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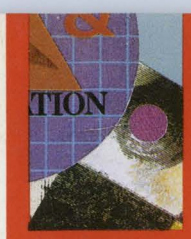

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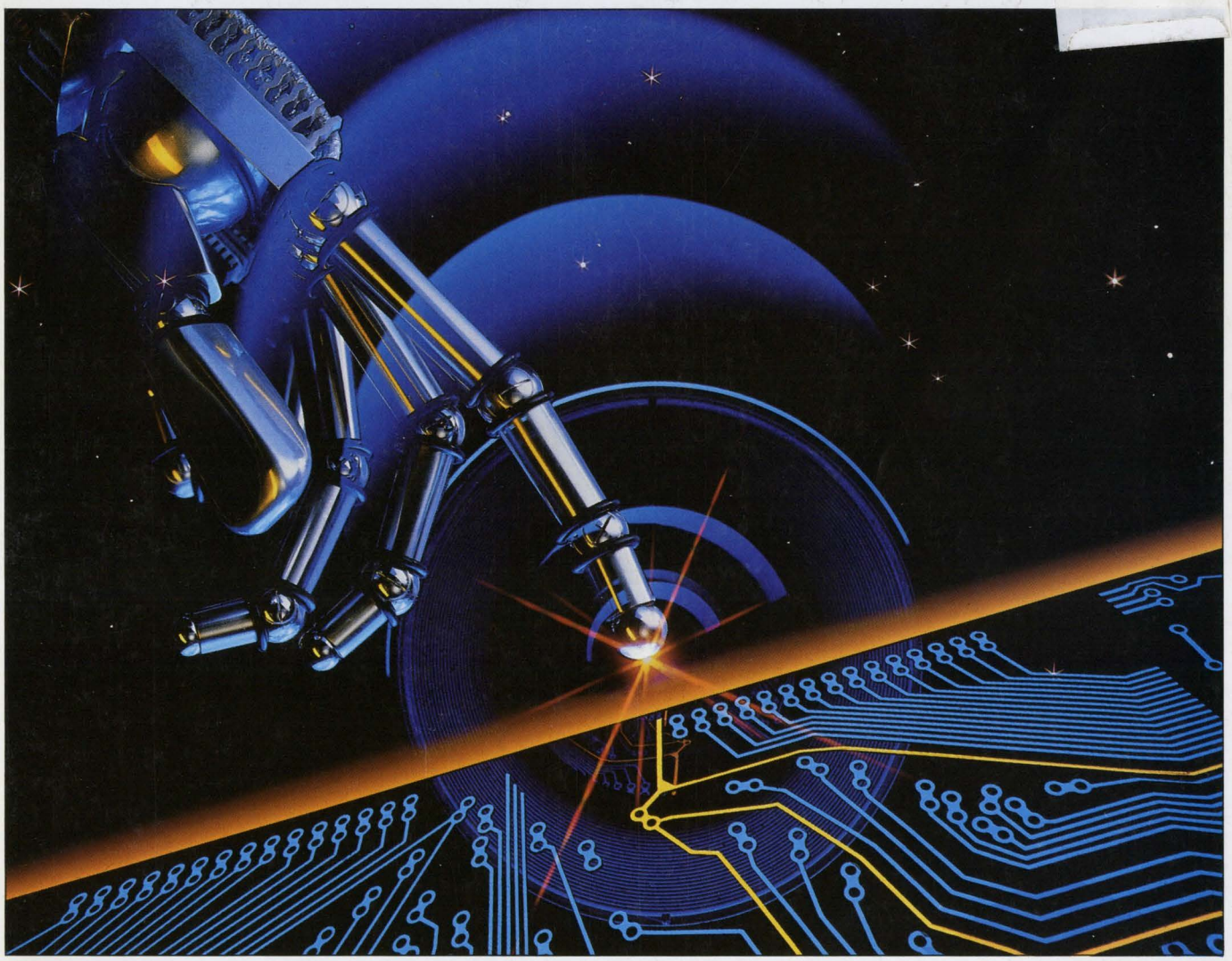

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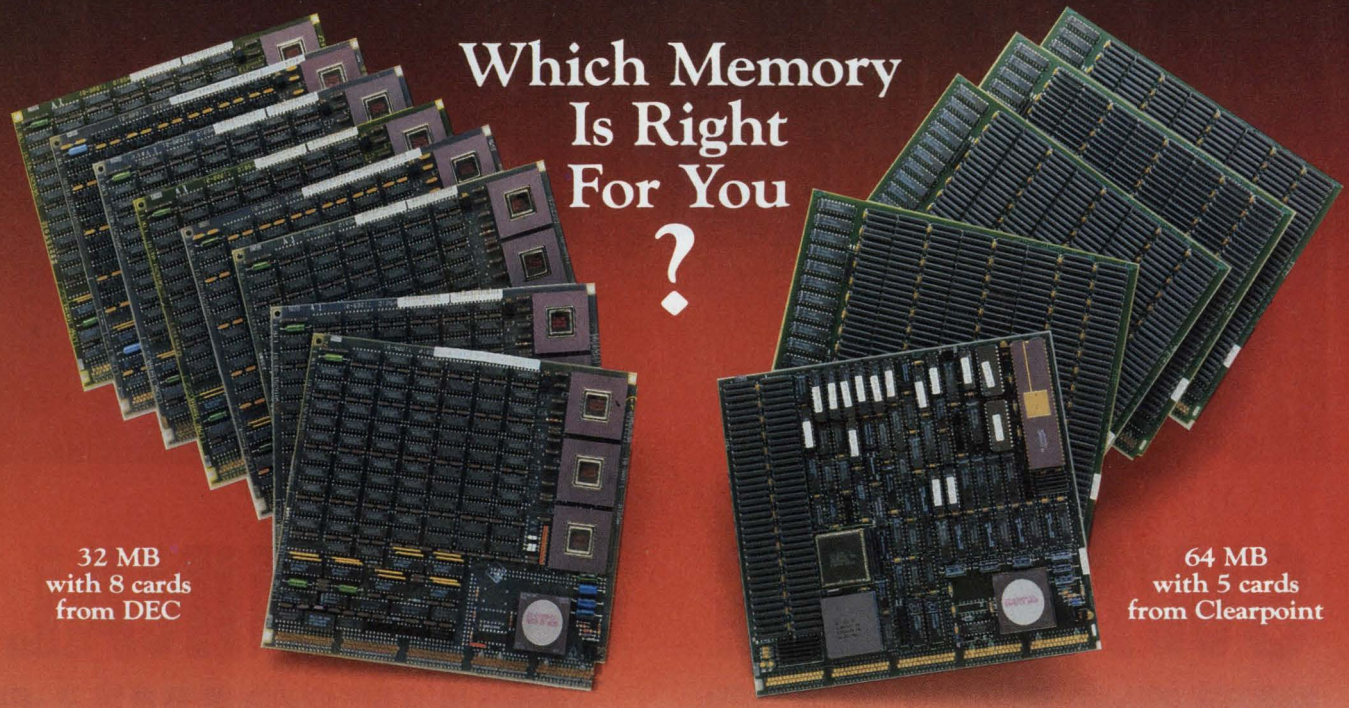

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	DEC	Clearpoint
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Memory per 5 BI slots	20 MB	64 MB
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*at list price, 32 MB system, based on DEC's March 2 price reduction.

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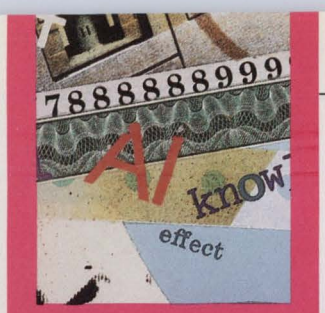

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ARTIFICIAL INTELLIGENCE

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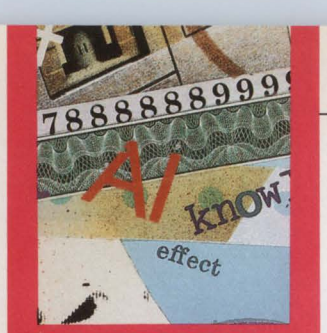

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DEPARTMENTS & COLUMNS

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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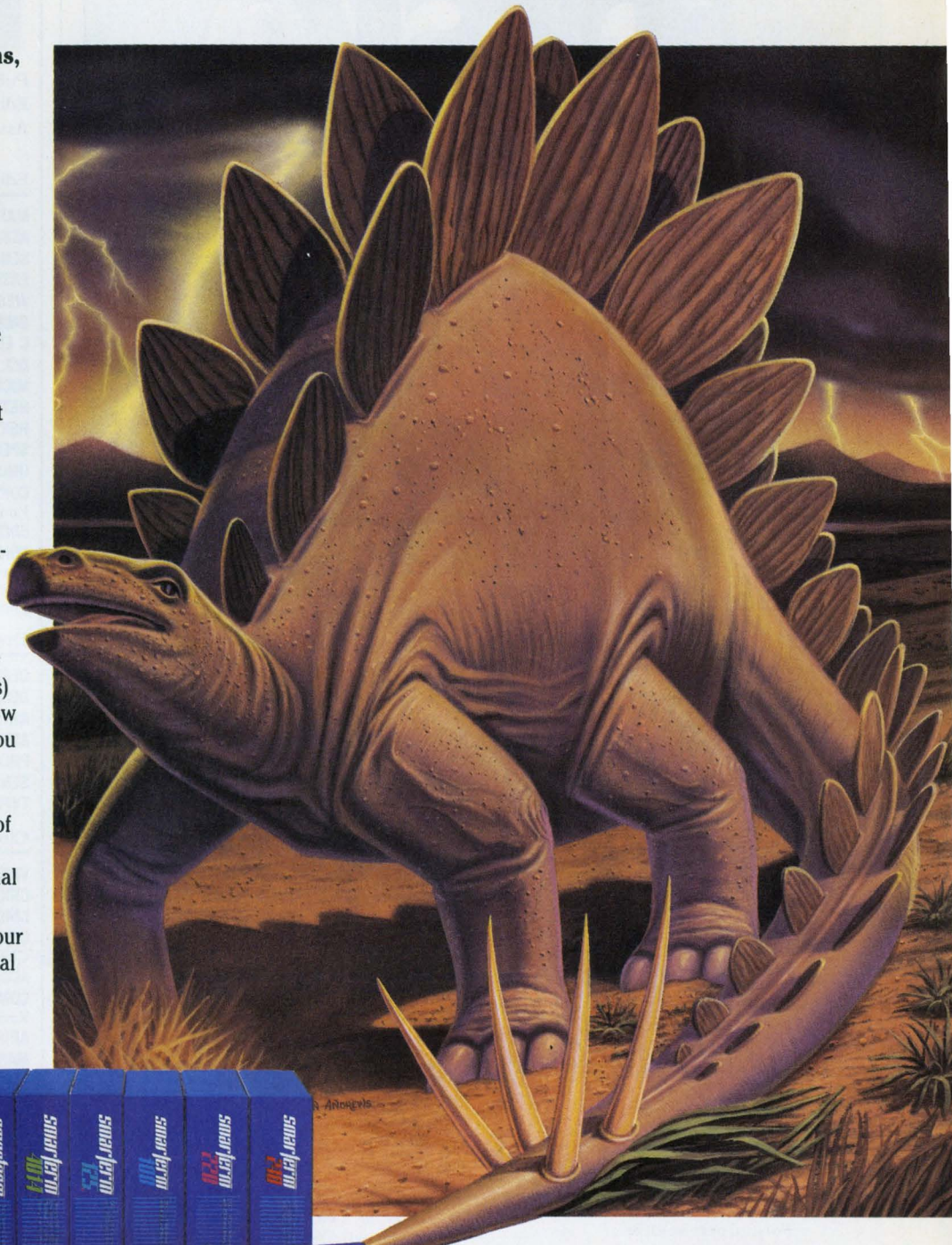

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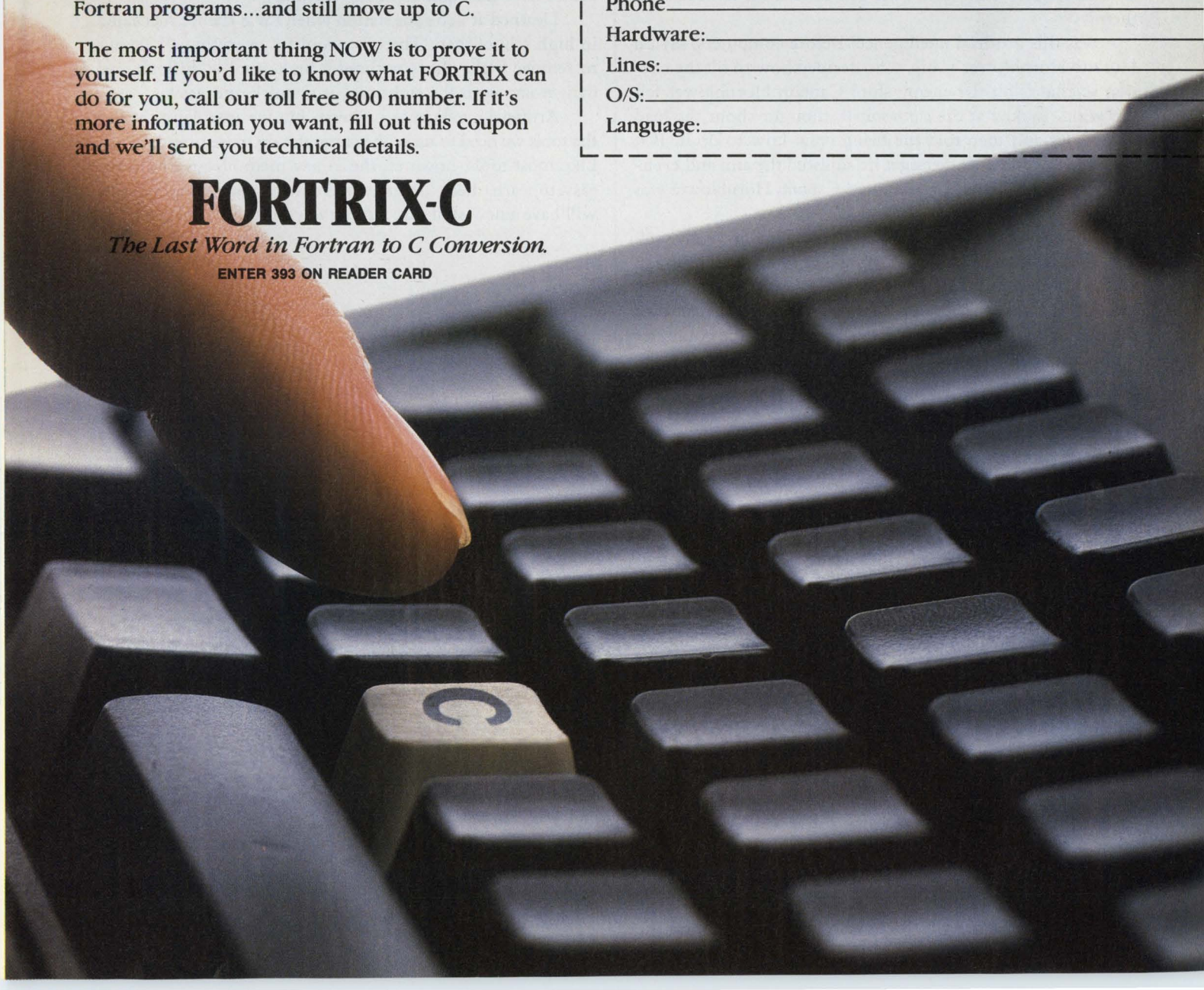


PUBLISHER

Carl Marbach

Is A Computer Intelligent?

A buzz word heard in computer corridors these days is artificial intelligence. Like office automation, I'm not sure anyone really knows what it is.

One thing it isn't is new. Artificial intelligence is as old as computers. The first computer that did anything useful was the ENIAC I, produced at the University of Pennsylvania. ENIAC computed artillery tables to be used by heavy guns in World War II. Here was the problem: A shell with a muzzle velocity of X, a weight of Y and an angle of inclination of Z would go how far? If the enemy were 25.7 kilometers away, at what angle would we tilt the gun so that the shell falls on them?

Was this artificial intelligence? Before computers, say on Horatio Hornblower's ship, who decided how to tilt the cannon so that it hit the enemy ship? Captain Hornblower felt the wind, looked at the cannonball, thought about the load of powder and then told the firing crew how to do it. If it was short or long of the target he adjusted the aim and eventually won the battle. No computer! Captain Hornblower was intelligent. Was ENIAC?

Tank warfare is cut and dry. If you can hit an enemy tank at 4 kilometers with your gun and he can't hit you until you are 3.5 kilometers apart, you win. Aiming and firing accuracy in tanks is crucial. A modern tank has a computer that aims the gun. The gunner sights-in the enemy, and the computer figures the wind, temperature, weight of shell, muzzle velocity, angle and speed of the tank and other variables, then sets the gun at the proper position for a precise hit. The accuracy is amazing, even if it is classified. Horatio Hornblower wouldn't stand a chance.

If these applications aren't artificial intelligence, then what is? I would submit that today's artificial intelligence systems, like office automation systems, aren't the first to be offered, rather they are tools to allow us to build applications that mimic what an intelligent person already can do. Like the accounting and database systems that we know already, artificial intelligence is another application that has been difficult to implement without the proper tools. COBOL, BASIC or FORTRAN are not good languages for artificial intelligence.

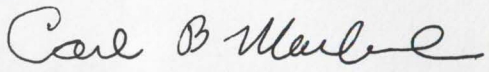
I was the programmer on a project in 1970-1971 to make a PDP-10 (DECsystem 10) diagnose an electrolyte imbalance in the blood. The goal was to have the program emulate Dr. Martin Goldberg, head of the Department of Medicine at the University of Pennsylvania. Ideally, the program and Dr. Goldberg would arrive at the same diagnosis given the same facts. FORTRAN was all we had and after the blood chemistry was entered it took 33 statements like this just to decide what other questions to ask:

```
IF((PCO2.GT.69.AND.PCO2.LE180.AND.H.LE.0.429*PCO2 + 22.AND.H.GE.
1 0.25*PCO2 + 27.7).OR.(PCO2.GT.62.AND.PCO2.LE.69.AND.
2 H.LE.0.345*PCO2 + 28.2.AND.H.GE.0.351*PCO2 + 20.8))GO TO 1200
```

It took a long time to write this application because we didn't have the right tools for the job.

I learned at Leo's gas station when I was trainee mechanic in high school that "There is a tool for everything." Trying to remove brake shoes without a brake tool is difficult and dangerous; with the right tool it is quick and easy.

Artificial intelligence isn't new, but we are finally getting the tools we need to make the computer do more useful things. Like most tools, however, these new methods aren't always easy to learn. Take the time, make them your own and you will have a new skill that will serve you well for a long time.



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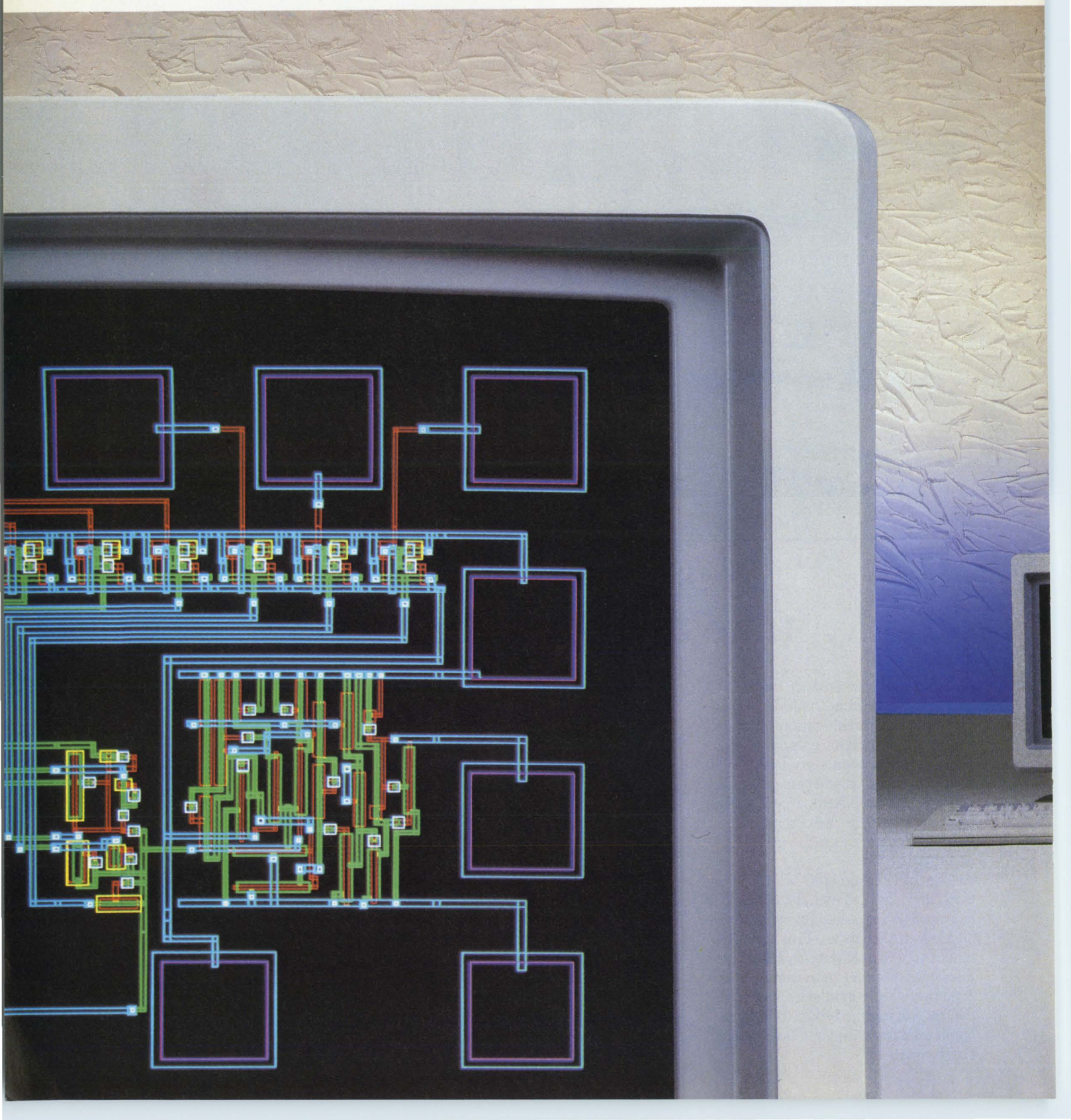
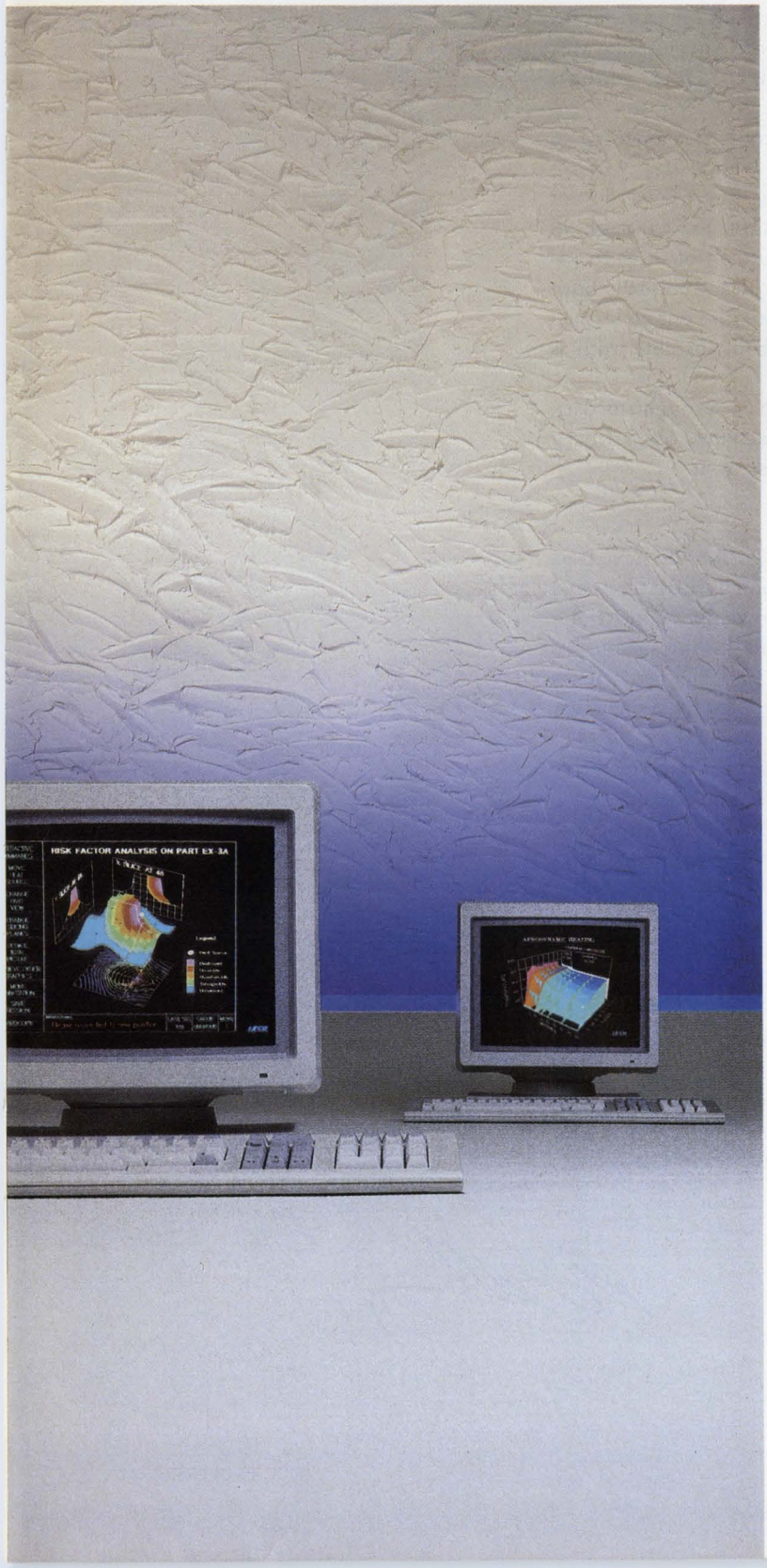


the First Family of terminals.



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*The TMS34010 Graphics System Processor

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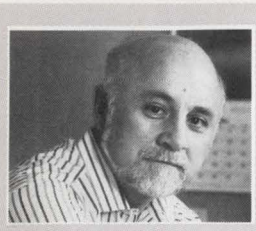


EDITORIAL

Dave Mallery

'Intelligence' Is Artificial

In this issue, we have a number of articles on artificial intelligence. AI is a marketer's dream come true. Just like MIS, it's a term that defies definition and, therefore, can have almost anything under its shadow.

I think the term works well because so little human activity has anything to do with intelligence.

Our species has an immense conceit about intelligence. Because we do not recognize other forms, we credit ourselves with sole possession. Even though 98 percent of our actions are reflexive or instinctive, we attribute all of them to intelligence. Throughout history, when someone has had a good idea, we usually burn him at the stake or hospitalize him. We "force fit" our experience into our prelearned models of experience and lash out at anything that deviates from absolute truth as we're convinced we know it.

The levels of intelligence exhibited by the machines we've wrought to date, closely follow the model in the last paragraph. If anyone ever achieves true artificial intelligence, the builder of the machine is almost sure to destroy it.

The Newest VAXs

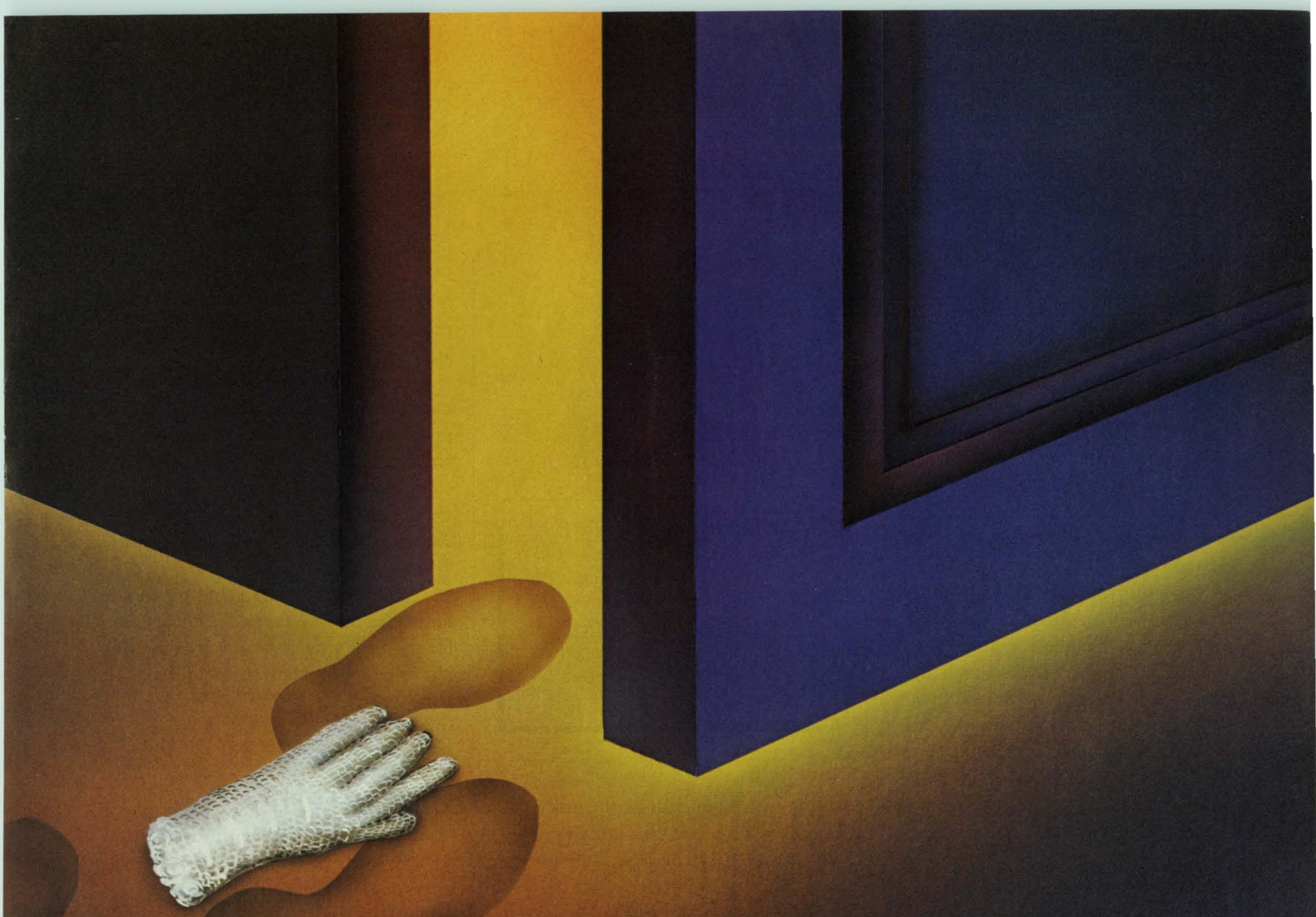
Every three weeks this editorial director heads North by East for the next DEC announcement. On March 4th, they rolled out three new models at the low end and middle of the 8000 series. Essentially, the two low-end machines consist of a CPU upgrade for the 8200/8300. A new CPU running at about 1.2 mips simply is substituted for the previous model and you have the 8250/8350. The better news is that the price has been reduced. The 8250s now start at $65,000. Given the lower prices of BI memory, an 8250 can be pretty attractive.

At the press conference, I asked about the gap in performance that I perceive between the uniprocessor 8250 and the uniprocessor 8530. If you're entirely I/O bound, the second processor in an 8350 is underused; i.e., it can't do I/O. The response was that they had done a lot of testing with *ALL-IN-1* and that it worked well in an 8350. To me, that proves that *ALL-IN-1* is CPU bound.

The other solution proposed was to cluster two 8250s. That's a good idea, but the hardware to do it isn't economical yet. Once a BI-based CI interface is available, it may become economical. I still feel that we need a good 2.x mip uniprocessor 8400. The 8530 is merely a wonderful exercise in footwork.

When is a computer a new model? You can change your 8500 into an 8530 by loading a new floppy with a firmware upgrade. (I have visions of reams of "get to here, count to 100,000, continue . . ." loops being snipped out.)

Much to DEC's credit, they're giving the upgrade to the installed 8500 base (this kind of model jockeying gives us fits with our Reader Qualification Cards).



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LETTERS

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

OVERLOOKED

It appears that we have been overlooked as a vendor/supplier of optical disk subsystems in your recently published report on optical storage (February issue). KOM Inc. provides a working solution with *OPTIFILE II*. *OPTIFILE II* offers customers a unique method of storing information: With the development of a true device driver consisting of software and a host adaptor board, DEC's VMS and RSX-11M+ operating systems can treat optical disk drives as if they were standard magnetic devices as the software emulates these characteristics.

OPTIFILE II remains unchanged because it's virtually unaffected by any new version releases of the operating system. The device driver software enables industry to take advantage of optical disk technology for records management, image processing, acquisition, and more.

Linda M. Bradley
Marketing Coordinator
KOM Inc.
Ottawa, Ontario, Canada

. . . AND

Regarding the optical storage article published in the February issue of *DEC PROFESSIONAL*, I found the article to be a very good primer on the technology and applications of optical recording.

On reaching your list of suppliers I noticed our name was not mentioned.

The Fujitsu M2505A is a 600-MB (formatted) WORM optical disk drive that fits a 5.25-inch full-height form factor. Fujitsu has implemented higher performance into this product by using a two-beam head. This device allows real-time data verification at writing, or direct read after write.

And our quick and precise track following system brings the error rate for our device into the same range as Winchesters (10-12). The high level of data integrity combined with its high capacity makes the drive ideal for archival storage applications.

Mike Nalls
Marketing Communications Manager
Fujitsu America Inc.
San Jose, California

DEC PROFESSIONAL regrets the oversight. Thanks for updating our readers.

CHANGING TIMES

As an end user of DEC mini PDP-11 computers and DEC Rainbow PCs, I am disappointed in your shift to articles related almost exclusively to VAX and MICROVAX users.

DEC's major success in its competition with IBM has been in addressing the needs of small- to medium-sized businesses through the PDP-11 systems at an affordable price. Additionally, the networking and compatibility of the Rainbows with PDP-11 systems and related PC software provided a real advantage to DEC users by their allegiance to DEC products.

Through DEC's lack of commitment to PDP-11, Rainbow and related, previously supported software, we users are out in the cold.

As an example of DEC's lack of consideration of users, we have had to purchase an IBM PC in order to run an enhanced version of a RealWorld Accounting package which was, until 1986, DEC Classified and recommended software that is no longer supported by DEC.

DEC achieved its standing in the minicomputer marketplace by concern for the little guy and now is abandoning us by its concentration on the VAX.

Richard C. Gay, CPC
iprGroup Inc.
Atlanta, Georgia

MOST HELPFUL

Your magazine has been most helpful and extremely informative. I always look forward to the next issue.

Steve Bushong
Manager Product Development
Organization for Industrial Research
San Diego, California

AUTO DIRECTORY DISPLAYER

As a recent VAX user and a new subscriber to *DEC PROFESSIONAL*, I found the article describing R. Bhavnani's auto directory displayer program useful in solving one of my VAX needs.

However, the Program 1 shown in your magazine contained one error, namely the omission of a parenthesis after "if" and before "disk" (nine lines from end).

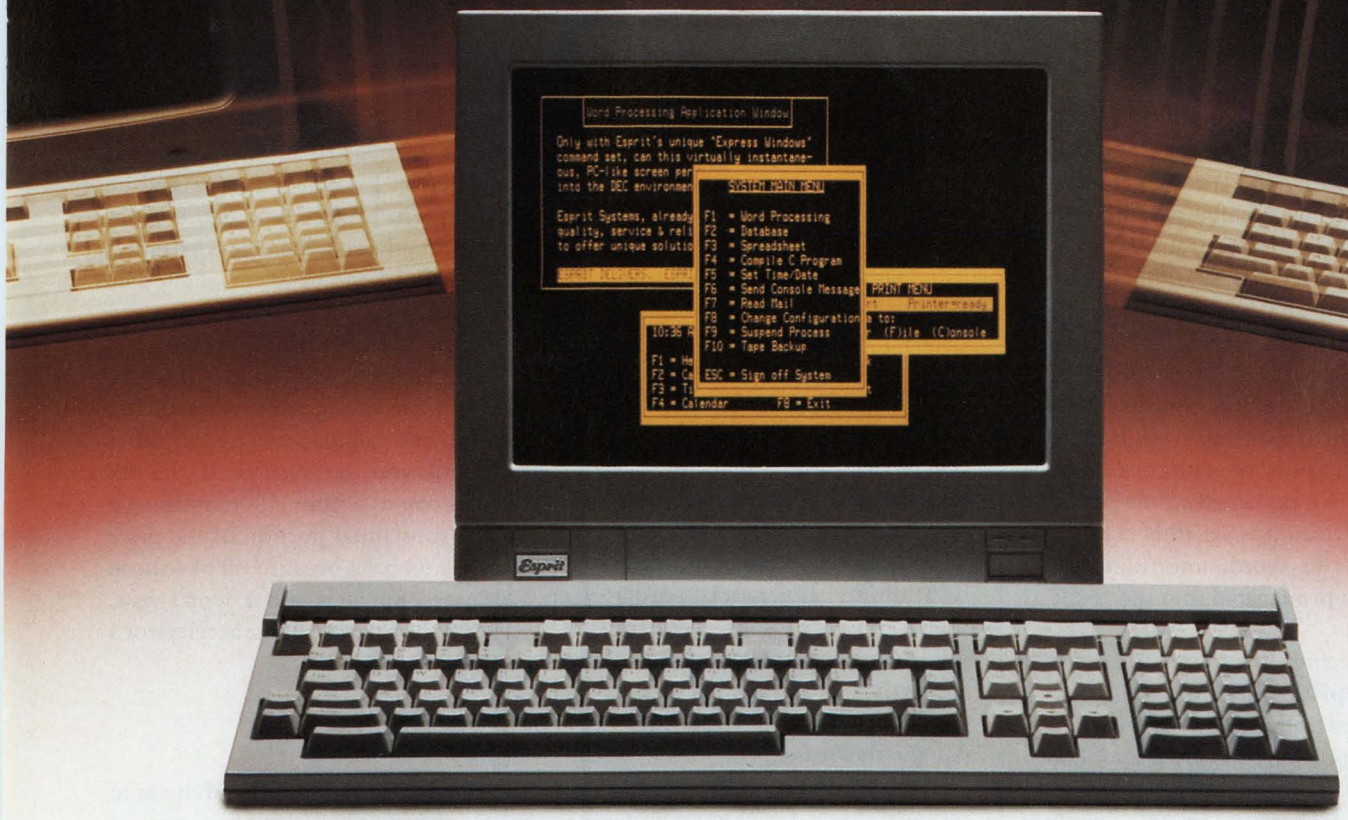
Also, in order to access SET_DEF from any directory, it requires:

```
SD :== @[dirname]SET_DEF
```

in the LOGIN.COM file.

Glyn James
Holland Patent, New York ■

CLEAR THE DEC'S



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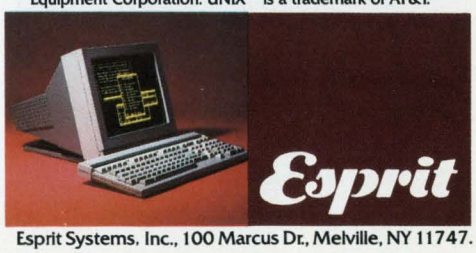
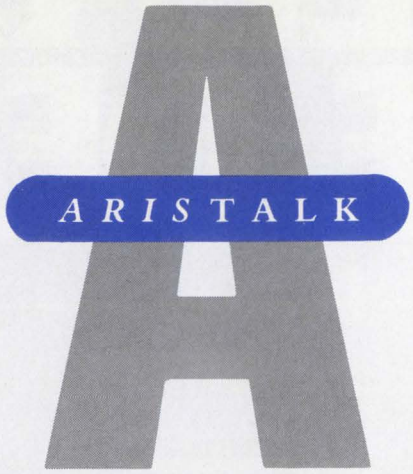


Esprit Systems, Inc., 100 Marcus Dr., Melville, NY 11747.

ENTER 426 ON READER CARD



INCOMPATIBLE SIGNS

QUERY:

Robert H. Schor: The January 1987 issue of *DEC PROFESSIONAL* (see "Letters" p.18) mentions an FPJ-11 problem regarding the incompatibility with RSTS (due, I believe, to interactions with the second general register set, though why a floating point chip should be bothered I don't know).

We've seen a different problem (under RT-11) in the way the chip does arithmetic. In converting from double to single precision, the chip can make sign errors. As explained to me, if the sign bit on word 3 is set (this is just a data bit in this word, not really the sign), it gets propagated into the result sign bit.

Our specific observation was to see the sine of -pi/2 evaluate to +1 instead of -1. I tried calling DEC about this, with no response yet. A friendly OEM says that DEC knows about it but has no plans to fix it, because, in DEC's eyes, the 11/73 is an obsolete machine (the problem occurs on 11/73 processors, the dual-wide AB board). What do I do? What's the point of a floating point chip that computes incorrectly? Does DEC plan a fix? Can I exchange/upgrade my current chip?

REPLY:

Andrew Duggan: Problems with the DCJ-11 and FPJ-11 have been around since before production of the chips, and I'm sure DEC knows all about it (at least the 18-MHz versions).

According to the *RSTS Software Dispatch*, the only problem mentioned is the DCJ-11 chipset problem with the MicroCode. My 11/84 (18 MHz) came without the FPJ-11 so that it would work (RSTS). I doubt if it ever will be installed. The projected fix date was six to nine months ago. Field Service didn't even know of the problem at all. The field change order (FCO) hasn't even gotten on the grapevine.

My advice to you is that if its on service, write a program to demonstrate the error and call for service every other day until you get results. If the fix doesn't come within 18 months, I'd want a substantial portion of the price of my 11/84 back because I'll have been VAXinated by then and I won't have received the floating point accelerator I paid for.

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 peek 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 or space parity, and dial (215) 542-9458. Baud rates: 300 or 1200.

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

PC-TO-VAX PAX

QUERY:

Eric Hudson: Can somebody advise as to the relative merits and performance of *Reflection 2*, *Reflection Plus*, *PolyCOM 220* and *SmarTerm 220* for running on an IBM PC/AT with a VAX host. I need extensive and frequent (daily) file transfer from the VAX into dBASE III or similar PC database. I need to know the problems associated with each product, if anybody has experience they'd be willing to share.

REPLIES:

Larry Huisingh: I don't know about the AT in particular, nor do I know about

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how well the products work with the VAX. Just for your information, though, *Reflection 2 Plus* is the same as *Reflection 2*, "plus," it allows you to perform BACKUP and RESTORE from your PC hard disk to a VAX host.

I use *Reflection 2* strictly as a terminal emulator to a PDP machine, and for the occasional capturing of ASCII data that I've used as input to dBASE III PLUS. *Reflection* has a VAXLINK program you upload to your VAX host to facilitate PC-to-VAX transfers.

It has the ability to transfer ASCII, binary, and image files. Image files are the same as binary files except that VMS and RMS file attribute information is appended. This way, when the image file is sent to a second VAX, it's identical to the original file on the first host. This is just some information I got from my manual. If you want more, you can call the *Reflection* people directly, at Walker Richer & Quinn Inc., (206) 324-0350.
Bob Willey: This message is being left with *SmarTerm 220* and an IBM PC/AT. I have good luck with the package accessing VAX/VMS, MICRO-11, A-to-Z and MICRO/RSX environments. Not a bad program. File transfer is not too bad and even has a built-in KERMIT mode. I haven't had a major problem, and I haven't had to read the manual much. Most information is on the ALT-S and ALT-H menus, and in Help.
Editor's note: Watch for DEC PROFESSIONAL's *continuing PC-to-VAX review series.*

NO HOME SHOULD BE WITHOUT ONE!

QUERY:
Eric Greene: It seems that some of the smaller PDP-11 systems are starting to trickle down to the home user. We presently have two PDP-11/23s and an ancient 11/34 sitting at home — all running under RT-11 V5. I would like to find other users and home hardware hackers interested in small PDPs for home use. There doesn't seem to be that much support for the home use of these fine computers. If someone knows of a User Group/BBS that would be of some help in mastering these machines, please let me know. There are about four of us in the Atlanta area working with PDPs as a home computer and we'd love to find some support / encouragement out there in an MS-DOS controlled world! We have a small DEC conference running on a local BBS (Pooh Corner [404] 458-6917) and would like to tie in with other DEC hobbyists.

REPLY:
Peter Heinicke: I wanted to let you know that I have three PDP-11s for home use also. I know of two other users in the Chicago area with home PDP-11s.

RA81 FAILURES

QUERY:
Allan B. Elkowitz: I'm getting killed by HDA and electronic system failures on my RA81s. So far, five out of seven have failed (in 12 months), some repeatedly. All have the so-called "new HDA." Any suggestions? My (hospital's) computer room is kept at a steady 68 degrees and 40 to 50 percent humidity and it's not open to users. Other equipment doesn't have this problem and power has been ruled out.

Can anyone recommend a DSA compatible large disk? I know about SI and about the problems with the Super Eagle. Help! Desperate!

REPLIES:
Andrew Duggan: I know how you feel. I too was the victim of RA81s. I only have two drives, but each has had the HDA replaced three times and I've had more read/write boards and servo boards than I care to think about. I can't really help with the DSA-compatible drives other than to tell you to go with SI and Eagles.

For your RAs: Make sure the spindle is grounded directly to the cabinet, and 68 degrees is too warm for 81s; try 60. Because I had the spindles *extra* grounded, I have not had one ECC error in almost 10 months. Start talking replacement and Field Service will really try. I run PDPs and I know DEC has a diagnostic and BBR utility they call *Scrubber.* If it exists for a VAX or HSC, have a disk specialist run it in VERIFY mode every month.
Kitty George: There is a scrubber that works for VMS. I can't speak for VAXclusters, but it's there for the UDA-type controllers.

As far as flakey disks — it's got to be environmental problems for these ailing RA81s. I recall that the original complainant works for a hospital. Could it be high-frequency radiation from CAT scan or X-ray equipment? I recall HP having their troubles with radio frequency waves in New York City skyscrapers a while ago.
Allan Elkowitz: I thought about your issues of radio frequency and X-rays. However, we have these computers in a room with metal- and lead-lined walls to shield out x-rays and to act as a Faraday cage against RF interference.

Also, our power is on dedicated lines separate from other equipment in the department. Keep in mind that it's only disks (not CPUs or memory) that are affected, and only the RA81s in particular. The RM05s and old RM80 run rock steady.
Kitty George: Assuming the room is shielded, then we "should" be able to rule out RF, X-rays and the effect of gamma rays on the RA81s during a full moon.

Have you taken one step back and looked at the controllers and the cables? You indicated that the RM05 and RM80 drives are doing fine; keep in mind that these are MASSBUS drives, not UNIBUS, and so have a different pathway into the guts of the CPU. I'm thinking of the hypothesis that the RAs appear to be going bad, when in reality the data sent back to the VAX is garbled by the cables or controllers or both. Also, have you tried rerouting the cables 'twixt the drives and the remainder of the system?

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PROGRAM

```
$ Set ver
$! This procedure calls PATCH/ABSOLUTE to modify the transfer address
$! array for an image. It it used to convert an image linked with
$! /TRACEBACK into one that looks like it has /NOTRACEBACK. The unmodified
$! version of the image file should be copied to itself first, in case
$! the file is corrupted during the operation and rendered unusable.
$!
$!
$ inquire/nopun p1 "Enter name of the $ image to be modified"
$ PATCH/ABSOLUTE/NOOUT/NOJOUR 'P1'
EXAMINE /WORD 2
DEFINE BASE = \
REPLACE /LONG BASE
80000168
EXIT
80000168
EXIT
EXIT
$ IF $STATUS THEN GOTO PATCH_IMAGE
$ PATCH/ABSOLUTE/NOOUT/NOJOUR 'P1'
EXAMINE /WORD 2
DEFINE BASE = \
REPLACE /LONG BASE
7FFEDF68
EXIT
7FFEDF68
EXIT
EXIT
$ IF $STATUS THEN GOTO PATCH_IMAGE
$ EXIT
$!
$!
$PATCH_IMAGE:
$! At this point we know we have an image that was linked with
$! /TRACEBACK. Now, modify the transfer address array so that the
$! image appears to the system as if it was linked /NOTRACEBACK.
$!
$ PATCH/ABSOLUTE/OUT='P1' 'P1'
EXAMINE /WORD 2
DEFINE BASE = \
!
EXAMINE /LONG BASE + 4
DEFINE CONTENTS = \
DEPOSIT /LONG BASE + 0 = CONTENTS
!
EXAMINE /LONG BASE + 8
DEFINE CONTENTS = \
DEPOSIT /LONG BASE + 4 = CONTENTS
!
EXAMINE /LONG BASE + 0C
DEFINE CONTENTS = \
DEPOSIT /LONG BASE + 8 = CONTENTS
!
UPDATE
EXIT
$ WRITE SYS$OUTPUT " "
$ WRITE SYS$OUTPUT "   Patch for ''P1'   with /NOTRACEBACK is complete."
$ WRITE SYS$OUTPUT " "
$EXIT
```

Allan Elkowitz:: Thank you for your thoughts. In general, I'm not too worried about grounding problems because I never get ECC errors. The drive just will not be there suddenly, without warning.

The computer room information was a typo. We keep the room between 60 and 63 most of the time. DEC keeps their working computer room in Shrewsbury, Massachusetts (where their disks are developed) at 72 to 78 degrees.

TRACEBACK, PATCH AND INSTALL

QUERY:

Tom Daley: I have a program that's used in conjunction with an OCR. It attempts to ALLOCATE a port before it begins the process of scanning pages. Since most of my users need to be able to run this program (and yet I don't care to give them enough privs to allocate ports anytime they choose), it would be neat if I could install the image with the necessary privs.

The problem is that the image was linked with /TRACEBACK under VMS 4.2 and the company that produced the program is no longer in business. About the time VMS 4.0 came out, I read an article in one of the *DEC Software Dispatches* that showed how to take the traceback flag out of an image by using the VMS PATCH utility. I regret to admit that I apparently discarded the document. Does anyone remember how to do this or have a copy of the COM file?

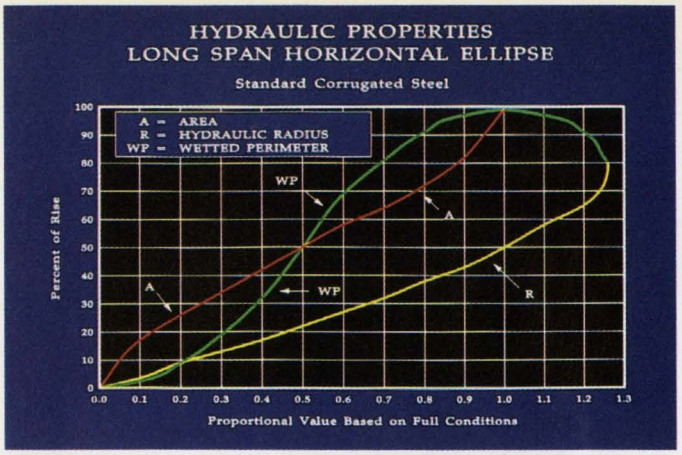
The quality of life at this site would be greatly enhanced if we could pull this off.

REPLIES:

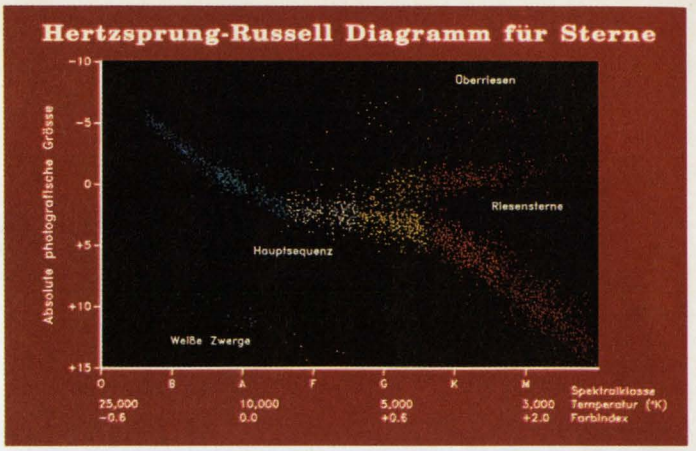
Gregg Deuchar: We've been using the following command file for about a year now. It works well.

Tom Daley: Gregg, thanks for the /TRACEBACK COM file! It worked fine and I'm very grateful for your help.

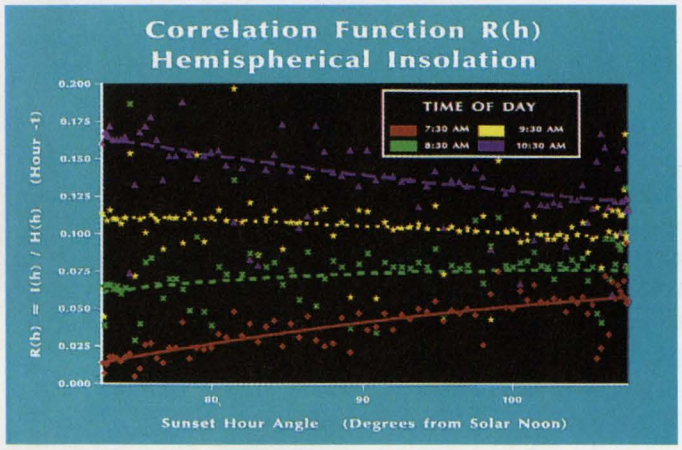
ARTICLE INTEREST QUOTIENT
Enter On Reader Card
High 768 Medium 772 Low 776



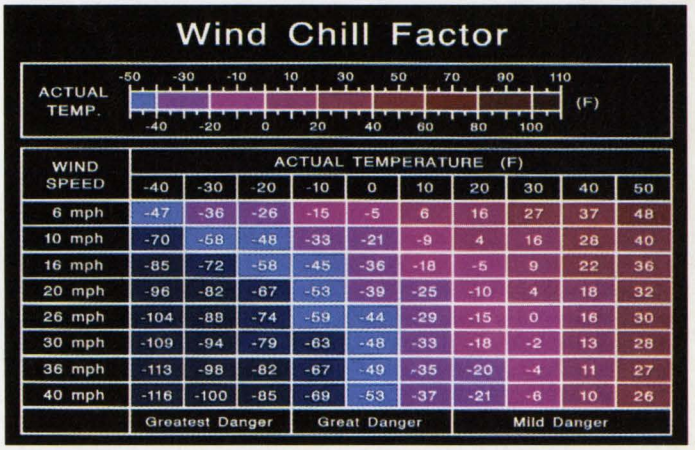
PicSure Plus' curve smoothing clarifies data representation. Shielding adds a professional look.



European text fonts offer a global graphics solution. Multiline annotations aid data interpretation.



Large datafiles can be read directly from disks. User retains complete control over all chart elements.



WIND SPEED	ACTUAL TEMPERATURE (F)									
	-40	-30	-20	-10	0	10	20	30	40	50
6 mph	-47	-36	-26	-15	-5	6	16	27	37	48
10 mph	-70	-58	-48	-33	-21	-9	4	16	28	40
16 mph	-85	-72	-58	-45	-36	-18	-5	9	22	36
20 mph	-96	-82	-67	-53	-39	-25	-10	4	18	32
26 mph	-104	-88	-74	-59	-44	-29	-15	0	16	30
30 mph	-109	-94	-79	-63	-48	-33	-18	-2	13	28
36 mph	-113	-98	-82	-67	-49	-35	-20	-4	11	27
40 mph	-116	-100	-85	-69	-53	-37	-21	-6	10	26
	Greatest Danger			Great Danger			Mild Danger			

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PicSure Plus runs on the entire VAX family, as well as a wide range of minicomputers and mainframes. Compose graphs on terminals and get hardcopies on laser printers, inkjet printers, pen plotters, and film recorders.

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ENTER 51 ON READER CARD

Digital's Layered Products

An Inside Look At Some Of DEC's Software Offerings

At a recent press briefing at Digital's main software development facility in Nashua, New Hampshire, *DEC PROFESSIONAL* had the opportunity to learn first hand about DEC's layered software products. DEC hopes to dispel the mistaken belief that it provides only computer hardware and a few operating systems. Actually, DEC sells about a dozen programming languages, screen management packages, software development tools, database systems, application generators, a transaction processing manager and computer conferencing software.

A good summary of DEC's layered software is contained in the pamphlet titled *VAX Software Quick Reference Guide.* More detailed information can be found in several handbooks: *VMS System Software Handbook*, *Information Management Handbook* and *Languages and Tools Handbook.* DEC also recently completed two tutorial books, *Introduction to Database Development* and *Introduction to Application Development,* which are excellent primers. Both show how to perform those tasks using DEC software.

After surveying the layered products, DEC demonstrated some of its newer products. We were particularly attracted to the VAX COBOL Generator.

COBOL GENERATOR is an icon-driven fourth-generation language. It lets a programmer write COBOL application programs entirely by moving pictures around on a screen.

To use COBOL Generator, the programmer draws the application with icons that COBOL Generator supplies along the bottom of the screen. The user "picks up" an icon and moves it to the appropriate place in his drawing. There are icons for file definition, terminal I/O, data processing, report writing, etc. Lines placed between icons indicate data flow or passing of control.

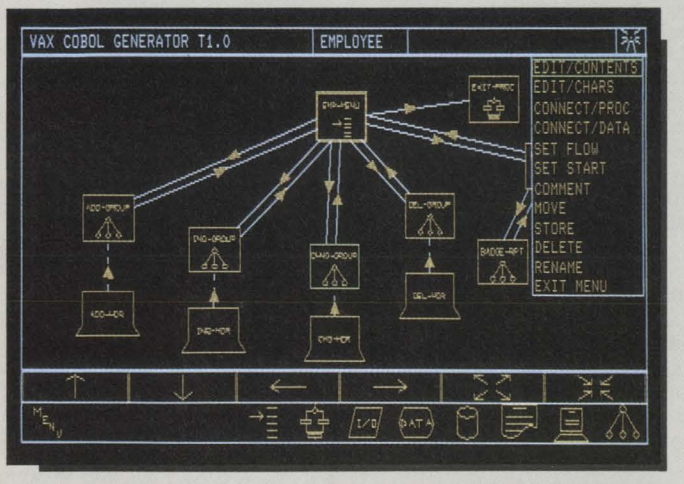
The application diagrams can be complex and are not limited to one screen-full. In fact, the screen that the programmer sees is a window onto a drawing that can extend in all directions. If the programmer wants to work on a piece that is off to the right, he just moves the window there.

After the drawing of the application is complete, the programmer selects an option named "GENERATE" that is contained in one of the icons. COBOL Generator then translates the picture into a COBOL program. (At this stage it is possible that the programmer has made a logical error in the drawing, and may need to correct it.)

When a COBOL program has been generated, the programmer leaves COBOL Generator. He then uses the standard VAX COBOL compiler to compile the program, and the VMS LINK utility to create an executable program. COBOL Generator can access either RMS files or use the *Rdb/VMS* relational database. If the icons that are supplied are not sufficient for a certain task, programmer-coded subroutines can be linked into the application.

The application is maintained by going back to the drawing and moving the icons around or adding new ones. Maintenance could be fun with this method of programming.

THE ICONIC, pictorial interface is so pleasant to work with that DEC should consider extending it to other products. In particular, it could be incorporated in software development tools



A moderately complex COBOL GENERATION program.

that address the early phases of development.

The existing VAXset tools (see *DEC PROFESSIONAL*, March 1987, Vol 6, No. 3) are used when a project has reached the coding stage or later. The diagrammatic nature of COBOL Generator, however, strongly resembles the classical structured design methods advocated by Yourdon and others.

DEC should consider creating a "software design tool" built around the COBOL Generator interface. Programmers could design software of any type with the icons and the tool would maintain data flow information and calling sequence lists. When a drawing is finished the tool could write the shell for each routine (in a language chosen by the programmer) with a correct parameter list, external declarations and subroutine calls. It even might produce some amount of documentation automatically.

The COBOL Generator looks like a winner, whether its ideas are extended to other products or not.

DEC Research Goes Home

Evaluating Friendliness In The Office Environment

While most computer software researchers test user friendliness in a controlled laboratory environment, DEC's John A. Whiteside, usability engineering group supervisor and technical director, advocates a more subjective and personal approach. "Observe the users at work," he told the National Research Council's Committee on Human Factors, in February.

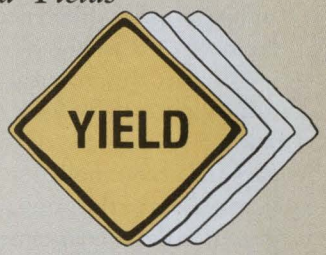
Whiteside, who holds an M.S. degree in computer science and a Ph.D. in experimental psychology, noted that in emerging disciplines like software engineering and usability engineering, "Much of the work is based on individual experience moderated by trial and error." Often, no effort is made to explain usability as an experience of the computer user, taking into account the user's needs, the software's fit with other programs, explicit usability goals and other relevent factors.

Under the "phenomenological" type of study engaged in by Whiteside, the researcher gathers data about users under conditions relating to the participant. A personal relationship with the participant and a genuine interest in what he's doing and experiencing are deemed essential.

The design team then uses the data codified into operational definitions. Examples include "user enthusiasm," the ease or difficulty of learning the new software, and "throughput." These attributes complement the measurable ones like the time to complete a task, frequency of help and documentation use, and percentage of errors.

Driving Without A License

Digital Looks, Listens And Yields On Its Licensing Policies



At a March press briefing, DEC had just finished summarizing the new computers being introduced and went on to describe another part of the announcement. When selling a CPU, customers could now inform DEC that the operating system would be transferred along with the hardware.

The audience sat in polite silence during the computer introductions, but now they stirred noisily. Pens came out of pockets. Whispering swept the room. Analysts gave each other knowing glances.

Why did such a seemingly dull subject like software licensing evoke more interest than new computers?

Because for more than a decade, every DEC operating system has been sold under a license that restricts the customer in transferring the software to anyone else. If a customer wants to sell a CPU and include the operating system in the sale, he can request permission from DEC.

DEC's approval has been important to customers; an operating system is worthless without a machine to run it, but can increase the value of a CPU sale. Over the years, DEC has approved these transfers routinely, and customers have come to take it for granted.

Last fall, DEC announced that it would start to enforce a right it always had: to say "No" to operating system transfer requests. Customers reacted angrily. Financial officers at major corporations said they had been carrying the operating system license as an asset for years, and DEC had made it worthless instantly.

Letters to the editors complained that DEC was becoming insensitive — just like another large computer vendor. People interested in buying the used computers were upset because now they had to buy a new operating system from DEC at a higher price.

On March 4, DEC announced it would liberalize the transfer of operating systems. Permission to transfer an operating system no longer will be required when its CPU is sold. The original owner simply can inform DEC of the sale. The new owner registers the operating system with DEC (at no charge) and becomes the official licensee.

At the same time, DEC revamped the procedure for transferring layered software products within a company. (Layered software runs on top of the operating system and includes languages, databases, tools and applications.) Previously, moving a layered product from one CPU to another in the same company

required DEC's permission. Now, the owner similarly can inform DEC of the move and pay a price difference if the new CPU is larger.

It was this reversal — from apparent aloofness toward customers to friendliness and accommodation — that caused the unusual interest at the announcement.

George Starr, publicity manager for DEC Corporate Software Services, spoke to *DEC PROFESSIONAL* after the meeting. "We listen to our customers," he said. "These new policies will make it easier to do business with Digital."

Without directly saying so, DEC admitted to making a mistake. It listened to its critics, fixed the problem and is to be congratulated.

—Charles Connell

Computerizing The Campus

Complete Computer System Coming To Lowell University From DEC

Soon, students at the University of Lowell, Lowell, Massachusetts, will register for classes from computer terminals and faculty members will perform literature searches from their offices.

Under a three-year program between the University of Lowell and DEC, the school will expand its campus-wide network and bring state-of-the-art computing to all of its programs.

The University will acquire $6.7 million worth of DEC computer equipment. DEC selected Lowell as the first institution of higher learning to participate in its Program for ADvanced Applications, Networks, and Computing for Education (ADvANCE).

Under the expanded network, the University will have a campus-wide electronic mail system, an electronic bulletin board to announce on-campus events, and an online database with course catalog and class-scheduling information.

The automated library system, expected to become a prototype for other libraries in the state, will support Lowell as well as various community and community college libraries.

The academic departments, including the College of Liberal Arts and the College of Engineering, will use DEC computers for teaching and advanced research.

Under the ADvANCE Program, DEC and an institution of higher learning establish a long-term partnership. Software or courseware developed by the university is offered at a nominal fee to other DEC users, according to the terms of the agreement.

The University of Lowell also will serve as a demonstration site for DEC's technology and hold communications activities with DEC, including local seminars, conferences and technology updates.

New Printer For 'DECtop' Publishing

Announcement Of The New ScriptPrinter Proves That DEC Is A Serious Entrant In The Desktop Market

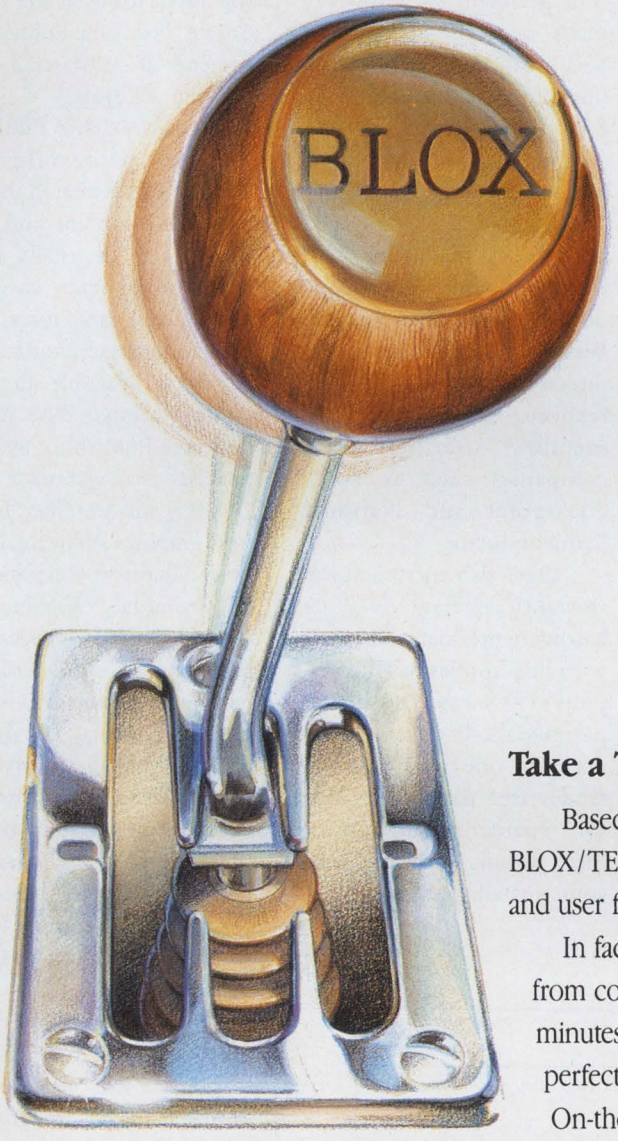
DEC's new ScriptPrinter, for low- to medium-volume applications, is the latest entry in the LN03 line of laser printers. The move demonstrates that DEC is seeking to capture a greater share of the lucrative desktop publishing market from companies such as Interleaf Corporation of Cambridge, Massachusetts, and from Apple Computer.

DEC's focus on establishing joint marketing agreements with companies in the field, further attests to the company's seriousness in the market. In addition, DEC has adopted the industry standard PostScript page description language. PostScript is used by the ScriptPrinter to create desktop publishing-quality pages of text, graphics and scanned images.

DEC intends the printer for users with low- to medium-volume requirements, and for electronic publishing applications, including office or CAD/CAM graphics applications.

The ScriptPrinter includes 29 resident typefaces and prints at eight pages per minute. It also prints files created using the ANSI/Sixel, ReGIS and Tektronix 4010/14 protocols, through VAX host resident software translators. The printer uses a standard RS232 serial interface, and is priced at $6,295 to make it competitive with other laser printers in its class.

HIGH PERFORMANCE DRIVING



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DEC Announces New Mid-Range Computers

Three New VAXs, Increased Warranty And Lower Price Keep DEC Competitive

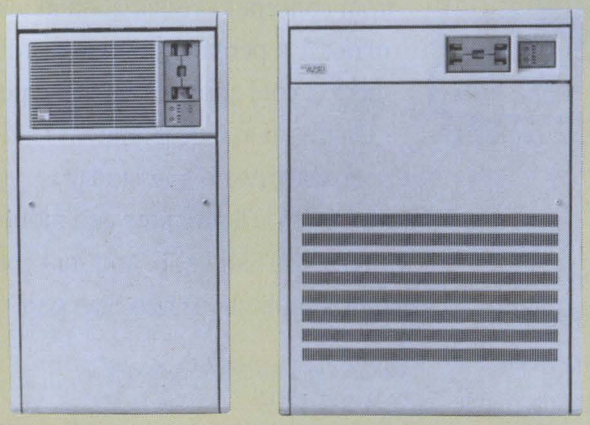
DEC recently announced three new mid-range VAX computers. Each of the new machines (8250, 8350 and 8530) replaces an older model in Digital's popular VAX line. All are built around the BI bus architecture and therefore can participate in a VAXcluster.

With a price starting at $65,000, the VAX 8250 becomes the entry level computer in the VAX line. The 8250 has a 40 percent price/performance improvement over the 8200, as well as being cheaper in actual dollars. The 8350 becomes the mid-range workhorse. Priced at $88,000 and above, this system uses ZMOS chip technology and, according to Digital, is now the price/performance leader in the VAX line.

The 8530 replaces the 8500. Prices start at $291,000 (very close to that of the 8500) with about a 30 percent performance improvement over the 8500. The 8530 contains the same physical hardware as the 8500, but achieves the performance increase with new, faster, microcode.

Digital also announced that prices for many VAX memory boards are being reduced about 50 percent. While DEC did not say so directly, this appears to be in response to competitive memory offerings from companies such as EMC, Clearpoint and National Semiconductor.

DEC also increased the warranty coverage on all its hardware products. The new warranty applies to all computers (VAX and PDP) and all peripherals. It covers products for one year and includes free parts and labor for repairs, installation of Field Change Orders, and some installation services.



The VAX 8250 system offers up to 40 percent price/performance over the VAX 8200.

Publishing With VAX

New Integrated Publishing Solutions Introduced By DEC

DEC unveiled two new VAX Integrated Publishing applications at the Corporate Electronic Publishing Systems Show, March 3-5, in Chicago, Illinois.

The VAXmate Publishing Solution for workgroup applications is geared to improve the content and appearance of internally produced documents such as newsletters, brochures, reports and presentations.

It is available in two configurations. The VAXmate VIP Publishing System consists of a VAXmate; *MS-Windows* and *MS-Chart* business graphics software, both from Microsoft Corporation of Redmond, Washington; *WPS-Plus* word processing software from Exceptional Business Solutions of Culver City, California; *PageMaker* desktop publishing software from Aldus Corporation of Seattle, Washington; an optional desktop laser ScriptPrinter; and an optional desktop image scanner from Microtek Labs Inc. of Gardena, California

The system is an Ethernet-based solution that is networked fully with other VAX systems. Users can create documents by accessing information directly from sources throughout an organization. VAXmate Publishing users also may share higher speed peripherals, such as the PrintServer 40, a 40-page-per-minute networked Postscript laser printer, or the ScriptPrinter.

The VAXmate VIP Publishing System costs $6,670. The price for the VIP Plus System, including the ScriptPrinter, is $12,190.

DEC's other new application, the VAX Departmental Publishing Solution, is the choice where workgroups share services and information to produce documents. It provides publishing software that can be accessed from *ALL-IN-1* for electronically mailing documents and integration with business applications.

The VAX Departmental Publishing Solution, configured to any size VAX, meets the varied needs of departments within an organization. In a typical solution there might be *ALL-IN-1, DECpage* for batch formatting and standardized style libraries, the VAX VTX videotex solution for sending and presenting electronic documents, and EDCS for maintaining files and revisions.

BASIS software for text information management is available from Information Dimensions Inc. of Dublin, Ohio. Prices for the VAX Departmental Publishing Solution begin at $41,691.

These applications are geared to enhance DEC's systems approach to publishing, with easy-to-configure solutions for each department within an organization. ■

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AI

DEC MAKES IT REAL

By Lori A. Snyder

Artificial Intelligence According To DEC.

Artificial intelligence (AI) can be described as an attempt to recreate the functioning of the human mind using computers. A more realistic description of AI is an attempt to make computers perform high-level tasks by making them "intelligent," something that has been realized in hundreds (maybe thousands) of applications to date.

The principle mechanisms to elevate the functional level of computers are expert systems, natural language, robotics and automatic programming technologies. DEC is enthusiastically researching and developing practical AI applications through the use of these technologies. DEC sees AI techniques as solutions to many of today's business and industrial problems.

DEC was the first commercial institution to become involved with AI when the eXpert CONfiguration (*XCON*) prototype was implemented in 1978, in collaboration with Carnegie Mellon University (CMU). CMU continues to be DEC's main research link today. Prior to 1978, however, DEC equipment also had been a popular choice for AI research — it had the necessary computing power and was interactive (LISP, the programming language used for AI applications, could not be run as a batch job). In fact, DEC's PDP-6 system (developed in the 1960s) was designed so that it would run LISP efficiently.

DEC has more than 400 people worldwide, dedicated to AI. In the U.S., DEC's AI activities occur at the Artificial Intelligence Technology Center (AITC) in Hudson, Massachusetts. Formed more than three years ago, AITC today employs more than 200 people. The main activities at AITC are AI product and services development and marketing, and development of AI engineering and manufacturing applications for internal use by DEC.

The AITC activities are divided among four separate groups. The AI Product Group is in charge of VAX LISP, VAX OPS5 and the AI VAXstation (basically a MICROVAX with packaging and software enhancements). The Intelligent Systems Technology Group develops internal applications like the *XCON* and *XSEL* expert systems. The AI Applications Group develops internal applications, primarily diagnostic expert systems, for the service organization. Finally, the AI Marketing Group is responsible not only for marketing DEC's hardware and software products, but DEC's training, consulting and timesharing services as well.

AI Hardware

DEC is not a proponent of special-purpose hardware. As one DEC ad puts it, the AI VAXstation is "the only artificial intelligence workstation smart enough to be a conventional one, too." DEC views AI as an extension of existing computer technology — DEC's AI software can run on standard VAX configurations (with the possible exception of additional memory requirements). Special-purpose AI hardware vendors argue that their computers provide greater performance because they are op-

timized for LISP instruction execution. DEC maintains that performance is a double-sided issue with productivity being measured in terms of overall project costs rather than at the level of LISP instruction execution. Besides, by not pursuing a specialized hardware strategy, DEC's AI products benefit from the efforts of the thousands of engineers devoted to developing DEC's standard systems.

The VAX historically has been a popular AI development computer, and most likely will continue as a popular choice, especially as AI leaves the research environment and enters industry. The VAX has a high cost/benefit ratio that makes it attractive in the business environment. Again, companies need not dedicate hardware solely to AI applications when they use general-purpose computers like the VAX.

The AI VAXstation

DEC's AI workstation, the AI VAXstation, essentially is a MICROVAX II with additional memory and a special graphics coprocessor. Particular hardware features include 9 MB of memory, a 71-MB disk (which can be expanded to three disks, for approximately 210 MB), a 95-MB streaming tape, a 19-inch, high-resolution graphics monitor, a three- button mouse and an Ethernet interface. Software includes VAX LISP, MICROVMS and Graphics Kernel System (GKS). The AI VAXstation contains a 32-bit floating point processor that enables computation-intensive applications. It can be standalone or networked and provides multitasking and multiwindowing capabilities. The workstation truly is a VAX and can run any layered product supported on a MICROVAX II configuration. In addition, because the AI VAXstation has the same architecture as the larger VAXs, porting applications from the single-user workstation to a multiuser system often is transparent.

AI Software

DEC supports a wide range of in-house and third party AI software. In the programming language arena, DEC offers VAX LISP, an im-

Schedule

Robots And Beyond: The Age Of Intelligent Machines Exhibition

Philadelphia, PA
Franklin Institute
June 13, 1987—August 30, 1987

Charlotte, NC
Discovery Place
October 3, 1987—Jan 3, 1988

Fort Worth, TX
Museum of Science & History
February 1, 1988—April 30, 1988

Los Angeles, CA
Museum of Science & Industry
June 3, 1988—August 29, 1988

St. Paul, MN
Science Museum of Minnesota
September 30, 1988—January 2, 1989

Chicago, IL
Museum of Science & Industry
February 1, 1989—April 30, 1989

Columbus, OH
Center of Science & Industry
June 8, 1989—September 3, 1989

plementation of Common LISP; VAX OPS5 designed for "industrial-strength" expert systems; INTERLISP (developed by the University of Southern California) which has built-in tools to support the "structured growth" style of programming; and PROLOG from Quintus Computer Systems of Mountain View, California, a symbolic processing language based on the logic of predicate calculus. VAX LISP and OPS5 will run on a VAX or AI VAXstation under VMS (VAX LISP also runs under ULTRIX), while INTERLISP and PROLOG run only on the VAX. DEC also markets many other AI software tools, including *Intellect* and the *AIT LISP Toolkit*, which have been developed by third-party vendors.

Expert Systems

DEC lists 17 expert systems developed and currently used by DEC internally, and has developed expert systems for more than 40 applications since 1978 (when the first expert system, *XCON,* was implemented). DEC's current expert systems include tape drive diagnostics (*AISPEAR*), VMS system crash analysis (*CDX*), circuit board wave soldering diagnostics (*KARNAK*), manufacturing scheduling (*ISA* and *ILOG*) and DECnet trouble-shooting (*NTC*), to mention a few.

The most renowned of DEC's expert systems unquestionably is *XCON,* the VAX and PDP-11 configuring program that ensures that each order submitted to manufacturing is a viable system (i.e., capable of being built). *XCON* works in conjunction with two other expert systems. The first, *XSEL,* is an interactive, user-friendly front end that helps the sales force select the computer system options best suited to the customer's needs. In doing so, *XSEL* guarantees that an order is complete. The other expert system, *XSITE,* is a site layout tool that considers such things as power and heat dissipation and minimum allowable clearances.

XCON is the world's largest production expert system and is used to assemble virtually all major DEC systems in the U.S. and Europe. It contains more than 5,000 (previously undocumented) rules and a "knowledge base" of more than 20,000 components. *XCON* configures the average order in approximately 45 seconds, running on a clustered VAX 8650.

Once the DEC computer system is configured and the site planned via *XSEL, XCON* and *XSITE,* a second trio of expert systems aids in manufacturing and delivering the new system. These programs, *ISA, ILOG* and *INET,* schedule orders, plan distribution of orders to customers and plan the assembly and test of the new system respectively.

Julie Kaewert, an AI marketing specialist at DEC, estimates that these expert systems (known as the "Knowledge Network") save DEC approximately $25 million annually. Undoubtedly, DEC would not have been able to achieve its current production levels without this effective use of expert systems technology.

Robotics

DEC's robotics efforts consist of an automatic materials handling system used to manufacture the VAX. Robots help distribute work items on the factory floor. The handling system is controlled by two expert systems, one that determines when and to which workstations "work-in-progress" items will be dispatched, and one that coordinates and drives these items via the robots, carousels and conveyors (see sidebar for more details). DEC estimates that it saves $25 million annually through the use of this automated handling system.

In August 1986, DEC announced a donation of $2 million to sponsor what has been called the nation's largest AI and robotics exhibition. The exhibit, "Robots and Beyond: The Age of Intelligent Machines," allows visitors to interact with expert systems and watch robots at work. Many of the Artificial Intelligence displays were furnished by DEC. "Robots and Beyond" premiered at the Boston Museum of Science in January 1987 and then went on national tour to member institu-

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tions in the Science Museum Collaborative.

DEC OFFERS TWO PRODUCTS that provide a natural language interface between the computer and user. *The DECtalk Voice Response System* converts computer text into surprisingly human-sounding speech. Applications of *DECtalk* include dialup message centers, information services, order processing, bank by phone, service dispatching and tools for the handicapped. *DECtalk* has an unlimited vocabulary because it employs sophisticated letter-to-sound rules. In addition, a user-defined dictionary with industry-specific terms and acronyms can be loaded.

The other product, *Intellect,* from Artificial Intelligence Corporation of Waltham, Massachusetts, allows database queries to VAX *Rdb/VMS* using everyday English. *Intellect* contains the rules of English grammar and syntax needed to understand queries, and a vocabulary of approximately 400 words.

DEC offers a variety of services associated with AI. DEC's training formats include lecture and lab courses, seminars, self-paced courses and books. Customized training courses and seminars also are available. Of primary emphasis is DEC's technology transfer program, *Select,* designed to help users apply advanced AI technology in practical ways.

Select consists of three levels based on customer need, experience and commitment. For example, level one allows a company to test AI technology without making a major commitment, by developing a basic expert system prototype. Level two enables a company to expand its AI capability from an early research phase to a practical expert system. And level three helps the customer achieve self-sufficiency with the goal of a functional expert system that can be meshed with the customer's mainstream business activities.

DEC's Automated Materials Handling System

DEC has implemented an Infinite Materials Handling System in two of its manufacturing facilities — Marlborough, Massachusetts and Burlington, Vermont. These systems control factory inventory and generate timely, accurate reports on work progress and quality. Key elements of each system are a pair of robots that transport assembly items, and two expert systems that determine when and to where items should be dispatched.

The robots used are the Trackbot and Storbot models from Creative Handling of Marlborough, Massachusetts. Trackbot runs on a track (hence the name), and moves both up and down and in and out of carousels to pick up materials. If required, it can move to the left or right to different carousels. Storbot moves on two axes (up and down and in and out) and copes with higher volume than Trackbot.

The expert systems *Dispatcher* and *Mover* are the controlling software for the entire materials handling system. *Dispatcher* determines the order in which work-in-progress (WIP) items are dispatched, and to which workstations they will be sent. *Mover* coordinates and drives WIP items via Trackbot and Storbot carousels and conveyors.

Dispatcher uses information in its knowledge base to select the best work item(s) to dispatch to a workstation, depending on current work status and demand on the factory floor. The knowledge base initially is created with interactive utilities that are part of the system. New work is entered into the system either by automatic utilities or interactive routines. *Dispatcher* performs updates automatically, but any exceptions that arise can be handled manually with interactive utilities.

Dispatcher's knowledge base contains information about four components that enable it to make decisions: workstation, route list, unit load and WIP. These elements, along with the validation table that verifies valid workstations, operations, parts and classes, represent the state of the manufacturing floor.

The WIP record is the element of the knowledge base that carries out the function

DEC's consulting services include surveys to determine whether an expert system may be an appropriate approach for a given problem, custom briefings and orientations and development of prototype and full-scale expert systems. DEC's consultants have assisted with business applications as diverse as banking, manufacturing and construction.

Finally, DEC offers timesharing services for potential customers to evaluate VAX AI software (without having to purchase it), and for customers who need additional, but temporary, computing power.

In the future, DEC plans to develop many more expert systems and expert system building programs for the VAX, optimizing and refining VAX LISP for greater performance and developing automatic programming applications. DEC's overall goal is to integrate AI with existing programming tools, like database management software, and to supplement existing tools with AI. For instance, DEC envisions AI providing an intelligent front end to COBOL. The integration of AI into existing technology expresses DEC's philosophy: AI is an *evolutionary* not *revolutionary* technology. DEC hopes to eliminate the sensationalism associated with AI and make it just another technology used to help people. — *Lori Snyder is* DEC PROFESSIONAL's *UNIX editor.*

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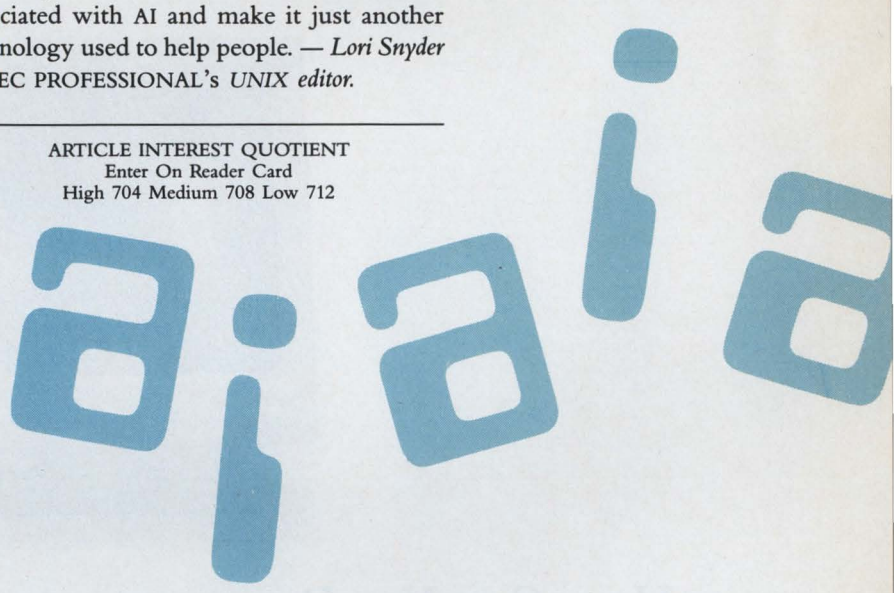

of tracking and dispatch control. Each WIP item is assigned a route list containing the steps required to manufacture the product. *Dispatcher* maintains a pointer in the route list to monitor work progress. When the WIP item is created, the next-step pointer points to the first step on the route list and is incremented to the following step when it reaches the arrival platform of a workstation. When an item reaches the last step on its routing, the system detaches all unit loads from the WIP and changes their type to "empty." The associated WIP record then is deleted.

The goal of *Dispatcher* is to fill each workstation to capacity with work. Whenever a workstation is idle or not at capacity, its status is set to "requesting work." While the system is in automatic mode, *Dispatcher* attempts to fill these requests. The system can be set to manual mode to handle exceptional requests; the operation then manually selects the desired WIP item.

Product status reports are generated easily using the materials handling system. Because *Dispatcher* continually is updating product route lists, it's a simple matter to track a given WIP item. The Controller, an interface between the operator and *Dispatcher,* provides a reporting facility for WIP items, route lists, unit loads and workstations.

The Controller also enables device faults and equipment failures to be logged, and provides error handling capabilities. In some instances the system offers suggestions on how to correct the errors appropriately.

Since its implementation at DEC's Marlborough, Massachusetts, facility two years ago, the materials handling system has been in operation six days a week for three shifts per day. During the first month, it reduced inventory by 50 percent, and inventory accounts increased in accuracy to 99.9 percent. DEC estimates that this system saves $25 million annually.

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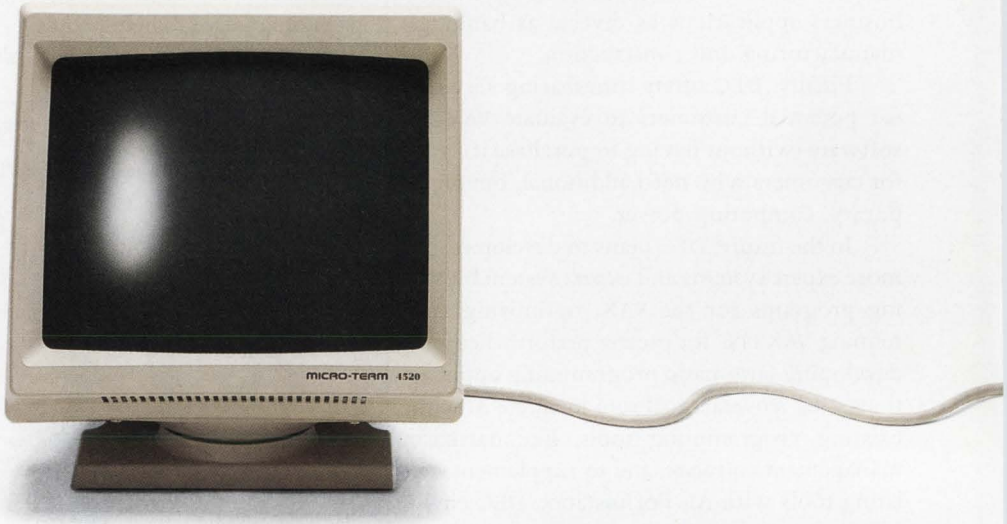

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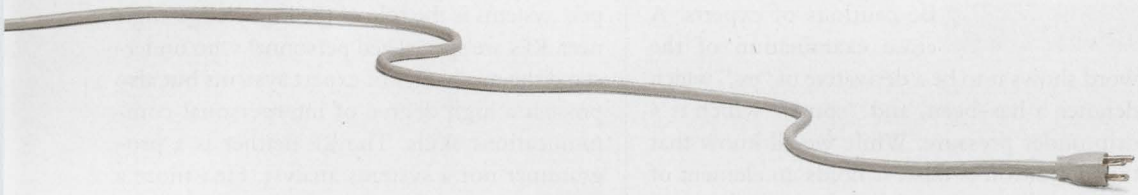

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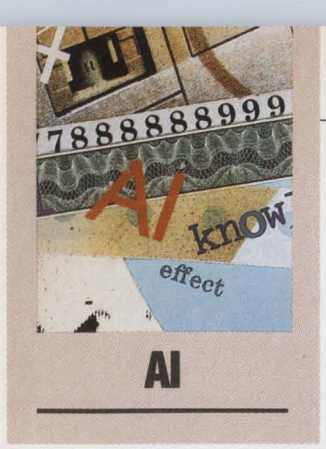


AI

EXPERT SYSTEMS

By Bill Hancock

If You Can't Hire An Expert, Build One!

Be cautious of experts. A close examination of the word shows it to be a derivative of "ex," which denotes a has-been, and "spurt," which is a drip under pressure. While we all know that this definition is false, it holds an element of truth: Experts, for all their expertise, can forget how they got that way, and, even worse, find it difficult to pass on their knowledge to those who need it.

To solve this problem, researchers turned to the power of the computer. Because a computer can store millions of facts and retrieve them in an orderly fashion, why not store expertise and allow its retrieval in a cognitive manner? Thus, the concept of expert systems was born.

EXPERT SYSTEMS HOLD the possibility of commercial applications for artificial intelligence. An expert system is a very sophisticated computer program, usually written in a popular AI-oriented language such as PROLOG or LISP, which allows the knowledge engineer (KE) to build a database of rules and facts and link them together in a useful and accessible way.

Rules, called heuristics, are derived from exhaustive interviews with human experts and placed into a rule database. Facts are uncovered similarly and both are linked together via a specialized software engine, termed an inference engine, which correlates rules and facts and returns information to the user.

One of the most important aspects of expert systems is the role of the knowledge engineer. KEs are specialized personnel who understand the mechanics of expert systems but also possess a high degree of interpersonal communications skills. The KE neither is a programmer nor a systems analyst. He's more a "technical psychologist" who understands how to get information from experts and translate it into something a system can understand. For instance, how do you get an expert on VAX tuning to explain how he goes about tuning a system? Worse, how do you get a non-technological expert, such as a horticulturist, to explain the best way to plant seedlings to achieve the maximum growth rate in the shortest time?

The problem usually is not in the entering of information into an expert system, but in understanding how an expert develops and applies his expertise. What's important is not only what machine and software to use or how to extract information from an expert, but also the answer to the basic question: What is an expert?

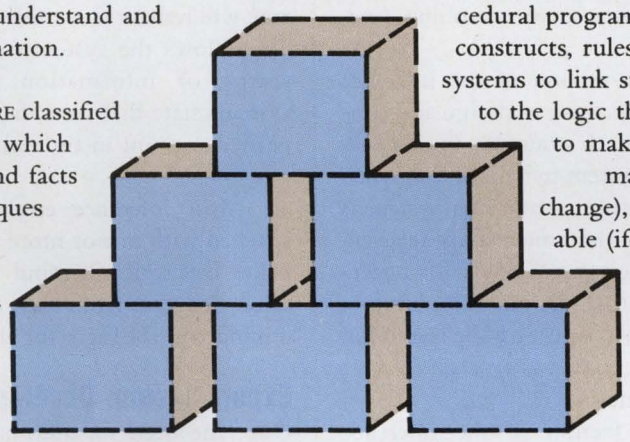
Most KEs agree that an expert:

1. Can solve a particular type of problem that most people cannot solve efficiently or effectively.
2. Is an authority in the top 10-20 percent of a given subject.
3. Knows how to search his knowledge base swiftly and arrive at reasonable and accurate conclusions.
4. Has acquired a superior knowledge base of materials related to his field of expertise (most psychologists believe that experts possess and use 50,000-100,000 different entities of infor-

mation; it takes approximately 10 years to acquire 50,000 items of expertise).
5. Possesses both surface knowledge of many related items and deep knowledge of his area of expertise.

Because of the level of expertise that an expert possesses, it can be very difficult to extract essential rules and facts. KEs should have skills over and above technical skills, before they can be useful in the development of an expert system. Essential skills include:
1. Expertise in knowledge representation, thought processing and knowledge acquisition.
2. Knowledge of the psychological implications of decision making and problem resolution.
3. Extensive experience in interviewing and interpretation.
4. A pleasant and persistent personality, oriented toward listening.

A KE eventually will become a pseudo-expert in a given project. The level of exper tise is determined by how much hands-on experience the KE is given in a project by the expert. Nonetheless, the KE will develop sufficient expertise in the field to be able to converse, understand and extrapolate information.



EXPERT SYSTEMS ARE classified by the method in which they store rules and facts and by the techniques used to search for stored information. These classifications, called knowledge representation mechanisms, are broken down into five basic, but very different, approaches: semantic networks, object-attribute-value triplets, rules, frames and logical expressions.

Semantic networks function by collecting items called "nodes." A node may include physical items (hats, coats, dogs), conceptual entities (places, numbers) or descriptors (worn, old, matronly). Nodes then are linked either through a class-instance relationship ("is-a"), a sub-property of another node ("has-a"), a definitional linkage (a coat that "covers" the arms defines what a coat does) or heuristic knowledge (a rule; e.g., "work 'causes' gloves to be worn").

Through this variety of relationship mechanisms, semantic networks are very flexible and new nodes/linkages may be defined as necessary. One additional benefit of semantic networks is that a node may inherit characteristics of adjacent nodes. This helps bound searches as well as allows faster identification of potential search paths to satisfy a request.

The second type of technique uses the combination of objects (physical or conceptual entities), attributes (general characteristics or properties associated with objects, like size, shape and color) and values (the specific nature of an attribute for a particular situation). In an O-A-V triplet, for instance, an object of a coat might have the attribute of elbow condition and a value of worn and shiny. O-A-V systems typically do not use simply O-A-V triplets to search; they most often combine O-A-V or A-V with some other knowledge identifier such as rules.

Rules typically are used in most expert systems. Very similar to procedural programming "IF-THEN" constructs, rules allow the expert systems to link stored information to the logic that an expert uses to make decisions. Rules may be fixed (never change), conditional, variable (if-this, then . . .) or uncertain, which causes logic to be invoked to make weighted decisions based on data, previous use patterns, new rules or other criteria.

Frames constitute yet another approach. An object is given a storage "container" that contains items called "slots" (storage entities). Slots may contain a variety of differing information types, like default values, sets of rules, procedural code to obtain a value (similar to a function in a high-level programming language) or a pointer to another frame.

A frame-oriented system is like a Chinese puzzle box. After getting to the box, it may contain the prize, another box or directions on how to get to another box not in the current

The inference section of the inference engine is relatively simple in design and consists basically of search strategies.

box. Frame systems typically combine the use of procedural knowledge perspectives (using algorithms in a manner familiar to classic programming techniques) and declarative-based (heuristic) methods to represent linkages to knowledge items and define search methods.

In addition to the base philosophical mechanism by which an expert system is developed, an inference engine must be included to provide a mechanism to implement the philosophy. Inference engines are the workhorse of an expert system: They must examine facts and rules and decide in what order inferences should be made, and must provide a means of control (where to begin a search and what to do if alternative reasoning lines emerge).

The inference section of the inference engine is relatively simple in design and consists basically of search strategies. First, *modus ponens*, allow the system to believe that when the premise of a rule is true, the system is entitled to believe the conclusions reached. Second, the engine must provide for uncertainty; how does it handle incomplete information? Finally, it also must handle resolution — discovering that a fact is true given a set of logical statements.

The control section of the inference engine provides for two separate problems — where to start and how to resolve conflicts. To provide these solutions a variety of techniques may be used (singularly or together), such as:

1. Chaining — Backward chaining systems are used when the values of the outcome are known. Most current expert systems use a backward chaining (also called a goal-driven) system. When a system has a large number of potential outcomes or the goal/solution is unknown, the techniques used to conduct the search are called data-driven or forward chaining techniques.
2. Depth-first or Breadth-first — Depth-first systems dig deeper and deeper into details as the chain of rules develops in response to questions asked of the user; e.g., searching for detail first is the theme of back-chaining in a depth-first manner. Breadth-first systems sweep across all premises in a rule before digging into detail. This technique is most efficient when a rule succeeds and the goal's attribute/value is obtained.
3. Monotonic or Non-monotonic Reasoning — Monotonic systems state that facts that are true will remain true throughout the session. This allows the system to grow steadily in search of information. Non-monotonic systems state that facts that may be true at a particular point in time may be retracted.

Most inference engines will be constructed with one or more of the above three major categories in mind and typically will select one item from each category in determining control logic for the engine.

Expert System Development

Once the need for automated expertise has been identified, the problem of expert system development rears its head. A five-phase approach frequently is recommended to ensure that the project progresses in a smooth, predictable manner and yields the best possible system to solve the problem.

PHASE I FOCUSES on selection of an appropriate problem. Expert systems are ideal as diagnostic tools and frequently are implemented as such. Even as a diagnostic tool, however, the proper goal of the system must be identified to extract and develop the system into a useful

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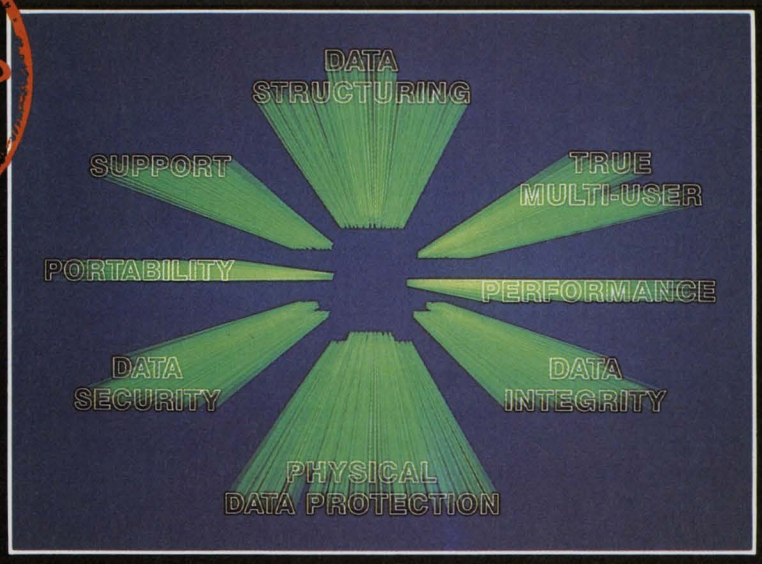

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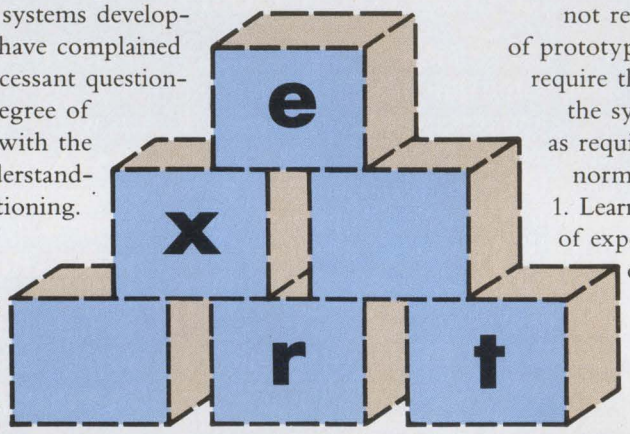
tool. The steps in Phase I include:

1. Identifying a problem area and a specific task in the problem area. This sounds easier than it is. Problems usually are ill-formed and don't accurately describe the issue to be solved. Other problems like poorly defined goals, time constraints in problem solving, non-specific methods and gray-area solutions contribute to the problem of solving a problem. The best goal is one of solving a highly focused problem with a limited number of solutions (a bounded problem). By either selecting a problem that has a finite number of solutions or imposing a finite number of solutions, the difficulty of expert system development decreases significantly.

2. Finding an expert willing to contribute his expertise. Many experts in non-technical fields become anxious when told that they've been selected to provide their expertise for an automated system. This occurs because of a fear of technology, job insecurity, the problem of a computer improperly solving a problem and creating a much larger one in the process, etc.

Another problem is that many experts simply don't have time to devote to the demands of such a task. Experts involved in expert systems development frequently have complained of exhaustion, incessant questioning and a high degree of stress associated with the issues of not understanding lines of questioning. There is also the concern of KEs not understanding what an expert believes is simple, etc. In short, finding a willing expert can be a chore.



3. Identifying a tentative approach to the problem. All problems have solutions; some desirable, some not. In the quest to develop an expert system, there are many approaches, including preliminary prototyping, scale of use issues and others. By identifying a potential tack, the expert system builder can make preliminary determinations on how to extract information from the expert as well as how to structure the expert system.

4. Analyzing the costs and benefits of an expert system. Not all expertise is well suited for an expert system. As mentioned, expert systems are useful when the information is extracted easily, the problem well defined and the solutions bounded. Not all problems can survive in this type of model, so it's impractical to expect an expert system to provide problem-solving capabilities to all types of problems.

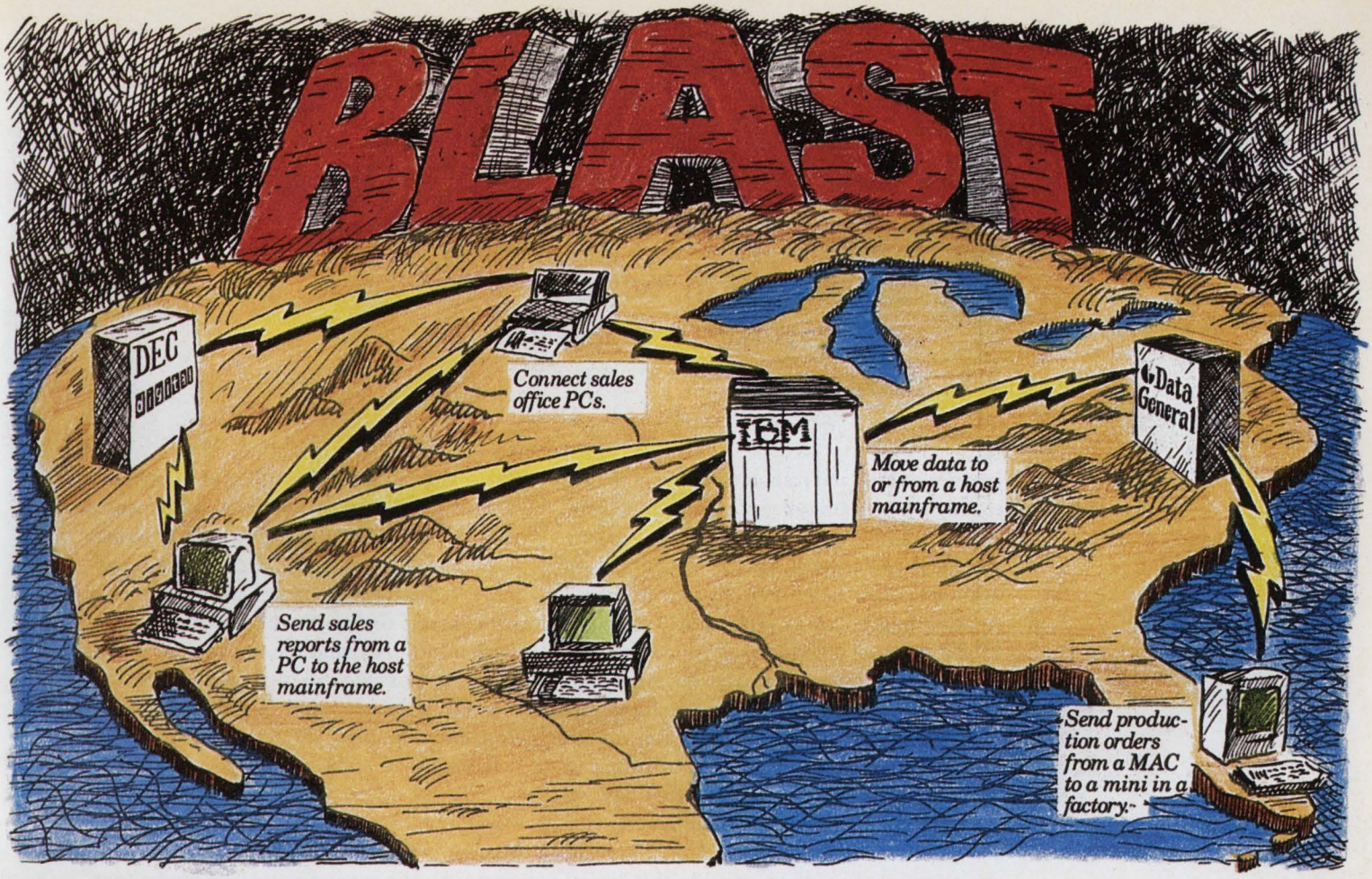
Analyzing the benefits of an expert system is critical to the proper expectation setting of potential users of the system as well as management expectations of what the system can and cannot do. If the potential benefits can justify the cost of development, then and only then can an expert system be viewed as cost-effective to develop and use.

5. Preparing a specific development plan. In all technical endeavors, the project plan and technical plan are critical to success. Who does what, when things are done, how things are tested, etc., are essential to the proper flow of a project. Expert systems are no different and require the same consideration.

PHASE II OF the expert system development involves the development of a prototype system. While most software systems do not require development of prototypes, expert systems require them to ensure that the system will perform as required. Phase II tasks normally include:

1. Learning about the area of expertise and the goal of the system. The KE must spend considerable time exploring the area of expertise to be captured and also to understand thoroughly the problem that must be solved so that there are no surprises. Sometimes during this phase it's discovered that the problem is too vague or unbounded. This may necessitate additional work in the area of problem definition and expert system service provision.

2. Specification of performance criteria. Some problems, while well bounded, may require so many rules and facts that the search strategy through the rules and facts takes an enormous



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It's very difficult to develop an expert system without some prototyping to select the proper tool . . .

amount of time and resources. Some problems require that certain types of responses be provided within a set time limit; otherwise, the system is useless to users. The specification of how fast and how often the system should respond to requests as well as provide input to the decision-making process of the user must be well categorized and documented.

3. Selection of an appropriate tool for expert system development. Most expert systems depend on a development tool environment to properly provide the necessary activity on completion of the system. Languages like LISP and PROLOG provide a good development environment, but don't provide the critical tools of inference engines, rule categorization, fact storage and other necessities in an expert system (these would have to be developed in LISP or PROLOG or another language to be able to use a language instead of a toolkit for an expert system).

In addition to development environment issues, different tools provide different inference logic capabilities, search strategies, total rule amounts, fact interpolation algorithms and other technologies that govern how the expert system "does its thing." It's important to understand the problem properly and develop a prototype to ensure that the proper expert system mechanisms to solve it are implemented in the development environment and that the environment is suited for rigorous use when the system is complete.

4. Developing a detailed design for a complete expert system. This step should be obvious. It's very difficult to develop an expert system without some prototyping to select the proper tool, and it's impossible to do a detailed design until the environment is well defined.

PHASE III OCCURS when the system starts to take shape. A core structure is implemented with a set of base rules and facts from which to build the full system. A complete knowledge acquisition campaign is implemented with experts to retrieve the maximum information and to expand the knowledge base as much as possible. In this phase, the user interface is tailored and overall system performance is monitored carefully to ensure that it meets usage criteria.

PHASE IV IS a painful phase of development because it involves the critical review of the system by the experts as well as invited outside experts and users. Phase IV often is considered the "ego-killing" phase because frequently users and experts require changes that can be tedious and restructuring of rule linkages that can be difficult. Also, performance in a real run-time environment is monitored for adherence to specifications.

PHASE V, the final step in the development process, provides for integration of the system into the environment in which it will be used. Users are trained, procedures are implemented and connectivity to other system components, if necessary, is accommodated. Also, a "technology transfer" agreement is completed between the expert system developer (if an outside company) and the client.

Most knowledge-oriented products are copyrighted by the developer and an unrestricted, royalty-free license often is granted to the client for the use of the expert system and rule/fact base. This is essential if the client is to use the expert system and associated software legally. Most vendors require this because they may find that the expert system developed has other marketing potential. They'll be very interested in ensuring that ownership of the

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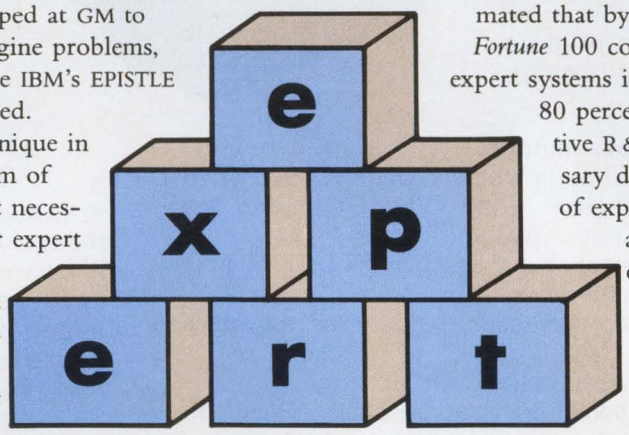
system remains firmly in the vendor's grasp, regardless of whether the client paid for development.

If this sounds unusual, take a look at the Digital Equipment Corporation *Standard Terms and Conditions for Software Services.* DEC has been pulling the same stunt for years. Even if a company hires DEC to develop software for it, the company doesn't own the software — DEC does. DEC agrees to grant a non-exclusive, royalty-free license to the developed software, but most customers never realize it (and many don't care). Read the clauses carefully when purchasing software licenses for development environments because expert system toolkit developers tend to get somewhat creative with their licensing procedures.

Applications For Expert Systems

Where is an expert system used? Many companies are starting to ask that question, but a few already are answering it with useful, working systems. DEC, long famous for its expert system configuration tool, XCON, and sales tool, XSEL, led the charge with commercial application of expert systems technology. Since that time, expert systems have been developed at GM to help diagnose engine problems, and programs like IBM's EPISTLE have been launched.

EPISTLE is unique in that it's a program of development, not necessarily a particular expert system. One of the expert systems in the overall program provides a kind of electronic mail sorting service for managers who use and receive electronic mail. Through this subsystem, rules on what mail to keep, what to do with routine items and other such actions could be taken easily without ever bothering managers with routine messages.



Other systems have been built to handle tough problems like network trouble-shooting. AT & T uses an expert system called Automated Cable Expertise (ACE) to help find cable faults, a job that usually takes about five years to train technical personnel to accomplish. Another AT & T expert system called Network Management Expert System (Nemesys) now helps reduce congestion on telephone networks, while Bellcore (the old Bell Labs) has an expert system called Real Time Expert Analysis and Control Tool — (REACT) that monitors network alarms and suggests corrective action. Not to be left out, DEC has developed an expert system called the Network Consultant that helps solve categories of LAN problems.

> A good expert system can help a company keep critical expertise in the firm.

Designing, implementing and using expert systems involves a great deal of planning and cash — big cash. But a good expert system can help a company keep critical expertise in the firm, regardless of whether personnel remain with the firm. It has been estimated that by 1990 most of the *Fortune* 100 companies will have expert systems in-house with over 80 percent involved in active R & D. This is necessary due to the shortage of experts in many areas and because of the competitive nature of today's marketplace. Expert systems never will replace human experts, at least not for a very long while. They are, however, here to stay.

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

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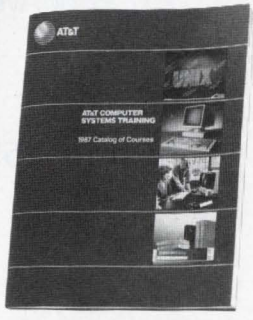

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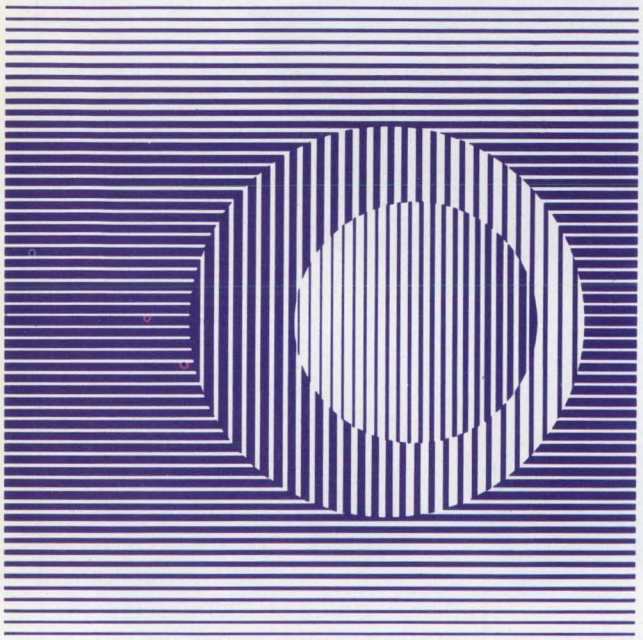

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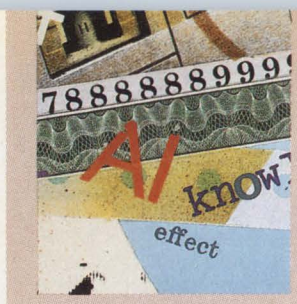

AI

MEASURING ARTIFICIAL INTELLIGENCE

By Charles Connell

What Does It Mean? How And Why Is It Done?

One of the major issues in modern computer science centers around the term artificial intelligence. There's little agreement about what it means. The non-technical public is often misled by it and the technical community is growing weary of hearing it applied to every new product.

A problem with discussions about AI is that it's treated as a quality that software either does or does not contain. Expert systems have it, but accounts receivable packages don't. Natural language query interfaces also have it, while text editing programs don't. Programs written in LISP by people working near MIT almost always have it, while anything written in COBOL definitely does not.

The reality is that computer software lies along a continuum of intelligence. The earliest programs in the 1950s were the beginning of machine intelligence, and those of today are a little further down the road. Certainly, there are intelligent tasks that no computer approaches today, but that we may see them do in the future.

In order to diminish the black and white nature of the AI debate, and in an attempt to discuss current software more clearly, we need to develop a scale of intelligence — the *DEC PROFESSIONAL* Machine Intelligence index (DPMI). As you read it, note that each step is written in the plural. For a human or machine to advance a step, it must be able to perform the task in a general manner. The DPMI, step-by-step, is as follows:

1. **Remembering facts.**
2. **Performing arithmetic calculations.**
3. **Remembering and following lists of instructions** — the ability to follow directions or be programmed.
4. **Playing games with fixed rules** — includes playing checkers, chess, tic tac toe and any new game that may be invented.
5. **Becoming better at games with experience** — the ability to develop new game strategies.
6. **Observing games and discovering their rules** — includes the ability to watch a baseball game and deduce its rules.
7. **Inventing games** — the ability to invent coherent games that are not minor variations of existing games.
8. **Learning categories for known objects.**
9. **Putting new objects into known categories.**
10. **Inventing new categories to organize the world.**
11. **Understanding and applying fuzzy categories** — the ability to understand that something is "colorful" if it more or less has certain properties. It's becoming clear to linguists and philosophers that the meanings of words and common concepts may not have exact specifications.

Note: Steps 8 through 11 involve organiz-

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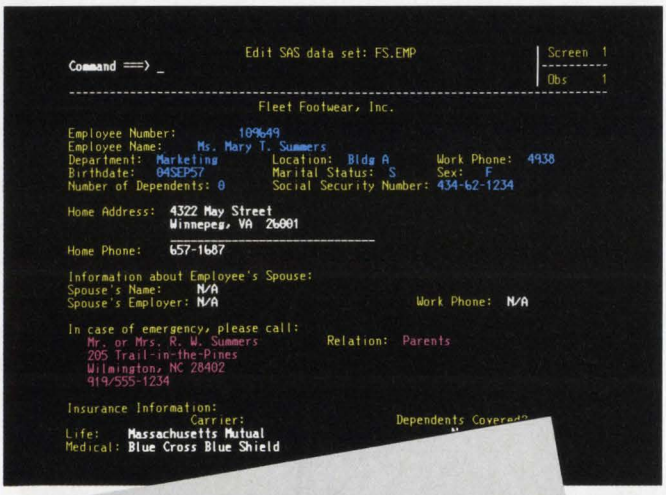

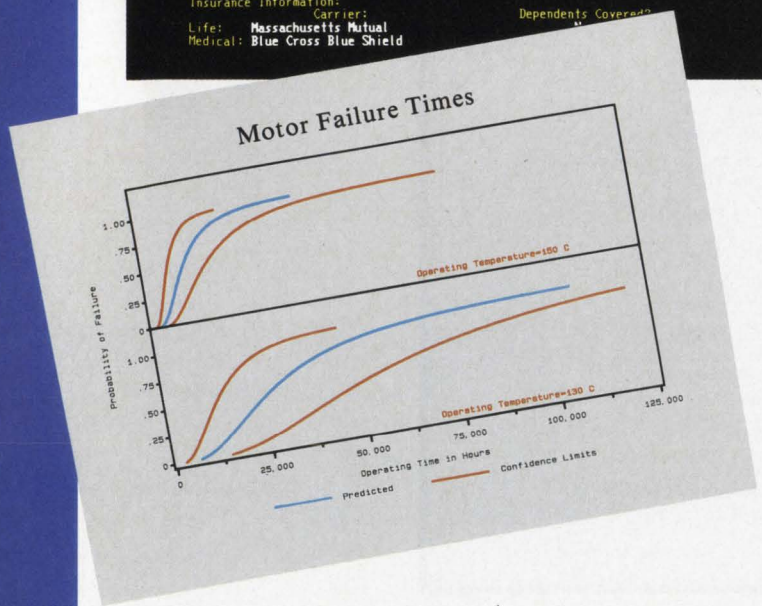

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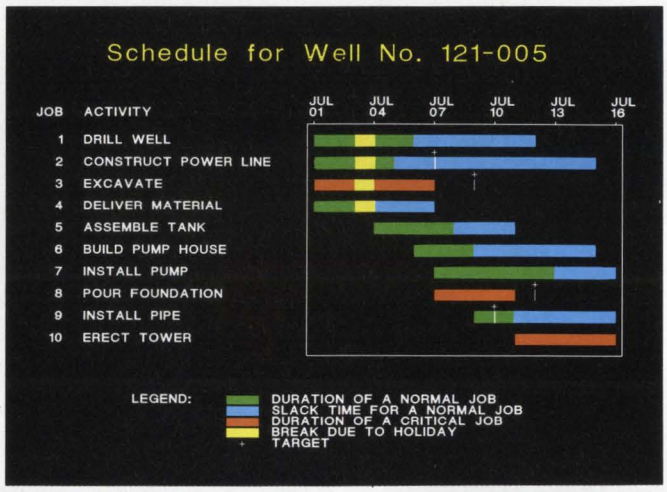

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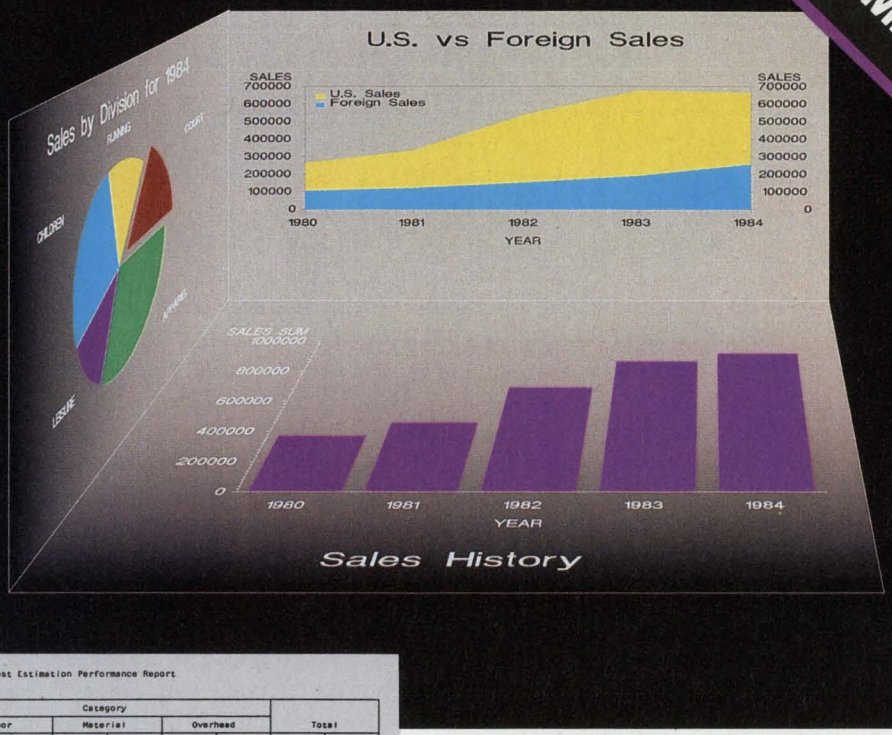

Cost Estimation Performance Report

		Category						Total	
		Labor		Material		Overhead			
		Estimate in $1,000s	Cost in $1,000s	Estimate in $1,000s	Cost in $1,000s	Estimate in $1,000s	Cost in $1,000s	Estimate in $1,000s	Cost in $1,000s
Estimator	Job								
Barbour	2618	549	538	715	763	101	103	1,365	1,404
	2635	619	624	312	298	82	81	1,013	1,003
	2645	589	581	425	423	86	85	1,100	1,089
	2695	119	124	98	103	18	19	235	246
	All Jobs	1,876	1,867	1,550	1,587	287	288	3,713	3,742
Murphy	Job								
	2647	149	144	267	254	32	30	448	428
	2651	748	727	538	523	109	106	1,395	1,356
	2665	836	794	345	353	106	102	1,287	1,249
	All Jobs	1,733	1,665	1,150	1,130	247	238	3,130	3,033
Richards	Job								
	2620	459	483	635	663	87	91	1,181	1,237
	2630	272	246	547	536	62	59	881	841
	2640	632	601	741	698	111	105	1,484	1,404
	2670	239	227	394	347	49	45	682	619
	2680	317	322	296	201	50	45	663	568
	All Jobs	1,919	1,879	2,613	2,445	359	345	4,891	4,669
All Estimators		5,528	5,411	5,313	5,162	893	871	11,734	11,444

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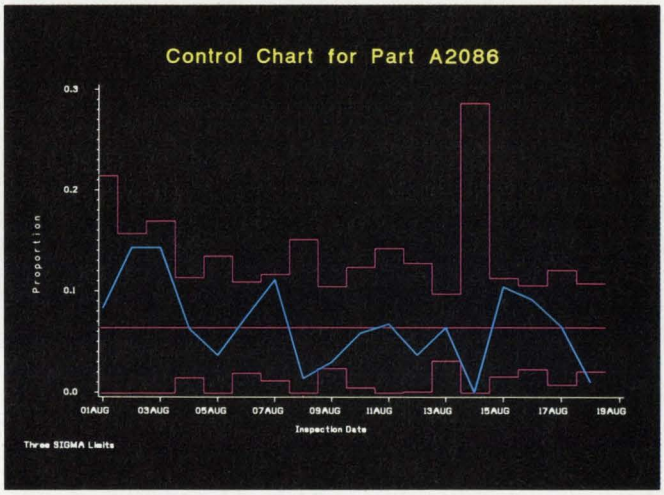
Above: New facilities in Version 5 let you customize your graphics presentations.

Below: Version 5 handles your quality control applications too.



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In a sample session, a personnel manager using *Intellect* might ask the following:

User: "Find the names of employees who are more than 25 years old."
(*Intellect* displays a list of these employees.)
User: "Employees who are older than 25 and female."
(*Intellect* displays this list.)
User: "And earn more than $25,000."
(*Intellect* displays this list.)

Intellect has several advantages over direct use of a database system. First, query languages can be difficult to learn and unforgiving of minor syntax errors. Second, *Intellect* provides a common interface to any database system on which it runs. It's also fun to use and can lead to the feeling that you're having a conversation with the computer.

Intellect's drawback is that, like many AI products, its capabilities are exaggerated by the vendor. The language it understands isn't "simply English" as Artificial Intelligence Corporation claims. As with any computer product, an *Intellect* user must go through a learning curve. The user must become familiar with *Intellect's* English dialect to dialect. You learn, for instance, that *Intellect* is confused by complex or casual questions like, "If Phil Margolis works here five more years, how long will he have worked here?" or "How much does Carol Parker make?"

Until recently, *Intellect* operated only with databases in the IBM world: *DB2, SQL/DS, IDMS, ADABAS.* Last summer, Artificial Intelligence Corporation rehosted *Intellect* to interface with Digital's *Rdb* on VAX/VMS. This provides users with a common front end to an IBM and a DEC database package, along with the advantages of a natural language query system.

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That night, information from all of the salespersons' customers is transmitted to the company's central office. At that site, a VAX runs the AI portion of *Client Profiling* and produces two reports about each customer. The reports are sent back to the PC at the field office and printed on a laser printer there. One report (15-20 pages) is a series of financial planning recommendations for the customer. The second report (four to six pages) is for the salesperson. It summarizes the recommendations and gives tips on selling those services to the customer.

Applied Expert Systems claims to have incorporated the knowledge and decision making of financial experts into its software. The recommendations made by *Client Profiling* are based on the customer's statement of his goals, and can include real estate investment, tax deferment, insurance and cash management. The types of investment instruments suggested also can be tailored to match the services offered by the financial advisor.

Client Profiling is based on another AI program from Applied Expert Systems, *PlanPower,* which runs on Xerox AI workstations and interacts directly with a user.

Client Profiling
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Environment: VAX/VMS (including MICROVAX) for central processing. User interface on IBM PC or compatible.

Price: $150,000 plus $150,000 per year. Includes tailoring for customer, installation and initial support.
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ing and classifying the world. The famous scene in *The Miracle Worker* when Helen Keller discovers the meaning of water is an example of Step 8. Step 9 is the task of recognizing that a new kind of tree is still a tree. Step 10 results in novel ways of seeing the world.

12. Using external senses to detect the world — having vision or hearing or radar or smell; some way to perceive the world and acquire knowledge about it.

13. Drawing conclusions from known facts — when a human or machine acts like a good detective, deducing something from known facts.

14. Finding new solutions to problems — solving a practical problem in a new way.

15. Searching for and discovering new facts about the world — being a scientist, thus adding to our collective knowledge of the world.

16. Learning artificial languages — the ability to learn and use mathematics and other symbol systems.

17. Using natural languages — the ability to communicate using human languages.

18. Learning natural languages — the dif-

A piece of charcoal and a cave wall work well as a device for storing facts.

ficult task of learning a human language by listening to it.

19. Pursuing self-generated goals — a human or machine chooses as his/its goal something that he/it has seen others pursue.

20. Pursuing novel self-generated goals — the ability to pursue a goal that no one (or thing) ever has; e.g., founding a new school of art or crusading for a new principle.

Where Are We Now?

Clearly, we have machines that are capable of several of the tasks on this intelligence index. A piece of charcoal and a cave wall work well as a device for storing facts. An abacus, and certainly any calculator, can perform arithmetic functions. Weaving looms controlled by punch cards (and lathes run by paper tape) are good at following lists of instructions. Computers can play an endless number of games, given proper programming.

Assuming a computer to be a machine composed of its hardware and software, we can give computers a rating of at least 4 on the DPMI index. Have they gone further?

The most sophisticated machines now available are expert systems, which can be viewed as players of real-life games. The rules of the games are to take in sketchy information (geological data about a region, for instance) and make valid predictions based on that information (where the oil deposits are, in this case). Current computers have an expanding ability to function as expert systems, and some can improve with use. There also are an increasing number of "expert system shells," which give their machines a broad ability to play and become better at the expert system game. While no computer is a well-rounded expert, like a person can be, computers earn a DPMI rating of 4.5 for these achievements.

There is no computer, however, that has the *general* ability to operate at level 5 or above. No present combination of hardware and software can learn from all games. Some mathematical programs have manipulated algebraic systems to produce new theorems (and their proofs), but the programs cannot operate on all of mathematics. There is software that can use a subset of English to communicate with the user, but it becomes confused when the conversation leaves a narrow domain. Speech-to-text programs become inoperative when there is background noise.

Mechanical vision systems can see pieces of the world, but cannot recognize their creator's face. Programs that categorize the world do so with great difficulty and frequent errors. In some cases, computers can put intelligent abilities together, but not as well as a five-year-old child.

Today's computers are impressive at calculating and data storage, and have begun to perform other intelligent behavior; but humans still are far ahead.

Although this point of view is controversial — there are some who believe that computers are nearly as smart as people right now — discussing intelligence in a quantitative sense, rather than qualitative, may help both sides of the debate. A scale like DPMI provides a method for measuring the developing future of AI.

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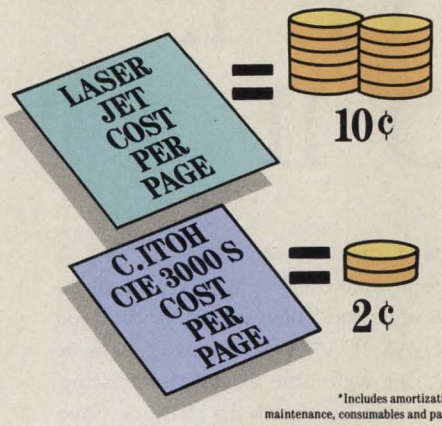

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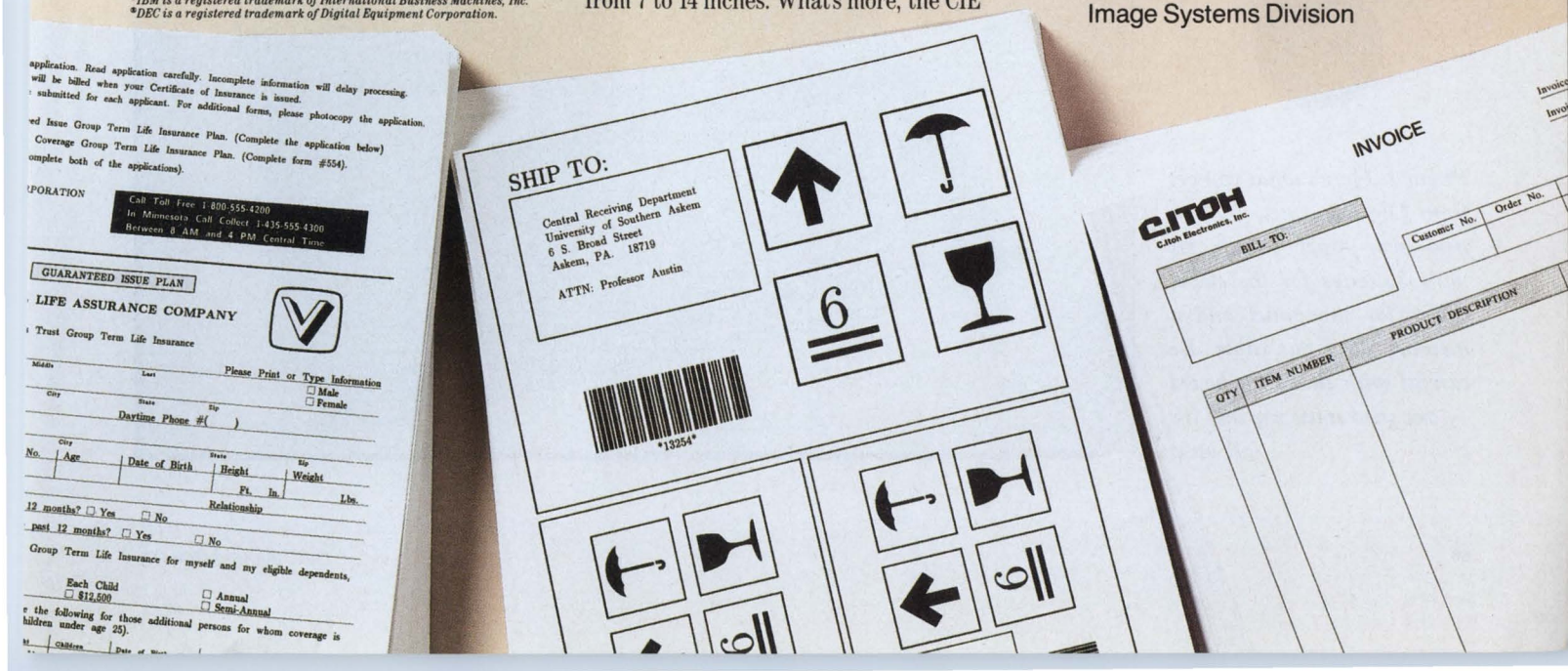

MICROVAX

GOOD-BYE I, HELLO II

By Dave Mallery

Convert your MICROVAX I into a MICROVAX II.

We found a MICROVAX I recently at an irresistible price. The upgrade kit was acquired from Scherers Development Inc., Dublin, Ohio. The pictures are to document the utter triviality of the upgrade.

I'm now looking for an older MICRO-PDP box so that I can rebirth the MICROVAX I as a workstation. There must be a sizable population of MICROVAX I sets out there languishing on shelves.

Maybe a diskless MICROVAX I and a DEQNA would make a decent LAVC member. Notes: You will need a new memory board for the MICROVAX II. VMS just doesn't hack it with 1 MB. We were able to run the existing SYSGEN'd system disk with no changes. Save the MICROVAX I boards for your grandchildren.

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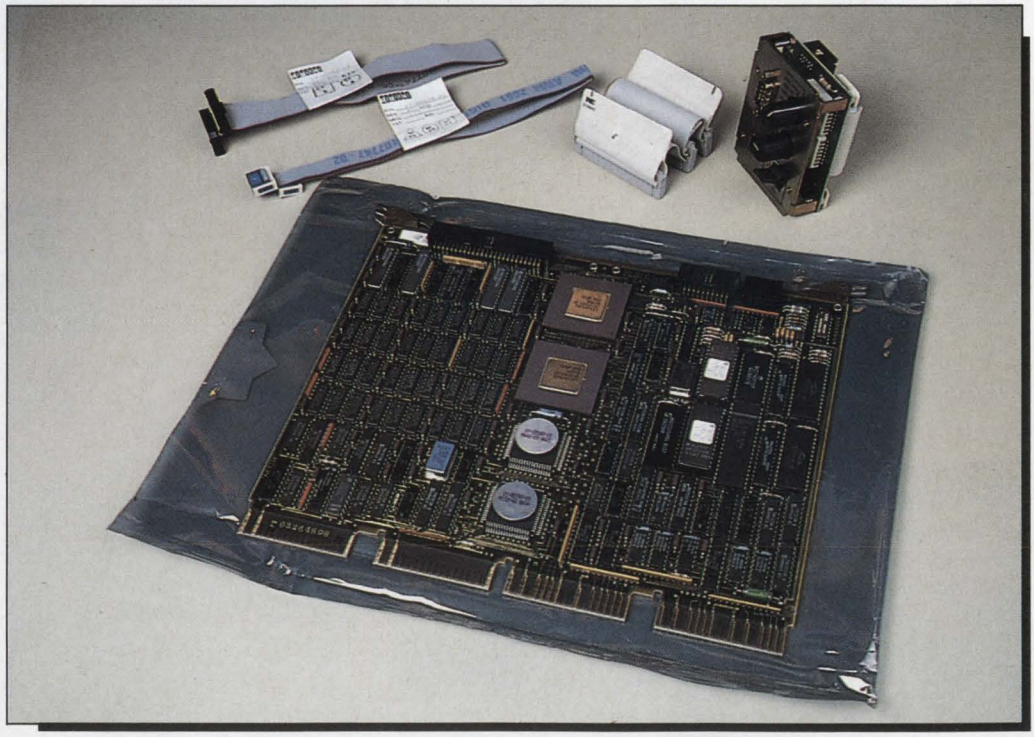

Joseph Eidelman

LABORATORY DECPRO TESTING CENTER

Photo 1. Here's what you get from Digital: a new CPU, a new rear-panel switch set with batteries for the clock, cables for the panel and a memory data bus cable. Be careful with that CPU board — one good static zap and it's all over.

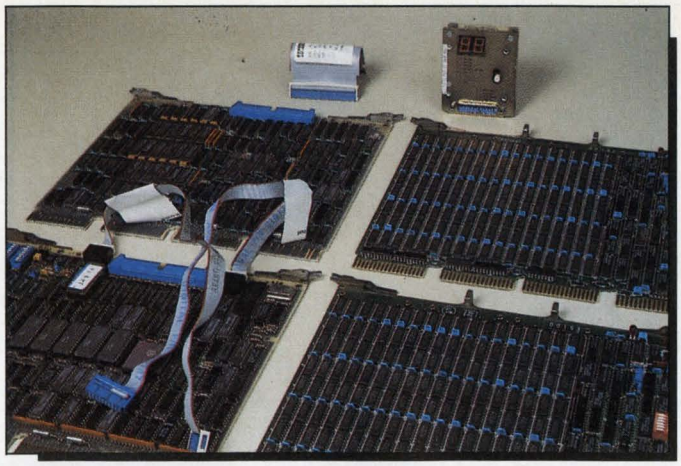

Photo 2. Go into the BA23 and remove both MICROVAX I CPU boards, and whatever memory boards happen to be there (in this case, two). You can give these to your cousin with the PDP-11.

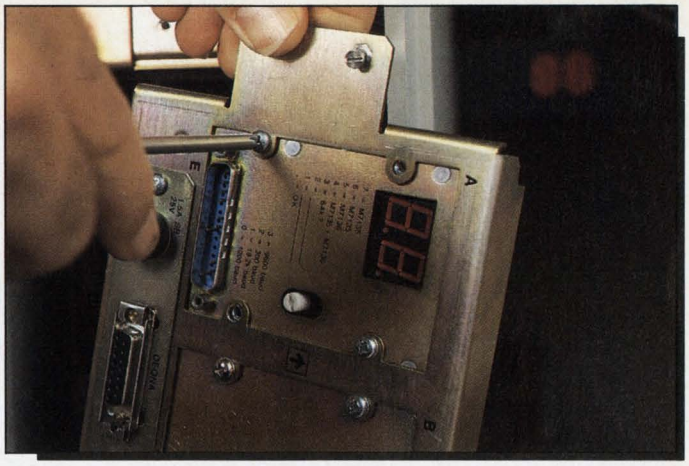

Photo 3. Remove the old rear panel switch plate.

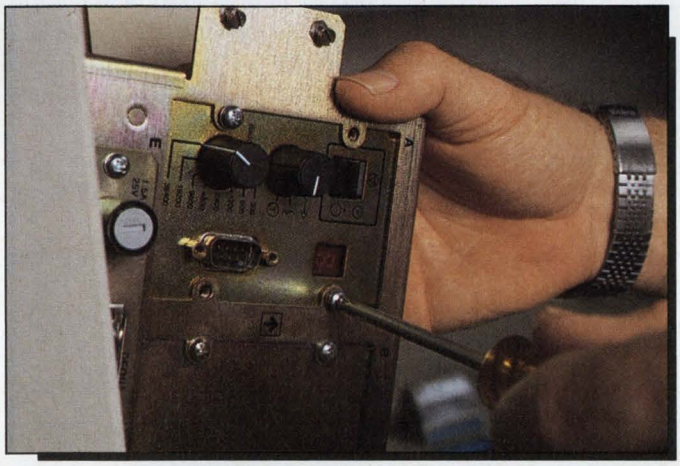

Photo 4. Install the replacement rear panel.

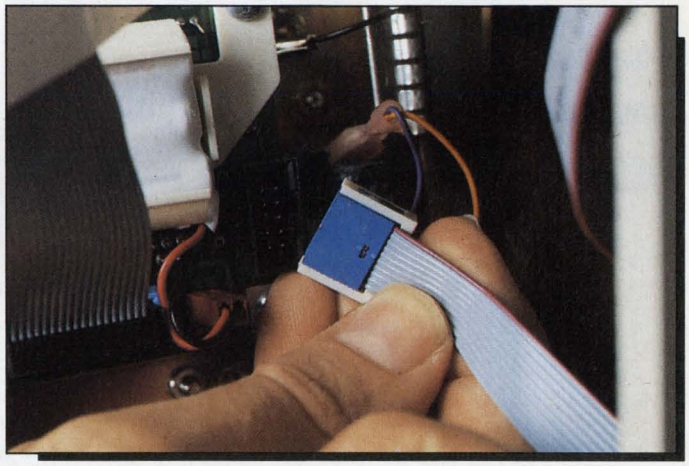

Photo 5. The small cable between the MICROVAX II CPU and the rear panel is keyed . . .

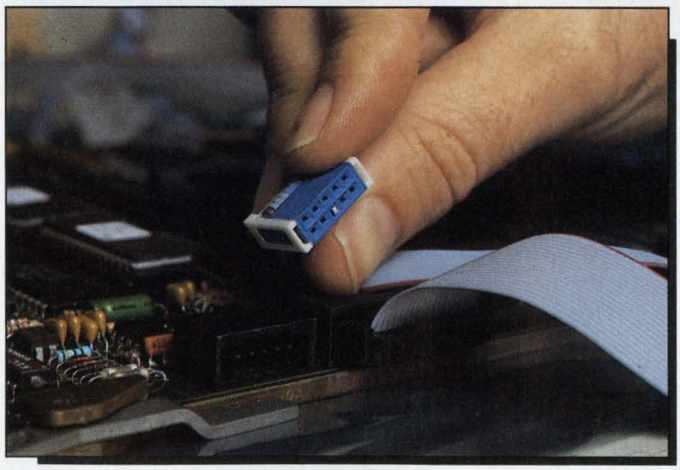

Photo 6. . . . note that the hole for the missing pin is plugged on the cable.

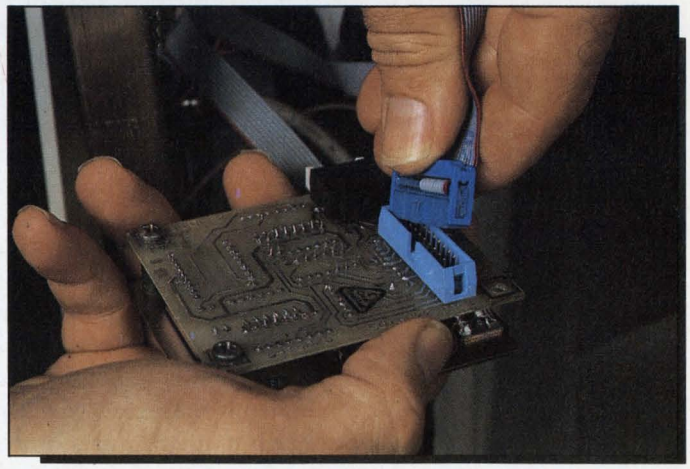

Photo 7. Notice that the larger cable to the rear is keyed with a notch in the receptacle that mates with the cable.

LANGUAGES

THEMIS

By Lawrence Stevens

A Natural Language Substitute For Formal Query Language.

The *THEMIS Management Information System* by Frey Associates, Amherst, New Hampshire, is a natural language interface to two VAX database management systems. It runs under VAX/VMS and interfaces to *DATATRIEVE* accessing RMS files, and to *ORACLE*.

THEMIS allows users to access database files using ordinary English instead of a formal query language. Here's an example of a request using *THEMIS* compared with the same request written in *DATATRIEVE*'s query language:

THEMIS: "Show me customer names and gross sales for Massachusetts customers."

DATATRIEVE: for A in CUST with (A. STATE-CODE = 'MA') store report using reported = A.CUSTOMER-NAME! A.COST-GROSS-SALES ! !! A.CUSTOMER-NUMBER !

This comparison was obtained by using *THEMIS'* SQLECHO command. That feature switches on an echo that displays the *DATATRIEVE*/Sequel query, which is generated by the *THEMIS* query. SQLECHO also can assist users who are having trouble getting an expected response from *THEMIS*.

A common problem with natural language systems results from the fact that English is not as precise as query languages. This leaves room for the computer to misinterpret a query. When that happens, users often have a hard time discovering why their queries are generating incorrect responses. SQLECHO, by displaying how the database language is interpreting the natural language query, often can help to clear up this confusion.

Like other natural language systems, *THEMIS* comes with a small built-in vocabulary of approximately 1,000 general-purpose words. Application-specific words have to be taught to *THEMIS* by the user group. Statements that expand *THEMIS'* vocabulary are called learning statements. These can be either global (i.e., usable by the entire organization) or personal (i.e., usable only when a specific user logs on). The advantage of this dual system of learning statements is evident when different members of an organization use words in different ways. For example, a payroll clerk can define "payroll" as "wages plus taxes," while an upper-level manager might define it as "the sum of all salaries."

Here's an example of an interaction with *THEMIS* that includes a learning statement:
User: List the heavy hitters.
THEMIS: I know the word "THE" but couldn't understand it in this context.
In the last request I couldn't understand the word "HEAVY."
In the last request I couldn't understand "HITTERS."
Unable to process that query.
User: Heavy hitters means companies with P/E ratios better than 30.
THEMIS: Should I consider "HEAVY HITTERS" to be a noun phrase that would mean that "THE HEAVY HITTERS" is meaningful?
User: Yes.
THEMIS: Should I consider "HITTERS" to be a noun, which would mean that "THE HITTERS" is meaningful?
User: Yes.
THEMIS: Excuse me for having to ask, but is "HITTER" the singular of "HITTERS"?
User: Yes.
THEMIS: Should I consider "HEAVY" to be an adjective?
User: Yes.

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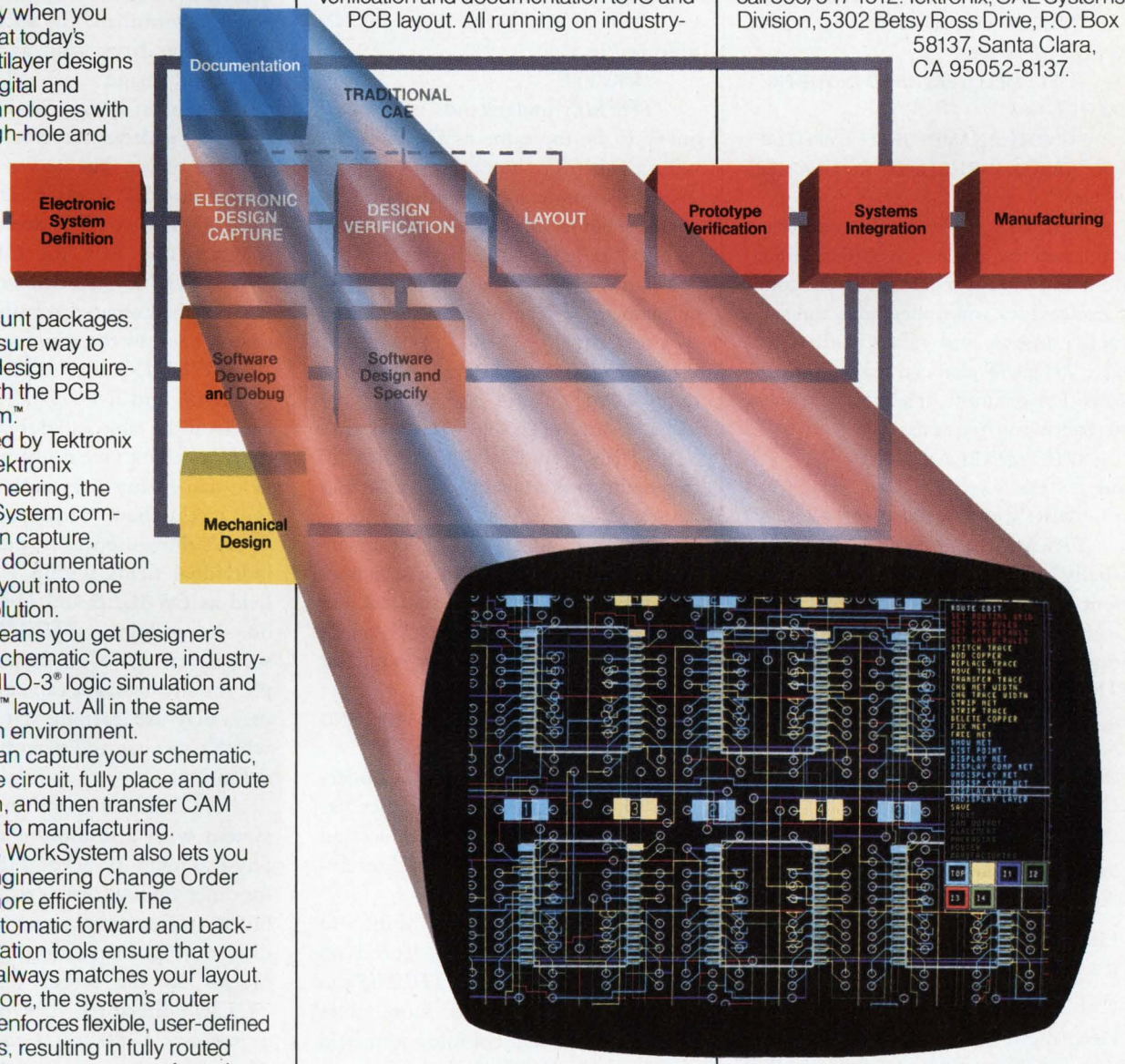

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A user also can ask *THEMIS* for help in finding the meanings of words already in its vocabulary:

User: What is the meaning of heavy hitters?

THEMIS: "HEAVY HITTERS" has been defined by a user as meaning companies with P/E ratios greater than 30.

THEMIS is able to understand such concepts as date and time relationships. For example, each of the following three queries will result in the same correct response:

"WHO WAS HIRED BETWEEN JANUARY '83 AND JUNE '83?"

"LIST EMPLOYEES HIRED IN THE FIRST HALF OF 1983."

"GIVE THE NAMES OF ALL EMPLOYEES WHO STARTED IN THE FIRST TWO QUARTERS OF 1983."

THEMIS understands mathematical functions, average, maximum, minimum and the aggregate functions total. It also divides, multiplies, adds and subtracts numbers and values in the database. *THEMIS* also can make comparisons. For example, it's able to process the following requests:

"WHO MAKES THE MOST?"

and

"WHO MAKES MORE THAN $30,000?"

THEMIS can be taught formulas, usually with only one learning statement. For example:

User: Who makes more than 1,000 pounds?

THEMIS: In the last request I do not understand "POUNDS." Unable to process that query.

User: A pound equals 1.54 dollars.

THEMIS
Frey Associates
Amherst, New Hampshire

Hardware Environment: MICROVAX II to VAX 8600 running VMS 4.3 or later.

Price: From $6,000 for the MICROVAX II to $36,000 for the VAX 8600. VAXcluster licenses are available for $8,000. Quantity discounts are available.

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THEMIS is able to understand pronouns that refer to previous sentences. For example, in the two queries:

"HOW MANY CUSTOMERS ARE LOCATED IN NEW HAMPSHIRE?"

followed by:

"WHAT ARE THEIR NAMES?"

THEMIS understands the word "their" to refer to the customers of the previous query.

THEMIS also understands arithmetic substitutions based on the previous sentence. For example, in the queries:

"WHO MAKES MORE THAN $50,000?"

followed by:

"$40,000?"

THEMIS understands the second query to be the same as the first, but with a substitute amount.

It also understands ambiguities in context. For example, assume the word "NAME" is defined as either an employee's name, a customer's name, a product name or a department name. In the two requests:

"GIVE ME THE SALESMEN'S NAMES"

followed by:

"LIST ALL NAMES BEGINNING WITH T"

THEMIS understands "names" in this context as referring to salesmen's names.

However, *THEMIS* doesn't understand all types of sentences. Compound sentences about unrelated subjects will stump *THEMIS*. And *THEMIS* cannot both list and calculate in a single request such as:

"LIST THE EMPLOYEES' SALARIES AND THEIR AVERAGE SALARY".

While *THEMIS* often can understand unclear or ambiguous queries, users have to be trained to be direct and clear in their wording, to avoid receiving an incorrect response.

In general, *THEMIS*' ability to handle the database properly depends on its integrity. For example, *THEMIS* can retrieve data from two or more tables only if they have a common join field or if it can find a join path from one to the other. If join fields do not have the same name, the site manager has to use learning statements to specify that they're join fields. And although *DATATRIEVE* allows the same field name to be used for two different elementary fields if they are within two different group fields, *THEMIS* requires that all elementary fields have different names.

THEMIS consists of two major software components. The *THEMIS SERVER*, written in INTERLISP, translates English-Language queries into *THEMIS QUERY LANGUAGE* (TQL) queries. The other software component is the *THEMIS DRIVER*. This program, written in FORTRAN, handles communications between terminals, the server and the DBMS. The driver runs as an installed privileged image.

When a query is input using English, the driver receives it and passes it to the server. The server then translates it into a TQL query and passes it back to the driver. The driver translates it into either SQL for *ORACLE* or *DATATRIEVE* and delivers it to the DBMS. The executed command then is passed back to the terminal.

THEMIS does support most *ORACLE* and *DATATRIEVE* security checks at the table and domain level. All users are able to see domain, tables and field names, but only authorized users can access them. However, *THEMIS* doesn't allow users to be excluded from individual fields within a domain or field as *ORACLE* and *DATATRIEVE* do. In addition, *THEMIS* includes security checks of its own. For example, the site manager can control which users may use learning statements, and which users can add personal or global definitions.

THEMIS runs on any VAX/VMS system with a minimum of 2 MB of physical memory beyond that required for other applications. It requires 12,000 blocks of free disk space on the system disk during installation, and 24,000 blocks on the target disk for the *THEMIS* directory.—*Lawrence Stevens is a free-lance writer based in Springfield, Massachusetts.*

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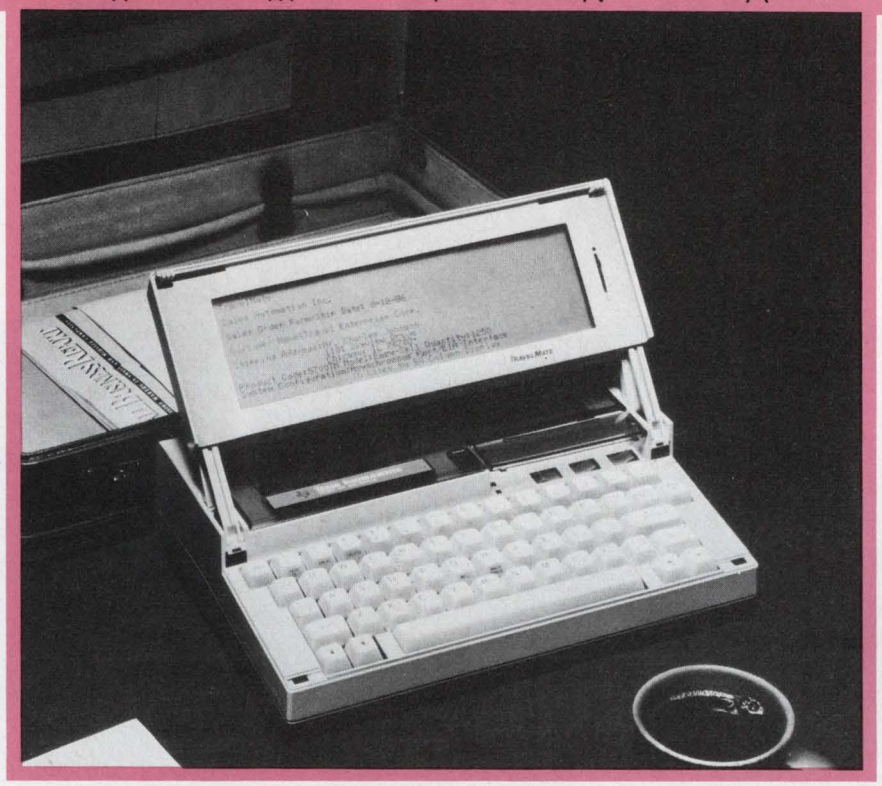

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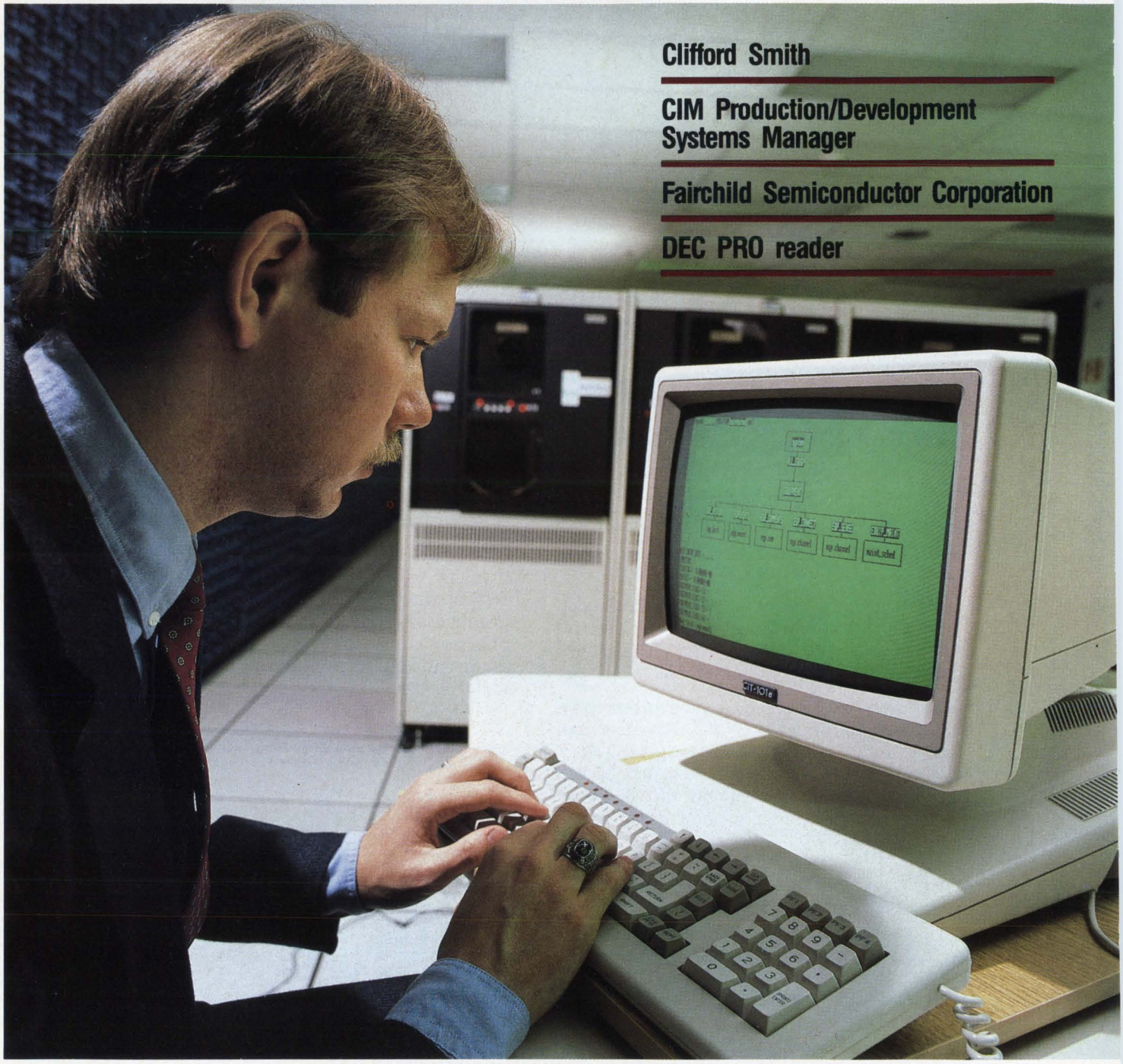

Clifford Smith

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

LANGUAGES

PROLOG

A Characterization For Cynics And Computer Programmers.

By David E. Carew

PROLOG is a product of the artificial intelligence (AI) research community. Its name is a play on the term "logic programming," and that about sums up the knowledge that many programmers, even well-informed ones, have about PROLOG.

To introduce PROLOG, consider the idea of direct effects versus side effects in ordinary computer language function calls. For example, take this possible fragment of C code that performs a function call:

```
armst = movearm(posarray, movarray)
```

The point of this fragment may not be simply to assign a new value to the variable **armst** based on one or more of the input argument values. The function **movearm( )** does directly return a value assigned to **armst**. However, this direct effect of a function is sometimes less pertinent than its possible side effects. With regard to our example, an experienced C programmer might suspect that the function **movearm( )** has the side effect of producing output to a device (a robot arm, perhaps), and then incidentally returning a value that may be a clue to the status of the device or the intended output.

In programming languages that allow functions to affect global values (i.e., values not passed as arguments) the so-called side effects can be extremely important, and the actual code can simultaneously be very elegant and very misleading. A well-known phenomenon in C is the "for loop" with a null body; all the work of the loop is accomplished by the side effects of functions that are referenced in the loop control statements. For some reason, this is regarded as advanced. (C programmers who write null-bodied for loops seem pleased with themselves.)

What has all this to do with PROLOG? One way to characterize PROLOG is to say that it's so advanced that it's 100 percent side effects. PROLOG programs never explicitly do anything; it's not even possible to assign a value to a variable in PROLOG.

PROLOG programs simply make assertions relating subjects to predicates, with the proviso that a predicate may or may not have a side effect or effects which may or may not cause something to happen. An example of a valid PROLOG fragment is:

```
barber (joe)
```

which makes the assertion "Joe is a barber." This is a simple statement of fact about a particular person, and the token *joe* may be thought of as a constant. PROLOG uses tokens beginning with a capital letter to denote variables. An assertion that uses a variable as its subject becomes a rule or generalization. For example, the PROLOG code:

```
will_give_shave (X) if barber (X)
```

asserts the generalization that "All barbers give shaves";
i.e;, if X is a barber, then X will give (you a)

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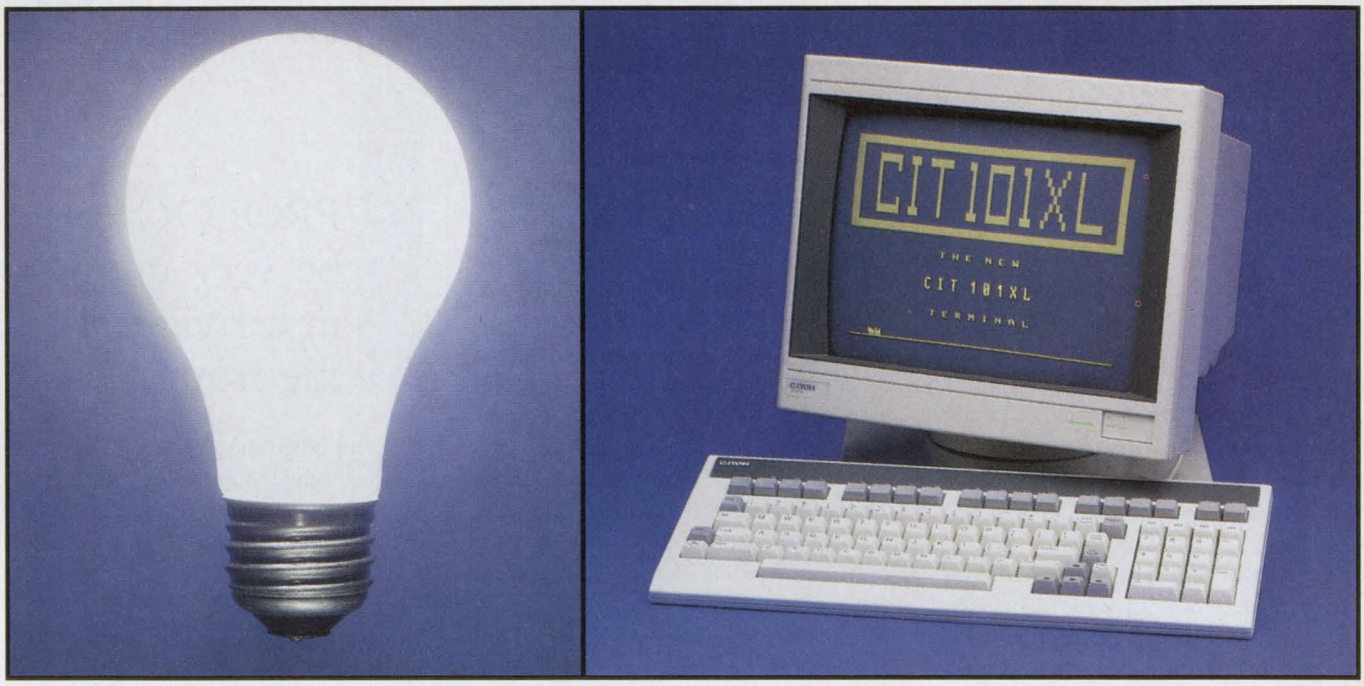

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shave. Assertions may be interlocked to describe arbitrarily complex situations:

```
barber (joe)
beautician (sue)
will_cut_hair (X) if barber (X) or
if beautician (X)
will_give_shave (X) if barber (X)
```

The above PROLOG code describes a situation where if you need a haircut, either Joe or Sue will do, but if you need a shave, you have to go to Joe.

The head-wrenching reality is that such a static collection of assertions is a valid, complete and executable PROLOG program. The entire point of a PROLOG program is to describe situations or encapsulate knowledge in the form of portable, unambiguous and machine-readable assertions, generalizations or rules.

WHAT'S MISSING from this view and why does it seem so foreign to someone accustomed to ordinary computer languages? All traditional programming languages contain some more or less abstract model of a computer. Assembly language contains a less abstract, more detailed model which fits particular hardware rather closely, while PASCAL contains a more abstract, generalized machine that is supposed to allow the programmer to worry less about the machine and concern himself more with the problem to be solved. The fundamental point is that procedural languages all contain some implicit machine; and programming is the act of making that machine assume one state at *this* point in time, and another state at *that* point in time, etc., in such a way that, for example, the general-purpose PASCAL machine simulates a particular purpose "payroll calculating engine." The truth is that PROLOG deliberately contains no machine!

The traditional relationship between a program and reality is that the program simulates some *real* behavior on a "finite state machine." The PROLOG relationship between a program and reality is that the program directly describes some local aspect of reality or "problem domain." It allows a computer to store data about data in a way that's reminiscent of the way that people seem to know what they know: by rules of thumb and by cases that apply with varying degrees of generality according to the context.

PROLOG is admirably pure-hearted in this regard, unlike LISP, or SAIL. The essence of PROLOG is purely static assertions of relationships.

The problem, from the standpoint of the programmer accustomed to traditional procedural languages, is that assertions don't do anything; they just seem to lie there. All the action that the traditional programmer is conditioned to want to control via looping and branching and stepping and so forth, is hidden. It's not the concern of the PROLOG source code, so it's simply absent from the code.

However, a computer is still a device that moves from state to state so long as power is applied. Some action in the form of a machine model and processes that simulate something must be lurking around somewhere. In PROLOG, this is the job of the inference engine, and it's built into the interpreter that executes PROLOG programs. A programmer can affect the action of the program either implicitly, by using predefined predicates that have side effects, like causing output to a terminal; or directly, by use of the PROLOG metalanguage, which essentially changes the behavior of the inference engine by allowing it to refer to and change its own state. Also, the predefined predicates may be referenced recursively to approximate looping and branching effects, and so on. This makes for some truly advanced (read that: remarkably hard to follow) code.

The implicit simulation wired into PROLOG's inference engine is roughly that of simulating a mathematician or logician using a long list of known true relationships (the PROLOG program) to prove or disprove a new conjecture.

The amazing strength of this simulation is that the computer can reach correct conclusions about genuinely new situations, and that it can "explain" (by dumping the process steps) exactly why and how it reached its result. If the computer is drastically wrong, the relationships and assertions (called heuristics) embodied in the PROLOG program can be modified rapidly and easily without worrying about a machine model and its state at the point of error. Many bugs in traditional code are due to the extremely dynamic nature of the machine model, which assumes an unexpected state at some particular point.

PROLOG can be very useful in arriving at the truth . . .

The terrible weakness of this simulation is that it's very restrictive. A mathematician proving theorems can't get the payroll out or handily keep an address list, or build a fast and sexy software tool. PROLOG partakes of some of the ivory tower and theoretical-not-practical qualities of the human university theoretician. PROLOG can be very useful in arriving at the truth about a (possibly complex) situation or problem; it can be frustratingly impractical in using that truth to accomplish some specific goal or purpose.

I'll wager that most real world programmers building systems for industrial use will spend as much time in the metalanguage where more of the action is, as they will in the static rule base of PROLOG itself. *—David E. Carew is a systems analyst for Cibar, Inc., Colorado Springs, Colorado.*

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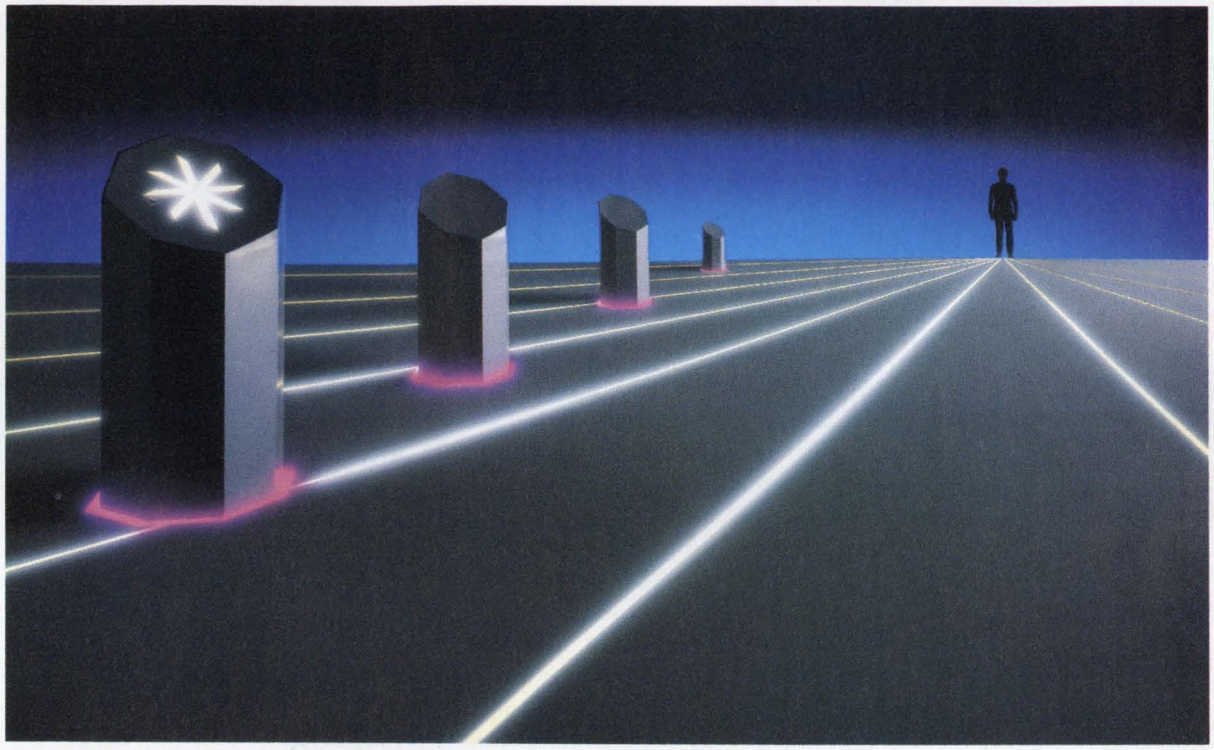

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AMAZING STORIES!

By David G. Goldstein

Output Technology's New Line Of Triple-Header Printers Is In The 'Believe-It-Or-Not' Category.

Rarely do products appear with claims so incredible as to demand verification, yet Output Technology Corporation (OTC) of Spokane, Washington, has announced a Trimatrix 700 series of printers that's in that category. Further, the device tested at *DEC PROFESSIONAL* supports the company's assertions.

The Trimatrix 700 is a series of printers with burst speeds of up to 700 characters per second. This incredible output rate is attained via three print heads that are used simultaneously during wide-carriage operations to produce high-quality, high-speed printing. Also, although our calculated throughput rate was slightly lower than OTC's, we're creating new evaluation methods just for this printer.

Three Heads Are Better Than One

The Trimatrix 700s are sleek, wide-carriage printers capable of printing up to 136 columns per line. Our test model, the OT-700e, is 27.3 x 16.7 x 6.3 inches and weighs 34 pounds. LEDs for power on, paper out and online are present, with an additional audible alarm for paper out. There also are switches for linefeed, formfeed and online.

The switches have a second function: They (mercifully) replace the normally used DIP switches to provide non-volatile print settings. The functions supported are numerous, including:

1. Self-test (test pattern)
2. Hex dump (all text dumped in its hexidecimal equivalent)
3. Set top of form
4. Forward/reverse paper movement
5. Emphasized print (ALL printing done in emphasized)
6. Characters per inch
7. Protocol
8. Slashed or normal zero (Ø, 0)
9. Automatic skipping of perforations
10. Automatic linefeed after carriage return.

Paper can be front or bottom loaded, although I found front loading much easier.

Versatility

The OT-700e is fast, tough and versatile. The printer has a variety of type styles, print capabilities and dot addressable graphics in two resolutions (50 x 72 and 100 x 72 dots per inch). It has various DEC and IBM emulations, modified Epson FX series command codes and foreign language character sets. The variations are implemented by escape codes and can be used to override default settings.

The OT-700e has excellent durability, rated at 4000 hours for a 100 percent duty cycle! Also, being capable of an original with up to six carbon copies, this printer is suited for almost any application.

The OT-700e has an adjustable tractor feed; both sides of the tractor can be moved simply by lifting a switch. You can set left, right, top and bottom margins, as well as horizontal and vertical tabs. The printer has a line length of 13.6 inches, for a maximum of 136 normal-sized and 226 condensed characters per line. Enlarged characters of two sizes (five and six characters per inch) also are available, as well

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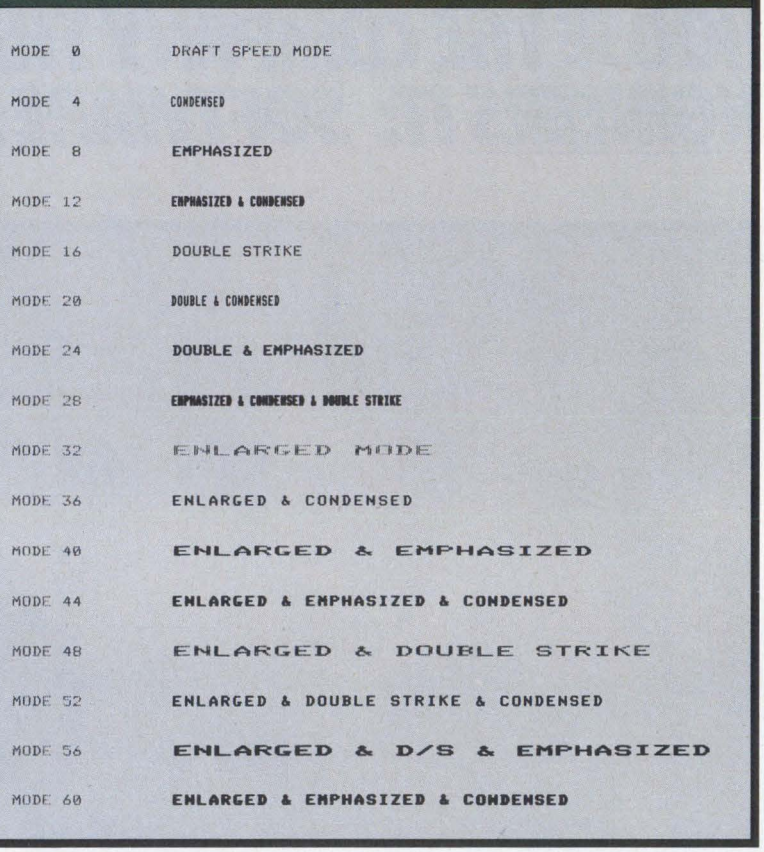
FIGURE 1.



as enhanced characters at 8.3 characters per inch. (See Figure 1 for print samples.)

Superscript and subscript printing, as well as IBM PC character sets one and two, are internally preprogrammed. These character sets provide various useful and interesting characters to enhance printouts. True descenders and underlining also are used. These features provide for fine print in all printer modes.

Near-letter quality (NLQ) printing also is available. NLQ as implemented on certain models, uses the Helvetica font. Throughput on the 700e at this level of perfection is 66 characters per second.

Bar coding is included on certain models with NLQ. Options for coding include height of bars, whether a human-readable line should be included, bar width and gap size between bars. (Bar coding was not tested for this review.)

Speed

The strengths of the OT-700 are many, yet the most obvious one is sheer output speed. OTC claims "burst" speeds of 700 characters per second, correspondence dual-pass print at 275 characters per second, NLQ printing at 66 characters per second and a throughput of 200 lines per minute at 10 characters per inch and six lines per inch. Our tests varied slightly.

"Burst speed," a common phrase used in advertising printers where things like linefeeds are overlooked to optimize speed, was not part of our test; instead we used maximum-print. Various line widths were used to test the printer with varying numbers of its print heads. Using 80 character lines with single pass draft printing, common in many correspondence applications, the printer logged in at 381 characters per second. Using the printer's full 136 column line — similar to invoices, etc. — all three print heads combined for an astounding 579 characters per second. At 80 columns, approximately 270 full lines were printed, and 255 full lines at 136 columns.

The printer neither is exceptionally noisy nor quiet (just under 70 decibles) and, unusually enough, can be operated without the cover. This feature probably is due to its ruggedness; the printer is

FIGURE 2.

BASIC Code	Hexadecimal Equivalent	Function
CHR$(0);CHR$(27);"C";CHR$(32)	00 1B 43 20	Hex Dump
CHR$(27); "3";CHR$(n)	1B 03 n	Line spacing at n/inch
CHR$(7)	07	Printer INTERNAL alarm
CHR$(27);"U";CHR$(1)	27 21 01	Print in one direction only
CHR$(27);"S";CHR$(1)	27 22 01	Prints at half speed (to reduce noise)

A sample of the escape codes used to address the print features of the OT-700e.

The strengths of the OT-700 are many, yet the most obvious one is sheer output speed.

designed to run endlessly.

If speed is OT-700's first name, then durability must be its last. The three heavy-duty printheads are rated for 900 million characters before recommended replacement, and the ribbons for six million. The duty cycle is 100 percent (continuous) for at least 4,000 hours.

The warranty is 180 days, with one year on the print heads. The manual contains some trouble-shooting details and lists many of the reorderable parts you might need.

Most significant is (800) 468-8788, OTC's "Help Line," which reveals a commitment to buyers after the purchase, as well as before.

There are so many models of the OT-700 available, that not everything can be mentioned. However, it's important to note several other significant features; for instance, the printer has both serial and parallel ports that can be internally adjusted (baud rate, data bits, etc.) by the front panel menu mentioned previously. Both 4K and 8K buffers are available, as well as the NLQ and bar codes mentioned earlier. And, practically any feature can be addressed via the escape codes, even some unexpected ones such as those in Figure 2.

OT-700e Printer
Output Technology Corporation
East 9922 Montgomery
Spokane, Washington 99206
(509) 926-3855

Compatible with a variety of computers. Models available for direct integration with IBM System 34/36/38. Models with bar coding capabilities are also available.
Price: $1,995.
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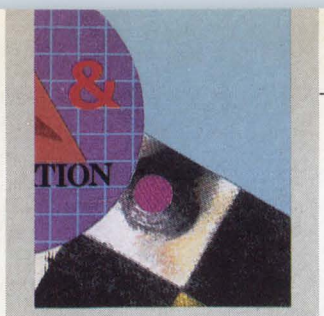
Almost Everything . . .

Although this series of printers has many fine features, there still are a few things that could be improved. First, the documentation, although helpful, organized and handsome, needs work. The operator's guide is divided into user's and programmer's sections and appendices. Every section is well-designed except for the one on escape codes, which is perhaps the most needed documentation of all. For example, the various dot addressable graphics modes are given only three (5.5 inch x 8.5 inch) pages in the manual. Also, the manual seems to be very IBM PC oriented; all programs are written in BASIC (apparently Microsoft BASIC because of the LPRINT commands.) My only other qualm with the printer is that it's not logic-seeking; the high-speed output is derived via bidirectional printing and sheer brute force. Therefore, I'd expect an even faster model to be developed.

The OTC-700 printers, however, can suit a variety of needs. Retailing at under $2,000, they are certainly worth consideration for any industrial application. With regard to versatility, durability and speed, this entry runs near the front of the pack in a race with many entries.
—David G. Goldstein is an independent consultant in Philadelphia, Pennsylvania.

ARTICLE INTEREST QUOTIENT
Enter On Reader Card
High 710 Medium 714 Low 718



DBMS

VAX SQL

By Philip A. Naecker

VAX Structured Query Language For Relational Databases.

VAX Structured Query Language (SQL) is a data definition and manipulation language for relational databases. SQL is a recently approved ANSI standard and is implemented (in varying degrees of standardization) by most vendors of relational database systems. SQL originated with IBM's *DB2* database product, and both VAX SQL and the ANSI standard are reasonably close to the *DB2* implementation.

VAX SQL is used together with a DSRI-compliant database to create a database, populate it with data, and store, read and modify both data and data definitions (see *DEC PROFESSIONAL*, April 1986 for a discussion of DSRI, the Digital Standard Relational Interface). SQL provides a user interface to the DSRI databases, and operates in either an interactive mode or as part of a precompiled program. Note that SQL is not a database system itself, just a user interface — the database function is performed by products that implement the DSRI standard, like DEC's *Rdb/VMS* or VAX IBM Data Access (*VIDA*). If you're a current user of *Datatrieve* or *Rdb*, read on — you may want to start using SQL.

VAX SQL Functions

SQL is essentially analogous in function to Digital's Relational Data Manipulation Language (RDML), provided with *Rdb/VMS*. SQL isn't really part of the database system at all, but communicates with it via DSRI. Running in any of three modes described below, SQL ultimately will generate DSRI calls that are checked for basic validity and then passed to a database system for execution. The database system can be any DSRI-compliant database, which includes DEC's *Rdb/VMS*, *Rdb/ELN*, *VIDA*, and some third-party databases like *Interbase* from Interbase Software Corporation, Tyngsborough, Massachusetts, provided that the database system supports the required level of DSRI. (Currently, *Rdb/ELN* doesn't support all of the functionality of DSRI that SQL requires.)

VAX SQL can be used in three different ways:

1. Interactively — SQL is used as an interpreter, similar to *Rdb/VMS*'s RDO utility or *Datatrieve* (see Example 1). In this mode, you can type commands at a terminal and see the responses, or execute command files in a batch job.
2. In Precompiled Programs — Using a high-level language such as COBOL, FORTRAN or PL/I (see Example 2). If you use precompiled programs, you can mix SQL statements with your high-level language statements, gaining the benefits of 4GL-like statements from SQL while retaining the control of 3GL languages.
3. At Run Time — Using dynamic SQL, you can generate SQL statements at run time (see Example 3), in contrast to precompiled SQL statements that you must embed in the program source code before it's compiled. Dynamic SQL gives you more flexibility for changing the way your program uses SQL at run time.

Interactively, SQL has a feel that's much like RDO, the standard utility for accessing DEC's *Rdb/VMS*. You can attach to a database

The Database Within — The Relational Model

As an alternative to the cumbersome, complicated and inflexible hierarchical and network data organization methods available at the time, E. F. Codd and others conceived the simple and elegant "relational" database almost 20 years ago. Concept became reality in the late '70s as actual computer implementations of the relational model appeared in products like *ORACLE* and *INGRES*. And today there are dozens of relational database products, each more or less based on Codd's original concepts, available for almost every kind and size of computer.

In a relational database, data records that correspond to people, places or things like "employees" or "invoices," are organized into tables called *relations.* The fields in each row of a relation collectively describe the row's corresponding real-world object; e.g., John Jones, born 10/1/45, lives in Colorado.

By acting on relations with "relational algebra" operations, new relations can be formed and complex questions can be answered. Everybody who earns more than $20,000 per year can be isolated from the "people" relation, for example, then connected with a "states" relation to further isolate the people who live in the Western United States.

The essential beauty of the relational model is that very complex real-world situations can be represented using such simple and straightforward techniques.

Rdb/VMS

Adherence to sound relational concepts guided Digital's development of *Rdb/VMS* and, as a result, the product serves not only as a full-function relational database, but as the foundation for a family of products that can be used to build applications on it.

Rdb/VMS includes everything you need to define and populate a relational database, arranged in software layers at various levels of the relational problem. Closest to the machine, the bottom layer of *Rdb/VMS* manages the disk space in which relations, fields and various support structures are stored. Database integrity functions like security checking and journaling, also are performed at this level.

The middle layer of *Rdb* — the Digital Standard Relational Interface (DSRI) — accepts and interprets all data definition, manipulation and query requests made of the database, passing them on to the lower level. Rigidly defined and documented by DEC, DSRI is the only way into *Rdb.*

Employed by database administrators or users to modify or query the database, *Rdb's* built-in command language, RDO, provides the uppermost layer of the *Rdb* product. The RDO commands entered by users are parsed by RDO, converted and passed onto DSRI, and finally to the database itself.

A Host Of Alternatives

While the *Datatrieve*-like RDO command syntax provides the basic functions a database administrator or programmer needs, it lacks the report-writer and CRT-display features most end users like. Working with *Rdb* through the DSRI, DEC products like *VAX Datatrieve, Rally* and *Teamdata* provide such specialized facilities. Similarly, a growing number of third parties are arming their most fearless programmers with a DSRI manual and turning them loose to develop new DSRI computing tools (like *SmartStar*), or to adapt existing ones to DSRI (like *FOCUS*). Similarly, for programmers requiring an ANSI-standard relational database language, there's DEC's VAXSQL.

— Al Cini

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in one of three ways: referencing the database by filename, referencing the database by its CDD pathname, or implicitly by defining the logical name SQL$DATABASE. Like RDO, if you use the CDD pathname, then SQL automatically will keep the CDD metadata in sync with the database metadata. If you change the size of a field, for example, that field changes in the database and in the CDD. You can use either EDT or TPU to edit commands you typed in. SQL keeps a buffer of up to 20 commands to be edited, just like RDO. There also is interactive HELP and SET and SHOW commands that are nearly identical to their RDO counterparts.

In precompiled programs, SQL again is analogous to the functions provided with the RDML precompiler, although it works with fewer languages.

. . . the attempt by DEC was to match DB2 precompiled code as closely as possible . . .

The syntax and functionality of precompiled SQL is dominated by the functionality of *DB2* precompiled SQL and the ANSI standard, however, and so is sometimes a little awkward and unnatural for a VAX user. Indeed, the attempt by DEC was to match *DB2* precompiled code as closely as possible, and sometimes this leads to some rather odd constructs.

For example, SQL uses "indicator variables" to indicate the presence of null (missing) values, whereas RDML uses a more VAX-like function, RDB$MISSING. Also, there's a rather strange message area set up, the SQL Communication Area (SQLCA). The SQLCA is used to pass information about the execution of SQL statements to the application program, but most of the fields

EXAMPLE 1.

```
Welcome to node OASIS!

Username: PAN
Password:
        Welcome to VMS V4.5 on node OASIS!
    Last interactive login on Tuesday, 10-FEB-1987 15:08
    Last non-interactive login on Sunday, 25-JAN-1987 04:02
Terminal: VT200          Port: _RTA1:          Time: 10-FEB-1987 15:53:54.17
Your current default directory is USER_DISK:[PAN]
$ sql:==$sql$
$ set def sys_scratch:[sql]
$ dir

Directory SYS_SCRATCH:[SQL]

SETHOST.LOG;1                          32  10-FEB-1987 15:53  [PAN]
SQL_PERSONNEL.RDB;1                  1084   9-FEB-1987 15:35  [PAN]
SQL_PERSONNEL.SNP;1                   202   9-FEB-1987 15:35  [PAN]

Total of 3 files, 1318 blocks.
$ define sql$database sql_personnel
$ sql
SQL> show tables
User Tables in Database with filename SQL$DATABASE
    COLLEGES
    CURRENT_INFO                    A view.
    CURRENT_JOB                     A view.
    CURRENT_SALARY                  A view.
    DEGREES
    DEPARTMENTS
    EMPLOYEES
    JOBS
    JOB_HISTORY
    SALARY_HISTORY
    WORK_STATUS
SQL> ! Let's find out if any employees went to the same school as their manager.
SQL> show table employees
 Columns for table EMPLOYEES
    EMPLOYEE_ID                     CHAR(5)
    LAST_NAME                       CHAR(14)
    FIRST_NAME                      CHAR(10)
    MIDDLE_INITIAL                  CHAR(1)
      DTR edit string     X.
    ADDRESS_DATA_1                  CHAR(25)
    ADDRESS_DATA_2                  CHAR(25)
    CITY                            CHAR(20)
    STATE                           CHAR(2)
    POSTAL_CODE                     CHAR(5)
    SEX                             CHAR(1)
    BIRTHDAY                        DATE
      DTR edit string     DD-MMM-YYYY
    STATUS_CODE                     CHAR(1)
SQL> show table current_job
 Columns for table CURRENT_JOB
    LAST_NAME                       CHAR(14)
    FIRST_NAME                      CHAR(10)
    EMPLOYEE_ID                     CHAR(5)
    JOB_CODE                        CHAR(4)
    DEPARTMENT_CODE                 CHAR(4)
    SUPERVISOR_ID                   CHAR(5)
    JOB_START                       DATE
SQL> show table degrees
 Columns for table DEGREES
    EMPLOYEE_ID                     CHAR(5)
    COLLEGE_CODE                    CHAR(4)
    YEAR_GIVEN                      SMALLINT
    DEGREE                          CHAR(3)
    DEGREE_FIELD                    CHAR(15)
$ sql
SQL> select cj.employee_id, cj.last_name, e.last_name, de.college_code from
cont>   degrees de,
cont>   degrees ds,
cont>   current_job cj,
cont>   employees e
cont>   where
cont>           ds.college_code <> " " and
cont>           ds.college_code = de.college_code and
cont>           cj.supervisor_id = ds.employee_id and
cont>           cj.employee_id = de.employee_id and
cont>           e.employee_id = ds.employee_id
cont>;
 CJ.EMPLOYEE_ID   CJ.LAST_NAME     E.LAST_NAME      DE.COLLEGE_CODE
 00172            Peters           Lasch            PRDU
 00206            Stornelli        Lasch            PRDU
 00244            Boyd             Sarkisian        PRDU
 00182            Iacobone         Stornelli        PRDU
 00182            Iacobone         Stornelli        PRDU
 00345            Stornelli        Mistretta        MIT
 00186            Watters          MacDonald        STAN
 00201            Clinton          MacDonald        STAN
 00374            Andriola         MacDonald        STAN
SQL> !We got some duplicates.  Let's eliminate those using the DISTINCT clause
SQL> select distinct(cj.employee_id), cj.last_name, e.last_name, de.college_code from
cont>   degrees de,
cont>   degrees ds,
cont>   current_job cj,
cont>   employees e
cont>   where
cont>           ds.college_code <> " " and
cont>           ds.college_code = de.college_code and
cont>           cj.supervisor_id = ds.employee_id and
cont>           cj.employee_id = de.employee_id and
cont>           e.employee_id = ds.employee_id
cont>;
 CJ.EMPLOYEE_ID   CJ.LAST_NAME     E.LAST_NAME      DE.COLLEGE_CODE
 00172            Peters           Lasch            PRDU
 00182            Iacobone         Stornelli        PRDU
 00186            Watters          MacDonald        STAN
 00201            Clinton          MacDonald        STAN
 00206            Stornelli        Lasch            PRDU
 00244            Boyd             Sarkisian        PRDU
 00345            Stornelli        Mistretta        MIT
 00374            Andriola         MacDonald        STAN
SQL> EXIT
```

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WE GO.

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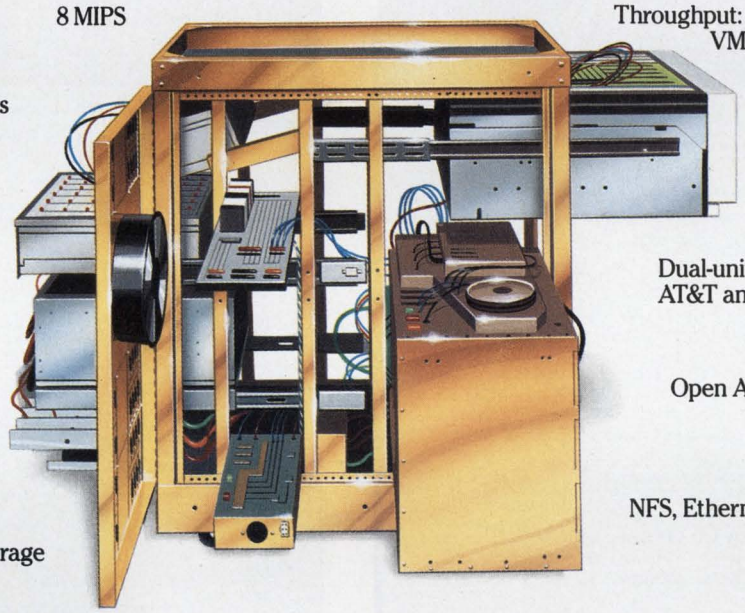

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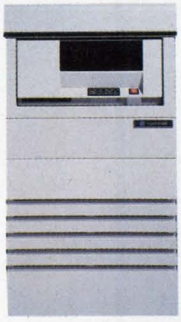

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in the SQLCA are not used by VAX SQL and are provided only for compatibility with *DB2*. However, all of this "strangeness" is in the name of compatibility. And don't forget that an old-time *DB2* user wouldn't have it any other way!

Both VAX SQL and DB2 SQL offer dynamic SQL, which has no exact counterpart in RDML, or in any other database system precompiler of which I'm aware. Dynamic SQL is a special kind of precompiled source code that lets your program generate SQL statements at run time, in contrast to regular precompiled statements that you must embed in your source text. You might use dynamic SQL if you want a terminal user to type in an SQL data retrieval expression that your program then will execute to retrieve information from the database.

As in Example 3, your program might perform statistics on various subsets of the data in a database. The user interactively could form the data subsets that your program then would process and output as statistical results on the terminal screen. Another use for dynamic SQL would involve keeping a file (or a database) of complex queries, retrieving those queries and then executing them on the fly.

There are some special precompiler statements that your program must use to generate dynamic SQL:

1. PREPARE checks the SQL statement for errors and assigns a name to it that you can use in later dynamic SQL statements. The SQL statement that is the argument to the PREPARE statement usually is stored in a program variable, and may have been solicited from the terminal or read from a file at run time.
2. DESCRIBE finds input and output

EXAMPLE 2.

```
IDENTIFICATION DIVISION.
PROGRAM-ID. DEMO_PRECOMPILED_SQL.
AUTHOR. P. Naecker

DATA DIVISION.
WORKING-STORAGE SECTION.
* Get a copy of the employee record directly from the database metadata
* definition in the dictionary...
COPY "PERSONNEL.RDB$RELATIONS.EMPLOYEES" FROM DICTIONARY.
01  NEW_BIRTHDAY          PIC S9(11)V9(7) USAGE COMP.
01  BIRTHDAY              PIC S9(11)V9(7) USAGE COMP.
01  EMPNO                 PIC X(5).
.
.
.

PROCEDURE DIVISION.
*
*   Set up an error handler...
    EXEC SQL
        WHENEVER SQLERROR GOTO HANDLE_SQL_ERROR
    END-EXEC
*
*   Perform some trivial operations using precompiled SQL...
    EXEC SQL
        DECLARE CHECK_EMPLOYEES CURSOR FOR
            SELECT EMPLOYEE_ID, BIRTHDAY FROM EMPLOYEES
            FOR UPDATE OF BIRTHDAY
    END-EXEC
*
*   Get the first record, using an indicator to check if we have
*   any missing values.
    EXEC SQL
        FETCH CHECK_EMPLOYEES INTO :EMPNO, :BIRTHDAY
    END-EXEC
*
*   We have a record.  We now will process each each record in turn, starting
*   with this one, until we have no more records.  After we are done processing
*   each record in ADD_A_DAY, we will FETCH another record, in this way finding
*   out "in advance" the condition when there are no more records, which is
*   indicated by SQLCODE NOT = 0.
*
    PERFORM ADD_A_DAY UNTIL SQLCODE NOT = 0.
    EXEC SQL
        CLOSE CHECK_EMPLOYEES
    END-EXEC
.
.
.
ADD_A_DAY.
*
*   We could perform some routine here, such as ask the terminal user for
*   information about this employee, or check in some non-database file for
*   information, or run a subroutine to evaluate whether or not this
*   employee should have his birthday modified...
.
.
.
    EXEC SQL
        UPDATE EMPLOYEES SET BIRTHDAY = :NEW_BIRTHDAY
    END-EXEC
.
.
.
*   Now fetch the next record, so we have it for the next time we want to
*   ADD_A_DAY.
    EXEC SQL
        FETCH CHECK_EMPLOYEES INTO :EMPNO, :BIRTHDAY
    END-EXEC.
.
.
.
```

EXAMPLE 3.

```
DATA DIVISION.
WORKING-STORAGE.
01  SELECT_COMMAND_STRING      PIC X(1000).
01  SALARY                     PIC S9(4) USAGE COMP.
.
.
.
*   First we create a special FETCH statement we will use later.  The
*   question mark is a placeholder for a COBOL variable in a later EXECUTE
*   statement.
    EXEC SQL
        PREPARE FETCH_STATEMENT FROM
        "FETCH SALARY_CURSOR INTO ?"
    END-EXEC
*
*   Append together a standard string and some input from the user
*   (the variable USERS_RETRIEVAL_STRING) into a variable that we then will
*   use in the PREPARE statement.  Assume that the USERS_RETRIEVAL_STRING
*   was obtained from the user via the terminal, and it can contain any
*   valid SQL WHERE clause.
*
    STRING
                "DECLARE SALARY_CURSOR CURSOR FOR"
                "SELECT SALARY_AMOUNT FROM CURRENT_SALARY WHERE"
                USERS_RETRIEVAL_STRING
    INTO SELECT_COMMAND_STRING
*
*   Execute the command string, including the user's input...
    EXEC SQL
        EXECUTE IMMEDIATE :SELECT_COMMAND_STRING
    END-EXEC
*   Normally there would be a test here to make sure the SELECT statement
*   executed correctly... We'll skip that for this simple example.
*   Next we open the cursor for output...
    EXEC SQL
        EXECUTE IMMEDIATE "OPEN SALARY_CURSOR"
    END-EXEC
*
*   Now we can loop over the FETCH statement until we have no more records.
*   Note that the FETCH statement has been compiled previously using the
*   PREPARE statement, and we simply are reusing the same statement each
*   time we EXECUTE it.  The SALARY variable is used in the place of the
*   question mark in the PREPARE statement above.
*
    PERFORM UNTIL SQLCODE NOT = 0
        EXEC SQL
            EXECUTE FETCH_STATEMENT USING :SALARY
        END-EXEC
*       Do some calculations or something with the salary...
.
.
.
    END-PERFORM
.
.
.
```

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CONTROL DATA

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parameters in the SQL statement and writes information about those parameters in the SQL Descriptor Area. The SQLDA is similar to the SQLCA and is used by SQL to communicate with the program about the parameters used in dynamic SQL statements. The SQLDA is available only for PL/I programs, however, which unfortunately makes it impossible for non-PL/I users to use dynamic statements unless they know the number and data types of the parameters in the statements.

3. The EXECUTE and EXECUTE IMMEDIATE statements cause a previously PREPAREd statement to execute.

4. The DECLARE CURSOR, OPEN, and FETCH statements work with cursors (see sidebar).

Things SQL Doesn't Do

There also are some things that SQL is not. It's not a complete replacement for RDO, the database maintenance utility of *Rdb*, or for the analogous utility in any other database system. RDO includes capability for interacting with the *Rdb* Monitor Process (a process that runs whenever database access is active to mediate activity between users and the database), for analyzing the physical and internal characteristics of the database or for making backup copies of the database.

Other database systems have utilities that perform similar housekeeping functions, and those functions cannot be done from SQL. (In some cases, those functions cannot even be done via the DSRI interface, although DSRI does contain a mechanism to specify those implementation-dependent functions.) However, if you prefer to use SQL instead of RDO, you certainly can use SQL for most daily functions, including defining and deleting database objects and similar metadata operations.

SQL doesn't have a callable interpreter interface, as does *Rdb* using RDML.

Views And Cursors

If you're familiar with views in a relational database system or in *Datatrieve*, you'll find views in SQL to be very comfortable objects. Views are simply a way to look at data in the database in a different way (from a different point of "view") without changing the way that the data is stored in the database. Here are two trivial examples:

Given a relation called EMPLOYEES that contains EMPLOYEE_NUMBER, NAME and DEPARTMENT, it's possible to make a view that contains just the EMPLOYEE_NUMBER and NAME of employees in the data processing department. In *Datatrieve*, this would be done with the statement:

```
DEFINE VIEW dp_view OF employees USING
01 selected_data OCCURS FOR employees WITH department EQ "DP".
  05 employee_number FROM employees.
  05 name FROM employees.
```

In SQL, the same statement would look like this:

```
CREATE VIEW dp_view AS SELECT
  E.employee_number
  E.name
FROM EMPLOYEES E WHERE department = "DP";
```

A slightly more complicated example demonstrates the real power of views. You can use a view to connect together data from two different records, in a process called a relational join. Suppose we have another relation called DEPARTMENTS that contains DEPARTMENT and MANAGER. We can construct a view that shows the employees and their supervisor (the department manager). In *Datatrieve*, we'd have:

```
DEFINE VIEW supervisor_view OF employees, departments USING
01 supervisor_list OCCURS FOR employees CROSS departments
 OVER DEPARTMENT.
  05 employee_number FROM employees.
  05 name FROM employees.
  05 manager FROM departments.
```

In SQL, the same view would look like this:

```
CREATE VIEW supervisor_list
  ( empno,
    employee_name,
    supervisor_name )
AS SELECT
    E.employee_number,
    E.name,
    D.manager
FROM
    employees E,
    departments D
```

```
WHERE
    E.department = D.department ;
```

Note how the SQL view also lets you change the name of the fields by assigning local column names (empno, employee_name, and supervisor_name) in the CREATE VIEW statement.

Now that we've created views, we can manipulate those views exactly as if they were new relations in the database. We can sort them, print them out, perform calculations on the data they contain and so forth. However, there is no physical data stored in the views themselves — they get their data from the other relations in the database at the time they're referenced. In SQL, if you have a view of a single relation (like our first example) you can store data into that relation, modify the data or even delete the record.

SQL cursors are much like views, except that they're accessed one record at a time. Both views and cursors are "result tables" in SQL terminology. Unlike views, the definition for a cursor is not stored in the database — it's not a permanent object. You must DECLARE a cursor in your program or interactive session, and that cursor exists until you exit the program or session. To begin accessing a cursor, SQL requires that you OPEN the cursor and then FETCH each record that you want to access. You cannot skip over records or back up — if you go past a record you must re-OPEN the cursor and begin again. As in our previous example, we can use a cursor to access records that are physically distinct but logically joined:

```
DECLARE supervisor_list CURSOR
  SELECT
    E.employee_number,
    E.name,
    D.manager
FROM
     employees E,
     departments D
WHERE
    E.department = D.department
ORDER BY
    E.name;

OPEN supervisor_list;
FETCH supervisor_list;
```

Each time we do a FETCH, SQL will return the next logical record from the cursor and print it. We can FETCH the data INTO some program fields if these statements are embedded in a precompiled SQL program. This gives our program control over when the records are to be returned. Note that the ORDER BY clause has told SQL to return the records to us in a particular order, alphabetically sorted by the employee's name.

As you can see, cursors are a useful construct in SQL, and they're used heavily in SQL programs. Your program can have as many different cursors as you like; all open simultaneously if you wish. You even can have the same cursor definition with different names, thus providing two record streams to access the same data.

In RDML, and some other systems, your program can construct arbitrary text strings representing statements in the appropriate data manipulation language. You then can pass these strings through a callable interface and *Rdb* will interpret, compile and execute the statements for you. For example, you might have a line, like the following, in a program that accesses an *Rdb* database:

```
RDB_STATUS = RDB$INTERPRET
('FOR E IN EMPLOYEES PRINT
E.SALARY END_FOR')
```

The string can be a variable declared in your program, and you also can pass arguments to be used in the *Rdb* statement and to transfer data to and from the database system. SQL doesn't have a corresponding SQL$INTERPRET. Instead, you must use the dynamic SQL form of precompiled SQL to accomplish the same function. However, this means that you cannot access SQL from a language that doesn't have a precompiler (COBOL, FORTRAN, PL/I), which isn't a limitation using the RDB$INTERPRET interface (any programming language that adheres to the VAX Calling Standard can use RDB$INTERPRET).

VAX SQL doesn't work with as many different languages as DML does, so you may not want to use SQL if you primarily are going to be using precompiled SQL (the most efficient way to use it) and don't want to program in COBOL, FORTRAN or PL/I. However, some third-party SQLs support more languages than DEC's VAX SQL.

Why SQL?

If you have *Rdb* or some other DSRI-compliant relational database product, you might wonder why you should purchase another layered product to do the same things you already do with RDO or *Datatrieve* or via a program interface. There are several reasons you may wish to consider VAX SQL.

The most likely reason is compatibility — not with your VAX database

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but with other databases. Because VAX SQL is very similar to IBM's *DB2* SQL, you probably can convert applications from an IBM machine using *DB2* to a DSRI database and SQL with a minimum of effort.

If your applications already are using precompiled SQL inside IBM COBOL, you may be able to convert the application programs with only those source code changes required to make the IBM COBOL program compile as VAX COBOL (which are likely to be

relatively few). Of course, you also can move the *DB2* SQL data definition statements to VAX SQL as well and use those SQL statements to define your DSRI database. Once you've moved the database, you'd be free to develop new applications in either SQL or RDML, or you even could use *Datatrieve* for it's excellent forms and report-writing capability.

You also could use SQL to develop an application on the VAX using VAX languages and VAX database products, and then move the application to the IBM machine for production. The advantage here is that the VAX is likely to be a much more effective development environment, but your organization may want to run large production applications on the IBM system.

Even if your application doesn't need compatibility with an IBM *DB2* database, you still may wish to use SQL. One reason would be "programmer comfort" — the people developing the application already may be familiar with SQL and may not want to learn another relational data manipulation language like RDML. If the application developers haven't used SQL on *DB2*, they may have used one of the many different relational database systems that support some flavor of SQL. Some offer excellent compatibility with the ANSI standard and/or the *DB2* implementation, whereas others have only a rough similarity to the standards.

In sum, DSRI-compliant VAX SQL is another tool you may want to add to your arsenal of database products. If you have any IBM *DB2* programmers in your shop, or if compatibility with IBM *DB2* databases is an issue, you certainly should take a look at VAX SQL.

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UNIX

REMOTE PROCEDURE CALLS

By Thomas Wikman

Distributed Processing Across Ethernet.

With the Network File System (NFS) becoming a standard in file access and distribution, it will become apparent to users that NFS is a sophisticated application of the UNIX Remote Procedure Call (RPC) mechanism. To implement NFS, some changes had to be incorporated into the existing handling of the UNIX file system; otherwise, almost all the code is written using RPC calls. The intent of this article is to analyze and explain the RPC mechanism and how it will affect the computer community in the future.

Terms And Concepts

A process in a system is an instance of a program in execution. In a UNIX system (and most operating systems), processes can execute simultaneously with no logical limit to their number, and many instances of a program can execute simultaneously on the same system. Processes can send data to and receive data from other processes. By abiding to a set of basic protocols, the processes can share the computation effort between them.

For example, assume you have a package that calculates data and writes it to the standard output, and another package that reads the data from the standard input and displays this data in graphic format. If this is to run in real-time, you would pipe the information from the number cruncher to the display process and voila, you have a somewhat distributed system. But assume you have two computers; one has the enhanced capability of number crunching (a VAX, for instance), and the other has the capability of creating great displays (for example, a Sun workstation). The most attractive scenario would be to maintain the number crunching process on the VAX and use the Sun to display the graphic output. This would be a real application of distributed processing between two or more independent computer systems. The client (the Sun workstation in this example) requests the server (the VAX) to perform the computation and return the results to the client (see Figure 1). Since both the Sun and the VAX use Ethernet as the communication media and both support the TCP and the UDP communication protocols, this environment is used for communication between these machines. TCP and UDP are communication protocols used by the Department of Defense and it has become a de facto standard in the communications world.

In this case, the Sun runs as the client and performs the following operations:

1. Establishes a communication channel via a socket with the VAX.
2. Requests the VAX to calculate the display data and return it to the Sun in a common data format.
3. Displays the data on the screen.

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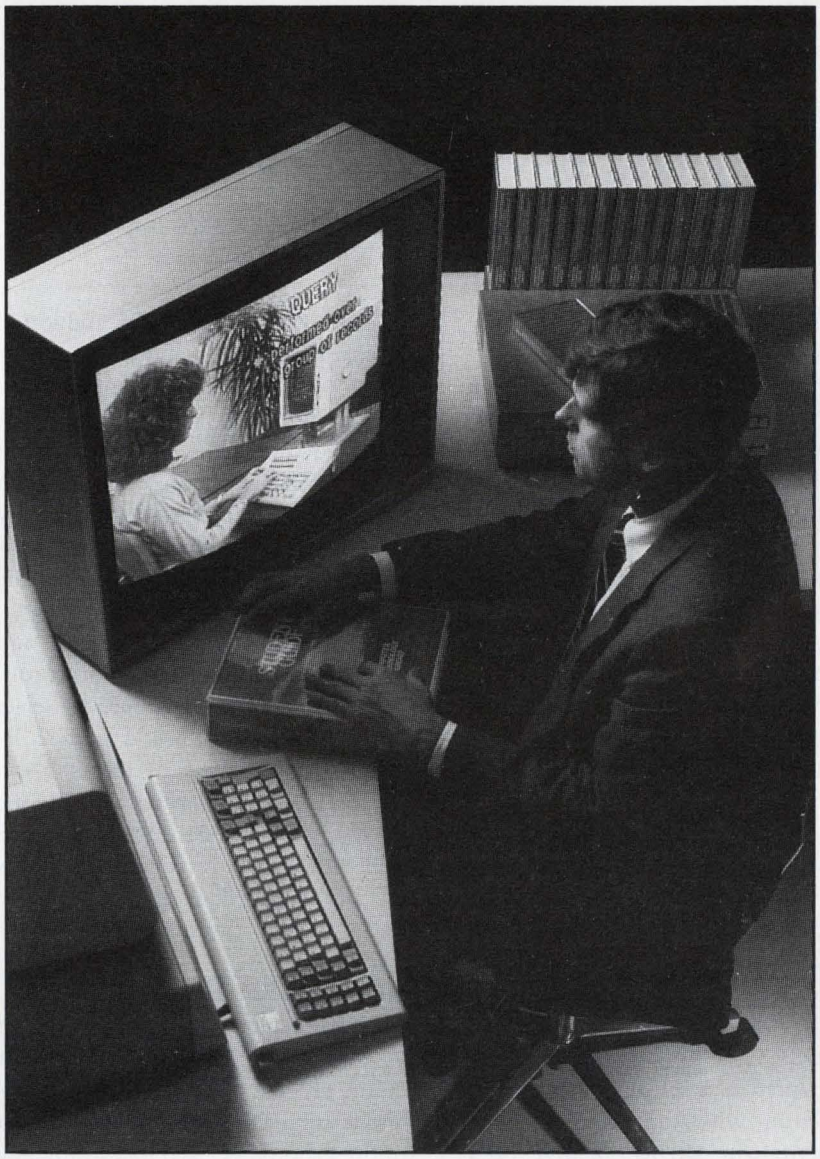

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The concept of RPC is powerful, and it will put the power of distributed processing in the hands of the government.

The server (the VAX) performs the following:
1. Advertises on the network that it can perform this computation.
2. Receives a request, services the request, and returns any results to the requesting client.

You now have a truly distributed processing environment where the processing is shared between the local client machine and a server machine on the network. This could grow more complex since the processing could be performed among many servers being controlled by one client.

Remote Procedure Call Basics

The RPC facility allows a server process to execute a call requested by a client process. Because we now have two separate processes, these processes no longer have to live on the same physical machine. The RPC mechanism is implemented as a set of procedures in conjunction with the eXternal Data Representation (XDR), which is a specification for portable data transmission. Both RPC and XDR are machine-independent, thus making it portable, and provide another means of interprocess communication. RPC and XDR are so closely connected that in order to understand the RPC facility, you have to understand the XDR facility and vice versa.

The purpose here is to help you better understand the RPC model. The concept of RPC is powerful, and it will put the power of distributed processing in the hands of the programmer. New software will be created using independent modules reading data from sockets that can be ported to any system. With networking becoming standard in any computing environment, more programs will be written using the RPC model.

RPC and XDR use both UDP and TCP as their communication protocols. It is up to the programmer to select which protocol to use. Figure 2 illustrates the layering of the RPC and XDR on top of the transport layer of the ISO model. A system can perform as a client as well as a server. It all depends whether both client and server have been ported to the specific system.

External Data Representation

The XDR standard is the backbone of the RPC package in that any data for remote procedure calls should be transmitted using the XDR library. The XDR routines should be used to transmit any data that is to be accessed by a remote procedure.

When data is accessed by different machine types, it is necessary to access portable data (i.e., a standard data format) that will look the same for all machines accessing it through the network. In our example, an integer from the Sun has to be byte-swapped before being read by the VAX. By using the XDR mechanism, both machines agree on a common data format to transfer data between them. This makes a very difficult task possible between machines with different architectures. The XDR routine can be viewed as a filter that translates data to a common format. For that data to be read, it has to be viewed through the same filter.

The XDR Library

The XDR library should be used when writing portable data. In fact, it should be used every time a program writes data that is to be viewed by another program or process. The XDR library contains filter routines for integers and floating point numbers, strings, structures, and many other C data representations. If the available data representations do not fit the requirements of a specific program, new constructs can be created by using lower level XDR filters.

The XDR filter either has to encode the data to portable format or decode the data to the specific machine format. So, when using the XDR procedures, you have to specify when to encode or decode the data. This usually is easy at a high level of programming, because the RPC routines perform the specification automatically, but it must be taken into consideration when installing low-level user-written RPC calls.

For each data type, there is an associated XDR routine. The naming convention of XDR routines is to have an **xdr_prefix** followed by the data type. For example, **xdr_long** is the XDR procedure for long integers, and **xdr_u_long** is the XDR routine for unsigned integers. The XDR procedure looks like this:

```
xdr_xxx(xdrs, fp)
XDR *xdrs;
xxx *fp;
{
.
.
}
```

In this case, **xxx** can be a long or any specific data structure that the client requires, and **xdrs** is the opaque handle, created by the RPC, from where the XDR routine is going to decide whether

to encode, decode or perform any other operation on the data.

The following data structure:

```
struct decpro {
        int a1;
        short a2;
        }
```

translates to the XDR translation routine shown in Program 1.

Xdr_decpro converts the **decpro** data structure into the appropriate stream to be passed by the RPC call.

```
.... | a1 | a2 | ..... (XDR stream)
```

All converted data is a multiple of four bytes (32 bits) in the XDR stream.

As illustrated in Figure 1, RPCs are used by a client to communicate with a server. The client calls a procedure to send data to a specified server. At reception of the data, the server calls a dispatch routine, satisfies the request, and sends any resulting data back to the client. At this time, the client continues to execute. It sounds too easy to be true, but it really works!

There are three layers of complexity in the RPC interface. All of these layers can be accessed by the programmer; however, some of the routines implemented in the highest layer might be available only on Sun servers/clients.

The highest layer is a set of routines destined to communicate with a specific server on the network, and the programmer does not have to be aware of the RPC mechanism. For example, **rnusers( )** returns the number of users on a remote machine, **rusers( )** returns user information on the remote machine, etc.

The Intermediate Layer

This will be the most frequently used layer by most application programs. As you will see, it is quite easy to write the Sun-to-VAX program using this layer. The complicated part lies in understanding the XDR structures; otherwise, it is straightforward and fairly easy to implement. If the client and the server both

FIGURE 1.

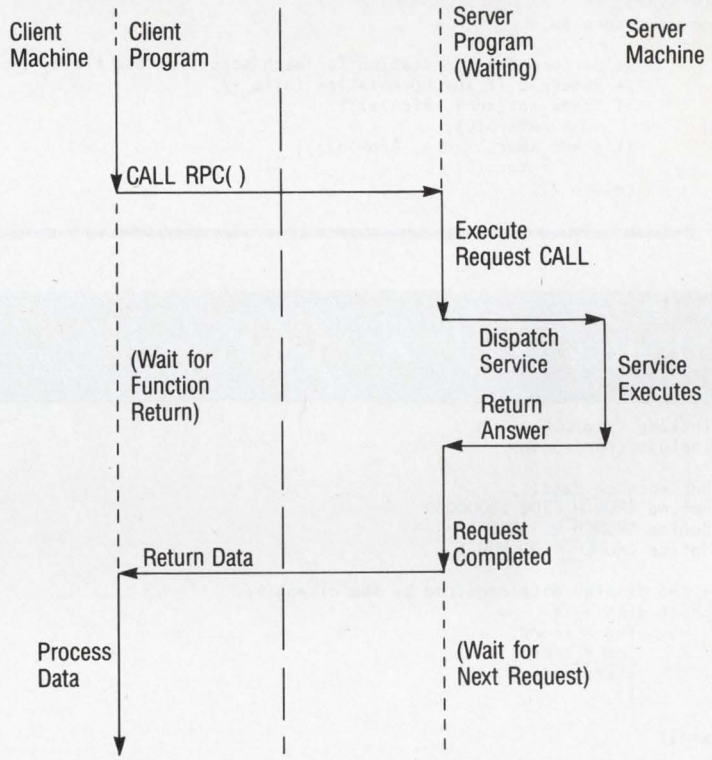
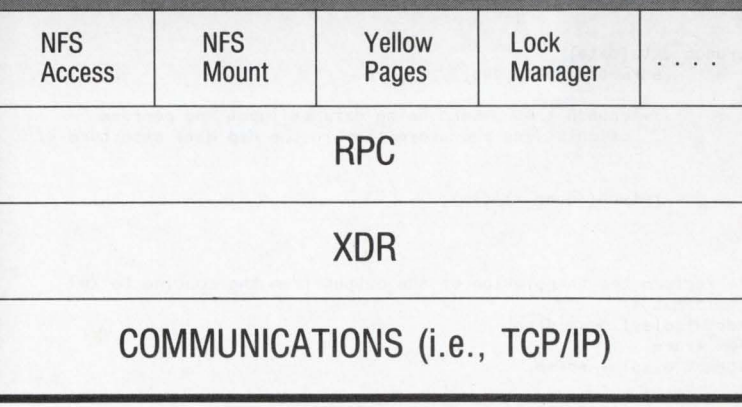


FIGURE 2.



PROGRAM 1.

```
xdr_decpro(xdrs, fp)
XDR *xdrs;
struct decpro fp;
{
        /* Perform the translation for each specific data field */
        /* Return 0 if any translation fails */
        if (!xdr_int(xdrs, &fp->a1))
                return(0);
        if (!xdr_short (xdrs, &fp->a2));
                return(0);
        return (1);
}
```

PROGRAM 2.

```
#include <stdio.h>
#include <rpc/rpc.h>

char *crunch_data();
#define CRUNCH_PROG 20000089
#define CRUNCH_VERSION 1
#define CRUNCH_PROC_NUM 1

/* the display data required by the client */
struct display {
        int X_coord;
        int Y_coord;
        short color;
        };

main()
{
        /* main server program */
        /* It uses the procedure crunch_data() to execute the number */
        /* crunching and it accepts a long integer as input and */
        /* returns the structure display to the client */
        registerrpc(CRUNCH_PROG, CRUNCH_VERSION, CRUNCH_PROC_NUM,
                crunch_data, xdr_long, xdr_display);

        svc_run();
        fprintf(stderr, "Error: svc_run failed\n");
        exit(1);
}

crunch_data(data)
        struct display dsp;
{
        /* crunch the numbers using data as input and perform
           calculations and store them in the dsp data structure */
                .
                .
        return((char *)&dsp);
}


/* Perform the translation of the output from the routine to XDR
   format */
xdr_display(xdrs, disp)
XDR *xdrs;
struct display *disp;
{
        if (!xdr_int(xdrs, &disp->X_coord))
                return(0);
        if (!xdr_int(xdrs, &disp->Y_coord))
                return(0);
        if (!xdr_short(xdrs, &disp->X_coord))
                return(0);
        return(1);
}
```

use the TCP and UDP protocols, it is an elegant and straightforward way of computation distribution.

RPC Program Numbers

Every RPC call has a program number, a version number, and a procedure number. The program number defines a procedure or a group of related procedures. Each program number has one or more version numbers so that when a change is made to the RPC, a new program number does not have to be assigned. This makes downward compatibility fairly easy when updates occur. The procedure number is used so that you can call a certain procedure relating to a specific program number.

Following is the range of program numbers that can be assigned:

```
        0 - 1fffffff defined by Sun
20000000 - 3fffffff defined by user
40000000 - 5fffffff transient
60000000 - ffffffff reserved
```

Sun Microsystems administers the first group of numbers, and these should be identical to all Sun customers. The second group is reserved to specific customer applications. The third range is for dynamically generated program numbers. The last range is reserved for future use.

The basic idea of RPC registration in the network is that you register an agreed upon program number that relates to a predefined procedure on the network. All requests for that number are satisfied by the specific server that posted the program number.

RPC Registration

In most cases, a server registers the RPC and then goes into an infinite loop while waiting to service requests. Using the Sun-to-VAX example, I am going to define the server that will number-crunch on the VAX. I leave it to you to define the actual number crunching computation. An example of the server side is shown in Program 2.

The **registerrpc( )** registers the procedure CRUNCH_PROC with the

RPC service package. The first, second, and third parameters of the **registerrpc** call define the program number, version number and procedure number. The fourth parameter defines the routine that handles the service. The fifth and sixth parameters define the input decoding and output encoding procedures; these last parameters have to be defined as XDR routines. The **svc_run( )** procedure is an infinite loop that services the RPC request. The **crunch_data( )** routine is called every time a request is received from the client. The XDR filter to handle the return data structure **(xdr_display)** is always called to translate the return data to the XDR common data format.

RPC Calling

After the server has come up on the VAX, the Sun has to post the request for display information. This call can be done as many times as appropriate. A version of the client side is given in Program 3.

The **callrpc( )** procedure calls the remote procedure associated with the program number, version number, and procedure number (respectively the second, third, and fourth parameters) that is to execute in the CRUNCH machine. The first parameter of **callrpc** is the host name of the server. The fifth and sixth parameters are the XDR routine and the input parameter to be transmitted to the server. The seventh and eighth parameters are the receiving parameters of the computation on the VAX. **Display_Routine( )** displays the values in the **disp** structure.

Most of the work to be done at this level is in the definition of the XDR procedures. It can be seen that the power of such an interface is tremendous.

Lowest Layer Of RPC

The lowest layer of RPC allows the programmer to access the internal data structures of the RPC, network, and XDR routines. It is at this level that the fun really begins. It is here that most optimization can be done to satisfy specific applications. If the above examples are not enough to satisfy your thirst about the RPC standard, I recommend reading the *RPC Programming Guide* distributed by Sun Microsystems.

PROGRAM 3.

```
#include <stdio.h>
#include <rpc/rpc.h>

#define CRUNCH_PROG 20000089
#define CRUNCH_VERSION 1
#define CRUNCH_PROC_NUM 1

/* the display data */
struct display {
        int X_coord;
        int Y_coord;
        short color;
        };

main()
{
        int counter;
        struct display disp;

        for (counter=0; counter< 1000; counter++){
           callrpc("CRUNCH", CRUNCH_PROG, CRUNCH_VERSION,
                CRUNCH_PROG_NUM, xdr_int, &counter, xdr_display, &disp);
           Display_Routine(&disp);
        }
}
```

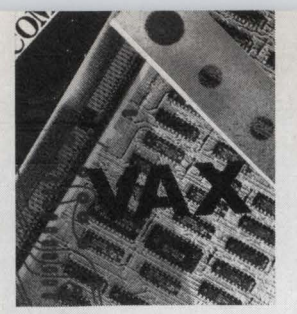
Network File System

The Network File System (NFS) is the first full function commercial package using the RPC method. It is not clear whether NFS or RPC came first. I think both developed each other, and as the NFS project developed, the RPC mechanism became more sophisticated.

NFS On Non-UNIX Systems

NFS can be implemented on non-UNIX operating systems. The only problem I foresee on NFS implementations on non-UNIX operating systems is the handling of the file system. Most systems support hierarchical file system representation, and that should be no problem. The problem crops up when hard and symbolic links are not supported by the non-UNIX operating system. Many UNIX programs use the **link( )** call, which is extremely difficult to implement in a non-UNIX system. I don't know whether these features ever will be retracted from the NFS standard, but it puts some very severe design issues on server ports to non-UNIX systems. The NFS server/client model has been ported to a wide variety of UNIX and non-UNIX systems including VAX/VMS (server version) and PC-DOS (client version).

The RPC mechanism is an excellent way to use the network and computer resources. Once the basic RPC has been ported to different machines running different operating systems, we will be able to share data and computing power among many different architectures and operating systems. This will make distributed processing a way of computing rather that a phrase written in an article. — *Thomas Wikman is a systems analyst at Quintus Corporation, Mountain View, California.*



VAX

AN EASY PRINT TIP

By S.S. Nagaraj

A Print/Spool Command Procedure For All VT200-Type Terminals.

While developing programs on VAX systems, it sometimes is convenient to print a file on the printer attached to the terminal. A typical method would be to type the file on the terminal and press <PRINT SCREEN>. Program 1 shows a method using a command procedure, that works on all VT200-type terminals. Note, that control characters such as <ESC> and <FF> were inserted into the command procedure using EDT's SPECINS function. — *S. S. Nagaraj is senior systems engineer at Computer Task Group Inc., Raleigh, North Carolina.*

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PROGRAM

```
$  !
$  ! Command procedure to print or spool the files on the
$  ! terminal.
$  !
$  ON CONTROL_Y THEN GOTO NORMAL_EXIT
$  ON WARNING THEN GOTO NORMAL_EXIT
$  ON ERROR THEN GOTO NORMAL_EXIT
$  ON SEVERE_ERROR THEN GOTO NORMAL_EXIT
$  IF F$GETDVI("SYS$OUTPUT","TT_DECCRT") .NES. "TRUE" THEN GOTO O_EXIT
$  !
$  !   It may be useful to Set the verify mode while debugging
$  !SET VERIFY
$  !
$  SET_PRINT = "<ESC>[5i"
$  SET_NORMAL = "<ESC>[4i"
$  FORM_FEED = "<FF>"
$  SET TERMINAL/FORM_FEED
$  !
$PRINT_LOOP:
$  INQUIRE FILE_NAME "File to Print (Press RET to end)"
$  If FILE_NAME .EQS. "" THEN EXIT
$  WRITE SYS$OUTPUT SET_PRINT
$  COPY 'FILE_NAME' TT:
$  WRITE SYS$OUTPUT FORM_FEED
$  WRITE SYS$OUTPUT SET_NORMAL
$  GOTO PRINT_LOOP
$  !
$NORMAL_EXIT:
$  WRITE SYS$OUTPUT SET_NORMAL
$  EXIT
$  !
$O_EXIT:
$  WRITE SYS$OUTPUT "The terminal is not a DEC terminal"
$  EXIT
```

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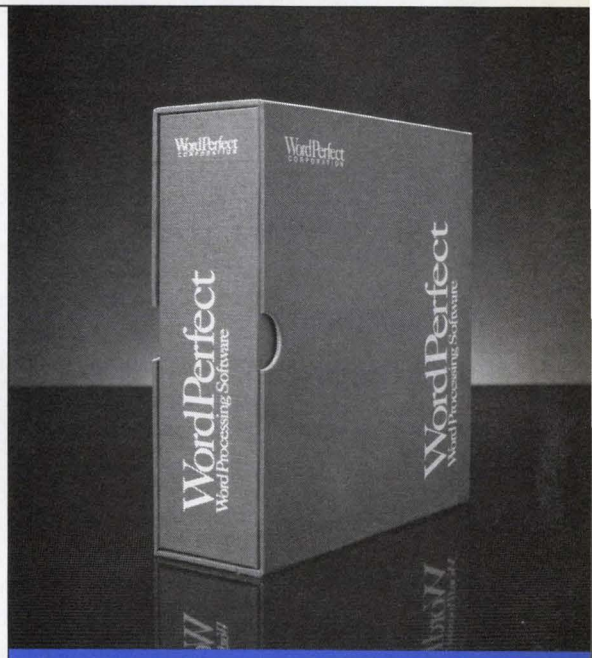

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COMMUNICATIONS

VTERM/220

By David Rasor and David Bynon

VT Emulation Requirements Mastered.

We're tough on requirements. Before a product gets our seal of approval, it must pass a rigorous series of testing and retesting in our computer lab. Over the next few months, we'll be reporting on a number of products that offer solutions, are installed and used easily; products that work, like *VTERM/220,* an IBM PC (and PC-compatible) terminal emulation package, from Coefficient Systems Corporation of New York City.

We have several MICROVAX systems connected by an Ethernet. Our terminals include a VAXstation and VT220s from DEC, IBM PC/XTs and ATs, and assorted clones. We need, and heavily depend on, good terminal emulation.

After one week of using *VTERM/220* on one of the PCs while developing an FMS application, our reaction was "Wow — these guys sure have mastered VT terminal emulation."

If Coefficient didn't intend *VTERM/220* to be an acronym for VT Emulation Requirements Mastered, maybe they should have, because that's exactly what they've done. *VTERM/220* is, in our opinion, a master emulator of DEC's VT220/100 series terminals on the IBM PC and compatibles.

Installation

VTERM/220 installation is a snap. Simply make a working copy of the master disk (non copy-protected) and invoke the program. It's that easy. It's generally suggested to make a subdirectory for the product and its file, which helps keep PC life orderly.

By entering ALT-S, you'll be presented with a series of setup screens that allow you to change terminal configuration, just as you would on a DEC VT200 or VT100. These configuration parameters modify terminal characteristics for the host computer interface.

Initially, we didn't have to modify any parameters, because the default settings had us up and running in seconds. In fact, it wasn't until a few days after we started using *VTERM/220* that we found one of its more useful features: multiple setup files. If you have different terminal needs at different times, *VTERM/220* supports multiple setup files that can be retrieved at will or at program execution time.

For PC-specific configuration, *VTERM/220* provides a menu-driven program called V2CONFIG that allows you to modify some of the features on the PC, like screen color, scrollback buffer size and printer handling — not a bad feature. Our only complaint is the inability to tell *VTERM/220* to ignore a color card. This was very annoying in one case, where we had a PC with a color graphics card and monochrome monitor. It took a while to find an acceptable foreground/background color combination.

Controls

Most control operations are performed by pressing ALT in conjunction with another key. These functions have been logically implemented:

1. ALT-S — Setup screen
2. ALT-H — Help
3. ALT-D — Default settings
4. ALT-G — Get a setup file
5. ALT-P — Put (save) a setup file, etc.

Terminal Emulation

The function keys, along with the CTRL and SHIFT keys, emulate the many functions of a

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If your display card is of the lesser 80-column flavor, never fear — you can scroll back and forth horizontally.

VT terminal. The numeric keypad is transformed into an application keypad, a blessing in itself, and almost exactly matches the VT220 keypad. What's missing is the EDT delete character key. In turn, they made the backspace key a true backspace. Many of the VT emulators we've tested don't remap the backspace key, which is frustrating because it always sends the cursor to the home position.

VTERM/220 supports 132-column mode, if your display card is of the 132-column variety. If your display card is of the lesser 80-column flavor, never fear — you can scroll back and forth horizontally.

To facilitate support of advanced video functions, VTERM pulls off some ingenious tricks: double-wide character lines, for example, merely have spaces added between the characters to make them appear D O U B L E W I D E. All things considered, because there are so many PC video display standards, *VTERM/220* handles the advanced video functions true to form.

File Transfer

One of the most important features of a terminal emulator is its ability to transfer files effortlessly between host and PC. *VTERM/220* supports ASCII, XMODEM, KERMIT, VTRANS7 and VTRANS8 protocols. VTRANS8 is Coefficient's proprietary protocol. *VTERM/220* includes the VTRANS8 source code for hosts running under VMS, RSTS/E and UNIX/XENIX systems. Coefficient claims it to be the fastest, most reliable and easiest file transfer protocols to use. We were unable to verify this, because KERMIT is our standard file transfer protocol (old dogs are hard to train).

We did test KERMIT transfers, however, and found them to be 100 percent compatible for the VAX with our

KERMIT-32. The commands used with *VTERM/220*'s KERMIT are much the same as in true KERMIT implementations. Supported are batch transfers and, most importantly, host server mode.

Converting Data

If you've downloaded data to your PC, you can convert it with ONESHOT, a utility program provided with *VTERM/220*. ONESHOT allows you to select information from reports, files or queries and place it directly into one of several popular spreadsheets or database formats. It's perfect for converting data from such favorites as *Datatrieve* and *DECalc*. The only restriction is that the data must be visibly readable (no control characters) when viewed using the DOS TYPE command. Records longer than 254 characters will be truncated.

We're impressed with *VTERM/220*'s ability to support a VT printer port. You can turn the printer on or off with or without the information being displayed to the screen. If the host is set up appropriately, you can print directly to your PC printer. We use the printer port option routinely, and also a PC printer to print documents, indexes and screen dumps from *ALL-IN-1*. This also has proved useful while remotely connected, via modem, to one of the MICROVAX systems. The only feature left out, in our opinion, is a print buffer.

The *VTERM/220* soft keys have a script language of their own, with 10 different commands.

Other Features

VTERM/220 supports up to 18 user-definable soft keys. Each soft key retains a command string as long as 63 characters. *VTERM/220*'s soft keys are compatible with the popular keyboard macro programs, as are all *VTERM/220* keyboard functions.

The *VTERM/220* soft keys have a script language of their own, with 10 different commands. With these, you can formulate complex host commands

While in DOS, you can run most DOS programs and still remain connected to your host.

to be issued with only two keystrokes. You also can do it your way. Setup screen four allows you to remap the keyboard to your liking and save the remapping to a file. This could come in very handy for those special applications that don't seem to work well on the PC.

A handy exit-to-DOS function is provided by depressing the "hot keys." The default hot keys are the SHIFT keys. You're free to change the hot-key assignment, using V2CONFIG, if the assignment conflicts with other memory-resident programs like *SideKick*.

While in DOS, you can run most DOS programs and still remain connected to your host. *VTERM/220* keeps the communication port active. You even can start up another session of *VTERM/220* and log onto another host system via a second communication (COM) port!

Documentation

VTERM/220 comes with a command reference card that could have been the size of a 3 X 5 card. Instead, it's as long as the keyboard itself. It contains room for you to write in any keyboard remapping, but also shows how the keyboard is mapped by default.

The manual is comprehensive and well organized. It's well written, easy to read, and easy to scan for information. It contains brief tutorials on how to get started, which is great for those not familiar with this type of software. Additionally, the documentation provides more than enough information for the technical guru who might want to change things around.

VTERM/220 is a master of VT terminal emulation. The only feature that could make this package better is a VT220-style keyboard (hint, hint). — *David Rasor is a microcomputer consultant for Bynon & Associates, Washington, D.C. David Bynon is a VAX systems consultant and our MICROVAX editor.*

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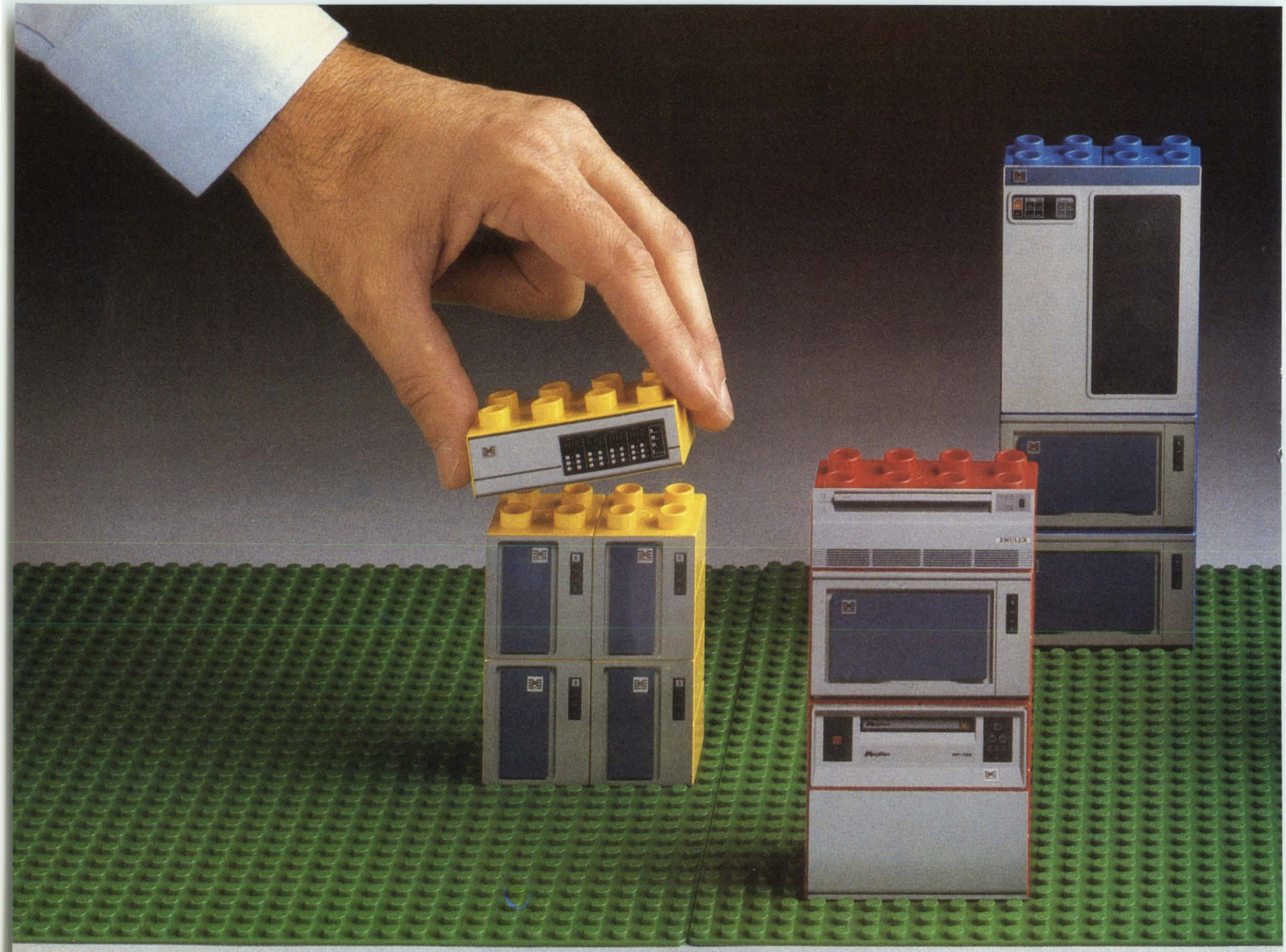

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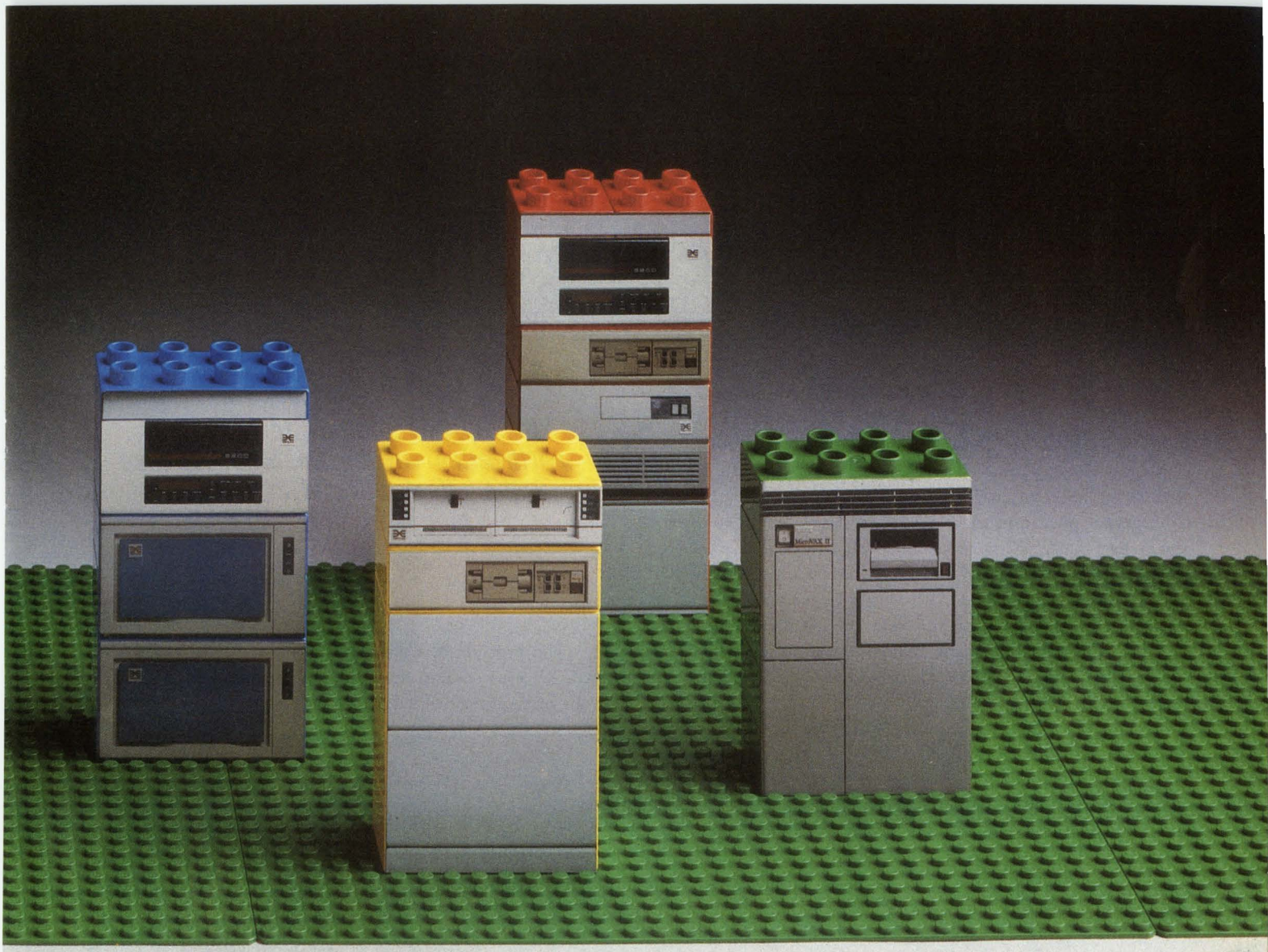

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DCL DIALOGUE

Kevin G. Barkes

DCLivering The Mail

The mailbag (both physical and electronic) really is stuffed this month, and if I don't start chipping away at it I'll never catch up. Many of your comments dealt with the DCL "stacks" procedures (*DEC PROFESSIONAL*, January 1987, Vol. 6, No. 1). I'm saving those letters for June, when we'll also publish a similar set of procedures for pushing and popping privileges. Intended for use by system managers, these command files should help take the drudgery out of setting and resetting privileges manually. Those of you concerned with symbol space considerations will have a field day with this one. (Here's a trivia question to tide you over. How many characters are there in the string containing all possible VMS privileges? Hold onto your CLISYMTBL values, folks!)

One of DCL's strong points is the variety of approaches available for tackling a problem. In my "Quick and Dirty DCL Debugging" column (September 1986, Vol. 5, No. 9), I suggested using a logical name "switch" to turn command procedure verification off and on. Eric Ross of New York City suggested using a global symbol as the "switch" instead of a logical name. Bob De Wolf, a system engineer based in Fullerton, California, developed his own "selective procedure verification" method. He suggests placing entry and exit sequences in all procedures requiring selective verification. A slightly modified version of his original approach follows:

```
$! Entry sequence:
$! Save current verification status in
$! the symbol SAVE_VERIFY. F$VERIFY(0)
$! turns off verification:
$ SAVE_VERIFY = F$VERIFY(0)
$!
$! Make sure the symbol DCL_VFY is
$! assigned so we don't generate an
$! error:
$ IF F$TYPE(DCL_VFY) .EQS. "" THEN -
  DCL_VFY = ""
$!
$! Let's assume this .COM file is named
$! TEST.COM. See text for explanation:
$ IF F$LOCATE("TEST.COM",DCL_VFY) .NE. -
    F$LENGTH(DCL_VFY) THEN SET VERIFY
.
.
$! Exit sequence:
$! EXIT_VERIFY is a "garbage" symbol
$! required by F$VERIFY, which sets
$! verification to its status at the
$! entry point to the procedure.
$ EXIT_VERIFY = F$VERIFY(SAVE_VERIFY)
```

> ***If F$LOCATE finds the filename, verification will be enabled because the offset will not match the length of DCL__VFY.***

The procedure is quite simple. You define the symbol DCL__VFY to contain the names of the files for which you want verification enabled. More than one file can be specified, such as:

```
$ DCL_VFY :== TEST.COM FILE.COM SAMPLE.COM
```

The command F$LENGTH(DCL__VFY) returns the length of the string in the DCL__VFY symbol. F$LOCATE("filename",DCL__VFY) looks for the starting offset of the string "filename" in DCL__VFY. If F$LOCATE finds the filename, verification will be enabled because the offset will not match the length of DCL__VFY. If the F$LOCATE call fails, the lexical returns the length of DCL__VFY. Because that value will match the F$LENGTH call, verification will not be turned on.

One drawback to this method is the need to "customize" each file so that the first argument to F$LOCATE is the name of the command procedure. If you make a mistake typing the file name, or change the name of the procedure and forget to update the F$LOCATE call, the sequence won't work.

You can avoid the need to insert the procedure name manually by substituting the following code in the entry sequence:

```
$! Have the lexical return the current
$! procedure name.
$ FILE = F$ENVIRONMENT("PROCEDURE")
$!
$! Extract just the name and file type,
$! since the lexical returns the full
$! file spec.
$ FILE = F$PARSE(FILE,,,"NAME")+F$PARSE(FILE,,,"TYPE")
$!
$! Perform the test:
$ IF F$LOCATE(FILE,DCL_VFY) .NE. F$LENGTH(DCL_VFY) THEN -
  SET VERIFY
```

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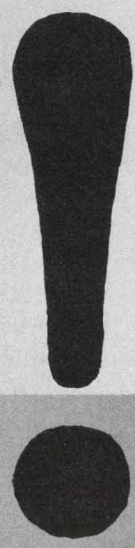

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You could reduce the three steps above into one line of code for added efficiency; we broke them down here for clarity.

Laurie Maytrott of the Florida Solar Energy Center pointed out that using the READ command instead of INQUIRE keeps unwanted data from getting into the RECALL buffer (see also the comments of P. Piotrowski in "DCL Dialogue," *DEC PROFESSIONAL*, February 1987, Vol. 6, No. 2).

Instead of using:

```
$ INQUIRE/NOPUNC PSWD "Today's password? "
```

use:

```
$ READ SYS$COMMAND PSWD /PROMPT="Today's password? "
```

Data entered via READ doesn't go through the DCL command interpreter, so the string symbol assignment operations performed by INQUIRE aren't done; i.e., uppercase conversion, space and tab compression, symbol substitution, and insertion into the RECALL buffer.

Two further notes on INQUIRE and the RECALL buffer: If you're using a DCL procedure to obtain a password and think you're safe by setting the terminal to NOECHO prior to doing the INQUIRE . . . Sorry! INQUIRE still sticks the data in the RECALL buffer, where it's quite readable. In these instances, use the READ command as described above. You know what they say . . . "INQUIRing minds want to know."

While there's no way to clear the RECALL buffer from DCL, Gerald Soo of Shared Medical Systems, Malvern, Pennsylvania, reported on ARIS that a MACRO program, FLUSH.MAR, is available on one of the 1986 DECUS tapes to perform this function. The program resets the command pointer to the beginning of the buffer, in essence making the commands that follow it inaccessible. Mr. Soo says the program "works quite well" and also is fast.

(Late news: Ms. Maytrott reports that FLUSH.MAR is on the DECUS VAX86A tape, in the [.BATTELLE] subdirectory. It was written by Mark Oakley of the Battelle Memorial Institute.)

Steven Texin, systems group manager of Boston Systems Office (BSO) raised an important issue which we haven't covered here: namely, methods of optimizing DCL code.

"I'm always very appreciative of the style used in documenting your DCL command files," Steven said. "They're not written for maximum performance under DCL, however, and I wonder if your readers realize that. It's quite impossible, of

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course, to write DCL routines that are both self-documenting and execute at maximum efficiency."

He's come quickly to the point of a major problem faced by all who write "instructional" software. To obtain optimum speed, especially in an interpreted language like DCL, it's necessary to eliminate all comment lines from within the active body of the code, structure the procedures so that infrequently used lines are well out of the main processing loops, use compound statements and limit the size of symbol names.

> ***"To obtain optimum speed, especially in an interpreted language like DCL, it's necessary to eliminate all comment lines from within the active body of the code. . . ."***

If this is done, however, the resulting command procedures are fairly indecipherable to all but the most advanced readers.

Steven's site makes a practice of keeping two versions of command files: one version containing full comments, another stripped down to the bare bones for speedy execution. It's an important point and I thank him for raising it.

As always, reader comments are welcome. For the fastest response, please leave your messages on ARIS — you can be assured they'll be seen not only by me but by the many DCL gurus who lurk constantly in the background. ARIS is free, except for the cost of the phone call. Make certain you have the mailing label from your *DEC PROFESSIONAL* when you call; only *DEC PROFESSIONAL* subscribers can access ARIS. The phone number is (215) 542-9458.

You also can reach me on the SYS$OUTPUT BBS, (412) 854-0511, FidoNet address 129/38. We're carrying the National VAX Echomail conference now, and frequently there are goodies in the VAX/DCL file area. I like to let users beat up on my .COM files and debug them before they appear here.

One recent addition was a TPU procedure by David Blanchard of Boulder, Colorado. Dave's utility translates the inverted question marks inserted by TPU when it encounters non-printable ASCII codes to EDT-like messages (<ESC>, <SUB>, etc.) It's a nifty utility and a sanity-saver for those irritated by TPU's non-communicative tendencies.

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Rex Jaeschke

Data Dictionaries And Zero-Sized Objects

Editor's note: The term data dictionary smacks of academic jargon. However, given the locations and different storage classes of objects provided by C, and the potential naming conflicts when interfacing with layered products, the concept of a data dictionary, at least for externals, is valid and quite necessary for any significant-sized C project. As well as discussing this idea, Mr. Jaeschke revisits a topic from his previous column and expands on it further.

Pick up any text on structured design and you'll see a discussion of the merits of a data dictionary. Stated briefly, a data dictionary is a list of names of objects along with their attributes. Typically, it is maintained, or at least displayed in various sorted orders, by name, type, size, etc., so items can be found quickly.

Apart from locating the definitions of existing objects, a data dictionary is also useful for creating new object definitions, particularly when choosing a new object's name. Obviously, it can't be the same as any existing object — that would be ambiguous and should generate a compile-time syntax error. You also may have designed a variable naming convention that allows for future and easy extension. After all, how many times have you known the names of all objects at the beginning of a project? Most of the projects I have seen don't even have such a list after the project is completed (but then I guess the project isn't really "complete").

The idea of a data dictionary can be applied to both internal and external objects (which in C are named using identifiers). The scope of internal identifiers is limited to a function or, at most, a source file. So, if you keep your functions small (in a modular fashion) and use the one-function-per-file approach I suggested earlier, there is less likelihood that more than one person currently will be working on a source file. Therefore, there is less chance of naming conflicts. The problem is more serious with externals since they are typically visible across all files and functions. Therefore, on a multi-person project, they must be dealt with by multiple programmers, and any change in an object's definition or name can have a dramatic impact on other programmers' existing and tested code.

In my recent columns on style, I suggested that all external definitions should be placed in the same file (perhaps in the one containing **main** since that would be a predictable location). Then all programmers would know where to find their attributes and initial values, if any. The corresponding set of declarations should reside in a header (possibly of the name **extern.h**). In any case, if you adopt these simple rules, an external data dictionary is generated as a side effect of your coding style. By doing so, you reduce and possibly eliminate the need for a separate written document. Why not put any related documentation in a comment in the external header? In this way, the header becomes the design document.

Just what should be in our data dictionary? Well to begin with, let's state what can't be there, or at least what is potentially reserved. (You might want to add reserved object entries and give them the "reserved" attribute just so the list is complete.) The keywords of C are reserved and cannot be used as identifiers; given that C is case sensitive, it is strongly suggested you *not* use their uppercase equivalents as identifiers. (Ditto for any perverted mixed-case versions such as **Double**, **DoublE** and **Main**.)

All of the standard function names, macros and derived (using **typedef**) types, such as **printf**, **NULL** and **FILE**, are reserved effectively. If you substitute your own definition for any of these, you're on your own (and non-ANSI conforming).

Since the proposed ANSI Standard is approaching acceptance and it adds several new keywords and many new macros and library functions, you would be well advised to reserve these identifiers ahead of time. (A list of these was published in my column on "The Run-Time Library — Part III" in Vol. 5, No. 8, August 1986, and in Chapter 11 of *Let's C Now*, Volume II.)

Then we have identifiers reserved by, or provided as extensions by your compiler. For example, **VAX**, **vax**, and **vaxc** all may be predefined macros in the VAX C compiler. Add to that all the identifiers used by any layered products such as FMS, DECnet and RMS and you'll have a sizable list. This last action may cause some grief, particularly if the layered products come from different sources or from sources that don't communicate with each other or at all. Since there is no way to protect or reserve external name space within C, it is likely that if you use three or more sources of headers you'll have the same name used for different objects, and this may not show up at compile-time. The compiler quietly may compile your code using the wrong definition — all the more reason to compare new library identifiers with your existing data dictionary so you can determine whether such conflicts exist. (If they do, you will have to change one of the headers and keep on changing it with each release of the product.)

Back to what you should put there yourself: certainly a list of all the external identifiers and macro names you have

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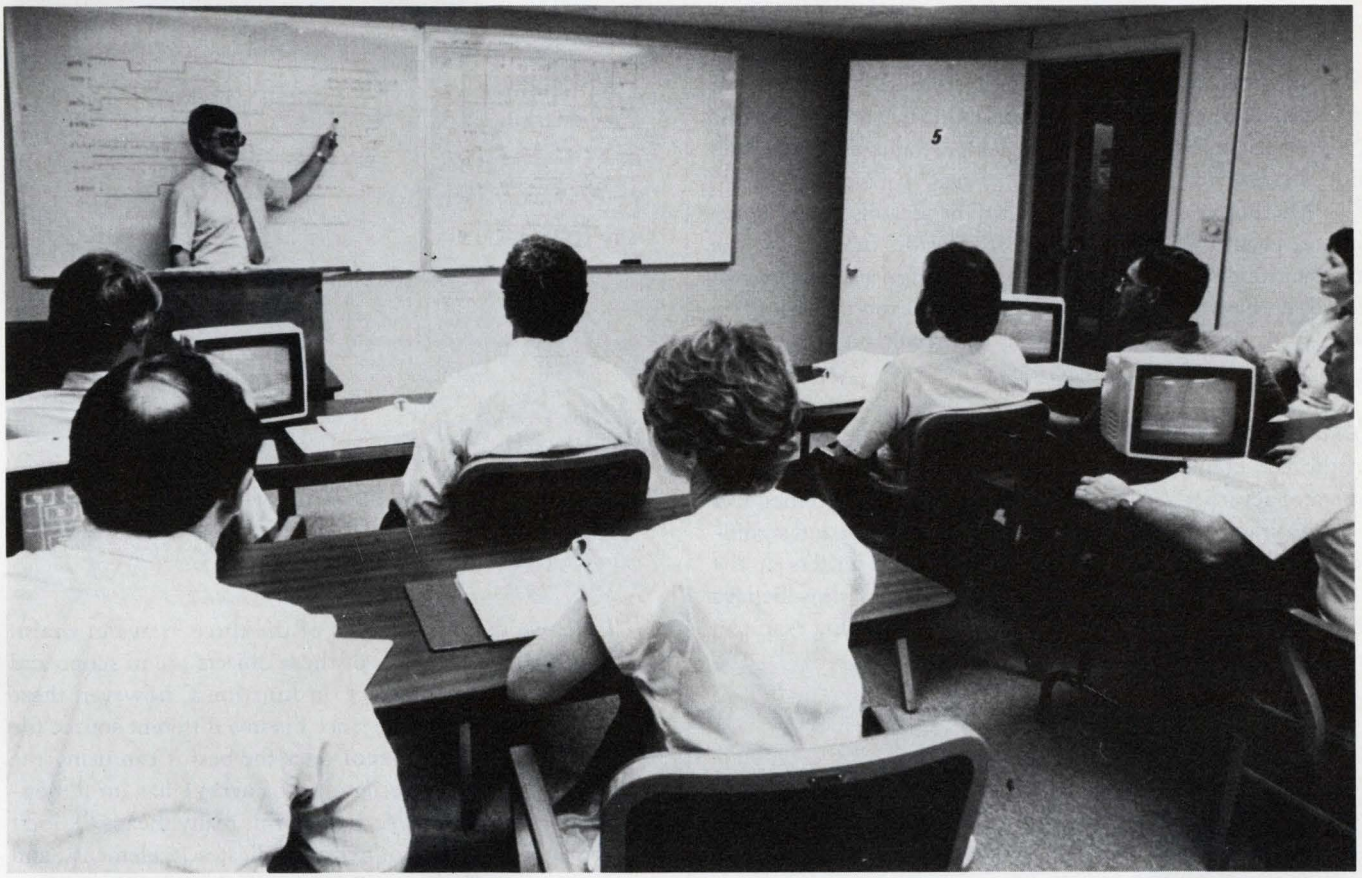

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invented. (External identifiers include both variables and function names.) Keep in mind that the character set, case and length externals may be limited by your linker, assembler or object module librarian. You also should establish spelling rules regarding the use of case and underscores. And don't use leading underscores, since that namespace typically is reserved for compiler and library implementers.

Finally, assign attributes to all of the objects. These include data type, size (if an aggregate) and class. (For externals, the class dictates the object's scope and life.) Apart from the supported classes, objects may reside on the heap, so that's another "class" alternative.

ONE FINAL COMMENT about having internal data dictionaries. If you invent an internal identifier and it has the same name as an external, then if both are in scope, the internal one will hide the external one, yet you may need to access both.

Whether you want to formalize the idea discussed above or not, eventually you will need to decide, or discover the information listed. Instead you should design a little better so you don't have to program defensively and run the risk of an unknown amount of trauma that can result only in poorer quality assurance and project delays.

Zero-Sized Objects

In the last column, we saw several cases where the **sizeof** operator returned a size of zero. At the time, this seemed like a reasonable result. However, after further thought and significant discussion with a number of compiler writers at the December 1986 ANSI C Standards meeting, I now believe those cases are syntax errors. Consider the following example:

```
/* sizeof(array of unknown size) */

#include <stdio.h>

main()
{
        static char (*aptr)[];

        printf("sizeof(*aptr) = %d\n", sizeof(*aptr));
}


sizeof(*aptr) = 0
```

As I discussed last month, **aptr** is a pointer to an array of characters where the actual size of the array pointed to is unknown. Since **aptr** points to the array, ***aptr** is the array. If the size of that array is unknown, then how can **sizeof(*aptr)** be zero? While all of my compilers returned zero, several senior ANSI C members assured me that a syntax error should have been produced — that's what their compilers do. The value zero in this case really means "I don't know the object's size."

Let's look at a more common situation in which array dimensions are omitted — in external array declarations:

```
/* sizeof(external arrays of known and unknown size) */

#include <stdio.h>

char array1[20];
char array2[10];
char array3[15];

main()
{
        void f();

        printf("---- function main ----\n");
        printf("sizeof(array1) = %d\n", sizeof(array1));
        printf("sizeof(array2) = %d\n", sizeof(array2));
        printf("sizeof(array3) = %d\n", sizeof(array3));

        f();
}

/* f.c */

#include <stdio.h>

extern char array1[];           /* unknown size */
extern char array2[10];         /* correct size */
extern char array3[12];         /* wrong size */

void f()
{
        printf("\n---- function f ----\n");
        printf("sizeof(array1) = %d\n", sizeof(array1));
        printf("sizeof(array2) = %d\n", sizeof(array2));
        printf("sizeof(array3) = %d\n", sizeof(array3));
}


---- function main ----
sizeof(array1) = 20
sizeof(array2) = 10
sizeof(array3) = 15

---- function f ----
sizeof(array1) = 0
sizeof(array2) = 10
sizeof(array3) = 12
```

Here, we display the sizes of the three arrays in **main**. In this case, the definitions of these objects are in scope and the sizes returned are correct. In function **f**, however, these definitions are not in scope since **f** is in a different source file from **main**. Therefore, **sizeof** does the best it can using the declarations. Since the declaration of **array1** has no dimension, **sizeof** returns zero. As before, this really means "I don't know." The declaration for **array2** indicates 10 elements, and that's what **sizeof** reports. For **array3 sizeof** returns 12.

Note, however, that the actual size of **array3** is 15. By declaring **array3** with a different size, we have introduced the possibility of a bug. Since **sizeof** takes as gospel any **extern** array dimension we provide, we must be careful not to define one thing in one place and declare it differently in another. The rule then, is either to omit the dimension in a declaration or to state it correctly, and if you adopt the latter approach you better place the declaration in a header so you don't run the risk of having different declarations. Actually, the dimensions in array declarations usually are omitted (in multidimensional arrays, the first dimension only often is omitted). The only case I can think of in which it is useful to have the dimension is in the use of **sizeof**.

The above discussion only holds true for external array declarations. It does not apply to arrays in formal function

argument declarations as shown in the next example:

```
/* sizeof(arrays as formal arguments) */

#include <stdio.h>

main()
{
        void f();
        char array11[20];
        long array12[10];
        double array13[15];

        printf("---- function main ----\n");
        printf("sizeof(array11) = %d\n", sizeof(array11));
        printf("sizeof(array12) = %d\n", sizeof(array12));
        printf("sizeof(array13) = %d\n", sizeof(array13));

        f(array11, array12, array13);
}

void f(array11, array12, array13)
char array11[];             /* unknown size */
long array12[10];           /* correct size */
double array13[12];         /* wrong size */
{
        printf("\n---- function f ----\n");
        printf("sizeof(array11) = %d\n", sizeof(array11));
        printf("sizeof(array12) = %d\n", sizeof(array12));
        printf("sizeof(array13) = %d\n", sizeof(array13));
}


---- function main ----
sizeof(array11) = 20
sizeof(array12) = 40
sizeof(array13) = 120

---- function f ----
sizeof(array11) = 4
sizeof(array12) = 4
sizeof(array13) = 4
```

In this case, the dimensions of the formal arguments are completely ignored since arrays are passed by address. Therefore, the three arguments are *** char**, *** long** and *** double**, respectively. As such, sizeof returns the sizes of these pointers, which on most 32-bit systems (and in Intel's large data pointer models) is 4 (as shown).

The proposed ANSI C Standard does not allow zero-sized objects, so it seems reasonable that **sizeof** never should return a size of zero. Rather, it should warn us that we are attempting to use the size of an object whose size cannot be determined.

If you need more evidence of the potential for confusion, let's look at one last example:

```
/* sizeof(array element of array with unknown size) */

#include <stdio.h>

char array1[20];

main()
{
        void f();

        g();
}

/* g.c */

#include <stdio.h>
#define NUMELEM sizeof(array1)/sizeof(array1[0])

extern char array1[];

void g()
{
        int i;

        printf("sizeof(array1)    = %d\n", sizeof(array1));
        printf("sizeof(array1[0]) = %d\n", sizeof(array1[0]));

        for (i = 0; i < NUMELEM; ++i)
                printf("%d\n", i);
}


sizeof(array1)    = 0
sizeof(array1[0]) = 1
```

Surprise. We have an array whose reported size is less than one of its elements. That is, the sum of the parts is much more than the whole. **NUMELEM** is set to 0/1, which is zero. Consequently, the **for** loop is never executed at all.

I plan to submit a formal paper to the ANSI C Standard's Committee to get this clarified, just for the record. I'll keep you informed of the results, as appropriate.

Reader Mail

Dear Rex,

My company is involved in developing software for the automation of large sales forces through a combination of IBM-PC compatible laptop machines networked into DEC PDP-11/73 minicomputers. We currently are using Whitesmiths' native C compiler V2.2 on RSX-11M-PLUS V2.1, and plan to upgrade to its new V3.0 compiler.

Our experience with the Whitesmiths' compiler is generally a favorable one, except that it is unfortunate from our viewpoint that Whitesmiths decided long ago to go off in its own direction in terms of the functions it provides. It is finally, in its new version, providing functions compatible with the proposed ANSI Standard, although existing customers still will face a conversion effort to use them.

One thing that I find virtually unacceptable, though, about the function support in the new version is the size of the code that is pulled into each executable task to support its emulation of the UNIX-style I/O. I've found that a program with only a blank main is 28 KB in size! Given that task space limitations on the PDP-11 are a bottleneck, this hurts. Even if you want to use printf, for instance, and have no desire to do anything but write to a terminal, all that overhead is still pulled in because of the possibility of redirection to a disk file.

There also are some syntax compatibility problems between V2.2 and V3.0, which are, at this point, undocumented by Whitesmiths. It looks like changes were prompted either by the proposed ANSI Standard, or to some new interpretation of K & R.

Here is Whitesmiths' reply:

We appreciate the reader's "generally favorable" reaction to our RSX-11M C compiler. He dramatically can reduce his program size by renaming his main function **__main** *instead of* **main**. *This avoids*

pulling in the code for command-line parsing and I/O redirection.

We have tried to document all language and library changes made to comply with ANSI, but there is always room for improvement. P. J. Plauger, president

I also would like to add a few comments. There is some interesting history regarding the fact that Whitesmiths' library is different from that of "standard" or UNIX C. When Whitesmiths became the first vendor of commercial C compilers there was no library standard, so it set out to build one. Whitesmiths did a good job, too — its own library is quite comprehensive and is uniformly supported in all its (many) hosted compiler environments. The library design was perhaps the first real attempt at providing a portable library environment. Whitesmiths was, and still is, the C vendor most experienced and interested in porting C code.

WHEN AT&T finally put together UNIX Version 7, it defined what was to become known as the "standard C library." This has formed the basis of most current compiler libraries and that of the proposed ANSI Standard. Despite Whitesmiths' early lead, it was not able to establish a de facto library standard and, considering that AT&T practically was giving UNIX (and C) away until recently and many thousands of college students received exposure to that and later releases, AT&T's version eventually won out. However, by that time Whitesmiths had established a customer base that depended on its library, plus I'm sure part of that library was designed specifically for its port projects, in which case the same functionality may not have been available from AT&T's library. And, of course, this all happened before C's popularity skyrocketed, so who is to say which approach was better?

Whitesmiths' V3 compilers all implement much of the proposed ANSI library and its new manuals are improved, particularly the most recent typeset version for the IBM 370-class machines. (Expect this typeset manual to be adopted to its other implementations.) Certainly, there will be some effort involved in changing from Whitesmiths' own library to that of the ANSI Standard, but that's life. Just when we get used to something and we start to use it effectively, along comes a newer and better idea. Economics dictate that vendors can support the old ways for just so long.

In any event, many of the UNIX C library routines could stand to have more descriptive names, changes in argument lists and better error handling. However, due to the huge amount of code that depends on them, warts and all; the ANSI Standard can only consolidate the existing library, it can't change it. Any new or different capability can be provided only through new functions. For example, fseek cannot handle very large files, so rather than change its argument types to handle bigger file positions (and break much existing code), the new functions fgetpos and fsetpos were added.

The C world is far from a perfect place but the proposed ANSI C Standard cleans it up considerably. Whitesmiths has been involved heavily in the standardization process from day one. P.J. Plauger serves as secretary of the ANSI committee and few, if any, have contributed more to the cause of C, since Ritchie designed the language. Considering Plauger is also the president of a large (and growing) company with international affiliates, it is difficult to see how he can keep his contribution so large.

In The Pipeline

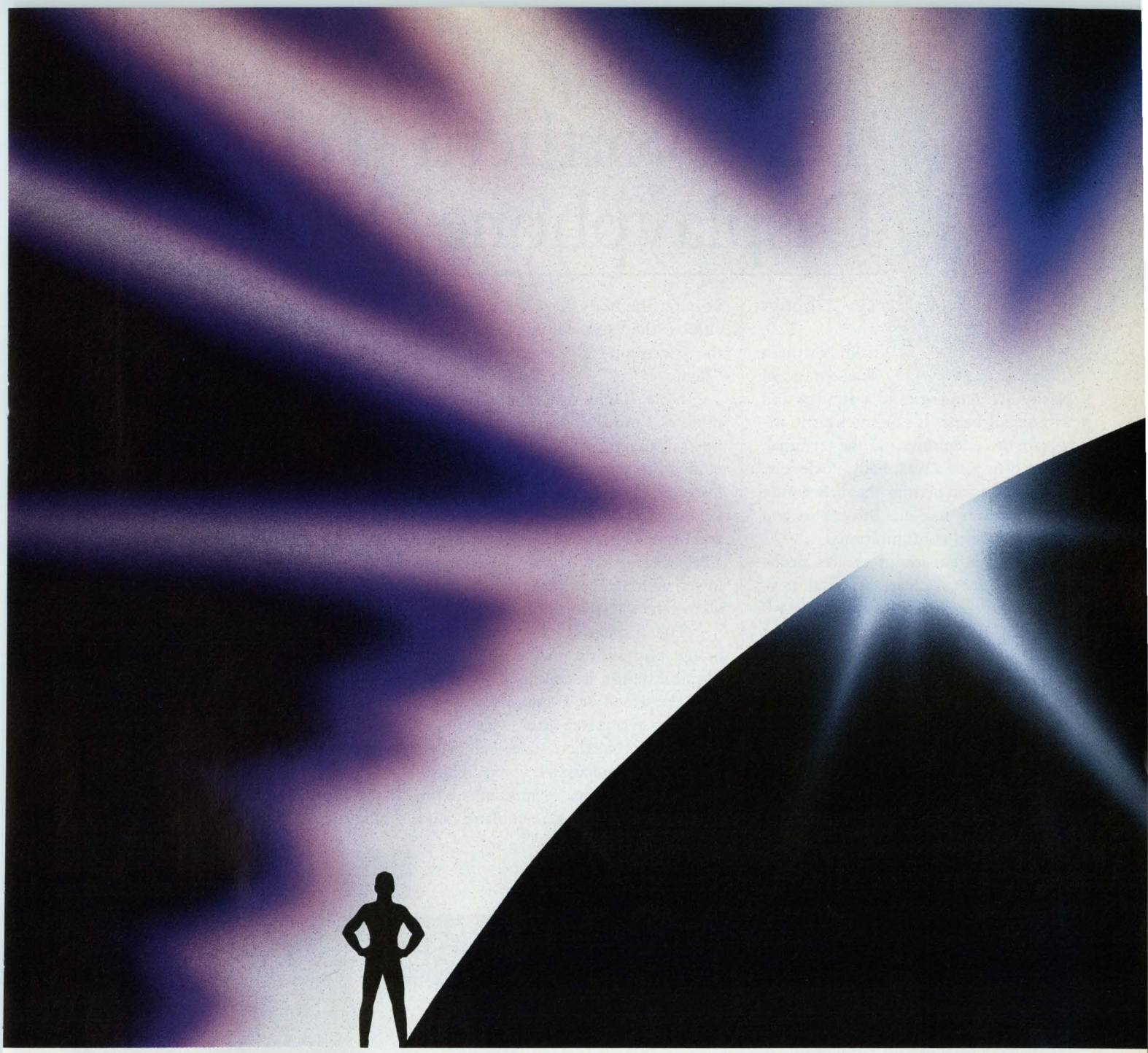
Previously, I've indicated the next month's topic at the end of each column. Lately, though, I've gotten sidetracked with extracurricular activities and reader mail and my projections have been delayed. So, rather than make any promises, I'll list the things currently in the pipeline.

I've received a copy of the DECUS C compiler and documentation set and plan to install and test it before I write the next column. By then I also should have Whitesmiths' V3 compiler for the PDP-11. Note that since that compiler supports much of the proposed ANSI Standard, it is bigger and no longer fits into 64 KB. Whitesmiths made the difficult decision to have the compiler itself use both Instruction and Data (I/D) space, allowing up to 64 KB of each, plus 64 KB if supervisor mode libraries ever are used. While this will allow the compiler to grow in the future it severely restricts its host machines. To the best of my knowledge I/D space is only available on more recent PDP-11 family members. It certainly isn't part of the 11/23, 11/23+ and 11/34 processors. Also, I believe the new release will run only on RSX-11M-PLUS. No more RSX-11M, RSTS or RT-11 upgrades, since they don't support I/D space (correct me if I'm wrong).

I have a set of the field test manuals for DEC's VAX C V2.3 that should be released by the time you read this. I've been waiting to discuss this compiler until this release came out. Now the ball is in my court. I'm also considering the possibility of having one of the VAX C developers contribute to a future column.

Last, I have taken delivery of my very own VT220, amber screen and all. I have been using a VT241 for some time, along with VT100s, and I plan to write an article or two on handling the various escape and control sequences generated from within C. (Back in September 1984, I showed how to access some of the VT100 capabilities using a set of C functions. This material became Chapter 5 in *Let's C Now*, Volume I.)

Readers are encouraged to submit any C-related comments and suggestions to Rex Jaeschke, 2051 Swans Neck Way, Reston, Virginia 22091. — *Rex Jaeschke is an independent consultant, author and lecturer and a member of the ANSI X3J11 standards committee for C.*



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The Northern Telecom Displayphone 220

The Displayphone 220, from Northern Telecom Inc. of Nashville, Tennessee, is a strange and wonderful beast. It's an attempt to integrate the telephone and the terminal, and still fit into a reasonable enclosure. This integration permits the inclusion of many features, like dial directories and stored modem configurations.

The size constraint creates problems, however, at least as far as keyboards are concerned. Every trade-off has its up side. The up side here is that the amount of desk space used is minimal.

I'm writing this article on the Displayphone in order to become accustomed to it and to prevent snap judgments. I get used to terminals and keyboards quickly, and my initial reactions usually fade as the underlying design niceties emerge. (My initial reaction here was that the keyboard is too small and doesn't have a nice feel.)

Looking at the photo, you'll see that there is a set of PF1-4 keys on the body. The telephone keyboard will double as the numeric pad on the VT220, but the numbers are *inverted*! If you have an EDT keypad imprinted on your cortex, you'll have to stand on your head!

Also missing are the other keypad keys — the period, the comma and the minus sign.

Lo and behold, the asterisk is the period; i.e., the Select key in EDT. The keypad number sign key is the comma (or Delete key in EDT). The Delete key does the minus sign work (delete word). The PF4 key still deletes the line. The keypad zero is the same as ever.

In this emulation, five of the 10 soft keys on the body have been preset to emulate the VT220 editing keypad, with the exception of "Insert Here" and "Remove."

Now I find that, after only five minutes, I'm already getting used to this new arrangement. This gives me the courage to explore some of the other features. Over to the right side of the keyboard are the Break (F5), Remove and Insert keys from the edit keypad and a Print Screen key. The arrows are in the lower right hand of the keyboard, mimicking the VT200 location more or less.

The display is easy to like. The orange phosphor is easy to read and the physical design is striking.

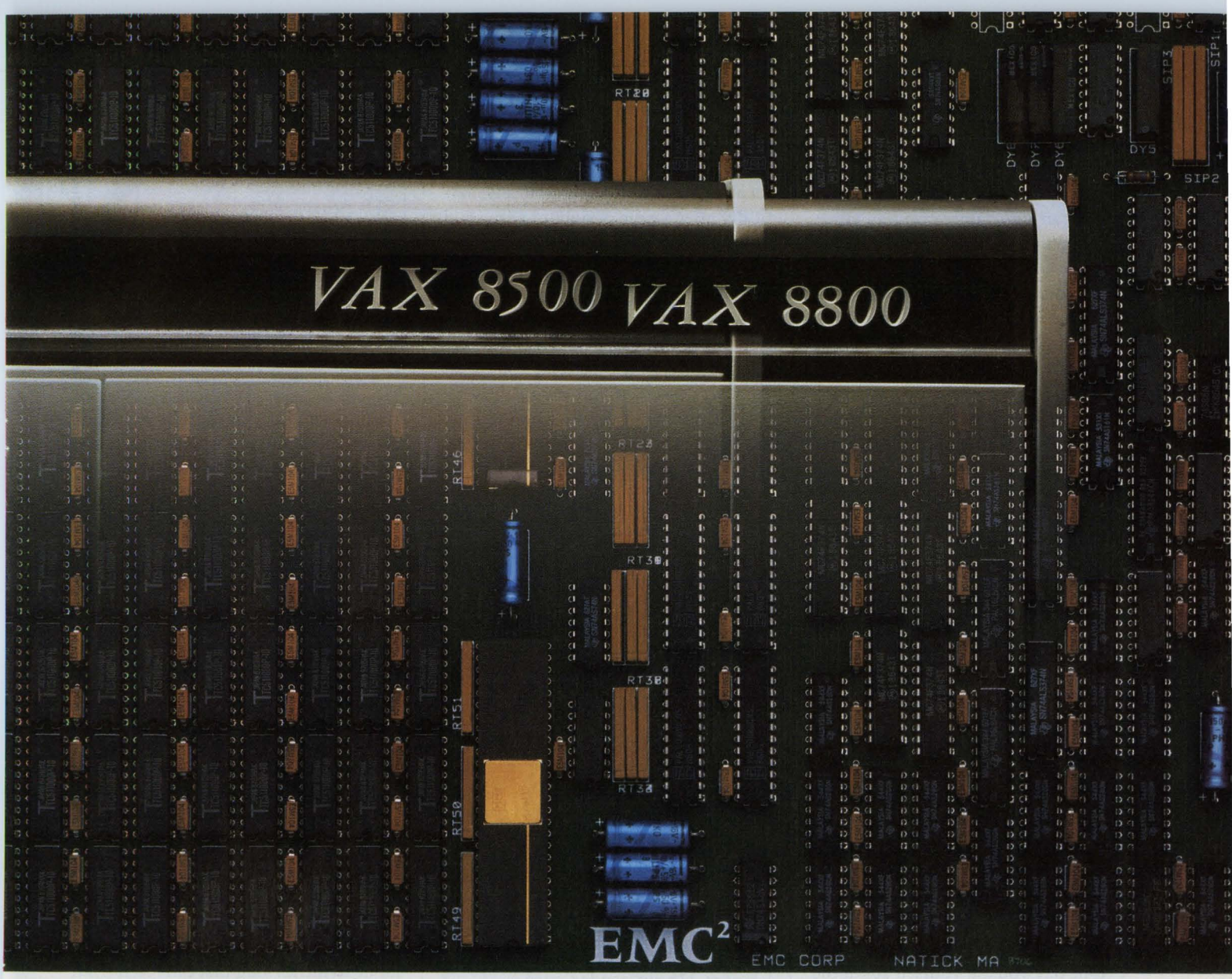
The telephone is integrated deeply into the terminal. (Just what you'd expect from Northern Telecom!) When you pick up the handset, you're in business, no matter what's happening on the screen. The current screen blanks, and a dialing screen appears. There's an independent call timer on the screen in addition to the clock-calendar. You can recall the working computer screen by pressing the Screen key during the phone call.

Dialing can be accomplished in many ways. The easiest way is to dial from the touch tone pad. The terminal has a "recall list" that you may add any manually dialed number to by using a soft key.

There's a two-layer directory structure in the terminal, accessed from the Directory key. The first level is a "main menu" of "types" of calls, and there is a 10-entry screen for each entry on the first level.

You simply divide your phone directories into major categories: personal, vendors, salespersons, etc.; use them as the entries in the high-level directory; and then fill in the numbers in the cor-

The Displayphone 220 handles both voice and data calls at the same time. You can access your database, and view or even enter information all while talking to your client.



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EMC² The System Enhancement Company

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responding low-level screen. Each number optionally carries a full set of modem specs (speed, parity, etc.), or the number can be characterized as voice. One entry should be set up as local, and will cause you to connect out the serial port to your local machine.

To use it, select the Directory key, then one digit for each level of the index. Dialing is immediate and automatic.

Individual pages of the directory can be password protected. That's a good feature because there's no other protection for the directory data you store. Northern Telecom might consider a "session login" screen for overall security. It could reset itself automatically after a time period, or at the end of an eight-hour period.

There's another nifty feature: a calculator. You access it by pressing the Services key and selecting Option 1. It's a simple four-banger, but very accessible. You can flip back and forth between your active screen and the calculator.

After an hour or so, I found that the keyboard is only a minor problem. My advice is, try it. I have no doubt that this terminal would be perfect for an executive whose computer use is limited and whose desk space is at a premium.

Displayphone 220
Northern Telecom Inc.
200 Athens Way
Nashville, TN 37228
(615) 734-4251

Price: $1,095 with modem; $895 without.

Enter 746 on reader card

FROM THE LAB-#2

Dave Mallery

The MXV50 Disk Controller

These days a MICROVAX II often grows up to be a real machine. The process usually starts with a big disk and its own controller, then, maybe a bigger terminal interface, a real tape drive, etc.

One day you ask yourself about the RDxx drive that's still sitting in the box. You haven't accessed it in months but you're still paying Field Service exorbitant rates to "maintain" it. Not only that, but you're also paying to maintain the RQDXn controller.

Out they come, but there's a problem: One week later, you're trying to read a floppy and . . .!

A Simple Solution

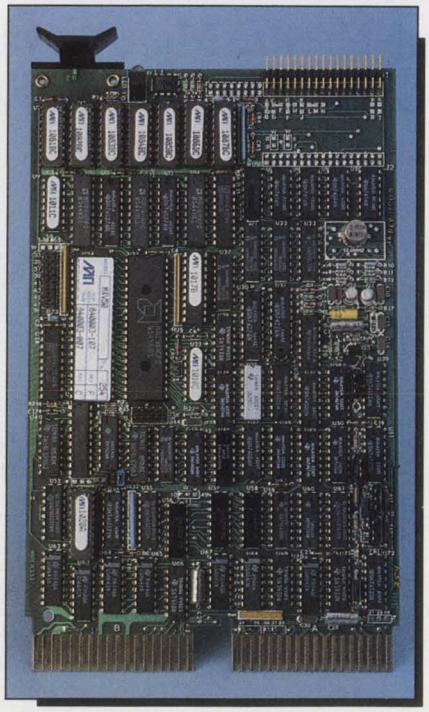
Remove both DEC pieces and send them down the hall to another MICROVAX that could use more storage. Pick up an MTI MXV50 dual floppy controller from Micro Technology Inc. of Placentia, California, and you're in business.

We installed one in our main MICROVAX. This machine has sprouted all of the obligitory big machine peripherals, but still needs the RX50 capacity to read articles sent into us in that format.

MXV50 Disk Controller
Micro Technology Inc.
1620 Miraloma Avenue
Placentia, California 92670
(714) 632-7580

Price: $965 each, $675 for quantities of 100 or more.

Enter 776 on reader card



Cabling for an RX50 is simpler than the standard lash-up for an RQDXn. The drive and the controller use a 34-pin cable connector. All you need is a cable about 18 inches long that can reach from the card cage back underneath the backplane and out to the drive. All the distribution panel nonsense can be skipped.

The controller, as shipped, is set up for Shugart drive compatibility. The cables we received were of the Shugart (34-pin edge connector) persuasion. To convert to true RX50, you must cut a jumper on the etch side of the board. This is located easily with the configuration card supplied with the manual.

I configured the controller to be the DUB (second) device.

Up it came.

Our floppies now are DUB0 and DUB1.

Simple.

Unassuming.

Neat!

FROM THE LAB-#3

Dave Mallery

ABLE's Muxmaster

A new data distribution system from ABLE Computer of Costa Mesa, California, the MUXMASTER has several slick features.

First, you can distribute your terminals *and* line printers anywhere within a total of 4,000 feet using only inexpensive shielded twisted pair cable. (That's one twisted pair and a ground!) Unless you have to run in a plenum with Teflon, your wire cost is minimal. There are two connectors on the distribution panel. You may attach up to 2,000 feet of copper wire to each. Optionally, ABLE has a fiberoptic link modem pair that can take you 6,000 feet before you have to start the copper wire. At the end of each cable you place a connector with a 260-ohm terminating resistor. In our installation, one of the two connectors is terminated right on the distribution panel, and the other at the first and only cluster controller.

The MUXMASTER has both Q-bus and UNIBUS interface cards. We evaluated the Q-bus version on our MICROVAX. The installation is trivial because there are no switch settings or jumpers. The distribution panel for up to 128 ports is a pair of simple DB9 connectors, which is refreshing. Rear panel space on any MICROVAX is always at a premium.

I said there were no switches or jumpers on the interface card. That's because you do all the setting from a little menu on the first cluster controller. The inevitable dip switch actually is located on the rear of the controller. You activate the configuration program by setting the number eight switch and hitting RETURN so the unit can autobaud your terminal (plugged into port zero). This menu-driven conversation is held just once and can be done from port zero of any convenient cluster controller (with the machine halted).

Each cluster controller box has 16 ports. The unit emulates DHVs, so the first 16 ports are TXA0: through TXB7:. We've tested them both as local terminals and for modem control, and we had no difficulties in either mode. We used the cluster controller on the MICROVAX at our DEXPO booths several times. The unit traveled across the country as checked baggage, came out of the box and worked. It then went back to Pennsylvania the same way and worked perfectly again.

In addition to the 16-port cluster controllers, ABLE also features a remote printer controller. This little unit can be located anywhere on the cable. It has a parallel printer connector on the box, but when the computer sees it, it just sees another DHV port. The box handles the parallel-to-serial conversion.

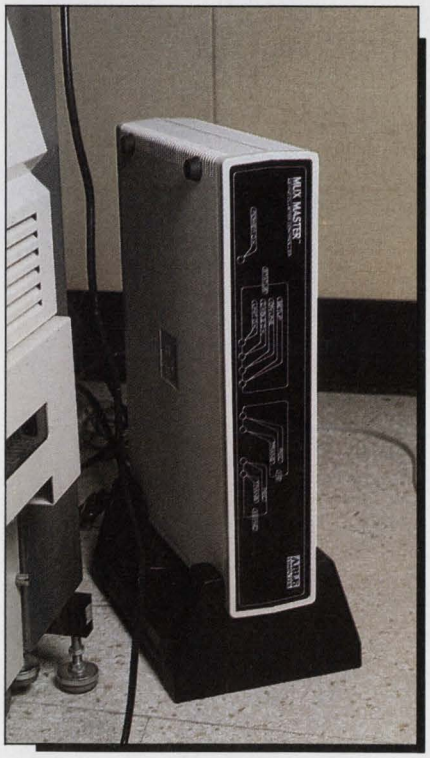
There are a number of things that the MUXMASTER will not do. It's not a switch. You only can have a single computer in the network. There is a limited switching option that works within a single controller only — you can share local printers and such that way.

What MUXMASTER does provide is an economical distribution medium for large buildings and small campus environments. It's an almost brainless installation, and has proved rugged over the several months we've been testing it.

MUXMASTER
ABLE Computer
3080 Airway Avenue
Costa Mesa, CA 92626
(714) 979-7030

Hardware Environment: Available for DEC Q-bus or UNIBUS systems. System includes host module (Q-bus or UNIBUS), cluster controller (eight or 16 line), power supply, 25-foot composite link cable, set labels for customer terminal, cable ID and cluster controller ID.

Price: $3,750 for the 16-line unit with host; $2,800 without host.
Enter 779 on reader card



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You're free to configure and improve system reliability.

Whether you attach to the VAXBI via the KDB50 or to your VAXcluster via an HSC50/70, the SMDI allows you to choose industry standard disk drives that have field proven reliability statistics in excess of 30,000 hours MTBF.

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Or write, Emulex Corporation,
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P.O. Box 6725,
Costa Mesa, CA 92626.

EMULEX

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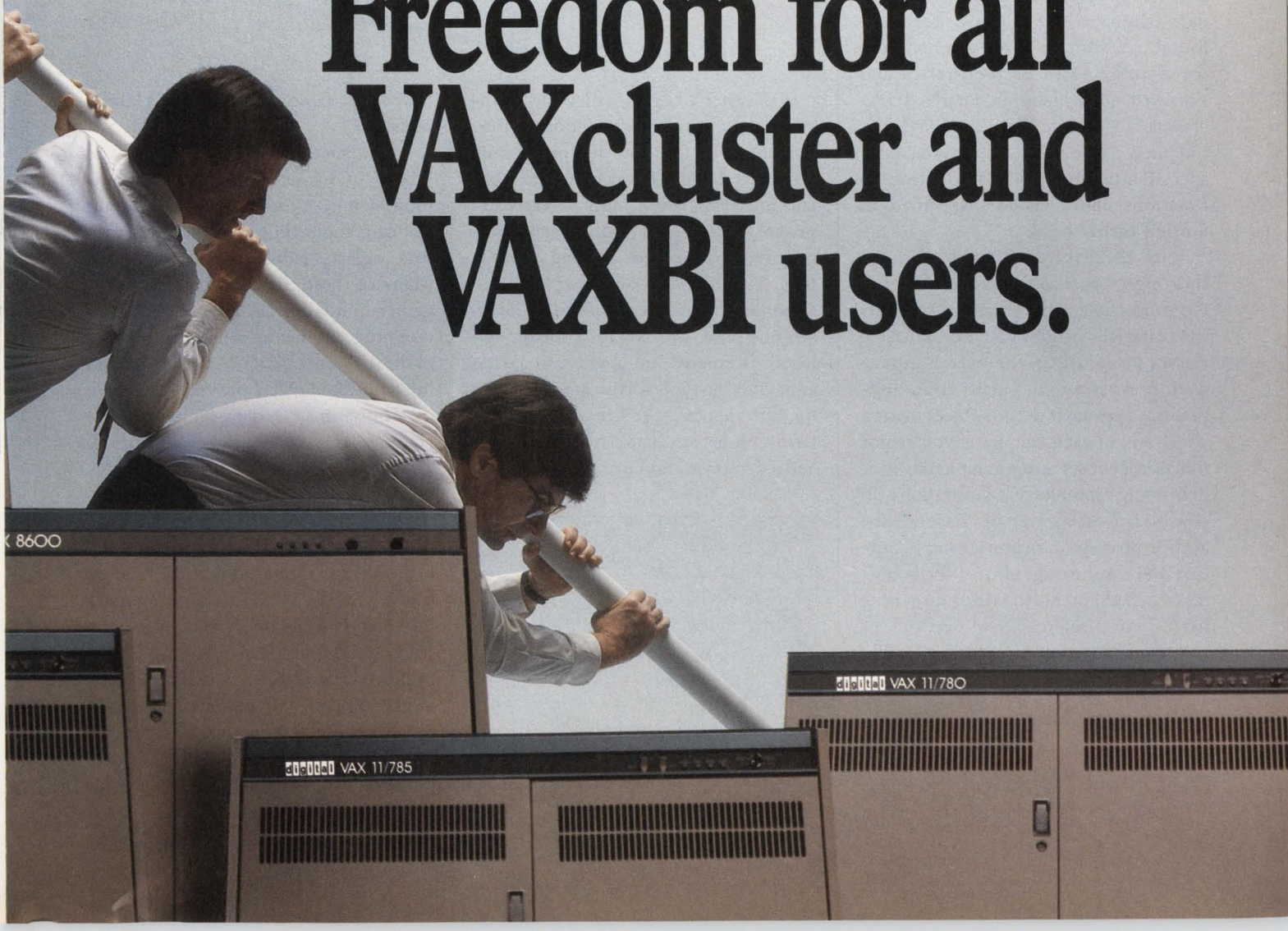


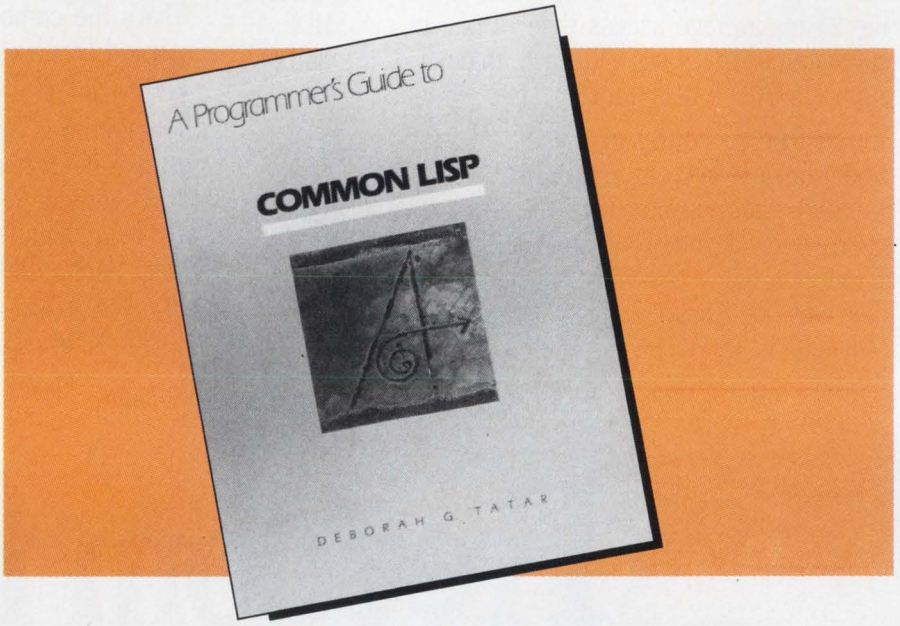
COMPUTER BOOKSHELF

R.B. Trelease, Ph.D.

A Programmer's Guide To Common LISP

Common LISP has become a de facto standard implementation of the LISP language for conventional (non-AI, non-LISP machine) computers. Digital Equipment Corporation has supported AI developers by distributing VAX COMMON LISP, and Gold Hill's GOLDEN COMMON LISP is available for compatible PC systems. Guy Steele's *Common LISP: The Language* (Digital Press, 1984) has proved to be a vital part of the complete documentation for these software packages. Steele's volume provides a comprehensive description/specification of the standard language but, as many users have found, it's difficult to use as a textbook for learning LISP. As the Preface and Forward note, Deborah Tatar's *A Programmer's Guide to Common LISP* was intended to be such a textbook, with special attention paid to adhering to functions and behaviors specified in Steele's earlier book.

In 12 chapters, Tatar provides a thorough, methodical overview of Common LISP programming. As befits the material's origins (Tatar taught LISP classes inside DEC), the overall organization stresses an instruction-and-practice approach to the subject matter. The body of each chapter covers major functional concepts, with numerous programming examples and illustrations. To consolidate each group of "lessons," the author provides a major concepts outline and a summary of new form syntax. Each chapter also winds up with a list of cross-references to sections of Steele and a group of exercises testing subject material comprehension.



Chapter 1 begins with a fairly conventional general introduction to fundamentals of LISP and list processing. Chapters 2 and 3 cover LISP data types and their evaluation, with an early exposure to CONS cell notation and a progressive approach to writing procedures. Variables are covered at length in Chapter 4, with examples of binding, scoping and the use of globals and locals. Recursive and iterative functions and PROGN-type forms are treated in the fifth chapter, together with a presentation on lists as data "tree" structures and a demonstration of a recursive solution to the famous "Towers of Hanoi" puzzle.

"Interactions With The Outside World" (Chapter 6) introduces Common LISP I/O functions for user input, printing, input type conversion, stream data objects and disk file handling. Many of these elements are drawn together in a fairly complex demonstration program that implements a version of the (by now classic) "Animals" guessing game. Chapter 7 provides coverage of Common LISP data structures, including association and property lists, arrays, vectors, hash tables and structures as well as examples of their supporting functions. "Manipulating Procedures As Data" (Chapter 8) treats the use of the interpreter to evaluate expressions, with the introduction of lambda lists (nameless functions) and the demonstration of functions including EVAL, MAPCAR, MAPCON, FUNCALL and APPLY. Chapter 9 presents advanced constructs useful in the creation of larger

A Programmer's Guide to Common LISP
Deborah C. Tatar
Digital Press
Bedford, MA, 1987
352 pages, softbound $23
DEC Part No. EY 6706E-DP.
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**Dataquest 1985 mid- year terminal shipment update.*

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DP587

programs: optional arguments, "dynamic non-local exits," signaling errors, packages, multiple values and conventions for commenting (documentation). Culminating the discussion of advanced constructs is an extensive example program, FORM, a "toy" text formatter.

The final three chapters of *A Programmer's Guide to Common LISP* deal with program compilation, LISP macros and expert systems. The compiler discussion includes notes on using function and file code, as well as information on types of declarations (special, type, inline and optimization), their syntax and disassembly of compiled functions. The chapter on macros commences by examining the necessity and drawbacks of these forms, and it proceeds through examples of expansion, definition (DEFMACRO and DEFTYPE functions), backquote-comma syntax, macro-defining macros and a macro-defining version of DEFSTRUCT. As a central example of expert system programming, the twelfth and final chapter presents OTTO, a "toy" system for diagnosis of automobile engine problems. The discussion includes aspects of rule definition, inference engine control structures, tracing system performance and system strengths and weaknesses. Fundamental concepts and application-specific examples are covered, with full source code provided for OTTO system.

Tatar's book concludes with a brief, annotated bibliography, a compendium of solutions to each chapter's exercises, a general index and an index of procedures and macros as defined in the text. The modest bibliography provides major source references for various LISP dialects, AI surveys and the LISP-like LOGO language.

Overall, *A Programmer's Guide to Common LISP* is well-worded, engaging and readable. Some chapters seem a bit brief, but as the summaries show, they provide fairly inclusive coverage of a majority of COMMON LISP features and functions. More so than some other LISP texts. Tatar's book progressively builds on a set of practical programming examples. While Tatar does spend her

share of time on the requisite "FOOBAR" abstract definitions, the reader is shown how to solve mathematical problems, parse text and create expert systems.

At rare points, the otherwise concise text petrifies. For example, in illustrating the use of SETF for changing the value of *BOOKS-BY-HOMER* Tatar unleashes:

```
(defvar *books-by-homer*
  '(Aeneid Odyssey))
*BOOKS-BY-HOMER*

*BOOKS-BY-HOMER*
(AENEID ODYSSEY)

...

(setf (car *books-by-homer*) 'Iliad)
ILIAD

...

*books-by-homer*
(ILIAD ODYSSEY)
```

After a few minutes of searching around for the redefinition of *BOOKS-BY-HOMER* to *EPIC-NARRATIVES-BY-HOMER*, it occurred to me that the appropriate text probably been lost somewhere between the magtape and the typesetter!

Although *A Programmer's Guide to Common LISP* is not a (yawn) university computer sciences text, it does a good job of teaching the specifics of a useful language dialect. Tatar seems to have fulfilled her prefatory promise to deliver an introductory text for LISP beginners and sophisticated programmers alike. Furthermore, while the VAX and XCON get their mention in the text, Tatar's volume shows that Digital Press continues to produce quality, general-appeal books, not camouflaged DEC technical manuals. — *Reviewed by R.B. Trelease, Ph.D., a medical research scientist in California.*

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High 701 Medium 705 Low 709

RSX CLINIC

CHANGING POWER FREQUENCY

QUESTION: *I support RSX systems for both 50- and 60-Hz power. Must I do a separate SYSGEN for each system? Does RSX have a simple way to change power frequency?*

REPLY: It's fairly easy to change the power frequency for RSX. The number of clock ticks per second is kept in one place, a single word in SYSCM, an executive data area. Change the value of $TKPS. The following example changes a system to 50 Hz. It uses the SWSTK$ macro to switch into executive state before changing the constant. The task must be built privileged:

```
        .MCALL  SWSTK$,EXIT$S
START:  SWSTK$  10$
        MOV     #50.,$TKPS
        RETURN
10$: EXIT$S
        .END    START
```

Examine your application code. If you have hard-coded time intervals as a number of ticks, your time intervals now may be wrong. In an application such as yours, time intervals should be calculated based on the line frequency present in the system. For example, a .5-second interval should not be coded as either 30 or 25 ticks, but rather should be calculated when needed, as in the following example, which will work correctly on 60-Hz power systems. It will not be correct on 50-Hz systems:

```
MOV     #30.,R0
        ;half a second, in 60-Hz ticks
```

This example will be correct on any frequency power system, assuming only an even number of ticks per second:

```
GTIM$S #BUFFER
        ;get system time parameters
MOV BUFFER+G.TICP,R0
        ;get ticks-per-second
ASR R0
        ;now halve it.

BUFFER: .BLKW 8.
```

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.

LINE FREQUENCY CLOCK IS FLEXIBLE

QUESTION: *I have a KW11-P Programmable Clock on my system. Must I use the KW11-P as the system clock? Must I do a SYSGEN to put it in?*

REPLY: A KW11-P typically is used as a source of high-frequency, precisely timed interrupts for real-time applications. The use of a KW11-P as a system clock is optional. The *RSX System Generation Manual* correctly warns against use of a KW11-P as a system clock because it can swamp an RSX system if used at high clock rates; i.e., more than 1,000 interrupts per second. Use of a KW11-P as a system clock also would lock you into a fixed clocking rate, so it's probably not a good idea in general.

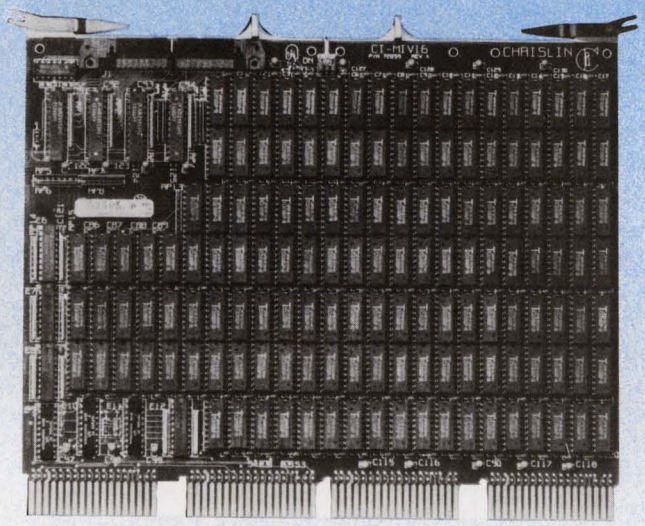
A more flexible design would be to use the line frequency clock as the system clock, and then write a task that connects to the KW11-P's interrupt using the CINT$ directive, so that the high-frequency interrupts are used just for your application. A fully worked out example is given in *The RSX Executive Manual*, in the section for the CINT$ directive. I have used a KW11-P only once as a system clock, and that was a case where the system power was provided by a diesel generator with an unstable line frequency. I installed the KW11-P as the system clock (yes, you must do a SYSGEN), but set it to generate 100 interrupts per second.

NO COMMAND LINE EDITOR

QUESTION: *Does RSX have a command line editor? We like the one in VAX/VMS, and miss it on RSX.*

REPLY: RSX does not have a command line editor at this time. I am told that a future release of M-PLUS will contain a command line editor, but no date has been set. Several command line editors exist on the DECUS RSX SIG tapes. My favorite is CLE, written by a programmer at the Mayo Clinic, Rochester, Minneota. It's on the Spring 1986 RSX Symposium Tape Collection, near the end of the tape. It saves the most recent 16 command lines and allows you to recall, edit, and reissue commands.

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



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SUBSYSTEMS

MICROVAX QBUS

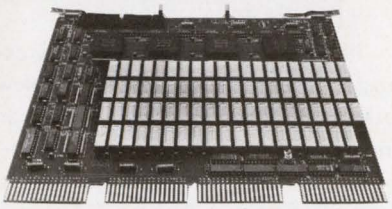
CI-1340 SERIES 168MB—900MB winchester with 8" floppy or tape backup.
CI-820 SERIES 20MB—150MB winchester with dual 8" floppy backup.
CI-550 SERIES 10MB—70MB winchester with 5¼" floppy backup.
CI-1220-TF: 2MB dual 8" floppy.

SYSTEMS

QBUS

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

CI-550



CI-MIV8-EDC

MEMORY

VAX

CI-VAX4: 4 megabyte error correcting for VAX 780/785.
CI-V53: 1 megabyte error correcting for VAX 725/730/750.

MICROVAX II

CI-MIV16/8/4: 16,8,4 megabyte parity modules.
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MANAGING YOUR MICROVAX

David's 'Yuppie Cluster' Grows Up

David W. Bynon

I've had a serious problem with the BA23 MICROVAX II systems I've installed recently: expansion. The BA23 systems have worked admirably for their original purpose but, as usual, more applications and more users have been added. The systems have reached their peripheral limit and, in two cases, their CPU limitations as well.

At this point I'm faced with two options: upgrading to larger systems (naw, too expensive) or expanding the current systems. You guessed it — I've chosen to expand with new storage and interface peripherals and, in the extreme cases, with additional CPUs.

My primary concern while implementing an upgrade is to remain 100 percent DEC compatible and DEC maintainable. That's not to say that I don't use third-party hardware; I do, as long as it fits seamlessly into the original DEC architecture and provides a more cost-effective solution.

Acquiring Extra Space

One of my biggest gripes is a computer system expanded in an ad hoc fashion, a disk drive here or a tape drive there . . . each addition in a separate expansion cabinet (or box), and each with its own menagerie of cables and wires. I dislike these systems with a passion, simply because they look like they've been thrown together without planning or design. To me, a high-performance computer is like an Italian sports car; you won't find a Ferrari owner who installs a stereo by wiring it up and tossing it in the glove box. Expansions should be carefully planned and executed.

My first expansion idea simply was to buy empty BA123 chassis and transfer the CPU, memory and peripherals from the current BA23 systems, and then work up from there. I like the BA123 chassis. It's a well engineered design with plenty of room for storage peripherals, cabling and maintenance.

> ***"My primary concern while implementing an upgrade is to remain 100 percent DEC compatible . . ."***

So much for my first idea. A call to my DEC Sales Representative ended any notion of using the BA123:

"Sorry fella, DEC's in the business of selling computer systems, not empty chassis. How about a new VAX 8300?"

"Thanks, I'll pass."

Next thought — a third-party expansion chassis. While at DEXPO New York last December, I investigated an innovative MICROVAX chassis system — the DA123 by Trimm Industries of North Hollywood, California. As you might have guessed from the name, the DA123 is a "world box." However, it's not simply a clone of DEC's BA123. The DA123 is far and above the better box. It offers a variety of solutions for mounting storage devices, I/O distribution panels and power supplies. Additionally, the DA123 is rugged.

The unique quality of the DA123 box, however, is that it can be integrated without voiding your DEC warranty or DEC Field Service eligibility. This amazing achievement is accomplished, simply enough, by allowing you to mount your original BA23 chassis inside the DA123. You then are free to integrate many combinations of eight- and 5¼-inch disk subsystems, and cartridge tape drives. The DA123 doubles the number of I/O distribution panels (cabinet kits) for terminals, printers, Ethernet and so on.

Another expansion approach is to strip the BA23 chassis from its tower enclosure and mount it in a DEC or DEC-compatible rack mount cabinet. These come in a variety of sizes, with the 30-inch (H9610-XX) and 40-inch (H9642-XX) systems being the most likely candidates for this application. Primary considerations for this type of mounting system are front load design, hinged rear door, 15 AMP power distribution unit, casters and plenty of ventilation. To aid cooling (the BA23 chassis vents to the side when rack mounted, which restricts air flow), many cabinet manufacturers build fan cooling units that bolt to the rear of the cabinet.

This type of repackaging approach is ideal if you want to upgrade to a 14-inch disk subsystem and reel-to-reel tape drive, if you need additional backplane space or if your system requires an inordinate number of I/O interfaces, like multiple modems, multiplexers, network interfaces and so on. Devices like these are better installed in rack cabinets or on shelves mounted in the cabinet. Wiring is easier, maintenance is easier and the package will look as if it were

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planned and not as if it had just happened.

Still another expansion technique is remote cable concentration. Remote cable concentrators are kits that relocate the physical terminal connection from the I/O distribution panel on the back of the MICROVAX to a small box mounted away from the MICROVAX. The benefit is two fold: First, a Remote Cable Concentrator only uses one "B" type I/O panel, whereas a DHV11 occupies two. This permits you to add another DHV11. Second, by using remote cable concentrators (especially in the case of a BA23 MICROVAX), you get the cable crowding away from the machine. The installation becomes tidier and the system is easier to work on.

Adding More CPU Power

The recent introduction of the Local Area VAXcluster (LAVC) has made incremental expansion of a MICROVAX system possible. Simply by connecting MICROVAX systems together via Ethernet, and installing the LAVC software, you can add additional CPU horsepower.

I've installed, and used extensively, two LAVC systems. The first, which we affectionately call the "Yuppie Cluster" (Young, Up-and-coming Processors), consists, currently, of five rack-mounted MICROVAX II systems: Biff, Skip, Buffy, Chaz, and Liz. This system was built expressly with expandability in mind as the processing needs of the organization grew. It's working!

Biff actually is a VAXstation II; he

TABLE 1.

Required Components	Cost
DA123 w/ front panels for 5.25" peripherals	$ 895.00
40 Watt power supply for additional drives	185.00
Power supply wiring harness	25.00
115 CFM fan kit for power supply	33.00
BA23 installation kit	20.00
5.25" drive brackets (3)	50.00
I/O panel	180.00
Total cost of cabinet upgrade (approx)	$1488.00

Table 1. Cost of migrating to the DA123.

TABLE 2.

BA23 (DH-630Q2-FA/FD)	BA123 (DH-630Q3-FA/FD)
KA630 with FPU 5-MB memory RQDX3/RD53 TK50 DZQ11 (4 ports)	KA630 with FPU 5-MB memory RQDX3/RD53 9TK50 DHV11 (8 ports)
$21,580.00 $23,068.00 <-- After upgrade to DA123	$29,430.00

Table 2. BA23 vs. BA123 price comparison.

TABLE 3.

Yuppie Cluster (5 MVII on LAVC)	VAX 8600
Max memory	80MB	68MB
MIPS	4.5 (approx)	4.2
Expandable	Yes (up to 13 nodes)	Yes (8650)
No. Users	48	48
Spec. Req.	None	A/C Computer room, 3-phase power
Base price	$114,000.00	$395,000.00

Table 3. Yuppie Cluster vs. VAX 8600.

plays head honcho to the others by providing mass storage and console support. By using a VAXstation, it's possible to have one central console device for all five systems, a la VAXstation windows (a convenience only).

Mass storage on Biff (and to the rest of the Yuppies) is provided by a pair of RD54, 159-MB "equal" drives from Trimarchi and Associates, Inc. of State College, Pennsylvania. The RD54 drives are mounted in a BA23 expansion chassis. These drives are equal in every way to DEC's own RD54 drive, with one notable exception — the price tag. The Trimarchi drive can be purchased for little more than half of what it costs from DEC, and shipment is speedy. The other four systems use their original DEC RD52s for local page and swap files (I don't believe completely in diskless systems).

In the present configuration, Biff and Skip are what I term "service machines." Skip provides all print queues and user batch queue services, which keep him pleasantly busy, while Biff handles software product queues; i.e., *ALL-IN-1* mail delivery, Message Router, etc. Interactive use of these two systems is not permitted. The load on Biff is kept light intentionally so he may concentrate on his primary task as a disk server.

The remaining Yuppies, Buffy, Chaz, and Liz, are application-specific processors. Buffy, for example, is the Office Automation (OA) processor. She provides services with products like *ALL-IN-1*, *WPS-PLUS*, *Datatrieve,* and *DECalc.* Chaz, on the other hand, is used for database systems, and Liz for program development.

The purpose of allocating each processor to a specific type of work is for performance. Each system is tuned for its particular application, whereas on a single system like the VAX 8600, the system must be tuned to provide average performance under all conditions.

Connectivity of the Yuppies was

accomplished using a DELNI (eight Ethernet transceivers in a box). The DELNI sits at the bottom of the processor cabinet, which makes for a clean and simple installation. Terminals interface to the Yuppies via DECservers (Ethernet terminal servers). While terminal servers are not as efficient as asynchronous serial port multiplexers like

> ***"Don't give up on your MICROVAX just because you've grown out of its original configuration."***

the DHV11 or DHQ11 (due to the number of layers of DECnet software used to transport the data), they do provide the added functionality of connecting with multiple host processors. In the case of the Yuppie Cluster, this was a key function.

What's The Point?

The point of all of this is simple: Don't give up on your MICROVAX just because you've grown out of its original configuration. It's an incredibly expandable system.

Digital and third-party vendors provide more options and expansion capabilities (not counting mips) for the MICROVAX than for any other VAX system: storage systems, memory, backplane extenders, chassis, cabinets and connectivity products. It's all available, and less expensive for the MICROVAX. Tables 1, 2 and 3 itemize the current cost of upgrading your MICROVAX. Why move up, when you can expand and save? — *David Bynon is a VAX systems consultant in Washington, D.C.*

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DEC PROFESSIONALS

Lori Snyder received her B.S. degree in electrical engineering from the Pennsylvania State University. After working at Hercules Inc., Wilmington, Delaware, where she developed engineering software on CAD/CAM and mainframe computers, Lori went to work for General Electric Space Division, Valley Forge, Pennsylvania. There she supported and developed engineering application software on VAXs and several other computers, and maintained a pair of UNIX-based workstations. She also developed and taught an introduction to VAX/VMS course.

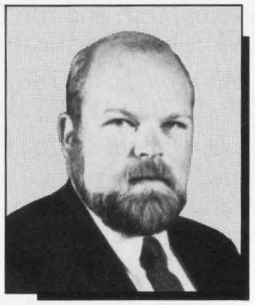
Lori's interest in the UNIX-based workstation lead her to a position with Valid Logic Systems, Wayne, Pennsylvania, as a systems engineer in Valid's local sales office. There she spent time maintaining several UNIX-based systems, and answering questions and teaching customers about UNIX and Valid's entire line of electronic design software. She also performed benchmarks for perspective customers and conducted training seminars.

Bill Hancock, our networking editor, is an internationally well-known and respected network and software engineering consultant who has held engineering and technical positions at DEC, Texas Instruments, SOHIO Petroleum Co., and IBM. He conducts seminars on various network issues and subjects and has more than 2,000 network designs to his credit.

Bill's clients include many of the Fortune 500 and governmental authorities such as the U.S, U.K, Germany, Switzerland, Japan, and the Peoples Republic of China. Bill is experienced in all aspects of communications and network design and implementation. He is one of two network expert delegates for the U.S. serving on the International Organization for Standardization (ISO) TC97/SC6/WG5 (Network Architecture) technical committee; serves as VP Engineering for Essential Resources, Inc., New York; and is the author of *Network Design and Implementation* and *Systems Management for VAX Systems.*

Charles Connell, East Coast editor, writes feature articles and works with professionals in his area who wish to contribute articles to our magazines. Chuck also visits East Coast OEMs and VARs in the DEC marketplace to review interesting new products and cover newsworthy events.

Lori Snyder



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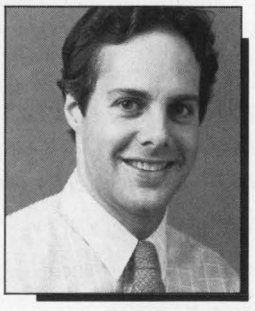

Charles Connell

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 especially is 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 an editor of the DECUS periodical, *The Wombat Examiner.*

Prior to becoming an independent consultant, Phil was manager of Information Services for a large engineering firm and was responsible for both hardware and software development in a mixed technical/commercial VAX shop.

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

As senior technical editor for *DEC PROFESSIONAL* and VAX editor for *VAX PROFESSIONAL*, **Al Cini** has written many articles on various DEC PDP-11 and VAX software products. He is president of Computer Methods Corporation, a technical training and software consulting firm specializing in applications implemented with DEC computer products.

Al's DEC system experience spans more than 10 years, and he is a widely recognized authority on VAX-based software development techniques. He has developed and presented a number of courses for DEC's Seminar Program's group, including the VAX FORTRAN and VAX COBOL Advanced Programming Concepts Seminars, and the VAX BASIC Version 3 Update Seminar. ■

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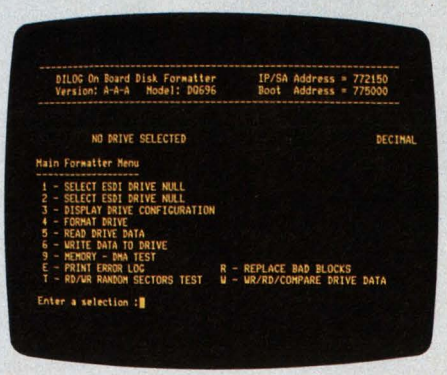

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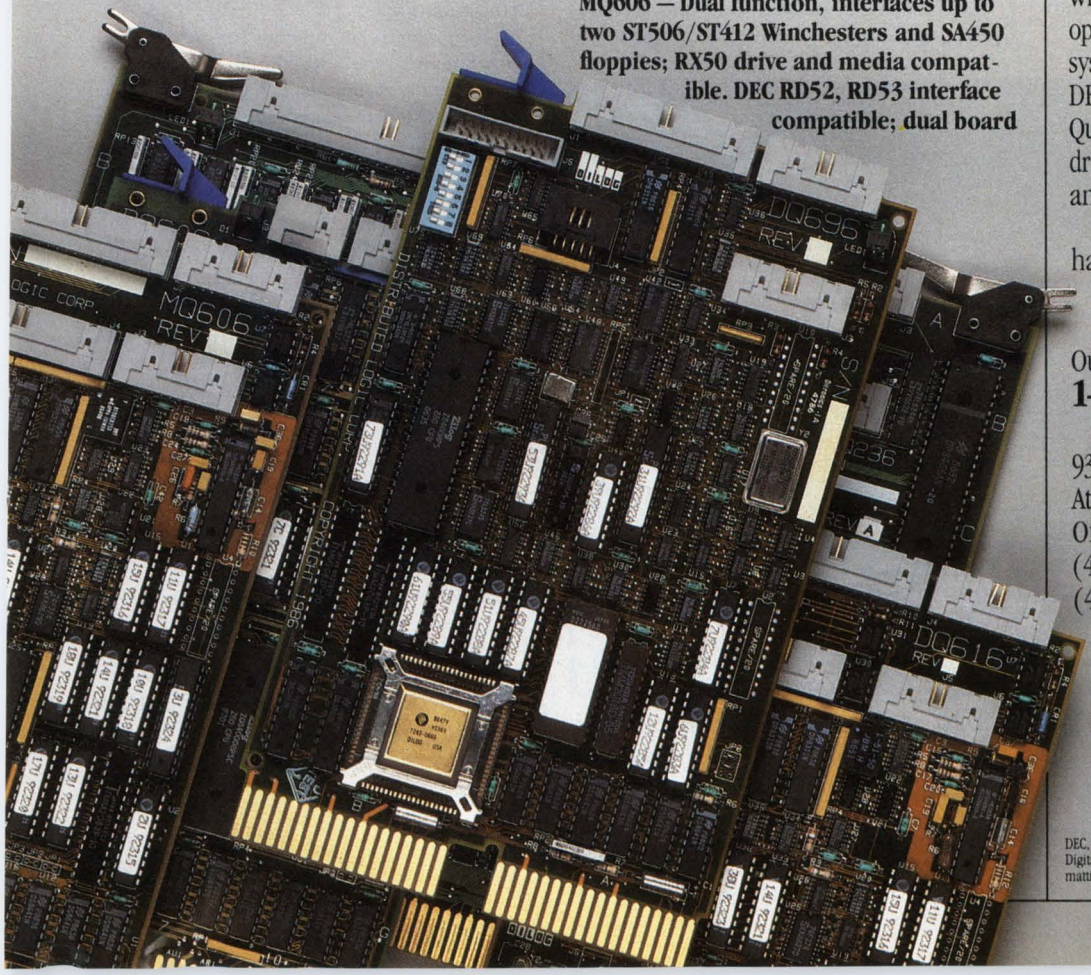

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ART/VMS Available On DEC Hardware

Inference Corporation's Automated Reasoning Tool (ART), an advanced software development tool, now is available on high performance, traditional hardware. ART/VMS is designed to develop business-critical expert systems applications on VAX computer systems.

ART/VMS, written in C, brings advanced technology to traditional hardware and operating system environments. These capabilities include sophisticated memory management, the pattern-matching structure that joins patterns both from the left and from the right, integrated object-oriented and rule-based programming that provides a new level of support for mixed initiative interfaces, as well as sophisticated graphics, programmer interfaces to the knowledge base and a pseudo-natural language syntax.

Normally priced at $65,000, the ART/VMS is being offered at $29,500 until July 31, 1987.

To learn more, contact Inference Corporation, 5300 West Century Blvd., Los Angeles, CA 90045; (213) 417-7997; Telex: 286747.

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DEC Europe Installs TOLAS

GSI Transcomm's TOLAS distribution management software system is being installed throughout DEC's extensive network of European warehouses and product distribution facilities. GSI Transcomm is providing Digital's European operations with the TOLAS order entry, inventory management, purchase order management and accounts payable software modules. In addition, GSI Transcomm is scheduled to develop several data interfaces that will allow TOLAS to be integrated with other existing software packages being used by Digital.

For more information, contact GSI Transcomm, 1380 Old Freeport Rd., Pittsburgh, PA 15238; (412) 963-6770, FAX 963-6779 or Telex: 629-46642.

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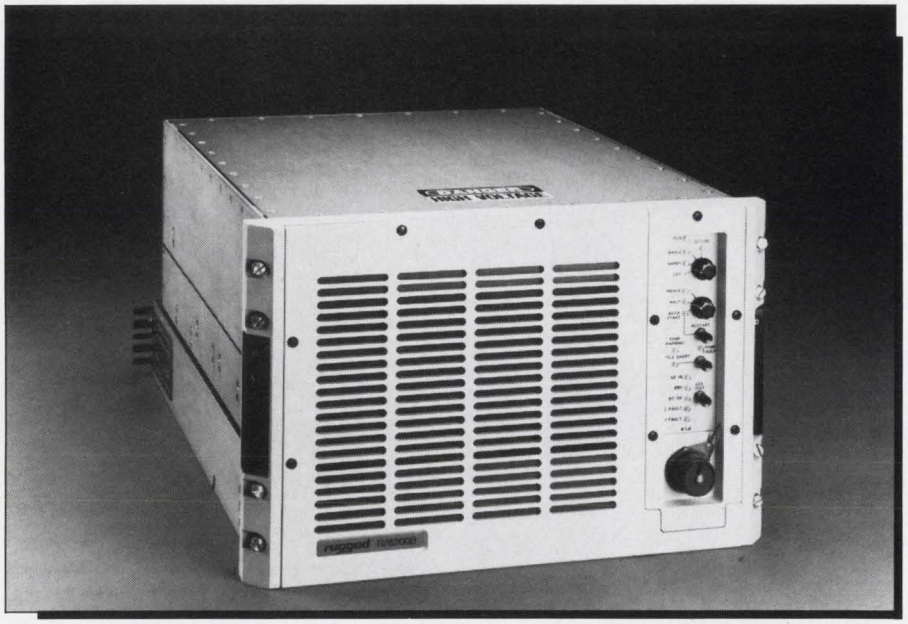

RUGGED DIGITAL'S R/8200 ruggedized DEC VAX 8200 computer system is for military applications.

R/8200 Designed For Military Applications

Incorporating full DEC VAX 8200 high-performance features, RUGGED DIGITAL's R/8200 ruggedized version of the computer system is designed to meet military requirements for mobile Command, Control and Communications (C^3I) or for electronic warfare applications. The R/8200 includes the high-speed 13.3 MB/second VAXBI interface bus, zero-insertion-force locking connector design and expandability to multiprocessor configurations.

Designed to operate in severe environments, the R/8200 meets the requirements of manned, mobile platforms such as truck-mounted shelters, large and small aircraft, submarines and surface ships. The R/8200 includes DEC computer electronics integrated with a heavy-duty extruded aluminum chassis, integral shock and vibration isolation, and a power supply system designed to military specifications. For further information, contact RUGGED DIGITAL SYSTEMS, Inc., 328 Gibralter Dr., Sunnyvale, CA 94089; (408) 747-1770.

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Common Lisp Available For The PDP And VAX

AIRS Ltd. announced the release of a complete Common Lisp development package for the PDP and VAX or MicroVAX. The package provides an AI workstation type of environment on general-purpose terminals. Current facilities include a structured editor, a complete debugging utility, windowing with mouse/digitizing pad support, and bit-mapped graphics (Tektronix 4010/4014 compatible).

Esprit Introduces The OPUS 220

Esprit Systems, Inc. has announced the OPUS 220, an enhanced VT220 compatible terminal which also is well suited for ANSI and UNIX/XENIX users. Esprit's OPUS 220 is backed by a free 24-hour replacement service. In addition, Esprit provides a toll free hot line should users require technical support.

The OPUS 220 is priced at $559. For more information, please contact Esprit Systems, Inc., 100 Marcus Dr., Melville, NY 11747; (516) 293-5600.

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An incremental garbage collection design has been implemented for efficient memory management, and an optimizing compiler enables compact code and rapid execution. Operating systems currently supported are RSTS V9 and VMS V4.2. A UNIX version will be available by August.

The package price is $4,000. For additional information, contact AIRS Ltd., 1914 N. 34th St., Ste. 106, Seattle, WA 98103; (206) 547-9710.

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ABLE COMPUTER Introduces MINX

ABLE COMPUTER introduces its Micro Integrated Network Exchange (MINX), a desktop-sized resource management system for asynchronous switching. MINX supports up to 480 ports in both distributed and concentrated applications. ABLE customers can begin switching for as low as $10 a port.

MINX features the combined strengths of LANs and switches such as distributed networking, centralized network management, user-initiated switching, network diagnostics, security levels, port contention, load balancing, multisessions and queuing.

Essential to current ABLE MUX MASTER users is the growth that MINX provides. By adding MINX to their system, ABLE users now can migrate to a multiple computer environment — without obsoleting their previous equipment investment.

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For more information, contact ABLE COMPUTER, 3080 Airway Ave., Costa Mesa, CA 92626; (714) 979-7030.

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EBS Runs On VAX/VMS Computers

Electronic Interface Associates, Inc. (EIA) announced Electronic Business Systems (EBS), a user-friendly integrated accounting package. EBS runs exclusively on the complete line of DEC's VAX/VMS computers.

Accounts receivable, accounts payable and general ledger are the main integrated modules. Assembly inventory, order processing, automatic invoicing and shipping, real-time posting, sales analysis, and complete on-demand monthly and annual reports are some of its many features.

EBS costs $1,995. For more information, contact Electronic Interface Associates, Inc., at (800) 992-0275 or in New York please call (212) 206-8850.

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ADM Announces DRS Version 4.1

Advanced Data Management, Inc. announced the availability of Version 4.1 of DRS, its database management and application development system for DEC's VAX computers.

Version 4.1 contains a new fourth generation report writing language, expanded application generation facilities, and a screen painter.

The new report writer is a high-level, block-structured, programming language for creating simple and complex reports. The DRS report writer provides complete and easy-to-use facilities for logical tests, computations, multiple sort breaks, rolling cross-foot and summary totals, page structured reports and block structured reports.

The report writer features support for laser printers, photocomposition output, data export, and database update. It also includes an interactive window-oriented, source language debugging facility.

Contact Advanced Data Management, Inc., at 15 Main Street, Kingston, NJ 08528; (609) 799-4600.

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Incotel Software Module Enhances ALL-IN-1

A new software module from Incotel provides a number of automatic auditing features that enhance the integrity of message traffic sent via DEC's ALL-IN-1 office menu system.

The Incotel module is called Secure Electronic Mail (SEM). It upgrades the DEC product, enabling it to handle the critical security needs (especially quantitative/numeric messages) for banking, financial services, manufacturing, transportation and other industries.

The SEM prevents undetected duplication of a message or any part of it. It also

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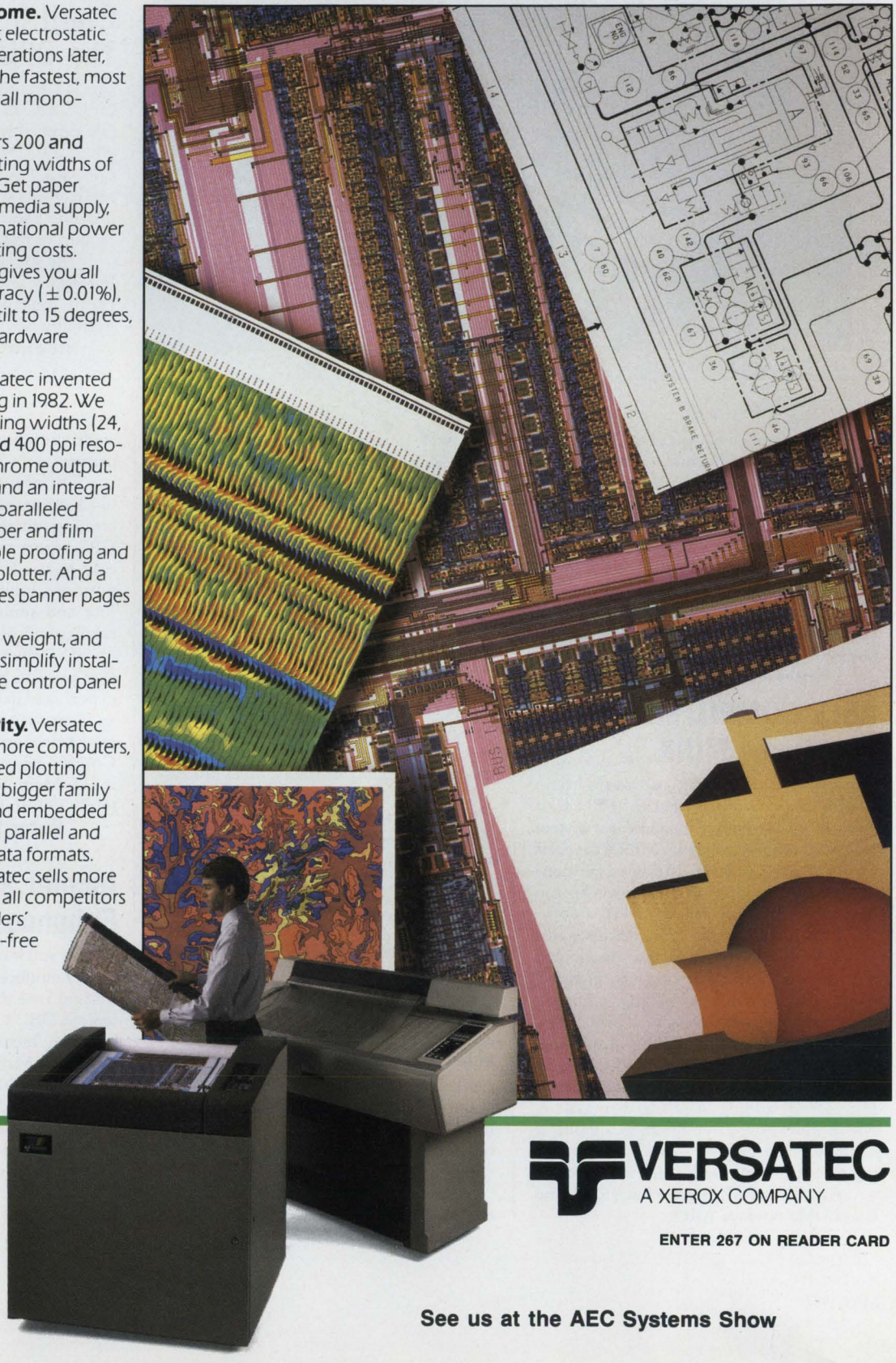

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makes undetected non-delivery of a message impossible. In addition, it provides the originator with a highly detailed delivery status report on demand.

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The SEM software product costs $6,000. For additional information, contact Pat Kielty, Manager, SEM Product, C&W Incotel Ltd., 5 Penn Plaza, New York, NY 10001; (212) 594-8340.

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New Version Of SQUEEZEPAK Released

DEMAC Software Ltd. has released Version 1.2 of SQUEEZEPAK, an on-line disk compression and optimization utility for VAX/VMS system environments.

Improvements in the release include a more powerful optimization algorithm combined with significantly reduced running times. Operation of the utility is still online (with the disk mounted), in place (no need for multidevice transfers) and unattended. For further information, contact DEMAC Software Ltd., 1260 Old Innes Rd., Ottawa, Ontario, Canada K1B 3V3; (613) 748-0209.

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RealWorld Job Cost Released By GABA

Glenn A. Barber & Associates, Inc. announced the release of RealWorld Job Cost for the VAX under VMS and PDP-11s under RT-11/TSX-PLUS.

RealWorld is a modular and integrated system that is cost effective on DEC minicomputers. Job Cost may stand alone or interface with RealWorld's accounts receivable, accounts payable, general ledger, payroll, purchase order, and inventory control. Both versions run in native mode environments written in VAX-COBOL and COBOL-PLUS respectively.

The Job Cost system is designed for use by any small- to medium-sized business that does jobs for customers. The RealWorld Job Cost allows management of labor, material, subcontract costs, profit, and up to five other user-defined cost types such as equipment costs and overhead.

Additional information can be obtained by calling GABA's Sales Dept. at (818) 980-6622 or writing Glenn A. Barber & Associates, Inc., 12229 Ventura Blvd., North Bldg., Studio City, CA 91604-2599.

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Ada Version Of Scribe Announced

UNILOGIC, Ltd. has announced availability of the Ada version of its Scribe Document Production System.

Scribe is easy-to-use text formatting and document production software. Scribe, on a general-purpose computer in conjunction with a laser printer, brings electronic publishing capabilities in-house. Scribe is well suited for the production of large documents. Scribe also is used to create documents such as reports, journal articles, technical specifications, and military standard documents, for printing on today's most advanced laser printers and photocomposers. Facilities for producing mathematical formulas and equations, tables, change bars, multiple column

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LOCK-11

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

layouts and merging graphics with text make Scribe the answer to the document production needs of a broad range of users.

Scribe currently is available on the VAX, IBM and Prime mainframes, and Sun, Apollo, IBM and various Unix workstations. Scribe supports over 50 different printers. For more information, contact UNILOGIC, Ltd. at Suite 440, Commerce Court, 4 Station Square, Pittsburgh, PA 15219-1119; (412) 281-5959.

Enter 911 on reader card

CAE Tools Available On VAX Solution Systems

CASE Technology has announced that its complete line of Vanguard computer-aided engineering (CAE) tools now are offered for use on DEC's new clustered and standalone VAX Solution Systems.

The CASE Vanguard system runs on Digital's entire line of VAX computers. The system includes the CAE industry's most advanced schematic design system, in combination with capabilities for PBC design (interactive and automatic), timing verification, logic simulation, circuit simulation and PLD generation. CASE also offers terminal emulation software that allows an IBM PC to work remotely with the Vanguard system on a VAX, MicroVAX or a node in the VAX Solution System.

For more information, contact CASE Technology at 2141 Landings Dr., Mountain View, CA 94043; (415) 962-1440. Telex: 506513 CASE TECH USA.

Enter 912 on reader card

SPSS Graphics Playback Facility Introduced

The SPSS Graphics Playback facility is available from SPSS. Playback provides the ability to replay a previous SPSS Graphics session in an interactive or batch mode. Playback also provides improved speed and accuracy in a typical Graphics session by allowing users to generate repetitive charts and graphs without having to re-enter specific command sequences. For VAX systems, Playback is available in Release 1.1 Level 2 of SPSS Graphics.

Playback creates a logfile of an interactive session. The logfile contains a record of every command entered, every menu selected and every form filled out during the session, etc. In the Playback session, Graphics takes its input from a specified logfile instead of from the keyboard. The Playback facility allows users to edit the logfile, add notes, delete portions of the session, change template names and library members, etc. It also allows users to edit the file to change labels, titles, data values, colors, device specifications, and other characteristics of graphs without having to run through the menus and forms.

SPSS Graphics is available from SPSS Inc., 444 N. Michigan Ave., Chicago, IL 60611; (312) 329-3500.

Enter 915 on reader card

Version 2 Upgrades VAX 11/750

Nemonix, Inc. has announced Version 2 of the CPU accelerator option for the VAX 11/750. Version 2 provides users with a 20 to 30 percent increase in overall CPU information throughput.

The Synchronized Clock Accelerator is

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and...

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★ Utility Package for TSX-Plus™ ★

(You'll wonder how you ever got along without it!)

- Over 60 programs
- System management tools
- Security aids
- Hardware configuration/testing programs
- Program test & development tools
- Full documentation
- One or two of these utilities is worth the price of the entire package!

Here's a sample of what's included—

For use with TSX+ only:

CTRLC* Control-C another user's program when it hangs (instead of KILLing the job).
HANDMP* Write a snapshot copy of current handler memory to a disk file for later analysis.
HANLOD* Load a fresh copy of handler ("fixes" some hung device situations).
LDSHOW* Show another user's logical disk subset (or subdirectory) mounts.
POUMP* Dumps out memory of TSX+ or of another user's running program.
SETOP* Sets operator console (terminal that OPERATOR messages go to).
SHOFIL* Lists all open files: file name, size, date, for each running program with job number and program name.
SQSY* Squeeze system disk from non-operator console terminal under TSX+.
TSBOOT* Reliably boot RT-11™ from TSX+ (for unsupported TSX+ devices).
TTPEEK* Most wanted utility! Displays what is being output to another user's terminal. Invaluable for locating problems with dialup users.
XSEND* Extended SEND command, sends to terminal whether or not logged on, time/date stamps message.
USAS* Show another user's assignments.

For use with either TSX+ and/or RT-11:

CMPRES Data compression program minimizes data transmission time or storage space.
COPBLK Generalized copy utility. Copies blocks, or byte strings, optionally concatenates at high speed.
CRSEG* Adds a segment to a directory (use with ?PIP-F-Device full).
CS Compute CRCs of files on a disk, or display names of those files that have changed since last run.
DIRBAK* Create a backup copy of a disk directory in case the directory becomes corrupted. A "must" program.
DIRDMP* Display directory in dump format (Octal, ASCII).
DIRRST* Restore a disk directory from the backup copy made by DIRBAK.

*A user must have sufficient privileges to use this program.

Other Products available for TSX+ and/or RT-11 include:

MAIL A comprehensive & user-friendly electronic mail system.
DE Driver The "Eagle" disk driver for adding a HUGE disk.
DU+ Driver for a HUGE MSCP disk.
TSX-NET "Transparent" communications between RT & TSX+.
ARCHIVE Tape utility for saving and restoring disk files and subdirectories in convenient "save-sets."
CT*OS Full-featured word processor (now supports complete multi-national character set).
JSAM Coming soon: multi-key ISAM for DBL 2.2 users.
TSX-Plus The user-friendly multi-user operating system.
DBL Dibol compiler for RT-11 and TSX-Plus.

DMPMAC Convert binary file (e.g., TRANSF.SAV) to MACRO for downloading to a remote system.
DSKCOM High speed disk compare.
FIXDIR* Patches an invalid directory to ignore bad segments.
MTCOPY Copy between magnetic tape and disk files. Duplicate arbitrarily formatted tape. (IBM, ANSI, DOS, etc.)
MTDUMP Dump a tape. Necessary tool for tape analysis.
NCRYPT Encrypt or decrypt a file with user specifiable encryption key for security of data.
SDIR Search through (possibly nested) subdirectories without having to mount them.
SEARCH High speed search and optional replace through wildcarded file(s) or devices. Many users' favorite program.
SEGSCH* Search for a file through a selected segment in a fouled up directory.
SET* Allows SET command of RT-11 handlers under TSX+ or TSX+ handlers under RT-11, also invaluable for debugging SET routines in handlers.
SETSHO* Display device handler set option values, and handler statistics, and SYSGEN configurations.
TRUNC Program to truncate a file to a smaller size.
UNDEL* Undeletes files selected by wildcards. Preserves original date. Works when CREATE command fails. Optionally uses DIRBAK file to locate unlocatable files.
YT Type a file backwards (for looking at the end of a file—where error messages are found).
ZFILE* Zeros a file/device/tape at high speed (for security reasons).

For use with RT-11 only:

BD Use BD to recover files on a disk when directory becomes unreadable (if DIRBAK has been run).
DLTEST Show CSR/Vector/Speed of DL-11's on system. Emit test pattern to a selected port.
SR For debugging a program which traps to 4 or 10. Dumps registers, stack, and instructions.
TC Display trace of EMTs when a program is run (decodes each EMT with directive name and argument values).
TERMSW Switch console to DL-11 port (no Multi Terminal Support required).
ZT Switch console to DZ-11 port (no Multi Terminal Suppt required).

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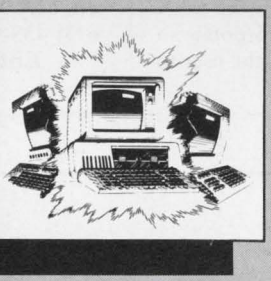
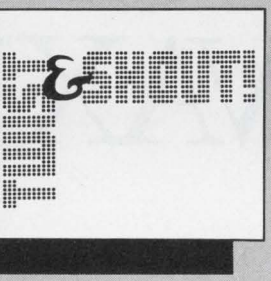
Intersecting Concepts Announces Three Great Software Utilities.



1. RUN IBM PC SOFTWARE WITH *CODE BLUE*™!

CODE BLUE instantly transforms your Rainbow's MS-DOS operating system into IBM PC-DOS *without* buying any new hardware. Increase your computer's power and versatility by adding popular non-graphics IBM PC programs like MultiMate, dBASE II, Norton Utilities, and XTREE to your Rainbow's library! *CODE BLUE* requires MS-DOS version 2.05 or later. Best results are obtained with over 768k of RAM.

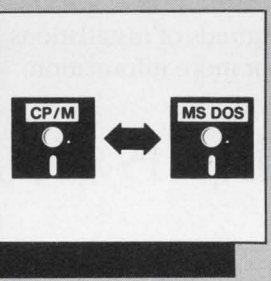
Price: $99.95



2. *TWIST & SHOUT!*™

Solve your sideways printing problem with *Twist & Shout!* With *Twist*, you can quickly print spreadsheets from Multiplan, Lotus 1-2-3, Symphony, or print practically any text file *sideways* using simple menu steps. With *Shout!*, you can instantly create banners using multiple typestyle letters ranging from 2" to 8"! *Twist & Shout!* is a two program package that includes both CP/M and MS-DOS versions and supports over 20 printers including DEC LA50.

Price: $49.95



3. *MEDIA MASTER*™!

Selected by Personal Computing as one of "The Best Software Utilities for under $100", *Media Master* is the industry standard for exchanging data between Rainbows and IBM PC's. With *Media Master*, your Rainbow can easily read, write and format over 40 CP/M and MS-DOS disk formats, including Osborne, Kaypro, and Zenith as well as the IBM PC and compatibles. Requires CP/M-86/80 and 128k RAM.

Price: $99.95

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800-628-2828, ext. 629

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a backplane attachment that increases the clock speed of the VAX 11/750 CPU. The SCA looks at several functions within the CPU and margins those functions to their maximum design capability. The margins are increased to within stable operational tolerances that are acceptable to the VAX 11/750 design. The SCA will incorporate an on-line/off-line switch enabling the user to isolate the SCA option. Therefore, the user can turn the accelerator option off, returning the CPU to its slower cycle time.

List price for the Synchronized Clock Accelerator is $8,200. For more information, write Nemonix, Inc., 106 South St., Hopkinton, MA 01748; (800) 435-8650, or in MA (617) 435-9087.

Enter 916 on reader card

Teamwork CASE Products Available For VAX/VMS

Cadre Technologies Inc.'s Teamwork computer-aided software engineering (CASE) products are available for the VAX/VMS product family from DEC.

Digital's VAX/VMS product family offers the productivity improving system components required to support complex software development projects. In addition, Teamwork uses Digital's Local Area VAXcluster System enabling users to tap the additional performance and storage capabilities of the MicroVAX II, VAX 700 series and VAX 8000 series.

To learn more, contact Cadre Technologies Inc., 222 Richmond St., Providence, RI 02903; (401) 351-5950.

Enter 917 on reader card

MEC Releases VAX Menuing Utility

Microsystems Engineering Corporation has created a new software utility, MASS-11 MENUS. This utility allows VAX users to integrate MASS-11 with third-party software or company-specific programs in a menu-driven environment without significantly affecting system performance.

The easily installed, standalone product also helps users customize menus from MASS-11 for special applications or installations. It allows the user to create menu systems that can run concurrently on the same VAX unit without compromising security. These programs can be called from MENUS in a user-specified logical sequence.

A license for MASS-11 MENUS sells for $12,500. The company's headquarters are at 2400 W. Hassell Rd., Ste. 400, Hoffman Estates, IL 60195; (312) 882-0111. Telex: 703-688.

Enter 918 on reader card

CHARM Ported To VAX Computers

Radian Corporation announced the availability of its Complex Hazardous Air Release Model (CHARM) software package on VAX/VMS computers. The CHARM system predicts the location, concentration and extent of a toxic gas cloud resulting from the accidental release of hazardous chemical compounds.

This VAX-based version of the CHARM package provides a multiuser environment and multitasking. The CHARM system can be linked to meteorological sensory equipment and data processing systems, and can accept digitized geophysical information for customizing local maps. Computer-aided de-

IEEE-488 multitasking software for ULTRIX-32 Operating System is provided by National Instruments.

sign software used in conjunction with digitization tablets can be used to create maps for use in the CHARM-produced display. For more information, contact Lou Fowler, CHARM Software Systems, Radian Corporation, 8501 Mo-Pac Blvd., P.O. Box 9948, Austin, TX 78766; (512) 454-4797.

Enter 919 on reader card

IEEE-488 Provided For ULTRIX-32

National Instruments now has full multitasking software for their General Purpose Interface Bus (GPIB) interfaced under the ULTRIX-32 operating system. The ULTRIX-32 handler is compatible with other National Instruments software support for multitasking systems including PC and UNIX operating systems. An application developed for this handler can be run on other multitasking handlers from National Instruments regardless of the operating system or machine. Thus, a program written for the ULTRIX-32 handler also can run on handlers for operating systems such as IBM AIX, SUN 4.2 UNIX, Masscomp RTU UNIX, Microsoft/IBM Xenix, SCO Xenix, and MicroVAX VMS.

The software has 20 high-level DEVICE functions that free the user from details of GPIB bus protocol and 25 low-level BOARD functions for users who need direct control of the bus for special applications. It also contains a screen-oriented configuration program not normally found on ULTRIX-32 packages. The menu-driven configuration program makes installation of the software straightforward.

The new multitasking handler is priced at $500, for the software, or $1,895 for the GPIB11V-2 interface board and software package.

For further information, contact National Instruments at 12109 Technology Blvd., Austin, TX 78727-6204; (512) 250-9119. In Texas call (800) IEEE-488. Others call (800) 531-4742. TWX: 756 737 NAT INST AUS.

Enter 914 on reader card

Codex Expands LAN Product Line

Codex Corporation has introduced two new wiring products: the Codex 4320 LAN Hub and the Codex 4303 Transceiver. These products are designed to leverage sales of OEM's resellers, and system integrators that market host systems with Ethernet ports by offering efficient and cost-effective connectivity/networking capabilities. The Codex 4320 LAN hub is an 8-to-1 LAN port sharing device that features Codex's patented collision avoidance technique. The Codex 4303 Transceiver features a compact design for convenient placement; and, like the LAN Hub, is compatible with Ethernet and IEEE 802.3 standards. Both products support OSI levels 1 & 2 for Ethernet and IEEE 802.3 compatible equipment.

The Codex 4320 port sharing device and the 4303 baseband transceiver sell for $1,095 and $270 respectively.

To find out more, contact Codex Corporation, 20 Cabot Boulevard, Mansfield, MA 02048-1193; (617) 364-2000. Telex: 92-2443.

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Look anywhere.

Startling video featuring dark characters on a bezel-to-bezel page white background with no edge distortion.

Text and graphics are both displayed at high resolution from one common bit-map, so they can be manipulated as one integrated image.

A modular, adaptable design and C language interface offer unsurpassed flexibility and resistance to obsolescence.

Compatible yet enhanced, the keyboard features the often requested Home, Escape, and Backspace keys built-in.

There's only one VT220 compatible that can do all this for under $700.

The VISUAL 603 Integrated Image™ display station stands alone. Its feature set goes so far beyond that of other DEC VT220 compatibles that it's establishing a new standard by which they are judged. Included are all the usual features you've come to expect in a compatible, such as downline-loadable character sets, full character attributes, more programmable function keys, VT52 and VT100 emulations, a DEC compatible keyboard, auxiliary port with device support, even desk-top accessories and window support. But that's just the beginning of the story.

A new standard in video presentation. The VISUAL 603 combines several features which together yield truly startling video performance: page white phosphor; flat profile, non-glare screen; overscanned video; flicker free, 70 Hz refresh rate; and fully bit-mapped, 1056 × 400 resolution. While the list goes on and on, what's important is how it looks compared to other displays in its price range. And comparisons are invited.

Now, graphics at an alphanumeric price. With its fully bit-mapped display memory, the VISUAL 603 supports Tektronix 4010/4014 graphics applications and DEC Sixel graphics transfers. And its two pages of graphics memory allow one graphics image to be viewed while another is drawn. And its Integrated Text and Graphics (ITAG) mode allows you to display a graphics image and alphanumeric data – using any VT220 display attribute – on the same screen.

FEATURE	VISUAL 603	DEC VT220	CIE CIT-224
Page White Phosphor:	Yes	No	No
Screen Refresh Rate:	70 Hz	60 Hz	60 Hz
Overscanned Video:	Yes	No	No
Character Size (80 Col):	11 × 14	7 × 9	7 × 10
Tektronix Graphics:	Yes	No	No
Integrated Text and Graphics:	Yes	No	No
List Price:	$695	$795	$699

New opportunities for VARs. The VISUAL 603 can be readily adapted by VARs using a C language software development toolkit. That means that, with the VISUAL 603, a VAR can now add value at the level of the peripheral, not just at the host computer system.

Look more closely at the VISUAL 603. For more information, write:

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DMA UNIBUS Introduced By GEN/COMP

A new DMA interface and interprocessor link is being introduced by GEN/COMP. The GEN/COMP Model 2042 DMA Interface for the UNIBUS features hardware parity generation and checking of transferred data to assure data transfer integrity. Ideal for connecting a high-speed digital I/O device to the UNIBUS and for interprocessor linking of two UNIBUS computers, it is software compatible with DEC DR11-W, DR11-B, or DA11-B interfaces.

Providing switch-selectable DMA pacing and one to 16-cycle burst lengths to improve system performance by conserving the UNIBUS bandwidth, peak transfer rate for the GEN/COMP Model 2042 DMA Interface can be selected through the range of 30,000 to 500,000 words/sec.

The GEN/COMP Model 2042 DMA Interface is priced at $1,000 and $1,500 with the optional opto-isolator long-line option. For more information, contact GEN/COMP Inc., 6 Algonquin Rd., Canton, MA 02021; (617) 828-2008.

Enter 920 on reader card

Prosig Offers ADIOM2 Software for MICROVMS

ADIOM2 is a library of software subroutines that relieves software developers from writing device drivers and data handlers in assembly level language for real-time applications involving the digitization and storage of electrical signals produced by various laboratory transducers such as accelerometers, microphones, strain gauges and thermocouples.

This is the first software subroutine library announced by Prosig USA in support of Digital's MICROVAX operating system. Application programs can be quickly developed, enabling researchers to collect millions of analog to digital values at continuous rates of up to 120,000 samples per second.

ADIOM2 is available for $1950 including one-year updates and support services. To learn more, call or write Prosig USA, Inc., P.O. Box 377, Rockaway, NJ 07866; (201) 366-3999.

Enter 922 on reader card

New Versions Of EM220 And EM4010 Announced

Diversified Computer Systems has announced new versions of its terminal emulation packages, EM220 and EM4010, that include additional features to support the VAX version of WordPerfect.

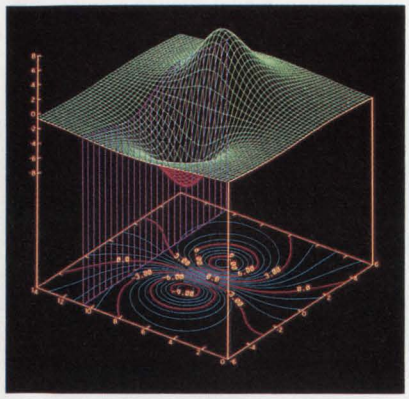
The new emulators include a WordPerfect mode that can be selected by the user or invoked from a host computer. When the emulator is operating in WordPerfect mode, users can edit their documents using keystrokes identical to those used in the PC version of WordPerfect.

Other new features include support for the IBM-Enhanced keyboard, down-line loadable character sets, additional 132-column modes, and support for the Ungarman-Bass Local Area Network, Net/one.

Although the new version does not support DECnet DOS or the VAXmate, support for these products will be announced in the near future. Existing customers with version 3.0 or higher can upgrade their emulation packages free by contacting DCS.

GRAF KIT™

A complete technical graphics package for VAX systems



GRAFkit™ is an integrated system of high level utilities including:

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- **ORGANIZES** and **DISPLAYS** large amounts of scientific, engineering, and technical data
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GRAFkit™ is based on and includes an ANSI/ISO GKS standard graphics package and supports over 30 popular graphics devices including Tektronix, HP, DEC, etc.

GRAFkit™ prices start at $3,995

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To learn more, contact Diversified Computer Systems, Inc., 3775 Iris Ave., Ste. 1B, Boulder, CO 80301; (303) 447-9251.

Enter 923 on reader card

Plessey Announces Two New PSA Disc Controllers

Plessey Peripheral Systems has added two disk controllers to its Storage Architecture products supporting the DEC MSCP emulation.

The DCV50 is a Q-bus disk controller supporting up to four physical drives on a quad-wide board. It supports the latest drives available with data transfer rates up to 2.5 MB and will support various SMD drives with different data transfer rates and capacities in mixed configurations.

The DCV54 is a quad-wide Q-bus ST506 controller supporting two Winchester drives and two RX50 or new RX33 floppies. Plessey's new PSA controllers offer support across the current versions of DEC operating systems.

The DCV50 sells for $1,155 and the DCV54 costs $1,075.

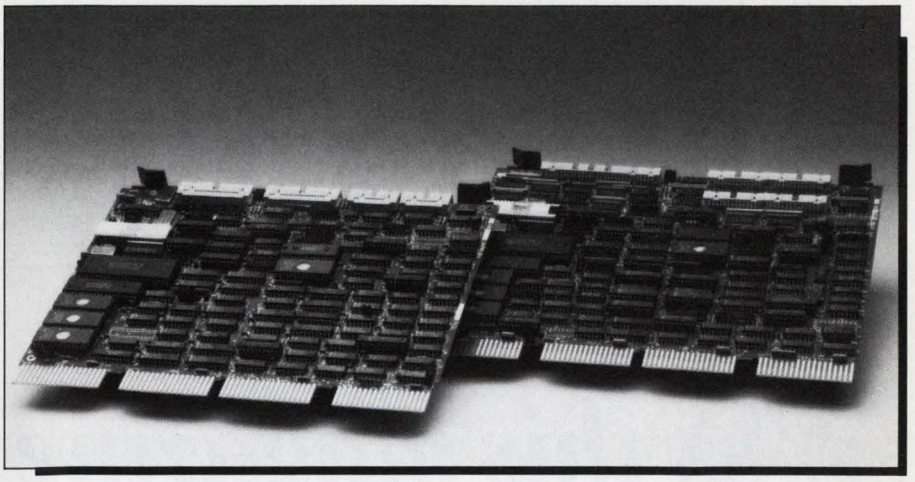
For additional information, contact Plessey Peripheral Systems, 17466 Daimler Ave., Irvine, CA 92714; telephone (800) 992-8744 or (714) 261-9945.

Enter 924 on reader card

Pulizzi Introduces TPC 115-10/MTD

Pulizzi Engineering, Inc. introduces controlled power up with the Z-Line TPC 115-10/MTD (Multiple Time Delay). It's only 1¾ x 8 x 19 inches large and is smaller than DEC's 874 by 50 percent and DEC's 861 by 75 percent. There are two unswitched outlets and eight switched, four in Switch 1 and four in Switch 2. There's an automatic four-second sequenced time delay power up between Switch 1 and Switch 2. Five remote ports provide remote ON/OFF, multiple emergency shut down and four second sequenced power up of additional equipment down line. EMI.FRI filtered protection as well as spike and surge protection is standard. For further information, contact Pulizzi Engineering, Inc., 3260 S. Susan, Santa Ana, CA 92704; (714) 540-4229.

Enter 925 on reader card



The DCV50 and DCV54 are Plessey Peripheral Systems' new disk controllers.

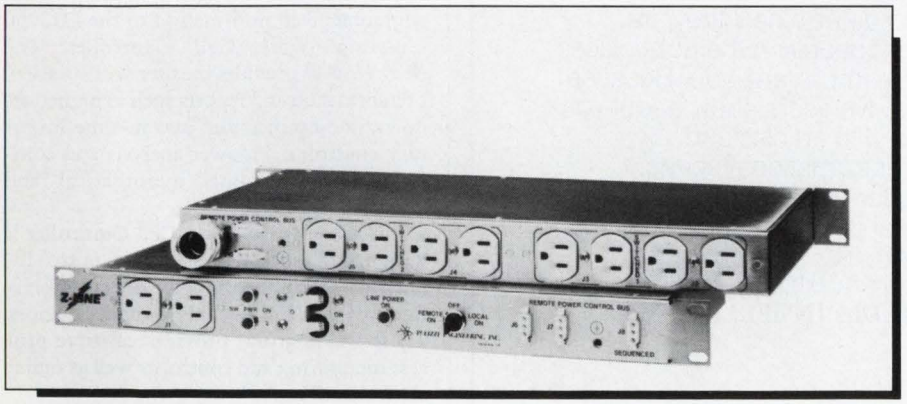
Ethernet Repeaters Provide Flexibility

American Photonics, Inc. recently announced RL6000 Ethernet repeaters. The RL6000L local repeater handles special problems of mixed V1.0, V2.0 and 802.3 networks and restores even severely distorted data packets from an Ethernet segment to original quality before retransmission to the next segment.

The RL6000L and RL6000R provide extensive diagnostic capabilities. Automatic segmentation temporarily suspends the repeater function if a problem on one Ethernet segment causes excessive data packet collisions. The repeaters also provide manual segmentation switches that are useful during installation or for network trouble-shooting and problem isolation. An array of front panel lights indicates data activity, collisions, heartbeat and segmentation status for each Ethernet segment.

For more information, contact American Photonics, Inc., 71 Commerce Dr., Brookfield Center, CT 06805; (800) 626-5745, in CT (203) 775-8950.

Enter 926 on reader card



TPC 115-10/MTD, by Pulizzi, has two unswitched and eight switched outlets.

Netron Announces NETRON/CAP

Netron Inc. has announced that the NETRON/CAP Development Center is available for DEC's new VAXmate. Using NETRON/CAP the VAXmate can produce portable COBOL applications for VAX/VMS and Wang VS systems, IBM PCs and compatibles, and IBM-CICS mainframes.

NETRON/CAP applications are fully compatible with existing COBOL programs and file structures. Organizations with IBM mainframes can continue to use them for heavy-duty number-crunching, while offloading prototyping, development, and maintenance of COBOL applications onto a VAXmate. For IBM-CICS mainframe applications, NETRON/CAP automatically produces command-level CICS code, including JCL, and BMS maps for screen programs.

The NETRON/CAP Development Center also is available on VAX/VMS and Wang VS systems, and IBM PCs and compatibles. NETRON/CAP for VAX and VAXmate systems starts at $14,000 with pricing based on the number of enabled terminals and the size of the CPU.

For more information, contact Netron Inc.,

99 St. Regis Crescent North, Downsview, Ontario M3J 1Y9; (416) 636-8333.

Enter 927 on reader card

DT-IRIS Provides Image Processing

A new MicroVAX II software package from Data Translation, the DT-IRIS Subroutine Library, provides programmers with access to numerous image processing functions, and relieves them of the difficult programming responsibilities under DEC's MicroVMS operating system. Programming image processing applications is easier and faster.

The DT-IRIS Subroutine Library is optimized for applications in which real-time processing speeds are essential. These areas include machine vision inspection, medical diagnostic imaging, scientific research and robotic vision.

For more information, contact Data Translation, Inc., 100 Locke Dr., Marlboro, MA 01752; (617) 481-3700. Telex: 951-646.

Enter 929 on reader card

RDM For MS-DOS Is Announced

Interactive Technology Inc. has an MS-DOS compatible version of its RDM database application developer. RDM for MS-DOS features the complete complement of RDM functions and features and allows for applications developed on PDP-11s or VAXs to be moved directly to an MS-DOS environment.

The operation of RDM in the MS-DOS environment is identical to that on the PDP-11 and the VAX. Performance is better than on a PDP-11 or a VAX 11/730; however, it does not match the MicroVAX II or larger VAXs. The initial release is a single user version compatible with MS-DOS 3.0 or later for operation on XTs or ATs with a minimum of 640 KB of memory. A hard disk is required, with a minimum of 20 MB recommended.

RDM is distributed for the MS-DOS market on 360K floppies, and a single-user CPU license costs $895.

To learn more, contact Interactive Technology Inc., 460 Park Plaza West, 10700 S.W. Beaverton Hillsdale Hwy., Beaverton, OR 97005; (800) 362-6203.

Enter 930 on reader card

UWCC Meets The Needs Of Plant Operations

Process Control Industries has chosen DEC's MicroVAX II to be the heart of their new Universal Work Cell Controller (UWCC), a comprehensive approach for production control and process automation.

Workstations, PLCs and such peripherals as robots, CNC machines and personal computers feed information to the D12000 Universal Work Cell Controller. The MicroVAX II provides the user with a variety of information and reports such as immediate downtime notification, just-in-time inventory control, manpower analysis and comprehensive real-time, hypothetical and historical reporting.

The Universal Work Cell Controller is designed to work with Process Control Industries' D1200 line of color operator interface workstations or other interface devices. These workstations provide real-time process monitoring and control as well as online alarm handling.

To learn more, contact Process Control

Industries, Inc., 300 Myles Standish Blvd., Taunton, MA 02780; (800) VIP-0001, or in MA (617) 880-3650.

Enter 930 on reader card

SAS System Runs On VAXstation 2000

SAS Institute Inc. announces that the SAS System will run on DEC's VAXstation 2000. The software will support VMS 4.5 and will be distributed on nine-track tape or TK 50 cartridge.

The SAS System, an integrated data analysis system and fourth-generation language for a wide range of applications, also supports DEC's VAX 8xxx and 11/7xx series under VMS and the MicroVAX II under MicroVMS.

For more information, contact the Software Sales Dept., SAS Institute Inc., Box 8000, SAS Circle, Cary, NC 27511-8000; (919) 467-8000.

Enter 936 on reader card

SCD-DHV11/8 Is DEC Compatible

Sigma Information Systems announces its new DEC compatible SCD-DHV11/8, an eight-line asynchronous communication multiplexer designed on a single dual-wide module. The SCD-DHV11/8 is compatible with DEC operating systems and diagnostics designed for the DHV11.

Design emphasis of the SCD-DHV11/8 is based on multiuser system applications where modem control and/or character buffering are of particular significance. All eight lines of the SCD-DHV11/8 have full modem control with EIA RS-232-C and RS-423 operation. Four lines can operate under RS-422. The module includes a 256-character buffer for received characters and DMA for transmitted data. Each communication line of the SCD-DHV11/8 is independently programmable for word format and hardware character echo, as well as for split transmit and receive baud rates up to 38.4K and for full or auto echo operation.

The SCD-DHV11/8 costs $792.

For more information, contact Sigma Sales, 3401 E. La Palma Ave., Anaheim, CA 92806; (714) 630-6553. Telex: 298607 SGMA. FAX (714) 630-5417.

Enter 946 on reader card

Intermetrics Introduces New Version Of Byron PDL

Intermetrics, Inc. announced the release of the new version of the Byron Program Development Language (PDL) and Document Generator for VAX/VMS systems. This Ada software development tool accepts the full Ada language and is written in Ada.

The Byron PDL is an extension of Ada, however, it has been used with other languages. Byron builds on Ada's existing PDL characteristics by embedding Byron PDL constructs in Ada commentary. Byron consists of the Byron Analyzer (the front end of Intermetrics' Ada compiler), a new Program Library and Program Library Manager, and a Document Generator that comes with five predefined templates including a MIL-STD-C5 generator. Any of the delivered templates may be changed, and users have the option of writing their own.

For more information, contact Intermetrics, Inc., 733 Concord Ave., Cambridge, MA 02138; (617) 661-1840. TWX: 710 320 7523.

Enter 939 on reader card

Chrislin Offers EDC Memory For MicroVAX II

Chrislin Industries introduces the CI-MIV8-EDC module for the MicroVAX II computer system. The CI-MIV8-EDC uses 1-MB Dynamic Rams. The memory is available with 8 MB and Error Detection and Correction on a single card. It also includes CSR register where memory errors are logged so you easily can do on-site repair to the board. The memory is completely hardware and software compatible with DEC's MicroVAX II system.

For more information and prices, contact Christine L. Seese, Chrislin Industries Caribe, Inc., Rd. 188, KM. 0.8, Industrial San Isidro, P.O. Box FF, Canovanas, P.R. 00629-1657; (800) 469-0736 or (809) 876-5205.

Enter 935 on reader card

NUCLEUS Menu System Enhanced By Version 1.0

Lexadica Software, Inc. released Version 1.0 of the NUCLEUS Menu System, which will enable a VAX/VMS system manager or software developer to build powerful and flexible end user menus in minutes. NUCLEUS can be used to provide a complete captive environment for the end user; NUCLEUS menus also can be invoked from the DCL prompt.

A NUCLEUS menu is a DCL command procedure centered around a MENU command that specifies the allowed applications and common selections and performs the menu display, user input, and help display. The application selections are processed in the menu command procedure with the complete power and flexibility of DCL. The common selections invoke general-purpose functions such as word processing, spreadsheet, electronic mail, and so on. The open architecture of NUCLEUS allows the integration of whatever software packages are desired to perform these functions.

NUCLEUS is priced from $715 on the MicroVAX II to $7,245 on the VAX 8800. For more information, contact Lexadica Software, Inc., P.O. Box 22822, Lexington, KY 40522; (606) 269-6971.

Enter 933 on reader card

Microtec Research Announces mcASM

Microtec Research Inc. has released mcASM, a second-generation structured microcode assembler to program microprogrammable processors such as the AMD Am2900 and Am29300 computer families, the Am29100 controller family and the Am29500 signal processor family. The product is a completely general-purpose microcode assembler.

mcASM simplifies the writing of microcode. The biggest advance is mcASM's built-in constraint management. Microword formats are defined during a definition phase through use of case structures that allow complex definitions of what legally may be placed in the microwords during the assembly phase. Illegal field combinations and illegal instruction values easily can be detected. mcASM's excellent constraint management allows many errors to be caught at assembly time before the debugging process starts, thereby shortening development time.

mcASM is distributed on VAX VMS, VAX ULTRIX and on PC-DOS. A binary license is $4,500 on the VAX and $2,000 on the PC.

For further information, contact Microtec Research Marketing/Sales Dept., 3930 Freedom Circle, Santa Clara, CA 95054; (800) 551-5554, or in CA (408) 733-2919.

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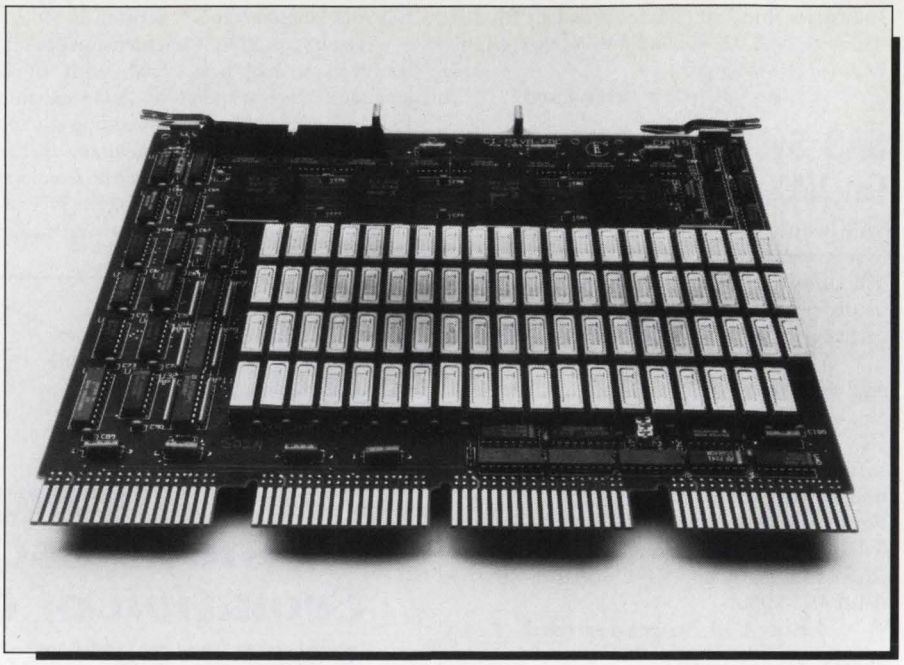

Chrislin Industries' CI-MIV8-EDC module for the MICROVAX II.

HASP+ Interconnects VAX To IBM System 34/36/38

Datanex HASP+, a DEC to IBM communications software product, allows the VAX and MicroVAX to link with IBM System 34/36/38 for efficient file transfer. Running HASP+ in HOST or CENTRAL mode allows the VAX to operate as a multileaving hasp host.

The IBM system needs IBM's Remote Job Entry Facility (RJEF). The link between the two systems can be over leased line or dial-up circuits. If the systems are close, a simple and inexpensive synchronous modem eliminator or line driver may be used. HASP+ operates at speeds to 56 Kbps.

HASP+ communications software is priced at $5,500 for VAX and $3,500 for MicroVAX.

For further information, contact Datanex, P.O. Box 1728, Eugene, OR 97440; (503) 687-2520.

Enter 938 on reader card

Nevada Western Offers Wire Management Panel

Nevada Western introduced the newest member of its family of panels for effective Wire Management. The Connectorized Balun Patch Panel reduces 24 coax to one twisted pair cable for a 24:1 wire reduction.

It eliminates long coax cable runs and permits twisted pair distribution with the flexibility of modular patching, thereby facilitating easier and more economical moves and changes.

It consists of a centralized group of female BNC coax connectors connected to Nevada Western Baluns for conversion to twisted pair and consolidation of those pairs into 25-pair connectors for economical wire runs.

Four sizes are available: 24, 32, 48, or 96 port configurations.

For further information, contact Nevada Western, 930 West Maude Ave., Sunnyvale, CA 94086-2801; (408) 737-1600.

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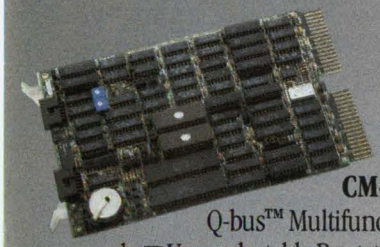
Camintonn Announces Five New Products For Improved DECxterity.™



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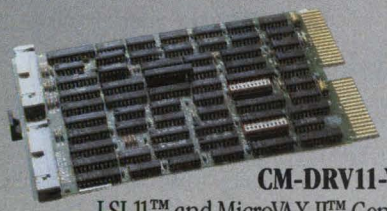
CMX-830-E
MicroVAX II™ ECC Memory Module ☐ 8 Megabytes High Reliability Memory ☐ Single-bit Errors Corrected Automatically ☐ LED Display of Single-bit Errors ☐ Double-bit Errors Signalled to CPU as Parity Errors



CM-DRV11-WA
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RTC PLUS Is Expanded

RTC PLUS V1.4, a FORTRAN and RATFOR to C Translator package has been released by Cobalt Blue. Initially developed as a RATFOR to C Translator, RTC Plus has now been expanded to allow translation of FORTRAN code into K&R C.

The Translator is ideally suited to translating non-I/O FORTRAN libraries, and code where I/O is concentrated in a few routines. RTC Plus FORTRAN extensions use VAX FORTRAN 77 syntax. FORTRAN-77 I/O, character and complex are not currently supported.

The package runs under the MS-DOS V2.2+ operating system and is priced at $325. For more information, contact Cobalt Blue, 1683 Milroy, Ste. 101, San Jose, CA 95124; (408) 723-0474.

Enter 932 on reader card

Tektronix Offers 4209 Color Graphics Terminal

Tektronix, Inc. introduced the fourth member of its new 4200 Series of intelligent color graphics terminals. The 4209 completes the transition of the Tektronix 4100 product line to the new 4200 Series.

Its large display screen and interactive graphics features make the 4209 desirable for users wishing a low-cost entry point to CAD. The 4209 background copy feature makes a crisp clear screen copy and frees up the terminal in 10 seconds or less.

The Tek Graphics feature set includes full segment support, true local zoom and pan, downloadable characters, and VT100 compatibility.

For further information, write Tektronix, Inc., P.O. Box 15273, Portland, OR 97215; (800) 225-5434. In OR call (503) 235-7202.

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DMR-11, DMV-11 Support FUSION Network Software

Network Research Corporation has announced an add-on option to FUSION Network Software to support DEC's DMR-11 and DMV-11 high-speed controllers. This option now enables users to attach their LANs to wide area networks via modems.

The option provides users with transparent interconnectivity for the TCP/IP file transfer protocols — TELNET, FTP, SMTP and TFTP — between geographically separated LANs.

The DMV-11 option for the MicroVAX supports up to 56K bps, and the DMR-11 for the VAX supports up to 1M bps high-speed data transfer for point to point com-

munications. The option also can be used to interconnect local clusters of VAX systems.

The DMR-11 and DMV-11 options are available as add-ons to FUSION Network Software, V 3.1.13 under the VMS operating system using the TCP/IP protocol.

Pricing for the option is $720 for the uVAX, $1,200 for VAX 7xx systems, and $1,800 8xxx series.

For more information, contact Network Research Corporation, 2380 N. Rose Ave., Oxnard, CA 93030; (805) 485-2700.

Enter 944 on reader card

LIBRA Unveils Accounting Software

LIBRA Programming, Inc. has released its line of accounting software for the DEC family of VAX Computers including the MicroVAX 2000 and MicroVAX II.

LIBRA software includes integrated modules for Accounts Payable, Accounts Receivable, Billing, Client Write-Up, General Ledger, Inventory, Job Costing, Order Entry, Payroll, and Property Management. All modules include 60 days installation assistance and support through a nationwide WATS network.

Find out more by contacting LIBRA Programming, Inc., 1954 E. 7000 South, Salt Lake City, UT 84121-3094; (800) 453-3827, UT (801) 943-2084, Alaska & Hawaii (800) 453-7750.

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MACSYMA Solves Tough Modeling Problems

MACSYMA mathematical computation software, available from Symbolics Inc.'s Computer Aided Mathematics Group, works on Sun Microsystems Inc.'s Sun-2 and Sun-3 workstations running the Sun 3.0 operating system, and on DEC's MicroVAX II workstation running the MicroVMS.

The layered applications software program operates on Symbolics 3600 family of symbolic processing systems, DEC's VAX line and the MC68010 version of the Masscomp MC5500 engineering workstation.

Used by scientists, engineers and mathematicians to solve complex modeling problems in technical fields, MACSYMA automates symbolic mathematical computation, resulting in improvements in speed, accuracy and modeling power.

The price for each new version of MACSYMA is $7,500.

To learn more, write or call Symbolics Inc., 11 Cambridge Center, Cambridge, MA 02142; (800) 622-7962.

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■

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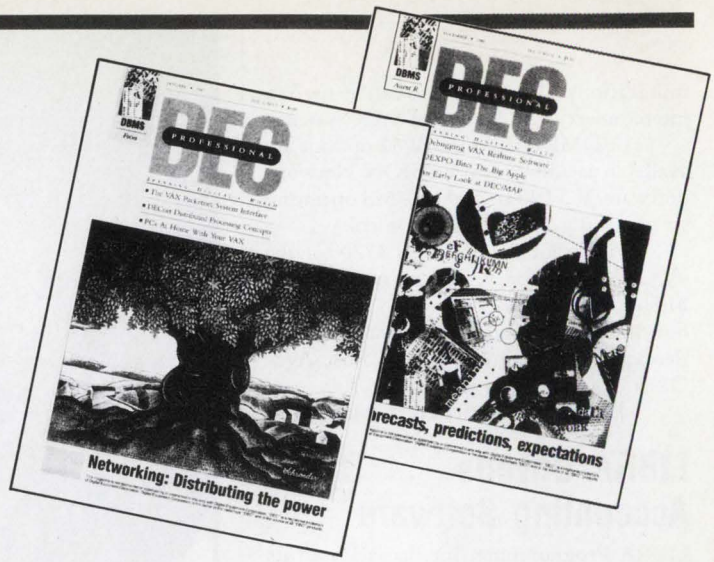

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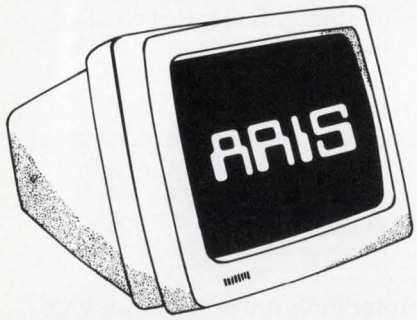

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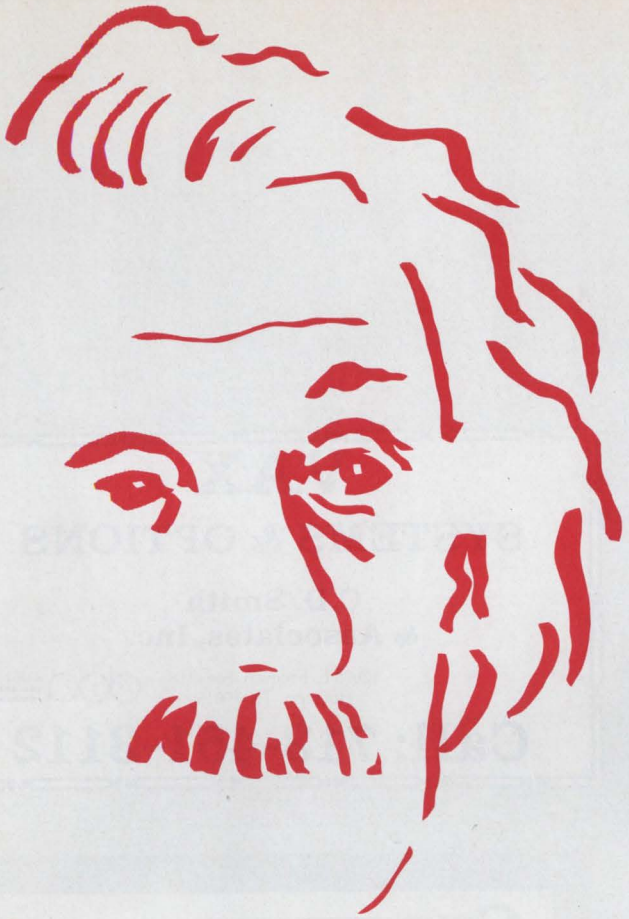

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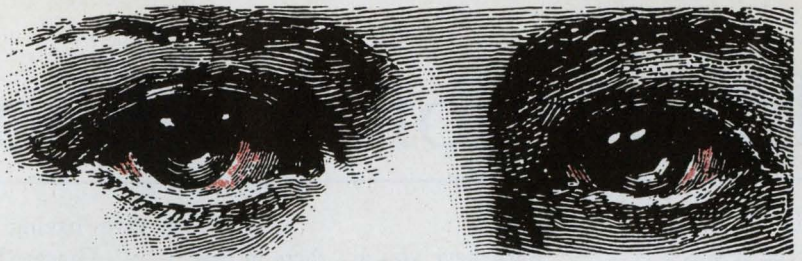

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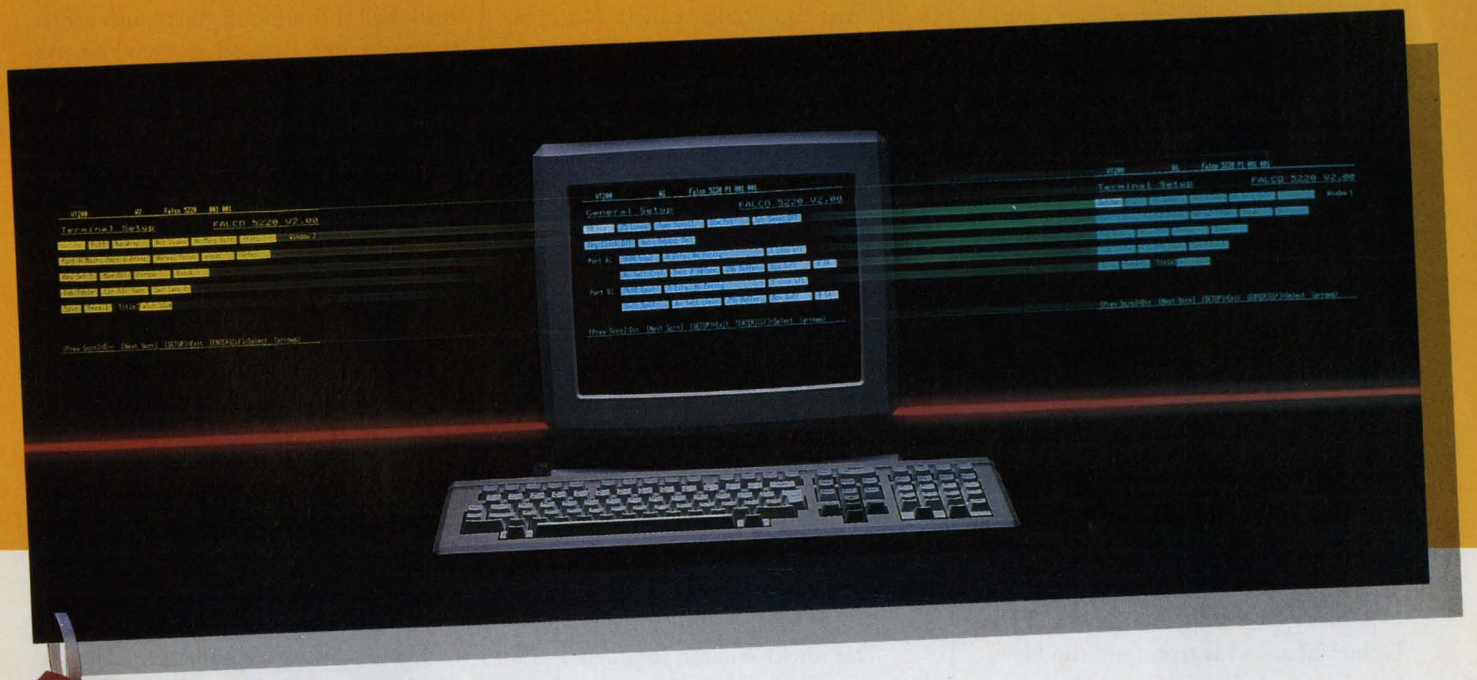

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BACK END

John C. Dvorak

Innovation Or Idiocy?

I found it in the street. It was a video tape of an old TV game show hosted by Jan Murray. I assume it was a pilot that must have been rejected. It was called *Innovation or Idiocy.* When the announcer said the word "innovation," a chime sounded. After the word "idiocy," there was an off-key buzzer. It was worth watching once, I thought.

"Ladies and gentlemen. Welcome to *Innovation* (ring!) *or Idiocy* (buzzz!). The game show that lets you be the judge. We'll bring out 10 contestants with new product ideas and you tell us whether the ideas are innovations (ring!) or idiocy (buzzz!). And heeeeere's our host . . . Mr. Jan Murray!"

"Howdy everybody. Welcome to our show. You in the studio audience each have two buttons in front of you and you'll vote for today's winner for innovation (ring!). The contestants have two minutes to explain their products and then answer a few questions from our celebrity panel."

"First we have Grace Hopper of the U.S. Navy. Ms. Hopper, (May I call you Grace? Thanks.) is from, uh, the Navy. She invented the first computer programming language. Well, I didn't know that. Welcome aboard, Grace!

Applause.

"Next, we have Evander Holyfield, the junior heavyweight WBA boxing champ. I'm sure they don't call you Junior, do they? Hahaha."

Applause.

"And finally, Norman Lear, TV producer. And a fine one at that."

Applause.

"Let's bring out our first contestant. From Redford, Oregon, Mr. Sam Beechum."

Applause.

"What have you got there in that white box?"

"Well, Jan, this is an innovative new software package. I figured once it's released it'll outsell everything ever marketed before it."

Murray takes the box and eyeballs it, shrugs his shoulders and looks over at the celebrity panel.

"Any questions panel? Norman, you look puzzled!"

Norman: "I don't know much about the software business. Does it have something to do with clothing?"

Grace: "It's computer software. Programs."

Evander: "Why is the box white? And I don't mean that to be a racially motivated query."

Sam: "You've stumbled on our ploy. If you recall, one of the Beatles' largest selling record albums was the *White Album.* We feel that a software package that captures that magic will sell like hotcakes. So we're selling it in a plain unmarked white box. Pretty innovative huh?"

Grace: "What's the product do?"

Sam: "Recipe filing."

The idiocy buzzer sounded and a huge hook jerked Sam Beechum offstage.

"We'll call that one 'no contest,' ladies and gentlemen.

"Our next contestant is George Parker. George, tell us about your innovation. I see you have a large TV projector, a computer and 10 keyboards."

"We use more than one computer at a time, Jan. This computer consists of 10 keyboards and a large screen that can be seen by 10 people. Whoever wants to use the computer just looks up to see if it's in use. If not, he starts typing away on his own keyboard. The company saves having to buy 10 machines!"

Grace: "I once saw something like that at M.I.T."

George: "I went to M.I.T."

"Audience, please vote!

"Our next contestant is Bruce Curtis. Tell us about your device, Bruce."

Bruce: "This is the dynamical chair cursor positioner. It looks like a chair, but has the functionality of a mouse or track ball. I first hook the connector to the computer, then sit in the chair. As I shift the weight on my rump around, I can position the cursor accurately on the screen. In this way, the computer user doesn't have to take his or her hands off the keyboard to move the cursor around."

Grace: "I once saw something like that at M.I.T."

Evander: "What if you weigh, say, 300 pounds?"

Norman: "I like it."

"Ladies and gentlemen, please vote!"

There were guys with handles for software boxes. One guy brought a lens filled with oil to place in front of a Macintosh to make the screen appear larger. Someone brought in a LAN that he swore worked and soon would be the standard network. It used ThinWire and was called *Hair Net.*

The tape was winding down and the audience made its selection. It was a tie between a guy who made edible RS-232 cables and the new 18-pound Compaq portable. I moaned and the tape snapped. I thought to myself, "Should I splice it to see what they won?" "Idiocy (buzzz!)," I said as I tossed it in the garbage.

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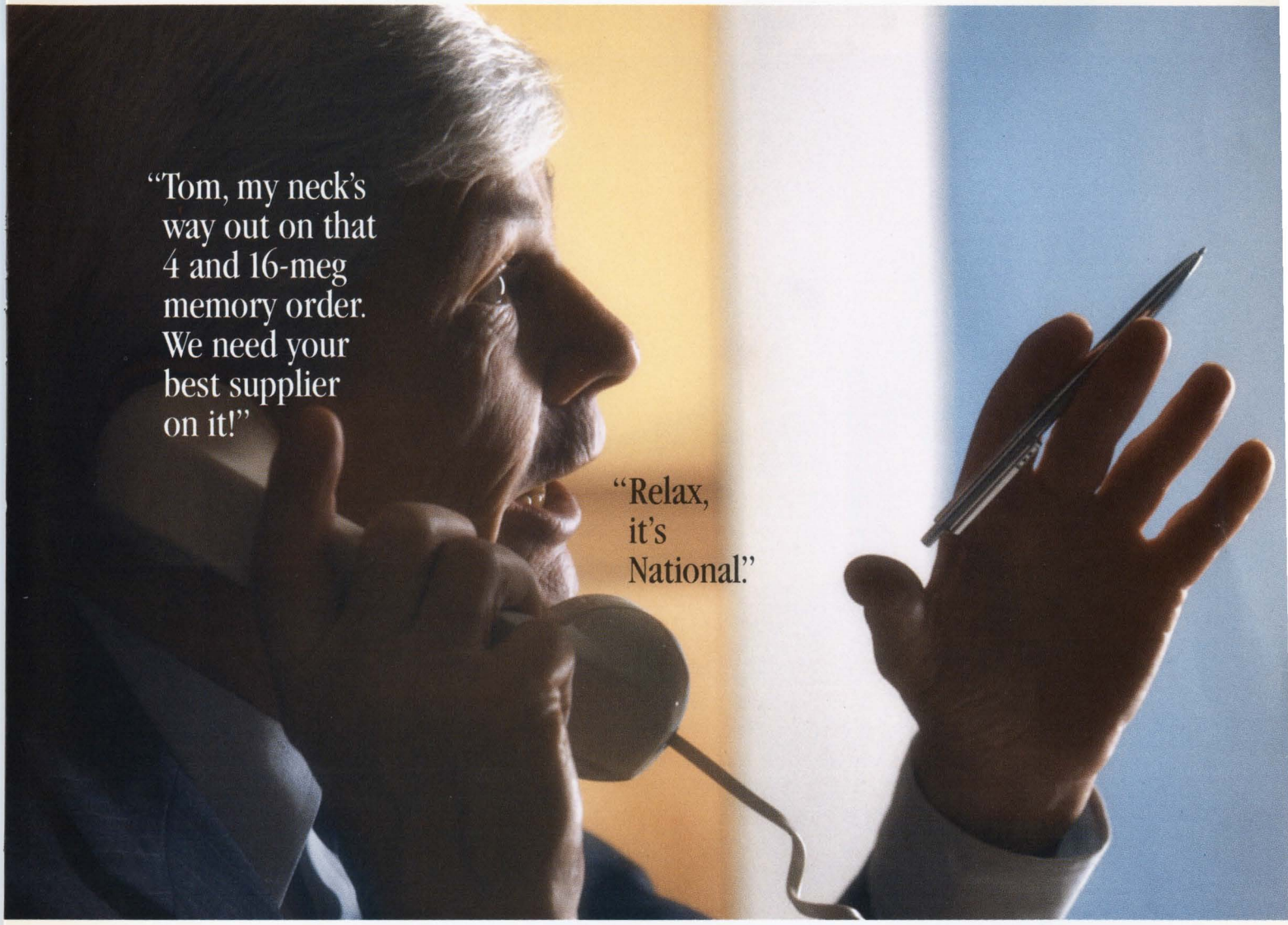

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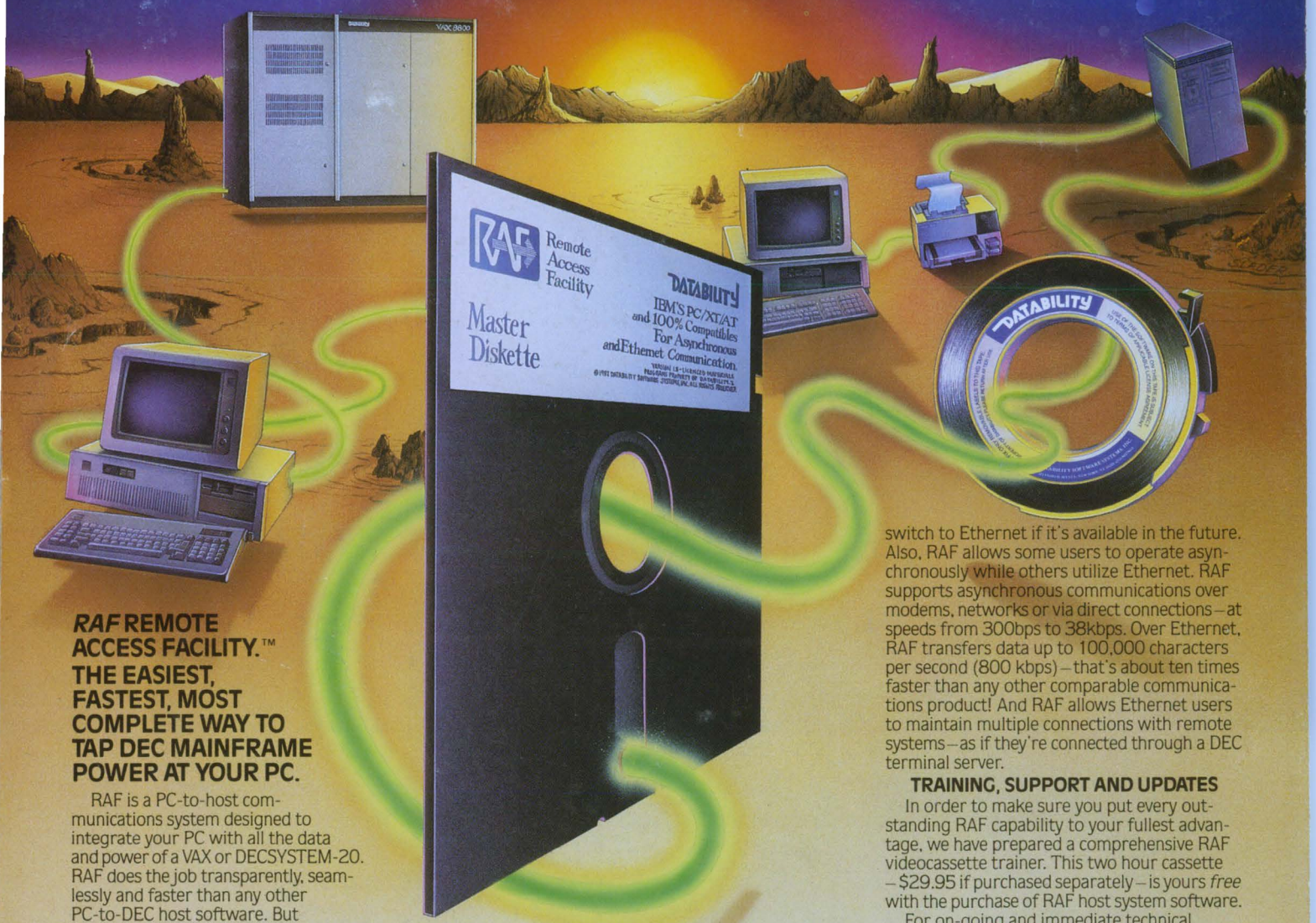

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