APRIL ■ 1987 VOL. 6, NO. 4 ■ $4.00

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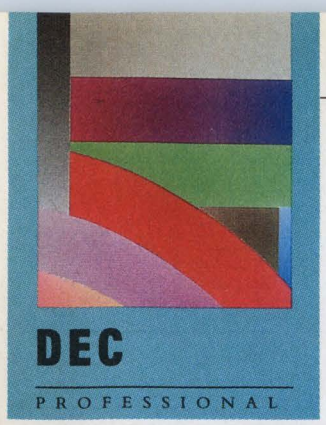

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MULTIPROCESSING

PRODUCT REVIEWS

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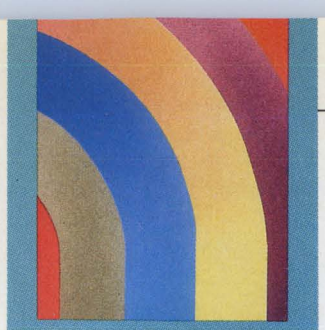
The lab seal indicates that the product reviewed has been tested by one of our experts in our Laboratory and Testing Center.

ON THE COVER:
This month's cover is the work of Pennsylvania-based airbrush artist Jim Serfass.



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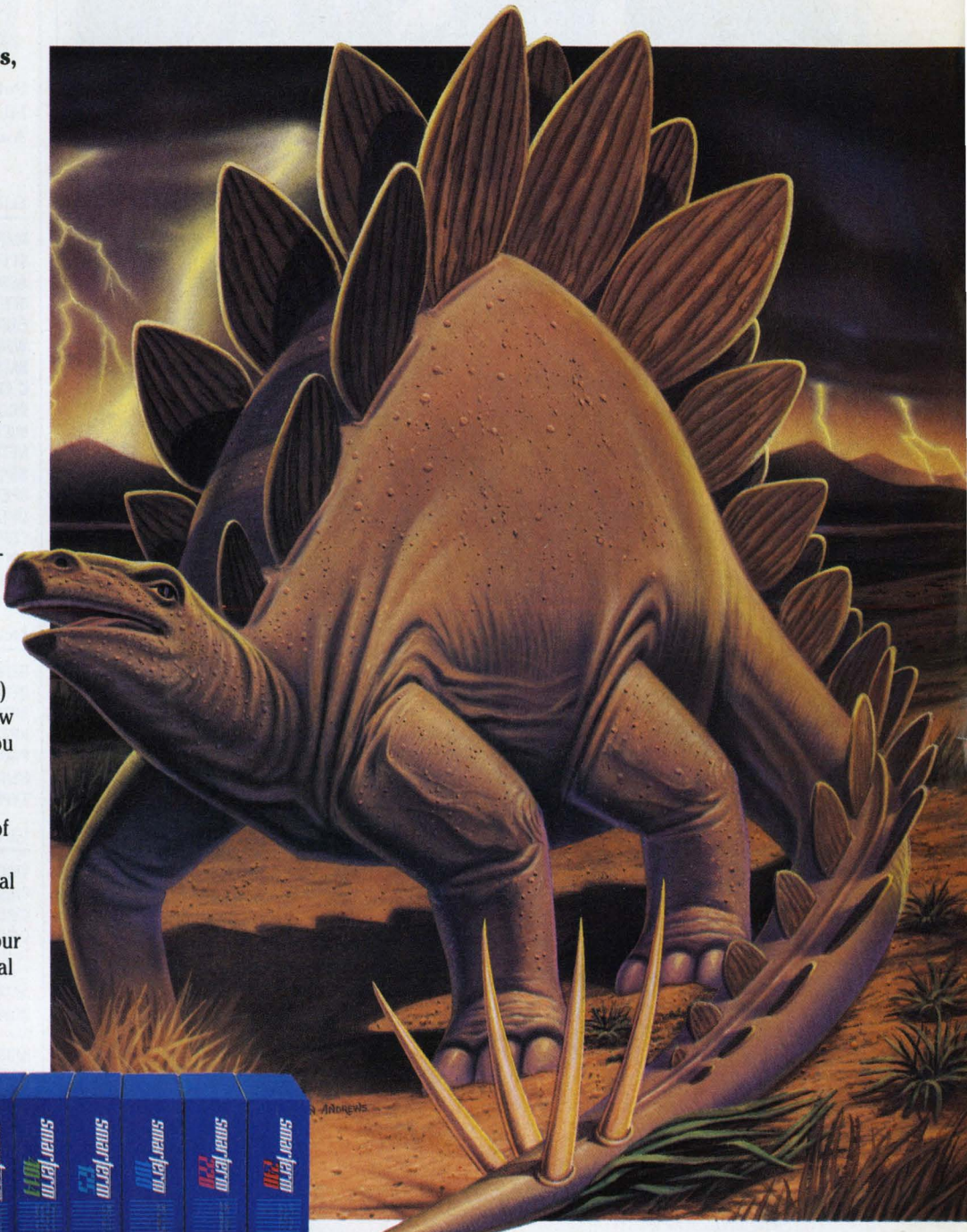

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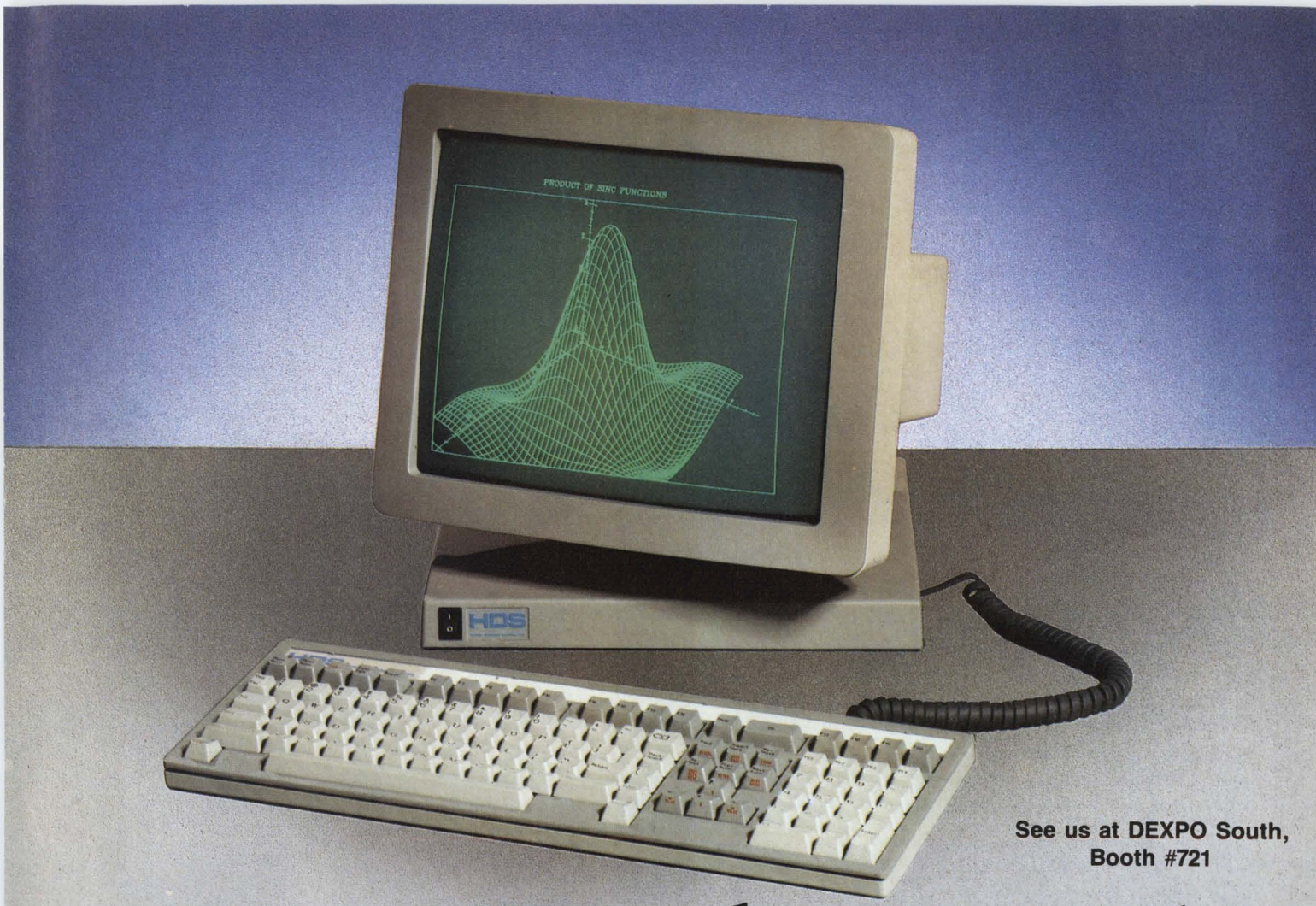

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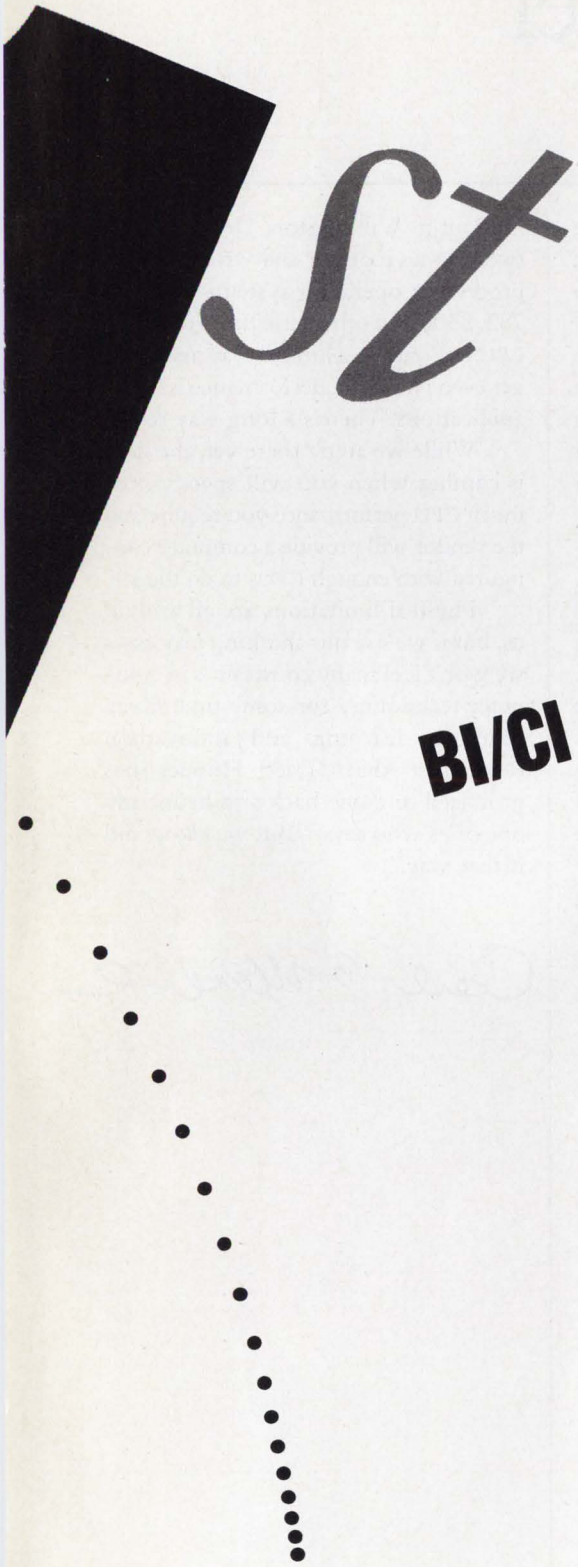

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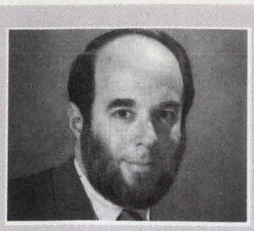


PUBLISHER

Carl Marbach

Multiple/Parallel Computing

Parallel computing with multiple processors is coming as surely as there will be summer in New York this June. Our physical world demands it.

We are surrounded by physical demands and constraints although we usually don't notice them. Speed limits on highways are artificial velocity constraints. But a land vehicle is unstable at speeds in the 100 to 200 MPH range no matter how it is designed: The finest Indianapolis race cars are on the ragged edge at 200 MPH. Stock cars that are even slower seem to crash regularly.

Airplanes aren't exempt. Breaking the sound barrier was once an impossible feat that now is surpassed daily by regularly scheduled New York-to-London Concordes. But even that supersonic plane is constrained by the frictional heating of its skin and is speed-limited by temperature rather than aerodynamics. A recent stretch of the Boeing 747 jetliners' wings resulted in a five percent increase in fuel efficiency, saving airlines that use this variant a lot of money. A further stretch that would have resulted in an even greater savings was ruled out because the longer wings wouldn't fit existing airline gates!

Our computers are limited, as far as we know, by the speed of light, which is the speed that electrical impulses travel in wires. IBM did research for some years on very cold (near zero) temperatures that theoretically could lower resistance to zero and make the impulses travel faster. It didn't work and the research has been abandoned. For the moment this means that computers are limited by physical laws of nature to speeds that are finite. While the CRAY and other supercomputers push these limits, there will be a wall beyond which they cannot go . . . but two processors should be able to do the work twice as fast as one, and four should be four times as powerful, and so on.

It's well known that two programmers don't produce twice the coding. This is because of interpersonal communications time and a certain amount of overhead between the two workers. Multiple CPUs also will have this overhead built in.

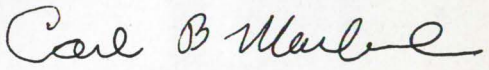
Looking at the size of the new MICROVAX 2000 is inspiring. Two of these powerful computers take up the same amount of space as one PC/AT. By clustering these two MICROVAXs using their standard Ethernet ports, they become a 2 MIP, eight user MICROVAX system in the same physical space as an IBM PC/AT!

The Intel chipmakers and original designers of the CPU on a chip have told us that we can expect densities to increase by a factor of 10 in 10 years. Since computer chips have length, depth and width, packaging 1,000 more circuits per chip is conceivable by 1997. While this will make computers faster, packaging more computers in one box will yield more performance than trying to make one chip faster. The problem that has yet to be solved completely is how to make multiple CPUs perform together efficiently.

Problems really can be seen as opportunities for people and companies with the kind of commitment Digital has shown over the last years. The first multiprocessing I knew about was in the late 60s and early 70s when a group at DuPont in Wilmington, Delaware, put two PDP-10s together and wrote a multiprocessing operating system. The VAX 782, 8300 and others use more than one CPU but only in a limited way and don't get even twice the performance in most applications. There's a long way to go.

While we aren't there yet, the time is coming when you will specify how much CPU performance you require and the vendor will provide a computer configured with enough CPUs to do the job.

Physical limitations are all around us, but if we use our thinking processes we won't feel many constraints in computer technology for some time. Keep thinking, learning and innovating. Remember that Grace Hopper has promised to come back and haunt any one of us who says, "But we *always* did it that way."



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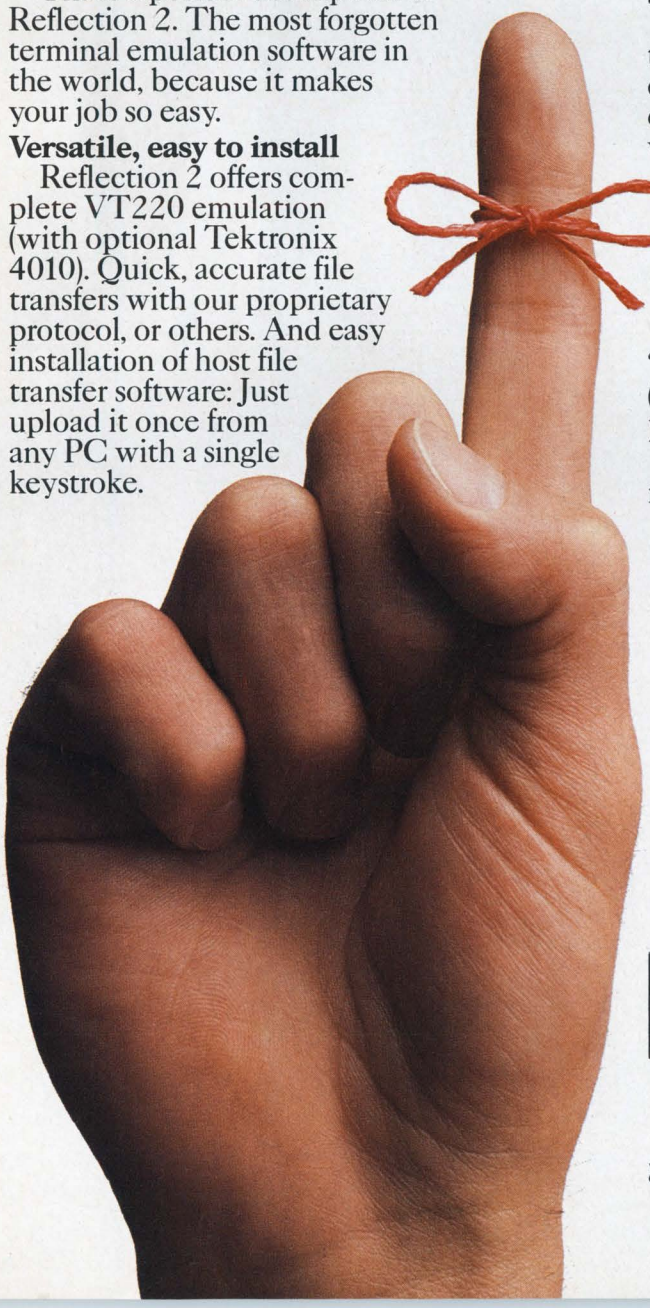

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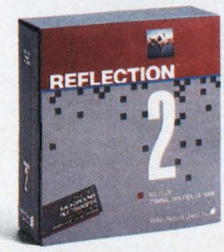

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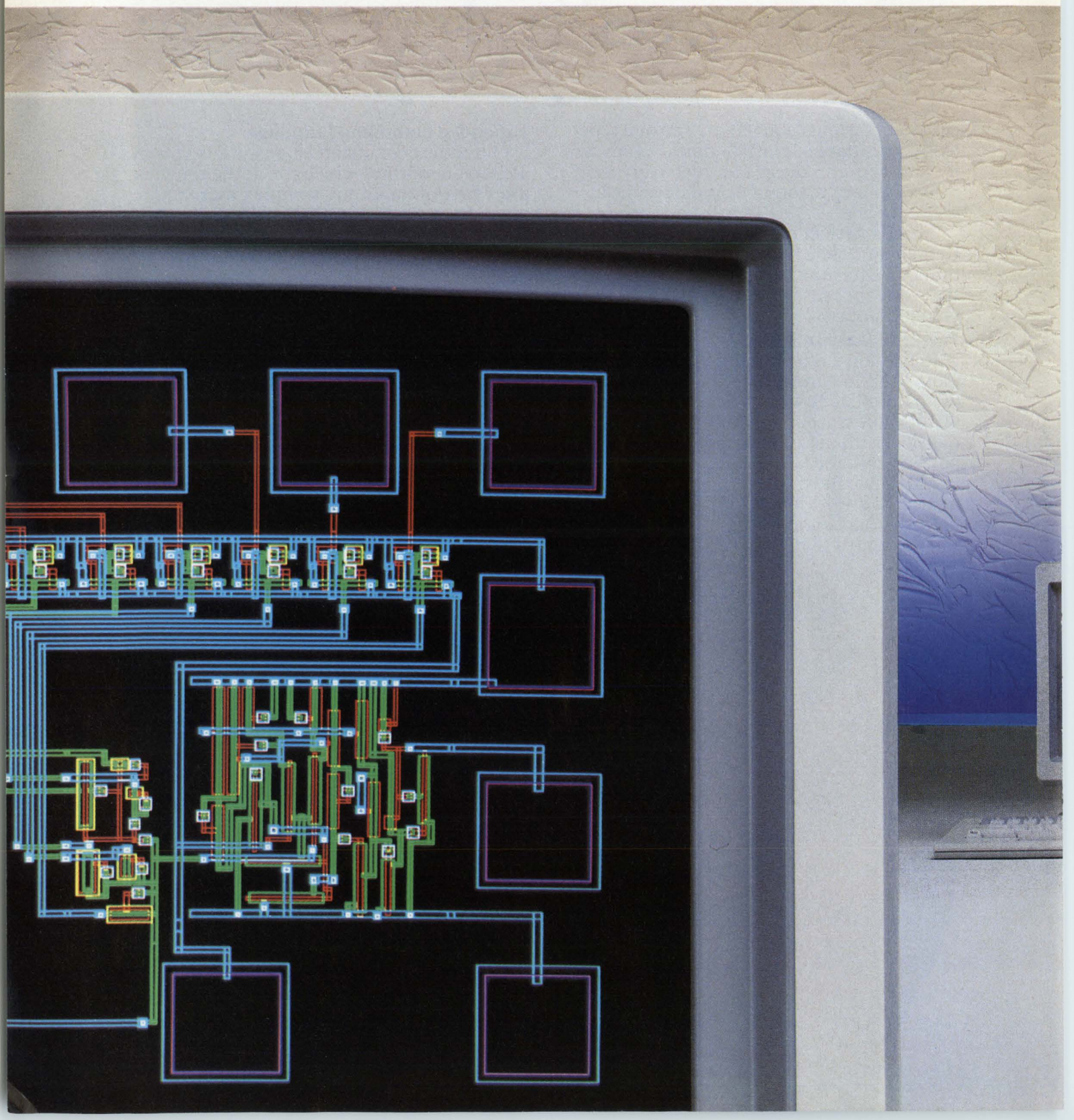

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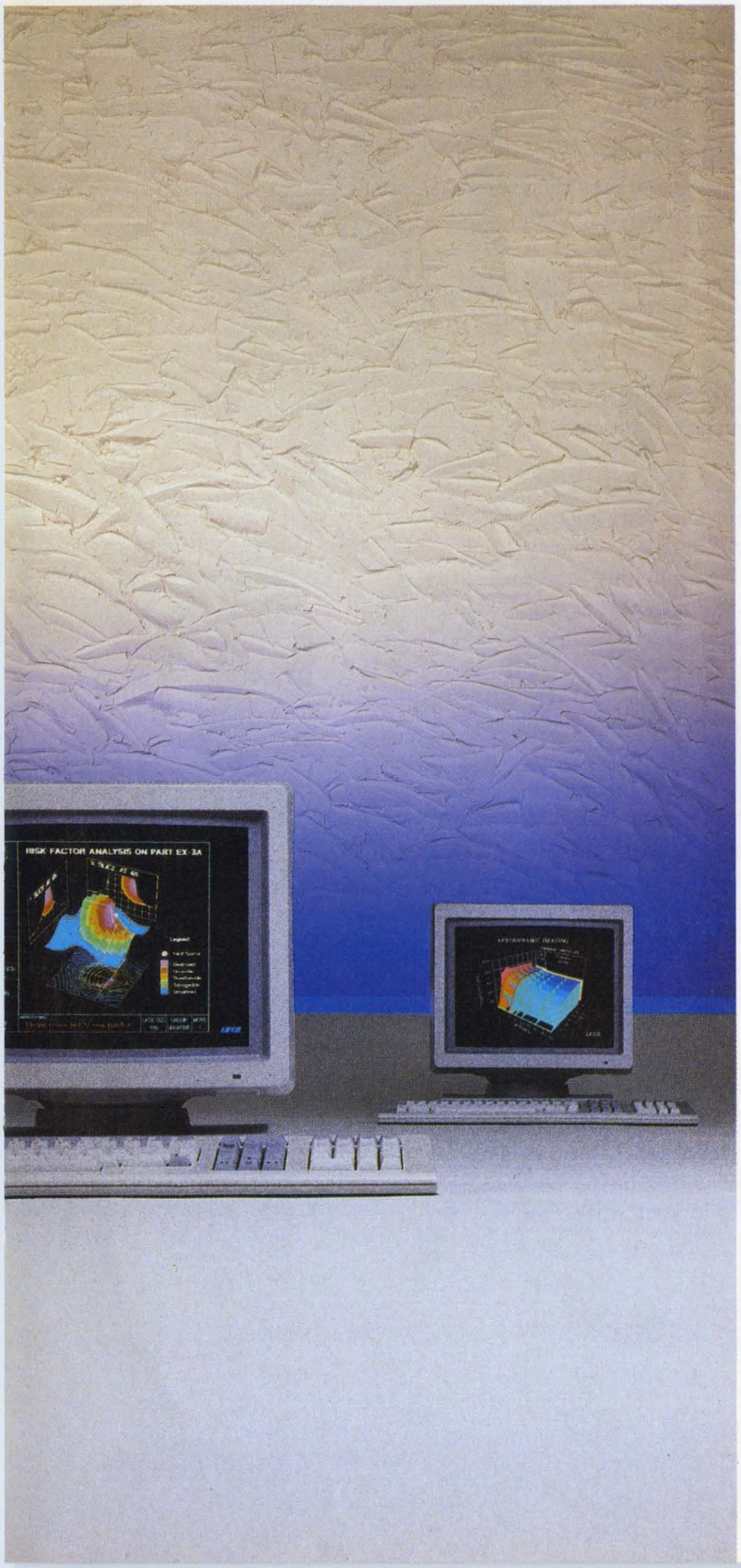

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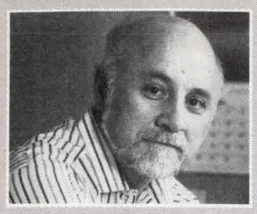

EDITORIAL

Dave Mallery

The Next Revolution

At the dawn of the industrial revolution, when you built a factory you harnessed a river or, later, built a huge steam engine. Then, you distributed the power through your mill via endless belts and pulleys to power the individual spinning machines, lathes or whatever.

With the advent of the fractional horsepower motor, individual machine tools and appliances became possible and took over the field. The efficiencies of providing the horsepower at the point of work saved all the transmission losses, hence, money.

Sitting on my Lab table is the next revolution in computing. It's ironic that it came from just such a mill. It's a box the size of a toaster oven, about half the size of an AT. It can sit on a ThinWire Ethernet and participate in a cluster. The basic formula is one-mip-for-four-folk-for-ten-grand, or one-mip-for-one-workstation for the same price.

It really fits the fractional horsepower model — it taps into its true power source, the cluster, through the ThinWire, yet delivers just enough muscle at the desk to get the job done.

The unsettling part is that there really isn't a bus in the box — at least not a bus we're familiar with. Instead, there's an "electrical" SCSI bus, but there are formidable problems facing the foreign peripheral driver writer. There is a memory bus and the capacity for 16 MB, however. Once you turn it on, all doubts vanish as the ever familiar VMS 4.5 environment comes up and the clear impression returns that you're in familiar territory. Yup, just another VAX. For more information on the new VAXstation 2000, see my review on page 146.

As we go to press, DEC has made a very courageous reversal of its recent policy on the transfer of operating system licenses. At a press briefing at Marlboro, DEC announced a sweeping liberalization and simplification of the licensing policies, including the removal of the transfer restriction. I see this policy change as the most reassuring sign in years that DEC still listens to all of us. (Next month we'll take a closer look at the implications of this announcement.) Any small revenue enhancement that might have come to the company as a result of the previous policy will pale when compared to the dividend in customer satisfaction that will come from this move.

As you read this issue, be sure to notice our *Article Interest Quotient* at the end of each article. Your vote, as a number on the Reader Inquiry Card, will help us to evaluate our issues and policies. This is not an attempt to rate our authors, but rather an opportunity to rate ourselves and verify the appropriateness of the material we select for publication. We value your input and will pay attention to your ratings.

I want to thank many of you who have taken the time to answer one or more of the many surveys we've sent out over the past year. Your input has enabled us to provide you with the kind of quality articles you've told us you wanted. Now it's time once again to let us know what you find most useful in your work as a DEC professional, and how we can help. We're listening!

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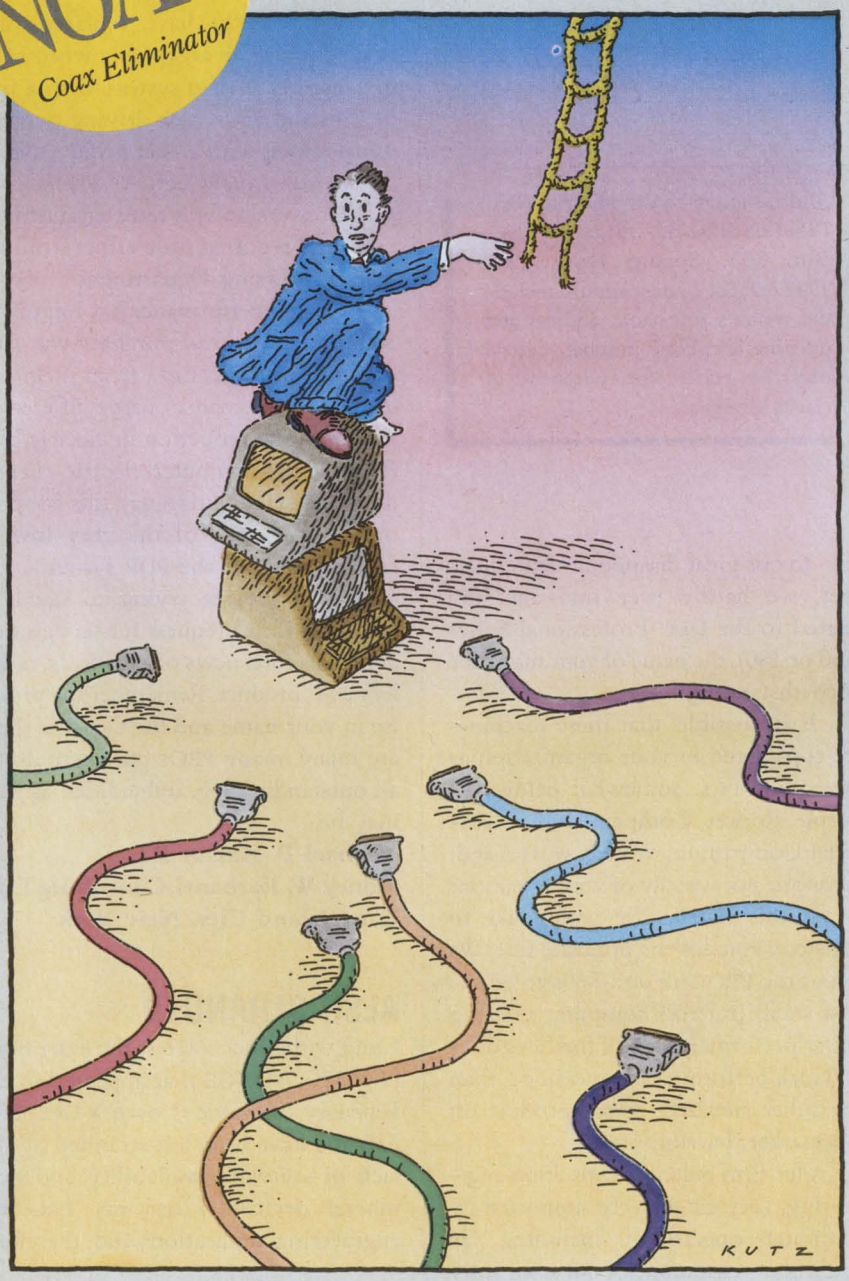

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LETTERS

SIGNIFICANT CONTRIBUTION

Dave Mallery's article entitled "Memories Are Made Of This" in the January edition of *DEC PROFESSIONAL* lacked one important fact. EMC manufactures 4-MB and 8-MB memory cards for the MICROVAX II and has done so for over 27 months. EMC, in fact, was the first manufacturer to offer diagnostics to help users and system managers of MICROVAX IIs. Actually, we believe we produce more units for the MICROVAX II than the sum total of the manufacturers you covered, except of course, DEC.

Our design has contributed to this success. We adopted a RAM replacement strategy that minimized the length of each etch. Specifically, the goal was to reduce the opportunity for noise to interfere with the memory array. The MICROVAX II design is noisy from an electrical standpoint and our design is the most conservative.

From a heat generation and air flow perspective, 256K ZIP RAMs produce an extremely small amount of heat relative to almost all other components. Our placement is well within conservative practices and our product reliability demonstrates this fact.

John R. Egan, V.P., Marketing
EMC Corporation
Natick, Massachusetts

WANTS RECOGNITION

We have been faithful readers of *DEC PROFESSIONAL*, found it informative and helpful as well as entertaining.

Address letters to the editor to *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.

To our great disappointment, however, we hardly ever find anything related to the DEC Professional Series (350 or 380), the name of your magazine notwithstanding!

Is it possible, that these machines are considered in your organization as low grade PCs, somewhat below the Purple Rocket Company Junior Personal Companion, or even worse; and, therefore, not worthy of your attention?

If this is true, we would like to register a vote for the opposite side: We found the PRO 350s and 380s to be the best small (micro?) computer offering better performance in all the categories in which performance is measured, than any other similarly priced product on the market, barring none.

Our firm practices consulting engineering, very extensively supported by computer operations, including far ranging development of our own software (in FORTRAN and MACRO, choice dictated by our needs).

We recently have replaced (upgraded is also an acceptable word here) our large PDP-11/70 system with a mix of 380s and 350s, each driving two terminals along with a laser printer, and all hooked up in DECnet.

Conversion was transparent to the users and required little effort from the Data Processing Department.

Overall performance has improved, and the total cost of purchase was paid out in a very short time, from saving on the DEC maintenance charge differential and from the reduction in electric bills (both actual computer electric current draw and air conditioning); this fast payout was in spite of the very low (!) salvage value of the PDP system.

What we are trying to say here translates into a request for recognition and, therefore, news on this truly excellent DEC product. Remember the promise in your name and the fact that there are many, many PROs out there doing an outstanding job, unheralded as they may be.

Michael B. Kassay P.E.
Sidney W. Barbanel Consulting Eng.
Long Island City, New York

ALSO STRANDED

I read with much interest the letter titled PRO 350 PLUNGE that appeared in the February '87 issue. I own a DEC PRO 350 and have been left stranded by the lack of software availability and peripheral devices. I use my PRO for engineering applications and, therefore,

FINALLY, A MICRO-TO-MAINFRAME PIPELINE THAT LETS YOU PLAY WITH A FULL DEC.

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write most of my own software, usually simulation programs; however, I have need for such things as a 9-track tape drive. In spite of these shortcomings, I still feel that this is one heck of a PC. I have an AT-compatible on which to base the claim that the PRO 350 with the Tool Kit has an operating system and capabilities that are advanced far beyond MS-DOS. The dual floppy disk drive provides my only interface to the real world of DEC; i.e., the MICROVAX users. Fortunately, DEC still provides hardware and software support (at a price) for the PRO. If this support no longer were available, my PRO would become an expensive paperweight.

I have found that the best workaround to the lack of general-purpose programs and peripherals is to purchase an IBM look-alike. I was given a version of KERMIT software and now transfer files between computers on a routine basis.

I would like to see more DEC support and products for the PRO, however that is unlikely. As for a larger disk, I suspect that soon the PRO parts will be available at a cheap price. If DEC continues to sell PRO support, I'll buy all the cheap devices for the PRO that DEC has to sell! Perhaps DEC should apologize to us PRO owners and allow us 50 percent off a MICROVAX II with a PRO trade-in.

Robert C. Rose
Analytic Specialties Corp.
Laguna Niguel, California

Dave Mallery: The PRO 300 Series is a victim of timing and technology. A PRO 380 makes a superb RT-11 machine, but the lack of peripherals makes it an orphan at birth! I have heard that CYPHER is bringing out a streamer tape (cartridge size) plus controller. The absence of a Q-bus is the Ultimate downfall (historians, take note).

There have been a few successful vertical market products generated by OEMs over the years. I am impressed by the success that Mr. Kassay (page 18) had distributing his application. Sadly, these are firmly out of the mainstream and doomed since no one (including DEC) wants to grow this segment.

May I suggest using our ARIS bulletin board as a rallying point for user information.

MODULAR SOLUTIONS

Having been an avid reader of *DEC PROFESSIONAL* for some time and noting that your articles are always right on track, we were pleased with the content of your November 1986 *From The Lab* article titled "Taming That Octopus Behind Your Processors."

Modular wiring for DEC computers, as well as other RS-232 systems, has been our bread and butter since 1983. Recently, DEC has endorsed this method with its DECconnect implementation.

Now you have pointed out a technique that we've used successfully for years. Incidentally, the cable you have invented also works with Able DMAX, Emulex CS02, CS21 and DEC DZ11.

Gary Eifert, Sales Manager
Datalink Solutions, Inc.
San Diego, California

ACCESS DENIED?

I am presenting this as an open letter to all VAX/VMS users, system managers, and assorted "VAX-ites." I am a longtime PDP/RSX person, having spent the last 10 (plus) years in every conceivable permutation of the PDP/RSX environment. My specialty is in the area of real-time data acquisition and analysis for laboratory, engineering and manufacturing process-control applications. I feel quite confident in saying that I know PDPs and RSX inside and out (hardware and software).

My question is, why do VAX/VMS people discount the abilities of PDPs in general, RSX in particular, and the people who love and use them/it? This applies not only to the general VAX-user community, but to DEC itself. I have repeatedly been denied access to VMS either explicitly ("No. You can't use our system."), or implicitly (through layer upon layer of arcane protection privileges, hidden or inaccessible documentation, or outright antagonism). It seems as if the only way to actually get to a VAX/VMS system is to: 1) return to college at a university that owns a VAX; 2) accept an entry-level position at a VAX software house; or 3) have a friend with a MICROVAX in his basement.

The reason I ask this is because I am an independent contractor who has met with potential clients and have been asked the inevitable question, "Do you know VAX/VMS?" When I answer honestly, "I have been exposed to VAX/VMS, and can function in that environment effectively" I get strange looks. It seems that an in-depth technical knowledge of RSX, 10 years of application experience, and a functional knowledge of VMS should count for more than a horrified look. Is VMS magic? Are VAXs so complex that they defy the understanding of someone not schooled in virtual machines. Are RSX people so dangerous that they must be confined to a sub-subdirectory with no access rights? Am I just dreaming this?

Roger A. Wyatt
Detroit, Michigan

Dave Mallery: I think the best answer is for you to acquire a MICROVAX I for your basement. You could pull this off using all the now obsolete pieces (RQDX1 and RD52) that are lying around and could be had for a classified ad.

You shouldn't have to spend too much to get this, and you'd have a captive system that you could blast to smithereens again and again until your VMS skills match those in RSX.

I have to agree with your customers, I wouldn't give anyone privileges on my VAX until I knew he was experienced. VMS systems really are survivable and will remain so as long as the privilege is closely guarded.

The only other way is to find a customer who is just starting with a VAX and work your way in: "free systems programming? . . ." ■

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"The best data-entry package on the market. Much more flexible than anything else".
Anne Miller, Energy Simulation Specialists

"Head and shoulders above other screen packages."
John Maloney, Enforcement Software

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Richard Rovinelli, Educational Services

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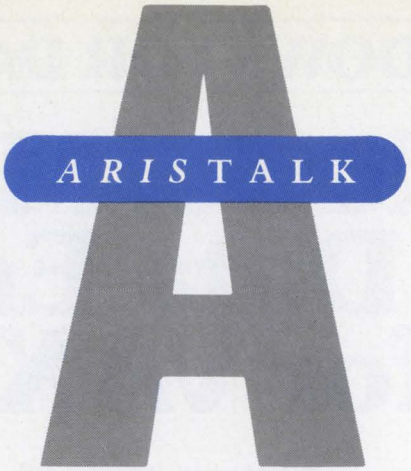

VAXcluster PRICEbuster

QUERY:

Patrick Wolfe: We're planning to add a new VAX 8500 to our VAX 750 and creating a VAXcluster without any HSCs. The traffic between machines won't be too great right now, and we find it hard to justify $45,000 more for an HSC50 and disk controller. Does anyone have a cluster of this flavor running? Are there any real problems with this that I should know about?

I know that shared queues will require one machine be the holder of the JOBSYSQUE.DAT, and we'll probably have only one SYSUAF.DAT as well, but I'm wondering if the access across the cluster interconnect (CI) to another system's local disks is too slow to support this reasonably.

REPLIES:

Mark Ruggiero: There are some things to watch for if you plan on running a cluster with a single queue file and SYSUAF.DAT. The VAX that owns the disk on which these files reside *must* be started first, and the disk *must* be MSCP served to the other VAX. Also, DECnet should be set up to use the CI as a network media. It normally is not used. The overhead on the VAX that owns the files should only be about five to 10 percent. If the SYSUAF file is shared, the overhead will be higher because of its use during login, logout, ACLs, etc. Remember: If the VAX with the files goes down, your cluster is shot!

I also don't know the impact of a system startup if the SYSUAF you need is on another machine because DECnet is not yet alive. It can work, but it's tricky.

Jonathan M. Prigot: Run, don't walk to the Digital Equipment Users Society (DECUS) for a copy of the *1985 Fall Proceedings*. Starting on page 567 is an article on just what you're looking for. You'll have to equip each processor with a CI adapter, and you'll have to use a star coupler, but no HSCs are required. The author's name and address are (as of the Fall, 1985 Symposium) Rochelle Lauer, Yale University Physics Department, P.O. Box 6666, New Haven, CT 06511.

How To Use ARIS

If you are a subscriber to *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, access our cumulative index, 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 some execllent 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. Baud rates: 300, 1200, or 2400.

In the near future, we will be including a transfer protocol to assist in downloading programs.

SPEEDING FILES CAUGHT BY DECNET

QUERY:

Elaine Kiernan: Has anybody out there looked at transfer rates for DECnet? We have DECnet for ULTRIX and Micro/RSX using an Ethernet. The transfer rate seems to be about 10 KB/second when moving a file from one system to another. A couple of users have asked me if it can be speeded up! I was wondering if the expected file transfer rates are documented anywhere, or if anyone has found ways to speed it up.

One thing I've found is that it's faster to receive a file than to send one; i.e. instead of using NFT on your local computer to send a file to a remote computer, it's faster to log onto the remote computer and use NFT to receive the file. Why this is, I don't know. Any illumination would be deeply appreciated!

REPLIES:

Gary Rice: DECnet transfers on an Ethernet seem to be bottlenecked at the respective hardware interface boards (i.e., the DEQNA board for your MICRO PDP-11) in combination with the processor speed. I've run some simple timing tests transferring one *very* large file (25,000 disk blocks) between VAXs. The results are 8600 to 8600 transfers 60 KB/minute, and 780 to 780 transfers 40 KB/minute.

It doesn't surprise me to hear that you're getting 10 KB. As for a way to speed it up, try a PDP 11/73 instead of your 11/23!

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The speed difference you mention is really dependent on your transfer point. The reason has to do with the establishment of a logical link between the two systems. Since you've logged onto the remote system and created a logical link already, "pulling" the file is faster than "pushing" it, because pushing it requires that a logical link be created before the file transfer can begin.
Elaine Kiernan: Thanks for your help, Gary. I discovered a DEC publication entitled *Networks and Communications Buyer's Guide*, April-June 1986. It contains a section on performance guidelines. It looks as if we're pretty normal. They tested the transfer speed with PDP 11/24s, 11/44s and VAX 750s. (We have 11/73s, which are comparable in speed to 11/44s.) The file transfer rate was about 10 KB/second. The DEC document was dated April-June, 1986. Thanks again!

OF SUN SPOTS, MOON BEAMS, AND MODEMS

QUERY:

Bob Christenson: HELP! We're experiencing problems with our DF224 modem. Well, we aren't sure where the problem is, actually, only that we're booted out of the modem. The messages that appear are:

%REM-S-END, control returned to node "NODE::"

%SYSTEM-W-DATAOVERUN, data overrun

We're then back on our system. If we reconnect, we pick up where we left off, but have several more "boot-outs" before things seem to settle down. Is this occurring because of:

1. Modem/terminal settings/parameters?
2. UAF settings/parameters?
3. The ever popular cosmic ray/sunspots theory?
4. None of the above.

We've tried to change some settings in the UAF to up some limits/settings based on educated (?) guesses, but haven't had any luck.

Any help would be greatly appreciated and, I'm sure, rewarded in the next life or heaven or wherever!

REPLIES:

Jeff Corbett: Although sunspots do play a definite roll, the phase of the moon is a more relevant factor. What's happening is that data is coming in too fast for the poor TTDRIVER to handle. A few things can help:

1. Set the modem's port to:
/WIDTH = 511/ALTYPAHEAD
to give you more buffering.
2. Increase the altypahead buffer size.
3. Make the VAX less busy so it can spend more time servicing your (read most important) I/O!

Bob Christenson: Jeff, thanks for the help regarding the modem. Enabling Altypahead alone has eliminated our problem (for now). If we run into additional problems, we'll try increasing the buffers' sizes.

TIPPECANOE AND TPU

QUERY:

Mike Montgomery: Is anyone having problems using the TPU command DCL to create a subprocess? It works for me in the system account but not in any other. I can't find the missing privilege or what the problem might be. Any ideas? The error message generated is: DCL subprocess could not be created.

REPLIES:

Chris Cebelenski: Check to see if the accounts are CAPTIVE in the UAF.
Steven MacNeil: Modify your accounts via AUTHORIZE. The qualifier /PRCLM = n defines the number of subprocesses that can exist at one time. I currently set that at 2.
Gary Gladstone: I've been using TPU since V4.2 and haven't had problems with the DCL command. I use it to get directories while editing. I know, when using the DCL command, that it creates a DCL buffer and then executes the command. Have you tried the SPAWN command?
Mike Montgomery: Thanks for replying. You got me looking. My PRCLM was set at 2, and after doing some reading, I found that under VMS V4.4, the suggested value for BYTLM was raised to 8192. I tried this and the DCL command now works!

HAS DEGREE BUT CAN'T READ!

QUERY:

Howard Pinsley: I have a tape that I wrote six years ago on a DEC-10, using the DEC-10 BACKUP facility. The tape contained my four years of college work. The tape has been shuffled around over the years and I just recently tried to read it (in any fashion) only to discover that it's unreadable; i.e., I get parity errors.

I've been told that it's totally unsalvageable. I was hoping, however, that someone might have or have heard of a utility to help me recover some of the data in any form. I'd appreciate any suggestions. I no longer have access to a DEC-10, but do have access to a VAX.

REPLIES:

Jonathan M. Prigot: DEC has a BBS setup for TOPS-to-VAX migration tools. The number is (617) 467-7437. After autobauding, log in at the @ prompt by entering:
LOGIN LCG.CUSTOMER CUSTOMER

The last CUSTOMER will not be echoed.
Terence M. Kennedy: If the tape was written at 1600 (or 6250) bpi, you're possibly in luck. Some tape drives (but not most of DEC's) can perform single-track error correction. IBM model 3420 drives do. Also, I think that the DEC TU78 can, but the VMS driver disables correction. If you can get an IBM shop to copy the tape, that at least takes care of the parity errors. If you can't find one, give me a call.

On the issue of reading the tape on a VAX, I believe DEC's Large Systems Group has a utility tape that can read some form of DEC 10/20 tape backups. If not, once you have a readable tape you should be able to find some 10 or so people here to help. ■

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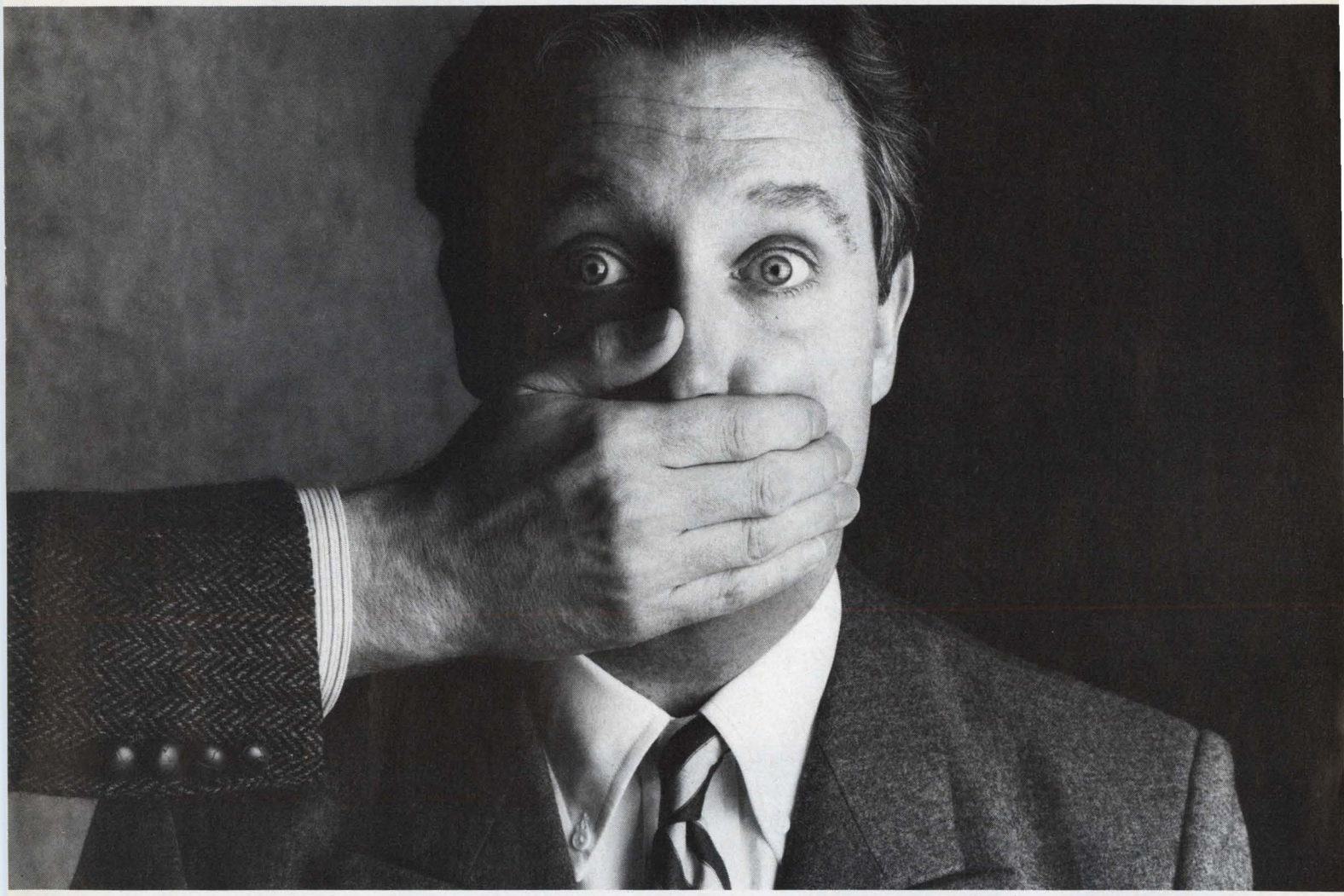

Among our largest customers are ~~General Electric, Westinghouse, Bankers Trust, Irma Development Corp., Exxon,~~ And the ~~U.S. Department of the Navy.~~

Big institutions can be very close-mouthed about the competitive edge they get from a powerful tool like VTERM/220. So while they'd prefer that we not name names, we can still tell you the reasons why we have more satisfied users than all our competition combined.

First of all, giant institutions don't stay giant by being sloppy. They spec things down to a gnat's eyebrow. That's why we're proud to say that VTERM's biggest fans are large corporate, scientific and government installations that perform very serious evaluations of communications software. They give VTERM the highest praise for accuracy of emulation, ease of use, multiplicity of features, speed of execution, and just plain quality.

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- Host data capture and conversion to Lotus® 1-2-3,® Symphony® and dBase.®
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- Programmable softkeys with script-like capabilities.
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VTERM/220 is not the only thing we have to talk about. There's also our VT100 emulator VTERM III, and our Tektronix™ 4010/4014 graphics emulator, VTERM/4010. Both of these VTERM's have a lot of the power of VTERM/220, including file transfer.

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DATELINE DEC

Work Group Computing Expanded

DEC Offers New VAXstation, MicroVAX, VAX Solutions System

Extending its offering of work group computing products, DEC recently unveiled the VAX Solutions Systems program, the VAXstation 2000 workstation, the MICROVAX 2000 multiuser system, and a one-year, on-site, system warranty for the two new desktop systems.

The new products are targeted at problem-solving in commercial, engineering, manufacturing, government, scientific and education markets — or any area where the productivity of individuals, work groups, departments and organizations is improved by cost-effective, distributed computing.

The VAX Solution System program consists of designing, building and testing fully integrated systems for specific industry applications. This program between DEC and third-party vendors is targeted at three major computing environments — VMS, ULTRIX, and MS-DOS. It combines DEC's hardware, software, communications and services with proven hardware and software from DEC's System Cooperative Marketing Program (SCMP) and Cooperative Marketing Program (CMP) suppliers.

DEC's family of VAX-based workstations. (L-R) The new VAXstation 2000, the monochrome VAXstation II system, the 4-plane and the 8-plane VAXstation II/GPX systems.

The VAXstation 2000 workstation is DEC's lowest cost, desktop VAX-based workstation. It offers dedicated 32- bit processing, graphics, windowing and networking capabilities. Typical applications include image processing, mechanical and architectural drawing, electronic schematic entry, automated commodities trading, technical publishing, office work group automation, computer-assisted software engineering (CASE), and software development.

The new workstation is available in both diskless and disk-based configurations and features high-performance graphics capabilities, sophisticated windowing, built-in networking capabilities, and the ability to cluster and share resources with DEC's other workstations and larger VAX systems via the Local Area VAXcluster software, NFS, and DECnet.

The diskless monochrome workstation with a one-year, on-site, system warranty is priced at $10,500. The disk-based monochrome workstation, also with a one-year, on-site, system warranty, is priced at $13,150. The color system and monochrome-to-color upgrades will be announced at a later date and will be based on the same graphic subsystem featured in the VAXstation II/GPX. Both the monochrome and color versions are based on the MICROVAX processor chip.

Priced under $10,000 net, the new MICROVAX 2000 is the lowest-cost multiuser VAX computer. It supports up to four directly connected users, and up to 16 users with network connection. It provides VAX computing performance for business or technical applications in either standalone or clustered environment.

The MICROVAX 2000 features the same CPU and FPU chip set as the MICROVAX II system. A standard configuration includes 4 MB of memory, 42 MB of disk storage, and a software license for either MICROVMS or ULTRIX-32.

The one-year, on-site, system warranty is included in the purchase price of both the VAXstation 2000 and MICROVAX 2000.

DEC, ABC To Market ABC/MM Software

Supports Maintenance Operations

DEC has signed a Cooperative Marketing Program (CMP) agreement with ABC Technologies, Inc., to market ABC/MM application software in the automotive, metal fabrication, petrochemical and service industries.

ABC/MM, which runs on the entire VAX line, supports the planning, scheduling and control of Maintenance Operations. It covers all aspects of corrective and preventive maintenance, including maintenance labor records, work order scheduling, estimating and capacity planning, performance control, budget control, equipment history, and inventory (stores) control.

LSU To Create Computer Network

DEC To Share Cost

Louisiana State University, Baton Rouge, Louisiana, has entered into a $2.4 million cooperative endeavor with DEC to create a computer network linking research centers across the campus.

DEC will share in the cost of the project and, in return, LSU will develop applications software for the computers.

The university will receive two clustered VAX 785s, 26 VAXstation II systems, six MICROVAX II computers and VAX/VMS. It also will receive assistance from DEC personnel in planning a campus-wide network for interactive graphics and research.

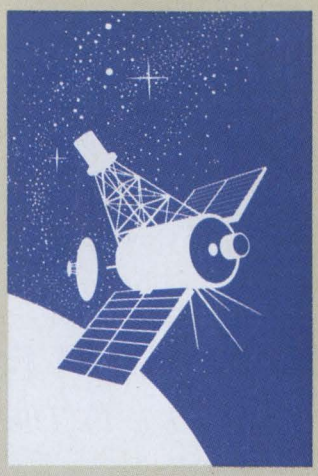
Space Center Gets VAX 8800

For 'Massive Parallel Processor'

The Goddard Space Flight Center in Greenbelt, Maryland, has signed an agreement with DEC to obtain a VAX 8800 for its unique *Massively Parallel Processor* (MPP). Scheduled for delivery by press time, the 8800 will be clustered with the MPP's host processor, a VAX 11/780, to speed up processing time significantly and increase memory capacity. The MPP is a noded part of SPAN, the NASA network with thousands of nodes worldwide. Access to the MPP from non-clustered nodes also is available.

The MPP is used primarily to perform simple operations on exceptionally large amounts of data, such as interpreting the huge data mosaic beamed to earth by satellites exploring the solar system. For many of the Center's purposes, including the running of complicated simulations, the existing MPP is even faster (and less expensive) than a Cray or Cyber supercomputer.

Goddard has granted MPP access to scientists throughout the United States and in a diversity of fields. Projects have included such tasks as the modeling of ocean circulation, the study of neural networks in the human brain and the analysis of groundwater movement.



The MPP has proved highly successful for image-related applications such as high resolution graphics generation. The Center also is exploring non-image-related applications. Potential applications for the MPP are limitless.

A conventional computer processes data one bit at a time. The MPP, however, is a network of 16,384 simple processors that perform identical operations simultaneously on different pieces of data. A "staging memory" component allows the computer to organize the data before and after processing.

There are limitations to parallel processing. Computer programs, for example, take longer to develop and modify. Also, all processors work in parallel on the same task, and there is direct contact only between immediate neighbor processors. As a result, interactions between more distant phenomena are more difficult to analyze. Finally, there is limited memory in the individual processors for many applications. Only simple operations can take place at each one. Strategies for sur-

mounting these difficulties are being developed.

When their new VAX is delivered, the Goddard staff anticipates another three to six months of work to redesign the system interface. Initially, the Center plans to offload software development to the 8800, and to use it as a remote host. Programs and files will be stored on the 8800 and become accessible to the 780 for processing.

—Bruce Feldman

MICRO/PDP-11 Family Enhanced

Upgrade Kit In The Works

DEC recently enhanced its line of PDP-11 microcomputers, including new configurations of its MICRO/PDP-11 computers and availability of new peripheral devices on its current systems.

Two new standard configurations of the MICRO/PDP-11/83 computer were announced, each incorporating DEC's recently announced RD54 159-MB 5.25-inch Winchester-technology hard disk. Additionally, two new standard MICRO/PDP-11/53 computer systems, incorporating the half-height RD32 42-MB Winchester-technology hard disk, were introduced.

The RD54 disks also are available as add-on peripheral devices to existing MICRO/PDP-11/73 and MICRO/PDP-11/83 systems.

Also, DEC expects to introduce a kit to upgrade MICRO/PDP-11/73, MICRO/PDP-11/23, and MICRO/PDP-11/23 PLUS computers to MICRO/PDP-11/83 computers.

MICRO/PDP-11/53 standard systems, including processor, 1 MB of memory, 42-MB disk drive and 95-MB cartridge tape drive are priced from $14,000. MICRO/PDP-11/83 standard systems with RD54 disk, 2 MB of memory, 95-MB cartridge drive, and 16-line multiplexer, are priced from $26,500. RD54 disk add-on units are priced from $7,900.

Understand VIA With Updated Manuals

DEC Briefs
DEC PRO *Editors*

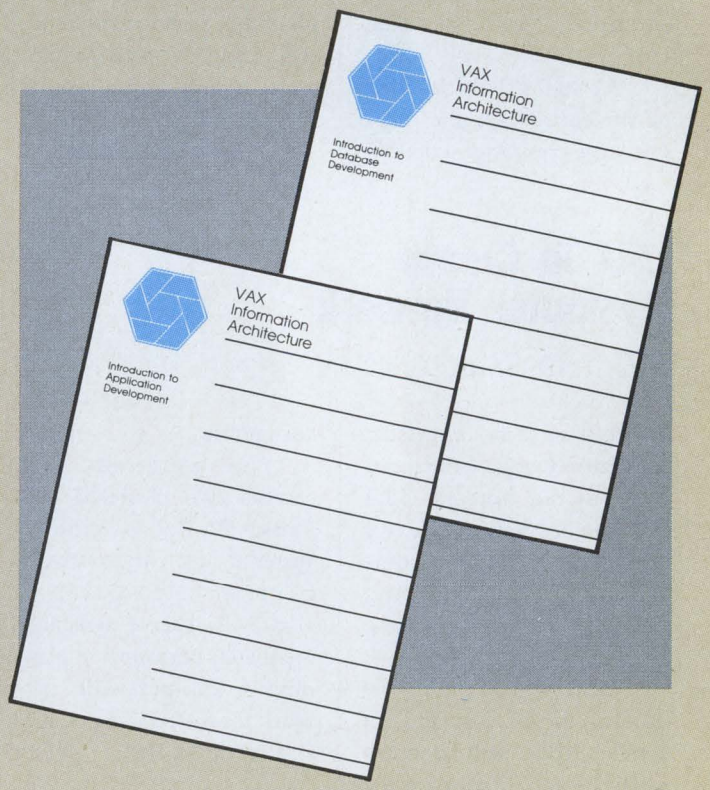
ACMS, TDMS, Rdb/VMS, VAX DBMS, DATATRIEVE . . . By now most VAX programmers and system designers should be tuned in to at least a few VAX Information Architecture (VIA) software products, but not many can claim familiarity with the entire range of DEC program development tools.

The VIA family played an important part in a recent DEC press briefing on "layered" software for the VAX/VMS operating system, which covered various DEC languages and the VAXset collection of programmer productivity tools (the Language Sensitive Editor, CMS, MMS, etc.) as well. It was a handy encounter indeed, offering a wealth of information for the writers and editors in attendance. But what about the legions of confused software engineers out there trying to find their way through these many products?

DEC to the rescue! The demos and presentations were very helpful, but the press session's real "sleepers" were two newly updated manuals that present a very thorough overview of VIA, VAXset, and other DEC development products in the context of a complete "Avertz Rent-A-Car" sample application.

The *VAX Information Architecture Introduction to Application Development* talks about products like ACMS and TDMS, which can be used in conjunction with VAX programming languages to develop high-powered transaction processing systems, and discusses managing the development effort with CMS and MMS, as well as program "tuning" with PCA.

Don't know whether to use VAX DBMS or Rdb/VMS? The *VAX Information Architecture Introduction to Database Development* lays out the features, benefits and trade-offs of DEC's database alternatives, and talks about how end-user computing products like DATATRIEVE, RALLY, and TEAMDATA



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can be used to access them. To round things out, it even includes a few usage examples of DEC's VIDA VAX/IBM cross-dictionary product, and the new VAX Data Distributor.

The manuals are small in size but truly huge in scope and value. They're available through your DEC sales representative or from DEC Direct, and should be on any VAX/VMS programmer's reading list.—*Al Cini*

Hancock Gives Keynote Address At DECUS UK

University Of York Hosts Symposium

Bill Hancock, networking editor for *DEC PROFESSIONAL*, was the keynote speaker at the DECUS UK/North Africa/Middle East symposium in York, England. The symposium, featuring the theme "The Network is the System" was held March 23-27 at the University of York.

Hancock delivered sessions on Ethernet, managing multi-vendor networks, communications futures, and DECnet internals.

SCMP To Include Petroleum Exploration Market

GeoQuest Systems First To Sign

GeoQuest Systems, Inc., of Houston, Texas, was the first SCMP supplier in the petroleum exploration market to sign an agreement with DEC when it expanded its System Cooperative Marketing Program (SCMP) in February.

As an SCMP supplier, GeoQuest will market its Interactive Exploration System (IES) software with the full range of VAX computers, including VAXstation productions, for applications in the petroleum exploration and production markets.

IES software is an integrated seismic interpretation system that helps explorationists accurately analyze and interpret seismic data, and determine the optimum location for drilling either exploration or production wells. It contains tools for two-dimensional and three-dimensional seismic interpretation, analysis and modeling, and synthetic seismogram generation and database management.

Digital Watch

A view of what's over the DEC horizon — little known facts, rumors, trends, and perhaps a little forecasting.

■ Preliminary views of the upcoming VT340 have been very favorable. The VT340, a new technology terminal, features high-resolution graphics, and a mouse, and is purported to have an appearance similar to the VAXmate PC. Having such a terminal in DEC's product line is essential for low-cost desktop publishing systems, productivity workstations, and other similar applications.

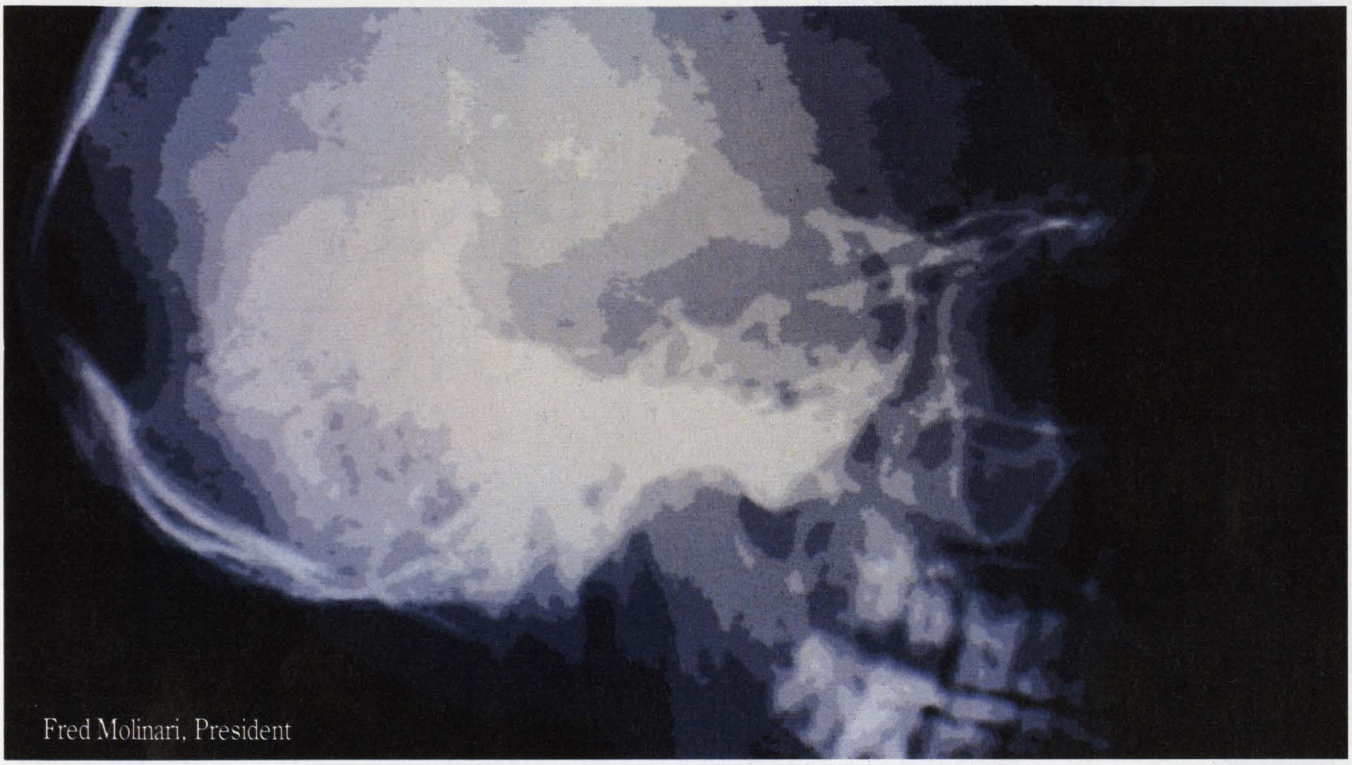
■ DEC has been readying a new MICROVAX system reported to be in the 3-4 MIPS range. Called the MICROVAX III (at this time), the new system may provide an upgrade path for existing MICROVAX II customers who require additional memory and computational power. Currently, the MICROVAX II has a 16-MB memory restriction due to the memory management unit (MMU) scatter-gather algorithm. Since the MMU is imbedded in the MICROVAX II CPU card, it is not practical to expect DEC to upgrade existing MICROVAX II cards to allow further memory growth. Preliminary information suggests that the MVIII will support a great deal more memory than the MVII and may provide for a card-swap situation for existing MICROVAX II customers. There is some question, however, as to whether existing MICROVAX II memory will need to be replaced to accommodate the new memory architecture.

■ Work progresses on still larger VAXcluster systems. Reports on two systems, dubbed the "9000" series indicate quad-processor systolic architectures that may run up to as high as 100 MIPS in the configuration.

■ Communication products will be getting a boost as well. A VAX-based SNA gateway box and card are in development with possible introduction this summer. With DEC's poor performance ratings in the PDP-11/24 gateway (the system is easily saturated by a low number of users), a faster gateway is essential to DEC's interconnect strategy. The first product, based on a MICROVAX chip on a board, will allow customers a low-end entry price and effectively offload SNA connectivity from the main system. The second product, a MICROVAX box-based product, will allow connectivity as a gateway from Ethernet or other networks. Digital continues work on Ethernet products. A fiber-based version of Ethernet is reported to be about three years off, but a prototype has been shown and the technology works. The fiber Ethernet should provide extremely fast communications capability (in excess of 100 Mbit/sec) and extended range over current Ethernet offerings. Another product, a fiber backbone for IEEE series networks (called FDDI MAC) still progresses and will allow inter-LAN connectivity.

■ With the introduction of the RD32 (41-MB, 5¼-inch half-height disk drive) for the VAXStation 2000 and the MICROVAX 2000, rumors have started to appear about a similar format 100-MB removable disk cartridge and a 200-MB fixed disk. Word also has it that DEC may be talking to Kodak about Kodak's new 12-MB 5¼-inch floppy drive as a possible inclusion into DEC's product offerings.

Thinking of Image Processing on a MicroVAX II? Think Data Translation.



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DT 2603 Low Cost Frame Grab	256x 256	64	✓	✓		4	✓	✓	1 Buffer 256x256x8 (64 KB)	✓				$1895
DT2651 High Res. Frame Grab and DT2658 Aux. Frame Proc.	512x 512	256	✓	✓	✓	4	✓	✓	2 Buffers 512x512x8 (512 KB) and 1 Buffer 512x512x16 (512 KB)	✓	✓	✓	DT-IRIS ($1995)	$2995 $1895

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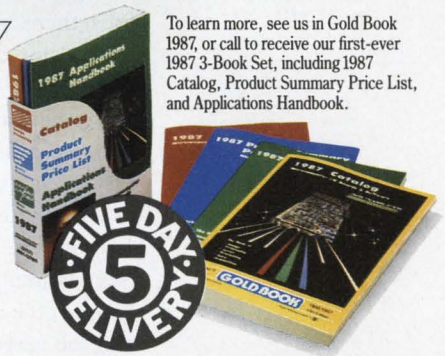

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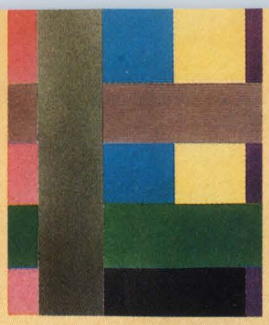


MULTIPROCESSING

SOUPING UP YOUR VAX

By Charles Connell

Math Coprocessors Are The Primary Ingredient.

Q: *You share a VAX/VMS system with other members of your project team. Recently, you've been running some signal processing applications that take several hours to complete. You'd like to get the results more quickly, but others already are complaining that you're using most of the system resources. Is there a solution short of buying a bigger VAX?*

A: Yes!

Q: *You're the system manager for a large VAX that's used by the in-house MIS group. The system runs at full capacity most of the time. Your boss just told you that you now must support the flight simulation engineering group as well. Is there a way to do this without buying another computer?*

A: Yes!

If you have compute-bound mathematical jobs, there are a number of math coprocessors (MCPs) for the VAX that can make a big difference in system performance. MCPs function by running all or part of the mathematical jobs that are causing problems on the VAX. The system, as a whole, benefits in two ways. First, users not running the mathematical jobs receive more resources, since the jobs that have been draining their time are handled elsewhere. Second, the users with the mathematical jobs may be served more quickly than they ever could be by the VAX, because MCPs are very fast at math processing.

Types Of Math Coprocessors

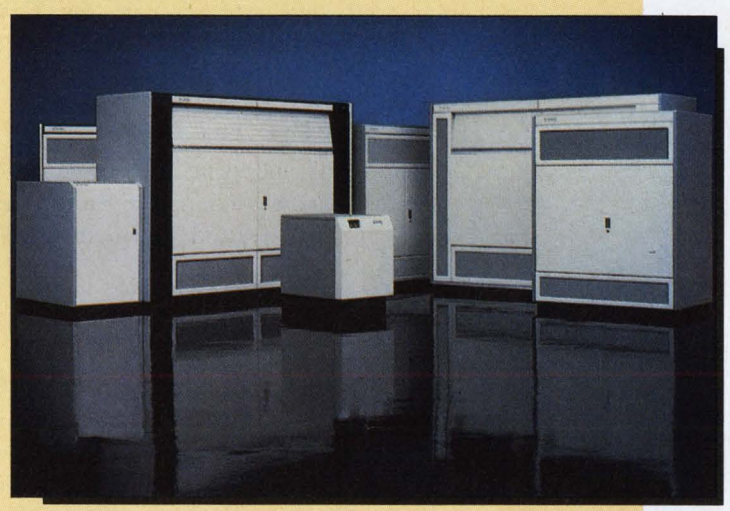
While there's a variety of hardware designed to speed up mathematical processing on a VAX, the options generally can be divided into three categories: array processors (APs), attached computers (ACs) and supercomputers with a VAX interface.

Array processors function by helping a VAX with the mathematical sections of number-crunching programs. The user's program continues to run on the VAX, with the VAX performing all I/O and remaining in ultimate control. The program calls the AP to perform lengthy computations, like matrix multiplication. APs usually are incapable of running an entire program on their own and their architectures are geared toward repetitive arithmetic computations on arrays of numbers.

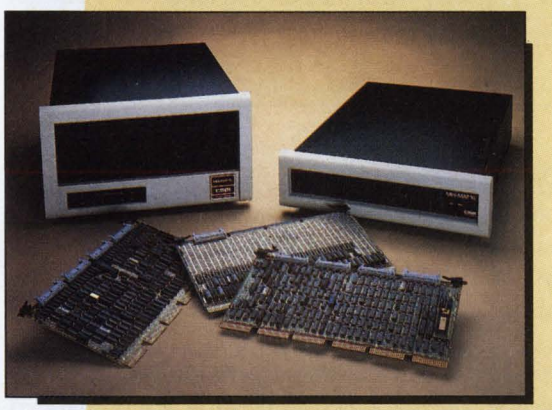
Attached computers are, as their name implies, more robust than array processors. They are capable of executing entire programs, often have their own operating systems and may control their own peripherals — such as disk drives. ACs are considered "attached" computers though, because their purpose is to offload mathematical jobs from the main computer. They are not designed or marketed as general purpose computer systems, even though they may have that capability. ACs also usually have an architecture similar to that of APs, that make them very fast when operating on lists of numbers.

Discussing a supercomputer with a VAX interface, in a sense, puts the cart before the horse. Supercomputers are expensive ($400,000 for a budget model) and it's inefficient for them to have "users" in the normal

The NMX-464 pedestal mound from Numerix Corporation of Newton, Massachusetts.

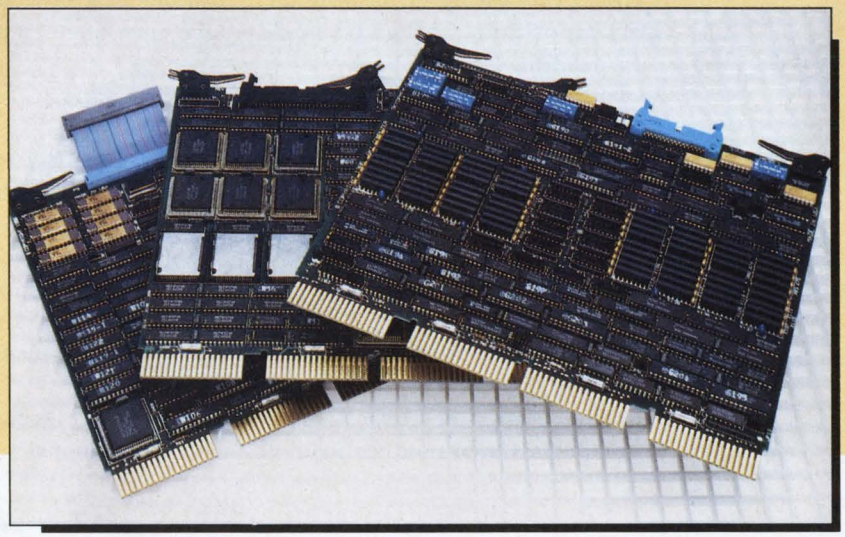


Floating Point Systems of Beaverton, Oregon, offers a family of M64 series minisupercomputers.



The Mini-MAP XL array processor from CSPI of Billerica, Massachusetts, offers 38 to 280 MFLOPs of computational power.

The WARRIOR-Q 20 MFLOP array processor from SKY Computers, Inc. of Lowell, Massachusetts.



sense. Any system manager in charge of a supercomputer wants potential users to perform software development and terminal I/O on a front-end processor. A VAX/VMS system is ideal for this purpose. It's probably more accurate, therefore, to think of a VAX as a front-end server for a supercomputer. Given a clean interface between the two, however, users of a VAX can view a supercomputer as a resource for mathematical processing.

(Editor's note: There are other kinds of coprocessors in addition to the math type discussed in this article. For information about database machines, which speed up data storage and retrieval, see the October and November 1986 issues of *DEC PROFESSIONAL.*)

How Fast Are They?

The performance gains from these products can be dramatic, given the right kind of problem. APs and ACs boast megaflop ratings in the range of 8 to 40. (A megaflop is one million floating point operations in one second.) One manufacturer I spoke with timed a fast Fourier transform at 1.08 seconds on a MICROVAX II, 0.74 seconds on a VAX 11/785 and 0.0007 seconds on its best AP. Supercomputers can operate above 100 megaflops.

In addition to this great speed, many MCPs use a 64-bit word length (a VAX uses 32-bit words). This allows these MCPs to do more work with each machine cycle and to operate on larger numbers and smaller numbers, and with more precision than a VAX.

While MCPs are capable of achieving this impressive performance, it's important to keep several points in mind about the statistics. First, performance measurements often are slippery. One machine may be very fast at a certain type of operation, making it look wonderful by that benchmark, but perform poorly when measured in other ways. The key question to ask an MCP vendor is: How much

Glossary Of Terms

Job- A collection of work from a user's point of view. A job is everything that must occur on a computer for the work to get done.

Program- A set of computer instructions contained in one disk file.

Process- The basic unit of work on a computer. As a program is running, it occupies one or more processes.

Subprocess- A process created by another process. The creating process (known as the parent) controls the subprocess. Subprocesses often are used to perform a subsidiary task for the parent, such as a specific numerical calculation.

Multiprocessing- Executing more than one process by switching back and forth between them. May give the appearance that the processes are being executed at the same time.

Parallel processing- Executing more than one process at the same time.

Decomposition- Changing a single program into more than one program that will run in parallel.

Concurrency- When more than one process is working on a problem. Can occur with either multiprocessing or parallel processing.

Data dependency- When data produced by one part of a concurrent job is used by another part.

Shared memory- An area of memory that is used by more than one process. Often used to send answers back and forth between them.

Global section- A DEC-specific term for shared memory.

Math coprocessor- Any computing device designed to help a general-purpose computer perform math operations.

Array processor- A math coprocessor designed for fast calculations with arrays of numbers. Usually incapable of other kinds of operations.

Attached computer- A special-purpose computer that is connected to a general-purpose computer. Often used for math or database operations.

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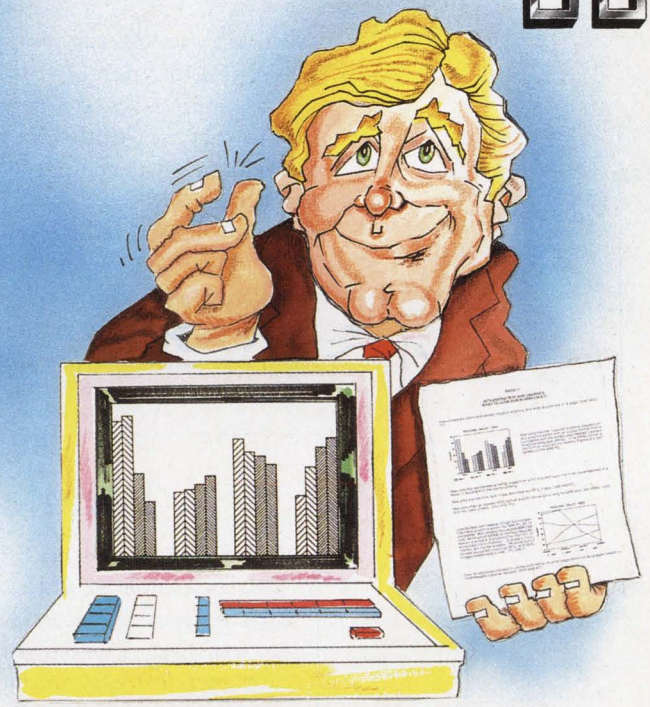

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. . . a program must be CPU-bound for an MCP to help.

faster will *your* VAX run *your* job with the MCP you're considering?

Second, MCPs are designed to help a system that frequently does long, complex mathematical calculations. Users who have invested in MCPs and found them a benefit, often run jobs that take several hours on a VAX. If your computer is called on several times a day to perform a 10-minute calculation, an MCP probably is not worth its price. Also, a program must be CPU-bound for an MCP to help. If a program is slow because it's waiting for I/O, there's little an MCP can do to improve the situation.

How do you actually go about using a math coprocessor? For array processors, there are two methods: subroutine calls from the VAX to the AP, and coprograms that operate simultaneously. The subroutine call method allows a programmer to write one program for the VAX. The program allocates the AP to the process, initializes it, requests whatever

Parallel Processing On A VAX

A VAX with a math coprocessor from another vendor fills a processing niche that DEC alone doesn't address. For this reason, DEC has worked closely with several of the attached processor manufacturers. The cooperation benefits everyone: DEC wins and holds onto customers who might be forced to use a supercomputer for their number crunching; customers can stay in the familiar VAX/VMS world and soup up their math processing power; and attached processor vendors enjoy a healthy business.

Can a user access dual processing without adding anything to a VAX? Yes . . . sort of. Three VAX models — 782, 8300 and 8800 — contain two processors. These second processors execute user jobs and add to the computer's overall performance. To a large extent however, the second processor isn't directly accessible by a user. Here's how they work: These VAXs contain an asymmetrical second processor — it can run any job for a user, but can't perform I/O or run in kernel mode. VMS uses the second processor to execute user jobs that are in a "ready to run" state and the scheduler keeps both processors active as much as possible. If a job executing on the second processor reaches either an I/O or kernel mode instruction, the job is interrupted and waits for VMS to restart it on the main processor. Unless VMS is unlucky, or all jobs perform constant I/O, some programs execute on the second processor and overall system performance improves.

Users who'd like to write a program that runs on both processors simultaneously may be disappointed though. VMS controls the scheduling of *all* processes; a job's asynchronous subprocess may run on the other processor or it may be time-sliced on the same processor the parent is using. There are no VMS system services that force a job to run on a certain processor or to fire up a subprocess and order it to run simultaneously on the second processor.

The dual processors in the VAX 782, 8300 and 8800 certainly increase their systems' performance, but exact control of processor scheduling remains under VMS's authority.

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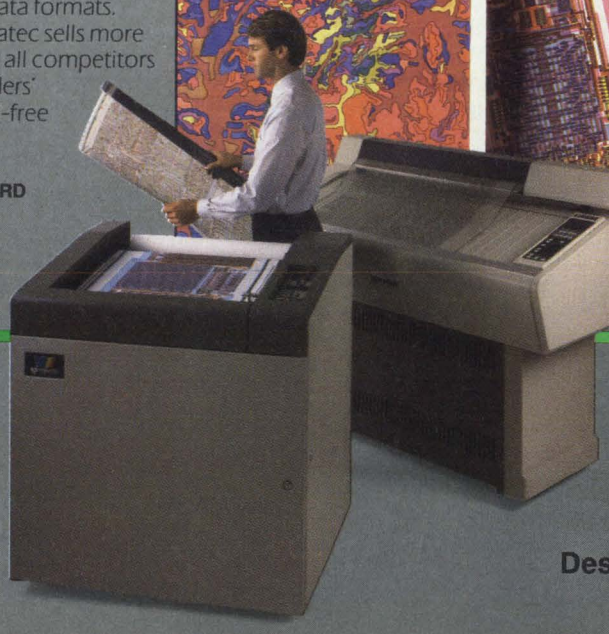

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calculations are desired and receives the answers back.

The coprogram method results in two separate programs, one for the VAX and one for the AP. At run time, VMS loads both programs and starts them simultaneously. The program on the VAX acts as an I/O shell for the AP, which does most of the processing. Some vendors who use the coprogram approach have made it fairly transparent. The programmer can write one program, and a special development tool changes it into two.

Attached computers and supercomputers are used somewhat differently. They are capable of running entire programs on their own, so the programmer writes a single program to run on the MCP. The source code, in most cases, is written on the VAX because VMS provides a good software development environment, and the MCP's time is too valuable for text editing. If the MCP vendor has supplied a cross-compiler, the program even may be compiled under VMS as well. If not, the source code is sent to the MCP for compilation. At run time, the VAX user sends input data to the MCP, requests it to run the program he has written and receives the answers in return.

Connecting An MCP

APs connect to a VAX directly on the CPU bus. They are in constant contact with the main program that's calling them, and must be able to receive data and instructions, and return answers, at the fastest possible speed. Attached computers and supercomputers, on the other hand, do not require as rapid a method of data exchange, because they tend to execute uninterrupted for a period of time. For these types of MCPs, communication channels (like Ethernet) are often used.

Computer systems becoming overloaded with mathematical processing or anticipating such a load, may benefit from the addition of an MCP. It's important to remember that this hardware is designed for certain kinds of CPU-intensive jobs, and will not help in every situation. If your VAX is spending most of its time on number-crunching, however, a math coprocessor may be a way to lighten its work load. ■

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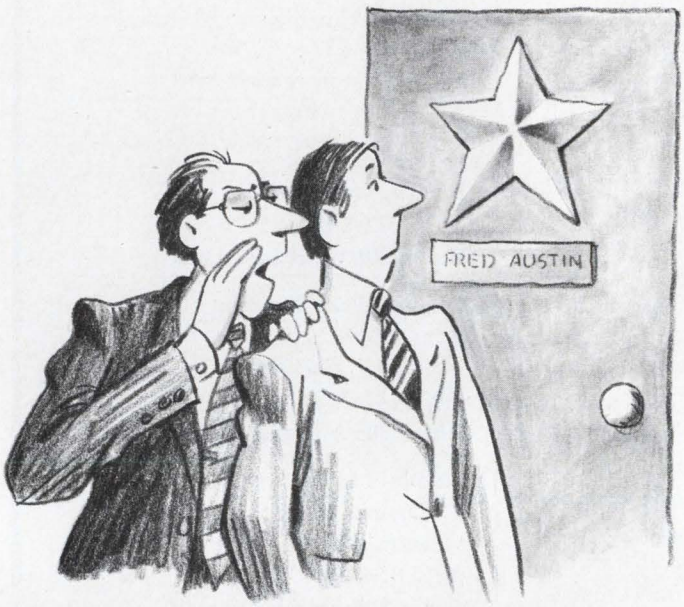

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DISTRIBUTED DBMSs

By Michael Fallon

The Race Is On!

Centralized DBMSs increasingly are being pushed from corporate mainframes to department-level computers as companies evolve toward distributed database management systems (D-DBMSs). The advantage of a D-DBMS is its ability to present information in a transparent manner and in the most appropriate format. A D-DBMS manages data physically located on a number of networked computers, with the logical appearance to the user or applications programmer of a single database.

D-DBMSs are becoming a reality because it's unacceptable for an application running on a PC to look like it was developed for a mainframe. These applications must be able to distribute data or talk to cooperative applications running on other processors.

Commercial D-DBMSs are few and far between. Tandem Computers of Cupertino, California, was one of the first vendors to offer a D-DBMS. In 1986, other suppliers in the DEC market joined it, including Oracle Corporation of Belmont, California, and Relational Technology of Alameda, California. DBMS suppliers apparently are getting into a market skirmish similar to the one being waged over relational DBMSs.

A survey of DBMS users in large organizations conducted by the research firm Management Roundtable of Chestnut Hill, Massachusetts, indicated that while many desire improvements in today's DBMSs, 23 percent more users wanted improvements in distributed operations than for any other feature.

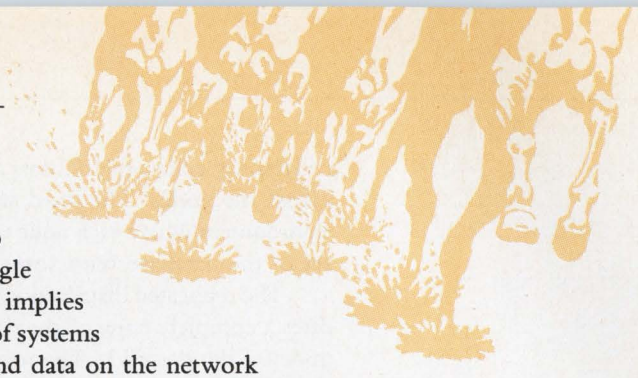
The Yankee Group of Boston, another research firm, states that DBMSs from minicomputer vendors, especially DEC and its cadre of third-party vendors, are widely installed at the supervisory computer level of manufacturing. These vendors are focused on a race to develop D-DBMSs for the integration of shop floor data.

At The Starting Gate

Computer Corporation of America (CCA) of Cambridge, Massachusetts, is one such company at the starting gate. CCA is in the running for a massive modernization of the Department of Defense's Worldwide Military Command and Control System, which is expected to take the rest of the decade. CCA hopes to introduce an ambitious new general-purpose DBMS written entirely in ADA. DEC reportedly is eager to spur the development of the project with funding or other assistance.

Code-named *Adaplex*, CCA's project draws on ADA's modular structure to create a DBMS that can be fully distributed across a network, and be ported to different hardware vendors. DEC's Government Systems division is looking for a way to sell more VAXs to the Department of Defense and reportedly sees *Adaplex* as a perfect opportunity.

The Yankee Group indicates that most D-DBMSs will be developed as extensions to relational DBMSs. The relational model works best for a D-DBMS because it meets the criteria of "distribution independence"; i.e., the application remains logically unimpaired when



data distribution first is introduced and subsequently if data is redistributed in the system. The Yankee Group believes that transforming a navigation-dependent DBMS into a distributed DBMS is significantly more difficult than moving from relational to distributed. The implication for users is that D-DBMSs will emerge as a performance enhancement path for relational DBMSs.

The SQL Standard

Software vendors will release distributed systems during the next two years based on the IBM-developed, and now ANSI-standard, SQL (pronounced sequel). The first such system was announced by Oracle Corporation in 1986. Its *SQL*Star* is an open-system D-DBMS consisting of three products: Distributed *ORACLE*, *SQL*NET* and *SQL*Connect.*

The open system architecture of *SQL*Star* permits the distribution of databases among *ORACLE* and non-*ORACLE* DBMSs housed on multiple dissimilar hardware. It's modeled on IBM's *R-Star* research work. The Yankee Group expects IBM to release its own commercial product called *System R**. It's an experimental but working D-DBMS, under extensive research and development at IBM's San Jose lab.

Data Distribution Versus Data Management

In defense, manufacturing, financial services and other markets, an important force driving the distribution of processing power is the sheer size of databases and the requirement for high performance. But most implementations of distributed processing don't address the issue of data management. Distributed processing isn't synonymous with distributed database management. Distributed systems disperse computing functions among several physical computing elements either co-located or geographically separated. Such a system uses a divide-and-conquer approach of cutting down database size to the point of acceptable performance.

There's an important distinction between a D-DBMS and a periodic reconciliation of data among the nodes in a distributed processing system. Data in a D-DBMS is managed by a number of networked computers with the outward appearance (to users) of a single database. This implies another layer of systems software to find data on the network and manage concurrent access requirements.

The traditional approach to data management in a distributed processing environment is a hierarchy of host and satellite processors. Each runs its own DBMS. The host controls a local database serving local applications. Information is exchanged between the two databases by batch updating facilities.

A classic example of host/satellite processing is a multisite manufacturer maintaining centralized order processing and production planning functions while each plant maintains its own inventory and shop-floor control data. The plant, during the course of a day, receives and ships inventory and the host computer logs orders. At the end of the day or shift, update journals are sent between the plant and the host to bring the databases back into conformity.

The plant-level computer and the corporate host update their own databases, therefore, identical DBMS capabilities aren't required at each node. What's needed is hardware supporting the same data communications interfaces and software for file maintenance and reporting. Oracle's D-DBMS offers a variety of network interfaces and gateways to support a multivendor hardware environment. They include a DECnet interface, asynchronous protocol and 3270 coaxial connections. Support is in the works for TCP/IP, SNA 6.2 and MAP.

Some users see host/satellite update as a way to exchange data between micros and supervisory-level computers. While this is achievable, batch updating isn't sufficient to support time-critical decision making. The Yankee Group views D-DBMSs and back-end DBMS hardware as the major alternatives to achieving interactive access to data in a distributed processing environment.

Data Distribution Across Networks

There are three ways of distributing data over a network. First, the entire database can be replicated on each node. Second, the database may be divided into mutually exclusive and

collectively exhaustive subsets and partitioned across the nodes. The third way is a hybrid environment where each node may have a subset of the database with some duplication.

The replicated distribution approach allocates a complete copy of the database to each node on the network. The major advantages include high reliability and availability, and simplicity of backup and recover operations. Updates present a challenge to replicated databases, however, because of software overhead and network traffic involved in synchronizing updates across all nodes.

Replicated databases are best for retrieval-intensive applications where update inefficiency is tolerable. A customer information hotline is an example of an application suitable for a replicated database.

The partitioned data distribution methodology splits the database over a number of nodes of the network and doesn't allow duplication. The database is partitioned into mutually exclusive and collectively exhaustive subsets. Each subset is assigned to a particular node. This approach can accommodate very large databases because the size of the database is limited only by the secondary storage available on the network as a whole. The size of a totally replicated database, in contrast, is limited by the secondary storage available at each node.

"Locality of reference" is the chief factor influencing reliability and availability of a partitioned database. If the database can be partitioned across the network so that the data located on a node is accessed almost exclusively by users at that node, locality of reference is high. High locality of reference provides better response time and less network traffic. Most requests or transactions also can be satisfied locally, preventing the whole system from coming down in the event of the failure of a node or the communications network. When there's little locality of reference, the efficiency of a partitioned database system degenerates rapidly.

Like replication, partitioning adds more complexity to DBMS software. A directory of the entire database is needed on every node to find the location of data required by a particular transaction or query. Because data isn't duplicated in a partitioned DBMS, some of the cross-node synchronization and locking algorithms required by a replicated DBMS aren't applicable.

Partitioned DBMSs are appropriate for a number of applications. At the supervisory computer level, for example, it's possible to partition the database so that most transactions are local.

A hybrid methodology divides the database into subsets, like in the partitioned methodology, but also permits some duplication of the partitions or portions of them. By combining partitioning with some data replication, each node can have exactly the data desired. The advantages include flexibility in allowing differing levels of accessibility, and reliability. For very large databases with variable locality of referencing, the hybrid methodology also may be the only feasible data distribution strategy for users.

The hybrid strategy, unfortunately for users and vendors, is the most difficult to implement. The DBMS must trace where the data exists on the network and synchronize the duplicate copies of the data during transactions. The interdependence of these two tasks means a lot of software overhead. Hybrid

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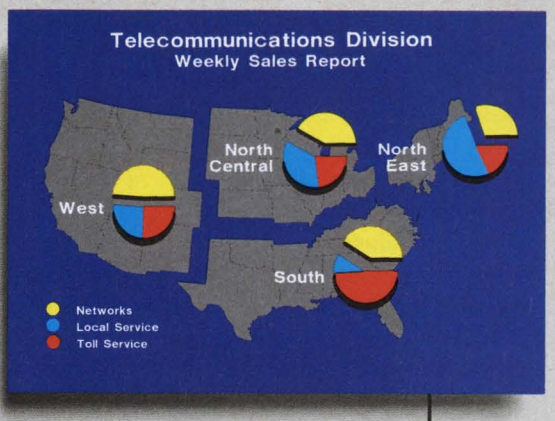

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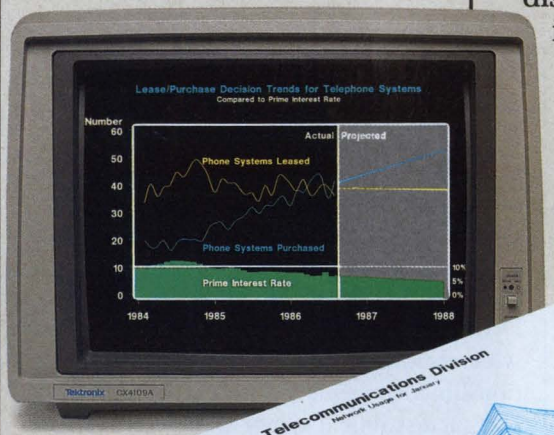

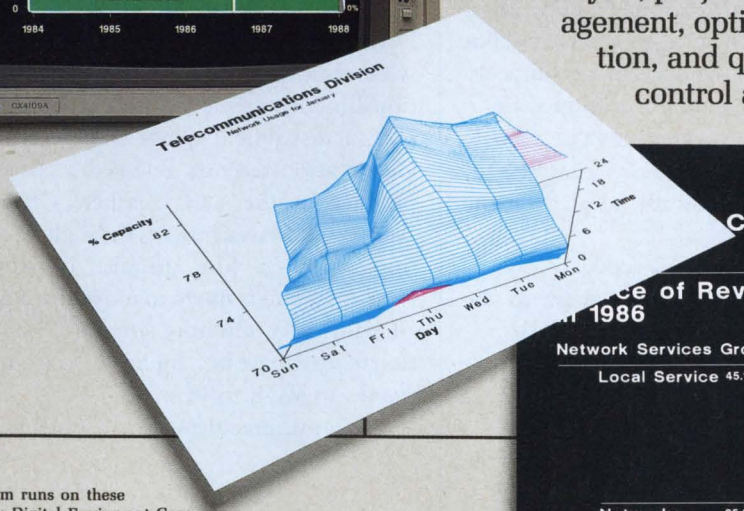

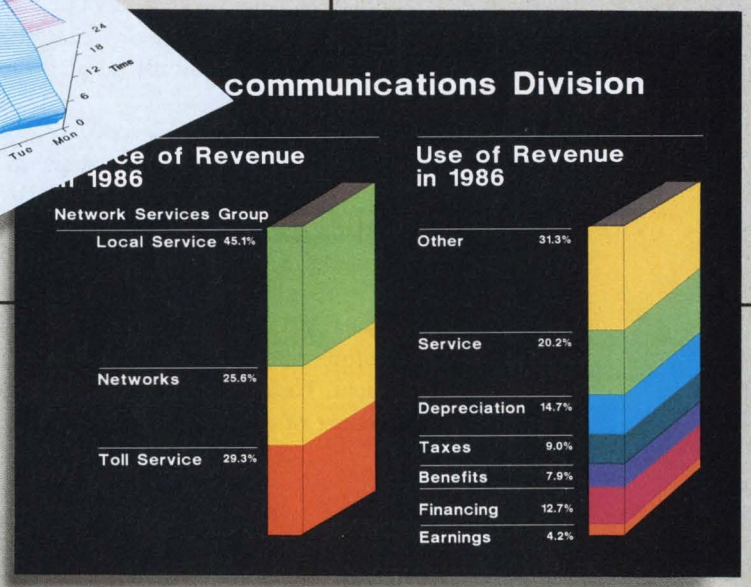

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Database Machines

D-DBMSs are being implemented as performance enhancements for relational DBMSs because one big drawback of relational systems has been the large amount of computer overhead involved in searching for and sorting data. The performance penalty is so great that it's unacceptable for some applications. Companies are purchasing more powerful computers or additional processors as an alternative to handle the extra work. A few vendors also are tackling the performance problem by offering processors known as "database machines," specifically to speed up DBMS operations. Some of these "back-end processors" completely take over DBMS functions.

The concept of the database machine is over a decade old. But only recently has it become practical, or almost necessary, to add a special computer for a DBMS. The database machine industry is dominated by startups. Britton Lee, Inc. of Los Gatos, California, was one of the first. Its Intelligent Database Machine (IDM) offloads DBMS operations from a host computer or even several dissimilar computers (see *DEC PROFESSIONAL*, October 1986, Vol. 5 No. 10 and November 1986, Vol. 5 No. 11 for a two-part review). This frees the host to concentrate on processing applications.

The IDM is positioned between a host and its external memory, hence the name back-end processor. The system includes host-interface and user software, and application programmer routines. IDMs work with DEC's VAX family and IBM's mainframes and PCs.

The database machine offloads DBMS tasks from the host. CPU use, therefore, is much less than with a host-only configuration. Also, with the hardware specifically designed for DBMSs, response time is much faster than with software-only approaches.

D-DBMSs also are difficult to tune during implementation. There's no truly satisfactory mathematical model to optimize performance. Iteration and trial and error play a large role in installing these DBMSs.

Problems In D-DBMSs Development

A distributed DBMS implies a single logical view of data distributed around a network of processors. This is advantageous for users, but developing a D-DBMS still has proved difficult. Layers of software must be developed to:

1. Support an overall perspective or a single system view of the database regardless of where the data is physically located on the network.
2. Define authorized user access.
3. Connect the single system view to the actual location of the data.
4. Implement global record locking and synchronization of updates.

Global locking and synchronization is the most complicated component of a D-DBMS to implement. Tandem Computer's solution was a byproduct of its fault-tolerance implementation. Since a Tandem configuration involves a minimum of two central processing units (CPU), the company had to confront the issue of a single system view across multiple processors. It handles partitioned DBMS integrity, in part, through its proprietary GUARDIAN operating system.

Crossing The Finish Line

D-DBMSs won't arrive in one fell swoop. As with relational systems, vendors will add functionality incrementally, starting with the easy part, a distributed query capability. Oracle Corporation recently released a commercial product in the DEC market. Cullinet of Westwood, Massachusetts, through its acquisition of Esvel (the original developer of HPSQL/V), also is likely to introduce a product later this year. Cullinet announced its intention to distribute key applications from mainframes to VAXs to PCs.

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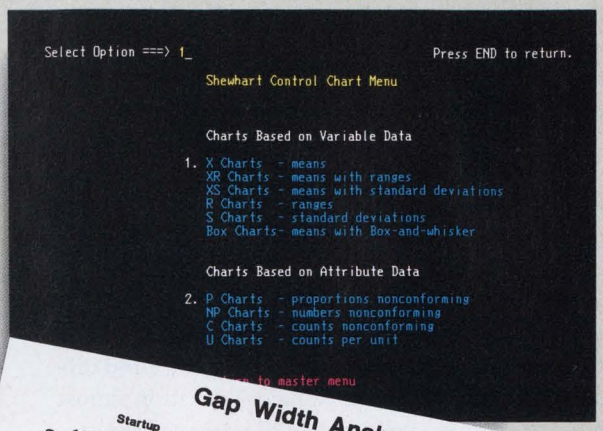

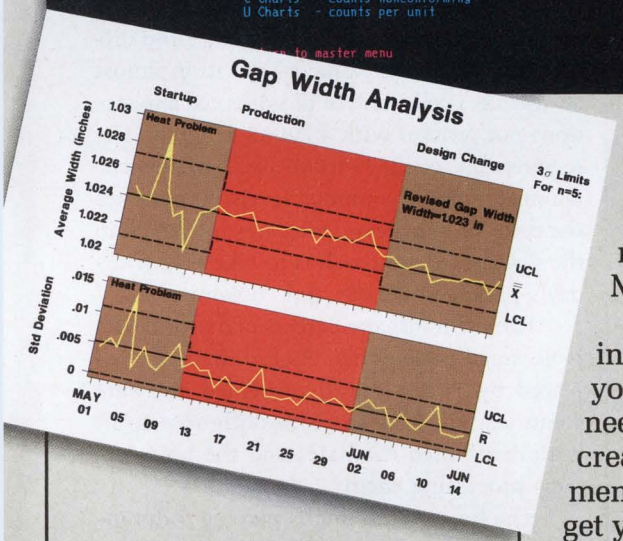

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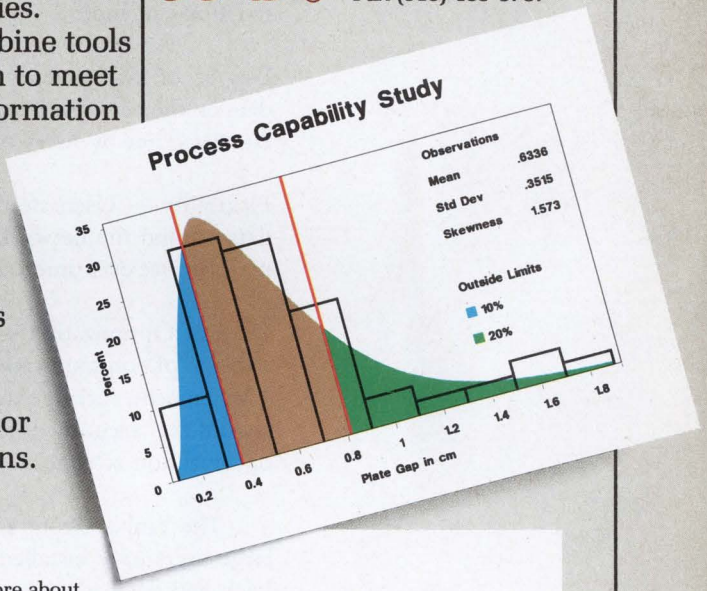

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ample, a user might want to distribute bill-of-material maintenance to the PC that's on the desk of an industrial engineer, and run work center scheduling on a VAX that's on the shop floor. These applications access and feed data to the mainframe applications.

Users, however, must be cautious of vendor marketing claims and statements in the press about early D-DBMS announcements. The first announcements are likely to be limited to viewing, as opposed to writing to, distributed data. Early entrants, for the sake of simplicity, are likely to adopt either the totally partitioned or totally replicated methodology. It's the hybrid data distribution capability, however, which ultimately is likely to allow users to configure a system meeting both data distribution needs and performance goals.

The issues for prospective users of D-DBMSs include:

Degree of Transparency — The location of data on the network must be managed by the D-DBMS, not by users or programmers.

Flexibility — Users need flexibility to move data around the network. This is to balance performance over time as requirements change.

Level of Optimization — Since a D-DBMS is a fusion of communications and information management, message traffic on the network should be accounted for by the D-DBMS optimization scheme.

The Yankee Group research indicates that large users have installed either D-DBMSs or back-end database processors. This provides the benefits of the relational model of data management for large multiple databases without creating multiple islands of information on separate supervisory-level computers. The Yankee Group views D-DBMSs as a potential alternative for users who need the benefits of relational systems but fear the performance penalty. A D-DBMS also presents a future migration path for current relational DBMS applications. Most relational DBMS vendors are developing distributed DBMS systems that maintain a single system point of view over multiple-networked host computers.

The D-DBMS approach has advantages, but clearly it's not a panacea. Technical and organizational problems must be overcome before it becomes widespread reality. The security problem surrounding the distribution of data among many departmental computers, makes it far more difficult to track, manage and protect classified information.

There's much work to be done on the user's part as well. Most companies find implementing a central database a large and difficult project. An existing organization almost always has a collection of file-oriented applications not written with a DBMS in mind. The requirements of the D-DBMS, with implementation at multiple computer levels, complicates the task. The challenge for users interested in the distributed approach is to take one of today's packaged DBMSs and customize it.

Remote transparent access of uniform data is no small issue either. As terminals are replaced by PCs, vertically oriented software solutions will have to be reconfigured to fit with distributed databases and the host systems processing them.

The host mainframe is playing a diminishing role in corporate America. It will not go away entirely, however, nor will its central database. Users just will be less aware of it. The central database will continue to run large transaction processing applications and house applications requiring a high level of data security. But it also will serve as the main repository for information which, increasingly, will be distributed to departmental processors and their subsets of the DBMS.

As resources become highly distributed in large corporations, a new model of information management will be required. Centralized, vertical information will flatten out, becoming more horizontal in structure.

Michael Fallon is a free-lance writer based in New York.

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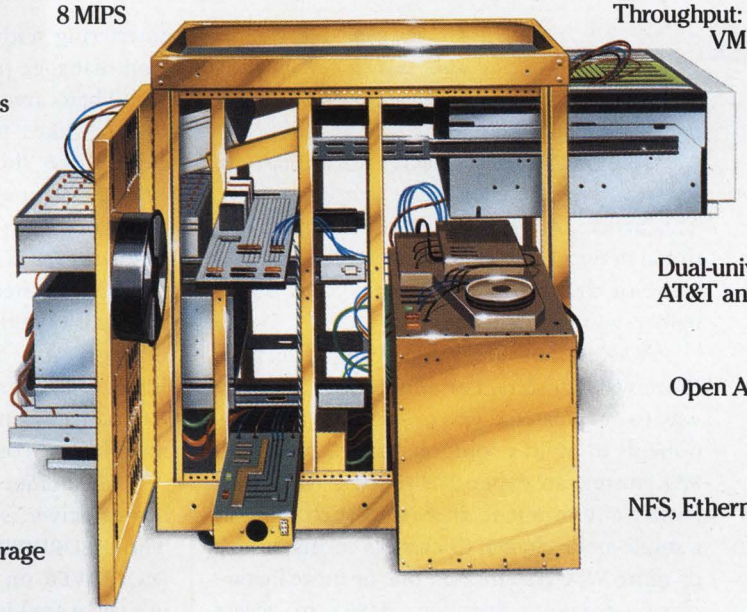

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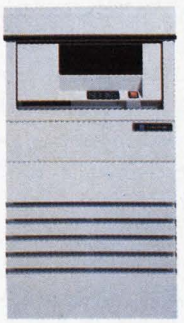

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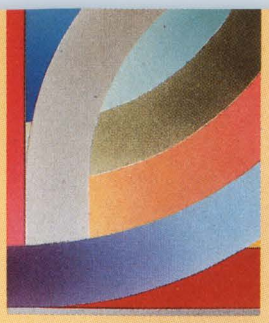


MULTIPROCESSING

NETWORKING CLUSTERS

By Bill Hancock

What You Don't Know Can Hurt You.

Forget some obscure tax code and it's your fault. Trust in your smiling computer salesperson and you'll wind up emptying your pockets. Run DECnet on your cluster (CI or Ethernet).

Yes, lack of knowledge can cause pain. This article is about the pain of using traditional networking methods with clusters, and some of the things you should think about before you get "clustered."

VAXclusters are a big deal, at least to those with clusters. For a long time, the only way to get clustered was to purchase the components to build a computer interconnect (CI) VAXcluster, an expensive process. In the CI cluster environment, there's no such thing as a single-node cluster. CI clusters consist of one or more VAX systems and one or more hierarchical storage controllers (HSC) to access shared disk and tape structures. These, plus the use of a passive wiring hub called a star coupler, formulate the basic hardware necessary for a CI-based VAXcluster.

The idea is simple: Share disk and tape drives among multiple systems and provide some level of disk backup and redundancy. Simplicity, in this case, costs money — lots of it. An HSC starts at approximately $32,000. Each controller is roughly $7,000. Disks cost between $12,000 to $20,000 (depending on where you buy them). Wiring will run another $3,000 to $5,000, and cluster software licenses add up too. The end result is an expensive mechanism to provide shareability and some level of redundancy. You also can run DECnet on the CI, if you like your network packets interfering with your disk, tape and connection manager traffic.

Then came Local Area Clusters or LAVCs as DEC likes to call them. LAVCs respond exactly like "big" clusters except that in the LAVC environment, the CI and HSC hardware aren't necessary. LAVCs are considerably less expensive (or are they?). A special device driver provides cluster "feel." It provides the SCS protocol on Ethernet so that the connection manager and other cluster components on larger clusters still think they're talking to a CI board, when, in reality, they're talking to an Ethernet controller.

The unique method in which the Ethernet device driver is written makes this possible. The XEDRIVER.EXE on a UNIBUS system (XQDRIVER on a Q-bus; ETDRIVER on a BI) is a fairly sophisticated device driver that acts as a class driver to the ESDRIVER.EXE port driver, which manages the buffering and activity on the Ethernet controller. What makes the XEDRIVER and its counterparts special is that each new protocol that "attaches" to the driver gets a new Unit Control Block (UCB).

Separate UCBs

Students of device drivers are aware that there's a separate UCB for each particular device port on a controller. A DZ11, for instance, has eight

. . . it's important to note that systems are becoming more network oriented.

separate ports, giving it eight UCBs per controller. A DMR-11 has a single port and, therefore, a single UCB per controller. An Ethernet controller also has only a single port per controller, but the driver fakes out the system by creating virtual device UCBs as new protocols are declared to the driver. The effect is that each new protocol specifies its intent to create a shareable (many programs can use it) or nonshareable (single program use only) UCB.

The driver also assigns a channel to the new UCB and creates a virtual device. On a freshly booted system with no network software activated, you'll see device XEA0:, the Ethernet controller. As new software protocols are declared to the controller, new virtual devices appear. DECnet uses various protocols, such as Maintenance Operations Protocol (MOP — downline loading), so that firing up DECnet causes the loading of various virtual devices. Local Area Transport (LAT) protocol causes the creation of another device, TCP/IP will create at least one more, and most likely there will be still more ad infinitum.

The reason for this bizarre behavior is simple: Ethernet is nothing more than a transport vehicle (the networking term is *datagram service*) for packets of any protocol type destined for any node on the Ethernet. The need to downline load, communicate task-to-task, transfer files and perform a host of other functions requires the use of various protocols and the changing of the state of the communications mechanism.

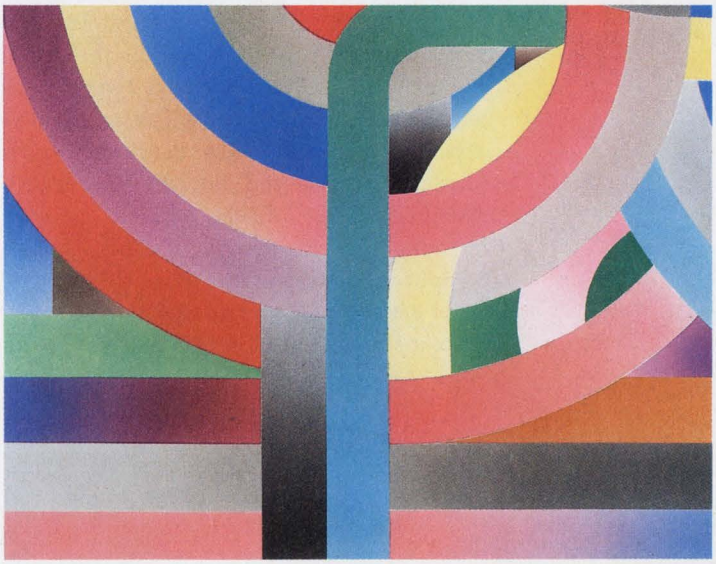
Since Ethernet is a shared service among various types of communications software, a method to allow different protocols and different line states had to be created to preclude major recoding of existing software products. This capability is why LAVCs work.

To get LAVCs to function, all DEC had to do was modify the lower-level primitives of the existing cluster software to understand not only the CI port and class drivers but also the Ethernet port and class drivers. The software then was created to support the SCS protocol (the one used on the CI hardware) as a valid Ethernet protocol, and all was well with the world. So, what looks like a feat of amazement actually was the result of design forethought and innovative programming.

Network-Ready Hardware

When considering clusters and networking, it's important to note that systems are becoming more network oriented. Look, for example, at the cable from an RM05 or RP06. It's large, hulking, multiwire cabling. The same applies to cables from third party vendors like System Industries or Emulex, for example. Large ribbon cables, each wire having its purpose, provide signal handshakes for data transfer from the drives to the controller and back.

Then consider the RA-series of cabling or, more specifically, the BC26V. It's a four-wire cable; black, small, and unassuming. It can be much longer than traditional hulking cables and appears to be more DEC-like than ribbon and RH cables, which are more IBM-like. The cables are smaller because the drives are smarter and communicate to UDA50s, KDA50s



or HSCs via a protocol, not wire signaling as in the case of the 30 or more ribbon or RH cables.

Some drives under development use coaxial or fiber cabling from the drive to the controller. This means that the disk (or other peripheral) is becoming a node within a processor architecture. Machines slowly are becoming more a box with networked components, than a cohesive, bus-oriented architecture.

This has several advantages. New peripherals can be added with hardware modifications and minor software enhancements. Peripherals may be placed further away from central components (disks on one floor, tapes on another, terminals scattered all over the place, etc.), and traditionally central components (memory and the CPU) actually may be located some distance apart to simplify packaging, add-ons, etc.

What does this have to do with clusters? Clusters are just a start. Now, on Ethernet, various MICROVAXs can share disks, print queues, batch queues, etc. In addition to disk sharing (through the use of an MSCP Server on each system in the cluster), shareable, distributed printers (e.g., PrinterServer 40) and terminals (DECServers 100/200 and Terminal Servers) are distributed away from the central system but look local due to network capabilities. The current cluster, therefore, could be expanded easily to allow distributed disks (directly connected to the Ethernet), distributed tape drives, shared network memory subsystems and, possibly, parallel computing between networked CPUs.

I get excited about all this, quite frankly. Also, it scares the hell out of me! Why? With distributed hardware comes distributed software. Digital already has published scholarly articles on a concept called the "software bus." Software is coded to recognize a virtual structure that looks like a computer bus (like peripherals are connected to a UNIBUS). The difference is that the core software for, say, ACMS could be located on a powerful VAX (like an 8800) with a smaller server component located on any system that desires access to the package. When a program comes up that requires the use of ACMS, the servers send the requests to the main software, which performs the actual computations involved. The peripheral system is less affected by software "hogginess" and hog-mode programs can be placed on systems that can handle them without affecting the running of the programming on less powerful systems.

What scares me is the problem of proper configuration of the network to handle the rise in network component use, along with the problems of maintenance, trouble-shooting, management and education of the user/programmer/manager.

Consider the problem of XEDRIVER again. As mentioned, XEDRIVER is capable of handling multiple protocols. This means, of course, that multiple queues must be maintained. While VAX drivers are asynchronous in nature, the access method to the controller (via CSRs and associated buffers) tends to serialize input and output. Because the controller itself is quite intelligent, it, too, has queues for various activities.

In the case of transferring data from the controller to the host software (in main memory), data is sent on a first in, first out (FIFO) basis. This is fine if the network has a single purpose and can be controlled by a main network program. But, what about expedited service for disk and tape traffic? At most sites, the need for shared disks between various systems is growing. Who, then, would want his or her disk and tape traffic interfered with by network packets? Worse yet, who wants his paging and swapping slowed down on a diskless system by someone who has SET HOST to a node and is running MONITOR? Not me!

Remember: Traffic load can be high even though not much data is being transferred.

Sound farfetched? It's not. It's real and it's now. DECnet has an expedited message service, but it's not for "user" messages and has nothing to do with anything other than DECnet. Because the same drive controls all access to the Ethernet controller, you'd expect that certain protocols like SCS would have priority over other protocols like LAT, simply because of the nature of the traffic being sent. Try to explain to a user that the reason the program is taking so long to sort the file is because DECnet and LAT are at the same priority as the disk access protocols and there's no way to expedite disk traffic over other types of network traffic!

When the functionality starts exceeding the intent of the original architecture, it's time to start looking at restraint or at a new architecture.

Hardware Performance

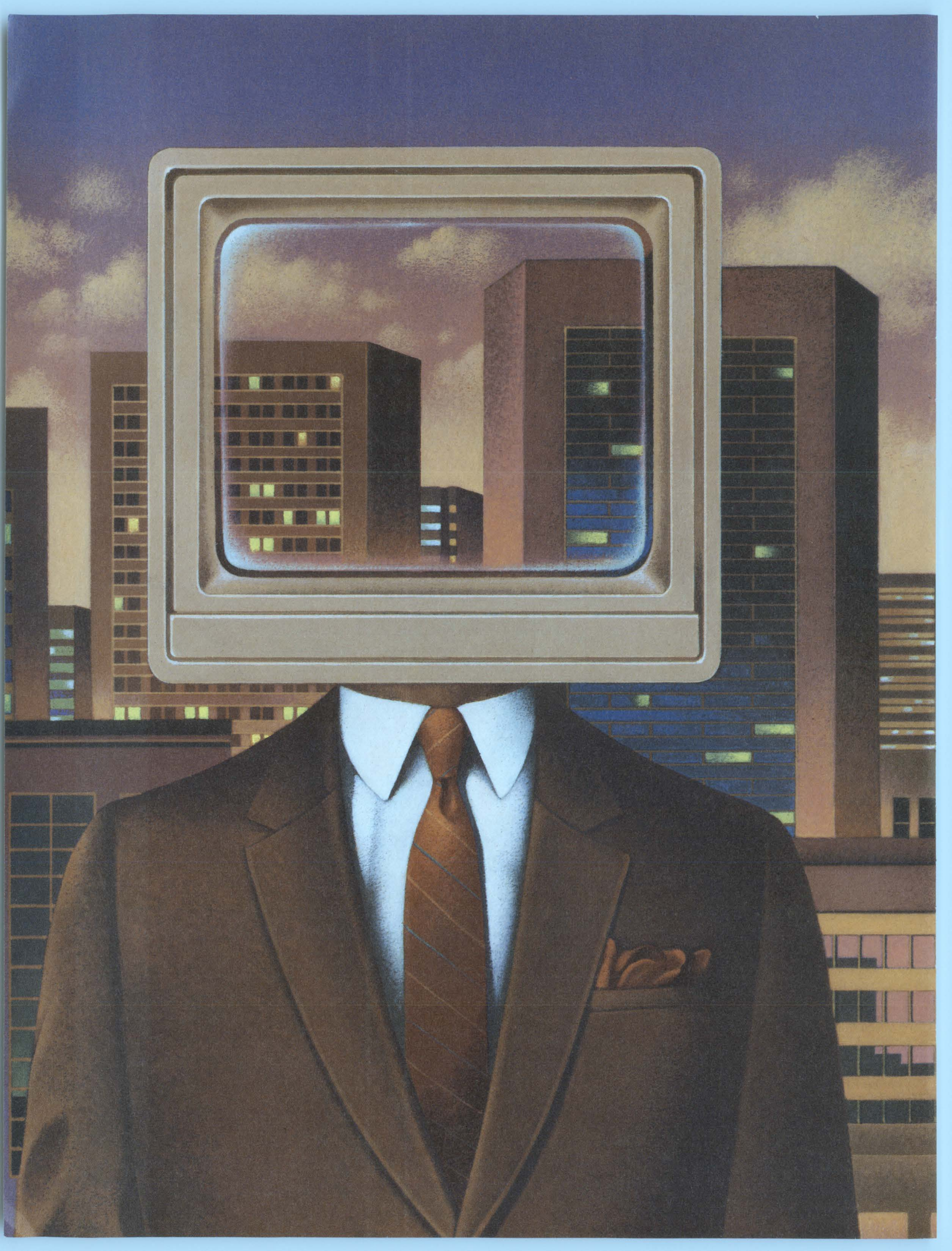
Another issue in clusters is hardware performance. It's easy enough to see that the traditional network traffic will interface with the disk and tape traffic. What's important to realize is that there's a lot more than just data traversing the network. To provoke data services, networks (including CI and Ethernet) must provide for the proper sequencing of data (getting all the data and in the right order), error control (retransmissions and corrections), status messages and many other items. All of this must be provided in addition to the transmission of the actual data.

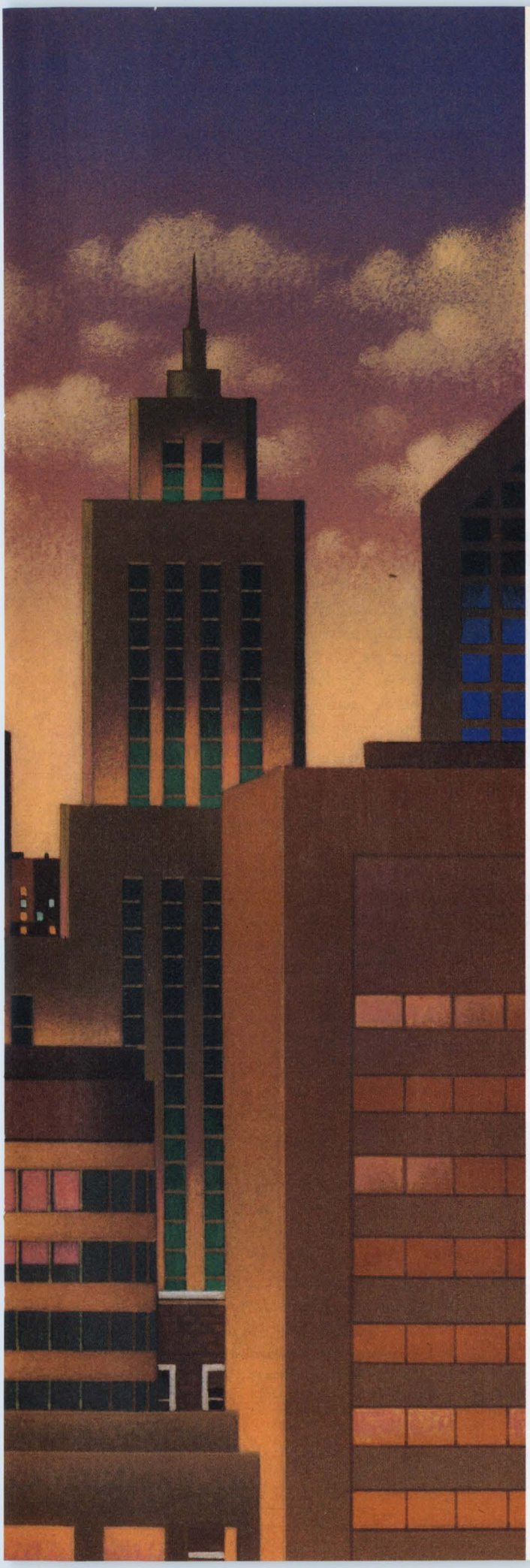
The problem in network performance, especially on LANs such as Ethernet, usually is not the wire itself. It's the delay caused by queueing of data from area to area of the processor, and the ability of the controller to receive and transmit data at a certain bits/second rate. Ethernet is rated at 10 Mbits/second. What does that mean? Essentially, that the Ethernet cable can handle bursts of traffic at speeds of up to 10 Mbits/second. It doesn't mean that any particular system can handle 10 Mbit speed traffic. In fact, many Ethernet controllers are capable of speeds of 1 to 2 Mbits/second with some high-performance controllers approaching the 4-Mbit range (these are fairly new and use the new Lance chipset from AMD).

It's unrealistic to assume that Ethernet is going to yield 10 Mbits/second of performance all the time or to hope for that kind of performance on per node basis. Considering a 2 Mbit speed per node, therefore, it's plain that the actual Ethernet cable bandwidth happily provides 10 Mbit service. In fact, I've seen few Ethernet networks where the actual 10 Mbit bandwidth was more than 15 percent used. Controllers, however, can become hopelessly swamped long before the cable reaches saturation point.

What governs bandwidth saturation at the controller is the popularity of the node. On an Ethernet, end nodes without frequent access that aren't members of an LAVC, may experience extremely good network response. Routing nodes, members of an LAVC and popular user nodes (hence, the probability of heavy LAT traffic) may experience controller saturation in a very short time, depending on traffic load, of course.

Remember: Traffic load can be high even though not much data is being transferred. Routing nodes between areas in a DECnet environment will see this. Traffic that's not destined for the router still must be routed. That takes memory, CPU time and bandwidth. Recently, I saw an 8600 that took up more than 20 percent of the CPU (when the system





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Memory and available CPU cycles always are problems on any VAX.

was idle) in DECnet overhead routing between two areas! The amount of data being transferred is just one problem of measuring throughput and performance; there's still the network overhead.

Placing additional controllers on a system to offload controller loading or bus loading/contention may aggravate the problem. Now, the system bus, like a UNIBUS, may become saturated or problems such as DMA contention may surface. this may not be the case with BI-based systems, but there are plenty of Q-bus and UNIBUS systems alive and well whose managers should think about contention and controller throughput when considering clustering.

The Memory Problem

Memory and available CPU cycles always are problems on any VAX. The more the merrier it seems. VAXs can be configured to keep more work in memory (through tuning and application adjustment) and effectively speed up certain classes of applications. Networking, however, requires that a great deal of memory be used to provide connectivity services, data structure storage, queue storage, buffering and many other required items. The result is that networks eat memory. Add a cluster onto that and more memory is required for disk servers (MSCP), buffers, structures and, like networking software, many other required items. Configuring clusters for memory-poor systems, therefore, is an invitation for problems. CPU time is also an issue. If you're on a routing system, routing requires CPU time. Slower systems take longer, which may increase the size of work queues, effectively increasing the queueing delay and reducing the overall throughput.

Cluster software requires CPU time to execute commands, communicate with other nodes, coordinate lock manager requests, synchronize events, etc., all of which contribute to system overhead. This overhead is required and little can be done to diminish it. It's something that must be considered however, when clustering. Clustering VAXs, either through a CI or through Ethernet, usually will involve the use of networking software, most often DECnet. What you don't consider about the coexistence of DECnet and cluster software (CI or LAVC) will come back to hurt you.

Proper consideration for cluster and network components, schedules and throughput expectations are critical for proper network and cluster operations.

Sometimes, what you don't know can hurt you.

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

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GRAPHICS

COOKING WITH *SAS*

By Al Cini

A Gourmet Software Package For The Statistical Master Chef.

Thinkers in business and science need good instincts and solid conceptual skills to sense trends, anticipate change and formulate theories about the relationships among various factors. To act on their theories, though, they need solid proof — carefully collected observations quantified and analyzed by proven statistical methods and presented clearly and graphically for the world to see.

Despite advances in artificial intelligence, computers still are a long way from generating scientific ideas for people, but products like *SAS* (pronounced sass) from SAS Institute Inc., Cary, North Carolina, can be enormously helpful to people with ideas that need to be refined and demonstrated.

At its heart, *SAS* is a comprehensive library of powerful and versatile statistical routines, honed for more than a decade to meet the needs of a demanding scientific community. Underneath, the product offers a data management facility to allow users to catalog, update and reformat observational information. On top, *SAS* provides a clean and consistent command interface to stored data and statistical routines, accessible either interactively or in "batch" mode. Optional *SAS* products like SAS/GRAPH provide enhanced capabilities in specialized areas.

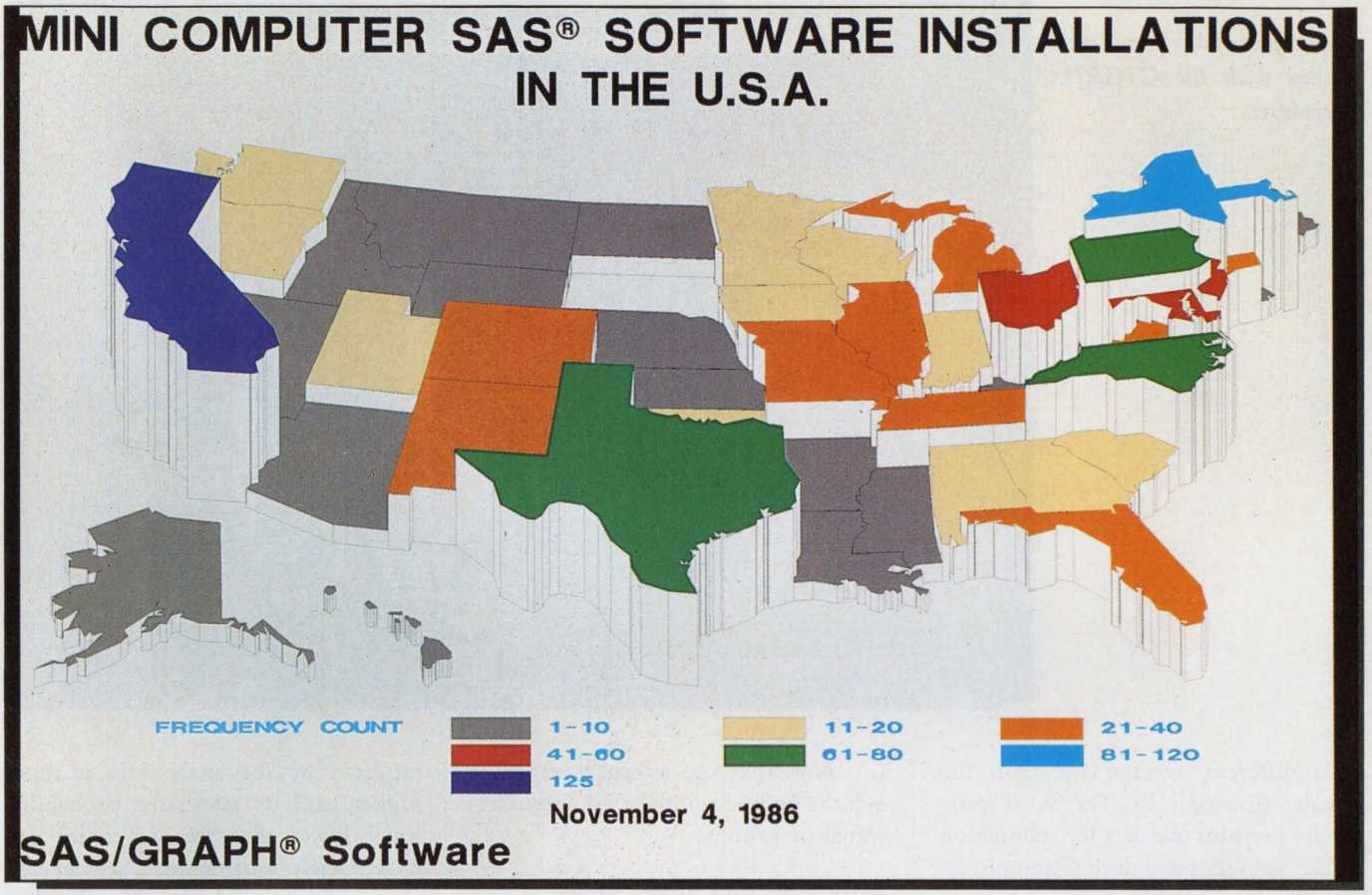
Make no mistake: In the world of data reduction, *SAS* is definitely a "power tool." If your idea of statistics is an occasional average or total, then *SAS* is more than you need. But if you're into market research or the physical or social sciences and you've got serious quantitative analysis problems, then *SAS* is worth serious consideration. Keep in mind, though, that the use and interpretation of results from an analysis of variance or general linear model demand an understanding of the underlying assumptions and applicability of such statistics. The proper application of these procedures requires at least a general textbook background in them.

For all their power, *SAS* statistical routines are remarkably easy to use. It's almost as easy to ask *SAS* to perform an involved stepwise regression or factor analysis as it is to ask for a simple plot or for descriptive statistics. A researcher working at a computer terminal can use *SAS* interactively to glide quickly from procedure to graph to procedure, using results derived at each step to help decide where to go in *SAS* for the right answers.

Is *SAS* the right product for you? If you haven't been scared off yet, a little practical *SAS* experience will help you decide whether you should invest in *SAS*. We'll use the product to analyze the results of a hypothetical study.

SAS Data Sets

To convey a sense of what its like to use *SAS*, let's conceive a "study" of how long it takes for people of various ages to climb a flight of stairs. An advertisement for subjects to participate in our research yields 26 male and female volunteers of various ages, which we



A prism map of the United States created with SAS/GRAPH software's GMAP procedure.

enter into a disk file, which *SAS* refers to as "data sets."

In Example 1, we've typed our subjects' information (name, age, and sex) directly into the *SAS* interactive "line mode" command editor interface. The product also provides the ability to read almost any file including *Datatrieve*-type extracts of conventional file and database structures into *SAS* data sets.

We're storing our observations in a data set named LIBR.PPL. The LIBR reference is to a standard VMS disk directory, as defined by the LIBNAME command. VMS users will find such *SAS*-to-VMS bridges a little unnatural at first, but considering that *SAS* commands behave essentially the same way regardless of the underlying operating system (*SAS* runs under VM/CMS, TSO, VSE and PC-DOS on IBM equipment; PRIMOS on Prime systems; and a variety of other environments as well as VAX/VMS), this is a reasonable compromise.

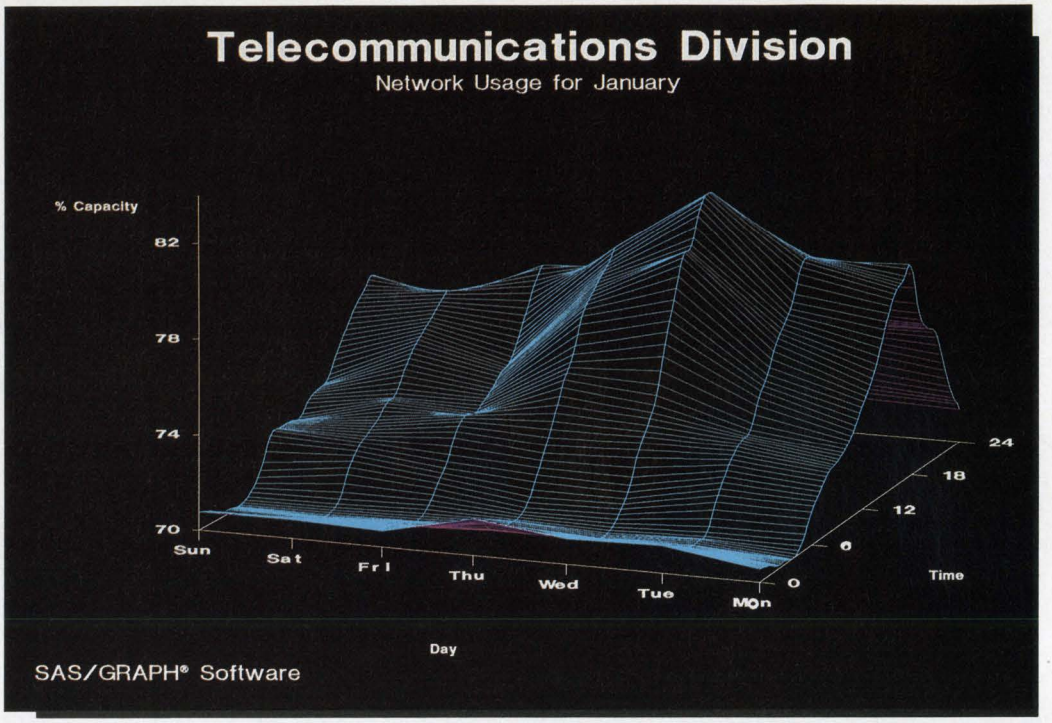
If we'd omitted the LIBR reference in LIBR.PPL, *SAS* would have stored our observations in a temporary data set (as WORK.PPL) which would be discarded at the end of the *SAS* session.

The *SAS* interactive line mode interface works on any TTY-type hardcopy or CRT. Mistaken lines can be recalled, fixed and re-entered. Prewritten *SAS* commands stored in RMS sequential files can be executed indirectly via the *SAS* %INCLUDE command. The X VMS command offers access to VMS DCL commands, to use TPU or EDT to edit indirect *SAS* commands, for example, without leaving *SAS*. The package also provides display terminal users with a full-screen editor facility, which we'll see a little later.

Averages And Differences

Before we proceed with the stair-climbing study, let's check to see whether the male respondents to our advertisement tend to be

A 3-D plot of day versus time created with the G3GRID procedure.



of a different average age than the females (Example 2). The SORT procedure prepares our data for submission to the MEANS procedure (Example 3).

The average ages of male and female subjects are somewhat different, but what's the probability that such a difference can be accounted for merely by random "luck of the draw?" In statistical terms, this calls for an analysis of variance (ANOVA) to test whether the difference in mean ages between our male and female subjects is "statistically significant" (see Example 4).

The *SAS* ANOVA procedure performs an analysis of variance on the averages of categorized observations, and computes the likelihood that any differences in the averages can be accounted for at random. Indeed, the small F statistic (.03) in Example 4 and its associated high (.86) probability, indicate that the observed differences in average age between our male and female subjects could very well be accidental, and can't reliably be assumed to prove a real difference between males and females in the general population.

Note that *SAS* adjusts its report to suit the defined width of the output terminal or printer.

Updating SAS Data Sets

Once we've timed and recorded our subjects' stair-climbing activity, we can enter the gathered data into a temporary *SAS* data set, MOREPPL (Example 5).

Through its SORT procedure and MERGE function, *SAS* enables us to combine these new datapoints with our existing subject data (Example 6). Note that the first SORT procedure refers by default to the most recently created data set, MOREPPL.

The *SAS* PRINT procedure can be used to list the contents of a *SAS* data set (Example 7).

SAS also provides a very rich repertoire of PASCAL-like DATA commands, which can be used to drop variables, calculate new variables from old ones and select certain observations from a data set for special processing.

Is there a significant difference between the sexes of our subjects with respect to how quickly they can climb our test staircase? Another job for ANOVA (Example 8). The F statistic reported by the analysis in is much higher, and its associated probability much lower, than for our earlier age-by-sex analysis of variance. We can conclude with confidence that there's a significant difference between our male and female subjects with respect to stair-climbing speeds.

The General Linear Model

To test complicated hypotheses not only about average differences between classes of observations but about the linear relationships among observed variables, *SAS* provides a very powerful General Linear Model (GLM) procedure. GLM allows a researcher to test whether the independent variables in a study (such as the sex and age values for our subjects) can be used individually or in combination to "predict" the dependent variable (speed). In Example 9, we use GLM to test again for sex differences in stair-climbing speed: Note that values for F and its associated probability derived by GLM are the same as for our earlier ANOVA study of sex differences,

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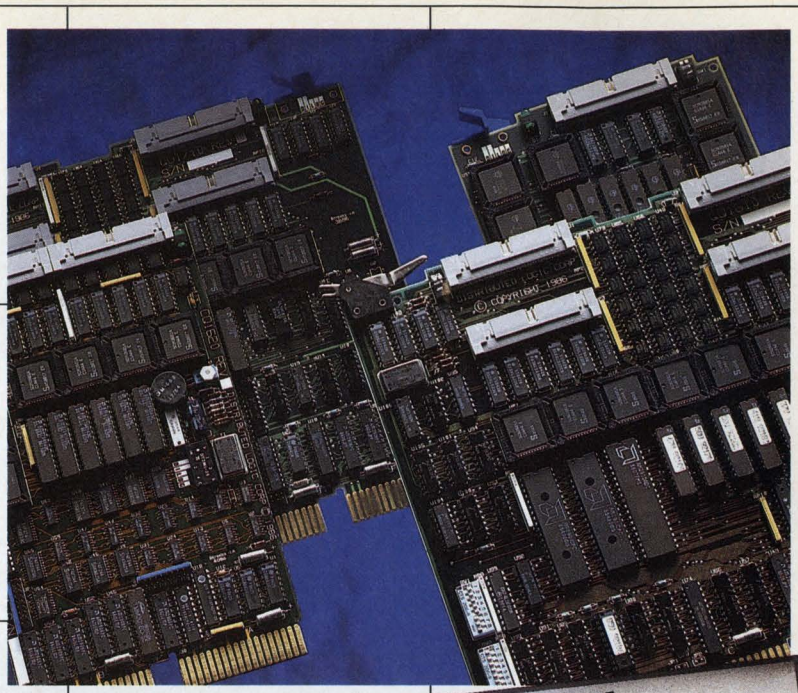
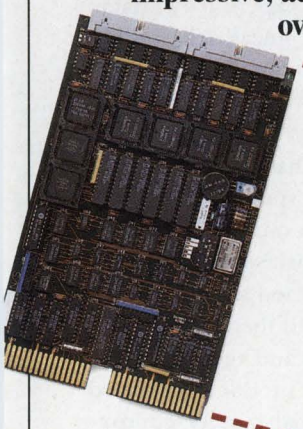


Right now, DILOG is delivering the latest generation of asynchronous communications controllers for QBUS and UNIBUS systems. Highlighted in the table, these four advanced products offer impressive, across-the-board advantages over DHU11 and DHV11. Here's how we give you more . . .



More Economy

DILOG's new generation communications controllers save from $40 to $90 per line. Multiply that by the lines in your system, and you'll see substantial bottom-line benefits.

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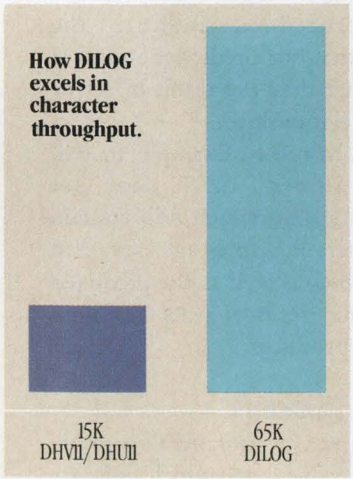
In every instance, DILOG uses a smaller board — typically dual-size — or puts more lines on the same size board.



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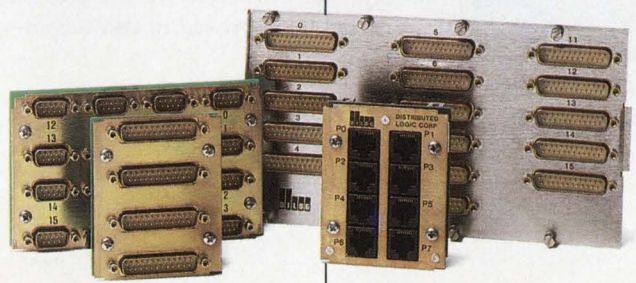

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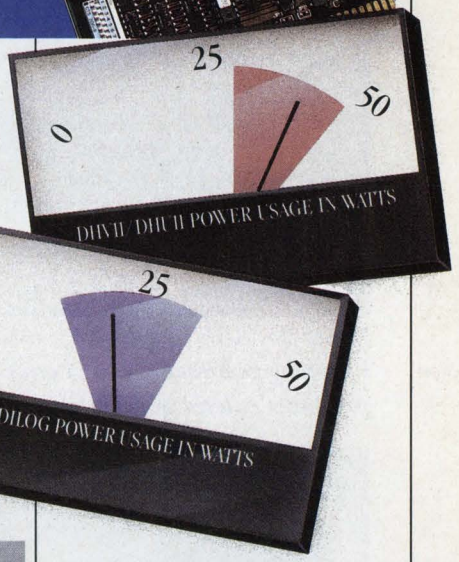

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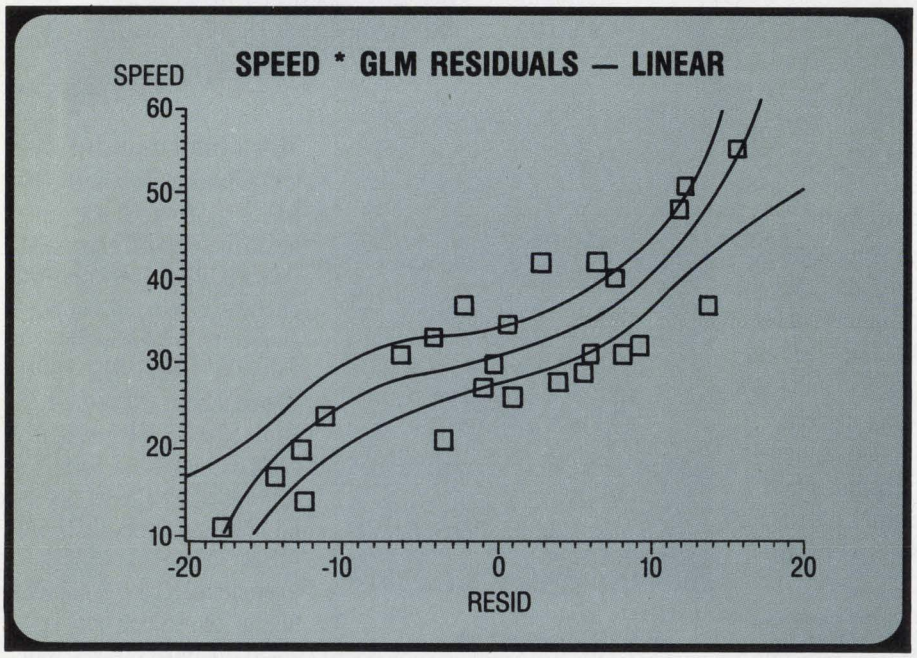
```
Command=>                                          SAS Log 10:43

   183 RUN;
NOTE: THE PROCEDURE GPLOT USED 00:00:04.71 CPU SECONDS, 51 PAGEFAULTS.
   184 TITLE 'SPEED * GLM RESIDUALS — LINEAR';
   185 SYMBOL1 W=1 C=STV V=DIAMOND;
   186 SYMBOL2 W=1 C=STV I=RC V=STAR;                    1
   187 SYMBOL3 W=1 C=STV I=RCCLM95 V=SQUARE;
   188 PROC GPLOT DATA=LIBR.PPLMODEL;
   189 PLOT SPEED*RESID=3;
   190 RUN;

NOTE: THE PROCEDURE GPLOT USED 00:00:04.56 CPU SECONDS, 21 PAGEFAULTS.
```

```
Command=>                                          Program Editor
                                                        2
00001 TITLE 'SPEED * GLM RESIDUALS — LINEAR';
00002 SYMBOL1 W=1 C=STV V=DIAMOND;
00003 SYMBOL2 W=1 C=STV I=RC V=STAR;
00004 SYMBOL3 W=1 C=STV I=RCCLM95 V=SQUARE;             3
00005 PROC GPLOT DATA=LIBR.PPLMODEL;
00006      PLOT SPEED*RESID=3;
00007 RUN;
00008
```

Screen 1a. SAS in full-screen mode, displaying the three screen regions: 1) SAS log, including informational and error messages; 2) SAS commands entered here; 3) SAS programs entered and modified here.



Screen 1b. Resulting SAS/GRAPH plot of linear model predicting speed from age. Plot includes superimposed fitted curves: Center curve is best fit to data points, outer curves define 95% confidence limits for a mean predicted value.

again demonstrating a significant difference between males and females on our experimental stair-climbing task. But GLM is more than a mere mathematical alternative to ANOVA. By formulating predictive equations involving several variables, we can ask GLM to test hypotheses regarding possible linear and curved correlations among observations, as well as about complex ANOVA-type class differences and interactions in experimental data.

Is there some linear relationship between a subject's age and how quickly he or she can climb stairs? To test for this, we ask the GLM procedure to construct a formula that "predicts" our observed climbing speeds (the dependent variable) from our observed ages (the independent variable). GLM uses a "least-squares" method to compute the predictive formula. If there's a relationship between speed and age, the resulting formula will produce predicted values for speed that closely approximate those we observed.

Residual values; i.e., the difference between the speed values our model predicts from the age of our subjects and the actual observed speed values, will be close to zero. The computed F statistic for our formula will, as it did with the ANOVA procedure, indicate the likelihood that our predictive model is a fluke rather than the result of a true age/speed relationship.

The GLM run in Example 10 will generate a new *SAS* data set (LIBR.PPLMODEL), which will contain all our observed name, age, sex, and speed variables as well as the predicted (PREDIC) and residual (RESID) values our model produces.

The Plot Thickens

As you can see, we obtained a significantly large value for F, which suggests a linear relationship between speed and age, but can the predictive strength of our model be improved to take advan-

EXAMPLE 1.

```
$ SAS
Copyright (c) 1986 SAS Institute Inc., Cary, N. C. 27511, U. S. A.
NOTE: VMS Version of SAS Release 5.16 at SAS INSTITUTE INC. - DEC PROFESSIONAL
      (01000003).
NOTE: LICENSED CPUID MODEL = VAX(CLASS D), SERIAL = 02005F7C.

1? /* This is an example SAS session
2? */;
3? LIBNAME LIBR '[.PERMANENT_SAS_AREA]';
4? DATA LIBR.PPL;
5?   INPUT NAME $ AGE SEX $;
6?   CARDS;
7? JOHN 4 M
8? BOB 4 M
9? SUE 6 F
10? JOE 6 M
11? ANNE 8 F
12? PETE 9 M
13? LOIS 9 F
14? WILMA 11 F
15? ART 15 M
16? DENISE 18 F
17? HENRY 22 M
18? DORIS 26 F
19? BARBARA 30 F
20? WILLY 30 M
21? DAN 33 M
22? JANE 37 F
23? ELLEN 40 F
24? GEORGE 40 M
25? TINA 42 F
26? EDNA 44 F
27? STEVE 45 M
28? FRANK 47 M
29? MARGE 50 F
30? BRUCE 53 M
31? JOHN 53 M
32? KATHY 56 F
33? ;

NOTE: THE DATA SET LIBR.PPL HAS 26 OBSERVATIONS AND 3 VARIABLES.
NOTE: THE DATA STEP USED 00:00:01.75 CPU SECONDS, 130 PAGEFAULTS.
```

EXAMPLE 2.

```
35? PROC SORT OUT = LIBR.SRTPPL;
36?   BY SEX;
37? RUN;
NOTE: THE DATA SET LIBR.SRTPPL HAS 26 OBSERVATIONS AND 3 VARIABLES.
NOTE: THE PROCEDURE SORT USED 00:00:01.69 CPU SECONDS, 130 PAGEFAULTS.
```

EXAMPLE 3.

```
38? PROC MEANS DATA = LIBR.SRTPPL
39?   N MEAN STD MIN MAX SKEWNESS;
40?   VAR AGE;
41?   BY SEX;
42?   TITLE 'AVERAGE AGE OBSERVATIONS BY SEX';
43? RUN;
```

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	SKEWNESS
SEX=F						
AGE	13	29.00000000	17.25784846	6.00000000	56.00000000	-0.00494344
SEX=M						
AGE	13	27.76923077	18.87305772	4.00000000	53.00000000	0.00401848

```
NOTE: THE PROCEDURE MEANS USED 00:00:01.16 CPU SECONDS, 76 PAGEFAULTS.
NOTE: THE PROCEDURE PRINTED PAGE 1.
```

EXAMPLE 4.

```
44? PROC ANOVA DATA=LIBR.SRTPPL;
45?   CLASS SEX;
46?   MODEL AGE=SEX;
47?   MEANS SEX;
48?   TITLE 'ARE AVERAGE AGES DIFFERENT BETWEEN SEXES?';
49? RUN;
```

ANALYSIS OF VARIANCE PROCEDURE
CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
SEX	2	F M

NUMBER OF OBSERVATIONS IN DATA SET = 26

DEPENDENT VARIABLE: AGE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE
MODEL	1	9.84615385	9.84615385	0.03
ERROR	24	7848.30769231	327.01282051	PR > F
CORRECTED TOTAL	25	7858.15384615		0.8637

R-SQUARE	C.V.	ROOT MSE	AGE MEAN
0.001253	63.7088	18.08349580	28.3846153

DEPENDENT VARIABLE: AGE

SOURCE	DF	ANOVA SS	F VALUE	PR > F
SEX	1	9.84615385	0.03	0.8637

MEANS

SEX	N	AGE
F	13	29.0000000
M	13	27.7692308

```
NOTE: THE PROCEDURE ANOVA USED 00:00:02.73 CPU SECONDS, 134 PAGEFAULTS.
NOTE: THE PROCEDURE PRINTED PAGES 2 THROUGH 5.
```

EXAMPLE 5.

```
50? DATA MOREPPL;
51?   INPUT NAME $ SPEED;
52?   CARDS;
53? JOHN 32
54? BOB 31
55? SUE 37
56? JOE 29
    .
    .
    .
77? JOHN 42
78? KATHY 56
NOTE: THE DATA SET WORK.MOREPPL HAS 26 OBSERVATIONS AND 2 VARIABLES.
NOTE: THE DATA STEP USED 00:00:01.31 CPU SECONDS, 81 PAGEFAULTS.
79?;
80? RUN;
```

EXAMPLE 6.

```
81? PROC SORT;
82?   BY NAME;
83? RUN;
NOTE: THE DATA SET WORK.MOREPPL HAS 26 OBSERVATIONS AND 2 VARIABLES.
NOTE: THE PROCEDURE SORT USED 00:00:01.03 CPU SECONDS, 5 PAGEFAULTS.
84? PROC SORT DATA = LIBR.PPL;
85?   BY NAME;
86? RUN;
NOTE: THE DATA SET LIBR.PPL HAS 26 OBSERVATIONS AND 3 VARIABLES
NOTE: THE PROCEDURE SORT USED 00:00:01.07 CPU SECONDS, 1 PAGEFAULTS.
87? DATA LIBR.NEWPPL;
88?   MERGE LIBR.PPL MOREPPL;
89?   BY NAME;
90? RUN;
NOTE: THE DATA SET LIBR.NEWPPL HAS 26 OBSERVATIONS AND 4 VARIABLES.
NOTE: THE DATA STEP USED 00:00:01.79 CPU SECONDS, 38 PAGEFAULTS.
```

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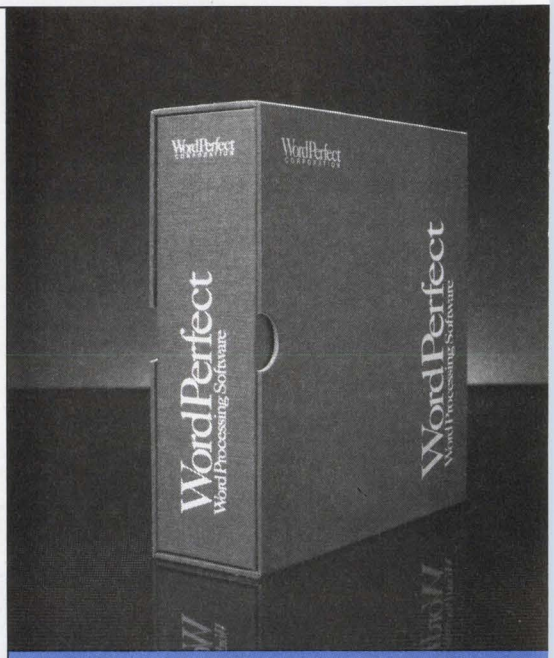

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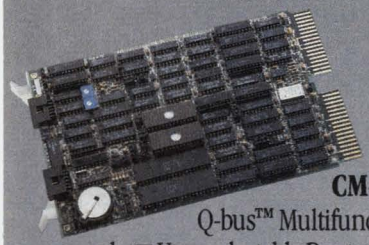

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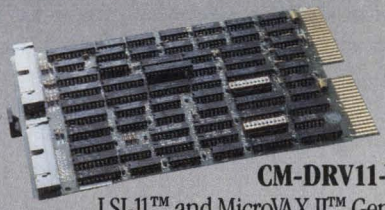

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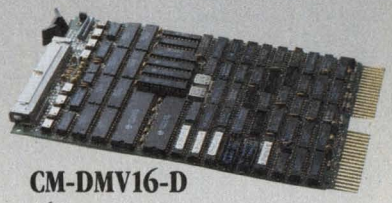

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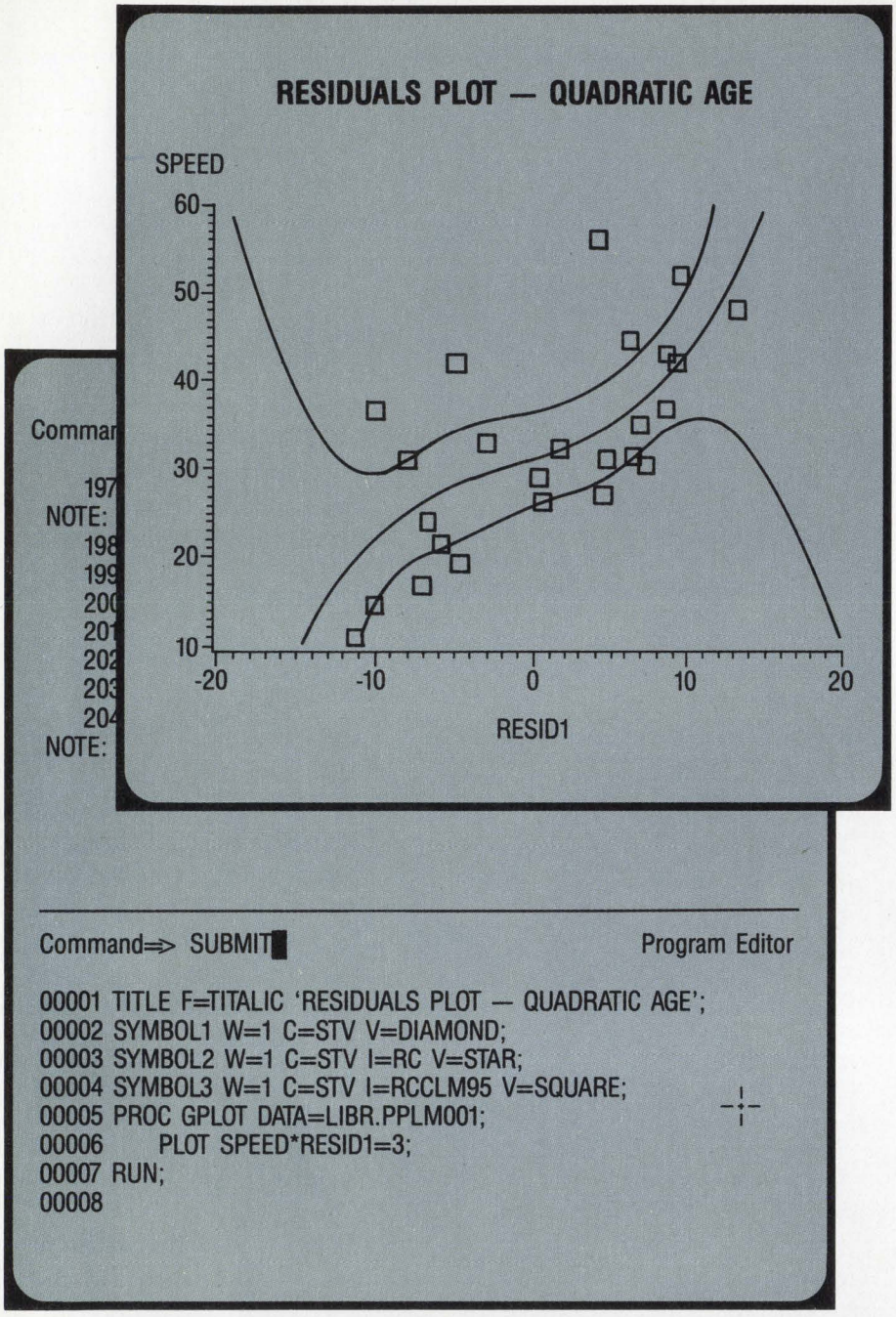

Screen 2. SAS/GRAPH plot of quadratic relationship between speed and age, from example analysis.

tage of a possible curved relationship between sex and age? Looking at the raw data, it seems that young people take a relatively long time to climb the stairs in our test, that climbing speed seems to improve as our subjects mature into their twenties, then apparently drops off as our subjects age into their forties and fifties. To help visulaize the age/speed relationship, we can simply ask SAS for a graph of age vs. speed. Or, we can plot the values our model predicts for climbing speed (written to LIBR.PPLMODEL as a result of our last GLM run) vs. actual speed observations, to see whether our predictions are consistently "off the mark" across the entire observed range. Such analyses of predicted and residual variables commonly follow a regression study, and are easily pursued in SAS.

Example 11 shows that our model's predicted climbing speed is closer to the actual observations at some parts of its range than at others, suggesting possible quadratic effects unaccounted for by our model.

SAS users with optional SAS/GRAPH software and a graphics terminal or plotter can get higher resolution graphics, including titles in various fonts and superimposed regression lines. (See Screens 1a-b, 2.)

Let's ask GLM to test for a quadratic (curved) relationship between speed and age. The GLM procedure's MODEL statement allows us to include predictive terms formed by calculations on variables in our data set (AGE*AGE). Again, for possible further analysis, we'll write our original observations as well as predicted and residual values into a new data set (Example 12).

The improvement in our quadratic model's F statistic over the linear model, confirms a curved relationship between speed and age.

Models And Models

How about a model predicting speed by both sex and age? The *SAS* GLM procedure allows the expression of almost any model, involving both classification (sex) and continuous (age) variables, and

EXAMPLE 7.

```
91+PROC PRINT DATA = LIBR.NEWPPL;
92+   TITLE 'MERGED OBSERVATIONS';
93+RUN;
                        MERGED OBSERVATIONS
                OBS    NAME       AGE    SEX    SPEED

                  1    ANNE         8     F      28
                  2    ART         15     M      14
                  3    BARBARA     30     F      31
                  4    BOB          4     M      31
                  5    BRUCE       53     M      37
                                    .
                                    .
                                    .
                 24    TINA        42     F      42
                 25    WILLY       30     M      17
                 26    WILMA       11     F      26

NOTE: THE PROCEDURE PRINT USED 00:00:01.41 CPU SECONDS, 53 PAGEFAULTS.
NOTE: THE PROCEDURE PRINTED PAGES 6 THROUGH 7.
```

EXAMPLE 8.

```
102? PROC ANOVA DATA=LIBR.NEWPPL;
103?   CLASS SEX;
104?   MEANS SEX;
105?   MODEL SPEED=SEX;
106?   TITLE 'ARE AVERAGE SPEEDS DIFFERENT BETWEEN SEXES?';
107? RUN;
                        ANALYSIS OF VARIANCE PROCEDURE
                            CLASS LEVEL INFORMATION
                            CLASS      LEVELS    VALUES
                            SEX             2    F M

                       NUMBER OF OBSERVATIONS IN DATA SET = 26
                            ANALYSIS OF VARIANCE PROCEDURE

DEPENDENT VARIABLE: SPEED

SOURCE                    DF      SUM OF SQUARES          MEAN SQUARE      F VALUE

MODEL                      1       775.53846154       775.53846154         8.43
ERROR                     24      2209.07692308        92.04487179       PR > F
CORRECTED TOTAL           25      2984.61538462                          0.0078

R-SQUARE                C.V.          ROOT MSE           SPEED MEAN
0.259845           30.1990          9.59400187          31.76923077

DEPENDENT VARIABLE: SPEED

SOURCE                    DF          ANOVA SS      F VALUE    PR > F

SEX                        1       775.53846154         8.43    0.0078

                                    MEANS

                          SEX          N          SPEED

                          F           13     37.2307692
                          M           13     26.3076923

NOTE: THE PROCEDURE ANOVA USED 00:00:02.05 CPU SECONDS, 0 PAGEFAULTS.
NOTE: THE PROCEDURE PRINTED PAGES 9 THROUGH 12.
```

EXAMPLE 9.

```
108? PROC GLM DATA=LIBR.NEWPPL;
109?   CLASS SEX;
110?   MODEL SPEED=SEX;
111?   TITLE 'GLM SOLUTION TO TEST FOR DIFFERENCES IN AVERAGE SPEED BETWEEN S
112? RUN;
                        GENERAL LINEAR MODELS PROCEDURE
                            CLASS LEVEL INFORMATION
                            CLASS      LEVELS    VALUES
                            SEX             2    F M

                       NUMBER OF OBSERVATIONS IN DATA SET = 26
                            GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SPEED

SOURCE                    DF      SUM OF SQUARES          MEAN SQUARE      F VALUE

MODEL                      1       775.53846154       775.53846154         8.43
ERROR                     24      2209.07692308        92.04487179       PR > F
CORRECTED TOTAL           25      2984.61538462                          0.0078

R-SQUARE                C.V.          ROOT MSE           SPEED MEAN
0.259845           30.1990          9.59400187          31.76923077

SOURCE                    DF          TYPE I SS   F VALUE    PR > F

SEX                        1       775.53846154         8.43    0.0078

SOURCE                    DF         TYPE III SS   F VALUE    PR > F

SEX                        1       775.53846154         8.43    0.0078
NOTE: THE PROCEDURE GLM USED 00:00:02.71 CPU SECONDS, 115 PAGEFAULTS.
NOTE: THE PROCEDURE PRINTED PAGES 13 THROUGH 15.
```

EXAMPLE 10.

```
113? PROC GLM DATA=LIBR.NEWPPL;
114?   CLASS SEX;
115?   MODEL SPEED = AGE;
116?   TITLE 'TEST OF SPEED PREDICTED BY AGE';
117?   OUTPUT OUT=LIBR.PPLMODEL P=PREDIC R=RESID;
118? RUN;
                        GENERAL LINEAR MODELS PROCEDURE

                            CLASS LEVEL INFORMATION
                            CLASS      LEVELS    VALUES
                            SEX             2    F M

                       NUMBER OF OBSERVATIONS IN DATA SET = 26

DEPENDENT VARIABLE: SPEED

SOURCE                    DF      SUM OF SQUARES          MEAN SQUARE      F VALUE

MODEL                      1       883.10526284       883.10526284        10.09
ERROR                     24      2101.51012177        87.56292174       PR > F
CORRECTED TOTAL           25      2984.61538462                          0.0041

R-SQUARE                C.V.          ROOT MSE           SPEED MEAN
0.295886           29.4546          9.35750617          31.76923077

DEPENDENT VARIABLE: SPEED

SOURCE                    DF          TYPE I SS   F VALUE    PR > F

AGE                        1       883.10526284        10.09    0.0041

SOURCE                    DF         TYPE III SS   F VALUE    PR > F

AGE                        1       883.10526284        10.09    0.0041

NOTE: THE DATA SET LIBR.PPLMODEL HAS 26 OBSERVATIONS AND 6 VARIABLES.
NOTE: THE PROCEDURE GLM USED 00:00:02.80 CPU SECONDS, 52 PAGEFAULTS.
NOTE: THE PROCEDURE PRINTED PAGES 16 THROUGH 18.
```

EXAMPLE 11.

```
119? PROC PLOT DATA=LIBR.PPLMODEL;
120?    PLOT SPEED*PREDIC="+";
121?    TITLE 'PLOT OF SPEED PREDICTED BY AGE';
122? RUN;
                        PLOT OF SPEED PREDICTED BY AGE                        19
                                                 11:11 SUNDAY, FEBRUARY 8, 1987

                     PLOT OF SPEED*PREDIC    SYMBOL USED IS +

    100 +
        |
  SPEED |
        |
        |                                                               +
     50 +                                                  +     +
        |            +                              +  + +          +
        |          + + ++ +      +       +   +              + +
        |               +                    +  +      +
        |                     +      +
      0 +
        -----------+----------+----------+----------+----------+------------------
               23.59472   27.28227   30.96983   34.65739   38.34494

                                PREDIC

NOTE:      2 OBS HIDDEN
NOTE: THE PROCEDURE PLOT USED 00:00:01.33 CPU SECONDS, 38 PAGEFAULTS.
NOTE: THE PROCEDURE PRINTED PAGE 19.
```

EXAMPLE 12.

```
127? PROC GLM;
128?    CLASS SEX;
129?    MODEL SPEED = AGE AGE*AGE;
130?    TITLE 'TEST OF SPEED PREDICTED BY QUADRATIC AGE';
131?    OUTPUT OUT=LIBR.PPLMOD1 P=PREDIC1 R=RESID1;
132? RUN;
                      GENERAL LINEAR MODELS PROCEDURE
                          CLASS LEVEL INFORMATION
                          CLASS     LEVELS     VALUES
                           SEX         2        F M

                 NUMBER OF OBSERVATIONS IN DATA SET = 26

DEPENDENT VARIABLE: SPEED

SOURCE              DF     SUM OF SQUARES       MEANS SQUARE     F VALUE

MODEL                2      1701.01441128       850.50720564       15.24

ERROR               23      1283.60097333        55.80873797     PR > F

CORRECTED TOTAL     25      2984.61538462                         0.0001

R-SQUARE           C.V.          ROOT MSE         SPEED MEAN

0.569928        23.5150        7.47052461        31.76923077

DEPENDENT VARIABLE: SPEED

SOURCE              DF        TYPE I SS    F VALUE    PR > F

AGE                  1     883.10526284      15.82    0.0006
AGE*AGE              1     817.90914844      14.66    0.0009

SOURCE              DF      TYPE III SS    F VALUE    PR > F

AGE                  1     454.79227997       8.15    0.0090
AGE*AGE              1     817.90914844      14.66    0.0009
NOTE: THE DATA SET LIBR.PPLMOD1 HAS 26 OBSERVATIONS AND 8 VARIABLES.
NOTE: THE PROCEDURE GLM USED 00:00:02.92 CPU SECONDS, 1 PAGEFAULTS.
NOTE: THE PROCEDURE PRINTED PAGES 21 THROUGH 23.
```

EXAMPLE 13.

```
146? PROC GLM;
147?    CLASS SEX;
148?    MODEL SPEED = AGE SEX / SOLUTION P E;
149?    TITLE 'HO: SPEED = AGE SEX ... EXPANDED REPORT RESULTS';
150+RUN;
                      GENERAL LINEAR MODELS PROCEDURE
                          CLASS LEVEL INFORMATION
                          CLASS     LEVELS     VALUES
                           SEX         2        F M

                 NUMBER OF OBSERVATIONS IN DATA SET = 26

DEPENDENT VARIABLE: SPEED

GENERAL FORM OF ESTIMABLE FUNCTIONS

EFFECT          COEFFICIENTS
INTERCEPT       L1

AGE             L2

SEX        F    L3
           M    L1-L3

DEPENDENT VARIABLE: SPEED

SOURCE              DF     SUM OF SQUARES       MEAN SQUARE     F VALUE

MODEL                2      1602.06277915      801.03138957       13.33

ERROR               23      1382.55260547       60.11098285     PR > F

CORRECTED TOTAL     25      2984.61538462                        0.0001

R-SQUARE           C.V.          ROOT MSE         SPEED MEAN

0.536774        24.4045        7.75312729        31.76923077

DEPENDENT VARIABLE: SPEED

SOURCE              DF        TYPE I SS    F VALUE    PR > F

AGE                  1     883.10526284      14.69    0.0009
SEX                  1     718.95751631      11.96    0.0021

SOURCE              DF      TYPE III SS    F VALUE    PR > F

AGE                  1     826.52431761      13.75    0.0012
SEX                  1     718.95751631      11.96    0.0021

                                            T FOR HO:     PR > |T|     STD ERROR OF
PARAMETER                  ESTIMATE        PARAMETER=0                   ESTIMATE

INTERCEPT              17.29605598 B           5.33        0.0001      3.24500937
AGE                     0.32451876             3.71        0.0012      0.08751629

DEPENDENT VARIABLE: SPEED

                                            T FOR HO:     PR > |T|     STD ERROR OF
PARAMETER                  ESTIMATE        PARAMETER=0                   ESTIMATE

SEX         F          10.52366922 B           3.46        0.0021      3.04293369
            M           0.00000000 B            .            .             .

DEPENDENT VARIABLE: SPEED

NOTE: THE X'X MATRIX HAS BEEN DEEMED SINGULAR AND A GENERALIZED
      INVERSE HAS BEEN EMPLOYED TO SOLVE THE NORMAL EQUATIONS.
      THE ABOVE ESTIMATES REPRESENT ONLY ONE OF MANY POSSIBLE
      SOLUTIONS TO THE NORMAL EQUATIONS. ESTIMATES FOLLOWED BY
      THE LETTER B ARE BIASED AND DO NOT ESTIMATE THE PARAMETER
      BUT ARE BLUE FOR SOME LINEAR COMBINATION OF PARAMETERS
      (OR ARE ZERO). THE EXPECTED VALUE OF THE BIASED ESTIMATORS
      MAY BE OBTAINED FROM THE GENERAL FORM OF ESTIMABLE
      FUNCTIONS. FOR THE BIASED ESTIMATORS, THE STD ERR IS THAT
      OF THE BIASED ESTIMATOR AND THE T VALUE TESTS
      HO: E(BIASED ESTIMATOR) = 0. ESTIMATES NOT FOLLOWED BY THE
      LETTER B ARE BLUE FOR THE PARAMETER.

DEPENDENT VARIABLE: SPEED

OBSERVATION          OBSERVED            PREDICTED             RESIDUAL
                       VALUE               VALUE

       1          28.00000000         30.41587528          -2.41587528
       2          31.00000000         37.55528799          -6.55528799
       3          27.00000000         33.66106288          -6.66106288
       4          30.00000000         36.25721295          -6.25721295
                                           .
                                           .
                                           .
      23          42.00000000         34.49555024           7.50444976
      24          21.00000000         20.21672482           0.78327518
      25          33.00000000         31.89940016           1.10059984
      26          17.00000000         27.03161877         -10.03161877

DEPENDENT VARIABLE: SPEED

           SUM OF RESIDUALS                                 -0.00000000
           SUM OF SQUARED RESIDUALS                       1382.55260547
           SUM OF SQUARED RESIDUALS - ERROR SS              -0.00000000
           FIRST ORDER AUTOCORRELATION                       0.17039444
           DURBIN-WATSON D                                   1.58220152
NOTE: THE PROCEDURE GLM USED 00:00:03.59 CPU SECONDS, 0 PAGEFAULTS.
NOTE: THE PROCEDURE PRINTED PAGES 29 THROUGH 37.
```

A large enough VAX or VAX-cluster can support a community of researchers using *SAS* interactively for most studies . . .

can produce a lot more than just some averages and an F statistic (Example 13). As you can see here, it is very easy to move around within *SAS*. Beyond ANOVA and GLM, *SAS* offers regression, factor/cluster analysis and many other statistical procedures.

Full-Screen Editing

Users with access to display terminals probably will prefer to use *SAS* interactively through its full screen rather than line mode interface. All it takes to enter full-screen mode is an OPTIONS DMS FSD = <device name> command in line mode, where valid device names include all DEC text and graphics displays as well as most Tektronix graphics terminals.

The *SAS* full-screen editor presents a user with a display organized into three windows, used to enter and modify *SAS* programs, to review the resulting program log and to submit *SAS* commands (Screen 1a). The VAX/VMS full-screen *SAS* interface is quite different from the TPU and EDT editors VAX users are familiar with, but is almost completely compatible with full-screen *SAS* on all other computers and operating systems. If you already know *SAS* from IBM or DG, you'll be up and running on a VAX in no time. If you're an experienced VAX user but new to *SAS*, you'll find yourself instinctively pushing all the wrong function keys. With practice, even users with deeply ingrained VAX habits can become comfortable under full-screen *SAS* within a few hours. For the hopelessly VAX-inated, *SAS* provides a facility for redefining function keys, which can be used to soften the differences between full-screen *SAS* and traditional VAX/VMS editing tools.

SAS/GRAPH And Beyond

Available as a *SAS* option, SAS/GRAPH overcomes the obvious limitations of crude scatterplots produced on text-only devices, as we see from our example study's PROC PLOT (Screens 1a-b, 2). The product supports a wide variety of graphics display and plotter devices, and offers a full range of plot, chart, and map output capabilities (see Photos).

Optional *SAS* software "layered" products include specialized operations research and project management tools (SAS/OR), and a package specially tailored for financial forecasting and business analysis (SAS/ETS).

Born To Run

SAS procedures involving small numbers of variables and observations finish almost instantly, even on a VAX-11/750. Our examples took only a few minutes of CPU time to complete. Of course, more ambitious studies can mean large working sets and lots of page faults as well as increased CPU time, but it's hard to conceive of a study that's too big (given sufficiently large page quotas and a little patience) to run on a VAX. VAX virtual memory architecture was born to run potentially enormous programs like *SAS*.

While we're on the subject, observations like page faults, execution times and working-set sizes could make terrific subjects for *SAS* analysis. The latest release of *SAS* includes a library of sample procedures that can be used to analyze and plot data collected by the VAX/VMS MONITOR utility, and might prove helpful at some sites in identifying and correcting the determinants of poor system performance.

SAS is much too big, complex and expensive a tool for most VAX users, whose simple data analysis and graphics presentation needs can be handled by low-end products like *Datatrieve, DECslide, DECgraph and DECalc*, but scientific and business VAX users requiring ambitious, high-precision data analyses will find *SAS* well worth the price.

Organizations already using *SAS* on their IBM mainframes should consider it for their VAXs. A large enough VAX or VAXcluster can support a community of researchers using *SAS* interactively for most studies, while perhaps shipping the relatively few large *SAS* analyses that need the extra horsepower, off to run in batch mode on Big Blue. ■

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High 818 Medium 822 Low 826

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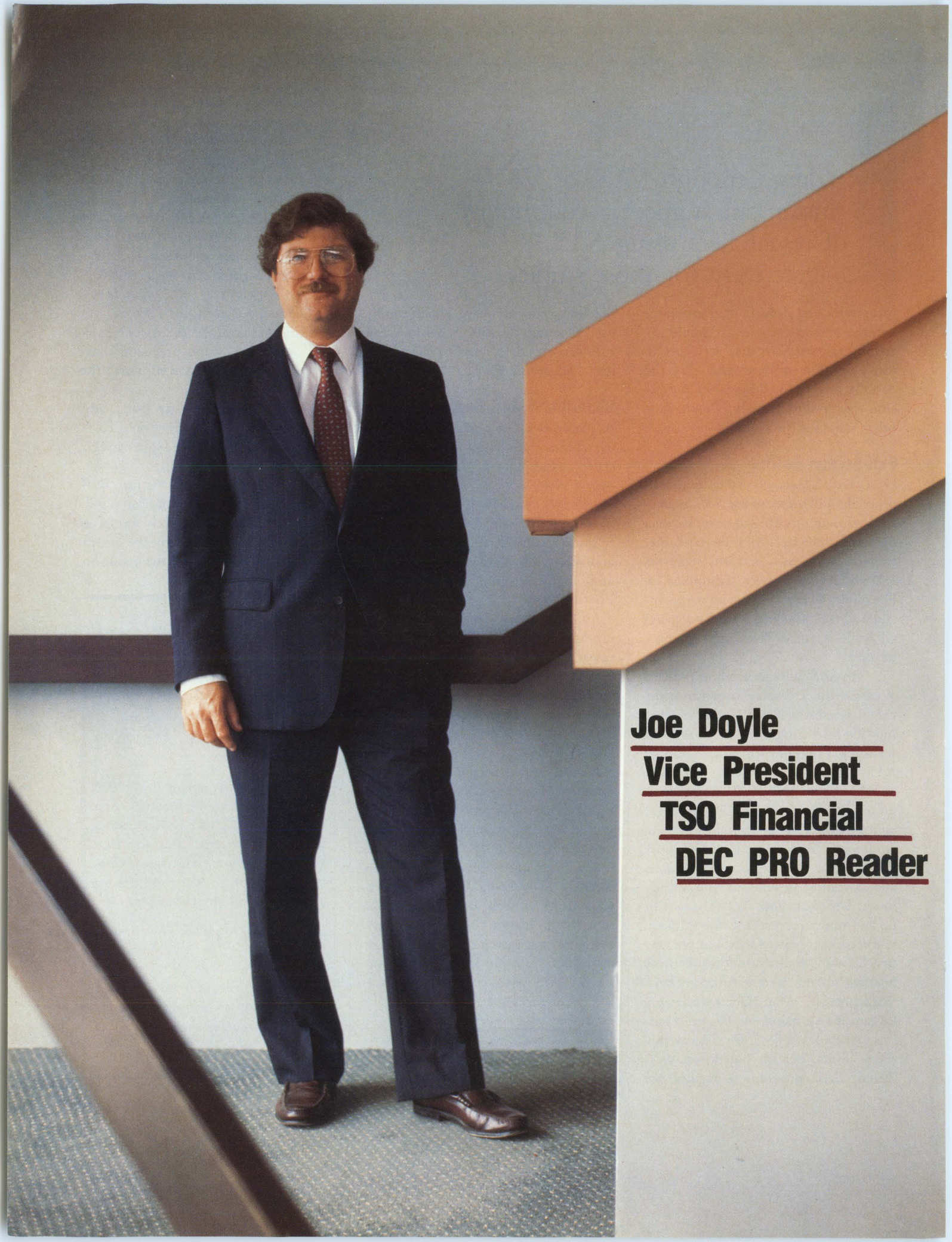
(919) 467-8000

Hardware Environment: DEC VAX/VMS, MICROVAX II, IBM-PC. Also available IBM OS, TSO, CMS, DOS/VSE, SSX, ICCF systems, and for Data General and Prime hardware configurations. Not all SAS products are available in all environments.

Price: $3,000 for MICROVAX II; from $1,500 to $8,000 for VAX; $1,500 for the IBM PC — one to three users. Prices reflect first year annual licensing fees. Reduced fees are available in succeeding years.

Enter 830 on reader card



Joe Doyle
Vice President
TSO Financial
DEC PRO Reader

WHO ARE THE DEC PROS?

They're people like Joe Doyle, VP of TSO Financial, Horsham, PA. Joe moved from high school math teacher to computer science teacher, to programmer, to analyst, to DP manager, to VP for MIS in just a few short years.

To Joe, the most important and difficult thing for an MIS professional is to separate the future from reality. You have to get the job done now, and at the same time, dodge obsolescence. That's why Joe went with DEC in the first place:

"By going with DEC three or four years ago we made the right choice. Later we were able to cluster, and clustering enabled us to grow."

"As DEC grew, we grew."

And grow they did. Joe now runs an operation encompassing a crew of 40 specialists, including programmers, analysts, microfilm operators, and mail and telemarketing pros. The hardware at TSO Financial, a direct marketer of financial services to individuals, consists of a room full of VAXs, including a new VAX 8500 — the 12th such installation in the country.

"I want articles that deal with performance issues."

Joe's management philosophy is to encourage professional growth by clearing the way for people to work on things that excite them, using equipment that allows that to happen. "MIS people like to work with state of the art hardware and software. Here, they get a chance to do that." And, despite enormous boardroom responsibilities, Joe, too, is still seen at his terminal writing programs at each opportunity.

In a computing magazine, Joe wants articles that present the facts and treat the reader with respect. "I'll form my own conclusions," he says. "I want articles written by users, not glossy overviews."

That's why Joe's a DEC PRO reader. For articles that inform and inspire. Articles that communicate.

What does Joe Doyle have to say about DEC PRO? "I like its independence. I trust its authors."

Clear, straightforward, honest. That's Joe Doyle.

That's DEC PRO.

DEC PROFESSIONAL

OPTICAL DISKS

OPTICAL ALLUSIONS

By Dave Mallery

The *LaserSystem* Optical Storage For VAX/VMS.

Consider a single removable spindle drive that can store approximately a gigabyte of data. Data is stored using a semiconductor laser to burn pits into a metallic coating on the media. These holes cause light/dark transitions in the light reflected back by the surface during a read operation. The read is accomplished with the same laser running at reduced power.

The major difference between this spindle and your old familiar magnetic one is that the writing is *permanent*. Some vendors maintain that the only viable emulation is tape. Others, including Perceptics Corporation of Knoxville, Tennessee, manufacturers and distributers of *Laser System*, have taken up the challenge of overcoming the formidable obstacles that the write-only format presents to the VMS file system.

The Perceptics *LaserSystem* includes an optical disk drive, a Q-bus or UNIBUS adapter, a *LaserWare* end user software license (*LaserWare* is the software component of *LaserSystem*), a set of cables and rack-mount slides, and a complete documentation package.

The problem with optical disk storage is this: Every time you change something, you have to rewrite it elsewhere on the disk and then find it. What about INDEXF.SYS? What about directories? That gigabyte will be consumed in nothing flat unless you're careful. Considering the price of media, writes are truly expensive. Imagine creating and extending a large file and then loading it in a subsequent pass. This results in two large files.

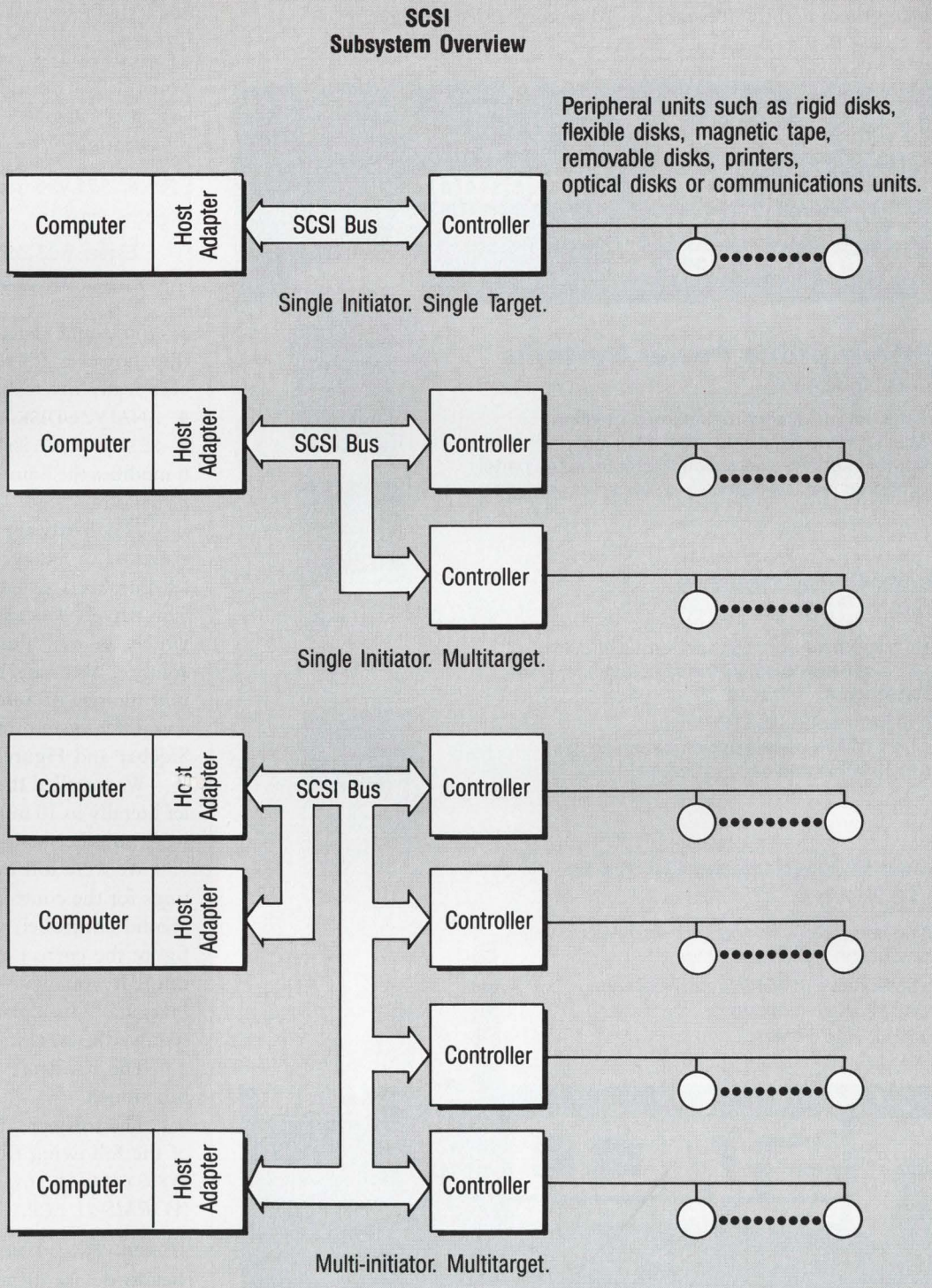
This medium does lend itself to archival applications. If you've seen the "juke boxes" at DEXPO, you've seen a robot in a box, selecting, flipping (yes, two-sided media) and inserting cartridges into one or more drives mounted within the box. If you have the need for hundreds of gigabytes of static data available in seconds, then this was made for you. The medium also lends itself to backup because of its size and 10-year data life, but the media is too expensive for any other than the most critical applications.

Perceptics has addressed the problems of the FILES-11 on-disk structure. The ODS-2 volume allocation bitmap and the file headers assume that they can be modified readily as files are added to the disk. Its *WORMS-11* (what a name!) format partitions the physical disk into two parts. The first is for the on-disk structures: home block, file headers, etc. The rest (99 percent) is available for data. The actual size of the first partition is determined by the /MAXIMUM_FILES parameter specified at initialization.

The major modification made by *WORMS-11* is additional structures that keep track of the current file headers. Directories are cached using a file on a magnetic volume. They're modified here and only written to optical media when flushed by a least recently used (LRU) algorithm or at dismount. There's no way to recover cached data after a crash. However, directories can be recovered after a crash using the ODRECOVER utility.

File information also is buffered on the disk file. The actual file size is optional, but

FIGURE 1.



Courtesy Emulex Corporation, Costa Mesa, California.

a thousand or so blocks seems to be the recommended size.

WORMS-11 is implemented by a pseudo-device driver and an ancillary control processor (ACP) that intercept the $QIOs from RMS and either emulates them or remaps them to the comparable structures on the optical media. No modifications to VMS are necessary. The standard VMS device driver is used. There are a few restrictions:

1. You can't reinitialize a pack.
2. If you rename a file, only the directory entry changes.

LaserSystem
Perceptics Corporation
Pellissippi Center
P.O. Box 22991
Knoxville, Tennessee 37933-0991
(615) 966-9200

Hardware Environment: Available for DEC, VAX and MICROVAX family, running VMS. UNIBUS and Q-bus compatibility.

Price: $21,950 for the UNIBUS or Q-bus version.

Enter 803 on reader card

3. You could delete a directory with files, however, it's recoverable (nothing ever really deletes!).
4. ANALYZE/DISK, doesn't!
5. SET VOLUME isn't any good because it modifies the home block (cf reinitialize restriction).

The hardware we received consisted of an LMS LaserDrive 1200 and an Emulex UC14 UNIBUS controller. The drive's a beauty. It's constructed largely of cast aluminum and exudes solidity. It's a rack mount (or tabletop) unit the size of a BA23 and has a small computer system interface (SCSI). (See Sidebar and Figure 1).

We installed the drive and controller literally in 10 minutes. Because there were no other MSCP controllers on our 750, we were able to use the default settings for the controller. If this were the second controller, you'd have to configure the correct CSR (trivial dip setting). If you were installing this in a "virginal" backplane, you'd have to remove the NPG jumper for the UC14.

The hardware came right up and functioned.

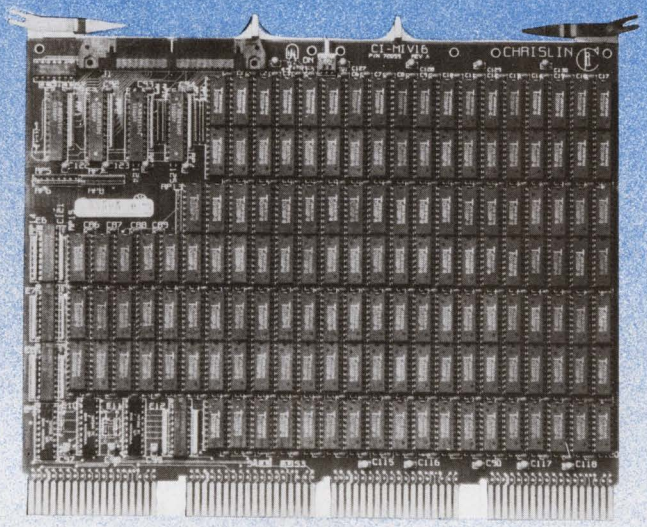
The software distribution consists of the following files:

SYS$SYSTEM:W11AACP.EXE — The *WORMS-11* ACP.

SYS$SYSTEM:ODDRIVER.EXE — Pseudo-device driver image.

SYS$SYSTEM:ODCONFIG.EXE — Optical disk configuration utility.

4MB VAX 780/785
16MB MICROVAX II
SINGLE BOARD MEMORIES



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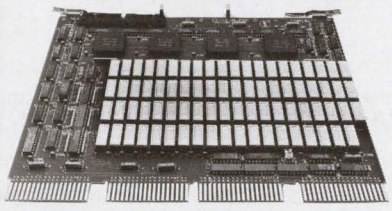
CI-1220-TF: 2MB dual 8" floppy.

SYSTEMS

QBUS

CI-MICRO-11: LSI-11/23 or 11/73 CPU, 256KB-4MB memory, 20MB-150MB winchester, 5¼" or 8" dual floppy, or cart. tape, serial ports, 4 x 8 backplane, power supply all in a rack/table-top chassis.

CI-550



CI-MIV8-EDC

MEMORY

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CI-V53: 1 megabyte error correcting for VAX 725/730/750.

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CI-MIV8-EDC: 8 megabyte with error detection and correction w/CSR.

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EUROPEAN REPRESENTATIVES: W. Germany—Dema Computertechnik (089) 272 32 40; Switzerland—DAP (01) 948 0580

SYS$SYSTEMODRECOVER.EXE — File recovery utility.

[LASERWARE...]*.* — ODRECOVER sources.

SYS$MANAGER:LASERWARE$STARTUP.COM — *LaserWare* startup command file.

Configure your system for the drive by modifying your STARTUP.COM. In our case, that consisted of telling the ACP where to locate its caching file. We chose one of our big Eagles. You must define a directory there to receive the cache file as well. This modification also makes the logical connection between the physical drive (in our case, DUA0:) and the logical drive (ODA0:) known to the ACP.

For the initial test, I copied an 18-MB file (36,092 blocks) from one of my high-speed Eagles (2.4 MB/second) onto the 750. The best data rate I could measure was 86 KB/second on an elapsed time of 3:30. The disk space used on the optical drive was exactly 36,092. No doubt the rate would be slightly higher on an empty system. I was a little disappointed by the spec sheet's optimistic 2-MB/second maximum burst transfer rate.

The brochure for the product gives an example of a FORTRAN-read benchmark that achieves approximately 150 KB/second. That's a lot more like reality and it was good of Perceptics to print the benchmarks on the same document.

Copying back from the optical to the magnetic yielded a little better data rate: 100 KB/second. This is probably because it wasn't necessary to use the intermediate disk caching. The WORM (Write Once, Read Mostly) optical disk is a fascinating study in trade-off and price sensitivity.

A single spindle with controller lists for $21,950. With careful shopping, you can get almost a gigabyte of non-removable magnetics for the same price today.

The real multiplier comes into effect when you're using one or more drives in a juke box accessing dozens of packs.

There's another problem: speed. The devices run at approximately one-half to one-third of the speed of an RA81. In most DP applications, magnetics are worth the extra dollars. The rated access time is about 150 ms versus the 30 ms or so for an RA, or the 17 ms for an Eagle.

The best application seems to be in gigantic volume, low-speed, random-access data files that don't change. Another might be for very large sequential data files that are passed in the traditional (tape) manner. A juke box makes a wonderful automated "tape" library.

There's another cost option on the horizon. Five-inch, form-factor drives now are appearing. These drives, while holding less data (600 MB), are much cheaper. This shifts the advantage away from magnetics for smaller (two to three gigabyte) applications. If media costs scale down as much as drive costs, many more applications become possible. ■

SCSI

The small computer system interface (SCSI) is a non-DEC bus that's used often in personal computers, and now is appearing more in the DEC world via adapters like the UC14 from Emulex Corporation of Costa Mesa, California, and the Liberty from Trimarchi and Associates of State College, Pennsylvania. The ANSI standard SCSI interface is a high-speed, eight-bit bus structure that allows up to eight host adapters and/or intelligent peripheral controllers to be interconnected.

Typically, you find a mix of disk controllers and small tape streamers. The SCSI bus uses a device-independent protocol that largely masks the data structure of the actual peripheral. This simplifies the transition to MSCP that the host adapter must make.

The SCSI bus is capable of decent data transfer rates, at least rates far in excess of those found with personal computers.

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VAX

INSTALLED SHAREABLE IMAGES

By Jim Hobbs

This Software Method Uses A Shareable Library Of Subroutines And Is Executed Through The LINK Or INSTALL Command.

Installed images provide several advantages to everyone on the system — user, programmer and system manager. Advantages to the user are faster image activations and a possible decrease in response times. For the programmer it means less compiling and relinking due to changes in shared subroutines or functions, and less time searching for all programs that use a modified routine. For the system manager, installed images provide a better use of memory. When using shared images, less memory is required for users of shared libraries as well as less paging I/O (or even swapping in severe cases). In addition, the data processing manager's budget gets the benefit of reduction in the physical size (on disk) of the executable image. Because the routines now are located in the shareable library, the amount of disk required is much less in each executable.

An added function, used only on complete image installations, is the addition of privileges to that image. This allows users who don't have a default privilege to have that privilege for the duration of the program. As soon as the image exits, so does the privilege.

There are several ways to use installed images, from the very simplistic to the somewhat difficult. Of course, the more difficult it becomes, the more advantageous shareable images become. In this article I'll discuss the installation of an entire image; individual routines; several routines combined as one; and the ultimate, several routines combined as one shareable library with transfer vectors.

INSTALL

These advantages are possible because of the INSTALL utility. Under Version 4, INSTALL has been changed slightly in the way it is invoked. The suggested way to invoke INSTALL is to define a symbol such as:

```
INSTALL :== $INSTALL/COMMAND_LINE
```

Use of INSTALL requires the use of the special privilege CMKRNL. Authorized access into the [SYSTEM] accounts is also useful.

The following is a list and short description of INSTALL command qualifiers used in the creation of a shared image:

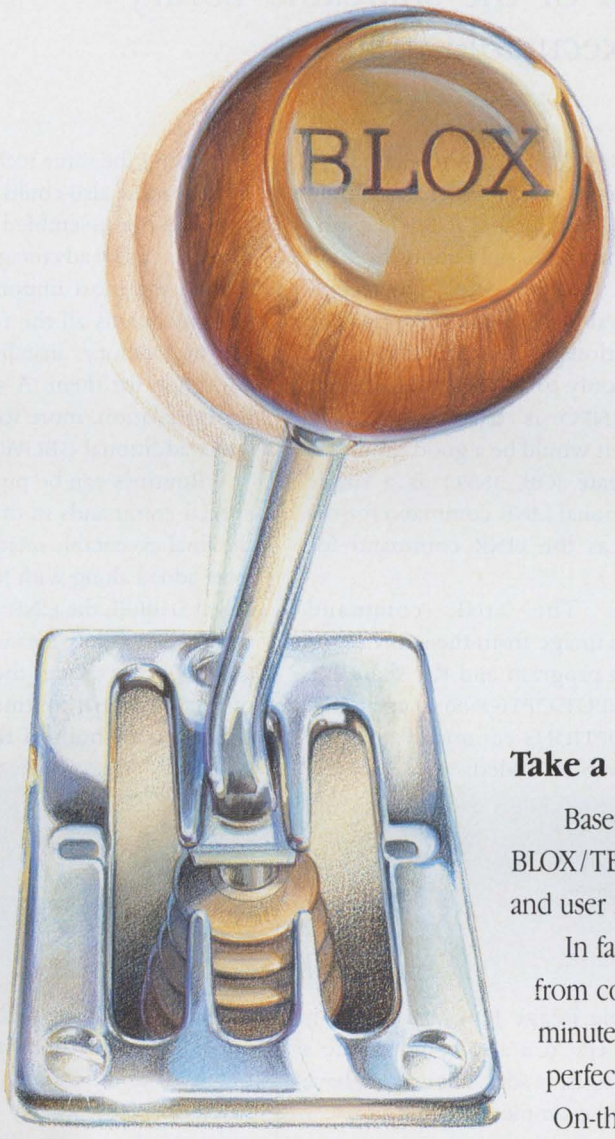
```
INSTALL           - to invoke the INSTALL utility
CREATE            - installs file as known image
/OPEN             - installs image permanently open
/HEADER_RESIDENT - installs image header record permanently in memory

/SHARE            - installs as a shared image with global sections
/PRIVILEGE=(priv,...) - installs an executable image with
```

The simplest type of installed image is one where the entire executable is made shareable. This doesn't require any special coding, or compile or LINK commands. After an executable has been created, invoking the INSTALL command will make that image shareable:

```
$ BASIC MAIN_PGM
$ BASIC JOB_INFO      ! collect process information (GETJPI)
$ LINK MAIN_PGM,JOB_INFO
$ COPY MAIN_PGM.EXE EXE:*.*
$! SET PROT= if required
$ INSTALL CREATE EXE:MAIN_PGM/OPEN/HEAD/SHARE
$! with the WORLD privilege collect info on another process
$ INSTALL CREATE EXE:MAIN_PGM/OPEN/HEAD/SHARE/PRIV=WORLD
```

HIGH PERFORMANCE DRIVING



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Routines can be put together into a library without any special commands in the creation of the shareable library or the final executable image.

This allows multiple users of MAIN_PGM to share only one copy of the program in memory. Each user has his own data space and shares the code space. The first INSTALL command will allow a user to get information only about his own process (unless he already has WORLD privilege). The second INSTALL command of the executable with WORLD privilege will allow it to collect information on any process on the system. Privileges can be added only to an executable image.

If the subroutine JOB_INFO is used extensively throughout numerous programs, it would be a good candidate for an installed routine. To create JOB_INFO as a single installed routine requires an additional LINK command for the JOB_INFO object file, as well as the LINK command for MAIN_PGM.

Here's the progression: The LINK command (LINK/SHARE) creates a shareable image from the subroutine. Then it is used to link the main program and the shareable image (LINK MAIN_PGM,SYS$INPUT:/OPTIONS) to create the executable image. Use of the /OPTIONS command qualifier allows special linker commands to be added:

```
$ LINK/SHARE JOB_INFO
$ COPY JOB_INFO.EXE SYS$SHARE:*.*
$!  SET PROT= if required
$ INSTALL CREATE JOB_INFO/OPEN/HEAD/SHARE
$!
$ LINK MAIN_PGM,SYS$INPUT:/OPTIONS
JOB_INFO/SHARE
^Z
$
```

The single routine shareable image JOB_INFO.EXE is placed in SYS$SHARE and installed. You also could define a logical to represent the shareable routine so that it doesn't have to be put into SYS$SHARE; for example:

```
ASSIGN _DUA0:[HOBBS]JOB_INFO JOB_INFO.
```

The /OPTIONS qualifier allows JOB_INFO to be linked with MAIN_PGM and specifies it as a shareable image.

Once an executable is linked against any shareable image, that image *must* be installed or the executable will not be able to be run. One disadvantage to linking the shareable image directly to the main program is that if the JOB_INFO routine is changed, the new shareable image must be relinked with all the executables that had been linked with its predecessor.

Using the same technique used to create JOB_INFO, any other routine also could be installed. Routines can be installed separately or assembled into a library of several subroutines. There are a few advantages to putting several routines into one library, the most important being simplicity for the person who maintains all the routines. Another advantage is better use of memory; installed images require some permanent allocation for them. A small amount of memory is required for installation, more for header residence. This may require some additional GBLPAGES to be set aside at system startup.

Routines can be put together into a library without any special commands in the creation of the shareable library or the final executable image. If another routine called LOGICAL were added along with JOB_INFO to create a shareable library called SHRLIB, the LINK command would be modified slightly from when it only created a single shareable routine. Note that the LINK that creates the executable uses the SHRLIB in place of the individual routine names. The main program may use either one or both of the routines within SHRLIB:

```
$ BASIC JOB_INFO
$ BASIC LOGICAL
$!
$ LINK/SHARE/EXE=SHRLIB SYS$INPUT:/OPTIONS
JOB_INFO
LOGICAL
^Z
$ COPY SHRLIB.EXE SYS$SHARE:*.*
$ INSTALL CREATE SHRLIB/OPEN/HEAD/SHARE
$!
$ LINK MAIN_PGM,SYS$INPUT:/OPTIONS
SHRLIB/SHARE
^Z
$
```

This makes the final linking of routines simpler, but, as before, it doesn't allow for changes in routines or additions to the shareable library without requiring the main program to be relinked again. To get around these problems, the use of transfer vectors is required. Simply, transfer vectors are entry points that jump to the start of the routine as opposed to the main program using absolute addresses. This allows routines to shrink or expand and still be addressable correctly; i.e., to allow for changes in shareable image routines.

The use of transfer vectors requires a small amount of

MACRO coding, which will provide the definition and resolution of routine addresses.

```
.title vector
.psect xfr_vector,pic,exe,nowrt,shr,gbl

.transfer  job_info
.mask      job_info
jmp        l^job_info+2

.transfer  logical
.mask      logical
jmp        l^logical+2

.end
```

This macro combined with the LINK command to create a multiple routine shareable image allows the best of all worlds. It allows for multiple routines for simplicity, routines can be changed without relinking with the main program and, if need be, up to 10 new routines can be added without any effect on the existing shareable library and the programs linked with it:

```
$  LINK/SHAREABLE/EXE=SHRLIB.EXE/MAP=SHRLIB.MAP SYS$INPUT:/OPTIONS
!
!  options
!
!  clusters
cluster = xfr_vector,,,xfrvector
collect = xfr_data, $local
collect = xfr_address, $addrs
collect = xfr_share, $code, $pdata, $icode
!
!  input files (objects)
!
job_info
logical
!
!  universal symbols
!
universal = job_info, logical
!
!  match conditions
!
gsmatch = lequal,1,0
!
^Z
```

In the above linker command, the options of COLLECT and CLUSTER allow the linker to create the shareable library in the specified order, transfer vectors then the subroutines. The UNIVERSAL option declares the specified symbol as global to ensure that it can be referred to by other objects. GSMATCH controls an identifier to major and minor versions of a shareable library, a type of level check to make sure that the main program and shareable library are both able to function together.

However, if any COMMONS are involved, it becomes more complex, depending on whether the common values are meant to be kept separately or to be shared as well. If the first choice, keeping the values within only one process, is desired, the use of another linker's /OPTION qualifier is required on both the creation of the shareable library and the final linking of the main program with the library. If you choose to share the common values, no additional commands are required, but this implies that any variable in the COMMON (JOB_INFO_COM) that is modified by any program linked to it, will change the same variable to the same value in all other programs linked to it.

The addition of the PSECT_ATTR can be added to any of the creations of shareable images or libraries.

PROGRAM 1.

```
$! MACRO PROGRAM TO DEFINE ROUTINES
$
$ CREATE VECTOR.MAR
.title vector
.psect xfr_vector,pic,exe,nowrt,shr,gbl

.transfer   job_info
.mask       job_info
jmp         l^job_info+2

.transfer   logical
.mask       logical
jmp         l^logical+2

; save space for future entries (8 bytes per entry)
.blkb 8*10        ;space for 10 entries
.end
^Z
$
$ MACRO VECTOR
$
$
$ LINK/SHAREABLE/EXE=SHRLIB.EXE/MAP=SHRLIB.MAP SYS$INPUT:/OPTIONS
!
!  option specifications
!
!  clusters
cluster = xfr_vector,,,xfrvector
collect = xfr_data, $local
collect = xfr_address, $addrs
collect = xfr_share, $code, $pdata, $icode
!
!  input files (objects)
!
job_info
logical
date_convert
!
!  universal symbols
!
universal = job_info, logical, date_convert
!
!  change psect for commons, do NOT share common areas
!
!  subroutine - common name
!
!  job_info - job_info_com
!  logical - logical_com
!
!
psect_attr = job_info_com,noshr
psect_attr = logical_com,noshr
!
!  match conditions
!
gsmatch = lequal,1,0
!
^Z
$ COPY SHRLIB.EXE SYS$SHARE:*.*
$!  change protection if necessary
$ INSTALL CREATE SHRLIB/OPEN/HEAD/SHARE/WRITE
$
$ LINK MAIN_PGM,SYS$INPUT/OPTIONS
sys$share:shrlib/share
!
psect_attr = job_info_com,noshr
psect_attr = logical_com,noshr
!
^Z
```

To maintain a separate COMMON(JOB_INFO_COM) data area between multiple programs, but allow each main program and the one subroutine to use it successfully, enter the following:

```
$ BASIC MAIN_PGM
$ BASIC JOB_INFO
$ LINK/SHARE JOB_INFO SYS$INPUT/OPTIONS
PSECT_ATTR=JOB_INFO_COM,NOSHR
^Z
$ ASSIGN SYS$SYSDEVICE:[HOBBS]JOB_INFO JOB_INFO
$ INSTALL CREATE JOB_INFO/OPEN/HEAD/SHARE/WRITE
$ LINK MAIN_PGM,SYS$INPUT/OPTIONS
JOB_INFO/SHARE
PSECT_ATTR=JOB_INFO_COM,NOSHR
^Z
$
```

You may have noticed that there are only a few additional lines required to accomplish the separate commons versus the shared commons. The additional line of:

```
PSECT_ATTR=JOB_INFO_COM,NOSHR
```

makes sure that the commons of that name have their own copies and that the data within them are not shared between images. This linker option command must be included on both the creation of the installed image as well as the final main program.

You also may have noticed an additional qualifier on the INSTALL command line /WRITE. This is required when a COMMON exists within the subroutine because it allows programs to change (write) global variables.

The addition of the PSECT_ATTR can be added to any of the creations of shareable images or libraries.

The creation of a shareable library that contains several routines, some of which use a common declaration that must not be shared, while allowing the expansion of up to 10 new routines to the library and changes to existing routines, comes together with the commands in Program 1.

Here the main program could use just one or all of the subroutines available in SHRLIB. Each user (process) will have his own version of the COMMON(s) and will *not* interchange values between users.

Although I describe the use of shareable images and libraries in terms of BASIC, any language can be used to create routines. References to have handy when attempting to do installed images are the INSTALL and LINK utility manuals and the users guide for the language you are using.

Jim Hobbs is a systems programmer for a major VAX installation in Golden, Colorado.

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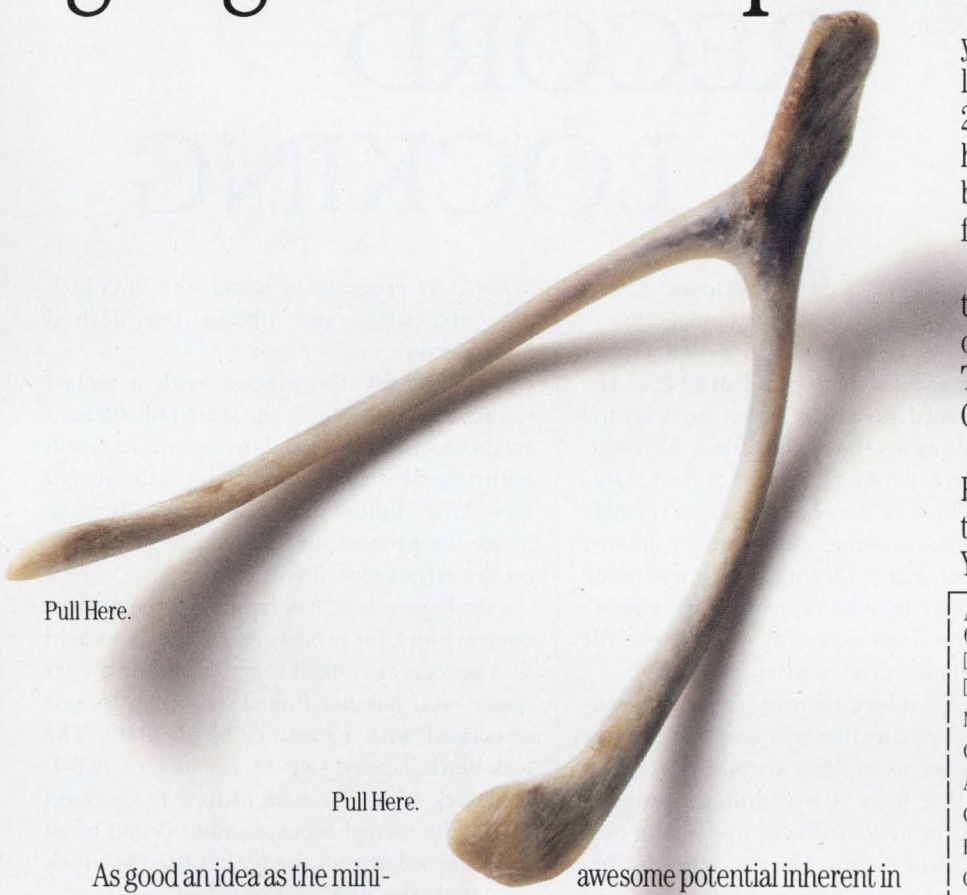

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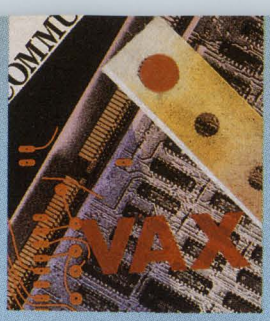

VAX

THE KEY TO RECORD LOCKING

By Bill Wine

Removing The Handcuffs From Shared File Access Systems.

At Jamestown Community College we're running VMS version 4.4 on a VAX cluster consisting of two 11/780s and an HSC50. The student record system is based on a central indexed file called the history file, which contains one record for each current or former student. The history file contains approximately 40,000 records keyed to social security number and student name. During peak registration periods, there may be as many as 30 interactive on-line users accessing the history file through applications written in COBOL.

The record locking problem must be addressed in systems like this one that provide shared file access to many users. Let's say, for example, that User A is running a program that opens the history file for update and then reads a student record. User B, who also has update access to the history file, tries to read the same student record but fails. The RMS file status code *92* is returned indicating record lock. In a COBOL program, you can hibernate for several seconds, then attempt again to read the record. User B will succeed in accessing the record only after it's unlocked by User A. User A can unlock the record by rewriting it or by reading a different record in the file. If User A fails to unlock the record, however, none of the other users with update access will be able to read it.

A quick and easy way to identify the user who locks a needed record would be useful. There's no DCL command or system service to provide this information, so I wrote a MACRO-32 program to search the VMS lock data structures and obtain the desired information.

To identify the process with a locked record, start by opening the shared file for read access only, and then read the record. RMS will return the file status *90*, indicating a soft record lock. Then, follow the VMS data structures to locate the process that placed the prior lock on the target record (see Figure 1).

In Figure 1, PCB-A represents the process control block for process A. All the locks held by a process are linked together on the owner queue — a circular linked list. Each lock is associated with a resource block (RSB). The lock block, labeled LKB-A1, is a lock on RSB-1. It's a lock at the file level. LKB-A2 is a lock on RSB-2, the virtual block number (VBN) of an index record within the file. LKB-A3 is a lock on RSB-3, the VBN of the record itself.

The lock mode of these three locks is NL or null, a nonrestrictive lock mode. LKB-A4 is a protected write (PW) lock on the target record. If process B had attempted update access to the target record, it would have failed — a protected write lock excludes other updaters from access. Process B in this example, however, is attempting read access only.

Note also, that all locks associated with a given resource are linked together on a state queue. This solution works because it creates the lock LKB-B3 on the same state queue as the

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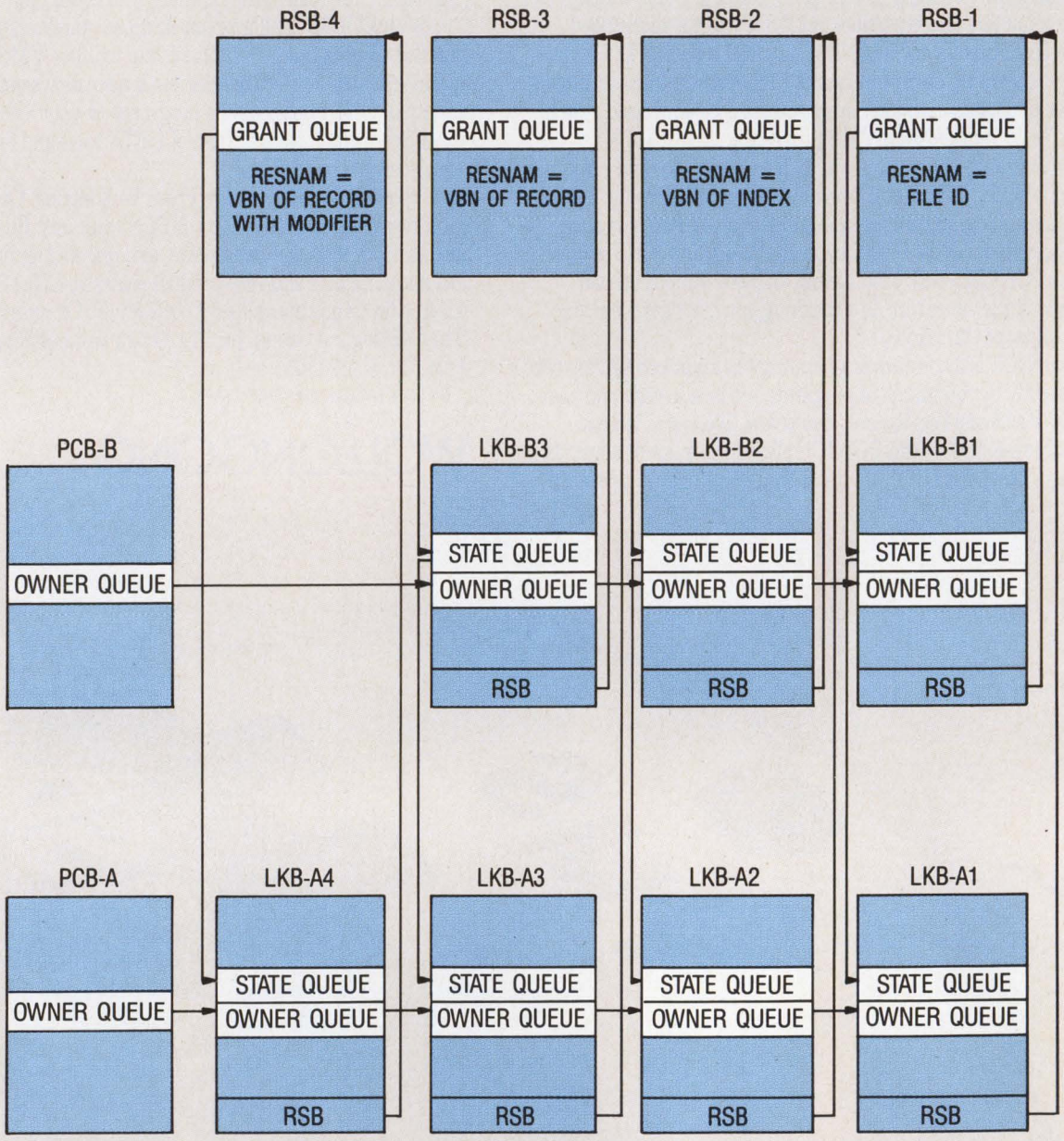
FIGURE 1.


RSB-4
RSB-3
RSB-2
RSB-1
GRANT QUEUE
RESNAM = VBN OF RECORD WITH MODIFIER
GRANT QUEUE
RESNAM = VBN OF RECORD
GRANT QUEUE
RESNAM = VBN OF INDEX
GRANT QUEUE
RESNAM = FILE ID
PCB-B
OWNER QUEUE
LKB-B3
LKB-B2
LKB-B1
STATE QUEUE
OWNER QUEUE
RSB
PCB-A
OWNER QUEUE
LKB-A4
LKB-A3
LKB-A2
LKB-A1
STATE QUEUE
OWNER QUEUE
RSB

The command file FINDLOCK.COM prompts for the file name, opens the file for shared read access, prompts for the record key and reads the record.

FIGURE 2.

```
Status    Remlkid     CSID        PID        Process    Image
Local                             20205A17   FINDER
Local                             20204E78   BILL       (TEST]HISTLOCK.EXE;1
Locked by process BILL running    [TEST]HISTLOCK.EXE;1 on this node
```

Figure 2a.

```
Status    Remlkid     CSID        PID        Process    Image
Local                             2020302E   FINDER
Master    45C60139    00010002    20200100   NULL
Locked on node VAX3; run program on that node
```

Figure 2b.

```
Status    Remlkid     CSID        PID        Process    Image
Copy      67DB07CD    00010001    20405463   FINDER
Copy      249607E4    00010001    20405C5F   BILL       [TEST]HISTLOCK.EXE;1
Locked by process BILL running [TEST]HISTLOCK.EXE;1 on this node
```

Figure 2c.

PROGRAM 1.

```
$ SET PROCESS/NAME=FINDER
$ INQUIRE FILENAME "Enter file name"
$ OPEN/READ/SHARE FILE 'FILENAME'
$ INQUIRE KEY "Enter record key"
$ READ/KEY='KEY' FILE REC
$ SPAWN/NOLOG RUN FINDLOCK
$ CLOSE FILE
```

lock LKB-A3. The lock block contains the process identification number (PID) of process A, the first process to lock the target record.

The command file FINDLOCK.COM prompts for the file name, opens the file for shared read access, prompts for the record key and reads the record (see Program 1). Then, a subprocess is spawned to run the program that searches the VMS data structures for the desired information. Useful data on each lock is displayed and a conclusion is printed at the end of the search. (See

Program 2 for the main program listing. Sample output appears in Figures 2a, b and c.)

The distributed lock manager in a cluster environment uses one node as the master node. Resource locks created by programs running on the master node are called *local locks*. A lock created by a program running on a node other than the master node results in two locks. One, the *process copy lock*, is on the remote node; the other, the *master lock*, resides on the master node. The process locking the desired record may be running on any node, therefore it's best to start the search on the master node. With practice, you'll know which is the master node.

Figure 2a shows sample output when both the locking process and the seeking process are running on the master node. Note that both locks are local locks. In Figure 2b, the seeking process is on the master node, but the locking process is on a remote node. Note that the second lock is a master lock. In this case, we can access the remote node with the DCL command SET HOST VAX3 and proceed to log-in and execute the command procedure. The output when both processes are on the same remote node is shown in Figure 2c. Now, both locks are process copy locks and the identity of the locking process is shown.

The CSID in Figures 2a-c is a unique internal identifier for each node in a cluster. In the case of a master lock, the CSID represents the node on which the process copy lock resides. The CSID shown with a process copy lock represents the master node. The subroutine NODENAME in Program 2 (page 89) searches the cluster data structures to find the nodename associated with a CSID.

The process running this program will need the privilege CMEXEC. To compile, enter:

```
$ MACRO
FINDLOCK + SYS$LIBRARY
  :LIB.MLB/LIB.
```

To link, enter:

```
$ LINK FINDLOCK,SYS$
  SYSTEM:SYS.STB.
```

I could have used a COBOL main program and a MACRO subprogram, but a DCL command procedure is more flexible — you can use it with any indexed file.

Bill Wine is a programmer at Jamestown Community College in Jamestown, New York.

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PROGRAM 2.

```
        .TITLE  FINDLOCK
;
;author: Bill Wine
;date:   September, 1986
;
;this program runs in a subprocess and searches the VMS lock data structures
;associated with the owner process

        $PCBDEF                 ;process control block offsets
        $LKBDEF                 ;lock block offsets
        $RSBDEF                 ;resource block offsets
        $JPIDEF                 ;GETJPI item codes
        $DYNDEF                 ;dynamic data structure codes
        $CLUBDEF                ;CLUB offsets
        $CSBDEF                 ;CSB offsets
        $SBDEF                  ;SB offsets

LOCAL:  .ASCII  /Local /                ;lock status literals
MASTER: .ASCII  /Master/
COPY:   .ASCII  /Copy  /
FAODESC:        .LONG   80              ;descriptor for FAO
                .ADDRESS        FAOBUF
FAOBUF: .BLKB   80
                                        ;output line descriptors
HEAD:   .ASCID  "!/Status   Remlkid    CSID!7* PID!8* Process!6* Image!20* "
STR1:   .ASCID  /!9<!AD!>!11<!XL!>!11<!XL!>!11<!XL!>!13<!AD!>!25<!AD!>/
STR2:   .ASCID  /Record is no longer locked/
STR3:   .ASCID  /!80<Not locked on this node; run this program on node !AC!>/
STR4:   .ASCID  /!80<Locked by process !AD running !AD on this node!>/
STR5:   .ASCID  /!80<Locked on node !AC; run program on that node!>/
STR6:   .ASCID  /Serious error - no lock block for owner process/

ITEMS:  .WORD   15                      ;item list for GETJPI
        .WORD   JPI$_PRCNAM             ;item code for process name
        .ADDRESS        PNAME
        .ADDRESS        PNAMES
        .WORD   39
        .WORD   JPI$_IMAGNAME           ;item code for image name
        .ADDRESS        INAME
        .ADDRESS        INAMES
        .LONG   0                       ;end of list
PNAME:  .BLKB   15                      ;process name
PNAMES: .BLKL   1                       ;and size returned
INAME:  .BLKB   39                      ;image name
INAMES: .BLKL   1                       ;and size returned
STATUS: .BLKL   1                       ;address of lock status literal
EPID:   .BLKL   1                       ;extended PID
REMLKID:        .BLKL   1               ;remote lock id
CSID:   .BLKL   1                       ;csid (internal node id)
PROCINDEX:      .BLKL   1               ;process index
PLACE:  .BLKL   1                       ;location of [ in image name
LOCK_TYPE:      .BLKL   1               ;local = 0, master = 1, copy = 2
LOCK_COUNT:     .LONG   0               ;count of locks found
NODENAME_ADDR:  .BLKL   1               ;address of nodename

        .ENTRY  FINDLOCK,^M<R4,R5,R7,R8,R9,R10,R11>     ;entry mask

1$:     $FAO_S  CTRSTR=HEAD,-           ;format the header
                OUTBUF=FAODESC
        PUSHAQ  FAODESC                 ;print the header
        CALLS   #1,G^LIB$PUT_OUTPUT
        $CMEXEC_S       ROUTIN=5$       ;enter executive mode
        RET                             ;return to DCL

5$:     .WORD   0                       ;start of executive mode code
        MOVL    @#SCH$GL_PCBVEC,R10     ;PCB vector, for use later
        MOVL    @#CTL$GL_PCB,R8         ;PCB of this subprocess
        MOVZBL  PCB$L_OWNER(R8),R8      ;process index of owner process
        MOVL    (R10)[R8],R8            ;PCB of owner process
        MOVL    PCB$L_LOCKQFL(R8),R7    ;lock owner queue forward link
        SUBL2   #LKB$L_OWNQFL,R7        ;lock block starting address
10$:    CMPB    #DYN$C_LKB,LKB$B_TYPE(R7)       ;is this a lock block?
        BEQL    15$                     ;yes, branch
        PUSHAQ  STR6                    ;no - serious error
        CALLS   #1,G^LIB$PUT_OUTPUT     ;print error message
        RET                             ;return from exec mode
15$:    MOVZBL  LKB$L_PID(R7),R9        ;process index of lock holder
        MOVL    LKB$L_REMLKID(R7),REMLKID       ;remote lock ID
        MOVL    LKB$L_PARENT(R7),R8     ;parent lock
        MOVL    LKB$L_RSB(R8),R8        ;parent rsb
        MOVL    RSB$L_CSID(R8),CSID     ;parent rsb csid
        BNEQ    17$                     ;process copy, branch
        BBC     #LKB$V_MSTCPY,LKB$W_STATUS(R7),16$
                                        ;if not master lock, branch
        MOVAB   MASTER,STATUS           ;master lock literal
        MOVL    #1,LOCK_TYPE            ;set lock type - master lock
        MOVL    LKB$L_CSID(R7),CSID     ;master lock csid
        BRB     18$                     ;branch
16$:    CLRL    LOCK_TYPE               ;set lock type - local lock
        MOVAB   LOCAL,STATUS            ;local lock literal
        BRB     18$                     ;branch
17$:    MOVAB   COPY,STATUS             ;process copy lock literal
        MOVL    #2,LOCK_TYPE            ;set lock type - process copy
18$:    MOVL    (R10)[R9],R8            ;PCB of lock holder
        MOVL    PCB$L_EPID(R8),EPID     ;EPID of lock holder
        $GETJPIW_S      PIDADR=EPID,-   ;system service call to get
                        ITMLST=ITEMS    ;process name and image name
        BLBS    R0,19$                  ;success, branch
        PUSHL   R0                      ;error
        CALLS   #1,G^LIB$SIGNAL         ;signal error
        RET                             ;return from exec mode
19$:    MOVAB   INAME,R5                ;strip device name from image name
        LOCC    #^A\[\,INAMES,(R5)
        MOVL    R0,INAMES               ;bytes remaining in image name
        MOVL    R1,PLACE                ;location of [ in image name
        $FAO_S  CTRSTR=STR1,-           ;format an output line
                OUTBUF=FAODESC,-        ;showing
                P1=#6,-                 ;lock type
                P2=STATUS,-
                P3=REMLKID,-            ;remote lock id
                P4=CSID,-               ;csid
                P5=EPID,-               ;extended pid
                P6=PNAMES,-             ;process name
                P7=#PNAME,-
                P8=INAMES,-             ;and image name
                P9=PLACE
        BLBS    R0,20$                  ;success, branch
        PUSHL   R0                      ;error
        CALLS   #1,G^LIB$SIGNAL         ;signal error
        RET                             ;return from exec mode
20$:    TSTL    LOCK_TYPE               ;local lock?
        BNEQ    25$                     ;no, branch
        MOVAB   FAOBUF,R4               ;set up to
        MOVAB   FAOBUF,R5               ;blank out fields
        MOVC5   #0,(R4),#^A\ \,#19,9(R5);local lock - blank out remote lock
                                        ;id and csid of output line
25$:    PUSHAQ  FAODESC                 ;output line on sys$output
        CALLS   #1,G^LIB$PUT_OUTPUT
        TSTL    LOCK_COUNT              ;test lock count
        BNEQ    26$                     ;if not first lock, branch
        BRW     50$                     ;first lock, branch
26$:    CMPL    #1,LOCK_TYPE            ;is this a master lock?
        BEQL    40$                     ;yes, branch
        $FAO_S  CTRSTR=STR4,-           ;format an output line for local
                OUTBUF=FAODESC,-        ;or process copy lock
                P1=PNAMES,-             ;showing process name
                P2=#PNAME,-
                P3=INAMES,-             ;and image name of locking process
                P4=PLACE
        BLBS    R0,30$                  ;success, branch
        PUSHL   R0                      ;error
        CALLS   #1,G^LIB$SIGNAL         ;signal error
        RET                             ;return from exec mode
30$:    PUSHAQ  FAODESC                 ;print str4
        BRB     45$                     ;branch
40$:    BSBW    NODENAME                ;get nodename
        $FAO_S  CTRSTR=STR5,-           ;format an output line
                OUTBUF=FAODESC,-        ;for master lock, showing nodename
                P1=NODENAME_ADDR        ;on which locking process is running
        BLBS    R0,44$                  ;success, branch
        PUSHL   R0                      ;error
        CALLS   #1,G^LIB$SIGNAL         ;signal error
        RET                             ;return from exec mode
44$:    PUSHAQ  FAODESC                 ;print str5
45$:    CALLS   #1,G^LIB$PUT_OUTPUT
50$:    INCL    LOCK_COUNT              ;increment lock count
        MOVL    LKB$L_SQFL(R7),R7       ;state queue forward link
        SUBL2   #LKB$L_SQFL,R7          ;address of lock block
        CMPB    #DYN$C_LKB,LKB$B_TYPE(R7)       ;is this a lock block?
        BNEQ    51$                     ;no, branch
        BRW     15$                     ;yes, branch to loop
51$:    DECL    LOCK_COUNT              ;decrement lock_count
        BNEQ    60$                     ;if > 1 lock was found, branch
        TSTL    CSID                    ;process copy lock?
        BNEQ    52$                     ;yes, branch
        PUSHAQ  STR2                    ;record no longer locked
        BRB     55$                     ;branch
52$:    BSBB    NODENAME                ;get nodename
        $FAO_S  CTRSTR=STR3,-           ;format an output line
                OUTBUF=FAODESC,-        ;for process copy lock, showing
                P1=NODENAME_ADDR        ;nodename of master copy
        BLBS    R0,54$                  ;success, branch
        PUSHL   R0                      ;error
        CALLS   #1,G^LIB$SIGNAL         ;signal error
        RET                             ;return from exec mode
54$:    PUSHAQ  FAODESC                 ;print message when only 1 lock
55$:    CALLS   #1,G^LIB$PUT_OUTPUT     ;has been found
60$:    RET                             ;return from exec mode

NODENAME:                               ;subroutine to get nodename
        MOVL    @#CLU$GL_CLUB,R11       ;first cluster block
        MOVL    CLUB$L_CSBQFL(R11),R11  ;first CSB
1$:     CMPL    CSID,CSB$L_CSID(R11)    ;is this the CSB for node we want
        BEQL    2$                      ;yes, branch
        MOVL    CSB$L_SYSQFL(R11),R11   ;no, get next CSB
        BRB     1$                      ;branch to loop
2$:     MOVL    CSB$L_SB(R11),R11       ;get SB
        MOVAB   SB$T_NODENAME(R11),NODENAME_ADDR        ;nodename
        RSB

        .END    FINDLOCK                ;end of program
```

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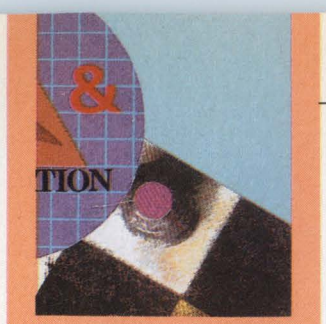

DBMS

DSRI

By Philip A. Naecker

Digital's Standard Relational Interface Is More Than Just An Interface — It's An Architecture.

When Digital introduced its first relational database several years ago, the company also introduced something called the Digital Standard Relational Interface (*DSRI*). Little has been written about it, but *DSRI* is the keystone in DEC's entire database strategy. Understanding *DSRI* is crucial if you want to understand Digital's plans for database software and hardware. In future issues, *DEC PROFESSIONAL* will review a number of *DSRI*-compliant products. If you are interested in relational databases but aren't familiar with DEC's relational database approach, this introduction to *DSRI* will be useful.

The Digital Standard Relational Interface is more than just an interface; it's also an architecture. It defines the calling mechanism, argument values, and call syntax to be used with all of Digital's relational database products. Although used internally for several years, the document that defines the architecture wasn't made public until last year. *DSRI* is a product you can purchase, but consists only of manuals because everything needed to use *DSRI* is shipped with the database products. More than just manuals and a DEC standard, though, *DSRI* forms the heart of all Digital's relational database products, and even may become a defacto industry standard and working interface to a host of non-Digital products. It seems certain that if and when Digital introduces a database machine, that machine will use *DSRI* as the software interface. In the future, we even may see *DSRI*-compliant access to RMS files and to non-relational databases.

The first question is "Why a standard at all?" It's true that there are many non-*DSRI* database systems in the market today, many of them very successful. Have these databases suffered for the lack of a standard? The answer probably is "Not yet, but eventually they will," and for a number of very good reasons.

A Few Definitions

First, a few definitions are in order. Relational databases are actually very simple animals. Briefly, here are the components of a relational database:

1. *Fields* are simply the definition of places to store data. They may be of any data type, including integer numbers, real numbers, dates and various kinds of strings.
2. Fields are grouped together into *relations*. Relations correspond to records in a file system. A relation always has the same fields, in the same order, for every instance of that relation. There are no variable-length relations or OCCURS clauses in a relational database system.
3. There is a special kind of relation, called a *system relation*, that contains information describing the data in the database. For example, one system relation may contain records that describe every field in the database. Another system relation may contain records that describe every relation in the database, and another may describe every index or key in the database. In this way, a relational database is said to be a self-describing data structure.
4. The information contained in system relations is collectively called *metadata*, or "data about data." It describes the database in such terms as the length and data type of fields, the fields in various records and so on.
5. All of these things (fields, relations, system relations, indexes and more) are grouped together into a single *database*. A database can be

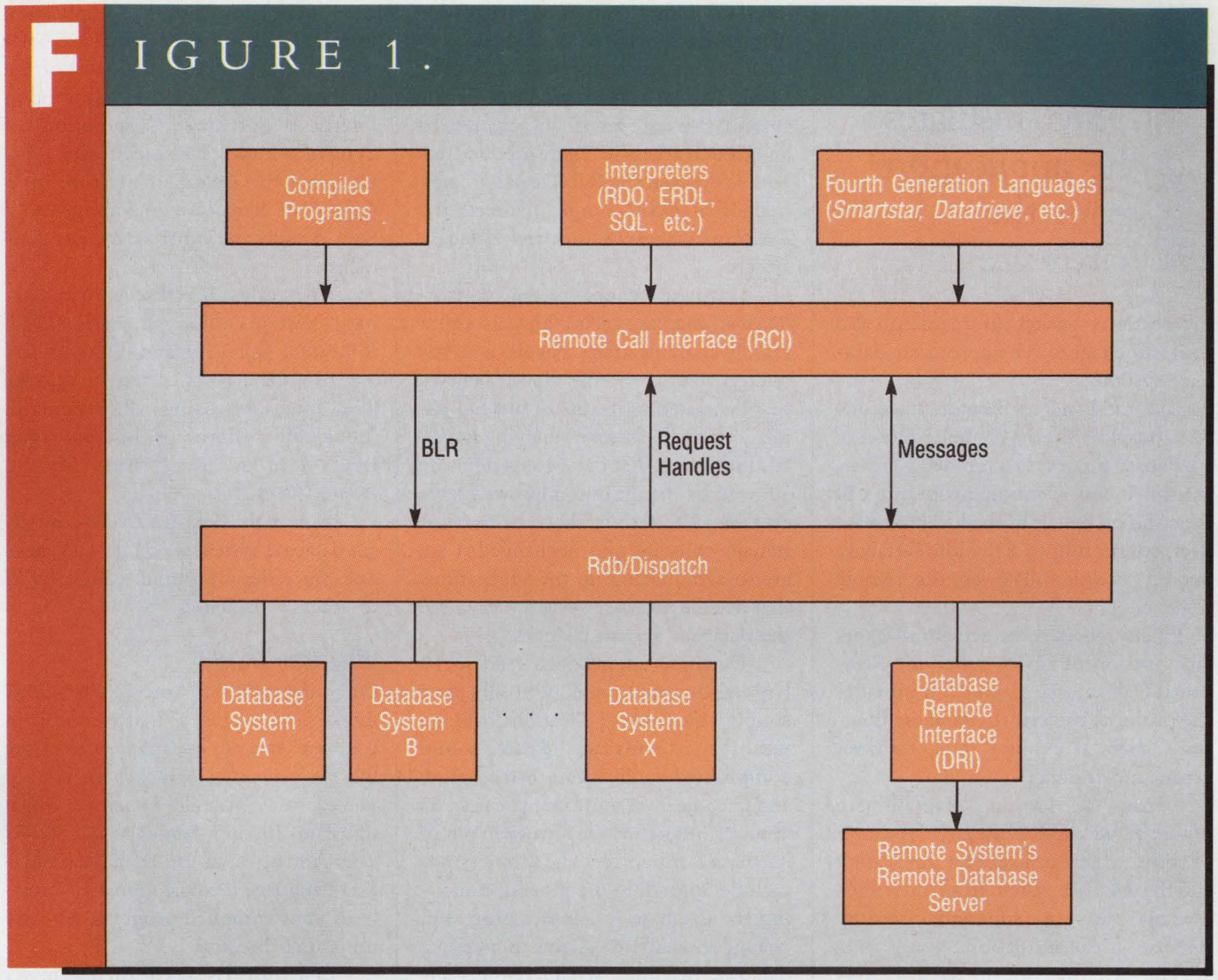

Figure 1. Layering of **DSRI** *architecture.*

treated as a single entity, the contents of which always are guaranteed to be in a consistent state.

The attribute that most differentiates a database from a file system is consistency, which a database guarantees to some degree. A database expends a great deal of resources making sure that the many users can access the same data in many different modes (read, write, etc.), and all users always will be given a consistent view of the database. This will be true even if one user's program fails or the system crashes.

There is an entire branch of science now devoted to databases, especially relational databases. Much of that science deals with defining the rules of relational databases in precise mathematical terms, proving the validity of conditions governing the preservation of consistency and so forth.

What Does It Do?

What does *DRSI* do? The answer is amazingly simple. *DSRI* does nearly nothing — and that's the beauty of it! Besides being a calling standard to be used by all *DSRI*-compliant database products, there is a limited number of functions that the *DSRI* layer of software actually performs:

1. There is a component of *DSRI*, called Rdb/Dispatch, that acts as a message switch, like the switchboard of a telephone system. Rdb/Dispatch verifies that the arguments in the call are valid, packages the call into a com-

DSRI insulates the application from the hardware . . .

munications packet (if required) and routes the call to the appropriate database system.

2. DRI, the Database Remote Interconnect, provides for the communication of a database request to a remote database. It implements a remote procedure call function on behalf of the local database user, connecting to a Remote Database Server module (RDS) on the remote node.

3. Finally, there is the actual call interface portion of *DSRI*, called the Relational Call Interface, or RCI. It provides the protocol to perform database functions such as request data, transmit errors and the like.

From the layering diagram (see Figure 1), we can see that *DSRI* is a layer of software that insulates the application and the database system from each other. The two parts have substantial freedom because of the insulation.

1. The developers of the database system can change anything they want about their software, except the interface. They can (and do) change the on-disk structure of the database, add or remove information from the system relations and add new functionality.

2. The developers of the application can change the database, too. Because Rdb/Dispatch directs database access at the correct database system at runtime, the entire database can move from one *DSRI*-compliant database system to another, from one node to another or even to a database machine — all without any changes to the application code.

3. Products like *Datatrieve, Rally* and *Teamdata* can be written to use the *DSRI* interface, rather than using any particular database system. Thus, when a new database system is introduced (such as VIDA, Digital's VAX IBM Data Access system) there are few, if any, changes to be made to access it. These products access *DSRI*, and the Rdb/Dispatch component of *DSRI* simply redirects the *DSRI* messages to the new database system.

Database technology, especially relational database technology, is still a rapidly evolving arena. No one who has built a database system seriously believes that his system is the be-all and end-all; relational databases are a moving target. It's important that database systems be allowed to change and improve. However, the interface to the systems must remain constant and unchanged if we are to avoid changing the applications that use the database system every time the database system changes.

Database applications tend to be large and complicated; after all, most simple computer applications have no need for a sophisticated database. And complicated applications tend to grow and become even more complicated. As applications grow, they may run out of database horsepower. The solution may include upgrading the processor, moving the database to another processor, changing database systems or adding a database machine. Whatever the solution, as long as both the old and new database systems use *DSRI*, the change will be nearly transparent to the application. *DSRI* insulates the application from the hardware, the database software and the internal structure of the database. In fact, one database vendor, Interbase Software Corporation of Tyngsborough, Massachusetts, implements the *DSRI* architecture on a variety of hardware including VAXs, Sun, Apollo and other UNIX environments.

Currently, Digital sells three database systems that support *DSRI*: Rdb/VMS, Rdb/ELN and VIDA. There are also third-party database systems like Interbase using the standard. (Look for reviews of Interbase and DEC's Rdb in future issues of *DEC PROFESSIONAL*.)

Although writing a *DSRI*-compliant database system is no easy task, anyone can write a program to use *DSRI* to access a database.

DSRI
Digital Equipment Corporation
Two documents make up the *DSRI* products:
The DSRI Handbook (DEC Order No. AA- V71A-TE) and *The DSRI Quick Reference Guide* (AA-GV74A-TE).
The executable images and include files for *DSRI* are delivered as part of the *DSRI*-compliant database product. Price: $350
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Why Use *DSRI*?

Of course, you don't need to use *DSRI* directly to access a *DSRI*-compliant database. You can use an interpreter like RDO to generate *DSRI* calls for you, or you can use a 4GL like *Datatrieve*, which translates its own language into *DSRI* calls. You also can use Data Manipulation Language (DML) commands directly in your compiled program. So why use *DSRI* directly?

One reason is speed. An interpreter or translator must do a certain amount of work to convert your commands into the corresponding *DSRI* calls. Some of that work is access to the database to obtain database metadata. Before *Datatrieve* or *RDO* or *Smartstar* can get data from the database for you, it needs to query the database to obtain the metadata. For example, the interpreter may need to know that TERMINATION_DATE is stored in an 8-byte date field. It answers this question by querying the database for information about TERMINATION_DATE, an operation that takes time and resources. If you have a program that always accesses

TERMINATION_DATE, you can avoid the metadata retrieval step by using *DSRI* directly.

You also will need to use *DSRI* directly if you don't know what database you will be using until runtime. This is one reason 4GLs like *Datatrieve* must use *DSRI* — because they don't know what database will be accessed or what will be done with it until the user types in commands. The 4GL then translates its own syntax into *DSRI* syntax and asks the database system to perform the database activity.

Another reason for using *DSRI* is to gain access to database functions unavailable via the other methods of using the database. For example, some functions of Rdb/VMS are unavailable unless you use *DSRI* directly.

DSRI Revealed

Besides Rdb/Dispatch, RCI, and DRI, there are three other important components to the *DSRI* architecture:

1. *Binary Language Representation* (BLR) is a procedural database language that consists of symbols whose values are unsigned bytes. From these bytes, a BLR request is constructed by the application program and is passed to the database system to be compiled and executed. The request includes instructions for retrieving or storing data and for transmitting messages between the database system and the user's program. It is the request that actually tells the database system what work is to be performed, not calls to RCI. One useful feature of requests is that they are reusable. A request, once compiled, can be used over and over again.
2. *Messages* are basically records that are defined in both the user's program and the database system. The program and the database system (via Rdb/Dispatch) send messages back and forth with the results of queries, information to be used in requests for data, and so on. Messages are used in requests to pass parameters to the request. For example, a message may contain the employee number and new salary of an employee to be given a raise.
3. *Handles* are integer numbers that uniquely identify certain objects in the database system, such as databases, transactions, and requests. A handle might be used to identify a request so that it can be reused, for example.

As you can see in Figure 1, BLR, messages and handles all are transmitted between the RCI and Rdb/Dispatch. Because these objects are very small in comparison to the size of the database or even the text of a database query, they can be transmitted efficiently across communications networks for distributed databases.

DSRI imposes a transaction model of database activity. A transaction is a series of operations that executes as a single unit or not at all. Transactions preserve database consistency by making sure that database update operations never are partially completed — they either complete totally or they fail totally. The application program controls the content of a transaction by explicitly marking the transaction's beginning and end, and within that transaction there is no *DSRI*-imposed restriction on what operations can be performed. You can read, modify or write data to any number of relations in any number of databases, and Rdb/Dispatch will ensure that either all of the operations complete or none completes. This is true even when the databases use different database systems (one might be Rdb/ELN and one Rdb/VMS) or are located on different nodes in the network. This capability, which arises from the architecture and not from any one database implementation, has tremendous potential for growth of distributed databases, database machines and the like. ■

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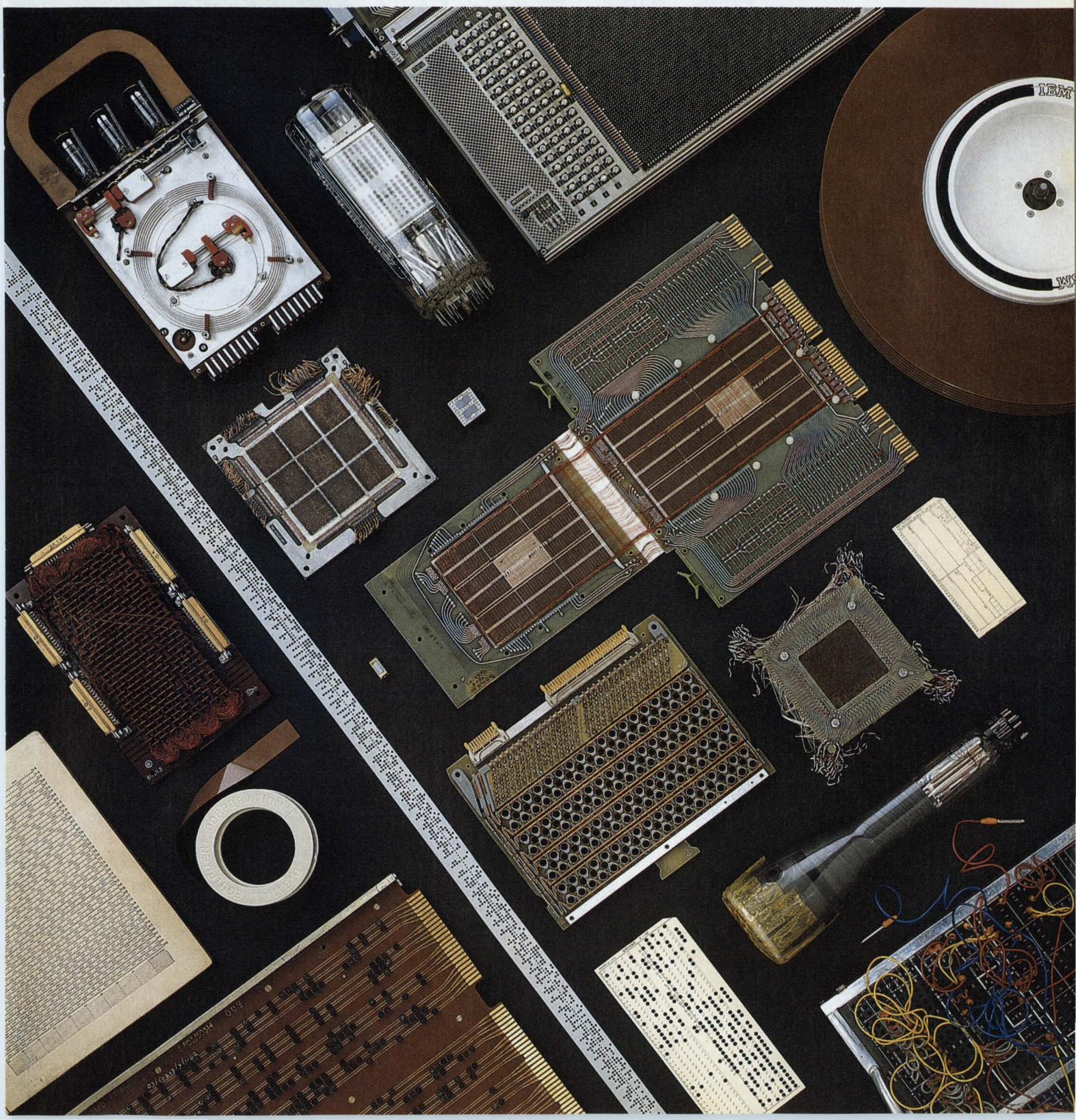


RSX

OVERLAYING RSX TASKS

By James A. McGlinchey

Ten Pounds In A Five-Pound Container?

I've been accused of being opposed to the use of overlays in RSX applications. That's not true. I am, however, opposed to the idea that overlaying is an instant solution to design problems. Use of overlays, like any other major facility in RSX, takes careful thought and a bit of tinkering. When used with appropriate respect, overlays can be serious tools. When abused by the unwary, overlays inflict punishment via unexpected overheads and increased development costs.

First, let's review some advantages and disadvantages to overlaying in general and the particulars of the two major techniques available in RSX. Code space requirements are a good place to start. The maximum total instantaneous code space for an RSX task can be either 32K words or 96K words, depending on the CPU and whether RSX-11M or RSX-11M-PLUS is being used. RSX-11M always limits a task to a 32K-word virtual address space, even if the hardware has support for separate mapping of instruction and data space. RSX-11M simply does not support this feature of the hardware, and never will. RSX-11M-PLUS can map a task's instruction and data space separately on those processors that can do it, namely the PDP-11/70, /44, /73, /53, /83 and /84. On these processors, RSX-11M-PLUS gives a task a potential code space of 32K words for user-written code, 32K words of data (including stack and impure data areas), and 32K words of supervisor library space. If M-PLUS is running on an 11/23 or 11/24, the task's space still is limited to the maximum of 32K words.

Overlaying is a technique used in RSX to cause the PDP-11's memory management unit to map a subset of a task's total code. By using overlaying, a task can be created whose total code size is greater than the capacity of the PDP-11's memory management unit; i.e., fit 10 pounds of stuff into a five-pound container. A task's memory requirements can be optimized via overlaying by selecting only the code that should be in memory at any given time; i.e., use the right size container to begin with.

Overlaying is implemented in RSX via two mechanisms: disk-resident overlays and memory-resident overlays. The two mechanisms are similar in that they enable you to control the amount of code currently mapped by the hardware. Either type of overlay can be specified in a .ODL file used as input to the RSX Task Builder.

A disk-resident overlay segment is loaded from the task image on the disk. This is the more classic concept of overlaying, with roots that go back into the dark ages of EDP. Careful control should be exercised here via the .ODL file; the "who overlays whom" problem often has mysterious side effects, particularly with regard to data contained in the overlay segments.

Disk-resident overlays have their overheads, both visible and transparent. The obvious overhead is that it costs a bit of disk I/O in order to roll in an overlay; partially hidden is the additional disk I/O required to load the entire code path in the overlay structure be-

tween the caller and the routine being called. Also partially hidden is the cost of the overlay loader run-time code and the tables used to specify the overlay segments. Left uncontrolled, the use of any overlaying technique can accumulate large overheads; disk-resident overlays are more insidious because the DMA activity imposed on the bus by loading all those overlays can slow down the system as a whole. The overlay loading mechanism is nicely done in that you experience minimum pain in overlaying a task; you simply designate each subroutine as being autoloaded, using the "*" indicator in the .ODL file for the Task Builder.

Memory-resident overlays at first glance appear to relieve these overheads. A task with memory-resident overlays sits entirely in memory, and sections of the task are selectively remapped as they are executed. Disregarding overheads, the remapping is entirely transparent to the task. Memory-resident overlaying is just as simple to incorporate into a task, indicated by the presence of a "!" indicator in the task's .ODL file.

I've created an example task to illustrate different techniques of overlaying and the effect of each (see Program 1). The task consists of a simple root segment, segment A, which calls segments B, C and G. Segment C in turn calls segments D, E and F. Although it's written in MACRO-11, the example task easily could be any compiled high-level language.

These segments are in themselves fairly small, so the first task structure has no overlays at all. The Task Builder command file for this structure is:

```
ATOG/CP,ATOG/-SP = A,B,C,D,E,F,G
```

The Task Builder map (Figure 1) shows the length of the task as 13312 (11310 + 2002, in octal). Root segment A starts at address 1254 to allow for a default size stack and task header.

A first attempt at overlaying might yield a task structure that contains each subroutine in its own separate segment. The subroutine is loaded when it's called. A tree structure diagram for this task looks like:

```
      +------B
      |--C
      |--D
A--   |
      |--E
      |--F
      +----G
```

The .ODL file for this task is:

```
.ROOT A- *(B,C,D,E,F,G)
.END
```

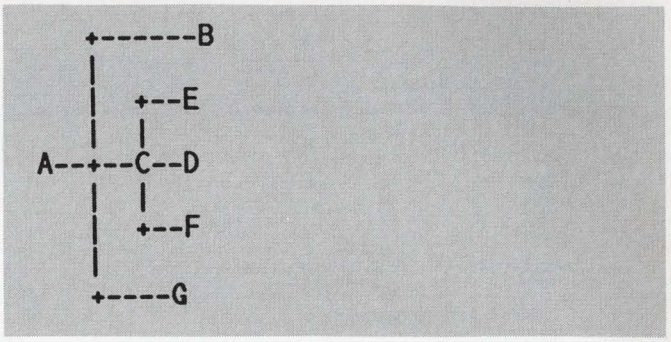
The table of addresses and lengths of the overlay segments appears on the first page of the task's map, as produced by the Task Builder. The overall task length is 5172 (octal) bytes, considerably shorter than the non-overlaid version. But the length of segment A is now 3170, longer than the non-overlaid version. This extra length is the space required for the overlay loading routines and the overlay descriptor tables. The length of each overlay segment has remained the same.

This structure would work acceptably if the need for each of the overlay segments were equally likely, because a call to any one of the segments almost always results in an overlay load from the disk. We have traded disk activity for memory space, in a rather heavy-handed manner (see Figure 2).

A method that offers more control of disk activity overheads is one of my favorite techniques. RSX tasks usually have four basic code sections, each defined by its purpose and probability of use:

1. A code body, nearly always resident.
2. An initialization segment, used only once.
3. A termination segment, used only once.
4. Several infrequently used subroutines.

An overlay tree can be created that takes advantage of these performance considerations to minimize the task length in memory:



Segments B and G are Dixie Code (used once and thrown away), so they can share memory with the resident body of the code which is contained in segment C. Segments E, F and G are so lightly used that they can be loaded every time they're needed without undue overheads.

The .ODL file for this type of structure is shown below:

```
        .ROOT   A- *(B,CLIMB,G)
CLIMB:  .FCTR   C- *(D,E,f)
        .END
```

The task length is dictated by its longest segment, so the overall task size is the same as the non-overlaid version. The disk overheads are now decreased, because segments are loaded less often (see Figure 3).

PROGRAM 1.

```
        .PSECT A,RW,I,LCL,REL,OVR
        .MCALL  EXIT$S

A::     CALL    B               ; The task root
        CALL    C
        CALL    G
        EXIT$S

        .BLKW   256.            ; space to create size.
        .END    A

        .PSECT B,RW,I,LCL,REL,OVR
B::     RETURN
        .BLKW   768.
        .END

        .PSECT C,RW,I,LCL,REL,OVR
C::     CALL    D
        CALL    E
        CALL    F
        RETURN
        .BLKW   256.
        .END

        .PSECT D,RW,I,LCL,REL,OVR
D::     RETURN
        .BLKW   256.
        .END

        .PSECT E,RW,I,LCL,REL,OVR
E::     RETURN
        .BLKW   256.
        .END

        .PSECT F,RW,I,LCL,REL,OVR
F::     RETURN
        .BLKW   256.
        .END

        .PSECT G,RW,I,LCL,REL,OVR
G::     RETURN
        .BLKW   512.
        .END
```

FIGURE 1.

```
Section                                          Title  Ident  File
-------                                          -----  -----  ----
A     :(RW,I,LCL,REL,OVR)     001254 001022 00530.
                              001254 001022 00530. .MAIN.        A.OBJ;1
B     :(RW,I,LCL,REL,OVR)     002276 003002 01538.
                              002276 003002 01538. .MAIN.        B.OBJ;1
C     :(RW,I,LCL,REL,OVR)     005300 001002 00514.
                              005300 001002 00514. .MAIN.        C.OBJ;2
D     :(RW,I,LCL,REL,OVR)     006302 001002 00514.
                              006302 001002 00514. .MAIN.        D.OBJ;1
E     :(RW,I,LCL,REL,OVR)     007304 001002 00514.
                              007304 001002 00514. .MAIN.        E.OBJ;1
F     :(RW,I,LCL,REL,OVR)     010306 001002 00514.
                              010306 001002 00514. .MAIN.        F.OBJ;1
G     :(RW,I,LCL,REL,OVR)     011310 002002 01026.
                              011310 002002 01026. .MAIN.        G.OBJ;1
```

FIGURE 2.

```
  Base    Top       Length
  ----    ---       ------
  000000  003167  003170  01656.      A
  003170  006171  003002  01538.      B
  003170  004171  001002  00514.      C
  003170  004171  001002  00514.      D
  003170  004171  001002  00514.      E
  003170  004171  001002  00514.      F
  003170  005171  002002  01026.      G
```

A first attempt at using memory-resident overlays for this task configuration consists of replacing the "!" operator for the "*" operator and running the Task Builder.

```
        .ROOT   2A-!(B,CLIMB,G)
CLIMB:  .FCTR   C-!(D,E,F)
        .END
```

The segment mapping looks different. Notice in the map that the segment groups now are aligned at Active Page Register (APR) boundaries. The task image size also seems to conflict with the task address limits. When all the segments are loaded, the actual size of the task in memory is 3520 (decimal) words. The memory-resident overlay mechanism involves using the RSX Memory Management directives to change the mapping of the task, thus selecting the subset of the code to be made available for execution. The memory management unit's APRs are in fact changed, thus affecting the remap. The Task Builder map shows that segments B, C and G are mapped by APR 1, since they are based at virtual address 20000. Segments D, E and F are mapped by APR 2, based at 40000. The actual size of the task in memory is 3,520 words; the use of the memory management unit requires the virtual address 0 through 57777 (see Figure 4).

The overhead incurred by using memory-resident overlays can be a surprise, because it's a common misconception that the entire task is loaded into memory. When this task is invoked, the root segment, A, is loaded into memory. As code in the overlays is executed, the root is extended, always loading all the code between the root and the overlay being called. The overlays are loaded and then left in memory by RSX. The task always is kept contiguous. The task image may be moved in memory to accommodate the necessary extensions. If the probability of use for each overlay is about the same, the entire task can be forced into memory by intentionally invoking a routine in the last segment, G, causing the last segment and all the intervening code to be loaded and left in memory. If, however, the execution frequency of the overlays varies, the task's size in memory can be controlled by linking the routines in the order of their probability of need. In our example, routines B and C are more likely to be used than routines D, E and F. G is the least used.

The RSX Exec's remapping of the memory management hardware to access memory-resident overlays also can result in high overheads. Although the overheads here are not nearly as high as those incurred by using disk-resident overlays, care still is needed. Group nested procedures so that they are within 4K words of each other, as indicated on the load map produced by the RSX Task Builder. The nested subroutines then are mapped by the same APR, and remapping will be un-

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FIGURE 3.

```
Base    Top     Length
----    ---     ------
000000  003167  003170  01656.      A
003170  006171  003002  01538.        B
003170  004235  001046  00550.        C
004240  005241  001002  00514.          D
004240  005241  001002  00514.          E
004240  005241  001002  00514.          F
003170  005171  002002  01026.        G
```

FIGURE 4.

```
Task  image  size  : 3520. words
Task address limits: 000000 057777
R-W disk blk limits: 000003 000025 000023 00019.

ATOG.TSK;3 Overlay description:
Base    Top     Length
----    ---     ------
000000  003761  003762  02034.      A
020000  023001  003002  01538.        B
020000  021015  001016  00526.        C
040000  041001  001002  00514.          D
040000  041001  001002  00514.          E
040000  041001  001002  00514.          F
020000  022001  002002  01026.        G
```

FIGURE 5.

```
Task  image  size  : 3360. words
Task address limits: 000000 037777
R-W disk blk limits: 000003 000022 000020 00016.
ATOG.TSK;1 Overlay description:
Base    Top     Length
----    ---     ------
000000  003557  003560  01904.      A
020000  023001  003002  01538.        B
020000  024007  004010  02056.        C
020000  022001  002002  01026.        G
```

FIGURE 6.

```
                .ROOT   A-!(B,CLIMB,G)
        CLIMB:  .FCTR   C-*(D,E,F)
                .END

Base    Top     Length
----    ---     ------
000000  003645  003646  01958.      A




020000  023001  003002  01538.        B
020000  022001  002002  01026.        G
020000  021045  001046  00550.        C
021050  022051  001002  00514.          D
021050  022051  001002  00514.          E
021050  022051  001002  00514.          F
```

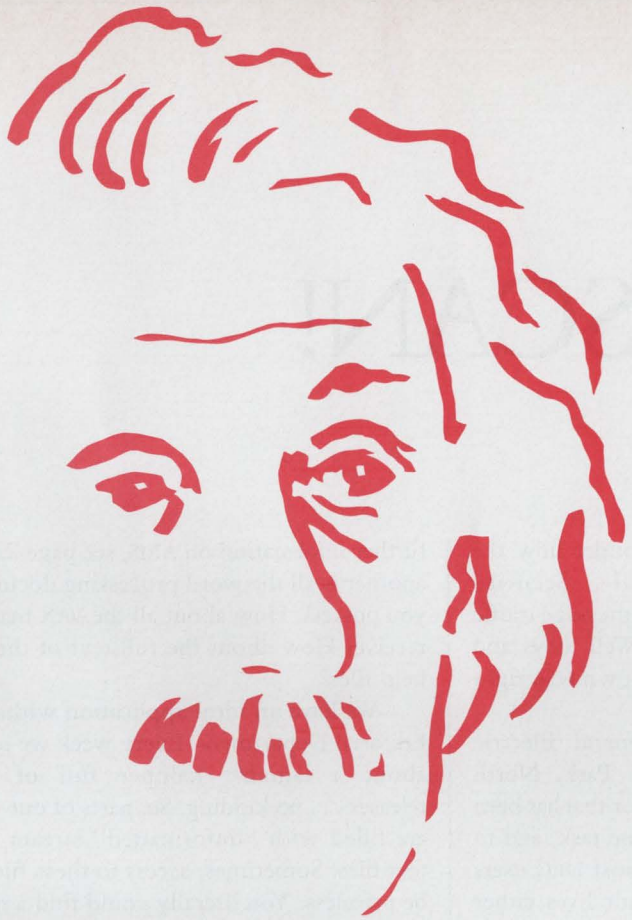
necessary once the first of the nested routines is called.

The next example shows routines C, D, E and F all mapped by the same APR. Segment C actually contains C, D, E and F. So, once segment C is mapped, all calls by C to D, E, and F are already mapped by the same APR, and the remapping overhead is avoided. For those who use RSX-11M-PLUS Version 3.0, the Fast Mapping facility is not used in remapping memory- resident overlays, although I'm told that Fast Mapping of memory-resident overlays will be incorporated in a future release of RSX-11M-PLUS (see Figure 5).

The two overlaying methods can be combined. This might be useful in a somewhat bizarre set of circumstances, and certainly is possible to accomplish with the Task Builder. Our last example shows a combination of both types of overlays (see Figure 6).

The rationale for using overlaying and choosing options becomes an important consideration in designing an application to run on RSX. The most common case I have seen is one where an RSX user creates a task that is smaller than the legal memory bounds, and then adds some code of sufficient size to exceed those memory bounds. The ominous message from TKB, "Task has illegal memory limits," tempts users to seek the quickest solution, which is the use of disk-resident overlays. Use of disk-resident overlays to fold code back on itself so it will fit into 32K words can be likened to trying to fit a size 15 foot into a size eight shoe by folding the toes back: It's going to be painful and something's bound to break. A threshold of diminishing returns, where more effort results in progressively less benefit, takes hold at an identifiable point in program development. This threshold occurs when the task's .ODL file must be reworked every time the task is built, and in my experience, this happens when the tenth overlay segment is created. Beyond that, more time gets spent coercing an overlaid task to fit into its memory bounds than developing the application. Time is better invested in a redesign of the task as a suite of cooperating tasks linked by some form of intertask communication. While the user may persist in the belief that once more the task can be made to fit, the laws of Parkinson and Murphy are working overtime to assure failure — it's only a matter of when. Wisely used, overlaying can give you efficient control over the use of your PDP-11's limited memory.

James McGlinchey is an independent software engineering consultant based in Essex Junction, Vermont.



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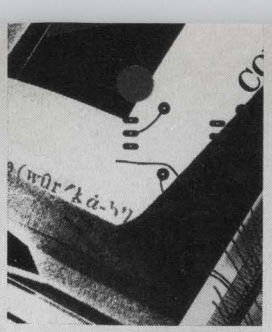

ATTACHED PROCESSOR

GESCAN!

By Dave Mallery

General Electric's Hardware Solution To A Classical Software Problem.

Ever wonder how the National Security Agency scans all international message traffic for key words and phrases? Well, boys and girls, now you can build your own NSA right in your computer room!

The GESCAN from General Electric Company, Research Triangle Park, North Carolina, is an attached processor that has been constructed to perform just one task, and to perform it very well. Now, most DEC users have spent much of their adult lives either waiting for RMS indices to be built, waiting for programs with RMS code to compile (RSTS/RSX), rebuilding RMS indices that have gone over the hill, or in some other fashion wasting time with indices.

But the question, "Why bother with them anyway?" is seldom asked. It's true that for most commercial applications, a few well-placed indices are a good idea. I still shudder when I see novice programmers build and maintain indices for the life of a system because *one* report is needed in that sequence. I'd make a side bet that if you were to look over the applications running on your machine, you'd find several instances of huge RMS indices being maintained and wasting disk space by the megabyte/year just because Fred Junior never learned how to run the sort utility!

The GESCAN system is engineered for a different problem. Instead of nice fixed-format records with fixed and defined fields, lots of data comes to us in straight ASCII streams. One example is a wire service. Another is the text of this article, and indeed, a full directory containing all the text we have published this year. Another good example is the directory containing all the conversations on ARIS (For further information on ARIS, see page 22.) Yet another is all the word processing documents you possess. How about all the VAX mail you receive? How about the full text of the VMS help files?

We have an ideal application within our Editorial Department. Every week we receive about a laundry hamper full of press releases . . . no kidding. So, parts of our world are filled with "unformatted" stream ASCII text files. Sometimes, access to these files can be priceless. You literally could find a needle in a haystack if you could search sequentially at superspeed.

The GESCAN system addresses the problem of searching the "unindexable." Now, that term is not quite right. There are several commercial text retrieval systems that work by building an index of every word in the data. (BASIS, BRS/Search and others). Now if you have an index of every word, you can find them. But, you also have an index and all the headaches that come with the territory. Usually, the indexed retrieval systems are wonderful at run time, but a bear to load. They don't work as well when you're looking for phrases or for the occurrence of certain words in any order within a certain variable distance from each other.

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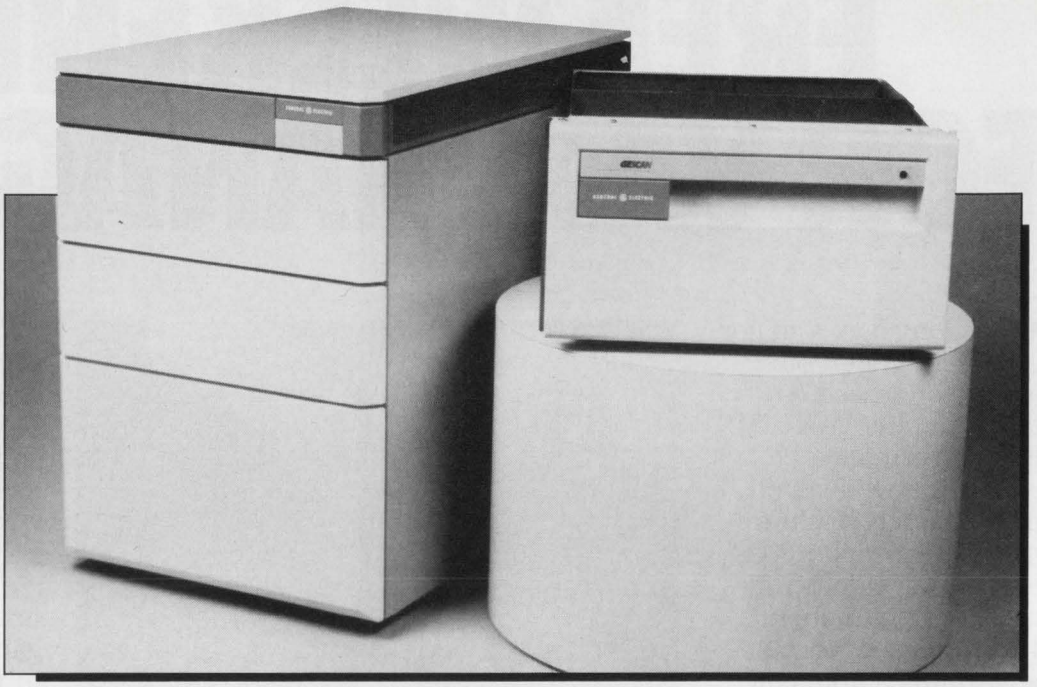

by a device driver and a lot of software that constitutes the user interface to the processor.

The processor itself consists of a variable number of search engines. There is no software in the unit. All the logic is "hard wired" and all of it proceeds at the same speed. The unit we have has twelve parallel search engines. That means that multiple independent, quite complex queries can operate on the content of the buffer at once, and none will slow down another.

Each search engine has 1 KB of user defined query and a 5 MB/sec comparison rate. That means that the aggregate parallel processing rate achievable by our unit is 60 MB/sec. The software is optimized to handle multiple queries. The demo supplied by GE does 25 at once.

Each search engine is divided into two main parts: the Term Match Processor (TMB) and the Logic Resolution Processor (LRP). The TMP is a series of custom chips that hold the character sequenced to be matched. When the TMP notes a match of a search term, it notifies the LRP. The LRP concerns itself with boolean expressions on the terms, proximity of terms and threshold counts. In other words, you can search for an instance in which at least three of five search terms show up. Each TMP contains 1 KB of memory for term storage. Data is prescreened through a translate table to eliminate non-searchable characters such as control characters, and to translate all to uppercase. All searches are case insensitive.

All hits are passed from the TMP to the LRP. The LRP basically decides that the term you have found fits all the other logical requirements of your query.

The host software retrieves the hits from the unit and saves them for subsequent hit file processing. The attached processor is involved only in the search process and the rest of the functions are performed by software on the host VAX. Think of it as a peripheral — you send it blocks of data via DMA, it returns pointers to strings that match your search arguments.

Now, we should discuss the format the data needs to be "searchable." Database files are created by a GESCAN utility. They may be anywhere in the system, protected or not by normal VMS protection and other mechanisms. Users may create them in their own accounts. Each database consists of five files:

1. .chr — the text file
2. .dol — document list: name and location of each member of database
3. .pgl — page list: list of contents of each database page
4. .fdf — field definitions
5. .act — journal of activity other than searching

The data itself can be totally simple (like the text of this article in an ASCII text file) or structured with special-purpose fields defined, such as:

```
<auth> Dave Mallery
<vols> Volume 6 Number 3
<page> page 119
<abst> Abstract: blah blah blah
<text> . . . . . .
```

Others that come to mind here are resumes and real estate listings — things that have headings and variable amounts of text that need searching.

Loading a database is fast. In fact, I can't discern the difference between loading and copying the sequential files. Remember, there is *no* index generated. I loaded about 340 articles in about an hour. I did it by building a batch control file. All the material was in one directory with the extension: .fin. The following DCL procedure did the trick:

```
$ DEFINE SYS$OUTPUT XX.COM
$ WRITE SYS$OUTPUT "GENDB"
$ WRITE SYS$OUTPUT "Y"
$ WRITE SYS$OUTPUT "ARTICLES"
$!
$ DIR_LOOP:
$ FILENAME = F$SEARCH("*.FIN;")
$ IF FILENAME .EQS. " " THEN
  GOTO DIR_END
$ VER = F$PARSE(FILENAME,,,
  "VERSION")
$ FILENAME = FILENAME — VER
$ GOSUB YES
$ WRITE SYS$OUTPUT FILENAME
$ GOTO DIR_LOOP
$!
$ YES:
$ WRITE SYS$OUTPUT "Y"
$ RETURN
$!
$ DIR_END:
$ WRITE SYS$OUTPUT "N"
$ WRITE SYS$OUTPUT "$ EXIT"
$ DEASSIGN SYS$OUTPUT
$ EXIT
```

The only problem I encountered in this technique was that the batch job was spoiled in document 341 when a piece of text that fit the definition of a field name was encountered in a document. Realize that this was the first attempt to load data and that more than half a year's editorial went in without a whimper on the first try. I used line mode EDT to remove the first 341 document names and "Y" responses from my control file and did it again. The rest of the

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documents went in without a whimper. The full search time now is about 54 seconds.

The field name definition is one to four characters, enclosed in < > and all alone on a line (default definition). If multiple documents are present inside a single file, they need to be delimited by a single exclamation point alone on a line.

If we were using this machine in-house for Editorial on ARIS, we would follow strict rules as above and provide fields like abstract and index entries along with the text.

Now for the query capabilities. There are two ways to enter a query: a free form DCL command like FIND or whatever symbol you define, and a structured screen editor that stores and retrieves queries and supports easy modification and retry. Once a query has started, you can switch modes while the query is still running and examine the hits as they are found.

The query capabilities of the system are:

1. Exact Term Match — All the terms in the query must be found in one document.
2. Near Term Match— At least one (or n of m) terms must be in one document.
3. Boolean Logic — and, or, not.
4. Wildcarding — !ate will find Gate, Fate, Date, etc. M?N will find all words, any length, that start with M and end with N. ?ad?af? will find most varients of the last name of the gentleman in charge of Libya. Leading wildcards are a special feature of GESCAN.
5. Proximity — Terms must be within a specified distance of each other in the document.
6. Range — \ 1980 \ 1986 \ gets all numbers between 1980 and 1986.
Sep \ 10 \ 17 \ , 1986 gets dates 10th to 17th.
Sep \ 10 \ \ , gets all of September greater than the 10th.
7. THESAURI — You may create lists of synonyms in a private thesaurus. When you reference a term in the thesaurus, all synonyms are included as terms in the search; e.g., D.E.C.;DEC;Digital Equipment.

Examples:

```
find reagan and gorb?v and
\ 04 \ 10 \ -jun-1986 in date
(where date is a field)
```

Remember, the most complex search and the simplest run is done in exactly the same amount of time!

```
camera AHEAD 5 WORDS photo?
```

will find documents that contain the

term CAMERA at least five words ahead of any word that starts with PHOTO.

```
a AHEAD 3 CHAR p
```

will get documents that have the letter *a* three letters ahead of the letter *p* in any word.

```
camera WITHIN 5 WORDS photo
```

will find camera or photo five words AHEAD OR BEHIND each other.

```
any 2 of (fortran,pl!1,c,cobol)
```

Hit Files

As a search proceeds and documents are located, pointers to them are placed in hit files. Documents in hit files can be annotated, edited (also changing the database), abstracted into brief "citation lists" for scanning, copied to VMS files from the database and printed in hardcopy. Hit files can be concatenated. Documents can be moved to other hit files. Documents in hit files can be sorted on their fields. Documents can be "tagged" with symbolic names creating subsets within a hit file that can be manipulated later by their tag (or absence of a tag).

There is a most extensive security system with audit trails that belies the origins of this product.

It is possible to set up continuous queries that are always active. Every new document added to a database will be scanned on arrival with no effort on your part. Hits can be routed to interested parties automatically. This is especially useful in wire service applications. We could use it to handle incoming press releases in conjunction with a document scanner (stay tuned).

In summary, this is a hardware solution to a classical software problem. It is priced in the same range as the software solutions (and indeed contains a great deal of software!), but will save you a large amount of CPU resource over the life of the system.

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COMMUNICATIONS

BLAST

Reliable Micro-To-Mainframe Communication.

By Victor J. Chorney

With all the fuss being made about micro-mainframe connections, there is little wonder that a plethora of products is appearing in the marketplace. Among the newcomers to the arena is a product that has been around for some time now. I don't remember when I saw the first *BLAST* advertisement, but I know it was more than a couple of years ago! The thing that caught my eye then was the claim that you could transfer data between hardware of differing manufacturers and differing operating systems. And if there was a manufacturer missing from the comprehensive (more than a hundred) list of vendors, its absence was not conspicuous. So, it was with a mixed set of emotions — expectation and skepticism — that I approached doing this evaluation.

Keep in mind, by the way, that except for transferring the software onto the hardware and making the necessary software hook-ups as part of the installation process, what I did on the PC was exactly what would have been done on any of the other supported systems.

Installation

BLAST comes on one disk and the installation process is simply a matter of executing a program that copies the program from the floppy to the hard disk. After that, the installation tasks define the system on which you are running and the parameters that you want to include in your version of *BLAST*.

This "customization" is best explained with an example. *BLAST* maintains a directory of connections or configurations of the systems with which you want to communicate. Since I didn't feel like calling every system I have access to, I added one to the existing directory (which includes the demo system at Communications Research Group). And the one I added was, naturally, access to Professional Press's VAX.

If there was anything else that could have been added to the profile described on the setup screen, I don't know what it is. Not only could I preset all the operating parameters — baud rate, parity, etc. — but I also was able to preset the necessary logon responses (see Screen 1).

Operation

Like most people, I hate to read manuals and, although I will describe the documentation later, I made scant use of it. This system is so easy to understand — there's even context sensitive help — I just went ahead and used it. I was able to dial in to the magazine's system and do a little browsing. This is a particularly important point, incidentally. *BLAST* is *not* a full-blown terminal emulation package, though it does support VT100 and VT52 emulation. It was not designed to be a tool for logging in and doing on-line work. It's fine as long as you don't have full-screen requirements, but with a 20 x 80 scrolling area, most formatted screens cannot be accessed easily. But *BLAST* is not meant to do that. It is a communications tool designed to support file transfer operations, and it does that very

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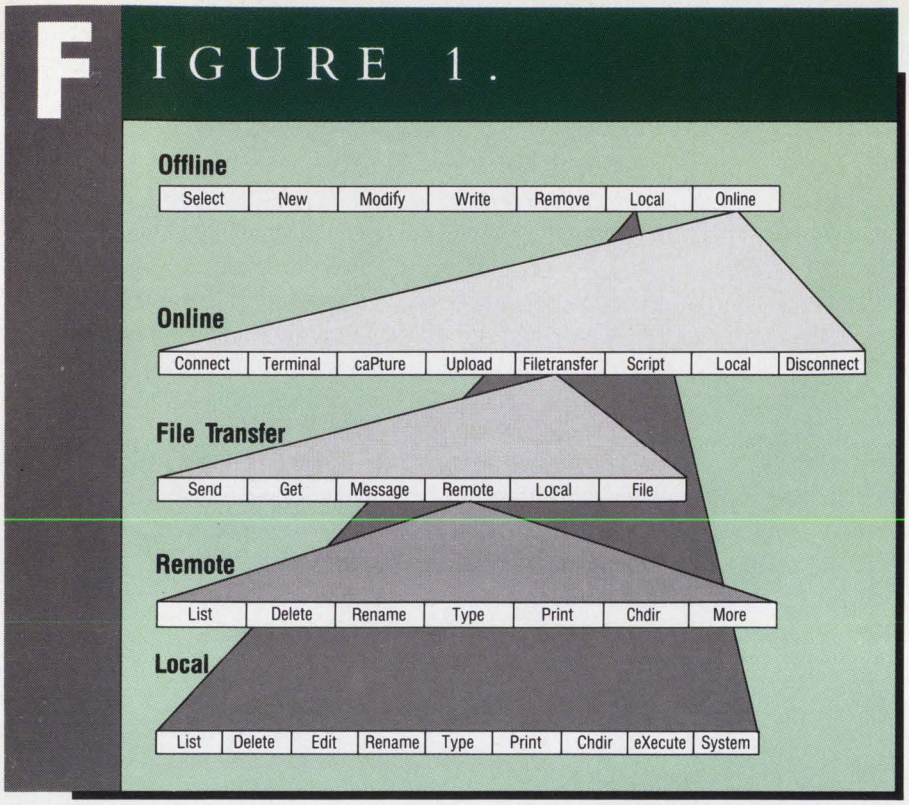

The **BLAST** *nested menu structure.*

Setupfor: setupname

Description:			
Phonenumber:			
Systemtype:			
ORIGINATE/ANSWER:	ORIGINATE	Emulation:	VT100
Userid:		Attentionkey:	K
Password:		Fullscreen:	NO
Commport:	COM1:	Localecho	NO
Modemtype:	HAYES	AutoLFIN	NO
Baudrate:	1200	AutoLFOUT:	NO
Parity:	NONE	Waitforecho:	NO
Protocol:	BLAST	Promptchar:	NONE
Logontimeout:	120	Chardelay:	0
Connecttimeout:	120	Linedelay:	0
Transferpassword:		XON/XOFFpacing:	YES
Scriptfile:		DTR/CTSpacing:	NO
Logfile:		7bitchannel:	YES
Translatefile:		Packetsize:	84
Keyboardfile:			

Screen 1. The **BLAST** *setup screen.*

well indeed. After logging out of the magazine's system, I selected the demo system in Baton Rouge. File transfer operations were extremely smooth and the files came across clean.

At this point I feel I must draw a parallel. I am a dyed-in-the-wool KERMIT fan. I use KERMIT for most of my file transfers, because I have confidence in its error-correcting capabilities, but, it's a technical tool and, though versatile, not very friendly. *BLAST* does what KERMIT does in terms of reliability, and it is packaged so that non-technical folks can use it with a great deal of comfort. Yes, it does flash messages on the screen that won't be all that informative to the general public, even though they're explained in the manual. But the operations you initiate are logical and easy to invoke.

Each command that can be invoked at any time is displayed as a meaningful word in reverse video. What you have, therefore, is a set of blocks running across the top of the screen and each item can be selected either by moving the cursor to the appropriate block and pressing the return key, or simply by pressing the first letter of the command (see Figure 1). The "menus" are nested, and retreat to the next higher level is made by pressing the ESCape key. You even end the program by ESCaping out of it.

Documentation

The operator's manual is presented in five sections, the boundaries of each being marked with firm dividers, unfortunately not tabbed. Also, as you will see from the following description, the organization does not really make sense. The information is well presented with lots of illustrations and clear, understandable text. But you may have to jump around to find everything you want to know about a particular subject.

The Introduction is a brief overview of *BLAST*'s capabilities and the keys used to invoke the various functions.

Section 2, Getting Started, covers installation, basic operations, setup, a

BLAST
Communications Research Group
5615 Corporate Blvd., 3rd Floor
Baton Rouge, LA 70808-9990
(800) 24-BLAST; (504) 923-0888

Price: Varies upon configuration; $250 for micros; $495-$2,000 for minicomputers; $5500 for mainframes.
Enter 851 on reader card.

tutorial (using the aforementioned demo system), setup parameters, file transfer and scripts. Yes, that's right, it supports scripts that you can write selecting from the 51 available script commands. This also means that you can develop sets of procedures that enable even the most cautious of users to initiate file transfers.

At this point, there is a curious departure in style. The next section deals with communications concepts — data formats, communications parameters, serial interfaces, modems, networks, software, and communications modes (terminal mode, error-free mode, etc.).

The fourth section returns to form by presenting the *BLAST* menu commands and script commands in detail and complete with examples.

The last section covers *BLAST* Concepts — program operation; setup (again, but in greater detail); terminal, local, error-free and script functions; and the appendices, which deal with the ASCII character set, *BLAST* utility files, and error codes. The explanation of the error codes is very brief and, though meaningful in context, offers no assistance toward recovering or resolving the problem.

The index is extensive but, unfortunately, refers only to the last section of the manual, rather than the entire set.

Error-Free Functions

The critical point of any transmission of data is ensuring, to the greatest degree possible, that no errors appear at the destination. Obviously, the most vulnerable time for errors to appear is during the transmission process. *BLAST* provides several options, through selection in the FileTransfer Menu, that take place under the auspices of the error-free link:

1. Send — send files to the remote system.
2. Get — request files from the remote system.
3. Message — send messages to the remote system operator (communication).
4. Remote — send operating system file management commands (delete, rename, etc.).

5. Local — access local system file management commands (delete, rename, etc.).
6. File — submit a list of error-free commands.

File transfer is accomplished using one of two modes of operation:

1. Image mode — a byte-for-byte copy of the source file to the destination file (primarily for binary files).
2. Text mode — transmission of the data by first translating the data from the source system's text data format to a standard interchange format and then translation after transmission to the receiving system's text data format.

Having been caught in the crunch of having to edit data on my system so it will conform to the data on the receiving system (CR-LF versus CR, for instance), I can really appreciate this.

Support

BLAST comes with a 90-day support policy that includes:

1. A warranty that the software will operate as specified.
2. Free upgrades for bug fixes.
3. Free technical support. You also get a subscription to the corporate newsletter, notice of new product announcements, and discounts on product upgrades.

Recommendation

BLAST's performance and ease of use are impressive. I was particularly gratified with this experience for one very selfish reason: I currently am working on a project that calls for data transmission between dissimilar systems and *BLAST* is available on each. My experience with the package has given me confidence in the product.

The PC *BLAST* interface and intelligence, available for all VAXs, were about to be announced at the time of this writing.

If you've been trying to fill a need for a solid file transfer package, give serious consideration to *BLAST*. If it's installed at each of the sites with which you do file transfers, no matter what the hardware, you've got an insurance policy on safe and reliable data transmission.

Victor J. Chorney is senior consultant at the accounting firm of Glickman, Berkovitz, Levinson & Weiner in Elkins Park, Pennsylvania.

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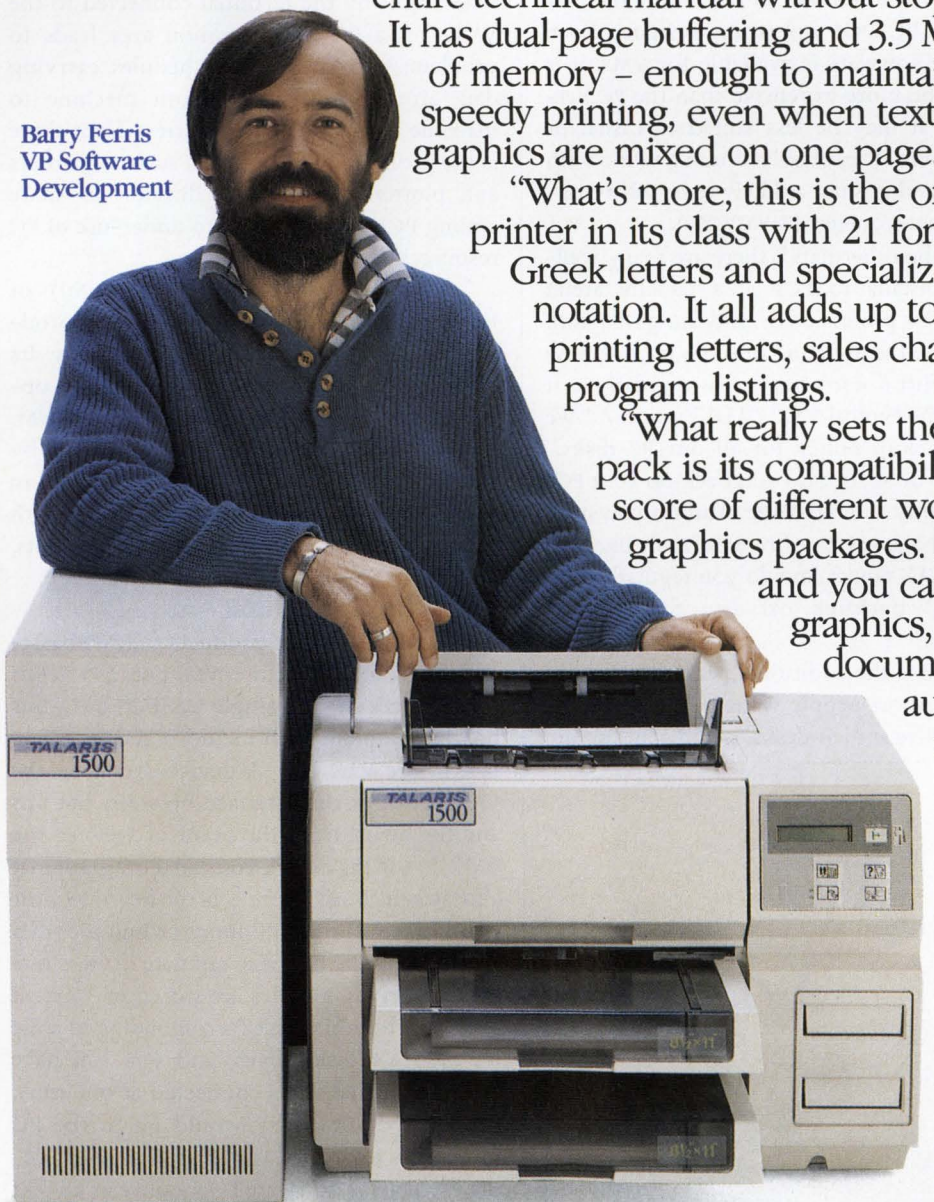

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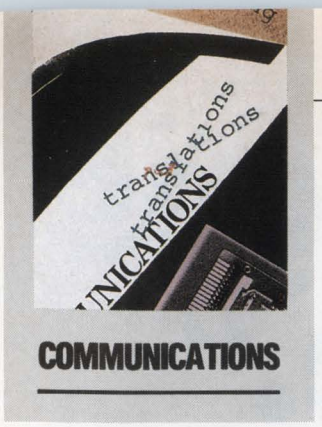

The *AT/BRIDGE*

Put A PC/AT Inside Your VAX.

By Philip A. Naecker

Numerous as they are, the number of software packages available for VMS pales in comparison to the number available for the MS-DOS and PC-DOS operating systems. Even when the software is available for VMS, it is likely to be more expensive than the PC version and it may be less suited to casual or novice users. It probably doesn't work with a mouse, and it is not as likely to be what-you-see-is-what-you-get (WYSIWYG).

On the other hand, there are many well-known pitfalls to PCs. PCs usually aren't managed by professionals, and things like disk backup and the updating of software with new versions just doesn't happen as regularly as it does on the typical VAX. "Ha!" you say. "We have a backup policy for all our PC disks." That may be so, but do you back up your PCs as frequently as your VAX? And do you store your PC backups in a fire-safe vault like you do your VAX tapes? And do you regularly send some PC backups off site for disaster protection?

There is the additional problem of sharing a PC; most people want to use their PCs while they're at their desks, not in some public corner of the office. But a PC at the desk tends to be under-used, and there is the ever-present problem of real estate on the desktop, already made tight by the terminal connected to the VAX. Yet a PC in a common area leads to problems with conflicting schedules, carrying data around in floppies from machine to machine, and similar difficulties. Then there is the problem of peripherals such as printers and plotters — they are difficult to share among PCs, again leading to under-use of PC resources.

Virtual Microsystems, Inc. (VMI) of Berkeley, California, started marketing products in 1982 to address these problems. Its original *BRIDGE* product was a UNIBUS option with four Z86 processors running CP/M. VMI has kept pace with the PC industry by successively offering an 8086 and now an 80286 version of the same idea, together with a few new and very significant enhancements.

The *BRIDGE* Solution

Each of the *BRIDGE* products follows basically the same architecture. VMI puts a PC-class microprocessor on a single UNIBUS or Q-bus board, complete with memory and an interface to the VAX bus. A device driver on the VAX manages the interface between the bus and the board from the point of view of the VAX. To use the board, you run a program that allocates the board, connects the board to your terminal emulating a PC monitor, and provides resources to the board to emulate devices like PC disk drives. PC files are stored in "virtual disks," each virtual disk corresponding to a file on the VAX disk drives, and you can have multiple virtual disks connected at one time. Output that normally would go to the PC monitor is redirected to the VAX terminal being used, and a software layer converts all text

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IT'S 2:28 AM

Some kid with a MODEM just figured out that you have 1.100.DEMO.

LOTS OF LUCK!

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IT'S 3:15 PM MONDAY

Tired of writing depreciation journals in 3.5.GL. Your third assistant bookkeeper just discovered the joys of 4.0.PAY.

He's on his way from the bank to the airport.

LOTS OF LUCK!

LOCK-11

IT'S 2:28 AM

The kid with his auto-dial MODEM just found your "new" dial-in number 555-0112 on the 112th try. He's in and you are out!

LOTS OF LUCK!

LOCK-11

IT'S 5:30 PM FRIDAY

Your FORMER programmer just went home.

He dialed into a non-priv account,let himself in through a back door ([1,82]xTSK(232)].

He is now linking the bottom of [1,2] to the top with ODT. He is planning a couple of custom monitor patches.

He is not mad anymore.

LOTS OF LUCK!

LOCK-11

TABLE 1.

Intel 80286 processor (8 MHz clock)
- 1 MB RAM
- Optional 80287 floating point processor
- IBM PC Expansion Bus Interface
- IBM PC Compatible RS232C port (UNIBUS version only)

AT/BRIDGE *hardware.*

TABLE 2.

UNIBUS Version
19-inch rack mountable cabinet
10 expansion slots
- 4 PC-compatible slots
- 6 AT-compatible slots

200 watt power supply
Supports two U286 coprocessors

Q-bus Version
17 x 13 x 6-inch cabinet
5 expansion slots
- 2 PC-compatible slots
- 3 AT-compatible slots

105 watt power supply

Optional IBM PC expansion bus.

TABLE 3.

ANSI.SYS	Device driver for ANSI escape sequences.
AUTOSPOL	Enables or disables the automatic print spooler.
DISMOUNT	Dismounts a virtual disk.
EXPORT	Exports binary or text files from MS-DOS virtual (or real) disks to the VAX.
FORMAT	Formats physical floppies in the attached expansion box.
IMPORT	Imports files from the VAX to MS-DOS.
MODE	Switches control from a VTxxx terminal to a color or monochrome monitor in the PC expansion box, and back.
PROTECT	Changes the DOS protection of a virtual disk.
STATUS	Displays the current status of all configured disks on the system, including physical and virtual disks.
VAX	Executes a VAX command in a subprocess.
VCREATE	Creates and mounts a virtual disk of size 360 KB to 30 MB.

DOS utilities from VMI.

and most graphics output to a format compatible with DEC VTxxx terminals.

The idea is simple and elegant. It provides a neat coprocessor solution to the problems associated with PCs for many applications. The advantages of this approach are many, including the fact that VAX peripherals tend to be faster and more cost effective than PC peripherals, and can be shared among many users and many different applications, both VAX- and PC-based. Security of DOS disks is layered on top of security of VMS files, so the information stored in virtual disks is quite secure in comparison to information stored on physical floppies or a hard disk in a public PC. There is relatively low overhead on the VAX, since the coprocessor uses the VAX only for I/O to the terminal and disks.

The newest member of the *BRIDGE* family is the *AT/BRIDGE* for the UNIBUS or Q-bus, called the U286 and Q286, respectively. The two boards have essentially the same configuration (see Table 1).

The Expansion Bus Interface allows the connection of an optional expansion box containing a standard IBM PC/AT- compatible bus. Any PC- or AT-compatible device can be plugged into that bus and will work as a peripheral to the PC card in the VAX. There was a PC-compatible 360-KB floppy drive and later a 1.2-MB floppy in the beta test version of the box that I test-drove for two months, and with two PC-compatible slots and three AT-compatible slots, there was a lot of room for hard disk drives, local area network interfaces, or any other AT peripheral I might have wanted (see Table 2).

Running a PC program using the *BRIDGE* is pretty easy (see Program 1). The software automatically locates the first available PC device on the bus, so if you have more than one *BRIDGE*

card, the user doesn't have to try each one to find a free *BRIDGE*. VMI provides some simple command procedures and menu systems that invoke the user interface to MS-DOS and optionally attach virtual disks to the first four drives (A: through D:), or you can use the VMI MOUNT utility from inside MS-DOS to mount a virtual disk.

Once inside MS-DOS, there are few differences from a standard PC. Since it is the MS-DOS operating system, virtually anything that runs on a standard PC will run on the *BRIDGE*. There are two modes of operation, from the terminal or from an attached monitor running on the optional expansion box. Obviously, some programs that depend on particular display hardware characteristics won't work on the VTxxx terminals, so don't try running *Flight Simulator* on your VT220. Any program that does normal ASCII output in a character-cell mode (as a spreadsheet or an editor might do) will work fine on your VTxxx terminal (or any other ANSI-standard terminal) without any modification. In addition, many programs that are customizable to work with different display hardware can be set up to display graphics even on, say, a VT240. VMI has extended some of the more common software to work this way, and I tested a copy of *Lotus 1-2-3* that was capable of displaying graphics on a VT240. There are no limitations at all if you run DOS from the optional expansion box with display hardware of your choice, since then the VAX simply is providing the disks and printers to the PC card and the monitor is connected directly to the PC processor.

You can choose either of two DOS emulation modes in addition to the default MS-DOS operating system environment. One provides compatibility with the DEC Rainbow and the other compatibility with the IBM PC. Under Rainbow emulation, you can run Rainbow versions of programs such as *Lotus 1-2-3* that use the special attributes of the Rainbow hardware. It also provides keyboard support for keys not normally available on a VTxxx but used on the Rainbow, like shifted function keys.

Under IBM PC emulation, an IBM emulation font is downloaded to your terminal, and a key sequence to view the 25th line of the display is provided. The IBM PC keypad is mapped to the VTxxx keypad and the HELP key on the VT200 causes the display of an IBM PC keypad emulation diagram (Figure 2).

Of course, the display rate of a terminal is generally a lot less than a PC, so repaint time for a spreadsheet might be markedly slower on the *BRIDGE* using a terminal than on a PC with an at-

tached monitor. Remember, however, that you can attach a monitor using the optional expansion box, in which case the display time is the same. And at 19.2K baud on a VT200, the difference in display time for non-graphic information is trivial. Furthermore, the actual processing time is determined by the 8 MHz clock rate of the 80286 chip and the access time of the relatively fast VAX disks, not by the display hardware.

Virtual disks have a number of advantages over normal floppies or hard disks on a PC. First, physical disk size is not a limitation; you can create virtual disks up to 30 MB in size and have as many of them as your VAX disk space allows. Further, disks grow in VAX allocation only as needed, so you don't waste a lot of space if you start off with larger virtual disks. A major advantage of virtual disks is that you can share

Virtual disks have a number of advantages over normal floppies or hard disks on a PC.

them. Passing data between several users of the *BRIDGE* is accomplished simply by pointing at the virtual disk file on the VAX with the MOUNT command in DOS. Multiple users can read the same disk simultaneously, but DOS limitations require that only one user can have a volume open for writing.

Licensing options vary between software vendors, but you may be able to purchase just a single license for your entire *BRIDGE* system, even if you have multiple coprocessor boards on your VAX. At worst you have to purchase a separate license for each coprocessor, but you still can have just a single copy of the software on line (in a virtual disk) and have to update only that single copy when new versions become available. VMI will sell many popular PC programs to you on a VAX-compatible distribution media, one tape containing

PROGRAM 1.

```
Welcome to node OASIS!

Username: PAN

Password:
        Welcome to VMS V4.5 on node OASIS!

    Last interactive login on Saturday,  7-FEB-1987 11:37
    Last non-interactive login on Sunday, 25-JAN-1987 04:02

Terminal: VT200         Port: _RTA1:          Time:  7-FEB-1987 13:00:41.51
Your current default directory is USER_DISK:[PAN]
$ @b86$:vmisym
$ set def [.msdos]
$ sho sym at
  AT == "@B86$:BRM -Q286"
$ at scratch

The BRIDGE Q-BUS/286 Version 5.1
(c) 1983, 1984, 1985, 1986 Virtual Microsystems, Inc.
1 Megabyte of Memory
MS-DOS version 3.10
(C)Copyright 1981,85 Microsoft Corp.
It Is Virtual.
Command v. 3.10 (C)Copyright Microsoft Corp 1981, 1985

E>
echo off
Are you running IBM-PC software? YES
VT-220 terminal detected.
VMS version of PC-BIOS 1.40 installed.
Downloading PCBIOS character font to terminal.

A>status

Drive A:  Virtual disk SCRATCH
Drive B:  Virtual disk NOT MOUNTED
Drive C:  Virtual disk NOT MOUNTED
Drive D:  Virtual disk NOT MOUNTED
Drive E:  Virtual disk MSYSTEM
Drive F:  1.2MB floppy disk
Drive G:  NOT CONFIGURED
Drive H:  NOT CONFIGURED
Drive I:  NOT CONFIGURED

A>mount b: msdos$:lotus
msdos$:lotus mounted on drive B
A>mount c: msdos$:dbase3
msdos$:dbase3 mounted on drive C

A>
A>status

Drive A:  Virtual disk SCRATCH
Drive B:  Virtual disk MSDOS$:LOTUS
Drive C:  Virtual disk MSDOS$:DBASE3
Drive D:  Virtual disk NOT MOUNTED
Drive E:  Virtual disk MSYSTEM
Drive F:  1.2MB floppy disk
Drive G:  NOT CONFIGURED
Drive H:  NOT CONFIGURED
Drive I:  NOT CONFIGURED


A>dir b:

 Volume in drive B is lotus

 Directory of  B:\

AUTOEXEC BAK       26   6-13-86   3:53p
AUTOEXEC BAT       33  11-07-86  11:39a
LOTUS        <DIR>      1-23-87   4:30p

 3 File(s)     266240 bytes free

A>dir c:

 Volume in drive C is MSDOS$:DBAS

 Directory of  C:\

DBASE    EXE   109568   1-06-87   1:50p
SED      EXE    34008  11-12-84  12:42p
SINSTALL EXE    22640  10-25-84  12:00p
DCONVERT EXE    60416  12-17-84   3:13p
INSTALL  HLP      896   1-14-85   1:09p
UNINSTAL HLP      768   1-14-85   1:09p
ASSIST   HLP    15223   7-15-84  10:44a
INSTALL  BAT      384  11-01-84   3:43p
UNINSTAL BAT      256   1-14-85   1:09p
INSTALLH COM    29504   1-14-85   1:09p
CONFIG   SYS      128   1-06-87   1:49p
DBASE    OVL   149504  11-02-84   1:43p
KONSTANT MEM      770   3-10-86   2:25p
SED      MSG    79232  11-12-84  12:32p
HELP     DBS    53760   7-15-84  10:44a
FUNCTION DBF      127  10-25-84  12:00p

 16 File(s)    653824 bytes free

A>host
$ LOG
  PAN          logged out at  7-FEB-1987 13:03:17.40
```

VMS is the system of choice for most VAX™ users. It uses the VAX to the fullest, provides a reliable base for commercial and engineering activities, and has many available applications packages.

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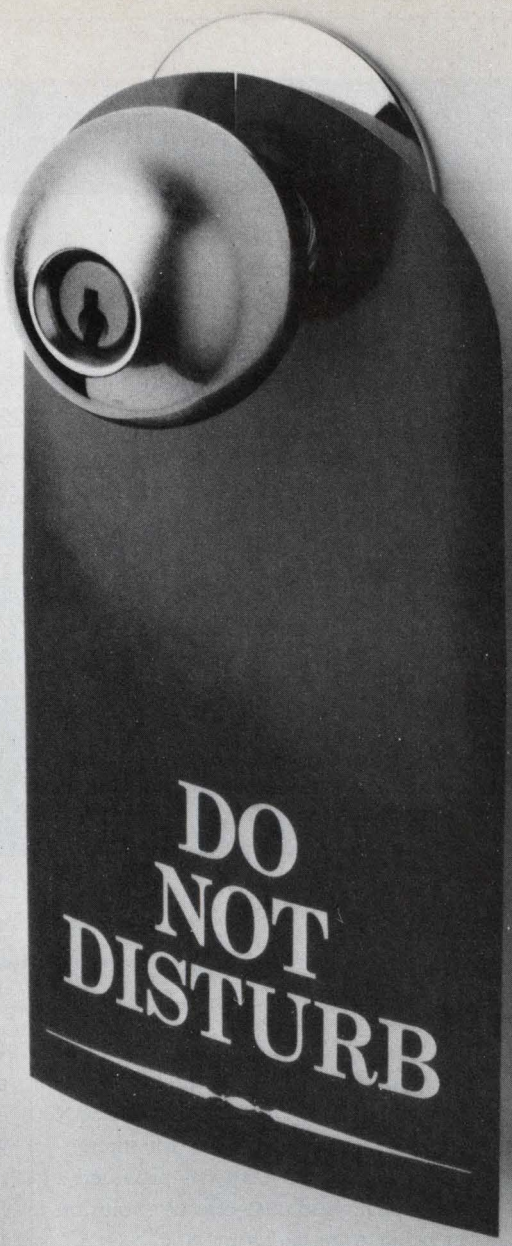

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FIGURE 1.

```
$ TYPE FIGURE2.LIS
```

Help	Do
Help	Reserved

F17	F18	F19	F20
Toggle Screen	Print Screen	Refresh Screen	Display Graph

VT-220 Application Keypad

Home	Insert	Delete
End	Pg-Up	Pg-Dn
	Up	
Left	Down	Right

VT-220 Keypad

Function Key	L-Shift R-Shift	Control	Alt
Home/7 F7	Up/8 F8	Pg-Up/9 F9	* Toggle
Right/4 F4	Null/5 F5	Left/6 F6	- Num-Lock
End/1 F1	Down/2 F2	Pg-Dn/3 F3	+
Insert/0 F10		Delete Caps-Lock	Scrl-Lock

```
Press Return to continue.

$
```

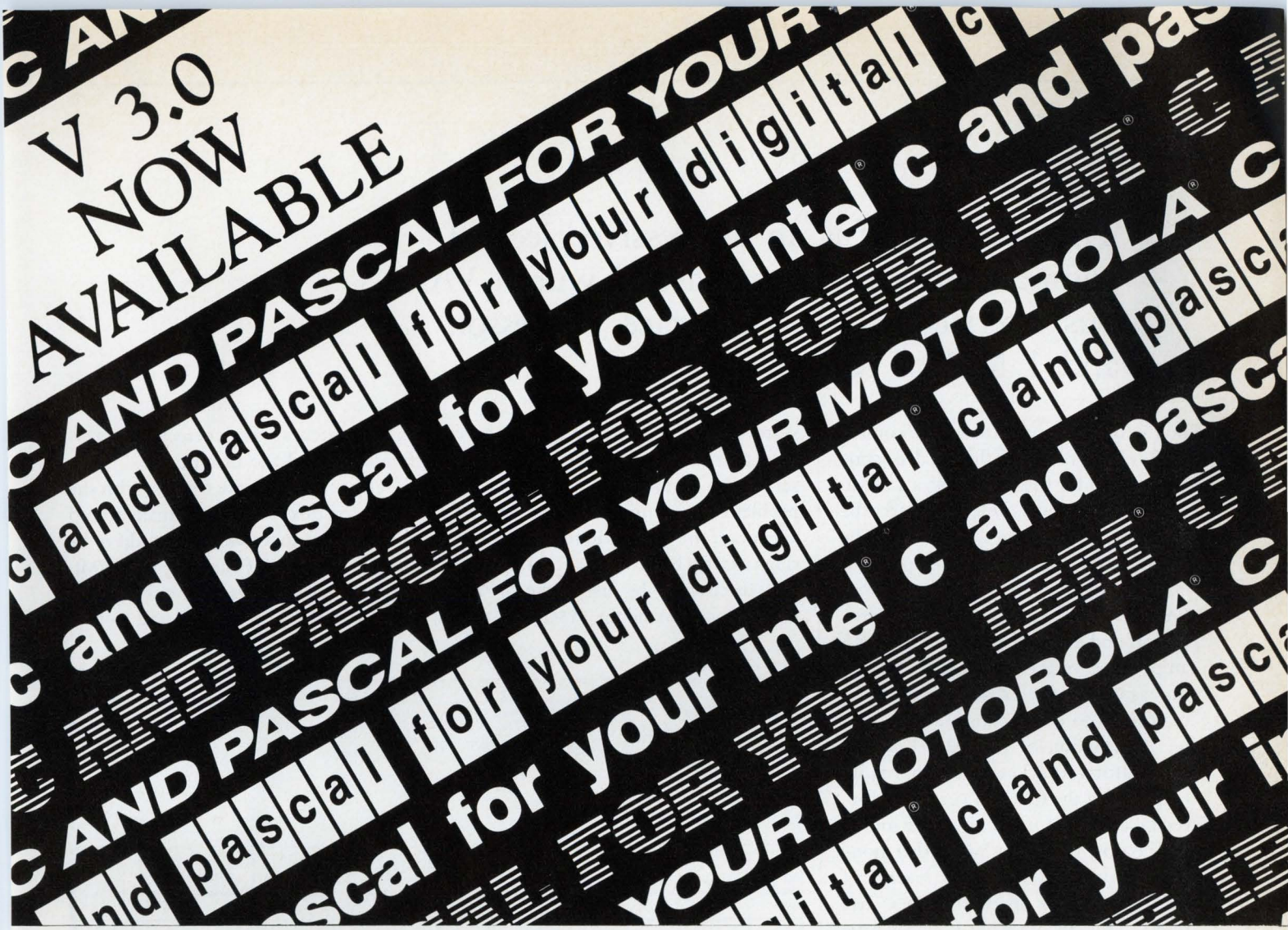
many different software packages, making software installation considerably easier.

The Network Coprocessor from VMI is just a slightly different flavor of the same hardware and software found in the *AT/BRIDGE*. Using an *AT/BRIDGE* 80286 board on the UNIBUS or Q-bus and an expansion box, VMI supplies software to support most of the many currently available local area networks on the PC. Simply plug a LAN card into the expansion box and software on the VAX emulates the file server normally supplied by the LAN vendor. The server software provides access to the VAX disks and print queues. Of course, a VAX or MICROVAX is likely to be a much more functional and cost-effective file server than any available from a LAN vendor, and you have the added features of not having any additional hardware or operating systems to maintain as well as having all the VAX functionality still available for interactive users. Again, VMI has provided a very elegant and cost-effective solution for tying together your PCs.

If you have PCs, but you don't need the power of a file server or you don't want to install a PC-based LAN, you still can store PC files on the VAX using VMI's *V-Drive* software. This virtual disk software comes in RS232 and Ethernet versions, and allows you to access virtual disks on the VAX from a PC. The Ethernet version of the software uses the standard Ethernet connection on the VAX or MICROVAX, a DEUNA, DELUA or DEQNA. Both versions allow PC users to have active VMS terminal sessions using the built-in VT220 emulator and to toggle between VMS and DOS with a hot-key. However, unlike other PC-to-VAX communications packages, *V-Drive* uses the same virtual disks on the VAX that the *BRIDGE* uses, so you can share data among PC users using RS232 connections, PC users connected to the Ethernet, and PC users on the *BRIDGE* boards. Again, users of *V-Drive* who use the virtual disks get the benefits of more cost-effective hardware and professionally managed backup services. The *V-Drive* solution is especially attractive if you have some users who need to use a PC nearly all the time (give them one, and give them *V-Drive*) and some users who need a PC occasionally, but need access to the same data as the heavy-duty users (give them access to a *BRIDGE* board).

Installation Of The System

The *BRIDGE* system I tested consisted of software on a TK50, a Q286 quad-wide board for my Q-bus, an expansion



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The board itself is an impressive piece of engineering, and is jam-packed with a VAX bus interface, PC bus interface, processor, and 1 MB of RAM.

box with five expansion slots, a combination hard disk and floppy disk controller card for the PC floppy, a 1.2-MB floppy drive, and a cable to connect the expansion box to the Q286 board. The board itself is an impressive piece of engineering, and is jam-packed with a VAX bus interface, PC bus interface, processor, and 1 MB of RAM. It draws 8.5 amps at +5 volts — a little high, but not unreasonable given that it drives a bus connected to the expansion box.

Installation of the Q286 board is straightforward. The board normally comes with the CSR and vector set correctly at the factory. If you have multiple boards, or if you have other non-DEC hardware in the upper reaches of the bus address space that DEC has reserved for customer use, you may have to change the dip switch settings. Setting these switches is no big deal, but if you need assistance, VMI will schedule telephone support for your installation. You can make an appointment and have someone available on the phone when you install the hardware. I used this service when I installed my board, and although the people I talked to at VMI were somewhat new in their jobs, I found them to be knowledgeable and helpful. (The board I used was not yet in production, so on occasion the support people had to talk to engineering to get answers to my questions.) The instructions in the manual were reasonably clear and included a discussion of how to use bus grant cards should you need to leave an open slot in your bus.

Since I had no other foreign hardware on my VAX, there should have been no conflicts with the addresses as set at the factory and I expected no problems. As it turned out, my beta test version of the board had the switch settings exactly backward, a fact I eventually discovered by using the SHOW/UNIBUS command in SYSGEN. Once those switches were correct, the Q286 board worked the first time.

I had a little more trouble with the expansion box, but we eventually traced the problem to a flaky floppy drive — hardly the fault of the people at VMI. The cabling also was very awkward on the expansion box that I tested — two

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stiff-shielded ribbon cables running from the expansion box directly to a connector on the Q-bus board, without any plugs or strain relief on the distribution panel of the MICROVAX. I have been assured, though, that this is not the final configuration and that a much improved cable is to be made available for the production version. I can sympathize with the cable designer, too. It's tough to run a bus (in this case, the PC-AT bus) over a cable outside the box without experiencing problems with interference, reflection, or losses. Even so, I don't really like a cabling system that requires a system manager or service technician to disconnect the cable from the back of the option card on the Q-bus just to move the machine or gain access to the option cards. A much better solution would use a plug on the distribution panel.

VMI Software

Installing the software is also straightforward, if a little hokey. You must use BACKUP to restore the software to your disk and then run a command procedure to build emulator software with the correct addresses. A command procedure must be added to the system's SYSTARTUP sequence to load the device driver each time the VAX boots.

I say the software is hokey because it is very non-standard in its use of VMS. I'm sure that the software folks at VMI are very capable, because the device driver and emulator software they've developed is no trivial item. But they missed the boat on the installation procedure, command procedures, menu utilities, and in their use of logical names. The installation procedure consists of using VMS backup to restore a saveset, followed by running a few command procedures and editing some system files. This sort of installation is best handled by the VMSINSTAL procedure of VMS. You have to be burned only a few times by poor installation procedures to know that VMSINSTAL is the *only* way to go.

The command procedures provided by VMI are very simple-minded, have

little or no error-handling capability, and in general fail to take full advantage of VMS. At least one site I know of had to completely rewrite the command procedure shell around the *BRIDGE* to make it reasonably fail-safe and functional. Instead of command procedures and symbol definitions, most system managers probably would prefer the use of Command Language Definitions (CLD) to be added to the system command tables. Also, the installation procedure doesn't add any help text to the DCL help files (HELPLIB), so users cannot get help with the DCL-level commands for the *BRIDGE*.

Potentially, the most serious problem is that the entire *BRIDGE* system depends on non-standard logical names. The correct format for logical names (indeed for all kinds of named resources) has been defined publicly by Digital since V2 of VMS. In V3, Digital published a separate manual, the *Guide to Creating Modular Programs on VAX/VMS*, that explicitly states all the requirements for creating logical names that will not conflict with other names on the system. Why is this important? It is important because a conflict between logical names will cause one of the conflicting products to fail, sometimes in ways that are not detected easily or reproduced. Some of the logical names in use in the *BRIDGE* product include "B86$" (invalid use of the dollar sign, which is reserved to Digital), "LOTUS" (easily conflicting with user-level logicals) and "SYS$WPRINTER". I know some system managers who have been burned so badly in the past that they flatly refuse to install any software that violates the VMS logical name standards, although I don't think it's quite that serious.

I've been told by people at VMI that they intend to improve their software by using VMSINSTAL and are considering adopting the VMS standard for logical names.

Nice Software Features

On the positive side, there is a menu system provided with the *BRIDGE* software that makes it easier for novice

users to connect to the *BRIDGE* and to perform basic functions such as transferring files to and from VMS. The menus are somewhat customizable, too, which is a nice feature. The user and system manager both can create "User Profiles" that define such options as which disks are to be mounted, what device is to be used for printer output, and which flavor of *BRIDGE* hardware (8086 or 80286) is to be used. Using the cursor, a novice user simply points at the profile that describes its function (e.g., "LEDGER" or "PROJECT_A") to get the correct disks mounted and the correct AUTOEXEC.BAT file run. Creating a user profile is easy too, and can be done from within the menu system. If no profile matches the function desired, cursor keys can be used to indicate which disks are to be mounted and the result can be saved optionally as a new profile.

There also is diagnostics software that can be run from the VAX to exercise the *BRIDGE* cells and identify certain classes of errors. I found this software to be quite useful at a site where we had a number of 8086 boards, because it allowed the system manager to identify which microprocessor cell had errors so we could busy that cell and prevent its use until a replacement board arrived.

VMI has provided a number of very useful extensions to the MS-DOS operating system to support the integration of MS-DOS with VMS (see Table 3). These utilities are primarily concerned with creating and using virtual disks and with accessing the VAX print functions from MS-DOS. I found these commands work well and have a natural interface. The convenience of working with virtual disks is enhanced greatly by the MOUNT, DISMOUNT, and VCREATE commands.

Overall, I prefer the solution of a virtual machine to the solution of a standalone PC for most applications. The VMI solution is elegant and powerful, if a bit pricey (see Box). If your need is for a PC for a single user, you definitely can find a cheaper solution in a standalone IBM PC clone. But if you are concerned with protecting your data, or making large disks available to the PC, or with many people sharing the same PC or data, the VMI *BRIDGE* is something you should investigate further. ■

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DCL DIALOGUE

Kevin G. Barkes

'Deep Cache' Tells All

I was deeply involved in designing a complex database application (written completely in DCL, of course) when the phone rang.

Lost in thought, I failed to identify myself. After a few seconds of silence, a nervous, muffled voice on the other end asked, "Are you the guy who writes the DCL stuff?"

"Yes," I replied. But before I could say my name and magazine affiliation, the caller ordered, "Turn on your recorder! Have I got something for you!"

Never one to argue with a reader, I activated the recorder in my answering machine. For the next half hour, I sat enthralled as the unidentified caller (I'll call him "Deep Cache") revealed major DCL- related product announcements scheduled for release on April 1 (April Fools Day) by the Merry Mites of Maynard.

The first important revelation is the development of a DEC-supported DCL compiler. Deep Cache says the new product, called DCL On-Line Performance Enhancer, DOPE for short, reads in standard DCL command procedures and translates them to a variant of VAX-11 BASIC. The resultant source code then can be compiled and linked using the new dialect BASIC Adaptive Recombinant Formatter (BARF).

You can contact Kevin G. Barkes by writing his office at 4107 Overlook Street, Library, PA 15129; *DEC PROFESSIONAL*, P.O. Box 503, Spring House, PA 19477; via CompuServe Easy-Plex, user I.D. 72067, 341; by calling the author's DCL BBS at (412) 854-0511 (FidoNet 129/38); or by leaving a message in the ARIS Suggestion Box, (215) 542-9458.

Deep Cache said the most difficult part of the project was modifying VAX-11 BASIC into the new BARF language. "DEC software engineers greatly underestimated the amount of time it would take to remove floating point capability," he reported. "Stripping out the ELSE and WHILE statements was a real bear, too."

In conjunction with the DOPE and BARF releases, Deep Cache revealed that DEC also has added several new lexical functions to the DCL repertoire. Some of the newer capabilities, which should be incorporated into VMS V4.601, include:

F$ENVIRONMENT("PERFORMANCE")-
This function performs an instant analysis of system performance, using advanced artificial intelligence techniques. Deep Cache says that unlike other lexicals, which use VAX/VMS System Services, this function actually invokes an expert system developed internally by DEC. "The problem," according to DC, "is that the expert system wasn't written by the VMS team — it was written by *Sales*. The function always returns the string, 'BUY AN 8800' ."

F$GETDVI("device","LITIGATION")-
"DEC's decided to become even more aggressive in pursuing third-party vendors who infringe on the VAX BI bus," Deep Cache said. This lexical, imbedded in the system startup command file, polls each device connected to the BI bus to determine if any "foreign invaders" are on the system. If non-DEC hardware is discovered, the system automatically calls out via the RDC line to a team of lawyers on 24-hour standby at DEC's support site in Colorado Springs. If the customer hasn't subscribed to the Remote Diagnostics facility, the system will not boot and will print out the message "No habla bogus BI" on the console device.

F$GETSYI("LICENSE_POLICY")-
The recent controversy over the transfer of VMS licenses has prompted DEC to reassure some user sites on an almost daily basis. To reduce costs associated with the massive influx of calls and letters, DEC added this function to provide online information about the current VMS licensing policy. Calls to the function return various string values, including "YES", "NO", "HMM . . . THAT'S A GOOD QUESTION", and "KEN WILL GET BACK TO YOU ON THAT".

F$COOKIE()-
The widespread popularity of "Fortune Cookie" software (programs that display cute messages to users at login) has prompted DEC to provide this built-in message generation capability. A sample of the text returned by calls to this function include "Digital Has It Now (but it's on back-order)," "We Don't Comment on Unannounced Products," "It's Not A Bug, It's A Feature," and "Will Be Fixed In A Forthcoming Release Of VMS."

In conjunction with the introduction of F$COOKIE(), DEC has announced "Sayings of Chairman Ken", a new release from Digital Press ($39.95, softcover).

Several major enhancements to

VMS security also are upcoming, according to Deep Cache, as a result of DEC's continued success in selling to various Department of Defense (DoD) agencies. In direct response to Pentagon specs, look for an upcoming version of VMS to contain an /INVISIBLE qualifier to the PRINT command which should help users protect unauthorized personnel from reading sensitive printouts. Also, watch for enhancements to the DECtalk interface, including "whisper" and "mumble" functions.

To further enhance security, all users have NL: as their default device. "It creates some file maintenance problems," Deep Cache admits, "but the data is absolutely secure, incremental backups are a snap, and the I/O is too fast to be believed."

No firm release date has been set for this security package. "The resulting systems are so secure, DoD can't figure out how to log in," DC reports. "DEC's scouring hacker BBSs for free-lance consulting help to resolve the problem."

Two other actions planned by DEC, while not directly related to system operation, also should make life easier for managers and users:

1. The announcement of a change to a long-rumored policy, whereby DEC will alter the manner in which it reimburses its technical writers for creating VMS documentation. While the new method wasn't revealed, Deep Cache confirms that DEC has abandoned its old payment procedure, which was based on the number of pounds of documentation produced.
2. The acknowledgment of user unhappiness with constant modification to various operating systems, high-level languages and layered software products. DEC therefore, will, at a slight premium, offer to support those sites wanting to continue operations with "old" software. Look for a selection box on future maintenance agreements where users can choose between "New Code" or "Classic Code."

I'd like to thank Deep Cache for these interesting nuggets. I offered to pay him for the information, but he refused "cache." Instead, he insisted I send him, of all the idiotic things, a coffee mug.

OK DC, your cup's on its way. As for a ride in my Porsche, well, would you settle for a monthly pass on Pittsburgh's trolley line?

Kevin G. Barkes is a specialist in VAX systems software, management, tuning and training in Library, Pennsylvania.

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Ralph Stamerjohn

System Crashes, Part 2

Different programmers enjoy different parts of the software cycle. The majority take greatest job satisfaction from actual coding, while others like the design phase. My specialty is debugging. I especially like solving system crashes. Crash dump files have the same effect on me as a mysterious caller to 221B Baker Street had on Sherlock Holmes.

My approach to crash dumps also follows Holmes' behavior at a crime scene. After quickly scanning a few crash dump listing pages, I alternate between periods of staring into space and frenzied page turning. When the culprit is apprehended, what I consider a perfectly logical explanation may seem to be the result of black magic.

Just as Sherlock Holmes was an expert in cigar ash, poisons, and footprints, I have mastered tracing through the system stack, locating the stray I/O, and accounting for all pool usage. Our expertise gives both Holmes and me the ability to observe minute facts and make startling deductions.

While crime probably is too large an area to be mastered by current artificial intelligence technology, crash analysis is a perfect application for an expert system. In fact, such a system could work almost unattended, getting the necessary input from the crash dump file and working on a rule base that includes the current sources and all known problems.

This article looks at some design goals for a crash analysis expert system and the initial rule base an RSX implementation of the system might follow.

Editor's Note: Part 1 appeared in the February issue.

THE GOAL OF CRASH analysis is to find and fix the logic that caused the system to crash. If we can't reach this goal, our purpose is to better understand why the system crashed at this particular point. Learning to avoid a crash is almost as good as an actual fix.

Our hypothetical crash analysis expert system starts with our observations of what was going on at the time of the crash. The first question the expert system always asks is "What was new or unique about the system at this point in time?" If we answer that Joe ran his new program for the first time, the system would ask Joe to run the program again before allowing normal use. A second crash might result in our giving Joe the rest of the day off as a means of avoiding future crashes.

One crash in 10 is resolved just by reviewing your observations, especially crashes caused by pilot error. It's more likely you will isolate the reason for the crash, and move further work on the problem to off-hours.

The other nine times, however, you need to dig into the crash dump. The hypothetical expert system first would ask some questions on how the system crashed: Did a failure take you to XDT, directly to the crash routine, or did you force a crash by starting at location 40? (See Part 1 for details on all the different ways an RSX system crashes.)

Our expert system then starts examining the crash dump file. Its first goal is to find the instruction that caused the system fault. That instruction is called the *physical crash point*. For instance, the following RSX executive instruction will cause a crash if R5 is an odd address instead of the expected UCB address:

One crash in 10 is resolved just by reviewing your observations, especially crashes caused by pilot error.

```
MOV U.RED(R5),R5    ;Get next redirect
                      chain
```

The various ways you can crash an RSX system determine how the expert system would find the program counter (PC), processor status (PS), stack pointer (R6) and general registers (R0-R5) for the physical crash point. The easiest case is an XDT crash. If the crash was generated by typing *X* to XDT, the physical crash PC/PS are shown on the crash listing on the "BEFORE CRASH PC/PS" line on the first page. The next line lists the general

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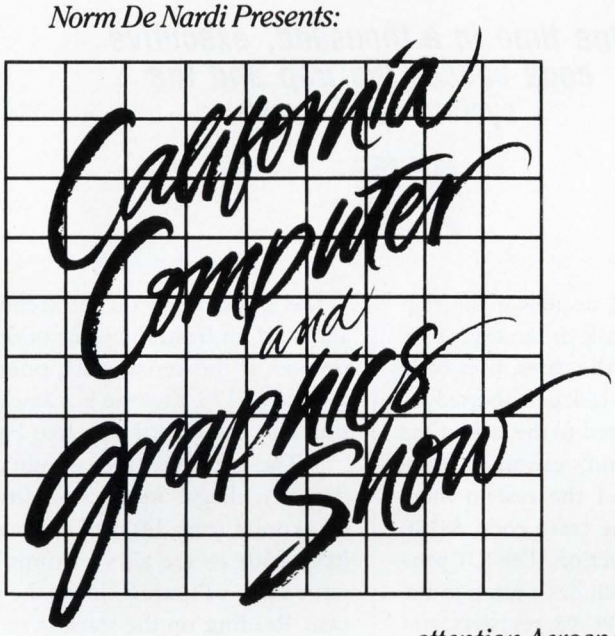

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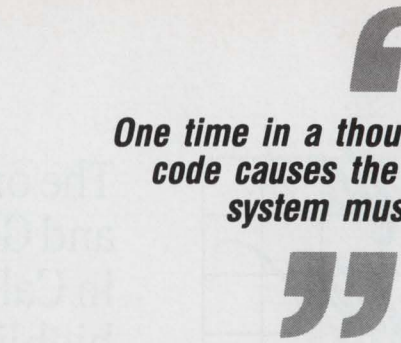
registers at the time XDT was called and SP(K) value on the first line is the kernel stack pointer (R6) when the crash occurred.

These values also are used if a crash is forced by starting at location 40, except the BEFORE CRASH PC/PS. The PC and PS values in the listing are meaningless. Instead you use the PC/PS you wrote down when you halted the system. These crucial values are lost when you restart the CPU at location 40.

The crash listings are misleading when you try to find the physical crash point when the system jumps directly to the crash routine. The BEFORE CRASH PC/PS are for the standard instruction (an IOT) that RSX issues when it has decided the system must crash. Furthermore, the registers and kernel stack pointer reflect the processing RSX did in deciding to crash. We really want to find the place that forced RSX to execute this code.

REMEMBER THAT ALL crashes in this category are initiated by some form of instruction trap: odd address, illegal instruction, segment fault, stack limit violation, or instruction (BPT, IOT, EMT, or TRAP). All of these traps are processed in the same way in the module SSTSR: The registers are saved, some trap specific data is pushed onto the stack, and RSX decides if the trap belongs to a user task or the executive. In 99.9 percent of the cases, user code is blamed and some task gets aborted (or an SST trap is declared to the task). One time in a thousand, executive code causes the trap and the system must crash. To get to the crash code, SSTSR issues an IOT instruction. The IOT processing in SSTSR includes a jump to the crash routine. The PC/PS, registers, and kernel stack of this IOT instruction are reported on the first page of the crash listing.



One time in a thousand, executive code causes the trap and the system must crash.

However, it is the contents of the kernel stack that interests us. There are six different cases to consider. Some simple pattern matching makes it easy to identify different cases from one another.

In all cases, you start by getting the kernel stack pointer from the first page of the crash listing. Then you turn to the kernel stack dump on the second page and start up from the value of the stack pointer. If the kernel stack pointer has a value of 376, the trap is a stack violation and the stack looks like Figure 1.

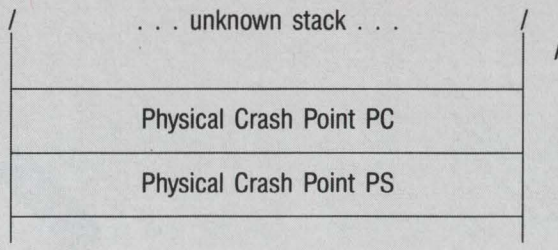
The next four cases — odd address (trap 4), illegal instruction (trap 10), breakpoint (trap 14), and segment fault (trap 250) — are all variations on the same theme. Figure 2 shows the general case. Reading up the stack is the PC/PS of the final IOT in SSTSR, two constant values that vary according to the type of trap, and any optional parameters. Next comes the return address of the executive coroutine used to save the registers and the saved R0-R5. We finally come to the PC/PS of the actual trap. This is the physical crash point. The registers at the time of the crash have been neatly saved on the stack.

The two constant values make it easy to find out which trap occurred. The table in Figure 3 shows the relationships. The pattern of odd address trap (4,0) probably is the most common. Only segment fault (12,2) has any optional parameters. The memory management registers SR0, SR2, and SR1 respectively are pushed onto the stack.

The last case is the IOT crash. The IOT instruction is the RSX crash instruction. There are over 20 places inside RSX where the executive becomes confused enough to crash the system deliberately. You get the physical crash point from the first page of the crash listing, just as if this were an XDT crash.

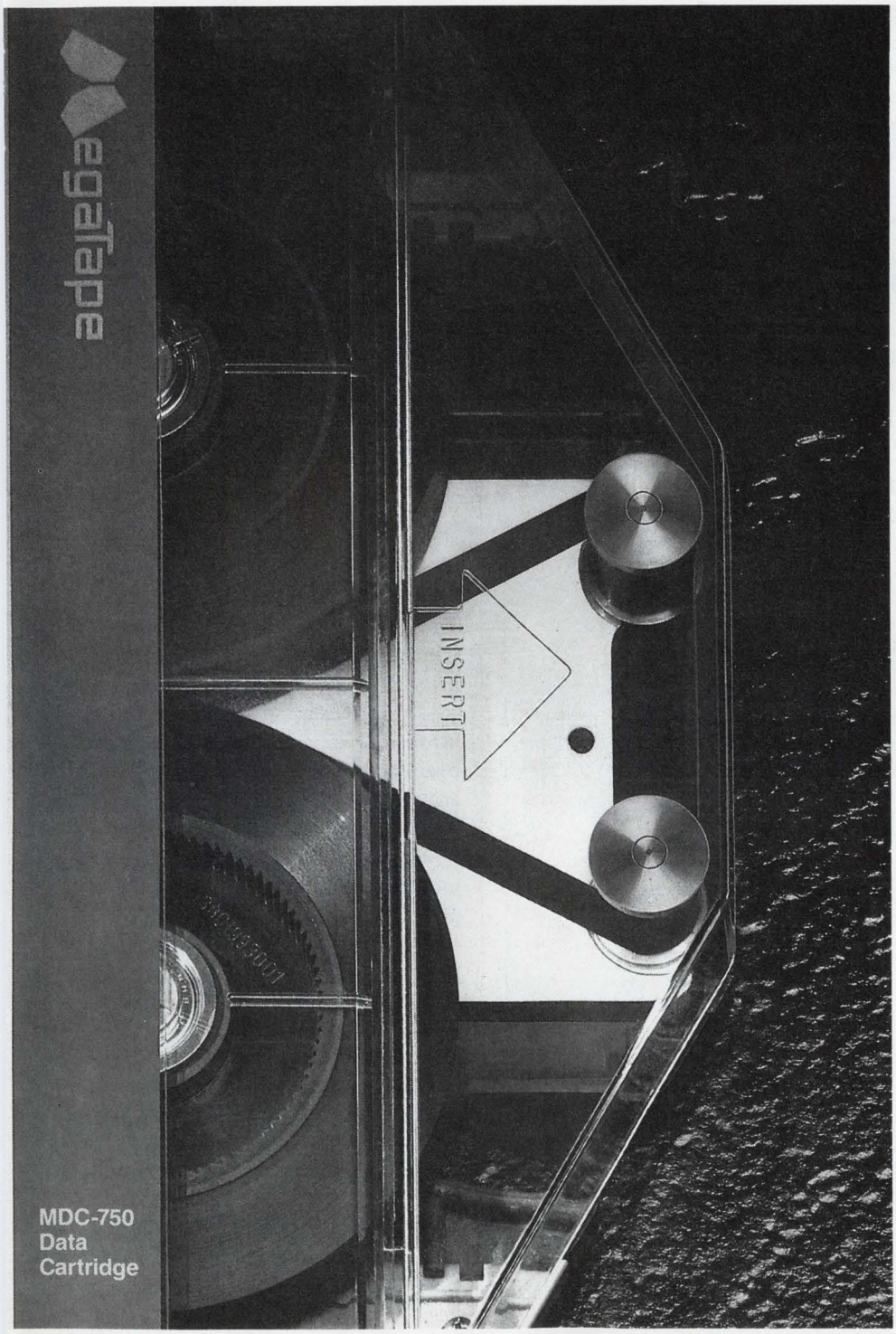
It only takes a few seconds to get the PC, PS, and general registers of the physical crash point (after you have done it once or twice). The expert system

FIGURE 1.



Stack violation.

Any disk backup system can save your data. This one can save your life.



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Getting To Code

The next step is to start reading code. It takes four stages to get from the physical crash data to the correct source listing. You map the PC to physical memory by using the memory management registers listed on the first page of the crash listing. You then find which component is loaded into this part of memory by scanning the memory map page in the crash dump listing. This page is found at the beginning of the partition information section. You then look at the component's task map to find the source module, and finally, look in the source module to see the instruction that caused the fault.

This process actually is not as involved as it sounds. Crashes always happen in kernel CPU state so you are only concerned with the Kernel I Space registers (lower left corner). If the PC is from 0 to 120000, the physical crash point is in the executive and you look directly in the executive map ([1,34]RSX11M.MAP) to find which module was involved. If the executive source listing isn't available, make one by using the following command:

```
MAC ,file = LB:[1,1]EXEMC/ML,SY:
    [11,10]RSXMC,file
```

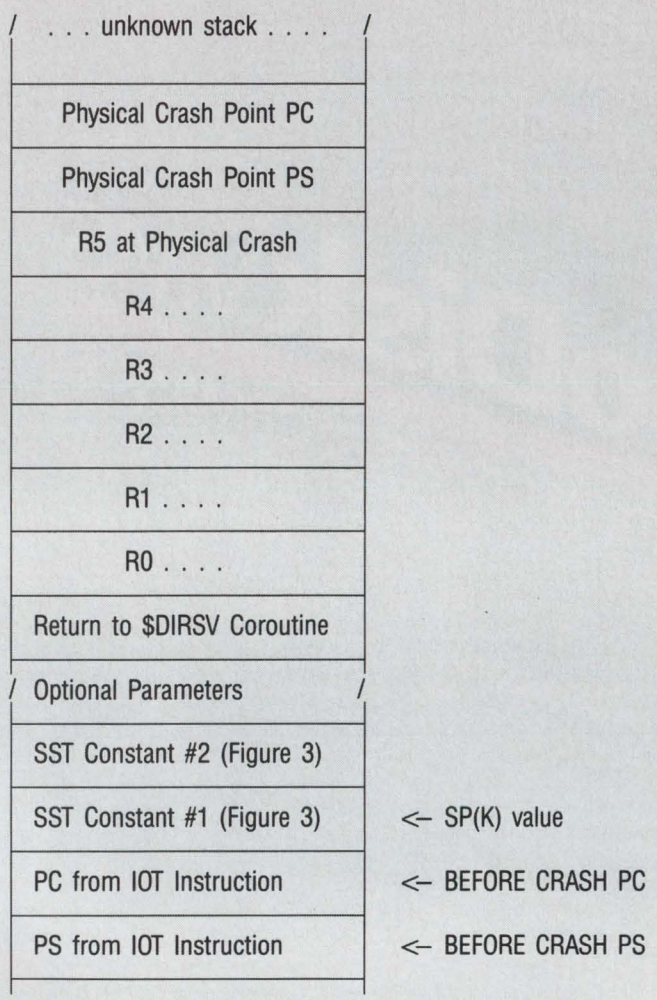
Addresses above 120000 are either device drivers or privilege tasks. The number in the appropriate memory management register gives the physical memory address in 32-word units. You append two zeros to get the octal physical address. It is then quick to scan along the base column in the memory map to find the component that begins just below some given physical address. You now know the component for which you might need to generate a map and listings.

The translation from crash dump PC to source listing instruction occurs over and over again during crash analysis. You need to remember that the PS at the time the PC was used determines which set of memory management registers are used to compute the physical memory address. *The PDP-11 Processor Handbook* has detailed information on the format of the processor status and the operation of the memory management registers.

Crash Detective

A crash is a sequence of time-ordered events: the system is performing normally, the logical error occurs, the system continues processing, the physical error occurs, and the system crashes.

FIGURE 2.



General case.

FIGURE 3.

Trap Type (Vector)		Constants #1,2
Odd Address	(4)	4,0
Illegal Instruction	(10)	4,10
Breakpoint	(14)	4,4
Segment Fault	(250)	12,2

SST codes.

The element of time is crucial to crash analysis. A crash dump gives you a snapshot of the system at the physical point of failure. All registers, stacks, and variables are frozen at this point. We need to try to use this information to walk backward in time to the logical error. The ideal crash analysis utility would be a screen-mode debugger that

> ***"When the logical error occurs in the same context as the physical crash point, it probably will take only one crash to solve the problem . . ."***

single-steps backward! Register and variable contents would be back-dated as far as possible.

Backward debugging is possible because the kernel stack provides the past history of what happened in the system since the last switch from user to kernel state. Walking up and down the stack lets you reconstruct the immediate chain of events.

The easiest crashes to solve are those where the sequence of events is TRAP TO EXECUTIVE (for example the SET EVENT FLAG directive is issued), some processing, logical error, some more processing, physical error, and crash. When the logical error occurs in the same context as the physical crash point, it probably will take only one crash to solve the problem because all the history is captured by the crash dump.

The difficult crashes are those in which the history from the logical error to the physical error has been lost. There is no cookbook approach that ap-

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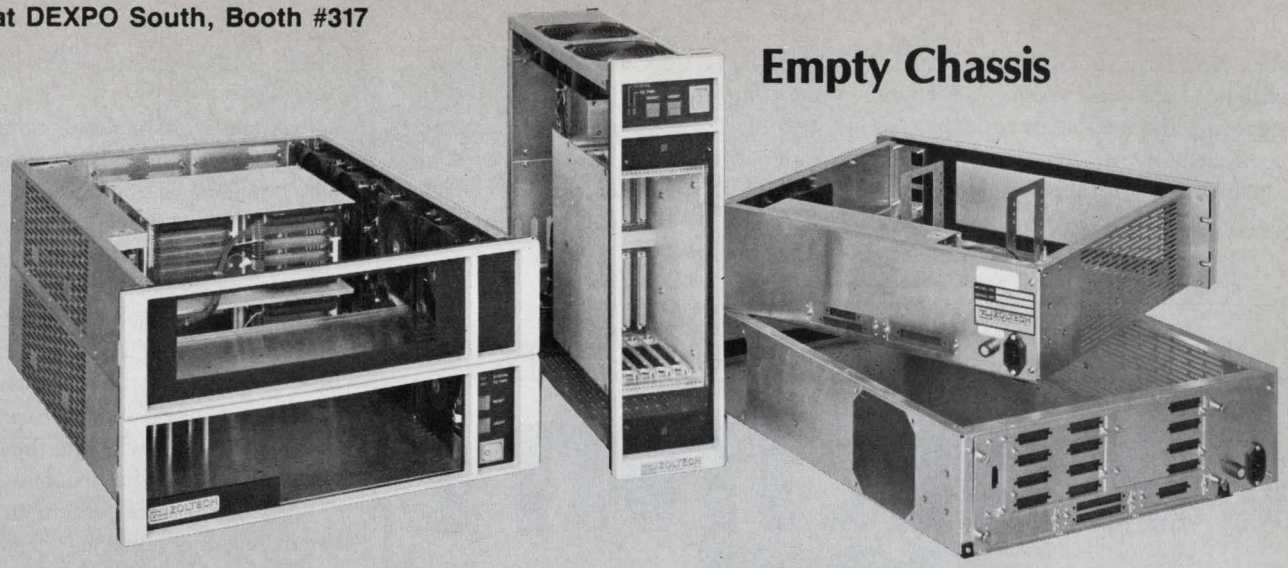

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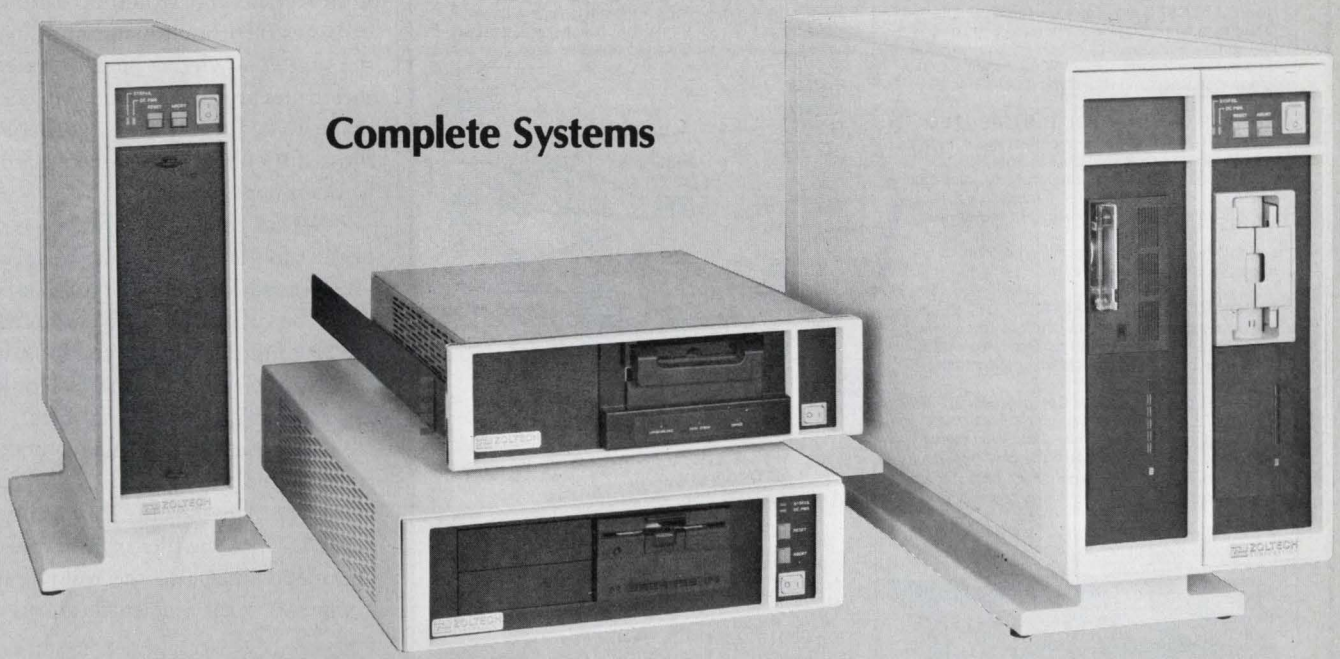

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plies. You have to collect the available evidence and use your judgement regarding the next steps to take.

It helps if you can learn to think like a PDP-11. It's critical to remember that a system crash is a completely logical event, at least from the point of view of the computer. If a routine has been successfully executed once, the exact same input to the same code will work the second, third, and all subsequent calls. If a call to this routine crashes the system, we need to find out what has changed.

Occam's razor also applies to crashes. Crashes often leave what seems to be unrelated or conflicting evidence. But when the crash finally is solved, the logical error turns out to be an obvious explanation for all the facts. As you accumulate evidence and symptoms about the problem, try to theorize the simplest glitch that fully would explain the facts. When you attempt to prove the theory, you either will find the bug, or learn more about the problem.

This is the point where an expert system becomes valuable. The evidence gleaned from crash dumps can point to actual problems if you apply a knowledge database to the data. For instance, if you tell me one of your symptoms in your system clock occasionally loses 18.2 minutes, I know the problem is a device forking twice. This and probably another hundred different rules can be coded.

Tricks

Unfortunately, it would take hundreds of pages of printed material to express the same knowledge because, in effect, these rules are all that I and others know about RSX. Experience is probably the most difficult subject you can attempt to document.

What I can cover, however, is some of the tools and tricks I use to solve the tough crashes. The first tool is what could be called the crash dump editor, the ZAP utility. ZAP lets you look at any word in any file. This is perfect for looking around in crash dump files.

ZAP uses an ODT-like syntax and is explained fully in *The RSX Utilities Manual*. ZAP is the only RSX utility that doesn't accept the filename on the initial command line. Use the following sequence to open a crash dump file:

```
>ZAP
ZAP>filename/AB/RO
```

The /AB switch tells ZAP to open the file in absolute mode. The /RO switch prevents you from accidentally

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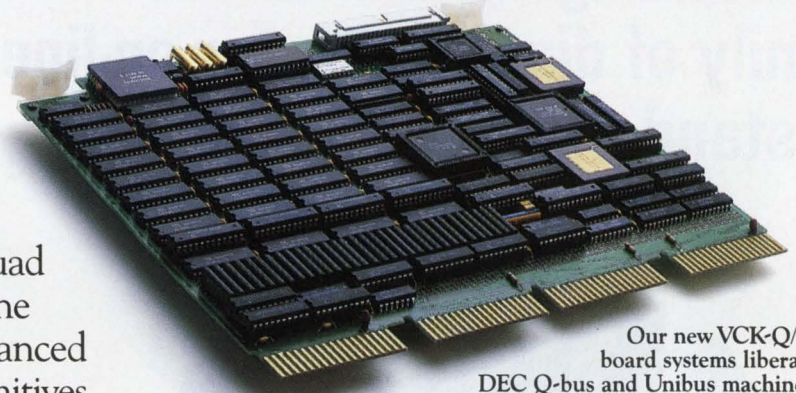

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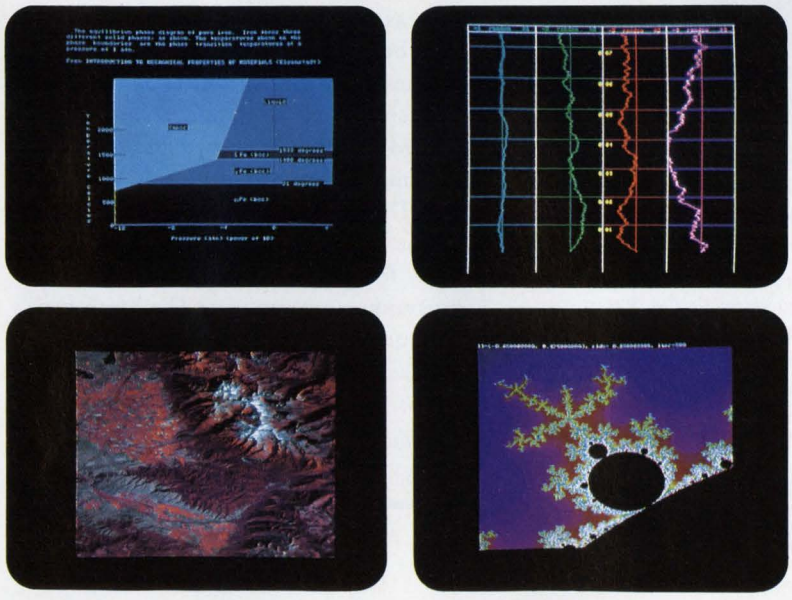

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modifying the crash file. Nothing can be more frustrating than spending 12 hours chasing down a bogus piece of evidence you put into the dump.

You use ZAP to dig out evidence from the crash dump. For instance, you have looked up the physical crash point in the source code and found the instruction we failed on was:

```
MOV U.RED(R5),R5     ;Get next redirect
                      chain
```

However, R5 at the time of the crash is not odd. What can explain the problem? ZAP commands can be used to find that the MOV instruction has been clobbered. ZAP can access only 32 KW from a given base address. When looking at a crash dump file, it's useful to set relocation registers to the base of various components. For example, 1:0;1R sets relocation register 1 to physical memory address 0 (block 1, byte 0).

Assume you want to examine location 123404 in F11ACP. According to the crash listing, F11ACP is located at physical address 345200. The following commands examine the desired address:

```
_346:200-120000;2R or _346:200;2R
_2,123404/             _2,3404/
```

It isn't difficult to write your own programs to do special analysis of crash dump files because the file format is fixed length 512-byte records. For example, your analysis shows something is eferencing location 30 (EMT trap) illegally and storing a 2456 in it. These numbers have to come from somewhere. It's worth a shot to write a throw away program to read the entire crash dump file and output all occurrences of 30 or 2456.

It probably is too late to develop a crash analysis expert system for RSX. On the other hand, I've heard estimates that as high as 100,000 RSX systems have been sold. If each of those systems crashes only once a month, 34 systems have crashed in the 15 minutes since you started reading this article. Is your system still up?

These tricks and more are discussed in the workbook Ken Johnson and I used for the Crash Dump Analysis presymposium seminar. The book can be found on the Fall 1982 RSX SIG tape.

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

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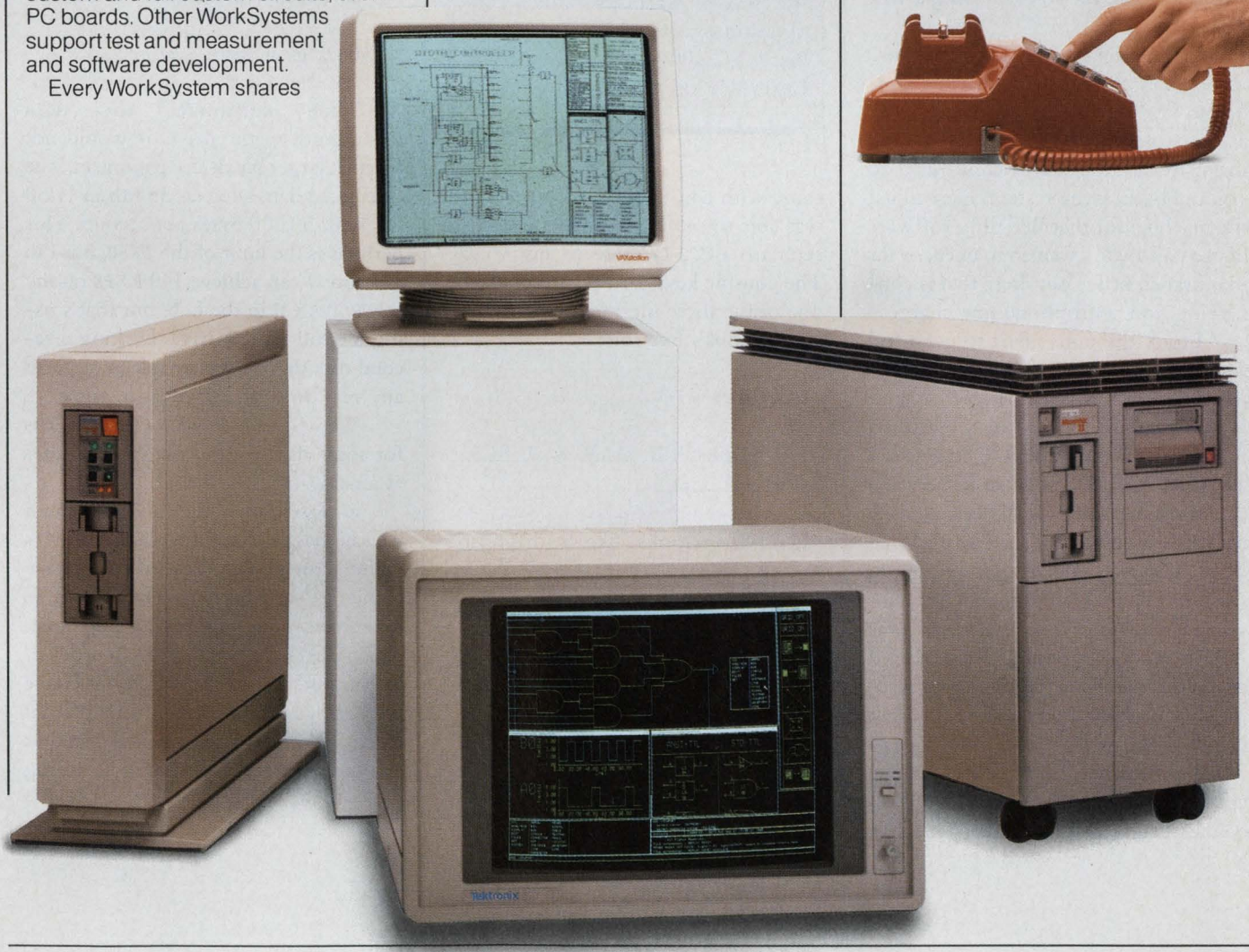

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DEC NEWS

Dave Mallery

MICROVAX 2000

Behold the shape of things to come! A busless (almost), smaller than a bread box appliance that will change the way we think about computing.

I could orate endlessly about the packaging, the footprint, the price, etc, but what really arrests me is the appliance concept. Here is enough machine for four busy users that can plug into a local area cluster and run without disks, yet do everything a VAX can do!

The model that my friends at DEC were good enough to lend us is configured for four users standalone. There is an expansion box with TK50 (and room for another half-height disk) so you can backup the system. Here is just the machine for that fledgling software house you always wanted to open, or for that branch office out there that is consuming you with phone line charges.

I took the units apart to get a feel for the maintainability. I am sure that the mean time to repair (MTTR) for any unit is under a half hour in the worst case. Judging from our own MICROVAXs, I am sure that the mean time between failures is very long. (Field Service is one of DEC's biggest profit centers!) When I put it back together after the photo session, I had a few moments of doubt when it refused to do anything. All was well, however, as soon as I remembered to put the ThinWire terminator connector back on. An unterminated Ethernet is very confused.

The units have a nice feel. They are compact and exude solidity. The interconnecting cabling is a snap. This unit

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came with DECconnect adaptors, but I was able to cable a terminal up using a standard BC22-D cable to my VT220. The console keyboard turned out to be one of the three modular ones. System startup looks like this:

```
KA410-A V1.0

F__..E..D..C?..B...A...9...8...7...6...5...
  4__..3__..2__..1...
```

(then what looks like a diagnostic callout:)

```
?? C 0080 000.1000

>>> (then you boot)
```

Obviously the quantity and quality of on-board diagnostics has gone up.

Once logged in, it's great to see that you still are in your familiar working space and that that cute little appliance really runs VMS.

I tried to get some initial data-rate determinations using the TK50 and good old backup. It took 11 minutes to create a standalone backup tape using the manager menu procedure.

An image backup took about 11:30 minutes. The TK50 was streaming for at least half of the time, if not more. Dismounting a TK50 takes forever and freezes your process. I noted that after 11:30, the machine was moving tape on but not doing any I/O. That went on for another six minutes, but CTRL-T verified that no more writing was going on.

The backup parameters I used were:

```
$backup/image/nocrc/buff:5
```

This maximizes the data throughput to the drive. It would not accept a larger block size parameter. The calculated data rate was 35 MB in 11:30 or about 50,700 bytes per second. This perhaps is the limit of the TK50, but I'm not sure. I can achieve 140 KBPS on my MICROVAX II in the Lab, but that's using a 6250 50 IPS drive. Lacking a second disk drive, I was unable to perform any real disk to disk measurement.

We will have to wait a few months for some hard figures on the data rates attainable over the LAVC.

A close look at the CPU (or should we say main system) reveals that DEC's manufacturing abilities recently have come far (see Photo 1). The tolerances for surface mounting that big chip (main data paths) in the center are an order of magnitude tighter than anything I have seen in true production from Digital recently. In fact, the pin density on that chip belies that we soon will be seeing

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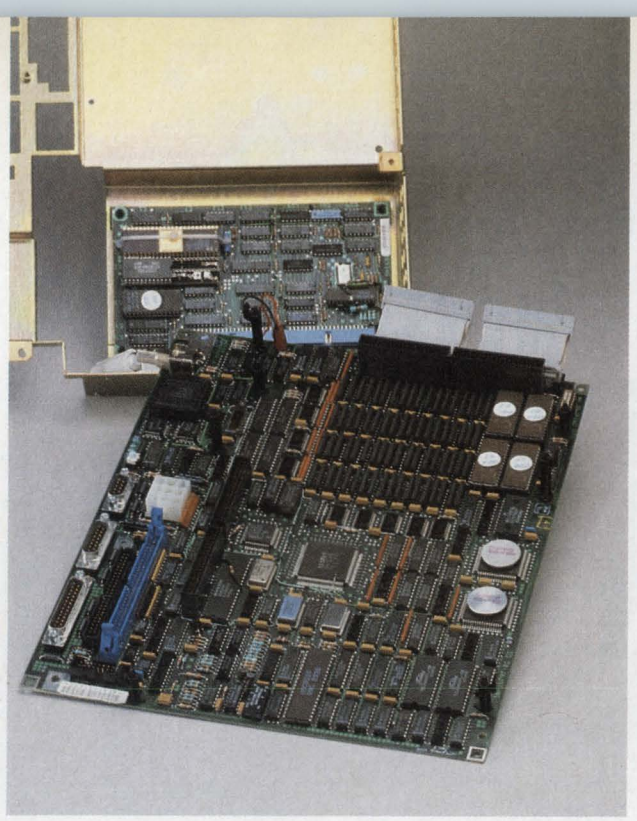

Photo 1.

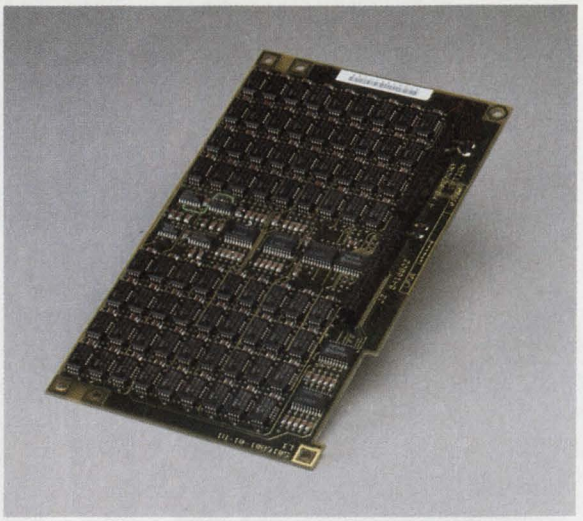

Photo 2.

truly massive compactness in most new products. I also note that there is still a long way to go in the shrinking process as most of the glue chips are 74LS family that are readily available in surface mount. This board truly contains all the generations of chip mounting technology. There are regular dip, skinny dip, zip mount, regular surface mount and the very dense variety in the center.

The 4-MB add-on board with surface mount 256K chips on both sides is shown in Photo 2.. Isn't it nice that the same board done with 1-MB surface mount chips will add up to 16 MB (which just happens to be the addressing capacity of the motherboard)? Add-in vendors take note: Surface mount is now the name of the game.

The cabinet is shown in Photo 3. The network interface (ThinWire) board sits on stand-offs above the power supply. There are two sets of power and signal cables for disk drives (so you can have half-heights. A good sign is that no modifications are made to the drives to "DEC-ize" them. There is an expansion interface extension on the bottom of the box. This provides room for cable connectors to an expansion box.

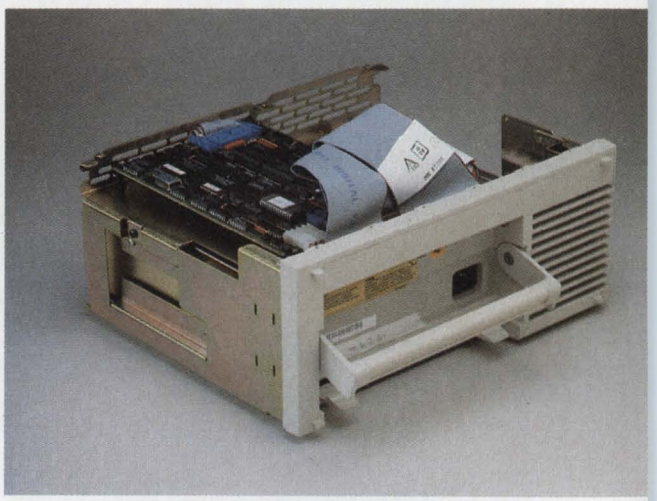

Photo 3.

In the expansion box (Photo 4) we find a small computer system interface (SCSI) to TK50 interface. At the bottom note the power terminator that uses up the extra power you might need for another half-height drive. The SCSI bus simply loops in and then back out to another connector for further expansion.

Editor's Note: For more information, see the MICROVAX 2000 announcement in Dateline DEC, page 26.

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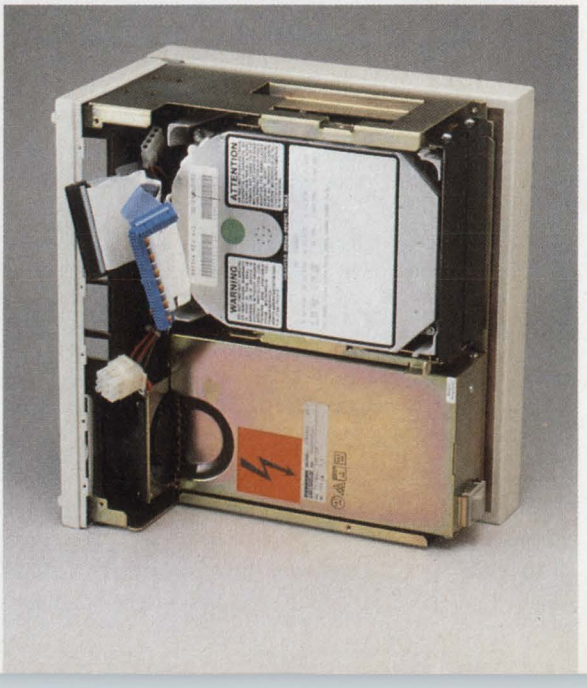

Photo 4.

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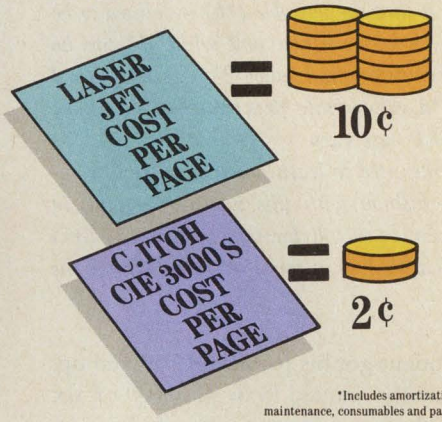

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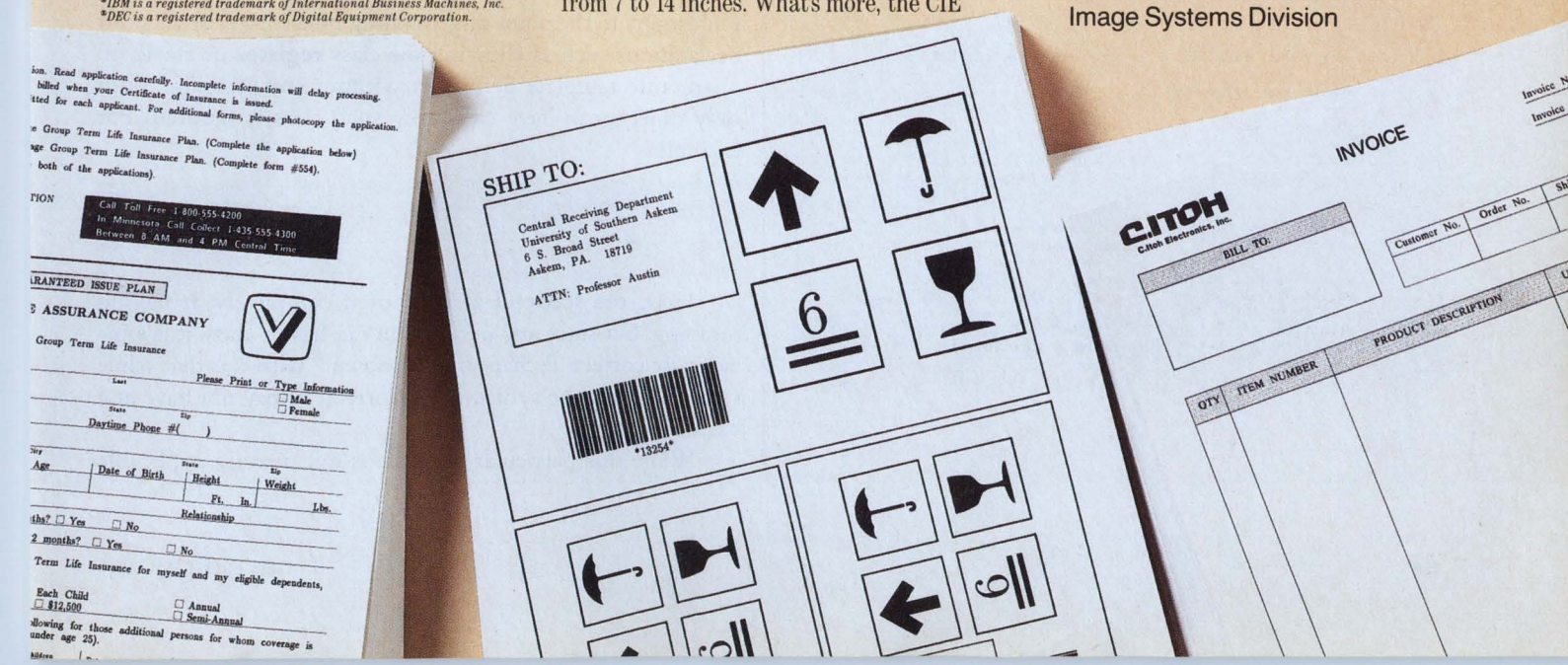


LET'S C NOW

Rex Jaeschke

Type Compatibility

Editor's note: The rules for C's type compatibility long have been known, but C compilers rarely have enforced them to any real degree. And even some versions of the LINT static analysis utility, designed specifically to highlight such inconsistencies, fail to check assignments thoroughly. As Mr. Jaeschke points out, this practice will come to an abrupt end when you install a compiler that conforms to the proposed ANSI C Standard. Forewarned is forearmed. The topic for this column was prompted by the following reader letter.

Dear Mr. Jaeschke:

I have been following your "Let's C Now" series with great interest for some time. Since I teach the C language at the college level, these articles have been of particular help in highlighting the less obvious implications of the language syntax and, on occasion, I have referred my students to them.

In my daytime job I am a C programmer, using the Portable C Compiler (PCC) under ULTRIX. The following example, presented by a student who got his parentheses mixed up, caused me to spend the better part of the next workday staring in disbelief at what the compiler was doing, and I thought I'd share it with you.

At first I figured that:

**(b)[6] is a char*
*(*b) is the address of an array of 6 chars*
(b) is a pointer to the address of an array of 6 chars

but boy was I wrong. To begin with, ***b*** *somehow is made equivalent to* ***(char **)****. For the gruesome details, see below:*

```
main()
{
        static char (*b)[6];    /* an unusual declaration */

        static char a[] = "Hello";
        char *c = a;
        char **d = &c;

        b = d;                  /* b = d gives no warning or lint error
                                   so b must be a char **. So b == d,
                                   but *b != *d. Watch. */

        printf("%u\n", d);      /* prints address of c (OK) */
        printf("%u\n", b);      /* same as above */

        printf("%s\n", *d);     /* prints "Hello" (OK) */
        printf("%s\n", *b);     /* prints 0 (but *b should == *d? */

        printf("%s\n", ++(*d)); /* prints "ello" (OK) */
        printf("%s\n", ++(*b)); /* causes a compiler error (???) */
}
```

What seems to happen is that the variable ***(*b)*** *is defined to be an array. This means that* ****b*** *is a constant and while* ***(b)*** *can be modified,* ****b*** *never will change its original value. Thus, setting* ***b = d*** *does not mean that* ****b == *d****. *Also, while* ****b*** *is treated as a constant (unchangeable), the value of* ***b*** can vary.

I would be extremely interested to learn whether other C compilers perform in a similar fashion with this monstrosity and, in fact, what the correct treatment of this declaration should be. I can't believe that this was what Ritchie had in mind when he defined the language.

When you say the student got his parentheses mixed up, I assume that what he really wanted was an array of six pointers to type **char**. If that were the case, the declaration should have been one of the following:

```
static char *b[6];
static char *(b)[6];
```

Since the parentheses in the latter declaration are redundant ([ ] bind tighter than the indirect operator *, K&R precedence table, page 49), this form is unlikely to be used, in which case, no parentheses are needed at all.

In any case, it is not important for our purposes to know what was intended, but rather to explain what actually happened.

Food For Thought

C is a very orthogonal language. It has a number of rules with almost no exceptions. For example, once you understand the operations possible on one particular type, you immediately know the operations possible on all types. C follows this philosophy to the point of generating nonsensical or vacuous declarations such as allowing the class **register** or **static** on a structure template definition without complaining. Since only objects can have class, any such class is ignored. For example:

```
static struct s {
        int i;
        double d;
};
```

Here, the **static** class is ignored completely. It has no meaning, but since any declaration can have a class, it is syntactically correct. Perhaps one "problem" with C is that while something may be syntactically correct, it may not have any useful meaning.

While this particular example is not directly applicable

to the problem above, it does indicate that if you think of C in the same terms you do of other (more restrictive, and perhaps "safer" and less-powerful) languages, occasionally you will be surprised, and generally in an unpleasant manner.

Taming The Monster

I have submitted this reader's "monstrosity" to four different compilers and one interpreter and each has behaved in exactly the same way, albeit with different address values being printed, as expected. So, are all five translators wrong or is the program "correct"? Well, the last statement does contain a fatal compilation error so let's defer a discussion of that problem until later. Once that was removed from the function, all my translators compiled and ran without error. However, I did get some interesting warnings at compilation time. I also passed the code through two versions of LINT and they both gave warnings as well.

The bottom line then, is that while the ULTRIX compiler and LINT should have generated at least one warning message, the behavior observed by the reader is reasonable. Even though the program is not technically correct, it does produce predictable results.

All examples following were run on a 16-bit machine where data pointers are two bytes long as is the *int* type. This matches the PDP-11 family and the small memory model on 8088-class machines. VAX and 680X0 would use 4-byte data pointers, but this is immaterial to the exercise.

All translators generated the following output, except that for each translator, the pair of address values contained a different value. Since these are the values of the variables **b** and **d**, respectively, and they are the same, we can deduce that the assignment **b = d** did indeed take place. Since **b** is a static variable and has no initializer list, it was initialized to the **NULL** pointer and, since it is no longer that value, the assignment must have worked.

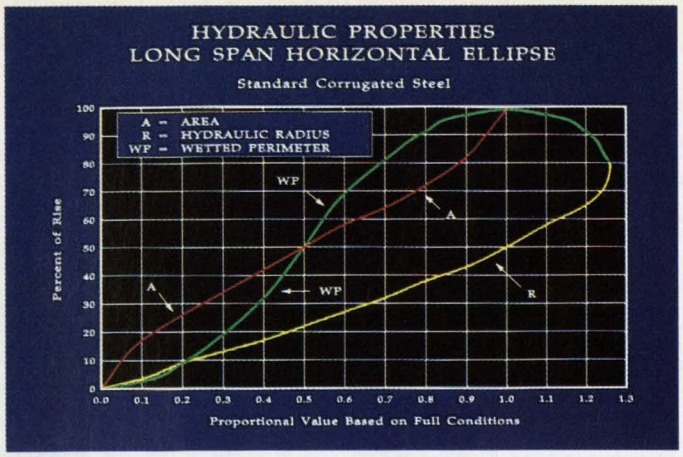
```
7038
7038
Hello
x
ello
```

If **b** and **d** both point to the same location, why aren't the same strings printed when **b** and **d** are used with **printf**'s **%s** mask? That's a very good question, but before we can answer that we need to know more about **b**. Just exactly what is it and is it type-compatible with **d**? After all, if we're trying to mix apples with oranges then perhaps we might expect something strange.

```
main()
{
        static char (*b)[6];
        static int (*b1)[6];

        static char b2[6];
        static int b3[6];

        static char a[] = "Hello";
        char *c = a;
        char **d = &c;

        b = d;

        printf("sizeof(b)   = %2d\n", sizeof(b));
        printf("sizeof(*b)  = %2d\n", sizeof(*b));
        printf("sizeof(**b) = %2d\n", sizeof(**b));
        printf("sizeof(b1)  = %2d\n", sizeof(b1));
        printf("sizeof(*b1) = %2d\n", sizeof(*b1));

        printf("sizeof(b2)  = %2d\n", sizeof(b2));
        printf("sizeof(*b2) = %2d\n", sizeof(*b2));
        printf("sizeof(b3)  = %2d\n", sizeof(b3));
        printf("sizeof(*b3) = %2d\n", sizeof(*b3));

        printf("sizeof(d)   = %2d\n", sizeof(d));
        printf("sizeof(*d)  = %2d\n", sizeof(*d));
        printf("sizeof(**d) = %2d\n", sizeof(**d));

        printf(" d using %%u %u\n", d);
        printf(" b using %%u %u\n", b);
        printf("*b using %%u %u\n", *b);

        printf("*d using %%s >%s<\n", *d);
        printf(" d using %%s >%s<\n", d);
        printf("*b using %%s >%s<\n", *b);
        printf(" b using %%s >%s<\n", b);

        printf("%s\n", ++(*d));
}

sizeof(b)   =  2
sizeof(*b)  =  6
sizeof(**b) =  1
sizeof(b1)  =  2
sizeof(*b1) = 12
sizeof(b2)  =  6
sizeof(*b2) =  1
sizeof(b3)  = 12
sizeof(*b3) =  2
sizeof(d)   =  2
sizeof(*d)  =  2
sizeof(**d) =  1
 d using %u 3078
 b using %u 3078
*b using %u 3078
*d using %s >Hello<
 d using %s >k<
*b using %s >k<
 b using %s >k<
ello
```

Is **b** an array or is it a pointer? Well, the size of **b** is two bytes, the same size as a data pointer (on our 16-bit machine). If **b** were an array, it would have to be an array of two characters, since that's the only array in C (on this machine) that possibly could have a size of two. Clearly, **b** is not such an array, so it must be a pointer to some object, but what type of object?

Since the * and **b** are explicitly bound using parentheses, let's look at the size of ***b**. Surprise! the size of the object being pointed to by **b** is six bytes and given that the declaration contains the type **char**, we deduce that **b** is a pointer to an array of six **chars**. Note that the declaration **char string[6];** is the same as **char (string)[6];** and by substituting the expression **(string)** with **(*b)** we see that **(*b)** is an array of 6- **char**. It is very important that you understand that **b** is a pointer to a 6-**char** array, *not* a pointer to a pointer to a **char** as suggested by the reader. While these may be the same conceptually, they are quite different types — they are *not* assignment type compatible. They are apples and oranges. Note that the size of the object pointed to by **d** is two, another pointer, as compared with 6 for **b**. The same discussion holds true for



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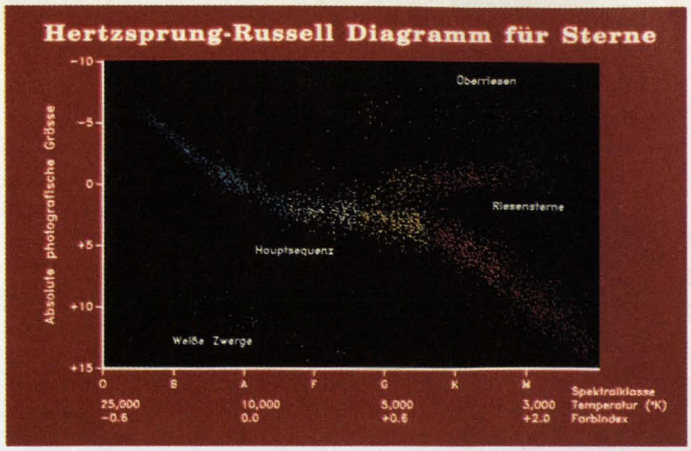

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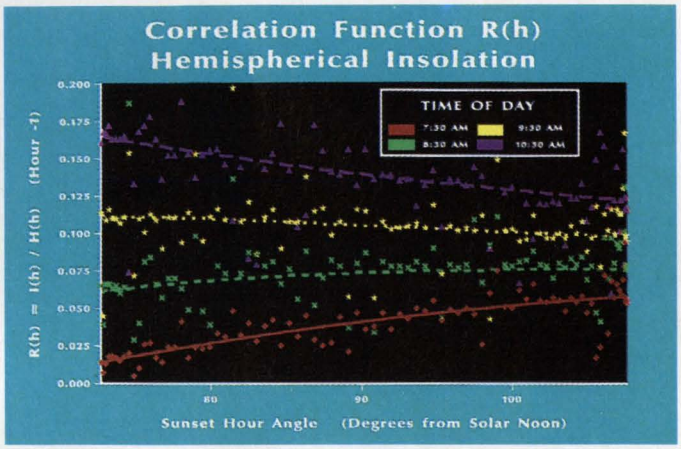

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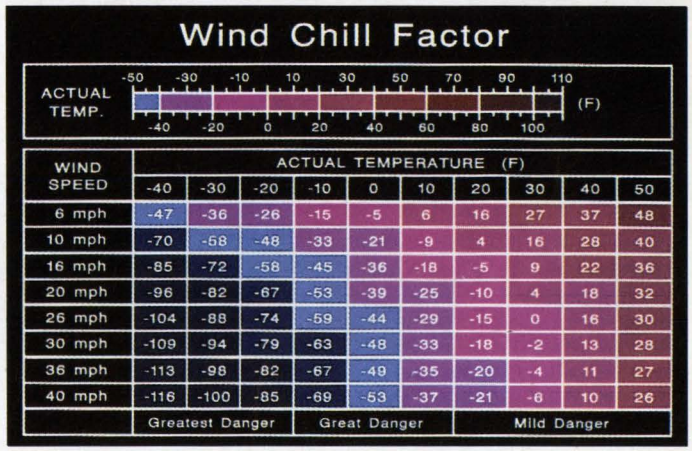

WIND SPEED	ACTUAL TEMPERATURE (F)									
	-40	-30	-20	-10	0	10	20	30	40	50
6 mph	-47	-36	-26	-15	-5	6	16	27	37	48
10 mph	-70	-58	-48	-33	-21	-9	4	16	28	40
16 mph	-85	-72	-58	-45	-36	-18	-5	9	22	36
20 mph	-96	-82	-67	-53	-39	-25	-10	4	18	32
26 mph	-104	-88	-74	-59	-44	-29	-15	0	16	30
30 mph	-109	-94	-79	-63	-48	-33	-18	-2	13	28
36 mph	-113	-98	-82	-67	-49	-35	-20	-4	11	27
40 mph	-116	-100	-85	-69	-53	-37	-21	-6	10	26
	Greatest Danger			Great Danger			Mild Danger			

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b1 which points to an array of 6 **int**s so **sizeof(*b1)** is 12 bytes.

A compiler with "maximum warnings requested" or LINT should flag the assignment **b = d** with a warning, since the operands are not of the same type. All my translators and both LINTs did so.

Do What I Mean, Not What I Say

Now, the really interesting part is as follows:

```
 b using %u 3078
*b using %u 3078
*b using %s >k<
 b using %s >k<
```

How can the value of **b** and the contents of the location pointed to by **b** be the same? Very interesting, and true, or at least it seems that way. In the first case, **b** is passed to **printf** and, since **b** is a pointer (a scalar), it is passed by value. It currently contains the same contents as **d**, that is, the address of **c**. And the result is as expected: The address of **c** is displayed. However, what happens with ***b**? Well, as we have ascertained, **b** points to a 6-character array, so **(*b)** *is* a 6-character array; and when an array is used as a function argument, the address of the array is passed. Since **b** contains that address, **b** actually is passed by value. So while **b** is not exactly the same as ***b**, both generate the same code when used as function arguments in this example. Therefore, the "contents of the location pointed to by **b**" as expected, are not the same as the "contents of the (same) location pointed to by **d**". So while ***d** is interpreted as the address of **a**, ***b** is interpreted as **&c**, not as the address of **a**.

This leads us to the last statement that caused a fatal compilation error. Since ***d** is the address of **a**, the expression **(*d)** is a pointer and, hence, an lvalue. That is, it can be on the left side of an assignment statement and, therefore, can be used with the + + and -- operators. However, we have seen that **(*b)** is an array and the + + and -- operators cannot be applied to an array; hence, the syntax error. As the reader points out, **(*b)** behaves like an array name.

Initializing Pointers To Arrays

Given that pointers to arrays can exist, how can they be initialized? Consider the following example:

```
main()
{
        static char (*b)[6];

        static char (*b4)[6] = "b4xxx";
        static char (*b5)[8] = "b5xxxxx";

        static char (*b4a)[] = "b4axx";
        static char (*b5a)[] = "b5axxxx";

        printf("sizeof(*b)  = %2d\n", sizeof(*b));
        printf("sizeof(*b4) = %2d\n", sizeof(*b4));
        printf("sizeof(*b5) = %2d\n", sizeof(*b5));
        printf("sizeof(*b4a)= %2d\n", sizeof(*b4a));
        printf("sizeof(*b5a)= %2d\n", sizeof(*b5a));

        b = b4;

        printf(" b using %%u %u\n", b);
        printf(" b using %%s >%s<\n", b);
```

> ***All four initializer lists are of type "pointer to char" and since the objects being initialized are pointers to arrays, each object is incompatible with its list.***

```
        b = b4a;

        printf(" b using %%u %u\n", b);
        printf(" b using %%s >%s<\n", b);

        b = b5;

        printf(" b using %%u %u\n", b);
        printf(" b using %%s >%s<\n", b);

        b = b5a;

        printf(" b using %%u %u\n", b);
        printf(" b using %%s >%s<\n", b);
}


sizeof(*b)  =  6
sizeof(*b4) =  6
sizeof(*b5) =  8
sizeof(*b4a)=  0
sizeof(*b5a)=  0
 b using %u 80
 b using %s >b4xxx<
 b using %u 94
 b using %s >b4axx<
 b using %u 86
 b using %s >b5xxxxx<
 b using %u 100
 b using %s >b5axxxx<
```

Again, all five translators produced the same output (with different address values of course). And again, all produced warning messages about type incompatibility. All four initializer lists are of type "pointer to **char**" and since the objects being initialized are pointers to arrays, each object is incompatible with its list. However, the program does work as expected; all four strings are printed correctly.

Since **b**, **b4** and **b4a** all are pointers to arrays of 6 **char**, they are type compatible and the assignments **b = b4** and **b = b4a** produce no warning. Similarly, **b5** and **b5a** are type compatible with each other, but not with **b**, so the assignments **b = b5** and **b = b5a** generate the warning "Type mismatch in assignment."

More Surprises

While **b**, **b4** and **b4a** are all pointers to arrays of 6 **char**, as expected by having the compiler calculate the array dimension, the size of the arrays pointed to by **b4a** and **b5a** is *zero*. This is most interesting, yet the program behaves in a rational way. All five translators displayed sizes of zero and I have no

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reason to doubt that result, which gets back to my earlier discussion about the philosophy of C. When you delve into the dark corners of C, get ready for some surprises.

Incidentally, while the following program does the expected, **ca** and **b** also are type incompatible. As it happens, I haven't been able to find a way to create an initialization list or rvalue of type pointer to array of ... without using an explicit cast. This is an interesting problem in itself, but then I've never had the need for such a data type. And after all, a pointer to a pointer to a **char** serves exactly the same purpose and is much better known (and loved) and managed.

```
main()
{
        static char ca[] = "caxxx";
        static char (*b)[6] = ca;
}
```

Can arrays be copied as a whole? Consider the following:

```
main()
{
        static char (*b)[6];
        static char (*b4)[6];

        b = b4;
        *b = *b4;
}
```

Since **b** and **b4** are both pointers to arrays of 6 **char** they are type compatible and the assignment **b = b4** is correct. Given that ***b** and ***b4** are actually arrays, what is the meaning of ***b = *b4**? Does this copy the whole array? Wishful thinking, but a reasonable idea. As it happens ***b** really does behave like an array name (and, in fact, may be strictly an array name) in which case it is static. That is, its value cannot be changed. In ANSI Standards parlance, ***b** and ***b4** are non-modifiable lvalues and, therefore, cannot be used on the left side of assignments (or with ++ and -- as discussed previously).

The Proposed ANSI Standard

Pay particular attention to the moral of this story: "Don't mix type-incompatible operands across the assignment operator." While **short = int;** and **float = double;** and **char * = int *** generally make sense and commonly are accepted by compilers, ANSI conforming translators will be obliged to flag as a syntax error any such "type incompatible" assignment. This will be a particular problem for those of you who freely assign pointers to one data type to pointers to another data type. In the future, you'll only be able to do this using an explicit cast. This means you'll have to clean up your loose code or add the cast to those instances where you really need type conversion.

I know many of you will complain that the ANSI Standard is breaking code that has worked (possibly) for many years and that C wasn't broken, so why is anyone fixing it? However, C may be the most popular language on micros and it's gaining in minis and mainframes. Believe it or not, many commercial (and other) applications are being written in C and non-trivial or large projects need all the help they can get regarding the detection of errors. Given the ease with which errors can be made in C, such detection is very welcome. If you really need to play tricks in C, the mechanism to do so still exists, it's just that the tricks now have to be overt. The ANSI Committee is not trying to turn C into PASCAL (or any other language for that matter), it is just trying to make it easier to write maintainable (and portable) code, an objective that many projects appear to have.

One Final Note

Consider the following:

```
struct {
        int i;
        double d;
} str1, str2;

struct {
        int i;
        double d;
} str3;
```

Structures **str1** and **str2** are type-compatible and **str1 = str1** makes sense. While it would be very difficult to see how the format and size of **str3** ever could be different from that of **str1** and **str2** for any given implementation, nevertheless, **str3** has a different type to **str1** and **str2** and, therefore, is not type compatible with them. If you really want **str3** to be the same as **str1** and **str2**, make it the same, *don't mix apples and oranges.*

Next issue I really will try to look at the process of developing a C project data dictionary. 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 X3J11 standards committee for C.

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LEGAL BUSINESS

Herbert Swartz

Trademarks

Since its inception, the computer has led the law on a merry chase — most notably, antitrust, contracts, copyright, patents, and trade secrets.

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A host of cases decided this decade has sown the confusion. Not unexpectedly, DEC has been involved: the recent decision by a federal court in New Jersey (Digital Equipment Corporation v. C. Itoh and Co.) over alleged infringement of the company's VT220 video display terminal.

With due humility, then, let's attempt to ring some sense out of the present relationship of trademark to the computer market.

Typically, when legal analysis is the subject, we begin with the broad proposition, in this instance two:

1. In the configuration of a computer product, it's possible to develop trademark rights — features such as size, shape, and color. As evidence, merely think of the IBM mark, and the APPLE Design mark;
2. Features that are classed as "functional" are *not* entitled to trademark protection.

In proceeding we are reminded that broad proposition descends into nuance and exception. So, is the basis for excluding function from the trademark ambit.

Trademarks are protected as long as they are in use. To attach trademark to function would be to grant a monopoly, a particular anathema to the American ethos of competition. Besides, patent protects function — but only for 14 years, so that free and active competition may follow.

What then is function? More than 30 years ago a federal court responded: "[A feature is functional if it is] an important ingredient in the commercial success of a product." But, what about the IBM and Apple marks? Are they irrelevant to the commercial success of the products? Self-evidently, companies that have developed enough goodwill in their marks, sell off them.

In 1982, the U.S. Supreme Court took its crack at a definition: "[A] product feature is functional if it is essential to the use or purpose of the article or if it affects the cost or quality of the article." While in 1985, the 7th U.S. Circuit Court of Appeals (Chicago) offered: "[Trademark is a] merely incidental feature which gives the brand some individual distinction but which producers of competing brands can readily do without."

Under this reasoning, the feature is evaluated from the point of view of the seller, not the customer. If a seller must incorporate a feature into his product to compete effectively, for example a video display terminal, the feature is functional. Conversely, if DEC put out pink computers, and stressed the point in its ads ("computer in the pink"), its trademark rights would stand tall.

In any event, in making the distinction, courts have stressed a host of other factors. In summary:

1. Existence of a patent for the feature is solid evidence that it is functional;
2. Advertisements that stress a feature's utility will come back to bedevil a trademark claimant;

> ***". . . let's attempt to ring some sense out of the present relationship of trademark to the computer market."***

3. A feature that reduces the cost of production also is headed down the non-trademark road;
4. If many competitors incorporate the feature, that too is strong evidence of functionality;
5. Is there a technical and practical alternative to the feature? If not, we probably are talking functional.

But let's assume the initial functional question has been solved. Then follows question two: "secondary meaning." Does the purchasing public associate the feature with a single source? If you want a pink computer, you must buy DEC. Yes, the public could be expected to make the distinc-

6

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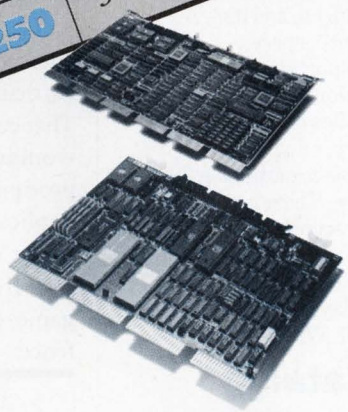

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tion; that all pink computers come from a single source.

To comply with secondary meaning, a trademark claimant should be prepared to show use of the feature for a lengthy period, sales volume for products using the feature, heavy advertising for the feature, and efforts to promote it in the public consciousness. While to the contrary, a defendant will attempt to show a number of companies using the feature, or similar ones, in their products.

In its case against C.Itoh, DEC sought to show a trademark in various features of the VT220 — among them, the wedge shape of the monitor, the shape of the keyboard, the color of the keyboard and monitor, and the layout of the keyboard.

But the court disagreed. It held functional those features of peripheral equipment that other companies would want to duplicate to permit them to compete for customers seeking to expand their systems or replace existing peripherals. Therefore, the design elements that users of a system become accustomed to are functional; otherwise, the court noted, different features would require extensive retraining of users. In sum, and by law, the keyboard design is functional in the "aftermarket" for DEC-compatible terminals. And if shape and color of the keyboard and monitor are nonfunctional, the court further concluded, no secondary meaning exists. Clearly, the court was influenced by DEC's own ads which emphasized the functionality of the product's design components.

What rules then for effecting trademark protection in computer products? At minimum, it would appear, these:

1. Select features that are truly distinctive (not beige as a color, for example). The features should be arbitrary and they should contribute little to the product's functionality, neither enhancing or detracting from the product's usefulness to customers.
2. Advertise with an eye to trademark. If only function is stressed, secondary meaning never can be shown.
3. Register trademarks. The evidence, though not conclusive, can never hurt. Failure to consult a trademark attorney on the various requirements of registering is wasteful and negligent.

> ***"Trademark has become a tough game on both sides . . ."***

While as for companies wishing to market compatible peripherals to be used with another company's installed base:

1. Duplicate as little as possible. Take advantage of every court's tilt toward competition and duplicate only what is necessary for successful competition. If a court can find "practical necessity," it won't find trademark infringement. Whereas deliberate copying of what is not functional is another matter.
2. Search. See how many other companies use the feature. Widespread use, especially in the mind of a court, equates to functional purpose, as does the inability of the claimant company to show single-source association, the touchstone of secondary meaning.
3. Use house marks. These differentiate you sufficiently, say some courts. Particularly if the marks are prominent. That could tip a court to say a consumer wouldn't be confused, even though product-design features have been duplicated and trademark infringement might otherwise exist.

Trademark has become a tough game on both sides of the computer fence. ■

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FROM THE LAB

Dave Mallery

The Qualogy Approach To Storage

Qualogy, Inc. of San Jose, California (formerly Data Systems Design) makes a rackmount storage system for MICROVAXs and Q-bus PDPs that's well worth note.

We tested the model QE-2400, which contains four Fujitsu 5-inch Winchesters for a total of about 560 MB of formatted disk space. There are several options in the formatting, the most interesting of which is volume shadowing. The controller (QE2) is a Q-bus ESDI controller that can handle up to four drives. The controller has a megabyte of cache and resident diagnostics that can be downloaded into the host machine for use. The controller is actually the Webster WQESD unit from "down under" affectionately known as the WOMBAT.

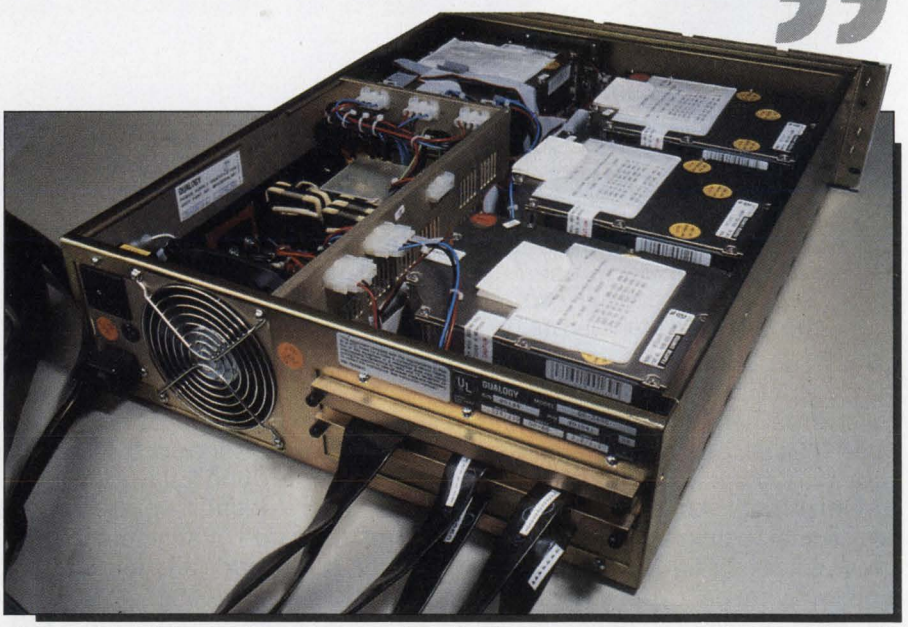
The Qualogy documentation is the finest hardware documentation set I have ever encountered. The task of documentation was taken seriously and given to professionals to do. The results speak for themselves. The book actually was *designed* from an aesthetic standpoint. The illustrations and tables are perfectly clear. The best test of a piece of work like this is that at the end of one reading, you are fully familiar with, and confident about, the subject machine. I think this book should be required reading in every documentation factory in the industry.

The physical set-up of the box is straightforward and simple. There is a solid looking 200 watt switching power supply surrounded by four disk drives. The drive data cables all are brought to the rear panel. The control cables are daisy chained. There is a single small cable that brings signals to the front panel from the controller board. This controls the write-protect and displays the status of each drive as well as the controller activity and voltage-OK.

A set of "FCC-ized" cables is supplied. A very simple clamp arrangement secures the shield of the cable to the cabinet, insuring proper grounding and strain relief. Our MICROVAX is in a BA23 cabinet. This is a "worst-case" for cable installation, given all the other devices vying for space on the rear bulkhead. There really is no best fix for the BA23 short of removing the rear bulkhead and destroying the shielding integrity. I brought all six cables through one of the openings, since the DEQNA panel was hogging the other opening. The cables all have ample lengths for maneuvering inside the bulkhead, so this rather tight fit is quite functional, even though not very beautiful.

The controller is a quad board. Now in this day of dual MSCP controllers, you have to have a good excuse to build a quad controller. There is a megabyte of cache memory on the board. Next year, Webster can build it

"Once I had the unit cabled up, I began with the diagnostics. These are contained on a ROM on the controller and are accessed easily from the MICROVAX under ODT."



A rear view of the Qualogy, four small Fuji drives and a power supply. Note the cable strain-relief system. Bad block information is carried in holders atop each drive.

FIGURE 1.

QUALOGY ESDI Diagnostic and Utility Program n.n

Unit	Drive	Offset	Size	Type	Shadow	Write	Status
0	0	35	287365	Normal	0	Late	Avail
1	1	35	287365	Normal	0	Late	Avail
2	2	35	287365	Normal	0	Late	Avail
3	3	35	287365	Normal	0	Late	Avail

Drive	Cyls	Heads	Sectors	Blocks	Mtype	Opt	Fair	Status
0	822	10	35	287700	Fixed	Near	24	spun up
1	822	10	35	287700	Fixed	Near	24	spun up
2	822	10	35	287700	Fixed	Near	24	spun up
3	822	10	35	287700	Fixed	Near	24	spun up

Drive number:

with megabit chips and surface mount technology and get it on a dual, but for now, I'll forgive them. There are also three sets of dip switches on the board.

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San Jose, CA 95131
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They are extremely simple and superbly documented, but their days are numbered. The dips are used to set the CSR, enable or disable the on-board bootstrap (used with PDPs), define whether the on-board diagnostics will be used with or without the CPU, determine the interrupt level and configure whether the drives will power up in a sequence or all at once. Next year, they can include these functions in the configuration software. The documentation is so fine that setting these simple switches is no burden at all.

Once I had the unit cabled up, I began with the diagnostics. These are contained on a ROM on the controller and are accessed easily from the MICROVAX under ODT. I want to lavish a little more praise at this point. This is the best way to ship diagnostics. The manufacturer makes no judgments about the configuration of your machine, but simply allows you to use the diagnostics. No hassle with RX50 diskettes or TK50 cartridges.

The diagnostics themselves are MENU driven and very clear. I noticed that all the drives in the box already had been "badded" as the lists of bad blocks were included in little plastic envelopes on top of each drive. When the diagnostics come up, they begin with a comprehensive disk status report (see Figure 1). The master menu is next:

```
** Master Menu **
1 Structure Disk
2 Test Disk
3 Manage bad blocks
4 Display error
5 Shadow options
```

I would like to tell you about numbers one and five. Option one allows you to specify many of the drive parameters, not only physical size, but optimization parameters as well (see Figure 2).

There is an excellent commentary in the documentation about each parameter. One question that occurred to me at the time was whether a shadow disk could operate with a different seek algorithm than its mate. That almost would guarantee different head positions, and hence, better overall seek optimization.

This brings me to shadowing; in brief, the use of a second drive by the controller to make an exact copy of the first disk in real-time. It is like continuous, real-time backup. The added advantage is that if the heads happen to be in different locations, the controller will use the set closest to the desired data to satisfy a read request.

After some initial testing to prove that the units did indeed work, I powered down and brought the diagnostics back in. To be thorough, I reformatted and badded one of the drives. The format pass first writes the sectors and then fills them with a test pattern for subsequent badding. There is a menu devoted to disk testing (see Figure 3). By working your way through these tests, you can develop a confidence level in the drive and the diagnostics. My only question is related to the pattern. Most badding utilities allow the selection of

FIGURE 2.

Option: 5

*** Drive configuration ***

```
Cylinders:                          1223
Heads:                              15
Full sectors per Track:             34
Track Spiralling Factor:            4
Seek Optimization: 0-none, 1-Nearest, 2-Elevator, 3-Forward
Optimization strategy [0-3]         1
Fairness Count:[1-255]              24
Unit number:                        2
Unit id:                            DURA81
Serial number:                      114166
Drive number:                       2
Size:                               622676
Offset:                             34
Shadow type:                        Normal
Host confirmation:                  On disk.

Press any key to continue
Read Lookahead size:                4
Cache: 0-Disabled, 1-Enabled        1
Command Queue Size; [1-32]          8
Front panel type: 0-None, 1-Passive, 2-Active       2

Press any key to continue       [RETURN to exit]
```

FIGURE 3.

**** Disk Test Menu ****
(! means all data on Disk destroyed)

```
1    Read All Disk (preserves all data)
2    ! Write disk !
3    ! Pattern Test !
4    ! Random Writes !
5    ECC Validation
6    Read Physical Block
7    Display Error Statistics
8    Zero Error Statistics
9    Test Cache, RAM & ROM
```

many different patterns. This one writes a single pattern and then reads it 10 times. I would suggest that no single pattern is really adequate for full badding.

Interestingly, a full run of the badding diagnostic yielded only one bad block. I then tried an option to replace bads using the manufacturer's defect table (recorded on the disk at the factory). The other bad blocks that were listed on the paper attached to the drive then showed up!

All was well.

The next step was to declare this drive the shadow of drive zero. The next step, was to copy the contents of drive zero to drive one. Just for fun, I changed the seek algorithm of the last drive and declared it to be the shadow of the third. There were no complaints as I copied the contents of the third to the fourth. The copy proceeds at about 20 MB per minute.

> ***A non-shadowed backup of the same material earlier had taken 14 minutes.***

I then brought VMS back up. Units DUB1 and DUB3 had vanished. I booted from DUB2 and started a BACKUP/IMAGE from DUB2 to DUB0 to see if there was any discernable overhead involved in the shadowing operation. A non-shadowed backup of the same material earlier had taken 14 minutes. That computes to a data rate per drive of about 148,000 bytes per second. Recalling the Iron Law of the universe: There Ain't No Such Thing As A Free Lunch (TANSTAAFL), the backup with shadowing took 24 minutes. (A data rate of only 86,300 bytes per second). This is understandable because twice as much

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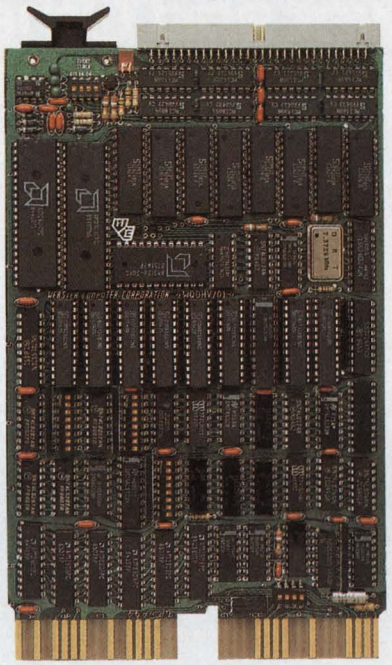

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disk I/O had to be performed to get the job done.

I decided to try another angle. One of the options in the disk structure is to mark the operation complete once the data is in cache, rather than on the disk. It seemed logical that this would be OK for the shadow volume, so down came the system and back in came the diagnostics.

I changed the disk structure to cause write-complete to be posted as

> ***"The advantage I see in the Qualogy box is that you have four sets of heads to work with."***

soon as the DUB1-bound data was in the cache. Back with VMS and a rerun of the image backup. . . . Alas, also 24 minutes.

So the moral is that if you want shadowing, you are going to pay for it. It would be very unwise to set both disks to report write-complete upon caching. But, being unwise by nature, I was compelled to try. Back to the diagnostics, this time changing DUB0's setup. Back to VMS for yet another BACKUP/IMAGE. By the way, this image we have been copying is about 124 MB in size.

At last, a difference: 20 minutes. I guess for those of you with UPS systems in your computer room. . . .

I also did a few comparisons with another disk and controller: the Emulex QD32 and Fuji 2333 (340 MB that transfers at 2.4 MB per second.) This is in many ways a more expensive setup. The drive is an 8-inch unit, which, with its power supply, is exactly one-half the size of the entire Qualogy unit.

There is no cache on the controller. The big difference is the drive. The average seek time for the little Fuji in the Qualogy box is 28 ms. The Fuji 2333 comes in at about 18 ms. The bigger Fuji transfers at 2.4 MB per second, the little guy at about 1.2 MB per second. There really should be no contest, but it's interesting to see how well the Qualogy actually does.

Copying about 3,000 blocks on DUA0: (big Fuji): 9 second Copying same file on DUB0: (li'l guy): 12 second These were done within the same account, so there was lots of head-thrashing.

Just for fun, I did the same thing on our main VAX 750 using 2.4-MB per second big Eagles. The operation there also took nine seconds.

The advantage I see in the Qualogy box is that you have four sets of heads to work with. If you design your application well, and cause files to be placed properly on the available drives, you can gain the large advantage that comes from reduced seek times. After all, the seek time is an order of magnitude larger than any other parameter. The many sets of heads can more than compensate for the slightly slower seek time by reducing the aggregate amount of seeking actually done!

Another good argument for using this configuration would be backup. In a large organization with multiple departmental MICROVAXs, backup becomes an almost insurmountable problem. Local Area VAXclustering is one solution, shadowing on non-networked machines is another. Don't eliminate backup, but keep the shadowing as your ace in the hole when all else fails. ■

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MANAGING YOUR MICROVAX

David W. Bynon

Performance Problems?

Note: In previous articles I have referred to MICROVMS as the MICROVAX operating system. DEC has announced that VAX/VMS V4.6 will support (and V4.5 does support) all VAX systems, thus eliminating the need for MICROVMS. For this reason I no longer will make reference to it. Those who continue to use MICROVMS may rest assured that all is the same, and finally, a VAX is a VAX is a VAX.

A common problem among MICROVAX system managers is how to direct the system's limited performance and resources to their fullest capability. Performance management is the direction of system resources (i.e., CPU, I/O and memory) and workload distribution. This article introduces the concepts, tools and methods available to the MICROVAX system manager to evaluate, tune and load balance MICROVAX resources.

Tuning is the process of adjusting system parameters to improve overall system performance and obtain optimal use of current system resources for a given workload. It doesn't involve modification or installation of additional hardware, and it can't fix problems caused by insufficient memory, a slow processor, too few disks or improper use. It is not a cure all.

Load balancing is the process of distributing a system's workload evenly throughout the day. While this scheduling often is difficult because of the work hours of interactive users, it always proves beneficial to the performance of a system.

THE FIRST STEP of any performance management effort is to evaluate the system. I can't remember how many times I've been called with the same old sob story:

"Dave, Biff and Skip were tuning the VAX. Now it's so slow we can't do a thing with it!"

"Why were they tuning it?" I asked.

"They thought it needed it."

Wrong!

Bynon's first theorem of VAXination: If your VAX isn't broken, don't fix it.

> ***"Load balancing is the process of distributing a system's workload evenly throughout the day."***

If the performance of your MICROVAX is satisfactory, why mess around with it? First evaluate and understand your system and its workload. Then, if or when you have a performance problem you'll be better equipped to make intelligent decisions about adjustments or changes.

Understand Your System Workload

One of the most important resources a system manager brings to the performance of a MICROVAX is a full understanding of the system's normal workload and use. Understanding how to use the system and what resources are demanded of it allows performance expectations to be set. In many cases, I've found that what's thought to be a performance problem merely is a case of unrealistic expectations. You can't compare VAXs with VAXs. You must compare workload and resources with workload and resources.

So, what should you know about your system? Here are some things to think about:

1. What's the average number of interactive users on the system?
2. What's the average number of active processes on the system?
3. What are the peak use hours of the system?
4. What common interactive tasks could be run in batch?
5. What commonly run tasks are CPU, memory or disk intensive?
6. What are the most common image activations?
7. What are the typical response times for various tasks?
8. Are there any known performance bottlenecks?
9. Are jobs often waiting in queue?

In most cases the system manager won't be the first to notice a performance or resource problem. Typically, a user complaint will prompt the initial investigation. In order to evaluate the complaint, therefore, you must collect some basic facts about the system at the time of the complaint:

1. How many users are on the system?
2. What are the task response times?
3. Are there jobs hung or waiting (MWAIT, RWSWP)?
4. What is the CPU use?
5. How much memory is free?
6. What are the I/O and page fault rates?

The reason for gathering this information is to prove to yourself that a problem does exist. Once that's determined, you can start an investigation to find the cause and possible solution.

Several VAX/VMS software tools, including SHOW, ACCOUNTING and

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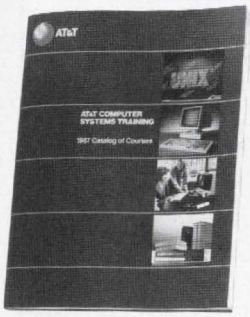

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MONITOR, are available to help you investigate a system and its activities, and to diagnose problems. As a MICROVAX system manager you'll want to become familiar with these tools, and take the time to investigate the typical CPU usage, normal memory consumption, typical page fault rates, and normal operational modes of your system.

The ACCOUNTING utility is useful for analyzing system use. It tells you how many users were on the system for a given period, what images were activated, what resources were consumed, and so forth. Remember, however, that the ACCOUNTING utility itself consumes resources (CPU, I/O and disk space). Only use it if you plan to take advantage of the data in ACCOUNTNG.DAT.

The MONITOR utility provides a wealth of information about the MICROVAX. In general, MONITOR will help you discover the most common resource limitations. One of the most useful features of MONITOR is its ability to collect and store system information over a period of time. You simply tell MONITOR what to collect, how often and for how long. This permits you to analyze the system over an extended period.

> ***If little memory is on the free page list you may have a memory limitation problem.***

Some hints about MONITOR: Use the DCL command MONITOR IO or MONITOR SYSTEM to observe free memory. If little memory is on the free page list you may have a memory limitation problem. Use MONITOR STATES, MONITOR MODES and MONITOR SYSTEM to observe CPU use. If many of the currently active processes are in the computable state, or if CPU use is at or near 100 percent, or if a high percentage of time is spent in kernel mode, you may have a CPU limitation. Finally, to observe system I/O use the DCL command MONITOR IO. Direct I/O is an indication of disk activity and buffered I/O is an indication of terminal activity.

The DCL SHOW command is useful for displaying information about the

system and processes. Use SHOW SYSTEM to display all processes currently running on the system. This display shows you, at a glance, process states (helps locate MWAIT or other resource wait states), process resource utilization and process names and IDs. Use the command SHOW PROCESS/IDENTIFICATION=n/CONTINUOUS to display information about a specific process (generally a user or batch job). This information is especially useful for determining working set parameters. Use SHOW MEMORY to display the current status of memory, page and swap file use.

When To Load Balance

Load balancing is a never ending task. The proficient system manager is forever investigating methods for spreading out the load. It simply doesn't make sense, from a performance point of view, to beat the heck out of a machine for eight hours a day, and then let it sit idle for the other 16.

Load balancing always should be performed before a tuning effort. This is because tuning is best geared toward the average work load, not the best or worst case work load.

Load balancing should be performed gradually, over a period of time, as the load on the system changes. There are two situations to avoid: First, don't get up one morning and decide you're going to balance the load. To repeat, load balancing must be performed gradually and with willing assistance from the users. Second, don't wait until the system is saturated to balance the load. Try to predict what the system load will be and begin to implement changes in that direction.

Load balancing is a simple matter of dispersing jobs evenly over the period of time available. This takes a cooperative effort from both users and the system manager. If you note that a user regularly invokes a long, resource-intensive task, for example, you might ask (or insist) that he submit it to run in batch at off-peak hours. Other methods of load balancing include set-

ting primary and secondary login days/hours in the UAF, lowering the number of interactive logins (SET LOGIN/INTERACTIVE = n), limiting the number of subprocess a user can create and adjusting the number of concurrent batch jobs the system will execute (INITIALIZE/QUEUE/JOB_LIMIT = n).

When To Tune

A VAX/VMS system rarely requires major tuning, with two exceptions. First, tuning almost always is necessary to take advantage of a new system configuration; e.g., the addition of more memory, real-time devices, disks, etc. Second, tuning is essential if you dramatically change the workload or type of workload; e.g., installing a memory-intensive product like ALL-IN-1 or changing from a primarily interactive mode to a batch-oriented mode.

The reason tuning is required so rarely is because VMS inherently tunes itself by dynamically adjusting system parameters while the system is in use. However, one of the principal reasons for tuning is to prevent VMS from having to make gross adjustments of system parameters, because this activity consumes CPU time.

Important VAX/VMS Parameters

VAX/VMS is a memory-driven system (which probably explains why Digital's first solution to any VAX problem is "Buy more memory!"). Therefore, the parameters that most affect VAX/VMS system performance are memory related.

One of the slickest VAX/VMS devices is its memory management mechanism, specifically the VAX/VMS Automatic Working Set Adjustment (AWSA). AWSA is a VAX/VMS function that furnishes a process with only as much physical memory as it needs to operate efficiently; i.e., to keep page faulting within established bounds. AWSA determines when it should give or take memory from a process by watching its page fault rate. Understanding AWSA, the parameters associated with it, and how the processes running on your system use memory is the first step in getting things tuned.

Directly related to AWSA is the process working set. A working set is the physical pages of memory allocated to a process. The limits of a process working set are defined by the UAF parameters WSDEFAULT, WSQUOTA and WSEXTENT. WSDEFAULT is the initial amount of memory allocated for a process. If a process needs more memory, it will be permitted to expand to the value of WSQUOTA. Finally, if memory is available and the process still needs more memory, then it's allowed to borrow memory up to a final limit, WSEXTENT. It's extremely important that each account have these values set correctly.

AWSA uses several mechanisms, based on time, quantities and page fault rates, to adjust process working sets. Each process is evaluated for working set adjustment on an interval established by the SYSGEN parameter ASWTIME. A process is considered for a working set adjustment if its page fault rate is above the parameter PFRATH or below the parameter PFRATHL. Memory is provided in increments specified by WSINC and taken in decrements specified by WSDEC. No process' working set will ever be increased above the value WSMAX or reduced below the value AWSMIN.

Additional Reading

From the VAX/VMS Document Set:
Guide to VAX/VMS Performance Management.
VAX/VMS Utilities MONITOR.

From the VAX/VMS Reference Set:
Guide to VAX/VMS System Management and Daily Operations (AUTOGEN and SYSGEN).
VAX/VMS DCL (SHOW command).

Another reference source is:
VAX/VMS Internals and Data Structures, Lawrence J. Kenah and Simon F. Bate, Digital Press, 1984.

Adjusting System Parameters

VAX/VMS is a complex operating system, and, therefore, has an elaborate set of rules and parameters to govern it. To make matters worse, many of the parameters that control VAX/VMS interact. Changing certain parameters will affect seemingly unrelated components drastically.

SYSGEN and AUTOGEN are two facilities to adjust and change system parameters (real men use ZAP or EDI as their text editor, on LA36s of course, and SYSGEN to tune their VAXs). AUTOGEN should be the tool of choice for non-system experts.

AUTOGEN is a command procedure that collects information about the running system and uses it to adjust SYSGEN parameters. Optionally, AUTOGEN will override its computed SYSGEN values with values provided in a user-defined parameter modification file (SYS$SYSTEM:MODPARAM.DAT).

The benefit of using AUTOGEN over changing parameters directly with SYSGEN, is that while you may not be a VAX/VMS internals expert, AUTOGEN is. AUTOGEN understands what parameters work together. If you want to decrease the parameter MAXPROCESSCNT, for example, AUTOGEN understands that BALSETCNT always should lag MAXPROCESSCNT by at least two (to take into account the swapper and null processes), and makes that additional adjustment for you.

If you are a VAX/VMS system novice, the easiest (and safest) tuning effort is to execute AUTOGEN, then adjust UAF parameters like working size, using the AUTHORIZE utility. The working set parameters and I/O parameters for an

account can be determined by watching a process' consumption of memory and I/O with the SHOW PROCESS/CONTINUOUS/ID = n command.

If you have memory available, working set sizes should be set as follows: WSDEFAULT can be a small value, 150-512 pages is fine. Keeping WSDEFAULT small prevents waste and makes process creation (initial logon, spawn) faster. WSQUOTA should be set to the maximum working set size to which a process will expand on a normal basis. Setting WSQUOTA to this value prevents excessive page faulting. Finally, if you want a process to borrow memory, set WSEXTENT to a value greater than WSQUOTA but less than the SYSGEN parameter WSMAX.

Note: Remember that a working set cannot grow larger than the SYSGEN parameter WSMAX. If larger working sets are required this parameter must be increased.

Load balancing and tuning are a slow process. Adjustments should be made gradually and the results compared against known statistics. You must plan to spend time monitoring the system after making modifications, to determine the results. The best method for determining whether tuning is successful is to monitor the system under a reproducible workload, or by monitoring various programs under fixed workload conditions. The best indication of a balanced system is if it remains busy steadily throughout the day with few peaks and valleys of activity.

In every performance management effort there comes a point of diminishing improvement. When you reach this point where a great deal of tuning or balancing time returns only a small performance improvement, it's time to call it quits and find a hardware solution to the performance problem.

David W. Bynon is a VAX systems consultant based in Gaithersburg, Maryland.

ARTICLE INTEREST QUOTIENT
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DEC PROFESSIONALS

Bill Hancock, our networking editor, is an internationally well-known and respected network and software engineering consultant who has held engineering and technical positions at DEC, Texas Instruments, SOHIO Petroleum Co., and IBM. He conducts seminars on various network issues and subjects and has more than 2,000 network designs to his credit.

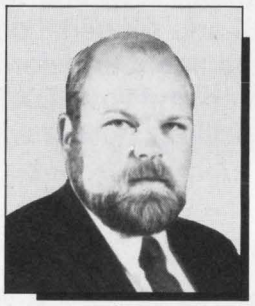
His clients include many of the Fortune 500 and governmental authorities such as the U.S, U.K, Germany, Switzerland, Japan, and the Peoples Republic of China. Bill is experienced in all aspects of communications and network design and implementation. He is one of two network expert delegates for the U.S. serving on the International Organization for Standardization (ISO) TC97/SC6/WG5 (Network Architecture) technical committee; serves as VP Engineering of Essential Resources, Inc., New York; and is the author of *Network Design and Implementation* and *Systems Management for VAX Systems.*

Philip A. Naecker is a consulting software engineer based in Altadena, California. As West Coast Editor, he keeps in touch with developments and activities in the DEC community on the West Coast. Phil writes on a variety of software and hardware topics, and is especially interested in databases, fourth generation languages, software development tools, special purpose processors, and workstations. He is a special technical consultant to the 4GL Special Interest Group (SIG) of DECUS, and he is an editor of the DECUS periodical, *The Wombat Examiner.*

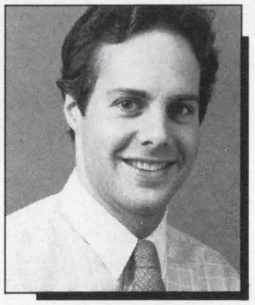
Prior to becoming an independent consultant, Phil was manager of Information Services for a large engineering firm and was responsible for both hardware and software development in a mixed technical/commercial VAX shop.

Phil's education includes a B.S. degree from the California Institute of Technology and graduate work at the University of California, Los Angeles.

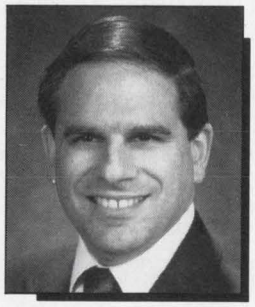
Victor J. Chorney has worked in data processing for 25 years and has held positions ranging from programmer to systems analyst, from remote system operator to systems programmer, from DP training manager to project manager. Vic has worked in many different application environments, including all areas of accounting (in which he holds a degree from Temple University), insurance, manufacturing, service industries, and software development. He also worked at Digital for five years in a variety of positions in software services.



Bill Hancock



Charles Connell



Victor J. Chorney

Vic currently is senior consultant in the Management and Technology Advisory Services Department of Glickman, Berkovitz, Levinson, and Weiner, a suburban-Philadelphia accounting firm. He also is program chairman for the Delaware Valley Rainbow Users Group. Vic has an ongoing interest in microcomputers and has presented several sessions at DECUS and at various user-group meetings on relevant subjects.

Based in the Boston area, East Coast editor **Charles Connell** writes feature articles and works with professionals in his area who wish to contribute articles to our magazines. Chuck also visits East Coast OEMs and VARs in the DEC marketplace to review interesting new products and cover newsworthy events.

Chuck has served as a VAX/VMS system programmer, college instructor, and consultant. His consulting work has included stints with DEC OEMs and DEC educational services. He holds a B.A. degree in linguistics from Hampshire College, and an M.A. in computer science from Boston University, where he specialized in computation theory.

Ralph Stamerjohn actively has been developing distributed computer network systems for more than 15 years. As the principal engineer and cofounder of Meridian Technology, St. Louis, Missouri, Ralph is responsible for the design of Meridian's network software packages, including RSX/VAX resource sharing (LAD/11); industry standard, multivendor communications (MERIT/XNS); and custom communications solutions. Prior to joining Meridian, Ralph served as senior systems programming specialist at Monsanto.

Ralph is a data communications industry expert, a frequent speaker at seminars and trade shows and an active member of DECUS. He has written many technical articles and is the author of "Resource Executive." He holds a B.S. degree in Computer Engineering from the University of Illinois.

Is your data spread out all over the lot?

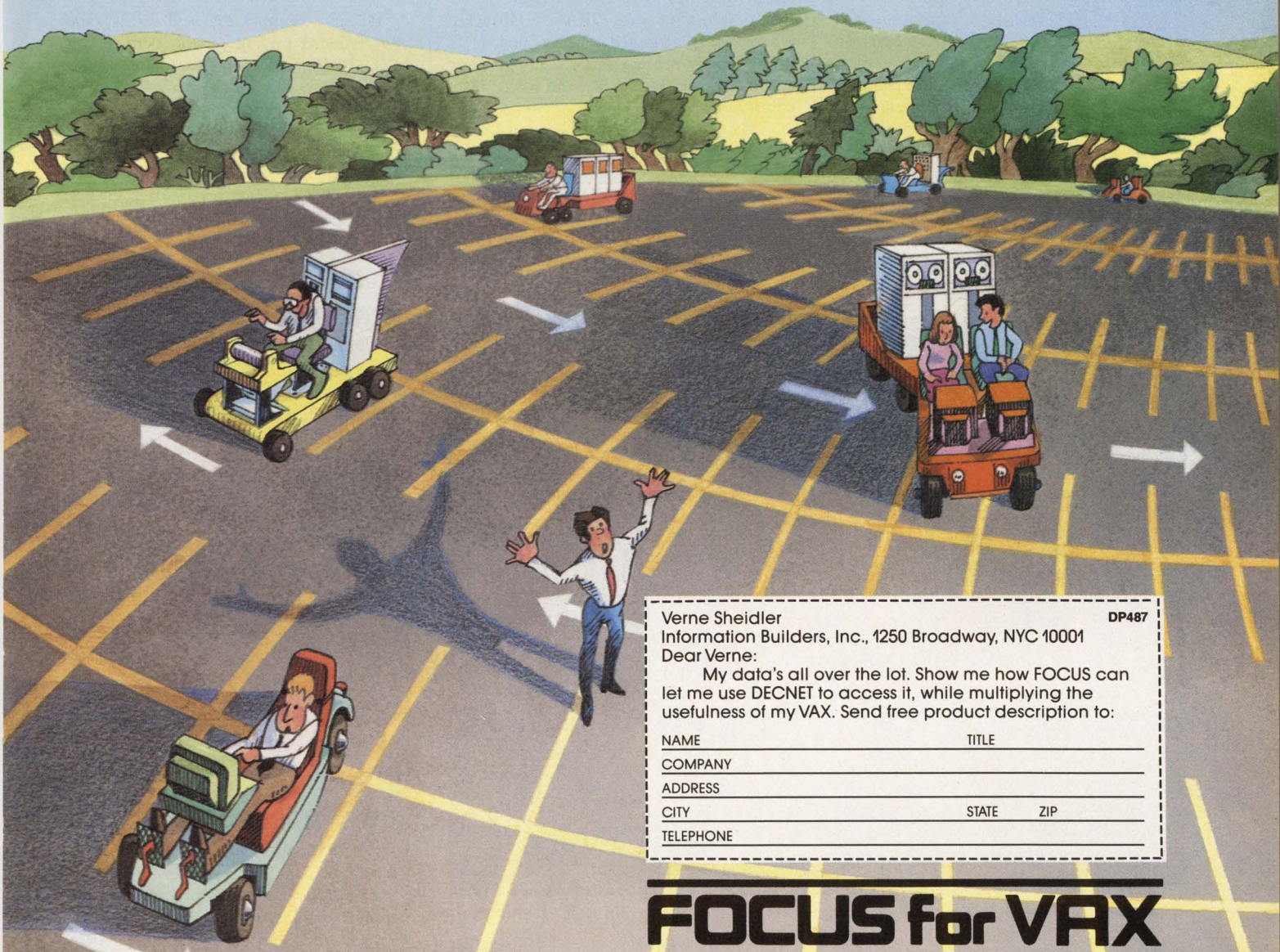
FOCUS can make distributed data management a reality for your VAX/VMS!

When you bring your VAX/VMS into the 4th generation with FOCUS, you get more than the complete decision support capabilities that FOCUS is famous for. You even get more than the application development productivity gains that have become a FOCUS hallmark.

You also get the ability to access and manipulate all your data, even when it's located at remote DECNET nodes!

Yes, FOCUS lets you use DECNET to its fullest advantage. It has the power to join, access and process multiple files in a single transaction stream, wherever they are in your network...even if they're spread out "all over the lot"...whether "all over the lot" means in another room, another building or another city.

Let FOCUS help you get **your** data together. It's available for all VAX/VMS systems from the MicroVAX through the VAX 8800 and VAXcluster. For a free product description with complete technical specifications, fill out the coupon below and mail it to Verne Sheidler, Dept. 37 Information Builders, Inc., 1250 Broadway, New York, NY 10001.



Verne Sheidler **DP487**
Information Builders, Inc., 1250 Broadway, NYC 10001
Dear Verne:

My data's all over the lot. Show me how FOCUS can let me use DECNET to access it, while multiplying the usefulness of my VAX. Send free product description to:

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MARKETPLACE

WORD-11 Adds New Features

Data Processing Design's newest version of WORD-11, WORD-11 4.1, has added on-line spelling error correction, on-line thesaurus, automatic hyphenation, table math functions, newspaper-style columns and side-by-side column support to WORD-11's other popular features. WORD-11 is word processing software for Digital VAX computers.

WORD-11 also provides proportional printing on the LN03, conversion between DECmates and IBM PC word processing software, characters for scientific equations, extensive list processing, and integration with Graphics-11 which allows the printing of text and graphics together on a laser printer.
For further information contact Data Processing Design, Inc., 1400 N. Basher St., Anaheim, CA 92807; (714) 970-1515. Telex: 182-278. Visit Booth No. 911.

Enter 970 on reader card

ICEX Announces Version 2.0 of GRAFkit

ICEX, Inc. has announced Version 2.0 of their graphics software, GRAFkit. GRAFkit is a low-cost, integrated system of high-level utilities for presenting data visually through graphics in the VAX/VMS and MicroVMS environments.

Major enhancements in Version 2.0 include concurrent and interactive graphic output to provide the simultaneous display of the graphics while they are being computed. Versatile graphic output also has been added. This allows the graphic output to be directed to a device-independent metafile (for use by the translator), a device specific file, a device, or a spooled device in a shared environment.
Additional information is available by contacting International Computer Exchange, Inc., 740C South Pierce Ave., Louisville, CO 80027; (303) 666-5400. Telex: 292-682. Stop by Booth No. 400.

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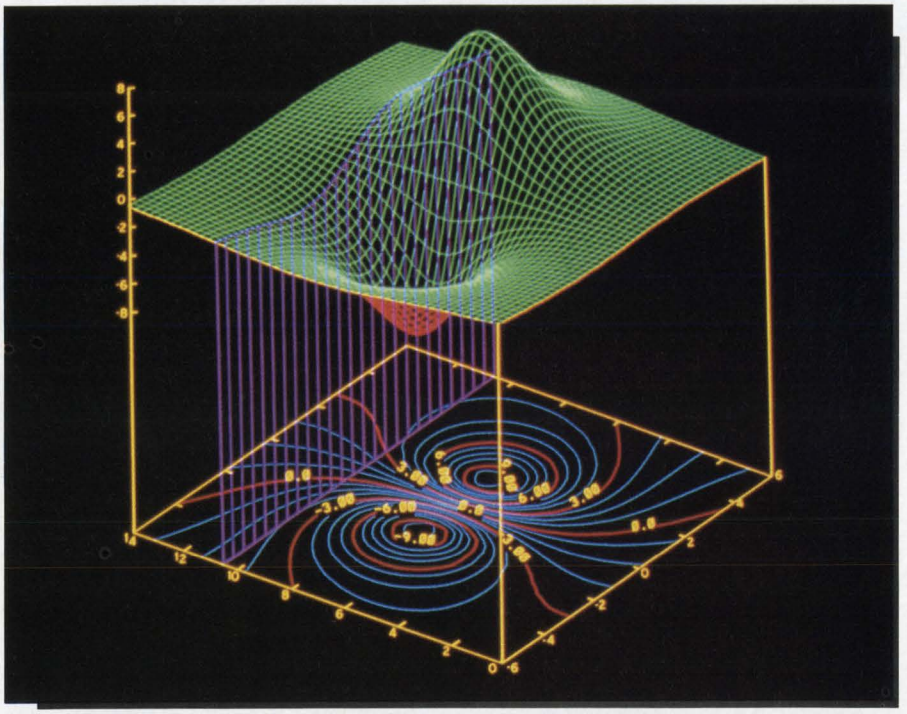


Version 2.0 of ICEX's GRAFkit presents data visually through graphics in the VAX/VMS and MicroVMS environments.

Price Reduced On MKG-10 Disk Head Inspector

At DEXPO South CPX will display and offer reduced pricing on the Four Power MKG-10 Disk Head Inspector for use on the RM02.

Previous pricing ranged from $395 to $650. A special price of $250 will be offered at DEXPO South.
Visit Booth No. 99 or contact CPX, 21900 Plummer St., Chatsworth, CA 91311; (818) 709-4003. Telex: 371-9692.

Enter 972 on reader card

Micro-Term Debuts 'Foresight Edition'

The "Foresight Edition" Series, by Micro-Term, is alphanumeric and graphics terminals that display fully formed letter-quality black characters on fully overscanned, reverse-video soft-white backgrounds.

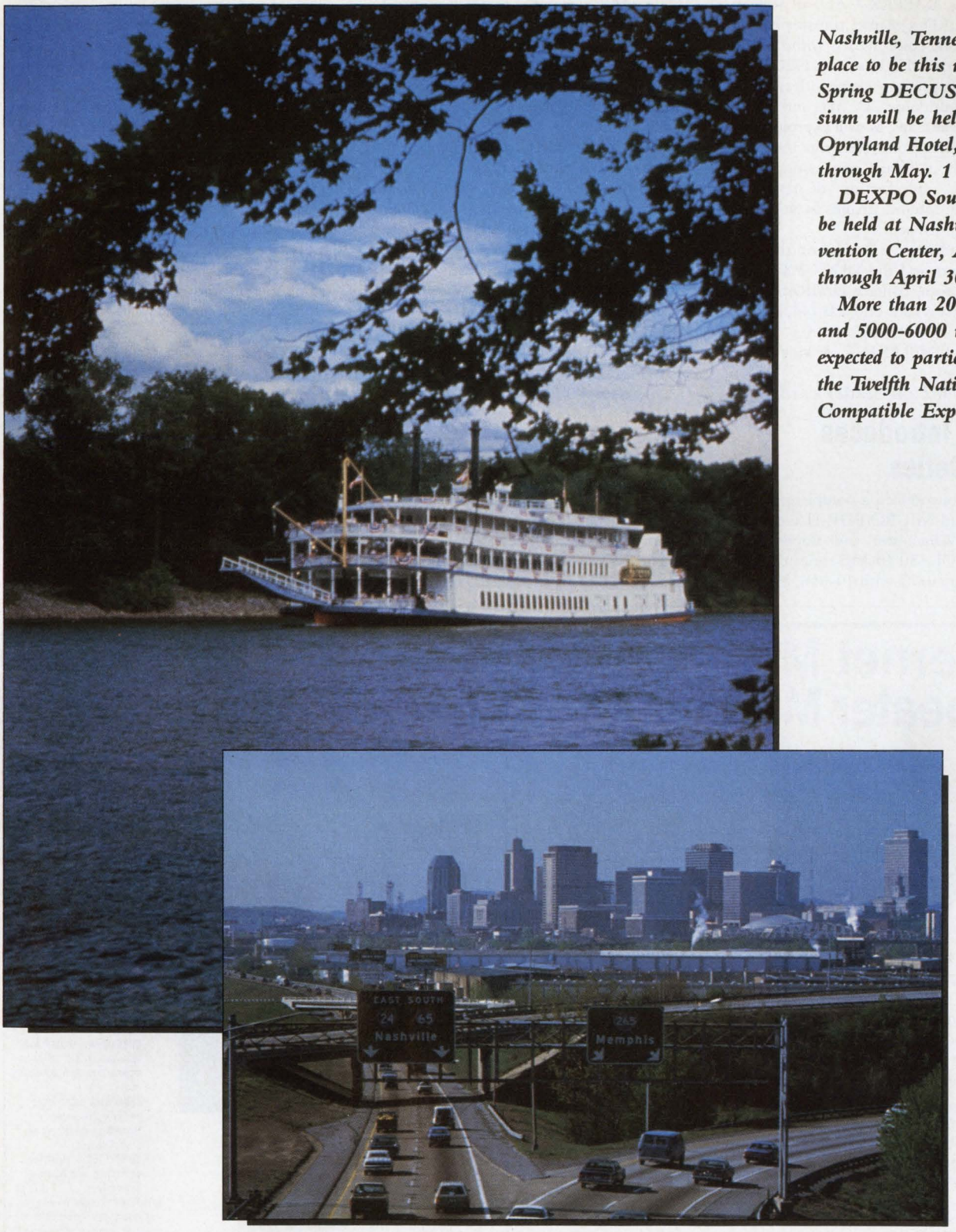
Among the products making their debut are Micro-Term's "Foresight" 4520, a feature-rich terminal that is a perfect DEC VT220 emulator; the "Foresight" 4525, the only DEC VT220-compatible terminal that can be upgraded to Tektronix 4010/4014 and ReGIS graphics capability; and the "Foresight" 4560 which combines a perfect DEC VT220 emulation with high-speed Tektronix 4010/4014 graphics compatibility.
For more information contact Kaye Sutton, 512 Rudder Rd., St. Louis, MO 63026; (314) 343-6515, or visit Booth No. 921.

Enter 901 on reader card

UNIRAS Unveils New Products

At DEXPO South 87, UNIRAS will demonstrate four new products.

RASPAK is a set of versatile, all-purpose graphics software tools with which you can tailor your own specialized graphics applica-



Nashville, Tennessee, is the place to be this month. The Spring DECUS Symposium will be held at the Opryland Hotel, April 27 through May. 1

DEXPO South 87 will be held at Nashville's Convention Center, April 28 through April 30.

More than 200 exhibitors and 5000-6000 visitors are expected to participate in the Twelfth National DEC-Compatible Exposition.

tion programs. RASPAK-CAD, an add-on package to CAD-systems, transforms 3D designs into solid color models with smooth shading and artificial light source. GEOPAK, an advanced mapping package, offers high-resolution, multicolor 2D, 3D, and "4D" contour and grid maps, as well as projections of flat contour maps onto planes in 3D space.

GIMAGE is image processing; e.g., high-accuracy reproduction of remotely sensed aerial or satellite images as well as of data in video format.

These products can be used on all DEC VAX computers and the VAX GPX.

To find out more, contact UNIRAS, Inc., 5429 LBJ Freeway, Ste. 650, LB 144, Dallas, TX 75240; (214) 980-1600, Telex: 510-100-0535 UNIRAS INC, or visit Booth No. 1028.

Enter 902 on reader card

Chrislin Introduces CI-550 Series

Chrislin has introduced a complete line of MicroVAX and MICRO/PDP-11 compatible add-on Winchester and floppy disk systems. The CI-550 40-MB series features disk and floppy units with 10-MB, 20-MB, and 40-MB capacity hard disk and 5 1/4 inches RX50 compatible floppy. The CI-550 also features disk only units with 45-MB, 70-MB, 120-MB, and 155-MB capacities. All disk units are high performance with access times of 30 ms or less and transfer rates of 625kb/sec.

All CI-550 units are completely compatible MSCP emulation, and come with diagnostics and formatters. All units are designed for quiet operation in tabletop applications, coming with their own power supply, fan, and cabling.

For further information, contact Gary A. Sirois, Chrislin Industries Caribe Inc., Rd. 188, KM. 0.8, Industrial San Isidro, P.O. Box FF, Canovanas, P.R. 00629-1657; (800) 468- 0763 or (809) 876-5205 (EST), or visit Booth No. 1211.

Enter 900 on reader card

Speakeasy Announces Grapheasy

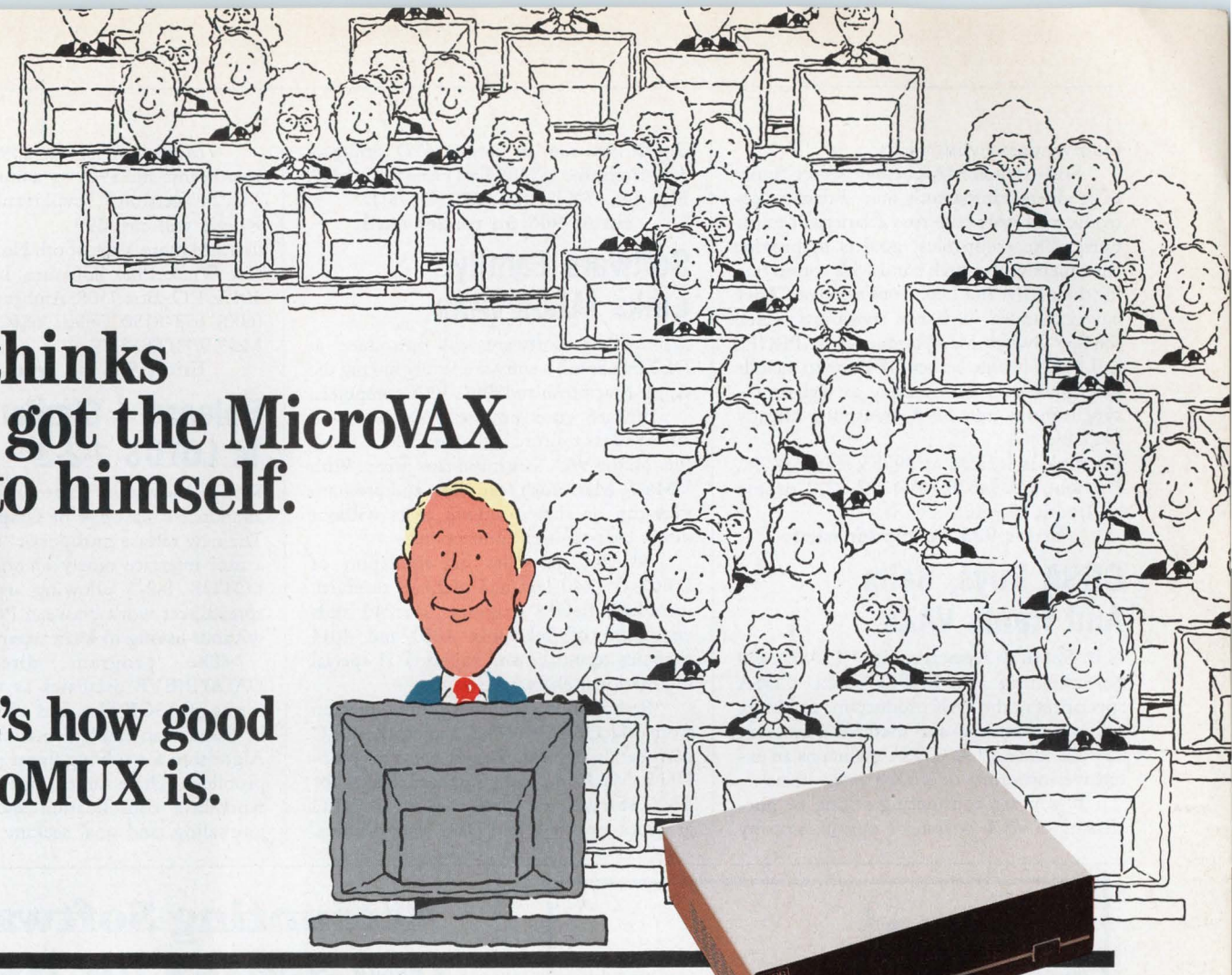
Speakeasy Computing Corporation has announced the release of Grapheasy, an enhancement to the Speakeasy IV System. Grapheasy is a modular tool kit that provides a flexible and easily used method for producing many types of graphs on a variety of devices. Grapheasy includes greater report writing features, a large number of device drivers, and a wide range of related graphical capabilities.

Grapheasy is included free to Speakeasy users. Speakeasy is available for IBM OS/MVS and VM/CMS, and DEC VAX/VMS systems. It also is operational on IBM-compatible micro computers. The current lease and service fee for mainframe usage at commercial sites is $7,000; the micro version can be licensed at a commercial rate of $975. For further information, contact Speakeasy Computing Corporation, 222 W. Adams St., Chicago, IL 60606; (312) 346- 2745, or visit Booth No. 311.

Enter 903 on reader card

Merger Exceeds E-Mail Requirements

Soft-Switch, Inc. and Interlink Computer Sciences, Inc. have joined to facilitate integration of both companies' products. By providing an interface between the Soft-Switch MAILbridge Servers and the Interlink 3711 Gateway, customers using both products will be able to integrate more tightly their



He thinks he's got the MicroVAX all to himself.

That's how good TurboMUX is.

Imagine a communications controller continuously transmitting over 100,000 characters per second on a MicroVAX II with only 14% CPU overhead.

And it runs seven times as fast as the DEC DHV11 on MicroVAX! Seven times faster than DEC's DHU11 on VAX.

Imagine a controller that cuts *program running time up to 1/9 of DHV emulations.* A controller that reduces the system interrupt rate by more than 40 to 1 over DHV. Tremendously low overhead.

No wonder we named it TurboMUX — the DHU Communications Subsystem from MDB Systems.

TurboMUX runs under any Q-Bus, Unibus, MicroVAX, or VAX operating system — as well as TSX-Plus®

One CPU slot gives you all the channels you need.

Only one quad-sized board is plugged into the MicroVAX II backplane, and it cables into a desk-top or rack-mount terminal adapter unit which accommodates 32 terminals. Not only is backplane real estate conserved, but the desk-top unit *contains its own power.*

Up to eight adapter units can be slaved — *offering up to 256 channels* going to terminals, PCs, printers, and other serial devices.

One TurboMUX does the work of 32 eight-channel DHV boards — at an incredible cost per line of under $130.

TurboMUX is available with full modem control, supporting all the DEC baud rates from 50 to 38.4KB.

The terminal adapter units can be located up to 1000 feet away from the CPU. They support terminals up to 4000 feet away, with RS-232-C and RS-423-A compatibility. TurboMUX saves the headache and cost of long, multiple cables.

Network congestion on Ethernet is cleared up completely.

Contact us for more information on TurboMUX — *the incredibly fast, powerful asynchronous multiplexor that keeps CPU overhead at a minimum.*

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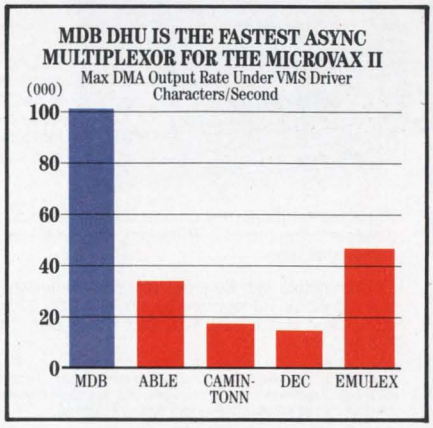

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multivendor environments.

Soft-Switch MAILbridge Server family of products transparently links different electronic mail systems across a variety of transports. The companies' goal is to provide customers with a high band with connection for their IBM and DEC environments. They have expanded the list of transports which the Soft-Switch MAILbridge Server/PROPS and MAILbridge Server DEC use to include the Interlink 3711 Gateway as well as bisynchronous and SNA transports already available.

Interlink is located at 39055 Hastings St., Fremont, CA 94538; (415) 792-6212, or stop by Booth No. 425.

Enter 905 on reader card

CDSA Buys, Sells And Rents VAXs

C.D. Smith & Associates, Inc. (CDSA) will be exhibiting at DEXPO South. CDSA specializes in the VAX product line and buys, sells and rents new and used VAX systems, options and CPUs. CDSA maintains an extensive inventory of VAX-related items.

If you are considering selling or purchasing a VAX system or option, stop by Booth No. 536, or contact C.D. Smith & Associates, Inc., 12605 East Freeway, Ste. 319, Houston, TX 77015; (713) 451-3112.

Enter 906 on reader card

Software Family Links MACs/VAXs

White Pine Software will introduce at DEXPO South a software family linking the Apple Macintosh and DEC VAX computers.

VMacS runs on the VAX host and allows users to store and manage Macintosh files on the VAX's disk and tape drives. With VMacS, Macintosh text, data, and program files can be shared among users without direct user-to-user connection.

Mac240 provides an emulation of DEC's VT240 text and graphics terminal, including ReGIS graphics. Mac240 adds emulation of Tektronix 4010 and 4014 graphics terminals and supports 11 special international character sets.

Reggie allows graphics communication from Macintosh-to-VAX and to the DEC peripherals beyond. Reggie converts MacDraw, MacPaint, and Clipboard images for VAX storage and presentation on DEC graphics terminals and DEC laser printers.

VMacS will sell for $399 for a single user license and $999 for a multiuser license. Mac240 version 1.3 will retail for $199 and Reggie will cost $99.

To learn more, visit Booth No. 1131, or contact White Pine Software, Inc., 75 Route 101A, P.O. Box 1108, Amherst, NH 03031; (603) 673-8150. Telex: 6502887627 MCI Mail WHITEPINE.

Enter 904 on reader card

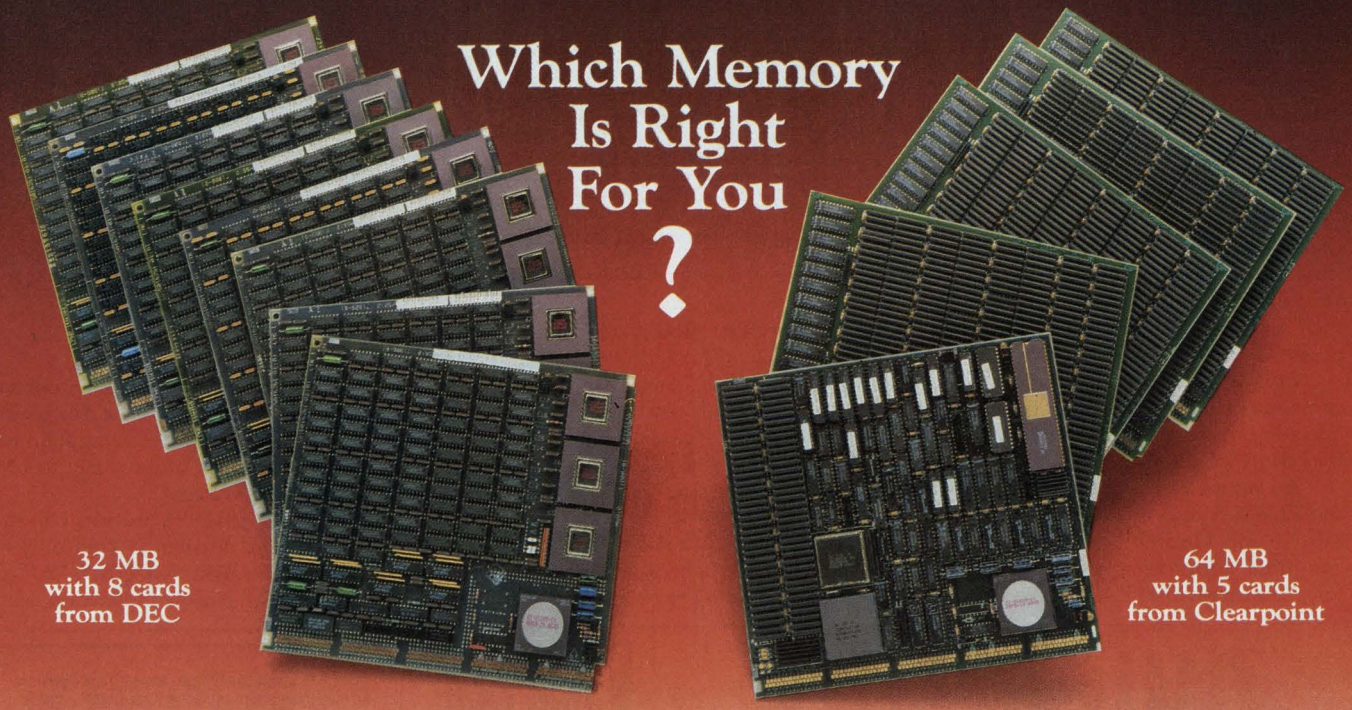
Release 4 Similar To LOTUS 1-2-3

Stone Mountain Computing recently announced release 4 of Graphic Outlook. The new release introduces "Lotus Mode," a user interface nearly identical to that of LOTUS 1-2-3 allowing users to move spreadsheet work between PCs and VAXs without having to learn separate programs.

The program directly reads DATATRIEVE databases as well as many forms of ASCII files, and offers, as a built-in feature, an implementation of Simplex Algorithm for solving linear programming problems. Three dimensional spreadsheets, worksheet consolidation and encryption, journaling, and goal seeking are featured.

BI-ORIGINAL?
BI-COMPATIBLE?

Which Memory Is Right For You ?



32 MB with 8 cards from DEC

64 MB with 5 cards from Clearpoint

DEC's 32 MB or Clearpoint's 64 MB Power

Unequalled Density Offered for VAXBI-Compatible Systems

Now Clearpoint provides VAX 8200 and 8300 users with a choice of memory densities at unmatched price savings, with equal or better performance.

NEW—64 MB Density Available with 16 MB Array Cards

The VBIRAM offers the maximum memory density using 16 MB array cards. Clearpoint offers either 32 MB in 5 slots using the 8 MB array cards or 64 MB in 5 slots using the new 16 MB arrays.

Only One BI Node per Memory Subsystem

To put 32 MB of DEC memory on an 8300 would consume half of all the BI nodes for memory. DEC cannot deliver 64 MB since all 16 nodes would be needed. Clearpoint offers up to 64 MB using only one BI node, allowing sophisticated systems and maximum memory.

Trade-in and Trade-up

Clearpoint lets you upgrade existing 2 or 4 MB memory cards up to 64 MB. By re-using the BIIC (Bus Interconnect Interface Chip), customers are assured of 100% VAXBI compatibility. The Clearpoint trade-in program gives users the maximum value for their boards—call Clearpoint and get the most for your DEC 2 MB cards.

Compare the Facts:

	DEC	Clearpoint
Memory per BI node	4 MB	64 MB
Memory per 5 BI slots	20 MB	64 MB
Read stall cycles	2	1
Future expandability	No	Yes
Full EDC—single bit correction and double bit detection	Yes	Yes
Warranty	1 Year	Lifetime with 24 hour repair/replace
Marginal cost per MB*	$1500	less than $500

*at list price, 32 MB system, based on DEC's March 2 price reduction.

See us at DEXPO South, Booth #537

CLEARPOINT INC.

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There is a Difference!

Clearpoint's totally unique VBIRAM memory upgrade subsystem separates the memory controller from the memory arrays. The controller communicates with the memory arrays over the C/D/E I/O connectors on the VAXBI backplane, thus providing a highly reliable connection with no cables. Memory sizing is done automatically without switches or jumpers.

All this—plus Clearpoint Reliability

All Clearpoint memory products are warranted for the lifetime of the system. Full customer support service, including a 24-hour repair/replacement policy, is available.

Write or call for the complete VBIRAM information kit containing:

- ☐ The **VBIRAM User's Manual** offers detailed technical information on installation, operation, performance, and diagnostic testing.
- ☐ The full-color, 24-page **Catalog and Memory Selection Guide.**
- ☐ The 60-page **Designer's Guide to Add-in Memory.**

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If my memory serves me right... it must be Clearpoint.

Special project scheduling functions perform date arithmetic. Over 80 built-in scientific and business functions are provided.

Demonstration tapes are available from Stone Mountain Computing Corporation, 1096 Cambridge Dr., Santa Barbara, CA 93111; (805) 964-9101, or come by Booth No. 407.

Enter 909 on reader card

IMSL Introduces Enhanced PROTRAN Product

IMSL has released Edition 1.0 of PDE/PROTRAN. It handles a large class of time-dependent, steady-state and eigenvalue problems in general two-dimensional regions. Its versatility makes it ideal for problems in areas such as elasticity, diffusion, heat conduction, potential energy, and fluid flow.

PDE/PROTRAN is available for VAX computers running under the BSD UNIX operating system (Version 4.2) with the Berkeley F77 compiler (Version 1.0).

An annual license costs between $2,000 and $2,900. A paid-up license costs between $10,800 and $16,500.

For more information, contact the IMSL Sales Division, 2500 ParkWest Tower One, 2500 CityWest Boulevard, Houston, TX 77042-3020; (713) 782-6060. Telex: 791923 IMSL INC HOU. Stop by Booth No. 401.

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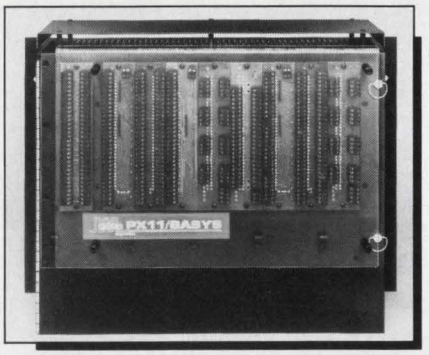


ADAC Corporation's PX11/BASYS is a tough environment data acquisition and control system.

Talaris To Exhibit Latest Laser Printer

Talaris Systems Inc. will be exhibiting a new version of its eight page-per-minute laser printers, featuring two 250-sheet paper bins for expanded capacity and more handling flexibility. The printer's output tray holds 250 sheets with switch-selectable face-down (collated) or face-up output. The printer is enhanced with the applications software and fonts required to take advantage of advanced laser technology.

Talaris also will be exhibiting the Talaris 7800 terminal with accompanying page previewing software packages, and a new 15 page-per-minute laser printer.

To learn more, contact Janice Kall, Talaris Systems Inc., P.O. Box 261580, San Diego, CA 92126; (619) 587-0787, or stop by Booth No. 915.

Enter 908 on reader card

ADAC Announces PX11/BASYS

ADAC announces a harsh environment, standalone or intelligent satellite data acquisition and control system featuring solid state "semi-conductor disk" mass storage to 4 MB of battery-packed RAM.

Model PX11/BASYS provides LSI-11/23 or 11/73-based distributed control while interfacing with IBM PC/XT/AT, VAX and DEC mini hosts. It also can function as host

to distributed control networks of ADAC PICOBASYS intelligent front-ends.

PX11/BASYS shares ADAC's PROM resident I/OBASIC programming language with other BASYS systems for complete program interchangeability. It also will support FORTRAN and PASCAL programs. Nonvolatile battery-backed CMOS RAM storage up to 4 MB assures ample data capacity. For complete details, contact ADAC Corporation, 70 Tower Office Pk., Woburn, MA 01801; (617) 935-6668. Telex: 951802, or visit Booth No. 504.

Enter 910 on reader card

EEC Systems Introduces TURBO DISK/VMS

EEC Systems, Inc. recently introduced their latest software offering — TURBO DISK/VMS, the Virtual Memory Device. TURBO DISK/VMS uses VAX/VMS's main memory for storage of data instead of a standard disk, with a speed several thousand times that of a conventional disk.

All transfers of data occur at CPU speed with no seek time or disk controller contention. Applications that benefit most from using the TURBO DISK/VMS package are those that heavily access files. Operationally, the TURBO DISK/VMS Virtual Memory Device is transparent to your applications. Any operation valid on a standard disk device also is valid for the TURBO DISK/VMS. File security is assured by the standard VAX/VMS protection scheme.

TURBO DISK/VMS can be seen at Booth No. 920, or by contacting EEC Systems, Inc., Millbrook Pk., 327/E Boston Post Rd., Sudbury, MA 01776; (617) 443-5106/6376.

Enter 913 on reader card

UNIBUS Enhancement Adds Years To UNIBUS Systems

Digital Data Systems, Inc., in conjunction with Setasi Research and Development, has developed a UNIBUS enhancement package that adds years to UNIBUS systems, allowing for cost savings and better planned migration. The package has an Ultra Fast Unibus Memory (UFUM) and a UNIBUS segment Isolator/High Speed Repeater (USI/HSR). Through the use of new proprietary circuitry, a memory has been created with a cycle time of less than 5 NSEC. System bandwidth is doubled, with certain applications realizing further improvements. The USI/HSR supports this by improving UNIBUS integrity, allowing the UNIBUS to run at the increased bandwidth of up to 6 MB, along with tripling its load capacity. If interested, contact Digital Data Systems, 1551 N.W. 65th Ave., Plantation, FL 33313; (305) 792-3290, or visit Booth No. 1136.

Enter 911 on reader card

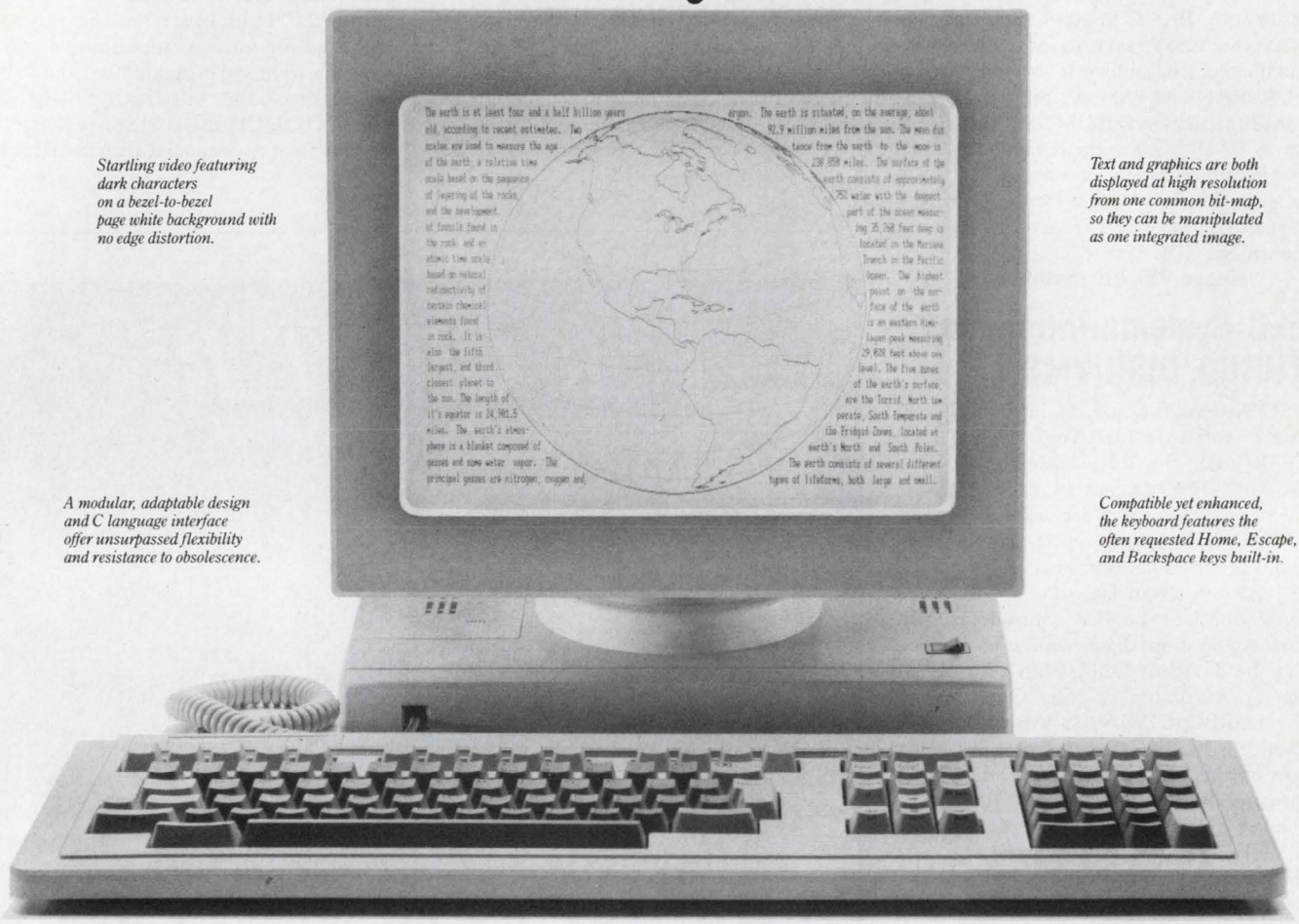
Touch Technologies Demonstrates INTOUCH

Touch Technologies, Inc. will demonstrate its new INTOUCH product at DEXPO South. INTOUCH is the next-generation language for VAX/VMS computers. It includes the power of a 4th GL without the overhead that commonly accompanies these languages. INTOUCH includes an easy-to-use language for novices; sophisticated extensions for technical programmers; and a simple, understandable interface to all VAX data files. INTOUCH also is a high-performance development environment with fast response

Look anywhere.

Startling video featuring dark characters on a bezel-to-bezel page white background with no edge distortion.

Text and graphics are both displayed at high resolution from one common bit-map, so they can be manipulated as one integrated image.



A modular, adaptable design and C language interface offer unsurpassed flexibility and resistance to obsolescence.

Compatible yet enhanced, the keyboard features the often requested Home, Escape, and Backspace keys built-in.

There's only one VT220 compatible that can do all this for under $700.

The VISUAL 603 Integrated Image™ display station stands alone. Its feature set goes so far beyond that of other DEC VT220 compatibles that it's establishing a new standard by which they are judged. Included are all the usual features you've come to expect in a compatible, such as downline-loadable character sets, full character attributes, more programmable function keys, VT52 and VT100 emulations, a DEC compatible keyboard, auxiliary port with device support, even desk-top accessories and window support. But that's just the beginning of the story.

A new standard in video presentation. The VISUAL 603 combines several features which together yield truly startling video performance: page white phosphor; flat profile, non-glare screen; overscanned video; flicker free, 70 Hz refresh rate; and fully bit-mapped, 1056 × 400 resolution. While the list goes on and on, what's important is how it looks compared to other displays in its price range. And comparisons are invited.

Now, graphics at an alphanumeric price. With its fully bit-mapped display memory, the VISUAL 603 supports Tektronix 4010/4014 graphics applications and DEC Sixel graphics transfers. And its two pages of graphics memory allow one graphics image to be viewed while another is drawn. And its Integrated Text and Graphics (ITAG) mode allows you to display a graphics image and alphanumeric data – using any VT220 display attribute – on the same screen.

FEATURE	VISUAL 603	DEC VT220	CIE CIT-224
Page White Phosphor:	Yes	No	No
Screen Refresh Rate:	70 Hz	60 Hz	60 Hz
Overscanned Video:	Yes	No	No
Character Size (80 Col):	11 × 14	7 × 9	7 × 10
Tektronix Graphics:	Yes	No	No
Integrated Text and Graphics:	Yes	No	No
List Price:	$695	$795	$699

New opportunities for VARs. The VISUAL 603 can be readily adapted by VARs using a C language software development toolkit. That means that, with the VISUAL 603, a VAR can now add value at the level of the peripheral, not just at the host computer system.

Look more closely at the VISUAL 603. For more information, write:

VISUAL TECHNOLOGY INCORPORATED
P.O. Box 5505, Peoria, Illinois 61601
Or, call toll free: (800)433-0880

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and the ability to interrupt program execution, change code, and then continue execution. High-level debug facilities include tracing program execution and recording execution timings and statistics.

INTOUCH will be demonstrated in Booth No. 444 hourly. To learn more, contact Tom Piskin at Touch Technologies, Inc., 9990 Mesa Rim Rd., Suite 220, San Diego, CA 92121; (619) 455-7404.

Enter 914 on reader card

ERI Debuts VAX/VMS For PROGRAMMERS

ERI will debut its newest video training product called "VAX/VMS FOR PROGRAMMERS." This series of eight videotapes and a 400-page workbook is designed to teach the programmer or computer-literate user to perform intermediate and advanced tasks under VMS. The series is language independent and covers a variety of topics essential to the VMS programmer.

A free two-week preview is offered. Clients can contact ERI and receive any full-length module of their choice, along with the corresponding workbook chapter to review before they purchase.

For further information, contact ERI Training, 462 Broadway, New York, NY 10013; (212) 334-1240, or stop by Booth No. 636.

Enter 916 on reader card

New Version Of 20/20 Demonstrated At DEXPO

Access Technology, Inc. will demonstrate a new ALL-IN-1 version of 20/20 at DEXPO South. This new version supports DEC's ALL-IN-1 Office and Information System, allowing 20/20 users to work within its file cabinet system.

ALL-IN-1 users can access 20/20 spreadsheet files just as they access all other documents under ALL-IN-1. Users also can mail live spreadsheet models across network nodes, write to the Scratchpad, and use the Interrupt facility and Gold keys.

20/20 starts at $3,300 on the MicroVAX II, and ranges up to $14,700 on the VAX 8800.

If you would like to learn more, contact Karen Doyle, Access Technology, Inc., 6 Pleasant St., So. Natick, MA 01760; (617) 655-9191, or visit Booth No. 829.

Enter 917 on reader card

Compugraphic Displays New Products

Compugraphic Corporation announces a wide range of custom type products. Compugraphic offers font cartridges that are configured to a user's specifications.

The addition of two new typefaces, OCR-A and OCR-B, brings the total library of monospaced fonts for the DEC LN01 and LN03 laser printers to 26. The current proportional typeface offering of 39 will double in 1987.

Compugraphic Corporation is located at 66 Concord St., Wilmington, MA 01887; (617) 658-5600, or visit Booth No. 445.

Enter 918 on reader card

Softool To Demonstrate CCC/DM Turnkey

Softool Corporation is expanding its applications platforms by adapting user turnkeys to

Q-MASTER 2 is Phoenix Data's continuous disk data acquisition interface.

its premier product Change and Configuration Control (CCC). The introduction of a CCC/DM (development and maintenance) turnkey provides a menu-driven layer with on-screen panels that minimize training and implementation of CCC. With this turnkey, users can manage and control all aspects of the development, quality assurance, maintenance, and production environments. Users also can access on-line help panels for immediate assistance.

The turnkey dramatically reduces the installation and implementation methodology that is required in configuration management, resulting in an immediate benefit to the user.

If you are interested, contact Softool Corporation, 340 South Kellogg Ave., Goleta, CA 93117; (805) 683-5777. Telex: 658334, or stop by at Booth No. 624.

Enter 915 on reader card

QM-2 Compatible With DEC Q-bus

Phoenix Data announces its new DEC Q-Bus Compatible Q-MASTER 2 (QM-2) DMA interface that transfers digitized data on a memory-to-memory basis for continuous disk rates up to 1,000 Kilowords-per-second. The QM-2 is compatible with Phoenix Data's IDAS series of Intelligent Data Acquisition Systems.

QM-2 is ideal for real-time multichannel analog-to-digital conversion tasks in multiplexed or simultaneous sampling environments including applications such as acoustic data analysis, vibration testing, turbine engine testing, flight tests and simulation, wind tunnels, structures, etc.

To find out more, contact Phoenix Data, Inc., 3384 W. Osborn Rd., Phoenix, AZ 85017; (602) 278-8528, or visit Booth No. 1037.

Enter 923 on reader card

EMC To Exhibit Memory For High-End VAXs

EMC Corporation will exhibit its new memory enhancement products for Digital's high-end VAX 8000 Series. EMC's memory upgrades are a pair of 16 MB memory arrays, and list for about 20 percent less than Digital's comparable product. The new product uses 1-Mbit RAM technology. Digital's memory design for its high-end computer systems uses 256K RAMs surface-mounted on eight daughter boards. This type of design incorporates more connections. As the number of connections increases, the reliability of a memory board decreases.

For more information about EMC's products stop by Booth No. 710, or contact EMC Corporation, Hopkinton, MA 01748-9103; (800) 222-EMC2, in MA (617) 475-2541.

Enter 921 on reader card

Timeline Offers Better Payroll System

Timeline, Inc. has announced the introduction of the Timeline Payroll/Personnel System which is available for VMS and RSTS/E operating systems.

The system is integrated with Timeline's data management system DIGIBASE, and

can generate custom payroll and personnel information and reports without programming assistance. It offers flexibility in defining earnings, taxes and deductions, including pension plans such as 401K. It produces all standard reports, has unlimited labor distribution capabilities and can accommodate all state and local tax provisions.

The RSTS/E version is written in BASIC-PLUS 2 and costs $12,500. The VAX version is written in VAX BASIC and costs $12,500 for MicroVAXs and $17,500 for larger VAXs.

For more information, contact Timeline, Inc., 3055 112th Ave. N.E., Suite 106, Bellevue, WA 98004; (206) 822-3140, or come to our demonstrations at Booth No. 432.

Enter 920 on reader card

CFS Benefits DP Departments

The latest version of Command File Scheduler (CFS) will be shown by Park Software, Inc., at DEXPO South. CFS is a program that provides complete control over the scheduling of VAX/VMS command files and provides a perpetual batch processing schedule.

New features in version 2.0 include extended error trapping, microfiche tape creation and enhanced report distribution features. CFS benefits the data processing department because its parameter-driven philosophy means command files can be generated automatically and submitted for daily, weekly and monthly processing. Computer resource requirements are identified before the processing cycle has begun.

CFS pricing ranges from $4,000 to $6,000. To learn more, contact Park Software, Inc., P.O. Box 31529, Seattle, WA 98103-1529; (206) 282-8886, or visit Booth No. 321.

Enter 922 on reader card

ISC Demonstrates ViewMATE

International Software Corporation (ISC) announces ViewMATE, a high-performance, PC-based windowing workstation for VMS or UNIX systems. Based on ISC's new MultiVIEW graphics controller and Vaxintosh software, ViewMATE permits multiple, simultaneous, virtual terminal sessions on a single RS-232 port. Vaxintosh software provides an intuitive, iconic-based interface to VMS and UNIX which also may be incorporated into applications. The user may browse or edit host or MS-DOS files, execute host or MS-DOS applications or tasks, or open subviews by pointing and clicking. ISC will demonstrate.

ViewMATE at DEXPO South in Booth No. 1121. For more information, contact Hal Abbott at Corporate Office, Box 10648 Edgemont, Golden, CO 80401; (303) 526- 0388.

Enter 924 on reader card

Sigma To Display STC-TSQ11A

Sigma Information Systems will display its high-performance tape cartridge drive controller for LSI-11 and MicroVAX systems using QIC-02 drives at DEXPO South. The STC-TSQ11A increases the internal data buffer from 8 KB to 32 KB.

The STC-TSQ11A emulates the DEC TK25/TS11. It is hardware compatible with LSI-11 series and MicroVAX CPUs and is software compatible with operating systems

TCP/IP for your PC

Networking for the IBM PC, AT and compatibles with the ARPA standard TCP/IP protocol family. These programs can be used to communicate from PC to PC, but more importantly, they can be used to communicate with other computers such as Vaxes running Ultrix or VMS, Sun workstations, Lisp Machines, and many others.

Programs Included:

- File transfer: *ftp, rcp, tftp*
- Remote login: *telnet, rlogin*
- Electronic mail: *smtp, mail*
- Remote printing: *lpr*
- Information: *finger, whois*
- Remote execution: *rexec, rsh*

Networks Supported:

- Ethernet from 3COM, BICC, Excelan, Interlan, National Semiconductor and Ungermann Bass
- Token Rings from Proteon
- X.25 from Scope
- SLIP (Serial IP) with standard async port

Requires MS-DOS 2.x - 3.x, 256K, one floppy, and a network interface. Binaries $400; programming libraries $500.

ftp Software, Inc.
P.O. Box 150
Kendall Square Branch
Boston, MA 02142
(617) 864-1711

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- Runs on-line or off-line
- Runs *FAST & SAFE* !!!

Benefits: Studies show 45-55% throughput gains when files are contiguous. Data base, CAD/CAM, word processing, and back up applications show significant improvement after fragmented files are "fixed" with RABBIT-7 Disk Optimizer.

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and application programs written for DEC's TK25 or TS11 tape subsystem. Features of the STC-TSQ11A include block mode transfer, media storage capacity of up to 118 MB and a large 32 KB data buffer.

The STC-TSQ11A is priced at $1,200. For more information, contact Sigma Sales, 3401 E. La Palma Ave., Anaheim, CA 92806; (714) 630-6553. Telex: 298607 SGMA, or stop by Booth No. 809.

Enter 925 on reader card

WordPerfect Released For The VAX

WordPerfect Corporation recently unveiled WordPerfect 4.08 for the VAX. Version 4.08 will run on all VAX/VMS machines. WordPerfect's VAX version is similar to version 4.1 for the PC with the exception of the sort and column features.

Features such as sorting, enhanced columns, comments, document summary, and preview features, will be added to the product this summer when version 4.2 is released for the VAX.

License fees for WordPerfect 4.08 on the VAX range between $5,000 and $29,000. More information can be obtained by contacting WordPerfect Corporation, 288 West Center, Orem, UT 84057; (801) 227-4000. Telex: 820618, or visit us at Booth No. 840.

Enter 926 on reader card

Financial Software Designed For VAXs

Collier-Jackson will be showing CJ/BUSINESS INFORMATION SYSTEMS at DEXPO. CJ/BUSINESS INFORMATION SYSTEMS is financial software designed for the VAX family.

Designed to answer accounting, payroll and personnel needs, the total package includes CJ/ADVANCED GENERAL LEDGER, CJ/ACCOUNTS PAYABLE, CJ/ACCOUNTS RECEIVABLE, CJ/FIXED ASSETS, CJ/PAYROLL, CJ/PERSONNEL, CJ/REPORT WRITER and CJ/EXECULINK.

To learn more, contact Collier-Jackson, Inc., 3708 West Cherry St., Tampa, FL 33607; (813) 872-9990, or stop by Booth No. 310.

Enter 928 on reader card

EasyEntry Displayed At DEXPO

Applied Information Systems, Inc. will display a new version of the EasyEntry forms management and data entry system at DEXPO South. The new version includes support for data dictionaries, internal data types, and improved handling of files with multiple record types.

EasyEntry offers quick data entry application generation without programming on the Digital VAX, PDP-11, Professional, Rainbow, and IBM PC. EasyEntry supports heavy data validation, rekey verification, file searches, math computations, windowing, and color. Users can store data in indexed or sequential files, perform keyed or non-keyed searches, call records to the screen, and modify or reverify the data. EasyEntry can be used as a standalone applications generator, or can be integrated with other software packages such as DATATRIEVE.

For more information, stop by Booth No. 905, or contact Applied Information Systems, Inc., 500 Eastowne Dr., Ste. 207, Chapel Hill, NC 27514; (800) 334-5510 or (919) 942-7801.

Enter 929 on reader card

TRIMM Releases TRIMM DA 123

TRIMM Industries announced a new packaging solution for MICRO-11 and MicroVAX II systems. The TRIMM DA 123 offers styling similar to DEC's BA 123 "World Box" and allows for mounting any 5.25 x 19-inch chassis.

The TRIMM DA 123 can support up to five 5.25-inch disk drives or two large capacity 8-inch and one 5.25-inch drives.

A shielded power supply module is offered with a variety of popular voltages and the optional I/O panel has switch selectable filtered incoming power from 100-240 vac. Serial, parallel and communication connector plates are available.

To find out more, contact TRIMM Industries, Inc., 11939 Sherman Rd., North Hollywood, CA 91605; (818) 983-1833, or visit Booth No. 1101.

Enter 931 on reader card

New RAF Software Integrates VAX Resources

PC users now can transparently use VAX printers directly from within PC programs using Datability Software Systems' RAF Remote Access Facility Version 1.8. The new RAF Software also provides an array of other capabilities including full VT220 support and PC viewing of remote messages.

The RAF product allows PCs to manipulate the full capabilities of remote DEC computer systems. PC applications such as file editors, spreadsheet programs, user-written programs and even MS-DOS commands can transparently manipulate files stored on remote DEC systems. RAF also allows users to write PC-based programs that call functions and subroutines that execute on the remote mainframe.

Stop by Booth No. 740, or contact Datability Software Systems, Inc., 322 Eighth Ave., 11th Floor, New York, NY 10001; (212) 807-7800.

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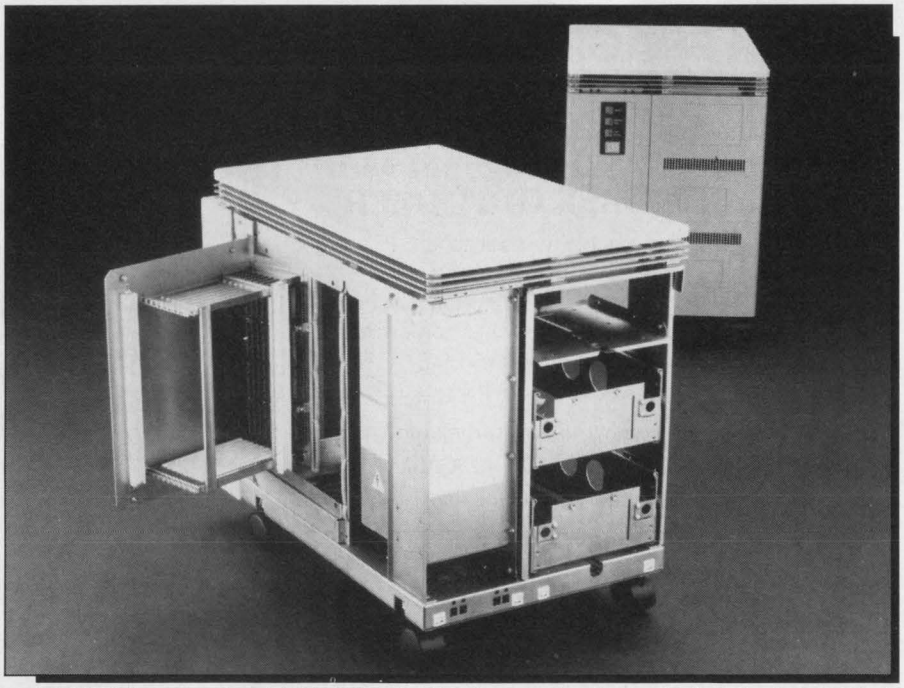

TRIMM Industries' TRIMM DA 123 is a packaging solution for MICRO-11 and MicroVAX systems.

Software Partners/32 Exhibits Products

Software Partners/32, Inc., announced that it will be exhibiting an enhanced version of TAPESYS, and a new product, KBMONITOR, at DEXPO.

TAPESYS V4.3 manages medium to large tape libraries in VAX/VMS environments, including VAXcluster and remote DECnet configurations.

KBMONITOR, a VAX/VMS Terminal Management System, brings together three separate functions: monitoring of idle terminals, logging them out after a specified period of inactivity; selective observation of all I/O from a specific keyboard, allowing security monitoring, logging of activity into data files, and casual observation of users; and enabling a privileged operator to participate in the I/O activity of the targeted terminal.

TAPESYS V4.3 is available from $3,000 to $7,600, and KBMONITOR prices range from $400 to $1,400 depending on processor size.

More information may be obtained by contacting Software Partners/32, Inc., at 447 Old Boston Rd., Topsfield, MA 01983; (617) 887-6409, or visit Booth No. 304.

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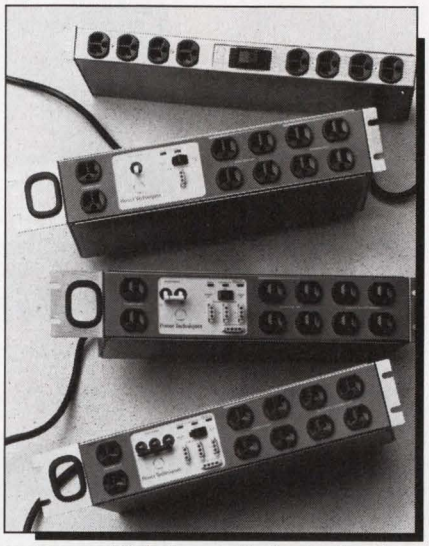

Power Techniques, Inc.'s single phase computer power controllers.

Power Techniques Offers PT Series

Power Techniques, Inc. offers a complete line of single phase computer power controllers for use in supermicro, mini, and supermini systems. The series cover voltages and amperages from 120v 12amp to 240v 24amp. Each model offers line noise, voltage surge, and transient voltage protection, plus electrostatic discharge (ESD) protection, all solid state low voltage control switching and variable time sequence delay.

The series includes PT-500, PT-1000, PT-2000 and PT-8740. Each series is available in 120v 60 Hz or 240v 50 Hz models. Models in the PT-2000 series are compatible with DEC's 871, 872 and 861 controllers. The PT-8740 series is compatible with the DEC 874 range of controllers.

Prices range from $195 for the PT-500 to $510 for the PT-8740. Find out more by contacting Power Techniques, Inc., 40 Aero Camino, Goleta, CA 93117; (805) 685-0533, or visit Booth No. 1206.

Enter 927 on reader card

WPS-PC, WPS-DOS Sort List Processing Files

Exceptional Business Solutions, Inc., announces the release of WPS-PC Version 2.0 and WPS-DOS Version 2.0, their new Gold Key style word processing. WPS-PC and WPS-DOS now Sort list documents for list processing. They also provide important new document exchange capabilities. DEC-mate document diskettes can be read and written directly by the IBM PC/XT/AT using the 1.2 MB diskette drive and by the RAINBOW. Also, WPS-PC and WPS-DOS both read and write DX files which allows fully formatted documents to be exchanged with WPS-PLUS/PC and WPS- PLUS/ Rainbow.

WPS-PC and WPS-DOS cost $275 each.

For a demonstration, stop by Booth No. 1007 or contact Exceptional Business Solutions, Inc., 10811 Washington Blvd., Suite 240, Culver City, CA 90230; (213) 558-3435.

Enter 933 on reader card

HDS Exhibits HDS2000 Series

Human Designed Systems, Inc. (HDS) will exhibit the new HDS2000 Series at DEXPO South. The Series provides a full range of compatible, upgradeable terminals — VT220 compatible, APL, medium- and high-resolution graphics — to meet the application needs of engineering, scientific, and business organizations.

The HDS2210, HDS2210G and HDS2210GX APL Display Terminals provide all the features of HDS ANSI and graphics terminals, with the addition of an APL character set, APL keyboard, and the ability to generate APL overstruck characters in ANSI and graphics modes.

The HDS2000 Terminals cost from $795 to $1,595 and delivery of the terminals is 30 days ARO.

Stop by Booth No. 721 or contact Human Designed Systems, Inc., 3440 Market St., Philadelphia, PA 19104; (215) 382-5000. Telex: 710 670 1460 HDS PHA.

Enter 935 on reader card

Perceptics Announces LaserSystem

Perceptics Corporation announces LaserSystem, a new digital optical disk storage subsystem for DEC VAX and MicroVAX computers running the VMS operating system.

LaserSystem is a complete, integrated, ready-to-use optical disk subsystem. It includes an LMS LaserDrive 1200 optical disk drive, an Emulex UC04/14 SCSI host adapter, Perceptics' LaserWare optical disk software, installation, and support.

The LMS LaserDrive 1200 stores 1,000 MB of data per side on a 12-inch, removable, write-once optical disk media cartridge. Media data integrity is enhanced by its Direct Read During Write (DRDW) and ECC margining features that automatically handle media defects. The drive has built-in self-diagnostics and is fully supported by the Control Data service organization.

To learn more, contact Perceptics Corporation, Pellissippi Center, Knoxville, TN 37922; (615) 966-9200, FAX No. (615) 966-9330; or visit Booth No. 533.

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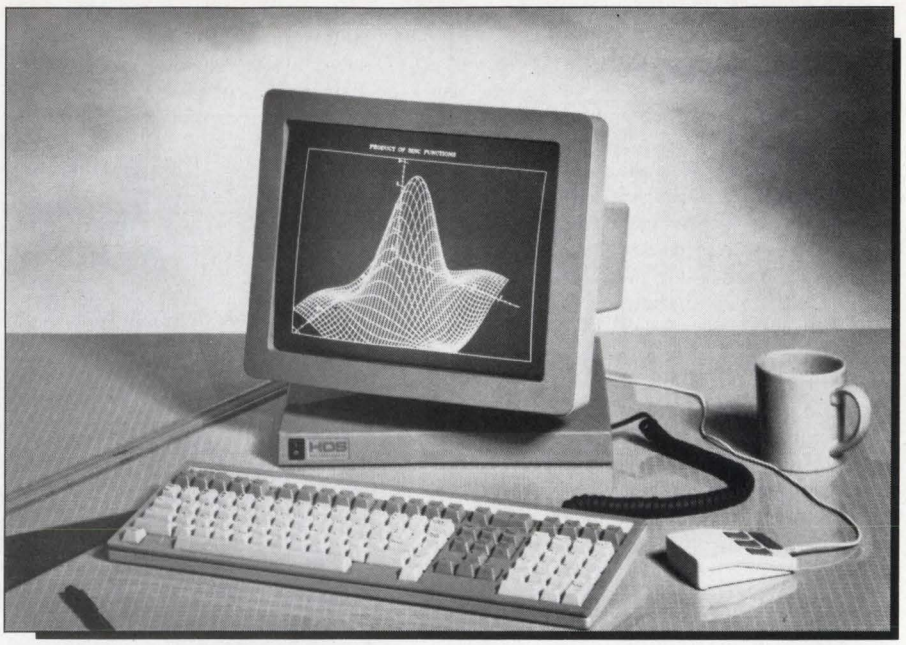

Human Designed Systems, Inc.'s HDS2200GX Graphics Terminal.

NAG Offers FORTRAN Workstation Library

Numerical Algorithms Group (NAG) offers 172 selected routines from its NAG FORTRAN Library for implementation on workstations and PCs.

The mathematics and statistics routines are selected from the 688 routines in the main library. The NAG FORTRAN Workstation Library provides the routines most frequently used by engineers and PC programmers. It currently is available for the DEC MicroVAX, IBM PC Family, IBM RT Systems, and Sun Workstations.

License fees range from $1,296 for a single workstation to $384 each for 11 or more. The annual support fee is $64 to $216.

For additional information, visit Booth No. 311 or contact Technical Sales, Numerical Algorithms Group, 1101 31st St., Ste. 100, Downers Grove, IL 60515; (312) 971-2337.

Enter 937 on reader card

KOM Enhances OPTIFILE II

KOM Inc. announced the release of Version 5.1 of its product, OPTIFILE II. The product will provide several advanced enhancements.

"Direct Access Unverified Write Mode" allows a user to increase substantially the speed of writing to an optical disk. Another enhancement allows a user to access the optical disk volume as it was on any previous "DISMOUNT". A third new feature, Error Log Report, is a detailed report provided by OPTIFILE II that will aid a user in interpreting user error messages.

OPTIFILE II now runs on OPTOTECH 5¼-inch write once optical disk drives. Customers now can use 400 MB of storage capacity on a 5¼-inch platter.

OPTIFILE II, a software device driver, enables a write once optical disk drive to appear as a standard magnetic disk drive on VMS and RSX-11M/PLUS operating systems.

For more information on OPTIFILE II, contact KOM Inc., 145 Spruce St., Ottawa, ON Canada K1R 6P1; (800) 267-0443, or visit Booth No. 1229.

Enter 942 on reader card

PowerHouse Ready For New MicroVAX 2000

Cognos Inc. has announced the availability of its fourth-generation language PowerHouse on DEC's MicroVAX 2000 system. This combination will permit smaller work groups to develop efficient and timely PowerHouse applications.

The MicroVAX 2000 system features full application portability, and can function as a part of a larger computing resource environment. As needs increase, DEC users can introduce expanded processing, storage and communications modules to the system. Visit us at Booth No. 421 or contact Cognos Corporation, 2 Corporate Place I-95, Peabody, MA 01960; (617) 720-1503.

Enter 936 on reader card

Enhanced Version Of SAS Offers Better Performance

SAS Institute Inc. announces an enhancement release for the SAS System running on DEC's VAX 8xxx and 11/7xx series under VMS and the MicroVAX II under MicroVMS.

The release includes a micro-to-host link. With the link, users can choose to run jobs locally on their PC or send them to the VAX for execution. Files can be moved between the VAX and PC with a single statement. The micro-to-host link supports RS232C (through an Asynchronous Communications Adapter) hardware connection with the PC and supports up to 9600 baud. To use the link, sites need base SAS software under VMS and PC DOS.

The Institute licenses all software on an annual basis with fees based on machine classification.

For more information, contact the Software Sales Department at SAS Institute Inc., Box 8000, SAS Circle, Cary, NC 27511-8000; (919) 467-8000, or visit Booth No. 1210.

Enter 934 on reader card

Medusa Available On VAXstation 2000

CIS Medusa, Inc. announced the availability of its complete line of Medusa software to support DEC's new VAXstation 2000 Desktop Workstation. Medusa also supports the entire VAXstation family of high-performance workstations and Digital's Local Area VAXcluster Systems.

Medusa offers drafting, design and detailing capabilities with an integrated solid modeler. Medusa software is available as a series of compatible modules, including two-dimensional drafting, three-dimensional design, parametrics, engineering data analysis, numerical control, geometric properties, shader, facilities layout, sheet metal design and relational database.

Contact CIS Medusa, Inc. at 201 Burlington Rd., Bedford, MA 01730; (617) 276-1288, or visit Booth No. 1032.

Enter 938 on reader card

New Version Of ILS Introduced For VAXs

Signal Technology Inc. has announced the release of a new version of its Interactive Laboratory System (ILS) for the VAX fam-

ily of computers. Version 6.0 offers expanded support for data acquisition and color graphics, an enhanced user interface, and multiwindow operations for VAXstation systems.

An integrated software system written in FORTRAN, ILS can be used in various scientific and engineering applications that require analysis of time series data using digital signal processing (DSP) techniques. These applications include acoustics, speech, biology, noise and vibration, radar, and sonar. ILS operations include frequency analysis, digital filtering, numerical analysis, data manipulation, and speech processing.

ILS prices range from $5,100 to $19,800. Signal Technology Inc. is located at 5951 Encina Rd., Goleta, CA 93117; (805) 683-3771, or visit Booth No. 741.

Enter 939 on reader card

IDE Software Supports VAXstation 2000

Interactive Development Environments, Inc. (IDE) has announced IDE's computer-aided software engineering environment, Software Through Pictures, which supports DEC's new VAXstation 2000 Desktop Workstation. Designed to provide powerful tools for use in the analysis and specification stages of the software development cycle, the package also can be used with any of Digital's VAXstation family of high-performance workstations and runs under either the ULTRIX-32m or MicroVMS operating systems.

For further information, contact Interactive Development Environments, Inc., 150 Fourth Street, Ste. 210, San Francisco, CA 94103; (415) 543-0900. Telex: 184 324 IDE, or visit Booth No. 1129.

Enter 940 on reader card

In conjunction with DEC's recent announcement of the VAXstation 2000 workstation, MicroVAX 2000 computer and the VAX Solution System Program, many companies unveiled compatible software products. The following announcements are from some of those companies. (For more information on DEC's announcement, see Dateline DEC, page 26 and Dave Mallery's article on the VAXstation 2000, page 146.)

DataMyte Interfaces With DEC's New System

DataMyte Corporation announced that its factory data collection system now can interface with DEC's new, multiuser VAX Solution Systems.

DataMyte's systems automate data collection, including dimension, weight, force, hardness, voltage, and appearance. DataMyte data collectors connect to hundreds of sensors and provide memory, shop-floor feedback and a path to DEC's VAX Solutions Systems.

For more information, contact DataMyte Corporation, 14960 Industrial Rd., Minnetonka, MN 55345; (612) 935-7704.

Enter 944 on reader card

EPIS Developed For VAX Solutions

Gately & Glew Data Services, Inc.'s Productivity Information System (EPIS) for automated collection and management of hourly employee data from the shop floor has been developed to run on DEC's multiuser VAX Solution Systems.

The new EPIS configuration is used to automate the acquisition of shop floor data required to support Payroll, Human Resources Management Systems, Computer Integrated Manufacturing (CIM) Systems and Manufacturing Resource Planning (MRP II) Systems. The software system includes time and attendance, job cost and employee scheduling modules and is compatible with many well-known bar code collection terminals. The system particularly is well-suited to the collection of hourly labor data originating within manufacturing groups connected through a VAX network.

Find out more by contacting Gately & Glew Data Services, Inc., 892 Worcester Rd., Wellesley, MA 02181; (617) 237-4800.

Enter 945 on reader card

Valid Offers CAE Tools For VAXstation 2000

Valid Logic Incorporated has announced the availability of its full range of electronic CAE tools on DEC's VAXstation 2000 Desktop Workstation as well as on the VAXstation II and VAXstation II/GPX workstations. Valid's CAE tools include ValidGED, a high-performance schematic capture package; ValidTIME, a sophisticated timing analysis program; ValidSIM, a logic simulator with the capability of simulating board level, system level, and ASIC designs; Valid-PACKAGER, a program that generates netlists and performs electrical checks on completed designs; and ValidFLAT, which converts hierarchical designs to flat designs and transfers designs created on foreign CAE systems to Valid-supported systems.

Valid's corporate headquarters is located at 2820 Orchard Parkway, San Jose, CA 95134; (408) 945-9400. Telex: 371 9004.

Enter 946 on reader card

SLAM II, MAP/I, TESS Run On VAXstation 2000

Pritsker & Associates, Inc.'s simulation products, SLAM II MAP/1 and TESS now are available on DEC's VAXstation 2000 and MicroVAX 2000 systems.

These VAX systems will support Pritsker's integrated set of simulation software products. Pritsker & Associates, Inc., made the announcement in conjunction with DEC's announcement of the two new high-speed 32-bit VAX processors and the VAX Solution Systems.

For more information, contact Pritsker & Associates, Inc., 1305 Cumberland Ave., P.O. Box 2413, West Lafayette, IN 47906; (317) 463-5557.

Enter 949 on reader card

HOK/CSC Run On Desktop Workstation

HOK Computer Service Corporation's facility management and design software packages are available for the VAXstation 2000. The software offers a method of creating and managing facility data for large corporations and organizations. It runs on any of DEC's VAXstations.

HOK/CSC's software products are fully integrated, thus allowing users to share and take full advantage of facility data. The systems have a great deal of built-in flexibility, so users can tailor a system to their own needs.

For more information, contact HOK/CSC, 802 North First St., St. Louis, MO 63102-2529; (314) 621-4700.

Enter 961 on reader card

OIR Announces Multi-II Applications

Organization for Industrial Research (OIR) recently announced the availability of the new OIR Multi-II Group Technology system on DEC's VAXstation 2000. OIR Multi-II also may be used with any of DEC's VAXstation family of workstations, and is

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supported by DEC's Local Area VAXcluster Systems.

OIR Multi-II is a fully integrated Group Technology system that uses state-of-the-art relational database technology for use in design and manufacturing environments. It has modules for the classification, retrieval, analysis, and standardization of designs, machined parts and other components, and manufacturing methods. Its application packages include computer-assisted process planning, automated time standards, and tool tracking and inventory control.

For more information, contact OIR, 100 Crosby Dr., Bedford, MA 01730; (617) 271-6870. Telex: 923483.

Enter 950 on reader card

LABTECH NOTEBOOK Compatible With VAXmate

Laboratory Technologies Corporation has announced that its LABTECH NOTEBOOK data acquisition and control package now runs on the VAXmate system.

LABTECH NOTEBOOK is a menu-driven system that sets up a PC with multiple data-acquisition channels that gather data samples from, and send control information to, attached instruments and other devices used in laboratory and industrial process control applications.

LABTECH NOTEBOOK can transfer acquired data to Lotus 1-2-3 and Symphony, BBN's RS/1, NWAStatpak, MathSoft's MathCAD, and many other programs for further statistical data analysis and display. These packages are available on the VAXmate system.

LABTECH NOTEBOOK is priced at $895. Find out more by contacting Laboratory Technologies Corporation, 255 Ballardvale St., Wilmington, MA 01887; (617) 657-5400.

Enter 948 on reader card

ABC Announces New Version

ABC Technologies Inc.'s full ABC/MM line of integrated maintenance management and inventory control software has been released to run on the new MicroVAX 2000.

The new version 3.1 of AVC/MM software is designed to support users performing simultaneous plant maintenance management functions. The ABC/MM Maintenance Management system includes eight tightly integrated modules for automatic preventive maintenance (PM) work orders, repair work order generation and tracking, planning aids and weekly scheduling to net craft availability, backlog control by craft, equipment maintenance history, stores catalog and availability, monthly budget reporting, and

numerous valuable reports.
To learn more, contact ABC Technologies, Inc., 215 14th St., West Vancouver, BC V7T 2P9; (604) 926-3808.

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DT2801, New Software Run On VAXmate

Data Translation announced the availability of plug-in cards and software that allows VAXmate system users to collect, analyze, and display analog and digital data in laboratory, process monitor and control, research, and industrial or factory automation environments.

The DT2801 series of multifunction analog and digital I/O boards can be plugged into either of the system's expansion slots. Two forms of software support are available. PCLAB is a subroutine library that allows you to write an application program in PASCAL, FORTRAN, C, or Turbo PASCAL and interface to the DT2801 series of analog and digital I/O boards. DT/NOTEBOOK is a standalone application program that allows you to define an environment, acquire data, perform curve fitting or FFT functions, generate output control functions, and display the results. The data format is industry standard so that additional analyses can be performed on the data files by DADiSP, Lotus 1-2-3, Symphony, or RS/1.

The DT2801 series starts at $495 and goes to $2,070 based on speed and resolution. The DT707 is priced at $179, PCLAB is priced at $249, and DT/NOTEBOOK is priced at $895.
Data Translation, Inc., is located at 100 Locke Dr., Marlboro, MA 01752. Call (617) 481-3700 for more information.

Enter 953 on reader card

SCI Teams Up With MicroVAX 2000

SCI Software, Inc. announced that its CHAMPS Maintenance Management Information System Software has been developed to run on the new MicroVAX 2000. The MicroVAX 2000 system is compatible with SCI Software's products which operate in the VAX environment.

The CHAMPS product system is an online maintenance management information system that provides decision-making support for improved maintenance, increased productivity, and reduced costs on every level.
To learn more, contact SCI Software, 1255 North Vantage Point Dr., Crystal River, FL 32692; (904) 795-2362, Telex: 910-997-4640.

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TouchStone Available For MicroVAX 2000

TouchStone Software Corporation recently announced the availability of The Connectables family of communications application products for DEC's new MicroVAX 2000 system. The Connectables software will enable ULTRIX and VMS systems to function at the center of a network made up of many types of UNIX systems, industry standard PCs, VAX/VMS computers and the Apple Macintosh.

The Connectables software consists of programs for each of the different types of systems in the network — PCworks for PCs, MacLine for the Macintosh, and UniCall or UniHost for MicroVAX or VAX systems. UniHost also is available for more than 150 other UNIX systems.

The UniHost program for a MicroVAX 2000 computer is priced at $395 for the ULTRIX operating system, and $595 for the MicroVMS operating system. The UniCall program for MicroVAX 2000 computers with the ULTRIX operating system is $995. PCworks and MacLine, for the PC and Macintosh, are priced at $195 and $145 respectively.

For product information, contact TouchStone at (213) 598-7746 or (800) 531-0450 (outside CA). Headquarters are located at 909 Electric Ave., Seal Beach, CA 90740.

Enter 947 on reader card

Tektronix Supports VAXstation 2000

The CAE Systems Division of Tektronix, Inc. announced the availability of its Designer's Database Schematic Capture (DDSC) and HILO-3 Logic Simulation System packages on the new VAXstation 2000 desktop workstation.

Tektronix's DDSC and HILO-3 core CAE applications are front-end design tools for schematic capture and logic simulation. Underlying these tools is Tektronix's Designer's Database that supports design trade-off analysis and the ability for a team of designers to have immediate access to pertinent design information.

For further information, contact Tektronix, CAE Systems Division, 5302 Betsy Ross Dr., Santa Clara, CA 95054; (408) 727-1234.

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Auto-trol Supports VAXstation 2000

Auto-trol Technology Corporation's software solutions for the mechanical design and engineering marketplace, technical publishing and the architecture-engineering-construction industry, are supported on DEC's VAXstation family of workstations, including the new VAXstation 2000.

Auto-trol Technology Corporation participates in Digital's System Cooperative Marketing Program (SCMP) under which the two companies install system solutions for industrial plant design, electronic publishing, and manufacturing.

For further information, contact Jere Brooks Hunter, Manager of Corporate Marketing, Auto-trol Technology Corporation, 12500 North Washington St., P.O. Box 33815, Denver, CO 80233; (800) 233-ATTC (Ext. 2022).

Enter 955 on reader card

Calma Offers CAE/CAD/CAM Products

Calma Company is offering its Prism/DDM and DIMENSION III computer-aided engineering, design and manufacturing (CAE/CAD/CAM) software for the VAXstation 2000 desktop workstation.

Designed to provide tools for use in the full spectrum of CAE/CAD/CAM industries, Prism/DDM and DIMENSION III also are available on the VAXstation II/GPX family of color workstations, and are supported by DEC's Local Area VAXcluster System.

Prism/DDM is a fully integrated mechanical CAE/CAD/CAM software system based on sophisticated solids modeling techniques. DIMENSION III is Calma's 3-D software for CAE/CAD systems in the A-E-C industries.

For more information, contact Calma Company, 501 Sycamore Dr., Milpitas, CA 95035-7489; (408) 434-4000; TWX: 37-20067F CALMA SNTC.

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Mitchell Management Offers MAPPS

Mitchell Management Systems, Inc. announced that its Management And Project Planning System (MAPPS) application package is available for the VAXstation 2000. MAPPS also is available for any of DEC's family of workstations and is supported by DEC's Local Area VAXcluster Systems.

MAPPS is an interactive software application that uses the Critical Path Method (CPM) of project planning and scheduling. The system allows networks to be modeled in time (duration) with associated cost and assigned resources.

Many reports are available from the MAPPS data. The data ranges are narrowed during selection along one or more of 30 different activity attributes. The resultant "cut" then is sorted in a sequence determined by the user. The data then is available to be reported in one of 31 different report formats. To learn more, contact Mitchell Management Systems, Inc., Westborough Office Park., 2000 West Park Dr., Westborough, MA 01581; (617) 366-0800. Telex: 710-347-1054.

Enter 960 on reader card

DesignAid Available For VAXstation 2000

Nastec Corporation, a Digital Cooperative Marketing Program (CMP) participant, announced the availability of DesignAid on the VAXstation 2000.

DesignAid, part of the CASE 2000 product line, is a structured analysis, design, and documentation tool that automates the front-end phases of requirements analysis and logical design. It can be used with any of the VAXstation workstations and is fully integrated within the VAX/VMS environment. It is compatible with DEC's programming tools, interfaces to electronic publishing systems, and uses Runoff for large document text processing.

DesignAid on the VAXstation family of workstations was developed in cooperation with Digital Equipment Corporation and RCA Aerospace and Defense. It is priced at $12,400 with volume discounts available.

For more information, contact Nastec Corp., 24681 Northwestern Highway, Southfield, MI 48075; (313) 353-3300.

Enter 957 on reader card

CASE Technology Extends CAE System

CASE Technology's complete line of Vanguard computer-aided engineering (CAE) tools now is offered for use on the clustered and standalone VAX Solution Systems.

The CASE Vanguard system runs on DEC's entire line of VAX computers — from the high-end 8000 Series to the new VAXstation 2000 and VAX Solution Systems. The Vanguard system includes the CAE industry's most advanced schematic design system, in combination with capabilities for PCB design (interactive and automatic), timing verification, logic simulation, circuit simulation and PLD generation. CASE also offers terminal emulation software that allows an IBM PC to work remotely with the Vanguard system on a VAX, MicroVAX or a node in the VAX Solution System.

For more information, contact CASE Technology at 2141 Landings Dr., Mountain View, CA 94043; (415) 962-1466; TWX: 506 513 CASE TECH USA.

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RS/1 Runs On DEC's Newest Systems

BBN Software products Corporation announced that its RS/1 data analysis software package for technical professionals has been developed to run on the VAXstation 2000 and MicroVAX 2000 computers.

RS/1 software for engineering, manufacturing and research and development environments is available in various configurations starting at $6,000.

For more information, contact BBN, 10 Fawcett St., Cambridge, MA 02238; (617) 864-1780.

Enter 956 on reader card

FutureNet's DASH For New Workstation

FutureNet, a Data I/O Company, is offering its DASH Schematic Designer software package for the VAXstation 2000. The VAXstation 2000 system may be used in clusters with the DASH products when connected via Digital's Local Area VAXcluster Network.

DASH schematic software on the VAXstation 2000 system is available from FutureNet for $7,495.

For additional information, contact FutureNet Corporation, 9310 Topanga Canyon Blvd., Chatsworth, CA 91311; (818) 700-0691. Telex: 910-494-2681.

Enter 958 on reader card

Synercom Supports VAXstation 2000

Synercom announced the availability of its INFORMAP III mapping database management software and industry applications packages on the VAXstation 2000.

This compatibility offers the mapping information management market the opportunity to increase the performance and speed of mapping database operations while reducing associated costs. INFORMAP III on a VAXstation 2000 combines the full functionality of high-resolution mapping graphics, database management and specialized cartographic functions with the CPU performance of the MicroVAX II. The INFORMAP III/VAXstation 2000 system may be used as part of a distributed database network when connected via DEC's Ethernet Local Area Network.

INFORMAP III also may be used with any VAXstation as well as the VAXBI-based 8000 series computers.

Find out more by contacting Synercom, 10405 Corporate Dr., Sugar Land, TX 77478; (713) 240-5000.

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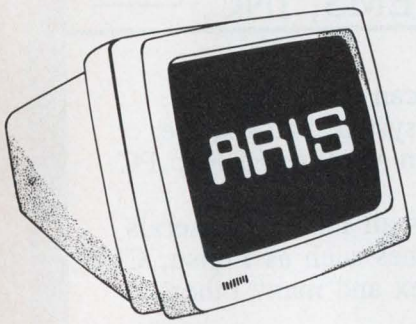

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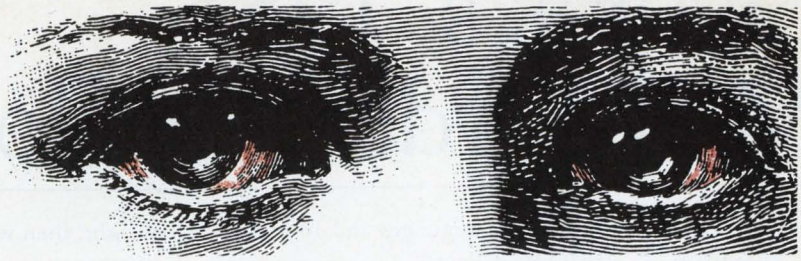

JUST CLEAR PERFORMANCE

THE FALCO 5220. A Window to Your DEC System.

The FALCO 5220 video display terminal can open new windows into your Micro-VAX or any other DEC computer system.

And what a crystal clear window it is! Screen resolution on the 5220 provides the most readable screen available among DEC compatible terminals. A 10 x 16 character cell drawn on a soft white (green or amber) CRT produces a clear display of data. The clear performance by the Falco 5220 means reduced eye strain for DEC users.

And what's more, there are two! windows in the Falco 5220. A combination of Falco's unique Multi-Host windowing (virtual terminals), concurrent processing (both ports Online simultaneously), and two pages of memory (standard, 4 optional) allows you to create two windows, two terminals at once.

And what a price tag! For more information on the Falco 5220 contact your local distributor.

ENTER 210 ON READER CARD

Falco
Data Products

1294 Hammerwood Ave.
Sunnyvale, CA 94089
In California: (800) 538-5383
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BACK END

John C. Dvorak

Dvorak's 1987 Mail Order Catalog

At first, the little microchip beeps were cute. In meetings, everyone laughed when 10 digital watches did their tiny peep-beeps on the hour. Then, there was a wave of "nudge" gadgets like dryers, microwaves, dishwashers and irons that went beep-beep-beep to let you know they were finished. Alarm clocks began to beep instead of buzz or ding; so too, cars. Toys began to emit UFOish beeps.

Then, the simulated microchip voices began to chirp out "Door Open!" in the car and "Load Film Now!" in cameras. Calculators came on the market that "spoke" the number you pressed. Alarm clocks did this with the time. Children's toys became more educational, teaching kids how to talk back.

Currently, the electronic gadget market is booming. It's loaded with high-tech cat doors that only open if kitty is wearing a special transmitter collar. There are invisible fences that zap Fido if he tries to escape. We're surrounded!

So, I'm starting a business. My catalog will be in the mail next week. In it you'll find a selection of truly useful, intelligent devices for the home. Each item listed in my *Automated Home Companion Catalog* is offered with a variety of voices, from French Upstairs Maid, to Marine Corps Drill Sergeant. Other voices include Sexy Woman/Man, Whining Kid, Jewish Mom, Southern Belle, Southern Sheriff, English Butler, French Chef, Longshoreman or, for an additional charge, a custom voice or voice of a famous personality.

Most voices are available in any of 23 different languages and 10 regional American dialects!

Just think of the continental flair you could add to your kitchen with a microwave that can interrupt with the "Excusez moi!" of the French Chef, a dishwasher that politely calls out "Gomen'nasai!" with the voice of a Japanese Geisha, and a timer alerting you with a Longshoreman's "Yo!"

Let's face it, it's impossible to get a kid to say please and thank you, but you should be able to buy an appliance that will.

Some of the other items in my catalog include:

The Plant Maven — A plant watering reminder that says "Please water me now, I'm thirsty!" And, "Thank you so much, you're my hero!"

The Nice Alarm — A pleasant alarm clock that sweetly whispers "Time to get up!" Of course, for sound sleepers the louder "Pssst. Hey, wake up!" might be needed. Or, the extra loud Marine Sergeant version also is available for the heavy sleeper "Get up NOW! AH CAAN'T HEAR YOOOU!"

Kiddie Patrol — This kiddie tender gives your child a mild but effective electric shock when he tries to wander into the street. A similar product by the same manufacturer is a device to cure wandering eyes in males. Hubby Tender gives a mild to severe shock.

Mirror, Mirror — This should be a favorite for the ladies. It's a mirror like that of the wicked stepmother in *Snow White:* "After all, who is the fairest of them all?" Twenty-three phrases in all, including "You look fabulous today!", "Go for that power lunch!", "Knock 'em dead, Killer!" and "You're hot!"

Positive Feedback Scale — The weight watcher's programmable reduction scale. Simply enter your desired weight, then weigh yourself. With each missing pound, the scale ooohs and ahhhs wonderful words of encouragement, like "Wow! Looking good!", "Come on, Skinny!" and "Go ahead! Get on! Oh, you *are* on!" Of course, if you gain weight, it might just say "Uumphh! Get off my back you tub of lard!"

Cabinet Commando — Have trouble with cabinet doors left open in the kitchen? Try our Cabinet Commando. It serves as a gentle reminder to "Close the cupboard!" There's also a bathroom version that encourages members to put the cap on the toothpaste and lower the toilet seat.

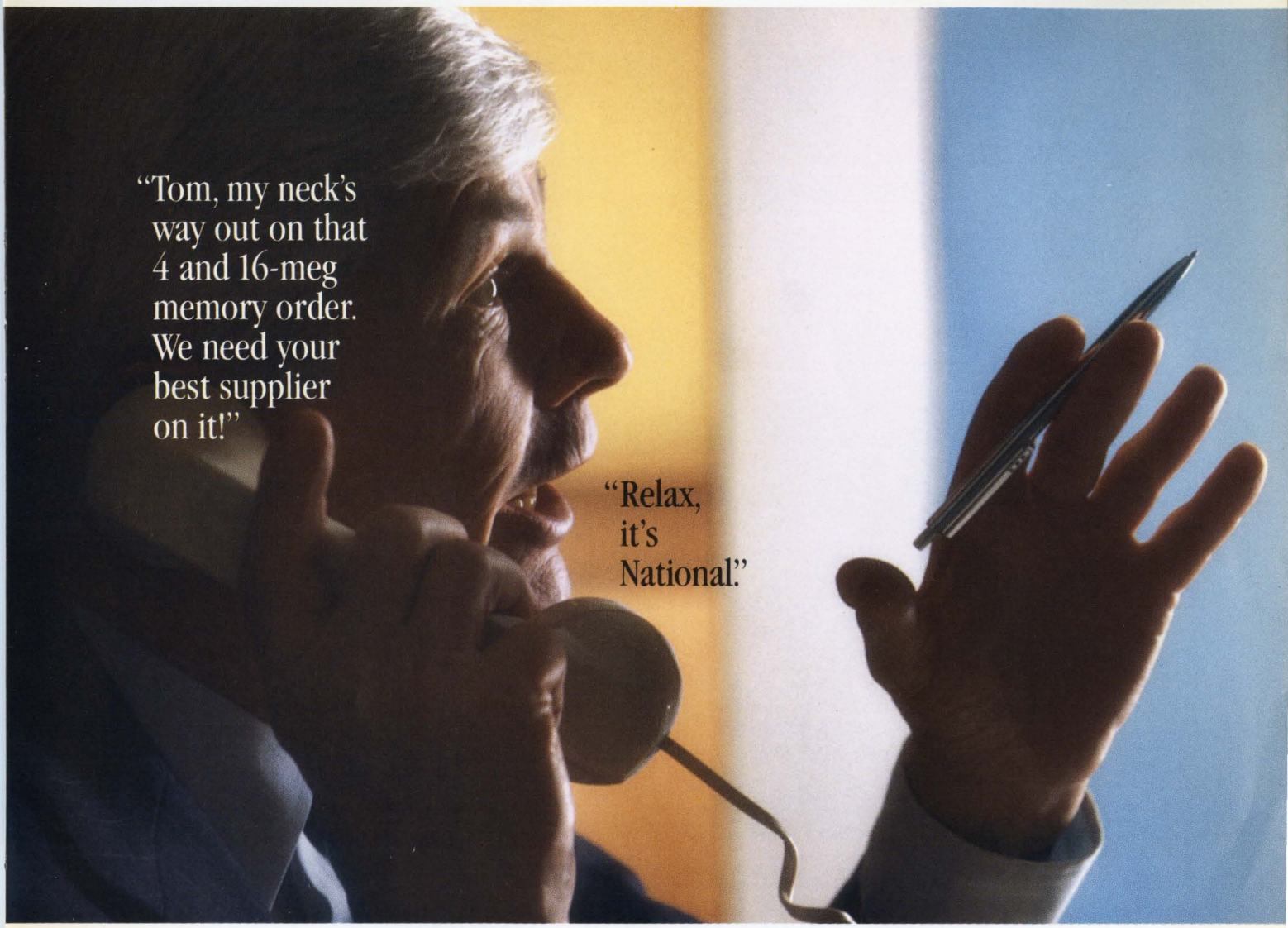
The TV Addict — A device to encourage television watching. If you're one of those who feel guilty about sitting down to watch a soap or a silly little sitcom, the TV whines "Come on, nobody has watched me all day! Please?" (Note to wives: The TV Addict also can be programmed to shout "What? Another football game?" whenever detecting one on the screen.)

Other devices still in R&D include:
A checkbook or credit card holder that whispers "Go ahead, you deserve it!"
A scale that lies "It's only water weight!"
A Portable Lie Detector — Useful at poker games or at lunch with the personnel manager.
An Avoid-Bill-Collector-Evasive-Telephone — Alters your voice up or down, one to six octaves.

Of course, I expect to make millions of dollars. Isn't technology wonderful?

National Semiconductor

See us at DEXPO South, Booth #809



Making customers feel comfortable and confident is something we're very good at.

For good reason. It's made National the biggest independent producer of DEC memory in the business.

You name it — VAX, Q-BUS, UNIBUS, from ¼MB to 16MB — we've got it. With quality and performance that meets or exceeds original manufacturer's specs.

All available for shipment right now. All with a comprehensive guarantee that's second to none.

And at prices that give new meaning to the word, "competitive."

AN EXCLUSIVE EXAMPLE

Our brand new NS865-16 memory board drastically reduces VAX 8600/8650 computer downtime. Unique on-board diagnostics allow simultaneous system and memory board testing. High visibility LED display immediately pinpoints DRAM failures.

So if you need DEC memory, and don't want hassles — call National and relax.

Phone 800 538-8510.
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ENTER 73 ON READER CARD

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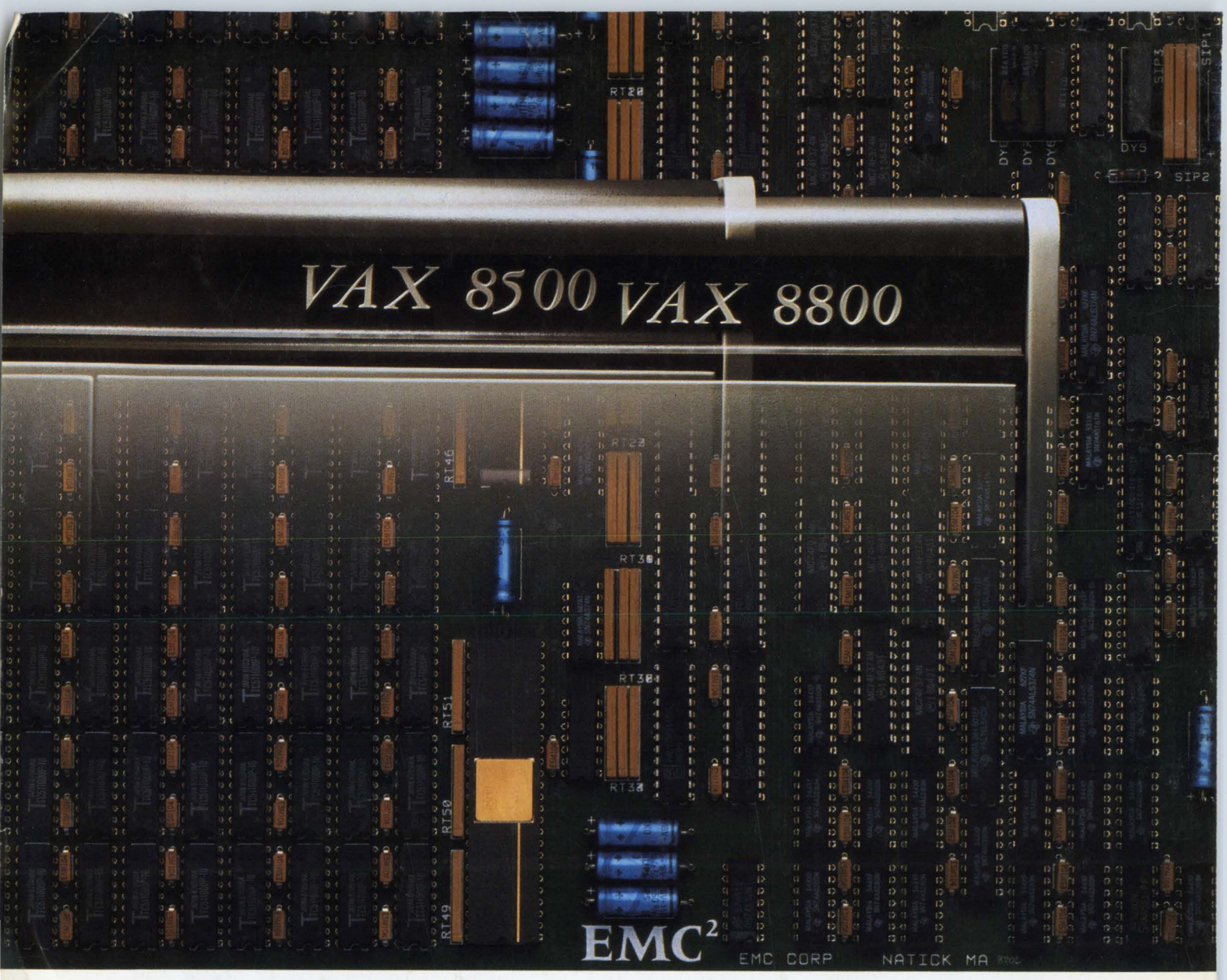

EMC's New 8000 Series Memory Upgrades Are A Lot Like Digital's. Except They're More Advanced, Better Serviced And More Reliable.

At last, you have an alternative when it comes to memory upgrades for 8500 up to 8800 VAXes. From EMC, the company that's been everyone's favorite all along.

In addition to saving you about 20–30 percent, even more if you've earned EMC trade-up credits, they'll impress you in ways you've come to expect.

For starters, our modules use the latest 1Mbit chips instead of older 256K RAMs. Which means our boards are inherently more reliable, since they use about 1/4 the number of connections.

And while we're on the subject of reliability, consider our stringent testing procedures. After burn-in, each board spends at least 24 hours running test patterns and diagnostics in one of our own VAX™ 8000 Series computers. Which is more quality control than even Digital provides.

What's more you'll get some pretty comforting guarantees from EMC.

We guarantee delivery to meet your demands. And we guarantee our boards for the life of your system. If you even suspect a problem, just give us a call. You'll have a replacement in your hands overnight. Or, you can select one of our priority service plans. In either case, you can return the suspect board after the replacement arrives.

And finally, we can just about guarantee, you'll like working with us. You get the commitment of an industry leader. The financial resources of a $100+ million corporation to back that commitment up. And the comfort of knowing we have the best track record in the business.

So when your VAX 8000 Series,* or any other VAX for that matter, is ready for an upgrade, move up with EMC. For more information contact EMC Corporation, Hopkinton, MA 01748-9103.

For More Information Or To Order, Call

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*EMC 8000 memory includes: 16MB arrays for VAX 86X0, 8500, 8550, 8700, 8800 computers.

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See us at DEXPO South, Booth #710

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