

UNIX™ REVIEW

THE PUBLICATION FOR THE UNIX™ COMMUNITY

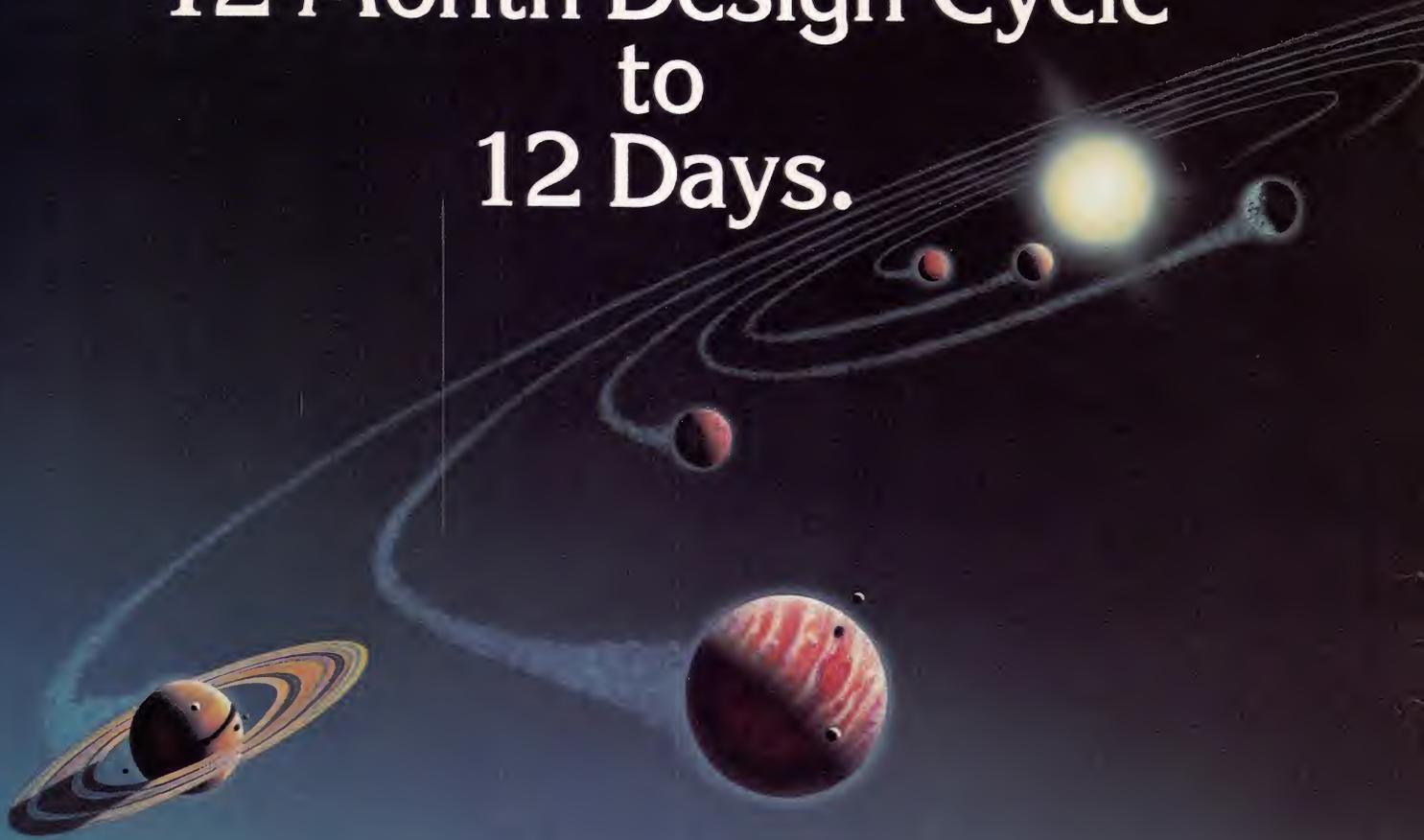
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VIEWPOINT

UNIX moves into the fast lane

The race is on.

The stakes are up.

In the featured event, we find two of the world's most fabled heavyweights, IBM and AT&T, battling for UNIX market supremacy. To the side scramble scores of smaller firms looking for market hedges against an impending UNIX shakeout.

Those still around when the dust finally settles stand to profit handsomely. UNIX interest is already high and continues to soar. Studies (see page 26) show exponential market growth reaching into the foreseeable future.

Not everybody, of course, applauds such developments. A substantial body of users with research/academic leanings regard the commercialization of UNIX with bemusement at best.

The changes, nevertheless have come and *UNIX REVIEW*, too, must grow to keep pace.

Some differences should already be apparent. We have a new look, a new production schedule and lots of new faces. We think you'll like the improvements.

We also think you'll like the changes we don't make. Much of what *UNIX REVIEW* has been will remain unaltered. Under David Fiedler's steady guidance, the magazine has developed a reputation for technical excellence. We mean to continue that tradition with a technical review board containing some of the finest minds in the UNIX community and a top-flight cadre of monthly columnists. You can count on *UNIX REVIEW* to be timely, analytic and hard-hitting.

Among the luminaries now helping to shape directions for *UNIX REVIEW* are Dr. Stephen Bourne, author of the standard programming shell bearing his



name; Bill Joy, author of the C shell, vi and termcap; Ted Dolotta, former director of Programmer Workbench activities at Bell Laboratories; Dr. Greg Chesson, creator of uucp protocol; John Mashey, one of the leading contributors to the Programmer's Workbench; Jeff Schriebman, president of UniSoft Corporation; Deborah Scherrer, noted Lawrence Berkeley Labs computer scientist; Jim Joyce, president of International Technical Seminars; Walter Zintz, executive director of Uni-Ops; David Fiedler, editor and publisher of *UNIQUE*; and Gene Dronek, author of the Aim Benchmark Suite.

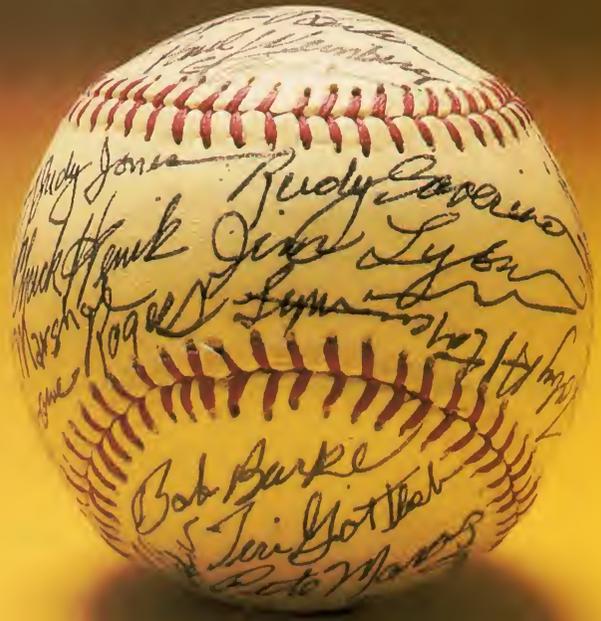
Each forthcoming *UNIX REVIEW* issue will put a selected topic into sharp focus, with commentary and insight from a variety of industry sources. Regular columns will help keep you informed of hardware announcements, software releases, forthcoming books, industry developments, marketing trends, technical tips and programming topics.

But, enough of the prologue. Read on and judge for yourself.

Oh, and by the way - do enjoy the race.

-Mark Compton

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The individual

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DEVIL'S ADVOCATE

AT&T and IBM stake out their turf

By Stan Kelly-Bootle

It will probably not be needed by an audience of proven discernment (may I leave the proof as an exercise for readers?), but I dutifully append:

UNIX is a Trademark of...some say Western Electric, some say Bell Laboratories, others cite AT&T, while still other indict AT&T Bell Laboratories, which seems the safest combination...

Such talispersons appear as rabbit's footnotes in most trade journals, and for good reason. My legal advisors, the broad-minded partnership known as O'Reilly, Schwartz, Mbotto, Wang, Saloli, Zapata & Smith, warn of the direst consequences to anyone failing to impute AT&T with the name UNIX and all it entails. Offenders, they say, can have their CTRL-Cs disabled and may even be confined to 86-DOS, Version 1.0, for up to five years. The fear, of course, is that UNIX might degenerate into a generic synonym for OS (Operating System), just as kleenex is now just any old tissue and hoover is any old red-baiting head of the FBI. However flattering such collectives may seem, marketing managers suffer much angst over visions of a confused public purchasing the wrong product.

Older readers may recall that in the 1950s, even IBM computers were sometimes called Univacs, al-



though recent studies suggest that IBM has suffered less than Sperry from this misnomeration.

I suspect that those who anxiously guard the UNIX Trademark have nightmares in which a prospective buyer approaches a friendly Computer Boutique salesperson:

"Does this Apple™ come with UNIX?"

"But, of course, sir/madam! This board gives you CP/M unix. Or you can have Apple DOS unix. You want unices, we got unices. Look, here's a PC-DOS unix; see them directory paths? hear them shells? Very unical indeed!"

"Does it have icons?"

"ICONS? Step right this way. You know, it really is a pleasure to sell to someone who keeps slap-bang up-to-date and demands state-of-the-

art. Here we have Macunix, just arrived today. Look at that screen absolutely seething with icons. And observe, they are not your Sesame Street, Mickey Mouse™ icons! These are the Berkeley icons, each one a challenge to your fund of art history trivia. Lots of fun. Here's an obvious one; this little portrait of Saint Jérôme en cardinal — you've already guessed: El Greco. I don't know them all yet. Let's try this French looking dignitary. Whoops! That must be Préfét Poubelle, the man who invented the trash can. I think I have a backup disk somewhere..."

You will readily understand why I take this Trademark imperative seriously in spite of the fact that whole classes of everyday words have been requisitioned and protected by hardware and software suppliers. I doubt there is one free fruit left in any orchard since the Apple™ spawned a cornucopia of oranges, gooseberries and no end of lemons. The Dictionary of National Biography has been thoroughly scoured for the catchy names of the great in order to add gloss to unworthy and irrelevant endeavors. I fear that Kant and Wittgenstein alone (and for different reasons) will escape the fate of Plato, Solon and Victor Emmanuel II.

The glut of Trademarks has been further increased by the insidious use of the wildcard " * ", whereby * stands for any string of any length. Intel™, for example,

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claims not only the letter "i", but MCS*, iCS* and many others — indeed an infinite number of appellations. ComputerLand has attempted to keep a lien on *Land in spite of prior claims from Disney and picky parts of the United Kingdom.

My inclination to join the crowd was triggered by the trademarking of 1-2-3 by Lotus Development Corporation. Ah, ah, I thought, if Lotus can manage to commandeer a few inductive axioms, before you can say "Joko Peano," they'll have cornered the entire set of positive integers! There was no time to lose. I called my legal consortium. Damn, they were all out except for Smith.

"Listen and listen good, Smith," I shouted. "I want a rush Trademark on the digits of greek pi."

"Too late," snapped Smith, "Moussaka Graphics was here this morning; they've registered just about every pie chart you ever saw..."

"Not pie charts," I roared. "I'm talking three point one four one five nine...more!"

"Will you accept twenty-two over seven?" Smith implored. "It's quite close and you'll save on the application fees."

I was in no mood to compromise. "Alles, Smith. I want the whole shebang. Every last single digit, whatever the cost. What's at stake? I'll tell you what's at stake! The whole of Mathematics is being blackmailed by a \$600 spread sheet!"

The rest is history. To underpin

Machines. Daring scouts had probed patiently to detect a weakness in IBM's market coverage — any slight fissure in the apparently impregnable citadel that IBM-watchers might call a "niche," some speck in the market not reached by an IBM device. There were precedents, such

ComputerLand has attempted to keep a lien on *Land in spite of prior claims from Disney and picky parts of the United Kingdom.

our rights, we booked Sir Laurence Olivier to recite greek pi to 100,000 places. His riveting performance is available on 30 historic LPs — the world's first digital recording.

AT&T, meanwhile, having fully secured its Trademark, was girding the loins, stiffening the corporate sinews and summoning the blood for its first exploratory skirmishes in the Holy War to liberate innocent Commerce, held captive for Seven Hundred and Seventy Seven Years by the cruel Infidel Business

as CDC's sortie into the number-crunching supercomputer niche and DEC's attack on the scientific mini-market. But now — it seemed that wherever one looked, the market was saturated BIG BLUE.

We may never know how AT&T arrived at its recent decision to launch the 3B series of computers. But suffice it to say, the battleground has been established: AT&T has uncovered a niche in the \$8000 to \$340,000 price range! Let battle commence!



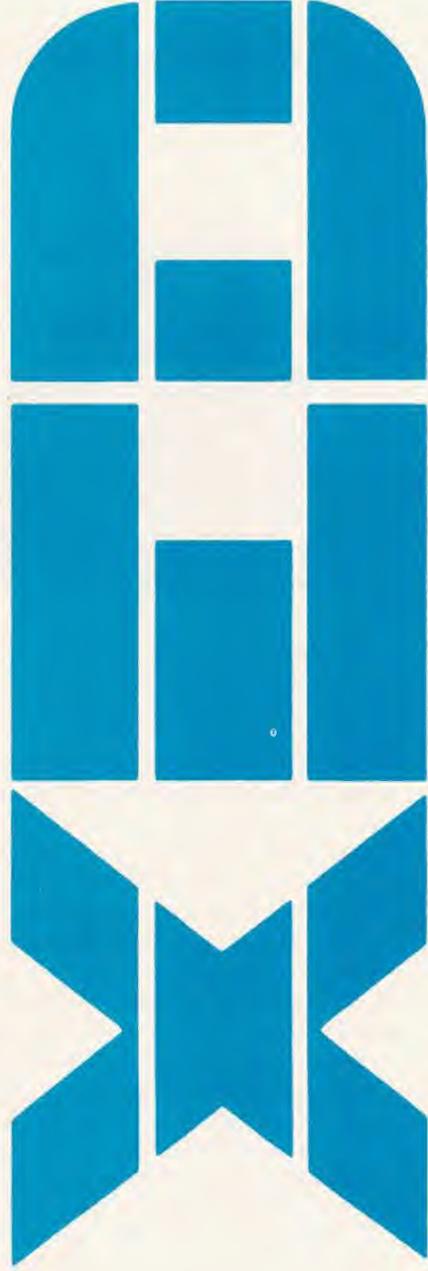
Will AT&T and IBM wage holy war?

ABOUT THE AUTHOR

Stan Kelly-Bootle is a grizzled mainframer who worked on the pioneer EDSAC I at Cambridge University in the early 1950s. As founder/President of the LISA Moaners' Club, he urges more machismo and less user-mollycoddling in software. In spite of some reservations, he feels that UNIX is a bandwagon heading in the right direction. His exposé of computer scientific epistemology in the lexicographic environment, "The Devil's DP Dictionary" (McGraw-Hill, 1981), is to appear soon in a Japanese language edition (Shizen Sha, Tokyo). ■

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INDUSTRY INSIDER

AT&T: The multi-billion dollar startup

by Mark G. Sobell

The UNIX market suddenly got a lot larger March 27, when leviathan AT&T announced its entry into the general purpose computer field. Unveiled at that time were three lines of computers based on UNIX system V, an Ethernet-compatible local area network and an IBM PC interface (for low-end machines).

The announcement didn't really surprise anyone - AT&T has been building computers and operating systems for a long time. But AT&T's first venture into retail enterprise does raise some very interesting questions:

What is AT&T's capability in the UNIX marketplace?

What effect will AT&T's computers have on competing hardware products?

What will AT&T's announcement mean to UNIX software manufacturers?

Before pondering these issues, though, let's take a closer look at the products themselves.

THE MACHINES

The smallest (3.6" x 22" x 17") of the new machines is the 3B2. AT&T calls it a "desk-top super-micro" and claims it will support 18 users. The 3B2 is built around the WE32000 microprocessor (the old BELLMAC-32A chip from Bell Labs) and comes with 1/2 to 2 MB of memory, either a 10 or 30 MB



disk and a 5-inch floppy disk drive.

The basic machine sells for just under \$10,000 and includes what AT&T calls "UNIX System V Core Package" software. According to Bob Sellinger, Application Engineering Manager for VARs (Value Added Resellers) at AT&T, the software that comes with the package will bring the system up and shut it down. It also includes a basic editor (ed).

The basic package, though, is truly basic. If you want the mail utility, you must buy network software for \$100. If you want to compile a C program, you can purchase a C compiler costing \$340. The **termcap** package comes as part of a terminal filters option. The vi editor is packaged separately from the spooler which in turn is separate from the FORTRAN compiler which in

turn is separate from **nroff**. The **nroff** program is now part of the Documenter's Workbench, a product that will not be available until "later this year."

AT&T has unbundled UNIX. Too bad. One of the most important features of UNIX is that a full complement of standard tools is always at the user's fingertips. Of course, under the AT&T scheme, users can still buy all the tools. Often, though, because of price, ignorance or wishful thinking, many of the tools won't be purchased. Much of the power of UNIX will thus be lost.

UNIX software manufacturers often design their products to make use of the tools typically bundled with UNIX. Many programs, for instance, may founder without tar to unload tapes and disks, make to install programs and any number of other UNIX utilities so common as to be considered an integral part of the operating environment.

Another questionable aspect of the 3B2 is its lack of a backup device other than the 5-inch floppy disk drive. It takes about 14 floppies to back up the 10 MB drive. Backups of the 30 MB drive, meanwhile, could easily consume 55 floppies - a reasonable demand to make of any user. Generally, if it is not easy to back up a system, the system will not be backed up. Remember also that with the 3B2, we're talking

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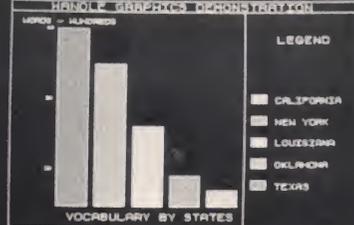
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about an 18-user system.

THE SUPERMINIS

On the next rung up the ladder is the 3B5/100 and 3B5/200, two "mid-range superminis." Again built around the WE32000 chip, AT&T says these machines will support 40 and 60 users, respectively. They feature up to 8 MB of error correcting memory, up to 160 MB of hard disk, a 9-track tape drive and UNIX System V (in its entirety). The 3B5/100 sells for a base price of \$57,000; the 3B5/200 goes for \$73,000.

At the top of the ladder is the 3B20 line. Priced at \$230,000, the 3B20S is the module upon which the remainder of the 3B20 line is built. Think of it as your basic VAX-eater.

The 3B20A (\$330,000) is an S model with an attached processing unit that reportedly boosts performance to almost twice that of a

3B20S. The 3B20D (\$340,000) is a fault-tolerant system featuring duplexed architecture and the UNIX RTR (real time reliable) operating system. The 3B20 line features

true, this would rate as quite a feat. Imagine updating code in the kernel without the system missing a cycle!

The 3B20 is not new - AT&T has been debugging it for years. It

Priced at \$230,000, the 3B20S is the module upon which the remainder of the 3B20 line is built. Think of it as your basic VAX-eater.

programmable microstores that give an OEM or VAR an advantage when customizing for applications.

According to AT&T, the 3B20D will continue to operate during diagnostics, repairs, maintenance operations, software updates and system administration functions. If

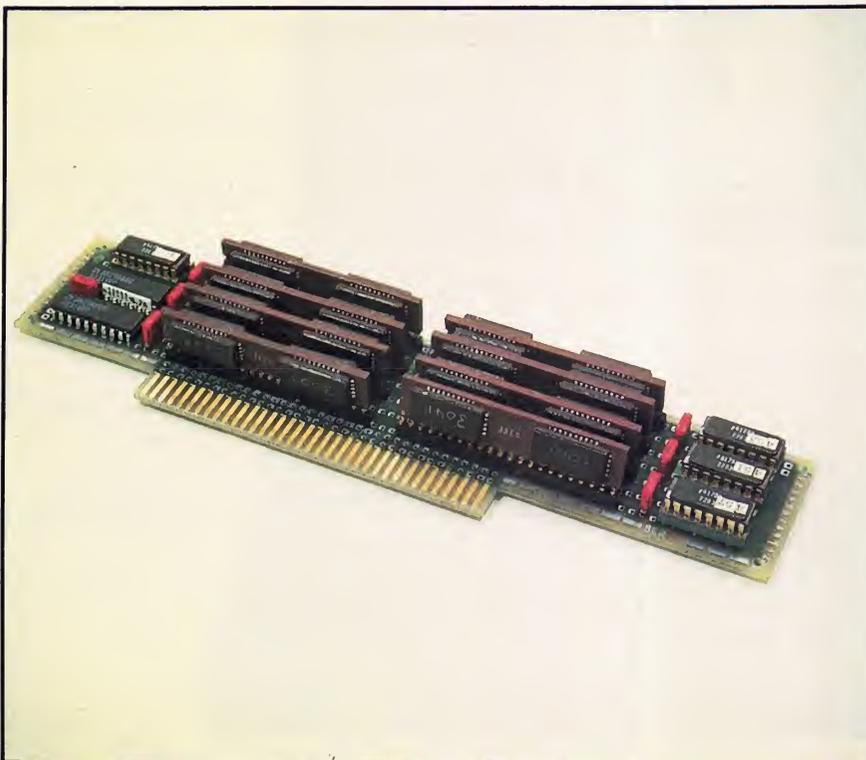
serves as the foundation for the AT&T telecommunications switching network. You use a 3B20D every time you dial an 800 number, so claims of reliability should be well founded.

One more point about the 3B20D: the UNIX RTR operating system is based on UNIX System III. Sellinger said it will be upgraded to System V by year's end. Source code for RTR is not available yet, but training and documentation are.

Neither the 3B5 nor the 3B20 is a virtual machine, but both can have main memory expanded to a very reasonable size (the 3B5 to 8 MB and the 3B20 series to 12-16 MB). The lack of virtual memory on the high-end machines means they will run faster but handle fewer programs at a time. Users will also find the size of the programs limited by the amount of memory. If you're willing to spring for extra main memory, though, the lack of virtual memory should not prove a problem for most applications.

To improve speed, the 3B5 and 3B20 series can also include an optional 8K bytes of cache memory.

The full line of AT&T offerings covers a wide range of user needs, with the most notable hole occurring at the low end. Industry sources expect AT&T to announce a personal computer capable of filling that void shortly. Speculation is that



When AT&T says it builds its machines "from the molecules up," it isn't kidding. This 1 MB RAM array, of AT&T design, is manufactured for the 3B2. It holds 1,048,576 bytes of information.



INTRODUCING YOUR WINDOW TO THE FUTURE.

The highly sophisticated 5620 asynchronous terminal is indicative of what you'll be working with in the future, as well as what you can expect from Teletype Corporation. It's a low-cost, dot-mapped, UNIX*-based terminal that offers a good value in switched or point-to-point private line environments.

What's most impressive about the 5620 is its unique capability to divide the display into multiple "windows" of varying sizes. Our electronic red "Mouse" lets you easily create and control the windows. And because the host views each window as a separate terminal, several functions can be in process on the 5620 at once. For example, a programmer can work on one program while one or more are compiling and the terminal is receiving and displaying electronic mail. You can also download the 5620, and run programs independent of the host.

While the 5620 is a programmer's dream, it's also a valuable business tool. It can be used to compare and contrast multiple business situations or cases simultaneously; to develop one case while one or more are being executed; or to examine two sets of files from more than one data base side by side.

You'll enjoy extremely high resolution no matter how much you put on the screen. The dot-mapped display boasts 100 dots per inch resolution on a 15 inch diagonal monitor. You can address a dot anywhere on the screen, which gives you full graphics capabilities. Line drawings and tracings can be made with the "Mouse".

Although the 5620 is complex, it's not difficult to operate. You can use the "Mouse" to control terminal functions through a series of user-friendly menus. There's also a full complement of ergonomic features like a low-profile keyboard that's light enough to rest in your lap, a high resolution screen with brightness control, and a special faceplate to reduce glare.

Of course, you can count on our established nationwide service organization for prompt service.

If you want to know what the future holds, take a look at our 5620. Its windows make it easy to see what's in store for Teletype Corporation and you. For more information, write Teletype Corporation, 5555 Touhy Ave., Dept. 3223-00, Skokie, IL 60077. Or call 1 800 323-1229, Extension 615.

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AT&T
Teletype Corporation

the machine will be IBM PC compatible. That certainly makes sense in light of AT&T's announcement of a PC interface.

THE NETWORKS

The PC interface works only with the 3B2. It connects one or more IBM or IBM-compatible Personal Computers running MS-DOS to a 3B2 using either an Omninet, Ethernet or RS-232 serial interface. It allows PC users to share the resources of the 3B2, execute commands on the 3B2 and load and unload files from the 3B2.

The 3B Net is a sophisticated, high-end, Ethernet-compatible local area network. It supports remote diagnostics, the capability of connecting to other machines on an Ethernet network and a master node for system administration.

THE SOFTWARE

UNIX System V Release 2 runs the full line of new products. It's AT&T's baby. Now that the AT&T folks have maneuvered the UNIX market where they want it, they're jumping head first into deep water. The scramble is on to get application

machines is that the 3B2 and 3B5 are reportedly object code compatible. The 3B20 line is upwardly source code compatible with the smaller machines.

CUSTOMER SUPPORT

A haunting question that inevitably arises is: how well will AT&T be able to support its customers? It is setting up 150 service centers and a number of 24-hour hotlines. But supporting customers in the use of a complex computing system is a far cry from teaching them how to use a telephone. Maintaining a computer is also very different from keeping a telephone working.

Look at the support offered by the mainstays of the high-end market, DEC and IBM, and you will see that both have built their reputations on service. Is AT&T going to be able to offer a comparable level of service fresh out of the starting gate?

VAR AND OEM SUPPORT

When asked whether the bus specs for the machines were available to manufacturers wanting to

and-see attitude because of the many questions that cannot be answered yet.

AT&T has yet to prove itself in both the retail and OEM/VAR marketplaces. If it can provide the necessary support to add-on and peripheral manufacturers, AT&T can better its position by presenting a variety of disk and tape drives, printers, graphics devices and other peripherals to its users. AT&T also needs to show it can provide the sort of customer support it's promised.

AT&T's low-end machines have the potential of simultaneously helping and hindering UNIX-based hardware manufacturers. Aid will be provided by solidifying UNIX as a standard and expanding the market. Damage will be done by taking away market share. For some hardware manufacturers, this may simply mean a smaller piece taken from a bigger pie. For others, though, survival might hinge on finding a profitable niche too small to interest AT&T.

Because UNIX provides excellent software development tools in an environment that is both malleable and common from machine to machine, UNIX software manufacturers should have a heyday. The main concern expressed by these vendors, though, is that UNIX become *the* standard multiuser operating system. There is no doubt but that the AT&T announcement has pushed UNIX that much closer to being the standard. But the question of who will profit most handsomely remains.

ABOUT THE AUTHOR

Mark G. Sobell is the author of "A Practical Guide to the UNIX System" (Benjamin/Cummings, 1984.) His 10 years in the computer industry include programming and technical writing experience. Mr. Sobell has been involved in UNIX for four years and is currently a consultant in the San Francisco Bay Area. ■

Now that the AT&T folks have maneuvered the UNIX market where they want it, they're jumping head first into deep water.

software developed for the new machines. AT&T just signed a "cooperative agreement" with Digital Research to develop a UNIX System V applications library. Most of the machines out of AT&T production this year will also be heading to VARs and OEMs (original equipment manufacturers). Look for several juicy developments to spring from that.

A nice feature of the new line of

build peripherals and other add-ons for the new machines, Selinger said that the architecture was "open." He said that in addition to releasing the bus specs, AT&T also intends to support manufacturers and provide debugging tools. (Does someone want to come up with a cartridge tape for the 3B2?)

CONCLUSIONS

Most people are taking a wait-

WHY DEC AND INTEL CHOSE THE MARK WILLIAMS C-COMPILER.

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UNIX ON THE IBM PC

Now, beneath that mild-mannered
PC-XT exterior beats the heart of a
real UNIX operating system

by Theodore C. Goldstein and Jessica A. Bernhardt

It is springtime on the Texas prairie. Tension builds as storm clouds gather over the home of IBM's Information Systems Group. Without warning, lightning sparks and thunder claps. Could this be a herald of the melding of Big Blue and AT&T's UNIX? IBM's own version of UNIX on the PC has finally arrived.

Dashing inside to avoid the clattering rain, we meet Robert M.

Blake, manager of IBM's Irving, Texas, facility. Our task: preview the Personal Computer Interactive Executive (PC/IX). A survey of our findings follows. Complete benchmark reviews and performance assessments of PC/IX and other PC UNIX products will appear in a forthcoming issue.

Our initial tests found PC/IX to be robust, fast and bugfree. In a

couple of hours, we ported over 2000 lines of system level C code to PC/IX. Like a well-tuned sports car, PC/IX's response time was quick and sure. PC/IX is a very polished product.

IBM's latest product is a solid single-user implementation of Interactive Systems Corporation's IS/3 for the PC/XT. IS/3 UNIX is a slightly enhanced version of AT&T's System III UNIX.

System III UNIX is a fine product, but Interactive Systems has improved it by adding the INed screen editor and the INet network. With the inclusion of INed, IBM has chosen to omit the popular Berkeley screen editor, vi. Also omitted is Berkeley's C-shell command interpreter. C-Shell and vi versions capable of working on PC/IX do exist, but Interactive Systems chose to leave them out since there is no official support for them under AT&T System III UNIX. Since vi is included in System V UNIX, IBM is likely to include it when it upgrades PC/IX from System III to System V.

The current price of System III PC/IX is \$900. Included are 19 floppy disks, several manuals and support from IBM through December 31, 1985.

The minimal system configuration to run PC/IX consists of an XT

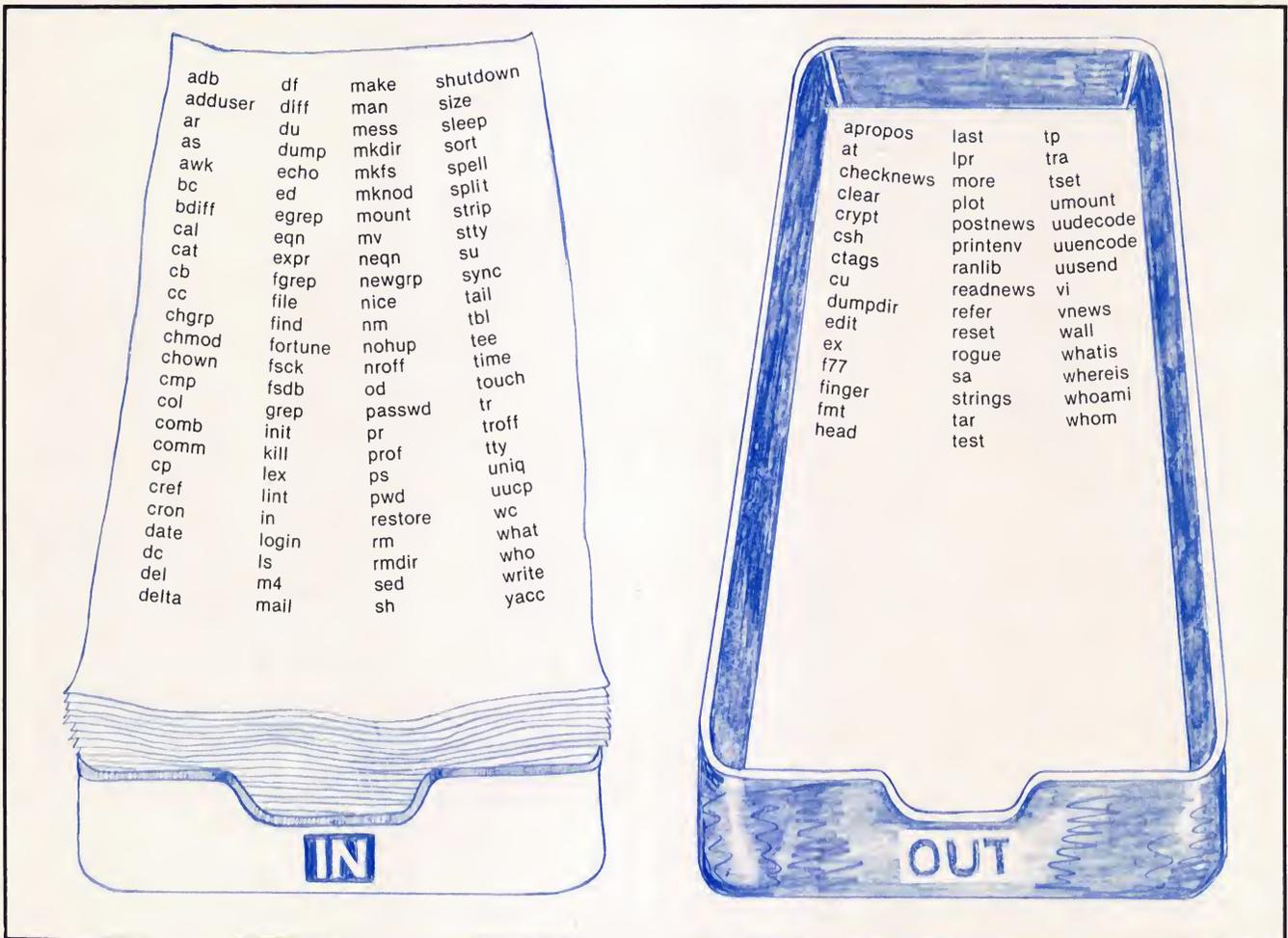


The PC/IX package: PC-XT hardware and 19 diskettes.



Illustration by Hope Epstein

PC/IX FEATURE



The "Ins" and the "Outs" of PC/IX. Space limitations forced IBM to make some choices. Here's a sampling of some common UNIX utilities that made it and some that didn't. Neither list is exhaustive.

model Personal Computer and keyboard, an inexpensive monochrome monitor, 256K bytes of memory and the PC/IX operating system. Together these cost about \$6400, making PC/IX one of the least expensive personal UNIX systems available.

So what's to keep you from placing your order this minute? PC/IX's \$900 price tag may not be much for a minicomputer version of UNIX, but PC-DOS, the most popular operating system on the IBM PC, is available for only \$40. Other PC microcomputer operating systems, including UNIX systems offered by other companies, are available for less than \$500.

Your \$900 will buy you a lot

from IBM, though. First, all System III utilities but **tar** (including **yacc**, **make**, **SCCS**, **nroff** and **troff**) are included in the PC/IX price. Additionally, the package includes full support from IBM through 1985. Typically, other UNIX companies' support services cost as much as half of the purchase price — for a one-year service agreement.

One complaint we have with PC/IX, though, is that the Personal Computer itself has only a comparatively slow 4.2 MHz Intel 8088 microprocessor. Even with Intel's 8087 arithmetic co-processor performing floating point operations, the IBM PC-XT is not a powerful machine.

In the PC/IX memory model,

the 8088 microprocessor is limited to 64K bytes of code and 64K bytes of data space. Users whose applications were developed on the larger VAX or Motorola 68000 will find this restriction cramping.

Moreover, the hard disks are small. Right now only two 10 MB IBM disk drives can run with PC/IX and the normal XT configuration contains only one, half of which is taken by PC/IX.

First-time loading of PC/IX requires about 19 floppies. Fortunately, loading is only done once and requires between a half and a full hour to complete.

Both a benefit and a detriment of the PC/IX system is the IBM PC's lack of memory management

hardware other than some limited segmentation provided by the Intel 8088. This works as a detriment because memory management would provide a limited amount of bounds checking on memory accesses. C language novices (and some experts) often find the implicit bounds checking that memory management provides a big help in locating pointer errors. But in the long run, the lack of memory management should prove beneficial because of the absence of wait states that could slow the system down. Wait states are caused by many memory management systems.

There are plenty of other things to like about PC/IX as well. First, the overall package is cheap and commonly available. There are over 100,000 XT's and XT-compatibles in customer hands already. And PC/IX

joins a family of systems already offered on the IBM PC, including PC-DOS, CP/M and P-System. Perhaps best of all, though, PC/IX comes with IBM support. IBM has already spent extensive time and effort debugging PC/IX, using its renowned quality assurance and beta testing methods. As mentioned earlier, PC/IX is also surprisingly fast.

WHAT MAKES PC/IX FAST?

To find out what makes PC/IX fast, we asked Brian Lucas of ISC in Maryland. Lucas replied that the way to make UNIX fast on the PC is to minimize the number of disk accesses involved.

"We pre-allocate up to eight contiguous 512K byte blocks at a time when we write a file," he

explained. "Before we do a disk read, we examine the I-node to determine whether the block we are about to read is contiguous with later blocks in the file. If it is, we just read all blocks in the memory block buffer pool."

Lucas went on to explain that PC/IX directories are handled similarly, except that only two blocks are pre-allocated at a time. Regular System III UNIX reads only one block at a time for both data and directories. UNIX also normally reads a program image off the disk into the block buffer pool and then copies it out of the block buffer pool into the memory location where it will be executed. Not only does this cause a wasteful copy, but it also means program data and programs compete for space in the block buffer pool. PC/IX fixes this problem by

IBM'S LENGTHY UNIX COURTSHIP

IBM started the PC/IX project over two years ago. There are rumors that the port of the project was completed as much as a year ago. So why is IBM only now releasing PC/IX?

"It took a year to turn UNIX into a product acceptable to IBM's high standards," said Robert Blake, manager of IBM's Information Systems Group. "AT&T's Bell Labs and the academic community developed UNIX in a very different fashion than IBM usually develops its products."

IBM has built a market-driven corporation around a mammoth hierarchy. Products are created and planned through intensive market research and extensive specification to support succeeding generations of

hardware systems. IBM, better than any other computer company, supports its hardware and software products with elaborate manuals and prompt bug fixes. The excellence of its support, more than anything else, keeps customers flocking to IBM.

For better or worse, UNIX ideology is the antithesis of IBM ideology. Rather than being market-driven, UNIX design was largely shaped by the technical motives of individual programmers. These motives ranged from pure and applied Computer Science objectives to interests in creating a more comfortable programming and writing environment. Only recently with the divestiture of the Bell System, has AT&T started to develop and mar-

ket UNIX as a salable product.

This, in large part, explains why UNIX suffers with many flaws. UNIX commands are not always consistent. Many are not particularly "user-friendly." Perhaps worst of all, documentation is disorganized and sometimes wrong. In spite of these flaws, UNIX's popularity grows due to its simplicity and elegance of operation. Once users pass the documentation barrier, they find UNIX to be a powerful and easy-to-use system.

IBM, which never wants to be left out of any marketplace, has thus introduced its own UNIX product, PC/IX.

"We wanted a UNIX product up to IBM's high product standards

Continued on Page 60

“Intelligence...is the artificial objects, especia

This quote appeared in a 1978 issue of *The Bell System Technical Journal* that was devoted to a series of papers constituting the first complete description of the UNIX™ operating system.

At that time, UNIX was used primarily by sophisticated programmers.

No longer. INTERACTIVE now offers UNIX software tools for every computer user: executives, engineers, office workers, and our oldest customers—those sophisticated programmers who have built UNIX into a major new force in the computer industry.

Here's how we built our enhanced version of UNIX.

First, we simplified the user's interface to UNIX.

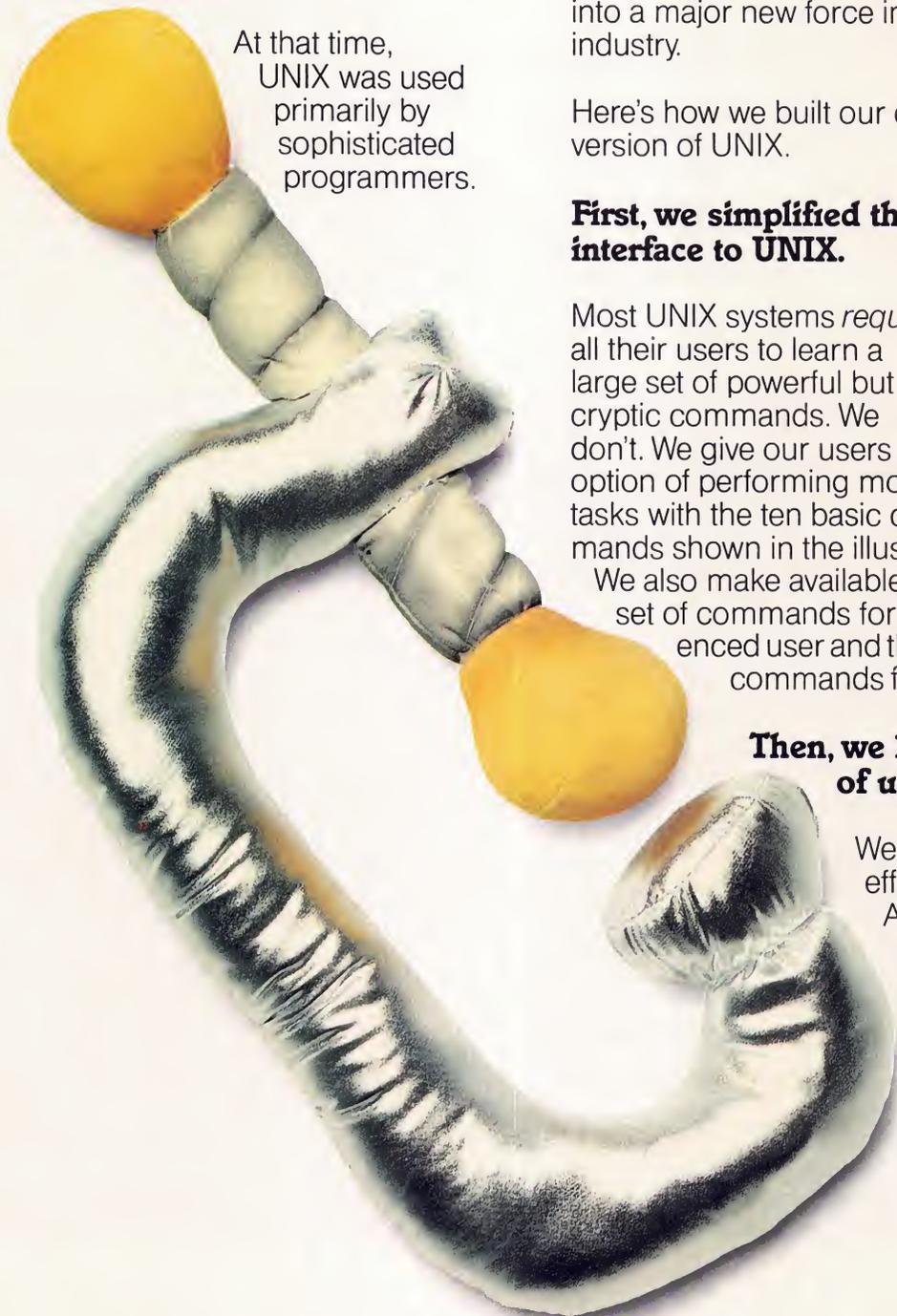
Most UNIX systems *require* all their users to learn a large set of powerful but cryptic commands. We don't. We give our users the option of performing most tasks with the ten basic commands shown in the illustration.

We also make available a larger set of commands for the experienced user and the full set of commands for the UNIX expert.



Then, we lowered the cost of using UNIX.

We've improved the efficiency of UNIX. And we shifted some of the workload from the



faculty of making ily tools to make tools.”

—Henri Bergson (1859-1941)

central processor to intelligent terminals. You can use our intelligent terminal or the IBM® Personal Computer to perform tasks normally assigned to a UNIX central processor.

Next, we adapted our software to new systems.

We started with our IS/3 system running on DEC™ PDP™ and VAX™ computers. And we refined our major tools so that they run as an extension to DEC's VMS™ operating system.

Recently, we adapted the entire IS/3 for the IBM Personal Computer. That product is now available from IBM. We have also completed a port of IS/3 to the SCI 1000, a multi-user system sold by SCI Systems.

Now, we're adding the applications needed in corporations and other large organizations.

We are already delivering an electronic mail system and a very sophisticated networking system. Our users can exchange files, share central resources such as laser printers, or send mail anywhere in a network. We are also delivering FORTRAN compilers, C

compilers and cross-compilers, and a powerful system for preparing memoranda, manuals, and other documents. We even have an option that allows you to send or receive mail through the TWX and Telex networks.

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doing the disk read of a program directly into the memory location where it will be executed. PC/IX thus utilizes memory more than most UNIX systems to save time spent accessing the disk. Large amounts of memory also help PC/IX run faster by providing more space in the block buffer pool. A PC/IX system runs fastest when it has the full 640K bytes of memory supported by the IBM PC.

Not only is the disk input/output fast on PC/IX's — it's also reliable. One of our favorite ways to test reliability of a system is to start as many processes as possible accessing the disk — and then pull out the plug. UNIX gurus may shudder at the thought, but it is an excellent way to test a system's reliability. PC/IX survived the test with flying colors, showing no file system corruption whatsoever. (We do not recommend this action, by the way, during normal use of any system.)

Lucas also discussed how floating point arithmetic work is accomplished on PC/IX. PC/IX supports floating point arithmetic both with and without an Intel 8087

arithmetic processor.

"Basically, to perform floating point computations, the compiler emits an interrupt call which traps out to the kernel," Lucas said. "The PC/IX kernel knows from the configuration switches whether or not the system has an 8087 installed. If the hardware system does have an 8087, the PC/IX kernel modifies the invoking program's code space by changing the instruction from an interrupt call to 8087 instructions directly. If the XT does not have an 8087, the PC/IX kernel invokes a floating point emulation subroutine which performs the desired operation."

Since the 8087's work is transparent to application software, the programmer never has to be concerned with whether or not the system actually has the arithmetic processor in place or not.

RECORD LOCKING

Another nice feature of PC/IX not common to many other UNIX systems is its record locking scheme. Record locking allows multiple

programs to concurrently access records in a file without the risk of each accidentally overwriting the other's operation. While there are a number of record locking schemes currently under discussion in the UNIX community, the /usr/group UNIX Standardization Committee has yet to issue a decision as to which is best. Interactive Systems chose to adopt for PC/IX the most common record locking scheme designed by John Bass.

Bass's method is elegantly simple. The program seeks a file pointer to the record using the `lseek` system call, and then issues a lock system call to specify the length of the record to be locked. For ease of use, contiguous locked records may be unlocked with a single `unlock` primitive. Processes may also suspend execution while waiting for a record to be unlocked. This record locking system is identical to the one supported by Onyx and Plexus.

Since PC/IX is a single-user system, record locking is largely superfluous. But a database distributed over several PC/IXs (distributed server model database system) would depend upon this sort of functionality to provide support for consistent transactions.

LANGUAGES

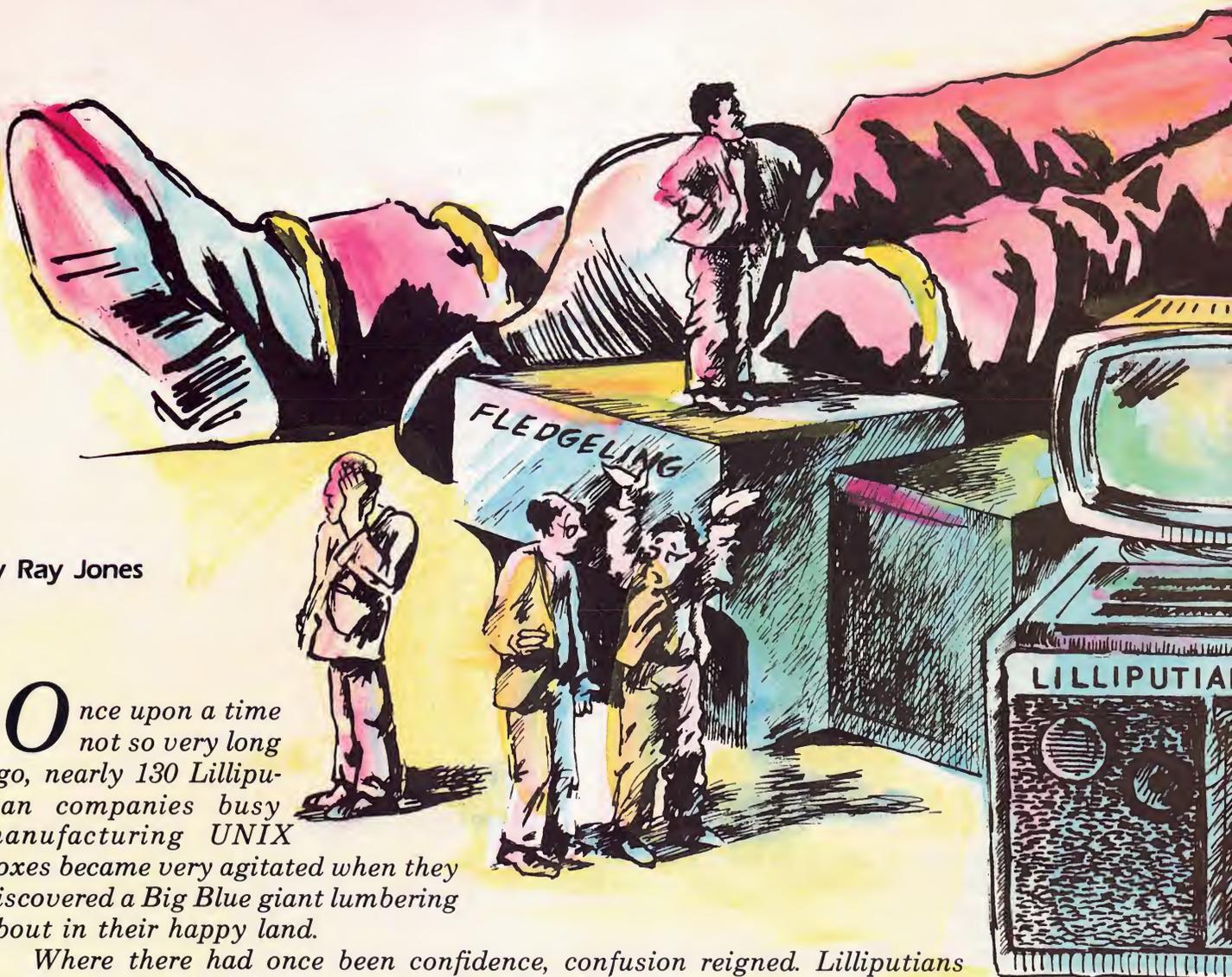
To develop system software on PC/IX requires either the use of C or assembly language. The assembly language available is the usual horrible UNIX assembler that encourages programmers to write in a higher level language. The only high level language PC/IX currently supports is Version 7 C. More high level languages will be supported, however, as ISC develops them or as IBM acquires them from third party software vendors (see below). [Editor's Note: *Infort*, a FORTRAN compiler based on AT&T's FORTRAN 77, was released by IBM in early May.] The `lex` and `yacc`

Continued on Page 92



IBM MOVES IN FOR ITS SHARE

What's to become of the little guys?



by Ray Jones

Once upon a time not so very long ago, nearly 130 Lilliputian companies busy manufacturing UNIX boxes became very agitated when they discovered a Big Blue giant lumbering about in their happy land.

Where there had once been confidence, confusion reigned. Lilliputians previously proud of their strategies for selling little boxes suddenly began to question their wisdom. They didn't know whether to rejoice, knowing the giant would open new territories; act normally, hoping the giant wouldn't notice them; run for cover; or flee the land altogether. They wondered if perhaps they shouldn't simply try to run a bit faster or attempt to beat the giant at his own game.

Which way to go? What to do? Only one thing was sure: Lilliput would never be the same.



Illustration by Hope Epstein

The shadow hanging over Lilliput, of course, is cast by the looming presence of IBM.

While some UNIX microcomputer companies might ask, "Why? Why us?" The question many industry observers are asking is: "What took IBM so long?"

Simply put, IBM is a market-driven company. Other companies do the pioneering. IBM does the cleaning up — *after* a market has already been established.

Each IBM announcement is backed by months of exhaustive research. The parameters of developing markets are closely studied and the effects a new product might have on existing IBM product lines are analyzed. By the time IBM is ready to move, it has determined the size of the market it intends to enter, knows the rate at which the market is likely to grow and has assessed its own penetration potential. Perhaps most important of all, IBM moves only after researching the desires and needs of its target clients.

So by sheer virtue of IBM's entry into the UNIX microcomputer market, other manufacturers can now be certain the market really exists — and that IBM has come in for its share. That share will

probably exceed 30 percent within the next two years. Let's look at the IBM product and try to determine why it will pack such a punch.

THAT OLD BLUE MAGIC

Is the processor faster? Does it have more memory or more disk space? Does it offer better communications? Is its UNIX port that much better? Does PC/IX cost that much less?

The answer to all these questions is an emphatic, "No!" But IBM does have an adequate product for the market segment it has chosen. And when a product bears the IBM emblem, adequacy suffices.

company that will surely be there when needed for support. IBM customers *know* that adequate documentation will be available and that there will be plenty of applications software for the system.

UNIX MARKET GROWTH

So just what is the current market and what immediate effects will the IBM entry have? The current installed base of sub-licensed UNIX is approximately 120,000 units, 65,000 of which were shipped in 1983. The 1984 projection holds that yet another 130,000 units will hit the market (Gnostic Concepts, Inc., 1984). To this we need to add

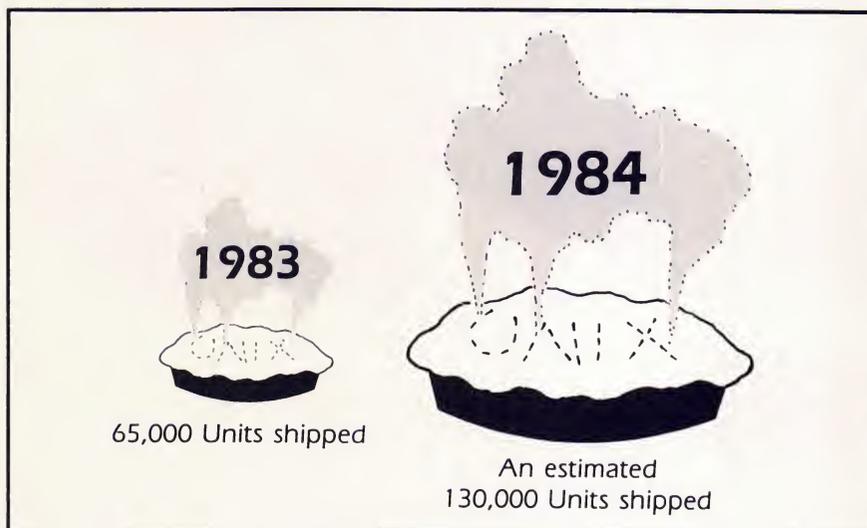
*Simply put, IBM is a market-driven company.
Other companies do the pioneering, IBM does
the cleaning up...*

From the perspective of the end user, there is enormous comfort in dealing with a large, well established

the installed base of non-licensed UNIX work-alikes — estimated to be about 125,000 in number.

The effects of IBM's entry should be positive for the UNIX market as a whole. End users, in particular, stand to benefit from a huge increase in the amount of software written or converted to run in the UNIX environment. One need only look back a couple of years at what happened in the MS-DOS market to verify this. When first introduced, MS-DOS application software was negligible. Now there is no operating system that offers more.

Until now, UNIX was found chiefly in environments where sophisticated users were willing to put up with "user hostile" aspects of the operating system. But penetration outside the software development, scientific, engineering and academic markets was limited.



UNIX hardware manufacturers can now feed from a bigger pie. Market forecasts show a 200 percent growth in sales this year.



Life just isn't fair. An elite handful of hardware manufacturers (seven in all) command a whopping 67 percent of the UNIX market, leaving only slim pickings for the vast majority of vendors.

To overcome this, much of the UNIX software currently being introduced hides the operating system from end users with menu front ends and other "user friendly" devices.

The rate at which this software is being developed is staggering. A study conducted last November could identify only 179 software packages available under UNIX (*UNIX Application Software Directory*, Onager Publishing). A subsequent study conducted five months later by the same group found 400 packages.

With the entry of IBM, many more packages will now be generated or converted to UNIX. By this time next year, there should be 800 to 1000 — or more — software packages to choose from. UNIX will very soon be legitimized in the office.

SOFTWARE PACKAGING

This has major implications for UNIX hardware vendors. Software packaging is likely to become a key to new systems sales. In a recent survey of 73 hardware companies,

the following tendencies towards software bundling were discovered: Operating System only, 47.3%; Productivity Tools (word processing, database management and spreadsheets), 40.5%; Business Applications (general accounting or financial packages), 10.8%; and Vertical Software, 1.4%

When these same companies were asked to describe the markets they service, they gave the following responses: OEM/VAR, 73.3%; Business/Office, 13.7%; Scientific/Engineering, 9.9%; and CAD/CAM, 3.1%. It is interesting to note that

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The NuBus design was developed to support sophisticated system architectures and eliminates the

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Anticipating industry trends, the power and expandability of TI's Nu Machine allow it to accept 32-bit processors of the future.

Open system supporting industry standards

TI's Nu Machine system is currently available with a

10-MHz 68010 processor supporting a UNIX™-based operating system with enhancements for windowing and high-resolution displays.

Those who want to design their own system processors and controllers can now license the NuBus design from Texas Instruments.

Also, a NuBus-to-Multibus™ converter allows the use of existing interface cards and peripherals from third parties.

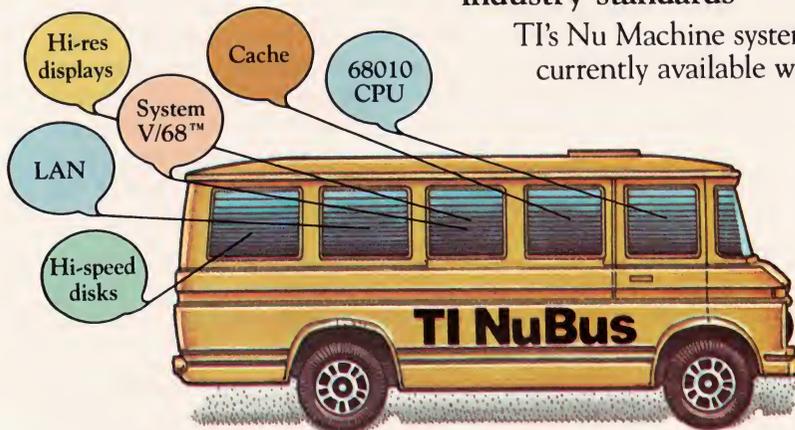
The system you can build on from now on

Because its high performance and flexibility are designed for the long run, TI's Nu Machine can be updated when other systems are outdated.

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at least 3.5 percent of the companies that considered the business market their prime focus did not even offer business software with their systems.

To see if there is a correlation between the level of software supplied and the number of systems shipped, let's look at the top 12 hardware vendors. These companies accounted for 80 percent of all systems shipped last year.

Of the 12, three indicated the OEM/VAR market as their target, seven (58%) pointed to the Business/Office market while one company each indicated an orientation towards Scientific/Engineering and CAD/CAM clients.

The systems shipped by these 12 companies fell into the following categories: OEM/VAR, 12%; Business/Office, 84%; Scientific/Engineering, 2.1%; and CAD/CAM, 1.9%

By simple math, then, we can deduce that the seven vendors selling systems that include bundles of Business/Office applications software accounted for 67 percent of all UNIX systems shipped last year (that's 84 percent of the 80 percent market share enjoyed by the top 12 companies). One of these seven companies, it should be noted, was IBM — and that was *before* the release of PC/IX. Another mathematical exercise shows that 95 percent of the companies selling

panies are going either to end users or dealers.

THE SUCCESS EQUATION

This doesn't mean that end user systems laden with business applications software offer the only

- 1) Is the software available from the same source as the hardware?
- 2) Is local service available?
- 3) Is there enough clearly written documentation to allow ease in use of the system?
- 4) Will somebody respond when help is needed?

So by sheer virtue of IBM's entry into the UNIX microcomputer market, other manufacturers can now be certain the market really exists...

road to success in the UNIX market. As OEMs and VARs complete their development cycles and begin moving products to end users at an accelerated rate, their segment of the hardware manufacture market will increase. But for the time being, business applications software plus productivity tools tends to equal healthy sales.

Does this then mean that, with increased software bundling, small UNIX hardware vendors might compete with IBM? Maybe, but remember that end users buy from Big Blue to achieve a "comfort level." The more comfortable the buyer is, the more likely he or she is

- 5) Will the company still be around next year when help or service is needed?
- 6) Is the price competitive?

If the customer feels uncomfortable about the answers to any of these questions, a sale is unlikely. This is particularly true now that IBM has entered the field. Lest there be any doubt, IBM has the right answers to these questions.

With the IBM option now open, other hardware vendors must take closer heed of their customers' needs — or risk serious consequences. Those that make attractive software offerings and provide adequate support might find that sharing a growing UNIX pie with IBM is not such a bad prospect.

The effects of IBM's entry should be positive for the UNIX market as a whole.

UNIX hardware service only 33 percent of the market.

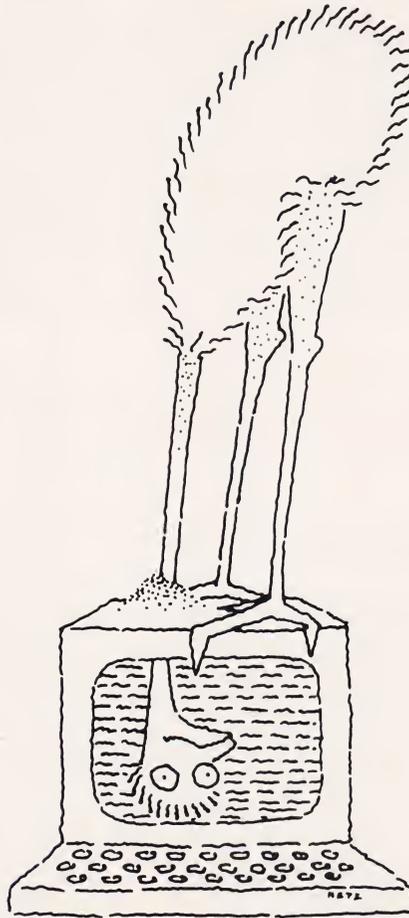
Yet another interesting conclusion is that all but 12 percent of the machines being sold by the top com-

to buy.

For a moment, put yourself in the place of the end user choosing a system. Some of the questions likely to arise include:

ABOUT THE AUTHOR

Ray Jones is President of Onager Publishing and author of the UNIX Applications Software Directory (Onager Publishing, 1983). He also works as a marketing consultant in the San Francisco Bay Area. ■



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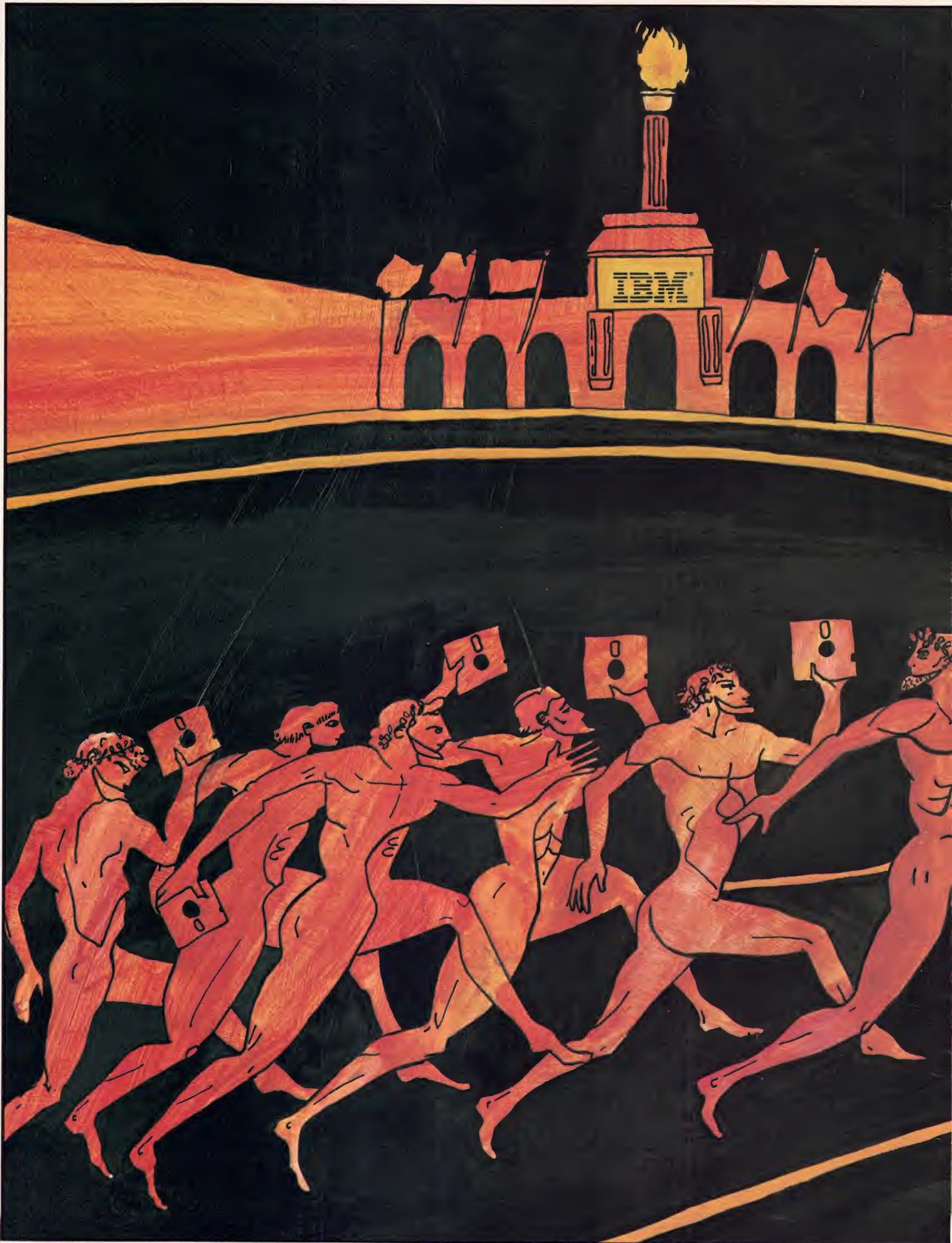
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LET THE SOFTWARE RACE COMMENCE!

A preliminary handicapper's guide to the software companies in the running for the PC/IX market

by Steve Rosenthal

Software that runs under PC/IX is on the way — but it will be at least a few months before you'll find much of a selection. And unless IBM contracts with major UNIX and MS-DOS software houses come through soon, many of the early offerings may come from small firms.

That's what industry insiders told *UNIX REVIEW* in an informal poll conducted over the last few weeks. Until PC/IX accounts for a large number of installed systems, potential sales of software packages to run under it will remain small. Therefore, most firms consider a decision about whether to produce software for PC/IX primarily a question of long term strategy.

The situation is further complicated by shifting alliances in the industry and the existence of several competing UNIX-based systems for the PC. Some of the smaller developers, in fact, plan to sit tight for a while so as to avoid falling into a possible battle between IBM and AT&T.

Developers therefore say that the first available applications for PC/IX are likely to come from three sources: large firms under contract with IBM, small and medium-sized firms that already have software running under System III or Microsoft Xenix, and new startups.

UNDER CONTRACT

It's clear that if PC/IX is going to become a popular operating system for the IBM PC and its work-alikes, users will need to have a wide choice of application programs.

IBM took a step toward filling the void in early May — with the announcement of two software packages developed by Interactive Systems Corporation, the Santa Monica-based UNIX house that produced PC/IX. One package, named *INfort*, offers users an adaption of Bell Lab's FORTRAN 77, while the other, an amalgamation of three communication utilities (*INmail*, *INnet*, and *FTP*) affords a range of local and remote communication options.

NEIGHBORING PORTS

Companies already running software under UNIX are expected to serve as a major source for PC/IX software. Because PC/IX is a fairly straightforward port of System III, the IBM version should be able to host any System III software that can fit within the memory and disk limitations of the PC-XT. Software companies that already have microcomputer-based software for System III or Xenix should have little trouble adapting it to PC/IX.



Illustration by Marianna Amicarella

Indeed, some of the minicomputer software companies say PC/IX may be just the vehicle they need to get a piece of the burgeoning PC market. With a much smaller investment than would be required to produce an MS-DOS version, these companies can tailor some of their existing UNIX-based software to PC/IX. For example, Horizon Software Systems, whose principal UNIX-family market has been tied into DEC and Altos machines, is one firm ready to make the translation. According to spokesperson Larry Swartz, "as soon as we can get a copy, we'll start porting our Horizon word processor," followed by spreadsheet, database and some graphics utilities.

The biggest bottleneck slowing the migration may come in the availability of suitable compilers. With UNIX-based programs compatible only at the high-level language source code plateau, each application will have to be modified slightly for the peculiarities of the PC and then re-compiled. Among the compilers needed are ones for C, Pascal, COBOL and FORTRAN.

So far, however, the heavy-hitters in the PC compiler market are still on the sidelines. Microsoft, still smarting over the IBM rejection of its Xenix port of System III, says it has no plans to provide any of its software tools on PC/IX.

Digital Research has signed up with AT&T to provide applications and software tools for System V, and it also has contracts pending with chipmakers Motorola and Intel. Spokesperson Dave Graebel says these arrangements don't preclude a DRI effort for PC/IX, but the company would at least wait for a sizable PC/IX market to develop before making any commitments.

Many of the business and financial packages for System III UNIX were written in COBOL. For example, Bytel Corporation whose COGEN and Menu Pro packages already run under Xenix, reports it "definitely will produce a PC/IX version as soon as RM COBOL or Level II COBOL is available."

Ryan-McFarland is also planning on porting its COBOL software to the PC/IX. Micro Focus, vendors of the popular Level II

COBOL, had no comment except to say it expects to make products available for PC/IX "when somebody pays us to."

Other compiler houses say they would like to work on PC/IX, but just don't have the time. Silicon Valley Software, for example, sells Pascal, FORTRAN and C compilers

*...the heavy-hitters in
the PC compiler
market are still on the
sidelines.*

as well as a BASIC interpreter that run under Xenix. But all their implementations generate code for the Motorola 68000 and National 16000 processors.

"UNIX is such a big market," says SVS President Steve Glanville, "and you can do everything at one level or a smaller part at a higher level." For now, at least, SVS will forego PC/IX.

A LONG WAYS FROM PC-DOS

Just as PC/IX offers UNIX houses a pathway into the PC market, PC/IX offers companies now writing software for the IBM PC a possible route to future UNIX systems. But if any of the PC-market leaders is thinking about UNIX, they'd prefer not to talk about it. Most of the large MS-DOS software houses will only say they have made no announcements thusfar concerning PC/IX and, as a matter of policy will not comment on unannounced products.

Among those taking this position are MicroPro International, Lotus Development and VisiCorp. MicroPro, developer of the best-selling Wordstar package "has no

HOPE FOR THE IMPATIENT

You don't have to wait for PC/IX software to get UNIX applications running on the IBM PC. Although largely eclipsed from popular notice by the more widely-used MS-DOS, Microsoft reports that its Xenix implementation of UNIX System III accounts for more installations than any other UNIX derivative.

The PC implementation of Xenix is licensed through The Santa Cruz Operation (SCO), which claims its system can support up to three users, has been proven in the field and comes with extensive software

support. Among the software tools already available are compilers for C, Level II COBOL, FORTRAN H and BASIC. Applications include word processing, spread sheets, database programs and accounting packages.

Other PC look-alikes include VenturCom's VENIX, Quantum's QNYX, Mark Williams' Coherent, Whitesmith's Idris and Network Consulting's Coherent (different from the Mark Williams product of the same name). All report that applications software is available now.

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current offerings for PC/IX," says spokesperson Judy McLean.

"We simply have not made an official announcement either way," echoes Chris Morgan of Lotus Development, producers of Lotus 1-2-3.

Other firms are more willing to comment, even if only to say that they will wait and see. With the PC-DOS market booming, most PC-DOS houses see little reason to invest effort in a new operating system when their current market is far from saturated.

"There are no plans in the R&D schedule to develop software under UNIX. However, if the market develops, we'll take another look," says Software Publishing's John Page. His firm's pfs: series has consistently made the lists

of top-selling software for the Personal Computer.

THE GREAT UNKNOWN

At least tens of thousands of PC users have had some experience with UNIX in the past, mostly during college. If you look at the waves of new software companies formed to write programs under CP/M and MS-DOS/PC-DOS, it's safe to predict that there is potential for a new cresting of companies formed to write UNIX software.

One of the keys to the virtual explosion of software for CP/M and PC-DOS was the low barrier to entry. For only a few thousand dollars, developers could get the hardware and software tools they needed to engage in



Interview

HEINZ LYCKLAMA

To get another slant on the race to develop PC/IX software, *UNIX REVIEW* went to Heinz Lycklama, Vice President of Technical Development at Interactive Systems Corporation. If there's anyone who knows about PC/IX, it's Lycklama. First, he worked with IBM to design the system and then he managed the

ISC team that executed the port. Before going to ISC, Lycklama built a solid reputation as a designer and implementor of operating systems at Bell Laboratories.

REVIEW: *What software currently exists for the PC/IX apart from standard System III offerings and the*

INed editor?

Lycklama: Well, for now, it's basically System III. You can pretty much do a one-to-one comparison of what's there and what's not there. Of course, some machine-specific programs — you know, some DECisms — are not there. Some communications programs, X.25 programs

serious program development.

Similarly, the cost of a complete PC/IX system is within reach of many employed recent graduates and even some students. If they already have access to a PC, the cost of entry is less than \$2000. If not, programs can be developed on other UNIX systems and then downloaded and customized on a borrowed machine.

As in the commercial market, expectation and perception will be the most important factors in determining the amount of effort these developers spend on PC/IX. But because individuals working on their own time can afford to bet on long shots, a significant number of these unknown developers will take a chance on being one of the few players in an uncrowded market unless

PC/IX clearly stumbles in its first few months.

So while PC/IX may technically be nothing more than a competent port of a superseded version of UNIX, which in itself was not designed to support casual end users, the product still has potential.

Many more fortunes have been made in the recent decades betting on IBM than have been made betting against it. If IBM backs PC/IX, software will appear. You can take that to the bank.

ABOUT THE AUTHOR

Steve Rosenthal is a lexicographer and writer living in Berkeley. His columns regularly appear in six microcomputer magazines. ■

and bisync stuff are also not there. It is the standard PC device that is supported — the floppy, the hard disk, asynchronous lines and the display monitor (both monochrome and color).

REVIEW: *But, at present, there is no off-the-shelf software?*

Lycklama: Right. Actually, besides the INed editor, there is one other package that plugs into the system. That is our (ISC's) Connect program, which is a virtual terminal communication program. This is all bundled in with the basic offering. PC/IX is sold as one package, but it is bundled in subsets.

There are a total of 19 diskettes, eight of which make up the core system, which is completely functional with the editor. The other packages are things like SCCS tools, program development tools, communication tools and word processing tools, each offered on separate diskettes. So users can load the core system and use only a few MB of disk storage and then load other pieces selectively.

On a 10 MB disk in a minimum system, a user would typically take up, say, 8 MB for a UNIX partition and 2 MB for an MS-DOS partition. They would cohabitate so you could boot up either MS-DOS or the PC/IX system. If you loaded just the core subset, though, you would only take up 2.5 to 3 MB of disk storage.

REVIEW: *With the IBM PC's major account orientation, how long do you suspect it will be before business*

applications begin appearing?

Lycklama: We ourselves are communicating with IBM about marketing our own application programs, called IN packages. [*Editors Note: A partial offering was announced by IBM in early May.*]

REVIEW: *Can you detail those a bit?*

Lycklama: The packages include INmail, a complete user-friendly mail system not at all like the Bell mail system. The Bell mail system is also provided as part of the basic offering, but our INmail system is an additional option that we now offer to all our end user customers.

Then we have the INnet package, which is our networking package. This, again, is a proven

be used for interactively transferring messages or files between two systems. You just log into the remote system and extract the files you want. Those are the three basic communication packages.

We also have a word processing package called INword, which is much more simplified than nroff. It is not quite a "what you see is what you get" type of word processing system, but it is somewhere between that and the complex primitives of nroff/troff.

Then we have INfort, our FORTRAN compiler based on the FORTRAN from Bell, FORTRAN 77. It contains some improvements and, of course, it's tailored to the architecture of the PC, which is no mean

**The PC/IX is not something I would
characterize as a home computer system – at
least not today. It is really for the professional.**

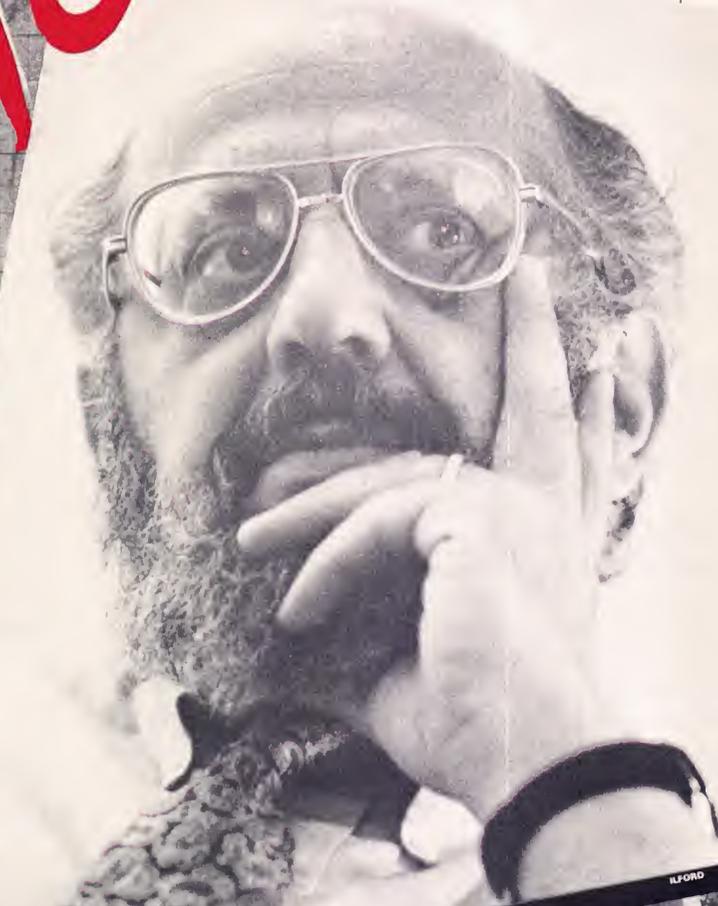
product we currently market to our end users. The INnet package is fairly independent of whatever communication link is available. You could use an RS-232 line, you can use an RS-232 line with a modem or you could use an X.25.

Another program is what we call FTP, for File Transfer Program, to

feat. Just try squeezing that compiler into a 64K address space and see if you can still generate fairly efficient code. [*Editors Note: The IBM announcement made in early May unveiled two packages: INfort and an amalgamation of INmail, INnet and FTP.*]

Continued on Page 84

Interview



Ted Dolotta

It is a sunny day in Santa Monica at Interactive System Corporation's headquarters, where Ted Dolotta, Senior Vice President of Technology, talks with *UNIX REVIEW* about PC/IX, Interactive's port of UNIX to the PC-XT

commissioned by IBM and given IBM's official blessing.

REVIEW: *What is PC/IX?*

Dolotta: PC/IX is an implementation of AT&T's UNIX System III

on the IBM PC. It presents the user and the programmer with the same interface as System III with the obvious hardware limitations and differences. And, it has some additional features — such as the Interactive editor, changed to make good use of the PC keyboard and display — and some other improvements to the user interface we have found useful. It also has some internal, invisible-to-the-user kernel differences to make it run better on the PC. But as far as the user is concerned, it is for all intents and purposes System III on the PC.

REVIEW: *It has System III system calls and such?*

Dolotta: Absolutely.

REVIEW: *If you wrote, for example, a device driver under System III on other hardware, will it run under PC/IX?*

Dolotta: To the extent that the device can be attached physically to the PC, yes.

REVIEW: *In a demonstration before this interview, I saw PC/IX come up in multiuser mode, and yet, of course, there is only one keyboard attached. Why?*

Dolotta: The PC is a personal computer. That is point number one.

Point number two is that the PC CPU is an 8088, which does not offer memory protection. To suggest that it is a good idea for more than one user to use it in general would be dangerous. And lastly, there was the issue of licensing: the system is sold as a single-user system.

REVIEW: *Are there extra slots for other RS-232 ports?*

Dolotta: The answer is yes, you can attach another terminal to it, but one would be doing that at one's own risk. The system is sold by IBM, and if you read their general information manual, PC/IX is described as a single concurrent user, multitasking system.

REVIEW: *What makes PC/IX seem so fast?*

Dolotta: The terminal interface is not standard RS-232, but rather writes directly to the display memory. So, when a user issues a command nothing much seems to happen at first, and then the whole screen suddenly fills.

Also, we have implemented contiguous files. All object code for the system resides in contiguous files, so that an exec gets the file all at once — which helps performance a great deal. User files are also contiguous — to the extent they can be.

The implementation has floating point emulation, but can make use of a 8087 chip if the chip is there. Whether the chip is there and is to be used is a run-time decision, and does not affect compilation — the code is the same. The first attempt at using floating point traps into a routine that determines whether the co-processor is there or not, and thereafter (if it is not) the code is interpreted. But if the co-processor is there, floating point instructions are executed directly, without being trapped.

DISK REQUIREMENTS

REVIEW: *What is the disk size on the PC?*

Dolotta: The PC disk holds 10 MB. You must have at least one, but you can have two. This is not a floppy-only system.

REVIEW: *Your back up media is ...?*

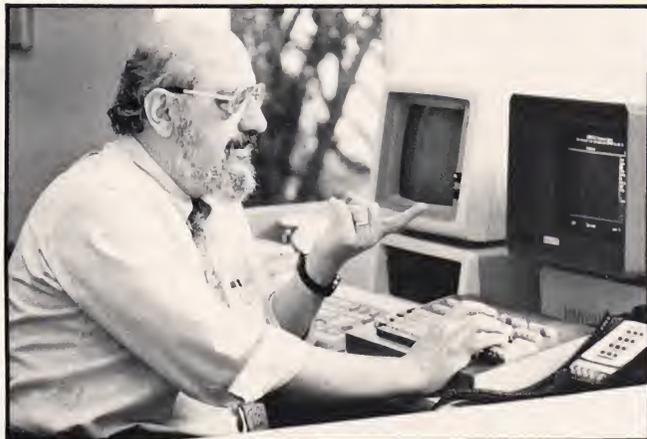
Dolotta: Floppy disk.

REVIEW: *How many floppies does PC/IX require?*

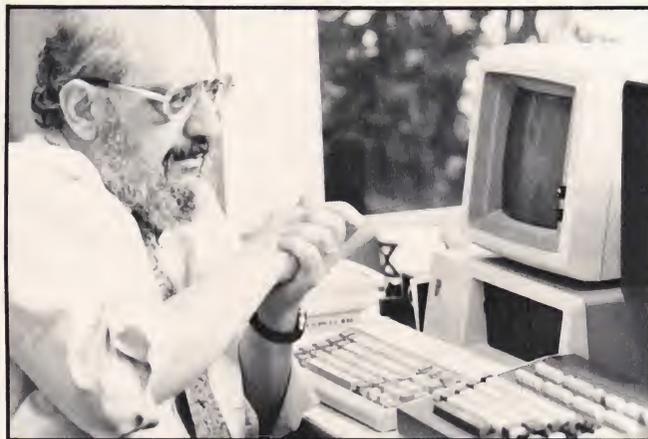
Dolotta: Nineteen diskettes.

NETWORKING

REVIEW: *Let us now turn to networking considerations. Does uucp exist on PC/IX?*



"As a general philosophy, we had no problem with adding those things we had available and perceived as useful."



"Generally, I think it is fair to say that the code and documentation took an awful lot of polish and improvement to make it more consistent, more robust and less buggy."

Dolotta: Yes. It uses an RS-232 port.

REVIEW: *But you are not supposed to hook a terminal to that port?*

Dolotta: No. The lack of memory protection makes simultaneous use dangerous, and I would seriously advise people debugging C programs simultaneously not to do so.

REVIEW: *What about SNA, so that PC/IX would be able to call up "Big Blue"?*

Dolotta: At this point, that just is not quite part of the plan.

REVIEW: *Ethernet?*

Dolotta: No, although there is obviously nothing to keep others from developing code that would provide these facilities on the PC.

I should point out that there is a document provided to every licensee called, "How to Write Device Drivers for PC/IX." So the fact that those facilities are not a part of the initial offering by IBM is not to say that they cannot be provided later by somebody else.

REVIEW: *The PC seems to be a potential candidate as a diskless workstation, with one PC having the hard disk option and other PCs hanging off of that.*

Dolotta: Remember, you are talking about the PC, which is a personal computer. In theory, it is possible to connect a PC as a workstation to a multiuser system, but not in the current implementation of PC/IX. It requires at present a 10 MB fixed disk.

REVIEW: *Your mention of the device driver tutorial brings up the question about what you have done to System III documentation. The manual, I understand, is not online?*

Dolotta: That is correct. It normally does not exist in an online form, although getting it there is obviously no big deal.

REVIEW: *What revisions were made to the basic UNIX System III Manual set?*

Dolotta: Basically, the user manual is much like the traditional *UNIX User's Manual* in the small, 6-inch by 9-inch form. The only way you will immediately observe it to be different from the Bell System manual is that it comes in a loose-leaf binder as opposed to a comb binder. However, it has been pored over and scrutinized — quite a few



errors, inaccuracies and inconsistencies have been eliminated, and it is more complete. It also has more examples. But if you look at it, you will have no problem recognizing the standard UNIX System III manual style.

Supplemental documentation consists of four manuals. One is the general information manual, which is an overview and synopsis of facilities.

SYSTEM MANAGER'S GUIDE

There is also the *Systems Manager's Guide*, which Bell's versions of UNIX never had — and Interactive's always had — a manual for whomever takes care of the system: how to install it, all the housekeeping tasks that you do with

the system. It has been almost totally rewritten with the single-user system in mind.

Just to give you the flavor of it, it has several pages of definitions and describes privileged users, installation procedures, system startup, shutdown, accounts for users, tailoring the user environment and the queueing system.

That is the one thing we did add: the general purpose queueing system for printers, other devices or networks. It's a much more general solution than you'll find in System III. There are also sections on file system backup, creating new file systems, file system integrity, configuring the system and optimizing it, and interfacing terminals and modems. There is a section on configuring auto-dialers and a section on the file system check program, *fsck*.

REVIEW: *Is it different from Kowalski's article on using fsck?*

Dolotta: Yes, we have improved that significantly. Using *fsck* is a much more automated thing. Very seldom is any user involvement required. And there is also the article I mentioned earlier on how to write device drivers for PC/IX, with plenty of examples, and a *uucp* installation guide.

There are two other documents. One is called the *Programmer's Guide*, and one called the *Text Processing Guide*.

REVIEW: *Are these not just the Bell documents warmed over?*

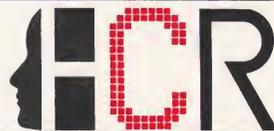
Dolotta: Well, they are in many instances parts of the same documents, but they have been significantly revised, bringing them up to date and making them more consistent. There are articles on C programming for the PC/IX, the C

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C ADVISOR

Working around PC/IX address limitations

by Bill Tuthill

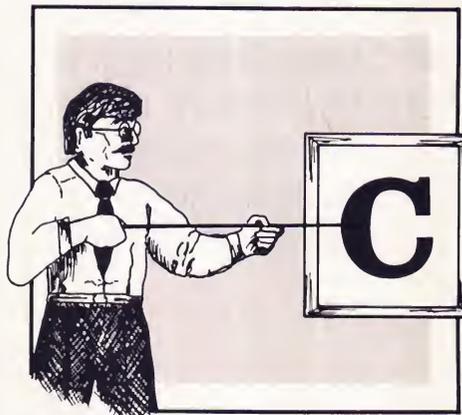
Much UNIX software development today is done on VAX computers and MC68000-based systems. Both machines offer large address spaces so programmers need not be overly concerned with memory savings.

On one hand, this allows software to be chock-full of useful features — the `:map` command of `vi`, for example, is not available without lots of memory. On the other hand, it also encourages extravagant programming practices of the sort found in VAXIMA, a LISP-based algebraic manipulation language that consumes about 2 MB of memory.

Some software developed for the VAX and the 68000 will not port to the IBM PC because of address limitations. This article explores pitfalls in porting programs to, and writing new software for, the PC/IX.

Writing C programs for the 8088 processor, the CPU running PC/IX, is much like programming used to be on the PDP-11. Processes are limited to 64K bytes of memory, although there is an option to segment text and data into 64K byte partitions, making for a total of 128K. Words are 16 bytes long, as they are on the PDP-11. One minor difference is that the 8088 has forward byte ordering, while the PDP has backward byte ordering. This does not affect most programmers, however. A more important difference is that the 8088 has no memory management, so array subscripts and pointers that go out of bounds will crash your program, and perhaps even the operating system, by mistake.

The C compiler on the PC/IX is based on Stephen Johnson's `pcc` (portable C compiler), taken from the System III release and revamped by Interactive Systems. This means that many recent extensions to



C — `enum`, `void`, structure assignment, identical names across structures — are available. The compiler will complain about assignment and comparison between incompatible types (such as integer and character pointers). More importantly, the data types `unsigned char`, `unsigned short` and `unsigned long` are implemented. This is not true of the C compiler for the 8088 implementation of Xenix. One drawback, however, is that flexnames have not been implemented (this was a Berkeley innovation to support

Pascal), so variable names must be unique in the first eight characters.

MEMORY LIMITATIONS

In order to run PC/IX, the PC-XT has to have at least 256K of main memory. The operating system takes up roughly half this space, leaving about 128K available for user programs. User programs are limited to 64K each, except when compiled using the `-i` flag for separate I&D (Instruction and Data):

```
$ cc -i program.c -o program
```

This means that instructions (or text) are loaded into one 64K partition, while data is loaded into another 64K partition. The `bss` (block storage segment) area is for uninitialized data and is included in the latter partition, after initialized data. This whole arrangement may alleviate the space crunch somewhat, but it does not solve the problem of small programs with large amounts of data or large programs with small amounts of data.

NO MEMORY MANAGEMENT

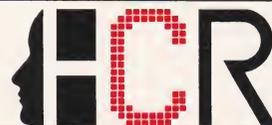
IBM does not supply a memory management unit

UNIX Operating Systems provide the standard environment for applications so they can be ported across advanced multi-tasking and multi-user systems. Word processing, spreadsheets, and database management are some of the applications already available under UNIX. Until now, no business and financial software has been available. Until now, the only solution has been to retrofit existing financial packages — packages that were written for systems with limited storage resources and limited interactive capability. Until HCR's Advanced Business Applications Software for UNIX.

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for the PC. Memory protection is almost non-existent on the 8088 and Intel has been slow to provide support chips for memory management. This problem is explained away by advertising the PC/IX as a single-user machine. This may be true when it's running MS-DOS, essentially a single-tasking operating system, but since UNIX is multitasking, a single user can strain the hardware as much as several users.

On the PC/IX, the operating system takes care of memory management. When there are more processes running than can fit in memory (in a long pipeline, for example), the least active ones are swapped out to hard disk. This is one reason why you need a PC-XT to run UNIX. Swapping is done in segments of 64K: an entire 64K segment will be swapped to disk when memory runs out and brought back into main memory when space becomes available again.

Problems may result when programmers get careless. Consider the following short program, guaranteed to crash itself.

```
main()
{
    char *cp = "Goodbye!";
    for (; ;)
        *cp -- = 0;
}
```

On computers with adequate memory management, this program will probably exit with a core dump and an error message such as "Memory fault" or "Bus error". But on the PC/IX, the hardware won't stop the pointer, which will soon zero out areas of memory where the program's text is executing. This will most likely modify your code in an unhealthy way, and perhaps even crash the system.

The only way to guard against such problems is to thoroughly debug your programs. If possible, they should be debugged on computers with memory management, so you can inspect core dumps to investigate problems and avoid crashing your operating system. Unfortunately, `lint` provides no help in this area. What's needed is a C compiler that can optionally check array subscripts to insure they are in bounds.

INTEGERS ARE 16 BITS

For programmers who have gotten used to 32-bit machines, such as the VAX, the 3B20 and the MC68000, it may come as a bit of a shock to realize that integers on the 8088 are only 16 bits long. This means that arithmetic overflow occurs above 32,767, and arithmetic underflow occurs below -32,768. For example, if you're keeping track of the number of characters in a file with an `int` variable, when you reach the 32,768th character, your program will say it's the -32,768th character, and so on, with negative numbers getting closer to zero. Using an `unsigned` variable doesn't help much: after the

65,535th character, the program will start counting again at zero.

These kind of mistakes happen more often than you would imagine. The `mail` program on 4.1 BSD, which was developed mostly on a VAX, kept track of the size

Writing C programs for the 8088 processor, the CPU running PC/IX, is much like programming used to be on the PDP-11.

of messages with an `unsigned` variable. On a VAX, where most of the testing was done, `unsigned` quantities can go above 4 billion before they recycle at zero. Needless to say, `mail` messages were hardly ever this long. However, when my organization started using this `mail` program on a PDP-11, users soon complained of truncated messages. Changing the `unsigned` declaration to a `long` fixed the problem.

The moral of the story: when you think some quantity may get very large, declare it as a `long`, and don't mess with half-way measures such as `unsigned`. Use `unsigned` only when storage space is at a premium and when you are certain values will never go above 65,000.

There are several subtle type clashes commonly encountered when porting from a 32-bit machine to a 16-bit machine. Many of them will be caught if you use `lint` to check your programs, but there are some problems `lint` won't detect. Consider the following code fragment:

```
{
    long li;
    unsigned ui;
    li = someval;
    ui = otherval;
    printf("li = %d, ui = %d\n", li, ui);
}
```

This code will seem to work on a VAX or a 68000, because a `long` is the same as an `int`. In practice, the value of `ui` will seldom rise above 2,147,483,647 (at which point it would print as a negative number). Consequently, moderate amounts of testing would not reveal any problem here. Because `lint` doesn't know much about `printf` statements, it will not spot this as a type clash (only the System V `lint` will flag this as an error).

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However, as soon as you port this program to a 16-bit machine, you'll realize there are problems. Printing a long variable with %d will yield garbage and the value of ui may soon exceed 32,767, at which point the program will start printing negative numbers. The code should have been written as follows:

```
{
    long li;
    unsigned ui;
    li = someval;
    ui = otherval;
    printf("li = %ld, ui = %u\n", li, ui);
}
```

The %ld means we are printing a long variable as a decimal number, and %u indicates we are printing an unsigned variable as a decimal number.

FORWARD BYTE ORDERING

In elementary C programming, differences in byte ordering from machine to machine don't matter a great deal. The C language and libraries take care of specifics such as word alignment, memory allocation and

For programmers who have gotten used to 32-bit machines, such as the VAX, the 3B20 and the MC68000, it may come as a bit of a shock to realize that integers on the 8088 are only 16 bits long.

character, line or binary I/O. Binary I/O is done with read(2), write(2), fread(3) and fwrite(3). When you do it, you end up with non-ASCII files. Trouble arises only when a program does binary I/O to a file, which is transferred to a machine with a different architecture where another program tries to read the file. Most tape and network programs work character by character, without any notion of binary file structures. As a result, they may write individual bytes of whole words in the wrong order. For example, consider this program, which does a binary write of a structure and then reads what

it has written character-by-character:

```
#include <stdio.h>
struct threetypes {
    char  c1, c2, c3, c4;
    short s1, s2, s3, s4;
    long  l1, l2, l3, l4;
} one_four = {
    1, 2, 3, 4,
    1, 2, 3, 4,
    1, 2, 3, 4
};
main() /* demonstrate byte ordering on a machine */
{
    FILE *fp;
    int c;
    if ((fp = fopen("/tmp/junk", "w")) == NULL)
        perror("/tmp/junk"), exit(1);
    fwrite(&one_four, sizeof(one_four), 1, fp);
    if ((fp = freopen("/tmp/junk", "r", fp)) == NULL)
        perror("/tmp/junk"), exit(1);
    while ((c =getc(fp)) != EOF)
        printf("%d ", c);
    putchar('\n');
    exit(0);
}
```

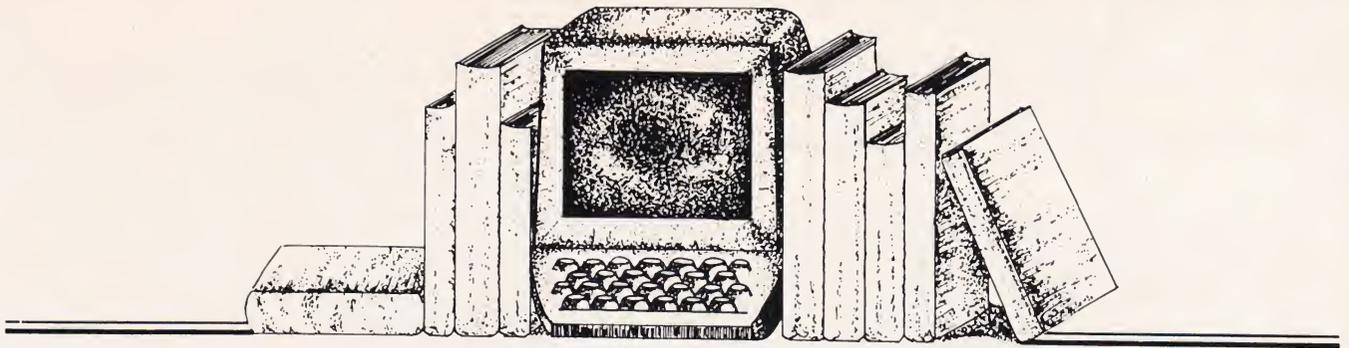
Here's what the program will print on different machines (bars have been added to separate the three types: char, short and long):

```
VAX:      1 2 3 4 | 1 0 2 0 3 0 4 0 | 1 0 0 0 2 0 0 0 3 0 0 0 4 0 0 0
68000:    1 2 3 4 | 0 1 0 2 0 3 0 4 | 0 0 0 1 0 0 0 2 0 0 0 3 0 0 0 4
PDP:      1 2 3 4 | 1 0 2 0 3 0 4 0 | 0 0 1 0 0 0 2 0 0 0 3 0 0 0 4 0
8088:     1 2 3 4 | 0 1 0 2 0 3 0 4 | 0 0 0 1 0 0 0 2 0 0 0 3 0 0 0 4
```

The VAX and 68000 have four characters per word, while the PDP and 8088 have two characters per word. The VAX and PDP have backward byte ordering within words, while the 68000 and 8088 have forward byte ordering. Notice how the output on a 68000 is exactly the same as the output on a 8088, even though the 68000 has four-byte integers, while the 8088 has 2-byte integers. In sharp contrast, the output on a VAX and PDP differ from each other, and from the others as well. This is a good argument in favor of forward byte ordering.

Many UNIX files have a binary structure that will not transport between machines unless you do byte swapping. Here are some examples of files that are not portable: tar files and tapes (inodes have many two byte quantities), dump files and tapes, most accounting files in /usr/adm, Versatec or Varian bitmap font files in vfont(5) format, core images and a.out executable images. To transfer these kind of files between a VAX

Continued on Page 78



/usr/lib

by Jim Joyce

PROGRAMMING IN C

Stephen G. Kochan's book on C (Hayden Book Co., 1983, 373pp, \$18.95) is a pleasant contrast to many of the recent books on UNIX and C. The fact that Chapter 13 (27pp) discusses the preprocessor attracted my attention, and upon reading that chapter first, I found it full of good advice. The other chapters were also quite good.

The introduction states, "As each new feature (of C) is presented, a small, *complete* program example is usually provided to illustrate the feature." The approach of teaching by example is undeniably immediate, rich and (when the code works) effective. Kochan's code is followed by program output, which reassures the reader that what is seen really works. It all makes for a very impressive package.

By and large, the formatting of code in the examples is quite thoughtful, though there is no explanation of why Kochan indents the first set of braces in every function definition. Given the overall clarity of what he does, such a quibble does not really count for much.

A quibble that should be raised, though, is about the dot-matrix font used for the examples. Since the

purpose of the book is to teach by example, the examples should be the clearest, cleanest part of the book. Even pasted-in character printer output would have been better.

There is also one grammatical nit to pick: Kochan misuses the word "unique." The frequency with which the word is used to mean "unusual" or "not frequent" is terribly jarring and does detract.

But hold on! Is this the worst

- and Arithmetic Expressions (17pp)
- 5. Program Looping (19pp)
- 6. Making Decisions (27pp)
- 7. Arrays (19pp)
- 8. Functions (39pp)
- 9. Structures (24pp)
- 10. Character Strings (34pp)
- 11. Pointers (38pp)
- 12. Operations on Bits (20pp)
- 13. The Preprocessor (17pp)
- 14. More on Data Types (8pp)
- 15. Working with Large Programs

**Kochan's book, simply, is the BEST
introduction to C published to date.**

that can be said about the book? By and large, YES! Kochan has done things I would do in a different order, but on the whole, the book is too good to get bogged down in such detail. This is, simply, the BEST introduction to C published to date.

Table of Contents for *Programming in C*

1. Introduction (3pp)
2. Some Fundamentals (6pp)
3. Writing a Program in C (7pp)
4. Variables, Constants, Data Types,

- (6pp)
- 16. Input and Output (23pp)
- 17. Miscellaneous Features and Advanced Topics (13pp)
- Appendices
- A. Language Summary (30pp)
- B. Common Programming Mistakes (4pp)
- C. The UNIX C Library (8pp)
- D. Compiling Programs Under UNIX (3pp)
- E. The Program **lint** (2pp)
- F. The ASCII Character Set (1pp)
- Index (5pp)

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C PROGRAMMER'S LIBRARY

Jack J. Purdum, Timothy C. Leslie and Alan L. Stegemoller have teamed up to produce what Que technical editor Chris DeVoney admits is two books in one. DeVoney states in the Foreword that "the first is a textbook, making suggestions and showing examples on designing and writing functions for your personal C library," while the second contains functions and programs the authors consider useful parts of a C programmer's library.

C Programmer's Library (Que Corporation, 1984, 366pp, \$19.95),

Fact:

Cardiovascular diseases will cause half of all deaths this year.

sadly misses its mark though, as a textbook showing examples on designing functions for a personal C library. The second part of the book may well be useful, as it gives source code to implement ISAM, but frankly this reviewer grew so irritated by the bad font choice for the code that he did not finish reading the book. Unfair? Read on.

The authors start with good intentions, taking the popular stance that building tools is a good thing. But the very first principle of building tools is to create ones that work. Advocates of tool building who do otherwise do no service to their philosophy.

Nevertheless, the first example these authors present reads as follows:

```
print f("Divide by zero error");
```

This code, compiled on any C compiler I know of produces errors rather than running code, because of the space between "print" and "f" (presumably a typographical error).

and dubbed "Highly Unreadable" by me and several programmers to whom I have shown the examples. Perhaps its illegibility kept the book's proofreaders from detecting the "print f" error, even though it is repeated four times within 10 lines of code.

The importance of single characters in C, such as wavy braces used as compound statement indicators make font readability an especially critical issue. With the Digital font, question marks trail off at the bottom into unreadability - no small matter in the following example taken from Figure 0.5 in the book:

```
y = (x == 5) ? 1 : 0;
```

The dot under the question mark in Digital is a speck I had to look hard to find.

Complaining about fonts and typos is one thing, but true technical errors are quite another. The authors assert that the question-colon construct "reflects more expertise in C and generates less code" than the

I wonder whether anyone
looked at the page proofs.

More irritating is the fact that the string does not end with a newline (`\n`) even though the message being shown is to be printed to a user's screen. If the cursor is supposed to hang at the end of the message for any reason, none is given. Later examples also score low on human engineering.

Part of the fault with the book lies with the choice of font, called "Digital" by the technical editor,

equivalent if-else. This perhaps displays more expertise in C, but the if-else definitely generates less code and is more readable - though I also prefer the question-colon construct because there are fewer characters to enter. Could the authors have meant that the question-colon form generates less *source* code? If so, they should at least mention that the if-else equivalent usually runs faster.

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This is a little known fact, perhaps, but it is certainly something that could have been explored before statements were made about economies of code. The error, ironically, occurs in a section titled "Knowing C and *Knowing C*" - the second, italicized occurrence of "Knowing" is presumably the wink of the cognoscenti.

Another kind of technical error is that of formatting code, though it is true that there are no rules a C compiler imposes on formatting. There is, however, the basic principle of being clear so that when code is read, it is as understandable as it can be. This is especially true for difficult-to-understand constructs in C, such as the question-colon.

Having taught C to hundreds of programmers, I know how hard some find the construct. Having read thousands of lines of C, I know how frequently the question-colon occurs in the UNIX utilities, the kernel and applications code.

Readability is first inhibited by the choice of the font, second, compounded by nested question-colon constructs, and third, exacerbated by bad formatting. I wonder whether anyone looked at the page proofs.

Table of Contents for *C Programmer's Library*

- 0. Laying the Groundwork (14pp)
- 1. Understanding C Data Types (29pp)
- 2. Sorting (47pp)
- 3. The General Terminal Library (67pp)
- 4. Code Fragments (21pp)
- 5. ISAM (99pp)
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- D. Linking Order for the Libraries and Programs (1pp)
- E. Using the Code in the UNIX Environment (2pp)
- F. Using the Code in the CP/M and MS-DOS Environments (7pp)
- Bibliography (1pp)
- Index (6pp)

in Chirlian's program is another '60s FORTRAN fingerprint, reminiscent of:

```
PRINT 8,C
8 FORMAT(I10)
```

from FORTRAN II (with FORMAT, remember?). One nice

Given a choice of the many books on C, this is not it.

INTRODUCTION TO C

Paul M. Chirlian's *Introduction to C* (Matrix Publishers, Inc., 1984, 187pp, \$15.95) harkens in thinking to FORTRAN books of the 1960s. The examples are highly arithmetic, bare-bones and user-negligent - right from the very first one:

```
/* program to add two integers */
main( )
{
    int a,b,c;
    a = 3;
    b = 4;
    c = a + b;
    printf("%10d",c);
}
```

The program does what he says it does, but surely programming has progressed in grace and charm to the point that the `printf` might have been:

```
printf("The sum of 3 and 4 is %d\n ,c);
```

so that there might have been some labelling of the output.

The "\n" I also added so that the cursor prompting for the next command does not jam right against the answer if the program is running under UNIX.

The gratuitous scale factor of 10

thing about `printf` is that it does intelligent things with formatting if it is given half a chance and is not interfered with.

Incorporating text in output is not discussed until page 41, which seems rather late. One might argue that the code itself makes obvious what the output is, but not in the face of:

```
ans = a-b;
prod = a*b;
quot = a/b;
```

in the program given on page 21. Using "diff" for "ans" would have been clearer, at least, though even with that change I cannot be convinced that interpreting output from a program should rely on being able to read the source code. Also, the lack of spaces around operators is very '60s.

I was surprised to see code on page 49 that insisted on reading exactly four characters when the prompt indicated the user was to type his/her name. This is, simply, bad programming and something to be avoided by everyone concerned with the craft, especially those learning it.

Speaking of reading the source code, the good news is that the code



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THE ARCHITECTURE OF INTELLIGENT COMPUTING.

is usually given in a readable monospace font, even though it is reduced in size more than I would prefer. The bad news is that I have shown the examples formatted as

they were in the book, which makes the code harder to read than it should be. Braces, thank goodness, are usually where they should be, but the absence of spaces and blank

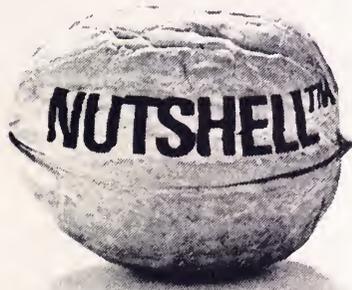
lines makes the code dense when it does not need to be.

This book is readable by those who are arithmetically inclined, but is that what programming is about?

Programs today read character data, and any program reading from a terminal will be reading characters, even if they are characters representing digits. A book on any programming language in which programs will be written to read characters from a file or a terminal needs to treat how to process characters rather than how to add, subtract, multiply or divide.

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ABOUT THE AUTHOR

While an instructor at UC Berkeley in the mid-1970s, Jim Joyce became the first person to teach UNIX outside of Bell Laboratories. He is now President of International Technical Seminars, Inc., and The Independent UNIX Bookstore. For more information about UNIX and C books, call (415) 621-1593. ■

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Copyright law made easy

by Glenn Groenewold

So you've spotted a need for a new program that no one else has filled and you plan to write it and license it to Goliath Corporation for marketing (or perhaps you intend to market it yourself). Is there an easy way you can protect yourself against the possibility that Goliath or someone else might rip you off by copying your program, making a few inconsequential changes and selling it as their own?

Yes, there certainly is. All you need to do is take the simple steps necessary to guard the copyright that the law automatically gives you. Asserting and maintaining your copyright is *easy*. You don't need to go to a lawyer since you can do it all yourself.

The first and most important thing you need to do is make sure that the copyright *notice* or *legend* appears in (or on) each and every copy of your program that you let out of your possession. The copyright legend is made up of three things: (1) the symbol © or (c), or the word "copyright" or the abbreviation "copr.", (2) the year you first let other people have access to a copy of your program and (3) your name. For example:

Copyright 1984 by Bruno Braino.
That's all that's needed, at least in the United States.

But don't make the mistake of doing anything less. Remember that if you leave out any of the required three items, your copyright notice



will be defective. Though this does not always invalidate your copyright, it's not something you want to take a chance with. Should you expect your creation to reach foreign countries, it's a good idea to add the words, "All rights reserved."

There is also one thing you should definitely not do. Adverse as you may be to cold legal notices, do not merely write a sweet little statement asking people who have your program to please, please not circulate your work among others. This may read warm and cozy, but it can jeopardize your copyright. And once a copyright is lost, it is gone forever. The fruits of your labor then become public property.

Where then do you put the copyright notice? This is another easy matter. You simply put it every place you reasonably can. It should be incorporated in the program itself

so that it will print out as part of the program, preferably both at the beginning and at the end. It should be on any written copies of the program. It should be on the container which houses the disk, tape or whatever your program is encoded on. Finally, it should appear in the documentation and any promotional material you send out regarding your program.

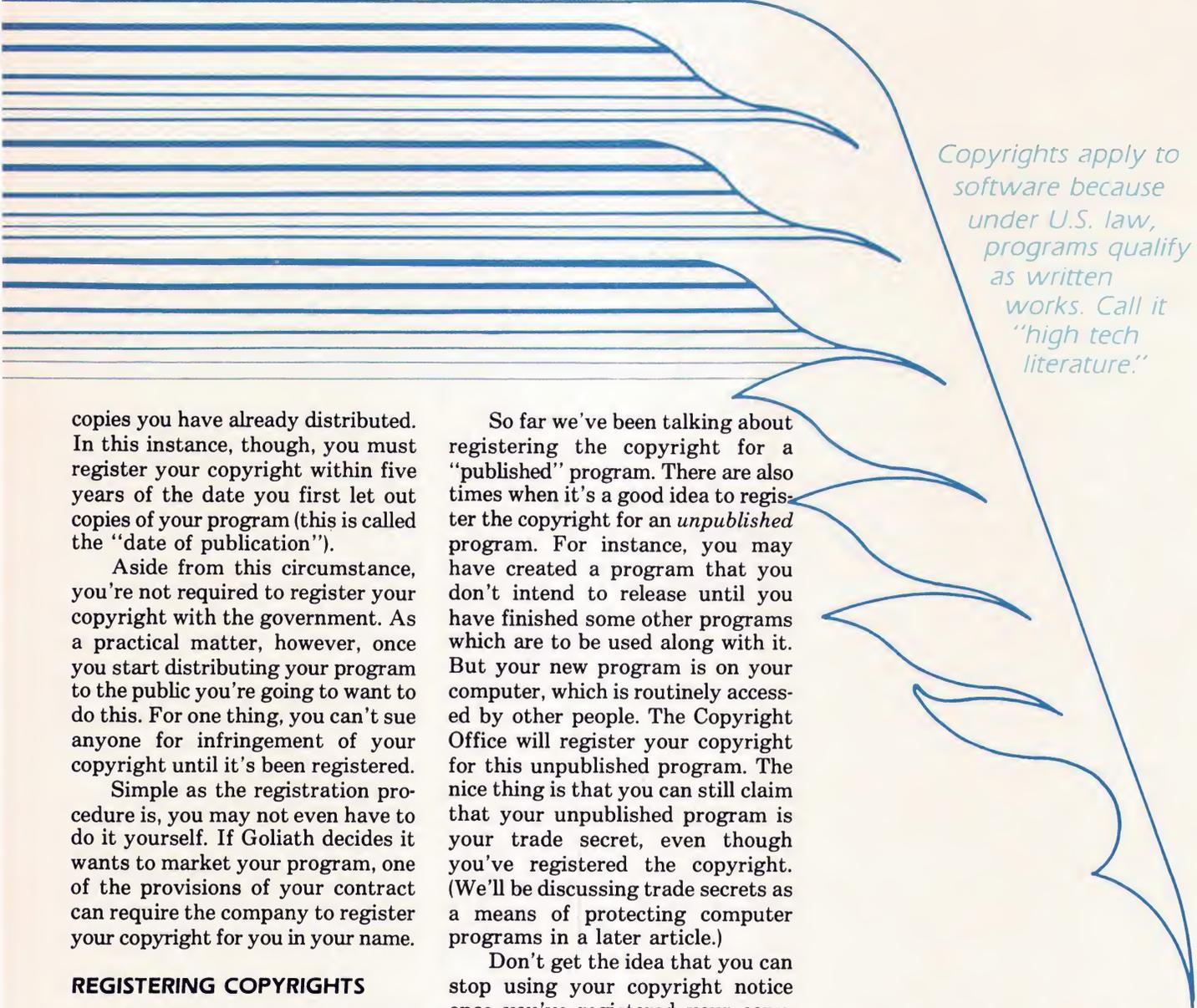
With these steps complete, you will be protected when you send your program to Goliath for its evaluation or let someone use it for a beta test. Nothing you've done up to this point requires sending anything to the government. There will come a point at which that should be done, but that won't necessarily be until later.

RECOVERING FROM ERRORS

Let's suppose you've let some of your friends have copies of your program that lacked a copyright notice. What can you do to repair the goof?

Well, before January 1, 1978, which was the date the present copyright law went into effect, you would have been in trouble. But the current law is a lot more forgiving of foibles. It says that if you've released only "a relatively small number" of copies of your program, you'll be all right. If you've let out more than that, things will still be okay if you register your copyright with the Copyright Office and make a reasonable effort to add the notice to the

RULES OF THE GAME



Copyrights apply to software because under U.S. law, programs qualify as written works. Call it "high tech literature."

copies you have already distributed. In this instance, though, you must register your copyright within five years of the date you first let out copies of your program (this is called the "date of publication").

Aside from this circumstance, you're not required to register your copyright with the government. As a practical matter, however, once you start distributing your program to the public you're going to want to do this. For one thing, you can't sue anyone for infringement of your copyright until it's been registered.

Simple as the registration procedure is, you may not even have to do it yourself. If Goliath decides it wants to market your program, one of the provisions of your contract can require the company to register your copyright for you in your name.

REGISTERING COPYRIGHTS

If you're going to register the copyright yourself, a telephone call to the Copyright Office's 24-hour number, 202/287-9100, will get you the form. The number for answers to any questions you may have is 202/287-8700. Form TX, which is used for software, is uncomplicated — believe it or not — and the \$10 fee shouldn't put undue strain on your pocketbook. You'll have to send the Copyright Office the first 25 and last 25 pages of your program in printed form. Obviously, if the complete printout of your program doesn't run 50 pages, you must send all of it.

So far we've been talking about registering the copyright for a "published" program. There are also times when it's a good idea to register the copyright for an *unpublished* program. For instance, you may have created a program that you don't intend to release until you have finished some other programs which are to be used along with it. But your new program is on your computer, which is routinely accessed by other people. The Copyright Office will register your copyright for this unpublished program. The nice thing is that you can still claim that your unpublished program is your trade secret, even though you've registered the copyright. (We'll be discussing trade secrets as a means of protecting computer programs in a later article.)

Don't get the idea that you can stop using your copyright notice once you've registered your copyright. You must still put the notice in or on your program and the things associated with it. If you fail to do this with a significant number of copies of your program, it will fall into the public domain, where anyone will be free to copy, use or sell it.

PROS AND CONS

Fine, so now you have your copyright. What does it do for you?

Perhaps it's best to start with what your copyright *won't* do for you. It won't prevent other people who know of your program from

writing one which in different fashion accomplishes exactly the same purpose as yours. A copyright does not protect an *idea*, but only the *expression* of that idea. This means that so long as nobody actually copies your program, other people are free to create and market programs in competition with it.

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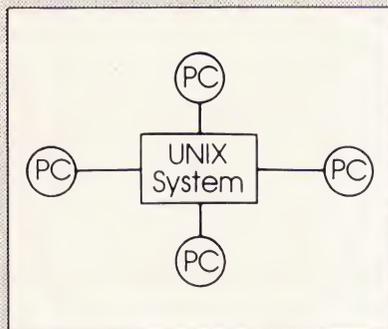
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RULES OF THE GAME

owned by a corporation. Someone who rips off your program can be made to pay damages to you and to pay your attorney's fees. A court can order the infringement stopped, and the government can seize the pirated programs and ban their further importation if they are being made outside the United States. Criminal charges can also be brought against people who have infringed your copyright.

OTHER PROTECTIONS

All in all, you get a pretty good package in exchange for taking very little trouble. You should take a few additional steps, though, to confound anyone who tries to lift your program. You can encrypt some unique identifying feature, perhaps your name, somewhere in the program. You might also insert something which does nothing at all. Since an infringer will seldom go

through your program carefully enough to catch such items, they'll usually appear in the pirated program.

These encodings are by no means a substitute for the copyright, but they do provide a strong backup of evidence should you end up in court.

Since a copyright for your program is easy to arrange and is inexpensive, there isn't really any good reason why you, a hardworking programmer, should lose the results of your labors to some ripoff artist or make an involuntary gift of them to the world at large.

ABOUT THE AUTHOR

Glenn Groenewold is a California attorney who divides his time between computer law and service as an administrative law judge. He has been active in trial and appellate work and has argued cases before the state Supreme Court. ■

UNIX COURTSHIP

Continued from Page 21

without destroying the character of what was already there," Blake said. "To accomplish this, IBM had to turn outside of their own resources to Interactive Systems Corporation. ISC is the oldest commercial licensee of UNIX, employing some of the original Bell Labs group, including Ted Dolotta and Heinz Lycklama."

IBM demanded a lot from Interactive Systems. All documentation had to match the product and there could be no known bugs in the system before it was released.

The working relationship between IBM and ISC is quite simple. IBM and IBM's beta test sites find bugs, which ISC in turn fixes. "Beta testing," incidentally, is a term that was invented by IBM.

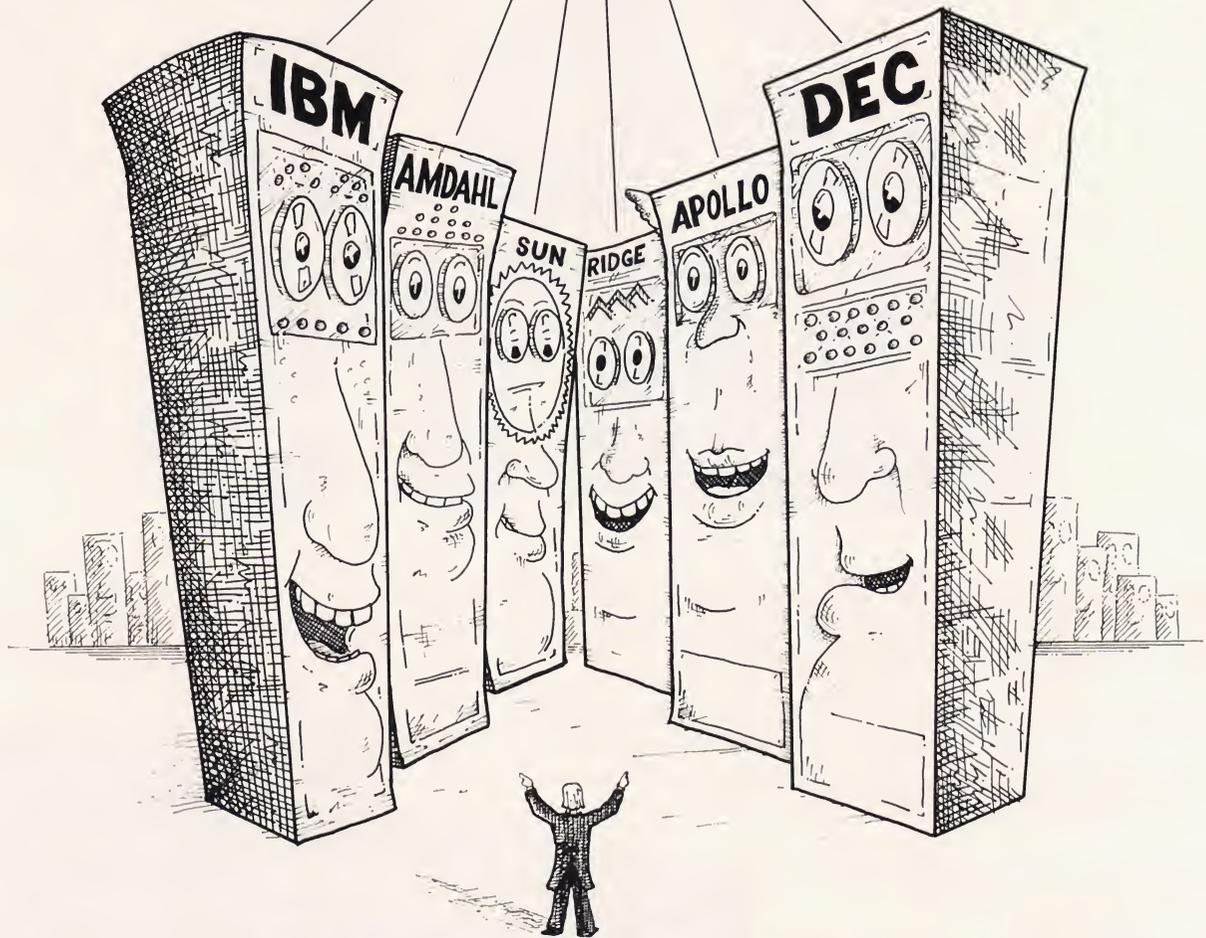
Due to money and time constraints, most UNIX system houses ship their products before they're fully tested and debugged. Thus, first customers (willingly or

unwillingly), serve as *de facto* beta test sites.

IBM, though, being the Goliath that it is, has had the time and money it's needed to test PC/IX, and to make it both optimized and bugfree.

"Most other software manufacturers view bugs as inevitable," explained Blake. "On the other hand, IBM views bugs as *defects* which should be fixed as soon as possible. As such, IBM has set up a special defect repair service called Information Programming Services Product Support Center (IPS/PSC). All owners of PC/IX who report a defect will be provided with an update free of charge. Large customers of IBM, so called NAD/NMD (National Accounts Customers), will be provided with an electric bulletin board to relay questions and problems with PC/IX to the Support Center." *T.G. and J.B.*

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THE HUMAN FACTOR

On finding idyllic harmony with UNIX

by Richard Morin

*All Watched Over by Machines
of Loving Grace...*

*I like to think (and the sooner
the better!) of a cybernetic meadow
where mammals and computers live
together in mutually programming
harmony like pure water touching
clear sky.*

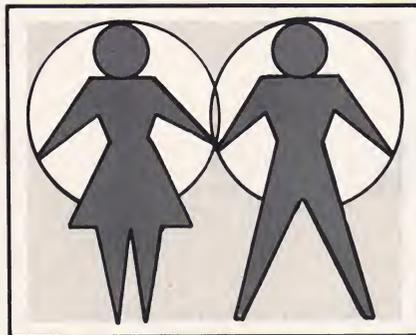
R. Brautigan

Ah, yes. But weren't we talking about UNIX? The dreaded land of greps, yaccs and such? Can one really talk about UNIX in terms of idyllic harmony? In a word, yes.

Most properly functioning systems are distinguished by harmony. The pieces interact smoothly, with little waste of time or energy. The interaction of an experienced user with the UNIX system is a good example of this. Rapid and effective use of computer resources is made possible by use of a myriad of powerful and synergistic commands. One might think that Brautigan's "mutually programming harmony" was already at hand.

Consider, though, the plight of the less experienced UNIX user, beset with a confusing variety of commands, files and rules. Little harmony is evident as this user shakily attempts to use UNIX to perform mundane functions without destroying a month's worth of previous work.

While some problems may stem from a lack of proper training, others



are inherent in the nature of UNIX. UNIX was developed in the world of research laboratories and universities, amidst source code, gurus and other amenities unavailable to the increasing number of isolated binary licensees (estimated to exceed 100,000 at this point). Problems acceptable in an initial development environment conflict strongly with the emerging status of UNIX as a mature operating system.

PROBLEM AREAS

Although the UNIX user interface has been critiqued before (see *The Trouble with UNIX*, David A. Norman, November, 1981, *Datamation*, or *The UNIX User Interface* series, Michael Heffler, August - December, 1983, *UNIX REVIEW*), a brief review of the major problem areas may now be in order:

- 1) The command syntax of UNIX is inconsistent. A standard exists, but there are many special cases, tricks and "features."

- 2) UNIX offers atrocious error messages. Cryptic, mostly undocumented and occasionally cute, they often fail to point the user in useful directions.
- 3) UNIX has, in general, very poor documentation. While the reference manual is relatively complete and refreshingly honest, it is all but inaccessible to novices. It is terse, and the needed information is often tucked away in obscure places.
- 4) The exceedingly obliging nature of UNIX can be a problem. UNIX assumes that you know what you are doing, and that you never make mistakes. Although the C shell (`cs`) provides some help in this regard, mistakes can still be deadly.
- 5) UNIX has no inherent notion of graphics, windows or any of the other nifty features found on many new UNIX workstations. This forces vendors to develop proprietary (hence, non-portable) software.
- 6) UNIX is not an easy operating system to learn. It has a large number of necessary yet difficult concepts. The structure of the file system, protections, pipes, regular expressions and daemons are just a few examples.

POTENTIAL SOLUTIONS

Not all of these problems will be easy to solve, but the emerging

UNIX industry is at work on some of them and could perhaps be cajoled or enticed to work on the rest. Point by point, then, what are our options?

A number of efforts are already being made to resolve problems with

UNIX command syntax. One of these is an attempt at standardization. The use of flags and such can be cleaned up fairly easily. Some of the larger utilities, such as `awk`, will not be so easy to sanitize. Still,

the effort is laudable and its results will be beneficial.

Other efforts seek to bypass current user shells entirely, often by means of menus. These "friendly" shells have the defect of hiding the powerful and expressive UNIX command language from users. This may lead users to employ a great number of "simple" commands to do jobs that could be better done by far fewer "difficult" ones.

Cleaning up and standardizing error messages would be a modest but very worthwhile effort for the UNIX industry to tackle. Some minimum standards for format and content could be developed and implemented. Leaving aside language processors and such, a skilled C hacker could solve the vast majority of UNIX error message problems with a few months of work.

As a complementary effort, a listing of all possible error messages, along with their sources and possible remedies, would be a very valuable addition to system documentation. A limited effort in this vein is a publication called *Responses to UNIX Commands*, by Henry McGilton and Rachel Morgan.

BIGGEST CHALLENGES

The documentation problem will not be solved quickly. Although some good introductory material has begun to surface, one has only to look at the comparable documentation on, say, VMS to see the holes. Several vendors are attempting to clean up the traditional documentation on their own, but it may well be that the task exceeds the resources of any one company. A UNIX industry consortium of some sort, though, could tackle the job and perhaps produce a new standard.

The obliging nature of UNIX is one of its charms, but a few safeguards should be installed as a matter of course when new systems are shipped to users. The `alias`

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HUMAN FACTOR

protection schemes, I/O redirection and regular expressions. While the Apple Macintosh environment provides a blatant contrast, even CP/M or VMS demands less of a novice.

Accomplished UNIX users employ a wide range of expertise in the course of a typical session, and have a broad and deep understanding of the techniques being used. Experts can quickly do jobs that might otherwise take hours of clerical drudgery, but only because of their extensive UNIX expertise. The use of complex combinations of commands depends upon a thorough

the uninitiated.

Where, then, does this leave the UNIX community? Well, the above changes, if effected, would produce a syntactically consistent UNIX, more properly documented and reasonably clean in terms of its diagnostic messages. This would help both novices and experienced users, though novices would be the primary beneficiaries. Protective shells could also help new users enter UNIX's complex world in a safer manner. Some users might never feel the need to move into raw UNIX at all.

This would not be a bad situa-

...one could do much worse than UNIX as the basis for almost any sort of portable, flexible, powerful user interface.

knowledge of the nature of each command being used.

There is an excellent new introductory text on UNIX called *The UNIX Programming Environment* (Kernighan & Pike, Prentice-Hall, 1984) that goes through shell scripts, **grep**, **sed**, **awk**, **yacc** and **troff**, as well as the C programming environment. It is hard to imagine a UNIX novice even trying to use a compiler-compiler such as **yacc**, let alone using it on a regular basis. Why then is **yacc** to be found in an introductory UNIX text? Simply because it is a key component of UNIX use.

The **troff** program, UNIX's answer to word processing, is generally considered to be too difficult for direct use by any but the most daring. The use of macro libraries is nearly universal, but a significant degree of flexibility is thereby lost. Again, the full power of UNIX is simply not available to

tion, then, and might even carry us through to that golden age of artificially intelligent user interfaces capable of always doing those things we *intend* to request. It may also be that UNIX will be found lurking underneath such a system, since one could do much worse than UNIX as the basis for almost any sort of portable, flexible, powerful user interface.

ABOUT THE AUTHOR

Richard Morin is an independent computer consultant specializing in the design, development and documentation of software for engineering, scientific and operating systems applications. He currently operates the Canta Forda Computer Lab in Ft. Washington, Maryland. ■

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OFF THE SHELF

UNIX in review

by Doug Merritt

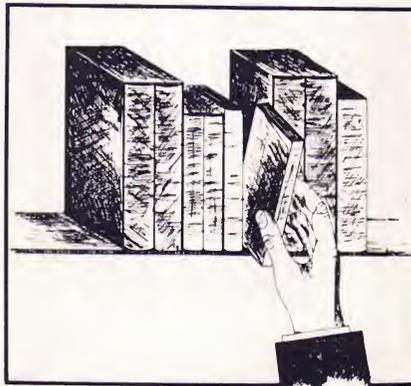
Some friends who know me all too well have claimed that *Off the Wall* might be a more appropriate name for my column than *Off the Shelf*. I can only plead, though that with this title, readers are more likely to guess that this is a software review column. Most of us, after all, are more interested in what is available in the way of off-the-shelf products — that is, what we want — than in off-the-wall products, which is what we all too often get.

Let me establish some ground rules. I will *not* use the same approach as Consumer Reports, which buys ten cars and then proceeds to test them to destruction. This gives it a sterling reputation, since it is obviously not bribed with the products it tests. While I would like to think that I am just as free from bias, I'm not willing to pay several thousand dollars each month to buy software.

The good news, though, is that I *am* willing to review any software received that I verify to be in working condition. A reference to the product will appear as a continuing listing in the "Software Yellow Pages," a new department to start in the August issue of *UNIX REVIEW*. I will also review competing or similar products together, when possible, to provide fair comparisons.

CRITERIA FOR REVIEWS

I assume most people read product reviews for the same reason I do: to benefit from someone else's experience with a product's quality



without having to risk getting their own fingers burned.

The review columns that I have tried to follow most regularly are those that are either most informative about my favorite topics, or are simply amusing and outrageous, such as Jerry Pournelle's column in *Byte*.

My personal experiences will give shape to the direction and format of this column; if you send me your opinions about what I am doing, I promise it will have an impact. I am not omniscient and so may even be unaware of some products unless you express an interest in hearing about them.

Every time I use a new piece of software, I grade it by my own standards. It can be quite difficult to say where objectivity ends and subjectivity begins. A summary of my criteria, though, would certainly include:

- Purpose (what is it for?)
- Scope (how powerful is it?)
- Flexibility (how many ways

can it be used?)

- Ease of use (first time, every time)
- Environment (what do I need to use it?)
- Support (am I on my own?)
- Documentation (can they explain it?)
- Price (cheap or ridiculous?)

All judgements are, to some degree, subjective. I will demonstrate here how I intend to put these categories to use in making my assessments by offering a sample review of UNIX itself. Most of my conclusions should come as no surprise, since UNIX has been so thoroughly analyzed by so many people. Thus, to save space I will not exhaustively consider the relative merits of different versions of UNIX.

PURPOSE

What functionality does UNIX provide, and for whom? UNIX was originally designed by Ken Thompson at Bell Laboratories to make a PDP-7 usable for his orbital simulator program. As far as I know, it worked fine for this purpose.

Later it was billed, by word of mouth mostly, as a useful software development and instructional environment for PDP-11s. Again, it seemed to work quite well for this purpose.

Recently, UNIX has been called the ideal operating system for just about any purpose on just about any machine. Although UNIX is available on more machines than any

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other operating system, it is not perfect for everyone since there are still far too few application packages available. Yet, it is an excellent software development environment, and is quickly becoming a good answer to a number of other needs as more application packages appear.

It might be more accurate to say UNIX is a very good environment for software development, text processing and portability (due to its widespread availability). There are other operating systems that outperform UNIX in given areas, but none that are as widely available or as standard, despite the multitude of UNIX "standards."

SCOPE OF FUNCTIONALITY (POWER)

UNIX rates unusually well in this area, although it does have some major flaws. Among its good points are its hierarchical file system, an online reference manual, a universal file type and structure (sequence of characters), pipes and a plethora of filter utilities that can be used in conjunction with pipes. UNIX also typically offers two very powerful programmable command interpreters, an extremely flexible text formatting system (**nroff** and **troff**), a wide range of powerful software and text development utilities and a remarkably small number of the misfeatures plaguing many other operating systems.

Among UNIX's weak points are its lack of real time features, its underdeveloped network features (though this is changing), its inflexible interprocess communication (with 4.2 BSD a possible exception), its badly designed user interfaces (poor error diagnostics and confusing command options are two examples), its lack of a useful help system (apart from an online manual and some quick reference features such as Berkeley UNIX's **whereis** and

apropos), and its overabundance of not-so-standard standards (Version 7, System 3, System 5, 4.2 BSD, Xenix, etc.).

FLEXIBILITY OF FUNCTIONALITY (ADAPTABILITY)

UNIX rates fairly well here. It has been used as the environment for just about every conceivable kind of application, although it has been sometimes necessary to modify it to suit certain needs. On an absolute scale of perfection, its flexibility rates about medium. Relative to most other widely used operating systems, though, it is very good.

EASE OF FIRST-TIME USE (USER FRIENDLINESS)

This is probably the weakest area in UNIX, and certainly the one most often complained about. UNIX software and documentation really does nothing to make learning easy, despite several well-written tutorials in certain areas. Chiefly responsible

EASE OF LONG TERM USE (EXPERT FRIENDLINESS)

This is one of UNIX's strong points. Although there are a few things that long term users dislike, UNIX is generally easy to use once you learn what is necessary to the task at hand. Most things that need to be done can be accomplished with a fairly small number of keystrokes or commands. Berkeley's screen editor, **vi**, for instance, has a pleasing set of commands that let you enter and manipulate text in a very effective way, although it could definitely use windows and multifile editing. Compare this, if you will, with the popular CP/M editor, **Wordstar**, which continued to annoy me even after two years of use.

Another example of long term ease is offered by UNIX's set of file manipulation commands (**cp**, **mv**, **cat**, **more**, **cmp**, **diff** and **sed**, to name a few). These provide a well-rounded, powerful, straightforward set of capabilities. While working with many different versions of the same

I assume most people read product reviews for the same reason I do: to benefit from someone else's experience with a product's quality without having to risk getting their own fingers burned.

for this are a bewildering inconsistency in command syntax, a lack of mnemonic names, a dearth of online help software and an overwhelming number of available commands. New users have to contend with utility commands, shell commands, editor commands and **nroff** commands.

program or text file can be painful on other systems, it is easy under UNIX.

SUPPORT

This is a favorite area of complaint. Until recently, UNIX was a

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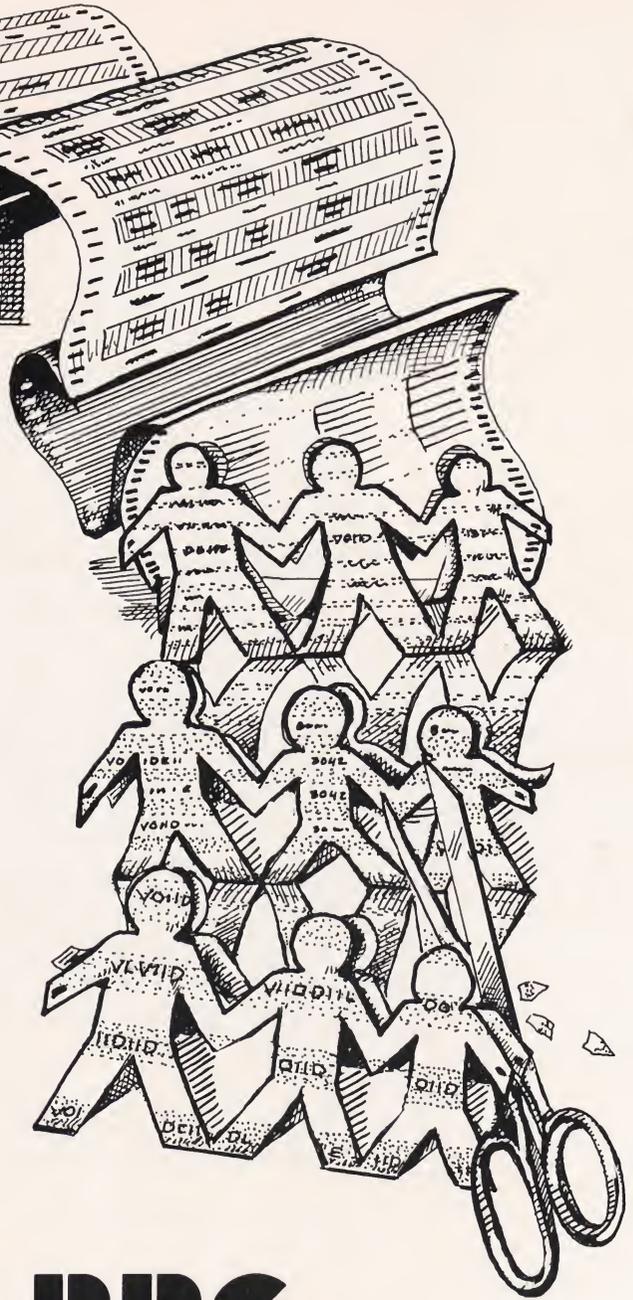
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"support-it-yourself" operating system because AT&T and Berkeley notions of support consisted of new releases at unpredictable intervals.

Supporting UNIX is an expensive proposition, since it involves purchase of the source code, maintenance of a contingent of all-too-rare UNIX gurus, and efforts to keep up with both the numerous bug reports from customers and the numerous new UNIX "standards" that keep appearing.

Some companies, such as Microsoft and UniSoft, claim to offer more support but in my experience have been no more responsive than AT&T. This is rapidly changing today. Within the next few years I expect everyone with a commercial offering of UNIX to provide extensive support. A growing number of other companies, too, are beginning to offer third-party support for UNIX.

A binary license for UNIX is now quite affordable — about \$100 per user — since AT&T restructured its price list last year. For this, you get a lot of bang for your buck.

Source licenses are still fairly expensive (\$43,000) but only in terms of affordability for small companies. This is still a cost-effective price. Some companies have charged over \$100,000 just for the source code to a BASIC compiler!

DOCUMENTATION

My feelings about UNIX documentation are mixed. Volumes Two and Three of the *UNIX Programmers Manual* are valuable additions, but Volume One has some serious problems. While Volume One is generally quite thorough, it can take a marathon session to find things unless you know exactly what you're looking for and where to find it. The format of the *Programmers Manual* also takes some getting used to.

The Permuted Index is usually obsolete, and is only helpful half the time whenever it is current.

There are a number of good tutorials on some UNIX areas that are now provided with the basic documentation, but they still aren't enough and there are still too few

quick reference aids. An appendix or two might help.

FUTURE COLUMNS

In next month's *Off the Shelf*, I will review TouchStone's "PC-Works" communication package, which transforms IBM PCs into workstations for UNIX systems. I'll be testing it on a 68000 Dual Systems 83/20, running UniSoft's Version 7 UNIX. In columns to come, I intend to cover a wide range of areas, including business applications, software development tools, communications and networking (anyone interested in modem or terminal reviews?), text formatting, graphics, artificial intelligence and computer aided design.

ABOUT THE AUTHOR

Doug Merritt became one of the earliest UNIX users outside Bell Laboratories while attending UC Berkeley in 1976. He helped to debug termcap and contributed to the development of vi and curses. Mr. Merritt now works as a consultant in the San Francisco Bay Area. ■

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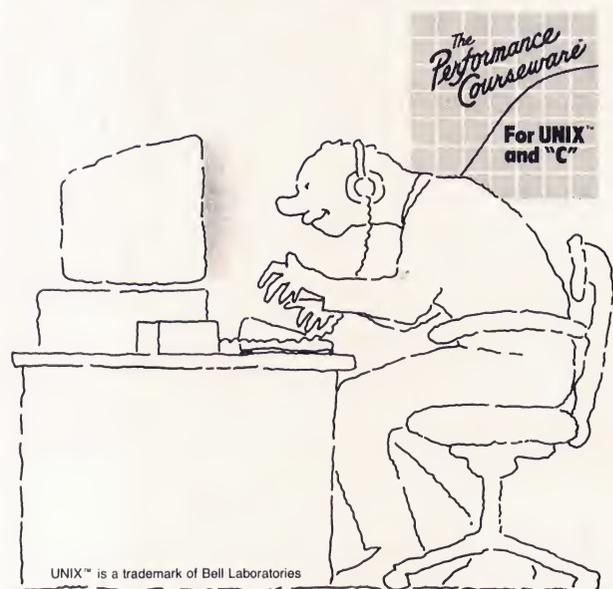
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C ADVISOR

Continued from Page 48

or PDP and a machine of any other architecture, it is necessary to use the `swab(3)` routine to exchange bytes.

Outside of AT&T and Bell Labs, most UNIX programmers are still working with Version 7 systems, such as Xenix, or with descendents of Version 7, such as 4.1 and 4.2 BSD. Despite all the marketing hype,

Memory protection is almost non-existent on the 8088 and Intel has been slow to provide support chips for memory management.

System III is only beginning to be commercially available and System V offerings are rare (although

AT&T systems will soon be generally available). PC/IX is based on System III UNIX. For programmers who are concerned with portability across different versions of UNIX, here are some tips:

The C libraries on System III are slightly different from those on Version 7. Included are some improvements and bug fixes. For example, `isprint()` on Version 7 claims that a space is not printable; this has been fixed on System III. The names of `index()` and `rindex()` have been changed to `strchr()` and `strrchr()`. The Version 7 macro calls `tolower()` and `toupper()` were replaced by functions that check to make sure the character being mapped is in fact appropriate for mapping; otherwise, punctuation marks may be changed to control characters. Macro calls are still available as `__tolower()` and `__toupper()`. Here is a way to deal with these changes:

```
#ifdef V7
# define strchr      index
# define strrchr     rindex
# define __tolower   tolower
# define __toupper   toupper
#endif
```

Plan to be where the UNIX* technical community will be.

The 1984 USENIX Conference and Vendor ExhibitionA, sponsored by the Usenix Association, is designed to promote the exchange of technical information and ideas among the Unix Community.

The Technical Conference will be held at the Hotel Utah, June 12th through 15th, 1984. A series of tutorial sessions is offered which will provide in-depth treatment of topics relevant to many users of Unix systems. The technical sessions demonstrate the breadth and depth of the research and development work being done within the Unix Community.

The vendor exhibition will be held at the Salt Palace Center, June 12 through 14th, 1984. The exhibition will bring together many major

suppliers on Unix-related products showing the latest technological achievements. Products exhibited will range from mainframes to micros, systems, peripherals and software.

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With this at the top of a C include file, your software will port back to Version 7 systems, unless it interacts with the terminal at a low level - the terminal driver on Systems III and V differs from the one on Version 7. Unfortunately, the only way to deal with these discrepancies is to include separate code for each variant of UNIX:

```
#ifdef V7
# include <sgtty.h>
#endif

#ifdef USG
# include <termio.h>
# include <fcntl.h>
#endif

#ifdef BSD
int linedisc = NTTYDISC;
ioctl(filedes, TIOCSETD, &linedisc);
#endif
```

The `sgtty.h` include file provides definitions for the `stty(2)` and `gtty(2)` system calls used for terminal handling on Version 7. The acronym USG stands for Unix Support Group, the organization within AT&T charged with supporting System V. The include file `termio.h` provides definitions for `ioctl(2)` system calls applying to terminals (both `stty(2)` and `gtty(2)` are gone from System III). The include file `fcntl.h` provides definitions for controlling file descriptors; it is available on 4.2 BSD as well. The new `tty` discipline, set for BSD systems in the example above, is the one that provides job control, word erase, echoing of control characters and other useful features still not available in System V.

ABOUT THE AUTHOR

Bill Tuthill was a leading UNIX and C consultant at UC Berkeley for four years prior to becoming a systems software analyst at Imagen Corporation. He enjoys a solid reputation in the UNIX community earned as part of the Berkeley team that enhanced Version 7 (BSD 4.0, 4.1 and 4.2). ■

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U N I X S O F T W A R E

TED DOLOTTA

Continued from Page 42

Reference Manual and Assembler Manual, debugging aids, **make**, **SCCS**, **lex**, **yacc**, **awk** — all those. There is also the **curses** document.

The *Text Processing Guide* contains all the text processing documentation you need in System III for using **nroff**, **troff**, etc.

There are three new documents, one a beginner's tutorial for PC/IX that is about 80 pages in length. There is also the *INed Reference Manual* and a document called "An Introduction to Text Processing on PC/IX."

It is a very simple introduction to **nroff** and the **mm**-macro package for creating simple documents targeted for the PC/IX, and happens to be by design the only document not typeset, but rather run off on a PC printer. It is a short document that lets people get off the ground quickly and start formatting text.

These are the main documents. In addition there is a classic little eight or 16 panel fold-out **mm** reference and a plasticized keyboard template.

REVIEW: *You mentioned curses, the package for cursor control and*

screen optimization. I noticed termcap is also in your port. Why?

Dolotta: They are there because the perception was that people would be interested in using them and it was not very difficult to put them in — so we did. As a general philosophy, we had no problem adding as a superset things we had available and that we perceived as useful, and so some of the Berkeley file system robustness is in the system.

REVIEW: *The fast file system?*

Dolotta: Not the fast file system. Just the re-ordering of writes to insure better reliability of the file system. Basically, we had no reason for not adding things except availability of resources and our desire to get the product out in time.

REVIEW: *Are there any missing System III utilities?*

Dolotta: Except for **tar** and a small number of device drivers, I really can't think of anything significant that is missing.

REVIEW: *What other Interactive enhancements have been made?*

Dolotta: In addition to **INed**, our screen editor, we have replaced the **cu** program by our own program called **Connect**. The **Connect** program gives us a more general and more robust product. In addition to **ls** we have an **li** command, which is a Berkeley-style listing of directory contents and a number of other things of that nature, such as the ability to deal with a color monitor.

REVIEW: *Is that an option that you can purchase from IBM or is that a purchase from another vendor?*

Dolotta: IBM sells color monitors, as far as I know.

REVIEW: *What about aids for backup. The **dump** and **restor** programs work with floppies. The same old **dump** and **restor**?*

Dolotta: No, a more intelligent one.

REVIEW: *Can you restart in, say, the middle of a **dump** on the fifth*

diskette?

Dolotta: Yes, I believe you can.

REVIEW: *Is your version of **mm** stripped of comments?*

Dolotta: I'm not sure I understand the question.

REVIEW: *John Mashey put comments throughout the **mm** macros.*

**...you can attach
another terminal to it,
but one would be
doing that at one's
own risk.**

However, as he said at a local Uni-Ops meetings, they were stripped out, condensed and have never seen the light of day.

Dolotta: If you get source, you get the whole thing. If you just get object, you get the condensed version.

REVIEW: *So this is the condensed version of the **mm** macros?*

Dolotta: It is not only condensed but it is one that does not insist on putting "Bell Laboratories" on top of every letter, etc. It has been generalized so it is no longer Bell System specific, unlike the one that comes with System III and System V.

Generally, I think it is fair to say that the **UNIX** code and documentation took an awful lot of polish and improvement to make them more consistent, more robust and less buggy. We've done a significant upgrade of the system, although we did not go to great lengths to increase features.

But there are some increased features: for instance, we have a **grep**

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command that allows users to search for paragraphs containing patterns. But, by and large, there are not many new features.

SUPPORT FOR PC/IX

REVIEW: *Who will support PC/IX?*
Dolotta: IBM.

REVIEW: *Will Interactive be supporting IBM?*
Dolotta: Yes.

REVIEW: *One of the questions I heard after the PC/IX announcement the Thursday before UNIFORM was "Why Interactive?"*

Dolotta: Because we are the best.

REVIEW: *Everyone expected Microsoft or Bell Labs; some might have even expected UniSoft.*

Dolotta: I cannot really comment on that. The fact of the matter is that we were asked by IBM if we would

be interested in doing the project, and we said "yes" — and we did it. It's as simple as that. As to why IBM chose to do business with us as

**"Why Interactive?
Because we are
the best."**

opposed to any of the other entities you mentioned, you would have to ask IBM. Needless to say, we think they made the right choice.

REVIEW: *What was your role in the project?*

Dolotta: To stay out of people's way. My role in the project, based upon

my responsibilities at Interactive, is the management of the technical side of the house — so, as such, the project managers report to me. I did not have any direct technical hand in this particular project.

THE PORT...

REVIEW: *Can we turn to the port itself? How long did it take? How many people were involved?*

Dolotta: You are beginning to touch on issues which are dangerously close to contractual matters. Our contract with IBM contains a clause that says that all the details of the port are confidential, so I find it a little uncomfortable discussing that sort of detail. It was not a trivial project by a long shot. It was a significant project. It was not a two-week port — I promise. ■

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HEINZ LYCKLAMA

Continued from Page 39

REVIEW: Will the packages be marketed by Interactive Systems or IBM?

Lycklama: They will be marketed by IBM as optional program offerings. You shouldn't be surprised if IBM also works with some other third party vendors with industry standard applications for UNIX.

REVIEW: So IBM will offer options produced by other vendors?

Lycklama: Yes. There are a few good COBOL compilers on the market for the 8088 that are as good as you can make COBOL in that environment. And there are Pascal compilers, word processing systems and database systems that are being developed.

REVIEW: Will there be competing options within the IBM optional offering?

Lycklama: I'm probably not in a good position to comment on that yet. IBM makes up the rules as to what they are going to market and what they won't. They will establish a relationship with companies to market specific applications but I'm sure others are not going to wait for IBM to port their packages to PC/IX.

REVIEW: So they'll do it on their own?

Lycklama: Yes. The IBM PC/IX will become just another system that their product runs on.

REVIEW: Within which forums do you anticipate the competition will be most pitched?

Lycklama: I think if you look through the /usr/group catalog (*The UNIX Catalog*) of available applications, you'll find a lot of relational database packages for small systems, a lot of accounting packages and some word processing systems. There is much being developed in a number of different categories.

REVIEW: Do you anticipate that

support for the PC/IX will come chiefly from the traditional UNIX software community or from the companies that have been servicing the IBM PC right along?

Lycklama: I think we're going to see more sophisticated programs initially that emphasize UNIX capabilities. There are a lot of programs available under MS-DOS today, but many of them are the obvious sorts of programs that are not very useful in a business environment. The more complicated programs like word processing, message systems and database systems are the kind that we are going to see developed for PC/IX. The PC/IX is not something I would characterize as a home computer system — at least not today. It is really for the professional.

REVIEW: But what of the office environment where PC-XTs running PC-DOS are already in use? Assuming the staff is comfortable with the software they're currently using, it would seem there might be some

resistance to learning a whole new set of utilities. Doesn't that suggest it might not be long before the Micropros, the Digital Researches, the VisiCorps and other companies deep into MS-DOS software port their products to the PC/IX?

Lycklama: I'm sure there will be some of that. In fact, you might note that a lot of the new applications we're beginning to see for MS-DOS have been written in C. There are also some good C compilers out there today for PC-DOS.

REVIEW: VisiCorp, in fact, has already made some public noises about porting some of its packages to UNIX.

Lycklama: It is a natural extension. The MS-DOS world is limited to a single task and that's rather constraining for some applications. I'm sure you'll see these applications migrate up to the PC/IX market.

REVIEW: Do you have a feeling for how long it will be until people who



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purchase PC/IX will have a true selection of off-the-shelf software?

Lycklama: Well, I would expect very shortly because IBM has been working with third parties to get application code ported. Those ports should encounter few obstacles since PC/IX is a true implementation of System III in terms of its system calls and its use of the C language. So it shouldn't take that long for those applications to become available once PC/IX is generally available.

REVIEW: *As you say, either with or without IBM blessings.*

Lycklama: Of course, I think most companies would like to see their software come out under the auspices of IBM because that would give them a bigger market. But even without IBM, these companies are not going to wait. They will go out and market their software themselves.

REVIEW: *Can you specify any of the software vendors we're discussing here?*

Lycklama: I think you can almost pick them by going through the /usr/group catalog. Ryan McFarland COBOL is a natural. Micropro's COBOL or some other implementation of COBOL would probably be likely candidates. Database systems like UNIFY would also be strong possibilities. This is not to say that IBM is not working directly with any of these companies, but...

REVIEW: *You would be very surprised if they didn't generate something for the PC/IX?*

Lycklama: That's right. All those popular packages will be available one way or another. As I said before, if IBM doesn't do it, they will do it themselves because they're just not going to miss that market.

REVIEW: *Do you see PC/IX ultimately selling to some market other than the small business market? Do you see the price dropping enough to push it into lower markets?*

Lycklama: Initially, PC/IX will be made available only through IBM's National Accounts Division, but I expect it will eventually be made available through retail channels as well. That's just the next natural step and it should open up the market considerably. [Editor's Note: *PC/IX surfaced in IBM retail stores in late April. Nineteen diskettes and the PC/IX series come in a 17-pound package bearing a \$900 price tag.*]

REVIEW: *Do you see an evolution of software for the PC/IX? What's the most pressing need? What sort of software will surface first? What will follow?*

Lycklama: Well, I think languages are the first natural step because if your application is written in a specific language, you want to make sure that language has been ported to the environment. That's why I mentioned that COBOL will probably be one of the first

those will move into the UNIX environment as well. If they don't, equivalent packages will. Quadratron has an integrated package that runs on UNIX and we (ISC) have our TEN/PLUS System. These packages really create an environment for building other applications in an integrated way.

I think you'll also see software appearing that increases networking capabilities. You can't do much with a single-user computer, after all — you can't talk to anybody else or exchange data.

REVIEW: *This is UNIX, after all.*
Lycklama: Right. This is UNIX. PC/IX does come with uucp, but that is a rather slow way to communicate and it's a rather limited environment. That's one of the reasons why we use our mail system (INmail) in our networking system. It's much more flexible than uucp. You can

The MS-DOS world is limited to a single task and that's rather constraining for some applications. I'm sure you'll see these applications migrate up to the PC/IX market.

languages to appear on PC/IX. There are a lot of accounting information programs written in COBOL, after all, and that can be ported to the PC/IX right after the COBOL compilers are. So, I think you'll see the current generation of applications being moved over first. Then I expect you will see more integrated environments being made available. There are a lot of people putting a lot of effort into creating integrated environments under MS-DOS, PC-DOS, Lotus 1-2-3, VisiOn and all of that. I expect some of

communicate over different communication links. It doesn't just have to be an RS-232. You can also use X.25, a synchronous link or even Ethernet. So I think you will see more software supporting communication between PCs and between PCs and mainframes.

People already have hardware in place that will perform communication tasks from a hardware point of view. There are also some 3270 emulators available under both PC-DOS and UNIX that I expect to migrate into PC/IX.

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REVIEW: *That brings up a question raised in Groff and Weinberg's "Understanding UNIX" about speculations that Interactive Systems is working on a port to the IBM 4300 series.*

Lycklama: I've heard some rumors to that effect. That is not a thing I can comment on. [Editor's Note: Rumors at press time had it that ISC would release the 4300 package May 15.]

REVIEW: *Bearing in mind the software evolution we were just discussing, how do you see the lineup of players changing over time?*

Lycklama: I expect PC/IX will widen the market for people presently producing applications for PC-DOS. We'll see some of these applications

ported to the UNIX environment. I also expect there will be new companies springing up.

REVIEW: *Do you think this product will be hot enough to spawn a whole new wave of companies?*

Lycklama: The market is big enough that there is room for more companies. There are only so many products that any one company can effectively build, market and support. There will be companies that have expertise in special niches that will want to market their products.

If you look at the microcomputer world revolving around the PC, you'll find four main operating systems. You've got UCSD Pascal, which, of course, is written in Pascal; then you have Digital Research's

CP/M (and eventually Concurrent CP/M), UNIX and MS-DOS. Of those four, two — DRI's CP/M and MS-DOS are written in assembler. Future versions of those are now being written in C. You can see the evolution. UNIX, of course, is already written in C, so that means that three of the four PC operating systems are C-based.

REVIEW: *There are plenty of UNIX micros out there that offer arguably superior hardware to the IBM PC for running UNIX. But, obviously, Interactive holds high hopes for the success of this product. Is that hope premised on the strength of IBM marketing, IBM support and the IBM name or is there something intrinsic about*

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PC/IX FEATURE

PC/IX that makes it attractive?

Lycklama: I think if you look at some of the conventional benchmark comparisons with other equivalent systems, you'll find we show very well.

REVIEW: *"Equivalent systems" being other systems that work on the PC?*

Lycklama: Right. We are rather proud of the way PC/IX performs. We have put a lot of effort into optimizing both the C compiler and the performance of the system itself — particularly in the areas of file handling and loading executable images off disk. We keep program images in contiguous files so that you can load the program with one seek to the disk. That has a tremendous impact on the performance of the system. When you benchmark that against some other systems, it really shows. Even the user level benchmarks come out very well.

REVIEW: *Of course, we're still talking about systems within the PC world. If we move outside that into 68000-based systems in particular, I suspect the comparisons are not so favorable. What is it about PC/IX that is going to lead a small business to buy a PC-XT instead of another piece of more powerful hardware?*

Lycklama: IBM has the name behind it and the applications that will soon be available.

REVIEW: *What about power per dollar? How does the PC/IX stack up there?*

Lycklama: A PC-XT loaded with PC/IX costs much less than a 68000-based system, but if you compare it with other 8088 machines, the IBM PC tends to be somewhat more costly than PC clones. But I think you get what you pay for. You have to consider the whole picture — the package of applications available and the support. The documentation is also very important and we put a lot of effort into our documentation

for PC/IX. We started with IS/3 manuals that were specific to the DEC world of the VAX and the PCP-11 and did a significant amount of work to edit out references to DEC devices and other DECisms.

REVIEW: *How long was PC/IX in the works?*

Lycklama: Well, it's been a while. I don't want to give you an exact timeframe, but the time that elapsed between the first kernel and the first customer was a fairly lengthy period — about six to eight months, I would say. That's because of the quality assurance that's gone into it. Beta testing took about eight weeks in itself and then when all the results came back, the bug fixes had to be folded in, documentation had to be reviewed and all those changes had to be folded in. There was quite a bit of detail to tend to.

REVIEW: *The fact Interactive agreed to do the port for the IBM PC obviously indicates you believe the major account market is ripe for UNIX. What leads you to that conclusion?*

Lycklama: I think you only have to read the UNIX press to validate that. There have been a few major announcements recently. AT&T is now in the UNIX market. That is the ultimate: first, IBM blesses the market and then AT&T blesses the market.

REVIEW: *By your own conjecture, though, what is it that UNIX offers that major accounts don't presently have?*

Lycklama: Flexibility in buying hardware. They can now choose different hardware; they are not tied into one main factory because of the portability of UNIX. That's flexibility. If Vendor A has cheaper hardware than Vendor B and they both have the same software, obviously a company would opt for the cheaper hardware — provided that vendor has a good reputation for support.

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PC/IX REVIEW

Continued from Page 24

software tools that assist in producing compilers are also provided with PC/IX.

The Bourne shell, which in many respects functions as a programming language, is also fully supported. Two versions of the shell are currently available under PC/IX, **sh** (the standard programming shell) and **rsh** (a restricted version of the shell). The standard shell provides full access to all of the system commands the user's identification allows. The **rsh** shell, as its name implies, provides limited access to a small pre-defined set of commands. IBM views **rsh** as a device for restricting certain users to limited system access. As in other implementations, both **sh** and **rsh** read commands from standard input.

TERMINAL, GRAPHICS AND KERNEL INTERFACES

The PC/IX kernel makes the IBM monitor and keyboard emulate the ANSI X3.64 terminal standard. Interfaces with terminals benefit from the inclusion of the Berkeley **curses** library and a **/etc/termcap** file description. The **curses** library is a subset of **vi**'s cursor manipulation routines that provides programmers with full screen cursor control. This is particularly useful for creating screen-oriented applications.

Both IBM's monochrome and color monitors are supported in text mode only. PC/IX's lack of a graphics routine can be handled by software developers via a device driver. Although this may be seen as a deficiency, it also presents an opportunity for enterprising software developers to create standard graphics packages (such as the SIGGRAPH Core package) for the PC/IX. IBM is likely to be a willing buyer of such products. Read on for more details.

IBM is making it easy for third party software and hardware developers to interface PC/IX with non-PC products. A copy of the kernel is provided in unlinked form and an excellent manual on how to write device drivers is included with every PC/IX system. To interface new hardware with the PC/IX, programmers need only write several subroutines and link them into the kernel.

ACCESS TO PC-DOS

Unlike some other UNIX look-alikes available for use on IBM's Personal Computer, the PC/IX kernel does not interface directly with PC-DOS or even emulate its system calls. PC-DOS is the most popular operating system on the PC and thus complete emulation would be very useful. Users can, however, transfer files to and from PC-DOS floppies through a set of four

utilities provided with PC/IX. These utilities include:

dosread - copy files from PC-DOS floppies onto PC/IX's hard disk
doswrite - copy files from PC/IX's hard disk onto PC-DOS floppies
dosdir - perform a DOS directory command on a PC-DOS floppy
dosdel - delete a file from DOS

Normally UNIX files use just a

Another nice feature of PC/IX not common to many other UNIX systems is its record locking scheme.

newline character to separate lines in a text file, while PC-DOS files (and most other systems) use a carriage character followed by a newline character. The **dosread** and **doswrite** commands do the appropriate translation if the correct flags are given.

FUTURE DIRECTIONS OF PC/IX

IBM has a long standing commitment to upward compatibility of software developed between successive generations of systems. Successors to the IBM PC running Intel's 8088 microprocessor will likely be running Intel's 186 and 286 microprocessors. PC/IX is good on the 8088 and will be even better on a 286 processor. One does not have to be a fortune teller to know that if PC/IX is successful on the PC-XT and a large application software base is developed for it, a future IBM 286 product will also definitely have PC/IX on it.

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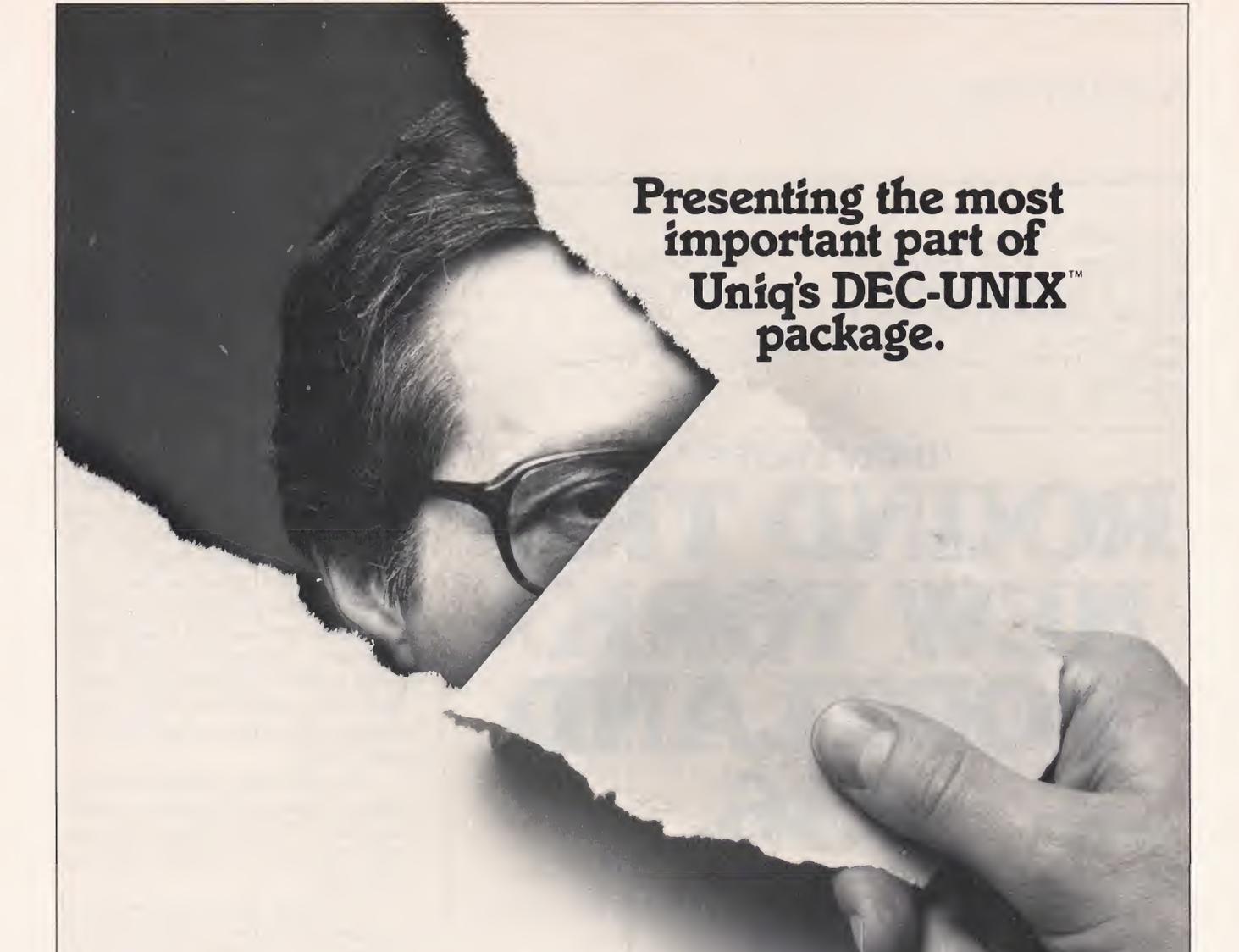
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PC/IX will be IBM's chain of product centers. If PC/IX's popularity grows, it might well be marketed through independent retail stores as well. Presently IBM wants to establish PC/IX's software base, especially in the development

environment.

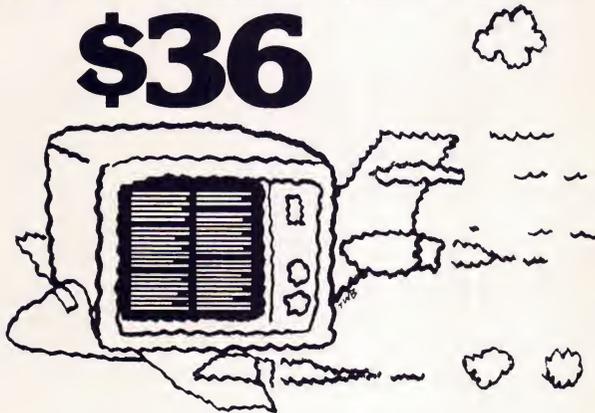
IBM, in fact, is planning to acquire third party software to run on PC/IX. Currently it is most interested in languages and application software. Any parties wishing to offer a package to IBM for

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CONCLUSIONS

Even without off-the-shelf software, we were very pleased with the PC/IX — limitations and all. The 64K address space limitation is cramping, but programmers can overcome this problem by dividing programs into several cooperating processes. Although limited disk space is also a shortcoming, larger IBM PC compatible disk drives already exist that can be interfaced with PC/IX.

The only major software limitation we found is the lack of various Berkeley UNIX utilities. Programmers will have to install these on their own.

The most significant benefit of this product is that it comes with the support of IBM and thus is likely to dominate the PC UNIX market. This, of course, may have unfortunate consequences for other perfectly good UNIX PC systems not sold under the IBM logo.

ABOUT THE AUTHORS

Theodore C., Goldstein is a Santa Cruz, California, consultant specializing in compiler, kernel and application software. Among the firms he has worked for are Sorcim, Whitesmiths, Intel, Tolerant Systems, Yates Ventures and VisiCorp. Mr. Goldstein is currently optimizing a C compiler for the 8086-186-286.

Jessica A. Bernhardt is a freelance writer and marketing consultant with a background in advertising and theatre. She is currently working to raise funds for a UC Santa Cruz humanities project.

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and is available for \$139. Model P12 (sized to fit atop an IBM PC system unit) offers six outlets, a digital clock and a disk storage bin and is available for \$199.

Power Directors exceed the 1983 *IEEE-587 Guide for Surge Voltages in Low Voltage Power Circuits*. Their fast response to transients comes via TransZorb semiconductor devices; TransZorbs respond to Voltage Spikes in less than a nanosecond (one billionth of a second).

For additional information, contact Computer Accessories Corporation, 7696 Formula Place, San Diego, CA 92121, 619/695-3773.

Circle No. 274 on Inquiry Card

IBM MAKES EXPERIMENTAL MILLION-BIT MEMORY CHIP

An experimental memory chip

capable of storing more than a million bits of information has been fabricated by IBM.

The experimental chip, called dynamic random access memory (DRAM), was fabricated on the same manufacturing line the company has used since 1978 for mass production of other high-density memory chips, including those that store 64,000 and 72,000 bits of data.

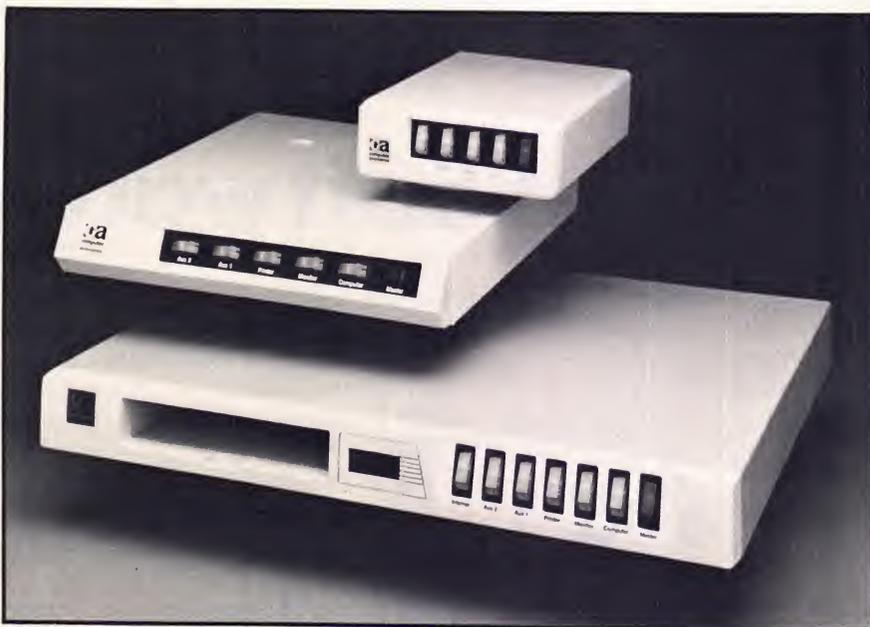
Use of these existing manufacturing facilities has both demonstrated the chip's manufacturability and accelerated its development for potential use in IBM products.

The megabit chip, developed at IBM's laboratory in Essex Junction, Vermont, was made using an extension of IBM's Silicon and Aluminin Metal Oxide Semiconductor (SAMOS) processing technology, which the company has been using since 1978, when it became the first to begin mass production of 64K chips.

The chip operates with a single-voltage, 5-volt power supply. The one-million-plus memory cells and their support circuitry occupy an 80.85-square millimeter area of silicon. The chip dimensions are 10.5 mm by 7.7 mm (about 3/8" by 5/16"). The time needed to read data out of the chip is 150 nanoseconds.

A paperback novel of about 250 pages could be stored in just six of these chips.

A number of improvements in photolithography and processing technology contributed to the development of the chip. Enhancements to conventional optical lithography and photoresist formulation made it possible to



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RECENT RELEASES

fabricate circuit elements on the chip as narrow as one micrometer – about 1/50 the width of a human hair.

Extending the capability of photolithography is of fundamental importance since, in general, halving

the width of the lines of a circuit pattern made it possible to fabricate the same pattern in only one-fourth the area.

The high storage density (13,025 bits per square millimeter) of the

new chip was also derived in part from the use of advanced processing technology. A new processing step that electronically insulates adjacent storage nodes from one another allows them to be placed less than one micrometer apart without creating unwanted electrical effects that would tend to impair chip performance.

Another processing development that directly contributed to the density of the one-megabyte chip was the use of the extremely thin nodes. This layer is only 15 nanometers thick, or about 50-60 atoms high.

Reducing the thickness of this layer makes it possible to increase the amount of electrical charge that can be stored without increasing the area of the node, which takes up a sizable fraction of the memory cell itself. In this way, a strong and easily sensed signal can be obtained from the cell without the need to enlarge its area.

The chip is packaged on a 22-pin ceramic substrate 12 millimeters square (about one-half inch on a side) using IBM's flip-chip bounding technology. This makes possible a packaging density of four megabits per square inch.

For more information, contact IBM at its General Technology Division, Essex Junction, VT 05452 802/769-2221.)



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NEW

ONE SIZE FITS ALL

Heurikon presents Minibox – a multiuser UNIX workstation based on its powerful HK68™ single board microcomputer and Uniplus+™ UNIX System III or System V operating system with Berkeley enhancements.

Designed with the OEM in mind, *one size fits all*. Both compact and flexible, the Minibox includes within its 10.5" w x 13.9" h x 20.5" frame a 200 or 400 watt power supply, six slot Multibus™ card cage, (4-5 available for user use!), single double density floppy disk drive, streamer tape drive, and 31 or 65 Mbyte Winchester drive (expandable to 280 Mbytes). All this within the same cabinet! System status LEDs on the front panel inform the user of CPU and disk drive activity.

With Uniplus+™, Minibox becomes a flexible and affordable tool for program development, text preparation, and general office tasks. Included is a full "C" com-

piler, associated assembler and linker/loader. Optional languages are:

Macro assembler, ISO Pascal compiler, FORTRAN-77 compiler, RM-COBOL™, SVS BASIC (DEC BASIC compatible interpreter), SMC BASIC (Basic-Four BB3 compatible interpreter), and Ada™. Other utilities include UltraCalc™ multiuser spread sheet, Unify™ DBM, Ethernet™, and floating point processor. Alternate operating systems available are PolyForth™, Regulus™, CP/M 68K™, and others.

*UNIX is a trademark of Bell Laboratories. Unify is a trademark of Unify Corp. UltraCalc is a trademark of Olympus Software. Ethernet is a trademark of Xerox Corp. Uniplus+ is a trademark of UniSoft Corp. PolyForth is a trademark of Forth, Inc. Regulus is a trademark of Alcyon Corp. CP/M-68K is a trademark of Digital Research. Ada is a registered trademark of the U.S. government, Ada Joint Program Office. RM-COBOL is a trademark of Ryan-McFarland Corp. HK68 is a trademark of Heurikon Corp. Multibus is a trademark of Intel Corp.

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Company _____ Phone _____
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UR 6/84

SALES AND MARKETING PROGRAM ANNOUNCED

Key Systems, Inc., a software development company founded in 1977, introduces the release of a new software program called PROSPECTING. Field tested for over one year, PROSPECTING is designed to increase the efficiency of sales and

marketing professionals.

PROSPECTING stores, searches and analyzes a wealth of information about customers or prospects and their product interests. The system will print personalized letters using letter files created by most word processors. In addition, the system prints envelopes, cards,

labels, status reports and marketing analysis reports. Other features include multiuser capabilities, password protection and extensive file searching capabilities.

PROSPECTING is available under CP/M, MP/M, MS-DOS, PC-DOS and XENIX. The suggested retail price is \$640.

For further information about PROSPECTING, contact Key Systems Inc., 512 Executive Park, Louisville, KY 40207, 502/897-3332.

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Published monthly by InfoPro Systems, UNIQUE is devoted to keeping users, vendors, and management up-to-date on the most recent hardware and software innovations in all versions of UNIX and C—changes that can affect your operations dramatically.

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FASTEST UNIX MICROCOMPUTER

The X-286, a desktop super-microcomputer from BDS, implements the XENIX operating system on Intel's 80286 processor. The basic configuration supports five users (expandable to 16). XENIX-286 includes both the Bourne and Berkeley (C) shells, vi, termcap, SCCS and further enhancements for semaphores, record and file locks. According to BDS, the X-286 outperforms any other microcomputer implementation of UNIX, delivering true supermini performance.

An Intel 310/286 with an enhanced I/O subsystem, the CX-286 incorporates the iAPX processor, an 80-bit 80287 numeric co-processor and 512 KB of error detecting and correcting RAM. RAM memory is dual ported between the system Multibus and a private high speed iLBX (local bus extension) bus.

The X-286 disk system includes a pipelined controller and 127 MB (formatted) of Winchester storage with an average access time of 30 ms (Maxtor XT-1140). The controller features automatic error correction of up to 11-bit burst errors and performs extensive disk subsystem

diagnostics. The fast rotary voice coil Winchester, large swap partitions and 1K internal XENIX block sizes deliver a high level of disk performance appropriate to the computational power of the iAPX 286 processor. A 5 1/4 inch 320 KB floppy, with software support for sector sizes from 128 to 1024, and a QIC-02 interface are also provided with the basic system. The X-286 is expandable to 16 MB of RAM and over 1 GB of disk.

For more information, contact BDS, Inc., 1400 Shephard Dr., Sterling, VA 22170, 703/430-0800.

Circle No. 280 on Inquiry Card

UNIX-BASED HORIZON SOFTWARE SYSTEM NOW OFFERED BY THE WOLLONGONG GROUP

Under an agreement announced in March by Horizon Software Systems, Inc. The Wollongong Group will distribute and fully support Horizon Software tools including Horizon Word Processing and the Horizon Spreadsheet.

Under the agreement, end users who purchase the Horizon Software System from The Wollongong Group will receive on-site installation, training and a 30-day warranty and support agreement. Users may obtain assistance from a service engineer by dialing a designated 800 number. A new release of the software package will be provided free of charge if it becomes available during the user's 30-day warranty period. An optional one-year warranty and support agreement is also offered.

"The Horizon Software System addresses the needs of the clients in our market perfectly," said David Preston, director of marketing at The Wollongong Group. "It's powerful enough to provide them with more than enough capabilities, but it doesn't take more than a few

hours to learn. This is important to us, as the majority of our customers are inexperienced UNIX users."

In addition to offering the

Horizon Software System to its general UNIX user base, The Wollongong Group will offer the Horizon product with its

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RECENT RELEASES

EUNICE and Pegasus products to users of Digital Equipment Corporation's VAX computers.

For more information, contact David Preston, Director of Marketing, The Wollongong Group

1129 San Antonio Rd., Palo Alto, CA 94030, 715/962-9224.

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(S) Sun, June 3
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(S) Sun, June 3
- INTRODUCTION TO THE BOURNE SHELL with Sharon Boucher
(LAX) Sat, June 9
- INTRODUCTION TO THE C SHELL with Jim Joyce
(LAX) Sat, June 9
- USER FRIENDLY awk with Sharon Boucher
(LAX) Sun, June 10
- FAST PROTOTYPING WITH UNIX with Gene Dronek
(LAX) Sun, June 10
- THE UNIX BLOCK I/O SYSTEM with Bob Nystrom
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- UNIX BLOCK DEVICE DRIVERS with Bob Nystrom
(S) Sat, June 23 (LAX) Sat, July 14
- UNIX NETWORKING with Greg Chesson
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- INSTALLING AND USING uucp with Bob Toxen
(S) Sun, June 24 (LAX) Sun, July 15
- UNIX SYSTEM SHELL SCRIPTS with Steve Bourne
(S) Sat, July 21 (LAX) Sat, June 30
- WRITING termcap ENTRIES with Doug Merritt
(S) Sat, July 21 (LAX) Sat, June 30
- WINNING STRATEGIES FOR MANAGEMENT with John Mashey
(S) Sun, July 22 (LAX) Sun, July 1
- 1001 WAYS TO SELL UNIX with Jim Joyce
(S) Sun, July 22 (LAX) Sun, July 1

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APECS/8000 FROM ADP NETWORK SERVICES

ADP Network Services announced the release of a new integrated project management system for computers ranging from super micros through mainframes, including DEC VAX, Onyx and other UNIX-compatible hardware.

APECS/8000 performs under the UNIX operating system (or UNIX emulator). The system is transportable, allowing clients to use APECS/8000 on the size of computer that best meets their needs while giving them a migration path to future computers without risk to their project management investment.

APECS/8000 incorporates a true relational database management system which provides a collection of data drawn upon for all calculations, reports and graphs. The system includes earned value analysis, critical path analysis, easy-to-use application building techniques, work breakdown and organization structure consolidation, and a full range of data entry screens, report writing and graphics capabilities.

According to G. Michael Sears, senior vice president of ADP Network Services, "APECS/8000 is the only UNIX-based project management system on the market that so completely addresses the computing needs of planners and project managers whether they use mainframes, minis or micros."

For more information, contact ADP Network Services, Inc., 175 Jackson Plaza, Ann Arbor, MI 48106, 313/769-6800.

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RECENT RELEASES

FOURTH GENERATION APPLICATION PORTED TO AT&T 3B LINE

Software Express announced that its entire Fourth Generation environment is running and

available on the AT&T 3B line of computers. The Fourth Generation environment includes APPGEN, a UNIX application generator and 10 application packages developed under APPGEN.

Since the APPGEN environment utilizes a highly portable parametric methodology, it operates on all UNIX versions and is compatible across all 3B lines running under UNIX System V. Since the 3B line can be fully configured to handle over 100 terminals, large systems houses that are migrating to UNIX have a technical and financial need to evolve their "coded" applications over to a parametric Fourth Generation environment to unburden them from the sheer weight of their programming overhead.

APPGEN is a Fourth Generation, non-procedural applications generator which allows developers to create new applications in 10 percent of the time typically consumed by older coded methods. The development process is accomplished through the English language, question/answer prompts in the development environment which in turn build parameter definition data files which drive the reentrant "C" level run-time modules.

APPGEN is a complete application development environment including not only all the development facilities required for producing complex, transaction-driven applications, but also induces a relational DBMS utilizing variable length records, field and multivalued attributes.

The product pricing is based on the number of terminals supported by each 3B model. APPGEN Development begins at \$6000, and the applications begin at \$600 each. They include General Ledger, Accounts Payable, Accounts Receivable, Payroll, Inventory/Order Entry, Fixed Assets, Job Cost, Professional Time Reporting and Account's Client Write-Up.

For more information, contact: Steve Thomas, Director, Marketing Communications, 713/974-2298, 800/231-0062.

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- Operating System Design: The XINU Approach by Douglas Comer (Prentice-Hall)
- The UNIX Programming Environment by Brian Kernighan and Rob Pike (Prentice-Hall)
- A Practical Guide to the UNIX System by Mark G. Sobell (Benjamin/Cummings)

■ C BOOKS

- The C Puzzle Book by Alan R. Feuer (Prentice-Hall)
- The C Programming Language by Brian W. Kernighan and Dennis M. Ritchie (Prentice-Hall)
- Learning to Program in C by Thomas Plum (Plum-Hall)
- C Programming Guide by Jack Purdum (Que Corp.)

■ C and vi REFERENCE CARDS

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- UNIQUE
- UNIX Review
- World UNIX & C

■ vi POSTER, UNIX SHELL POSTER

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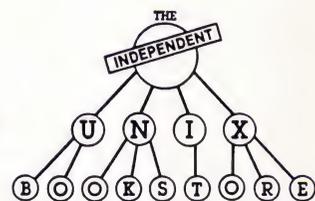
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CALENDAR

UNIX REVIEW preview calendar of events

JUNE

May 30-June 1 CAPE Seminar, Los Angeles, CA: *The UNIX System*. Contact: The Center for Advanced Professional Education, 1820 East Garry Street, Suite 110, Santa Ana, CA 92705; 714/261-0240.

June 2-3 International Technical Seminars, Sunnyvale, CA: *File System Maintenance Tools* (Bob Nystrom); *System Administration Tools* (Jim Joyce); *File System Repair* (Bob Toxen); *UNIX Tuning and System Performance* (Jeff Schriebman). Contact: International Technical Seminars, 520 Waller Street, San Francisco, CA 94117; 415/621-6415.

June 4-8 Bunker Ramo Seminars, Trumbull, CT: *Introduction to UNIX*. Contact: Bunker Ramo Information Systems, Director of Training Services Group, 35 Nutmeg Drive, Trumbull, CT 06609; 203/386-2600.

June 9-10 International Technical Seminars, Los Angeles, CA: *Introduction to the Bourne Shell* (Sharon Boucher); *Introduction to the C Shell* (Jim Joyce); *User Friendly awk* (Sharon Boucher); *Fast Prototyping with*

UNIX (Gene Dronek). Contact: ITS (see June 2-3).

June 11-15 Bunker Ramo Seminars, Trumbull, CT: *Programming in C*. Contact: Bunker Ramo Information Systems (see June 4-8).

June 11-15 Plum Hall Training, Concord, MA: *UNIX Workshop*. Contact: Plum Hall, 1 Spruce Street, Cardiff, NJ 08232; 609/927-3770.

June 12-15 USENIX Summer Conference, Salt Lake City, UT. Contact: USENIX Conference Office, PO Box 385, Sunset Beach, CA 90742; 213/592-3243.

June 13-15 Digital Seminar Program, Boston, MA: *UNIX Operating System Overview*. Contact: Digital Educational Services, 12 Crosby Drive, Bedford, MA 01730; 617/276-4949.

June 18-22 Bunker Ramo Seminars, Trumbull, CT: *Introduction to UNIX; Advanced C Methods*. Contact: Bunker Ramo Information Systems (see June 4-8).

June 18-22 Plum Hall Training, Concord, MA: *C Programming Workshop*. Contact: Plum Hall (see June 11-15).

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CALENDAR

June 20-22 Digital Seminar Program, Boston, MA: *The C Programming Language*. Contact: Digital Educational Services (see June 13-15).

June 23-24 International Technical Seminars, Sunnyvale, CA: *UNIX's Block I/O System* (Bob Nystrom); *UNIX Block Device Drivers* (Bob Nystrom); *UNIX Networking* (Greg Chesson); *Installing and Using uucp* (Bob Toxen). Contact: ITS (see June 2-3).

June 25-29 Bunker Ramo Seminars, Trumbull, CT: *Advanced UNIX Methods*. Contact: Bunker Ramo Information Systems (see June 4-8).

June 25-29 Plum Hall Training, Concord, MA: *Advanced C Topics*. Contact: Plum Hall (see June 11-15).

June 26 Local Area Networks, Palo Alto, CA: *Low Cost Personal UNIX's*. Expert panel discussion on UNIX topics. Contact: Uni-Ops (UNIX users membership group), John Bass, 408/996-0557, or Paul Fronberg, 408/988-1755.

June 30-July 1 International Technical Seminars, Los Angeles, CA: *UNIX System Shell Scripts* (Steve Bourne); *Writing termcap Entries* (Doug Merritt); *Winning Strategies for Management* (John Mashey); *1001 Ways to Sell UNIX* (Jim Joyce). Contact: ITS (see June 2-3).

JULY

July 9-13 Plum Hall Training, New York, NY: *UNIX*

Workshop. Contact: Plum Hall (see June 11-15).

July 14-15 International Technical Seminars, Los Angeles, CA: *UNIX's Block I/O System* (Bob Nystrom); *UNIX Block Device Drivers* (Bob Nystrom); *UNIX Networking* (Greg Chesson); *Installing and Using uucp* (Bob Toxen). Contact: ITS (see June 2-3).

July 16-20 Plum Hall Training, New York, NY: *C Programming Workshop*. Contact: Plum Hall (see June 11-15).

July 18-20 Digital Seminar Program, Washington, DC: *UNIX Operating System Overview*. Contact: Digital Educational Services (see June 13-15).

July 21-22 International Technical Seminars, Sunnyvale, CA: *UNIX System Shell Scripts* (Steve Bourne); *Writing termcap Entries* (Doug Merritt); *Winning Strategies for Management* (John Mashey); *1001 Ways to Sell UNIX* (Jim Joyce). Contact: ITS (see June 2-3).

July 23-27 Plum Hall Training, New York, NY: *Advanced C Topics*. Contact: Plum Hall (see June 11-15).

July 25-27 Digital Seminar Program, Washington, DC: *The C Contact: Digital Educational Services* (see June 13-15).

July 31 Uni-Ops Monthly Meeting, Palo Alto, CA: *UNIX Kernel Overview*. Contact: Uni-Ops (see June 26).

AUGUST

August 8-10 Digital Seminar Program, Seattle, WA: *UNIX Operating System Overview*. Contact: Digital Educational Services (see June 13-15).

August 15-17 Digital Seminar Program, Seattle, WA: *The C Programming Language*. Contact: Digital Educational Services (see June 13-15).

August 20-24 Plum Hall Training, Raleigh, NC: *Advanced C Topics*. Contact: Plum Hall (see June 11-15).

August 28 Uni-Ops Monthly Meeting, Palo Alto, CA: *UNIX and IBM PC's*. Contact: Uni-Ops (see June 26).

SEPTEMBER

September 11-14 UNIX Systems Expo/84, Los Angeles, CA: Contact: Computer Faire, Inc., 611 Veterans Boulevard, Redwood City, CA 94063; 415/364-4294, or CFI in Newton, MA, 617/965-8350.

OCTOBER

October 16-18 UNIX/EXPO, The UNIX Operating System Exposition, New York, NY. Contact: National Expositions Co., Inc., 14 West 40th Street, New York, NY 10018; 212/391-9111.

Dear Readers: If you or your company are planning events of interest to the UNIX community, please send announcements to: UNIX Review Calendar 520 Waller Street, San Francisco, CA 94117

Please include sponsor, date and location of event, address of contact and relevant background information.

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