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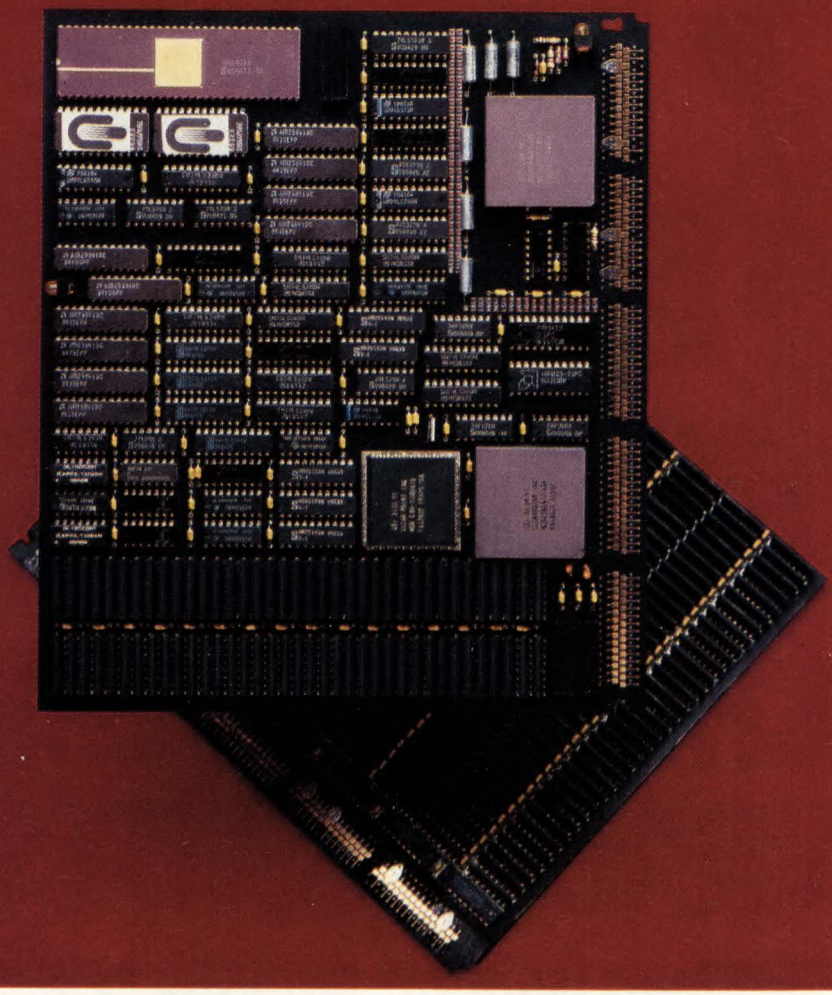

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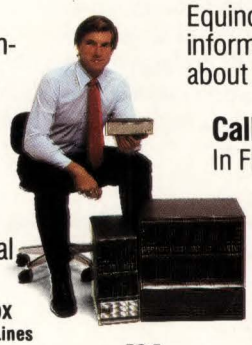

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MARCH 1987 VOL. 6, NO. 3

SOFTWARE DEVELOPMENT

PRODUCT REVIEWS

Continued on page 6.

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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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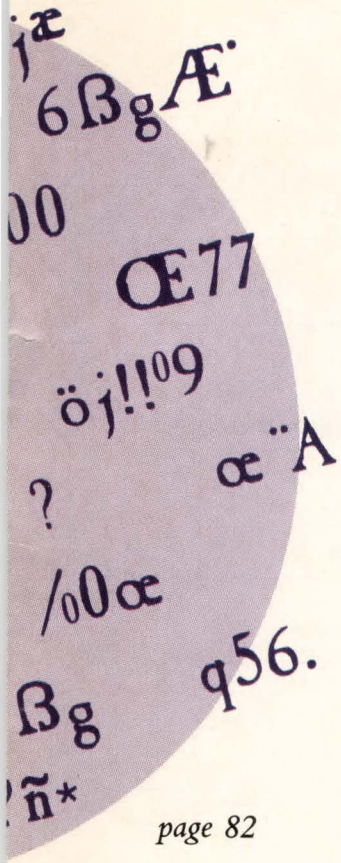

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ARTICLES

DEPARTMENTS & COLUMNS

The ARIS symbol on an article indicates that the program segments are available electronically on our Automated Reader Information Service. Dial (215) 542-9458.

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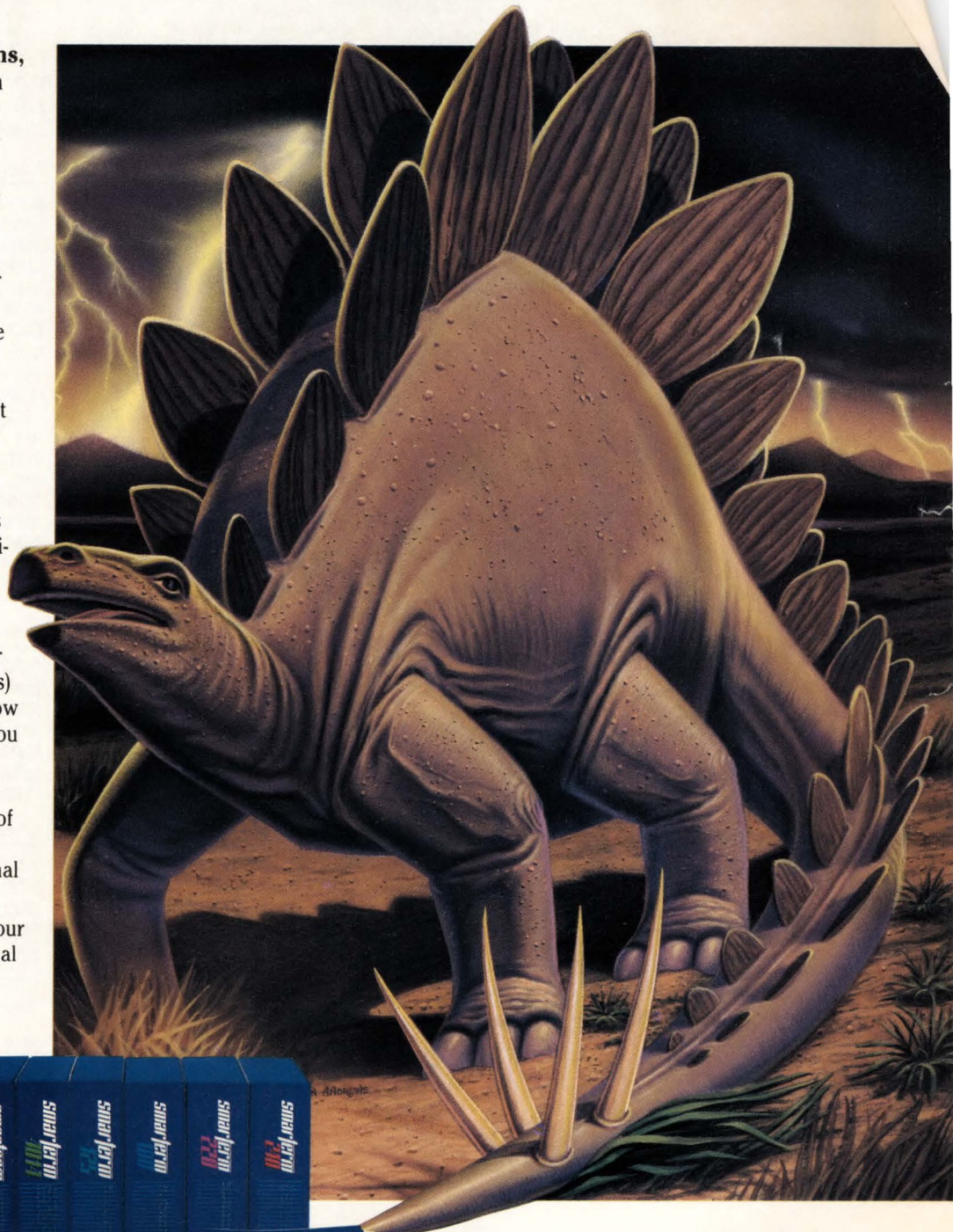

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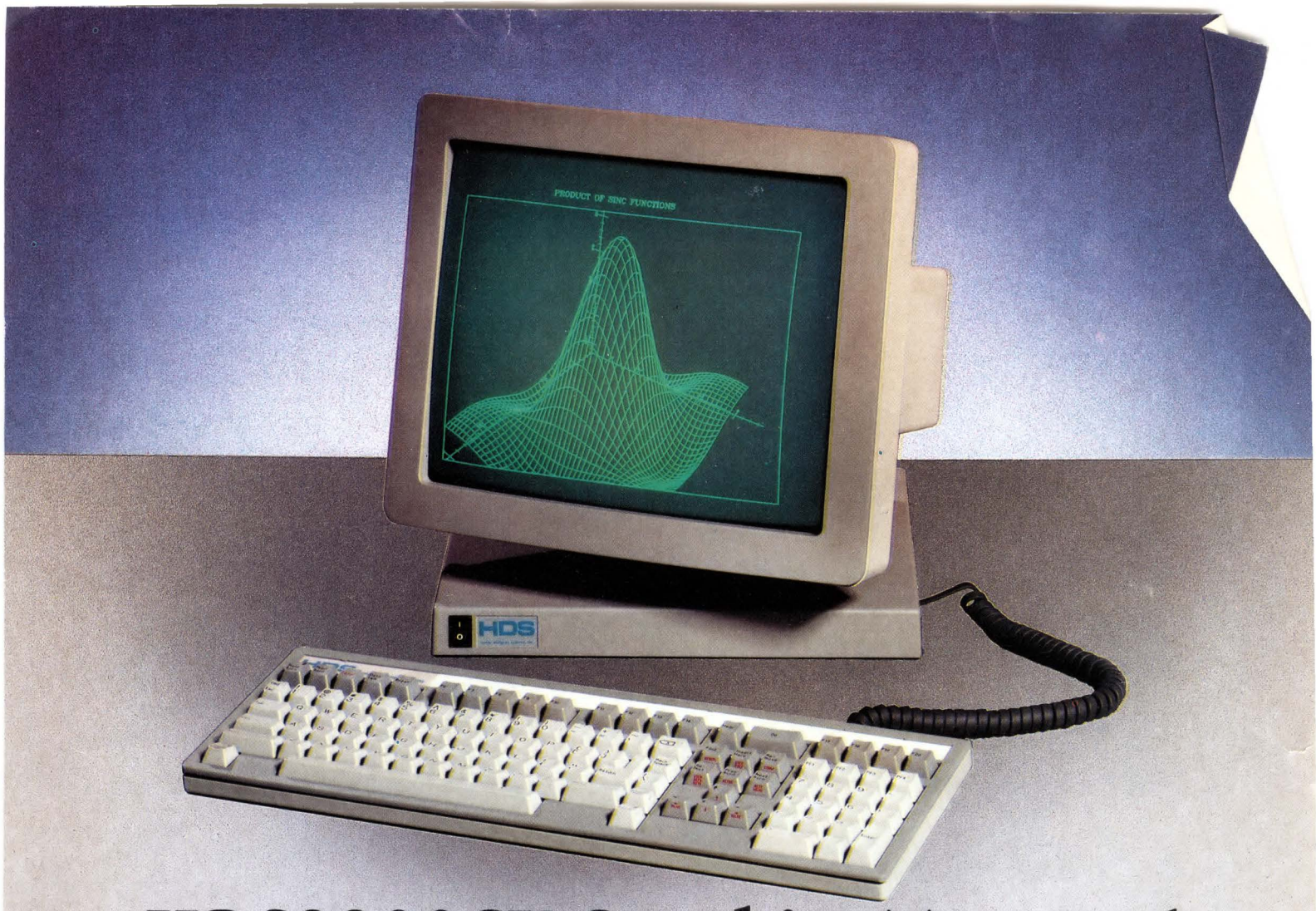

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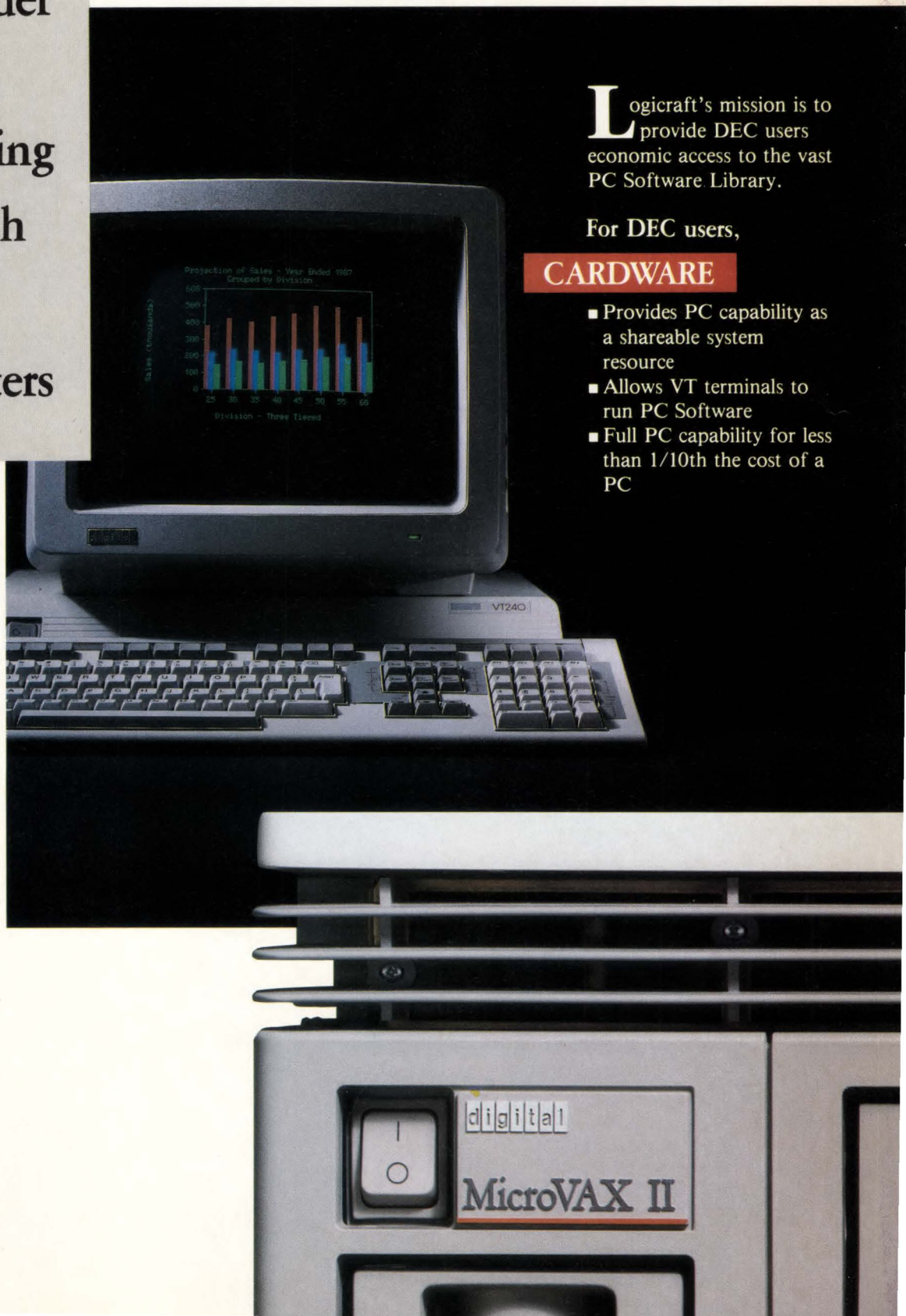

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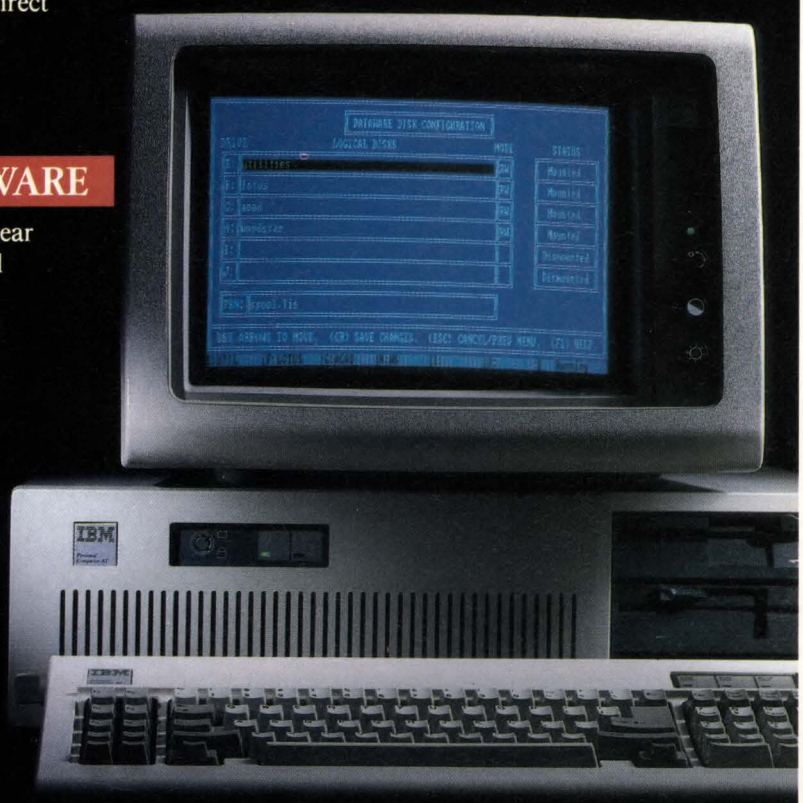

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PUBLISHER

Carl Marbach

Communication

I had a meeting the other day in our Lexington, Massachusetts, office where one of the attendees remarked that the directions he had received to find the office only had one wrong turn; directions with only one bug weren't too bad.

Working with computers isn't so forgiving. Exactness is the *only* thing that counts. Given the challenge, most people couldn't give exact directions on how to make breakfast. Think about it: Did you remember to use a potholder to handle the hot pots, or describe when to stop pouring the milk into the cereal? Washing the fruit requires turning the water on. Did you remember to turn it off in your instructions, and did you cook the shell as well as your eggs?

Bugs are nothing new to programs or computers. Early DEC timesharing computers had the Dynamic Debugging Technique (DDT, now banned by the EPA) to help eradicate program bugs. ODT and other derivations just don't do it for me like DDT did. It took strong measures to get the bugs out of our programs.

Today, instead of better debuggers, we use preventive medicine: better third generation languages and newer fourth generation tools that help us build applications. But no matter what we use, software development is a big job. Hard to conceive, difficult to manage, tedious to document, impossible to describe to non-developers (like the people who will use it), and taken for granted when it is finally finished (usually long after everyone thought it would be), large applications are a challenge to all of us.

The main problem in application development isn't bugs in the software; it's software that doesn't fit the needs of the users it is developed for. That happens because we don't communicate well with each other. It's hard for the accountant to tell you exactly what he needs. More often than not, when you're finished, he remembers that when the company loses money, something different is done with the statements you so painfully coded. And while the bookkeeper knows that that line item can't exceed $99,000, the computer won't know unless the programmer tells it and the programmer won't know unless the bookkeeper tells the programming staff, but the bookkeeper won't tell us unless we ask. . . .

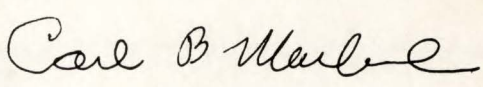
What we need is better training. Not only of the software developers, but of the people who will be using the system being built. Users need more knowledge of how systems are designed and built. We have to teach them more about how programs are constructed, systems written and applications maintained. Early and frequent user/developer interaction is crucial to any major application and the more informed all the parties are, the better the job will be.

Finally, we should insist that users be an integral part of the design and implementation team. When the Federal Aviation Administration (FAA) developed the computer programs used in today's radar air traffic control, it didn't use professional programmers. It retrained air traffic controllers as programmers with the idea that communicating their needs to non-controllers was less efficient than using controllers as programmers. The system works and is what the controllers needed, but it's hard to maintain and runs on hardware that is so specialized it can't take advantage of new technology as it comes along. The lesson is clear that the critical part of any application is translating what the *needs* are into a workable system.

What we practice is an art, but not a black art that is closed to outsiders. Rather than make the people who will use the system into programmers, let's educate them enough so that they can help us design, build and implement a system that accomplishes their goals, while at the same time ensuring that the application is designed to be maintained and upgraded. We have an "installed base" of personal computers that could be utilized to teach non-technical people about the technical aspects of programming. Few businesses exist without these personal workstations and many of these machines are based in homes; this is just another task they can run.

Maybe the hardest task in building an application is working and communicating with people. Two people don't do twice the work, because they have to spend overhead in communicating and coordinating what they are doing. When you have more than two, the problem increases exponentially.

The next time you're working on a project with some non-technical people, take the time to explain some of your challenges. Solicit their help and make them a part of the job at hand. Understanding what the other guy knows and is thinking will help build a successful application. Your computer can't help you with understanding. You'll have to do it yourself.



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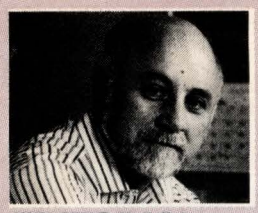

EDITORIAL

Dave Mallery

'Memento Mori'

Someone at Digital finally has figured out how to manipulate the media. The announcement of the 89xx cluster configurations produced more prime time TV coverage for Digital than they have garnered in the last 10 years. The funniest thing is that the announcement was hardly an announcement, but the timing was perfect. No news or business report that evening could resist juxtaposing Digital with its 98 percent earnings increase against the grim 40 percent reduction posted by IBM. The "announcement" only served to get the camera crews there.

If there is a DEC Internal Emmy Award, it should go to their Public Relations Department.

Other than the PR coup, there was another side of the announcement that should be noted.

DEC announced complete systems . . . soup to nuts hardware/system/software configurations complete with warranty, service and resident software specialist. Just one line item on the PO, sign here and lets play golf. . . .

You have to hand it to DEC, the package is tailored to the intended buyer.

In ancient Rome, when the conquering general returned with the goodies and got his big parade, they always had a slave in the chariot whispering in his ear: "Memento mori" (Remember, you are mortal).

I would whisper in the general's ear: Remember all us little guys who paid our maintenance bills from 1977 to 1984 and bought all this for you. . . .

Other Goodies

I made some (to me) major discoveries about data rates and VMS backup in the Lab this month. I feel strongly that benchmarks mean almost nothing unless you can relate them to the real world in which you work. In doing some *real* benches with VMS backup, I found out volumes about the /CRC switch. Anyone doing backup should check it out (doesn't everyone?).

I've been getting some good feedback about remarks I made here recently about LAT vs. traditional terminal interfaces including a response from DEC (see Letters page 18). This will not be the end of the discussion.

The 14-MB 750 memory upgrade is covered this month. To date, both EMC and NEMONIX have announced compatible products. Trendata/Standard Memories has announced the 4-MB boards. Nemonix also has its own version of the CPU accelerator. It seems that there are many 750s out there. Our circulation records show that more than 35,000 of you indicated that you use a 750.

This issue also has a really fine tutorial article on VAXELN. It comes directly from a principal engineer at Digital and is well worth your time.

If there is an area you would like covered in the Lab, send me a note on ARIS.

If you just asked, "What is ARIS?" check it out.

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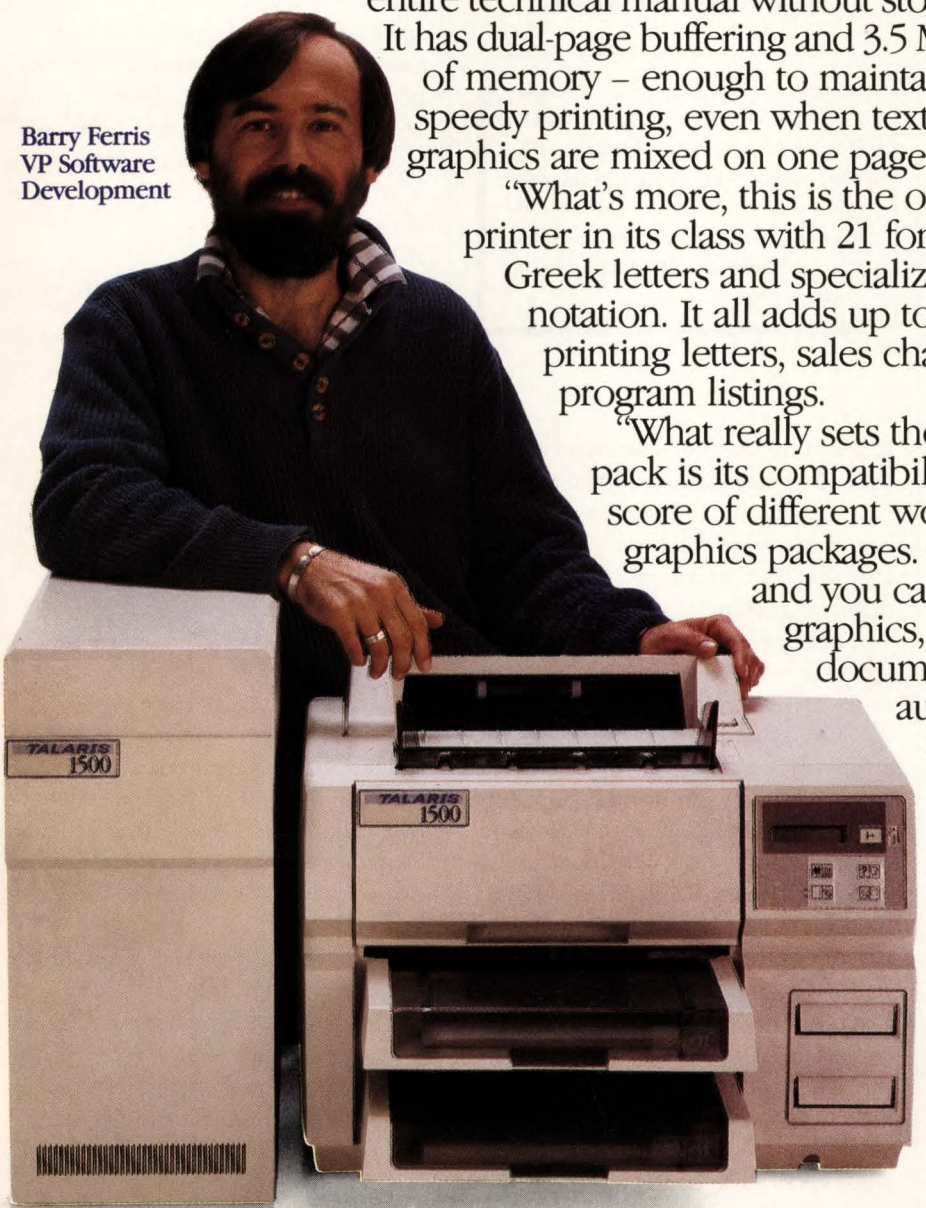

Barry Ferris
VP Software
Development

"What's more, this is the only printer in its class with 21 fonts built in, including Greek letters and specialized symbols for scientific notation. It all adds up to great flexibility in printing letters, sales charts, equations, and program listings.

"What really sets the T1500 apart from the pack is its compatibility with more than a score of different word processing and graphics packages. Add our Talaris software and you can merge text and graphics, format complex documents, overlay forms, and automatically down-load any of our 1000 typefaces.

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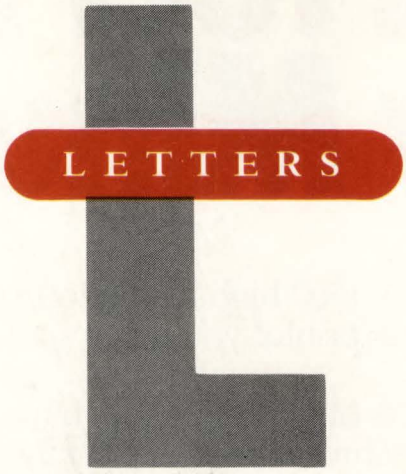

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MORE ON LAT

In Dave Mallery's Editorial on page 16 of the January issue, he states: "Some ways of connecting terminals squander CPU, others loaf along, and a few actually perform wonders. My inquiry recently uncovered that DEC's much acclaimed LAT protocol actually is the worst offender of all: Hundreds of characters can be involved in the simple act of transmitting a single character to the host and echoing it back to the terminal, all of them using up precious CPU time."

One of our engineers offers the following:

Typing a single character involves two round trips assuming nothing else is done — one trip to the host with the data, one trip back with the response requested flag set and a credit, a second trip to the host system and a second trip back.

Each of these messages uses 14 bytes of Ethernet header and eight bytes of LAT VC header. The first message will have a six-byte slot, and the response message a four-byte slot. The total is somewhere around 100 bytes, which largely is irrelevant since the minimum packet size is 64 bytes, so the four messages consume 256 bytes.

I assume the issue is the two round trips. If the host did not set the response requested flag, only one trip would be necessary. But experience shows that if data was input, but not output, it will be output later. And, it is more efficient to have the server generate the message to solicit the unechoed data than to have the host generate an unsolicited message (which will be followed by another round trip from the server). There are arguable optimizations that involve deferred acknowledgement, but they wouldn't be as responsive as LAT and would be complex when combined with timer driven operation.

LAT is designed to operate more efficiently as the applied load is increased. Under light loading, hopefully the host system has more CPU to waste. In general, if the comparison is to backplane multiplexers when typing a single character, LAT (and other message based protocols) cannot operate as efficiently processing an Ethernet packet as a terminal multiplexer can processing a character.

My response would be that there is little to be learned from analyzing one character typed at a keyboard. (Riding a bus system late at night will result in a similar story about the inefficient use of buses.)

Compare LAT supporting 32 data entry terminals connected to the same host system concurrently active with any other terminal connection method, and LAT will win. Under these conditions, LAT will generate approximately 24 messages/second. This is representative of the type of demanding workload our customers might generate.

Bill Gassman
Digital Equipment Corporation
Merrimack, New Hampshire

LIBRARY MAINSTAY

Your magazine is one heck of a good resource tool and is a mainstay of my computer library.

John A. Uchman, CEO
International Processing Sys. Inc.
Chicago, Illinois

A DURABLE 'FAD'

The January edition of *DEC PROFESSIONAL* suggests, in the piece titled "Fads and Fast Computers Don't Mix" by John C. Dvorak, that the Radio Shack Model II was a "fad" to be classed with Nehru jackets and earth shoes.

There was, in the late '70s and early '80s, a class of personal and small business computers built around the Z80 CPU, eight-inch floppies, and (usually) the CP/M operating system. The Radio Shack Model II was the most successful

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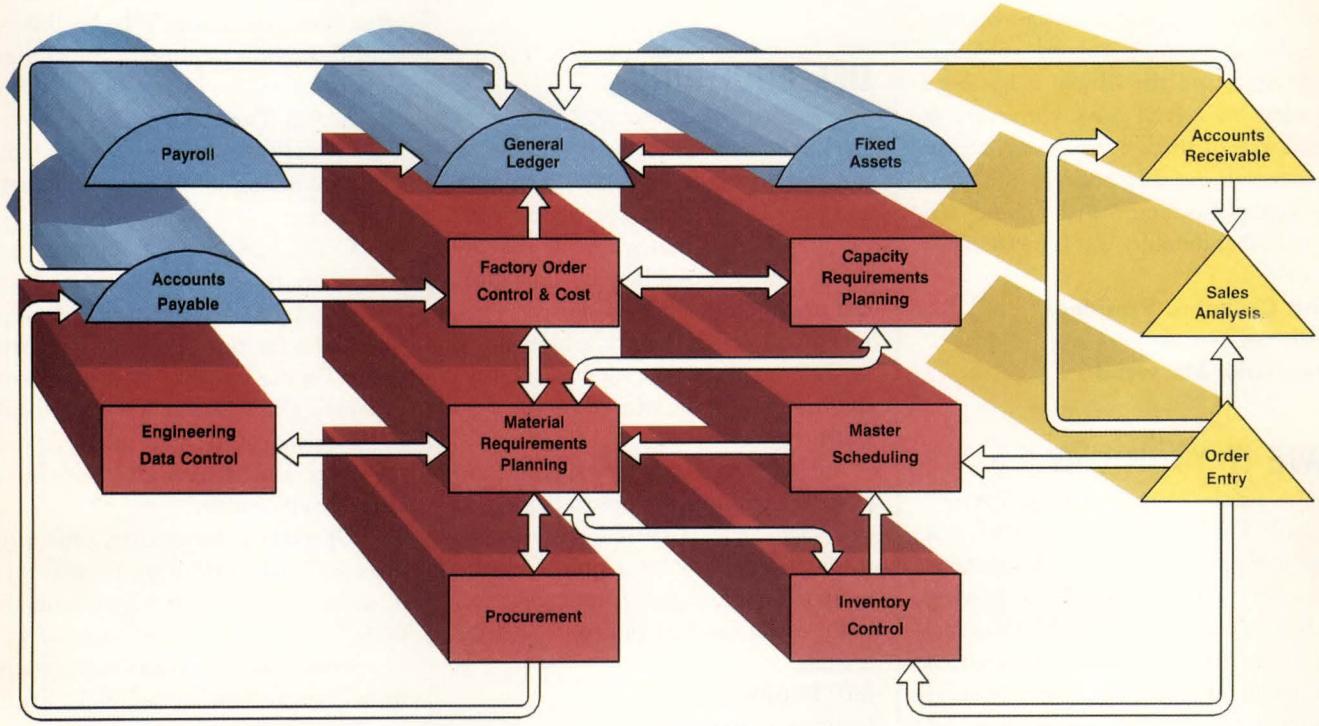

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of this class of machine. Tens of thousands were sold and many thousands still are in use. Several newsletters cater to their owners (we publish one) and we do a nice business writing new programs for these old machines. Incidentally, Radio Shack still will repair them at their repair centers.

All computers become obsolete with time, and the Model II has been obsolete for several years. Nevertheless, thousands of small businesses continue to depend on this antique for their business computing. I wish I could start a "fad" that durable. Was the PDP-8 just a fad?

John Culleton, President
Culleton Group
Sykesville, Maryland

HAVE IT YOUR WAY

In the article "VAX as Foster Parent" (January 1987, p. 46), Mr. Marbach was kind to mention that even Macintoshes can communicate with VAXs. Having used both LisaTerminal and MacTerminal in VT100 mode, I have experienced almost no difficulty and a lot of success (using EDT as well as uploading and downloading large files; e.g., FORTRAN, BASIC, data, etc., up to 300 blocks).

While it is true that changing the background to black in one of these communication packages makes the screen look non-Macintosh, or changing it to white looks non-VT100, neither option takes away from the inherent usefulness of this hardware or software. It is not a case of "Heads you lose, tails you don't win," as he states, but rather "You can have it YOUR WAY!"

The Mac Plus is a winner in my book.

John M. Kohlenberger
TRW/BMD
San Bernardino, California

Judging from the response in our "mail bag" regarding the use of Macintoshes with VAXs, there apparently are quite a number of you experimenting with communicating between these machines. We, therefore, are planning to bring you a series of articles throughout the year, that focus on your special needs. Please let us hear from you regarding your interest in such a series, and be sure to send us your requests, ideas, suggestions, etc.

DCL ADDITIONS

We implemented the DCL directory stack command procedures outlined in the January issue of "DCL Dialogue" and they work great! There are a couple of additions that we made that are useful: First, combine all four procedures into one file (less clutter). Then when you define the procedures do so as, for example, @dirstack dirs, and have the first line in the procedure file do a GOTO 'P1.

Also, enter a directory specification in PUSH without the brackets, so you can do "PUSH.stuff" to go to [USER.STUFF], etc. It requires a little work to handle logical names correctly, but it easily can be handled using DEC lexicals.

Jeff Templon
Indiana University
Bloomington, Indiana

Kevin Barkes: Thanks for your kind words. As I mentioned in the column, Mr. Liebes had included variations of the procedures to permit "stacking" of privileges and UICs. Judging from the response to the January DCL Dialogue, there's a demand for this type of utility.

I've written procedures for these functions, which currently are being beta tested and generally beaten upon by the users of my DCL BBS. Look for the .COM files in a two-part column beginning in May.

THANKS FOR THE HELP

Thank you for the series on "Managing Your MICROVAX" by David W. Bynon. I just bought one, and despite the very good documentation, I have some things on my mind that hopefully will be clarified through these articles.

I really enjoyed John Dvorak's contribution, "The World's Greatest Light Bulb Joke" (December 1986). Most jokes depend on pictures. Looking through my papers, I found something of a joke which I copied sometime in the late '50s. It seems nothing much has changed since. Unfortunately, I did not write down the name of the originator, but I thought it might still amuse your readers.

Access Time: The years between 1936 and 1945 in Germany and Italy.

Circulating Memory: A visiting professor.

Code: A sickness for which, at present, there is no cure.

Conditional Jump: A suicide pact.

Consolidation: Making two programs do the work of two programs.

Five Digit Multiplier: One hand.

Logician: One who meditates on the facts and arrives at conclusions already self-evident.

Operations Researcher: One who does the least work in the longest time in order to figure out how to do the most work in the shortest time.

Versatility: The ability of programmers to recite Shakespeare while drawing flow charts.

Rudi W. Stange
West Germany

VALUABLE RESOURCE

DEC PROFESSIONAL continues to be a valuable resource to our company. We rely on it for the technical articles as well as for purchasing new equipment and software.

Ray Kapahi, Project Engineer
Radian Corporation
Sacramento, California ■

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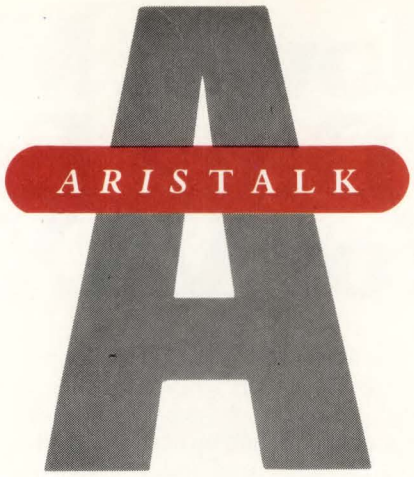

Find A RSTS Job!

QUERY:

Ron Kaledas: Does anyone know how I can get the job name of other jobs on the system (V8.0), either by a SYS call or a peek? I have BASIC and PASCAL to use. There doesn't seem to be anything in the monitor tables that will let me do that. I'm already using them to find out if a job is hibernating, but I also need to know the job name. Thanks, Ron.

REPLIES:

Steven P. Davis: The job name is relatively easy to find for another job. You either can peek through the monitor tables or use the SYS call to get job statistics.

The SYS call is a lot easier:

```
900     DIM M%(30%)
1000    INPUT "Job"; JOB%
\       CHANGE SYS(CHR$(6%)+CHR$(26%)+
          CHR$(JOB%)+CHR$(0%)) TO M%
\       JOBNAME$ = RAD$(M%(17%)+SWAP%
          (M%(18%)))+RAD$(M%(19%)+SWAP%
          (M%(20%)))
\       PRINT JOBNAME$
\       GOTO 1000
```

You can get all kinds of information on jobs using this SYS call. Look it up in the programming manual. If you really want to peek, check out the job tables in KERNEL.MAC.

Mark Ruggiero: Have you tried looking through the SYSTAT program sources? You also can find the run-time system, CPU, etc., of the job.

Andrew Duggan: Get SYSTAT.BAS from your SYSGEN tape. It contains a wealth of information you can use to find out all sorts of information. I run V9.1 and have made several custom changes to SYSTAT.

Ron Kaledas: Thank you everyone for all of your help. I'll be trying out this stuff on Monday. I know the information is in the programming manual, but I find it lacking in descriptions, just like the system services manual for VMS. Anyway, thanks again, everyone.

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 excellent advice. Each month, we will select and publish some of the most interesting queries and replies.

To log in, you'll need your subscriber number (it's on your mailing label). Then, just set your terminal to 7 bits, 1 stop, no/space parity, and dial (215) 542-9458. Baud rates: 300, 1200, or 2400.

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

Write-Lock, Read, Weep

QUERY:

Steve Smith: We have a problem. One of our RA81s write-locks itself at random. This is the second time in two weeks on a different drive. Has anybody else had this problem? Is there a solution? Any help would be appreciated. From out in the cold in Nova Scotia.

REPLIES:

Bill Gutschow: We also had the problem pop up with the disk becoming write-locked for no apparent reason. Unfortunately, it was our system disk, and the only way we could shut down was using SYS$SYSTEM:OPCRASH.

Luckily, we've only had the problem once (knock on something hard).

David W. Bynon: Steve, RA81s are known for problems with the control panel. I've experienced the same problem on two different drives. It's time to look into having the control panel repaired or replaced. ■

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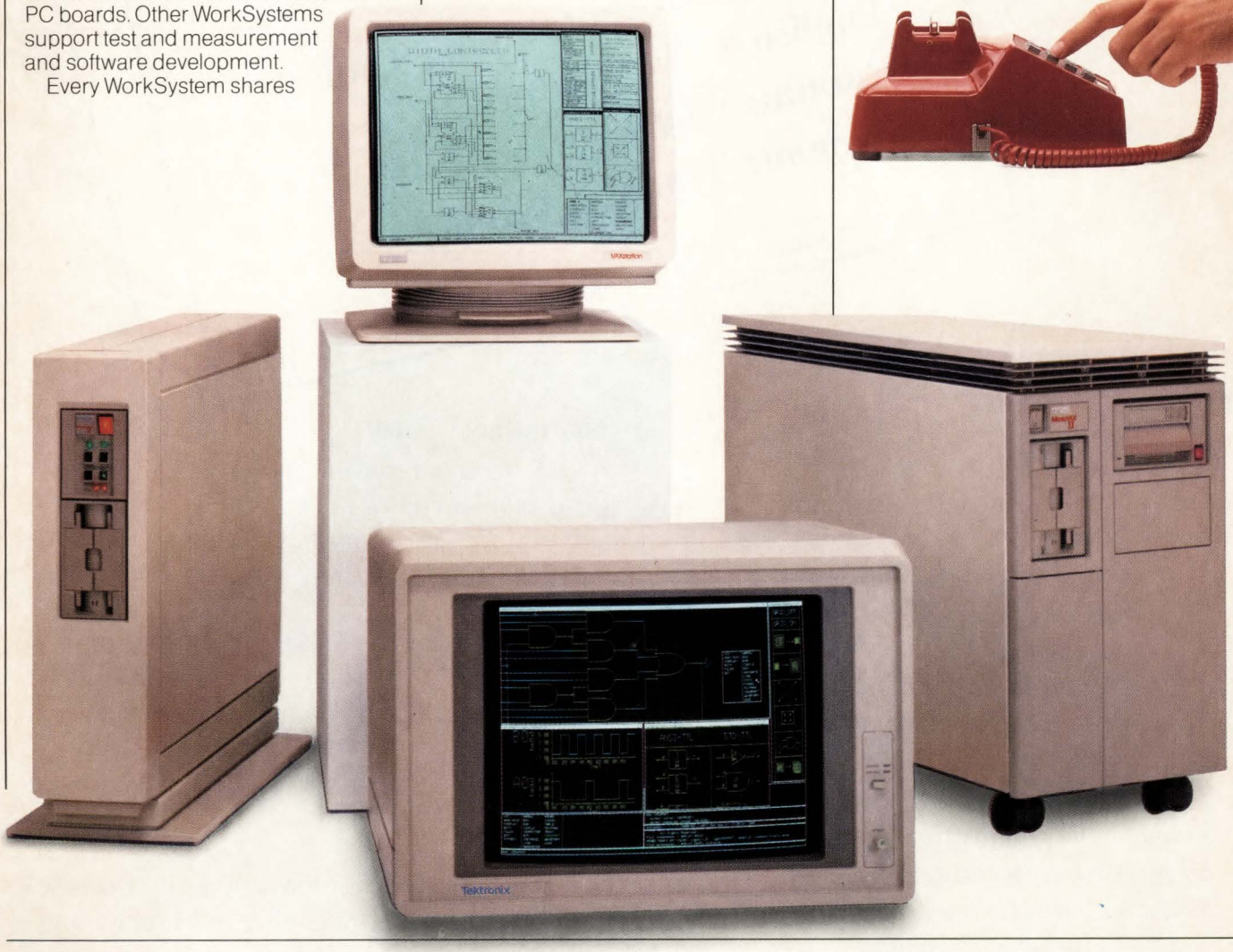

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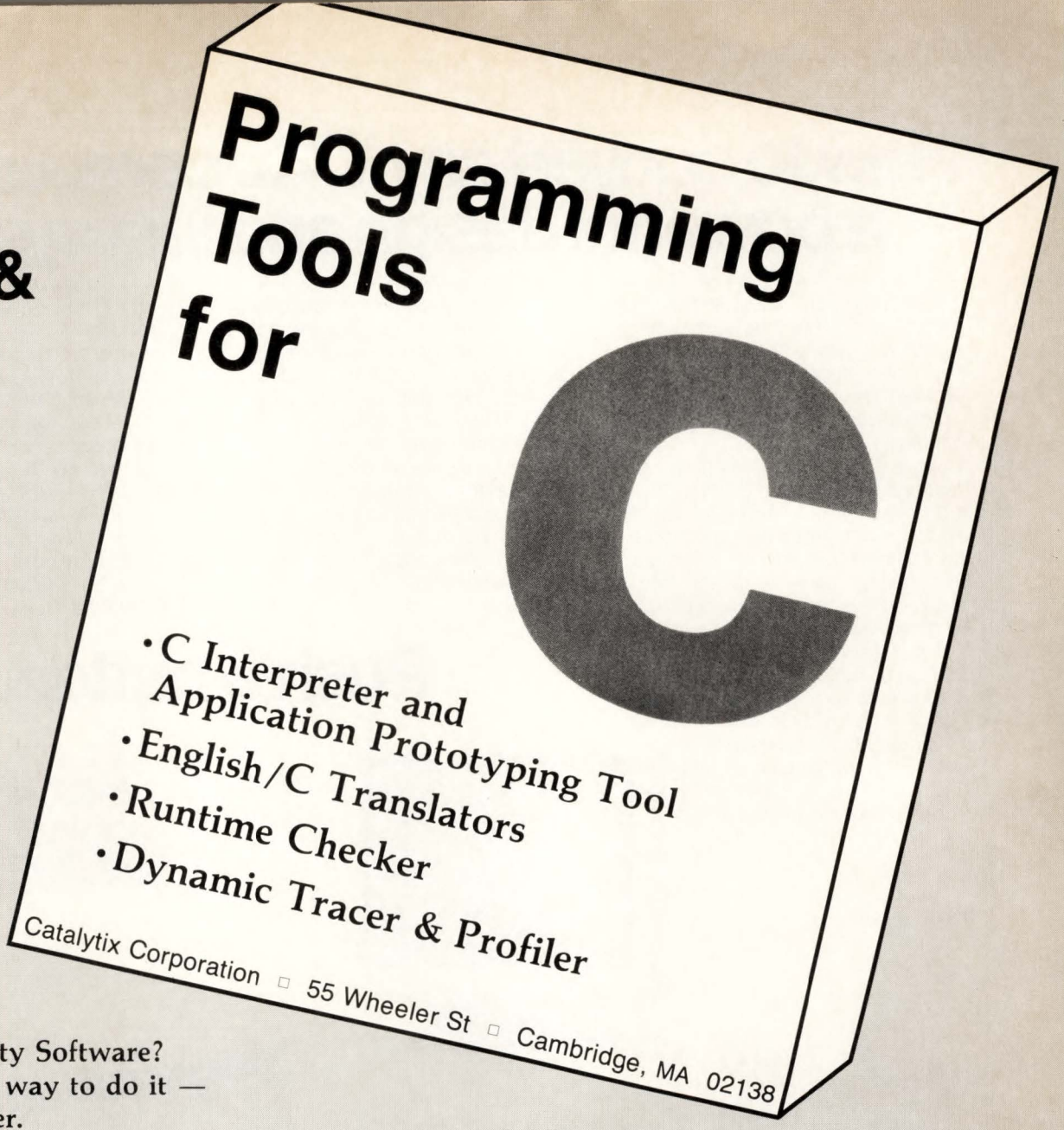

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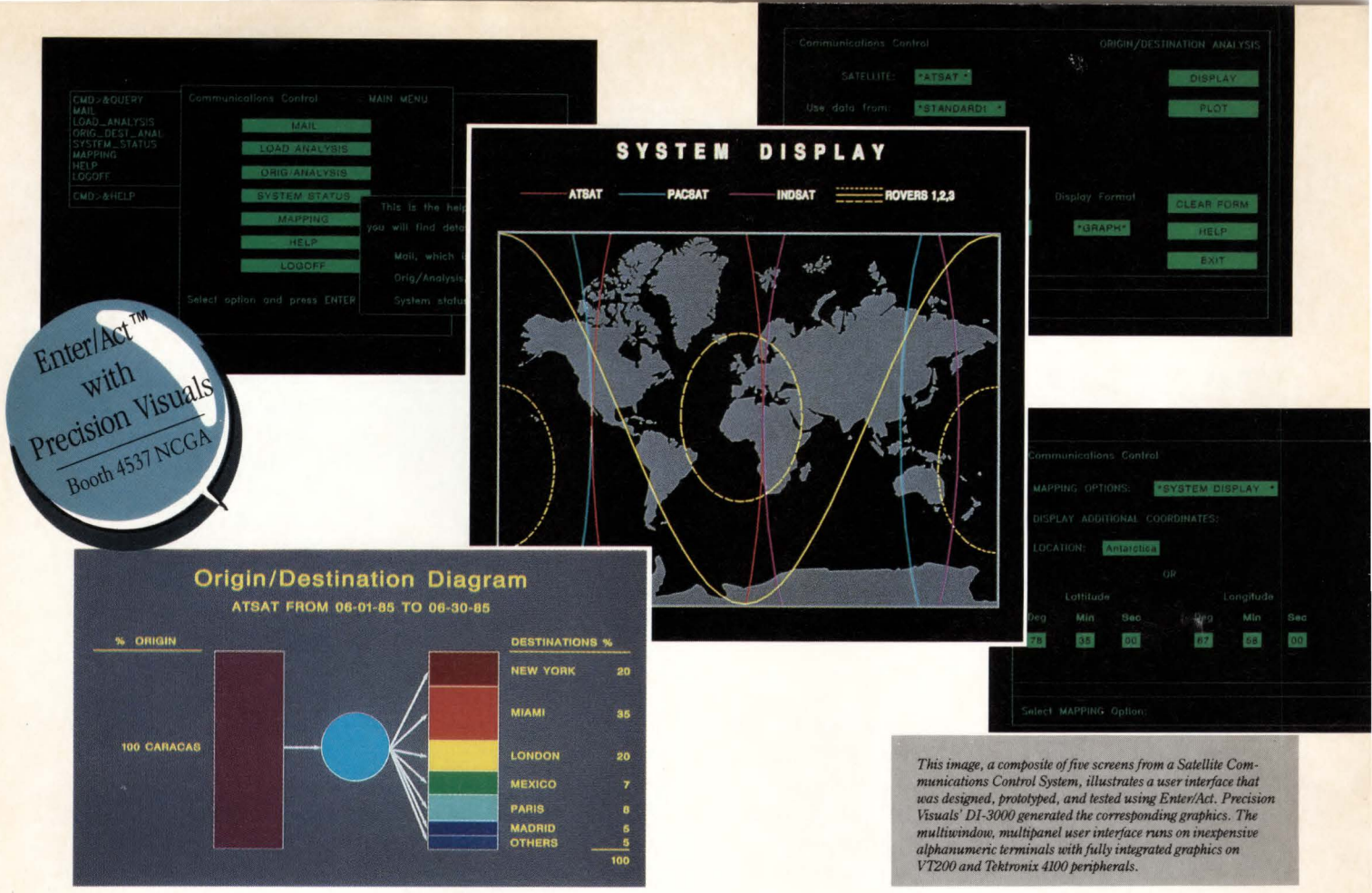

This image, a composite of five screens from a Satellite Communications Control System, illustrates a user interface that was designed, prototyped, and tested using Enter/Act. Precision Visuals' DI-3000 generated the corresponding graphics. The multiwindow, multipanel user interface runs on inexpensive alphanumeric terminals with fully integrated graphics on VT200 and Tektronix 4100 peripherals.

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The Features

Enter/Act's modular interaction management tools allow runtime selection of the user's preferred interaction method — keyboard commands for experts, action and data menus for occasional users, or prompting dialogues for novices — all displayed in windows with controls to move, size, pop, scroll, or delete. Other key features include: ☐ An interactive (WYSIWYG) menu definition utility ☐ Several layers of context-sensitive on-line HELP embedded easily in the user interface, from one-line reminders to multi-screen tutorials ☐ Multiple security levels for control of information access ☐ A macro utility to capture action sequences and later invoke them with a single command ☐ Command renaming and automatic recognition of command abbreviation ☐ Example-intensive reference and tutorial documentation.

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Enter/Act lets you quickly define and refine user interfaces in your development environment, and then get top runtime performance when your applications move into production. Initially offered in the DEC VAX/VMS and MicroVAX world, Enter/Act's rich interface capabilities bring you fast, workstation-like windowing capabilities on inexpensive alphanumeric terminals like VT100s. Available with Precision Visuals' DI-3000 graphics library, Enter/Act supports all the popular graphics peripherals, and ensures device independence.

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DATELINE DEC

Most Powerful VAXs Announced On Wall Street

Combined Hardware, Software, Services Provide Up To 50X Throughput Of VAX 11/780

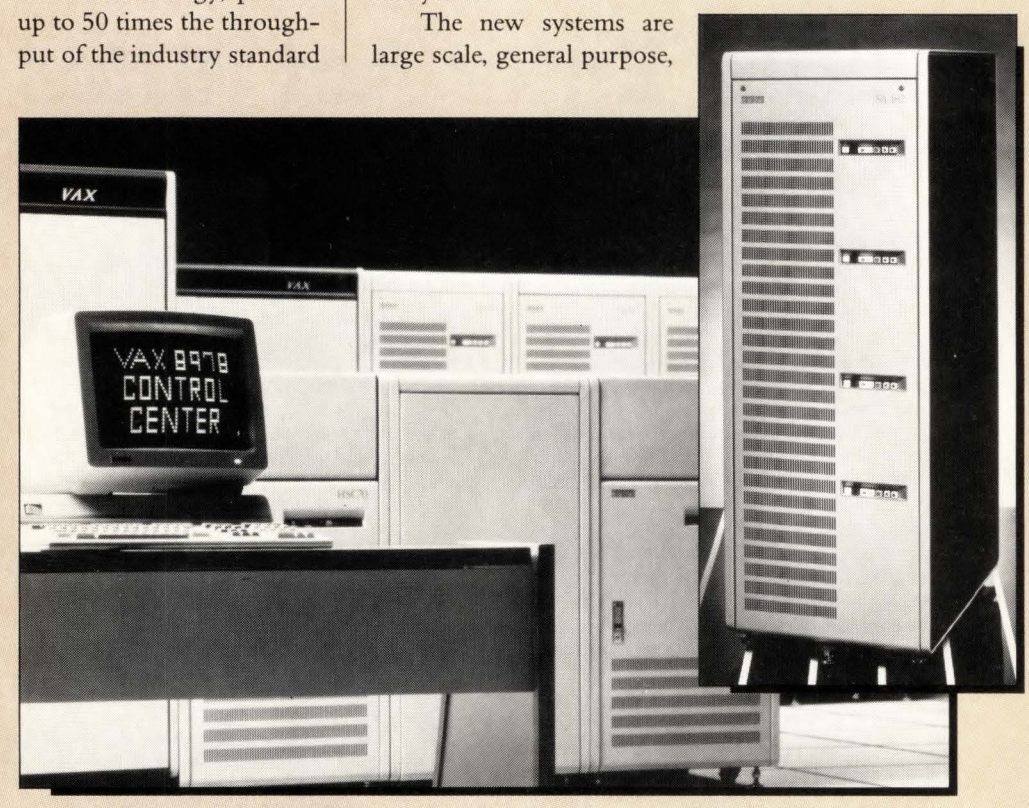
At a press conference held at its Wall Street office, DEC unveiled its most powerful VAX configurations ever offered. The 8974 and 8978, based on DEC's VAXcluster technology, provide up to 50 times the throughput of the industry standard VAX 11/780 and can support more than 1,000 users interactively. Each system consists of four or eight VAX 8700 processors, HSC70 I/O processors and a new storage subsystem.

The new systems are large scale, general purpose, multiple application computers that address a variety of data processing, database management, and office automation needs. They are fully compatible with other members of the VAX family and can be linked to them via DECnet local- or wide-area networking hardware and software. Upgrading software and adding new processors and controllers are both easily accomplished while the system is in operation. All hardware components are redundant or dual-accessed, so preventive maintenance of one component, or the repairing of a malfunction, doesn't interrupt continuous operations.

The 8974 is priced at $2.57 million and the 8978 is priced at $4.79 million. Hardware installation and a one-year warranty are standard.

"We are so confident about the system and data availability achieved by these new VAX systems that we are backing both VAX 8974 and 8978 with the highest level, most comprehensive service and support program ever offered in the industry. This program provides for one year of total system coverage, including full hardware warranty, software support and training," said Robert Glorioso, vice president, High Performance Systems.

Both new systems incorporate the new SA482 Storage Array, the highest-capacity storage product ever offered by DEC. It provides 2.488 Gbytes of user-accessible data storage in a 5.5 square-foot floor space.



DEC's new VAX 8978 provides 50 times the power of the 11/780 and includes DEC's highest capacity storage subsystem, the SA482.

Coupled with the HSC70 I/O processor, the SA482 delivers mainframe-class I/O performance and ensures high levels of data integrity and availability. It conforms to Digital Storage Architecture (DSA) and to DEC's Standard Disk Interconnect (SDI), enabling it to be used with all present and future DSA/SDI controllers and I/O servers. The SA482 Storage Array is list priced at $84,000, including a one-year warranty, making it the first of DEC's disk-storage products to be offered with that coverage.

Also provided as a standard feature is the VAX Performance Advisor (VPA), a layered software product designed to analyze performance data of VAXs and make recommendations to system managers on how to improve system performance. VPA analyzes performance on both single-processor VAX/VMS and VAXcluster systems, using a set of rules that covers processor, memory and I/O performance. It runs under version 4.4 of VMS and can be used with any VAX 11/750, 11/78x or 8000 series system, including VAXcluster systems. Licenses start at $5,500.

VAX Volume Shadowing software, also standard with the system, enables users to have their systems automatically duplicate critical data so that the information is available immediately if one of the copies becomes unavailable.

Other new products announced include the VAX Data Distributor, which automatically distributes relational data among multiple processors, and the VAX SQL, an implementation of the Structured Query Language, which provides VAX users with an interactive query capability popular in many high-level commercial computing environments. DEC also announced new additions to its VAX Information Architecture that allow all VAXs to manage massive quantities of data. DEC's DBMS and Rdb database management products have been enhanced to improve performance and functionality.

Possible Third-Party Source For High-End VAX Memory

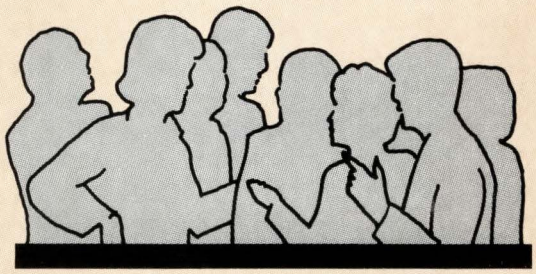
EMC To Complete Development Soon

EMC Corporation recently announced that it is developing memory arrays for the high-end VAX BI-architecture computers. It expects development to be complete, and customer shipments to begin, at the end of April. If EMC succeeds in developing these memory cards, it will be the first third-party source for the boards.

The VAX 8500, 8550, 8700 and 8800 machines use a memory controller that connects to the BI bus. On the other side of the controller is a memory bus called the Memory Interconnect (MI). The EMC memory boards will connect to the MI bus.

An EMC spokeswoman said that the company does not anticipate legal action from DEC about EMC's use of the MI bus. EMC plans to sell the boards for about 20 percent less than equivalent DEC products.

—Charles Connell



Seattle To Host 13th Annual Computer Fair

10,000 Visitors Expected

The 13th Annual Computer Fair, which attracts over 10,000 visitors each year, will be held March 18 and 19 on the University of Washington campus in Seattle. This event, sponsored by the University's Academic Computing Services, features 100 vendor displays that show the latest in networking systems, computer-aided design, image processing, desktop publishing, personal computers, supercomputers, and other technology needed by professionals in all fields.

Free seminars, open to the public, will discuss topics of current concern such as management of very large distributed databases, supplying data on CD/ROM, desktop publishing, integrating computers and communications, and management of microcomputer support services.

Complementing these activities will be workshops on specialized topics. These include a nationally recognized two-day seminar on computers in manufacturing, a conference on education and technology which will focus on human/computer interaction, the regular meeting of the Federal Information Management Council, and a workshop for users of supercomputers (Washington is among the top 10 states in number of supercomputers).

There is no charge for admission to any of the displays or seminars, other than the two-day manufacturing seminar.

For more information, contact Thomas H. Bennett, U.W. Academic Computing Services, 3737 Brooklyn Avenue Northeast, Seattle, Washington 98105; (206) 543-5728.

Much Ado About Something

Last Chance To Voice Your Opinion

On October 10, 1986, the ANSI X3 Secretariat released the following news release.

Washington, D.C. — X3, the Accredited Standards Committee on Information Processing Systems, announces a four-month public review and comment period on draft-proposed American National Standard, X3.159-198x. The public review period extends from November 7, 1986, to March 7, 1987.

This standard specifies the form and establishes the interpretation of programs expressed in the programming language C. Its purpose is to promote portability, reliability, maintainability, and efficient execution of C language programs on a variety of computer systems. Sections are included that detail the C language itself and the contents of the C language execution library. Appendices summarize aspects of both of them, and enumerate factors that influence the portability of C programs. While this standard is intended to guide knowledgeable C language programmers as well as implementers of C language translation systems, the document is not designed to serve as a tutorial.

This draft standard is available for public review and comment for a four-month period ending March 7, 1987. Copies may be obtained from GLOBAL ENGINEERING DOCUMENTS, INC. by calling (800) 854-7179.

Single copy price: $65.

The toll-free telephone number is available only in the U.S. and Canada. If you cannot call using this number, the full number with area code, and telex numbers, are as follows:
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The document set contains both the draft Standard and the Rationale document and both will remain relatively static for some time. Also, it is almost certain there will be at least one two-month review period later in 1987. Reading the Standard is heavy going and very time-consuming. If you have more than a passing interest in the future of C, you probably should become an Observing member of the Committee just so you receive copies of all working documents. To obtain information about Committee membership contact:

Dr. Thomas Plum
X3J11 Vice-Chair
Plum Hall, Inc.
1 Spruce Ave.
Cardiff, NJ 08232
(609) 927-3770

The meeting agenda for 1987, during which the public review periods will occur, and the Standard hopefully will be voted out, is as follows:

March 9-13,
Boulder, Colorado.
June 8-12, Paris, France.
September 14-18,
Boston, Massachusetts.
December 7-11,
Phoenix, Arizona.

—Rex Jaeschke

Demystifying Computer Memory

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The marketing communications department of Clearpoint Inc. recently published a 60-page book with this title that covers virtually every aspect of memory design and connection. The book is divided into five chapters: an overview of the third-party memory market, considerations in choosing a computer system and its memory, design of I/O buses, design of memory boards, and an overview of Clearpoint and its products.

While Clearpoint concentrates on manufacturing and selling memory boards for a number of computer systems (DEC, Apollo, Sun, IBM PC), this book contains lucid explanations of a wide range of topics.

The second chapter summarizes many of the important operating systems available today and explains "closed" vs. "open" hardware architectures. Chapter 3 begins by describing caching, pipelining, bus multiplexing and bus protocols. It then discusses all of the bus architectures found on DEC computers — a frequently confusing topic — and compares them to buses from other computer vendors. Chapter 4 addresses memory technologies (NMOS vs. CMOS vs. ECL, etc.), chip density, memory diagnostics, and radio interference by computers. Along with the above information, you'll find an introduction to error detection and correction algorithms, and a good explanation of reliability measurements.

If you have had trouble keeping track of all the DEC I/O buses or the different semiconductor technologies — or forgotten the difference between EPROMs, EEPROMs, DRAMs and SRAMs — this book is for you. Contact Clearpoint Inc. (99 South Street, Hopkinton, MA, 01748; 617- 435-5395).

—Charles Connell

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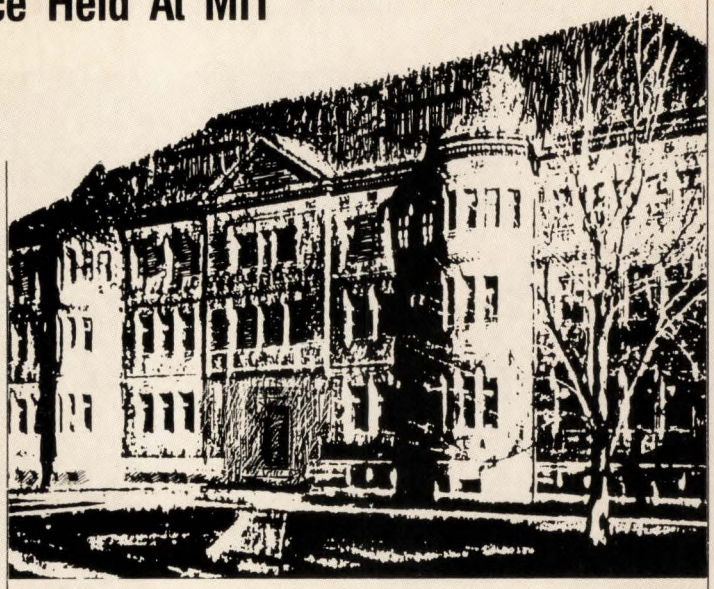

The first X Window System Conference was held January 15 at the Massachusetts Institute of Technology, Cambridge, Massachusetts. The Project Athena-sponsored users conference was held to discuss current work being done by various companies developing applications and systems software for the X Window System.

Project Athena is the MIT-initiated exploration of the use of high-performance computer workstations in its curriculum. A windowing system allows a screen to display multiple applications at the same time. The X Window System extends this capability to a networked environment.

Coincident with the X conference was a joint press announcement held by several workstation and application vendors, pledging support for version 11 of the X Window System as a public windowing standard for the graphical computing environment. The companies included Adobe Systems, Inc.; Apollo Computer, Inc.; Applix, Inc.; Dana Computers; Data General Corporation; Digital Equipment Corporation; Hewlett-Packard Company; Mass-Comp; Siemens AG; Sony Corporation and Stellar Computer, Inc. The commitment and support of X Window is believed to mark the first time a larger number of computer manufacturers have cooperated in the initiation of an industry standard.

The computer manufacturers will:

1. Promote X Window as industry standard for the display of graphic information in a networked environment and urge all interested parties to participate in its specification and refinement.
2. Cooperate with others to develop and enhance X Window further.
3. Encourage formal standards bodies to adopt X Window as a global industry standard.
4. Incorporate X Window in new products.

The companies also announced a cooperative effort to extend X Window to include a set of high-level user tools on top of the standard to allow application developers to easily create user environments and interfaces. A proposed specification for such a set of tools has been submitted to MIT.

The users conference was attended by a large number of worldwide hardware and software vendors, OEMs for workstations, and members of educational institutions. The inventors of the X Window System, Jim Gettys and Robert Scheifler, chaired the conference. It included seminars about current application implementations and birds-of-a-feather sessions on the X-Toolkit, X-Extensibility and the future of the X protocol.

Scheifler presented a key paper on the forthcoming version 11 of the X protocol. Some of the key new features he outlined were statefulness, double-buffered output, flexible font types, shareable color maps, backing store capabilities, new hooks for window managers and protocol extensibility.

Of interest to vendors porting X to their new hardware was the seminar on the implementation of version 11 on a model frame-buffer device. The individual pieces of the device-independent portion of X, like fonts and graphics, color maps, graphics contexts (statefulness), cursor handling and window management were discussed.

On the extensibility front, engineers from DEC discussed a mechanism for extending the X protocol, using 3-D graphics as an example (X is a 2-D graphic interface per se). Because of the extension mechanism now available in version 11 (unavailable in version 10) 3-D graphics programming could be embedded into it.

Perhaps the most important presentation of the afternoon was on the X Toolkit given by Ram Rao of DEC's ULTRIX Engineering Group. This brand new layer of software currently is being developed for application writers and is expected to provide a haven for implementing new applications. With this new software, applications could be ported very quickly to new environments. The software, jointly developed by DEC and Hewlett-Packard Corporation, is expected to be adopted by application developers and provide an industry-wide programming interface for developing a wide variety of applications, expected to run on a wide variety of operating systems and user-interface environments.

—Vasudev Bhandarkar, DEC's ULTRIX Engineering Group.

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APPLICATIONS

WORKING IN REAL-TIME

By Scott H. Davis

Dedicated Real-Time Programming in High-Level Languages Is Easier Than Ever.

Dedicated real-time processors have become integral components of many types of hybrid products such as automated production machines, instruments, robots, and special-purpose workstations.

The needs of an operating system in this environment are quite different from those in general-purpose applications. Real-time applications usually require guaranteed response time to external events as they occur. Because the processor is embedded in the end product, the operating system cannot require support hardware for its own use that is not also required by the application.

Real-time application software traditionally has been implemented in assembly language by the application engineer. This meant that design engineers had to be experts in assembly languages, computer architectures and operating systems. They had to be familiar with the characteristics of the particular processors and devices they were using, as well as operating system design techniques for providing appropriate application system services.

Today, there are host-based software development tools for dedicated real-time programming that do not require computer expertise, are significantly faster and easier to use than previous tools, and allow engineers to concentrate their efforts on the functional design of the end product. These tools typically include compilers, utilities and debuggers that execute on a general-purpose host machine, and are used for developing a customized target application. Provided with these tools are libraries of operating system software for the target CPU that include real-time kernel software, device drivers, file systems and communications facilities. These systems are designed, above all, for simplicity

Real-time software functions and programming techniques in this article are illustrated with examples using development systems designed for 16-bit and 32-bit processors made by Digital Equipment Corporation. Digital's MicroPower/PASCAL toolkit for 16-bit, Q-bus-based PDP-11 computers supports target CPUs from the single-board SBC-11/21 and KXT-11C peripheral processors up through the J-11-based MICROPDP-11/83. The MicroPower/PASCAL development system is available for three general-purpose operating systems: RT-11 single-user or RSX-11M multiuser operating systems for PDP-11 hosts and VAX/VMS for VAX hosts.

The VAXELN development system for low-end 32-bit VAX computers executes on a range of target machines that currently spans the MICROVAX-based machines at the low end up through the VAX-8700 at the high end. VAX/VMS is the general-purpose operating system used on the host development machine.

The 16-bit MicroPower/PASCAL and 32-bit VAXELN systems each include high-level languages that are extended versions of PASCAL. Both high-level languages implement ISO-standard PASCAL syntax with various extensions. A VAXELN application in PASCAL is given in the accompanying sidebar. Additional languages available for VAXELN include C and Ada.

TABLE 1.

Objects	Operations
Process* (Dynamic Process)**	Allocate/Deallocate (Memory)***
Memory (Same)	Create/Delete (All Objects)
Message (Data Packet)	Exit/Stop (Process)
Device (Interrupt Vector)	
Event (None)	Suspend/Resume (Process)
Job (Static Process)	
Name (Logical Name)	Send/Receive (Message)
Port (Packet Queue)	Signal/Wait
Semaphore (Same)	(Synchronization Object)

* in VAXELN systems
**equivalent in MicroPower/PASCAL systems
***applicable objects

in concept and application, as well as for real-time performance and minimal hardware configurations.

Most real-time software development systems, while differing in some respects, have much in common. Though tailored to different computer architectures, they provide similar programming features for application designers. Their real-time languages are extensions of familiar high-level languages whose structured architectures make them particularly suitable for real-time development. Their kernels and I/O systems facilitate development and execution of efficient real-time systems. Their development procedures integrate all steps from creating source code in a high-level language on a host computer to debugging executable images on the target processor.

A real-time operating system is dedicated to a single application and includes only those system services that are needed for the specific tasks involved. A general-purpose operating system, on the other hand, may be called on to execute any type of computer programs on demand. Since it does not require as much main memory and mass storage as a general-purpose operating system, a real-time operating system can fit comfortably in a microcomputer's limited hardware environment, yet deliver all the functionality needed for successful use of the machine.

The software image that is loaded into the target processor for real-time processing consists of the vendor-supplied real-time operating system and one or more user-written application programs (Figure 1). The user assembles the target system software from a toolkit's software components and writes the application programs in a real-time enhanced high-level language, also provided by the vendor.

The operating system includes a number of modular software components: kernel, run-time libraries, device drivers, file system, communications services, and debugger. Some of these components are mandatory in all systems, others are optional as needed by the application. The kernel, also called the real-time executive, is the control software that allocates and manages the processor's hardware resources — CPU, memory and I/O devices — and controls execution of all other system and application software. The kernel may be modular so that its size can be reduced by omitting functions not required by the application.

Run-time libraries, which consist of frequently used interface routines that can be called by application programs, also are modular and so include only those routines that actually are needed. Device drivers, which

Memory space occupied is much smaller than for a general-purpose operating system.

are interface routines or programs that control I/O devices, need to be included only if the particular device is present and being used by the application.

The file system and communications services are used in conjunction with device drivers to provide a more robust set of operations on mass storage or communication devices. The file system, which provides file-oriented access to mass storage devices, is optional since some applications require no such directory services. The communications services, which equip the processor to communicate with other processors, enable programs on both sides of a communications link to talk to one another. These services furnish guaranteed data delivery and circuit multiplexing on a communications link that otherwise is not guaranteed to be free of errors. They also conceal the complex synchronization involved in interprocessor communications from application programs.

Real-time operating systems tend to be simple, small and fast, allowing the final system to execute with as little hardware as possible and perform tasks quickly in a predictable amount of time. Memory space occupied is much smaller than for a general-purpose operating system; for example, the minimum total application size for VAXELN is 256 KB, in contrast with 1 MB for VAX/VMS. The time consumed by the real-time operating system in allocating resources and by those resources in performing their assigned functions is critical. It must be short enough not to adversely affect the performance characteristics of the external devices involved in the applications. For instance, interrupt response time with VAXELN V2.3 on a MICROVAX II averages 33 microseconds.

Modern real-time kernels are object-oriented. That is, they define a small set of hardware and software elements, called *objects*, and a set of actions, called *operations*, that the kernel can perform on these objects at the request of applications. Objects represent either hardware or software resources. Hardware resources typically are I/O devices or memory. Software resources are shared data used for process synchronization or interprocess communication. Table 1 lists objects and operations common to both the MicroPower/PASCAL and VAXELN kernels; there are others unique to individual kernels because of differences in the underlying computer architectures.

A principal goal in designing an easy-to-

FIGURE 1.

Vendor-Supplied Real-Time Operating System	User-Written Application Programs
Kernel	P1
Run-time Library	P2
File Service	P3
Network Service	P4
Disk Driver	P5
Terminal Driver	P6
Debugger	P7
.	.
.	.

FIGURE 2a.

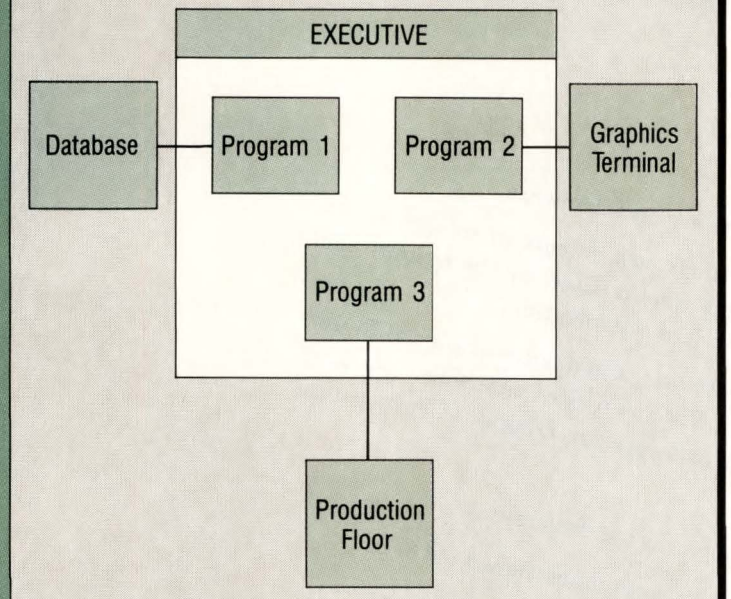
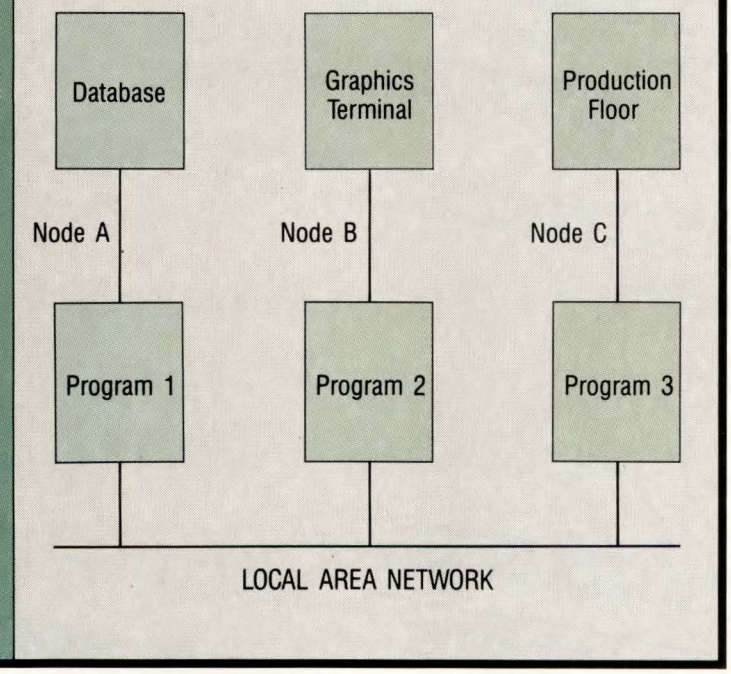


FIGURE 2b.



use kernel is to define as few objects and operations as possible, yet provide the software developer with a full vocabulary that can express any functions the processor might be asked to perform simply.

Target And Host

The greater versatility and variety of development resources offered by a general-purpose operating system still are needed, however, to support the process of creating the application software or *target image*. A text or language-sensitive editor is used to enter and modify source code in the high-level language, a compiler converts source code to optimized object code that can be understood by the target processor, and linkers integrate the real-time modules and applications into a single executable target image.

For some applications, the target processor itself can act as the host computer for application development, as long as it has adequate facilities to support the general-purpose operating system (memory and mass storage). An alternative to this approach is the base real-time application development systems on two computers, a host and a target. The application image is developed with the help of general-purpose resources on the host and debugged and tested on the target.

There are several advantages to host-based development. Debugging will have minimal impact on the execution of the application in this environment because the application execution in the target machine is independent of load characteristics on the host machine (the debugger and host OS will not alter timing in the application). The timing relationships between real-time events and hardware during debugging are more accurate because the actual hardware configuration is being used in the target system.

High-Level Languages

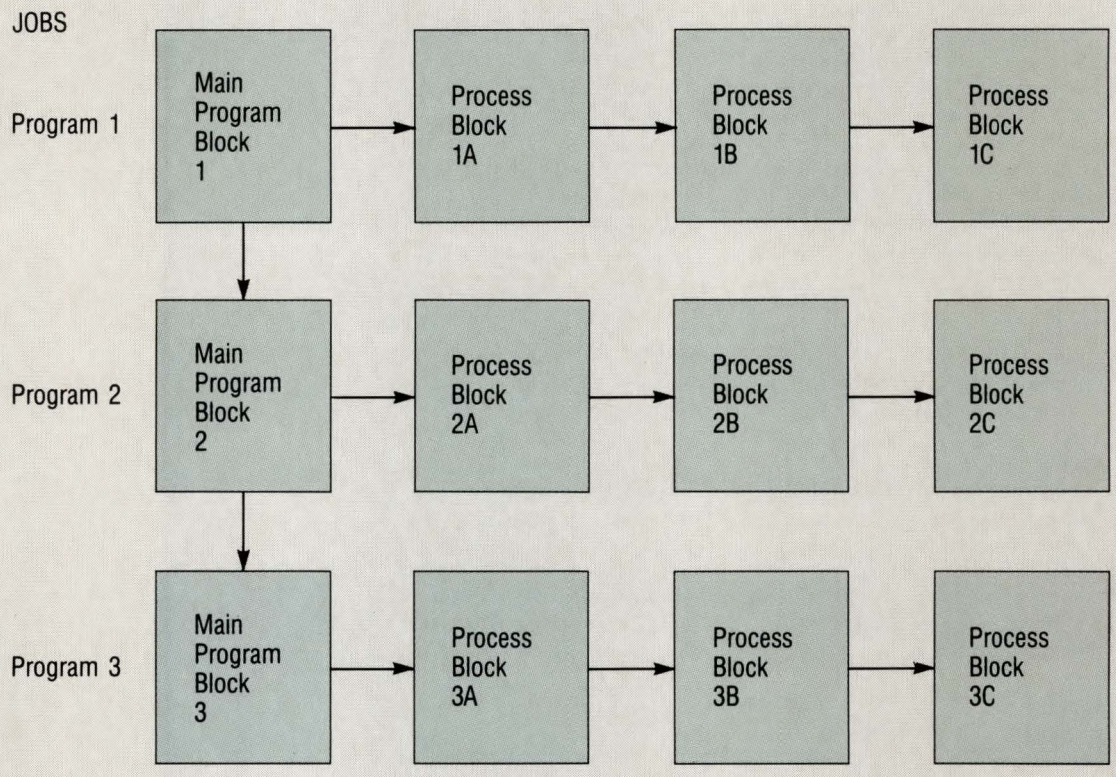
Real-time programming in assembly language is usually a long, complex process even for an expert programmer. Users once also had to develop their own system software along with the application itself. However, assembly

Stepper Motor Program

```
{ ELN stepper motor example program                                    }
{ This program controls a stepper motor via start and stop buttons.    }
{ The interface device for both the buttons and the motor is a DRV11J, }
{ a four-channel parallel port device for the Q-bus. Channel A provides }
{ the button input. Channel B provides the motor output signals.       }
module motor;
{ Declare separately compiled include modules for type checking        }
include $drv_utility, { VAXELN DRV11J interface procedures }
        $elnmsg, $pascalmsg, $kernelmsg, $get_message_text;    { Error messages }
{ Constant declarations }
  const
    start = 2;              { Start button signal }
    stop = 4;               { Stop button signal }
    motor_on = 1;           { Motor on command }
    motor_off = 0;          { Motor off command }
    data_buffer_size = 1;
{ Data types }
  type
    io_function = (io$read, io$write); { DRV11J commands }
  var
    stat: integer;                                  { Error status          }
    drv11j: drv$;                                   { DRV11J context record }
    buffer_pointer: ^drv$buffer(data_buffer_size);{ DRV11J data buffer      }
    motor_stepper: process;                         { Motor driver process  }
{drv11j configuration                                                       }
{                                                                           }
{ channel a  -> read from input buttons                                     }
{ channel b  -> write to motor                                              }
{                                                                           }
{ Access_port procedure performs the function specified by COMMAND on the  }
{ DRV11J channel specified by CHANNEL using the data buffer DATA.           }
  procedure access_port(command: io_function;
                        channel: integer;
                        var data: integer);
    begin
      if command = io$read
        then
          begin
            { Issue a read command of one byte and copy the data into the   }
            { output variable, DATA.                                        }
            eln$drv_read(drv11j, channel, 1);
            data := buffer_pointer^[channel,1];
          end
        else
          begin
            { Otherwise issue a write command of one byte from the data in  }
            { the input variable, DATA.                                     }
          buffer_pointer^[channel,1] := data;
          eln$drv_write(drv11j, channel, 1);
        end;
    end;
  procedure wait_for_start;
{ Procedure WAIT_FOR_START will wait for a command to come in from the      }
{ buttons. If the command is not a START command, it will loop back and     }
{ wait for the next command. Once a START is received, the procedure will   }
```

Continued . . .

FIGURE 2c.



language coding affords the programmer the necessary direct access to specific I/O hardware in order to deal with the external events controlled by the processor. Assembly languages can assure efficient machine code that executes a given computing task in the shortest possible time.

The high-level language extensions used in real-time software development are designed to incorporate these advantages of assembly languages, while maintaining the high-level language's own inherent simplicity. Provision is made for access to I/O hardware, a capability not normally available in the high-level languages. In converting the user's source code to object code for the target processor, today's high-level language compilers can optimize applications programs to make them smaller and run faster. At its best, optimized high-level language code can run very nearly as efficiently as manually optimized assembly language code.

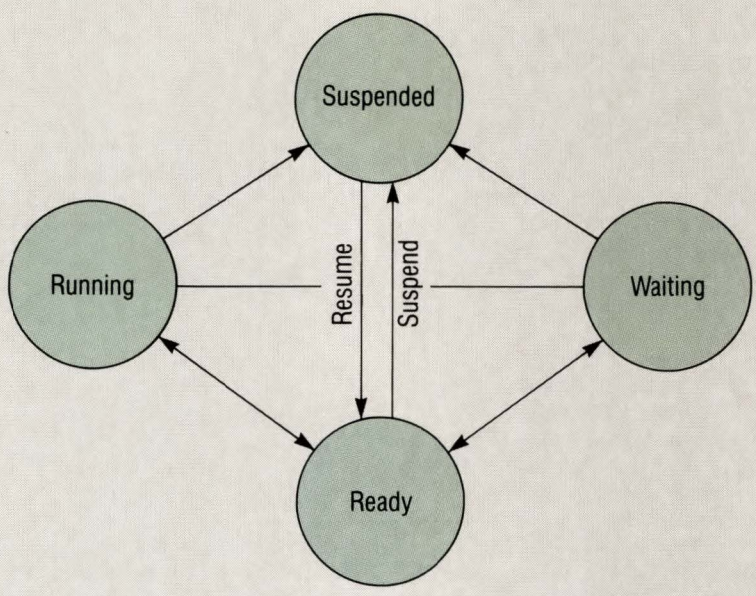
Standard ISO PASCAL has a number of advantages for real-time programming:

1. Block structure. Statements are grouped into blocks that represent easily understood portions of the application's source code.
2. Strongly typed. All variables are defined prior to use and used consistently throughout a program. Strong type checking increases programmer productivity because the compiler can detect data type errors at compile time, rather than later at run time.
3. Powerful data structures. Dissimilar data structures can be combined within records in the same ways they are logically combined in the application.
4. Maintainable code. Block structure and

```
{ return to the caller.                                                    }
    var
      data: integer;
    begin
      repeat
        access_port(io$read, drv$a, data);
      until data = start;
    end;
procedure wait_for_stop;
{ Procedure WAIT_FOR_STOP will wait for a command to come in from the      }
{ buttons. If the command is not a STOP command, it will loop back and     }
{ wait for the next command. Once a STOP is received, the procedure will   }
{ issue a MOTOR_OFF command to make sure that the motor is turned off.     }
{ Then it will return to the caller.                                       }
    var
      data: integer;
    begin
      repeat
        access_port(io$read, drv$a, data);
      until data = stop;
      data := motor_off;
      access_port(io$write, drv$b, data);
    end;
process_block stepper;
{ The process STEPPER is a concurrent process that will wake up once every }
{ second. When it wakes up, it will step the motor one turn by sequentially }
{ issuing a MOTOR_on followed by a MOTOR_OFF. It will then go back to      }
{ sleep for another second.                                                }
{ This process executes concurrently with the main program.                }
    var
      data: integer;
      step_time: integer;
    begin
      step_time := time_value('0 0:0:1.0');
      while true do
        begin
          wait_any(time := step_time);
          data := motor_on;
          access_port(io$write, drv$b, data);
          data := motor_off;
          access_port(io$write, drv$b, data);
        end;
    end;
program motor (input, output);
{ Main program for the stepper motor.                                      }
procedure report_error(stat: integer);
{ Error detecting and reporting procedure.                                 }
    var
      result: varying_string (255);
      wh_flag:get_status_flags;
    begin
      if not odd(stat)
        then
          begin
            eln$get_status_text (stat, wh_flag, result);
            writeln(result);
          end;
```

Continued . . .

FIGURE 3.



procedure-based languages break an application into small, functionally complete modules.

5. Self-documenting. The highly readable modular source code is also largely self-documenting. (See Sidebar.)

Other high-level languages that have similar attributes for real-time programming include C, Ada, and Modula-2. FORTRAN, another common high-level language used for real-time programming, does not have these features.

Concurrency And Processes

Real-time systems must be capable of performing multiple tasks simultaneously, on demand or *concurrently*. These tasks have well-defined points of interaction with each other. Each task has its own unique context, is separately scheduled for execution on the CPU, and is functionally complete. Multitasking, an essential capability in real-time programming, provides that each portion of the application independently can perform its particular function. While only one task at a time can execute, the real-time operating system is responsible for seeing to it that the CPU (as well as other resources) is shared efficiently by all tasks.

Concurrency operates at four levels in a real-time operating system:

1. Multiprogramming (Figure 2a). More than one application program can be running on one processor. Each program can be handling a portion of one multiprogram application, or each can be supporting an independent application.
2. Multiprocessing. Programs controlled by a single real-time operating system can be running simultaneously on two or more processors in a single machine.
3. Distributed Processing (Figure 2b). Programs controlled by multiple real-time operating systems can be running simultaneously on machines at different nodes in a local (or wide area) network.

```
    end;
{ Main program block }
    begin
        { First initialize the DRV11J.                                    }
      eln$drv_initialize('DRV11J', drv11j, buffer_pointer, data_buffer_size,
                         [drv$b,drv$c], false);
{ Next create the motor stepper process.                                  }
create_process(motor_stepper, stepper, status := stat);
{ SUSPEND the motor stepper process to prevent its execution until        }
{ a start command is received.                                            }
suspend(motor_stepper, status := stat);
report_error(stat);
{ Set relative process priorities. The main program has higher            }
{ priority than the stepper process.                                      }
set_process_priority(motor_stepper, 10);
if odd(stat)
    then
      while true do
        begin
          { Main loop }
          { Wait for the start command }
          wait_for_start;
          { When the start is received, resume the motor process }
          resume(motor_stepper, status:= stat);
          report_error(stat);
          { Wait for the stop command }
          wait_for_stop;
          { Suspend the motor process and loop back }
          suspend(motor_stepper, status := stat);
          (report_error(stat);
        end;
      end.
    end;
```

4. Multitasking (Figure 2c). Each execution of each program (also called a job) consists of a family of processes — one or more independent threads of execution. All processes in a program are free to execute concurrently as necessary and can be scheduled independently. Processes can be created dynamically on an as-needed basis in the program.

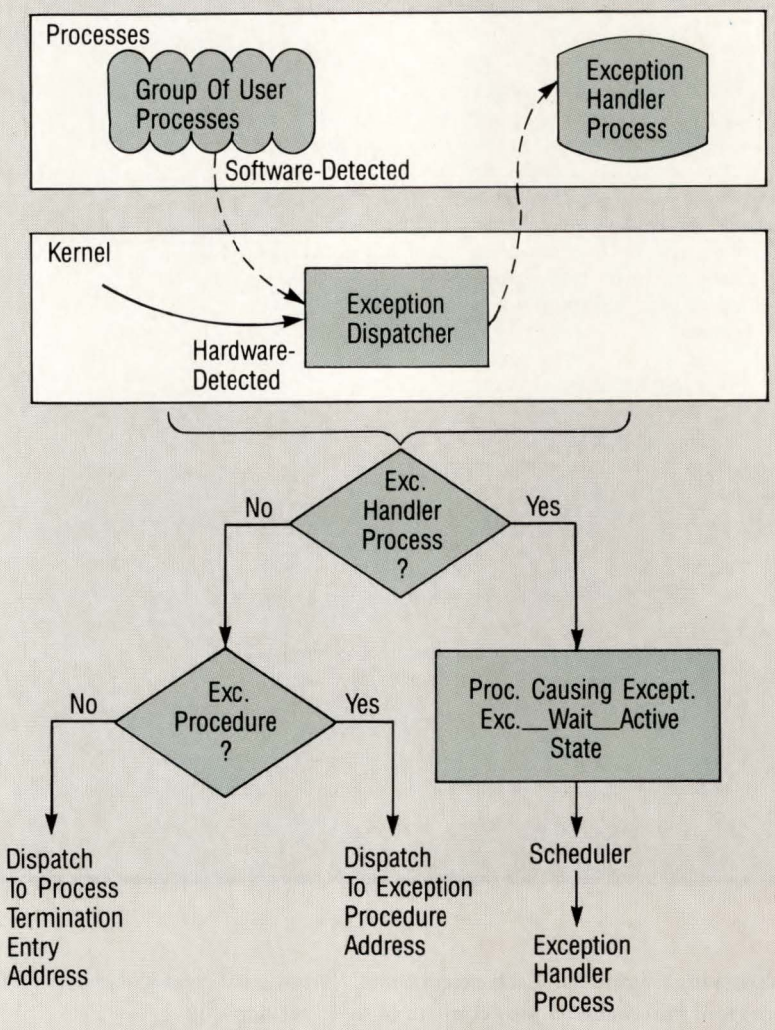
Note that in Table 1, JOB and PROCESS are defined as objects and manipulated by operations.

Micropower/PASCAL is a multiprogramming, multitasking development environment. Programs are defined statically, but multiple tasks can be created dynamically from PASCAL by means of procedure-like constructs. VAXELN is a multiprogramming, multitasking, distributed system. Multiple programs and tasks are created dynamically through system service calls.

In multiprocessing and distributed processing, the software developer need not know whether an application is to run on one processor, on more than one processor at a single node, or on processors at two or more nodes in a network. A VAXELN system can span two or more nodes in local area networks transparently through use of its distributed name service and networking software. If one or more programs are relocated to processors at other nodes, the network service software at those nodes handles message-based communications transparently.

MicroPower/PASCAL systems, while not

FIGURE 4.



supporting such transparent distributed processing, do provide for task-to-task communications between processors over both asynchronous and synchronous serial lines, as well as Ethernet LANs.

Real-Time Functionality

There are seven basic types of services provided by a real-time kernel: multitasking, process synchronization, interprocess communication, scheduling, interrupt handling, exception handling, and memory allocation. Any good real-time kernel offered by hardware or software vendors must provide for all these services, regardless of terminology.

Multitasking

Multitasking is the level of concurrency at which the application developer will spend the most coding time. Here, for each program in the application, the variables are defined and the program divided into the necessary number of tasks. There is a separate process for each task to be performed, each process concentrates on its own task, and tasks may

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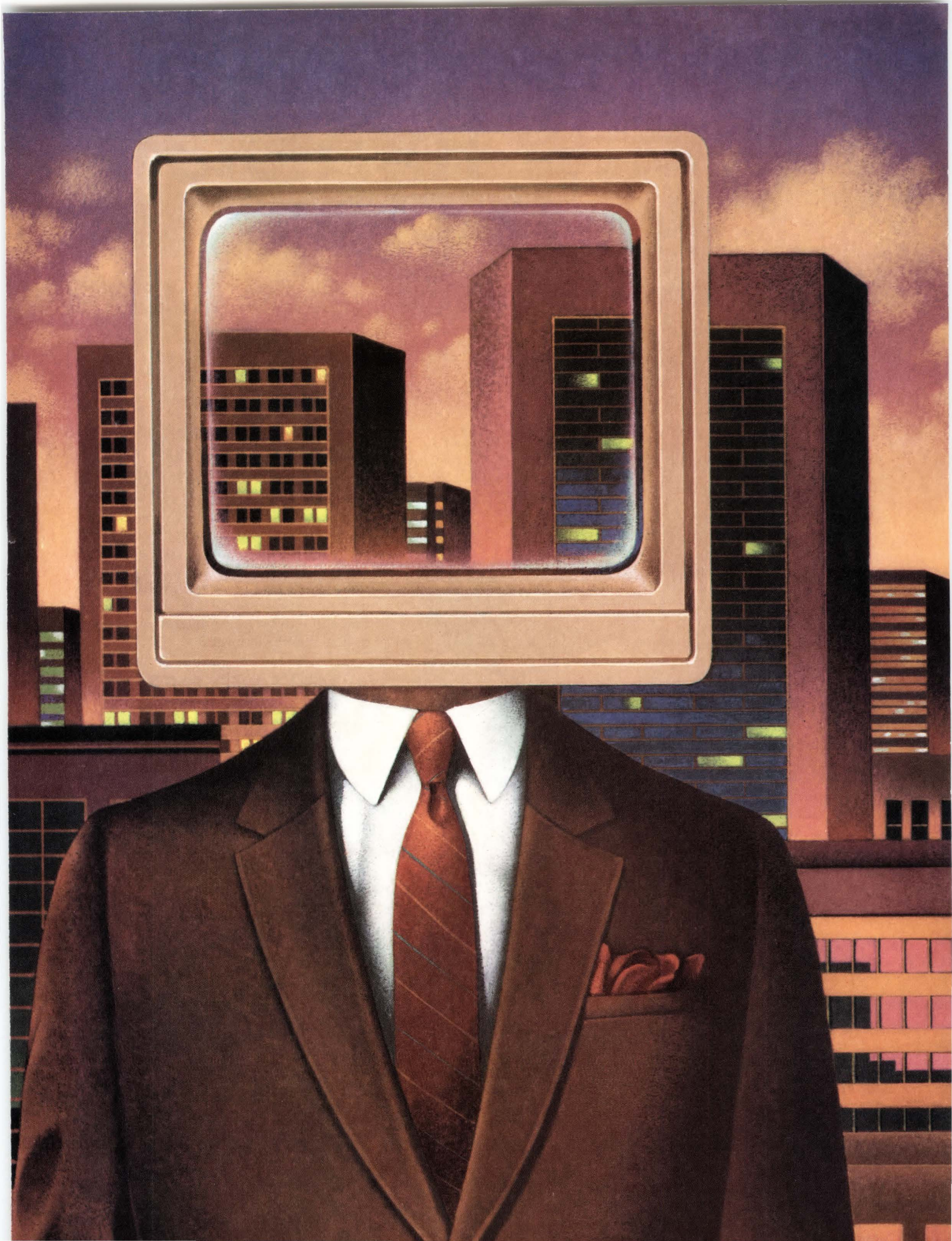

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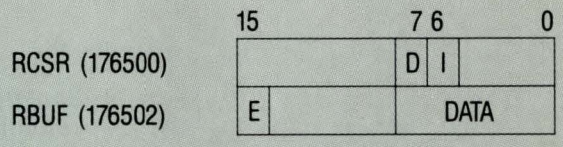
FIGURE 5.




```
VAR receiver : [AT(%0'176500'), volatile] packed record
                 interrupt_____enable : [pos(6)]BOOLEAN;
                 done :                 [pos(7)]BOOLEAN;
                 data :                 [pos(16)]CHAR;
                 error :                [pos(31)]BOOLEAN;
                 END;

WITH receiver DO
  BEGIN
    WHILE NOT done DO;        (*wait for done bit *)
    IF NOT error THEN newchar := data
  END;
```

or may not execute concurrently. The speed of the program is, in principle, the speed of the slowest thread of execution. While some tasks are unable to execute (waiting for a resource or event), other processes can make use of the CPU to do useful work for the application.

Process Synchronization

Process synchronization is a mechanism for coordinating execution of two or more processes (typically, one process waits for another to complete an operation). Process synchronization is needed in two instances, *mutual exclusion* and *event response*. Mutual exclusion is the case in which a process is using a shared resource and must have exclusive access to it in order to prevent corruption of the resource. Event response is needed when a process wishes to be activated in order to respond to a particular event, external or internal. Any multitasking-based real-time operating system must include mechanisms designed to answer these needs.

A common synchronization mechanism used by both the MicroPower/PASCAL and VAXELN real-time systems is the SEMAPHORE object (Table 1), a gate variable that controls access to one or more system resources, such as shared memory. Before a process accesses a shared resource, it performs a WAIT operation on the SEMAPHORE. The semantics of the WAIT is that, if the gate is open, the process closes it and continues, or else the process is blocked until the SEMAPHORE is opened. When a process has completed its use of the resource, it signals the SEMAPHORE so that any other waiting process can proceed.

Interprocess Communication

The processes that are part of the same program have common address space, allowing them to communicate with each other by means of shared variables declared in the program. Because these processes execute concurrently, access to shared data must be synchronized by means of statements within the program and process blocks involved in that job.

Processes in different jobs, however, require other means of communication. Interprocess communication is required when data must be transmitted in addition to the processes being synchronized. MicroPower/

The scheduling algorithms for VAXELN and MicroPower/PASCAL are triggered by any significant event.

PASCAL, for example, uses four communication mechanisms, depending on the circumstances: shared memory (between processes in the same job), ring buffers or data packets (when moving small amounts of data), and address packets (when moving large amounts of data).

VAXELN jobs, however, communicate via messages for all circumstances by using memory management functions of the VAX architecture. This is accomplished by switching an area of memory from the data space of the source process to the data space of the destination process. This procedure is faster than packet transfers because no data actually is copied. VAXELN also allows for shared data areas.

Data can be exchanged between programs on separate processors through use of the optional network service module in a real-time operating system (Figure 1). The programs can be distributed physically among processors at different nodes (Figure 2b) in a network and still be able to communicate via messages just as if they were running on the same processor. This is the case with VAXELN, where messages from node to node automatically are encapsulated in message protocols provided by LAN software, resulting in transparent communication.

Exchange of data between two nodes in a MicroPower/PASCAL real-time system, for example, is accomplished through use of PASCAL I/O statements. Except for the syntax denoting an OPEN operation being performed on a communications channel, the programs on the source and destination nodes are written entirely in standard PASCAL.

The different approaches to interprocess communication taken by these two real-time operating systems illustrate the fact that real-time systems depend heavily on the underlying machine architecture. However, since both real-time systems have appropriate mechanisms for interprocess communication, application programming is conceptually the same in both cases.

Scheduling

A real-time system's kernel is responsible for scheduling or allocating the CPU. A general-purpose operating system's primary goal is to divide the CPU fairly among equal priority processes. However, a real-time operating system is not concerned with fair sharing but with allowing the application developer to control which processes get the CPU and for how long they own it. Unnecessary switches between processes are avoided in order to gain better performance.

Each process in an application program always is in one of four states (Figure 3):

1. Running. Process is in control of the CPU and executing.
2. Ready. Process is eligible to execute but currently does not have control of the CPU. Ready is the initial state of every process immediately after its creation.
3. Waiting. Process is standing by for one or more conditions to be satisfied. It may be waiting for a particular amount of time to elapse, occurrence of a particular event, or receipt of a message.
4. Suspended. Process can put itself or any other process into the suspended state with the SUSPEND operation. A suspended process becomes eligible to execute again (that is, enters the ready state) only after a RESUME operation.

The scheduling service is invoked as a result of predefined process state transitions. The scheduling algorithms in both

FIGURE 6a.

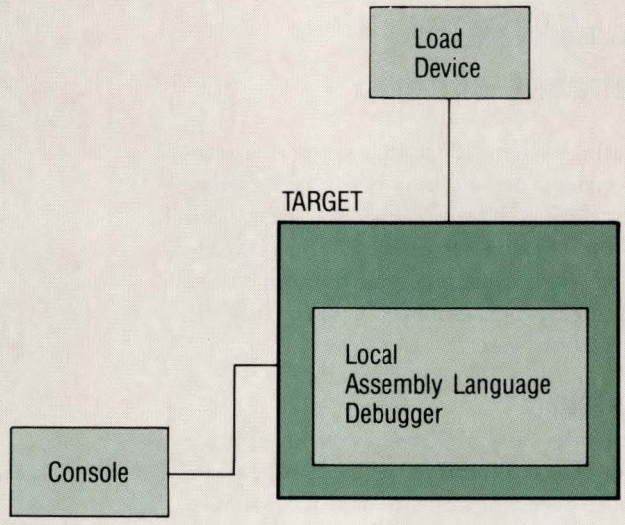
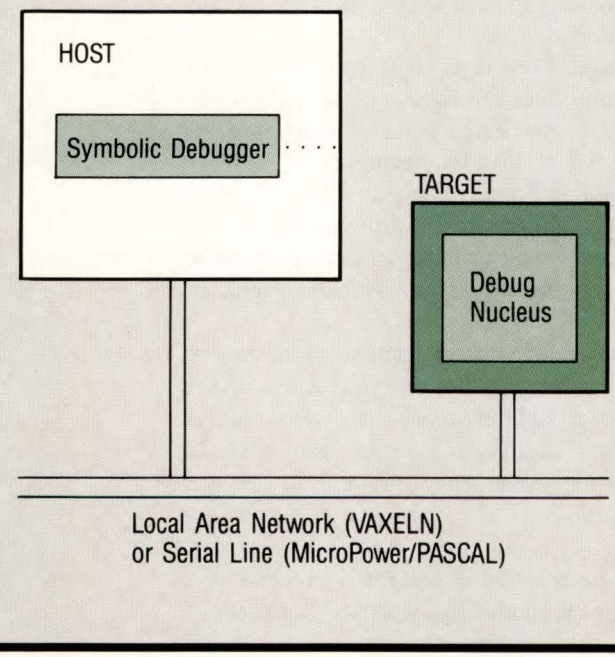


FIGURE 6b.



MicroPower/PASCAL and VAXELN are priority-based and pre-emptive (not time-slice). The ready process having the highest priority executes before any lower priority process, but can be pre-empted before completion by any higher priority ready process; i.e., one that has newly entered the ready state.

The scheduling algorithms for VAXELN and MicroPower/PASCAL are triggered by any *significant event*. Significant events are defined as transitions out of the running state or into the ready state. Relative priorities are revised by the scheduler whenever there is a change in ready processes available for running or a change in priorities through program control.

Interrupt Dispatching

The real-time kernel must provide an efficient mechanism for handling interrupt requests from devices so as to respond to external events as quickly as possible. Key features in the realm of interrupt dispatching are *interrupt response*, the time it takes from an interrupt grant to execution of the appropriate interrupt service routine, and *interrupt latency*, the time from an interrupt request to interrupt service routine execution. Both must be minimal and predictable. The VAXELN interrupt dispatcher is only two to three instructions long. MicroPower/PASCAL has different interrupt dispatching codes, ranging from three instructions to 16, for different hardware options.

The real-time operating system also must provide mechanisms to connect interrupt vectors to interrupt service routines (ISRs), guidelines for structuring ISRs, and mechanisms for issuing system services from within ISRs.

In VAXELN, the CREATE_DEVICE service is used to create the synchronization object representing an interrupt-driven device. The service also completes the association between a device's interrupt vector and the ISR in the device driver. The WAIT_ANY operation holds the driver process in the waiting state until the ISR allows it to continue. A SIGNAL_DEVICE call from the ISR signals the device object and wakes up the driver process.

VAXELN ISRs are written in high-level languages.

Exception handling is the set of services that deals with unexpected conditions that arise during the course of real-time processing. Dedicated applications execute for lengthy periods of time and must be designed to withstand error conditions gracefully. The exception condition may be detected by either hardware or software. For instance, hardware-detected exceptions include dividing by zero, floating-point traps and memory management faults. An example of a software-detected exception is an application program running out of memory space during execution.

MicroPower/PASCAL's exception facility addresses exception conditions with either of two mechanisms: an *exception handler* process or an *exception procedure*. An exception handler process, which is dedicated to a particular type of exception condition, corrects the condition for other processes. An exception procedure is a subroutine within a process designed specifically to handle an exception in only that process. The decision diagram in Figure 4 summarizes how the kernel's exception dispatcher checks in sequence the availability of an appropriate exception handler process and exception procedure. If neither is available; i.e., the exception cannot be handled, the process is aborted.

Memory Allocation

Dynamic memory allocation describes a process's ability to acquire memory space as needed for a given task and then return that space to the free pool for use by other tasks when no longer needed. A real-time kernel must be able to multiplex use of memory because the limited amount available in dedicated systems has to be efficiently used. Without this ability, memory space would be acquired by successive program executions, used as needed, and then withheld permanently in an idle state. As a result, a real-time processor without dynamic memory allocation must have a substantially larger memory.

High-Level Language Extensions

In addition to being extended for multitasking and system services, high-level languages for real-time systems include extensions for I/O processing. It is vital that a real-time system be capable of handling all three types of I/O, *interrupt-driven, programmed*, and *polled*.

In interrupt-driven I/O, the processor issues an I/O command to an external device and then resumes other tasks until it receives an interrupt from that device indicating that the operation has completed. The processor time is used very efficiently, and the only delay in servicing the device is the interrupt dispatching overhead and possible servicing of a higher priority device.

In programmed I/O, the processor issues a command to the I/O device and then waits in a loop until the device is finished. Although the processor cannot perform any other tasks while waiting, programmed I/O offers the highest I/O throughput of the three types; there is virtually no delay in availability of the CPU between the time when the device is ready and when it is serviced.

In polled I/O, code in the driver periodically checks each device for completion of an I/O request. Polled I/O typically has the lowest throughput, but it can approach the throughput of programmed I/O with a short enough time interval between checks.

Both the MicroPower/PASCAL and VAXELN development systems handle all three types of I/O with language extensions that allow direct manipulation of control status registers (CSRs). CSRs, which are hardware registers in the I/O device controllers, appear to application programs as 16-bit memory locations on the processor's I/O bus.

In order to effectively program CSRs, the high-level language must have access to variables that overlay (are associated or aligned with) the corresponding addresses of the CSRs, as well as individual bit fields within a CSR. The two 16-bit formatted words in Figure 5 represent the CSR format for a Digital DLV11-style serial line controller. The first 16-bit CSR (RCSR) contains status and control bits (including interrupt enable), and the second CSR (RBUF) contains the transferred byte of data. The CSR definition syntax shown at the bottom of Figure 5 is for MicroPower/PASCAL.

MicroPower/PASCAL extensions provide for three additional attributes of variables in order to provide the necessary CSR representation. The POS attribute allows aligning a

Real-time development systems provide full symbolic debugging, which significantly improves programmer productivity.

record field with a particular bit position in the CSR. The AT attribute aligns a variable with a fixed address in the processor. VOLATILE informs the PASCAL compiler that access to a particular variable should not be optimized. (Compilers typically put frequently used variables in general-purpose registers. This can't be done with CSRs because the important thing is not just the value of the variable, but the access to the actual location aligned with it.) As shown in Figure 5, the CSR can be accessed with standard PASCAL statements, treating status bits as BOOLEANs and the transferred byte as a CHARacter.

VAXELN also uses PASCAL records for CSR representation, but implements the other functions differently, because of differences between VAX and PDP-11 architectures.

Application Development

Application development for real-time systems has been simplified in regard to creating source code for application programs and debugging object code. Compilers have been extended to allow independent development and compilation of source code modules. This is useful in planning and in sharing development among several programmers, as well as decreasing maintenance cost.

As each module is compiled, VAXELN's EPASCAL compiler automatically checks the consistency of declarations or cross-references involving it and the other modules already compiled. Inconsistencies in declarations and use are reported at compile time. The compiler also provides for one-time definition of declarations that covers all uses of the declared items in other modules. Without one-time definition, declarations must be redefined in each module, and mismatched declarations can be very troublesome to detect.

A set of linkage utility programs is used to generate program images. Linkers combine the component modules to produce an executable image of each program. A system builder then creates the application image (Figure 1) by combining program images with the real-time operating system software. The application image is transferred to the target processor in one of three ways, either by bootstrapping off a mass storage device, programming into PROM or down-line loading from the host to the target via a communications link (Figures 6a and 6b).

Real-time development systems provide full symbolic debugging, which significantly improves programmer productivity. In symbolic debugging, the object code in the application image is debugged with the same variable names and syntax used in writing the source code.

High-level language debugging in VAXELN can be done locally on the target or remotely from the host. If the target configuration includes a console terminal, an onboard version of the debugging software can be run (Figure 6a). If not, as in many embedded standalone real-time applications, debugging is done remotely, with only a small debug nucleus on the target (Figure 6b). MicroPower/PASCAL offers remote symbolic debugging only.

Symbolic debuggers provide access to variables, source code, machine instructions and hardware registers. The same debug commands are used in testing and examining all levels of system software. All processes (threads of execution) in the system can be debugged in one debugger session on one terminal.

Scott Davis is principle software engineer, Dedicated Real-Time Systems Development, at Digital Equipment Corporation, Maynard, Massachusetts.

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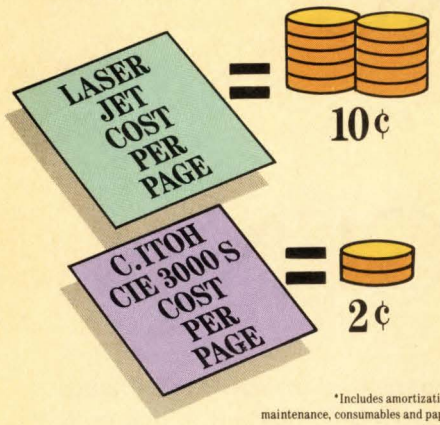

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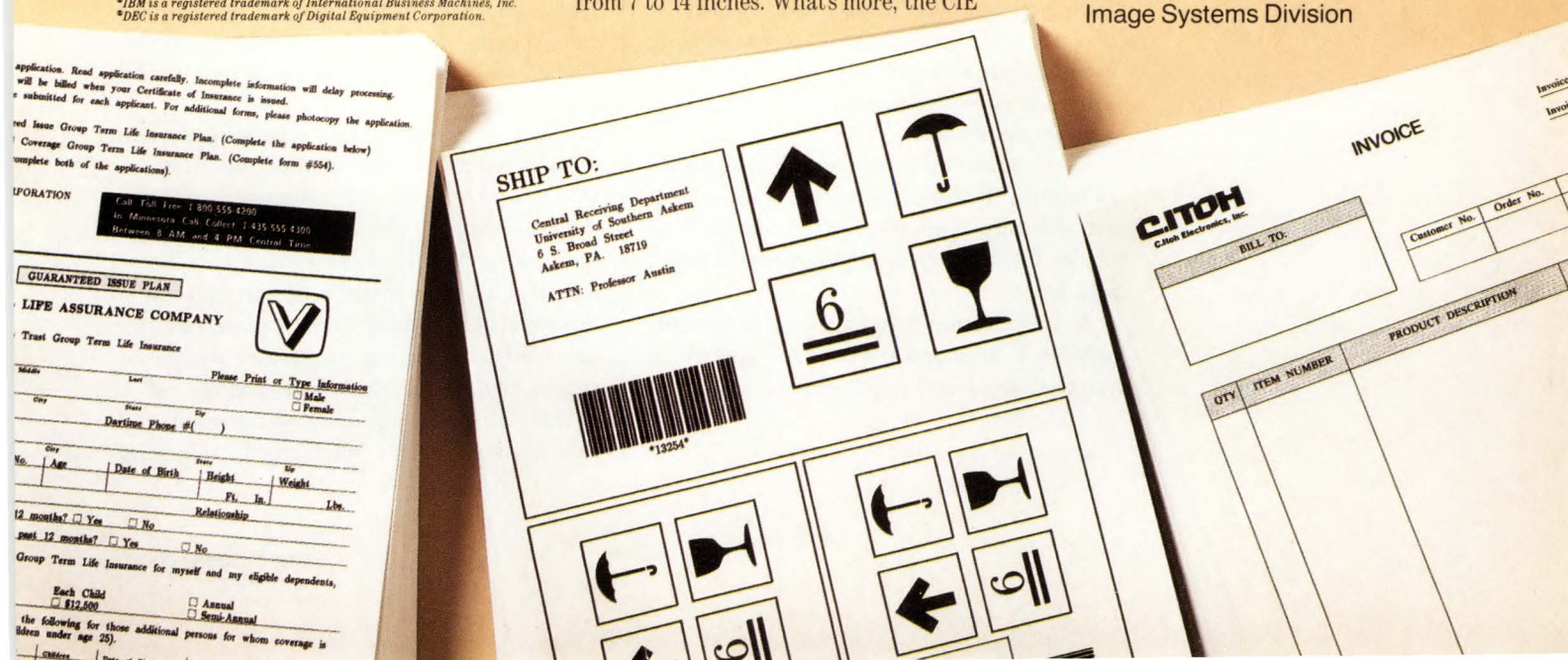
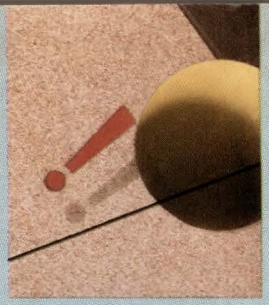




SYSTEMS DESIGN

VERIFYING WITH *VERLANGEN*

By Dr. Dianne E. Britton and Harry Rosenthal

Software Tools For Formally Specifying And Verifying Systems Designs.

Q: Why bother formally verifying systems designs?

A: For critical systems, verified design can increase confidence that a system will meet its requirements. Verifying a system design also can catch design flaws early in the product life cycle, while the cost of correcting them is relatively low.

FOR RCA AEROSPACE and Defense and other defense contractors there is another motivation. Verified design was thrust into a position of special importance in August 1983 when the Department of Defense published its "Trusted Computer System Evaluation Criteria" for secure computer systems. Depending on security policies and assurances, a secure computer system can be rated from as low as "D," minimal protection, to "A1," verified design. The Department of Defense currently is using these criteria to rate existing systems, such as the Honeywell SCOMP, and to provide rating requirements for systems yet to be implemented.

Verlangen is a German verb that means "to require." It also is the name of a set of tools that formally specifies system designs and verifies that they meet requirements. The set includes:

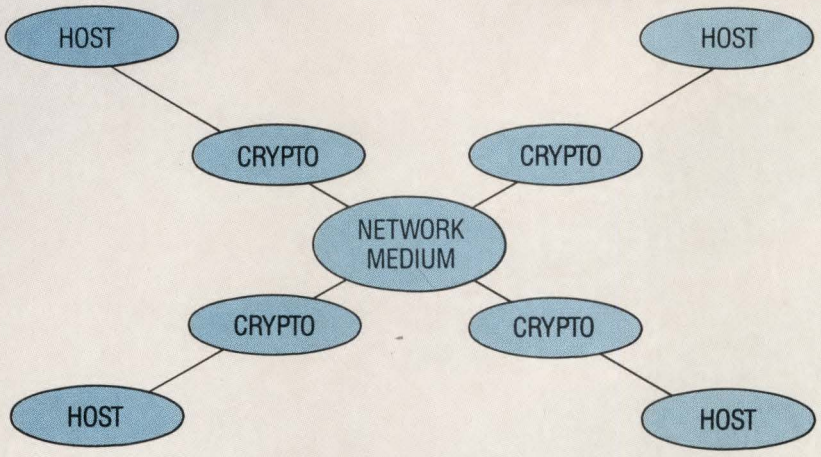
1. A specification language — to provide high-level language features for specifying system designs and requirements.
2. A compiler — to translate a specification into definitions and theorems in first-order logic.
3. A theorem prover — to verify that a design satisfies requirements.

Verlangen is appropriate for many kinds of computer systems, including distributed systems, communications networks and operating systems. A translator eventually will be added to implement verified designs in software.

The Software Engineering Laboratory (SEL) of RCA's Advanced Technology Laboratories (ATL) is the organization developing Verlangen. The objective of the group has been to produce verified designs as required in the A1 category without being restricted to verifying security requirements only. Although several other languages and systems can specify and verify system designs, Verlangen has special strengths not found elsewhere.

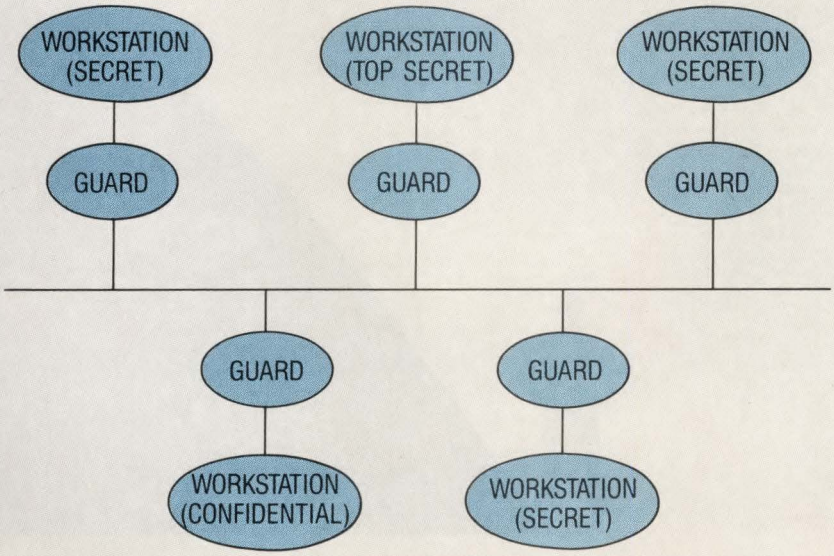
Verlangen encourages separating system designs/requirements and their verifications into tractable units. The language provides *classes* to support object-oriented design and *levels* to support levels of refinement. These language features make Verlangen specifications readable and keep verification manageable. When a change in system design or requirements necessitates a change in a Verlangen specification, most theorems and proofs will remain unchanged, requiring

FIGURE 1.



A network with end-to-end encryption. Only encrypted messages traverse the network. Two hosts communicate only if they are authorized to do so.

FIGURE 2.



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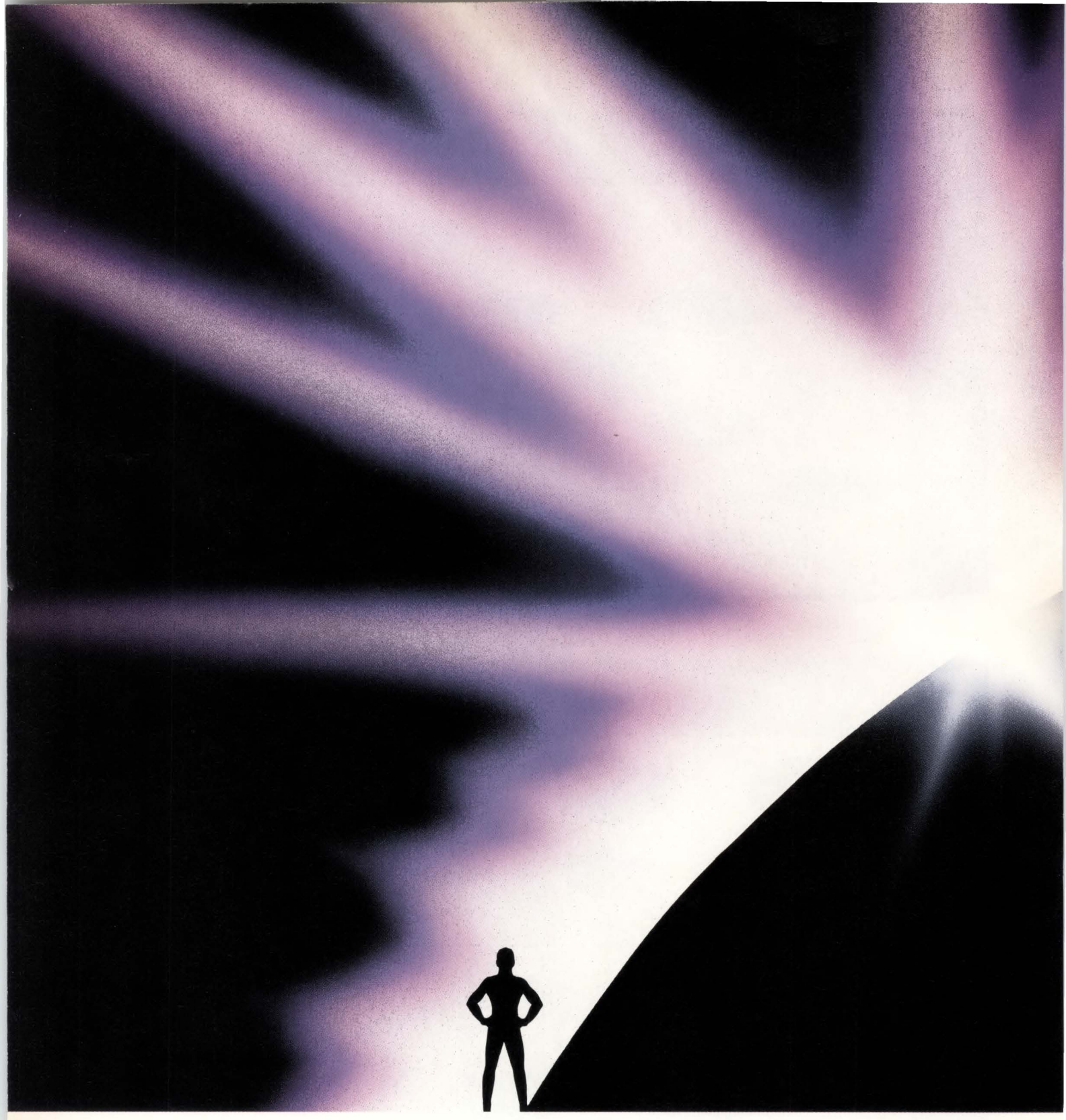

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FIGURE 3.

```
CLASS Guard(CONST max:Lev) IS
   VAR netin,netout:Obj;
   VAR dest:Subj;
   VAR netinfull,netoutfull:BOOLEAN
          INITIALLY FALSE;

   PROCEDURE fromnet(o:Obj; l:Lev) IS
     PRECONDITION NOT netinfull;
     EFFECT
       IF l <= max
         THEN (netinfull' & netin' = o)
         ELSE NOT netinful';
       SAME netoutfull, netout, dest;
   END fromnet;

   PROCEDURE touser(o:Obj) IS . . .
   PROCEDURE fromuser(d:Subj; o:Obj) IS . . .
   PROCEDURE tonet(d:subj; o:Obj; l:Lev) IS..

   INVARIANT netinok IS
     netinfull =>
      EXISTS g:Guard EXISTS l:Lev
      ( g << THIS &
        g.fromnet(netin,l) &
        l <= max );

   INVARIANT filter USING netinok IS
     FORALL o:Obj
      ( touser(o) =>
      EXISTS g:Guard EXISTS l:Lev
      ( g << THIS &
        g.fromnet(o,l) &
        l <= max )
     );
    . . .

END Guard;
```

Guard class declaration from the Secure LAN specification.

relatively little added effort to verify the changed specification.

Verlangen is uniquely applicable to truly concurrent/parallel systems like distributed systems and networks. The model for communications between subsystems is extremely flexible, allowing the specification of a great variety of synchronization schemes. This contrasts Verlangen with the Gypsy Verification System. Although Gypsy (from the University of Texas at Austin) commonly is chosen for verifying network and distributed applications, it imposes a very restrictive message-based communications model.

The desire to verify designs of secure communication networks and distributed systems has been important to the development of Verlangen. We've used Verlangen to specify and verify the design of a communications network with end-to-end encryption

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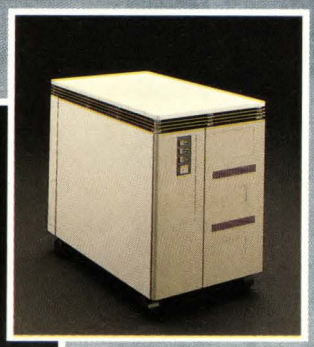

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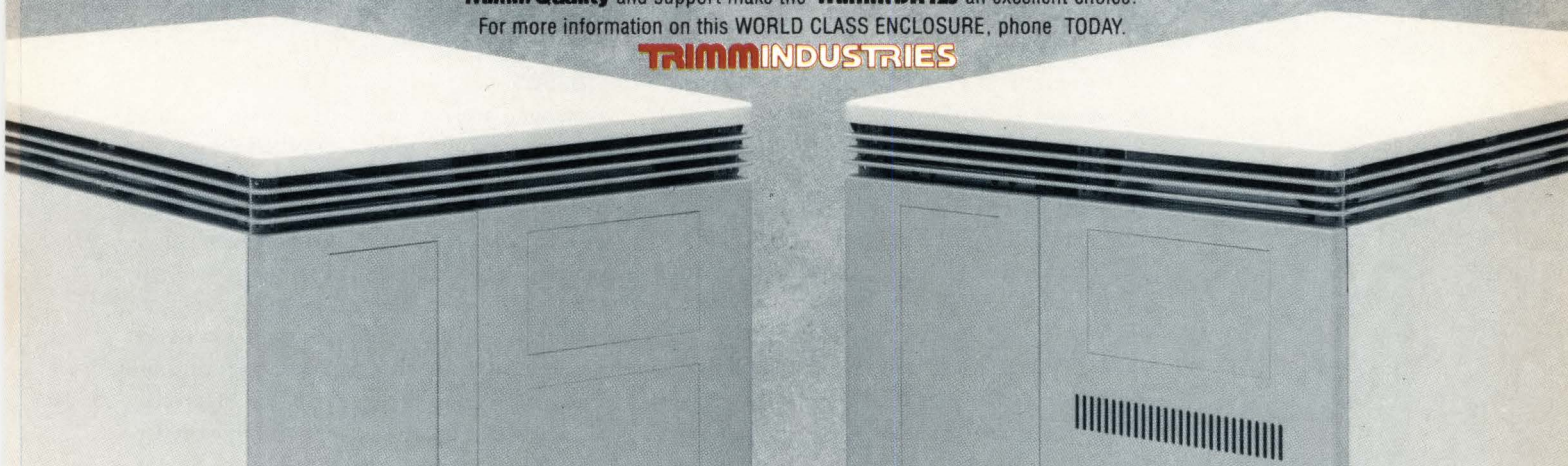

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FIGURE 4.

```
CLASS WorkStation(CONST myself:Subj) IS . . .

CLASS Guard(CONST max:Lev) IS . . .

CLASS System IS
    CONST Clearance(s:Subj):Lev;
    VAR user(s:Subj):WorkStation(s);
    VAR guard(s:Subj):Guard(Clearance(s));

    FORALL s,d:Subj FORALL o:Obj
       SYNC user(s).send(d,o),
            guard(s).fromuser(d,o);
    . . .

    INVARIANT Origination
            USING WorkStation.knowledge,
                  Guard.filter,
                  Guard.transport
    IS FORALL s:Subj FORALL o:Obj
       ( user(s).knows(o) = >
          EXISTS sys:LANSystem
          ( sys << THIS &
            sys.user(Originator(o)).write(o)
          )
       );
    . . .
END System;
```

Excerpt from the LAN specification defines concurrent classes.

(see Figure 1). All messages that travel over the network are encrypted to prevent their being trapped. Only hosts that are authorized to communicate exchange unencrypted messages.

In Figure 2 a multilevel Secure LAN connects several workstations that do not deal with or understand security levels. Each workstation is assigned a fixed security level and only operates at that level. Between the workstations and the LAN are guards, one for each workstation. The guards restrict the flow of messages between workstations, to enforce multilevel security. The examples displayed use the Verlangen specification for this application.

Although Verlangen is not a programming language, it includes many programming language features, such as block structure, identifier scope and visibility rules, and user-defined data types. These features are equally valuable for expressing program and design specifications.

Classes

Verlangen uses a language construct called CLASS to support object-oriented design and verification. This combines the concept of abstract data type from programming languages with the concept of state machine from specification languages. An abstract data type defines a set of values and provides functions (or operations) that yield new values in the set from old ones. A state machine goes through states or cycles to do its job. A Verlangen class is an abstract data type whose values represent the states of a state machine.

Most system entities can be modeled as state machines; hence, the class is a very useful and general construct. We use classes to repre-

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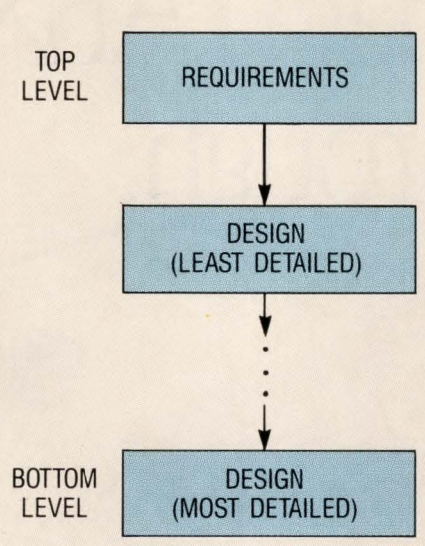
FIGURE 5.




```
LEVEL mls IS
   . . .
   CLASS System IS
      . . .
      INVARIANT SimpleSecurityCondition . . .
      INVARIANT StarProperty . . .
      CONSTRAINT NoDowngrading . . .
   END System;
END mls;

LEVEL lan REFINES mls IS
   . . .
   CLASS WorkStation . . .
   CLASS Guard . . .
   CLASS System . . .
END lan;
```

Levels of refinement.

sent data structures, processes, hosts, front-ends, communication links and communication networks, etc. We define a new class whenever we want to represent a new kind of system entity. If a system includes several similar entities that operate more or less independently — for example, the guards in Figure 2 — we define a class for that kind of entity and specify that there are several instances of that kind of entity in the system. A class instance appears in a Verlangen specification as a variable whose data type is given by the name of the class.

Each class instance represents a particular state machine and is called an *object*. A sequence of values (states) called a history is associated with an object. The first value in the history represents the state machines' initial state, and the other values represent each subsequent state. To define the possible histories, a class definition specifies initial values for its objects (or a condition on initial values) and some operations that yield new values from old ones.

How do we use the Verlangen class construct? Consider the guard unit from the Secure LAN. Each guard, which is assigned the security level of its workstation, has two functions. The guard uses its security level to label all data that goes from its workstation to the network. The guard also prevents data with a higher security level from reaching the workstation.

Each guard is modeled as a state machine. A Verlangen class called *Guard* is defined, which specifies a class of state machines — all the guard units (see Figure 3). The guards aren't identical because their security levels may be different. So, the *Guard* class definition has a parameter: a constant *max* of type *lev*. Each *VAR* declaration for the variable of type *Guard* will assign a value to *max*.

Each *Guard* value represents a state. The variables, declared by *VAR*, represent the components of the state. These components have types *lev*, *subj*, and *obj*, representing, respectively, security levels, names of individual workstations and classified data objects.

The procedures in the *Guard* class definition represent operations that take the guard from one state to the next. Verlangen procedures include a *precondition* and an *effect*. Both

Proving the verification theorems verifies that the design does indeed satisfy the assertions.

are expressed as one or more logical formulas. The precondition selects those states in which the operation may occur; i.e., the operation may occur in a state only if the precondition is met. The effect specifies the state after the operation in terms of the state before the operation. Primed identifiers, (e.g., *netin'*) refer to values after the operation; unprimed identifiers refer to values before the operation.

To express requirements on a class, we include assertions in the class definition. There are two kinds of assertions. An *invariant* is a condition that we want every state of every object in the class to satisfy. A *constraint* is a condition that we want to hold between each two subsequent states in every object history.

The *Guard* class defines two invariants, *filter* and *netinok*. The filter invariant states that the guard passes data to its workstation only if the data came over the network from a workstation with the same for a lower security level. We may regard the filter invariant as a requirement placed on the class — a property maintained regardless of the class implementation. It refers only to the procedures and constant parameters of the class, not to the internal variables.

For every assertion that appears in a class definition, the Verlangen compiler produces verification theorems. Proving the verification theorems verifies that the design does indeed satisfy the assertions. For example, we verify an invariant by induction; therefore, for an invariant, the compiler produces theorems that correspond to the basis and induction steps of an inductive proof:

Basis: The initial state satisfies the invariant.

Induction: If an arbitrary state satisfies the invariant, then the next state does also.

An invariant often is not inductive; i.e., not strong enough for the inductive proof to succeed. To obtain a verification, then, we determine additional supporting invariants and include them in the specification. When these invariants appear in a USING clause of a noninductive invariant, the compiler adds them as hypotheses to that invariant's verification theorems. For example, netinok supports filter, which is not inductive.

Concurrency

Verlangen allows us to decompose a system into (or compose a system from) simpler subsystems. This approach to system design generally is accepted as effective for operating systems. For distributed systems and communications networks, the approach also is a natural one. The system naturally decomposes into a set of concurrent, interacting subsystems — the host computers, front-end processors, gateways, etc.

We model a system composed of subsystems by a collection of state machines, and define a class for each different kind of state machine. In the class definition for the overall system, we declare variables that represent the component subsystems. The data types of these variables are the classes for the corresponding state machines. This specifies that the state of the overall system is composed of the subsystem states.

The Secure LAN specification, for example, defines three classes: *WorkStation*, *Guard*, and *System* (see Figure 4). The class *System* represents the overall system, composed of several workstations and guards. In the definition for *System*, the workstations and guards appear as variables of type *WorkStation* and *Guard*, respectively.

Verlangen uses SYNC statements to specify how concurrent subsystems are to be synchronized. These statements correlate events (operations) that occur in the sub-

FIGURE 6.

```
PROVE FORALL this:Guard FORALL max:Lev
        ( initial(this,max) &
          FORALL old:Guard netinok(old)
            => filter(this) )

PROVE FORALL this:Guard FORALL o:Obj FORALL l:Lev
        ( filter(this) &
          FORALL old:Guard netinok(old) &
          fromnet(this,o,1)
            => filter(NEXT(this)) )

PROVE FORALL this:Guard FORALL o:Obj
        ( filter(this) &
          FORALL old:Guard netinok(old) &
          touser(this,o)
            => filter(NEXT(this)) )

PROVE FORALL this:Guard FORALL d:Subj FORALL o:Obj
        ( filter(this) &
          FORALL old:Guard netinok(old) &
          fromuser(this,d,o)
            => filter(NEXT(this)) )

PROVE FORALL this:Guard FORALL d:Subj FORALL o:Obj FORALL l:Lev
        ( filter(this) &
          FORALL old:Guard netinok(old) &
          tonet(this,d,o,l)
            => filter(NEXT(this)) )
```

Theorems for verifying filter invariant, taken from the Secure LAN specification.

systems. A SYNC statement says that certain events in the subsystems cannot occur unless they occur together.

The *System* class definition in Figure 4 includes SYNC statements that state how the workstations interact with the guards, and how the guards interact with each other. A user workstation, for example, sends data only if its guard receives it, and vice versa.

When a specification consists of several classes, the verification of each class is carried out independently. Supporting invariants, however, may come from outside a class.

In the Secure LAN specification, for example, we included an invariant called *Origination* in the *System* class definition. This invariant asserts that any data object known by a user workstation was created by a user workstation on the network. This rules out, for example, a design where the guards spontaneously create data objects of their own. *Invariants* of the *WorkStation* and *Guard* classes support the *Origination* invariant.

Levels Of Refinement

Verlangen uses successive levels of refinement to support design. That means we can write a Verlangen specification as one or more ordered levels, each a complete specification of the whole system (see Figure 5). The first (or "top") level presents the most abstract view of the system. Each successive level presents a more concrete specification than the preceding one, and includes a map that specifies how it relates to its predecessor. To verify a specification that consists of more than one level, we show that the individual levels

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Verlangen development is an ongoing effort of the skill center.

are self-consistent and that neighboring levels are consistent with each other.

We usually organize a two-level specification where the top level represents a set of requirements placed on the system, and the bottom level represents the system design. This approach ideally allows us to use a set of requirements; e.g., a model of multilevel security, over and over again with different system designs.

The Secure LAN example is a two-level Verlangen specification. The top level specifies a model of multilevel security, and the bottom level specifies the design of the Secure LAN. The Verlangen fragments in Figures 3 and 4 came from the bottom level.

Verification

The Verlangen compiler translates a Verlangen specification into a collection of definitions and theorems in typed first-order logic. The theorems state that classes satisfy their assertions, and neighboring levels are consistent. By proving the theorems from the definitions, we verify that the specified system design satisfies the specified system requirements. Figure 6 shows theorems the Verlangen compiler produced to verify the filter invariant of the *Guard* class.

The translation of a class definition declares a type that has the same name as the class. The type's values represent the states of the state machines that the class represents. The translation also defines a relation *precedes* and a function *next*. *Precedes* defines a partial ordering on values of the type, and next is a successor function that satisfies *precedes (x,next(x))*. When we give *next* a state (in the history of a state machine), *next* yields the next state in the history.

A variable declared within a class definition translates into a state function. Given a state, the function returns the value of the variable for that state. A constant also translates into a state function. An invariant translates into a state predicate. Given a state, the predicate determines whether the state satisfies the invariant. Initial conditions, constraints, and procedures all translate into state predicates. A SYNC statement translates into an axiom stating the equivalence of the state predicates that represent the synchronized procedures. Mappings between levels generally are represented by axioms that relate the entities of one level to another.

Formal Verification At ATL

ATL supports a formal verification skill center at its Software Engineering Laboratory to meet the verification needs of RCA Aerospace and Defense. Verification systems available to the skill center include the Gypsy Verification System and Verlangen.

Verlangen development is an ongoing effort of the skill center. The Verlangen compiler has been implemented in the PASCAL programming language and runs under VAX/VMS. The Verlangen theorem prover comes from the commercially available *Verus* verification system (Compion Corporation, Urbana, Illinois) and runs in the same environment as the compiler. We presently are adding features to the specification language that improve its expressive power and extend the range of properties that can be verified.

Eventually, a translator will be added to the Verlangen toolset that will produce a separate translation from a Verlangen specification into the Department of Defense's Ada programming language code. This code will be a "skeleton" of a software implementation of the specified system. A skeleton is an incomplete implementation; it substitutes assertions (imbedded in formal comments, as in Anna) for omitted code. To obtain a complete implementation that meets the system requirements, a programmer adds Ada code that satisfies the imbedded assertions.

Ada is a registered trademark of the U.S. Department of Defense, Ada Joint Programming Office.

Dr. Dianne E. Britton is a senior member of the engineering staff, and Harry Rosenthal is manager of RCA ATL's Software Engineering Laboratory at RCA/Aerospace and Defense, Moorestown, New Jersey.

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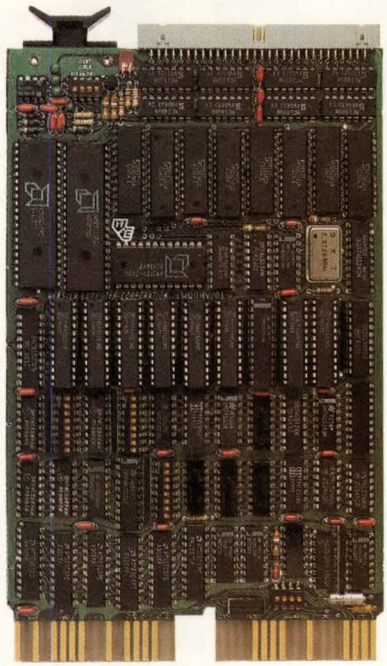

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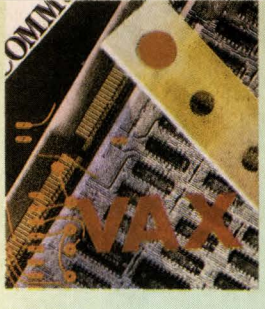

VAX

OLDER IS BETTER

Mid-Life Kickers For Your VAX 750, Part 1.

By Dave Mallery

This is the first in a series on mid-life kickers for the VAX 11/750. In future installments, we'll report on such items as our debugging of a CPU accelerator and the CMI options available for the VAX 11/750. Several third-party vendors recently have unveiled reworks of the 8-MB controller boards and entries into the 4-MB memory array market. We'll be reporting on those, too. Keep watching!

We bought ours — a 750 — about two years ago. The day we had to buy a computer, there were no MICROVAXs to be had other than the MICROVAX I, and that wasn't worth having.

Without a doubt, the 750 is the most reliable DEC machine I've ever owned. In two years of continuous use, this venerable DEC box never has had a service call. Not one! What's wrong with it now has to do with its origin. A brief review:

The VAX 11/750 was cast as a small machine without many upgrade paths. It was severely memory bound. The machine first appeared in the days when 16K chips were new and you needed four boards per megabyte. A 2 MB 750 was a pretty sorry computer to behold! The first big kicker arrived with the availability of 256K memory chips. Driven by the desire to sell lots of replacement memory boards, Digital granted the 750 owner a new memory controller board that allowed a maximum of 8 MB. Our machine came with one of these and runs the full 8 MB. I find that with nearly 20 users and generous WSMAXs, I get close to using it all up. True, I could get more restrictive with the working sets, but then I'd pay a performance penalty — more memory is preferable.

The 750 was designed with a relatively high-speed backplane interconnect called the CMI bus. Three CMI slots are available for high-speed peripheral controllers; the UNIBUS uses a fourth slot. In a sense, like the 780 SBI, these slots are timesharing the backplane. Controllers in one slot do not detract from those in others. A souped-up 750 typically has all its disks and tapes on the CMI slots, leaving the UNIBUS for terminal traffic.

Of course, *DEC PROFESSIONAL*'s 750 has all three CMI slots occupied — two with disk controllers (Systems Industries just updated its 9900s to the high-speed 2.4 MB/second and up), one with an 8-MB disk cache imbedded, and the third with an interface for the STC Avalanche 6250/1600 tape drive.

The UNIBUS is inhabited by whatever terminal interfaces we currently are evaluating and a few other strange and wonderful devices.

What's right about the 750 then, is that it's a nice mid-scale machine with enough hooks to support some hefty peripherals. It's also blessed with extraordinary reliability because it's a bit "newer" than the venerable 780.

A memory upgrade option appeared recently, with no hoopla, in the *DECdirect* add-on and upgrade catalog. It's called the MS750-HB and consists of three boards: a new memory controller board and two 4-MB add-in boards (see Photos 1 and 2). When you install these in an 8-MB 750, you get a 14-MB 750 and two 1-MB spares, plus an old-model memory controller which you can give to your

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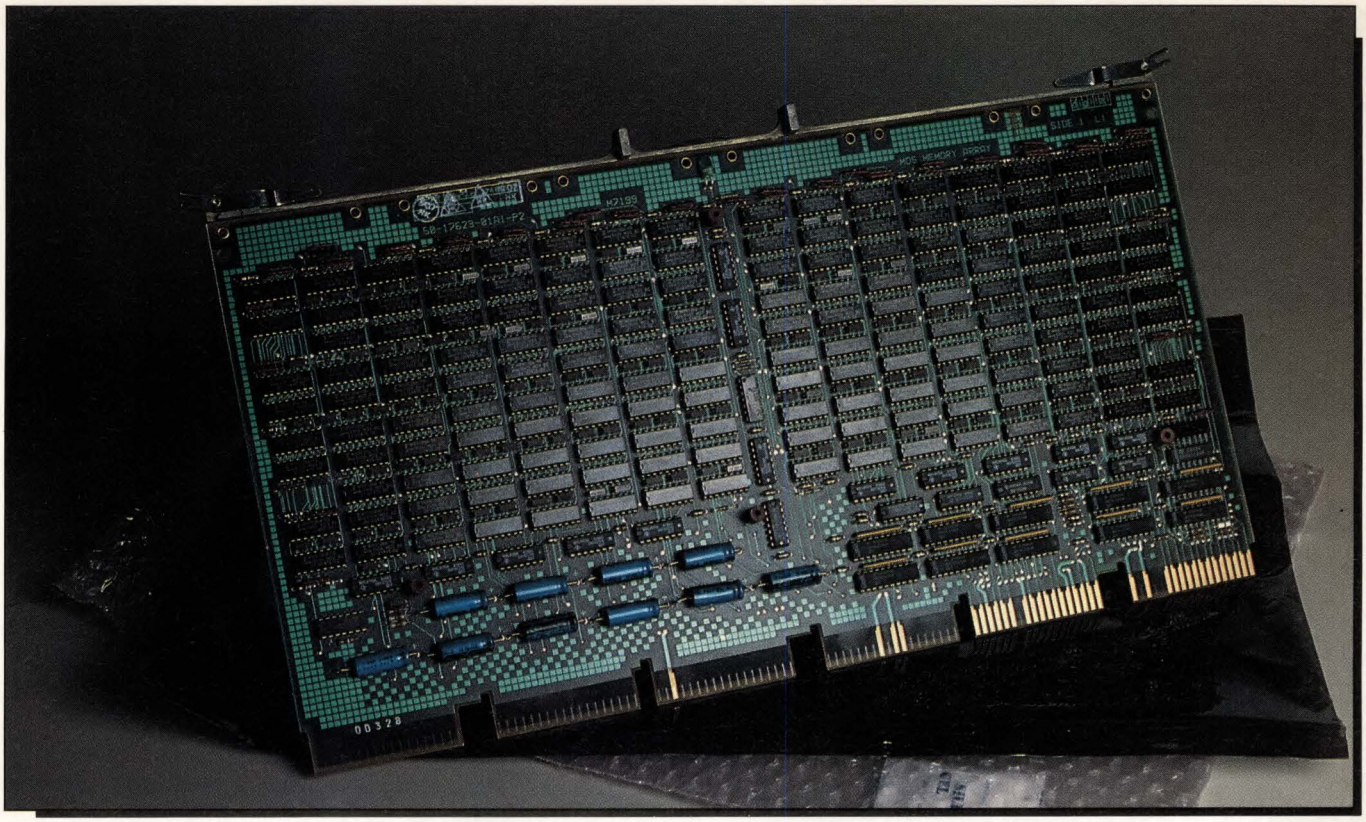
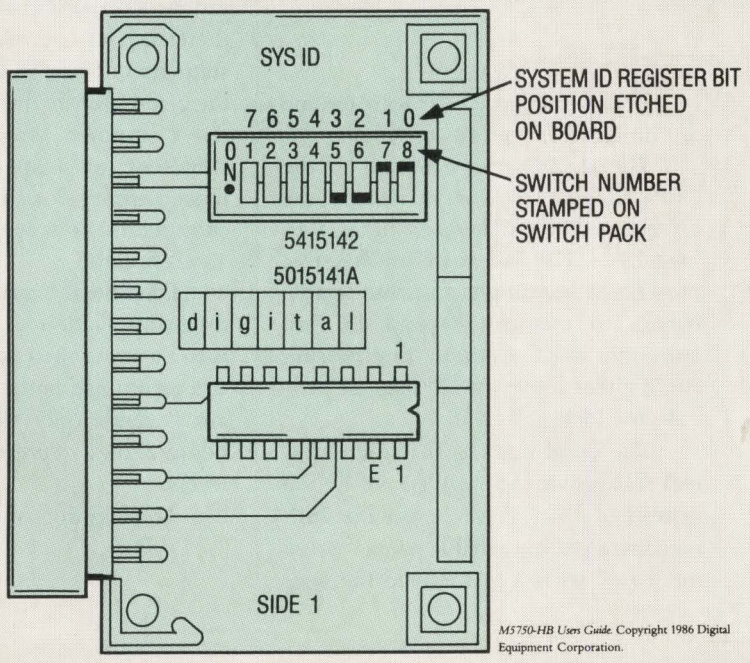


One of two 4-MB add-in memory boards from DEC's MS750-HB VAX memory upgrade option.

FIGURE 1.



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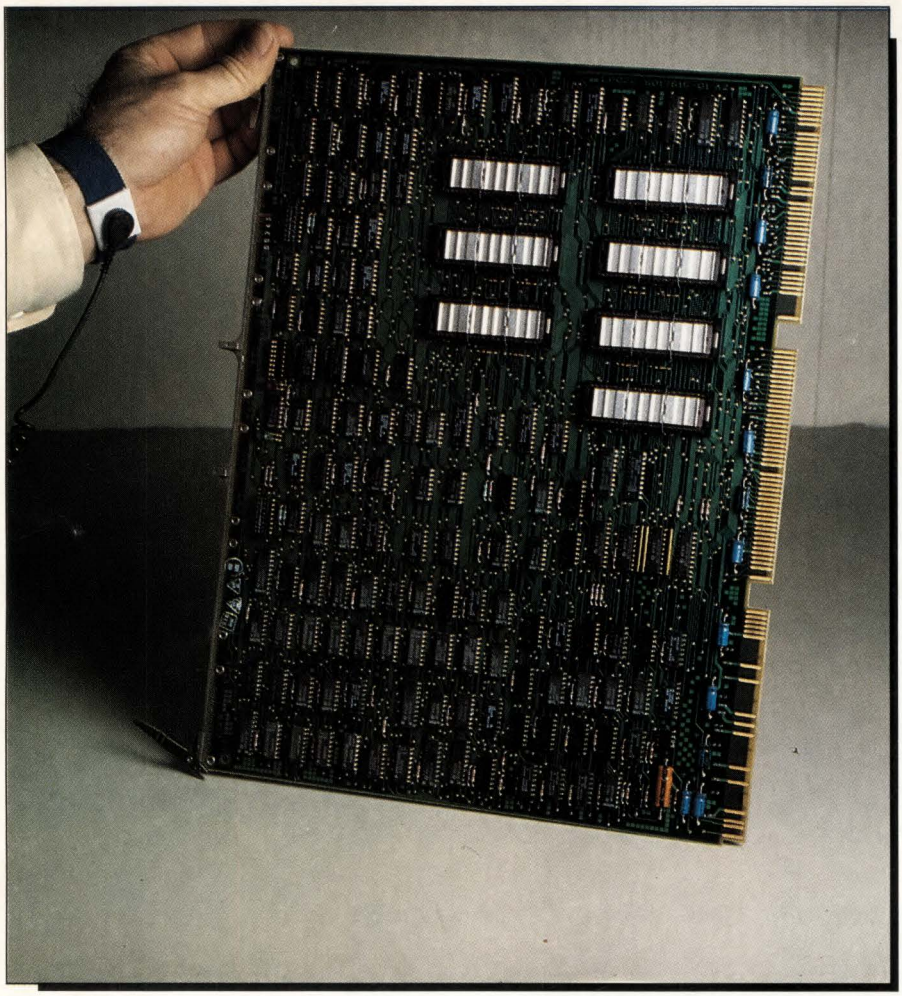
The SID Switch Pack Module.



The memory controller board from the MS750-HB memory upgrade option.

grandchildren. The prerequisites for installation are a C-level backplane, VMS 4.4, remote diagnostics and current diagnostics (BE-FI26A-DE). Note: To see if you have a C-level backplane, look at the System Identification Register from ODT:

```
>>>E/I 3E (inspect mem loc 3E)
```

response:

```
I       0000003E      02005FX8

02 = cpu type (750)
00 = must be zero
5F = Control store revision (5F = 95)
X8 = X is cpu revision, 8 means rev C
     backplane
```

If you don't have a C backplane and are on service, you can order one.

The absolute upperbound of the 750's address space is created by the presence of the CMI I/O page in the 16th megabyte. The sad truth is that this presents a seemingly insurmountable barrier to memory beyond 15 MB, although DEC Central Engineering could either move the I/O page or provide for locking it out.

The good news is that there's no real reason why you can't have 15 MB instead of 14. (I haven't run the 15th megabyte yet, but reliable people assure me it will work.) Just extend the wire wrap over one more slot on the backplane, acquire a third 4-MB card and leave only three of your 1-MB cards in place after the upgrade. You should be able to get a third card from spares. What you're not supposed to be able to do is set foot in that 16th megabyte.

Installation

The installation of the upgrade is quite simple. Apply two (or three if you want 15 MB) wire wraps to your backplane. Now, remove the right-most memory boards and the controller, and replace them with the two or three boards in the upgrade. These wires simply carry the extra address bit to the memory arrays. They use pins on the backplane that aren't used by the previous memory controller and, therefore, don't have to be removed if you remove the upgrade.

After you put in the wire wraps, you have to update the System ID (SID) switch pack. This is a dip switch that lives on a little card attached to the rear of the backplane. Make sure you note exactly where it's located so you can put it back correctly! (See Figure 1.)

This memory upgrade is reflected in the SID register by changing the last nibble to "C" (3 = OFF, 2 = OFF, 1 = ON, 0 = ON). Ignore the switch numbers on the dip and use the ones on the etch. Get out your wrist strap and static mat (if you're a purist) and swap the cards. Donate the megabyte cards to the Computer Museum. There now should be two 4-MB cards in the right-most memory slots. The rest of the slots should hold your remaining (up to six) 1-MB boards.

DEC Field Service will be glad to do the installation for you if the product is to be under their aegis. The diagnostics mentioned in the installation guide are available only from Field Service, because they represent the latest rev levels.

The addition of these extra mega-

bytes to a heavily loaded machine should be a godsend. Remember to increase the WSMAX parameters on selected users so that they will grow into the newly available space. The greatest improvements, of course, will be seen by installations that were causing swapping to occur by restricting the working set size. These installations can relieve the situation and greatly unburden their machines with these extra megabytes.

Don't forget to check the SYSGEN parameter, PHYSICALPAGES, which specifies the maximum physical memory allowed in your machine. And make sure it's at least 28,672 pages; otherwise, your machine will never use them. The command SHOW MEMORY tells all when you come up.

War Story

Our installation was quite problematic. A typo in the prerelease documentation gave the incorrect pins for the wire wrap. Even when this was corrected, we couldn't boot. The problem turned out to be a boot cartridge that didn't contain the V4.4 VMB I thought was there, but rather a previous version that knew nothing of the upgrade. (Version 4.4 is the first VMS release to support the new controller. We're now running it under 4.5.) This paragraph, therefore, is being written on a 14-MB 11/750. We never did run the diagnostics — the machine just came up under V4.5 and all was well!

The first thing I noticed was that a bit more memory was shown as permanently allocated to VMS with the SHOW MEMORY command. Also, the presence of the extra megabytes seems to have a global effect on the system, because the total use is now sliding *over* 8 MB with exactly the same load as before. Some constraints imposed by the 8-MB ceiling no longer are there.

Postscript

Its two weeks later and there have been absolutely no memory errors or any other event even remotely attributable to the memory. It seems to be a stable, solid addition to a fine machine! ■

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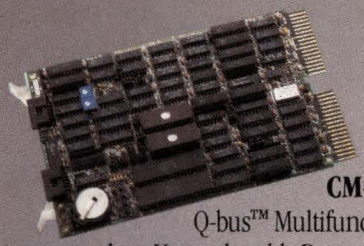

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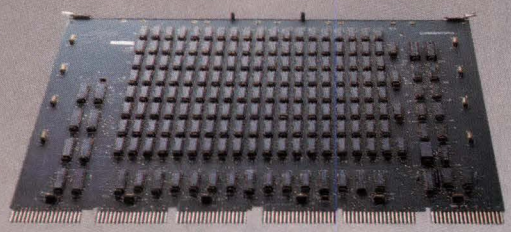

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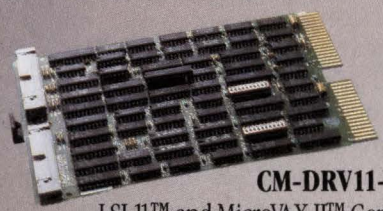

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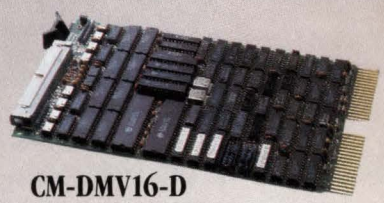

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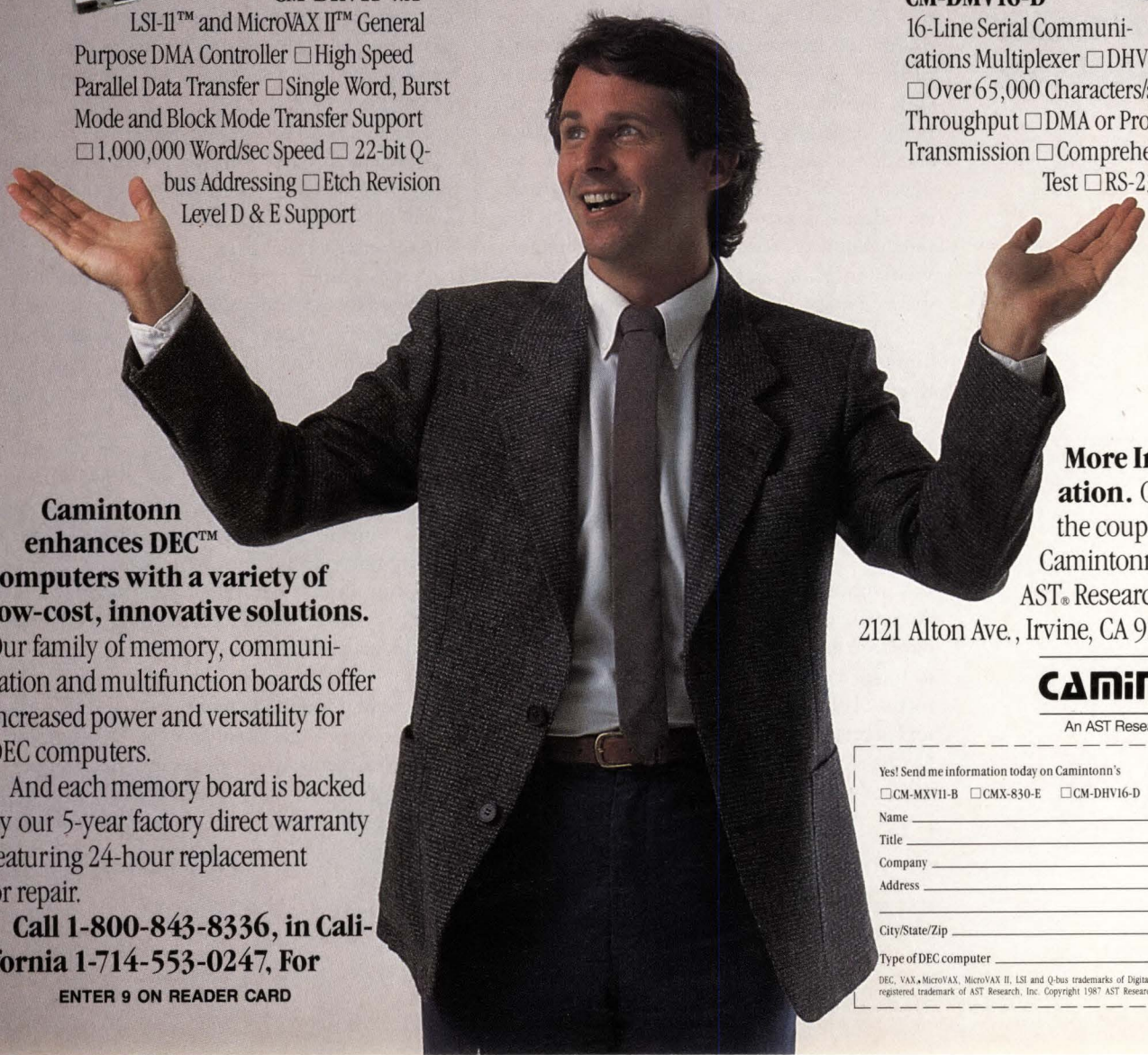

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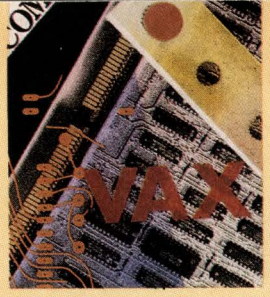

VAX

DEC's VAXset TOOLS

By Charles Connell

Shaving Time Off The VAX/VMS Software Development Cycle.

One reason the VAX line of computers and the VMS operating system have sold well is because they form an excellent software development environment.

DEC has realized that the nature of programming has changed. "Software development" no longer means hacking out machine code during the wee hours of the morning and being dependent on one guru who understands it all. Instead, modern software development requires such things as written specifications, project teams, progress reports, intelligent text editors, source level debuggers, verifiable testing and performance monitors to name a few.

DEC sells a set of programming tools known as "VAXset," which works in conjunction with the VAX/VMS languages. VAXset gives programmers a number of ways to address these software development changes and speed up the software development cycle. The tools in VAXset can be used separately or in combination, and include:

1. Language Sensitive Editor

An intelligent text editor designed for program development, Language Sensitive Editor (LSE), is formed around a full-screen editor with many of the features found in other modern text editors, including file import/export, macro key definitions and multiple editing windows.

There are many fancy text editors around these days. What distinguishes LSE is its knowledge of programming languages and its hooks to the VMS compilers. When you begin editing a file with LSE, it looks at the extension on the filename to determine the programming language you're using. In the editing session, LSE then helps you write appropriate syntax for the language by providing templates for easy-to-forget constructs. A single keystroke, for instance, expands to the proper DO-WHILE statement, another to the CASE statement and a third to the IF-THEN-ELSE construct.

LSE comes with syntax templates for most of the VAX programming languages, and the ability to modify and add templates. The language to which LSE is sensitive can be selected manually as well, if the file extension does not give it away.

After a program is written, you can call the compiler from within LSE (it knows which compiler to use). If there are any errors, LSE takes you to each one and displays the appropriate compilation error message. After the program has compiled, you can spawn a subprocess to link and run it, then return to LSE to make changes.

2. Source Code Analyzer

The Source Code Analyzer (SCA) provides static program analysis of symbol declaration and usage. The symbols covered include constants, types, variables, files, subroutines and functions.

A CMS library holds the master copy of every file . . .

SCA provides some of the analysis that compilers and linkers routinely perform but keep to themselves. You use SCA by asking queries about the set of source files that make up a software system. Questions that SCA can answer about a program include:

1. Where is the parameter LAST_NAME_LENGTH declared?
2. Where is the global variable OUTPUT_DEVICE declared?
3. What are all the lines in any source file that reference the variable ACCOUNT_NUMBER?
4. What are all the lines in any source file that write to the variable ACCOUNT_NUMBER?
5. Which subroutines use the include file CUSTOMER_LIST.DAT?

In addition to this standard lexical analysis, SCA provides some special features related to subprogram declaration and use. The two most significant are calling sequence verification and call list construction.

The VMS linker links any subprogram to a call for that name, even if the declaration and reference have different calling sequences. SCA can check an entire set of source files to be sure that each subprogram declaration and its calls take the same number of parameters with the same data types. If the subprogram is a function, SCA can check the type of the return too. SCA also will construct a call list (what calls what) for an entire program by reading the source files — a task that can take hours when done by hand.

3. Code Management System

The Code Management System (CMS) is a file librarian that stores and organizes source code.

CMS centers around a set of directories that you set up to hold your project's source code and, if you wish, documentation. Once created, these directories are maintained by CMS as the project libraries. You use CMS commands to move files into the libraries, obtain copies of files, request editing privileges on a file, and return a file to its library after editing. In exchange for allowing CMS to control the project libraries, you receive a great deal of organization.

A CMS library holds the master copy of every file, so you never lose any files (a common problem when many

programmers work on one project). Also, since all requests for copies of a file go through CMS, two users never will accidentally make changes to a program simultaneously — the second person always is told that someone else is working on the file. One of the best aspects of CMS, however, is that it saves every file at every stage of development.

When a programmer requests an editing copy of a file from a library, CMS notes the state of the file at that time. When the programmer returns the updated copy to the library, CMS makes a note of the difference between the old and new versions. During the next file update the same process occurs. As a result, a project member can request the latest copy of a file or any previous version at any time. This allows bad bug fixes to be rolled back and customers with old software to be supported (you always have the old source code).

Finally, CMS provides excellent reporting capabilities. You can find virtually anything you'd like to know about a project, including who worked on a file during its history and what changes they made, who is currently editing any file, how long it took to develop each module, and exactly which version of each source went into a certain release.

4. Module Management System

Module Management System (MMS) is a tool for building and maintaining executable program images.

MMS starts when the programming for a project is finished or nearly finished. Just as CMS centers around a set of project libraries, MMS revolves around a description of the executable image you'd like to build. The description states the names of the source files that will be compiled, the names of their resulting object files, how to link the object files together, any object libraries that will be used during the link, and any compilation or link qualifiers you'd like to use. The description is stored in a standard ASCII file and is written using the MMS syntax for describing program images.

Testing often is one of the most hated phases of software development.

Once written, a description provides several benefits. Primarily, it removes the chance of error when compiling and linking a program. A project with hundreds of source files and multiple programming languages can be difficult to build correctly. The complexity is increased if the building process uses text and object libraries, special command qualifiers, and link options. MMS always reproduces the same program image, given the same description file.

MMS also performs intelligent incremental builds. After a set of source files has been compiled and linked into a program, it's common for a few of the source files to be edited and the program rebuilt. In this case, MMS recompiles only the source files that have changed since the last build, then relinks the object files. If an include file changes, MMS likewise recompiles only the source files that use the include file. This kind of incremental building can save hours of computer time during a software project.

5. DEC Test Manager

The DEC Test Manager (DTM) is a tool for storing, organizing and running software regression tests.

Testing often is one of the most hated phases of software development. It can take mind-numbing hours of typing on a terminal, looking for infrequent bugs that may be difficult to reproduce once found. DTM removes much of this tedium by running regression tests in batch and by searching test output for errors.

You begin using DTM by defining a set of tests for a piece of software. You

PCA often is used to analyze a complex sequence of events, usually designed to simulate a customer's worst-case scenario.

write command procedures that run each test and provide the tests' input, then, enter the tests into a DTM test library. Next, direct DTM to run each test to establish benchmark output, directing this output to the library as well. (Defining screen-oriented interactive tests is nearly identical, except that you ask DTM to create a test script for you by recording one of your interactive sessions.) Note that throughout the test definitions, DTM assumes your software is running correctly and gives the right output for each test.

Once you enter a set of tests and their benchmarks to a test library, you can run and check them at any time with little supervision. Here's how it works: Suppose you recently have added several new features to a compiler your company sells. You want to know if any new features introduce bugs to old functions (has the program regressed?). With a few commands, DTM will run every test you've defined for the compiler, compare each result with its benchmark and save those results that vary from their benchmarks. By running the tests at night (a common approach), you can arrive in the morning and inspect only the tests that failed.

6. Performance And Coverage Analyzer

The Performance and Coverage Analyzer (PCA) provides a way to look inside a program as it runs, gather data about the program's performance and analyze it in a number of ways.

When you're developing software, it's common to be unhappy with a program's initial performance. Response to the user's terminal commands may be slow, or large volumes of file I/O may take too long, or the program just may be slow in general. It's often hard to isolate the cause of the performance problem though, because VMS gives only course data about a program's internal functioning.

PCA gives all the internal run-time data about a program that you've ever dreamed of, and you use it in several steps. First, compile each program module with the DEBUG qualifier so the object file contains source code information. Second, link all the object files into a PCA-runable image, similar to creating a DEBUG image. Then, invoke PCA and specify the kind of data you'd like to collect about the program you're analyzing: CPU usage, counts of subroutine calls, I/O data, system service usage, etc. Next, run your program. PCA collects the data you requested.

When the program finishes, use PCA again to analyze the data gathered during run time. You can find the lines of code that consumed the most CPU time, display counts of subroutine calls (to determine the most critical modules), or see which part of the program performed the most I/O, etc. The analysis makes it easy to see the location of performance bottlenecks. Those areas then are candidates for rewriting and optimization.

Using The Tools Together

The tools in VAXset were developed as separate products — some appeared several years ago, some just recently. DEC, however, has made an effort to integrate them. Almost any of the tools can be used with any of the others, but some combinations are more natural:

LSE/SCA. Because SCA searches for objects in a program, you'll usually want to see, and possibly edit, the objects once you find them. The most natural way is from a text editor. With this goal in mind, LSE and SCA are highly integrated. Any SCA command can be given from LSE, and multiple SCA queries can occupy multiple LSE windows. A common example is when you're editing a subroutine and find that you must change its calling sequence. You can use a second LSE window and an SCA search command to find and edit all places where the subroutine is called.

CMS/MMS. An MMS description file easily can be told that the source code for a program is stored in one or more CMS libraries. When used in this way, MMS adds another step to its process. Instead of working with source code that it finds in the user's directory, MMS goes out to the appropriate CMS libraries and fetches the source files first. You can run MMS in an empty directory. It will build a program completely from scratch, fetching the code from CMS libraries and then compiling and linking it.

It also is possible to write a description file that builds any particular release version of a program. MMS can use this description to build the latest version for

which the library has source code, or to retrieve the source code as it was a year ago and build that release level.

DTM/PCA. This rather interesting combination has two payoffs. Suppose you have a set of tests that you run on each release of your software product. It would be nice to know if the tests, taken as a whole, exercise all the code paths in your program, because an untested code path can contain a hidden bug. PCA can do this by analyzing an entire set of DTM tests, and reporting any lines of code not executed by any test.

This partnership between DTM and PCA also works in reverse. PCA often is used to analyze a complex sequence of events, usually designed to simulate a customer's worst-case scenario. These test scripts can be difficult to remember exactly. DTM can be used to hold and execute all the test scripts you use when analyzing your program with PCA. This eliminates any error in reproducing a script and makes it easy to rerun them all.

I've used several of the VAXset tools on a number of software development projects. If your programming projects are of significant size (more than one programmer over more than a few months), VAXset tools are worth their price. Every tool isn't applicable to every project — some programs don't need performance improvement, for instance. Most projects, however, could use a few of the tools. If they can prevent a couple of lost source files or speed up one part of the programming process, you could save thousands of dollars. ■

VAXset
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SECURITY

THE ART OF ENCRYPTION

By Layton Galbraith

A Simple But Effective Encrypter/Decrypter Program.

The art of encryption is steeped in mysticism and black magic. Most of us imagine the beady-eyed cryptographer carrying a briefcase full of secret papers in one hand, and a slew of mathematical treatises in the other. Off in the shadows we see an FBI agent protecting the important scientist from foreign agents. If, perchance, you happened to talk to this mystic, you'd notice his speech to be as cryptic as the documents he carries.

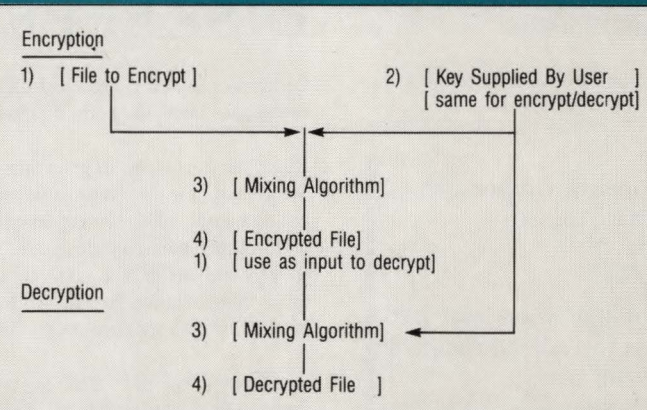
Program 1 shows a simple algorithm to encrypt and decrypt text files like those produced by EDT. You can enhance the program to pick up and save file attributes as part of the encryption, so that on decryption the output file would be recreated with the original file attributes and file contents. Thus, ISAMs, .EXEs, libraries, and even backup save sets can be handled properly. I'll stick with the good old variable length text files, however, and let you deal with the fun challenges.

One word of caution. The program isn't meant to create encryptions to thwart professional code breakers, but should provide a measure of in-house protection for sensitive files. A block diagram outlines the simplicity of the program (see Figure 1).

Four elements form the encrypter or decrypter: an *input file*, a *key*, a *mixing algorithm* and an *output file*. Most of us understand the input and output file. The key, though, is supplied at program execution time and can be anything the user wishes — his name, telephone number or the contents of an entire file, for instance. In this particular algorithm, the key must be the same for the decryption as it was for the encryption. The program at run time will query for the names of the input and output files, and for a key.

The mixing algorithm is the heart of the program and is neither mysterious nor black

FIGURE 1.



PROGRAM 1.

```
      OPTIONS / NOCHECK
!-----------------------------------------------------!
! PROGRAM NAME  :  SIMPLE.FOR                         !
! AUTHOR        :  LAYTON GALBRAITH                   !
!                                                     !
! LANGUAGE      :  VAX FORTRAN V4.5, VMS 4.4          !
! Special       :  COMPILE:  $FORTRAN/NOCHECK SIMPLE  !
!                                                     !
!-----------------------------------------------------!
! DESCRIPTION   :  Program asks for an input filename,!
!                  an output filename and a key.      !
!                  If the input file is encrypted, then!
!                  the output file is decrypted.      !
!                  If the input file is decrypted, then!
!                  the output file is encrypted.      !
!                  Any file type can be encrypted, but!
!                  presently the decryption always will!
!                  be a variable length file.         !
!                  The contents will be OK, but       !
!                  the file attributes may be wrong.  !
!                  This would be devastating on an ISAM,!
!                  for example.                       !
!                                                     !
!-----------------------------------------------------!
! OPERATION                                           !
!       COMPILE :  FOR/NOCHECK SIMPLE                 !
!       LINK    :  LINK SIMPLE                        !
!       RUN     :  RUN SIMPLE                         !
!-----------------------------------------------------!
      CHARACTER*100 IN_FILE, OUT_FILE
      CHARACTER*65000 H_IN
      INTEGER*4 H_IN_I4 (16250)
      EQUIVALENCE ( H_IN, H_IN_I4 )
      CHARACTER*65000 H_OUT
      INTEGER*4 H_OUT_I4 (16250)
      EQUIVALENCE ( H_OUT, H_OUT_I4 )
      CHARACTER*512 KEY
      BYTE KEY_B (512)
      INTEGER*4 KEY_I4(128)
      EQUIVALENCE ( KEY, KEY_I4, KEY_B )
!----------------------!
! BEGIN EXECUTION      !
!----------------------!
      WRITE(6,100)
100   FORMAT ( ' ', A, $ )
      WRITE(6,100) '-------------------------------------'
      WRITE(6,100) 'SIMPLE.FOR  -- ENCRYPTER / DECRYPTER'
      WRITE(6,100) '-------------------------------------'
!----------------------!
! GET INPUT FILE NAME  !
!----------------------!
      WRITE(6,100) 'INPUT FILE: '
      READ (5,200) L, IN_FILE(1:L)
200   FORMAT ( Q, A )
      OPEN ( UNIT=1, TYPE='OLD', NAME=IN_FILE(1:L), READONLY )
!----------------------!
! GET OUTPUT FILE NAME !
!----------------------!
      WRITE(6,100) 'OUTPUT FILE: '
      READ (5,200) L, OUT_FILE(1:L)
      OPEN ( UNIT=2, TYPE='NEW', NAME=OUT_FILE(1:L),
     X         CARRIAGECONTROL='LIST', RECL=30000 )
!--------------!
! GET THE KEY  !
!--------------!
      KEY = ' '
      WRITE ( 6,100 ) 'ENTER KEY: '
      READ ( 5, 200 ) L, KEY(1:L)
!-------------------------------------!
! 1:  PROPOGATE KEYS ACCROSS 512 BYTES !
! 2:  DON'T LET ANY KEY BE '00'X       !
!-------------------------------------!
      IF ( L .LT. 512 ) THEN
        J = 0
        DO I = L+1, 512
          J = J + 1
          IF ( KEY_B(J) .EQ. 0 ) KEY_B(J) = I
          KEY_B(I) = KEY_B(J) + J
        ENDDO
      ENDIF
!----------------------!
! MASSAGE THE KEYS     !
!----------------------!
      DO I=1, 128
       CALL RND01 ( KEY_I4(I), I_RESULT )
      ENDDO
      IP = 0
!------------------------------!
! 1:  DO ENCRYPT OR DECRYPT    !
! 2:  REVOLVE ON THE KEYS      !
! 3:  GENERATE RUNNING KEYS    !
!------------------------------!
400   READ ( 1, 200, END=1000 ) L, H_IN(1:L)
      IF ( L .LE. 0 ) THEN
        WRITE( 2, 500 )
500     FORMAT ( A )
        GOTO 400
      ENDIF
      N = 0
      I_END = L + 4
      DO I=1, I_END, 4
        IP = IP + 1
        IF ( IP .GT. 128 ) IP = 1
        CALL RND01 ( KEY_I4(IP), I_RESULT )
        N = N + 1
        H_OUT_I4(N) = H_IN_I4(N) .XOR. I_RESULT
      ENDDO
      WRITE(2,500) H_OUT(1:L)
      GOTO 400
!-------!
! EOF   !
!-------!
1000  WRITE(6,*)
      WRITE(6,*) '------------------------'
      WRITE(6,*) 'Normal EOF on input file'
      WRITE(6,*) '------------------------'
      CALL EXIT
      END
C-----------------------------------------------
      OPTIONS / NOCHECK
      SUBROUTINE RND01 ( IN_KEY, I_RESULT )
!-------------------------------------------!
! Simple Simon random number generator.     !
! User needs to substitute his own.         !
!-------------------------------------------!
      REAL*4 R4
      INTEGER*4 I4
      BYTE B4(4)
      EQUIVALENCE ( I4, B4, R4 )
      INTEGER*4 K2/3298755/, K3/9873199/, K4/0/
!------------------------------!
! OK, lets do the random number !
! Generate 4 bytes             !
!------------------------------!
      K4 = K4 + 1
      K1    = IN_KEY * K2 + K3
      B4(1) = K1
      K1    = K1 * K2 + K4
      B4(2) = K1
      K1    = K1 * K2
      B4(3) = K1
      K1    = K1 * K2 + K4 + 1
      B4(4) = K1
!------------------------------!
! Load I_RESULT and IN_KEY     !
!------------------------------!
      I_RESULT = I4
      IN_KEY   = I4
      RETURN
      END
```

magic. When you understand it you can make it as complex as you desire.

1. Let X be the original data from the input file.
2. Let Y be the key or a derivative of it.
3. Let .xor. be the function "exclusive-or".
4. Let Z be the encrypted output file.
5. Then Z = X .xor. Y

Reiterating, we take the data from the input file, exclusive-or the key on it and write out the result to a file. It so happens that if X is the file to be encrypted, then Z is the encryption, and if X is the file to be decrypted, then Z is the decryption.

This kind of encrypter, unlike simple substitution of one character for another, doesn't encrypt a given character to a given set of bits. The letter A, for example, could go to any 8-bit code on encryption. Even with this, however, there are other problems. One occurs when the user enters all binary zeros as a key. The output text is identical to the input text; i.e., not encrypted at all. Another problem occurs when the key consists of the same characters. In this case, every input character is shifted by the same amount to a new bit configuration. A, for example, would always encode to the same output.

Use of a random number generator eliminates these problems. The user's input key seeds the random number generator whose output will be used in the mixer. Other possibilities include a set of random number generators where the user specifies the sequence.

One of the main problems of a software encrypter versus a hardware encrypter is that the software version is changed easily. This can have terrible consequences for all the files encrypted by the old version; i.e., they can't be decrypted by the new version. There are other problems with the algorithm, but the purpose of this article is to show a simple encrypter.

Layton Galbraith is a VAX system manager for Signetics Corporation in Albuquerque, New Mexico.

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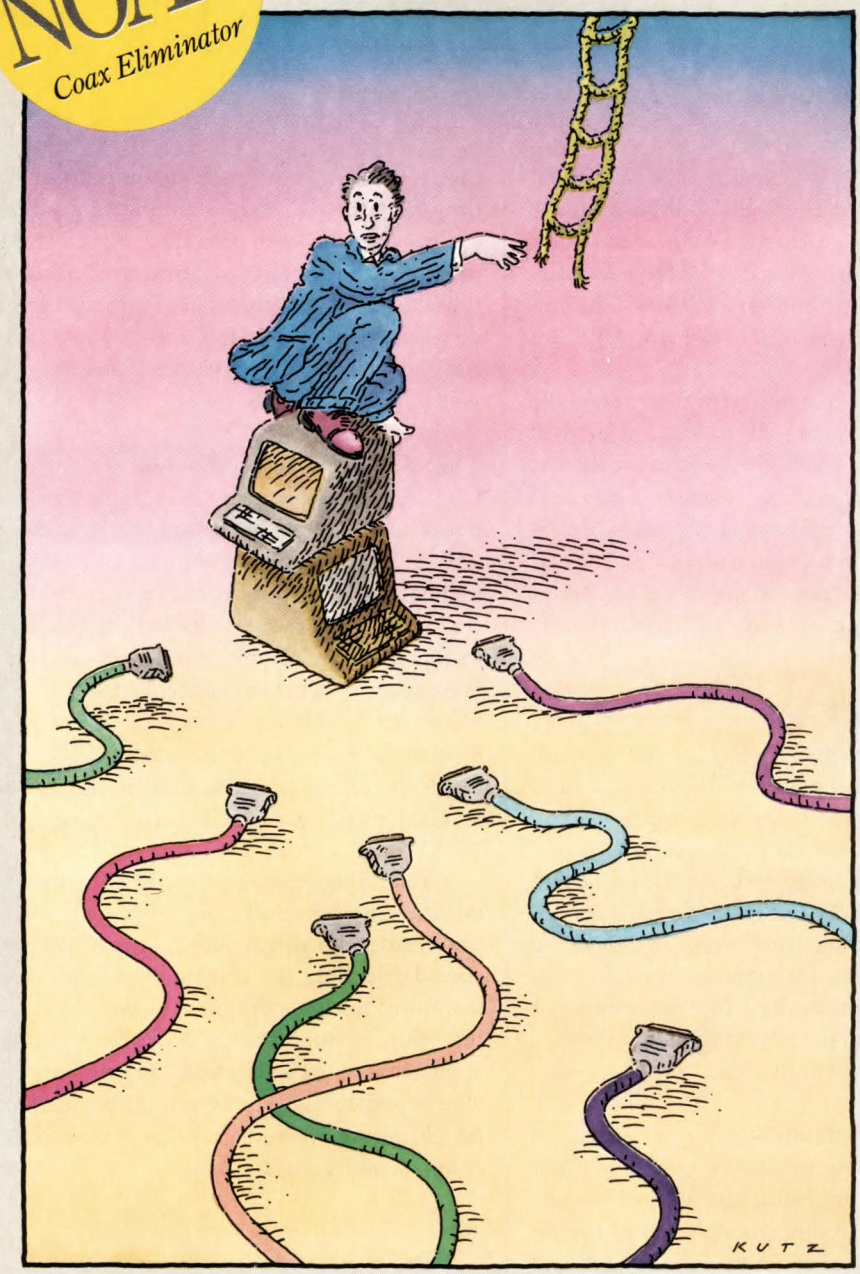

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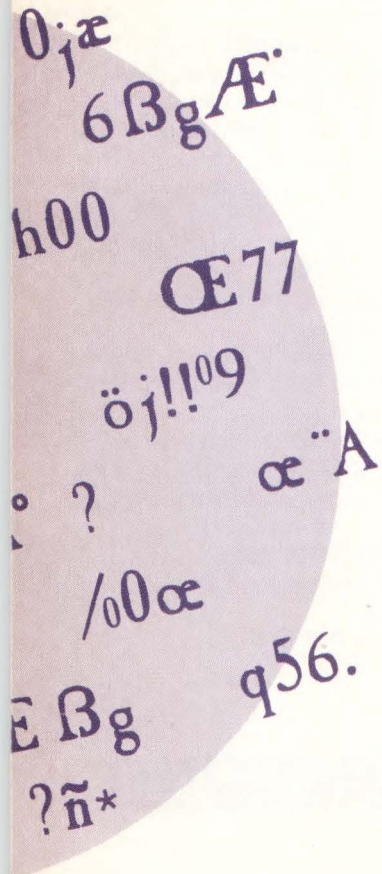
SECURITY

SECURE YOUR SYSTEM !

By Philip A. Naecker

Six Steps To Safety.



Nearly one-half of all medium-sized companies that suffered destruction of their computer facilities (because of natural and manmade disasters) were out of business within two years. Do you really want to play "Bet Your Company"?

Depending on your environment and the criticalness of your applications, your site will require some level of physical security. Without physical security, all the software protection in the world won't prevent a determined hacker from gaining access to your system. Here are a few of the more important steps you can take to make your system more secure:

1. Identify the Threat

Before you develop a plan for the physical security of a computer installation you need to understand the threat you are protecting against. By threat, we mean not only the source of the damage, but also the scope and implications. For example, even if you are operating in a site with very little hacking (a small company, for example) you may be at great risk from damage to your computer system based on the impact that downtime or loss of data would have on corporate operations.

Take a few minutes (right now!) and jot down a quick summary of your computer facilities and equipment. List things like your main computer room, remote terminal rooms, PCs, modems and communications lines, and your tape storage vault. Each of these is vulnerable to a different kind of physical threat: PCs can be stolen, tape vaults can catch fire or be flooded, and communications lines can be tampered with or tapped. Now list the probable and worst-case impact of each of those threats. (You don't have to go into great detail. If your site is like most, you'll find enough threats in the first ten items to keep you busy for months.)

2. Keep the Doors Locked

It's surprising how many sites don't lock the doors to the computer room, or lock them only at night. Besides the threat of environmental contamination from extra user traffic, there is also the risk of a hacker using access to the hardware to open a hole in your software security. There are dozens of ways for a hacker to do this:

- Gain access to the system console.
- Swap communications lines or media.
- Gain access to a privileged terminal.

You should keep the doors to all computer facilities locked at all times. If you have to grant access to the facility to many people, consider locking the surrounding work area instead of just the computer room, and leaving the room itself unlocked. Another approach is to use an electronic key system that allows you to easily lock out all but certain people during off-hours, and keeps track of all comings and goings.

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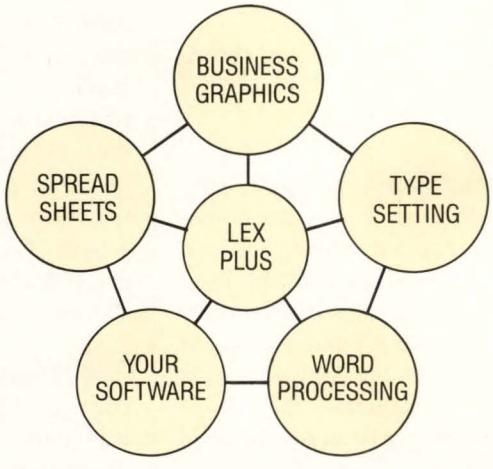

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Your communications closets are another hacker's playground. If you depend on recognizing terminal lines, say, to make sure only users in the Personnel Department can access salary information, it's a pretty simple switch for someone with even moderate knowledge to connect the Personnel terminal to his own office. There are also the more sophisticated operations, like tapping lines and grabbing passwords, or simply watching data go by.

3. Protect Your Media

In addition to locking the doors to the computer room you also must make sure the tape vault stays locked at all times. One of the easiest ways to get access to protected data is through the backup media. Even if you implement software security that prevents a non-privileged user from accessing protected media, someone always can take it to another site where he has adequate privileges. And of course there is the threat of a worm being inserted in backup media, waiting for a backup restoration to hatch.

Be sure that you erase any scratch media given to users to avoid data scavenging.

4. Protect Your Dialups

Dialup modems are an obvious potential entry point for outside hackers. There are many things you can do to limit your risk from a hacker randomly dialing your modem's phone number and then somehow breaking your software security, including the use of callback systems, password protected modems and terminal lines, and the like.

But the most frequent source of security compromise through dialup isn't as complicated — many sites have simple problems with modem hangup. If the modem does not properly signal a hangup to the host, the next person who dials in is likely to be connected to the previous user's session. If that previous user has access to sensitive information or privileges, you've compromised your system security, C2 rating or no.

You also should consider changing your dialup phone numbers periodically. If a hacker has discovered your system and is waiting for a chink in the software armor to develop (like a new operating system release opening a previously closed hole), a simple step like changing your phone number can make sure your computer is not at home when the hacker comes knocking. This step also helps in the case where the intruder is a former employee or a guest you once let use your system.

5. Theft

Now that everyone has a computer system, there's a serious black market for all sorts of computer equipment. Obvious targets are PCs, terminals and printers. Most of the many locking systems that are widely available will do an adequate job of deterring most theft of these items.

A less obvious problem is theft of parts, spares and media. There have been cases reported by the FBI where a thief entered universities and actually removed boards from CPUs, which he then sold at vastly reduced prices in the used equipment market. Obviously, spares are also at risk for this sort of activity. So, if you're concerned with protecting your data, be sure you have all your media under lock and key.

6. Disaster Protection

All the software security in the world isn't going to help you when a natural disaster strikes. If your site is destroyed by fire, it doesn't matter whether you've changed your passwords recently — what matters is the quality of your disaster planning.

Do you have a disaster plan? Written down and audited by a consultant who specializes in such things? Does everyone know what it is? There are two parts to a disaster plan—the part that tells you what to do *before* the disaster strikes and the part that tells you what to do *after* the disaster strikes. If you haven't done the first part, the second part will be easy: In case of disaster, leave town and look for another job.

There are three major parts to successful recovery from a disaster. First, you must recover your data. Generally, that means you've had a great backup procedure in place and your data is safe in a highly secure offside vault. If you're lucky you didn't lose your on-site tape vault and you can get all your data back, right up to and including last night's backup.

Second, you have to get access to some processing capacity while your own system is down. See if you can work out an agreement with a similar site nearby. Each side can agree to provide up to one-half of all available computer resources to the other should a disaster strike. (My advice is that if you don't have a disaster plan yet, you shouldn't be concerned with what will happen if a disaster wipes out the other site too. That's covered in the advanced course.) If you are heavily dependent on communications lines, check with the carrier about the practicality of emergency reconnection to the other site. If it's not practical, perhaps you should look for a site closer or arrange for some backup communications to the other site.

Of course, you don't want to permanently move into the site you are sharing. Have a plan for rebuilding your own facilities and assign your best hardware person to that task. Depending on the disaster that has befallen you, you may have to build at another location as you await reconstruction and repair of your original quarters. A detailed description of your existing configuration (kept up-to-date, of course) will help in dealing with the insurance company and in locating replacement hardware. ■

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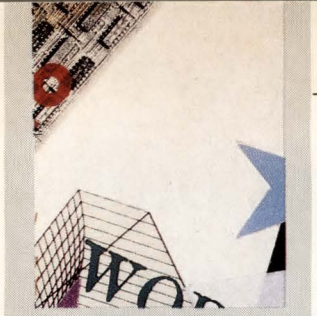


GRAPHICS

DESIGNER GRAPHICS

By David Goldstein

RENDER and MGSP — Two Names You'll Love To Have 'Stitched' On Your Screens.

Graphics is one of the hottest topics in the computer field today. Among the most notable software entries are two products from Multiware, Inc., Davis, California — *RENDER*, a business oriented graphing program, and the *Multiware Graphics Subroutine Package* (*MGSP*), a collection of *RENDER*'s FORTRAN-callable subroutines. Both are sophisticated tools for delving into this burgeoning area, and support a wide variety of configurations. They are highly portable and run under most PDP-11 and VAX operating systems, including RT-11, RSX-11, RSX-11M-PLUS, TSX-PLUS and VMS. The items overlap somewhat, but each is a powerful, dedicated piece of software in its own right.

The documentation lists almost fifty different output devices for the packages, including terminals, plotters and laser printers (although the latter requires special preparation.) The available support and documentation for the products are good enough to allow easy use on a variety of configurations.

MGSP IS A SERIES of two-dimensional FORTRAN subroutines for use in combination with driver programs. These programs, with their accompanying parameters, cover a wide range of topics and perform functions such as defining graph coordinates, creating and displaying polygons and manipulating text graphically. Interfacing the subroutines to FORTRAN programs is simple, and for other languages it's necessary only to observe standard parameter passing conventions (see Examples 1a and 1b).

MGSP is a collection of routines called by the *RENDER* program, although it probably is more useful than the combined subroutines and *RENDER* driver. By carefully selecting graphing, text display, line and polygon manipulation routines, most sophisticated tasks are reduced to a "black box" system of algorithm implementation.

By using the two-dimensional polygon drawing, rotation, translation, scaling and fill routines, for example, three-dimensional graphics routines become a matter of calling debugged lower-level routines to satisfy your particular algorithmic needs. It's unnecessary to worry about the particulars, although an addition of three-dimensional routines is one of the few enhancements the packages really could use.

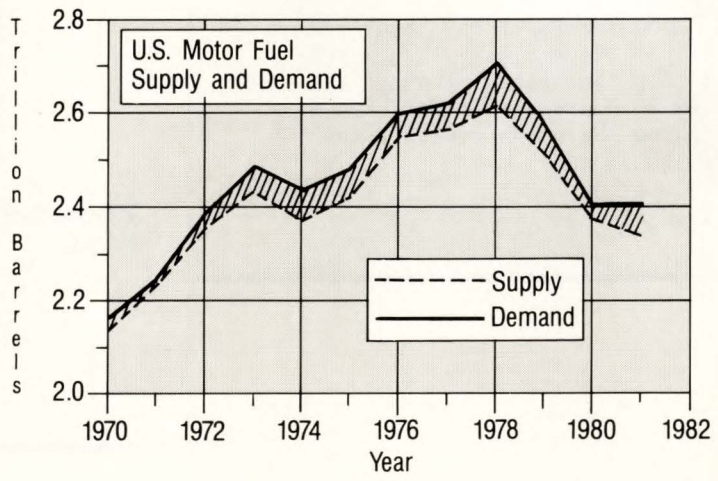
Alternatively, it's easy to achieve complicated combinations of graphics and text using the bit-mapped graphics routines. Because business graphics is *RENDER*'s principal application, *MGSP* also has numerous routines to produce bar graphs, line graphs and pie charts. Even more interesting is the reported ability to manipulate the size of screens of output to combine various displays on a single page.

Nicest of all, is that the routines, which are black boxes portable to a variety of systems, don't require the endless conversion procedures common when transferring graphics from one display system to another. Happiness

EXAMPLE 1a.

```
c
c     Use MGSP to make a graph of U.S. Motor Fuel Supply
c     and Demand.  Shade area between curves.
c
      integer ltypes(2)
      real years(12), supply(12), demand(12)
      data system /'VMS '/
      data years / 1970., 1971., 1972., 1973., 1974., 1975.,
     1             1976., 1977., 1978., 1979., 1980., 1981. /
      data supply / 2.136, 2.231, 2.352, 2.434, 2.371, 2.421,
     1              2.549, 2.566, 2.615, 2.514, 2.375, 2.338 /
      data demand / 2.162, 2.243, 2.382, 2.484, 2.434, 2.478,
     1              2.597, 2.620, 2.707, 2.580, 2.401, 2.404 /
      data np /12/
      data ltypes /3373, 1/
      data sxmin /0.0/, sxmax /10.0/
      data symin /0.0/, symax /7.2/
      data vxmin /1.75/, vxmax /9.0/
      data vymin /1.75/, vymax /6.5/
      data wxmin /1970./, wxmax /1982./
      data wymin / 2.0 /, wymax / 2.8 /
c
      write (5, 1001)
 1001 format(' Device type? ',$)
      read (5, 1004) dtype
 1004 format(A4)
c
c     Initialize the MGSP system.
c
      call PLOPEN ('FUEL5.OUT', 4, dtype, system)
      call SCINIT
      call SCRDEF (sxmin, sxmax, symin, symax)
c
c     Select various software character sets
c
      call STSOFT
      call STCSPA (1, 0, 0)
      call STCSET ('COMPLEX_ROMAN', 2)
      call STCSET ('TRIPLEX_ROMAN', 3)
c
c     Define the viewport and window boundaries.
c     Then define intervals and style of tic marks.
c
      call VIEWPT (vxmin, vxmax, vymin, vymax)
      call WINDOW (wxmin, wxmax, wymin, wymax)
      call STTICX (2.0, 1.0)
      call STTICY (0.2, 0.1)
      call STKATT (2, 3, 1)
c
c     Make title box
c
      call STLTHC (0.02)
      call STCBSZ (0.18, 0.24)
      call STJUST (7)
      vxmid = (vxmin+vxmax)/2.0
      call STTXPR
      call GRTEXT (99,'U.S. Motor Fuel0<Supply and Dem
     1 vxmin+0.25, vymax-.25
      call STTXPF
c
c     Draw line-type legend
c
      call STCBSZ (0.12, 0.18)
      call STCSTN (2)
      call SCLLEG ('\', 2, 'SupplyDemand', 6, ltypes, 5, 6.6, 3.1)
c
c     Draw the axes and first curve, then select dashed pattern
c     and draw second curve.
c
      call WFRAME
      call STLTHC (0.04)
      call AGRAPH (years, demand, np)
      call WCCURV (years, demand, np)
      call STLINT (3373)
      call WCCURV (years, supply, np)
c
*c    Shade area between curves
*c
*     call STLINT (1)
*     call STSELP (0)
*     call WCSHCI (years(1), wymin, years(np), wymin)
*     call WCSHCR (years, supply, np)
*     call STFILP (4, 1, 70, 2, 26)
*     call STSELP (4)
*     call WCSHCR (years, demand, np)
c
c     Label the axes
c
      call HORLBL (99, 'Year\')
      call VRTLBL (99, 'Trillion Barrels\')
                     .     .
                     .     .
                     .     .
```

EXAMPLE 1b.



is having merely one line of changes and recompilation to perform to get a new site up and running.

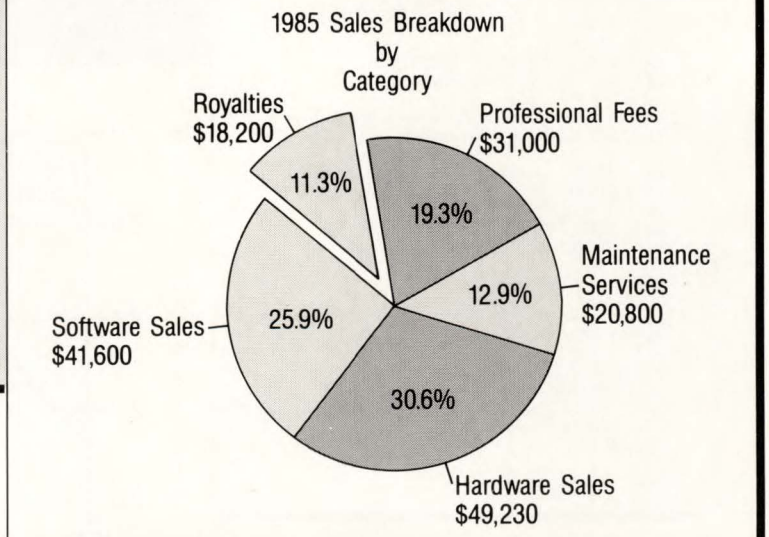
RENDER IS EASY TO USE yet produces sophisticated business graphics. It uses a pseudo-programming language, dubbed an *interpreter* by Multiware, to step through lines of code sequentially. The user specifies the activity desired and the parameters for the operation. The program then executes *MGSP* subroutines to perform the actual graphics functions. This scheme provides a convenient high-level language interface enabling non-programmers to produce elaborate business presentations.

EXAMPLE 2a.

```
! PC4.DAT
! Pie chart with label variances

SCRDEF 0.0 10.0 0.0 7.2
VIEWPT 0.0 10.0 0.0 7.2
STSOFT
STCSPA 1 0 0
STCBSZ .25 .40
STJUST 8
GRTEXT "1985 Sales Breakdown0<by0<Category" 5.0 7.1
STPIOP
        0                   !  omit label strings
        1                   !  place % values inside slice
        2                   !  numeric values outside & under
                            !  string labels
        2                   !  treat numeric data as "$"
STCBSZ  .12  .22            !  small characters for legends
SCPLEG "-- Legend --"       !  write legend
        5
          "Professional Fees" 2
         "Royalties          3
         "Software Sales"    4
         "Hardware Sales"    5
          "Maintenance Services"  6
        3                   !  place via
         9.9 0.1            !    at this
STCBSZ .15 .25
PICHRT 5
   31000 "Professional Fees"   2
  -18200 "Royalties"           3
   41600 "Software Sales"      4
   49230 "Hardware Sales"      5
   20800 "Maintenance0<Services" 6
   3.9 2.9
   2.0
  30.0
```

EXAMPLE 2b.



RENDER supports a multitude of *MGSP* activities, and includes such primitives as:

SCRDEF — Defines physical screen boundaries allowing users to map their display in units they're comfortable with (e.g., inches, pixels, etc.). This command is part of a scheme that provides an interesting advantage over other approaches. Because you define the display in a device-independent fashion according to your wishes — in centimeters, for example — the picture always will appear in these units, and with the same boundaries. This is true whether working with a Tektronix 4017, an HP plotter or an Apple Laser Writer. To change devices, you must only specify the device name in the first line of your program. All display changes are internal to *RENDER* (see Example 2a.).

VIEWPT — Defines a viewport to examine for all future functions. This can be used, for example, when you define a chart and only wish to look at a certain segment of the information. For example, use this command when you're only using part of a page for a graph, and reserving the rest for some other display.

WordPerfect Makes Debut on the VAX

Successful runs on Data General systems and IBM Personal Computers have set the stage for WordPerfect's anticipated debut on the VAX. The new version promises the same accomplished performance in terms of quality, power, and flexibility which have made WordPerfect Corporation the critics' choice for word processing on the PC.

Beautifully programmed

The new VMS edition of WordPerfect is written in assembly language to reduce overhead and increase performance. It is arranged to keep character I/O to a minimum and to use memory sparingly.

WordPerfect's installation procedure allows an experienced systems manager to install the program without consulting a systems engineer. The support documentation includes a learning section with step-by-step lessons for the new user and a feature-by-feature reference section for the expert. The VAX version is practically identical to the PC and DG versions so that a practiced WordPerfect user will feel comfortable with the software in a very short time.

WordPerfect documents from any other computer are compatible with WordPerfect documents created on the VAX.

Variety show

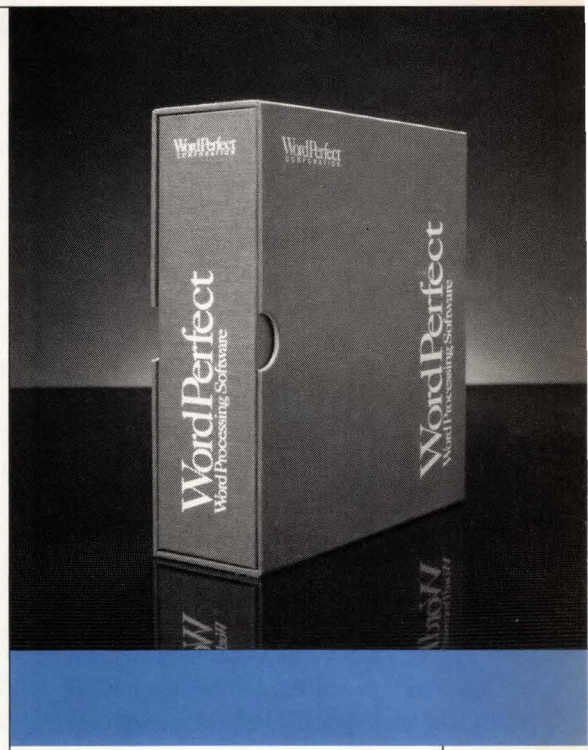
The list of available WordPerfect features goes on and on. Some notables include document password protection, endnotes and footnotes, math, macros, merge, newspaper columns, proportional spacing, a speller, table of contents and index generation, timed file backup, a thesaurus, and support for more than 100 printers. In fact, multiple copies of complete or partial documents can be printed from a single Printer Control menu.

Reservations

WordPerfect for the VAX ranges in price from $5,000 on the MicroVAX II to $13,000 on the 8800. A 30% discount is available for subsequent copies and for government and large accounts. A 50% discount is offered for a cluster copy and for schools. DEC VARs and OEMs that want to offer WordPerfect to their customers will receive additional discounts.

Future performances

Early in 1987, versions of WordPerfect will be ready for the Macintosh, Amiga, and Atari ST computers. Later in the year, WordPerfect will open on IBM's 370 machines, the NCR Tower, and other computers as well. WordPerfect documents created on the VAX will, of course, be compatible with documents created with future versions.



WordPerfect is bringing audiences to their feet with its superb performance on a variety of machines. For more information about the new version for VAX, call or write to the VAX Products Division of WordPerfect Corporation.

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DRWRSC — One of a multitude of commands for drawing line segments on charts. You can create lines with many different appearances, with or without marker symbols. You can draw lines as polygons to specify a thickness.

SCARCD — Draws arcs of a specified angle, radius and center. Use this in combination with the line and polygon commands to generate almost any two-dimensional shape.

STLOGX — Gets log scale for X-direction. *RENDER* supports conventional and logarithmic scale graphs. For graphing purposes, you also can draw tick marks at varying intervals.

GRTEXT — Writes graphics-displayed text at screen coordinates. The package contains 14 separate fonts, including two symbol sets and various foreign languages that can be activated at will. The program also facilitates character size, proportional spacing and text justification.

GTMISV — Performs error checking. This command can be used to prompt for missing values in specified routines.

SCSYMD — Draws a user-defined symbol at specified coordinates. This is to enhance specific areas of a graph for effective presentations.

STPRAN — Sets polygon rotational angle. You can define, rotate, and fill polygons (with various patterns). With this command you can draw almost anything with no more than an elementary knowledge of geometry.

BARCHH — Draws bar chart with labelled axis. *RENDER* can finagle practically any type of two-dimensional graph you can dream up, although its specialties are bars, pies and lines.

PICHRT — Draws pie chart with labels. *RENDER*'s pies are especially nice, and you can specify such features as exploded sections.

Obviously, *RENDER* can address a variety of business graphics needs. There are well over one hundred routines to use. Graphs can have protected sections or text descriptions, various markers for points, different shades of regions, unusual types of lines for plots and a variety of other functions. Graphs also can be clipped, scaled and modified. (See Examples 2a and 2b.)

There's a tremendous amount of power here that cannot be overlooked.

RENDER has so many functions that it's difficult to remember them all; their names are not intuitive. Another problem is the user interface. The program is half computer language (routines and parameters must be specified in the editor, then sent to *RENDER* where executed, then re-edited for any changes) and half software package (the commands are simple and the parameters well detailed). Fulfilling your own "totally new" concept of graphics could therefore be time consuming. Also, *RENDER* is syntax sensitive and doesn't accommodate variables or alternate input devices such as light pens and graphics tablets.

What's impressive about the package, however, is that the sheer number of commands enables you to manipulate the program in unique ways, for example, creating music notation in a matter of minutes. In a nutshell, *RENDER* provides very sophisticated graphics programming in a device independent design. It facilitates most graphics patterns efficiently, concisely, and — most important — very professionally.

Both *RENDER* and *MGSP* are well designed, flexible tools for their specific markets, and come with excellent documentation. *RENDER* includes a user's guide that proceeds step by step toward increasingly complicated graphs, while *MGSP* features a detailed programmer's reference manual. The *MGSP* documentation also includes such niceties as sample FORTRAN programs as a guide for users of the subroutines. The documentation for both products is clear, helpful and complete.

It is of utmost importance to consider your specific needs before deciding which of these fine packages is right for you. *RENDER* is user-oriented, running in a batch-like mode of operation. You use a standard editor to edit files and send them to *RENDER*, which then displays the results on the screen. *MGSP*, in comparison, is a subroutine package that requires a programmer-designed interface to create databases used by the subroutines. Both packages require practice for fluency, but are worth the investment. There's a tremendous amount of power here that cannot be overlooked.

David Goldstein is an independent consultant in Philadelphia, Pennsylvania.

RENDER and ***MGSP***
Multiware, Inc.
2121 Second Street, Suite 107
Davis, California 95616
(916) 756-3291
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Price: *RENDER* — $900 for a single CPU license.
MGSP — From $1750 for RT-11 to $3,600 for VMS.

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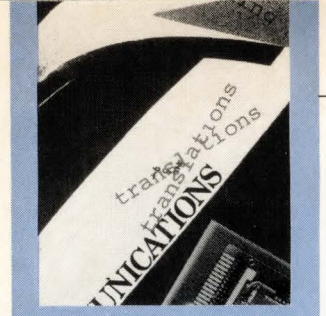

COMMUNICATIONS

SmarTerm 240

A Terminal Emulation And File Transfer Package With A '240' IQ.

By Victor J. Chorney

Persoft Inc., Madison, Wisconsin, which has been in the communication software business for some time now, has added yet another product to its already significant line: *SmarTerm 240*, a VT240 graphics terminal emulator. Not surprisingly, the entire package is put together quite professionally. Both the software and accompanying documentation reflect Persoft's considerable experience in this area.

SmarTerm 240 has implemented windows (as have so many of today's packages), but with reasonable restraint and a conservative approach to (technical) implementation and presentation. As a result, *SmarTerm 240* is attractive and functional.

The latest release of *SmarTerm 240*, V1.1, includes downline-load editable fonts from *WPS-Plus* and other packages, and EGA graphics support in the Tektronix mode.

Installation

Three disks come in a sealed envelope which, when opened, signifies acceptance of the license agreement terms printed thereon. The disks, labeled Installation, Master, and Utility/Sample Programs, then can be placed in the pockets on the enclosed plastic diskette holder page. You initiate the installation from the A drive. It can be done step-by-step or automatically. The former provides access to the installation options in detail; the latter simply puts everything where you direct it, with the only pause being for creation of a backup disk. This, incidentally, is where some of Persoft's experience shows. Instead of having to hand write a label for the backup copy, they provide a preprinted label complete with license and version numbers.

Once you've typed in ST240 (or ST240-C if you're using a composite monitor), the opening screen comes up and you're asked to select the configuration you want. At this point, you must create at least one configuration or custom version of the software. When you select a configuration by number (there are eight available) it brings up the Setup Mode window (see Screen 1). The options presented include:

1. My Favorite Parameters

This option allows you to grab (or "hoist") the windows covering items you may want to alter while using *SmarTerm 240*. By hoisting the printer window (under Hardware Parameters), for example, you can access that window directly through My Favorite Parameters rather than having to select Hardware Parameters, then Printer Selection.

2. Configuration Name

This is an eight-character field which you can use to identify your special configuration.

3. Terminal Mode

This option refers to the type of terminal you want to emulate: VT52, VT100, VT125, VT220, VT240, VT640 (Digital Engineering Retro-Graphics terminal), Tektronix 4010 or 4014 terminal.

4. Hardware Parameters

The choices here are for printer and plotter types (see Screen 2).

5. Keyboard Mapping

With this option, you can "program" the function and keyboard key equivalents to those of a Digital keyboard.

6. Softkey Definitions

This option allows you to go even further than the mapping described above, by providing a

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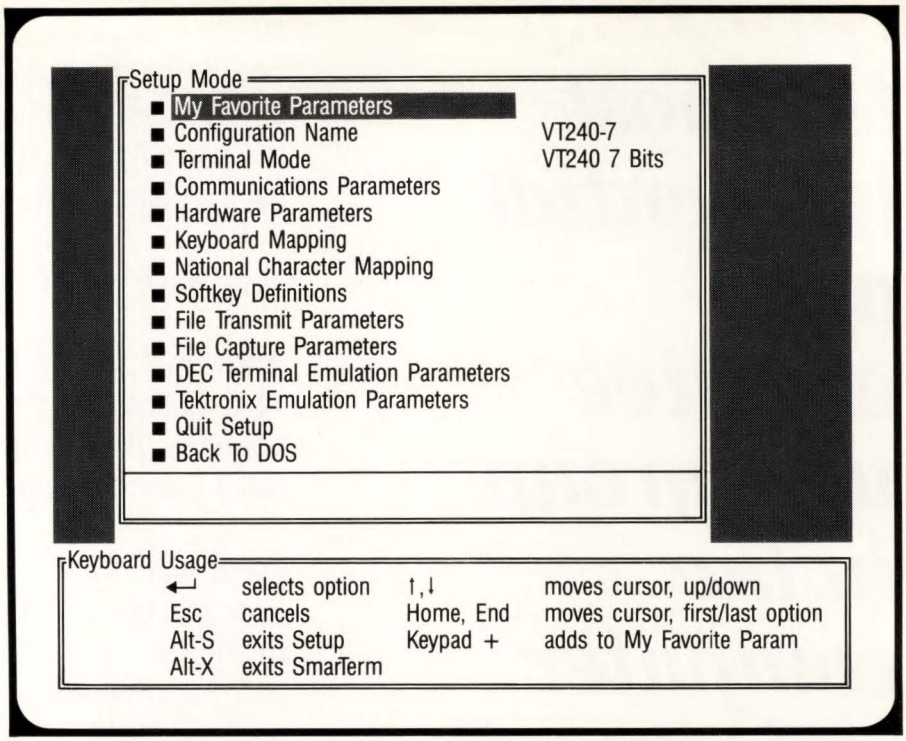
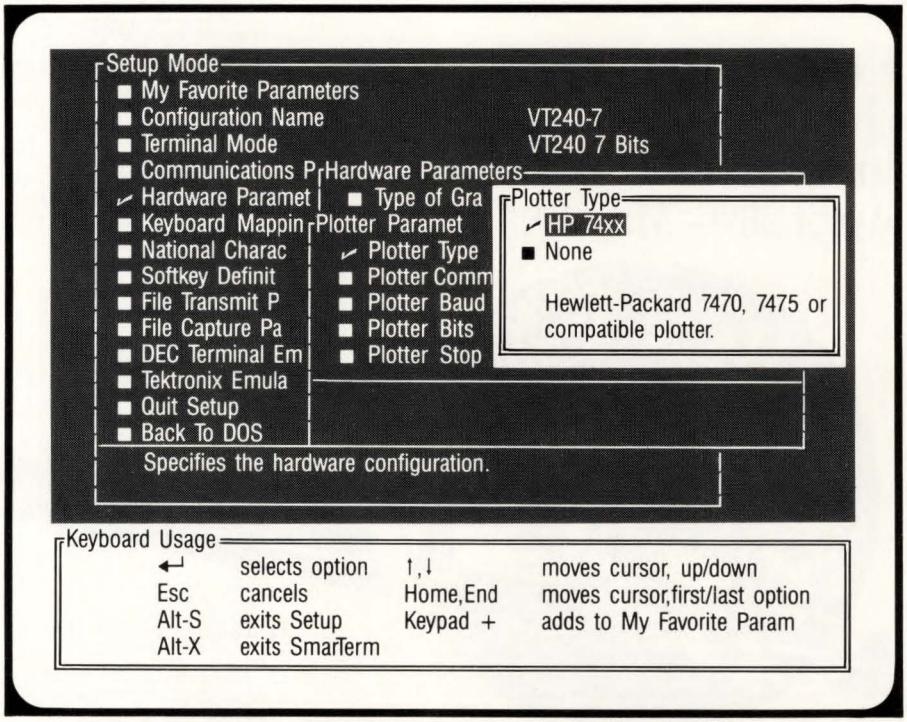
Digital Equipment Computer Users Society
219 Boston Post Road (BP02)
Marlboro, MA 01752-1850

SmarTerm 240
Persoft, Inc.
465 Science Drive
Madison, WI 53711
(608) 273-6000
Hardware Environment: IBM-PC (or compatible).
Minimum configuration: 512K RAM, at least one double-sided diskette drive, monochrome monitor.
For graphics capability: Hercules (or compatible) Graphics Card or 80-Column Color Display or Enhanced Color Display Card, with IBM Color/Graphics Adapter or Enhanced Graphics Adapter, asynchronous I/O board (for COM1 or COM2 port), and PC-DOS, any version between 2.0 and 3.2.

There also is a networking kit available for an additional $50, which includes support for Bridge Communication's EtherTerm system, and the Ungermann-Bass Net/1 system. Users of V1.0 can upgrade to V1.1 for $50, or for $100 to include the networking option.
Price: $295.



Screen 1. The Setup mode main menu.



Screen 2. The windows used to set the plotter type parameters for Tektronix mode operation.

means for you to define "softkeys"; i.e., keys that contain your own choice of data, such as frequently used commands.

Documentation

The documentation consists of a user manual, a reference card (really a booklet), and three keyboard strips with room for you to write your own customized definitions. The user manual is comprehensive and well tabbed, and has a very detailed index. The Trouble-shooting section contains not only a list of error messages with accompanying textual explanations for the errors, but also some common "questions and answers," which can be quite helpful in problem solving.

The Appendix contains handy information like Tektronix, DEC Multinational, and IBM-PC character sets, and also cable wiring information.

As a nice touch, there's also a tab entitled "Technical Notes." I'm always writing myself little messages about things to do (or not do) when using a system, and now there's an appropriate place to put them.

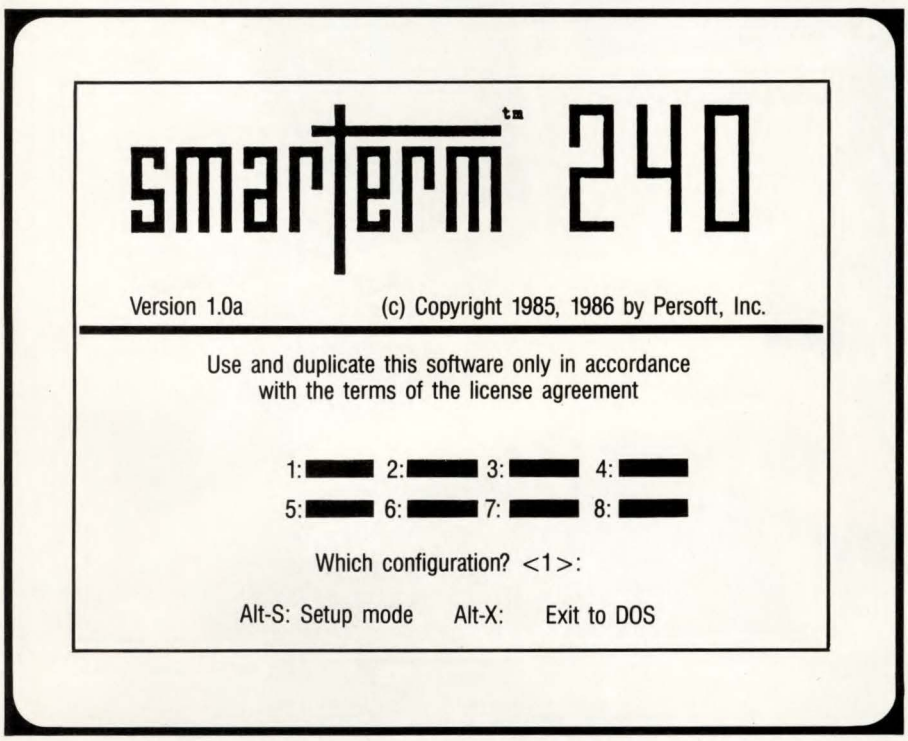
I do have one gripe: the binder rings do not stay closed when moving a group of pages. This was a constant annoyance during the normal information searching that takes place when getting started with a system.

Operation

Online help, a real necessity when you go from package to package, is activated by pressing Alt-H. When you do, a window appears with the help menu cleanly presented. You initiate the various functions by using some combination of the Alt key with another key that is likely to be a mnemonic; i.e., Alt-E for erase, Alt-L for local, Alt-P for print, Alt-S for Setup, etc.

SmarTerm 240 provides ReGIS emulation that works well. the Wombat in Datatrieve shows up nicely. I tried some other graphics demo files and they, too, appeared as if I were using a real, live DEC terminal.

One really unique and interesting item is the "zoom" feature. That's right,



The SmarTerm 240 Welcome Screen.

One really unique and interesting item is the "zoom" feature.

you can move in to inspect a section, pull back to see the entire image and also scan around for a particular section. A really nice implementation!

The system also supports three modes of file transfer: PDIP (Persoft's own), the popular public domain XMODEM and KERMIT. Persoft supplies the host software for PDIP. Although XMODEM is popular among micros, it's not usually available on larger systems. KERMIT, of course, works on almost anything.

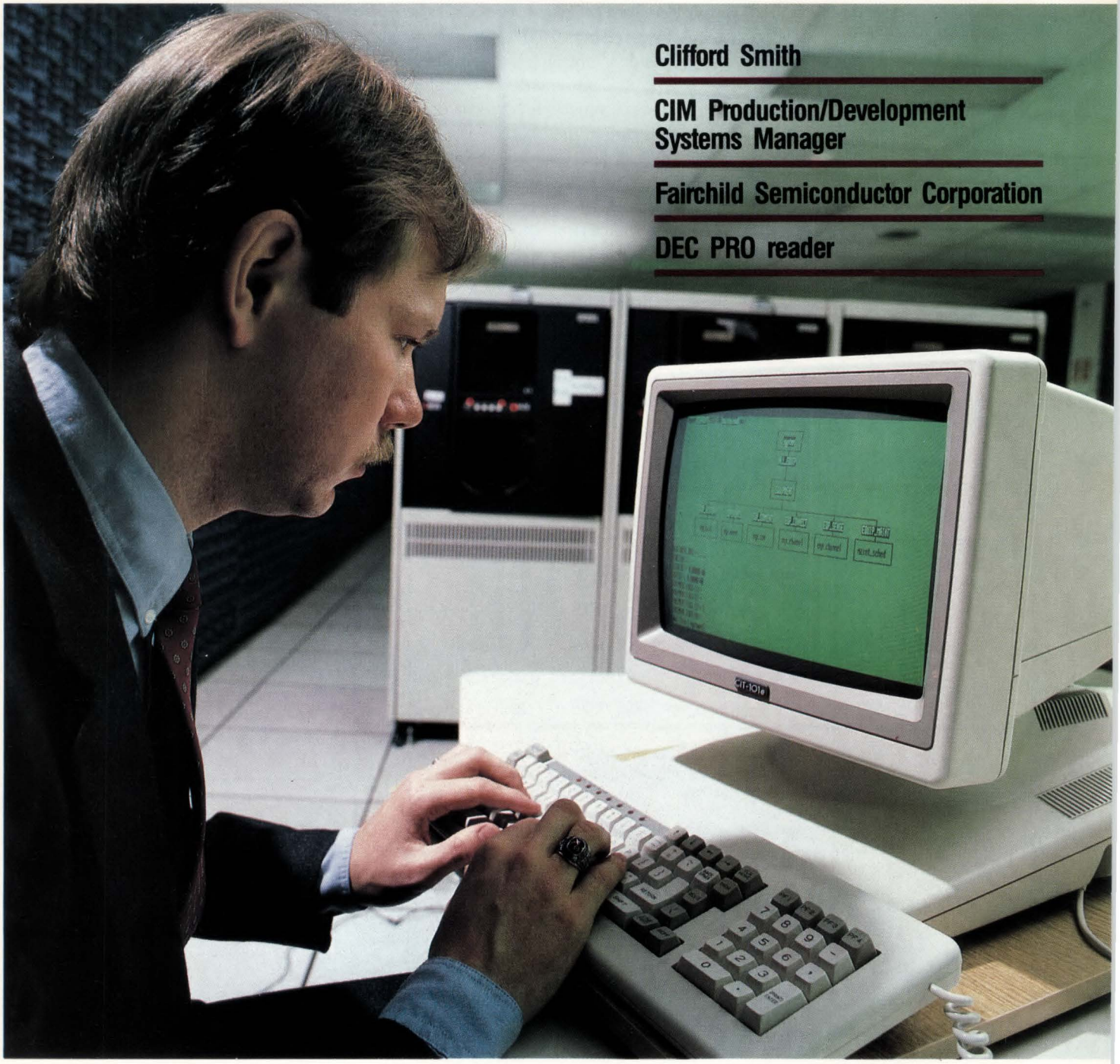
Oh yes, and if you just want to log into one of the online database services, *SmarTerm 240* will accommodate you by acting as a dumb terminal (TTY).

Finally, if you need to drop into DOS temporarily, selecting the Exit option "shells you out," and typing EXIT returns you to *SmarTerm 240* (Alt-X is the true exit from the system).

If you need a general-purpose communications package that's easy to set up and use, and is well documented, *SmarTerm 240* belongs on your shopping list. I was very pleased with its performance (as advertised) and its ease of use. *SmartTerm 240*, therefore, goes onto my list as well.

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

WHO ARE THE


Clifford Smith
CIM Production/Development Systems Manager
Fairchild Semiconductor Corporation
DEC PRO reader

DEC PROS...?

People like Clifford Smith of Fairchild Semiconductor Corporation, South Portland, Maine . . . sailor, camper, log-home builder and CIM Production/Development Systems Manager. From a Scientific Programming and Performance Evaluation position at DEC, Cliff went on to manage systems at the Harvard Science Center, then went to Strategic Information in Burlington to manage a systems group before coming to Fairchild.

At its South Portland facility, Fairchild manufactures semicustom chips and boards. Its computer integrated (CIM) system ranges from the factory floor to the executive suite and the MIS world. Powering it all are a couple of VAX 780s and an 8600 in the Fabrication Data Center and three more 780s in the Assembly Data Center. Cliff manages this multimillion dollar system and it's still growing.

The CIM Function

"Out on the manufacturing floor, there's a monitor set up at every station for the operator to use as well as automated testing equipment. Information gathered at these stations is either keyed in manually or acquired automatically, then shipped up here. The monitors track information on yields so we know exactly, from very early on, that if there's a problem with a particular lot, we can catch it before a lot of money is wasted. We can also look for ways to improve yields. That information will be connected to the MIS world so that an order entry by a customer can automatically start a lot through the system. So MIS has a stake in this system as well. We're trying to bridge that MIS/engineering world, trying to reduce as much redundancy of data as we can. That's our CIM function."

Cliff says that DEC has helped by "going towards Local Area VAXclusters

that make life a little bit easier for both users and us. They have dedicated CPUs and we can now support the users out there and handle things for them, like backups, and all the things that protect their data."

DEC's Biggest Challenge

He thinks DEC's biggest challenge over the next five years will be in the marketplace. "Yes, they're very strong," says Cliff, "but I don't know how their closing off people from the BI BUS is going to affect them. They're going to lose some of their engineering base, the people who got them there in the first place.

The CIM Challenge

As for the next technology step in CIM, Smith sees it as communications. "Getting all the components to talk to each other. It seems that the technology is there, it's more a matter of implementing it at the start."

According to Cliff, CIM's primary responsibility is to provide access to data so that "everything can talk to everybody." In fact, he says the biggest challenge over the next few years is to expand the knowledge base . . . "trying to make sure that everybody has as much knowledge as possible to be able to do his job well."

Valuable Information from *DEC PROFESSIONAL*

And he also looks to *DEC PROFESSIONAL*. "When I read *DEC PRO*, I look for information. The examples that are in *DEC PRO* have quite a range — from rudimentary DCL on up. Usually the most valuable information is a little out of the ordinary like one recent issue that covered shareable images. So that's very handy. To me it's an extension of DECUS."

Cliff also turns to *DEC PRO* for product reviews. "Many times *DEC PRO* will have recently reviewed a particular product that I've been meaning to get in here and take a look at anyway. There are pros and cons to it and these come out in the articles. That sort of thing is very helpful. It's pretty straightforward. The product has some good points and some bad points, and the review leaves it up to the readers to decide whether that's going to help them or hurt them in their installation. That's good."

That's why Cliff is a *DEC PRO* reader. For solid information and honest reporting. A true professional. That's Cliff Smith.

That's *DEC PRO*.

DEC PROFESSIONAL

MICROVAX

VAXSTATION/ RC-PLUS

By Philip A. Naecker

Upgrading Your VAXstation/RC.

DEC introduced the VAXstation II/RC (Reduced Cost or Restricted Configuration, depending on whom you talk to) last May. At the time, the RC cost about $10,000 less than the regular VAXstation but had only one significant difference — it was said to be non-expandable. A VAXstation basically is a MICROVAX with another board on the Q-bus (or two in the case of some GPX models). Virtually any option or peripheral that works in a MICROVAX works in the VAXstation as long as you have enough slots in the eight-slot, quad-wide Q-22 bus backplane, and enough power (243 watts total). So how is it that the VAXstation II/RC is non-expandable?

There are two differences between a VAXstation II and the VAXstation II/RC. First, the emblem on the front of the VAXstation II/RC says "VAXstation II/RC" while the emblem on the front of the VAXstation II says "VAXstation II." That's clearly not going to make it non-expandable. The second difference is that the backplane has three slots that have been filled with epoxy, making it impossible to plug in any more peripherals (see Photo). One expansion path is to remove the dual-wide Ethernet connection (a DEQNA) and the 2-MB memory board, and replace them with a DHV-11 (for terminal ports) and an 8-MB memory board. That takes about 15 minutes to do. But if you want to add any more controllers, you're stuck; that is, unless you change the backplane.

Well, it turns out that the Q22-bus eight-slot backplane costs about $400. What's more, it's a Field Replaceable Unit (FRU) and there are complete instructions for replacing it in the VAXstation owner's manual, including the part number. A few phone calls, a MasterCharge number, and in two days the backplane arrives at your door.

Great Engineering

I think you have to take a MICROVAX completely apart before you can appreciate fully the fine engineering that has gone into the box and packaging. Sure, the electronic engineering on the boards is really nice, too, but you'll never be impacted directly by that because there's not much a user can do with a board except pull it out and put in another one. In contrast, the mechanical packaging of a MICROVAX directly affects the serviceability and expandability, and in particular, makes it easy for a user to perform significant maintenance operations (such as replacing the entire backplane) with little difficulty.

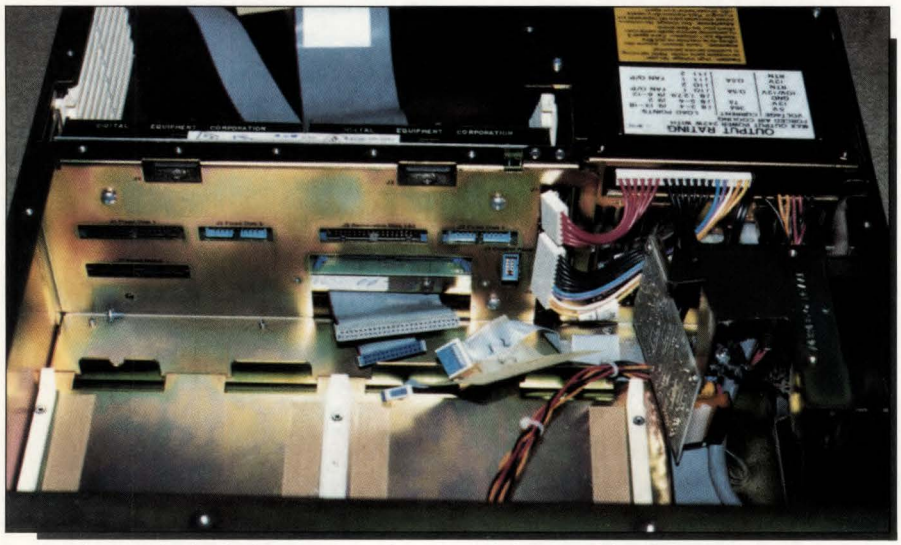
"Dang those DEC engineers," a friend said to me. "Can you believe it? Taking apart a MICROVAX requires *twice* the number of tools that they could have done it with. It requires a Phillips screwdriver *and* a slotted screwdriver. Don't you think they could have changed those four slotted screws to Phillips? Boy, I'm really disappointed." Yeah, life is hard sometimes.

The instructions for removing the FRUs are clear and easy to follow. Virtually every step is shown in a diagram. The cable connections are easy to make with the right amount

TABLE 1.

TIME	STEP
11:12	Shutdown (after performing a complete backup).
11:14	Remove all external cables.
11:20	Remove processor box from case.
11:22	Remove access covers to modules and drives.
11:28	Open and remove rear I/O distribution panel.
11:40	Remove modules from Q-bus.
11:54	All modules out. Remove fan cowling.
12:05	Remove drives and cables connecting to backplane. Remove cable trap door.
12:10	Remove backplane.
12:15	Remove backplane distribution panel. Check part numbers and revision level with new backplane.
12:25	Begin replacement of backplane.
12:27	Backplane in. Install trap door.
12:30	Plug in backplane cables.
12:34	Install drives.
12:45	Replace fan cowling.
12:48	Replace modules.
1:20	Replace rear I/O distribution panel.
1:30	Replace cabinet and reconnect external cables.
1:35	Power up.
1:38	Up and running VMS. SYSGEN> SHOW/UNIBUS shows that the module is in place and recognized.

Steps in replacing the H9762-A Q-bus backplane on a MICROVAX.



Replacing the backplane means almost total disassembly of the BA23 components. Here, all CPU cards and disk drives are out and all that remains is the disk cable distribution panel.

of slack on each cable, but not so much that the extra gets in the way. Every ribbon cable in the box has the red stripe on the same side, and all of the cable connectors either are keyed or have a label indicating the top of the connector. All of the mounted connectors are labeled, too, so it's trivial to relate the instructions to the physical connections to be made. The drives are removed by depressing a tab with your finger, and they slide out in a few seconds.

Replacing the FRUs usually is the reverse of the removal procedure. There are no "gotchas" that require three hands to keep parts in place while you try to screw them back together.

The removal and replacement of the Q-bus modules, however, is a little difficult if you have to do it from the back of the box with the machine inside the plastic case, because the clearance between modules is so tight and you have to reach in several inches. Any warping of the board or any components that stand too high on the board will make it hard to get the board to seat properly. However, this is not a problem when the machine is out of the case and the access door off (see Photo), because then you can insert the modules one at a time, from the bottom, with the CPU board going in last. It's also easier to connect the cables to the boards when you have a clear view from the top as well as the back. If you plan to add a new module to a MICROVAX, I would recommend that at a minimum you remove the machine from the plastic case and lay it flat on the floor or a table, thus avoiding the difficulty of working with the rear cover floating loose and having to reach in a few extra inches.

Whenever you handle any peripheral modules, be aware that static electricity is a serious hazard to the boards. Even a small static discharge could destroy some components. The key to avoiding the problem is to use a wrist strap and static pad that assures that your body, the module, and the

FIGURE 1.

A	B	C	D	Slot
KA630-AA CPU				1
MS630 2 Megabytes Memory				2
Open		DEQNA		3
VCB01 Bit Map Video Controller				4
RQDX3 Disk Controller		TQK50 Tape Controller		5

VAXstation II/RC backplane configuration.

FIGURE 2.

A	B	C	D	Slot
KA630-AA CPU				1
CMX830 8 Megabytes Memory				2
MS630 2 Megabytes Memory				3
DEQNA Ethernet Controller		CMDHV11 Terminal Ports		4
VCB01 Bit Map Video Controller				5
RQDX3 Disk Controller		TQK50 Tape Controller		6
Open				7
Open				8

Backplane configuration after upgrade.

CPU box are all at the same potential. Pick up the modules only by the metal handles.

To get to the backplane on a VAXstation you have to remove nearly every other FRU, with the exception of the power supply, control panel and fans. On the other hand, it takes a little more than two hours for the entire process. (See Table 1).

The backplane configuration of a VAXstation II/RC consists of components shown in Figure 1. Even though there is an open dual-wide slot, it will only accommodate memory. I wanted to upgrade the memory and add some terminal ports. I also needed some extra slots to add future peripherals. I selected 8 MB of memory from Camintonn/AST (the CMX830) and an AST Research DHV-11 look-alike (CMDHV11). After the upgrade, my backplane configuration looked like Figure 2.

This configuration affords me 11 MB of memory (there is 1 MB on the CPU board) which is not too shabby for a single-user system. Actually, I have enough spare memory that I set up a 2-MB virtual disk when I boot and place frequently used files there. If I crash, I lose that data, but I only put things in the disk that I can afford to lose. That leaves me 9 MBs of useful memory, so I give a lot of that to RMS for XQP caches and RMS buffers.

I have two spare slots, which isn't a lot. One of them currently is taken up by a PC/AT emulator board I'm testing. Since my next disk is likely not to be RQDX3 compatible, I'll probably put a controller in one of the remaining dual slots, leaving only one dual slot free. Of course, I can remove the 2-MB memory board without too much impact, and I also can drop the DEQNA since I'm not currently connected to an Ethernet. Those two steps would afford me two more dual-wide slots, since slot three can hold only memory in the CD rows.

With this configuration, the greatest limitation is the small disk that comes with the VAXstation II/RC, a 71-MB RD53. It seems like a lot, until you fill up 23,000 blocks with a pagefile (I use my pagefile as my swap and dump files, too) and install a few layered products. I am doing a lot of software development, so I leave lots of VMS libraries and symbol tables online. It all adds up, and there are times when I have less than 10,000 blocks left.

Installing new options in your MICROVAX is likely to be as easy for you as it was for me. Of course, you should be careful that any operations you perform on your MICROVAX won't void your warranty or service contract. And remember to be especially careful to avoid static electric discharge near sensitive components. ■

LEGAL

ESOP's Fables

By Herbert Swartz

'Hidden Gems Amidst The Carnage.'

The computer industry has a major new player. And it (sorry, but not a she or a he) comes from a most ironic source. The participant arrives courtesy of The Tax Reform Act of 1986.

Employee Stock Ownership Plans (ESOPs), as reformulated under the statute, are now integral to running, selling, or being employed in a computer business, which by itself is surprising. The popular — and correct — notion is that the new law is indeed revolutionary, but to the detriment of business in general. After all, where else but from increased business taxes can the money be found to replace the estimated annual loss of $24 billion from lowered personal income tax rates?

"The carnage is everywhere," comments attorney Luis Granados, president of ESOP Consulting Group in Washington. "The tax landscape has become littered with the wreckage of shattered business plans resulting from passage of the bill."

But ESOPs are a different story, and for good reason. These trusts are formed by management to shift stock ownership into the hands of employees so that, eventually, either employees will end up owning the business, or the company will be obligated to pay the employee — at some future date — the value of his stock ownership. No matter which option comes to pass, employee stock ownership "is the bulwark of capitalism," according to Senator Robert Packwood of Oregon, who championed the ESOP cause in Congress.

Hyperbole aside, ESOPs emerged from Congress as "the hidden gems amidst the carnage," in Granados' words. Even as paradoxical gems, ESOPs have as much (if not more) to offer owners of computer businesses as they do the employees in those companies.

CONSIDER THE POINT in its broadest basis: Computer companies, as with all companies, exist to increase productivity and profits. Last September, just before the bill was signed by President Reagan, the initial pragmatic evidence of the contribution by ESOPs to those two ends became available when the National Center for Employee Ownership (NCEO) in Arlington, Virginia, released the following statement:

"A new study from the NCEO establishes for the first time a casual relationship between employee ownership and corporate performance. The study found that over a 10-year period companies with ESOPs would generate 46 percent more jobs and 40 percent greater sales growth than they would have generated without employee ownership."

As NCEO Executive Director Corey Rosen adds: "[Companies must] now view employee ownership not only as a good employee benefit, but as a way to improve productivity in an increasingly competitive economy." The Congressional instinct obviously has proved correct.

Herewith, then, is a description of the "hidden gems," or how they might unfold in

The disk backup system that pays for itself in 18 seconds.

That's about how long it takes to load a MegaTape cartridge and start the backup process.

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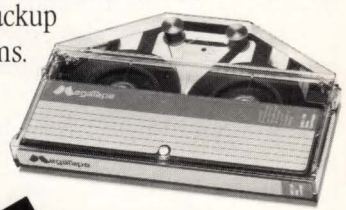
So stop wasting all those hours. Pick up the phone now and call MegaTape.

In a few seconds, you could be on the way to a breakthrough in solving your backup problems.



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the computer-industry context:

A computer company wants employees to share in ownership; it wants to sell them stock. As well, the sale will provide the company added funds.

The appropriate vehicle is the ESOP, a trust formed by the company, with independent trustees, for the benefit of the employees.

All is fine so far, but where is the money to come from?

Banks, or other "commercial lenders," replies Congress. "We want them to lend to ESOPs, with the stock as collateral and the company as guarantor of the obligation." But how do we prod banks to lend?

"Simple," answers Congress again, and it legislated that 50 percent of all interest from loans to ESOPs can be excluded from income. Under the new tax code, the top corporate rate is 34 percent. Thus, banks are looking at just 17 percent taxation on the interest income from these loans. Since all manner of tax shelters has been destroyed under the new tax statute, banks and other "commercial lenders" have one fine tax shelter just for the taking.

Congress even took the trouble to provide a negative component to ensure that banks have a so-called "tax appetite." Previously, banks were not all that eager to avoid taxes through loans to ESOPs. More attractive were industrial revenue bonds or the deductions allowed for loan-loss reserves. So, Congress merely cut the availability of these deductions, or tax-protection devices.

While Congress also provided for bank hesitancy, they would prefer lending directly to companies (a business with which they are more familiar) than ESOPs. Who wants to have to sue a bunch of employees to collect in the event of default? Thus, Congress further provided that ESOP loans can be made to companies themselves instead of ESOPs, as long as the loan at bottom is for purchase of company stock by the ESOP.

Finally, Congress provided that insurance companies, finance companies, "other commercial lenders," and, yes, even mutual funds can lend to ESOPs and secure the tax advantages. If banks don't want to play the new ESOP game, no doubt someone else will.

Either way, Congress expressed the hope, too, that banks or other lenders would pass their tax savings onto ESOP borrowers; i.e., charge a lower rate of interest for ESOP loans. And, according to an NCEO spokesman, this has been happening: The rate of interest for ESOP loans runs as much as 20 percent lower than the interest rate for other bank loans.

So, at bottom:

1. Companies can receive money that banks should be eager to lend, and at a reduced rate; *and*
2. Companies have an additional and cheaper source of working capital, over and above their line of credit with the bank.

Indeed, Congress went out of its way here as well to benefit employers: The companies do not have to fund the ESOP at the same time or under identical terms as the underlying bank loan.

Notes Granados, companies are looking at "revolving-credit ESOPs." As illustration, he offers the following:

"Suppose Smith Computer Company has a revolving credit line to provide itself working capital, and in 1987 it uses $1 million of this credit. Smith Company also maintains a profit sharing plan, with annual contributions averaging $1 million that it typically funds from cash on hand. Under the new law, Smith Company and its revolving-credit lender can shuffle paper to allow the lender the 50 percent interest exclusion, passing part of the tax savings back to Smith Company in the form of lower interest rates.

"First, Smith Company freezes the profit-sharing plan and directs future employee benefit contributions to a newly created ESOP. Next, instead of using the $1 million of cash on hand to fund the profit sharing plan, it uses the cash on hand to fund its working capital requirements. Then, instead of funding the profit sharing plan with the cash on hand, it funds the ESOP contribution by drawing on its revolving credit line.

"Presto — the year's borrowings under the revolving credit line become eligible for the ESOP interest exclusion."

All of which is so attractive that Granados concludes, "With the flexibility provided by the new law, any company with a revolving credit line and ongoing defined contribution plan payments would have to have a masochistic streak to refuse to take advantage of what is available."

YET CONGRESS WAS FAR from through, because what is borrowed must be paid back, but in this instance with a twist: Companies are allowed to deduct their repayments; dollars to principal of a loan as deductible dollars, in short. And can that statement be made anywhere else under the Internal Revenue Code? Just imagine paying off the principal of a mortgage with deductible dollars. But homes, in this case, take a back seat to ESOPs.

True, Congress did establish some limits: The deductible contributions by a company to its ESOP that used to repay the principal of the loan are limited to no more than 25 percent of annual payroll, which means that a loan cannot be repaid with deductible dollars any sooner than four years, unless the company pays dividends on the stock owned by the ESOP, which then is used to repay the principal.

In such a case, the 25 percent limitation does not apply. In short, dividends are deductible if earmarked for loan payments, while all interest payments are deductible as well; i.e., from company to ESOP to bank.

Next, having inspired banks to lend, and businesses to grow through ESOPs, Congress turned to owners. In

Benefits don't have to wait for retirement, said Congress.

the magazine business, owners of a closely held company dream of selling out to a Rupert Murdoch; in the computer business, of finding a ready wallet at IBM. "But why bother," said Congress. "Simply look across the office. There's the new player in town, the ESOP, and it is loaded with money and wondrous tax consequences for the seller."

So, where a sale once meant capital gains of 20 percent to the seller on the profit, now congress has abolished capital gains under the new bill. The new personal rate of 28 percent will control, unless the sale is made to an ESOP, in which case there is *no tax* on the profit.

Truth to tell, this is a mere deferral, and available only if the ESOP dollars to the selling owner are used to buy a similar amount of U.S. securities within a year (sort of similar to the deferral allowed with the sale of a home and purchase of a new one).

Basis in the new stock remains the same as in the original stock; a similar amount of profits will be subject to the 28 percent tax rate once the new stock is sold, unless the new stock is not sold. It is held until the new owner's demise. Then basis is stepped up to market, so at the end, tax is not simply deferred, *it is forgiven altogether.*

The owner in the closely held company may prefer to retain the company stock until his death. Then two problems arise for his heirs: One, they need liquidity to pay the 50 percent estate tax due; and two, all the stock is taken into valuing the amount of the estate, unless . . . the estate sells the stock to the ESOP. Liquidity is, of course, gained to pay those infernal estate taxes. But presto again, only half as much is due. The estate, said Congress, can deduct 50 percent of the sale price from the computation of the estate. Absolute forgiveness a second time, in short, and never mind talk of mere deferral.

WITH THE DESIGN of these provisions to aid banks, businesses, individual owners, and their estates, Congress was not simply conferring benefits on the beneficiaries involved. It had its eye on the employee ball. Workers should no longer have to worry about a company being sold out from under them, or of the company ceasing upon an owner's demise. Jobs and the business should remain intact while those happy prospects should spur productivity and profitability. The company, after all, most likely will wind up as the asset of those who toil in its behalf.

Congress wasn't through yet, this time with straightforward benefits to workers. Seemingly, ESOPs are another form of retirement benefits. Not so. They also are income vehicles for employees during working years.

First, dividends paid by a company to the ESOP also are deductible to the company if paid in turn in cash to employees. Next, ESOP stock now vests in as few as three years, down from the 10 to 15 years under previous law. And payouts to workers who terminate employment must begin within five years thereafter, and be completed within another five years.

Benefits don't have to wait for retirement, said Congress. They can begin when the employee leaves the company no matter what his age. In theory, an employee who started young at a company could begin receiving ESOP benefits in his twenties.

So, employees have the chance for added income from dividends paid during their employment. They also have the chance for either stock or cash after they leave, and long before retirement. While finally, at retirement age, they can exercise the right of "diversification options." The company not only has to buy their stock (not required under previous law), but they can elect the form (cash or stock) and timetable of repurchase.

These last several benefits to employees actually are a mixed blessing to employers. A company could get caught in its own liquidity crunch as the obligations to repurchase company stock from employees commence before retirement. A challenge has been posed to ESOP trustees, companies, and financial planners, though it must be noted that these new employee payout and vesting provisions are not an increase in amounts due, but simply an acceleration.

How should companies meet the challenge? The work can be done, the experts agree, with sound actuarial projections of future payouts and repurchase obligations.

Clearly a caveat is in order, though, as Granados offers: "Those who fail to project their cash needs and plan for them will wind up with 'broke ESOPs' that will depress their stock price, perhaps subject themselves to fiduciary liability, and give the ESOP concept a black eye."

Hmm — actuarial projections, projecting cash needs, broke ESOPS. . . . Sounds like a job for computer software. Better still, a job for the computer industry itself.

Herbert Swartz, a graduate of Harvard Law School, is a veteran writer on computer law.

DCL DIALOGUE

Kevin G. Barkes

DCL Terminal Manipulation

In response to a reader's request last month, I appealed to terminal wizards for information on changing terminal characteristics from within DCL command procedures. It will be a few more months before that comprehensive, reader-written article arrives. In the meantime, the question piqued my curiosity. So, armed with the *VT220 Pocket Programmer Guide* and the August, 1985, issue of *VAX PROFESSIONAL*, I decided to whip together a fast command procedure to give readers some terminal handling capability until the definitive work arrives in the mail.

The *VAX PRO* article, "Nifty Things To Do With VAX DCL Command Procedures," by Allen Watson, contains a method for including terminal escape sequences in command files *without really including them*, "a distinction," according to Watson, "that is extremely important when it comes time to print [to a line printer] the command procedure."

The first command procedure, USETERM.COM, defines the global symbols used to change display characteristics and terminal attributes. The command file DEMO.COM runs a little demonstration on your terminal and shows the various methods for using the definitions.

If USETERM is invoked without parameters (e.g., $@USETERM), the "static" definitions are assigned as global symbols. If a valid GOTO label is supplied, the procedure jumps directly to the named label, assigns the values passed to a global symbol of the same name, then immediately exits. For example, to set up a scrolling region on the terminal starting on line 10 and extending for five lines, enter:

```
$ @USETERM SCROLL 10 15
$ WRITE SYS$OUTPUT SCROLL
```

The procedures should work on VT220s set up to recognize 7-bit control sequences as well as VT10xs with advanced video options.

Armed with these samples, users should be able to devise a number of permutations of the sequences.

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

PROGRAM 1.

```
$! USETERM.COM
$!
$! Sets up symbols which can be used to change terminal display
$! characteristics and attributes.
$!
$! Define symbols so escape sequences in this command file are all
$! "printable."
$!
$     ESC[0,32]          = %X1B      ! Escape character
$     CSI                = ESC+"["   ! Control sequence introducer
$     BELL[0,32]         = %X7       ! Bell
$!
$!
$! Trap errors:
$ ON WARNING THEN GOTO CATCH_ERROR
$!
$!
$! If specified, execute one of the sequences requiring passed variables:
$!
$ IF P1 .NES. "" THEN GOTO 'P1'
$!
$!
$! Turn on/off bold or increased intensity:
$       BOLD_ON               == CSI+"1"+"m"
$       BOLD_OFF              == CSI+"2"+"2"+"m"
$!
$! Turn on/off underlining:
$       ULINE_ON              == CSI+"4"+"m"
$       ULINE_OFF             == CSI+"2"+"4"+"m"
$!
$! Turn on/off blinking:
$       BLINK_ON              == CSI+"5"+"m"
$       BLINK_OFF             == CSI+"2"+"5"+"m"
$!
$! Turn on/off reverse image:
$       REV_ON                == CSI+"7"+"m"
$       REV_OFF               == CSI+"2"+"7"+"m"
$!
$! Turn off all attributes:
$       NORMAL                == CSI+"0"+"m"
$!
$! Turn on single-width:
$       S_WIDTH               == ESC+"#"+"5"
$!
$! Turn on double-width:
$       D_WIDTH               == ESC+"#"+"6"
$!
$! Double-height sequences:
$       D_HEIGHT_TOP          == ESC+"#"+"3"
$       D_HEIGHT_BOT          == ESC+"#"+"4"
$!
$! Save current cursor position:
$       S_CURSOR              == ESC+"7"
$!
$! Restore previously-saved position:
$       R_CURSOR              == ESC+"8"
$!
$! Move cursor down one line in same column:
$       IND                   == ESC+"D"
$!
$! Move cursor up one line in same column:
$       R_IND                 == ESC+"M"
$!
$! Move cursor to first position on next line:
$       N_LINE                == ESC+"E"
$!
$! Erases the entire display, changed to single-width, cursor does not move:
$       C_ALL                 == CSI+"2"+"J"
$!
$! Erases the display from the start of screen to the current position:
$       C_TO_START            == CSI+"1"+"J"
$!
$! Erases the display from the current position to the end of the screen:
$       C_TO_END              == CSI+"0"+"J"
$!
$! Return the cursor to line 1, column 1:
$       HOME_SCREEN           == CSI+"0"+"0"+"H"
$!
$! Reposition the cursor to line 1, column 1 and clear the screen:
$       CLEAR_SCREEN          == HOME_SCREEN+C_TO_END
$!
```

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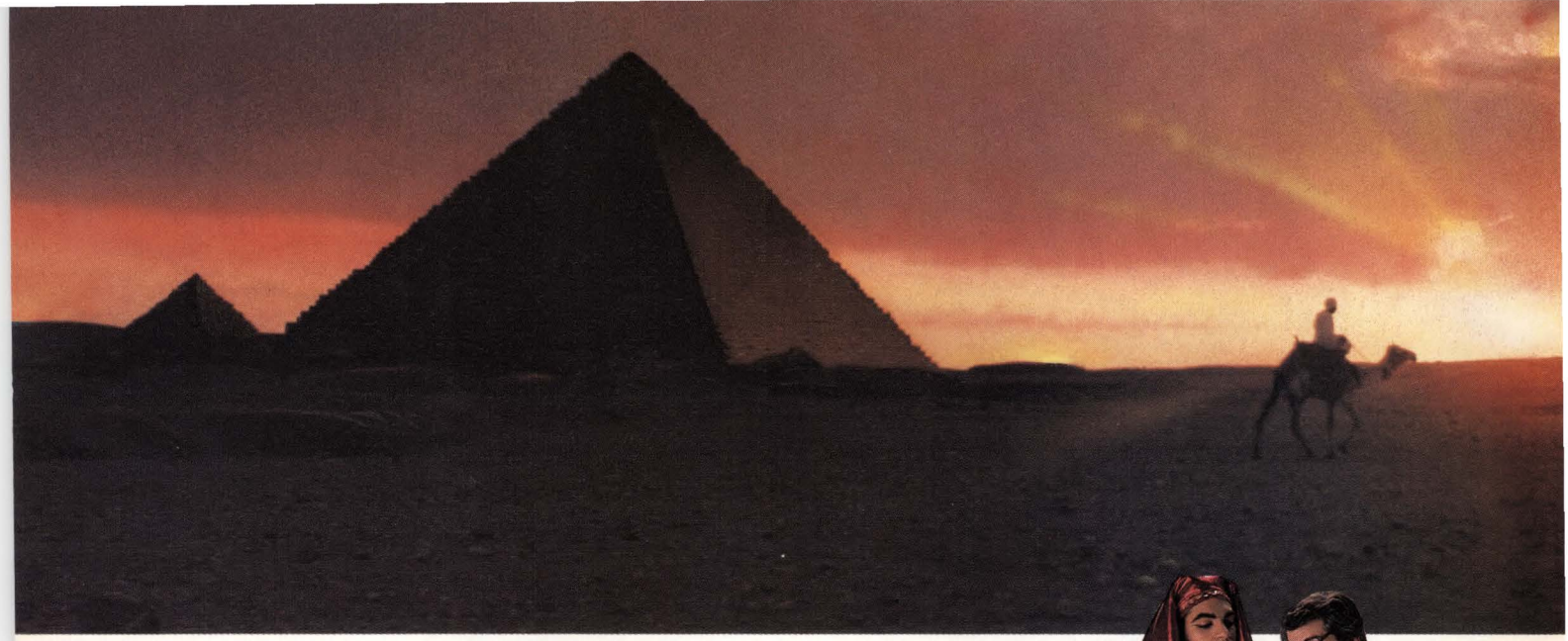
PROGRAM 1. . . . continued

```
$! Terminal test:
$       TERMTEST                == ESC+"#"+"8"
$!
$! Terminal modes:
$!
$! Change to 132-column mode:
$       C132                    == CSI+"?"+"3"+"h"
$!
$! Change to 80-column mode:
$       C80                     == CSI+"?"+"3"+"l" ! (lower case L)
$!
$! Set smooth scrolling:
$       SMOOTH                  == CSI+"?"+"4"+"h"
$!
$! Set jump scrolling:
$       JUMP                    == CSI+"?"+"4"+"l" ! (lower case L)
$!
$! Set screen to reverse video:
$       R_VIDEO                 == CSI+"?"+"5"+"h"
$!
$! Set screen to normal video:
$       N_VIDEO                 == CSI+"?"+"5"+"l" ! (lower case L)
$!
$! Turn auto-wrap on:
$       WRAP_ON                 == CSI+"?"+"7"+"h"
$!
$! Turn auto-wrap off:
$       WRAP_OFF                == CSI+"?"+"7"+"l" ! (lower case L)
$!
$! Turn auto-repeat on:
$       REPEAT_ON               == CSI+"?"+"8"+"h"
$!
$! Turn auto-repeat off:
$       REPEAT_OFF              == CSI+"?"+"8"+"l" ! (lower case L)
$!
$ EXIT
$!
$! Set scrolling area according to passed 'p' parameters:
$!
$ SCROLL:
$       SCROLL == CSI+P2+";"+P3+"r"
$ EXIT
$!
$! Move cursor up:
$ UP:
$       UP == CSI+P2+"A"
$       EXIT
$!
$! Move cursor down:
$ DOWN:
$       DOWN == CSI+P2+"B"
$       EXIT
$!
$! Move cursor forward:
$ FORWARD:
$       FORWARD == CSI+P2+"C"
$       EXIT
$!
$! Move cursor backward:
$ BACKWARD:
$       BACKWARD ==  CSI+P2+"D"
$       EXIT
$!
$! Position cursor:
$ POSITION:
$       POSITION ==  CSI+P2+";"+P3+"f"
$       EXIT
$!
$! Error handling:
$ CATCH_ERROR:
$! (Status code %X38148 is an unsatisfied goto)
$       IF $STATUS .EQ. %X38148 THEN GOTO BADPARM
$       WRITE SYS$OUTPUT "Unknown error."
$       EXIT
$!
$ BADPARM:
$       WRITE SYS$OUTPUT P1," is an invalid parameter."
$       EXIT
$!
```

PROGRAM 2.

```
$! DEMO.COM
$! Command procedure to demonstrate the use of some of the
$! symbol assignments in USETERM.COM
$!
$ WSO := WRITE SYS$OUTPUT
$ PAUSE1 := WAIT 00:00:01
$ PAUSE2 := WAIT 00:00:02
$ PAUSE3 := WAIT 00:00:03
$ PAUSE4 := WAIT 00:00:04
$ USETERM := @USETERM
$ USETERM
$ WSO CLEAR_SCREEN
$ USETERM POSITION 12 15
$ USETERM FORWARD 14
$ WSO POSITION+D_HEIGHT_TOP+"DEMO.COM"
$ WSO FORWARD+D_HEIGHT_BOT+"DEMO.COM"
$ WSO R_VIDEO
$ PAUSE1
$ WSO N_VIDEO
$ PAUSE1
$ WSO R_VIDEO
$ PAUSE1
$ WSO N_VIDEO
$ PAUSE1
$ WSO CLEAR_SCREEN
$ COPY/NOLOG SYS$INPUT SYS$OUTPUT
        By using the symbols defined in USETERM.COM, you can display a
                number of terminal characteristics, including:

$ PAUSE1
$ WSO BOLD_ON,"Bold type",BOLD_OFF
$ PAUSE1
$ WSO "         ",ULINE_ON,"Underlined type",ULINE_OFF
$ PAUSE1
$ WSO "                         ",BLINK_ON,"Blinking type,",BLINK_OFF
$ WSO ""
$ PAUSE1
$ WSO "                                         ",REV_ON,-
  "Reversed type",REV_OFF
$ WSO BOLD_ON,"And ",ULINE_ON,"combinations ",BLINK_ON,"of ",REV_ON,"each."
$ WSO NORMAL,""
$ PAUSE3
$ WSO D_WIDTH,"Display double width lines,"
$ PAUSE2
$ WSO D_HEIGHT_TOP,"or double height lines"
$ WSO D_HEIGHT_BOT,"or double height lines"
$ USETERM SCROLL 20 24
$ WSO SCROLL
$ WSO ""
$ COPY/NOLOG SYS$INPUT SYS$OUTPUT
        You can set up a scrolling window for your command procedures,
                leaving your original display intact.

$ PAUSE2
$ COPY/NOLOG SYS$INPUT SYS$OUTPUT
You can change your terminal characteristics....

$ PAUSE1
$ WSO JUMP
$ COPY/NOLOG SYS$INPUT SYS$OUTPUT

                        From
                            Jump
                                Scrolling....
$ PAUSE2
$ WSO SMOOTH
$ COPY/NOLOG SYS$INPUT SYS$OUTPUT


                        To
                          Smooth
                                Scrolling...
$ WSO JUMP
$ PAUSE2
$ WSO CLEAR_SCREEN
$ USETERM UP 5
$ USETERM DOWN 15
$ USETERM FORWARD 20
$ WSO DOWN,BOLD_ON,BLINK_ON,"Move"
$ PAUSE2
$ WSO UP,FORWARD,"around",FORWARD,UP,"the",UP,FORWARD,"screen",NORMAL
$ PAUSE2
$ WSO DOWN,"Change the terminal to 132 character display..."
$ PAUSE2
$ WSO C132
$ WSO "and back to 80 columns..."
$ PAUSE2
$ WSO C80
$ PAUSE2
$ WSO "Save a cursor position:  X",S_CURSOR
$ PAUSE2
$ USETERM DOWN 15
$ WSO DOWN,"Move",R_IND,"around",R_IND,"the",R_IND,"screen...",IND,"Then",-
  R_CURSOR,"return to the marked position...."
$ PAUSE2
$ WSO "Erase to the beginning to the screen..."
$ PAUSE2
$ WSO C_TO_START
$ WSO "And to the end..."
$ PAUSE2
$ WSO C_TO_END
$ PAUSE2
$ WSO "Clear the screen & maintain the current cursor position."
$ PAUSE2
$ WSO C_ALL,"All from DCL!"
$ PAUSE2
$ WSO "END OF DEMO.COM"
$ PAUSE2
$ WSO CLEAR_SCREEN
$ EXIT
```

■



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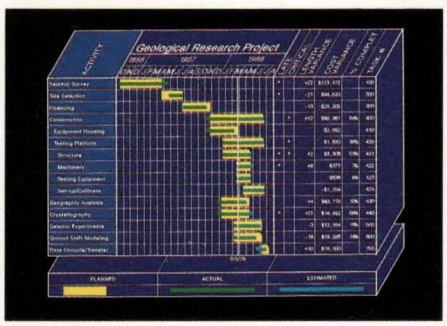

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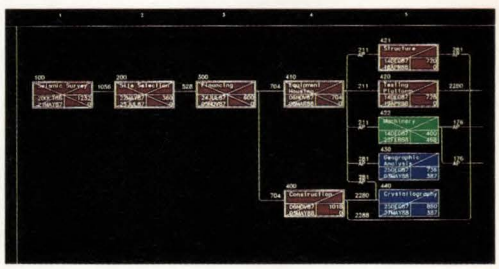

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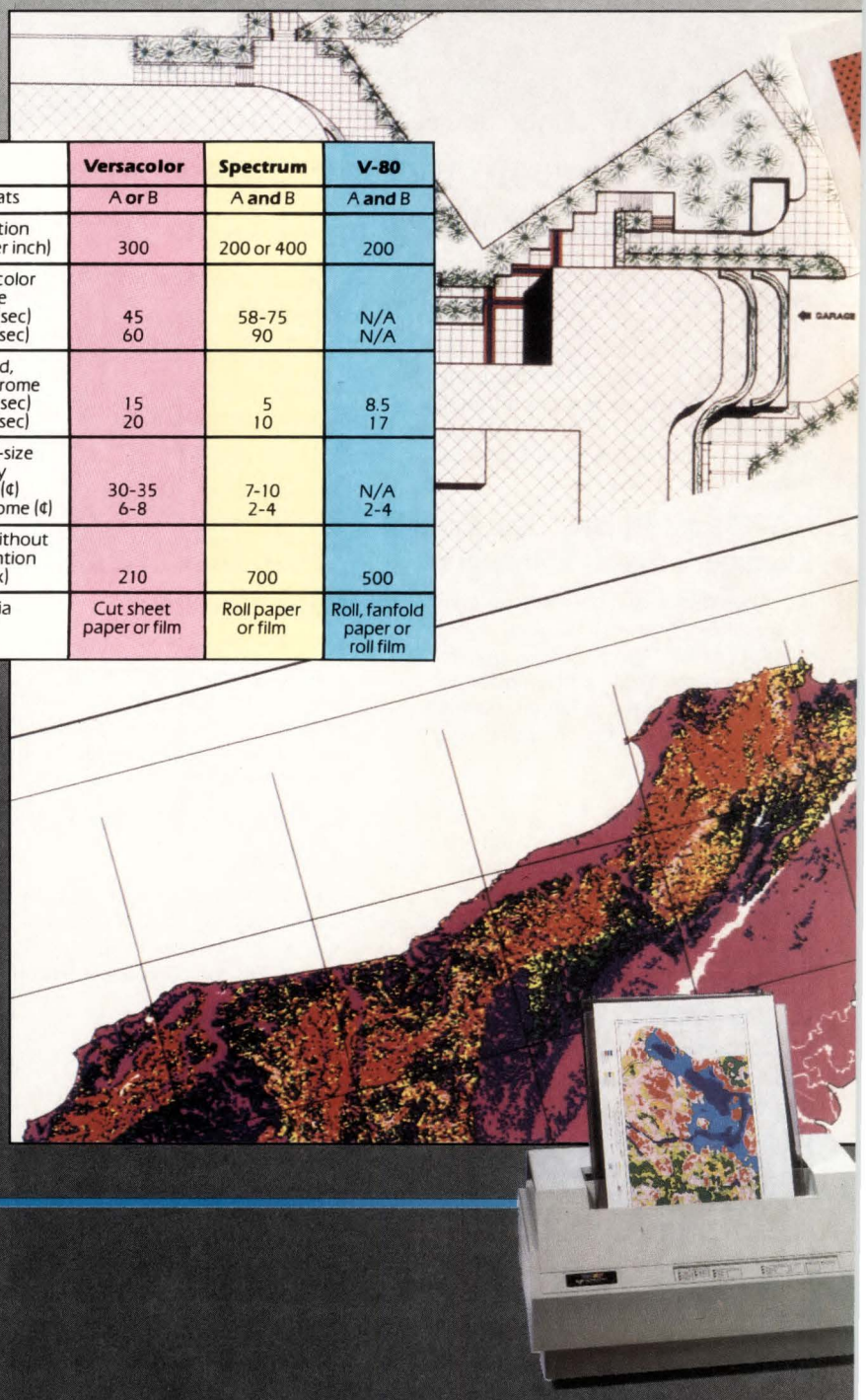

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LET'S C NOW

Rex Jaeschke

Problems In malloc City

Editor's note: Last month, Mr. Jaeschke promised to address the topic of C project data dictionaries in this issue. However, an interesting reader letter has pre-empted his plan. A reader writes:

Dear Mr. Jaeschke:

First, let me thank you for your great series of articles. I also would like to suggest a possible topic for a future column. The subject is advanced pointer usage. I have had many occasions to use pointers to pointers as arguments to functions, as the following program shows. I would be pleased to see more coverage of the more esoteric uses of pointers.

Thanks for your letter. Having been involved in teaching C as a first language, and to PASCAL, and other language proponents, I have heard many students state that pointers themselves are esoteric. Certainly, pointers in general are a difficult concept to grasp for typical high-level language programmers, and the syntax for their use in C can be even more of a struggle. "Just when should I use the * before the pointer name?" In any case, pointers remain perhaps the most valuable aspect of C and, along with the wide selection of native and derived data types, allow a wealth of data structures to be defined and manipulated with ease and simplicity.

Before we look at advanced pointer use, let's spend a few moments looking at the demonstration program the reader supplied. While it amply conveys his message, it does contain some very subtle errors — the kind you may never recognize on any one particular system, but they still are technically incorrect. While I'm sure the reader intended this as an example rather than as a specimen of "correct" code, there are some lessons to be learned, as we shall see.

```
#include <stdtyp.h>
#include <stdio.h>

main()
{
        int size;
        char *string;

        set(&size, &string);
        printf("size = %d\n", size);
        printf("string = %s\n", string);
}

set(sizeptr, bufptr)
int *sizeptr;
char **bufptr;
{
        char *malloc();

        *sizeptr = 10;
        *bufptr = (char *) malloc((*sizeptr) + 5);
        strncat(*bufptr, "abcdefghijklmnopq", *sizeptr);
        printf("string = %s\n", *bufptr);
}


string = abcdefghij
size = 10
string = abcdefghij
```

The Problem

The content and purpose of the header **stdtyp.h** was not stated and its omission doesn't seem to have any bearing on the example. The problem here is that we have allocated a variable to store the size of a string and a pointer to that string, yet we don't know the size and we don't know where it will be stored. If the size and the string location can be supplied elsewhere, we can manipulate the string via our size and pointer. Not an uncommon technique.

Since **&string** is used as an argument to **set** and **string** is a pointer to **char**, then what is passed is the address of a pointer to **char**, or more simply (??), a pointer to a pointer to a char. Therefore, the formal argument is declared as **char ****bufptr**; to indicate this. Function **set** initializes the size of the string, allocates storage space for it, and initializes it.

The program looked harmless enough, so I keyed it in and ran it. It produced the output shown above, as I expected. But all was not well in C-land because, being a curious person, I ran the same executable program a number of times sometime later and, behold, the output was different. No edits, no recompilation, no relinking, but different results. The unexpected output looked something like this:

```
string = <garbage>abcdefghij
size = 10
string = <garbage>abcdefghij
```

While the 10 expected characters were still there, they contained a prefix of characters, some printable, some not; and the prefix contents often varied from run to run — obviously, a hardware problem! Actually, it's a subtle "problem" with the implementation of the C run-time library, specifically, with the **malloc** function.

As it happens, we got exactly the "right" results on all

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occasions. However, in this case, "right" means "as should reasonably be expected" rather than "what I wanted." For an explanation, let's look at what **malloc** does. According to Harbison & Steele (in *A C Reference Manual*, Prentice Hall, 1984), "**malloc** allocates a region of memory large enough to hold an object whose size is given. The region of memory is not specially initialized in any way; the caller must assume that it contains garbage information. A pointer to the first element of the region is returned. Typically, the caller immediately will cast the result pointer to an appropriate pointer type."

So, while **malloc** correctly allocates space for 15 characters, that space is not guaranteed to be initialized (even though some implementations actually may do so). So when **strncat** tries to append text to that buffer, it does it beginning at the first null byte it finds in the allocated space. If the first byte just happens to be a '\0', then the program works as expected. If not, then **strncat** appends the given text to the garbage it finds in the allocated space. In fact, the results may even be disastrous. Consider the case where the last byte in the allocated region is the only one to contain a '\0'. Now **strncat** happily appends 10 more characters trashing whatever happens to be there, beyond the allocated space. Perhaps it is trashing space previously allocated by the same program. It even may result in a "memory protection violation" if the task tries to write beyond its own address space. Of course, the same problems will occur if the allocated space contains no '\0' characters; **strncat** just will keep looking until it finds one or tries to exceed the program's bounds.

The Answers, Please

There are two solutions. We either can make sure we never try to append a string to an uninitialized area, or we can make sure the area is initialized to some known value. The first solution follows:

```
*bufptr = (char *) malloc((*sizeptr) + 5);
strncpy(*bufptr, "abcdefghijklmnopq", *sizeptr);
```

Here, **strncpy** is used instead of **strncat**. This causes 10 characters to be copied to the allocated area starting at the beginning, regardless of the initial contents of that area. The second solution guarantees the area's initial contents as follows:

```
*bufptr = (char *) calloc((*sizeptr + 5), sizeof(char));
strncat(*bufptr, "abcdefghijklmnopq", *sizeptr);
```

Whereas **malloc** does not guarantee initial contents, **calloc** does; **calloc** initializes the allocated space to all-bits zero and, since on most (if not all) implementations '\0' is represented by a char containing all-bits zero, **strncat** finds a '\0' string terminator in the first **char** of the allocated space. Therefore, the results are as expected. The only syntactic difference between **malloc** and **calloc** is that **calloc** requires the size to be broken into the object size and number of objects rather than given as a total allocation size. Note that it always is a good practice to use **sizeof(object)** in calculating the arguments for **malloc** and **calloc** (and **realloc**), so you can document the code better and not have to rely on knowledge of your implementation's object sizes.

Also, strictly speaking, the size arguments to these functions are unsigned integral values, not signed as used in these examples. On a 2's complement machine, both signed and unsigned **int**s have the same size, the sign bit just is interpreted differently. The "correct" function calls should be:

```
... malloc((unsigned) ((*sizeptr) + 5));
... calloc((unsigned) (*sizeptr + 5), sizeof(char));
```

This is not just a theoretical problem. Consider a 16-bit machine such as the PDP-11 or Intel 8088. We have a program that needs to allocate an array on the heap to store 33,000 characters. The following function calls will not work as you might expect.

```
... malloc(33000 * sizeof(char));
... calloc(33000, sizeof(char));
```

The numeric constants 33000 are too big to be represented as **int**s, so they are stored and passed to the allocation routines as **long int**s. However, these routines are expecting an **unsigned int** as their first argument. Therefore, they misinterpret the contents of the stack frame passed to them and, consequently, allocate the wrong amount of (and possibly less than needed) space. The constants 33000 are treated as if they had been written 33000L.

For similar reasons, the following call is "incorrect."

```
... calloc((unsigned) 100, 10);
```

Even though the first argument to **calloc** is unsigned, the second one isn't and it should be, since that is the type expected by **calloc**. Strictly speaking then, the correct call should be:

```
... calloc((unsigned) 100, (unsigned) 10);
```

Of course, on our favorite brand of machine, the second explicit cast is unnecessary in this case, but if we need to allocate space for an object whose size was 33000 bytes (heaven forbid), we would fall into the same trap. That constant would be passed as a **long int** instead of an **unsigned int**.

Let's take one more look at **malloc**.

```
... malloc((unsigned) (33000 * sizeof(char)));
```

It appears that the argument passed is of the correct type, but what about the type of the expression? Since 33000 is too big to fit in an **int**, it is treated as a **long int**. The type returned by **sizeof** typically will be **unsigned int** (although it could be **unsigned long**). The arithmetic is done in signed **long int**

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precision and the result is cast to **unsigned int**. And if the value fits into an **unsigned int** without loss of bits, the correct answer will be obtained, as in this example.

These examples have been very simple *and* obvious since constant values are used. However, in reality, one or both of the arguments will be variables whose values may change from one call to the next. In this case it is very necessary to validate them so they are not outside of the range valid for the implementation. For example, the following call is perfectly valid, but the results produced probably would be surprising on a 16-bit machine if the result of the multiplication was truncated when cast to an **int**:

```
int number;
unsigned int size = 8;

number = 20000;
...
... malloc((unsigned) (number * size);
```

In this case, **number** is inadvertently set to some unrealistically high value, yet **malloc** takes the truncated size passed to it. If **malloc** fails, we are close to finding the problem. However, if the truncated size is small enough so that **malloc** actually can allocate it, the program plods merrily on only to die in some obscure (or perhaps spectacular) way when we try to use the space we thought we previously had allocated. The moral of the story: If you give an allocation routine unreasonable values, you can't rely on a non-NULL pointer return value meaning that the space was allocated. What it *does* mean is that some space was allocated, not necessarily the amount you thought you asked for, just the truncated interpretation thereof.

Passing By Address Versus By Value

Why must the two arguments be passed to **set** by address? If **size** and **string** were initialized in **main**, they could be. However, their values are established by **set**, and if the arguments were passed by value, they could not be updated. They must be passed to set by address, so **set** can update the original variables in **main** via those addresses. Removing that extra level of indirection doesn't work as shown by the next example.

```
main()
{
        ...
        set(&size, string);
}

set(sizeptr, bufptr)
int *sizeptr;
char *bufptr;
{
        char *malloc();

        *sizeptr = 10;
        bufptr = (char *) malloc((*sizeptr) + 5);
        strncpy(bufptr, "abcdefghijklmnopq", *sizeptr);
        printf("string = %s\n", bufptr);
}
```

```
string = abcdefghij
size = 10
string = <garbage>
```

Since **size** is passed by address, its value is updated correctly by **set**. However, the address returned from **malloc** is never copied to **string** in **main**.

It is quite possible you have been using pointers with double indirection without knowing it. An array of pointers to objects is a common example. Since an array reference is really a pointer reference, then accessing an element in an array of pointers is using a pointer to a pointer. For example:

```
#include <stdio.h>

main(argc, argv)
int argc;
char *argv[];

{
        int i;

        for (i = 0; i < argc; ++i)
                printf("argv[%d] = >%s<\n", i, argv[i]);
}
```

When used with the following input:

```
test val1 val2 val3
```

the output is:

```
argv[0] = >test<
argv[1] = >val1<
argv[2] = >val2<
argv[3] = >val3<
```

argv is a pointer to a pointer to a **char**. This is perhaps more evident if the declaration of **argv** is changed to:

```
main(argc, argv)
int argc;
char **argv;    /* "different" declaration */
{
```

As it happens, the two declaration formats are *exactly* equivalent. The same thing applies to UNIX (and other) environments that support a third argument to **main**, called **envp**. This is an array of **char** strings that contain information about "environment variables." Since I got sidetracked on the reader example above, we haven't really discussed advanced pointer usage, so I'll recycle that topic for future consideration.

Next issue I'll look at the idea of developing a data dictionary and answer more reader mail. 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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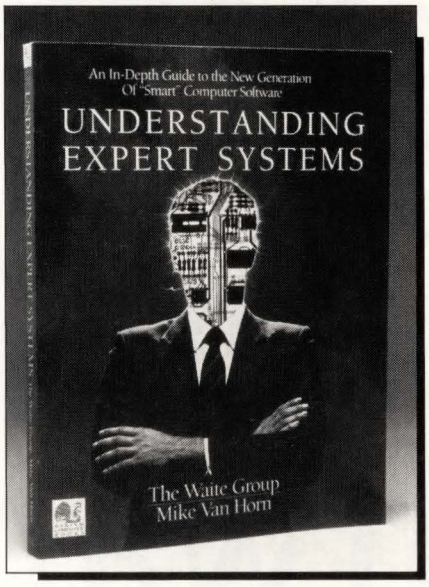
New Books On AI

Things keep getting better! Reviewers and readers interested in artificial intelligence (AI) research and programming techniques now have a flood of new books to wade through. Offerings range from introductory guide books aimed at nonprogramming, non-computer-experienced beginners, to research monographs and graduate-level textbooks for computer scientists and AI researchers. As you will find, the books reviewed here fall somewhere in the middle of that range, with Rauch-Hindin's two-volume set occupying the higher, more computer-sophisticated ground.

The availability of a range of AI publications provides a great stimulus for the evolution of new techniques for computer-assisted problem solving. Many functional systems, using various programming techniques to emulate human reasoning, have been developed in the relative isolation of commercial research laboratories and universities. Beyond professional academic journals and industrial reports, technical/computer publishers and the popular press have been responsible for the widespread dissemination and accessibility of knowledge concerning these new AI programming techniques. A serious computer enthusiast or small-business person might not be able to afford a LISP-machine research system, yet a relatively inexpensive selection of books can supply an invaluable education in AI fundamentals and innovative problem-solving techniques.

Initiates to AI soon will encounter DEC computers and software at work in



the field. Given Digital's long-term investment in research and development, and an early commercial expert system experience, most books on AI technology contain accounts of practical systems running on DEC hardware. The books reviewed here are no exception: Among the examples cited in the texts are numerous applications running on VAXs and other Digital computers.

Understanding Expert Systems by the Waite Group and Mike Van Horn is a softbound introduction to knowledge-based systems for beginners and non-computer scientists. Writing in a clear, fairly straightforward manner, the authors present the basics of expert systems with a series of hypothetical problems/examples from practical "commercial" systems. The text is supported by a generous collection of diagrams, listings and cartoons, highlighting the topics discussed. First mention of a DEC expert system comes on page 16 with the introduction of R1/XCON, the VAX system hardware "configurator" program. Later chapters help develop a fuller picture of Digital's pioneering experience with the design, implementation, and continued support of this "work-a-day" expert system.

Understanding Expert Systems is divided into eight chapters, plus an index and a topically organized bibliography. Chapters 1 and 2, "Expert on a Disk" and "What is an Expert System?" introduce hypothetical and real expert systems by demonstrating how they interact with the user on several levels of function. Examples are presented plainly and understandably. Early in Chapter 1, even before the column heading "Expert Systems: Panacea or Peril?" readers also are introduced to social and ethical issues in AI. While this is no undergraduate philosophy textbook, it does make readers aware that things such as liability laws, the IRS, and market forces lurk behind decisions to develop special expert systems.

Chapter 3, "Developing a Small Expert System," illustrates practical problem solving with Expert-Ease, the commercial PC expert system program set. Examples from stock and weather forecasting are used to show shortcomings and advantages for each problem approach, introducing the notion of ex-

Understanding Expert Systems
The Waite Group and
Mike Van Horn
Bantam Electronic Publishing
New York, 1986
235 pages, softbound
$14.95

pert systems becoming too complex to be worth the effort.

Chapter 4, "Getting Knowledge into the Computer," is concerned with "knowledge acquisition" — obtaining useful problem-solving information from experts and codifying it in a "knowledge base" and an "inference engine" for use by the computer. Chapter 5, "Searching through Knowledge for Answers," begins with a discussion of heuristic search strategies, such as "treasure-hunting" and the "backward-reasoning detective." Further examples of decision trees and forward/backward reasoning with rules are demonstrated, using examples from MYCIN, the blood-borne infection diagnoser.

"How the Computer Reads Knowledge," Chapter 6, provides how such knowledge can be represented, introducing predicate logic, LISP, probabilities, fuzzy factors and natural language. With a modest 36 large-print pages in the sixth chapter, the discussion can't lapse into deep consideration of programming techniques, but major properties are illustrated, including drawbacks and benefits of specialized languages.

Chapter 7 approaches use of tools and "Developing Your Expert System" by showing how the MYCIN rulebase can be stripped out to produce the interface/inference engine (EMYCIN). The engine then is used with different "domain specific" rules to make different expert systems for pulmonary function testing (PUFF) and structural engineering (SACON). Other illustrated examples include TEIRISIAS (an EMYCIN rule-building aid), KS300/DRILLING ADVISOR, M.1 and S.1 microcomputer expert systems, R1/XCON, and HEARSAY.

The final chapter, "The Promise of Expert Systems," covers not only the promise, but what the authors see as some of the major disappointments of current AI technology. Together with a discussion of achievements and shortcomings, the authors assess some of the social impacts of AI technology and raise the question about the "true" intelligence of expert systems.

Although for a computer-based scientist and AI developer *Understanding Expert Systems* provided a light review of familiar material, I found the text far from tedious. While the authors take a simplifying approach to explaining expert system technology, their practical use of working examples and principals helps provide a readable introduction to a subtly complex field.

Artificial Intelligence in Business, Science, and Industry
Wendy B. Rauch-Hindin
Published 1985 by:
Prentice-Hall
Englewood Cliffs, NJ
Volume I — Fundamentals
331 pages, permabound
Volume II — Applications
348 pages, permabound

For those with a more intense or professional interest in AI, the two-volume set, *Artificial Intelligence in Business, Science, and Industry* by Wendy Rauch-Hindin, may be a valuable source of practical information about a large variety of commercial systems and tools. Based on a series of articles that appeared in the professional computer trade journal, *Systems and Software*, these two volumes provide a wide-ranging overview of current AI technologies, offering profuse illustrations of system screens, program output logs, photographs, functional diagrams, and bibliographic reference lists. The author takes a technical editor's approach, with detailed coverage and discussion of important concepts and development issues. For me, a good part of the excitement in these volumes was generated by excellent text figures showing program output and graphics-oriented screens of tools such as KEE, IKE, and PICON.

Volume I — "Fundamentals" — is divided into 15 chapters and four major sections:

1. Introduction to Artificial Intelligence
2. Expert/Knowledge-Based Systems
3. AI Application Development Tools
4. Understanding Language

The first three chapters, which provide an in-depth introduction to AI, begin with encounters with different, practical expert systems. From an industrial-strength start, the discussion proceeds through the requisite definition, "What Is AI?" and descriptions of branches (expert systems, natural language, and perception) to correction of common misconceptions about AI and computers.

The next six chapters comprise a major section on experts and knowledge-based systems. Chapter 4 presents basic expert system architecture and describes suitable problems and knowledge domains. Knowledge-based structures (rules and frames) and inference/problem-solving strategies (including forward and backward chaining) are introduced in the fifth and sixth chapters, respectively. Further aspects of knowledge representation (frames, rules, and processes) and logic (semantics, inheritance, and object-oriented programming) are detailed in Chapters 7 and 8. Chapter 9 winds up the expert system section discussing many aspects of the process of acquiring knowledge from experts.

Chapters 10 and 11 comprise a mini-application guide to building expert/knowledge-based systems. Microcomputer-based development is demonstrated with M.1, Personal Consultant, Expert-Ease, and RuleMaster tools. Mainframe applications are represented by KEE (e.g., REACTORS

control), LOOPS, PICON (process control), and IKE. The mainframe application chapter is riddled with references to VAX implementations.

The final section of Volume I comprises a small book on computer-based natural language systems. Chapter 12 introduces the problems of natural language interpretation, including recognition, analysis, and parsing. Chapter 13, "Natural-Language Goes Commercial — For Mainframes through Micros" describes natural language interfaces for commercial programs, as well as aspects of database management, lexicons, and grammars.

The following chapter presents some interesting and "unconventional" microcomputer approaches to natural language problems, including the Savvy command recognition system and the Clout interface for the R:Base database management system. Chapter 15, "Natural Language through Meaning," discusses using scripts for assessing meaning, and the volume closes with several apocryphal stories about programs drawing erroneous political conclusions from interpretation of newspaper text.

Like Volume I, Volume II — "Applications" — is divided into several major sections. The first two sections, "Expert/Knowledge-based Systems in Industry" and "AI in Business and Finance" provide seven chapters of descriptions of various AI and expert system application programs in use in industry and business. Chapters 1 through 4 devote separate coverage to planning/scheduling systems, management and factory monitoring, sales/distribution management, and diagnosis/trouble-shooting. Systems demonstrated include the Opgen printed circuit board design planner, the ISIS job shop scheduler, and the IMS factory management system.

DEC's big showing comes in Chapter 3, with an in-depth examination of the XCON VAX expert, along with a look at the XSEL (computer sales assistant), ISA (Intelligent Scheduling Assistant for manufacturing orders), IMACS (Intelligent Management Assistant for Computer Systems Manufacturing), and ILOG (Intelligent Logistics System) ensemble for automating computer order flow. Chapter 4 reviews various kinds of industrial trouble-shooting systems, from the G.E. CATS diesel/electric locomotive diagnoser to the ACE system for analyzing automated telephone system problems.

Chapters 5 through 7 examine the characteristics of AI and expert system programs at work in business and finance. Aspects of expert database

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management systems are first explored in relation to stock trading, portfolio management, and adapting businesses to AI methods. Chapter 6 considers natural language, fuzzy logic, and application types important in finance and asset/liability management. Chapter 7 reviews issues of database management and report generation in business applications including consulting, publishing, and office automation.

As a section, Chapters 8, 9, and 10 provide a review of some current AI programs in use for specialized problems in science, medicine, and engineering. While the real "science" offerings are a bit thin, as typified by the nuclear process control example (more control technology than science), a more comprehensive look is taken at math/statistical analysis, as well as at functional hospital management and medical alert systems. Engineering examples include a VLSI chip design program, a circuit design system, and automated electronic test instrument system. Chapter 11 is a standalone overview of some practical computer vision systems.

The last five chapters of Volume II deal with more advanced technical details and directions for future development. AI programming languages, including PROLOG, LISP versions, OPS5, and OPS83, are reviewed with a modest degree of technical detail in Chapter 12. Chapter 13 provides additional consideration of hardware/software implementation issues, including mice, windows, object-orientation, garbage collection, and development tools. Chapter 14 examines hardware design for AI programming, focusing on LISP machine architecture, yet discussing the advantages and disadvantages of "general-purpose" computer architectures such as DEC's MICROVAX AI workstation. This last section should be interesting to those considering the evolution of different processing systems for AI task execution.

The last two chapters discuss problems of automated program coding and take the requisite parting look at AI in the crystal ball. The author, like other AI proponents, foresees learning and discovery programs, with a continued evolution and redefinition of what constitutes artificial intelligence.

Although the two volumes of *Artificial Intelligence in Business, Science, and Industry* do not comprise a knowledge engineer's cookbook or a comprehensive theoretical development guide, they nevertheless furnish a valuable technical reference for assessing the current state of AI achievement. Rauch-Hindin's work contributes a set of historical reference points, documenting what could be accomplished with the AI tools of the mid-1980s. While the hardware and specific techniques described certainly will be superseded, these books will provide a lasting record of the look and performance of the second wave of knowledge-based computer systems.

Reviewed by R.B. Trelease, Ph.D., a medical research scientist in California.

FROM THE LAB

Dave Mallery

Aviv Tape Components . . .

. . . In which we learn volumes about tape data rates and, unexpectedly, the VMS BACKUP utility.

We've been integrating a MICROVAX II into our production computer room. One of the truly necessary parts of a production computer is a tape drive. Today, a proper tape drive can cost as much as a MICROVAX II, especially when it's a 6250 bpi drive mounted in a cabinet. We also had to consider that big tape drives are very under-used at our operation. We use them essentially as backup and data interchange devices. (We have no large tape-oriented jobs except for each issue's label tape production). On the other hand, with several gigs of disk space on the VAX 750, a 6250 bpi drive is an operational necessity. Even our MICROVAX has a minimum of 300 MB on board and thus is a good candidate for a 6250.

In planning to introduce the MICROVAX II as our second production machine, therefore, I also had to plan for tape capacity. The drive we have is an STC Avalanche. It's 1600/6250 bpi and is the earlier, non-streaming model. It's also blessed with a cable interface that's different from the "industry standard" Pertec cables.

The STC interface uses a pair of 60-conductor cables, just like the *A* cable on an SMD disk. In fact, I was able to use a number of these that I found lying around the Lab to hook it up, thus saving a chunk of change.

The key to sharing the tape drive lay in finding a Q-bus controller to match the drive and an A/B switch that also could handle these somewhat non-standard cables.

THE SOLUTION WAS an Aviv TFC 925A controller. This handles most drives with the STC type interface including the Fujitsu 234x, the Siemens M12E, the Telex 9250/9270 and the CDC Keystone III. The Aviv Model 925B deals with a host of Pertec format drives, and Model 925C handles the full 1.25 MB/second, to keep a Fujitsu 2436 streaming at 2200 IPS. (That is if your computer can keep up the data rate off the disks!)

> ***"Today, a proper tape drive can cost as much as a MICROVAX II, especially when it's a 6250 bpi drive mounted in a cabinet."***

The A/B switch (Model DPS 805) also is from Aviv. The exterior of this little device is the essence of simplicity. It actually switches the two 60-conductor cables electronically. There's nothing mechanical beyond the panel push buttons. These switches come in more complex arrangements that allow multiple routing of multiple drives and computers. Our application, however, is far too simple for that.

I installed the switch by connecting the drive first, next, the original cables that went to the 750. I then was able to verify that the unit worked with the 750 alone before adding the MICROVAX. The switch is an entirely uneventful unit that's justified because it saves and better uses an existing tape drive.

Performance Discoveries

I decided to run some benchmarks to gauge the actual throughput I could achieve from the MICROVAX, and to see if there were any switch settings that might affect performance.

The initial test was to make an image backup off the MICROVAX system disk. There were approximately 130 MB of data, filling a single reel of 6250 tape nicely.

The drive in question is a 50 ips start-stop drive. Writing long blocks, it should be able to approach a data transfer rate of 310 KB/second. My initial test on a standalone machine, using settings supplied by the manufacturer, took 39 minutes to write the tape. This calculates to a net data rate of approximately 53 KB/second. The A-disk controller feeding the tape was a Webster with a 1-MB cache. The drives (ESDI CDCs from American Digital) are capable of 1 MB/second.

So where's the data rate? I prefer this method of measurement because it relates to *real* work on a *real* machine, performed constantly in a *real* situation. It doesn't matter how fast a device is in an idealized situation, because such contexts don't exist.

THE NEXT TEST was to see if the VMS directory structure, also being backed up, was a cause of overhead. I just happened to have a large, somewhat contiguous file on another drive. This file

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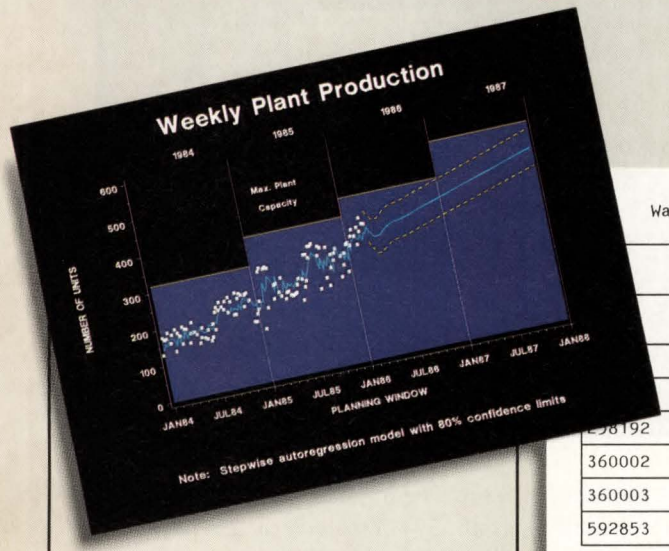

Warehouse Inventory Report - 16JAN87

	Quantity on Hand	Quantity on Order	Projected Reorder Date
	123980	10000	THU, FEB 12, 87
	89450	5000	FRI, FEB 20, 87
598192	20110	1000	MON, MAR 30, 87
360002	8585	0	TUE, FEB 10, 87
360003	15985	500	TUE, FEB 10, 87
592853	469120	20000	WED, FEB 18, 87

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		Lowest	Highest	Mean	Percent
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40	6	1	6	3.5	33
50	6	3	8	5.5	66
60	6	4	9	6.5	83
70	7	4	10	7.0	85

* Computer Intelligence, January 1986.

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Woburn, Massachusetts 01801
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TFC 925A Controller
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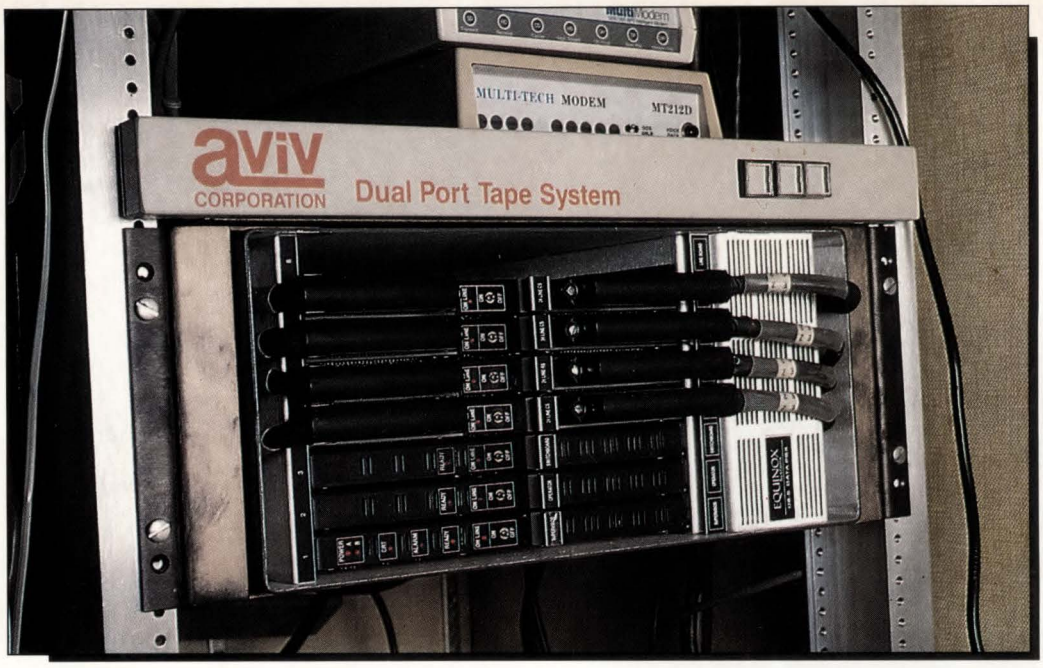
Tape Resource Sharing,
Model DPS 805
Price: $2,100



is about 50,000 blocks and is essentially contiguous.

A simple backup of this file took 8:10. Again, a rather measly 51 KB/second.

Q: Is it the ESDI drives and the Wombat?

A: I installed my trusty Emulex QD32 and 2.4 MB/second Fuji 2333 to see if the Wombat controller was at fault. I got the same data rate again — approximately 50 KB/second. Clearly, I was on to something. After all, this is a MICROVAX II!

Perhaps BACKUP is to blame. Perhaps there's something in the program that's producing CPU binding. The next test, I reasoned, should be to unload the CPU as much as possible.

The answer emerged as soon as I tried BACKUP with the /NOCRC qualifier. BACKUP computes and stores a cyclic redundancy checksum (CRC) in each data block to help it recover bad tape reads. This is in addition to any hardware CRC encoding performed by the tape drive.

The difference was amazing. The CPU time reported by CTRL-T went from 33 minutes to less than five. The wall time went from 41 to 24 minutes. CPU use (via MONITOR SYSTEM) went from 85-90 percent to about 25 percent, while the physical I/O went from 15/second to about 35/second!

The prime reason is that the CRC instruction is one of the few "emulated" on the MICROVAX II and, therefore, is an Achilles heel. Yes, here it is, right in the heart of the most widely used DEC utility in VMS! And I thought those DEC engineers studied billions of lines of code when they chose the instructions to emulate. Hmm . . .

THE CALCULATED DATA RATE now reached 86,111 bytes/second. Much better, but still far off the expected mark — I was hoping to break 100,000 bytes/second. One observation was that there still was much pausing even though the drive really moved when it got going. Perhaps if I put back the /BUFF:5 parameter and tried again, I thought.

On the next try, the elapsed time was 16 minutes, while the CPU time was 4:41. The calculated data rate was 129,166 bytes/second. BUFF:5 is a potent parameter. It must allow a faster physical I/O via a classic ring buffer system.

I noted that, for a time in the middle of the run, the tape stuttered quite a bit. The physical I/O rate went down from 39-43/second to 25-27/second. The disk being dumped was a near perfect specimen because it had just been restored from an image itself. I guess there are some directories in the middle that are very small, or there are a very large number of very small files.

The other alternative is to measure a single contiguous file, to see if it's merely directory overhead causing all of this. Such a measurement on a large file would maximize the data flow to the drive and minimize the effect of directory overhead.

Here are the results of a single file (52179 blocks, essentially contiguous) on the MICROVAX II:

```
BACKUP/BUFF:5/CRC
CPU: 8:16
Clock: 8:57
Data rate: 52,000

BACKUP/BUFF:%/NOCRC
CPU: 0:48
Clock: 3:24
Data rate: 137,000
```

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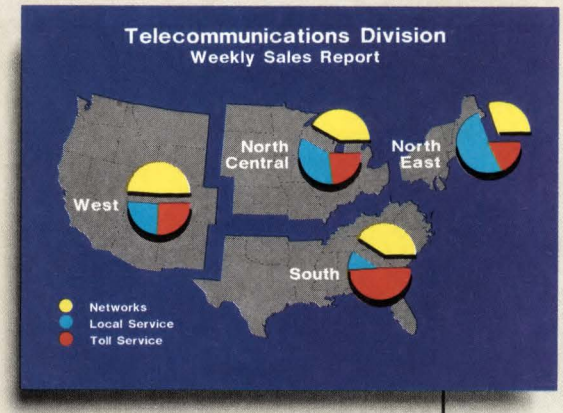

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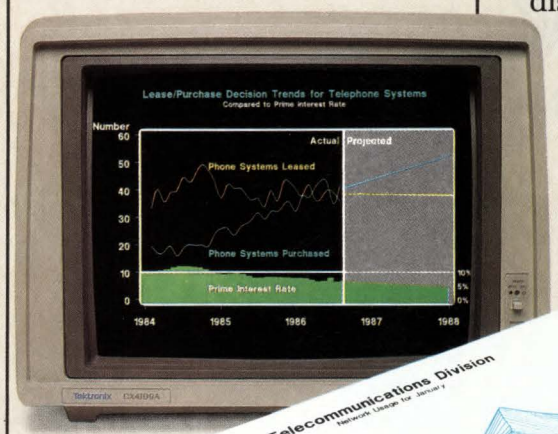

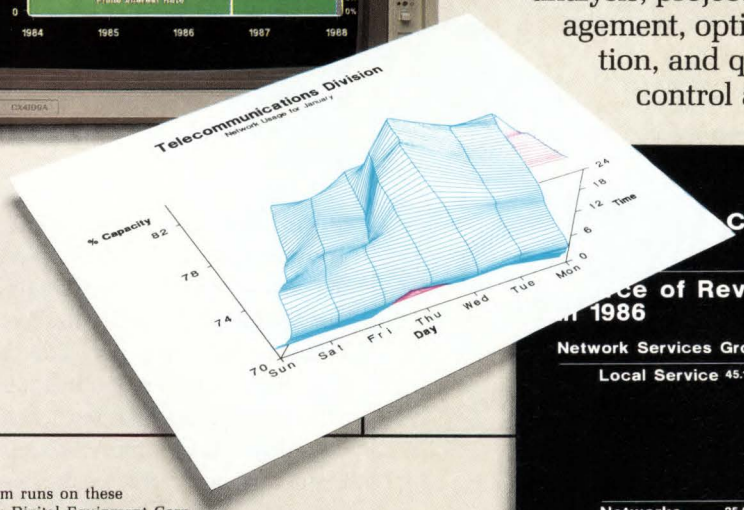

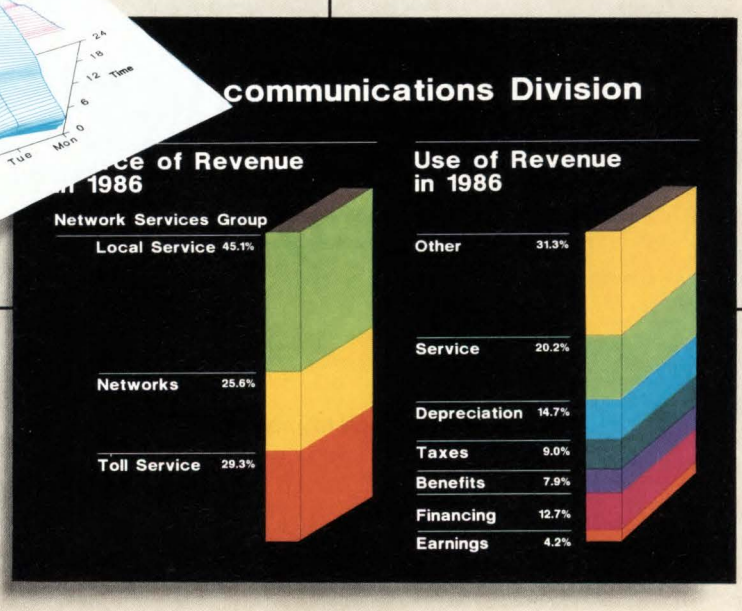

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Here, clearly isolated, we see that the CRC computation is the bad guy! The computation causes the job to run almost three times as long, and contributes almost nine times as much CPU! The absence of heavy directory overhead allowed the net data rate to rise approximately 10 MB/second.

Another test was to perform a similar experiment on the 750 (which has the native CRC instruction) and the same physical tape drive.

Here are the 750 results with a 32.767-MB contiguous file:

```
BACKUP/BUFF:5/CRC
CPU: 6:12
Clock: 5:30
Data rate: 99,300

BACKUP/BUFF:5/NOCRC
CPU: 1:25
Clock: 3:49
Data rate: 140,000
```

It's evident that even though the CRC is considerably more CPU intensive, it's not nearly as bad as the same on the MICROVAX II.

In the /NOCRC example, it seemed that the drive was spinning "flat out." Perhaps this test is bringing us to the upper limit with 8K blocks on a start-stop drive. The best test of this would be a program to write larger blocks.

BACKUP, fortunately, is capable of larger block sizes via the /BLOCK_SIZE:n parameter. I worked with my 32-MB file on the 750 and went for the max:

Block	Data rate	Wall	CPU
8192	153,000	3:37	1:22
16384	182,000	3:00	1:00
32768	206,000	2:41	1:00
65534	218,000	2:29	0:53

At the 65534 block size, the tape was practically a streamer. The curve was flattening toward a limit of approximately 230 KB/second. This was on an unloaded machine, except for roughly five ARIS users.

The system manager faces tradeoffs in establishing backup procedures. Truly massive data rates *are* attainable at the cost of the additional *software* CRC that VMS BACKUP performs. Personally, I choose the larger data rate, because most (all?) tape drives, including our STC, perform a *hardware* CRC anyway. I'd rather run a lot more backups more frequently, and rely on the hardware CRC and lots of high-quality, fresh tape. ■

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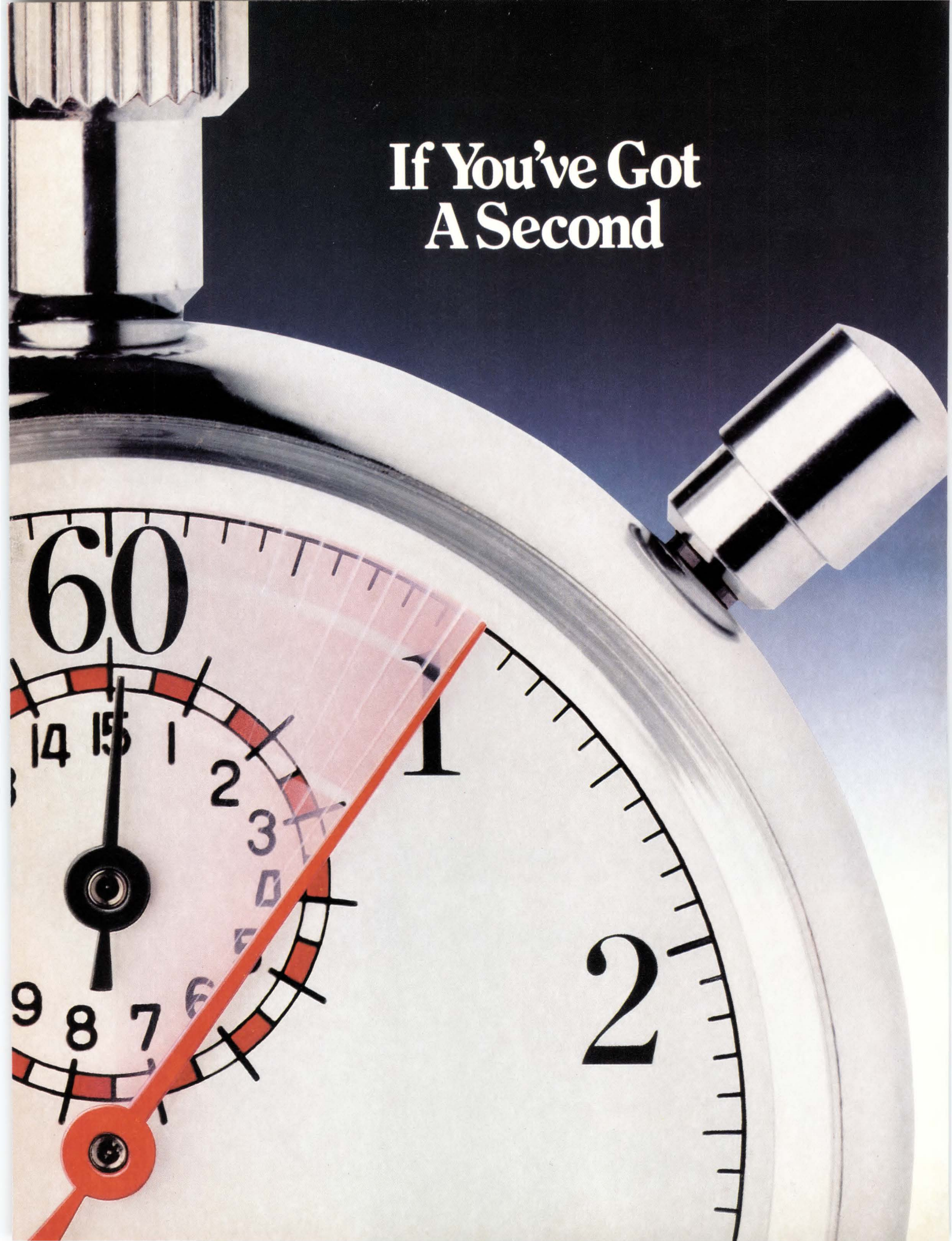
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MANAGING YOUR MICROVAX

David W. Bynon

Data Management

So now your MICROVAX is fully installed (it's humming along and feeling perky), the users are all trained and happy (electronic mail abounds in the system), and the boss is getting used to not having a paper-cluttered desk. Now what? Well, Mr. and Ms. MICROVAX manager, don't relax. You have work to do. You have data to manage!

It may be small, but the MICROVAX is a powerful resource. A *DEC PROFESSIONAL* reader wrote recently of her new MICROVAX II system with 16 MB of memory, an RA81 disk drive, 20 terminals, and 10 DEC microcomputers connected via DECnet. For those of you gasping, configurations such as this are common. A properly configured MICROVAX is a tried and true workhorse.

Keeping up with the MICROVAX system and its users is not as simple as making sure the hardware is in perfect working order and the users are content. Part of the MICROVAX system manager's job is to preserve user data; i.e., document-files, databases, program source code, and so on, and to maintain a healthy file system.

System Backup

I have a motto about data: "Save it now while you still have it." I can't understand users who spend hours and hours editing a document or building a spreadsheet, only to lose it to a system crash or other failure. Such an instance is not the system manager's fault, and the best you can do is teach the user to save his work often. However, if a user loses an old file (a file older than a day), whether it's the user's fault is inconsequential; it's the MICROVAX system manager's fault if the file wasn't backed up and recoverable in some previous form.

System backup is a serious part of the MICROVAX system manager's job. Consider the number of people using your MICROVAX system, the number of hours they use it, and the last time you performed a system backup. The man-hours add up. If, for example, you have 11 system users who average three hours a day on the system and you back up only once a week, your organization potentially could lose 165 man-hours due to a disk failure or other catastrophe.

The most difficult part of system backup is getting organized and coming up with a scheme that works for you. Just as every MICROVAX system is a little different, so too should be the backup plan. Here are some steps to get you going:

1. Determine your backup needs. How critical is your data? Do users create enough data to warrant daily backup? Every other day? Weekly? How quickly must you be able to restore after a data loss?
2. Determine your primary and, if possible, secondary backup medium. MICROVAXs come in configurations with RX50, RA60, TK50, TSV05, and an abundance of third-party offerings. This is important, because you need to know what tapes or disks to keep in stock.
3. Determine when you can back up. Is it critical that all files be backed up in full (i.e., must all user activity be shut down)? Can your backup fit on a single volume (i.e., one tape or disk)?
4. Decide how you'll keep track of the backup volumes.
5. Decide how you can store your volumes to form a library.
6. Decide how long you will keep backup volumes. Does your application require long-term archive recovery? Are the files currently on the system that all the users care about?
7. Write a command procedure to automate the whole process.

When and how often you back up should be based on the amount of data your system generates and the type of backup device you have. For example, if your system and users generate 10 MB of new data a week, and you use a TK50, you might think about tossing a TK50 cartridge in the drive every Friday afternoon and submitting a backup command procedure for batch processing over the weekend. On the other hand, if your system backup device is an RX50 and the system produces 30 MB of new data per week, you should consider coming in early each morning to do the backup. You also should think about getting a tape drive.

System backups come in two basic flavors: the *image backup* and the *incremental backup*. An image backup is a full copy of a disk volume. It can be used to restore the contents of a disk completely, or to retrieve a single file. An incremental backup is a copy of the files and their parent directories created since the most recent backup. An incremental backup is used to supplement an image backup when a volume must be restored.

The image/incremental backup strategy is used to save time and backup media. For example, at one of my sites we have a MICROVAX II with four RA81 drives. Recent image backups on this system, using a TSV05, consume 15-16 tapes and several hours of the operator's

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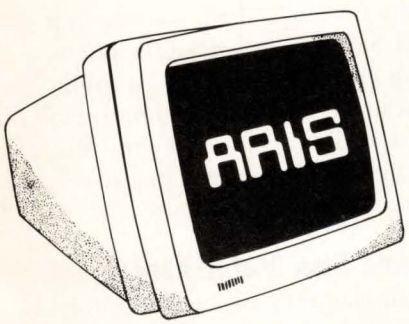

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PROGRAM 1.

```
$!-----------------------------------!
$! VAX/VMS BACKUP UTILITY            !
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$!-----------------------------------!
$!
$! SITE-SPECIFIC DEVICE DEFINITIONS
$!
$ PRIM_SRC = "DUB"              ! PRIMARY SOURCE DEVICE TYPE
$ SEC_SRC  = "DUA"              ! SECONDARDY SOURCE DEVICE TYPE
$ PRIM_DEST= "MUA"              ! PRIMARY BACKUP DEVICE TYPE
$ SEC_DEST = "DUA"              ! SECONDARY BACKUP DEVICE TYPE
$ DEF_SRC  = "DUB1:"            ! DEFAULT SOURCE DEVICE
$ DEF_DEST = "MUA0:"            ! DEFAULT DESTINATION DEVICE
$ BACKUP$DISK = "SYS$COMMON:[SYSMGR.BACKUP]" !DISK & DIRECTORY OF AUTOBACK.COM
$ WRTLCK   = "DUB1:,DUA0:"      ! DRIVES TO SOFTWARE WRITE LOCK
$ TAPE_DEV = "MU"               ! SITE TAPE DEVICE MU, MT, MM...
$!
$! DEFINE VT100 ADVANCED VIDEO MODES (NOTE: IF USING A VT200 FAMILY TERMINAL
$! YOU MUST REDEFINE THE ESCAPE CHARACTER, OR SET YOUR TERMINAL TO VT100
$! MODE).
$!
$       esc[0,8] == %X9b                ! ASCII escape
$       erase == "[J"                   ! VT100 erase screen seq
$       home == "[H"                    ! VT100 home cursor seq
$       dbl1 == "''esc'#3"              ! Double height char seq 1
$       dbl2 == "''esc'#4"              ! Double height char seq 2
$       rev == "''esc'[7m"              ! Reverse video
$       nor == "''esc'[0m''esc'5"       ! Normal mode
$       bold == "''esc'[1m"             ! Bold characters
$       goXY == "''esc'["               ! Goto line;column
$!
$! DEFINE SPECIAL COMMANDS
$!
$       CLR == "write sys$output esc,home,esc,erase"    ! Clear screen
$       SAY == "write sys$output"                       ! Write a string
$!
$! GET THE NAME OF THE DEVICE TO BE BACKED UP
$!
$ GET_SOURCE:
$       clr
$       say bold,dbl1,"Enter the source device:"
$       say bold,dbl2,"Enter the source device:",nor
$       show device 'prim_src'
$       if sec_src .nes. "" then show device 'sec_src'
$       say ""
$       inquire source "What disk would you like to backup ['']def_src']"
$       if source .eqs. "" then source = def_src
$!
$! GET THE NAME OF THE BACKUP (DESTINATION) DEVICE
!
$ GET_DESTINATION:
$       clr
$       say bold,dbl1,"Enter the destination device:"
$       say bold,dbl2,"Enter the destination device:",nor
$       show device 'prim_dest'
$       if sec_dest .nes. "" then show device 'sec_dest'
$       say ""
$       inquire dest "What device would you like to backup to ['']def_dest']"
$       if dest .eqs. "" then dest = def_dest
$       if (f$locate("''dest'","''wrtlck'") .eq. f$length("''wrtlck'")) then -
          goto backup_type
$       clr
$       say "Drive ''dest' is software write-locked."
$       exit
$!
$! GET THE TYPE OF BACKUP (FULL, INC...)
$!
$ BACKUP_TYPE:
$       clr
$       say bold,dbl1,"Enter the type of backup:"
$       say bold,dbl2,"Enter the type of backup:",nor
$       copy sys$input sys$output
```

time. The system is backed up every day. The incremental backups, on the other hand, require only one tape and take just a few minutes.

Backup command procedures are as varied as the DEC computer sites you find them in. It would be impossible for me to say what your requirements are. You'll have to assess your own situation and make these decisions. However, I've included a command procedure called AUTOBACK.COM, which has proved useful to me at a number of sites (see Program 1). I use it for most of my MICROVAX (and VAX) backup chores. One nice feature of the procedure is that it shows you available devices. If, like me, you manage many VAX systems, you'll appreciate this feature.

At the beginning of the AUTOBACK.COM procedure are a number of symbols that you can modify to comply with your system configuration.

Off-Site Storage

In addition to regularly backing up your system, you should keep off-site storage. This is a media safe or cabinet in a location separate from your computer facility or office. It protects you in the event of a fire or flood. Think how cheap it would be to keep a monthly system backup and copies of software distribution in an off-site location, compared to what it would cost to replace the data. You can't lose by implementing an off-site storage program.

File And Disk Maintenance

Disk capacity is by far the worst problem to plague the MICROVAX. Because of the small disk systems, the MICROVAX system manager must be frugal about the use of disk space and be knowledgeable about problems related to small disk systems. He also must perform file and disk maintenance more often.

File and disk maintenance isn't a file or disk repair operation, as the name implies. Rather, file and disk maintenance

is the care and feeding of a file system, including both system and user directories.

Disk Fragmentation

Of the many problems associated with small disk systems, fragmentation is the killer. It goes completely unnoticed at most sites. The reason is because fragmentation occurs gradually over a period of time. It's neither a hardware problem nor a software problem; it's an inherent characteristic of all disk systems.

Fragmentation develops after a disk has been in use for a while or fills to a certain capacity. Because of the randomness at which files are written and deleted, after a certain point, files no longer can be written to contiguous blocks on the disk. When this happens, the disk's available storage is said to be fragmented; storage is available only in small blocks scattered about the disk rather than in one large continuous space. While the disk still is capable of storing data in these small blocks, it takes much longer to do so. So, after a time, a perfectly good disk in hardware working order will degrade the performance of your system.

There are a couple of methods to cure a fragmented disk. The first (and cheapest) method is simply to perform a full backup and restore of your disk. This works because the restore operation writes the files back, in as contiguous an order as possible. How often you do this will depend on the amount of activity on your system.

The second method is to purchase and use a disk structuring utility (see related articles in *DEC PROFESSIONAL*, November, 1986, Vol. 5, No. 11, page 70; and, in February, 1987, Vol. 6, No. 2, page 46). These utility programs rid your disk of fragmentation and restructure the disk for faster operation.

Purging And Deleting Old Files

No system management chore is more mundane than bouncing around from directory to directory purging and

PROGRAM 1. . . . continued

```
The following backup methods are available:

        INC     -       Backup files created since the last backup
        FULL    -       Backup all files
        SAVESET -       Backup specified files to a BACKUP Save Set

$       inquire backtype "What type of backup do you want [INC]"
$       if backtype .eqs. "" then backtype = "INC"
$       if backtype .nes. "INC" .and. -
           backtype .nes. "FULL" .and. -
           backtype .nes. "SAVESET" then goto backup_type
$       if backtype .nes. "SAVESET" then goto verify_type
$!
$! IF SAVE_SET BACKUP, ASK FOR THE FILE_SPEC
$!
$ GET_FILESPEC:
$       clr
$       say bold,"Please enter the <files-spec> to be backed-up."
$       say "Example:  [MYDIR...]*.*"
$       say "(If the <file-spec> is not found you will be asked again)
$       say "",nor
$       inquire/nopunc files "Files: "
$       if files .eqs. "" then goto get_filespec
$       if f$search("''files'") .eqs. "" then goto get_filespec
$!
$! ASK FOR A SAVE_SET NAME
$!
$ GET_SAVSET:
$       say "",bold
$       say "Please enter the <directory-spec> and SAVE_SET name."
$       say "Example:  [MYDIR]MYFILES.BAK"
$       say "",nor
$       inquire/nopunc savset "Save set: "
$       if files .eqs. "" then goto get_savset
$!
$! VERIFY THAT THE USER KNOWS WHAT THEY HAVE ASKED FOR
$!
$ VERIFY_TYPE:
$       clr
$       bcktyp = "n incremental"
$       if backtype .eqs. "FULL" then bcktyp = " full"
$       if backtype .eqs. "SAVESET" then bcktyp = " save set (''SAVSET
$       say bold,"You want a''bcktyp' backup of ''source' to ''dest'"
$       inquire ok "Is this correct [Y/N]''nor'"
$       if .not. ok then goto get_source
$!
$! CREATE THE BACKUP JOB FILE
$!
$       open/write outfile 'BACKUP$DISK'bckupjob.com
$       write outfile "$srcmnt = ""FALSE"""
$       write outfile "$if f$getdvi(""''source'"",""MNT"") ", -
          ".eqs. ""TRUE"" then goto no_mnt"
$       write outfile "$mount ''source' /noshare/over=id"
$       write outfile "$srcmnt = ""TRUE"""
$       write outfile "$NO_MNT:"
$!
$! DETERMINE BACKUP TYPE AND WRITE THE CORRECT COMMANDS
$!
$       if backtype .nes. "INC" then goto full_backup
$       volname = f$getdvi("''source'","VOLNAM")
$       write outfile "$mount /for/noshare ''dest'"
$       write outfile -
          "$backup /log/fast/record/ignore=inter/since=backup ", -
```

deleting old files. However, purging log files, temporary files, and the like is necessary for the obvious reason that it frees disk space and possibly contiguous space.

One solution to the excess file problem is to define a file version limit for specific files or directories. This, in effect, makes files self purging. The DCL commands used for this purpose are:

```
$ SET FILE /VERSION_LIMIT=n
  file_spec
$ SET DIRECTORY /VERSION
  _LIMIT=n directory_spec
```

The SET FILE /VERSION_LIMIT command limits the number of versions to "n" for the specified file. The SET DIRECTORY /VERSION_LIMIT command limits the number of versions for files created in the specified directory.

Effective File Systems

How you maintain your file system and set up your directories will play a significant role in the usefulness and performance of your disk system — usefulness being ease of use in an organizational sense, and performance being how long it takes the system to locate files.

Due to the way VMS searches for files, it's more efficient to have many directories with fewer files than to have fewer directories with many files. Those who use Digital's *ALL-IN-1* software and choose to use only one shared file cabinet, will feel the consequences of this mistake. As the number of files in a directory increase; so will the time it takes to find them.

Creating multiple directories and subdirectories is another reason to promote a superior file organization. When I train new VMS users I explain how VMS directory structure is like a file cabinet. The top level (login) directory is the cabinet, the drawers are second-level directories, the folders are third-level directories, and so on. I've found that directory structures with as many as two to three sub-directory levels work the best. Any more, and the file specifications become too cumbersome.

Limiting Disk Usage

I'm not a big fan of limiting the amount of disk space a user can consume. If users want to be creative, so be it. This is one of the reasons we have computers. However, if users want to be wasteful, we have a way to deal with that as well — the DISK QUOTA utility.

The DISK QUOTA Utility is a VAX/VMS system management tool that allows the MICROVAX system manager to control disk volume use. DISK QUOTA permits the specification of two quotas for each user or UIC, *permanent* and *overdraft*. The permanent quota specifies, in disk blocks, the amount of disk space a user can consume on a disk volume. The overdraft quota defines the number of additional blocks a user can consume when he has exceeded his permanent quota.

Each disk volume under DISK QUOTA control requires a data file called QUOTA.SYS, which resides in the root directory ([000,000]). The file must be created before you can enable DISK QUOTA protection. For example:

```
$ MCR DISKQUOTA
DISKQ> USE DUA0:
DISKQ> CREATE
DISKQ> ^Z
$
```

Once the QUOTA.SYS file has been created for a volume, you may add users or accounts:

```
$ MCR DISKQUOTA
DISKQ> USE DUB1:
DISKQ> ADD BYNON
  /PERMQUOTA=10240
  /OVERDRAFT=512
DISKQ> SHOW BYNON
UIC [BYNON] has 0 blocks used
of 10240 authorized, 512 permitted
  overdraft.
DISKQ> ^Z
$
```

The DISKQUOTA utility is an effective system management tool if you need to enforce disk usage.

Don't overlook the importance of data management. It took a *lot* of time and money to produce the information on your system, but it only will take you a *little* time and effort to keep it available to the users.

David Bynon is a VAX systems consultant in Washington, D.C.

PROGRAM 1. . . . continued

```
          "''source'[*...] ''dest'backup.inc"
$       goto common
$ FULL_BACKUP:
$       if backtype .nes. "FULL" then goto savset_backup
$       volname = f$getdvi("''source'","VOLNAM")
$ FULL_TO_DISK:
$       if f$locate(tape_dev,dest) .ne. f$length(dest) then goto full_to_tape
$       write outfile "$mount /for/noshare ''dest'"
$       write outfile "$backup /log/init/record/image/ignore=interlock ", -
          "''source' ''dest'"
$       goto common
$ FULL_TO_TAPE:
$       write outfile "$initialize ''dest' backup"
$       write outfile "$mount /for/noshare ''dest'"
$       write outfile "$backup /log/init/record/image/ignore=interlock ", -
          "''source' ''dest'''volname'.bak/save_set"
$       goto common
$ SAVSET_BACKUP:
$       write outfile "$mount /for/noshare/over=(id) ''dest'"
$       write outfile -
          "$backup /log ''source'''files' ''dest'''savset'/save_set"
$ COMMON:
$       write outfile "$dismount ''dest'"
$       write outfile "$if srcmnt then dismount ''source'"
$       close outfile
$!
$! EXECUTE THE JOB FILE
$!
$       clr
$       say bold,dbl1,"System backup in progress..."
$       say bold,dbl2,"System backup in progress..."
$       say bold,rev,goXY,"23;30H[ Please Wait ]",nor
$       say esc,"[5;20r"                                    ! set scroll region
$       say goXY,"5;1H "
$       @'BACKUP$DISK'bckupjob
$       delete 'backup$disk'bckupjob.com;*
$       if f$getdvi("''dest'","MNT") .nes. "FALSE" then goto logfail
$       say esc,"[1;24r"                                    ! set scroll region
$!
$! LOG THE BACKUP TO THE BACKUP LOG FILE
$!
$       open/append outfile 'BACKUP$DISK'sys$backup.log
$       date = f$time()
$       write outfile "Disk ''source' backed-up to ''dest' on ''date'"
$       close outfile
$       clr
$       say bold,"Backup complete.",nor
$       exit
$!
$! LOG THE BACKUP FAILURE TO THE BACKUP LOG FILE
$!
$ LOGFAIL:
$       open/append outfile 'BACKUP$DISK'sys$backup.log
$       date = f$time()
$       write outfile "Backup of ''source' to ''dest' failed on ''date'"
$       close outfile
$       dismount 'dest'/nounload
$       clr
$       say bold,"Backup failed to complete.",nor
$       exit
$!
$ NO_SUCH_DEV:
$ DEV_MOUNTED:
$ EXIT:
```

RSX CLINIC

By James McGlinchey

I respond to those questions that are interesting and applicable to the general RSX user. Please mail your questions to: RSX Clinic, *DEC PROFESSIONAL*, P.O. Box 503, Spring House, PA 19477-0503. Questions also can be submitted through ARIS.

SACROSANCT BUFFERS

QUESTION: *I have an RSX task that is clogging my system when it shouldn't be. I have its priority set low, and it is checkpointable, yet it takes a long time to get out into the checkpoint file. Is there some way to speed up checkpointing in RSX?*

REPLY: Strictly speaking, your problem isn't checkpointing, but rather the effect that DMA I/O has on an RSX task. The RSX Executive regards buffers used for DMA transfers to be sacrosanct because DMA I/O in an RSX system is buffered directly into the specified task buffer. A task's buffer, therefore, must be kept in memory when DMA is outstanding, even to the effect of holding up checkpointing and task aborts while the DMA I/O is in progress. This is a design consideration to maximize I/O speed in RSX, and is not (should not be) changed.

Look elsewhere in your system for the cause of this problem. I/O requests in RSX are initiated on the basis of the requesting task's priority; a high-priority task could cause this effect if it is doing intensive DMA operations. A sure-fire fix for this particular problem, if you are using RSX-11M-PLUS, is to put the buffers in a dynamic region. Since the DMA buffers then are external to the task, the task will be checkpointed, leaving only the buffer in memory.

COMMUNICATION PROBLEMS

QUESTION: *Using a PDP-11/44, LAT-11, RSX-11M-PLUS, Ethernet, and DECserver 100, we need to address physical ports on the DECserver 100 in order to communicate with slave devices. These devices are used in a process-control environment and are "polled" by the PDP. As such, we need to initiate (from the PDP) communications with a specific physical port on a specific DECserver.*

I understand that the device names on the DECserver are issued dynamically so that physical port 1 could be LTA1: or LTAn:. As long as we can determine the device name of the physical port, I think our problem is solved.

REPLY: You're right. The DECserver port name is assigned dynamically as the data path is created, and therefore can

be assigned a random terminal number. In order to coerce a specific port-to-terminal assignment, about the only thing you can do is create the server port/terminal correspondence at boot time, before anyone else has had a chance to log in and grab a DECserver port. You then will get the same port assigned to the same RSX terminal number. It's not elegant, I know, but it will work, and it's probably the only practical solution. (Thanks are due to Jim Dunn of Simmonds Precision, Vergennes, Vermont, for his help with this question.)

WRITING ACPs

QUESTION: *Where can I get documentation describing the requirements for a user-written Ancillary Control Processor (ACP)? I am using RSX-11M-PLUS version 2.1.*

REPLY: An ACP typically is used to implement a protocol across a class of devices. It can be viewed as an intelligent extension of a device driver, although it is inherently more flexible, as ACPs can take advantage of services and control mechanisms available only to user tasks. Since it is a task, it can compete with other tasks for system resources more equitably than can a device driver. Since an ACP is not bound to a specific device, it can perform I/O to other devices during the processing of an I/O request. ACPs are tricky to write, requiring experience writing RSX device drivers at least.

The following documents would help:

McGlinchey, J.: "What's an ACP?" *Fall 1981 DECUS Symposium Proceedings;*

Stamerjohn, Ralph: "Sample ACP," *Spring 1980 DECUS RSX Symposium Tape Collection;*

Stamerjohn, Ralph: "Up Your ACP," *Spring 1980 DECUS RSX Symposium Tape Collection.*

STUCK SERIAL LINES

QUESTION: *How may I clear a serial line that has become "locked up"? This problem typically occurs when a device other than a terminal (CPU, plotter, etc.) has been hooked to a line that is not slaved, and one or more characters have been "typed." The offending characters might include Control-S, but not always.*

REPLY: Stuck serial lines are cleared heuristically; that is, find out what's wrong and fix it. The best cure is prevention, and your question contains its own answer. Ports for non-terminal devices should be set SLAVE and Read-Pass-All (RPA). Your serial port gets locked up because one of those Control-S characters gets to MCR and causes the port to stop absorbing characters. ■

OPINION

Bob Besner

DEC For The Defense

The defense of the nation is based on automated data processing technology, and VAX architecture plays an important, if subordinate, role. VAX/VMS is not ranked highly as part of embedded weapon systems or as a weapons command and control system, however, it's used extensively by defense contractors and the government bureaucracy to accomplish many worthwhile tasks, including equipment maintenance and personnel record keeping. By providing a more secure computing environment, DEC could enhance its defense potential greatly.

The U.S. Department of Defense published evaluation criteria several years ago for "trusted computer systems." This presented a yardstick for assessing the security of computers like the VAX for the processing of classified information. It also provided development guidance for manufacturers. Other western governments, including Canada, adopted the criteria for defining acquisition requirements. The criteria is divided into a hierarchical structure with each of the divisions representing a major improvement in the overall confidence level of a system.

The scope of a trusted environment includes protection mechanisms incorporating hardware, firmware, software, documentation and personnel controls. The system is evaluated for trustworthiness from the point of its initial design to it's final application within the defense envelope. DEC, like most computer vendors, is secretive about its in-house development efforts, however, this is an insufficient level of protection for defense purposes.

The classification criteria is grouped into the following levels:

1. Minimal Protection Discretionary/ Controlled Access. This is the most fundamental level of protection defined in the criteria. A system must provide credible controls, limiting computer access on an individual basis. Users must be able to protect private information and keep others from accidentally reading or destroying their data. This environment also must be acceptab le to cooperative users processing data at the same level of sensitivity.

> ***"VAX/VMS delivers part of the mandatory protection structure . . ."***

The key to this level of security is that it's discretionary. Much of the control is applied as needed and specified by the system manager.

VAX/VMS meets this minimum standard very well in that it provides a framework for separating users and data. The system has access control lists identifying users and files, forces users to authenticate their identity with a password, and allows them to specify and control file sharing. It also protects the operating system from user tampering and links the operating system to hardware. Finally, the manufacturer's detailed documentation is not available readily to the masses.

2. Monitor Level Mandatory Protection. This classification level, which includes the above requirements, also imposes mandatory access control over objects — exported information in particular. Permissions must follow a file even when the file is moved to a new location, and default access levels must be built for new files. The labels and control structure surrounding a file must not be ambiguous when information is being exported. Finally, any changes in the computer's configuration must be auditable by the operating system.

It's necessary that the system control the routing of data (files or reports) to appropriately labeled devices, according to the sensitivity level of the data. The system also has to notify the user of the data's sensitivity level and of any changes made to it during an interactive session.

An audit trail for the system administrator helps identify most access-type events on the system. The communication path between a process and a user must be initiated by a user and be worthy of trust. This includes the examination of a channel by actual measurement or engineering estimation for a maximum bandwidth. Under mandatory controls, the system also tracks the configuration management and software design.

VAX/VMS delivers part of the mandatory protection structure, however, whether DEC can take credit or whether it's a result of the hard work of systems programmers is debatable. There are

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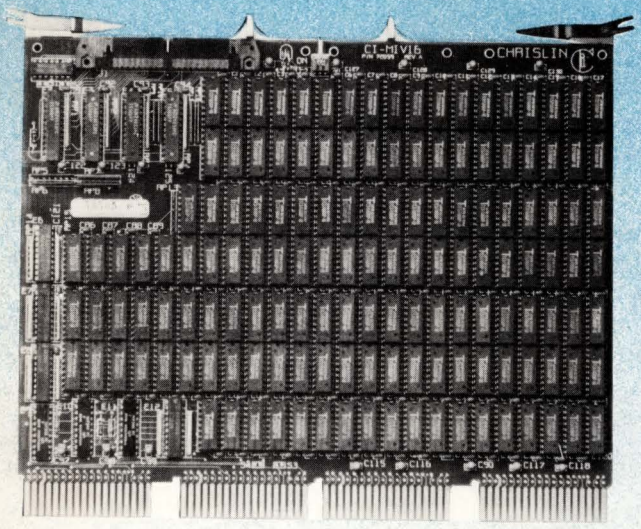

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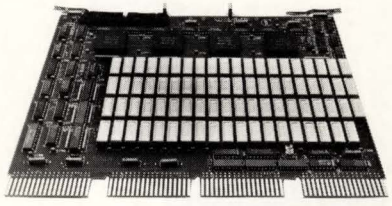

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major deficiencies in VAX/VMS security when judged against this level of criteria. The control block structure used to support users, groups and files under VAX/VMS is effective, but systems programmers know them and they're written on accessible disk media. You could substitute a different printer or terminal on the end of a cable, for example, without the operating system detecting it. You also could control report routing through home grown routines. Finally, too much of VAX/VMS security is based on optional controls.

Those of us who like the VAX try to convince our superiors that, with a little tinkering, it could meet most of the requirements defined for this level of security. One solution is to isolate them totally for classified processing in an enclosed, emission-free room. That approach works fine for the machines, but users don't like working in a cold, noisy, windowless room.

3. Extensive Verified Protection. Any system that can meet this highest level of security can process classified data. This category is functionally equivalent to the previous levels in that no additional architectural features are required. The distinguishing characteristic of systems in this class is the imposed use of formal security controls during both the design and in-service stages of the total system. You can trust a system at this level, because it has been rigorously planned, controlled, designed and built within a totally secure environment. The reference validation mechanism is tamper proof, always invoked during the life cycle of the system and tested for completeness. Unless you actually worked on the development of one of these systems, you wouldn't even know they existed.

Full certification by the Department of Defense isn't easy to achieve but, once obtained, says something important about your computer. Who knows — maybe DEC has one in the works, but the VAX certainly isn't it.

VAX/VMS has admirable capabilities, but was developed essentially for cooperative, friendly users. As DEC makes progress on features required to reach higher levels of security, it will gain wider acceptance in the defense community. The defense procurement process may not provide sufficient incentives to develop security features, however, combined with incentives from financial institutions DEC could make inroads in this area.

Bob Besner is a systems analyst involved in the development of online bilingual applications for the Canadian government.

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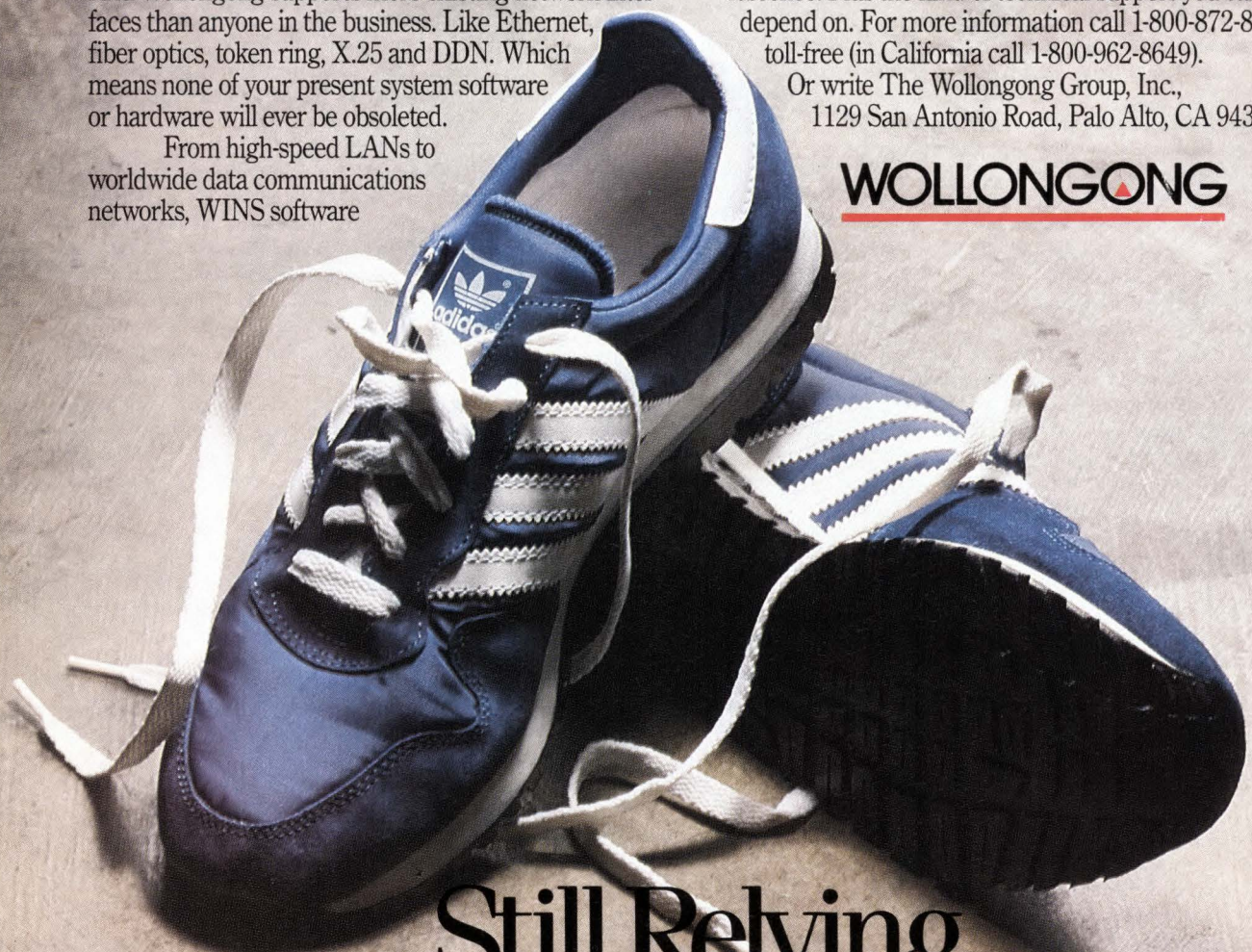

Still Relying On The Old System For Network Communications?

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DEC PROFESSIONALS

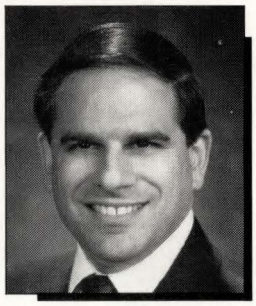
Rex Jaeschke is a Reston, Virginia-based independent computer consultant, writer and lecturer. While he has experience in a wide variety of applications hardware and operating systems, his specialties are PDP-11 and VAX-11 environments, and the C language. Much of Rex's current work is with PDP-11/73s and 11/44s in real-time, process control with RSX-11M-PLUS and RSX-11s, DECnet, FMS-11, FORTRAN, MACRO-11 and color graphics.

In the C arena, Rex is the co-founder and editor of *The C Journal*, a quarterly publication on the C language. He also is a member of the ANSI C Standard's Committee and writes regular columns on C and microcomputing. Rex received his education from the South Australian Institute of Technology.

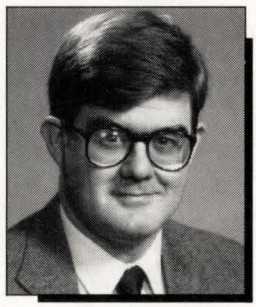
Victor J. Chorney has worked in data processing for 25 years and has held positions ranging from programmer to systems analyst, from remote system operator to systems programmer, from DP training manager to project manager. Vic has worked in many different application environments, including all areas 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.

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 and has presented several sessions at DECUS and various user-group meetings on relevant subjects.

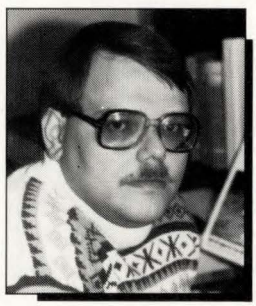
James McGlinchey is an independent software engineering consultant specializing in the use of RSX and VMS in industrial and other real-time applications. An engineer by trade, Jim often can be found in waste water treatment plants and steel mills, up to his elbows in RSX system problems. Jim has spent over 12 years as an RSX systems programmer. He is the author of many articles on RSX and its use, including "RSX Clinic," a regular *DEC PROFESSIONAL* feature. Jim maintains his home and consulting base in Essex Junction, Vermont.



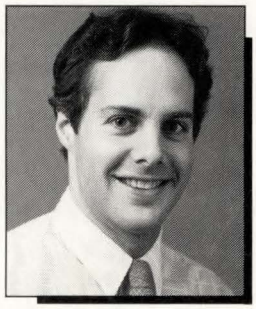
Victor J. Chorney



James McGlinchey



Kevin G. Barkes



Charles Connell

Kevin G. Barkes is a suburban Pittsburgh-based independent consultant. He specializes in VAX/VMS systems configuration, operation, tuning, management and training, as well as VAX-based large-scale publishing systems.

Prior to forming his consulting business, Kevin was systems manager of a Mid-Atlantic legal and financial printing company, manager of a small typesetting firm, coordinator of a governmental information-referral agency, and city editor of one daily and two weekly newspapers.

Charles Connell, East Coast editor, writes feature articles and works with professionals in the Boston 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.

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 is 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.

Phil's education includes a B.S. degree from the California Institute of Technology and graduate work at the University of California, Los Angeles.

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MARKETPLACE

68SU Slave Processor Made For VAXs

Ranyan Corporation introduced the first 68020-based supermicrocomputer designed to serve as a slave processor in high-volume data processing applications on VAX computers made by DEC.

Each 68SU has a UNIBUS-compatible port for interaction with the VAX and a VME-compatible port for interconnection with other 68SU units in clusters. When used in clusters, the 68SU slave units can coordinate the timing of their activities via a synchronous bit bus. A 32-bit wide DMA channel also is provided for communications between 68SU units. Each board set is connected to the VAX host by plugging it into a standard DEC BA-11 expansion chassis that resides in the VAX system.

The Ranyan Model 68SU slave processor is priced at $5,850 per two-board set with 1 MB of RAM memory.

For further information, contact Mr. Roger Aouizerat, president, Ranyan, Corp., 15239 Springdale St., Huntington Beach, CA 92649; (714) 895-5504.

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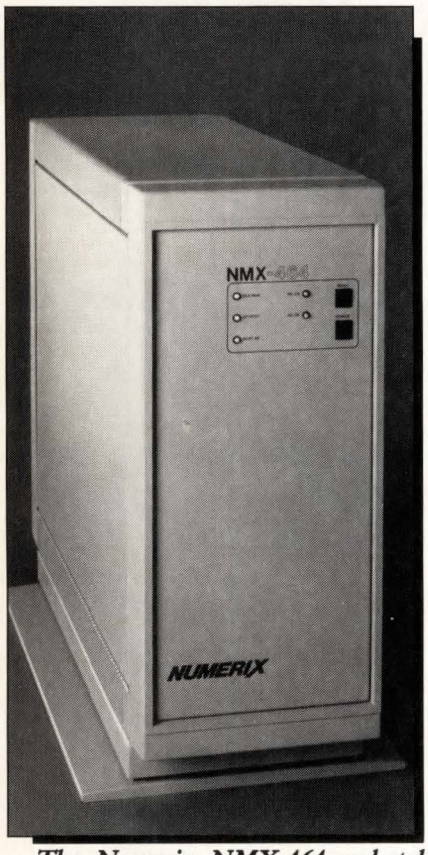

The Numerix NMX-464 pedestal mount configuration.

NMX-464 Provides Scientific Computing

Numerix Corporation recently introduced the NMX-464, a network resource that adds high-performance vector processing to VAX computers.

The NMX-464 is a unique computer engine that is tightly coupled to the VAX hardware architecture and the VMS operating system. Its 64/32-bit mixed-mode arithmetic capability allows users applications to be optimized for speed versus precision in a single processor.

Integrated Vector Processing (IVP) software available with the NMX-464 allows transparent use of its vector processing capability in a VMS program development environment. An optimizing FORTRAN compiler which allows fast vector and scalar program execution with the need for microcode programming is included as a subset of the IVP software.

The NMX-464 entry-level price of $66,500 and a multiuser software package that allows up to four users access to its capabilities, provides an excellent match to the MicroVAX II or VAX 8200. A price/performance match is maintained when multiple units are used with higher performance computers such as the VAX 8550 or VAX 8800.

Find out more by contacting Numerix Corporation, 20 Ossipee Road, Newton, MA 02164-1444; (617) 964-2500.

Enter 904 on reader card

ASK Announces DecisionMaker

ASK Computer Systems recently announced the availability of its decision support software product, DecisionMaker, on DEC's VAX series minicomputers. DecisionMaker links ASK's MANMAN Information System directly to managers who need summary information in order to make decisions. With only a few keystrokes, managers instantly have the information they need, such as year-to-date sales, total inventory value or pro forma financial statements.

DecisionMaker ranges in price from $8,100 to $15,000, depending on the VAX computer model purchased (or already installed).

To learn more, contact ASK Computer Systems, Inc., 730 Distel Dr., Los Altos, CA 94022; (415) 969-4442. Telex: 297341.

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ACUCOBOL Has 3,500 LPM Compiles

Computer Cognition has announced the release of ACUCOBOL, a C-based, RM-COBOL compatible compiler for VAX/VMS and VAX/ULTRIX environments.

ACUCOBOL provides a development and a run-time environment under VMS that is compatible at the source level with software produced for the Ryan McFarland Version 2 COBOL compiler/run-time environment. ACUCOBOL code generated under VMS can be run under ULTRIX or any of the more that 25 separate UNIX operating systems to which ACUCOBOL already has been ported. Thus, COBOL programmers can write programs in ACUCOBOL for multiple operating system environments, or

Primavera Offers P3 With Graphics

Primavera Project Planner (P3) and Primavision plotter graphics from Primavera Systems, Inc., are project management software systems that give managers complete control over large and small projects.

P3's capabilities include critical path scheduling, resource allocation and leveling, and cost control. Primavision plotter graphics system produces time-scaled bar charts and network logic diagrams for use in project coordination and management review.

Both products are available on the VAX under VMS 4.2 or greater. The combined packages are priced at $12,000 for three-user VAX sites.

Contact Primavera Systems, Inc., Two Bala Plaza, Bala Cynwyd, PA 19004; (215) 667-8600. Telex: 910-997-0484.

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they may continue to use DEC COBOL for internal development, then recompile using ACUCOBOL in its DEC COBOL compatibility mode to migrate software to the UNIX marketplace. For existing UNIX applications, ACUCOBOL provides an easy migration path to ULTRIX and VMS operating systems.

Compiler pricing for DEC systems begins at $3,000, with run-time prices starting at $450 each.

ACUCOBOL may be ordered by contacting Computer Cognition, 6696 Mesa Ridge Rd., San Diego, CA 92121-2906; (619) 453-6660.

Enter 902 on reader card

DADiSP 1.03 Features DSP PIPELINE

DSP Systems announces version 1.03 of the DADiSP Worksheet, the first technical spreadsheet software for digital signal analysis.

DADiSP version 1.03 features the DSP PIPELINE. PIPELINE boosts the power of DADiSP substantially by allowing users to run external programs within the DADiSP environment.

DADiSP for IBM PC/XT/AT and compatibles requires the EGA, CGA, or Hercules graphics adapter. DADiSP directly supports nine different printers for hardcopy output. DADiSP also runs on workstation computers from DEC, Hewlett-Packard, and MASSCOMP.

The DADiSP Worksheet for PCs sells for $795 including six months of free updates and product support.

For more information, contact DSP Systems, One Kendall Square, Cambridge, MA 02139; (617) 577-1133.

Enter 903 on reader card

Data Entry Unveils Portable ScriptWriter

Portable ScriptWriter, an ultra-clipboard that takes handwritten data from a paper form and enters it directly into its own computer memory in ASCII code, was unveiled at COMDEX/Fall 1986 by Data Entry Systems.

The unit's writing surface holds standard paper forms that are completed in hand-printed characters with an ordinary ballpoint pen. A small LCD display provides real-time readout of data entered. Corrections are made instantly by printing over the erroneous character.

Ten different forms and 50,000 characters can be stored in ScriptWriter's standard memory on a single day. This capacity allows the storage of about 50 completed forms per day; additional memory is available for custom applications. ScriptWriter is compatible with DEC, IBM, Apple, Kaypro, and all computers that accept an RS232 serial port.

To learn more, contact Data Entry Systems, Inc., 6767 Madison Pike, Suite 195, Huntsville, AL 35806; (205) 830-2766.

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Windows For Data 2.0 Now Available

Vermont Creative software has released version 2.0 of Windows for Data. Windows for Data enables C-language developers to incorporate advanced windowing, menu, and data entry capabilities in their programs. It provides portability and high performance under DOS, XENIX, UNIX, and VMS.

A highlight of version 2.0 is an internal debugging system that traces errors and reports memory corruption. Other new features include a screen layout aid, foreign language compatibility, multiple choice fields, scrollable sub-forms, free-form field movement, and improved flexibility in form and menu management.

Object-code and full source-code versions are available for DOS, XENIX, UNIX, and VMS; and all versions are now royalty free. The PC-DOS versions of Windows for DATA is $295.

Contact Vermont Creative Software, 21 Elm Ave., Richford, VT 05476; (802) 848-7738.

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ONE COMMUNITY. ONE LANGUAGE.

Digital's VAX has become the foundation for a community of development systems – PDP-11s, 68000s and PC-ATs – yet, until now, no high-performance development language spanned the range of architectures and operating systems. Now there is one. **Pascal-2**™

Your VAX can become the development vehicle for PDP-11 code (RSX or RT-11 target), for MS-DOS applications, or for 68000/20 VERSAdos and UNIX systems through **Pascal-2** cross-compilers. And you can even turn the solution around and use our MS-DOS-to-VMS cross-compiler to offload your VAX. (We know what happens to VMS system response when six developers compile programs simultaneously!)

Oregon Software's matrix of **Pascal-2 native and cross-compilers** creates a single high-level development environment to solve the programming problems faced by the world's toughest industries – aerospace, communications, robotics, process control, medicine.

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Modula-2 Available For VAX/VMS And ULTRIX

A cross development Modula-2 language system now is available for the DEC VAX/VMS and ULTRIX computer systems. This product produces code for execution on target systems based on the Motorola MC68000 family of microprocessors and includes functionality to support applications stored in ROM. Output formats include Motorola S-records, Sun Microsystems UNIX workstation object files, and AT&T UNIX System v.2 Common Object File Format (COFF) object files. This product has been completed by Djavaheri Brothers.

Modula-2 is a programming language derived mostly from the PASCAL language. With Modula-2/68-CD, program modules can be compiled separately. An executable process then can be built by linking with other previously compiled program modules. This allows Modula-2 programs to be used for building complex software systems that use previously written and debugged subroutined libraries. For special computer systems based on the MC68000 processor family, the linked Modula-2 programs are written in the Motorola S-record format and then downloaded to standard development systems.

The price for the Modula-2/68-CD is $3,600.

For more information, contact Stan Oxborne, Djavaheri Bros., P.O. Box 4759, 697 Saturn Court, Foster City, CA 94404-0759; (415) 341-1768.

Enter 918 on reader card

Mdbs Releases GURU 1.1

Mdbs, Inc. recently released GURU 1.1, a new version of its expert system environment, GURU.

GURU's enhanced expert system capabilities allow users to process KnowledgeMan/2, dBASE III and dBASE III Plus files as though they were GURU tables, and to access Lotus 1-2-3 spreadsheets directly.

Other major enhancements announced are GURU's knowledge tree and case saving features. The knowledge tree allows developers to view a diagram of a rule set showing the relationships between variables, rules and goals.

GURU combines reasoning capabilities and familiar software development tools for embedding intelligence in applications and creating expert systems.

GURU 1.1 will sell for GURU's current price of $6,500.

To learn more, contact Mdbs, Inc., P.O. Box 248, Lafayette, IN 47902; (317) 463-2581. Telex: 209147 ISE UR.

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NRC Provides FNS For Fiber Optic LAN

Network Research Corporation (NRC) has entered into an agreement with Canstar Communications of Toronto, Canada, to provide its FUSION Network Software (FNS) protocols for a local area network (LAN) based on fiber optic technology to be marketed by Canstar. NRC will supply FNS source code to support TCP/IP protocols on the high-performance Canstar network.

The fiber optic LAN was developed by Canstar in conjunction with the Computer Systems Research Group of the University of Toronto. The LAN already has been beta tested successfully at several government facilities in the U.S. and Canada.

FUSION network software products from NRC currently are available to support a broad range of operating systems, including all popular versions of UNIX as well as MS-DOS and VMS. FNS runs on a variety of machines including 8086/8087-based systems, 68000-based systems, and VAXs. FNS supports the XNS protocols as well as TCP/IP.

For more information, contact Network Research Corp. at 2380 N. Rose Ave., Oxnard, CA 93030; (805) 485-2700.

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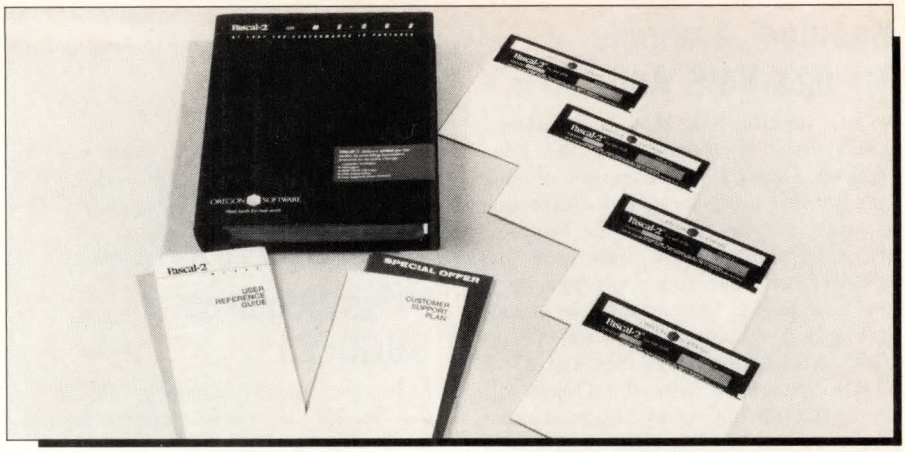
PASCAL-2 Compiler Available For MS-DOS

Oregon Software's PASCAL-2 compiler now is available for MS-DOS. Also available for the VAX, 68000, and PDP- 11 environments, PASCAL-2 for the PC generates extremely compact code that has been benchmarked as 10 to 40 percent faster than Microsoft PASCAL and two to three times faster than Borland's TURBO PASCAL.

MS-DOS PASCAL-2 features a large-memory model and 32-bit integer support. Because all PASCAL-2 implementations are compatible, the availability of PASCAL-2 on MS-DOS allows developers to port programs between IBM PCs and high-performance superminis, minis and super-micros such as the VAX, VAXmate, MicroVAX, 68000/20, PDP-11 and 32000.



Oregon Software now offers an MS-DOS version of its PASCAL-2 compiler.

Special introductory price is $350 for the PASCAL package (normally $395). Oregon Software is located at 6915 SW Macadam Ave., Portland, OR, 97219; (503) 245-2202. TWX: 910-464-4779.

Enter 920 on reader card

Systems Strategies Unveils VAX-Link Family

Systems Strategies, Inc., an AGS Company, introduced its new family of VAX-to-IBM communications software packages at DEXPO East 86.

Systems Strategies' VAX-Link family enables VAX and MicroVAX computers to interconnect with IBM Systems Network

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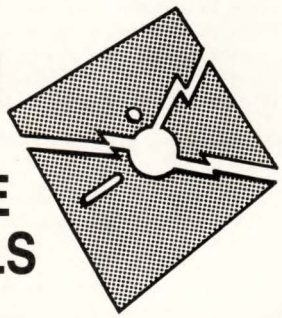

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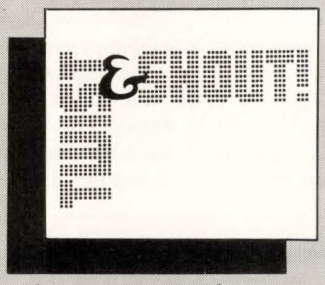
Price: $99.95



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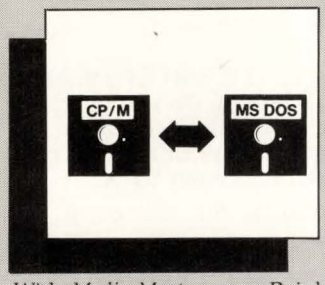

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Architecture (SNA) and Binary Synchronous Communications (BSC) networks, as well as exchange information over international X.25 packet-switched networks. The software is available on VAX and MicroVAX systems under ULTRIX, UNIX, and VMS operating systems.

The VAX-Link packages are downloaded in RAM onto DEC's standard, high-performance communications processor boards, such as the KCT for the VAX UNIBUS and the KMV for the MICROVAX Q- bus.

Learn more by contacting Systems Strategies, Inc., 225 W. 34th St., New York, NY 10001; (212) 279-8400; Telex: 380226.

Enter 924 on reader card

Cognition Introduces New MCAE System

Cognition Inc., recently introduced the Mechanical Advantage 1500/GPX, for Mechanical Computer-Aided Engineering (MCAE).

The Mechanical Advantage 1500/GPX (MA1500/GPX) is based on the VAXstation II/GPX. It helps the mechanical engineer quickly create, analyze, and optimize product concepts in the preliminary design stage by creating an integrated Engineering Model. The engineer then can manipulate the model easily to explore alternative solutions and arrive at an optimal design.

The MA 1500/GPX is available immediately on a 90-day ARO basis. Pricing for the two-seat configuration, including all hardware and software, is $105,000.

For more information, contact Cognition, 900 Tech Park Dr., Billerica, MA 01821; (617) 667-4800.

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Sigma Announces SA-H147 CPU Enclosure

A new seven-inch high CPU enclosure with backplane options for LSI-11 and MicroVAX applications now is available from Sigma Information Systems. Designated the SA-H147, the enclosure is available in either a standard 19-inch rackmount or tabletop version.

The SA-H147 includes a 12-row, quad-wide backplane with 24 dual Q-bus slots for the LSI-11 or 18 dual plus 3 C-D slots for MicroVAX applications. The backplane assembly includes 22-bit addressing, termination resistors and an interrupt priority structure.

The enclosure's 400-watt switching power supply assembly with power fail detect circuitry is designed for 50/60 Hz operation and provides +5VDC @ 50A, +12VDC @ 5A, and -12VDC @ 5A. AC input can be converted easily between 115VAC and 230VAC; DC output voltages are regulated and adjustable.

The list price of the SA-H147 is $1,917. Quantity discounts are available.

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

Enter 923 on reader card

RayPort Introduces Mini-Set System

Mini-Set, a four-terminal minicomputer-based typographic system, has been introduced by RayPort Systems, Inc.

The basic Mini-Set hardware configuration is comprised of four RP-500 editing terminals, a DEC PDP-11/73 minicomputer with 2 MB of memory, an 80-MB Winchester disk for program and job storage, a 70-MB tape cartridge for job archiving and

Winchester backup, and a serial photo unit interface.

Software includes a typesetting program that incorporates intelligent formatting with conditional execution of formats and logical arithmetic statements, kerning based on letter pairs or letter shapes, 110,000-word spelling check dictionary, 10,000-word hyphenation dictionary, and more.

Mini-Set sells for $45,000 and includes installation, training and the basic RayPort proprietary typesetting software. The new system is designed for typehouses with annual revenues of $250,000 to $1 million. For more information call or write RayPort Systems, Inc., 10 Union Place, New Windsor, NY 12550; (914) 562-1982.

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FastComm Systems Launches dCOMM->LINK

dCOMM->LINK has been introduced by FastComm Systems, Inc. Designed to expand the capabilities of Ashton-Tate's dBASE III PLUS and other database management programs such as Quicksilver, Foxbase Plus, and Clipper, dCOMM->LINK adds a new dimension to database management. It allows external devices, remote systems, and outside dialup computer services to exchange data directly to any databases that use the Ashton-Tate's standards for storage and management.

The types of devices that can be connected directly to a dBASE system include bar code readers, cash registers, computer service systems, or any other database.

dCOMM->LINK allows any dBASE system to accept incoming calls and handle data transfers automatically. It also can be programmed to place calls to acquire data automatically.

The suggested retail price of dCOMM->LINK is $295.

To learn more, contact FastComm Systems, Inc., 1704 22d St., Santa Monica, CA 90405; (213) 828-9551.

Enter 927 on reader card

RTFILE Supports Logical Views

Contel Business Networks announced that RTFILE, its proprietary interactive relational database management system, now supports logical views in its Transaction Processor. Users now can create screens using RTFILE's Display Generator based on either physical data files or logical views. Use of a logical view within RTFILE's Transaction Processor simplifies the output of fields from multiple-related records on one screen and also allows for extended online data validation. In addition to the VAX and MicroVAX VMS version, RTFILE also is available for the PDP-11s and RT-11, RSX-11M/M+, MICRORSX, RSTS, MICRORSTS, TSX-Plus, and Share-Plus; the Professional 300 series under P/OS; the Rainbow under MS-DOS; and the IBM PC/XT/AT and compatibles under PC-DOS.

For more information, contact Judith Mangels, RTFILE Marketing, Contel Business Networks, 4330 East West Highway, Ste. 200, Bethesda, MD 20814; (301) 654-9120.

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Promod Introduces Ada CFG

Promod Inc. has introduced an Ada code frame generator (CFG) option for its ProMod series of computer-aided software engineering (CASE) environments. The new Ada capability integrates the Ada language with Structured Analysis and Modular Design in a complete CASE life cycle program.

Available now for the VAX, IBM PC/XT/AT and AT&T 6300 series computers,

In over 100 installations on five continents . . .

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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!

LOCK-11

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

ProMod CASE environments with Ada CFG will take the software designer step-by-step from structured analysis through automatic Ada code frame generation.

The Promod Ada code frame generator is used during the implementation phase of the ProMod CASE program, automatically creating Ada program templates from the preceding design phases. Programmers are provided with a fully "roughed-in" framework of the system structure in the target language, suitable for most compilers and system editors for finish work.
For more information, contact Promod, Inc., 22981 Alcalde Dr., Laguna Hills, CA 92653; (714) 855-3046.

Enter 929 on reader card

Cortex Interfaces Products With Rdb

Cortex Corporation has announced an interface to connect two Cortex products, Application Factory 4.0 and CorVision, to DEC's relational database, Rdb. Both Cortex products are application development systems that automate the software life cycle.

Application Factory 4.0 and CorVision, Cortex's recently announced CASE product, automate the development of medium to large, multiuser, information processing applications. The Rdb interface is incorporated into both products with no additional charge to the user.

Each application has the ability to read data from, and write data to, an Rdb database as well as to standard RMS files. Cortex's syntax-free end user facility can access both Rdb and RMS fields in a single query.
For more information, contact Cortex, 138 Technology Dr., Waltham, MA 02154; (617) 894-7000.

Enter 930 on reader card

Software Results Reduces Prices

Software Results Corporation has reduced the prices for its HASP/VMS Q-bus and SNA/VMS UNIBUS COMBOARD systems.

Both COMBOARD systems are complete hardware/software interconnects that permit users of DEC computers to communicate with IBM and other central mainframes.

The HASP/VMS Q-bus COMBOARD system ranges from $3,500 to $9,500, and the SNA/VMS UNIBUS COMBOARD system costs between $4,500 and $15,500. Both systems include SENDplus software for the COMBOARD host node, and one additional node. In addition, they can run speeds up to 56 KB.

For additional information, contact Ernest DeRose at 2887 Silver Drive, Columbus, OH 43211-1081; Telephone: (614) 267-2203 or toll-free (800) SRC-DATA. TELEX 467495.

Enter 931 on reader card

MICOM Introduces INSTANET6000 Series 20

MICOM's INSTANET6000 Series 20 Data PABX is a low-cost solution to interconnecting terminals, minicomputers and PCs in an intelligent data communications network. Using inexpensive twisted pair wiring, it serves up to 250 channels with simultaneous data transmission at rates to 19.2 kbps, yet it's small enough to fit on a table top, desk or shelf, and is easy to install, configure and operate.

The INSTANET6000 Series 20's port selection feature allows terminal and PC users easy access to one or more minicomputers, such as those from DEC, HP, Prime and Tandem, without direct wiring to each resource.

The INSTANET6000 Series 20 is available for $4,500 for a 34-channel unit; a fully expanded 250-channel system is $77 per channel. MICOM's rental option makes a

Series 20 available at $5 to $10 per channel, per month.

For more information, call MICOM Systems, Inc., 4100 Los Angeles Ave., Simi Valley, CA 93062-8100; (800) MICOM US.

Enter 933 on reader card

Rugged Installs First TEMPEST Rugged Systems

Rugged Digital Systems, Inc., announced delivery of the first Ruggedized MicroVAX II (R/630) systems incorporating a full TEMPEST design. Built for military applications, Rugged Digital products are based on DEC commercial computer systems. Rugged Digital adapts existing commercial components for military applications using specially designed chassis, card cages and power supplies. All Rugged Digital systems meet military shock, vibration, and temperature specifications.

For further information contact Rugged Digital Systems, Inc., 328 Gibraltar Dr., Sunnyvale, CA 94089; (408) 747-1770.

Enter 934 on reader card

Techmate Expands VAXmate Functions

An expansion module for the DEC VAXmate now is available from Hitech Materials, Inc. HTM's expansion module, the Techmate, includes eight IBM AT compatible expansion slots; two are 8-bit and the remaining six are 16-bit slots. The unit is an integrated cabinet complete with power supply, host adaptor, fan, connecters and cables.

The Techmate was designed for the VAXmate to allow incorporation of large-capacity hard disk drives. In addition, it serves to upgrade the capabilities of the VAXmate by providing slots for popular IBM options.

With the Techmate, the VAXmate can use hard disks (up to 140 MB), removable hard disks (up to 50 MB), streaming tape backup, cassette tape backup and the Extended Memory Card compatible with Lotus/Intel/Microsoft.

For more information, contact Hitech Materials, Inc., 849 Ward Dr., Santa Barbara, CA 93111; (805) 964-3535.

Enter 935 on reader card

J & L Introduces MIMESIS

J & L Software, Inc. announced MIMESIS software, a customizable interface that can emulate the input of a variety of operating systems. MIMESIS software comes with either a sample VMS or MS-DOS-style shell already created, and the MIMESIS compiler,

the tool used to create and modify user interfaces.

MIMESIS is suitable for companies moving to the UNIX environment from VMS or DOS systems. Employees can switch over to the UNIX system immediately, with no training. It also is appropriate for multisystem users who want to create one common interface in order to increase their productivity.

MIMESIS currently is supported on the UNIX operating system and can be made to run under most any system that supports the "C" language. MIMESIS, with the MIMESIS compiler and either a sample DOS or VMS interface, is priced from $2,000 to $10,000 per CPU binary license.

J & L Software, Inc. is located at 1337 Heidi Dr., Plano, TX 75023; (214) 423-1960.

Enter 936 on reader card

U.S. Design Unveils Add-In Expansion Kit

U.S. Design Corporation has introduced the USDC 280-Q, its new add-in storage expansion product for MicroVAX II "World Box" computer systems. The USDC 280-Q allows users of Q-bus-based systems to add 280 MB of unformatted disk storage at a fraction of the cost of standalone subsystems.

The USDC 280-Q, designed for easy installation into DEC's BA-123 enclosure, contains U.S. Design's 1108-01, MSCP-compatible SCSI host adapter, a Maxtor XT-3000 280-MB (unformatted) disk drive, cables and all mounting hardware.

For more information, contact Jeff Lessner, U.S. Design Corp. 5100 Philadelphia Way, Lanham, MD 20706; (301) 577-2880.

Enter 937 on reader card

GABA Releases RealWorld 4.0

Glenn A. Barber & Associates, Inc. (GABA) has released version 4.0 of the RealWorld accounting software, which is available for PDP-11s under RT- 11/TSX-Plus and for the VAX and MicroVAX under VMS. Version 4.0 brings RealWorld to a higher level of functionality.

RealWorld's version 4.0 includes these fully integrated and modular software packages: General Ledger, Accounts Receivable, Accounts Payable, Payroll, Inventory Control, Order Entry/Billing, Sales Analysis, Job Cost (new package), and Purchase Order (new package). Version 4.0 contains many major enhancement modifications to allow the correct interfaces with the new Job Costing and Purchase Order modules.

More information can be obtained by calling the sales department at GABA, (818) 980-6622, or writing Glenn A. Barber & Associates, Inc., 12229 Ventura Blvd., North Building, Studio City, CA 91604.

Enter 938 on reader card

FAME Releases New Version

FAME Software Corporation announced the second annual enhancement of its flagship software product, FAME version 4.5. FAME (Forecasting, Analysis, and Modeling Environment) is an interactive system for the solution of quantitative business problems in securities analysis, commodities research, finance marketing and economics.

FAME can be run on most departmental minicomputers, as well as large corporate mainframes, from the VAX 750 to the IBM Sierra. It is available on an annual lease basis, the cost depending on the size of the system on which it will be used. A three month trial package is available for $3,000.

For additional information, contact Perry Stein at FAME Software Corporation, 6869 Marshall Rd., Dexter, MI 48130; (313) 426-2730.

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M&D Announces PC MinLink For VAX

In response to customer requirements for downloading/uploading capabilities, McCormack & Dodge Corp. introduced PC MinLink for G/L PLUS, its General Ledger System. The new tool allows VAX users to selectively download general ledger data to PC workstations, analyze the information, then upload it back to the host computer.

The product includes prebuilt test data extraction requests to facilitate downloading and prebuilt spreadsheet templates to enhance modeling and forecast analysis. It also includes functional menus and HELP screens, and uses G/L PLUS' on-line query facility for data extractions to minimize the learning curve. M&D will back the product with education and on-going support.

PC MinLink is priced at $4,500 for a single site license.

To learn more, contact McCormack & Dodge, 1225 Worcester Rd., Natick, MA 01760; (617) 655-8200.

Enter 939 on reader card

Mentec Introduces M70 Series

Mentec Computer Systems Ltd. has introduced a range of Q-bus compatible single board computers, the M70 series based on the Digital J-11 processor chip. The M70 offers J-11 CPU; 1/2-MB, 1-MB or 2-MB on-board, fast ECC RAM (cache speed); 4 SLU (DLV11-J compatible); and bootstrap, all on a single quad Q-bus module. The M71 has been designed for embedded applications and features sockets for up to 512 KB EPROM and two parallel ports (11/21 compatible), as well as 256-KB or 1-MB ECC RAM, 4 SLU and bootstrap, again on a single quad Q-bus module.

The modules are completely software and diagnostic transparent and run all Digital PDP software and operating systems without alteration.

For more information, contact Mentec at Sandyford Industrial Estate, Leopardstown Rd., Foxrock, Dublin 18, Ireland; telephone 952316; Telex: 93309.

Enter 940 on reader card

Enhancements Expand Computer Capabilities

Celerity Computing has announced system enhancements that expand the capabilities of its entire line of computer systems.

The enhancements speed the performance of applications developed on Celerity systems by up to 35 percent, double the number of on-line users supported, and allow many software programs written for VAX/VMS systems to be ported easily to Celerity systems.

By turning its native implementation of the 4.2 Berkeley System Distribution (BSD) UNIX operating system, Celerity has doubled the number of simultaneous on-line users supported on all of its models. The maximum number of users supported now is 256 on Celerity's high-end C1260 system, 128 users on the mid-range C1230, and 64 on the entry-level C1200.

Celerity has improved its FORTRAN-77 and C compilers to increase by 25 to 35 percent the speed at which software applications written in these languages will run. In addition, special revisions to Celerity's FORTRAN-77 compiler make it compatible with the VMS FORTRAN-77 compiler, allowing applications written in FORTRAN-77 for VAX systems to be ported easily to Celerity systems without extensive modification. The VMS FORTRAN-77 compiler contains several non-standard extensions that make it incompatible with most other FORTRAN compilers.

Celerity's UNIX superminicomputers employ a reduced instruction set (RISC) architecture and are powerful multiuser

systems for engineering, scientific research and database analysis and query applications. Celerity computers operate on industry-standard hardware and software platforms and are designed to operate specifically as high-performance multi-vendor servers for engineers and scientists using workstations, personal computers and terminals. They support interactive and compute-intensive applications without off-loading to more expensive, remote computers.

If you need more information, contact Celerity Computing, 9692 Via Excelencia, San Diego, CA 92126; (619) 271-9940.

Enter 941 on reader card

QG-1280A Enhances The MicroVAX

The QG-1280A, by MATROX, is a general-purpose 1280 x 1024 color graphics/imaging controller board set that operates at 60 Hz non-interlaced and has 8-bit planes with a 256 of 16 million color palette. The QG-1280A provides VT-100 operation and local graphics input support for mouses and trackballs.

The QG-1280 is ideal for graphic and imaging applications in the CAD/CAM, process control, engineering workstations, cartography, instrumentation, and medical imaging sectors.

The board draws at 35,000 vectors/sec and 15,000 characters/sec. Ultra-fast raster operating speeds of 13,000,000 pixels/sec means that images can be copied between the displayable memory and the 2K x 1K read/write memory in fractions of a second.

An important feature of the QG-1280A is its high-level instruction set. The on-board National 32016 CPU reads the graphics instructions stored in the on-board 512-byte FIFO and translates the commands into a form that the on-board Hitachi ACRTC understands.

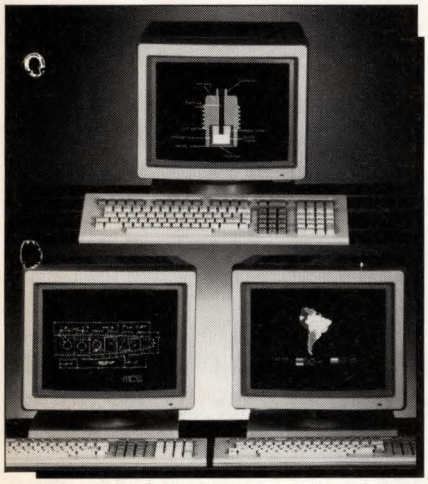
Three-dimensional modeling is available on the QG-1280A. All the important graphics commands (moves, line draws, rectangle, etc.) are available in 3-D 32-bit virtual coordinates. The complex rotational and translational algorithms characteristic of 3-D object manipulation all are performed by the on-board 32016.

Using the DMA port of the QG-1280A, complete 1,280 x 1,024 images can be loaded into the frame buffer in one second. The QG-1280A is suitable for applications such as cartography and medical imaging where graphics often are overlayed over the image. The QG-1280A also can be used as a VT-100 terminal. The VT-100 emulator running on the on-board National 32016 CPU eliminates the need for a separate system terminal saving cost and desk space.

The QG-1280A is priced at $4,995

(OEM qty. 1). To receive a literature package write to MATROX Electronics Ltd., 1055 St. Regis Blvd., Dorval, PQ, Canada H9P 2T4. In the U.S. call (800) 361-4903. Call (514) 685-2630 to speak with a MATROX sales person.

Enter 943 on reader card



The GO-400 Series — GraphOn's first series of color composite terminals.

GraphOn Announces GO-400 Series

The GO-400 Series is GraphOn's first family of color composite terminals. The GO-400 Series supports a range of industry standard interfaces from Tektronix (4100/4200 series) and DEC (VT220 and ReGIS graphics).

The GO-405 emulates the Tektronix 4205 (480 x 360 resolution) and supports ReGIS (800 x 520 resolution). The GO- 405 is priced at $2,995. The GO-407 emulates the Tektronix 4207 (640 x 480 resolution), and it provides ReGIS (800 x 520 resolution) and full VT220 alphanumerics. It sells for $3,795. The GO-411 emulates the Tektronix 4111 (1024 x 768 resolution) and 4207 (640 x 80 resolution), with ReGIS (800 x 520 resolution) and full VT220 alphanumerics. This lists for $5,995. Options are available on all models.

To find out more, contact GraphOn Corporation, Tower One, Fifth Floor, 1901 South Bascom Ave., Campbell, CA 95008; (800) GRAPHON, or (408) 371- 8500.

Enter 932 on reader card

Meet New IRS Rules With TOM Software

A new application program from TOM Software enables businesses to format tax information for storage on magnetic media and prepare the media for submission to the Internal Revenue Service. A recent IRS regulation stipulates that quantities of over 500 W-2 or 1099 forms (250 in 1987) from a single source must be submitted on magnetic media.

Detailed reports produced by the application provide sequential listings that allow the user to verify data before preparing magnetic tapes of diskettes. These reports also provide an audit trail of all extracted W-2 and 1099 data. The program's file maintenance utilities allow the user to define and maintain system-wide parameters.

The new application integrates with TOM's payroll or accounts payable applications running under the SPEED I or SPEED II system software. Compatible computers include the Wang VS series and 2200; IBM XT, AT and compatibles; DEC VAX and MicroVAX; and Altros. Pricing varies by CPU.

For more information, contact TOM Software, 127 S.W. 156th, P.O. Box 66596, Seattle, WA 98166; (206) 246-7022. Telex: 32-0011 TOM SEA.

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UIS Shows Systems Software

United Information Services Ltd. (UIS), of Epsom, will be showing an exclusive range of systems software products aimed at boosting the efficiency of VAX/VMS systems at DEXPO Europe 87.

The products include the new I-MON image monitor which has been designed to help the user remove program bottlenecks in VAX/VMS program code. I-MON gathers samples from a running program and produces a histogram display of where time is being spent. Rectifying inefficient code identified by I-MON can improve a system's performance by up to 500 percent.

For further information, contact United Information Service Ltd., Apex House, 4a-10 West St., Epsom, Surrey KT18 7RG; telephone 03727 29655. Telex: 21788; or stop by Stand No. 109.

Enter 908 on reader card

STI Announces New VAX DBMS With SQL

Signal Technology Inc. (STI) has announced a new release of its relational database management system (RDBMS) and fourth-generation language (4GL) that incorporates a Structured Query Language (SQL) interface to VAX RMS and Rdb/VMS file structures. The Version 5.0 release provides SQL for the company's SMARTSTAR and OMNIBASE products.

Both products operate in the VAX/VMS environment and are essentially the same in function and capability, but OMNIBASE works in conjunction with Britton Lee Inc.'s Intelligent Database Machine (IDM) or with the RS series Relational Server. These machines offload relational database operations from a host computer, freeing up the CPU for general-purpose applications.

To learn more, stop by Stand No. 213, or contact Signal Technology at Mountbatten House, Victoria St., Windsor, Berkshire SL4 1HE; telephone 0753 857181.

Enter 909 on reader card

GEMINI Makes Its Debut

Pioneer Computer Systems will be launching GEMINI at DEXPO Europe 87. GEMINI is an advanced relational applications generator designed to use the VAX Rdb/VMS relational database fully as a core element for an integrated set of productivity tools.

GEMINI's objective is to aid the rapid production of complex commercial applications. The utilities within GEMINI are fully on-line interactive "what you see is what you get" design tools to enable novices and advanced users to produce useful and easy-to-use applications quickly.

GEMINI is designed to support a multilingual environment. Menu options, error messages, DML code and user-defined forms and reports can be defined in the user's choice of language.

For more information, contact Pioneer Computer Systems Ltd., 4 Albion Place, Northampton NNI 1UD; telephone 0604 39096; or stop by Stand No. 311.

Enter 910 on reader card

ABLE Launches The MUX MASTER-LP

ABLE Computer has launched a new high-performance parallel line printer controller for use with its DEC compatible MUX MASTER networking system.

The MUX MASTER-LP, can be added to a MUX MASTER network at any point. The MUX MASTER-LP is software compatible with VMS, MicroVMS, RSTS, RSX, and ULTRIX operating systems, and its single parallel printer port appears to the host computer as an asynchronous port on the host interface. Under true DMA operation, a maximum data transfer rate of 15,000 characters per second can be achieved, allowing the MUX MASTER-LP to cope easily with printing speeds of more than 11,000 lines per minute (170 pages per minute). Various user selectable configuration and termination options ensure that the MUX MASTER-LP will accommodate most standard line printers.

For more information, contact ABLE Computer House, 287 London Rd., Newbury, Berkshire RG13 2QJ; telephone (0635) 32125; or stop by Stand No. 129.

Enter 911 on reader card

Dataram Features Memory Products

Dataram will display a full spectrum of DEC memory technology at DEXPO Europe.

Featured will be Dataram's DR-283, PDP-11/83 and 11/84 PMI-BUS memory. This quad size DR-283 memory board offers 1-, 2-, and 4-MB capacities, plus associated ECC check information. Dataram's DR-283Q version may be used with any Q-bus-based processor.

The DR-283 and DR-283Q also feature a Control Status Register (CSR), On-Board Error Indicator, Block Mode DMA and supports Battery Backup.

Visit Stand No. 1 and see Dataram's DEC memory products, or contact the company at P.O. Box 7528, Princeton, NJ 08543-7528; (609) 799-0071.

Enter 914 on reader card

DISC Releases DBL/MS-NET

DISC, the developer of DBL, announces its newest release, DBL/MS-Net, DBL for IBM PC/Net and compatible implementation of multiuser applications using MS-DOS 3.1

ATTENTION VENDORS

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

For further information contact:

The Editorial Department,
Professional Press,
921 Bethlehem Pike,
Spring House, PA 19477.

record locking standards. It allows proven applications running on minicomputers to be used on PC-based networks. The product also runs on the Alloy PC-Plus.

DBL, a high-level business programming language, allows a universal range of existing DIBOL- and DBL-based application packages to be ported to any of the operating systems on which it runs, including MS-DOS, Novell's NetWare, VMS, RSTS, and RSX. Programs developed in DBL are ported easily to any of the above operating systems using only one set of source code. Find out more by contacting Digital Information Systems Corporation, 11070 White Rock Rd., Suite 210, Rancho Cordova, CA 95670; (916) 635-7300; or stop by Stand No. 422.

Enter 913 on reader card

EDR-4 Added To Andelos Line

Andelos Systems has a new addition to its range of editing systems for DEC computers. The EDR range still is the only EDT compatible editor that off-loads the editing workload from the host while being totally transparent to the user.

The new EDR-4 hardware has a 68000 processor, up to 512K of memory, and a choice of file transfer interfaces. EDR-4 offers serial line transfer, suitable for small to medium size files, and modem users. In addition, DMA and network options are offered, allowing files up to 1000 blocks to be rapidly transferred and edited. EDR-4 is available for $350.

Andelos can be contacted by telephone 0635-201150, or stop by Stand No. 5.

Enter 916 on reader card

BUSS Introduces New Driver

Bradford University Software Services (BUSS) will introduce a new SIMPLEPOT generic device driver, developed for the non-expert programmer, at DEXPO Europe.

Also on display will be the latest version of SIMPLEPLOT-GKS. In addition to giving users access to a wide choice of graphics and text, the GKS version gives the option of more sophisticated graphics in two-, three- , and four-dimensional forms.

The graphics software program developed specifically for nonprogrammers, Even Simpler Plot (ESP), also will be available for demonstration.

For more information, please contact Karol Blackburn, BUSS Limited, 29 Campus Road, Bradford, West Yorkshire BD7 1HR. Telephone: (0274) 309214; or stop by Stand No. 436.

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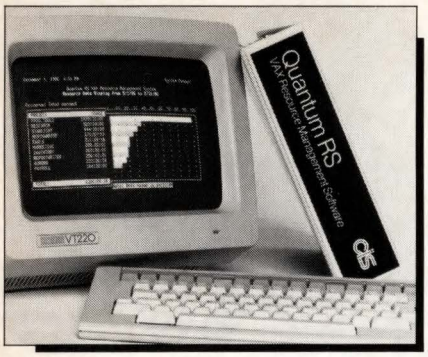


CIS' Quantum RS resource management software.

CIS Debuts Quantum RS V.4.2.

CIS announces the release of Quantum RS version 4.2 VAX/VMS resource management software for single, networked or clustered VAX systems. The new release will be demonstrated for the first time at DEXPO Europe. Version 4.2 incorporates over 50 enhancements and new features. Because of new I/O routines, Quantum RS operates up to 45 percent faster.

The project accounting programs have been redesigned to be more flexible and to require less overhead. Users can call their own project verification routines or they can use the standard project verify routines supplied with Quantum RS. The new version operates on all versions of VMS 4.0 and later.

Quantum RS licenses for the first CPU are priced from $2,750 for the MicroVAX II to $13,200 for the VAX 8800 series.

CIS is headquartered at 165 Bay State Dr., Braintree, MA 02184; (617) 848- 7515. Stop by Stand No. 200 for more information.

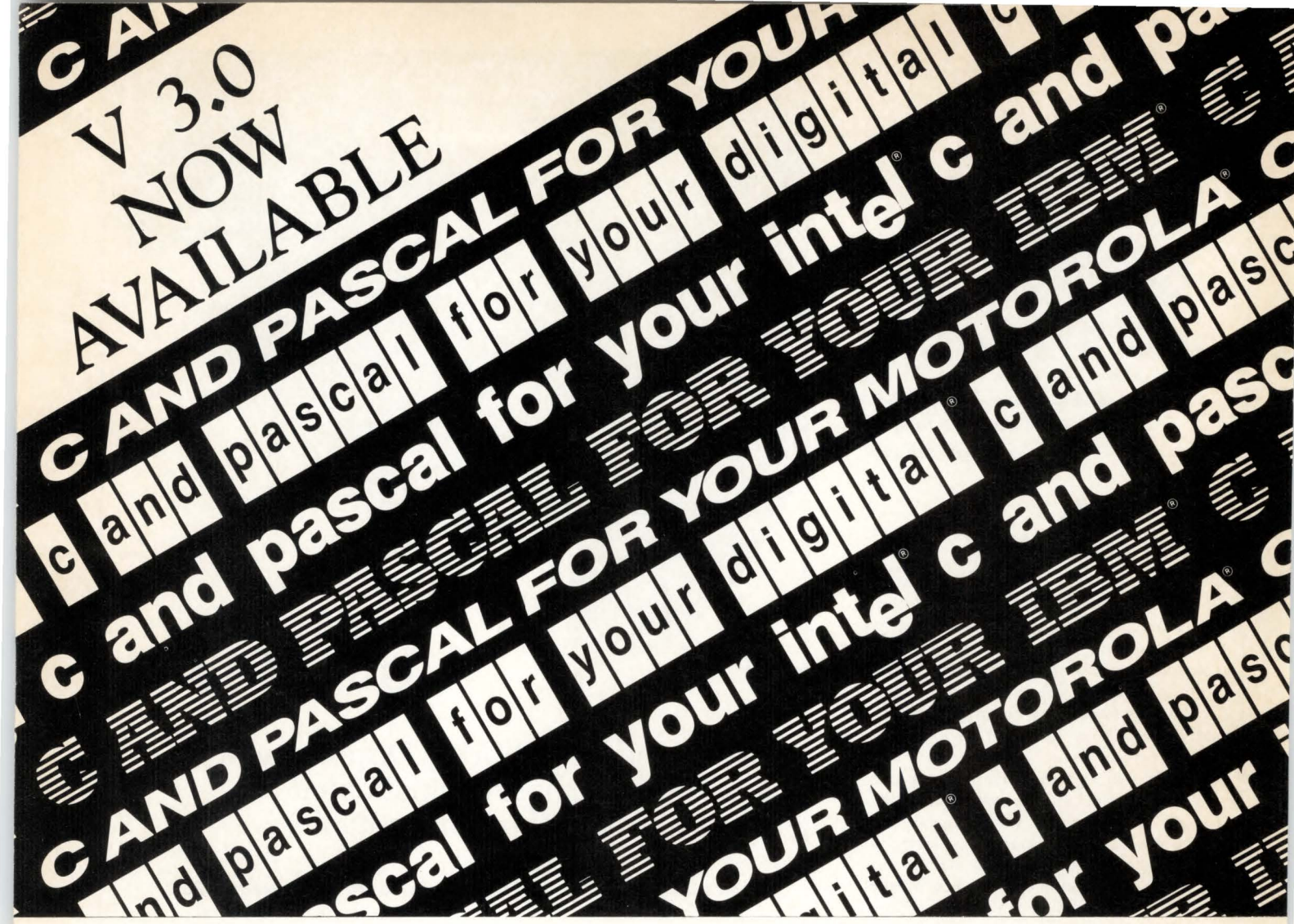
Enter 912 on reader card

SIA Demonstrates SIR/DBMS

Service in Informatics and Analysis Limited (SIA) will be demonstrating version 2.2 of SIR/DBMS for the first time in Europe. SIR/DBMS, "The Intelligent Relational System," provides full-screen database creation and amendment, the ability to read and write external files, automatic screens generator and enhanced SQL.

Portable from PC to Cray, including the complete VAX range, SIR completes its 4GL with a full procedural language, camera-ready tales option, and report writers for those occasions when "SQL is not enough." For more details, contact Stephen Keal by telephone 01-730-4544, or stop by Stand No. 304.

Enter 915 on reader card ■



Whitesmiths, Ltd. Has The Compiler You Want On The Machine You Use.

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Version 3.0 of Whitesmiths compilers is now available, with new features and functionality designed to meet the needs of today's professional software developers. Features include a C source level interactive debugger with breakpointing and variable display, a powerful multi-segment linker for generating ROM-based code, and the ability to display high-level source code, assembly language, and machine object code on one listing.

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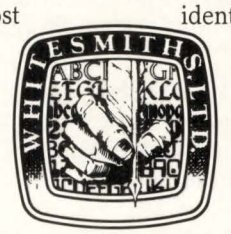

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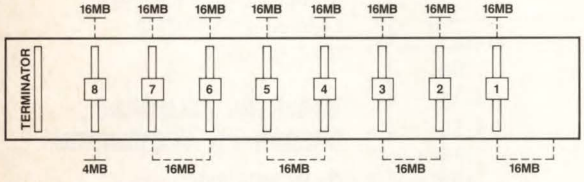

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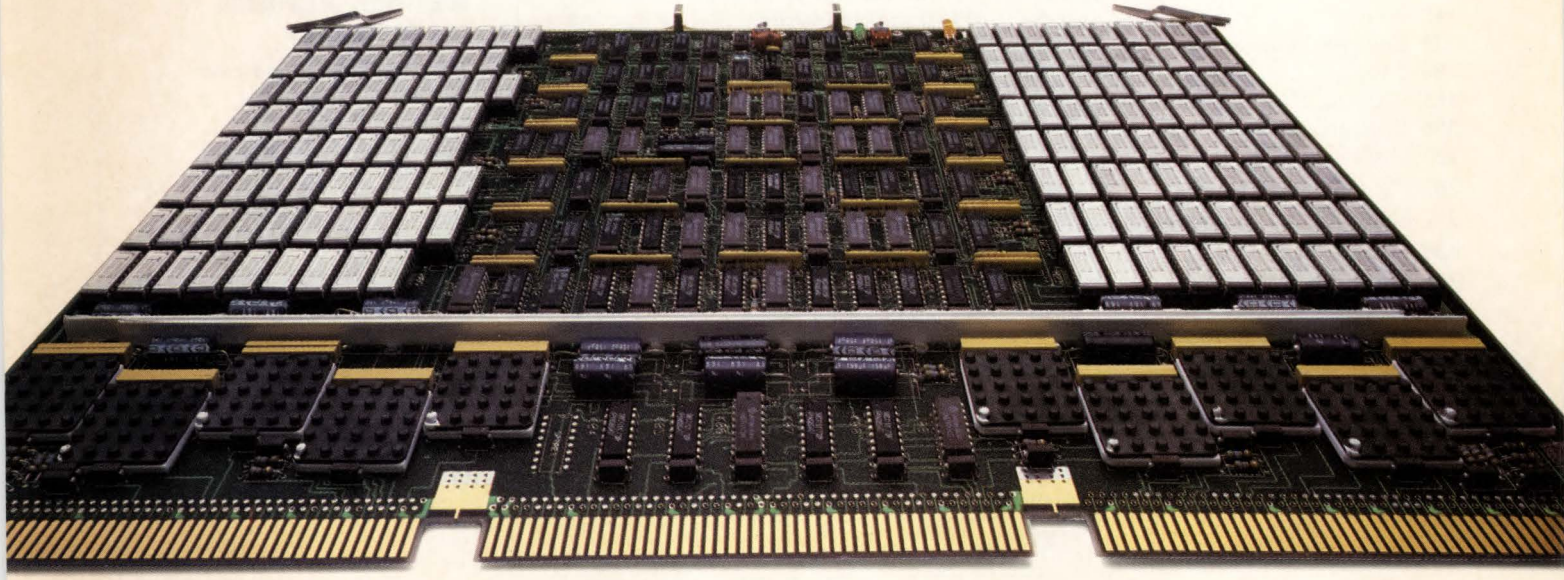

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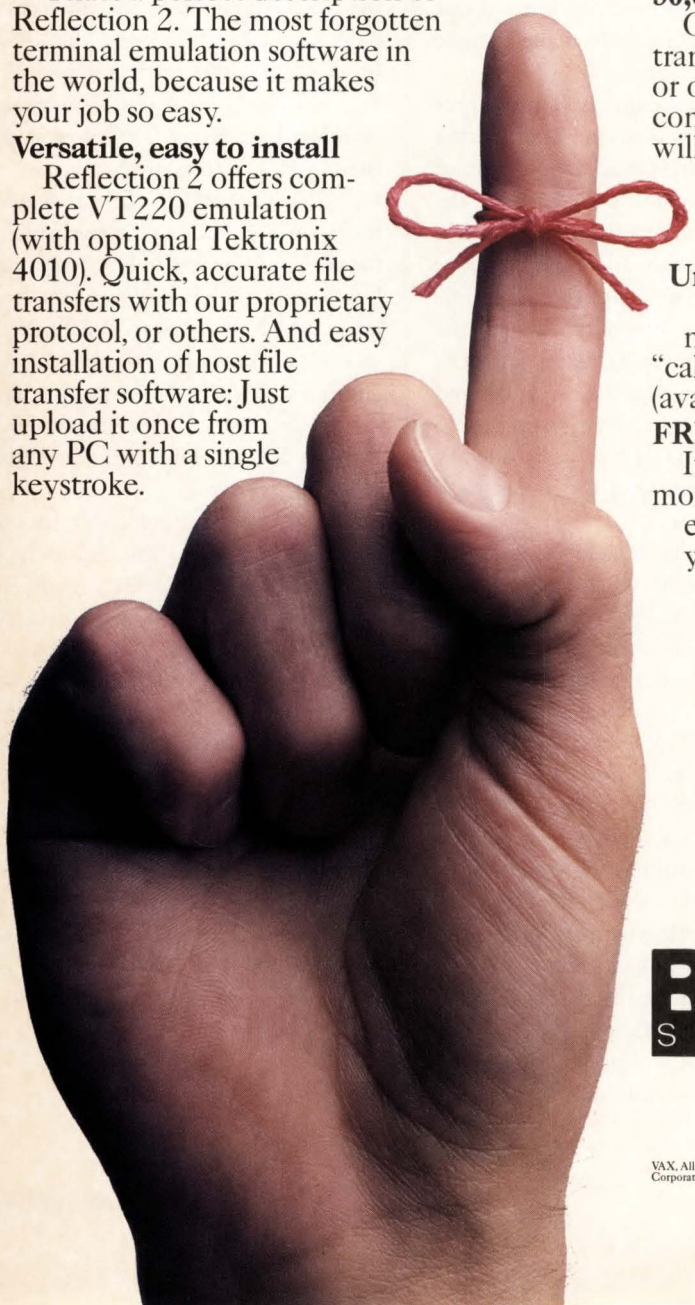

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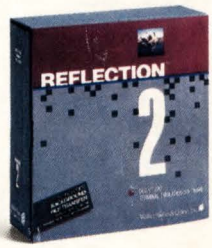

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John C. Dvorak

Bizarre Time Capsule Befuddles Experts

You probably didn't read the story about the "Reverse Time Capsule," because most of the newspapers thought it was a hoax. Who would believe that someone in the future buried a time capsule to be retrieved in the past? It was too weird for most newspaper editors to use, if for no other reason than that the capsule contained a copy of DEC PROFESSIONAL *dated March, 2002!*

Believe it or not, there on the back page was my column! It was prefaced by the editor who said it was written as a warning to those relying too much on computers.

The magazine had shrunk in size to 30 pages. When you read my column, you'll know why. Here it is in its entirety:

The Last Column
By John C. Dvorak
SILICON VALLEY, March, 2002 — The newspaper racks stood in rows, empty. There was no news anymore. Cars sat abandoned in the middle of the street. A thick coating of dust made them all a brownish grey. Skyscrapers, once alive with important business, were dark, silent, empty.

The long runways at the international airport were overgrown with weeds. A couple of large commercial jets lingered on the runway waiting for the take-off that never happened. They couldn't move. In fact, nothing worked once the computers stopped.

The city and the rest of the world marked time until the computers came alive again, but no one expected they would. At first it was, "Just a moment sir, they'll be up soon." Then, "We're waiting for replacement parts." Finally it was, "Closed for business until computers come up." Some people still are waiting.

That was six months ago. The computers never did come up again and neither did anything else that was electrical. For some unknown reason the earth's magnetic poles reversed. It had happened once before, a few million years ago. No one expected it to happen again, and no one thought it would screw up all the theories of electricity too. But it did. Using "new magnets" some scientists have been able to create crude electrical generators, but not one scientist has been able to make a single transistor that works.

It's become a comedy. The evangelists claimed it was divine intervention until they couldn't broadcast on radio or TV; then it became the work of the devil. Some insisted that the communists did it because the Russians have perfected a new magnet-compatible transistor. Some theorists insisted that flying saucers (carrying aliens fearful of a world war using the dreaded and potentially earth-cracking neon bomb) would create a hazard to interplanetary navigation. Reversing the poles took care of the threat.

Whatever the cause, it happened. I remember exactly what I was doing when it happened, too. I think everyone does. It was kind of like remembering what you were doing when President Spock was shot a few years back. When the poles began to reverse I felt funny, nauseated. Then I noticed that my brand-new, super CD player wasn't working. At first there was a terrible hiss. Then, nothing. Within a few minutes the lights went out; I thought it was a power fluctuation. As the day went on, everything started to go haywire. My microwave oven overcooked everything. My digital watch went blank. The VCR stopped working altogether. The telephones weren't working properly.

I decided to go to the grocery store. It was a real mess. The electronic checkout wasn't working. People were lined up and down the aisles, just waiting and waiting. The clerks didn't know what to do without the fancy price scanners.

I gave up and left for home. Then, my car's computerized fuel injection system began to fritz-out. I finally left it at an intersection and began to walk; the signal lights were out anyway. The bank was closed. It never did reopen. Lots of companies never reopened.

Hundreds of computer salesmen wandered the streets aimlessly, cursing their useless demo units.

The blue collar workers were the lucky ones; life didn't change much for them. The post office never skipped a beat — the mail came every day, just as late and slow as ever. The railroads weren't affected at all — the old diesel engines still worked. The poorest farmers did the best. In fact, the more old-fashioned the business, the more likely it was to survive.

It's a disaster, especially for me. I have nothing to do but report layoffs and company closings for a small newspaper in Berkeley. I hate to write with a typewriter! I have an old friend who's a tomato farmer, and I hope to go into business with him.

Let this be a warning: Get out of the technology business! It was sure a lesson for me. My coach at the University of California Varsity Technology Writing Team told me I should learn a trade. He said I might not be able to write about technology forever. I didn't listen, and now I have to start all over as a tomato farmer. **Don't let this happen to you!**

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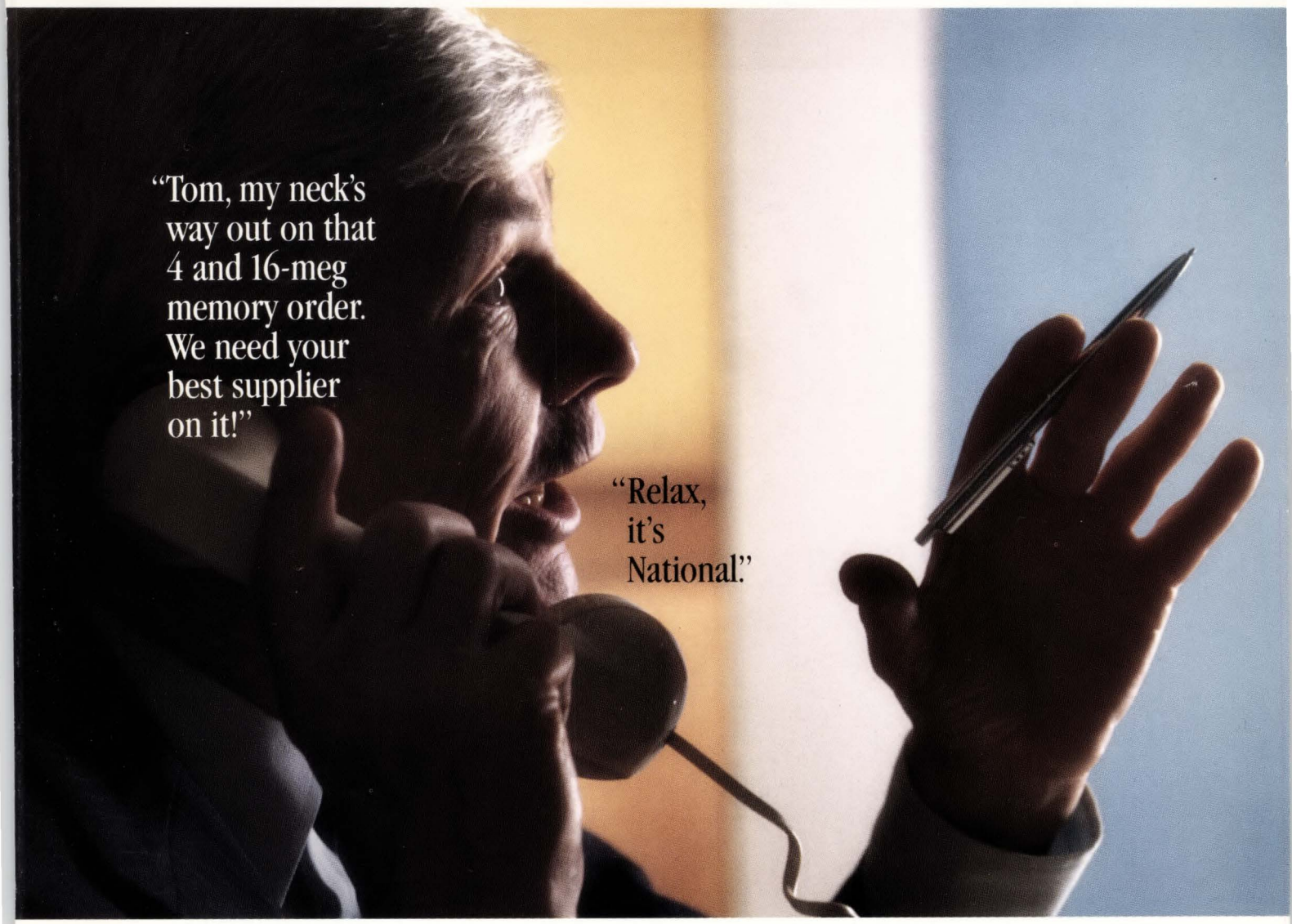

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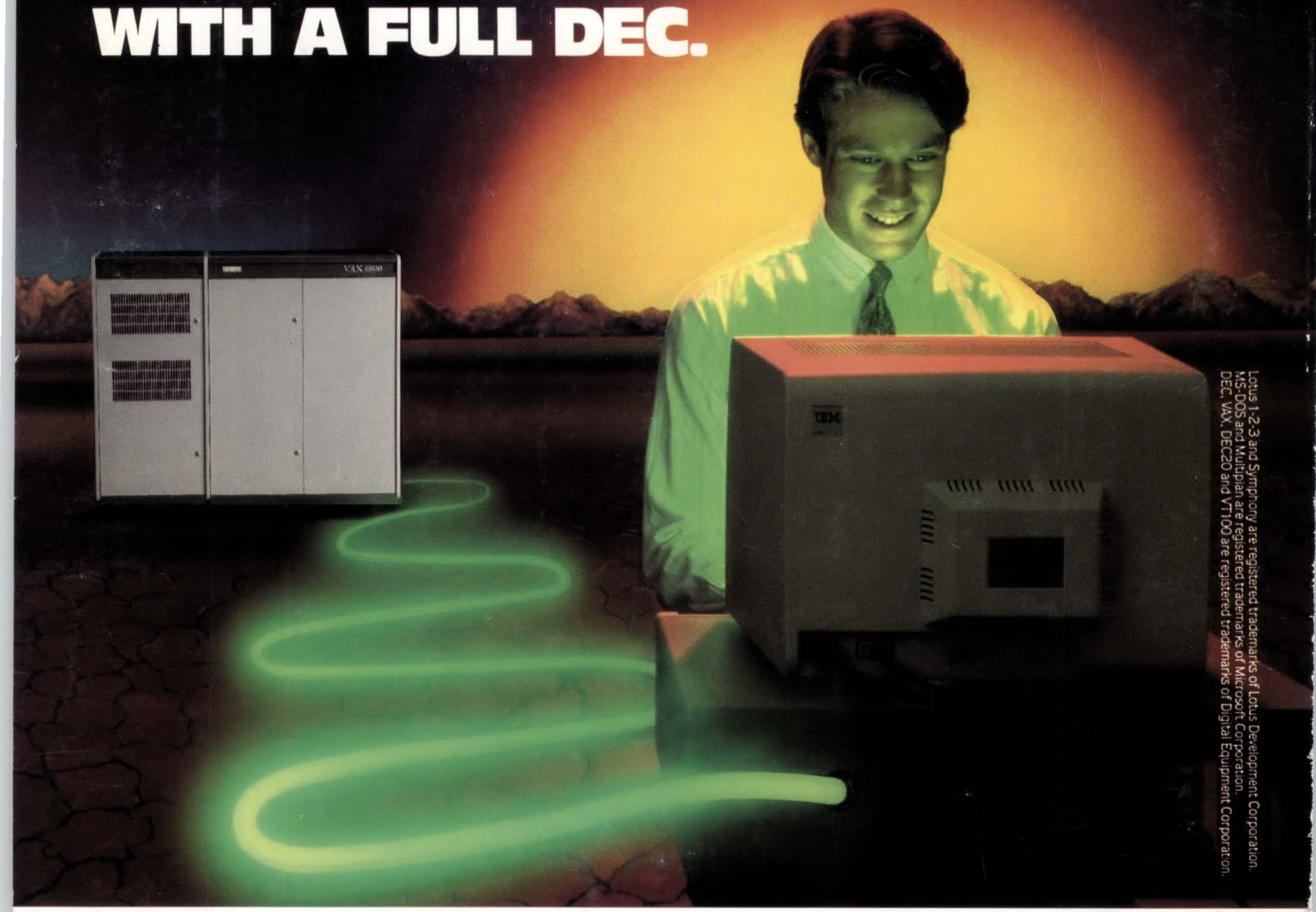

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