution agreement with the Redwood Technology Group, the authors of VOX.

VOX doesn't need a systems programmer to put it together, and it will integrate all office automation software directly. It supports the leading software products and lets you make the choice for word processing, spreadsheet, database and business graphics. It extracts data from one product and transfers it directly to another. And VOX will mail any file electronically.

VOX has a set of office management tools including a project manager, conference room scheduler, calendar, phone book, calculator, file manager and file printer.

It's currently available on VAX and MicroVAX series under VMS and MicroVMS. Other hardware lines and models are under development. Price range is $4,000 to $26,500.

For more information, contact SOLVEware Systems at 2323 West Fifth Avenue, Columbus, OH 43204; (614) 488-1891.

Enter 907 on reader card

SPSS Adds DATATRIEVE Interface

An addition to the SPSS-X data analysis system of a new interface to the VAX data management language, DATATRIEVE, is being offered by SPSS, Inc. The interface joins two frequently installed software systems at VAX sites and means the powerful data analysis and reporting capabilities of SPSS-X may be applied to data stored and managed by DATATRIEVE. In addition, SPSS-X can access data stored in VAX DBMS and Rdb/VMS data management systems.

You may access DATATRIEVE data from within SPSS-X by specifying the domain. SPSS-X reads all the records and elementary fields and assigns default formats, missing values, and labels using information in DATATRIEVE.

You can perform other tasks such as read only selected fields, read a limited number of records, pass commands to DATATRIEVE, and more.

SPSS-X offers DATATRIEVE users a flexible report generator. The SPSS-X Tables option adds the ability to create customized presentation-quality tables, including the stub-and-banner variety. To complete the reporting process of analysis done on DATATRIEVE records, SPSS-X output files may be routed to SPSS Graphics for preparation of high-impact charts. Both SPSS-X Tables and Graphics support drivers for most DEC terminals and printers.

For more information, contact SPSS at 444 North Michigan Avenue, Chicago, IL 60611; (312) 329-3500.

Enter 910 on reader card

MICRO-MATCH Makes Interfacing Easy

Command Computer Corporation's MICRO-MATCH provides ready-made interfaces between micros and micro peripherals.

MICRO-MATCH is a set of two reference volumes of easy-to-use diagrams and step-by-step instructions for interconnecting micros to printers, micros to CRTs, micros to modems, and micros to plotters.

All that is required to interface two devices is to locate the respective device pair in the index and then go to the appropriate page. MICRO-MATCH will lead you through the rest.

The product is available in two versions: All-Vendor Version ($690 a year, including service) and the Single-Vendor Version (ranging from $29 to $149 per volume), which is available for DEC computers.

For more information, contact Command Computer Corporation at 36 Columbia Terrace, Weehawken, NJ 07087; (201) 865-8500.

Enter 909 on reader card

PC/EDT Updated To Version 3.0

Boston Business Computing, Ltd.'s PC/EDT 3.0 allows you to perform VAX editing on personal computers and some UNIX workstations.

The new release is 300 percent faster than version 1.2. Other enhancements are learn mode, improved VAX LINE mode compatibility, OVERSTRIKE/INSERT modes, and support for the new enhanced PC/AT keyboard.

PC/EDT version 3.0 is available at a cost of $250. Current owners can upgrade by returning their original diskette with a payment of $100.

More information describing the PC/EDT version 3.0 release is available from Boston Business Computer, Ltd., Riverwalk Center, 360 Merrimack Street, Lawrence, MA 01843; (617) 683-7920.

Enter 926 on reader card

Star Coupler Released For Ethernet 802.3

Richard Hirschmann of America, Inc. has introduced the ASGE Active Star Coupler to Ethernet 802.3 specifications. This fiber optic-based LAN offers interference-free, repeaterless transmission to 4000 m.

Up to 20 active cards are housed in a 19-inch rack, with each card capable of interfacing another ASGE star point, or an optical transceiver connected to a CPU or peripheral. The transceiver directs all CSMA/CD functions as well as heart beat according to Ethernet.

Since the Star Coupler is an active system, complete signal regeneration occurs at the star points. This affords maximum optical power at all output ports. Network planning is thus reduced to single lines versus complicated calculations of attenuation or dynamics as required by passive systems.

For more information, contact Richard Hirschmann of America, Inc., P.O. Box 229 Industrial Row, Riverdale, NJ 07457; (201) 835-5002.

Enter 911 on reader card

Disk Controller Runs On MicroVAX II

The new MV-DK11-RM quad size HSMD disk controller, from MDB Systems, Inc., provides data transfer rates from 1.2 to 2.5 megabytes per second, dependent upon the drive.

It can operate the fastest disk drives available, including the latest Fujitsu M2333, the Eagle XP (2.4 MB per second) as well as slower drives, such as the Fujitsu Eagle and Century Data's 2400 and 2600 (1.8 MB per second), and Control Data's 9762 or 9766 (1.2 MB per second).

Utilizing RM03 or RM05 emulation, the DK-11 read and write data rates are more than 30 percent faster than any controller on the market, including those that utilize DEC's MSCP (Mass Storage Control Protocol).

The controller can support two physical drives at one or two logical units per drive for a maximum of four logical units. Disk drive sizes can be from 67 MB to over six GB formatted. Consecutive sectors of data can be transferred at a 20-MHz serial data rate (2.5 MB per second) without sector interleaving.

On-board three-sector buffer (1536 bytes) provides for data smoothing and elimination of data late errors. DEC-compatible 32-bit Error Correction Code (ECC) combined with 16-bit CRC are used to generate/check for media defect flagging and header errors.

The controller is software configured (via use of ODT at the operator's console) for parameters such as: Emulation Mode, Number of cylinders/heads/sectors for physical drive, Interrupt vector, Hardware or Software error correction, Sector Interleave, or Horizontal or Vertical mapping.

The DK11 controller is supplied with a MicroVMS driver on TK50 compatible tape cartridge or RX50 compatible 5 1/4-inch diskette. Available immediately, the MV-DK11-RM has a list price of $2,400 with substantial OEM discounts offered.

For more information, contact MDB Systems, Inc. at 1995 North Batavia Street, Orange, CA 92665; (714) 998-6900. TWX 910-593-1339.

Enter 913 on reader card

New 5220 Terminal Is DEC-Compatible

Falco Data Products' new 5220 video display terminal is fully compatible with the DEC VT220, VT100 and VT52, and includes many features including multihost windowing, two pages of memory, ultra-high screen resolution, a soft white phosphor display and automatic cable configuration RS232C or RS422 communications ports.

To provide ultra-high resolution and good character readability, the terminal's 400 scan lines with 25-kHz horizontal output produces a 10 x 16 letter quality character cell. The screen display can be formatted in the standard 24 lines by 80 columns or display as much data as needed up to a maximum of 40 lines by 132 columns.

A soft white (P167 phosphor) display on the terminal's 14-inch, non-glare flat profile CRT reduces eye fatigue and improves user efficiency. Standard green (P31 phosphor) and amber (P134 phosphor) displays are available at no additional cost.

Multihost windowing enables you to set up or store displays on two separate windows using data being concurrently received from one or more hosts via two ports. When combined with the Falco 5220's two pages of memory, the two windows communicating through the two ports create immediate access to two virtual DEC terminals in one display.

For more information, contact Falco Data Products, Inc. at 1294 Hammerwood Avenue, Sunnyvale, CA 94089; (408) 745-7123.

Enter 912 on reader card

Control Data Offers Third-Party Support

Control Data Corporation has entered the third-party software support market. The company offers the DEC Software Support Service and the IBM Software Support Service in Washington, D.C., Boston and Chicago.

Both services are packaged, predefined products that provide consulting and support by Control Data to ensure that DEC and IBM software is maintained properly, that updates are installed efficiently and customers are trained effectively to use the software.

Control Data's Software Support Service for IBM and DEC products provides services in the areas of software maintenance, major upgrade installations, operations workshops, user consulting and assistance and telephone support.

For more information, contact Control Data at (612) 853-5945.

Enter 914 on reader card

Video Terminal Added To Esprit Family

The ESP 6515 is Esprit Systems, Inc.'s latest addition to its DEC-compatible video computer display terminal family.

The Esprit 6515 is a plug-for-plug emulation of the DEC VT220, while being fully compatible with all DEC VT100 applications software. By adding an Esprit 9310 module to the Esprit 6515, the system becomes a personal computer capable of running all PC-compatible software. The list price is $795.

The 6515 is fully compatible with all major DEC system software, including the "All-In-One" WIPS spreadsheet and file management program, and MASS-11 word processing, running under the VAX/VMS protocol. The 6515 runs the DEC system 10/20 accounting/database package, and PDP-11 RSTS data inquiry application.

For more information, contact Esprit Systems, Inc. at 100 Marcus Drive, Melville, NY 11747.

Enter 916 on reader card

DIALOGUE Simplifies Data Programming

Computertime Network Corp.'s DIALOGUE is a new high level productivity system aimed at reducing the current industry backlog of VAX/VMS file projects.

DIALOGUE is a 4GL, no-programming system allowing programmers and end users to create, maintain, enhance and inquire upon both single and multiple, related RMS files. It can be used to perform maintenance and inquiry upon any existing RMS file type or to set up new applications running against either existing or new files.

DIALOGUE requires no change in current programs and techniques. It's compatible with all popular standard languages.

For more information, contact Computertime Network Corp. at 400 Amherst Street, Nashua, NH 03063; (603) 673-1014.

Enter 917 on reader card

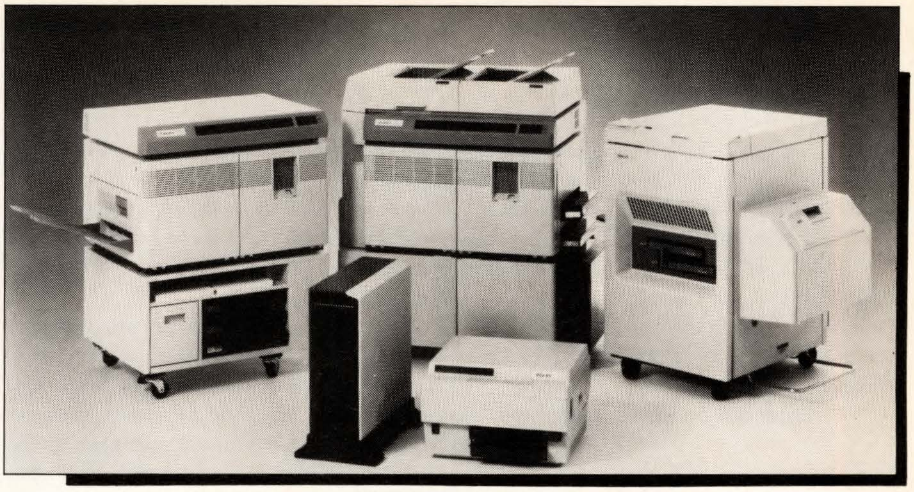


IMAGEN Corp.'s new ImageServer XP product line includes major enhancements.

XP Line To Enhance Printer Family

IMAGEN Corporation has made major additions and enhancements to its ImageServer product family. Designated ImageServer XP (for Extended Performance), the new line supports work group document processing requirements with sophisticated paper handling and accelerated throughput of high quality text graphics.

There are two new 20-page-per-minute laser print engines, improvements to the imPRESS page description language, additional emulation capabilities, more communication functions, and expanded file system capacity allowing more resident fonts. The ImageServer XP line is comprised of the Model 7320, 4324, 3320, and 2308. All models, ranging in speed from eight to 24 pages per minute, are managed by the intelligent ImageServer XP Image Processor, which features a trio of Motorola 68000 multibus-based microprocessors and IMAGEN's proprietary Real Time Rasterization technique.

The ImageServer XP Model 7320 features automatic duplexing, three input trays, dual offset stackers, and accommodates 11-inch x 17-inch paper. Assisted by the XP Image Processor, the Model 7320 prints at a true 20 pages per minute and provides 300-dots-per-inch resolution. Three megabytes of memory and a 2.5-megabyte Raster Image Buffer are standard, allowing fast translation of the most complex graphics. The 7320 supports UNIX, DEC VMS and IBM 3270 host environments, and is software compatible with IMAGEN's other family members.

Model 3320 is IMAGEN's new mid-range printing system. It provides medium capacity paper input and is the lowest cost laser printer available that can handle 11-inch x 17-inch paper formats. The XP 3320 is priced at approximately $22,000.

The Model 4324 has three input bins, a face down offset stacker, and accommodates 11-inch x 17-inch paper formats. It produces 24 pages per minute and sells for approximately $30,000. The Model 2308 is a table-top system that features collation, page reversal and automatic jam recovery. It runs at eight pages per minute and sells for approximately $9,000.

For more information, contact IMAGEN at 2650 San Tomas Expressway, Santa Clara, CA 95052-8101; (408) 986-9400.

Enter 920 on reader card

EXECmail Available At Reduced Price

Executive Software, Inc.'s special release of its EXECmail electronic mail software package for VAX and PDP-11 systems comes with a $495 price tag. The company first began offering EXECmail for the VAX in 1982 at a price of $16,000.

EXECmail runs on VAX/VMS and PDP-11 RSTS systems.

Find out more by contacting Executive Software, Inc. at 5537 Tuxedo Terrace, Los Angelels, CA 90068; (213) 461-6688.

Enter 918 on reader card

Software Accelerates User Development

Precision Visuals' new User Interface Management System (UIMS) for technical software users, Enter/Act, is a high level tools set that handles all application aspects of the user/computer interface, including prompt/command interaction, data entry or action menus, and both alphanumeric and graphics windows. It reduces the amount of code required to build user interfaces by 30-70 percent depending on the application's complexity. Interface updates and corrections are integrated quickly, reducing post-release maintenance resources.

For end users, Enter/Act provides better quality and more flexible program interaction. Controls are accessed to move, size, pop, scroll, or delete windows, even on non-intelligent, VT-100-like peripherals. The system offers end user selectable dual capability for menus and commands. Novices benefit from menus while experts move faster with commands.

Enter/Act permits application prototypes to be implemented in days rather than months, as with conventional methods. End users can test drive the system before significant time and money are invested, leading to better tuned designs and more satisfied users. Developers required to demonstrate project feasibility as part of approval or bidding cycles benefit particularly from rapid prototyping.

Other features enhance productivity for application developers and end users, including an interactive WYSIWYG menu layout utility; multilayer, context-sensitive HELP and tutorial files; security levels to control information access; automatic recognition of command abbreviations; a BASIC-like command macro facility; debugging aids; example-intensive reference and tutorial documentation; and a hands-on training course covering principles of interface design and use of Enter/Act.

Initially offered in the DEC VAX/VMS environment, Enter/Act is machine-independent and runs on any device with alpha-


FILE TRANSFER IN PROGRESS
Please wait ....

numeric capabilities similar to DEC's VT-100. Graphics terminals initially supported include DEC VT-240/241, VT-100 with Retrographics, Tektronix 4105/07/09/11/15/25, and Westward Series 2000. Available immediately, North American prices for Enter/Act vary with CPU power. Mid-range VAX pricing is $20,000 for initial development license, which includes a one-week training course.

For more information, contact Precision Visuals, 6260 Lookout Road, Boulder, CO 80301; (303) 530-9000.

Enter 919 on reader card

Link Announces New Terminals

LINK Technologies, Inc. has added two products to its alphanumeric terminal line. The new terminals, the LINK 220WP and PCTerm WP, are special word processing versions of current LINK products with features that adapt them to these specific application areas.

The LINK 220WP is a version of the LINK 220 terminal, which is an ANSI 3.64 compatible device emulating the VT52, VT100, and VT220 terminals manufactured by DEC, modified for word processing applications. The unit includes a word processing keyboard with 41 specially labeled word processing function keys. These keys allow document manipulation and modification with single keystrokes and are compatible with currently available word processing application packages.

Functions include a full-range of file handling, document positioning, text attribute control and editing commands, as well as all of the functions of the standard LINK 220. The LINK 220 WP is available with the company's new soft white screen phosphor. With this display, black characters appear on a white background in the same format as the printed page.

The PCTerm WP is a version of the company's PCTerm product modified for word processing applications. PCTerm is designed to allow users of IBM and compatible PCs to expand their systems to multiuser configurations by installing slave cards and the PCTerm workstation.

The LINK 220WP is available now at a list price of $649, while the LINK PCTerm WP is available at a list price of $699.

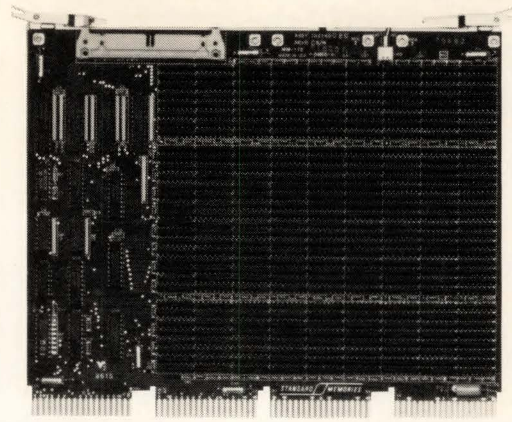
For more information, contact LINK Technologies, Inc. at 47339 Warm Springs Blvd., Fremont, CA 94539; (415) 651-8000.

Enter 921 on reader card

Tatung Offers TVT-7261 Terminal

A new multiemulation terminal by Tatung Company of America, Computer Products Division, the TVT-7261, is compatible with ANSI and ASCII VDT protocols.

The TVT-7261 offers emulation of sev-



The Standard Memories PINCOMM 630SX memory module.

eral different terminals currently on the market, including Televideo models 912/920/925/910+, DEC VT131/102/100/52, and LSI ADM-3A/5.

The tilt and swivel display unit of the TVT-7261 features a 14-inch, dark-tinted, green standard screen with resolution of 10 x 15 character cells per 80 columns. The display format of the TVT-7261 includes a 26th user line with 132 characters. Scrolling may be either jump up/down, or smooth up/down. The cursor may be block, underline, or no cursor, with the additional option of static or blinking. Character sets featured are 128 ASCII, 46 European, and 48 special graphic characters.

The unit is priced at $695 and private label and OEM modifications are encouraged. For additional information, contact Roy Pacheco, Tatung Company of America, Inc., Computer Products Division, 2850 El Presidio Street, Long Beach, CA 90810; (213) 637-2105.

Enter 922 on reader card

Standard Memory Debuts Memory Module

A new 8-MB semiconductor add-in memory, from Standard Memories Division of Trendata Corp., is for use in all MicroVAX II computers and MicroVAX II-based workstations.

The Standard Memories PINCOMM 630SX memory module provides 8 MB of storage capacity on a single board, using 256K RAMs. Hardware and software compatible with the MicroVAX II, it's equivalent to two DEC MS630BB memories. It installs directly into one of the two memory slots of the computer, and allows up to 16 MB of memory in the system.

The PINCOMM 630SX features an On-line/Off-line switch, allowing the memory to be put off-line as an aid in troubleshooting or in configuring a system. Other features include a Power-on LED and two LEDs that indicate activation of each 4-MB bank of memory. The PINCOMM 630SX carries Standard Memories' 10-year 5 Plus 5 Warranty.

For more information, contact Standard Memories at 3400 W. Segerstrom Ave., Santa Ana, CA 92704; (714) 540-3605.

Enter 923 on reader card

ISE Announces New VAX/VMS Software

The ACT User Accounting and Chargeback System from ISE, Inc. supports a variety of accounting methods including cash-based operations, purchase order-based operations, in-house resource chargeback, and project accounting.

The system automatically collects and maintains usage information. ACT notifies the manager and users when account parameters are exceeded. The system optionally can turn off those users. The user has access to all data about his or her own account and the manager can access all data and help information.

Detailed reports are generated daily and

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automatically. Summary information and statements are generated monthly and automatically. Many user-setable parameters exist to facilitate customizing all operations. ACT provides simple commands for adding new users (creating a UAF entry, creating a directory, and adding other billing information) and deleting old ones.

Full support is provided for clusters and DECnetted systems. It's available for the MicroVAX to the VAX 8800. Price is $660 to $13,500.

For more information, contact ISE, Inc., P.O. Box 241740, Los Angeles, CA 90024-1740; (213) 837-8339.

Enter 924 on reader card

Enhancements Added To Series 100

Imaging Technology, Inc. has reduced list prices, as well as adding major enhancements to its family of real-time, single-board image processors, the Series 100.

An enhanced version of the Series 100 modules features an expanded frame memory to provide storage of multiple images, an optional resolution of 640 x 512 for acquiring, processing, and displaying square pixels, and the ability to scan different sections of frame memory simultaneously. The price of the standard Series 100 modules has been reduced and now includes pseudocolor output.

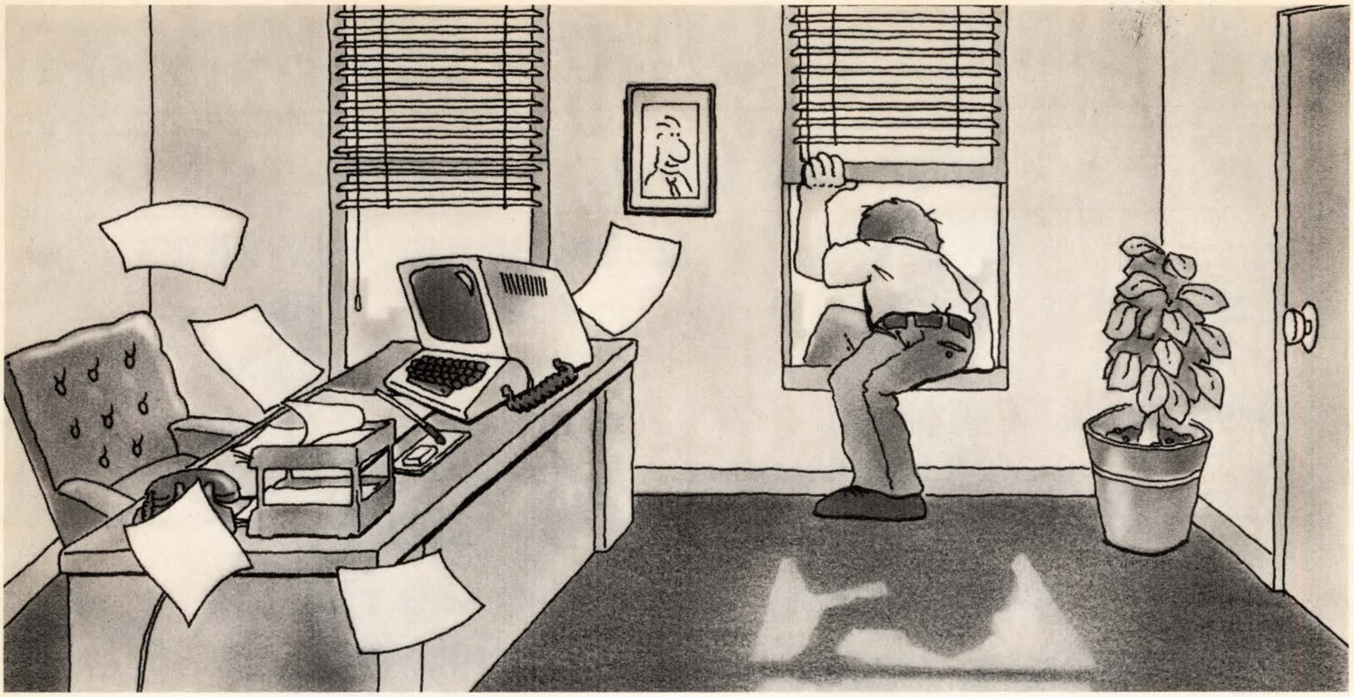
Two important features that have been incorporated into the enhanced version of the real-time, single-board Series 100 image processor are expanded frame memory that provides either twice (1024 x 512 x 12-bits) or four times (1024 x 1024 x 12-bits) the amount as the standard product, and no-charge order option of storing and displaying an image of either 512 x 512 or 640 x 512 pixels, which corresponds to a 1:1 aspect ratio. This allows Series 100 users to acquire, process, and display square pixels.

All standard Series 100 boards are available stock to 30 days. All enhanced versions (Multibus, Q-bus, and VMEbus) are now available.

The Standard Version costs $3,995 and the Expanded Frame Memory Versions cost $4,495.

For more information, contact Imaging Technology, Inc., 600 West Cummings Park, Woburn, MA 01801.

Enter 925 on reader card



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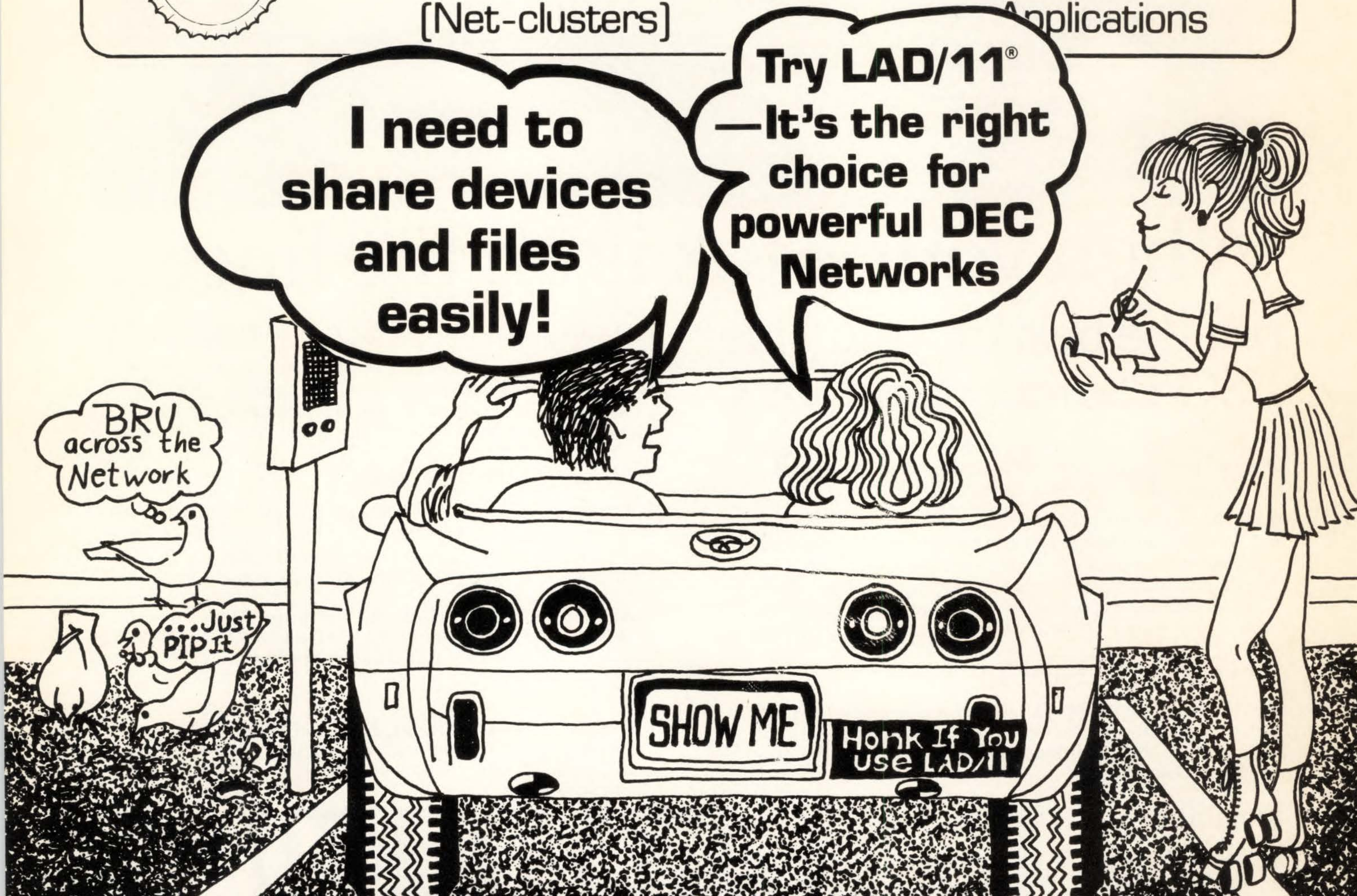

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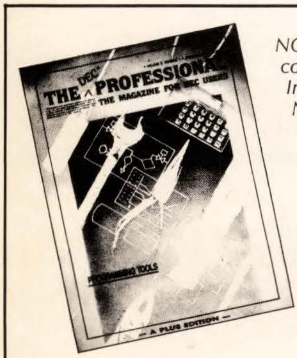

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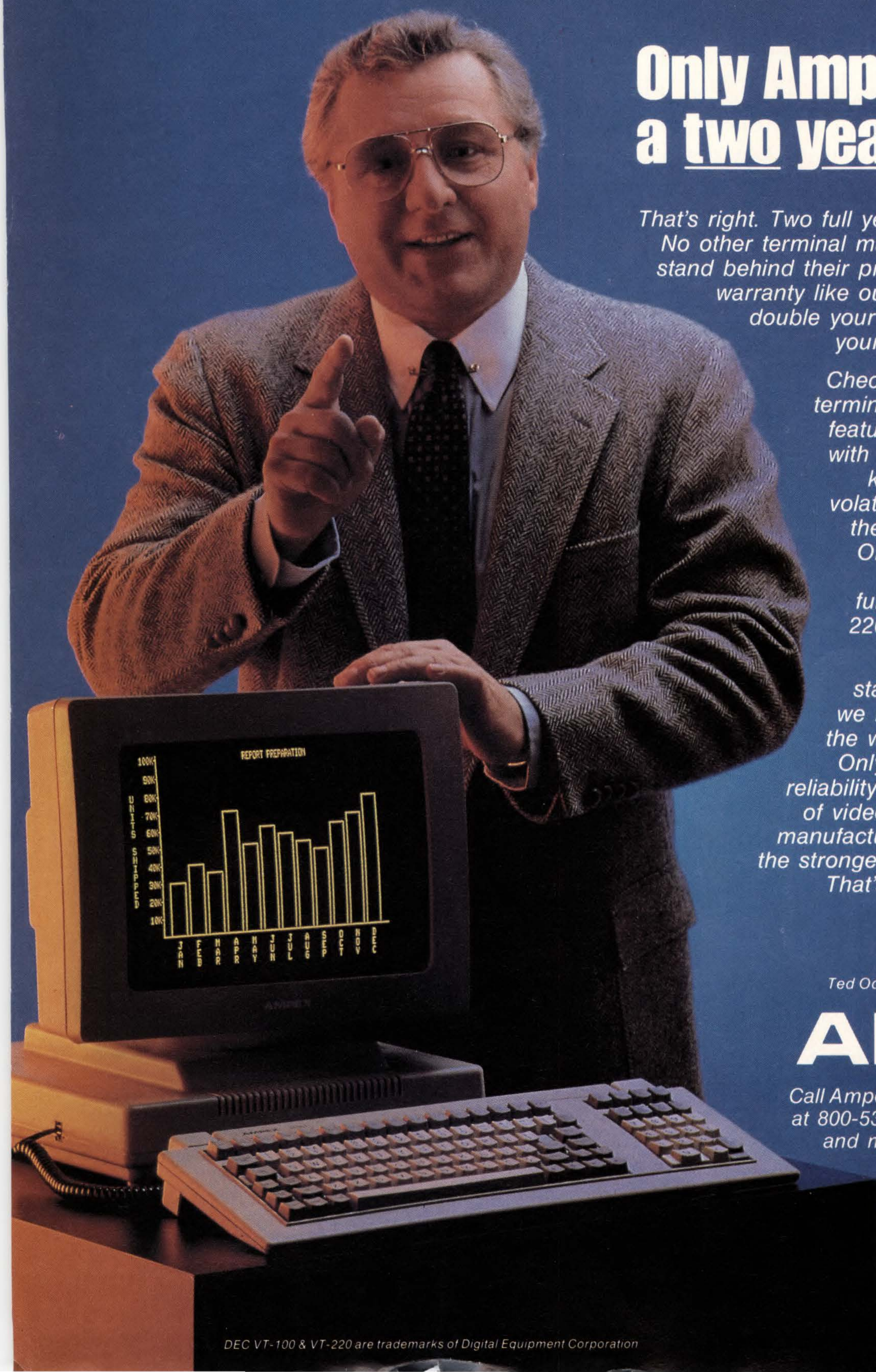

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THE BACK END

UNIX Is Dead! Wanna Fight??

By John C. Dvorak

Summer is over and a plague of UNIX programmers is upon us. College kids, wet behind the ears; greenhorns, rubes. They pour out of various campuses talking about ROFF and ED and pipes and paths, and they look for work. They're impressed with themselves. After all, they've learned the language of a secret society. If they're from Berkeley, they've learned the secret language of a secret society.

They all program in C, and wherever they go they change the prompts on whatever computer they get their hands on so it resembles a UNIX machine. The creative ones go into whatever operating system they have to use and find a symbol or token table; then they change the commands to look like UNIX. The *more* creative ones customize the commands further so they are even more cryptic and weird than UNIX. Whether these people ever do any real work is a mystery.

"Yes, weeell, to list my files I merely type P; MJOI."

"P; MJOI?? What the heck does that mean?"

"It just so happens that if I put my coffee cup on the keyboard and rock it a certain way, that's what it will type; so, I do that to list my files!"

While it's good to see these kids doing something other than wasting quarters on endless games of Pole Position, I'm not so sure UNIX dabbling is much better for society.

I feel this way, not so much because UNIX is an old-fashioned OS that has a special place reserved in hell, but because its time has passed. UNIX is dead, but no one bothered to claim the body. It lives like a zombie on college computers and serves as a gateway to all sorts of weird networks.

UNIX haunts marketing men, too. I remember when Fortune Systems was getting started. That's about the time that a bumper crop of college-bred UNIX drones was dumped like mulch into the marketplace. They all were singing the praises of UNIX to the low end of the market.

So, I went to this strategy demonstration given by one of the vice presidents of Fortune Systems. These guys surely were ahead of their time, and it was a perfect example of having too much bad information. The Fortune 16:32 (or was it 32:16? In either case it looked like a biblical reference . . .) said unto us: "Come to me for thine microprocessor and spend, spend, spend!" It was the first camel of microcomputers. Like a horse designed by committee (aka camel), the Fortune was preceded by too much market research. A lot of this was skewed by the hordes of UNIX maniacs running through the valley waving the UNIX flag.

First of all, I was shown a slide that clearly showed the Motorola 68000 as the world's greatest microprocessor.

The 68000 beat everything. Personally, I can't remember what it was pitted against — probably the 8080, the 6502 and a 4004. Whatever, this was the chip to use.

Then the company did some market research and, because writers, pundits, researchers, secretaries, publishers, and programmers all said that UNIX was the next hot operating system, they chose it for their own little machine.

The UNIX community yelled, "Yea!" But, they continued to use free university-provided time, and none of the UNIX hackers bought the little UNIX boxes. Well, that was okay — it was intended to be a business machine, anyway.

Ooops! Gee, it seems that the businessmen couldn't cope with UNIX and "$ 1s /bin|pr -p -t" or any other such nonsense. So, they had to build a performance-sapping shell around the system, code name: SLOW. So much for the UNIX world takeover. I figured that would be the last I heard of it.

Not so. Last week, a guy walked up to me as I was writing this column on a portable computer in a San Francisco bistro. He had been reading it through binoculars from across the room. "So, you don't like UNIX, huh, Dvorak? What's better, MS-DOS?? Hahahaha!"

"IBM's VM is the happening operating system," was my quick rejoinder.

"VM doesn't run on minis and micros. It's just a shell, anyway," he shot back.

"Is not!"

"Is too!"

"Is not!"

He took a swing at me and I caught him a good one in the stomach. We punched each other for a good 15 minutes. All of a sudden he stopped and yelled,

"Hey, what's going on here? Where am I? Wow, I remember my name! What happened?"

"We were fighting about UNIX," I said.

"UNIX? I was fighting about UNIX? My God . . . I was hypnotized!"

True story.

So, try snapping your fingers in the face of one of these UNIX maniacs next time he flies off the handle.

See what happens.

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