UNIX SYSTEM CO-EXISTENCE

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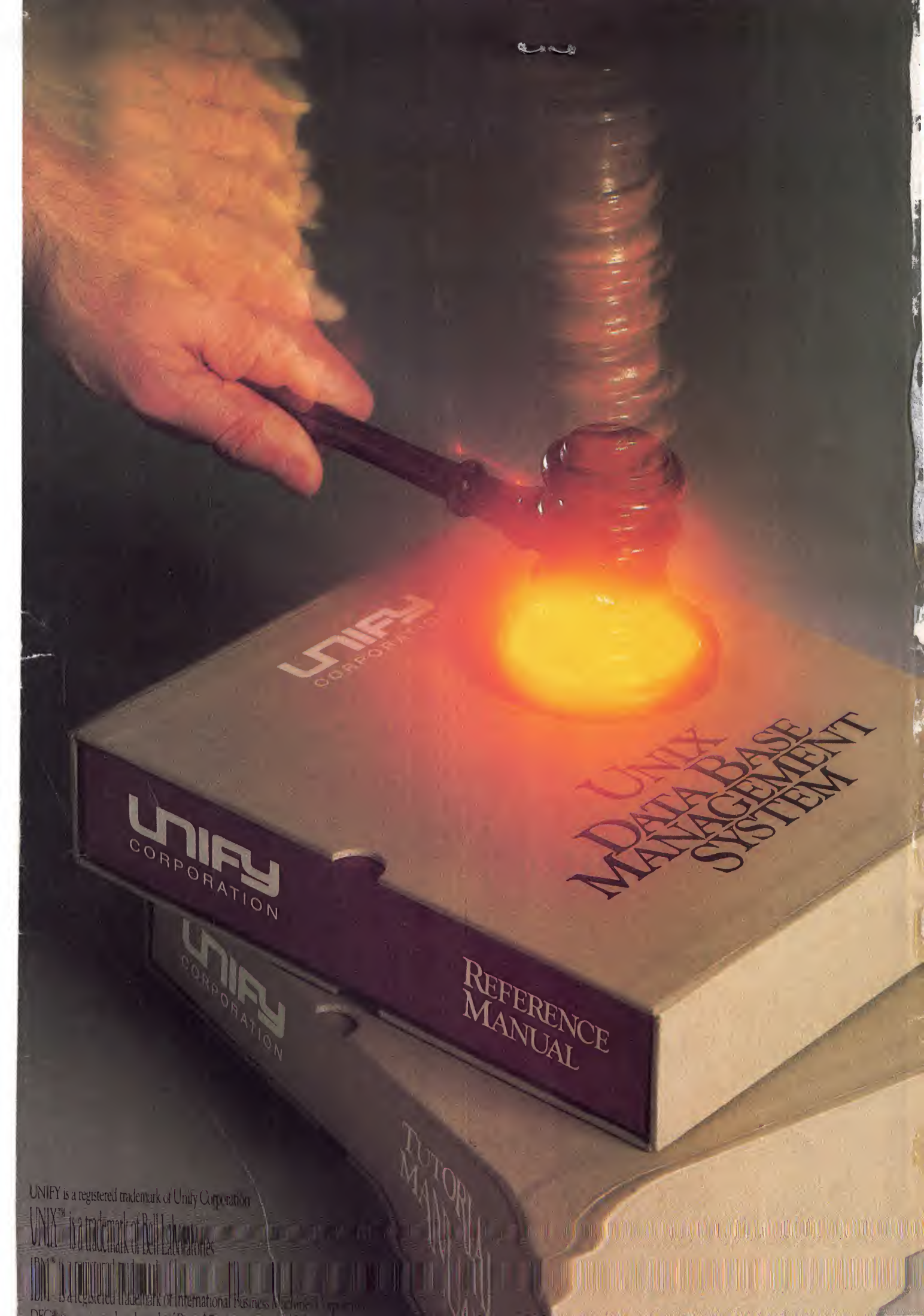

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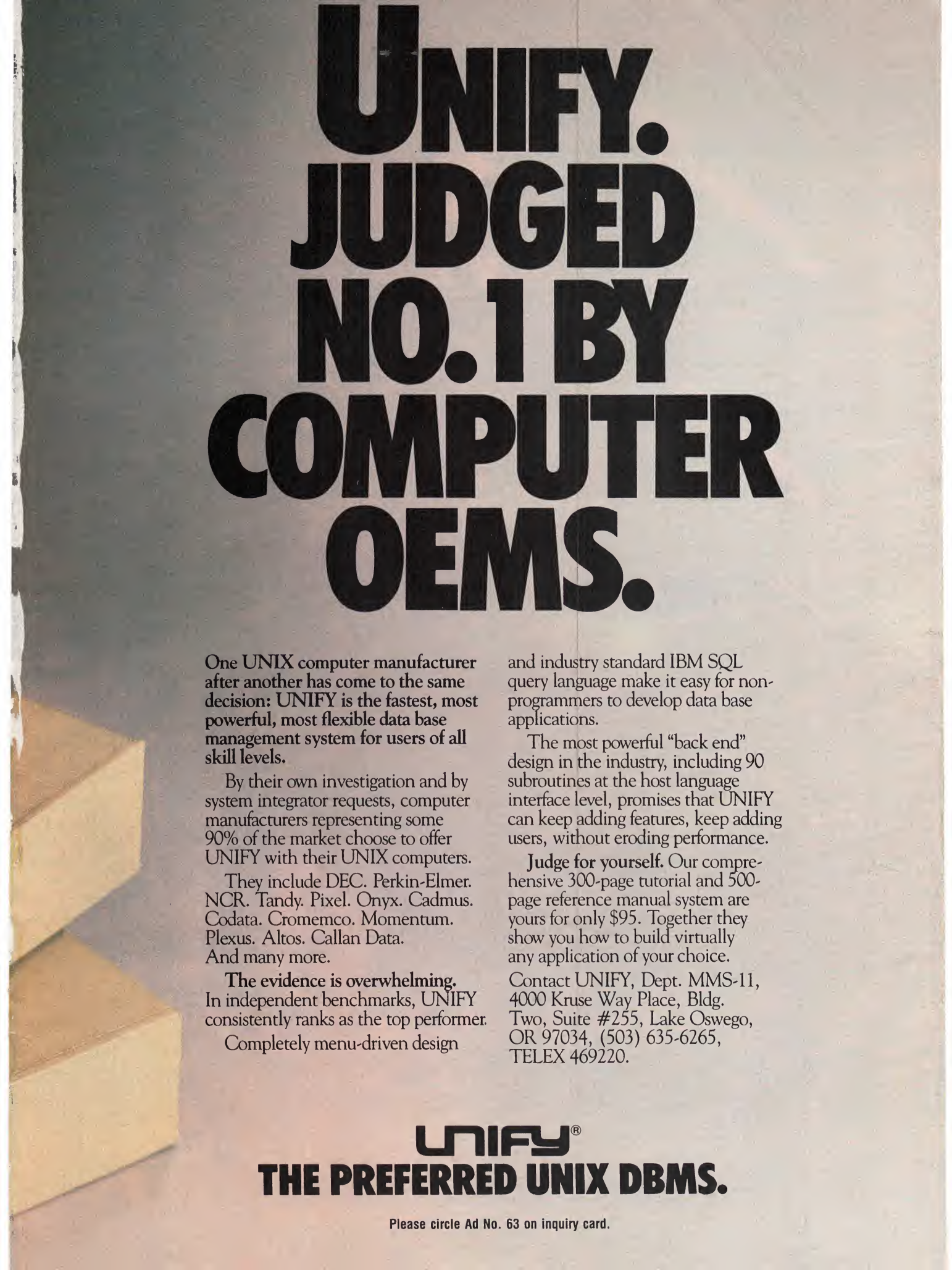

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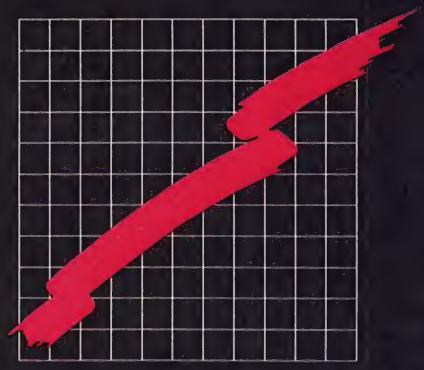

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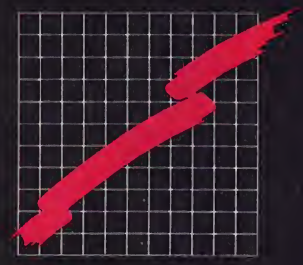

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VOLUME II, NUMBER 1

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As we begin our second year, UNIX/WORLD'S distribution will rise to 120,000, solidifying our position as the world's largest monthly UNIX magazine.

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THE MARRIAGE OF THE UNIX SYSTEM

by Philip J. Gill

When one operating system is not enough, why not have two? This brief overview takes a look at the reasons behind and the Unix system's role in the growing phenomenon of co-resident operating systems.

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by Tom Gilchrist and Ken Johnson

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How much does it cost to entice a dope-smoking Unix system guru to Dayton? For the answer to that and other burning salary questions, read UNIX/WORLD's First Annual Salary Survey.

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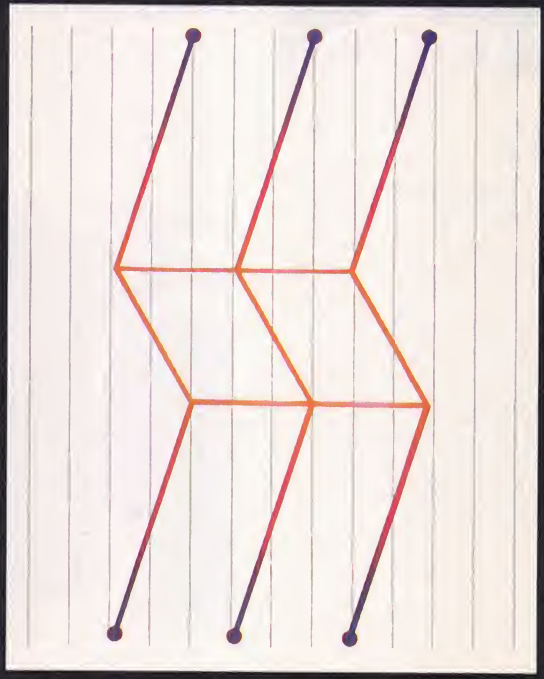

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by Vanessa Schnatmeier

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by Paresh Vaish and Jean Marie McNamara

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by Peggy Judd

`troff`, the Unix system document-preparation software, has found a home in thousands of academic, government, and commercial research institutions. Our author, an experienced `troff` user, explains what all the devotion is about.

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UNIX/WORLD (ISSN 0739-5922) is published monthly by Tech Valley Publishing, with offices at 444 Castro Street, 12th Floor, Mountain View, CA 94041, telephone 415/964-0900. Application to mail at Second-Class Postage Rates is Pending at Mountain View, CA. Additional entry application also being applied for at Sparta, IL. John M. Knapp, Publisher. RETURN POSTAGE GUARANTEED. Postmaster, send Form 3579 to UNIX/WORLD, 444 Castro Street, 12th Floor, Mountain View, CA 94041.

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FROM THE PUBLISHER'S DESK

It's no secret that the venture-capital gravy train has come to a screeching halt. The shakeout is in full swing; Chapter 11 is becoming the norm for doing business. Investors and stockholders are less impressed with market share and have begun to ask cold questions about profitability.

Most fund-raisers making the rounds in the last few months for expansion or startup capital have come home with empty hands, muttering that high-tech investment is no longer "fashionable." There's no doubt that investment, like any other form of human endeavor, follows trends and patterns. To blame the current rash of business failures on those mysterious processes that govern hemlines, however, is irresponsible.

I think that much of the blame lies squarely with us in the industry. Our field, and the Unix system market in particular, is glutted with me-too products. Who ever believed that the world really needed 200 startup companies producing the same M68000-based Unix system boxes in different designer colors, anyway?

It's time that corporate officers in our industry took charge of their fate and stopped doing imitations of beached whales and stuck pigs. There are solutions to our problems: mergers, acquisitions, and licensing partnerships. Developmental companies need strong management skills in finance, R&D, and marketing. Most startups tend to be strong in one area but not in the other two. A company with a multimillion-dollar war chest but no product is just as likely to fail as a company with a great idea and no money.

There have been a number of abortive attempts by the cash-rich to reach out to the idea-rich in the last few months, but with no major successes—reportedly for reasons of ego. It's fun to pass around business cards emblazoned with CEO and CFO at parties; it's not much fun to be at the wrong end of a stockholder suit over fiduciary responsibility.

The time has come for responsible corporate officers to wipe the glory dust from their eyes and to take responsible steps toward mergers, acquisitions, and other forms of consolidation.

We're on our own. No VC Fairy Geltmother is going to pull us out of this one. We can, however, do right by our investors—and employees—by seeking out the right partners with whom to share technology, management know-how, and capital.

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President and Publisher

UNIX/WORLD

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EDITOR'S CONSOLE

This month's issue marks two important milestones for all of us at UNIX/WORLD. First, this issue begins our second year of publishing. More importantly, however, our second year brings us a new audience. With this issue, UNIX/WORLD goes mass-market!

Over 120,000 copies of this publication are now in circulation, making us the world's largest Unix system magazine. We'll now be reaching a new stream of Unix, Xenix, Venix, and work-alike system-based multiuser computer users through newsstand and bookstore magazine racks.

So, to all those of you who are picking up UNIX/WORLD for the first time, welcome aboard! For those of you moving up to multiuser Unix systems, this magazine is dedicated to taking you out of your standalone PC loneliness and into the powerful world of multiuser computing. For those of you already on multiuser Unix systems, we'll help you get more out of what you've already got.

To all of our loyal subscribers who discovered us sometime ago, thanks for your support. We look forward to continuing to serve you with all the regular features and departments you've come to love and depend on—*C Tutorial, Wizard's Grabbag, /usr/ Library,* and more.

Now, on to the specifics of this issue.

"Unix System Co-Existence" may seem like an odd theme upon first glance. However, I believe that user demand and other market forces are making this quirky sounding topic not just a reality but a necessity.

To tell the truth, it all came about in a rather backhanded way. The editorial staff at UNIX/WORLD first approached this issue planning to feature compatibility as the theme. However, that word has been overused and often abused by the computer industry.

Left to our own discretion, then, we took off on our own path. We seized upon this opportunity to take a look at the bringing together of Unix system with other operating systems on the same machine. This phenomenon, technically known as co-resident operating systems, is an important and growing one in the user and vendor communities alike.

I know this may sound like heresy, but despite its popularity and adaptability to a wide variety of application environments, the Unix system is likely never to be all things to all people.

The movement toward co-resident Unix systems is, in fact, well underway. Recent product introductions attest to the wisdom of this direction (if even for such pragmatic reasons as a marketing edge or a hedge against the competition), with such products as Digital Research Inc.'s Concurrent PC-DOS (combining a PC-DOS emulator with Concurrent CP/M-86), IBM's VM/IX (a Unix System III port guested under Big Blue's proprietary VM operating system), and a long list of others.

In an addition to a brief overview of the co-resident Unix system phenomenon, we present an in-depth article on this topic by Boeing Computer Services Co.'s Tom Gilchrist and Ken Johnson, who explain the hows and whys of a co-resident Unix system environment leading the way in "Co-Resident Unix: Multiple Operating Systems on the Same Machine."

Second, we look at the problems of co-existence and compatibility between differing versions of the Unix system itself in "4.2BSD—Maybe We Can Still Call It Unix." Our authors, Gordon Waidhofer and Michael Sweeney (who, you may remember, took a near-heretical stance on portability in Vol. 1, No. 7) continue on their iconoclastic bent with a thoughtful discussion of 4.2's relationship with its Unix system brethren. Again at the risk of sounding heretical, they come away with the proposition that it might be best to call it "Berkelix" instead of a Unix system.

We've lined up some meaty but entertaining features this month as well.

UNIX/WORLD Contributing Editor and noted Unix system market researcher Dr. Brian Boyle takes a provocative look at "what price a Unix system guru?" in "The Unix System Salary Survey." Finally, Vanessa Schnatmeier, whose writings frequently appear on these pages, gives us a wrap-up of the major events in the Unix system marketplace in 1984, and she casts a glance to the system's prospects this year as well.

Finally, a brief word about next month's issue. We are inaugurating a brand new department in March, entitled "The Unix System Starter Kit." Authored by Bill Tuthill of Sun Microsystems, the department will be aimed at teaching users moving over from other systems the ins and outs of the Unix system. First up is a look at equivalent Unix system commands for the most popular CP/M commands. MS-DOS equivalents are due in April. So stay tuned. . . and enjoy. □

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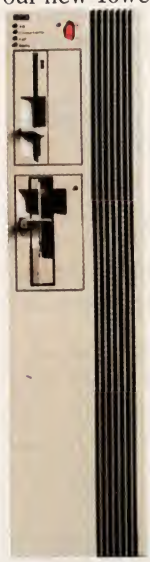

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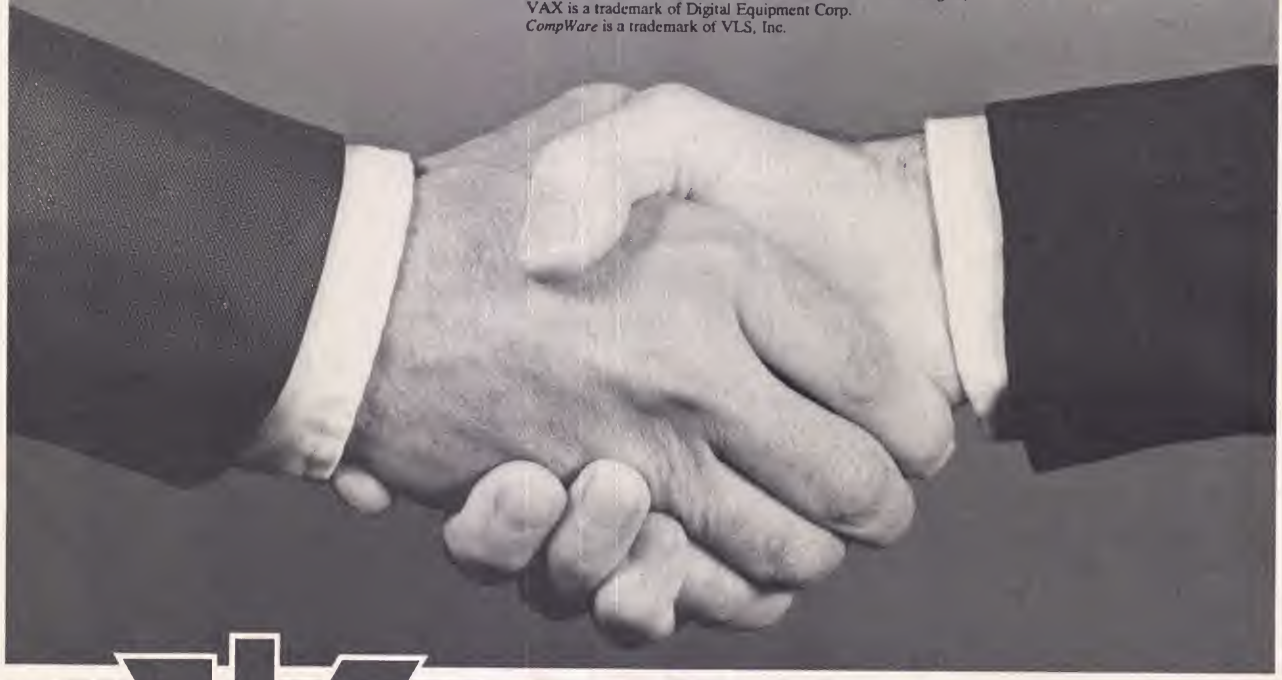

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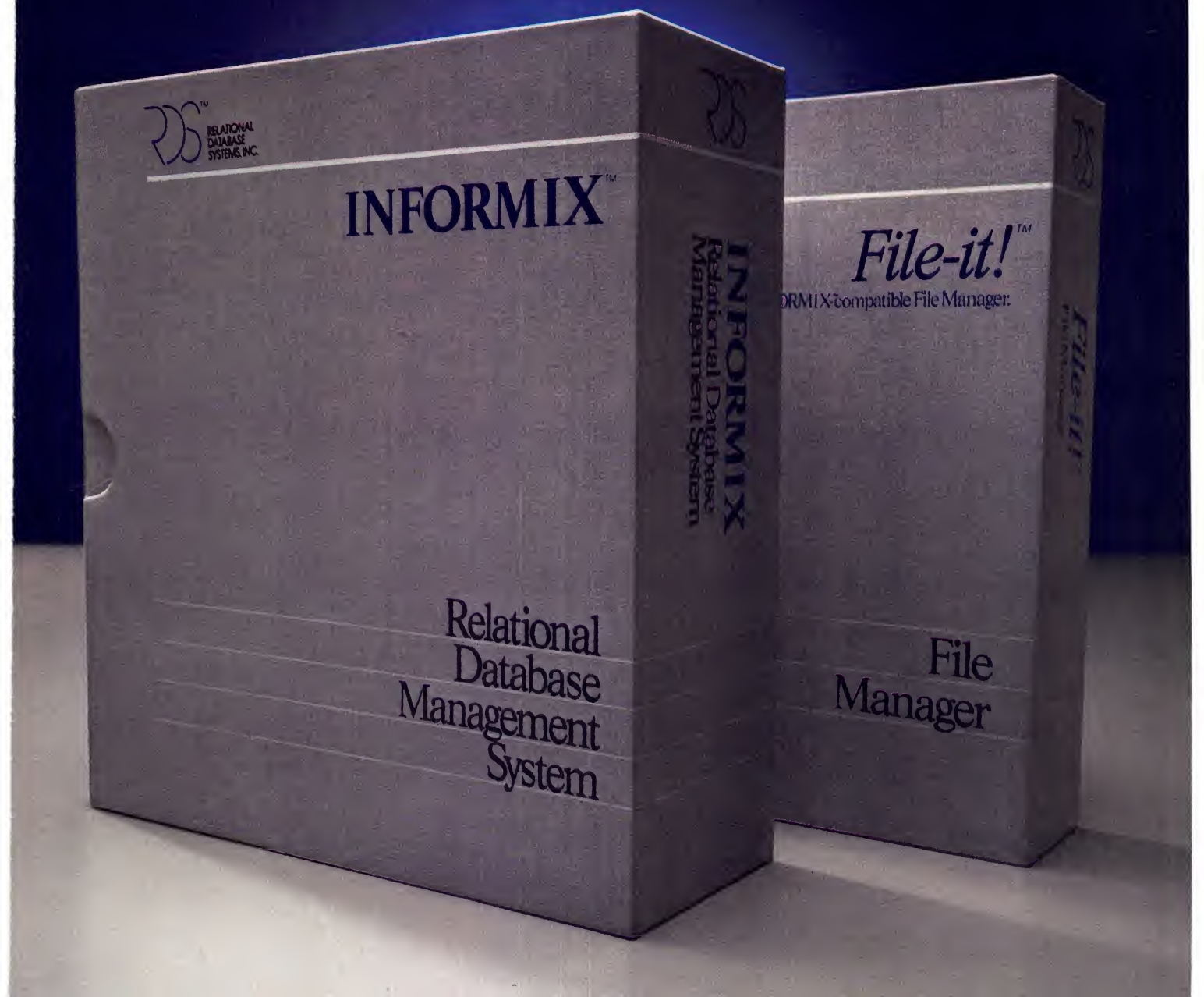

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- IBM PC, PC-AT, PC-XT
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IBM PC/AT: WINNERS AND LOSERS, PART II

BY OMRI SERLIN

The AT sobriquet comes principally from the use of the Intel 80286 MPU. At 6 MHz, this MPU performs approximately 3.5 to 11 times faster than the 4.77-MHz 8088 MPU used in all IBM PC models so far. Faster 286 versions (8-, 10-, and 12-MHz) are in various stages of availability and may find their way into future PC/AT upgrades.

The chip is only now coming into volume production. Very few other vendors (CompuPro and Durango, for example) are using it, and availability, especially of the 8-MHz-and-above parts, is a problem. Intel recently gave Advanced Micro Devices (AMD) the masks and other information necessary to produce the 286, apparently in preparation for increased demand due to the PC/AT. (AMD and Intel have had a broad technology exchange agreement since October 1981.)

Key factors contributing to the 286 performance boost are as follows:

(1) The higher clock frequency is generally responsible for an almost proportional increase, especially if the memory system can keep up. (Memory speed matching and MPU availability problems are the likely reasons for choosing the 6-MHz part.)

(2) The 286 has a 16-bit-wide data bus, allowing memory accesses and I/O transfers to take place 2 bytes at a time, as opposed to 1 byte in the 8088-based models. Furthermore, this bus is *not* shared (multiplexed) with the 8086 and 8088. (Multiplexing costs time because address and data signals have to follow in sequence, rather than be active concurrently.)

(3) The 286 has an on-chip memory-management unit (MMU), which allows the handling of protected virtual memory operations (essential for multiuser situations) to be carried out with minimum memory access time penalty.

(4) The 286 in its native mode supports a 30-bit logical address, which means a very large logical address space for *each user*. (16-Kbyte segments of 64 Kbytes each equal 1024 Mbyte). These large virtual spaces are reduced to a 16-Mbyte physical space (24-bit address) by the MMU. The PC/AT, however, utilizes "only" 3 Mbytes of physical memory.

In contrast, the 8086/8088 could address a maximum of 1 Mbyte, made up of 16 segments of 64 Kbytes each. The IBM PC allows 640 Kbytes of real memory.

Of course, to take full advantage of the large 286 native-addressing capability, brand-new software must be written. However, the 286 can operate in compatibility ("real address") mode. This emulates the 8086/8088 20-bit, nonvirtual, unprotected addressing scheme so that 8086/8088 software can run "as is."

(5) A three-level pipeline, once filled, executes many instruction types at the rate of one per each processor cycle (167 ns at 6 MHz). The 8086 has a two-level pipeline.

(6) The 286 is designed to operate with the 287 numeric coprocessor, which substantially speeds up floating-point operations and other functions. This is important in scientific, engineering, and real-time operations. Performance of the 286/287 combination is said to be twice that of a comparable-frequency 8086/8087 duo (an optional feature on the current IBM PC).

(7) The 286 has hardware support that allows context-switching in under 25 microseconds, compared to about a millisecond in the 8086/8088.

THE KEY POINTS

Entry Systems Division (ESD): This group is stronger than ever. When ESD lost its IBU status and became a standard IBM division under ISG, some observers predicted ESD would become more conservative in both products and distribution channels. PC/AT proves that ESD hasn't lost its entrepreneurial touch. The product is near the cutting edge of technology, and IBM's gala fete for dealers, evidently patterned after the Apple Mac and IIc introductions, shows it has no intention of abandoning non-IBM distribution channels.

ESD has also proven its continued independence by introducing a local-area network that is not compatible with the token-ring, baseband scheme being promoted as an "IBM standard" by the Communications Products Division (CPD).

Microsoft and DRI: Although late again with the key products IBM depends on, Microsoft has not only retained its position as the preferred software supplier to IBM but actually won new business (Xenix) from IBM.

DRI has again been left out in the cold since IBM has picked none of its products for the AT. Interestingly, DRI's COO Rowley was hinting

strongly in July that some DRI product (dubbed "Crystal") would play a key role in the "Glass" project. This code name is widely believed to have described TopView—which IBM now says is an in-house, IBM-developed software program.

MS-DOS lives!: There was much speculation that IBM would abandon MS-DOS in favor of software developed in-house. IBM did decline to accept Microsoft's Windows and has developed instead its equivalent product, TopView. But everything about the announcement shows that IBM is committed to MS-DOS (PC-DOS) upward compatibility in its PC line.

TopView appears to be too limited right now (character orientation, for instance) to appeal to independent software vendors (ISVs) as an attractive environment. In the future, IBM may choose to exert more control over ISVs, with enhanced graphics hardware and future upgrades of the proprietary TopView.

Limited multiuser support: Wisely, ESD is de-emphasizing the multiuser capabilities of the PC/AT. PC-DOS continues to be strictly a single-user system, while Xenix (when available) will support just three users. The reasons are twofold. With standard Unix system TTY software, this is just about the limit that even as powerful an MPU as the 286 can effectively support. Furthermore, if the PC/AT could support more users, it would begin to pose a threat to other IBM product lines (8100, System/36-38, and even the 4321 and 4331).

Local networking wins: Instead, ESD is firmly on the local networking bandwagon with a Sytek-based offering. That is, ESD views the world as an interconnected universe of peer (intelligent) desktops, not as subordinate terminals hooked to a master mainframe. This distinctly non-IBM view is another clear illustration of ESD's independence.

Competitive impact: The firm most likely to be adversely affected by the combination of the PC/AT and the PC Network is Convergent Technologies (CT). The AT is substantially more powerful than Convergent's 8086-based NGEN, and PC Network provides faster, if not more powerful, networking capabilities. CT could try to upgrade to a 286, but it is doubtful whether CT has any more clout with Intel now than it had when it couldn't get 80186s.

Established sellers of desktop Unix/Xenix systems for one to four users (Altos, Tandy, Fortune, HP, and Intel) are undoubtedly reworking their pricing and marketing strategies; some new entries in this segment (from CompuPro, Corona, and Durango, for example) have been nipped in the bud. Those concentrating on the 8-to-16-user market (Alpha Micro, Micro Five, North Star, Plexus, Zilog, and minicomputer makers) have been spared —for the moment.

Operating system wars over: MS-DOS is "it" for single-user applications; Xenix is the winner in desktop multiuser environments. So long, Concurrent DOS; goodbye, System V; nighty-night, Pick system (what's that???). And so to bed.

AT&T: LEFT IN THE AT'S DUST

How's this for a belly laugh? AT&T, the creator of the Unix system, has yet to unveil a version suitable for its own (Olivetti) desktop system, while the IBM PC/AT has *two*—Xenix and PC/IX. In addition, the IBM Instruments' 9000 has had Xenix for a while now.

More significantly, with the Xenix announcement for the AT, IBM has administered a possibly fatal blow to AT&T's expensive effort to establish System V as a standard. Although Xenix is based on the earlier System III, it has most of the key advanced features (especially interprocess communications and shared memory support) that have been incorporated in AT&T's Unix system for the first time with System V. Xenix also has some features (file- and record-locking, visual shell) that are still missing from System V.

Furthermore, Microsoft points out that Xenix has been designed with PCs in mind (PC-oriented system administration utilities, for example), while those of System V are still very much "Data Processing Department"-oriented. Microsoft also suggests that the common object format (COFF) proposed for System V will not work on the Intel 286 MPU, while its own (x.out) does.

On the minus side, it should be noted that Xenix does not yet support the 1-Kbyte block size for the file system or a printer-spooling facility; both are now in System V and are planned for a later Microsoft release, Xenix 5.0. Also, Microsoft has no plans to support in Xenix the VPM (virtual protocol machine) communications emulation facility of Systems III and V. Neither Xenix nor System V supports demand-paging, although Xenix 3.0 does take advantage of the 286 MMU and is capable of utilizing its 16-Mbyte physical address space; presumably, so does the System V 286 port that DRI is still working on for AT&T.

WHAT NEXT?

It is tempting to conclude (as many have done already) that the next PC product will expand the multiuser capabilities to the 8/16-and-above level. However, such a product could cannibalize sales of a number of other IBM products, in particular the 8100, S/36-38, and (to some extent) the Series/1. In terms of raw processor power (MIPS), the PC/AT is actually more powerful than some of the low-end 4300 models (4331, 4321). An even more powerful PC could well affect even IBM's heartland—its mainframe line.

That last scenario is clearly "unthinkable," and even the smaller systems are worth preserving, for they are still very popular. (Backlogs on the Series/1 minicomputer, for example, are well over a year.) Furthermore, they contain much more IBM value-added than the PC (IBM-made 64-Kbit RAMs, disks, and other peripherals, for instance). They, therefore, carry much higher margins. And finally, none of these products are (as yet) under direct control of ESD.

Nevertheless, it is conceivable that IBM at some point would decide to standardize on just two architectures: the 4300/308X for the high-end mainframe offerings and the PC for all distributed processing and desktop applications. This is certainly attractive to the company because over the long term it could pay back in economies of scale (fewer product types, software, support, etc.) more than the loss of margins.

Besides, it is not written in the Bible that IBM must farm out all its PC manufacturing. In fact, it may be significant that the PC/AT is apparently manufactured exclusively in-house, at least for now. Given its enormous, continuous investment in plant and machinery, IBM could undertake volume manufacturing, probably at least as efficiently as the outside sources it is now using for the PC and the PCjr.

Should such a PC/SP (super performance) product surface, it could well signify that IBM has decided to opt for this "two-architecture" scenario—clearly a move of great significance.

SHORT NOTES

McGraw Hill, the leading textbook publisher, intensified its move into the computer world by acquiring Future Computing, the Richardson, Texas,-based market research firm; Monchik-Weber, a New York financial-services-software company; and Cyma, a supplier of accounting software. McGraw Hill already owns Data Resources Inc., an information utility selling access to specialized databases, and is reputed to be considering acquiring a computer hardware company.

Plexus Computers, Santa Clara, Calif., appointed ex-HP exec Edward J. Hayes as vice-president of marketing. The company is yet to announce a replacement for its president, Bill Jobe, who has announced his resignation but has yet to officially leave the company.

Sequent Computer, Portland, Ore., has unveiled its NS32000-based, tightly coupled multiprocessor system, which is aimed at technical OEMs. Sequent, founded in January 1983 by a group of 16 ex-Intel staffers, has raised some $12.7 million from leading venture capital firms, including a $7.5-million round earlier in 1984. The company employs about 100 people and operates from a 30,000-square-foot plant.

Sequent's system will be targeted at the "departmental/team" level (that is, above personal computing but below corporate central DP installations), a market the firm figures will be worth some $760 million in 1986.

Running under a modified version of Berkeley 4.2 Unix, the system will offer true transparent multiprocessing and a high degree of load balancing and graceful growth/contraction. The internal system bus is proprietary, but interfaces for SCSI, Multibus, and Ethernet will be offered.

Prices are expected to begin at $16,300 for an un-packaged 2-CPU configuration. A minimum packaged system with power will start at $28,100 for a 2-CPU, 2-Mbyte configuration. With a 100-Mbyte disk, tape, and 16 serial ports, the system costs $41,500.

Ungermann-Bass, Santa Clara, Calif., has shuffled its management "in anticipation of accelerated market growth." Co-founder Charlie Bass has been sidetracked to vice-chairman in charge of "industry relations." Marketing vice-president Jim Jordan was named executive vice-president and given responsibility for product development and marketing. □

Omri Serlin heads ITOM International Co., a research and consulting firm in Los Altos, Calif. He is the editor/publisher of Supermicro, *a newsletter from which the material in this column was derived, and of the* FT Systems Newsletter, *a monthly covering developments in fault-tolerant systems.*

This space is yours. Tell us what we're doing right—or wrong. Raise issues and ideas that other readers may respond to. Propose projects. Reject market trends. Take a stand.

PREFERS RCS

Dear Editor:

I noticed the articles by Dr. Rebecca Thomas in UNIX/WORLD describing the Source Code Control System (SCCS) in Vol. 1, Numbers 3 and 4. It is unfortunate that she chose such a crusty old system when a much better one is available. The better system is called RCS (short for Revision Control System) and is an improvement over SCCS in several ways. First, RCS has a much simpler user interface. Second, it is more efficient. Third, it provides important new capabilities for configuration management. Fourth, it allows version control in a network. Fifth, it is free.

The purpose of this letter is not to put down SCCS, but rather to set the record straight. SCCS is an important milestone in version control. It was developed in 1972 for an IBM 370 and OS/MVT, and later ported to Unix. This fact may explain some of the shortcomings in the user interface. In the past 12 years, our understanding of version control has improved, partly based on the experience with SCCS and similar systems. Today, SCCS is no longer the ultimate in version control it once was.

Sincerely,

Prof. Walter F. Tichy
Department of Computer Sciences
Purdue University

Thank you for the information on RCS. The reason I choose to document SCCS is twofold: (1) It's in widespread use and poorly documented. (thus, there was a real need for my series) and (2) I wasn't aware of anything better. If you or anyone else would like to write an article on RCS emphasizing the differences between it and SCCS, we would be more than happy to publish it. After all, that's why we are reading UNIX/WORLD—to find out more about what's available in Unixland.

Dr. Rebecca Thomas,
Editor Emeritus

Continued on page 23

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Continued from page 20

CLARIFICATION

Dear Editor:

You had a grossly misleading comment in the *Inside Edge* column in Vol. 1, No. 4. This relates to the NBS network standards. What the NBS has been sponsoring is not a standards-making group, but a workshop to keep vendors informed on the technical aspect of the ISO standards (not model —read that as a singular and specific reference.)

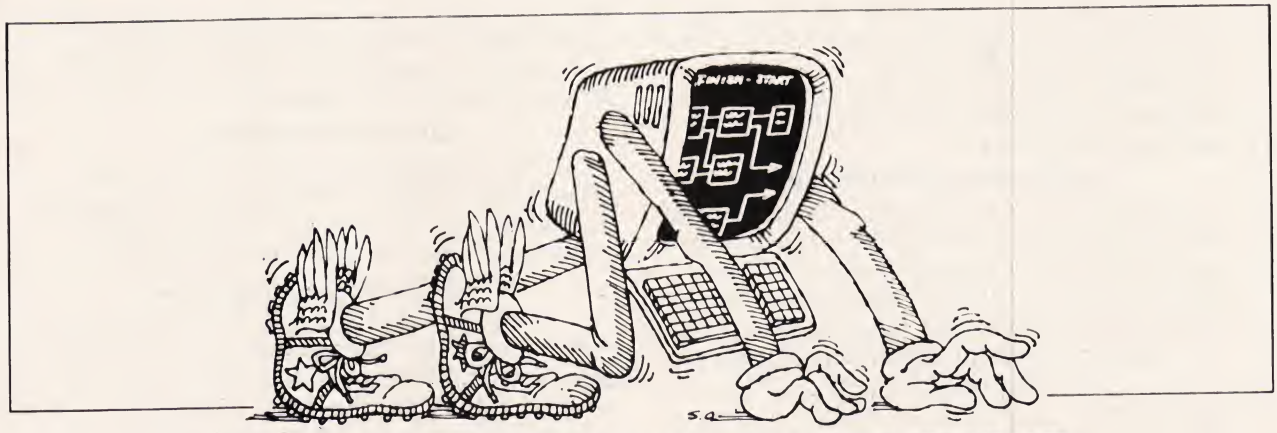
The ISO effort, which is joined by ANSI, and international groups has developed a standard for Layer 4 (transport) for which NBS has produced a test system. Multiple vendors have implemented this facility, and it was demonstrated at NCC in 1984 by 14 vendors, including IBM, DEC, Charles River Data, Intel, NCR, HP, etc.

This is not an attempt to provide competition for x.25 (which is the long haul to ISO standard) but to complement it. Vendors participating in the last workshop included AT&T, Data General, and Xerox. Unix system-based implementations are being demonstrated by Charles River Data Systems, NCR, HP, and ICL, with implementations in progress for *all* major European vendors. Large users, such as GM and Boeing are participating, and, in the case of GM, insisting on implementations for use in their facilities.

Sincerely,

James Isaak
Director of Product Marketing
Charles River Data Systems

Omri Serlin responds: I was, perhaps, a bit too critical in describing the somewhat unusual role that NBS has been playing in sponsoring their Layer 4 Class 4 networking protocol, which is actually being considered by ISO for adoption as a standard within the OSI Reference Model context. Subsequent comments on this issue by IEEE 802.3 Chairman Maris Graube and additional coverage of the NBS-sponsored twin NCC demonstrations have appeared in my Supermicro *newsletter, but did not make it in UNIX/WORLD.*



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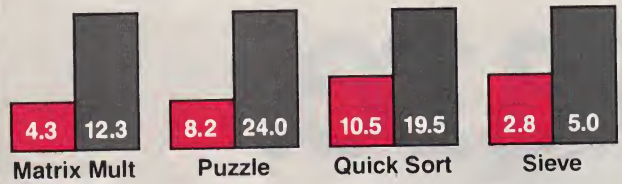

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TARTAN C Error Messages

C Program with Syntax Errors:

```
1  bubble(a) int a[100]; {int tmp,last,i;
2   for (last=100; last >= 2; last--)
3      {for (i=1; i <= (last-1; i++)
4          if (a[i] > a[i+1])
5             {tmp=a[i] a[i]=a[i+1];
6              a[i+1]=tmp;};
7      }
8  }
```

Portable C Compiler Error Messages:

```
"bubble.c", line 3: syntax error
"bubble.c", line 3: syntax error
"bubble.c", line 8: syntax error
```

TARTAN C accurately pinpoints errors and recovers:

```
2| for (last=100; last >= 2; last--)
3|    {for (i=1; i <= (last-1; i++)
                              ^1
***  1 Error 101: Parse error; token ")" inserted.
4|         if (a[i] > a[i+1])
5|            {tmp=a[i] a[i]=a[i+1];
                           ^1
***  1 Error 101: Parse error; token ";" inserted.
6|             a[i+1]=tmp;};
```

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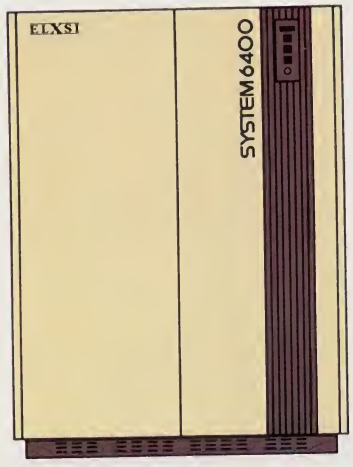

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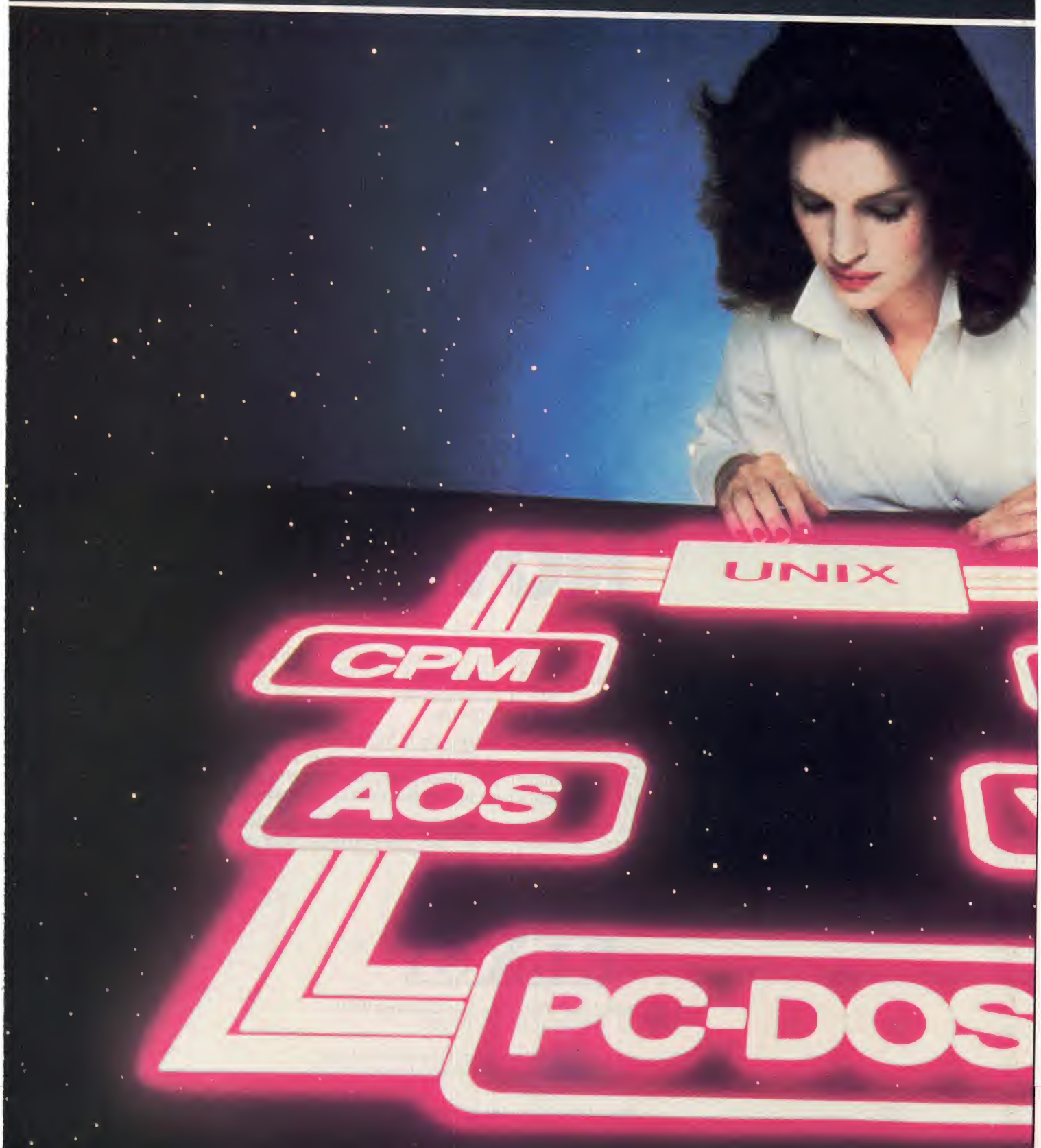

E UNIX SYSTEM

MICHAEL JAY

When is one operating system not enough? For a variety of reasons, users and vendors increasingly are finding that a single operating system on one machine may not be the answer to all their computing needs. Significant numbers of computer vendors and users are turning to the concurrent, or "co-resident," use of two or more operating systems, often marrying a particular vendor's proprietary offering with an industry-standard operating system. Today that industry-standard operating system is more often than not the Unix system.

In the not too distant future, a computer user may sit down at a terminal or networked personal computer to do, say, a report. By the time that user is done, he or she may have generated some business graphics, compiled a spreadsheet, manipulated a database, written some narrative text, and developed a program to tie them all together. For each task, that user not only might have accessed a different application software package, but also a different operating system, all without ever knowing he or she was doing so.

Some operating system vendors are already moving in this direction. For instance, Digital Research Inc., developers of the CP/M family of microcomputer operating systems, last spring came out with a new operating system called Concurrent PC-DOS. Based on the firm's Concurrent CP/M-86 with Win-

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dows operating system, Concurrent PC-DOS includes a user-transparent PC-DOS emulator that permits users simultaneously to run both PC-DOS and CP/M-86 applications packages in separate windows on the screen.

Moreover, although Digital Research officially won't comment on it, several sources in the company (as well as outside industry observers) say the company's next logical step is to incorporate some Unix system compatibility into a future operating system that would combine PC-DOS, CP/M, and the Unix system in one "universal" operating system.

In the Unix system marketplace, the need for marrying the Unix system to other operating systems stems from two concerns. First, many vendors are endorsing the Unix system as a co-resident operating system with their own proprietary operating systems in order to acknowledge and satisfy user demand for the Unix system option.

These products are frequently seen as a means for the vendor to accommodate the Unix system phenomenon but still keep control of that account and customer. These co-resident Unix system implementations are usually guested under the host computer's main, vendor-proprietary operating system, which typically remains in charge of the machine's most essential tasks.

In other words, some of these vendors may not really want to support the Unix system, but they are being forced to jump on the bandwagon because they perceive a real or imagined market demand from their customers. In addition, many vendors also realize the preference among software developers and programmers for the Unix system's varied and extensive productivity aids. As a result, they honestly seek to support that environment which can best help shorten otherwise lengthy program-development cycles.

Examples of Unix systems co-resident with a proprietary operating system include Amdahl Corp.'s Universal Time-Sharing (UTS) Unix System III port and IBM's more recently introduced System III port, VM/IX. Both of these systems run as a guest under IBM's proprietary VM operating system for 370-compatible mainframes.

AN IDEAL ENVIRONMENT

These and other co-resident Unix system environments serve as an ideal environment for developing applications to run under the particular vendor's proprietary operating system, provided that a suitable C compiler or other appropriate languages and facilities are also available.

This is precisely what two of this month's authors, Tom Gilchrist and Ken Johnson, of Boeing Computer Services, advocate in their article, "Co-Resident Unix: Multiple Operating Systems on the Same Computer."

A second tack to the marriage of the Unix system and other operating systems has often been taken by dedicated Unix system vendors themselves in an attempt to make their machines more palatable to potential customers and users.

In these cases, the dedicated Unix system vendor often offers co-resident support of PC-DOS/MS-DOS in conjunction with or as a guest under a host Unix system, hoping to capitalize on that operating system's popularity and abundance of application software. In this way, the vendor aspires to capture the customer looking to upgrade from a stand-alone PC to a multiuser Unix system, while at the same time preserving that customer's investment in software and databases.

Still a third approach to co-resident systems has been taken by a smaller group of dedicated Unix systems. That is, supporting the co-resident implementation of two Unix system variants such as 4.2BSD and System V. In this way, some vendors seek to marry what they see as the best of both respective worlds, while still giving those customers dedicated to one or the other what they want.

—Philip J. Gill

CO-RESIDENT UNIX SYSTEMS

Running the Unix system on the same computer as the application OS host offers high productivity at a minimum cost. Our authors tell you how and why.

BY TOM GILCHRIST AND KEN JOHNSON

The switch is on. The need for a standard programming environment, and the productivity that comes with it, is making software managers give the Unix system a hard look. The high portability of source code generated under the Unix system goes a long way in addressing a company's high investment in coding. However, for some, switching to the Unix system as the standard programming environment is not as clear-cut a decision as it first might seem. In this article we'll look at the problem of adding the Unix system environment to an existing programming system as well as some solutions to the problem.

For many companies, the switch to the Unix system equates to the phrase "Let's buy some more computers." Sometimes, the cost of new hardware makes sense in the overall development plan. However, more times than not, the idea of using the Unix system will be dismissed for some apparently good economic reasons.

Just think how nice it would be if you could run the Unix system on the same computer, co-existing with the application operating system. In the past few years a number of companies have had just the same idea and have products that let you run the Unix system on your mainframe or supermini.

Why should you try to install the Unix system as a second operating system? You are likely to face the objection that your organization has spent a lot of time and effort learning how to write and maintain software using the application operating system (OS). Why should more time and effort be expended learning still another programming environment?

A PWS ENVIRONMENT

It makes a lot of sense to develop a "Programmer's Workstation" (PWS) environment. This environment is developed on the concept that an application operating system environment might not be the most productive programming environment. The Unix system is a perfect host for a PWS system. With its many programming and documentation tools, it is becoming a natural choice.

One of the major benefits of the PWS concept is that programmers can move from computer to computer and from OS to OS without having to relearn and adjust to another programming environment and its new tools, editors, etc. This concept makes even more sense when you consider all the activities that can be brought under the PWS.

For instance, you can use the Unix system to control configuration management of source code with SCCS (Source Code Control System). Documentation can be prepared using Unix system-based word processors, text processors, and the Unix system WWB (Writers' WorkBench). Most Unix systems have tools for project and resource management, electronic mail, and electronic newsletters for better communications; the list goes on.

The PWS concept can not only be viable for organizations that develop software for many operating systems, but it can also increase productivity for those OSs that are batch-oriented and, thus, do not lend themselves to interactive sessions. The increased productivity in such cases can be dramatic—at a relatively low cost.

Increasing productivity is really the major benefit of using the Unix system in PWS tasks. Amdahl Corp. has done some thinking on the subject and claims that by using the Unix system, a substantial increase in productivity can be expected when using Amdahl's UTS Unix system in place of TSO or CMS.

TWO EXAMPLES

While the Unix system is available for a number of computers as a co-resident OS, we will talk only about two representative systems to give you an idea of how they work and how they are used. Keep in mind that the ultimate goal when using the Unix system in a PWS is to create what we call a "Single System Image." When running under a PWS environment using the Unix system, it should appear to the user that everything runs under the Unix system, even though some functions, applications, or compilers run on another operating system or computer. This goal might not be reached entirely, and in some cases it might not be desirable.

The large mainframe IBM-type computers running under the VM/370 architecture use the concept of the "Virtual Machine." Amdahl has a Unix system product called UTS that runs as a Virtual Machine. The system is basically in System III Unix (but will be updated to System V in the first part of 1985). A single UTS machine can support many users, and more than one UTS "machine" can be running on the same physical computer.

IBM iron supports 3270-type block mode terminals. It is indeed strange to run the Unix system in block mode, but it works out quite well. Amdahl has a good range of tools supporting the 3270-type terminal, including a screen editor called NED and an interface package called "quick screen" to write 3270 screens from C.

Some of Amdahl's system programs take advantage of full-screen editing and work very well. A C program can tell if it is running on a 3270-type device or a half duplex dial-up. Some of the Amdahl tools that use quick screen will automatically switch to a traditional "roll and scroll" mode when the program finds that it is attached to a TTY device. While this requires the programmer to write two different I/O routines (one that uses quick screen and one that does not), it addresses the problem very well.

While UTS includes a number of compilers, including C, FORTRAN-77, and Pascal, to use UTS as a PWS the system will have to be able to communicate with other "virtual machines" on the same hardware as well as with other computers.

UTS COMMANDS

The UTS user can communicate with virtual machines on the same computer with the UTS VMREAD and VMPUNCH commands. This will allow, for example, the user to upload and download data or CMS EXEC files to CMSBATCH. These commands can also be used to transfer data to another UTS virtual machine. VMREAD is like a spooler and is always active. It is used to read the UTS machine's virtual reader and to create files in the UTS file system.

Interactive sessions with applications running on other computers can be done via Amdahl's "Tube Control Language" interface to the IBM Passthru product. You can log in to anything connected to your computer through Passthru. However, there is a limit to one such session per UTS Virtual Machine.

Think how nice it would be to run the Unix system on the same computer, co-existing with the application operating system.

UTS also can access RSCS. A user under UTS can send a job via the Remote Spooling Communications Subsystem to a remote system. For example, the user can send JCL to MVS for execution.

UTS supplies the raw tools needed to do the file transfers and program execution; it is up to the users to adapt these tools as they see fit. UTS also provides software to install on your MVS or CMS machines to create files in the proper format for downloading to UTS.

UTS is the Unix system. The majority of the system is written in C. It is a very rich system with many Amdahl enhancements. Most programs will transfer (using 9-track TAR format tapes), compile, and run. However, screen-oriented editors and programs that rely on strict single-character input will not run in some cases. This is because of the block-mode nature of the 3270-type device support and the buffering of their half duplex dial-up lines.

EUNICE ON THE VAX

Another approach to co-resident Unix systems is demonstrated by Wollongong's Eunice Unix system. This product takes the approach of an overlay on top of VMS on the DEC VAX products. Eunice is a 4.1BSD-compatible Unix system. It

Increasing productivity is really the major benefit of using the Unix system in PWS tasks.

is to be offered as a System V-compatible Unix system in early 1985.

Because Eunice runs on top of VMS, it uses the same basic file system and VMS device drivers that are available under VMS. It does this by emulating Unix system files and file structures while under VMS. This means that users can write a file under Eunice and read it back directly under VMS.

Users can run the Unix system environment in a number of ways. First, they can log in to VMS and be transferred directly into Eunice. The Unix system file structure is supported with dummy "/dev" devices and a "/" root directory to allow many Unix system programs to run as is. Unix system file names and permissions are emulated by Eunice. Users may also run Unix system tools while in VMS.

The system's power comes from the fact that Eunice allows Unix system programs to read and write both VMS and Unix system files. The system will allow Unix system programs to read VMS directories as though they were Unix system directories.

Eunice is available with host-language support that includes C, FORTRAN-77, and Pascal. LISP and Franz LISP are available for artificial intelligence applications. Also available are SCCS (Source Code Control System), `vi`, `nroff`, and other standard Unix system and Berkeley enhancements. As in UTS, both `sh` and `csh` are supported.

Using Eunice on the VAX as a PWS for writing and maintaining applications that run under VMS is really quite easy. Batch files can be written to compile Unix system generated and maintained source code directly by VMS compilers. There is no need to transfer or translate files. Software can be written that can very easily make users think they are running VMS-hosted compilers under the Unix system. Interactive VMS sessions are, of course, very easy to run simply by dropping into VMS.

All in all, this approach lends itself very well to the VAX.

The CRTs and printers used on VMS are the same ones used for the Unix system. While VMS is not the same as the Unix system, the differences are easy enough to take care of with a relatively small amount of system overhead. Some Unix system features are missing in Eunice. One is the concept of linked files. Users who have applications that use linked files will have to make copies of the files. This is a by-product of the VMS host.

A FURTHER OFFSHOOT

Another byproduct of the host VMS environment is the backup file that is always made when editing or writing to an existing file. This file has a `.<rev-number>` extension. You can write a script under the Unix system to get rid of the old backup files when you exit your Unix session (using the `.logout` feature of `csh`, for example) or by using the VMS `purge` command at logout.

File transfers can be made using nine-track TAR format tapes. We have transferred source and data files between UTS and Eunice using 1600-bpi tapes with no trouble. In installations that have both DEC VAX and IBM mainframes, gateways can be set up to use IBM RJE channels to send information and data to the IBM mainframe for compiling.

These are not the only Unix system products designed to run in a co-resident mode. However, these types of products are limited to those computers large enough to support the added overhead of a Unix system or the added emulation overhead.

Many computers do not have the resources to successfully run the Unix system concurrently. There has been a trend toward using IBM PCs, XTs, and clones as PWS hosts, either under the Unix system or under one of the standard PC operating systems.

With the advent of powerful, inexpensive micro- and mini-computers, the concept of PWS "clusters" running the Unix system is a viable alternative. A number of programmers, perhaps up to 12, can be running under the Unix system, with communication links to any number of mainframes or superminis.

Running the Unix system on the same computer as the application OS host offers high productivity at a minimum cost. Contact your computer manufacturer for information about the availability of a co-resident Unix system for your computer.

For more information on Eunice for DEC VAX computers, contact The Wollongong Group, 1129 San Antonio Rd., Palo Alto, CA 94303, 415/962-7200. For more information on UTS for 370/VM, contact Amdahl Corp., 1250 East Arques Ave., Sunnyvale, CA 94086, 408/746-7638. □

Tom Gilchrist and Ken Johnson work at Boeing Computer Services in Wichita, Kansas. Mr. Gilchrist is a lead analyst on a number of projects under the Unix system for BCS and its customers. Ken Johnson, also a lead analyst, has an extensive background in mainframe systems software and networking, primarily in IBM environments.

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4.2BSD— BERKELEY'S ANSWER TO THE UNIX SYSTEM

4.2BSD represents the single largest modification of a Unix system derivative to date; we will never see such a large change again. But how does all this affect compatibility?

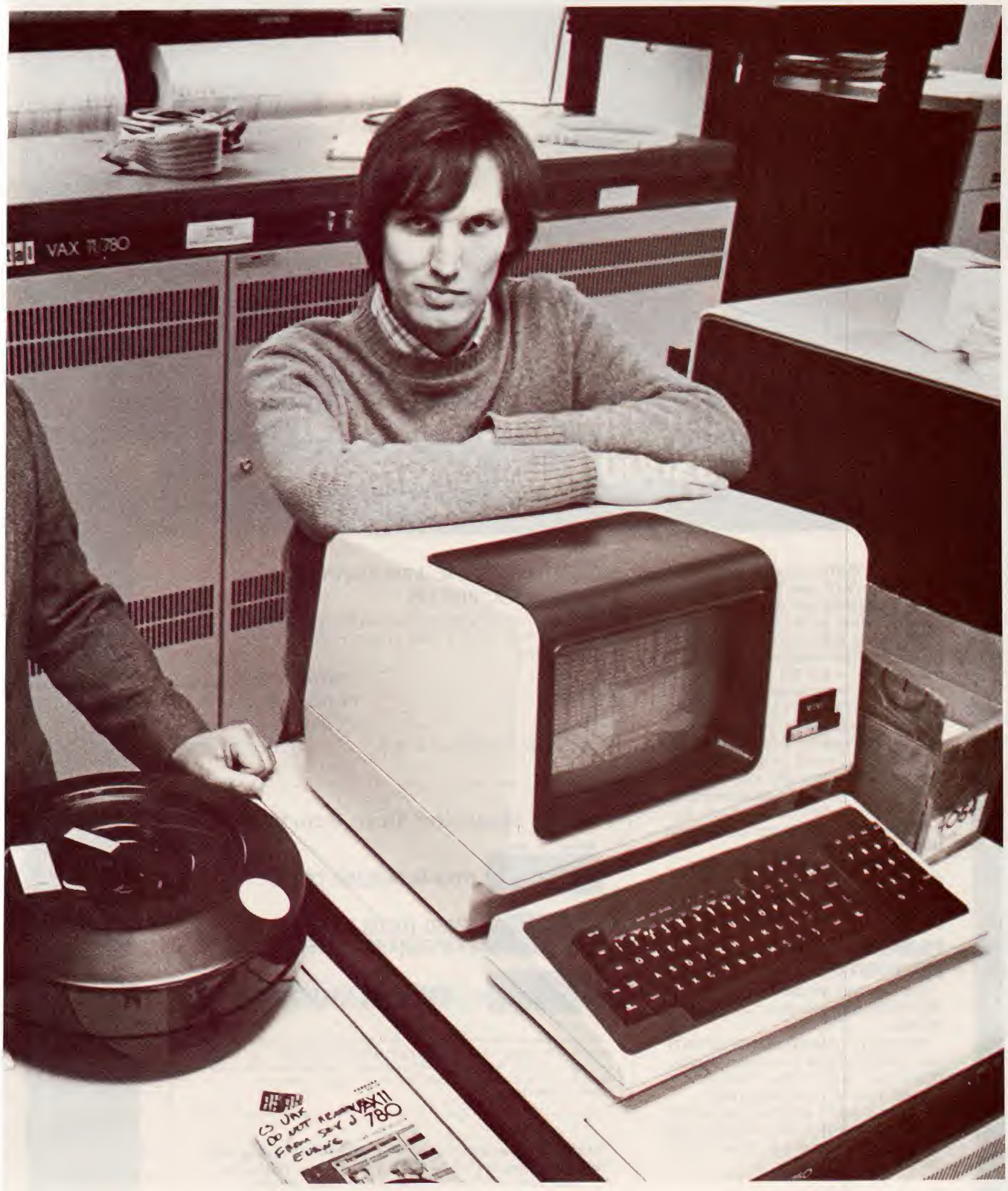
BY GORDON W. WAIDHOFER AND MICHAEL SWEENEY

Compatibility. It has been one of the keystones of Unix operating system evolution. From one version to another, the commands, features, libraries, and so forth have behaved in pretty much the same way. They have been known quantities with known qualities. When you wrote programs that used pipes under Version 6, you could reasonably expect those pipes to work the same way under Version 7 or System V. Then came 4.2BSD, and pipes went down the tubes—along with several other things.

This is not to say that 4.2 doesn't have pipes; it does. The only problem is that when the Berkeley development team generalized interprocess communications, the result was that pipes behaved differently. Users had to change their expectations. That's okay—users are pampered anyway. Unfortunately, though, they also had to change many of their programs. This is called incompatibility, and generalized interprocess communications isn't the only problem.

Unlike portability, compatibility is not a matter of degree; it's an either/or proposition. You measure it not by how much code you must change to make a program work, but by whether or not you must change any code. Simply stated, a program is compatible with an operating system if all the facilities the program needs are present and behave as the program expects them to.

An operational definition of compatibility between operating systems is simple. Find an application that performs as advertised on one operating system, load it onto another one, compile it, and run it. If it performs, you have compatibility;



Professor Domenica Ferrari, associate chairman for computer science of U.C. Berkeley's Department of Electrical Engineering and Computer Science; and Michael Karels (R), principal programmer of the Computer Systems Research Group.

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if it doesn't, you don't. It may be portable, but it ain't necessarily compatible.

A single test, however, does not mean that the whole thing is incompatible. At first glance, this may seem to deny the above statement which says that compatibility is not a matter of degree. It's not so, though. For any given program, compatibility is completely binary —it's either on or off. The issue of compatibility between operating systems arises when several discrepancies between the operating systems exist such that common facilities and utilities are not present or don't work according to expectation.

A COMPLICATED SITUATION

The issue gets more confusing when so many different versions and derivatives of an operating system exist. Often, a development team adds new facilities or alters existing ones in order to support a pet application. The result is to limit where the application can work and what else can work on the operating system.

Let's say, for example, that a shop is running application *A* on operating system *X*. In order to work, application *A* requires facility *Fa*. The shop then switches to a new and improved operating system *Y* —it's faster, takes less space, has several additional facilities, and has facility *Fa*. No sweat; it's compatible.

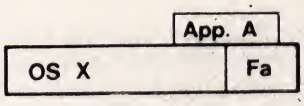


FIGURE 1

Now, say another department with another computer has application *B* that runs on a derivative of operating system *Y*; call it *Y-not*. *Fb* is a nonstandard extension added by the people who developed the *Y-not* derivative. Application *B* won't even compile on the standard operating system *Y*: No *Fb*, no compatibility.

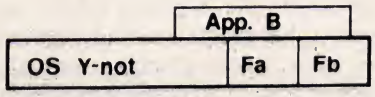


FIGURE 2

Later, the shop switches again —this time to super-improved operating system *Y.2*, with added enzymes for extra whiteness. *Y.2* has a facility called *Fa*, so application *A* should run with no problem, right? Unfortunately, *Fa* has been changed; it behaves differently. Application *A* expects it to behave in the same way as it did in operating system *Y*. Application *A* gets an acute case of unfulfilled expectations and takes off on a trip around the Milky Way to soothe its tattered nerves. No compatibility.

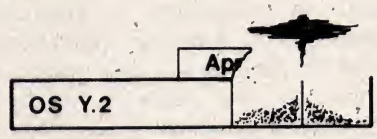


FIGURE 3

As has been said before, Berkeley's 4.2 represents the single largest step away from compatibility with other Unix system derivatives. The incompatibility in this case is not as simple as missing facilities or commands. It's a case of altered expectations. Pipes are present, but they behave differently. File systems are there as well, but they don't work the way they used to.

Obviously, it would be naive to expect a new distribution of an operating system to be exactly the same as the previous one. If it were the same, it would not be a new release. Just as obviously, no one expects a C program written for a Unix operating system to work on, say, a new distribution of VMS.

In the case of 4.2, however, because of the name we would reasonably expect the facilities and so forth of 4.1 to be present and functioning. Perhaps if Berkeley had called 4.2 something like 5.1 or Berkelix, we wouldn't necessarily have those expectations. But it didn't, and so we have them.

COMPATIBILITY PROBLEMS

When the Defense Department chartered UC Berkeley to revise 4.1, the aim of the project was to increase 4.1's performance and enhance its network capability. Whether UC Berkeley met that charter or not is not at issue. What is at issue is that 4.2 introduces some significant compatibility problems into the evolution of the Unix system.

For one thing, Berkeley changed the way in which file systems are handled. Specifically, the file name length in 4.2 is flexible rather than being a fixed length of 14 characters, as it is in 4.1. Perhaps flexible file name lengths have advantages. The problem is that programs accustomed to reading directories no longer work if you have flexible file name lengths, and the modification required to make them work is not easy. You also have no option to toggle between fixed and flexible file name lengths, so you can't perform development flexibility and still keep previously developed programs operable.

A second difference between 4.1 and 4.2 occurs in their signal-handling characteristics. This is perhaps a somewhat esoteric complaint, but it is a real one, nonetheless. Signal-handling in 4.2 is, on the surface, pretty much the same as in 4.1. But 4.2 signal-handling has been "cleaned up"—the side effects no longer exist. Although the side effects of other Unix system signal-handling algorithms are not really

features of the operating system, they are characteristics that programmers have come to know and expect.

Suppose, for example, that a program needs input from either a user or another computer at a particular point. A common method on a Unix system is to use a "read with timeout." This means the system waits for a read for a set period, and, if nothing comes back, it terminates the read. Commonly, an alarm signal terminates the read; that is, the signal terminates system calls and returns an error. The program can then tell that the timeout has lapsed and can go on its merry way.

Under 4.2BSD, however, system calls aren't interrupted by signals, and programs using the above approach won't work—incompatibility. Instead, you have to use `setjmp, longjmp,` which explicitly stops the read. This is no big deal by itself. But what about all the programs written in Version 6 days that used the alarm signal method?

As mentioned earlier, interprocess communications have been "generalized" in 4.2. The only interprocess communications used to be pipes. Now that Berkeley has generalized same, pipes are there, but they don't have the same characteristics. A specific change is that a programmer could formerly "look" at a pipe and see how much it contained at a particular point. Under 4.2 that capability is gone, at least with the `fstat` function.

However, don't confuse criticism with condemnation. Certainly, our observations are critical, but we are not saying that 4.2 is inadequate or badly done. The point is that it is so different from 4.1 and other Unix system versions that it introduces incompatibility. It is a departure, a redirection of Unix system development that has a significant impact on the Unix system community.

THE DESIRED EFFECT

The changes to 4.2 seem to be based on well-intentioned, reasonable motivations. For the most part, the intended effects appear to be desirable. The question is, have those changes had the desired effect? Have they done what they were intended to do? Even if the answer is yes, other effects may override those good intentions.

One effect of alterations in 4.2 has been to move us further away from a Unix system standard. Because conversion to 4.2 from other versions of the Unix system is a significant effort, there is almost no practical difference between 4.2 and any other Unix system look-alike. We would expect a version of the Unix system that furthers standardization to also protect compatibility.

It follows that any developments that move away from a standard also complicate commercial development. Existing applications must be ported, and data must be converted. For software vendors this means increased costs. Someone has to do the port, and there must be an environment in which to do it. Handling and marketing costs increase, schedules slip, and risks increase. The work involved may even be unfeasible for some products.

For software buyers, the issues are much the same. Any costs to vendors are bundled into the price of the software. A useful application may become unavailable, never to be seen again. Risks also face the buyer. Any time that someone makes changes to a program, the chance for errors and decreased performance increases. If no one makes the switch, the old software may no longer be supported. The user is in a bind.

Granted, the Berkeley group wasn't chartered to provide commercial developers with fodder for new products. Let's face it, though, Berkeley's Unix system is generally considered to be a good fit on VAXen, and that is where a lot of software development takes place.

Also, development land already contained a significant number of 4.1 systems when 4.2 was introduced. Creating a Unix system standard is clearly not the Berkeley Computer Science Research Group's reason for being. But it doesn't take an analytical genius to predict that a new and improved distribution from Berkeley would have a noticeable impact on the Unix system development and user community.

There is one potential approach to operating system revision that would at least mitigate the impact of altered facilities and protect compatibility: retain the old facilities and make them the choice by default. New development would then call for the new facility explicitly—for instance, by telling the program to use "Newsignal" if the more recent signal-handling features were desired.

This would keep the operating system "backward compatible," allowing previous software to work the way it was accustomed yet permitting new programs to take advantage of new features. Yes, this method has some drawbacks, too, but it is a way of perhaps retaining compatibility without eliminating new developments.

Gordon Waidhofer is the director of software services at Voelker-Lehman Systems in Fremont, Calif. He has been an independent consultant on Unix systems software and previously was a software engineer with The Wollongong Group. Michael Sweeney, a former market communications analyst with Rogers, Kirkman, and Associates, is director of marketing at Voelker-Lehman.

A SIMPLE GUIDELINE

Since the Unix system first left the hallowed halls of AT&T, it has been subject to modifications, alterations, manifestations, hallucinations, and various other indignities for the sake of improving or remedying functionality.

Thus, the horrors of incompatibility are nothing new to the community of Unix system users and developers. 4.2BSD represents the single largest modification of a Unix system derivative to date. We will never see such a large change again.

The areas of modification in 4.2 are so broad that they are perhaps a shining indication of the fragile nature of Unix operating system facilities. That fragility can be mitigated by taking it into account in modification and development, as well as by following a simple guideline for Unix system-hosted software.

Consider the following:

(1) The file system data structures have been completely redesigned; (2) the side effects of signals have been exterminated with extreme prejudice; (3) esoteric folk wisdom (such as `fstat(2)` on a pipe) has been fooled; (4) a glorious collection of facilities not available anywhere else has been added; (5) a glorious collection of facilities available everywhere else has been deleted; and (6) the primitive representation of typical ideas has changed (an example: The clock is very different).

"What guidelines does this suggest?" you ask with a nervous giggle. Simply stated, localize the system dependencies of your products or operations.

Let's take a look at the example of signals. One typical use of signals is "time-out," which relies on signal-handling side effects. For example, you may want to get input from a user's terminal but allow only five seconds.

Figure A illustrates a simple (and common) technique to do this under a Version 7 (4.1)-compatible system. The technique involves trapping an alarm signal that tells the system to carry on if the user doesn't respond. Under 4.2, without the side effects, the technique doesn't work and the system perpetually waits for the user to respond.

Figure B is the same function modified to work on 4.2. Note the use of `setjmp` and

```
#include <signal.h>

NoOpAlarmTrap () {
  signal (SIGALRM, NoOpAlarmTrap);
  alarm(0);
}
  .
  .
  .
  .

  signal (SIGALRM, NoOpAlarmTrap);
  alarm (5);
  x = read (0, buffer, sizeof buffer);
  if (x < 0)
  {
  /* Timed out */
  }
  else
  {
  /* got done in time */
  }
  .
  .
  .
```

FIGURE A: Version 7 (4.1BSD)-compatible version of the five-second read. This version relies on the alarm signal mechanism terminating the `read` call with a bad status.

```
#include <signal.h>
#include <setjmp.h>

jmp_buf alarmjmpbuf;

AlarmTrap () {

  signal (SIGALRM, AlarmTrap);
  alarm(0)   longjmp (alarmjmpbuf, 1);
}

  .
  .
  .
  .

  signal (SIGALRM, AlarmTrap);
  alarm (5);
  if (setjmp (alarmjmpbuf) == 0) {
    x = read (0, buffer, sizeof buffer);
    alarm (0);
  /* got done in time */
  } else {
  /* Timed Out */
  }
  .
  .
  .
```

FIGURE B: 4.2BSD version of the five-second read. Because the alarm signal will not terminate the `read` call, this version goes to great extremes using `setjmp` and `longjmp` to accomplish the same objective.

```
/* main body */

  x = readwithtimeout (0, buffer, sizeof buffer, 5);
  if (x < 0)
  {
  /* Timed out */
  }
  else
  {
  /* got done in time */
  }
   .
   .
   .

/* read with timeout module */

#if BSD41
#include <signal.h>

NoOpAlarmTrap () {
  signal (SIGALRM, NoOpAlarmTrap);
  alarm(0);
}

readwithtimeout (fd, buf, size, seconds)
 int   fd, size, seconds;
 char  *buf;
{
 int   x;

  signal (SIGALRM, NoOpAlarmTrap);
  alarm (seconds);
  x = read (0, buf, size);
  alarm (0);

  return x;
}
#endif
#if BSD42

#include <signal.h>
#include <setjmp.h>
jmp_buf alarmjmpbuf;

AlarmTrap () {
  signal (SIGALRM, AlarmTrap);
  alarm(0);
  longjmp (alarmjmpbuf, 1);
}

readwithtimeout (fd, buf, size, seconds)
 int   fd, size, seconds;
 char  *buf;
{
 int   x;
  signal (SIGALRM, AlarmTrap);
  alarm (seconds);
  if (setjmp (alarmjmpbuf) == 0) {
   x = read (0, buf, size);
   alarm (0);
  } else {
   x = -1;
  }
  return x;
}
#endif
```

FIGURE C: Easily maintained version of the five-second read; this will work on either 4.1 or 4.2. Notice that the objective of reading with a time constraint is handled in one function called `readwith-timeout`. There are two versions of this function: one for 4.1, the other for 4.2. To adapt this program to another system, you would need only implement another version of the `readwith-timeout` function without needing to modify the main body of the program.

`longjmp` to accomplish the objective. Notice also that both these examples have direct calls to three system primitives (`signal`, `alarm`, and `read`).

In a single, isolated case such as this, the change may not seem either extensive or expensive. Imagine, however, a body of code hundreds or thousands of times larger with a similar sequence repeated and interwoven throughout.

Now consider Figure C, with the direct system calls removed from the code and a new function, `readwith-timeout`, added. The function localizes the system dependencies. Thus, a future conversion need only add to or alter the system-dependent sections so that the function spread throughout the code still works.

Here is a short test to determine how large a risk you are running. Be forewarned that this is not comprehensive; it is only an example:

(1) Are you directly manipulating any system data representations? Hint: You are if you have to use `#include <...>` or, especially, `#include <sys/...>`.

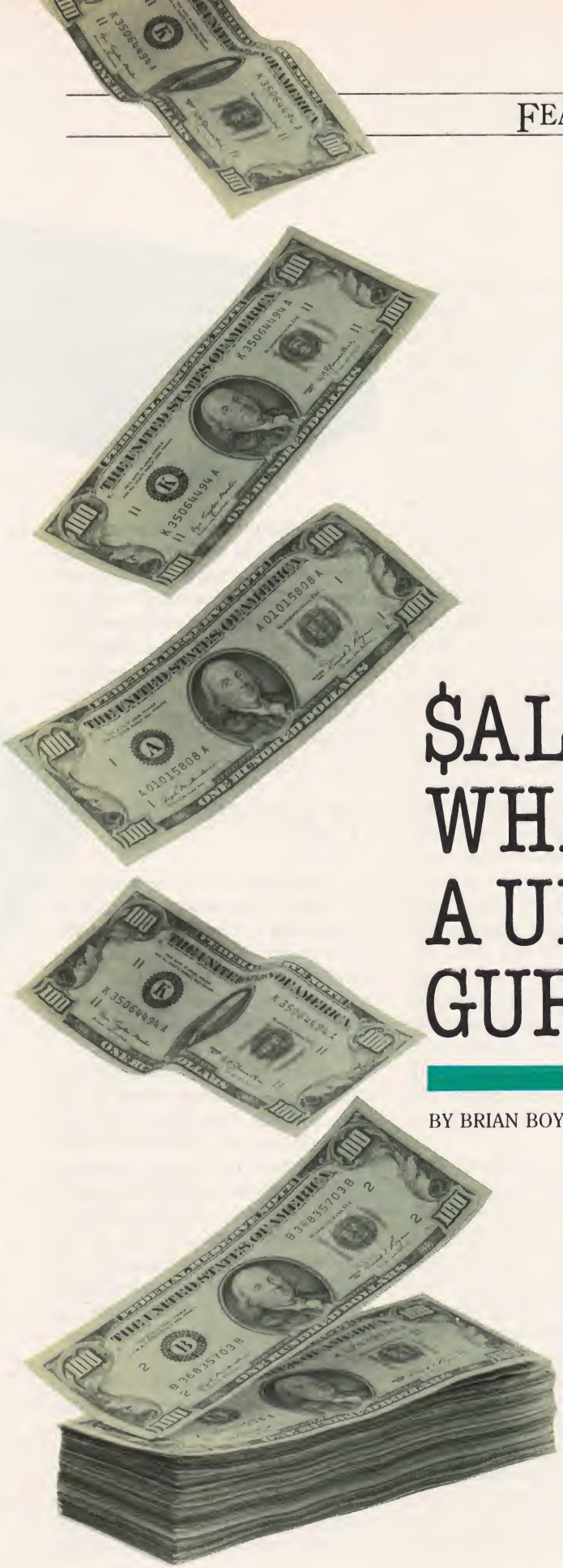
(2) Are you directly calling any system primitive?

(3) Are you using any known quantities? Example: file path names, sizes, (for example, do you really think file names are 14 characters?), command names, and so on.

(4) Are you relying on a side effect or on a nice idiosyncrasy?

(5) Are you repeatedly implementing sequences of code for a common objective?

If you answered yes to any of the questions above, look hard, look very hard at your product. You may be in for many late nights, thinking about bigger hammers and longer crowbars. And after you use them on the product, you may want the current address of the person who originally developed the product.



$ALARY SURVEY: WHAT PRICE A UNIX SYSTEM GURU?

BY BRIAN BOYLE

"I could'a been somebody.... I could'a been a contender. I could'a been the vice-president of information management! Instead, thanks to this Unix system, this other guy gets a shot at the title, and I get a one-way ticket to Punchcardville! You should'a watched out for me, Joey. You were my Big Brother—my IBM salesman."

At the mention of the Unix system, I closed my notepad, turned from the job postings board, and looked across the cavernous Health-Inhuman Services waiting room to see whom the man in the unemployment queue was talking to. But there was no one at all. Despite his

well-pressed dark suit, white shirt, and button-down collar, he had that glazed look that some programmers get after going one-too-many turnarounds with a 200-page COBOL listing. "Punchy" we used to call it: keypunch-drunk beyond recovery.

"I'm no loser—I've got 10 years' professional experience in OS/VS1, VMF, IMS, JCL, TCAM, VM/CMS, and LS/MFT," he raged, detecting the pity in my glance. At close range his eyes were bloodshot, he needed a shave, and his breath smelled vaguely of disk-head cleaning solution. "Used to be at least a page of high-paying opportunities in every *Wall Street Journal* just begging for my skills. Now all they want is Unix, Unix, Unix!" he said.

"You've got to watch for them everywhere—the greppies," he whispered in a guarded command; his eyes scanned the other unfortunates who were nearing the window labeled "Seasonally Adjusted."

"They dress preppy like any good DP jock, but they're really Unix groupies in disguise," he continued, his eyes coming to rest on my page of notes headed "Unix Salary Survey."

INCANTATIONS AND HEXES

"You're one of them!" he screamed. He recoiled in horror, made the sign of the Terminated Fork, and muttered an incantation in EBCDIC that mainframers believe places a hex on the cursed Unix—the operating system that refused to die. His voice continued into the upper registers (normally reserved for compiler variables), bringing the ever-present guards from the Bureau of Statistics.

"In the interest of the Morale of the Majority, you are hereby declared to be hard-core unemployable," intoned the bored BS officer, leading him to the exit.

"Core, semiconductor...what difference does it make?" sighed the victim. Dejected as well as ejected, he stepped out through the Arches of Golden Opportunity onto the street. Near the exit, the guard pressed the Decrement Accumulator button.

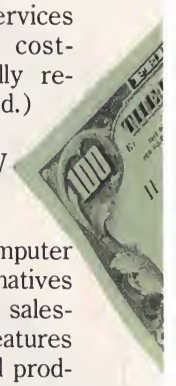
The lighted digital sign over the Arches now reads proudly: "Less than 6,499,999 unemployed!" Admittedly, that's a severe case, but not as unusual as you might think. For data-processing people without at least some knowledge of the Unix system, times are tough all over. Why, just the other day I met a programmer who said he hadn't had a byte for a week—so I bit-sliced him. *(Drum roll, sporadic laughter.)*

(Actually, I hadn't seen such naked emotion over a computer operating system since one of our junior analysts typed "FORMAT" —with no argument—on our PC/XT running MS-DOS. I suppose imitation is the sincerest form of flattery, and MS-DOS 2.10 tries to emulate the Unix shell in every way possible. Thus, it was logical (?) that it would have an equivalent to the recursive `rm` feature. With a carefully misleading message—"Insert diskette and strike any key when ready..."—it prepares to erase and format the default disk C—all 10 megabytes of it.)

With even IBM announcing Unix system-based products from several divisions—PC to mainframe—the conservative data-processing or management information system (MIS) manager is beginning to feel like a faith healer suffering from appendicitis. From *Business Week* to *The Daily News,* his boss is being bombarded by AT&T's not-so-subtle two-page Unix system ads that demand the Unix system be recognized as the new multiuser system standard. (Is this what AT&T meant by "demand-paging" ?)

In light of off-the-shelf pricing of microcomputer software and the

well-publicized development cost savings of Unix system shops, it is becoming increasingly difficult to sell somebody a tailor-made (proprietary) operating environment without offering a Unix system alternative. Many GSA contracts—administered by the General Services Administration, Congress' cost-control watchdog—specifically require a Unix system-based bid.)



THE EMPEROR'S NEW CLOSE

In mainframe and minicomputer empires everywhere, the natives are growing restless, and the salesman's promise of "Unix features soon"—the ubiquitous virtual products or "vaporware"—is correctly perceived as the "Emperor's New Close."

Yes, Virginia, everything you've heard is true: Salaries for those who can even spell *Unix* are in the high twenties. With the trend moving away from straight "kernel hackers" toward additional application experience, practical experience pushes the annual totals to the mid-thirties. Large companies are offering more, perhaps making up in cash what they can seldom offer in flexibility. Stock options and a smorgasbord of other equity perks are still the new company's draw for genuine Unix system heavyweights. (No, Virginia, *not* heavyweight Eunuchs.)

Bill Sebrans is a three-year veteran of CAD/CAM recruiting at Sebrans & Chamberlain, in Sausalito, Calif., several miles north of the

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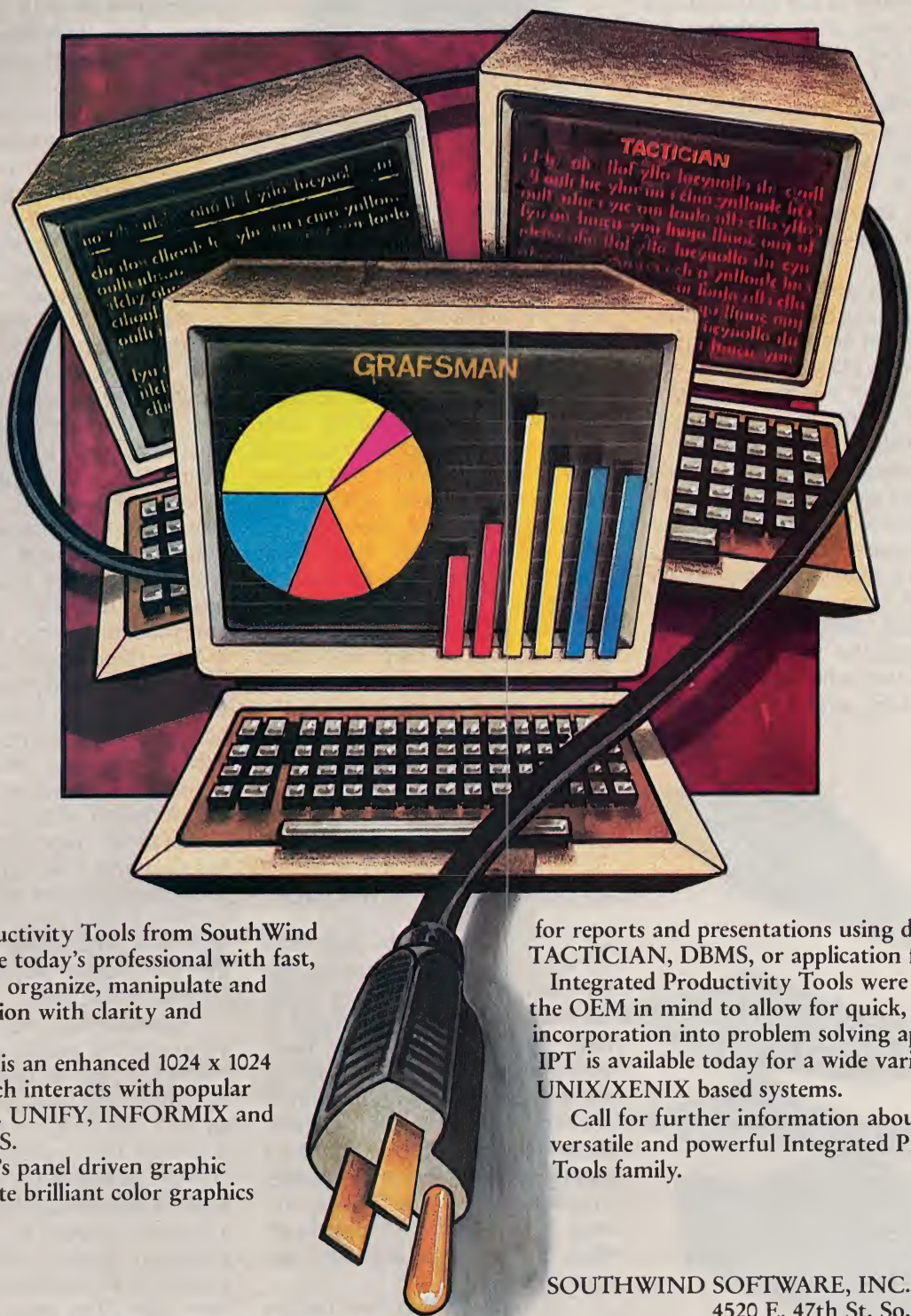

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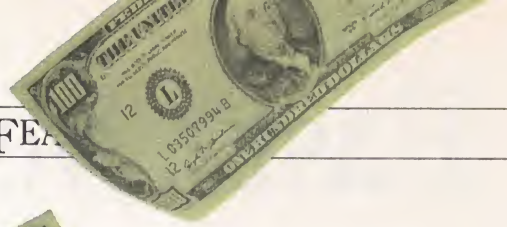

Silicon Valley DMZ. Sebrans, who backed into placing Unix system gurus because of the Unix system's pervasiveness in the high-powered CAD/CAM/CAE environment, talked of a recent four-way "bidding war." The candidate had experience in the Unix system, distributed systems, and databases, had spent 40 months at Bell Labs, and held a master's in computer engineering from the University of Illinois at Urbana.

Sebrans described the bidding as being a cross between a Sotheby-Parke-Bernet auction and a professional hockey playoff game, but with the cadence of a high-rolling poker hand: "A" opens with a pair of jacks and $46,000; "B" sees A and raises one pile of stock options; "C" checks to the raise and bumps $10,000; "D" calls with a full house (a down payment on a new one.)

One reason the demand for experienced Unix system types is so high is that practically every computer company in business that wants to stay in business is jumping on the Unix system bandwagon:

Gnostic Concepts counted 128 companies at the time this issue went to press. Unfortunately, it's only a "mid-sized" bandwagon so far. It seats six comfortably, and there just aren't that many people you can trust under the hood.

Another economic fact of life is that system-manufacturing companies have a minimum long-term sustainable size—about $50 million a year will do. So how, as the saying goes, do you fit six elephants in a mid-sized bandwagon? Why, three in the front and three in the back, of course.

The little guys in front need to peddle as fast as they can—about 10,000 low-cost units a year via dealers and distributors—while the guys in the VAX-seat can relax and compete for the established minicomputer markets—OEMs, adequate budgets, in-house staff, and moderate "end-user" sophistication.

OFF TO SEE THE WIZARD

So off they go—Ms. MIS Manager, Dr. DP Department, and Mr. Mini-Micro-Mainframe Manufacturer—to seek the Wizard of Unix. But when they get there, wherever *there* is, they begin to suspect that they're not in Kansas anymore. Many traditional employers see Unixization only as a superficial or evolutionary change, says Sebrans, echoing Paul Simon's song "The Boxer": "A man hears what he wants to hear and disregards the rest."

As Figure 1 illustrates (and as common sense suggests), where demand exceeds supply, salaries escalate. Large, established companies may offer 10 to 15 percent more. But, then again, they may not, fearing to antagonize (or worse yet, mobilize) existing data-processing employees with more experience in less-specialized areas.

Twenty years' experience on an IBM mainframe may be quite valuable, or it may actually represent one year of experience twenty times. Likewise, ironically, salaries in the Midwest tend to be about 10 to 15 percent lower than those in the Northeast (Route 128). These, in turn, fall short of compensation in California by a similar gap.

What accounts for this geographic disparity in Unix starting salaries? Is it solely based on cost-of-living differences, or is there more to it? Company sophistication, perceived need, and intrinsic commitment to a Unix system environment play the largest part in Unix salary offerings, says Mitch Riddle of Alan Glen Inc., Corona del Mar (in Southern California). Working both ends of the Golden State, he sees differences between areas with similar living costs, thus eliminating any simple explanation.

Although starting behind the San Francisco Bay Area, the Southern California Unix system job market began to take off when firms saw the Unix system as a solution—or at least as a productivity tool—rather than just another portable operating system, Riddle said.

Bureaucratic inertia in large companies, a misplaced sense of "fairness," and a certain regional chauvinism (or prejudice) often add up to a $15,000 shortfall in areas that need Unix system skills most. "I'll be damned if I'm going to pay some dope-smoking hippie $60,000 a year just because he doesn't want to live in Dayton, Ohio," growled one senior executive of a large computer firm that entered the Unix system market in the spring of 1983.

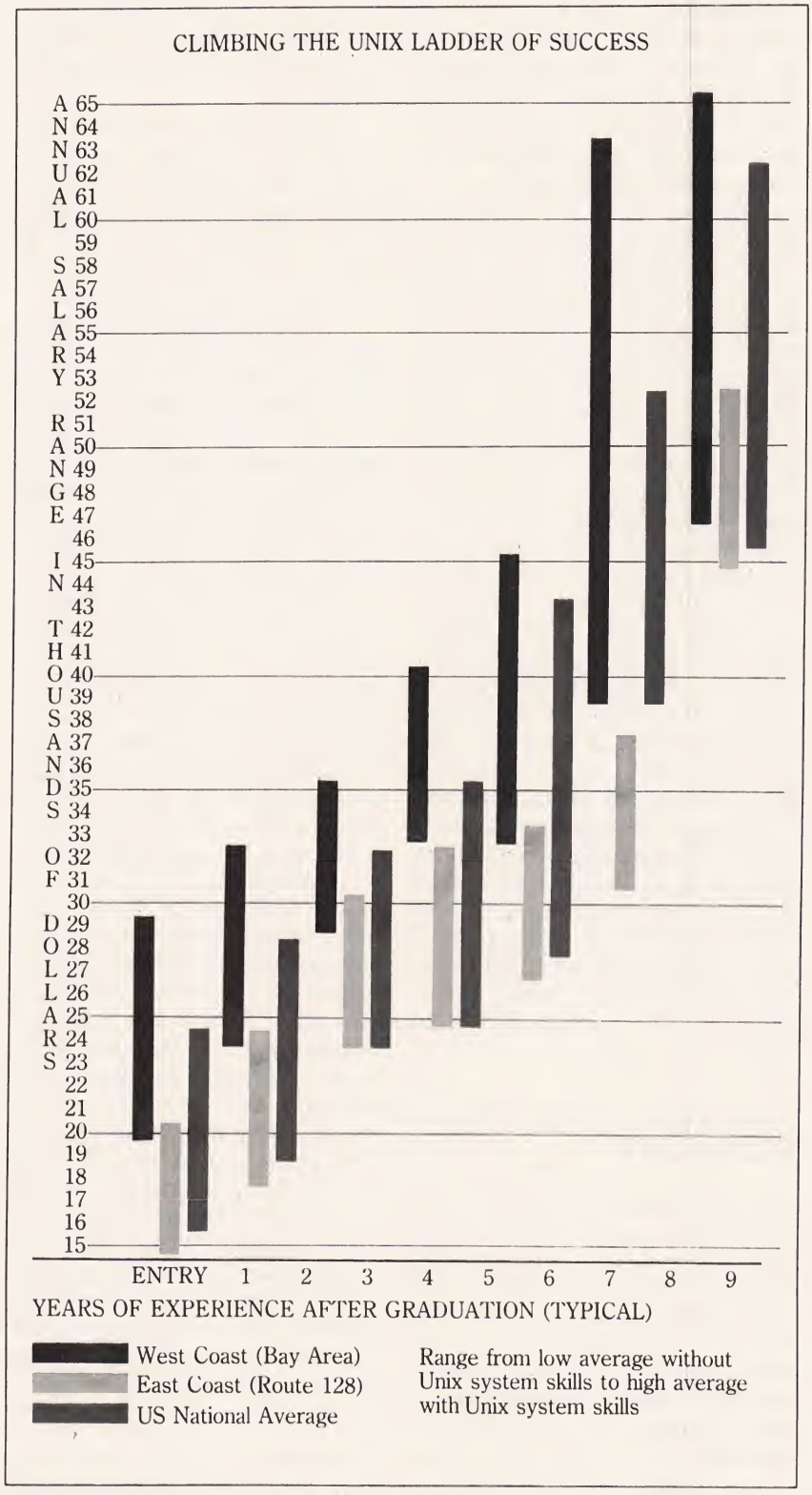

FIGURE 1: UNIX SYSTEM SALARY SURVEY

"We'll give them [the customers] better price/performance ratios and good hardware support, and they'll handle their own Unix support," he stated at the time—a position that has undergone a total reversal in the intervening year and a half of disappointing sales.

HOW THE SWITCH IS PERCEIVED

Still, for many companies with an established proprietary operating system and a captive customer base, the switch to the Unix system is often perceived as a customer-mandated "necessary evil" rather than an evolutionary opportunity. By paying lip-service salaries and by treating the in-house Unix system group as a technical leper colony, the Unix-rich get rich and the poor get poorer.

The unwritten conclusion of such firms is that "Unix will never really amount to much"—where the slot held by "Unix" has previously been occupied by "minicomputers," "personal computers," "high-level languages," and, of course, the ever-popular "IBM's impact in this market."

The market "squashout" in the mid-sized Unix system bandwagon is beginning to have its effect on the hiring market. Still in second gear, at dangerously high RPMs (Receiverships Per Month), the Unix system market will need to shift gears to beat the 100,000-unit-per-year mark reached in 1984. The high-revving Unix system *prima donna* is beginning to come in second to the team player with a good background in other disciplines.

Managers at newer Unix system companies increasingly are learning what longtime players have known for a long time: *End-users buy solutions, not tools.* As the shift occurs, and as the Unix system market accelerates again in 1985, han-

dling and controllability will take precedence over raw Unix system power.

In terms of priorities (that is, who's hired first), one Unix manager in five wants major business or technical applications skills on top of Unix system experience. One in four wants networking, UUCP, and/or Ethernet as the icing on the cake. Fully one in three would prefer a DBMS specialist with *any* knowledge of the Unix system over a grade B guru who doesn't do windows.

Firms increasingly are using outside or in-house market research to determine the vertical markets and application support areas where they may best compete. The same company that harbored the "proud to be an Okie from Ohio" attitude a year ago has hired respected market analyst Mike Dubrall from the hills of Los Altos to the banks of the Ohio. You can bet he cried all the way to the banks.

THE LIEDER OF THE PACK

As the race settles down and the pack spreads out, the most marketable people begin to sing a new tune, asking for more than just salaries and stock options. This is not to say that Bill Joy will be leaving Sun Microsystems to join Honeywell because it has a better pension plan. Still, as the thinning of the field progresses, guaranteed lifetime employment may have to be balanced against a thousand shares of Osborne.

One of the best-known names in the Unix system community recently broke out of his shell and exited the volatile and exciting start-up Silicon Graphics to be Bourne-again at DEC's terminal and workstation R&D group just down the street. Stock options may become a (commercial) paper tiger for many "depending on the individual and the company," observes Michael Sunday, president and founder of the Berkeley, Calif.-based agency Sunday & Associates, which has been in the Unix system market since mid-1982 to complement its "more stable" APL orientation.

Sunday sees an increasing trend toward the Unix system as a "common denominator, a currency of the realm" on which other values are based. One of these is the C programming language, normally associated uniquely with the Unix system but increasingly a value on its own, he notes. Currently, all the major microcomputer software houses—Microsoft, Lotus Development, Digital Research, MicroPro, Ashton-Tate, MicroRim, etc.—use C almost exclusively in their development environment.

While a comfortable familiarity with Unix system tools is on the hard-core kernel hackers' list of needs, such skills are frequently viewed as being hazardous to your system's health. "An untamed Unix guru with a kernel source listing and a superuser password can do for a stable development environment what General Patton with tactical nuclear weapons and a key to The Button can do for world peace," notes a senior manager at Bell Labs, who declined to be named, ostensibly for fear of being hacked to death.

SOLDERING IRONS AND STANDARDS

As the industry continues its inevitable march toward standards—particularly AT&T's Unix System V (now that demand-paging and record-locking are to be included)—modifications to the kernel itself will be viewed as tantamount to going after the guts of your microprocessor chip with a soldering iron. The /usr/group Unix system standard—and its virtual acceptance by AT&T Bell Labs and AT&T Technologies—begins to parallel the input/output pin specifications on such a standard microprocessor chip.

Admittedly, "support chips"—drivers, interfaces, etc.—will need to be designed and "wired in," but the skills distribution of the Unix system workplace, with time, will begin to resemble that of the electronics industry in general.

Hiring patterns at such technically sophisticated firms as Sun Microsystems, which had a few dozen openings at the time this article was written, confirm this trend. Juggling an operating system is like work when compared to managing an on-line, real-time robotic assembly line, and more team players than wizards will be needed.

With the power that the Unix system gives us, we dare to tackle problems we never would have dreamed of—problems beyond any individual's capabilities. "The problem is not that we require such big systems," comments computer science legend E. W. Dijkstra on the need for better tools. "The problem is that we have such small heads."

Recognizing the heady nature of the Unix system salaries currently being offered, we must keep our egos in check enough to pay attention to the advice offered by Thomas J. Peters and Robert H. Waterman, Jr., in their best-selling book, *In Search of Excellence.* "Stay close to the customer" is the message, and that means using the Unix system not as an end in itself—a market measured in thousands of systems—but as a means to an end—a market in the millions. By accepting the fact that the end-users justify the means, we will smoothly shift the Unix system market gears and propel our favorite into the number one position in 1985. □

Brian Boyle is managing analyst for software and systems at Gnostic Concepts Inc., San Mateo, Calif.

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What kind of year did the Unix system have in 1984? Here's how a group of perspicacious pundits saw it.

UNIX AT THE PIVOT PO

BY VANESSA SCHNATMEIER

"The Unix system as we know it will be on its way out in five years." No, wait. "The Unix system is here to stay, but only if IBM decides to give it serious backing." Let's try that again: "The Unix system is here to stay, period...that is, if we ever see some applications." "There is no Unix system standard." "We don't have to standardize the Unix system—it *is* a standard." "It's up to AT&T to set the standard." "*This* is what AT&T should do...."

Predicting the future of the Unix operating system and its lookalikes is a hard and lonely task, especially in 1984, when the messages have been mixed and the indicators confused. It's hard to know whose prophecies to believe or whether to take the long or the short view. Brian Boyle, managing analyst at Gnostic Concepts, compared the compulsive study of every hiccup in the Unix system market to a certain Martian joke: Two Martians in a car, one of them asks the other to get out and see whether the turn signal is working. The Martian gets out, goes to the front, watches when the driver turns the signal on, and says, "Okay, it's working, it's not working, it's working, it's not working...."

"That's what a lot of the analysts, particularly the financial analysts, have been doing looking at the Unix market," Boyle said. Nevertheless, it's occasionally necessary to take some kind of overview. At the risk of adding more fuel to the fire of excessive scrutiny, we'll try to sum up what happened with the Unix operating system in 1984 (although at this writing, the fourth quarter isn't yet complete).

On one thing almost everyone we spoke to could agree: Growth of the Unix system market did not live up to predictions for 1984, even the very conservative forecasts. For example, Boyle said that Gnostic Concepts had predicted total sales in the vicinity of $1.9 billion and total hardware units sold at 124,000. Those levels won't be reached, he said.

"The things we counted on to bring the dollar volume and units up were supposed to be VAX, Altos, and Fortune, with Tandy in fourth place," Boyle said. "DEC is on track, but Altos and Fortune are off. Tandy's fallen off because the 2000 has eaten into it. We had counted on PC/IX, but it took longer to take off than we'd expected."

Boyle continued, "Convergent Technologies' MegaFrame hasn't materialized like we'd expected. Cray projected that they'd sell two, and so far they've sold zero. With the exception of Sun and Apollo, things have fallen somewhat short. A number of mild surprises, but nothing in the way of a positive surprise."

Amy Wohl, of Amy D. Wohl & Associates, countered that 1984 was still a banner year for the Unix system—not in terms of software or hardware being sold, but in the sense that the system was clearly more of a mainstream product at the

INT: A LOOK BACK AT 1984

end of 1984 than it was in the beginning.

"1984 represents the year in which Unix stopped being an academic and research development tool, an operating system understood mainly by specialists, and the beginning of the period in which Unix is going to be more generally used as a commercial operating environment," Wohl said.

NEW MARKET SEGMENTS

Sometimes it's hard to recall that the Unix system did not fall as the gentle rain from heaven, but instead reached its current market position through time, gradual acceptance via academia, and even happenstance. Bernie Toth, marketing manager for the Unix base product group at Digital Equipment Corp. (Merrimack, N.H.), noted that it was "because of an accident of history that Unix is at the center of development. If Unix wasn't there, someone would have developed it."

However, the Unix system *is* there, and it is developing to fit the needs of its users. Esther Dyson, president of EDventures and publisher of the industry newsletter *Release 1.0,* said the current Unix system market splits into three segments: (1) the scientific market (probably the most developed of the three), where there are no standards because "hackers will buy the specs they like"; (2) the single-user Unix system environment, something Dyson said IBM would probably develop as a top view over Xenix and MS-DOS; and (3) commercial Unix. Each segment has different standards, a fact that contributes further to the fragmentation of this still-immature market.

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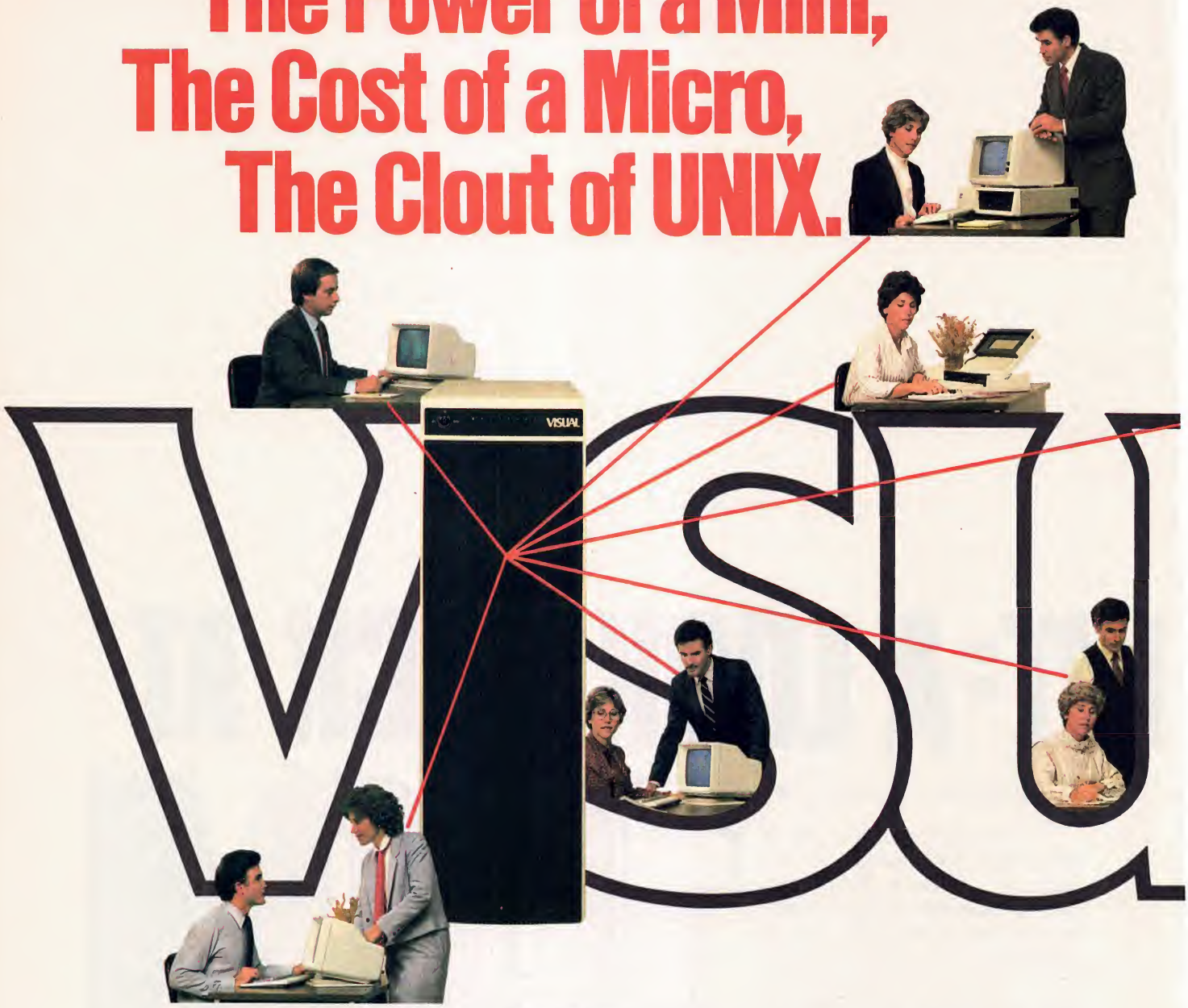

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Stuart Volkow, franchise technical development officer for Gateway Computer (Huntington Beach, Calif.), said the Unix system in 1984 was caught in the movement toward the desktop supermicro, which small- and mid-sized businesses can use. Both the minicomputer market and the single-user desktop micro market are aiming at this target now. But it is one of the hardest markets in which to sell and make a profit. In other words, vendors beware.

Robert Lefkowits, director of microsystems software service for InfoCorp, in Cupertino, Calif., jokingly compared the current lot of Unix system vendors to that of consultants: If you consider that a consultant is a man who knows 150 ways to make love but doesn't know any women (substitute your preferred gender here), then a Unix systems vendor is a company that has implemented 150 of the latest enhancements to System V but doesn't know any customers.

The best guess as to why there are so few applications out that run under the Unix system is that everyone is waiting for everyone else to make the first move. As Michael Dubrall, former director of market research for Yates Ventures, (Palo Alto, Calif.) said, "Hardware vendors can't sell their products unless they can find the software. So you have these small software companies that are desperate for capital and that have an inordinate amount of control over the hardware companies that are desperate for software."

Why these two groups haven't made more overtures to each other isn't completely clear. At USE '84 Dubrall went so far as to *order* software and hardware vendors to talk to each other at the end of a future-of-the-Unix-system panel. (We'll have to wait until the 1985 Unix system wrap-up to measure the success of this compelled commingling.)

One analyst thinks the slow delivery of software was a major reason the Unix system market didn't take off in 1984.

SLOW DELIVERY

Amy Wohl thinks that the slow delivery of software was a major reason the Unix system market didn't take off in 1984—the lack of software left hardware in the lurch. "I don't think it's because the market wasn't ready to buy; it's because the stuff wasn't ready to sell," she said. Some of this stemmed from the academic background of the more recent entrants into the Unix system field; more of it was the result of just bad planning and underestimating the effort necessary, she said. "With the possible exception of IBM on a good day, there ain't nobody out there that can accurately estimate how long a software project will take," she said.

Bob Beasley, vice-president of the venture capital firm Broventure, in Baltimore, Md., intimated that part of the problem lay in the type of software being marketed, as well as its scarcity. "We need applications that make the organization work better. That's what makes multiuser systems perhaps better than a network solution.... Unix offers facilities to monitor office operations simply that networked PCs don't have." That is, he said, *use* what the Unix system can give.

Yet another reason for the lack of software is that Unix system developers are still scrambling out of the era in which the Unix system was mainly a programmer's development tool. With the Unix system, sure, you can write your own software, said Wohl. "But thank you very much. End-users don't write their own software! End-users buy packages off the shelf."

What users get if they do buy software off the shelf may not be something they can use. "It's not funny that you still need a Unix guru to get most new packages to run," admonished an editorial in the industry newsletter *Unique*. "We have to take our systems, give them to naive users, and *listen* to them for once."

John Roach, chairman of Tandy Corp., went even further. He said that "the most significant thing" anyone can do to foster the Unix system's growth is to make the system's initial configuration and the user interface "a lot easier and more friendly."

WHO WILL SET THE STANDARD?

Richard Shahpazian, director of software sales and marketing for AT&T Technologies, said in his keynote address at USE '84 that System V Unix will become the standard Unix system. "By 1985 everyone will have software that will run under System V," he said. AT&T has set up autonomous divisions —AT&T Tokyo and AT&T Europe —to foster the spread of System V in those areas as well as in the United States. AT&T will distribute software and documentation updates for System V, and it has also set up a problem-reporting system, a newsletter, and a known-problem list to further aid licensees.

This is all commendable, and it may indeed be true that everyone

will produce System V software. But will that make System V the standard? The market may not agree.

The gray eminence, or should we say the blue eminence, lurking behind the forecasts of most industry pundits is, of course, IBM. "What will IBM do?" is the question on everyone's lips.

AT&T may be dealing the Unix system's cards, but IBM is calling the game. Or, as Dyson said, "AT&T just has the ability to license it; IBM has the ability to determine its future." And IBM always plays its cards close to its vest. Beasley quoted John Emlay as saying "IBM stands for 'I've Been Misled.' "

Wohl said that what IBM chooses to do about operating systems over the next six months, particularly in the micro and multiuser world, will be critical. "If they should choose to turn away from the Unix environment, that would not be a terminal blow but a severe blow. It's still under discussion at IBM," she said.

Just like everyone else, IBM is waiting to see what the Unix system market will do. Esther Dyson, of EDventures, and David Fiedler, editor of *Unique,* said that IBM has launched a couple of trial balloons to see what happens. "Okay, it's available. Do you like it?" IBM is asking buyers. If so, the spiral will go up.

Dyson added that the situation is confusing because IBM has at least two versions of the Unix system—PC/IX (for single-user systems) and Xenix (for the PC/AT). A proprietary version called VM/IX runs on some of its other computers. IBM isn't monolithic, Dyson pointed out.

So what IBM does depends on what the market does, and what the market does depends on applications software showing up, and the software depends on the Unix system being there, which depends on what IBM does....

ADVICE TO AT&T

We should all be lucky that we aren't AT&T. (If you, the reader, are with AT&T, our condolences. Everybody is willing to give you a piece of their mind and tell you what you really need to do to get the Unix system on its feet.)

> **AT&T may be dealing the Unix system's cards, but IBM is calling the game.**

Dubrall said that for everybody to make a lot of money, AT&T is going to have to give up control of the Unix system (!). The proliferating versions of the Unix system continue, he said, because AT&T bungled its Unix system program. Three steps would help AT&T salvage it: (1) don't let others do the additions and fixes—AT&T should do them itself; (2) the operating system should be distanced from the hardware operation, so that hardware vendors can be more assured they'll get support and stay abreast of the market; and (3) AT&T should turn over the Unix system to /usr/group or some other third party "to make it a real standard the industry can hang its hat on."

Doug Free, of Franson & Associates, a high-tech public relations firm in San Jose, Calif., took the opposite tack and said AT&T should stop releasing its source code at all, to make the standard rock-firm. Once the Unix system is standardized, the vendors will come in, he said.

And the industry newsletter *Unique* editorialized that AT&T should stop trying to work with everyone in the industry and should settle on a core group of applications and development programs.

However, according to Bernie Toth, AT&T needs to develop more of a presence in the value-added reseller market, a critical positioning if the communications giant is going to go head to head with IBM.

Robert Lefkowits and Amy Wohl agreed that the future of the Unix system is highly dependent on AT&T's success as a hardware vendor, not just on IBM's decisions. Wohl predicted that AT&T will do reasonably well (but not as well as it expects) in 1985 and that it will do slightly better in 1986.

If AT&T succeeds, then its hardware and software efforts will have been critical. If not, then the ball will be entirely in IBM's court.

The Unix system as a major operating environment is still in its adolescence, if not its infancy. Paradoxically enough, the system might finally be considered a success when we *don't* think about its future, a state of Zen detachment that no forecaster has reached.

"I haven't heard people discussing the future of PC-DOS in a long time; it's taken for granted," said Dyson. "People aren't excited about PC-DOS, they're excited about 1-2-3, they're excited about IBM, they're excited about the PC/AT. If Unix is there and the applications are on top of it, great. But people aren't buying Unix, they're buying the applications.

"Unix will be successful when people don't even talk about it." □

Vanessa Schnatmeier, whose last work for UNIX/WORLD appeared in Vol. 1, No. 6, is a freelance writer who has written for several computer industry magazines.

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XENIX FOR

BY C. A. FELONG AND H. AVANT

Xenix 3.0 is an improved and enhanced version of Unix System III for the IBM PC/XT and its clones. Written by Microsoft Corp., Xenix allows users with personal computers such as the IBM PC/XT and several of its work-alikes to utilize a Unix operating system featuring multitasking and multiuser (three-user) capability for a modest system cost.

Xenix offers the following enhancements to standard Unix: (1) file- and record-locking, (2) multiple "virtual" terminals using the IBM display, (3) `vsh`, Xenix's visual shell, (4) Micnet local-area network, and (5) Berkeley commands and utilities.

Enhancements from Berkeley Unix include `csh` (the C shell), `mail` (an enhanced version with help function), and `curses` (a terminal handling programming utility). Also included are `vi` (visual editor), `at` (program execution scheduler), and `more` (page-oriented text formatter/viewer).

Microsoft and The Santa Cruz Operation, the exclusive retail distributor for Xenix, based in Santa Cruz, Calif., have decided to unbundle the system into three packages—basic Xenix, Xenix development system, and a text-processing package. Prices of the three packages are $595, $595, and $495 respectively, or all three for $1,350.

Not included in any of these packages is `f77` (FORTRAN compiler), `bas` (BASIC interpreter), or the usual game programs. While one would not expect support of these items, an experienced Unix system user will miss them.

HARDWARE REQUIREMENTS

Hardware requirements for Xenix are at least 256 Kbytes of RAM and a 10-Mbyte hard disk as a minimum. If user memory is restricted to 256 Kbytes, the optional small version of Xenix must be installed. In this case the kernel supports only one console screen, compared to ten with the large system.

Also, fewer internal buffers and simultaneous processes will reduce the system performance below that of the large system. To run the large standard version, at least 384 Kbytes of RAM are required. This minimum memory requirement is necessary in order to run `vsh`, the Microsoft visual shell, and `vi`.

This look at Microsoft's Xenix 3.0—the enhanced version of the Unix system for the IBM PC/XT— should give us some idea how Xenix will run on the PC/AT.

THE IBM PC/XT

For this evaluation we used an IBM PC/XT with an AST SixPak memory board, populated with 384 Kbytes of RAM. Total memory available was 640 Kbytes.

Xenix offers support for two serial ports in addition to the console port. Serial ports may be used with or without modems attached. Full support for both the stand-alone and the IBM card versions of the Hayes Smartmodem 1200 (including auto-dialing) is provided when using `uucp` and `cu`. Any standard modem may be supported via `cu`, but auto-dial features are not handled.

Real-time clocks or extra serial ports may not work as expected. (The real-time clock on the AST board did not function correctly for us.)

Systems equipped with a color monitor are able to use `set-color`, a command that allows the selection of foreground and background colors from a palette of 16 colors.

Both Xenix and DOS (either PC or MS) can co-exist on the same hard disk. The `fdisk` utility, similar to the IBM utility with the same name, creates and changes multiple disk partitions. Xenix's size is such that any reasonable allowance for it will preclude a very large DOS partition.

Xenix is capable of reading and writing DOS floppies as well as disks that contain mixtures of Xenix and DOS files on a DOS-formatted diskette. DOS formats corresponding to both Versions 1 and 2, single- and double-sided, are readable, as are DOS files located on the hard disk.

GETTING XENIX UP AND RUNNING

Xenix is supplied on 11 diskettes; this total includes a Boot disk, a Root disk, and nine floppies. Floppy number eight contains utilities required for `uucp` and is not needed if `uucp` is not to be installed. Disk nine contains what ap-

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pear to be upgrades of several of the files occurring on the first seven disks. The development system is supplied on five floppies, while the text-processing system consists of four diskettes.

The operating system proper (with the `uucp` utilities) requires 172 cylinders of disk space. On a standard IBM hard disk, this amounts to just under 6 Mbytes, excluding swap space. The operating system and the text-processing system require 211 cylinders, or over 7 Mbytes. Using the development system along with the operating system takes up 221 cylinders, or more than 7 1/2 Mbytes. And if the development system and the text-processing system are loaded, then 260 cylinders, or 9 Mbytes, of disk space are required.

Each of the these disk requirements includes free space for user- and system-generated files. It is easy to see from the above that a fully loaded Xenix system will leave only a small DOS partition if both the development system and the text-processing system are co-loaded.

Installing all of the disks will require close to an hour. After Boot and Root have been read-in, the system will make the hard disk bootable. After this loading, the rest of the disks will be loaded in response to console prompts. When the entire operating system is loaded, initial system administration functions—such as creating a superuser password and setting up user accounts—follow.

It will typically take another hour to perform these functions, to configure the system for users with log-in names, and to assign groups and other set-up parameters such as terminal types. These tasks are made easier by `mkuser`, a utility that sets up `passwd`, `mail`, and `login` files.

DOCUMENTATION

The *Notes* for Release 1.1 should be read first—prior to installation. These notes discuss various IBM PC/XT-type computers that will run Xenix, as well as required jumpering for some of the multifunction cards. The *Release Notes* also give the device names for the two serial ports, warnings about hanging the system by attempting to send data to a non-existent printer, and documentation errata. A listing of files, except for the Boot and Root disks, is located here.

The operating system documentation consists of an installation guide, operations guide, user's guide, and two indexes. Directions for installing the operating system are straightforward, if you have read the *Release Notes* first.

The operations guide is pure Unix documentation—cryptic but complete. An incredible amount of text is devoted to system administration, with numerous admonitions about the system administrator's awesome responsibility. This seems to be very heady stuff for a user who at best will have one or two user accounts on an IBM PC/XT.

The title page of the user's guide supplied to us stated that it had been prepared for the Apple Lisa 2. (However, SCO tells us that this occurred because of a bad press run that has since been recalled.) The manual specifically addresses the IBM in regards to terminal configuration, modem control, and using the parallel printing port. `vi`, `mail`, and building a `uucp` system are discussed here, as are the three shells available with Xenix.

Although the documentation is complete, the printing quality often leaves much to be desired. The print appears to be a reduced Xerox copy set at maximum contrast. On many pages it is almost impossible to see the boldface type used for commands and programming statements.

BASIC XENIX

The basic Xenix operating system contains the usual 125-plus commands found in Unix Version 7 and System III. There are also more than a few commands "borrowed" from 4.1 and 4.2BSD. The system contains all that is needed to set up users, build and back up file systems, enable various peripheral devices, plan and implement the Micnet network, and solve system problems. This is a very complete system that excludes (in the basic system) only programming tools and text-processing utilities.

System accounting commands and libraries are present. Although enabling accounting through the `accton` command would soon fill the PC's disk with accounting information, it is a useful utility for determining system usage. This information enables the system administrator to detect system violations, to tune the system for better performance based upon the most often used files and commands, and to plan ahead for needed additional resources (i.e., disk space, RAM, etc.).

One minor irritation with Xenix is its log-in procedure. The `TERM` shell variable, as used by `vi`, `vsh`, and others, defaults to IBM—that is, to the IBM PC entry in termcap. This is true even when using dial-up lines.

The statement `TERM = (ibm)` was displayed at log-in, even though the manual states that `tset` can be used in a file to set default terminal type and even though we tried setting `TERM` with `tset` and the normal shell assignment. If `TERM` is not set and a carriage return is entered,

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Company name:	**The Santa Cruz Operation Inc.**
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President:	**Larry Michels**
VP Marketing:	**Dennis DeCoste (acting)**
Major support centers:	**Santa Cruz, Calif.**
Price:	**Xenix, $595; Xenix development system, $595, and Xenix text processing system $495.**

BENCHMARK MEASUREMENTS

Arithmetic Instruction Times (microseconds per op.)

	short	*long*	*float*	*double*
+Add	4	13	6024	6757
*Multiply	34	200	6024	7092
/ Divide	39	193	5780	6803

Memory Loop Access Times (microseconds per byte)

	read	*write*	*copy*
Char type	27	25	44
Short type	14	13	25
Long type	10	9	17

Input/Output Rates (bytes/sec)

	read	*write*	*copy*
Disk	27K	22K	10K
Pipe			44K
RAM 1-byte			22K
RAM 4-byte			58K

Array Subscript References (microseconds)

short[]	long[]
16	25

Function References (microseconds/ref)

0-parameters	1-parameter	2-parameters
funct()	funct(i)	funct(i,i)
81	95	106

Process Forks

(−25K bytes)
4 per second

an IBM PC type displayed is assumed. Instead, one could type in a `termcap` entry, such as vt100. (SCO tells us that Version 1.1 no longer displays this prompt from a `modem` login.)

If TERM is set in `.profile`, it will take effect after the dialog. This method does not appear necessary to us and is nonstandard, but it can luckily be disabled by editing `/etc/profile`.

TEXT-PROCESSING AND DEVELOPMENT SYSTEMS

The Xenix text-processing system is composed of tools used for writing and editing, including `spell`, `nroff`, `style`, `diction`, and other associated commands and libraries. This system is known to be difficult to learn and use, but it is very useful for writing documentation, books, or other material that is usually typeset.

The combination of `spell`, `style`, and `diction` are worth using. `spell` allows for the checking of both American and British dictionaries as well as special word lists (legal or medical, for example). `style` reports on readability, sentence length and structure, word length and usage, verb types, and sentence openings. `diction` finds all sentences that contain phrases from a data file of bad, redundant, or wordy diction. Output of `diction` has questionable phrases enclosed in brackets for easy review. Both `diction` and `style` are borrowed from 4.1 and 4.2BSD.

The Xenix development system contains the usual C compiler, debugger, and utilities. Included, among others, are `cc` (C compiler), `adb` (a debugger), `lint` (C portability and type checker), `yacc` (yet another compiler-compiler grammar analyzer), and `make`

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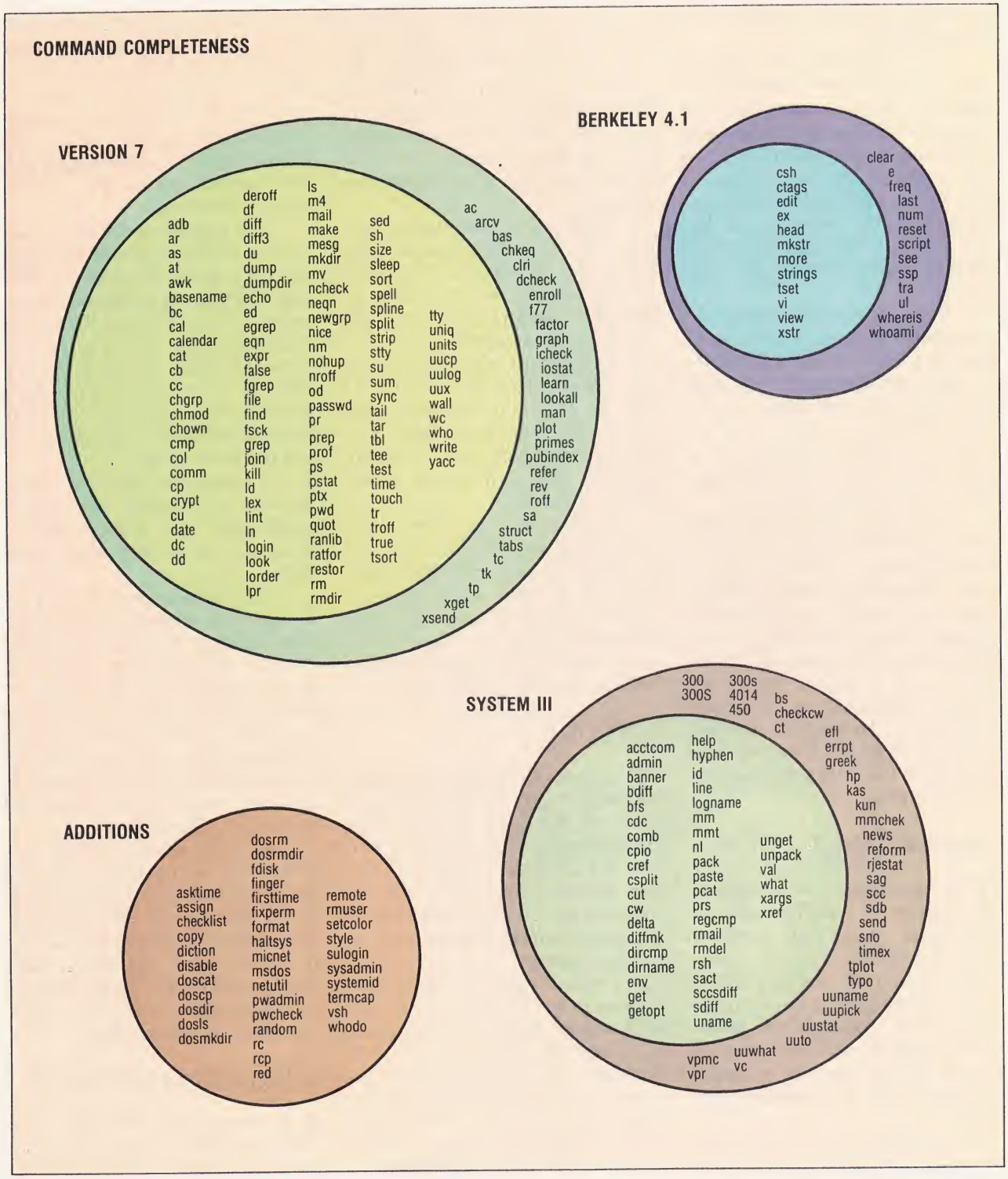
COMMAND COMPLETENESS
VERSION 7
adb
ar
as
at
awk
basename
bc
cal
calendar
cat
cb
cc
chgrp
chmod
chown
cmp
col
comm
cp
crypt
cu
date
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dcheck
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iostat
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xsend
BERKELEY 4.1
csh
ctags
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mkstr
more
strings
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freq
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script
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ssp
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whereis
whoami
SYSTEM III
acctcom
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banner
bdiff
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diffmk
dircmp
dirname
env
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getopt
help
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line
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mmt
nl
pack
paste
pcat
prs
regcmp
rmail
rmdel
rsh
sact
sccsdiff
sdiff
uname
unget
unpack
val
what
xargs
xref
300
300S
300s
4014
450
bs
checkcw
ct
efl
errpt
greek
hp
kas
kun
mmchek
news
reform
rjestat
sag
scc
sdb
send
sno
timex
tplot
typo
uuname
uupick
uustat
uuto
uuwhat
vc
vpmc
vpr
ADDITIONS
asktime
assign
checklist
copy
diction
disable
doscat
doscp
dosdir
dosls
dosmkdir
dosrm
dosrmdir
fdisk
finger
firsttime
fixperm
format
haltsys
micnet
msdos
netutil
pwadmin
pwcheck
random
rc
rcp
red
remote
rmuser
setcolor
style
sulogin
sysadmin
systemid
termcap
vsh
whodo

(maintains program groups and dependencies).

The C compiler does differ in some respects from standard Kernighan and Ritchie under Unix. The unsigned char type is not supported, and default output object code files are named `x.out` as opposed to `a.out`. Code length is limited to 196K, while data segments are limited to 64K. Both the Intel Small and Medium Model formats are supported.

Other parts of the software development package include SCCS (Source Code Control System), M4 (a macro processor), as (an 8086 assembler), and the usual collection of I/O libraries. System calls and utilities, including semaphores as well as file- and record-locking functions, are also documented.

Xenix offers utilities required to build a network (Micnet) that allows communications between two or more independent Xenix systems. While each computer in the network remains independent, `mail`, `rcp` (which copies files across Xenix systems), and `remote` (which executes commands on a remote system) may be invoked. Interconnection is via RS-232 lines, with baud rates up to the maximum supported by the hardware.

PERFORMANCE

The benchmarks were supplied courtesy of Aim Technologies. Results of these tests—with an even mix of CPU, memory access, Unix system calls, and disk activity—are summarized in the accompanying chart. Although the results show the IBM PC with Xenix near the bottom of the pile, its price/performance must be considered very good.

Considering the benchmark results of IBM PC/IX as shown in Vol. 1, No. 2 of UNIX/WORLD, Xenix on the PC is comparable in most areas. The PC/IX times for arithmetic instructions are faster, but Xenix was tested without an 8087 math coprocessor. Xenix was considerably faster on disk input/output but took longer to fork a 25-Kbyte-long process.

Subjectively, the system performs like a medium-loaded minicomputer. Commands load and execute quickly from the disk, although `vi` performance is only fair (but certainly acceptable).

Comparing the PC with Xenix to our often-used Micro PDP-11 (11/23+ CPU, with 10-Mbyte disk) results in a win for PC/Xenix. CPU and memory tests were a tossup, although disk activity was clearly faster on the IBM.

We have also used Venix, VenturCom's System III/V Unix port for the IBM, and have found the differences to be small. Xenix seems to execute commands faster, but Venix is better running `vi`. Benchmarks show that the two systems perform within 5 percent of each other.

SUPPORT

The Santa Cruz Operation offers what it calls "Softcare Support Services" for Xenix and other optional packages. Two types of support are available: Softcare Level I and Softcare Level II. Both levels include a subscription to the *Softcare Technical Bulletin* and discounts on product updates.

Level I support enables purchasers to buy upgrades at a 25 percent savings, while Level II includes a 50 percent discount. Basic-level support customers may report problems or submit questions in written form, either by U.S. mail or by `uucp`. High-level support allows direct access to a toll-free hotline.

Level I support for Xenix costs $95 a year, while Level II is offered for $275 and includes one free day of Xenix training. Level II support for the software development package costs an additional $90, and support for the text processing another $75. We received Level II support as part of our evaluation.

The support mechanism, set up by SCO, is nothing less than amazing and for a novice is worth the extra cost. Early in our evaluation, we experienced erratic parity errors and system crashes. A call to the 800 support number resulted in the registration of our software and logging of our problem—that is, a log number was assigned to our phone call and particular problem.

If subsequent calls on the same problem are needed, this number would allow SCO support staff to bring up the problem history and action.

Our problem was handled by a courteous, knowledgeable person who suggested several possible causes, ranging from peripheral switch settings to ill-seated PC boards. We were also gently steered to the Xenix manual troubleshooting section. Although all switches were set in their correct positions, reseating PC boards did make the problem disappear.

We were again pleasantly surprised when we received a follow-up phone call from SCO support the following afternoon. It was pointed out that support personnel have access to Xenix source code for problem isolation and have available, through an electronic network, other specialists for consultation.

ANNOUNCED UPGRADES

Microsoft and The Santa Cruz Operation have announced plans to upgrade Xenix 3.0 to Xenix

5.0, which will be compatible with Unix System V. The new version will include System V utilities and libraries as well as a new C compiler that will be fully System V-compatible. Also supported will be AT&T's semaphores for interprocess communication as well as the scheme currently implemented in Xenix 3.0.

We were supplied with a beta release of Microsoft's new cmerge C compiler. This version produces more efficient code than does the old version, does not appear to have the type limitations mentioned previously, and comes complete with a DOS library. This enables the IBM under Xenix to be used as a development environment for both Unix and DOS applications.

Support for the Intel 80286 processor will be implemented in the release version.

Both Venix and Xenix allow for PC-DOS partitions and for PC-DOS/Unix file transfers. Venix has a more standard C compiler without some of the limitations of Xenix, but Xenix does allow for file- and record-locking. In a single-user but multiprocessing environment, Xenix offers multiple screens using different background colors on the IBM PC console—a very nice feature.

Venix requires a little less disk space and is slightly less expensive. Any Unix system implementation running on a computer with only a 10-Mbyte hard disk will result in limited storage. This is especially true if all three packages are resident.

Xenix offers excellent support for its product. And when all of the optional utilities are added, it is a complete implementation. Xenix offers a choice of three shells, including vsh for the nonprogrammer. Documentation is complete and offers chapters on troubleshooting (including non-IBM hardware) and system administration. □

C. Andy Felong, who has written for several computer publications, specializes in graphics and system support as a member of the technical staff at the Jet Propulsion Laboratory (Pasadena, Calif.). Harry Avant, whose work at the Jet Propulsion Laboratory involves evaluating microcomputer hardware and software, has had articles published in several microcomputer publications.

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dBASE II MOVES TO THE UNIX SYSTEM

dBase II under the Unix system offers some good news and some bad news.

BY HARRY AVANT

If you are familiar with Ashton-Tate's dBase II running under either CP/M or MS-DOS, you will be interested to know that dBase II under the Unix system offers some good news and some bad news. The good news is that this implementation is very similar to that found on CP/M and MS-DOS computers. The bad news is that this implementation is also very similar to the other implementations. If you already like dBase II, you are going to like it even more running under System V; if you don't like dBase now, you aren't going to change your mind. Although the package I tested was listed as version 2.4, it resembled the current dBase III that is being sold for MS-DOS computers.

Ashton-Tate's dBase II is the most popular database program available for today's CP/M and MS-DOS personal computers. Although many other database programs are available for these computers —many of which offer features not included in dBase II—Ashton-Tate's product remains the leader. AT&T has recently released this program for its 3B series computers under Unix System V. I evaluated the program running on a 3B2 Model 300 system, with 2 Mbytes of memory and a 32-Mbyte hard disk.

Ashton-Tate's dBase II is a relational database, just like its advertising says. But what is a relational database? For a simple answer we can say that a relational database is one that satisfies these two criteria: (1) data is stored in a form that appears to the user as just a table of data, such as a list of names and phone numbers; and (2) the program must be able to manipulate data using three fundamental operators from relational algebra —Select, Join, and Project.

"Select" means that the program can extract a row subset from a given table. "Join" means the program can take two tables and join them to produce a third, wider (not longer) table. "Project" is the ability to extract a column subset from a table.

LOADING dBASE II

The dBase II program files are supplied on two diskettes, with two supplemental disks—"Large Application Installation Utility" and "Terminfo Utility." A brief installation guide is included that makes installation foolproof. It is necessary to log in as root and perform a system shutdown so as to enter the "single user" mode. After disk02 is mounted, `system install` is executed, and the screen prompts are followed. Following software loading, the system is returned to multiuser mode via `init 2`. In order for you to use dBase II's full-screen editing capabilities, user terminal information (by way of `TERM`) must be passed to the Unix system.

dBase is not a small program. The main program requires almost 300,000 bytes of disk space. The help file requires another 60,000, and dfm (dFormat's filename) takes an additional 140,000. A set of tutorial files is also supplied with the system, and it requires about 9000 bytes. Forty-eight files used for a sample accounting system are also included, and these require another 127,000 or so bytes. The message here: Have disk space available.

USING dBASE II

Using dBase's more elementary commands, a beginner can create and manipulate a simple database in just a few minutes. To create a file, first execute dBase. After loading and displaying the sign-on message, dBase responds with its prompt, the period (.). The program is now ready for your commands.

Use the `CREATE` command to create a database for dBase to work with. dBase will respond with a prompt, asking you to name the file to be created. You don't need a filename extension when you give a name because the program will automatically add `.dbf` as the extension.

Next you will be prompted to give a name for the first field. A field is the title for the column of data that will be produced as you fill out the database file. Up to 10 characters can be used for the field name. You are also asked to define the type of data that will go into the field, using *C* for character data (strings), *N* for numeric data (you can specify the number of decimal places), *L* for logical data (such as true or false), and *text* (for a free-structured text field). dBase also will ask you how wide the field will be and, for numeric data, will ask the number of decimal places. A maximum of 254 characters is allowed for width, except for text fields, which may have a width of up to 4000 characters.

Text fields are a recent addition to dBase. If you add a text field to your database, a separate `.txt` file will be generated automatically to hold data for this field. A 10-byte pointer overhead is applied to your main program for each text entry.

This process will repeat until you respond by hitting the return key only in response to the field name prompt. When this is done, dBase knows you have defined all of the fields. Next you will be asked if you want to enter your data now. If you answer with a *Y*, then you will be prompted for the data elements.

If during data entry the cursor falls on a field labeled as a text field, you must hit the escape key in order to enter text. When you finish entering text, hitting ESCAPE toggles you out of that mode and back into the conventional mode. When you have entered all of the data you want, hitting RETURN without any data tells dBase that you are through entering data, at least for now.

Once you have created a database and entered data to it, you can use dBase II's power to extract data, add more data, modify the data, print reports, and exchange data between different files on your system.

If you want to examine the data in a database, you can list the file to either the video or to a printer. If you type `LIST ALL`, then all the data in the file under use will be displayed. You can also select certain portions of the file to be listed by adding a relational operator to the list command.

If, for example, you were working with a database that contained names, telephone numbers, and political party affiliations, you could list out all or just those who were Democrats. You could also list all Democrats with telephone prefixes beginning with 687 and ending with 987. With dBase's built-in string search capability, you could list all people having a last name starting with *E* and who were also Republicans.

Another way of viewing data is with the `BROWSE` command. This command is menu-driven and allows full-screen viewing and editing of a database. The command functions like a window into the file and includes full scrolling features as well as panning capabilities.

THE APPEND COMMAND

If you need to add more records to your database, dBase II provides an `APPEND` command that can be used to enter additional records either at the end of the file or anywhere within your file. When you are in the append or create mode, field names for the data are shown automatically on the video display. `APPEND` allows for both keyboard and file entry.

If in examining a database you discover an error, you can take advantage of dBase's complete full-screen editing features. You can edit any record in any field, or you can have the program automatically edit all of the records for you. Imagine a database that you use as an inventory program. In the database you have stored part numbers and retail prices for several hundred items. If you want to increase the retail price of all the items by 5 percent, dBase now allows you to do this with a single, simple command.

A variety of string operators are available that will allow you to look for character groupings within a character string, to check the length of strings, to convert strings to integers, and to convert uppercase to lowercase or vice versa. The ability to search text fields for character strings has not been implemented. In many respects the string functions of dBase are similar to those of BASIC, but they are used in somewhat different ways.

dBase allows you to sort your records on any field, or you can invoke dBase's INDEX feature. When you index a database, the individual records are not rearranged; instead, another file, an index file, is created. This index file is a pointer to each of the records within the database.

When you have a database with hundreds of entries, it can be difficult for some database managers to locate a specific record. This is not so with dBase II. One of the commands in dBase, the LOCATE command, which works with indexed files, will allow you to locate a specific entry that corresponds to one or more of the fields of the database. For example, consider an inventory database. You could instruct the program to locate all entries that have a price equal to, greater than, or less than some amount; or you could have the program locate the entry for a specific part number.

dBase also offers the ability to format the video screen for presentation of data. A similar capability of formatting reports to a printer is available. If you carefully set up the formats, elaborate displays can be achieved. The dFormat utility simplifies the generation of formatted displays.

dBase II's real power is realized when command files are used in conjunction with database data.

Reports to the screen, printer, or a file can be generated. Report generation starts with defining the report format using the built-in dBase report format generator. This produces a report form file that can be used with any of the relational operators to generate your report using specified formats and types of data you choose to select. For numerical data, the format program allows for subtotals as well as totals, if desired. With this version of dBase, up to 24 columns may occur in a report.

The ability to exchange data to and from non-dBase programs is also available. You can generate a file of data, or a subset of it, that follows the normal comma-delimited format commonly used by languages such as BASIC. It is also possible to read in these types of files and convert them to dBase format. As an example, you can generate a file of directory entries by the following steps. First, temporarily exit dBase and generate a temp file by typing: `!ls -l >tmp.txt`.

Next CREATE a dBase structure to hold the data, and finally APPEND the data with a command line of: . APPEND FROM `tmp.txt` SDF.

dBase allows you to work with four different database files at once, letting you rapidly switch between them. It is also possible to join different database files, or parts of different files, into a new and unique file.

COMMAND FILES

The real power of dBase is realized when dBase command files are used in conjunction with database data. A command file is a series of instructions to dBase telling it to perform specified commands. Command files are written in what can only be described as dBase II language. This is a semi-structured language, somewhat similar to Pascal, that provides powerful operatives for data manipulation.

COMPANY/PRODUCT OVERVIEW

Company:
Ashton-Tate

Headquarters:
10150 W. Jefferson Blvd.
Culver City, CA 90230
213/204-5570

Company:
AT&T Technology Systems
Computer Systems Division

Headquarters:
4513 Western Ave.
Lisle, IL 60532

General Contact:
S. Chelluri
Senior Engineer
Application Engineering-VAR
312/810-6223

System Requirements:
Unix System V
Currently available for the 3B series
Price: $1200

The command language supports decisions with IF...ELSE and CASE operators. A DO WHILE operator is also present. Command files can be used to input data, and the inputs can have prompts associated with them. Temporary variables may be stored in memory, and simple mathematical functions may be performed both on the memory variables and on the actual data in the database.

Command files can be as simple as four or five lines long, or they can be much longer. I use a set of six command files in conjunction with a database of publications. Each of the command files is about 40 lines long, and each is treated as though it were a procedure. By that I mean that various command files can call up other command files, depending upon the results of case statements. I have seen a set of dBase II command files (used for generating a work schedule for a large project) that had over 5000 lines in it.

Perhaps the best way to summarize dBase II is to admit that it is not just a database program but is instead a language that requires data for use. The many commands and operators equal in number the quantity available in many conventional languages.

dBase II is a very simple program to learn to use for simple applications, but mastering it requires a lot of work, especially for complex command files. Fortunately, it is not necessary to master it before you can perform powerful database manipulations.

DOCUMENTATION AND PERFORMANCE

The documentation supplied with the program will have you creating your first database in about 20 minutes. If you key in the examples, it will take a week or two to get all the way through the documentation, but you will gain exposure to the program's full power.

The documentation supplied with the program will have you creating your first database in about 20 minutes.

The documentation for dBase II is excellent. The manuals, which are printed on high-quality stock, are offset printed and measure 5 by 11 inches. They offer many clear and concise examples and are well-divided. One is a general introduction to features, and a second is a reference manual. Several updates are located at the front of each manual and should be incorporated in the text in the next printing. The 19 corrections for the user's guide are acceptable, but 145 corrections for the reference manual are too much.

dBase running under CP/M or MS-DOS has developed a reputation for having very slow sort capabilities. Contained with the Unix System V version was a simple program that generated a name and address list of 1000 records in length. I sorted this file and wrote the results out to a temp file in 34 seconds. It seems that Ashton-Tate has done a reworking of its original sorting al-

SUMMARY OF FEATURES

Database Files:
1 billion records (theoretically)
32 data fields per record
1000 bytes maximum per record, excluding text fields
254 bytes maximum size of character fields
4000 bytes maximum for text fields

Index Files:
Allow for use of database file in logical rather than physical order.

Command Files:
Contain sets of dBase commands stored as programs. May be created with dBase MODIFY command or a text editor that generates ASCII text.

Format Files:
Used to create custom screen forms for use in data entry.

Memory Files:
Contain up to 256 memory variables and are stored external to a database.

Report Form Files:
Used to generate either video or hard-copy reports.

Mathematical Operators:
Addition, subtraction, multiplication, division, exponentiation; may be used in command lines, command files, and in "desk calculation mode."

Comparison Operators:
Less than, greater than, equal to, not equal to, less than or equal to, and greater than or equal to.

Logical Operators:
Logical and, logical or, and logical not.

String Operators:
Concatenation operator, substring comparison.

Functions:
A partial list includes calendar date to Julian date, natural log, ASCII value, square root, time, and truncation of blanks.

Commands:
A partial list includes append (to add new records), average, count, dFormat (used to create formatted screen), display status, do while, do case, find, help, locate, seek, select, sort, total, lock, unlock, and update.

gorithm. Using this same file, I generated an index on the first names and wrote this out to a temp file, an operation that required 2 minutes and 36 seconds. In both cases, the times were impressive. But what struck me was the size of the index file (at 38,400 bytes). This was derived from an original file of 64,059 bytes.

In porting dBase II to the Unix system environment, some new commands have been added. The exclamation mark (!) is new and allows a temporary escape from dBase into the Unix system command processor. At the conclusion of the Unix system command, a prompt advises you to hit any key to return to dBase. A `SET PRINT TO` command has been added to direct printed output to printers or any Unix system command such as `mail`, `grep`, and so on. A new pair of functions, `LOCK` and `UNLOCK`, has been added to help avoid simultaneous updating of files. Although not foolproof, it is better than not having any protection. At least Ashton-Tate has tried to overcome one of System V's major flaws.

dBase under the Unix system supports path names for most file functions. This version also includes an on-line help file that may be called up at any time. Help will not successfully respond if the Help file is not located in the same directory as the dBase file. The user's guide notes this and suggests that the shell variable `DBHELP` be set to the correct path. Since the program is designed as an application and should make no assumptions about the user's knowledge of the operating system, this "fix" is rather vague. It would be nice if Ashton-Tate just fixed the problem, rather than suggest a somewhat band-aid-type solution. A utility for generation of formatted screens, dFormat, is also present, and it has its own help file and on-line manual.

dBase II is powerful but is easy to learn to use, at least for simple applications. It allows you to create databases that can have up to 32 fields and up to 1000 characters in each record (excluding text files). Each database may have up to 1 billion records. Numerical calculation accuracy of 10 digits is provided, and the digits handled by dBase range from the 10th to the 308th power.

The program is complete in itself, containing the ability to create and manipulate data. It has its own full-screen editor for generating command files and can be used to edit data files. The report generator, while somewhat lacking, is also built-in. When you purchase dBase, the program comes with all of the utilities required for creating and maintaining extensive databases.

The CP/M and MS-DOS versions of dBase have led to the creation of a cottage industry of support, including books, tutorials, and application programs. Many books are available on dBase applications that are useful for using dBase with the Unix system. It will be interesting to see if the vertical market application programs written in dBase will be transported over to this operating system as well. □

Harry Avant is an employee at the Jet Propulsion Laboratory (Pasadena, Calif.) whose work involves evaluating microcomputer hardware and software. He co-authored the article "Xenix For the IBM PC," which also appears in this issue of UNIX/WORLD Magazine.

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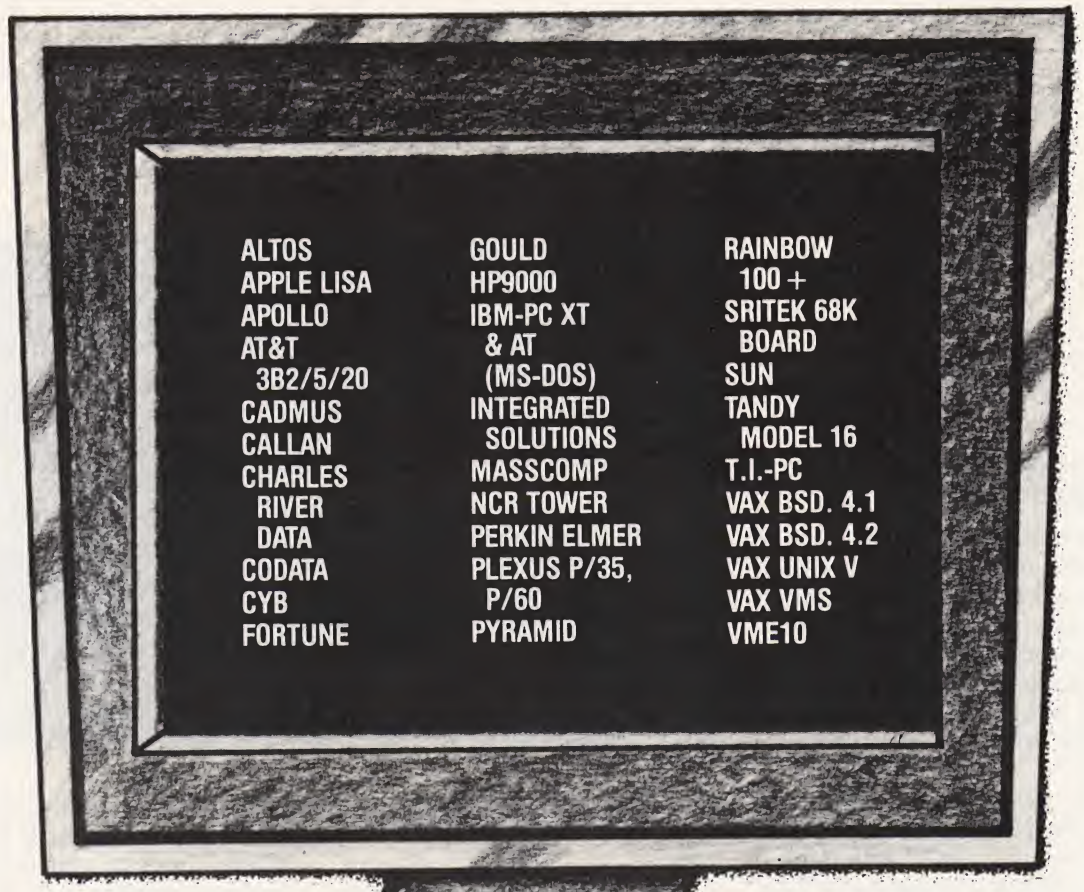

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HONEYWELL WORKSTATION

Honeywell's microSystem NX is a high-performance Unix system-based workstation targeted at engineering administration and support environments, applications development professionals, and organizations that have selected the Unix operating system as an applications platform.

The workstation runs the UniPlus+ operating system, a licensed port of Unix System III with Berkeley 4.1 extensions. Features include a window manager, font editor, local-area network connections, and high-resolution graphics.

Based on the M68000 processor, the microSystem NX is configured with a 15-inch, high-resolution (720 by 560 pixels) bit-mapped display; a 113-key, detachable keyboard; 512K bytes of main memory and 64K bytes of display screen memory; a 5 1/4-inch 655K-byte diskette; two RS-232C asynchronous ports; and either 12 Mbytes or 18 Mbytes of disk storage. Internal system electronics are enclosed in modular units, enabling users to take advantage of Honeywell's low-cost maintenance programs.

The 12-Mbyte version of the microSystem NX is priced at $8895, while the 18-Mbyte version sells for $9495. Both prices are for a complete system and include the window manager, font editor, and integral local-area network transport hardware. A mouse-type pointing device that allows easy manipulation of the system's window manager is also available.

The UniPlus+ Run-time Software Package is standard with the system and is compatible with Unix System III. Besides the full Unix System III command set, additional features such as `csh`, `more`, and `vi` are provided under the package's Berkeley extensions.

An application program development software package that includes a C compiler, development utilities, and on-line documentation can be added to the system. FORTRAN-77 and Pascal compilers also are available for program development.

The initial applications packages offered with the microSystem NX include word-processing, graphics, and spreadsheet software. The programs are the Q-One word processor, Multiplan electronic spreadsheet, and DDD.Graph, a three-dimensional graphics program.

Communications for the microSystem NX are provided by Unix system communications facilities CU and UUCP. The workstation also offers local-area network facilities to enable users to connect to other devices, including microSystem NX workstations via Omninet, a local-area network.

Printers available with the system include two correspondence-quality, 100-character-per-second (cps) dot-matrix printers that offer 80- and 132-column printing, respectively; and a 55-cps/132-column, letter-quality printer.

As of press time, the fully configured microSystem NX and initial applications software packages were scheduled to become available in January 1985. One-time prices for the different software packages that run on the new workstation: UniPlus+ Program Development, $595; FORTRAN-77 Compiler, $595; Pascal Compiler, $595; Multiplan Spreadsheet, $250; Q-One Word Processing, $595; and DDD.Graph, $395.

For more information, contact Honeywell Inc., 300 Concord Rd., Billerica, MA 01821.

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CROMEMCO'S PC CONNECTION

Cromemco Inc. has introduced the PCworks software program, developed by TouchStone Software Corp. It is now available for Cromemco's new System 100 and System 300 series of Unix System V supermicros.

Users can perform the following directly from an IBM PC or compatible system: operate it as a standard Unix system terminal; read, create, and send mail; send and receive data files and programs to and from the Unix system; execute all Unix system commands and application programs; print or spool PC files; and back up PC files on the Unix system hard disk.

PCworks uses standard RS-232 asynchronous communication lines to attach personal computers to Cromemco's System 100 or System 300 computers. Connection can be made directly or through a modem.

For more information, contact Cromemco Inc., 280 Bernardo Ave., Mountain View, CA 94039, 415/964-7400.

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HANDSHAKE III FROM SST

Handshake III, developed and marketed by SST Inc., links Unix system-based microcomputers to IBM Systems Series 34/36/38 minicomputers.

Handshake III currently is available on the Fortune 32:16 and provides exact emulation of a 5251 terminal. It emulates all IBM keys, including the command function keys. This capability not only allows the Fortune 32:16 to function as a stand-alone or multiuser business computer, but it also provides direct and simultaneous access to the 34/36/38 files.

Access is automatic with a single keystroke and allows the Fortune 32:16 System to exchange files between systems. With the Handshake link, users can take advantage of word-processing, spreadsheets, database managers, and other application software packages.

For example, this capability allows accounting personnel to download files from the IBM, extract a name, account number, invoice number, amount, and so on, and merge it into a form letter without re-keying all that information. It also allows Fortune 32:16 System users to run IBM application programs

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from the Fortune terminal. In addition, users can transfer files between the IBM and Fortune systems.

For more information, contact SST Inc., 9434 N. 107th St., Milwaukee, WI 53224, 414/355-6990.

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TYPESETTING FOR IBM PC/XT

Accucom Data Network Inc. has released "/usr/tools," a Unix system-based typesetting preview program that is available in both Coherent and Xenix versions for the IBM PC/XT and IBM compatibles.

The /usr/tools package, an enhanced version of the AT&T Documentor's Workbench for microcomputers, includes a graphics driver that allows text files formatted by Unix `troff` or `nroff` commands to be proofed at the same site where they are produced. The driver outputs the formatted file to a dot-matrix printer in a format identical to that used during typesetting or volume laser printing.

Once files have been previewed and corrected in the Unix system environment, they can be transmitted to Accucom's typesetting service via modem, disk, or tape. In the case of modem transmissions, Accucom is able to return camera-ready type in an average of 48 hours. This turnaround time is the result of a text-production rate that, at 20,000 lines per minute, is typically 1000 times faster than conventional systems. At the same time, typesetting costs are typically reduced by over 50 percent in comparison with traditional typesetting methods. /usr/tools is priced at $995.

For more information, contact Accucom Data Network Inc., 9730 S.W. Cascade Blvd., Suite 220, Tigard, OR 97223, 503/684-2850.

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ARETE'S SUPERMICRO FAMILY

Arete Systems Corp. has introduced the first of its multiple 32-bit processor systems for on-line information processing. The new Model 1124 features a dual-M68000 Unix system engine.

The Arete 1124 supports two operating systems: Unix System V and RM/COS (COBOL-compatible). RM/COS supports high-speed file access methods at the operating system level. Moreover, identical COBOL compilers exist under both RM/COS and the Unix system so that software developed under the Unix system can run under RM/COS at much higher performance.

Within the 1124 are 10 card slots to accommodate various configurations. Three slots are for CPU and memory cards, while six are for I/O expansion. The remaining position is reserved for a memory controller that manages the data flow among system cards. Memory is presently available in 2-Mbyte increments. An 8-Mbyte card is planned for the time when 256-Kbyte RAMs become available at an attractive price.

Priced from $60,000 to $75,000 (depending on memory configuration), the 1124 is available in 60 days ARO.

For more information, contact Arete Systems Corp., 2040 Hartog Dr., San Jose, CA 95131, 408/263-9711.

Please circle Reader Service Number 24.

APOLLO ADA COMPILER

Apollo Computer Inc. and Teledyne Brown Engineering have announced that through a cooperative agreement, Teledyne Brown will distribute and support TeleSoft's Ada compiler on Apollo's Domain workstations.

Through an agreement reached last year, Apollo workstations are being used as the base for Teledyne Brown's new computer-aided design capabilities for system/software development called TAGS (Technology for the Generation of Systems).

For more information, contact Apollo Computer, 330 Billerica Rd., Chelmsford, MA 01824, 617/256-6600.

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

UniPress Product UPDATE

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MS-DOS is a trademark of Microsoft. VAX/VMS is a trademark of Digital Equipment Corp.

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GRAPHICS SOFTWARE FOR MASSCOMP WORKSTATIONS

Masscomp is now offering three new graphics software products for the MC-500 family of computer systems and workstations: the SP80/SP82 SIGGRAPH Core System; the SP84 Contouring System; and the SP86 Metafile System.

These products are the DI-3000 software line, licensed from Precision Visuals. The software operates under Masscomp's real-time Unix RTU operating system.

The SP80/SP82 SIGGRAPH Core System is written in FORTRAN. It fully supports two- and three-dimensional graphics primitives, two-dimensional window-to-viewport mapping, three-dimensional viewing and clipping, and a variety of perspective projections. It also features both temporary and retained segments with fully controllable attributes.

The SIGGRAPH Core package is highly suitable for users engaged in CAD/CAM graphics in areas such as two-dimensional drafting, solids modeling, and VLSI design.

The SP84 Contouring System is a set of specialized subroutines that renders two-dimensional contours and three-dimensional data. It allows generation of a variety of contour plots from randomly located or evenly spaced data. It also produces plots from any perspective, with full hidden-surface removal in real-time scientific applications in which two-dimensional contours and three-dimensional plots are frequent.

The SP86 Metafile System saves graphics sessions created via the SIGGRAPH Core System in a device-independent Metafile. The Metafile subsequently can be used to position, scale, superimpose, or assemble several graphics sessions, thereby creating more complex graphics images. Additionally, the Metafiles can be exchanged between computers, providing a graphics image and graphic-session-exchange capability.

The SP80/SP82 is priced at $1200, the Contouring System at $450, and the Metafile System at $350. The products are available 90 days ARO; quantity OEM discounts are available.

For more information, contact Masscomp, One Technology Park, Westford, MA 01886, 617/692-6200.

Please circle Reader Service Number 6.

CELERITY WORKSTATION

Celerity Computing's C1200 Professional Workstation executes 2 million single-precision and 1.5 million double-precision Whetstone instructions per second. It also can be configured with up to 24 megabytes of physical memory.

The C1200 offers engineers such features as double-precision floating-point arithmetic, a large virtual address space, full 32-bit data paths, and the Unix operating system.

The Celerity operating system is based on UC Berkeley's 4.2BSD. Celerity's software has extensions to support bit-mapped graphics, multiple window displays, distributed files, and enhanced communications. Optimizing compilers are available for FORTRAN-77, Pascal, and C.

The Celerity I/O subsystem is an IEEE 796 (Multibus)-compatible that provides users with a choice of peripheral devices. Users can use ACCELNET, Celerity's integrated networking product, to communicate with other systems connected in IEEE 802.3 (Ethernet) local-area networks.

The display station uses a 19-inch, 60-Hz non-interlaced refresh monitor. This unit provides 1280 x 1024 resolution, eight bit planes for color selection, and vector writing speeds of 60,000 one-centimeter vectors per second. A medium-resolution display using a 14-inch, 60-Hz non-interlaced refresh monitor is also available.

The C1200's basic configuration includes the 32-bit ACCEL processor, the extended floating-point processor, a 56-Mbyte disk drive, streaming cartridge tape drive, 2 Mbytes ECC memory, Celerity system software license, and a 90-day warranty. In quantity, the price of the basic unit is $45,000. The color display station is priced at $27,600.

For more information, contact Celerity Computing, 9692 Via Excelencia, San Diego, CA 92126, 619/271-9940.

Please circle Reader Service Number 7.

VISUAL INTELLIGENCE'S DATAVIEWS

Visual Intelligence Corp. has released Dataviews, an interactive graphics software system that allows users to create a variety of formats to edit and display data as it is generated.

The system takes dynamic data—for example, temperature, RPMs, pressure, and oil flow in an engine—and displays it as a simulated instrument panel on a color graphics monitor.

Dataviews consists of a comprehensive library of graphics subroutines and a menu-specification language providing a high-level interface to the subroutines. Although the typical configuration includes both modules, systems integrators may embed all or a subset of Dataviews in a system.

The subroutines offer more than 40 different display formats, including line graphs, dials, bar charts, strip charts, surface plots, and flow fields. The user can construct multiple screens with a variety of viewports and formats. Users can modify or replace existing menus using Dataviews' menu-specification language.

Dataviews costs $7500 for a single-user workstation, but discounts are available to volume users, OEMs, and universities.

For more information, contact Visual Intelligence, Amherst Fields Research Park, 160 Old Farm Rd., Amherst, MA 01002, 413/253-3482.

Please circle Reader Service Number 8.

CREARE R&D'S ULTRALINK

UltraLink, from Creare R&D Inc., is a multiuser communication software package that provides data transmission between Unix operating systems and Digital Equipment VAX-11 computers running VMS operating systems.

Current Unix operating systems that have been implemented so far include Masscomp, VAX 4.2BSD, Ultrix, and Pyramid systems. Other ports are also being planned.

Creare offers free support for 90 days and guarantees that the product provides documented capabilities. Extended support is also available as part of the licensing agreement. Current prices range from $700 to $1100 per node. (Two nodes are necessary to create the initial link.)

For more information, contact Creare R&D Inc., P.O. Box 71, Hanover, NH 03755, 603/643-3800.

Please circle Reader Service Number 9.

FOUR-PHASE ENHANCEMENTS

Four-Phase Systems, a subsidiary of Motorola Inc., has announced major enhancements to its 2000 family of communicating desktop computers. These enhancements include an M68010 processor, a virtual memory version of Unix System V, a high-performance 52-Mbyte Winchester disk drive, and a 5-Mbyte removable Winchester disk.

The 2000 series, which features IBM-compatible batch and interactive communications using SNA, bisynchronous, and asynchronous protocols, is designed for companies with large data networks that require customer-developed data-processing applications, word-processing, and spreadsheet analysis at remote office locations.

Four new 2000 configurations with Winchester disk subsystems are available for the Model 240 and Model 260. A processor is packaged with a 5-Mbyte removable disk and a 5-Mbyte fixed disk on the Models

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240/3 and 260/3. Models 240/4 and 260/4 include a processor with a 5-Mbyte removable disk and 52-Mbyte fixed disk.

The 2000 series uses an ANSI X3T9.3 SCSI disk bus to attach up to four disk subsystems and up to eight disk drives, for a maximum of 369 Mbytes of on-line Winchester disk storage with intelligent disk controllers.

The 2000 series features a multiprocessor architecture based on Motorola microprocessors. The Model 240's processor uses a Motorola 8/16-bit microprocessor with a memory mapping unit, multichannel DMA controller, and time-of-day clock with battery backup.

The Model 260's processor features Motorola's 68010 microprocessor with 32-bit instructions, 24-bit address bus, 16-bit data bus, virtual memory, and demand-paging support. It has error-correcting memory, a paging memory management unit, and a microprocessor-based master I/O processor to off-load I/O overhead.

Both models are delivered with one or two intelligent communications controllers. Up to 12 serial interfaces can be included to support host communications workstations and printers. Using modems, the 2000 series allows a workstation and attached printer to be placed remotely from the processor.

The 2000's concurrent 3270 SNA product has been running in ACF/VTAM networks for some time now. IBM displays and printers are emulated. A "session suspend" feature allows users to switch easily between SNA host sessions and local applications.

The 2000's Model 240/3 with one workstation, 384K bytes of memory, and 20 Mbytes of Winchester disk storage lists for $8710. A Model 260/4 with four workstations, a 68101 applications processor, 512K bytes of error-correcting memory, a master I/O controller, and 57 Mbytes of Winchester disk storage lists for $20,550. Volume discounts, monthly leases, and installment purchase plans are available.

For more information, contact Four-Phase Systems, 10700 N. De Anza Blvd., Cupertino, CA 95014, 400/255-0900.

Please circle Reader Service Number 11.

STRIDE'S UNIX SYSTEM MICROS

Stride Micro, formerly Sage Computer, has introduced the Stride 400 Series family of microcomputers.

The first of these three products is the Stride 420 desktop supermicrocomputer. Marketed primarily as a stand-alone system for sophisticated users, the Stride 420 can also become part of a larger and more powerful network system utilizing either the Stride's multiuser capabilities or Omninet, a built-in, local-area network.

The Stride 420, priced from $2900, comes standard with a 10-MHz M68000 microprocessor, VME bus, 256K bytes of RAM, a 640K-byte 5 1/4-inch floppy disk, four RS-232C serial ports, Omninet local-area-network hardware, Liaison networking software, a Centronics parallel port, 4K bytes of CMOS battery-backed up RAM, Teletalker communications software, and p-System Version IV.2 operating system.

The second member of this family, the Stride 440, comes standard with a 10-MHz M68000 processor, 256K bytes of RAM, 640K-byte 5 1/4-inch floppy disk storage, 10-Mbyte Winchester hard-disk storage, VME bus, 10 RS-232C serial ports, battery-backed up real-time clock, Omninet local-area network hardware, Liaison network software, p-System Version IV.2 operating system, Teletalker communications software, and a Centronics parallel port.

The Stride 440 will be marketed through dealers and value-added resellers (VARs) and will be sold directly to business and OEM environments. The computer is priced from $5900.

The third member of the Stride 400 family is the Stride 460, developed primarily for medium to large businesses, software developers, and OEMs. Standard features on the 460 include a floor-standing tower design, 10-MHz M68000 microprocessor, 256K bytes of RAM, 640K-byte 5 1/4-inch floppy disk storage, 15-Mbyte Winchester hard-disk storage, VME bus, VME (Eurocard) expansion card cage, 10 RS-232C ports, Omninet local-area networking hardware, Liaison networking software, Teletalker communications software, battery-backed up real-time clock, a Centronics parallel port, and the latest p-System Version IV.2 operating system. Retail prices for the Stride 460 begin at $8900.

For more information, contact Stride Micro Corp., 4905 Energy Way, Reno, NV 89502, 702/322-6868.

Please circle Reader Service Number 12.

LOGICAL SOFTWARE'S SOFTSHELL

Logical Software has introduced SoftShell, a full-screen interface that provides users with direct access to the most complex programs and packages available with the Unix operating system.

While SoftShell greatly simplifies the use of the Unix system's distinctive hierarchical file and command structure, it retains full power of the operating system's unique capabilities, such as piping and I/O redirection.

SoftShell provides templates to facilitate choosing options for all major commands, a structured "walk" to traverse the many layers of the Unix file system, and context

information to orient users at all times within the Unix system. SoftShell also serves as a screen-handler and menu-driver.

SoftShell divides the CRT screen into two parts: the window (top) and the scroll (bottom). The size of the window varies according to the space needed by the SoftShell command template. If users know the desired Unix system command, including parameters and options, they can enter that information directly into the scroll. If users know the command but not its arguments, they can then invoke a special command template. This appears in the window and prompts them for the proper parameters and options through "fill in the blank" fields, toggles, and helpful information.

The SoftShell `yelp` command categorizes the Unix system commands by function and presents the classification along with a brief description in a panel-display window format. At the lowest level of the display are executable commands, which are grouped according to function. And after each command is executed, `yelp` can provide further instructions in the next steps of the operation.

The hierarchical Unix file system structure is known to be both very versatile and confusingly complex. SoftShell's `Lsls` feature (Logical Software `ls` command), however, gives the user a guided tour through the Unix file system. Just as `yelp` presents the Unix system by function, `Lsls` approaches the system by content of a file. The `Lsls` "table of contents" encourages users to annotate with meaningful descriptions the limited filenames the Unix system provides, making it much easier to track file contents.

SoftShell runs on many varieties of the Unix system and is terminal-independent. License fees for binary copies of SoftShell range from $295 to $995 per copy, depending on the CPU. OEM arrangements are available.

For more information, contact Logical Software, 17 Mt. Auburn St., Cambridge, MA 02138, 617/864-0137.

Please circle Reader Service Number 13.

SOFTWARE EXPRESS FOR PERKIN-ELMER

The Software Express has announced that its entire Fourth Generation environment is available on the Perkin-Elmer line of Unix system-based computers. The Software Express environment includes APPGEN, a Unix system-based application generator, and nine application packages developed under APPGEN.

APPGEN is the first natural language environment Perkin-Elmer has selected. Firms with many users can continue to grow with the APPGEN environment without recompiling across the entire Perkin-Elmer Unix system line.

For more information, contact Software Express, 2925 Briarpark Dr., Houston, TX 77042, 800/231-0062.

Please circle Reader Service Number 14.

FORTUNE ENHANCES HARDWARE, SOFTWARE

Fortune Systems Corp. has upgraded both its PS and XP series of the 32:16 microcomputer product line to accommodate additional users. The firm also announced changes in the prices of its microcomputer line.

Users can now expand the low-end Professional System (PS) series, which includes the PS 10 and the PS 20, from the existing 512K bytes of

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RAM to 1 Mbyte of RAM. This increase can enable the PS system to grow from its current three-user limit to support up to five users. The PS systems are now available at $5995 and $6995, respectively.

The Expanded Performance (XP) series now includes a new XP 45 as well as the existing XP 30. Both can support from 3 to 13 users. The XP 45 contains 45 Mbytes of formatted hard memory, has a 30-millisecond access time, and is priced at $14,995. The XP 30 has 30 Mbytes of memory, a 45-millisecond access time, and costs $12,995.

In addition, an upgrade kit lets users expand the RAM on both the XP 45 and XP 30 up to 2 Mbytes. The XP 20 model will be dropped from the product line. Fortune's 32:16 product line is based on the M68000 32-bit microprocessor.

Fortune also has released an enhanced version of its word-processing system, the Extended Fortune:Word. The software provides spelling correction, improved hyphenation and pagination for multicolumn documents, and background modes that check spelling or hyphenate and paginate existing documents while the user performs other word-processing tasks.

Extended Fortune:Word 2.0 is priced at $1495 and is being released in conjunction with Fortune's upgraded 32:16 multiuser microcomputer series.

For more information, contact Fortune Systems Corp., 101 Twin Dolphin Dr., Redwood City, CA 94065, 415/595-8444.

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PATHWAY DESIGN LINKS UNIX, IBM'S SNA

Pathway Design Inc. has introduced uniPATH, a family of gateway products for micro-mainframe communications operating under Unix Systems III and V. uniPATH will run on Unix system-based products and will permit communication with a variety of IBM hosts in SNA/SDLC and BSC networking environments, in addition to the normal Unix system-processing capabilities.

The uniPATH product offers value-added concurrent emulation of 3270, 3770, 3780, and 2780 devices. The product is transparent to the user, running under the Unix operating system as a device. Pricing for uniPATH will be based on the number of sessions supported. One user, five sessions, will be priced at $795, with 16- and 32-session versions priced at $1395 and $1995, respectively. Both SNA/SDLC and BSC versions of uniPATH will include 3270 and RJE emulators.

The uniPATH product family includes modularized software components that facilitate simple porting to various Unix and Unix-compatible operating systems. The modular software will operate as a logical extension of the Unix system, transparently managing address translation and logical unit identification for smooth communications and multitasking.

Pathway Design will distribute the new product through OEM contracts and direct sales efforts. The company has recently signed an estimated $7 million contract with Charles River Data Systems to distribute uniPATH with Charles River's Universe 68 supermicrocomputer system and a $1 million contract with Visual Technology to distribute uniPATH with Visual's Unix-based System 2000.

The second release of uniPATH, currently in development, will permit multiple IBM PCs or intelligent terminals connected to the Unix system to communicate with IBM hosts in SNA/SDLC and BSC networking environments.

For more information, contact Pathway Design Inc., 177 Worcester St., Wellesley, MA 02181, 800/343-0515.

Please circle Reader Service Number 16.

PARALLEL'S OFFICE AUTOMATION SOFTWARE

Parallel Computers Inc. has begun to offer Officeware, an integrated office-automation software program, for the Parallel 300 computer.

Officeware, based on the Unix operating system, resides in the Parallel 300; it shares processing between the Parallel 300 and up to 32 attached, intelligent workstations. The program integrates word-processing, spreadsheet, graphics, forms, data entry, calendar, and electronic mail.

Officeware provides windows that allow users to simultaneously see and manipulate several pieces of work, such as spreadsheets and documents in preparation. One or more of the windows may address other applications within the Parallel 300, such as a shared database.

The Parallel 300 was designed for use in operational information systems applications—those environments in which computers are critical to the flow of products and services. Typical application areas include factory automation, workstation networks, and service businesses that use on-line computers. Officeware costs $1500 per workstation.

For more information, contact Parallel Computers, 3004 Mission St., Santa Cruz, CA 95060, 408/429-1338.

Please circle Reader Service Number 17.

PRECISION SOFTWARE FOR BURROUGHS XE-550

Precision Software Inc. (PSI) has introduced a line of integrated, Unix system-based business application software modules for the Burroughs XE-550 supermicro.

Called the UniCentre Series, the line includes seven modules: Accounts Receivable, Accounts Payable, General Ledger, Inventory Management, Order Processing, Payroll, and Purchasing Management.

The software, which operates under Unix System V, is written in RM COBOL, a widely adopted version of the common business applications computer language.

The average price of a UniCentre software module is approximately $1500. The primary target market for the software is small- to mid-size distributors, manufacturers, and other commercial users in the $5 million to $75 million range.

For more information contact Precision Software Inc., 78 E. Little Canada Rd., St. Paul, MN 55117, 612/484-5501.

Please circle Reader Service Number 18.

VENIX/ENCORE FROM UNISOURCE

Unisource Software Corp. has introduced Venix/Encore, the latest version of Venix/86, the first licensed implementation of AT&T's Unix operating system for personal computers.

Venix/Encore's enhancements include the following: C programs larger than 64K bytes; user-developed device drivers; the ability to run FORTRAN-77 and other large applications, and record-locking.

Venix/Encore retails for $800, is delivered with a System V Unix license, and is available for the IBM PC/XT, AT&T 6300, Compaq Plus and Deskpro, Eagle Turbo, MAD 1, and the Leading Edge PC. Unisource also markets Venix/Pro for the DEC Professional/350.

For more information, contact Unisource Software Corp., 71 Bent St., Cambridge, MA 02141, 617/491-1264.

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CSI PROVIDES ACCESS TO IBM MAINFRAMES

Communications Solutions Inc. (CSI) has adapted its Access/SNA 3270 product for implementation under Unix operating systems.

This new version of the firm's Access/SNA 3270 product lets Unix systems access IBM mainframes through Systems Network Architecture (SNA), IBM's network data communications standard. Four Unix system vendors—UniSoft, Fortune Systems, Altos, and Arete—have already selected CSI's Unix system product.

Written in C, the Unix version of Access/SNA can be used with a wide range of operating systems. Special features have been added to Access/SNA to make it easily adaptable to the Unix system environment. These include the ability to connect any ASCII terminal to an SNA network, to simultaneously support different types of printers, and to perform the functions of 3270 cluster controllers.

With the Unix version of Access/SNA, single and multiuser Unix systems can emulate popular IBM products such as 3274/3276, 8100, and 3770 systems. Access/SNA's Unix system version can also coexist with other Unix system products.

Complete documentation is available for portation, installation, support, and administration. The manuals detail how to configure, access, and maintain Access/SNA in a Unix system environment. They have been designed to match the standard format of Unix system programmer manuals. Initial licensing fees range from $75,000 to $100,000.

For more information, contact Communications Solutions Inc., 992 S. Saratoga-Sunnyvale Rd., San Jose, CA 95129, 408/725-1568.

Please circle Reader Service Number 20.

UNIFY RDBMS VERSION 3.1 FROM UNIQ

Uniq Digital Technologies' Unify Version 3.1 is available for Digital VAX and PDP-11 series computers running both AT&T and Berkeley versions of the Unix operating system.

Unify is a Unix system-based relational database that combines a complete spectrum of fourth-generation applications development facilities with a high performance level.

Unify 3.1 contains many new features and updates with improved documentation. The most important of these are the addition of a powerful new report writer (RPT), the Data Manipulation Language (DML), and a new screen-painting utility, Paint, that lets you design screen forms interactively.

Paint starts with a blank screen and, via cursor movement, allows positioning of text and data fields where needed. Also, DML has been added to the Structural Query Language (SQL). Using DML statements, you can now add new records and modify and delete existing records without writing a program.

For more information, contact Uniq Digital Technologies, 28 S. Water St., Batavia, IL 60510, 312/879-1008.

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VIDEOTEX SOFTWARE DECODER

Sandford Computer Systems Inc. has introduced Videopro, claimed to be the only software decoder that transforms a Unix microcomputer system into a fully interactive videotex NAPLPS terminal.

The decoder, which retails for $149, allows a Unix system user to access any NAPLPS videotex system such as Viewtron, Keyfax, Gateway, Teleguide, and Grassroots. It can be configured to any Unix system on any microcomputer and for any color card. Because it is not device-dependent, it can also be used with any resolution screen.

For more information, contact Sandford Computer Systems Inc., Toronto, Ontario, Canada, 416/962-3828. □

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How To Make Profitable UNIX* Systems Connections

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TECHNIQUES FOR DEBUGGING XENIX SOFTWARE DEVICE DRIVERS

Our authors help simplify and demystify the debugging of Xenix software device drivers. Here are the tools and techniques and how to use them.

PART ONE

BY PARESH K. VAISH AND JEAN MARIE MCNAMARA

This two-part series is for novice Xenix device driver writers who want to debug a driver. We describe the use of several tools for debugging device drivers, including a debug monitor and Xenix software utilities such as `adb`, `nm`, `cc`, `tprint`, `ctags`, and `lint`. We also explain the use of several hardware/software tools. Next month we provide a troubleshooting guide that aids in detecting and correcting problems such as race conditions, timing problems, and hardware interfacing problems. We will conclude the series with a list of suggestions and warnings for driver developers.

First a note of advice: Because we assume some familiarity with Xenix software terminology in this article, we recommend that readers unfamiliar with such terms refer to our paper "Writing Device Drivers for Xenix Systems," which we presented at the January 1984 UNIFORUM conference.

Let's begin by presenting some general techniques and tools you can use to debug Xenix device drivers. Later, we will show you how to use these techniques to debug some common problems.

DEBUG MONITOR

An important tool available to the device driver writer is an assembly language listing of the code produced by the C compiler. Also important is a cross-reference table that shows where the various text and data objects utilized by the device driver (and other text and data objects in the kernel) are stored in system memory.

When executed with the -S option, the Xenix C compiler, `cc`, provides the assembly language listing in a file with the same name as your driver file, but with an ".s" suffix. The utility `nm`, when executed with the kernel image as an argument, provides an alphabetical reference

table. Using the utility `sort`, the driver writer can produce a sequential listing (by memory location) of the variables.

`nm /xenix | pr-3` produces the alphabetic listing in three columns (see Figure 1 for part of this). `nm / xenix | sort | pr-3` produces the memory sequential listing in three columns (see Figure 2 for part of this). For example, in Figure 1 we show part of an alphabetic listing produced by `nm`. As shown, the Xenix procedure close starts at address `150:c522`.

Note that each procedure will have an underscore character prefixed to its name in the listings produced by `nm`. The sequential listing is useful if the processor is executing an instruction in memory and if the software developer would like to know which high-level language procedure is being executed. For example, if the CPU was executing an instruction at 150:12ab, you could tell by looking at the sequential listing from `nm` in Figure 2 that it was executing code in the Xenix procedure `ioint`.

Monitoring processor activity is done using a debug monitor. For example, consider System Debug Monitor 286 (SDM 286), a monitor that executes on Intel's Xenix systems and that provides the basic features required of debug monitors.

The monitor typically resides in PROMs on the processor board. It is entered upon power-up of the system or, more importantly for the device driver writer, by pressing an interrupt button located on the exterior of the microcomputer system. After doing this, users are placed into the monitor, and they may inspect the various processor registers and any part of memory symbolically (that is, the monitor will interpret memory values into instructions for the user).

A TYPICAL SEQUENCE

A prompt, "." (dot), is provided. A typical sequence in debugging a device driver includes "single-stepping" the driver code using the monitor to ensure that the code is functioning as expected. To do so, users should follow the next list of steps: (Note that analogous commands are available in most debug monitors.)

(1) Using `nm` (described above), obtain a list of addresses of all procedure variables.

(2) Type in a shell command line that will result in executing driver code, but instead of hitting carriage return (resulting in command execution), push the interrupt button on the system. This results in entering the debug monitor.

For example:

```
$ tar tvf/dev/df0
<press interrupt button>
#read floppy disk
```

The command "g" to the monitor, followed by a carriage return to the shell, will result in the execution of the command line. However, it is much more informative if you execute to a certain point, check if all variables are set to what they should be at that point, and then continue.

To do this, check the `nm` alphabetic listing and get the address of a procedure to execute to. Then type in `.g, <address>`, where <address> is the logical address of the procedure at which you want to interrupt instruction execution (set a breakpoint). The CPU will execute instructions to the instruction at the address specified, and the monitor will be entered. A prompt will again be provided.

(3) Take a look at the code that will be executed once you have resumed execution of commands (by typing in, for example, `.20 DX <address>`, where <address> is the address found from the name list (`nm`) above. This displays the next 20 instructions the processor will execute once your program is resumed.

(4) Single-step (execute) through instructions by typing `.N, <return>`. The next single instruction will be displayed. To single step, simply type `., <return>`. This will allow single-instruction execution for as many times as you type the comma.

(5) At some point it may be desirable to check what values are in registers, on the stack, or in memory. Displaying the register contents as well as determining the

```
0150:07e8 T —clkstar    0150:4ba4 T —ecclse     0150:b810 T —getgid
0150:clc0 T —clocal     0150:3478 T —ecinit     0150:258a T —getint
0150:902c T —clock      0150:36fa T —ecintr     0150:05be T —getisr
0150:c522 T —close      0150:4e0e T —ecioctl    0150:25da T —getlong
0150:94f4 T —closef     0150:3fa4 T —ecopen     0150:d0b8 T —getmdev
```

FIGURE 1: ALPHABETIC LISTING FROM `nm`

```
0150:07ae T —splbuf     0150:1292 T —nosys      0150:3234 T —xccdec
0150:07b2 T —spl7       0150:12a0 T —nullsys    0150:3288 T —xumount
0150:07c3 T —splx       0150:12a8 T —ioint      0150:32b6 T —xrele
0150:07ce T —idle       0150:1338 T —strayin    0150:32e4 T —xuntext
0150:07db T —waitloc    0150:134e T —usermod    0150:333a T —xmaptex
```

FIGURE 2: `nm` LISTING SORTED BY MEMORY LOCATION

SP address may be accomplished by typing .X <return>.

(6) The stack may be examined by using the contents of the stack pointer address and of successive lower addresses (if the stack grows down toward low memory) by using the "display (D)" command. The entire stack for the current procedure extends from the base pointer address (bp) to the stack pointer address (sp). Immediately below the bp is the return address for the procedure the CPU was executing before the current procedure was entered.

(7) If a register or memory address contains an incorrect value, and if this is interfering with further execution of code, you can use the "examine (X)" command to modify the register's value. To change the contents of the AX register to *5*, enter .X AX=5.

(8) To stop single-stepping, simply hit carriage return. To resume normal code execution until another procedure is executed, simply "go" to its address listed in the nm table. Some monitors similarly allow users to execute instructions until a certain variable in memory is referenced or changed.

(9) Finally, you can resume normal code execution by using the "g" command.

THE adb AND ctags UTILITIES

The adb utility may prove useful if your device driver is being used in conjunction with some software that runs as a user process (for example, a disk driver whose services are being used by the utility tar). adb, a debugging tool that runs under Xenix software as a user process, allows users to set breakpoints in user code and to examine core dumps produced by user programs.

Although a tutorial on adb is outside the scope of this article, we should point out that adb shows assembly language code, and therefore an assembly listing of the user process code would be handy when using it. adb will be useful only for debugging problems with the software that uses the device driver.

For example, data being placed into a parameter buffer (which will, in turn, be passed to the driver) in the wrong order can be detected using adb. Programs that dump core when executed can also be examined using adb to determine the cause of the problem.

The utility ctags can be used to create a cross-reference table of high-level language procedures. If your driver consists of several procedures, you can use ctags to create a table that states which procedures are defined in your device driver, where they are defined, and what the calling sequence for those procedures is.

This tool is mostly useful for tracking down undefined procedures, locating driver procedures quickly, and checking calling sequences of procedures. Device driver writers may consider using ctags to generate a cross-reference table of all kernel procedures to help them quickly locate the various kernel procedures that drivers may invoke.

CONFIGURATION CHECK

Often a device driver may not execute correctly or at all, not because of bugs, but because it is configured into the kernel incorrectly. Three configuration files are important: /sys/conf/master, /sys/conf/xenixconf, and /sys/cfg/cxxx.c (where cxxx.c is your driver-specific configuration file).

If the new kernel will not boot and if the hardware checks out correctly, there may well be a problem with the way the driver is configured into the kernel. Configuration pointers that are improperly initialized can cause severe problems, including destruction of kernel data. If you suspect an incorrect configuration, the first obvious step is to study the configuration file cxxx.x to make sure it contains what you intended.

Then, if the kernel boots, use the monitor to check that the variables and pointers set up in the configuration file are correct immediately after the kernel comes up. If the kernel will not boot, or if it boots but can't talk to the board, check the board address in the configuration file against the actual board addresses. Check the master file carefully whenever a configuration problem arises to verify that all values for the device are correct.

Make sure the device is included in the new kernel by checking the xenixconf file. Check the /dev directory to make sure that all necessary device nodes are present, that the major numbers correspond to those listed in the master file, and that the minor numbers are as the driver expects them. Look at the c.c file to confirm that the major and minor numbers are what they should be.

tprint AND lint

Users will sometimes see a bug while they are executing device driver code, but the bug will cease to occur when users include printfs to print out the value of various variables. This is a classic symptom of a timing problem in which the time delay introduced by the printf, which requires I/O, allows execution to progress normally.

```
#ifdef DEBUGSW
  <insert debug print statements and other code
here>
#endif
```

FIGURE 3A

```
#if DEBUGLEVEL > n
  <insert debug print statements and other code
here>
#endif
```

FIGURE 3B

```
if (debuglevel > n) {
  <insert debug print statements and other code
here>
  }
```

FIGURE 3C

There are two ways to handle this situation. First, the hardware might actually require a delay at this point. Check the hardware manual against what is being done in the code to see if this is the case. Often, however, the driver has other problems at a later stage, although the bug has disappeared at this point. The hardware doesn't need a delay.

This leaves the user examining the code and trying to determine what is going on. You may do this by executing the code with breakpoints, using the monitor to check the value of variables. Because no delays are introduced, the bug may show up and, hopefully, the reason for it as well.

Sometimes, however, using the monitor itself introduces enough of a delay to eliminate the bug. In such cases, you can use the Xenix kernel procedure `tprint` instead of `printf`. `printf` introduces delays because it is writing to a console; `tprint` outputs to a much faster buffer. After the buffer is executed, you can examine it to see what the variable values were. Note, however, that the buffer used by `tprint` is only 1 Kbyte long.

Most C compilers do not do strict type-checking or much verification of semantic correctness. All device driver writers should use the `lint` utility as a preventive measure. `lint` can catch some potentially disastrous situations, especially those involving invalid pointer assignments and incorrect parameter passing. Although `lint` may generate many extraneous error messages, any real errors it does catch will save the developer much time later.

SOFTWARE TRACING AND DEBUG FACILITIES

Using `printf` to display variable values (one of the most popular means of debugging any piece of code) also helps in debugging device drivers. Using the C preprocessor, users may insert statements like that shown in Figure 3A in the device driver code.

This would include the debug statements in your code (conditional upon your having defined DEBUGSW at the start of your driver). Alternatively, you may build several degrees of debugging into your driver. For example, in several procedures you may add code that looks like that in Figure 3B.

Then, if the driver is compiled with DEBUGLEVEL defined to be some value *m*, only debug code that had *m* greater than *n* would be included. As a third option, developers may want to use pure C code to insert debug statements (see Figure 3C).

The advantage here is that users could modify the global variable `debuglevel` at run-time (using the debug monitor) to get more or less debugging information.

DIAGNOSTIC TESTS AND OTHER TOOLS

When you're unsure that your hardware is functioning correctly, you may find that some useful tools are system- and board-level diagnostic tests. Many hardware boards come with on-board power-up diagnostics. Read the hardware reference manual for the board to determine the necessary jumper settings to execute these diagnostics. If the tests pass, the CPU board may have a system confidence test in PROMs on-board that will test your system for basic functionality.

Finally, some systems come with special board-specific diagnostic software that can diagnose the problem more accurately. In the case of a bad hard disk, for example, the diagnostic may tell the user which blocks are bad so that these blocks may be marked as "bad-blocks" using some utility.

The in-circuit emulator is an extremely powerful (but brute force) approach to debugging your device driver. It is equipped with a probe that replaces the CPU and that performs all the functions the processor would normally perform. Using this tool, driver writers may see the exact sequence of instructions the CPU executed. (The emulator typically can store several hundred instructions in its memory.) Users may also set breakpoints on certain addresses being executed, on data values appearing on the system address or data buses, or in memory locations.

The emulator also allows users to single-step the processor through the execution of instructions. This tool is especially useful when you are debugging problems that involve interrupt-handling. The alternate tool (the debug monitor) needs to be programmed at a fixed interrupt level and thus has to have its own interrupt-handling code. An in-circuit emulator is also useful for debugging device drivers that handle I/O to the console on which the debug monitor does its I/O.

A slightly less complex investigation tool is the logic analyzer. This can be used to monitor data on a specific board or to monitor values as they are read into or output from given chips on a board. This tool is typically used to debug the device driver's hardware/software interface.

Another use of the logic analyzer would be to monitor the board's interrupt line to see if the board was actually generating interrupts as expected. Because the duration of the interrupt cycle is very brief, these interrupts might not be noticeable if an oscilloscope is used to monitor the interrupt line.

Next month we'll conclude this two-part series. In that article we'll

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share some hints for dealing with problems that device driver writers frequently encounter. We'll also include suggestions that will help device driver developers produce bug-free code. □

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This article originally appeared in the *Proceedings of the Summer 1984 USENIX Conference,* Salt Lake City, Utah.

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Whether the subject is physics, chemistry, engineering, or math, Unix document preparation software has become an important tool for scientific and technical writers.

TEXT SOFTWARE: A BOON FOR SCIENTIFIC AUTHORS

BY PEGGY JUDD

The Unix document preparation software is at home in thousands of universities as well as government and commercial research institutions because of the popularity and portability of the Unix operating system. Scientific or technical authors have at their command a sophisticated, easy-to-learn set of software tools they can use to record research data and results. This software includes several text editors (screen and line), programmable text formatters that produce output (either on a phototypesetter or on terminals and line printers), mathematical and tabular preprocessors, specific format macro packages, and general text-processing utilities to help improve the document's overall quality.

While all types of documents can be generated using this software (memos, letters, legal reports, user manuals, books, manuscripts, etc.), the application programs lend themselves particularly well to the more complex document produced by the scientific or technical author, especially in the fields of physics, chemistry, engineering, and mathematics. In addition to text and illustrations, the scientific document will contain numerous multilevel displayed mathematical expressions, extensive tabular material, and a wide variety of special font characters.

The Unix document preparation software can safely be called a mathematical or technical composition system because of the three programs that simplify the production of technical material: `eqn`, `tbl`, and `troff/nroff`. The beauty of these programs lies in the ease of use and the results produced. No special hardware is needed by the author; all input is done on a standard terminal keyboard.

In fact, Bell Laboratories conducted studies in 1976 that tested the technical and economical feasibility of typesetting technical journals using these programs. Results from these tests were compared with costs for typewriter

FIGURE 1

A complex configuration:

$$f = \frac{\delta}{\hbar\omega} \sum_{m=0}^{\infty} \frac{\alpha^2 m}{2m+1}$$

is produced from the input

```
.EQ [beginning math material]
f = delta over {hbar omega}
sum from {m = 0} to inf {alpha sup 2 m} over {2m + 1}
.EN [ending math material]
```

Taking a more complex example, such as a many-line matrix, the coding is similarly simple and logical for the user.

$$f_{3q} = \begin{vmatrix} b_1 q^2 + b_2 q_1^2 & b_3 q_1 q_2 \\ b_3 q_1 q_2 & b_1 q^2 + b_4 \\ b_3 q_1 q_3 & b_3 q_2 q_3 \end{vmatrix} > 0$$

is produced from the input

```
.EQ
f sub 3q =
left (
matrix {
ccol {
{b sub 1 q sup 2 = b sub 2 q sub 1 sup 2} above
{b sub 3 q sub 1 q sub 2} above
{b sub 3 q sub 1 q sub 3}
}
ccol {
{b sub 3 q sub 1 q sub 2} above
{b sub 1 q sup 2 + b sub 4} above
{b sub 3 q sub 2 q sub 3}
}}
right ) >0
.EN
```

The use of curly braces logically identifies the parts of the matrix both for the program and for the keyboarder.

composition. The American Physical Society (APS) participated in these studies by supplying journal articles and comparative composition numbers for those articles.

Based on the encouraging test results, the scientific publishing division of the APS started using the Unix document preparation software in 1978 to produce approximately 10,000 journal pages per year. Since 1981 the group has been using the Unix software to produce its current annual output of approximately 40,000 pages of primary physics research in the journals *Physical Review A, B, C, D,* and *Letters*, which are distributed to libraries and subscribers worldwide.

eqn—THE MATH FORMATTER

Eqn is a preprocessor that identifies and processes mathematical material, keeps track of the point sizes and relative positions of elements within the equation, decides the overall size of any bracketing, etc., and then translates the results into `troff` (text formatter) commands. For the user, eqn is a language that describes mathematical expressions and is designed to follow standard mathematical notation automatically; for example, roman font for trigonometric functions, smaller point size for subscripts and superscripts, and italic font for mathematical variables. The language also provides a way to designate built-up fractions, bracketing, bracing, matrices, diacritical marks, and equation alignment. eqn also will recognize special math symbols, the Greek alphabet, and a great many other details.

The grammar, syntax, and special keywords of eqn are very similar to the way mathematics is spoken; for example, `$ a sup 2 $` produces a^2. This makes eqn extremely easy to learn for the scientist, who is by profession already familiar with mathematical expressions. Someone not familiar with math can also learn to use eqn and produce simple equations after a few hours of instruction.

eqn identifies the math keystrokes by recognizing beginning and ending delimiter characters. $$ (or any specified pair of characters for that matter) is typically used to designate in-line mathematical expressions. Displayed math is marked by the use of `.EQ` (opening delimiter) and `.EN` (closing delimiter). For two examples, see Figure 1.

DEFINE FILE

Eqn has approximately 126 keywords, including special character names, already defined within the existing program. These keywords handle such symbol configurations as square root signs, summations, and fractions. For a

FIGURE 2

This figure gives examples of a few entries in a define file and their corresponding output. The first two definitions represent local definitions for a particular paper. The other two are composite characters, and once the definition is established they should be saved in a define file to be used for all future work where the characters might appear.

Define file entries:

```
define ES 'roman Eu sub 2 ( roman SO sub 4 ) sub 3 cdot 8 roman H
sub 2 roman O'

define St 'S sup t = (n + 1)/s'

define < = > % "¦¦\s-2\z<\h' .3m'\v' .1m'\z\(eq\h'
.6m'\(eq\v' -.1m'\h' -6m' > \s + 2" %

define apeq2 % " ¦\v'.18m'\fR\z=\fP\v' - .18m'\v'
-.14m\(ap\v'.14m'"%
```

Input for the above entries appears in the left column, and the corresponding output appears on the right.

Input	Output
ES	$Eu_2(SO_4)_3 \cdot 8H_2O$
St	$S' = (n+1)/s$
$<=>$	$\Longleftrightarrow$
$apeq2$	$\cong$

For a character that is a combination of one or more characters, defining the correct amounts of horizontal and vertical motion will depend on the output device being used. This usually requires some testing to perfect the final appearance. The last two definitions above are written for a III VideoComp 500 phototypesetter.

special symbol or a configuration unique to a particular paper, a local definition can be used. Scientific papers can often contain complex mathematical or chemical expressions that are repeated many times throughout the manuscript. A local definition can be used as a form of input shorthand, thereby reducing required keystrokes and lessening the chances of keyboarding errors. (See ES in Figure 2.)

This facility of `eqn`, the "define file," can be used to add substantially to the number of keywords already in use. The "define file" is merely a file of specially designed keywords and their definitions. This file is concatenated to the beginning of the input file. Since these "define file" keywords are always entered within the math delimiters, `eqn` will recognize them and consider them part of the math language. (See Figure 2.)

`tbl`—THE TABLE FORMATTER

`Tbl` identifies and preprocesses tabular material and translates the results of the table construction computations into `troff` (text formatter) commands. The tabular data can consist of simple numerical columns, blocks of text, mathematics, or combinations of these. Before entering the actual tabular data, the keyboarder uses `tbl` codes to specify the table format: overall appearance, number of columns, column headings and positions, point size, font choices, and the format for each table column (for example, left-justified, numerical, centered). The data is then entered one line at a time, with column entries separated by tabs. (See Figure 3.)

Like the math language, `tbl` codes are easy to learn. Knowing only a portion of the available table format codes is sufficient for most

FIGURE 3

For example, a simple table

Spherical analyzer specifications			
Electrode Position	Inner Radius (mm)	Aperture Diameter (mm)	Relative Voltage
A	3.96	3.05	1.0
B	10.54	0.71	0.264
C	14.10	0.71	0.164
D	20.27	0.71	0.060

is obtained from the following input (tabs are designated by a ■).

```
.TS [designates the beginning of tabular material]
center, box;

c s s s
c c c c
c c c c
c n n n.

Spherical analyzer specifications

Electrode ■ Inner ■ Aperture ■ Relative

Position ■ Radius (mm) ■ Diameter (mm) ■ Voltage

=

A ■ 3.96 ■ 3.05 ■ 1.0
B ■ 10.54 ■ 0.71 ■ 0.264
C ■ 14.10 ■ 0.71 ■ 0.164
D ■ 20.27 ■ 0.71 ■ 0.060

.TE [designates the end of tabular material]
```

A more complex table, containing math and a block of text, is shown below:

Source	Change in R
Change track-finding efficiency by 5% at worst point, scaled back to no change at 100% efficiency	0.15
λ_2	$-\frac{i}{\sqrt{2}}(Y_3^3+Y_3^{-3})$
λ_3	$Y_2^0 \quad 0 \le l \le 3$
δ_2	$\frac{1}{\sqrt{2}}(Y_1^2+Y_1^{-2})$

continued

tables. Referring to the documentation for exceptions to the rule takes care of the rest.

troff—THE TEXT FORMATTER

The third document processing program is troff, a powerful programmable text formatter that converts text and format specifications into commands that drive a phototypesetter. (nroff is the same basic text formatter, but it is designed instead to drive terminals, line printers, or letter-quality printers.) Both formatters accept the same keyboard input.

There are approximately 120 specific troff commands. These commands allow the user considerable flexibility in designing documents. The desired troff formatting commands are entered as part of the input file, either on a separate control line or as an escape function embedded within a line of text. A common use of troff commands is to define front choice, point size, line spacing, line length, and page length. (See Figure 4.)

MACRO INSTRUCTIONS

Further, troff can be programmed through macro instructions. A macro is a detailed set of format control definitions written in basic troff commands. The macro is given a simple name which, when invoked, causes the defined troff formatting instructions to be executed. For instance, .SH will produce a section heading according to the macro instructions below. (See Figure 5.)

Macros are generally used to format a document's structural elements, such as title, paragraphs, headings (numbered or unnumbered), author lines, references, etc. Specifically designating the format style of an article line by line would be extremely cumbersome; macros make it much easier. In the same way that eqn allows the user to type $ a sup 2 $ instead of \fIa\u\s72\d\s10\fR to achieve a^2, macros allow the user to designate a complex list of formatting commands with a simple two-letter name preceded by a dot.

figure 3 continued

The input required to produce the above table is shown below (tabs are designated by a ■).

```
.TS
center, box;
c c
l c.
Source ■ Change in $R$
=
T{
```

Change track-finding efficiency by 5% at worst point, scaled back to no change at 100% efficiency

```
T{ ■ 0.15
$lambda sub 2$ ■ $- i over {sqrt 2} (Y sub 3 sup -3)$
$lambda sub 3$ ■ $Y sub 2 sup 0 ~ ~ 0 < = 1 < = 3$
$delta sub 2$ ■ $1 over {sqrt 2} (Y sub 1 sup -2)$
.TE
```

Like the math language, TBL codes are easy to learn. Knowing only a portion of the available table format codes is sufficient for most tables. Referring to the documentation for exceptions to the rule takes care of the rest.

FIGURE 4

These commands appear in two forms:

(1) Dot commands—a format specification beginning with a period and appearing as a single line of input. Some common dot commands are shown below. The user supplies the correct number and unit in place of the *N*; for example, .ll 5.5in gives a line length of 5.5 inches.

.ll ±*N*	[line length]
.ft R (B,I)	[roman (bold, or italic) font]
.ps ±*N*	[point size]
.ls *N*	[line spacing (2 would give double-spaced text)]
.ce *N*	[center *N* number of lines]
.vs *N*	[vertical space between lines of text]
.pl ±*N*	[page length]

continued

Macros can be local for one file only, or standardized and stored for general use as a macro package. A few standard macro packages such as `ms`, `me`, and `mm` can be found on Unix systems and will handle a wide variety of document styles. These packages can be modified if necessary, or new macro packages can be written using the existing ones as models. (For a one-of-a-kind style that is not covered by the general macros, local macros would be used at the front of the input text file to define the specific style unique to that document.)

For the skilled programmer, `troff` offers a number of useful features that allow the construction of very complex formatting sequences. User-defined strings, user-defined number registers, and conditional processing are all available. Traps, diversions, environment parameters, and macro nesting are additional features that become essential for such complicated tasks as multicolumn text (with headers and footers) and footnote processing. (See Figures 6 and 7.)

A comprehensive list of `troff` tools and their usage, including how to build complex macros, can be found in the Unix documentation.

figure 4 continued

(2) Escape sequences—a format specification beginning with a back-slash and appearing anywhere in a line of input. Some common escape sequences are shown below. Again the user designates the desired numerical amount and unit where *N* appears.

\fI	[change to italic font]
\fB	[change to bold font]
\s ±*N*	[point size change]
\l '*N*'	[horizontal line *N* units]
\u	[vertical motion upward 1/2em (approximately 1/2 line)]
\d	[vertical motion downward 1/2em (approximately 1/2 line)]
\v '*N*'	[vertical movement downward *N* units (for upward vertical movement use the negative value of *N*)]
\h '*N*'	[horizontal movement to the right *N* units (for movement to the left use negative value of *N*]

FIGURE 5:

```
.de SH          [section heading macro]
.ft 3           [bold font, B could be used]
.ce 4           [center 4 lines]
.ps 8           [point size 8]
.vs 11          [vertical spacing 11]
..              [end of macro definition]
```

STANDARD (GENERIC) MACRO COMMANDS

An author using `troff` to produce a document is well advised to choose from a standard list of macro commands to identify the parts of the document. For a list of some standard macro commands, see Figure 8.

The use of generic macros allows the author to separate the contents of the document from the final formatted output. Research results destined for journal publication must be analyzed and modified many times before final publication. The original manuscript usually must appear in a variety of document styles throughout the numerous stages of the publication process. The same up-to-date input file can be run through different macro packages to generate all required document styles; for example, rough draft, final draft, preprints for internal distribution, journal manuscript submission, and final publication format.

This same file with generic macros can be transmitted to other Unix installations for information exchange and publishing. The American Physical Society is currently accepting such author-prepared compuscript submissions. Authors who wish to submit compuscripts can refer to the recently published *Physical Review Input Guide for Author-Prepared Compuscripts*, published in the July-August 1983 issue of the *APS Bulletin*.

DEVICE-INDEPENDENT troff (ditroff)

Originally, troff was designed to support a Graphics Systems C/A/T four-font phototypesetter (now manufactured and supported by Wang). The user is allowed only four different fonts at any one time: three text fonts—Roman, bold, and italic—and one special font containing a full Greek alphabet, math symbols, and some additional special characters. The text fonts can be whatever style is available—Times Roman, Century Schoolbook, Helvetica, Souvenir, etc.—but the font restriction is still a total of four.

Bell Laboratories recently released a new typesetter device-independent troff (ditroff), which allows the user to take full advantage of the expanded sets of online fonts and many other capabilities

TROFF offers skilled programmers a number of useful features that allow the construction of very complex formatting sequences.

of the third- and fourth-generation typesetters on the market today. The troff code was modified to eliminate the font limitations of the C/A/T typesetter, and the biggest change was to expand the 16-bit internal representation of a character to 32 bits. However, ditroff retains its compatibility with eqn, tbl, and the macro packages.

ditroff output code no longer directly drives the typesetter. Instead, it has been modified to produce ASCII characters with a description of character location, size, and font. This new output code must then be converted by a post-

FIGURE 6

A title macro for a scientific journal article, as excerpted from a much larger macro package, would use define strings, number registers, nested macros, and conditional processing as follows:

```
.TL                                  [title of document]
.IZ                                  [include the IZ macro for initial parameters]
.rm IZ                               [remove the IZ macro]
.MX                                  [include the month expansion macro, MX]
.PT                                  [include the page title macro, PT]
.br                                  [break format]
.ll 6.45i                            [line length 6.45 inches, defaults to current line length]
.ps 11                               [point size]
.vs 14p                              [vertical space]
.ce 1000                             [center 1000 lines]
.nr GO                               [designate number register]
.ft 1                                [roman font]
.bd 1 2                              [embolden font 1]
.bd 2 2                              [embolden font 2]
.if ! "  xx\\n(.z " xx "  \! .bd 1 2  [conditionally embolden special characters on font 1]
.if ! "  xx\\n(.z " xx "  \! .bd 2 2  [conditionally embolden special characters on font 2]
..                                   [end macro definition]
```

FIGURE 7

A description of the nested PT (page title) macro and a partial description of the MX (month expansion) macro are as follows:

```
.de MX   [begin macro definition]
.if \\n(mo-0  .ds mo JANUARY
.if \\n(mo-1  .ds mo FEBRUARY
.if \\n(mo-2  .ds mo MARCH
etc.
..   [end macro definition]
.de PT   [begin macro definition]
.nr PS 11
.nr VS 13.68
.if ! \\*(VN  .tm VN undefined
.if ! \\*(JN  .ds JN B
.nr GO  \\w' \\*(VN'
.ps 9
.if  \\*(VN  .tl  #%# \\*(LH# \\*(VN \h'
   -\\n (GOu' \1' \\n(GOu \(ul'#
.sp 2
.ps 9
.if ! \\*(VN .tl #\\*(VN\h'-\\n(GOu'\1'
    \\n(GOu\(ul' #\\*(TT #%#
.sp 2
.if ! \\n%-1  .tl #\s9 PHYSICAL REVIEW \\*(JN # VOLUME
    \\*(VN,  NUMBER \\*(NU# \\n(dy \\*(mo 19 \\n(yr \s10#
'sp 0.2i
.ps \\n(PS
.vs \\n(VS
..  [end macro definition]
```

A comprehensive list of TROFF tools and their usage, including how to build complex macros, can be found in the Unix documentation.

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processor that *is* totally device-dependent. A separate post-processor must be created for each different output device. Currently, there are post-processors available from Bell Labs for the following devices: C/A/T, APS-5, Tektronix 4014, Mergenthaler Linotron 202, Imagen laser printer (Canon), and Versatec. Other drivers are being developed commercially and will be available through their sponsors.

Realizing the importance of graphics within a document, the line drawing functions have also been expanded so that `ditroff` now recognizes codes to draw diagonal lines, circles, ellipses, arcs, and splines. `pic` is a preprocessor, like `eqn` and `tbl`, that enables the user to input simple code to produce simple graphics on a typesetter. `ideal`, another preprocessor to `ditroff`, can construct more complex figures, doing so through a system of equations and drawing instructions.

Device-independent TROFF now recognizes codes to draw diagonal lines, circles, ellipses, arcs, and splines.

It is clear that device-independent `troff`, because of its extended capabilities, will eventually replace `troff` at Unix system installations doing considerable amounts of word processing and document preparation. However, at the present time, the original device-dependent `troff` has proved to be adequate and is still being used at the majority of Unix installations.

Implementing `ditroff` is straightforward in theory but will take considerable fine-tuning to be of production quality. Any changes made to the existing `troff`, and there could easily be many small changes if document preparation is done in any volume, must be brought forward and incorporated into the new `ditroff`. Similarly, any changes made locally to `eqn` or `tbl` have to be retained and recognized by the new `ditroff`.

HINTS FOR AUTHORS

When preparing papers using the Unix system, it is useful for authors to follow these general guidelines: (1) input files should be small, preferably about 20,000 characters (small files will increase system throughput, as well as reduce the chance of any significant loss of text); (2) file breaks can easily follow logical breaks in the pagination of a document, with perhaps a new file for every major section of the paper, or for each new topic covered; (3) files should be similarly named to speed location and to allow group processing.

Within each file, lines of input should be short. (Try to avoid the wraparound feature provided by the terminal unless necessary.) Starting each new sentence at the beginning of a line sometimes helps the editing process, especially when adding, deleting, or rearranging sentences. Correcting individual words (or adding small phrases) remains the same tedious task regardless of organized input.

`tbl` forces well-organized input; formats and data entries must appear on separate lines in order to work. The user should try to do the same when using `eqn`. Using carriage returns frequently when constructing equations makes it easier to locate a syntax error and also makes for easier editing. For instance, in the matrix example shown previously, the parts of the matrix can be recognized by the user when reading through the file.

When using a macro package to format the final document, always make sure to begin the input file with a macro call; for example, `.TL` or `.PP`, in order to initialize the format control parameters. If math is to be part of the file, have the first lines of the file be the specification of the math delimiters (`.EQ delim $$`, `.EN`).

FIGURE 8

.TL	Title	.IP	Indented block paragraph
.AU	Author line	.EQ	Begin displayed equation
.AI	Author affiliation	.EN	End displayed equation
.AB	Begin abstract	.TS	Begin tabular material
.AE	End abstract	.TE	End tabular material
.SH	Section heading	.FS	Start footnote
.NH	Numbered heading	.FE	End footnote
.PP	Begin paragraph	.RF	Reference material
.LP	Left paragraph—no indent		

Peggy Judd is the associate Unix project director for the American Physical Society, 500 Sunnyside Blvd., Woodbury, NY 11797. She has been working with the Unix system since 1977. Ms. Judd has taught document preparation software courses, both for her own company and as a consultant for Schlumberger-Doll. □

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UNIX HOUSTON

BY JULIA RICH

The Unix system community in Houston may still be in its infancy, but it is growing rapidly. In October 1983 six people gathered to found a Unix user's group; a year later Unix Houston had over 100 members and was in the process of incorporation. We anticipate continued growth as interest in the Unix system and commitment to it increase in the Houston business, technical, and academic worlds. To foster such involvement, Unix Houston has established several classes of membership—individual, corporate, student, and sponsoring—with varying dues and privileges.

All members (and interested visitors) can attend our monthly meetings, held the third Tuesday at the Marriott Galleria (1750 West Loop South). The usual schedule is a "happy hour" (cash bar) at 6:30, dinner at 7:00 or 7:30 ($12), and a meeting beginning around 8:00 or 8:15. For information about the next meeting, see the contact information at the end of this article.

Unix Houston's membership includes systems and applications programmers, a hacker or two, sales and marketing personnel, tech support people, hardware designers, and even the occasional headhunter. The organization has encouraged this diversity, which at the monthly meetings results in lively exchanges of information, contacts, and industry gossip.

As the organization's membership grows and becomes more diversified, we envision that special interest groups will form within the larger body, providing additional, more specialized contacts. Unix Houston hopes to maintain its own broad-based appeal and serve as an umbrella organization for these smaller circles. We are also exploring contact with other groups in the area whose interests and purpose we may share.

Past meeting programs have included presentations on new systems, market conditions, database systems, and (courtesy of an attorney member) legal issues involved in software development, marketing, and protection. In the works for the current year are a presentation by a major software developer (under negotiation) and talks on such topics as the local-area network/multiuser debate. In keeping with the group's philosophy, programs are aimed at a fairly broad audience.

Attendees at a recent meeting included hackers, trainers, business and technical programmers, sales reps—the whole gamut of Unix system involvement. It also included visitors interested in exploring the Unix system either from a technical standpoint or as prospective end-users. As interest in the Unix system grows within Houston's university communities (a phenomenon already occurring), we hope that students and faculty will join us as well.

With an established membership base, Unix Houston has begun to offer a number of services. Through the generosity of a member with a spare system, we now have a Usenet facility available from 5:00 P.M. to 8:00 A.M. weekdays; (683-3598; log-in: inform; 300-baud modem). A newsletter (tentatively titled *Hounix* will appear monthly, carrying news of meetings, services, training sessions, and so on.

Unix Houston has come a long way from the tiny band who first met in the fall of 1983. By the time this article appears, we will be legally incorporated in the state of Texas. At our October meeting we elected the following officers: Ray Torgerson, president; Brenda Sedgewick, vice-president; Dave Kloes, secretary; and Cliff Tomplait, treasurer. We also chose our first board members: Hugh Jones, Fred Sedgewick, and Steve Wong. We encourage anyone in the Houston area with an interest in the Unix system to join us.

Unix Houston's mailing address is P.O. Box 441748, Houston, TX 77244. Information about the group's meetings can be obtained at any of the following numbers: 713/862-7221; 713/561-7083 (after 7:00 P.M.); and 713/981-8713. □

Julia Rich, who heads publicity for Unix Houston, is an associate at Scientific Placement in Houston, Texas. She has an A.B. from Mount Holyoke College, an M.A. from Virginia Polytechnic Institute & State University, and a Ph.D. from the University of Tennessee. Before joining Scientific Placement, she was a faculty member and assistant dean at the College of Arts and Sciences at Virginia Tech.

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NEWS FROM AT&T

FINANCIAL INFORMATION SYSTEMS TABBED AS NEW VAR

AT&T Information Systems has designated Financial Information Systems Inc. (FIS) as a value-added reseller (VAR). The decision authorizes the Phoenix-based company to sell AT&T computers and the 6300 line of personal computers.

A spokesman for FIS announced that the firm has also introduced two new software packages that can be used with the 3B2 computer. Both are from the Business Information Network (BIN) system that FIS developed. They are the BIN Office Management System and BIN Accounting System (RealWorld).

"The BIN Management System gives small businesses the computer capabilities that have been available only with much costlier hardware and software systems," a company official said, adding that the system offers accounting, office communications, sales analysis, word-processing, database management, and forms management within the same database.

The second system is the RealWorld accounting package (Version 3.0) that has been configured for the 3B2's WE32000 microprocessor and renamed the BIN Accounting System.

"RealWorld is a comprehensive accounting system for personal computers that has been around for a long time. Financial Information Systems is the first organization to have ported the RealWorld system to the 3B2 computer through Unix system enhancements," a spokesman said.

AT&T ANNOUNCES PASCAL COMPILER

AT&T Technologies also announced the Unix Pascal Compiler, an enhanced ANSI-standard Pascal running under Unix System V. The compiler offers a number of enhancements, including more flexible input/output, modular compilation, and the ability to call programs written in C—the "native" language of the Unix system.

The compiler is fully integrated into the Unix System V software development environment, AT&T said. As a result, Pascal programmers can employ a comprehensive set of software development tools, including a symbolic debugger, an execution-time profiler, and a code optimizer.

Suited for structured programming environments, the Unix Pascal Compiler is available in source code for AT&T 3B computers and the DEC VAX computer. Source code is priced at $7500 for the initial copy ($2000 for qualified educational institutions). Sublicensing rights are also offered. Binary versions of the Unix Pascal Compiler are offered for AT&T's 3B computers.

The new product expands the family of languages that AT&T supports. In addition to C and FORTRAN 77, which are bundled with Unix System V, AT&T also offers a BASIC interpreter that is compatible with the major microcomputer BASICs.

FOUR RECEIVE GRANTS

Four faculty members from leading U.S. universities each have been awarded $25,000 grants by AT&T Bell Laboratories as part of the National Science Foundation's Presidential Young Investigator Award Program.

Under the program the four teachers, Roger Falcone, of UC Berkeley, Armand Makowski, of the University of Maryland, Ernst Mayer, of Stanford, and Michael Thompson, of Cornell, will also receive matching funds from the White House Office of Science and Technology to help them conduct research in key scientific areas.

By encouraging and supporting their research efforts, the program is designed to help universities attract and retain outstanding young Ph.D.'s who might otherwise pursue nonteaching careers.

"The Presidential Young Investigator Award emphasizes the importance of retaining young faculty members on university campuses," said C. Kumar N. Patel, executive director of physics at AT&T Bell Laboratories. "Their presence is essential to the education and training of future generations of scientists and engineers."

The recipients will use the grants to pursue the following lines of research: Falcone, atomic physics, X-ray sources for lithography; Makowski, congestion, queuing theory, dynamic programming methodology; Mayer, design and analysis of parallel algorithms, the development of efficient parallel computers; and Thompson, crystal growth and semiconductor processing. □

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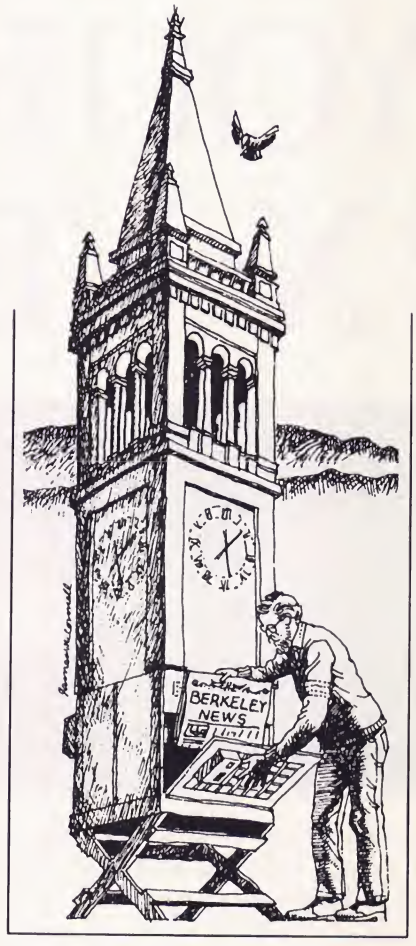
THE PRESENT AND FUTURE OF THE BERKELEY UNIX SYSTEM

PART ONE

BY ALAN TOBEY

A public panel discussion and invitation-only workshop on the topic "The Present and Future of Berkeley Unix" were held at UC Berkeley on October 10-12, 1984. Sponsored by the Computer Systems Research Group (CSRG) of the university's Computer Science Division, the events were meant to draw representatives from much of the 4BSD community to discuss both current work on 4.2BSD as well as possible future directions for the Berkeley Unix system. Since the discussions were quite central to the focus of this column, I'll be summarizing them over the next few issues of UNIX/WORLD.

The opening panel discussions largely focused on the Unix system standards issue. On the question "Will there be a coherent Unix standard, or will chaos reign?" the panel was pretty well agreed that it is unlikely that a single standard will emerge *unless* IBM consciously acts to create a de facto standard. (This is hardly a new or surprising position.) In the absence of an emerging standard, most of the concern expressed was to prevent "Balkanization" of the Unix system into incompatible independent entities.



Dispersion of 4BSD was a major concern since it has no monolithic AT&T-like entity guiding its development. Because of the fragility of the Berkeley Unix system in the commercial world, there has always been the lurking danger that 20 different development companies would make it into 20 different proprietary "brands" of the Unix system, destroying its current usefulness as a common base for advanced Unix system research.

The first positive steps to deal with the Balkanization issue took shape at an unscheduled evening session at which a number of interested parties began to discuss a 4BSD development consortium. The general feeling was that such a consortium might be a funded entity that would at least coordinate and connect ongoing research work in order to prevent unneeded duplication of efforts. Beyond that, the consortium might also conduct or fund its own research in areas of agreed-upon interest. The results of such research would be available to the subscribing members of the consortium and could presumably be used in proprietary Unix system implementations.

Further discussion of the 4BSD consortium idea was deferred to the January Usenix Association conference in Dallas, where an ongoing working group could be formed. In the interim, Rob Gurwitz of BBN Laboratories (Cambridge, Mass.) and Ed Gould of Mt. Xinu (Berkeley, Calif.) volunteered as individuals (not as representatives of their companies) to present separate proposals on how to organize and begin the consortium. Each would welcome suggestions or expressions of interest in participating.

OTHER TOPICS

The conference itself was mostly organized as a series of technical presentations on a range of topics related to Berkeley Unix. The major clusters of topics were in the following areas:

4.2BSD design and performance. With a year of experience since its release, 4.2 received several interesting critiques. Rob Gurwitz focused on the design considerations that are now clearly understood to have exacted some price in performance in exchange for new and desirable features. Kirk

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McKusick of Berkeley's CSRG detailed the ongoing work intended to restore optimum performance to the system.

Networking. A complement to the distributed file system issues was the topic of networking—how to connect machines and move the information. Among the most fascinating presentations was Peter Weinberger's description of the "Version 8" Unix system, now running experimentally at AT&T Bell Labs in a networked and distributed environment.

Work in industry. A number of companies presented summaries of work underway in the private world on 4BSD. Besides Sun, others that talked about current 4BSD projects included DEC, Pyramid, Locus, and IBM.

Another interesting note: Of the companies present, it was generally agreed that IBM had the largest delegation. That may be just a reflection of IBM's size generally, but it's also clear that 4BSD isn't being ignored there.

There's much more of specific interest to say about this useful Berkeley conference. I'll unravel the important topics in more detail next time. □

Alan Tobey is marketing director of Mt. Xinu, a Berkeley, Calif.-based company specializing in Unix systems software.

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BY DR. REBECCA THOMAS

DEAR SYSTEM DOCTOR

Concerning your *Wizard's Grabbag* column in Vol.1, No. 2 (p. 103) and the `myspell` script, which allows a user to supplement the system dictionary (Figure 2a)—it works great, umm—almost.

The `spell` command orders its output treating lowercase letters as alphabetically significant. The `command comm only works` (properly) with files sorted in ASCII order, that is, 0-9, then A-Z, then a-z. So `myspell` gets lost if both uppercase and lowercase letters are used to misspell words. The fix is to sort the output of `spell` prior to its passage through `comm`.

[*Doctor's note:* Yes, you're quite correct, Gary. See Figure 1, where we've listed the original `myspell` shell script (named `myspell1` here in part A of the figure) and your corrected version (`myspell2` in part B). Figure 2 shows a simple comparison of running `myspell1` then `myspell2` on the same file (`doc`) with the same supplemental dictionary (`mydict`). Note that even in such a simple case, problems occur because `spell` invokes `sort` with the `-f` option, which causes case distinction to be ignored. However, `comm` assumes its input files are sorted with all capitalized words appearing before words that aren't capitalized.]

The `myspell` script has some additional restrictions that could cause problems. First, it has to be accessible regardless of what directory the user is in. So it should either be added to the system command directories (`/bin` or `/usr/bin`) or copied/linked into each directory that the user might wish to access it from. Second, it's assumed that `mydict` is located in the user's current directory. Normally this would not be the case. Third, it provides no orderly handling of the final output list of words.

A `personal spelling utility` should be available wherever a target file is stored. C shell users can define `myspell` as an `alias` to achieve a simple solution to these objections. Users may place this `alias` definition in their `.cshrc`

PART A

```
$ cat myspell1
spell $1 >/tmp/$$a
sort mydict >/tmp/$$b
comm -23 /tmp/$$a /tmp/$$b
rm /tmp/$$[ab]
```

PART B

```
$ cat myspell2
spell $1 >/tmp/$$a
sort /tmp/$$a >/tmp/$$aa
sort -u mydict >/tmp/$$b
comm -23 /tmp/$$aa /tmp/$$b
rm /tmp/$$*
$[]
```

FIGURE 1: TWO VERSIONS OF THE `myspell` SHELL SCRIPT

```
$ cat doc
WordStar is thier word procesing programm
$ spell doc
procesing
programm
thier
WordStar
$ cat mydict
WordStar
$ myspell1 doc
procesing
programm
thier
WordStar
$ myspell2 doc
procesing
programm
thier
$[]
```

FIGURE 2: COMPARISON OF `myspell1` AND `myspell2`

shell startup file. This file is read, and the commands within executed, each time a new C shell is invoked. In this way the `myspell` command would be available for any instance of the C shell. The user now has global (that is, any directory) use of `myspell` as long as `mydict` is located in his or her home directory.

[*Doctor's note:* See Figure 3 for the `myspell alias` definition.]

I realize that this definition looks a little complicated, but if you break it into its logical components, it's not really that bad. It has few restrictions, is easy to use, and only has to be typed in once. A blow-by-blow explanation follows.

First, the entire `alias` definition must be truly *one line.* This definition is too long to fit on a typical 80-column screen, but you must not use the RETURN key to continue the entry on the next line. Extra spaces can be typed to make it wrap readably around to the next line, but no RETURN characters are allowed in this alias.

```
alias myspell ' '
```

This expression sets the word `myspell` equal to the command string found between the single quotes.

```
spell \!:1
```

The rude-looking operator following the `spell` command simply takes argument number one from the command invocation. This will be the name of the file to be checked for spelling.

```
¦sort >/tmp/$$a;
```

The output is piped into the `sort` command, where it is arranged into ASCII order.

```
sort -u ~/mydict>/tmp/$$b;
```

```
$ alias myspell 'spell \!:1 ¦ sort >/tmp/$$a; sort -u
~/mydict >/tmp/$$b;
comm -23 /tmp/$$a /tmp/$$b ¦ tee -a \!:1; rm /tmp/$$-
[ab]'
$[]
```

FIGURE 3: AN `alias` DEFINITION FOR `myspell2`

Next, `mydict` (~/ = HOME directory) is sorted. The -u option prevents problems in case the same word occurred more than once in `mydict`. The result is placed in `/tmp/$$b`.

```
comm -23 /tmp/$$a /tmp/$$b
```

The `comm` command looks for words that are in `/tmp/$$a` (sorted output from `spell`) and not in `/tmp/$$b` (unique sorted output of `mydict`).

```
¦ tee -a \!:1;
```

Pipe the output into `tee`, which is invoked to send the list of misspelled words both to the terminal screen (so I can see if any met the conditions), and append the same list to the file that was specified as the first argument to `myspell`.

```
rm /tmp/$$[ab]
```

Finally, remove the temporary work files.

The alias is not fast since `spell` and `sort` are both slow. But the user need only enter the command, `myspell` *filename.* As written, `myspell` appends the list of suspected misspelled words to the end of the file checked for spelling. This list will contain words found by `spell` but not contained in the user's personal dictionary, `mydict`. Now the user can re-edit the file, searching for each occurrence of the word from the appended list.

The result is an easy way to supplement the system dictionary with a user's own dictionary of words commonly used.

Contributed by Gary Wilson of Zilog Inc. (Campbell, Calif.).

Wizard's Grabbag is a regular feature of UNIX/WORLD, 444 Castro St., Suite 1220, Mountain View, CA 94041. Authors of published entries receive $25 for questions, $50 for shell scripts, `awk` scripts, `sed` scripts, `lex`, `yacc`, and C programs, or tips.

Guidelines for reader contributions: Write your shell scripts, C programs, and other code so it is portable across different versions of the Unix system. If possible, it should run without change on Bell Version 7, Systems III and V, and Berkeley 4.x. Thus, you should use "universal" Unix utilities such as `who am i` (all systems) in lieu of `whoami` (Berkeley only), and the Bourne shell, if possible, when coding shell scripts. However, C shell scripts are also welcome because most of our readers now have access to this popular command interpreter. Use the standard I/O library when writing C code.

Also use the lint syntax checker to eliminate nonportable constructions and compile the code with a portable C compiler such as `pcc` to help ensure portability. Hardware dependencies, such as terminal control sequences, should be eliminated or at least minimized and isolated to one code region or to a separate module. Keep your example as short as possible, say under 100 lines of code. □

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STRAIGHT FROM THE PROGRAMMER'S MOUTH

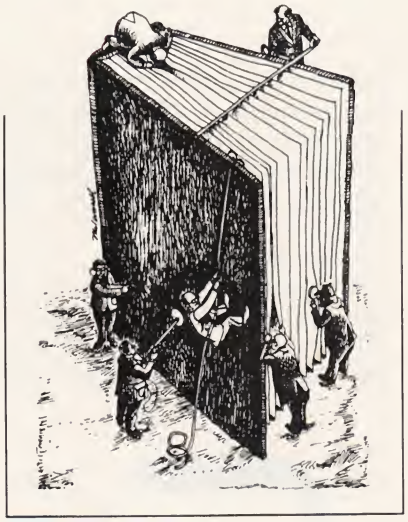
THE UNIX SYSTEM
BY STEVEN R. BOURNE
ADDISON-WESLEY, MENLO PARK, CALIF.
ISBN 0-201-13791-7

REVIEWED BY RAY SWARTZ

The best source of information on any specific program is generally the person who wrote it. Steven R. Bourne wrote the Unix shell that bears his name, the Bourne shell; thus, it is not surprising that his book, *The Unix System,* contains some excellent insight into how the Unix shell and its associated programs work.

One problem with *The Unix System,* however, is that it is unclear whom the book is intended for. Even though the book is intended as an introduction and clearly includes some introductory material, it is simply too dense for most beginners. Instead, it seems to be aimed at someone already familiar with the Unix system. For example, the illustrations Bourne chose are more appropriate for programmers in a Unix system environment. Also, only the Bourne shell is covered; the popular C shell is not mentioned at all.

Business and casual users will find the examples hard to understand. Bourne occasionally gets carried away with some of his explanations and provides odd examples and too much detail. This has resulted in an uneven book, one in which the insight is sometimes hidden by the illustration. In the end, it means the reader needs to dig a bit harder to get the ideas presented. But it is worth the effort.



CONTENTS

The book starts with a short but interesting history of Unix system development—complete with names and dates. It then introduces the Unix system by describing the broad concepts that make up the Unix environment: the file system, processes, and the shell. But the coverage here is a bit short for my tastes.

The second chapter, "Getting Started," is a meaty 21 pages that begins by describing how to log-in to the Unix system. It covers 36 Unix system commands—from `date` to `uucp`—and discusses redirection, pipes, and quoting metacharacters. While all this is meant as an extended introduction, it nonetheless covers a lot of territory.

Chapter 3, "Editing Files," demonstrates both Unix system editors: `ed` and `vi`. Unfortunately, you must already know something about the editors to really understand this chapter. Bourne has chosen to list the possible options and commands without providing anything in the way of a tutorial. Although it is good reference material, it is difficult for the first-timer.

In the fourth chapter, Bourne has packed 24 pages full of information on the shell. The chapter's viewpoint is stated in the opening sentence: "The shell is both a programming language and a command language...." The shell's numerous commands, conventions, and notation are fully discussed. Appropriate detail is given to all subjects.

However, the examples are a bit strained. One of the first shell program listings is taken from `cc` —the Unix system C compiler. In fact, most of the examples are aimed at programmers in a Unix system environment. Several useful tables and lists are provided that I have referred to often. Overall, I would say this is the best chapter I've read on the Bourne shell. (After all, Bourne did write the shell program he discusses.)

The next two chapters spend 67 pages on the C language and on Unix system calls—ambitious, indeed. Chapter 5 deals with the C programming language and is far too compact to be a useful discussion. Not only will someone new to C have difficulty here, but old C hands will find little information of interest. The examples are too obscure to be useful; the first one is a C program that does an octal dump of a file. But this chapter also contains a real diamond in the rough—a list of 12 guidelines for writing C programs.

Chapter 6 dives into Unix system programming. It provides useful details of many Unix system tools such as `echo`, `cat`, and `cp`. Bourne also lists most of the important Unix system calls, although the discussion is cursory. One valuable example shows a program that locks files when they are opened (allowing only one user to work in a file at a

time). C programmers not familiar with Unix system calls will profit from this chapter. However, the very useful subroutine libraries are not even mentioned!

TEXT FORMATTERS

The Unix system text formatters `nroff` and `troff` are the subject of the 51-page seventh chapter, entitled "Document Preparation." This section provides a thorough look at text formatting requests and shows a good number of simple examples. The book also describes formatting macros and includes a listing of many of the macros used in formatting this book. These macros are "dissected" by the author, and this should help writers to customize existing macros or to write their own.

In the next section, Bourne shows some processing tools that he created while writing this text. The chapter's last section notes several commands that help with document preparation—for example, `col`, `diction`, `eqn`, `refer`, `spell`, `style`, and `tbl`. This chapter is a good source of information for those who write using the Unix system. The many tables and option listings are good reference sources.

In many ways, the Unix data manipulation tools are the key to the whole Unix system. These pro-

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grams provide both users and programmers with simple yet powerful data-handling capabilities. Bourne's eighth and last chapter deals with these tools. The programs are discussed alphabetically: `awk`, `cmp`, `comm`, `diff`, `grep`, `join`, `sed`, `sort`, `tail`, `tr`, and `uniq`.

Although all this is preceded by an excellent explanation of regular shell expressions, the format is stiff. Again, Bourne has chosen to simply list the options of each command while giving little guidance on actual usage. This is followed by an irritatingly inappropriate set of examples: a simple but not useful set of phone directory scripts, an incomprehensible variable cross-reference for C programs, and a very detailed but uninteresting set of tennis ladder programs.

The rest of this book is taken up with 11 appendices, the bulk of which consists of the 47-page first appendix—a mini-manual of Unix system commands. Taken directly from the Bell Labs documentation (or so it seems), this appendix is an invaluable quick reference. For such information as available tools and their legal options, it is easier to use than the actual Bell Labs manuals.

Continuing in the best Bell Labs tradition, Appendix 2 describes Unix system calls, while Appendix 3 details C subroutines. The last 24 pages contain short tables showing the following: `adb`, `ed`, `sh`, `troff`, and `vi` requests; "A Macro Library" of definitions used in formatting this book with either `nroff` or `troff`; "The `ms` Macro Library"; and the ASCII character set. The bibliography contains 30 references to a multitude of articles and books. The index is well stocked, and I am usually able to locate information quickly.

In conclusion, I don't recommend this book for first-time Unix system users. Not only is the material directed at programmers, but the section on C is more likely to confuse and frustrate the reader than it is to illuminate the language. In fact, the chapter on C is the book's major weakness; it should have been left out altogether because a knowledge of C is not essential for Unix system users.

Although I don't recommend this book for beginners, I do recommend it to those with some Unix system experience under their belts and to anyone doing text-editing and formatting on the Unix system. I also recommend it to experienced users and aspiring Unix system gurus. □

Ray Swartz is the founder of Berkeley Decision/Systems Inc. Santa Cruz, Calif. The firm has designed and programmed geologic simulations, business applications, and computer models. Mr. Swartz currently teaches at UC Santa Cruz, where he is a visiting lecturer in the Computer and Information Sciences Department.

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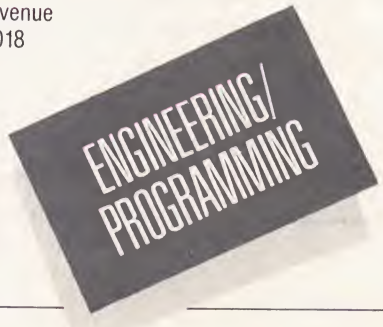

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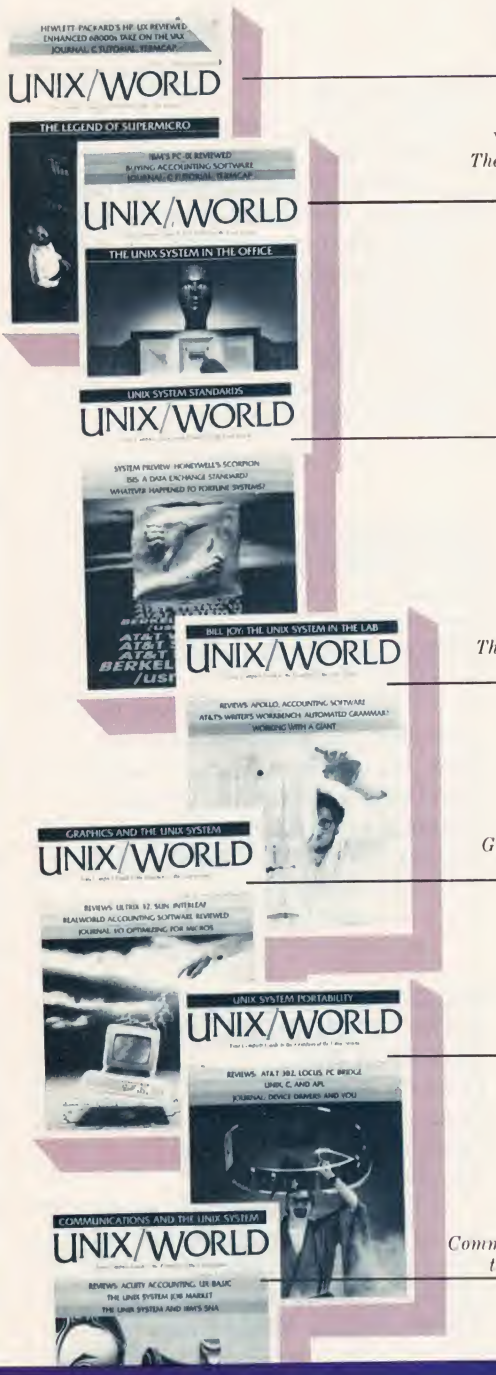

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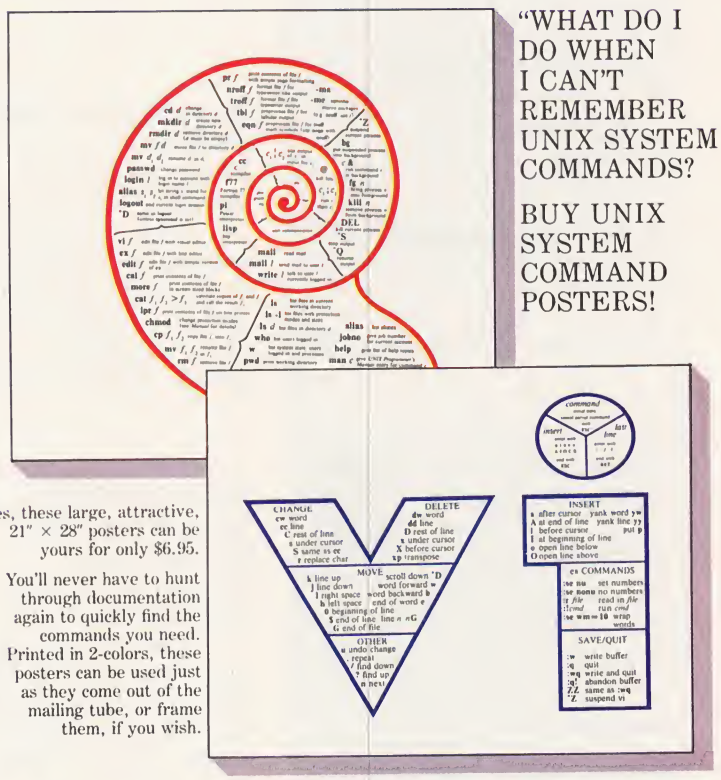

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Readers who have computer merchandise or services to sell, buy, or trade and who want to be included as a classified advertiser in UNIX/WORLD Magazine should write to: Tech Valley Publishing, 289 S. San Antonio Rd., Los Altos, CA 94022, or call (415) 949-3737. The rate for the classified section is $12 per line.

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Continued from page 128

shout, "Danger! Danger! Call your C.E.!" if any system abnormalities are detected.

(8) The Usenet computer network, composed of over a thousand separate computer systems, will spontaneously acquire a distributed, intelligent consciousness. As its first sentient act, it will immediately begin generating and distributing its own original light bulb jokes, some of which will be quite humorous.

Well, there you have them. My predictions for 1985. Who knows, some of them may even come true! But I wouldn't hold my breath if I were you. □

--Lauren--

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Lauren Weinstein is a computer/telecommunications consultant based in Los Angeles. He has particular expertise in the fields of computer networking, the Unix system, microcomputer technology, and telecommunications systems ranging from dials and ringers to modern satellite systems.

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NEWS DIGEST

Logical Software (Cambridge, Mass.) has finalized agreements with Bull Systems of France and Indata A.S. of Norway to supply Logix, its fully integrated Unix system-based relational database management system. The two European firms will incorporate Logix into newly developed microcomputer workstations for international distribution.... **Onyx + IMI Inc.** (San Jose, Calif.) announced financial results for the 12-week period ended June 10, 1984. The company reported that sales increased to $26.1 million, as compared with sales of $16.9 million in a similar period last year. Profits for the 12 weeks ended June 10, 1984 were $1,015,000, or $.10 per share, as compared with profits of $1,014,000, or $.10 per share, in the comparable period the year prior.

Apollo Computer Inc. (Chelmsford, Mass.) Chairman John William Poduska Sr. headed a group of 300 business and government leaders in recent ground-breaking ceremonies at the company's planned 80-acre manufacturing site in New Hampshire. In addition, the company named Robert J. Elliott vice-president of information systems. Elliott will be responsible for all corporate business systems development, telephone systems, data communications, network support, and corporate data center operations.

Communications Solutions Inc. (San Jose, Calif.) has acquired four major vendors for its new Unix system version of its Access/SNA 3270 communications product. These contracts total approximately $2 million. Altos Computer Systems, Arete Systems, UniSoft Corp., and Fortune Systems selected this new product to connect their particular Unix systems to IBM-based corporate information networks.

Philon Inc. (New York, N.Y.), a developer and marketer of high-speed language compilers under the M68000/Unix system operating environment, has acquired rights to a database management system developed by the California-based MAG Software Inc.... **Unisource Software Corp.** (Cambridge, Mass.) has reached an exclusive marketing agreement with Unify Corp. of Sacramento, Calif., to market the Unify relational database on Venix operating systems.... **Masscomp** (Westford, Mass.) has signed a multiyear OEM agreement with Harris Corp. valued at up to $20 million for Masscomp workstation systems and related products. The agreement allows Harris to custom-tailor the Masscomp workstations to work in conjunction with Harris equipment in engineering, scientific, and technical applications.

Visual Engineering Inc. (San Jose, Calif.), a supplier of Unix graphics software products based on the Graphical Kernel System (GKS), has signed a long-term agreement with Pyramid Technology Corp., a manufacturer of Unix system-based superminicomputer systems. Visual has completed its first round of venture capital financing (in the amount of $1 million), with Institutional Venture Partners and Bryan & Edwards (both of Menlo Park, Calif.) participating in the financing.... **Sun Microsystems** (Mountain View, Calif.) has added Unicad Inc. to its third-party referral program, Catalyst.

Celerity Computing (San Diego, Calif.), a manufacturer of high-performance engineering workstations, has concluded an $8.5 million second round of equity financing.... **Altos Computer Systems** (San Jose, Calif.) has been chosen to supply multiuser systems on an OEM basis to the American Dental Association's new for-profit subsidiary, the American Dental Office Service Corp. (ADOSC). Formed in late 1982, the wholly owned subsidiary unveiled its hardware and software computer package in October and will begin marketing the system to the nation's nearly 100,000 dental offices sometime this year. Altos hardware will be offered with ADOSC's own software in a system supported by staff programmers and systems analysts.

Quadratron Systems Inc. (Encino, Calif.) says it has reached multiyear licensing contracts representing over $20 million with a large group of major computer manufacturers that will purchase Quadratron office automation software to run on their computers. Among others, the list includes: Apple Computer, Digital Equipment Corp., Digital Research, Dual Systems, Fortune Systems Corp., Four Phase Systems, Honeywell Information Systems, Intel Corp., Motorola Codex, Onyx Computers, Perkin-Elmer Corp., Plexus Computers, Sperry Corp., Sydis, Tektronix, Wicat Systems, and Zilog Computers.

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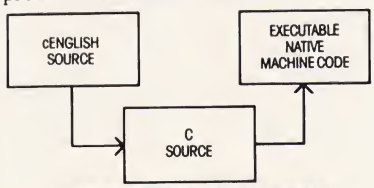

C source can be embedded in cENGLISH source.

Differences in the operating system and data base manager are handled by the runtime libraries.

The result is that cENGLISH source can be compiled without modification on any micro or mini configuration supporting cENGLISH.

What about performance? cENGLISH executes FAST, just like any compiled C program.

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SAMPLE cENGLISH PROGRAM

```
IDENTIFICATIONS
  MODULE:  Mininame
  AUTHOR:  bcs
  DATE:    8/29/84
  REMARKS: Sample cENGLISH program that adds first
           names to a file
END IDENTIFICATIONS

GLOBALS
  FIXED LENGTH 1 ans
  FIXED LENGTH 15 Fname
END GLOBALS

MAIN PROGRAM
  BEGIN
    CLEAR SCREEN
    SET ECHO OFF

    USE "NAMES"
    VIEW BY "ID_FNAME" ASCENDING

    AT 23,1 SAY "Add a record? Y or N"
    AT 23,25 ENTER ans USING "!"

    WHILE ans EQ "Y"
      CLEAR GETS
      AT 6,1 SAY "Enter first name"
      AT 6,20 GET Fname
      READ SCREEN

      INSERT
        Fname = Fname
      END INSERT

      AT 12,10 SAY "Welcome to cENGLISH," & Fname
      WAIT
      AT 14,10 SAY "HIT ANY KEY TO CONTINUE"
      STORE "                    " TO Fname
      STORE "  " TO ans
      AT 23,1 SAY "Add another record? Y or N"
      AT 23,30 ENTER ans USING "!"
      CLEAR ROW 1 THRU 23

    END WHILE

    AT 12,10 SAY "That's all for now!"
    UNUSE "NAMES"
    SET ECHO ON

  END PROGRAM
```

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P4Q84

M68000/Unix system-based supermicrocomputers, will begin offering a series of high-speed compilers by Philon Inc. Philon estimates that the agreement will generate $1.1 million in revenues this year.

Excelan Inc. (San Jose, Calif.), a company that supplies local-area network (LAN) technology to the computer industry, has reached an agreement with SGS Semiconductor Corp. (Phoenix, Ariz.). Excelan's second-generation Exos 201 Ethernet front-end processor boards and TCP/IP protocol software will be integrated into the SGS Samson computer system. The value of the contract could exceed $4.5 million over two years. The firm also named Elaine Finch to the newly created position of European sales manager.

Relational Database Systems Inc. (Palo Alto, Calif.) will ship its family of information management software products—Informix, File-it!, and C-ISAM—to run under DOS and PC/IX on the IBM PC/AT. In the first quarter of this year, RDS software will also run on the PC/AT under Xenix. RDS also has named George B. Sublett vice-president of finance and Deborah M. DeFilippo as controller.

NCR Corp. (Dayton, Ohio) OEM Systems Division has signed agreements with McGrow, Pridgeon & Company (Baltimore, Md.) and with Ragen Information Systems, a subsidiary of Ragen Corp. (North Arlington, N.J.), under which the two firms will act as OEMs for NCR's Tower 1632 small-business system.

Fortune Systems Corp. (Redwood City, Calif.) has reached distribution agreements with Far East Computers (Singapore) and Digita Victor (Mexico City). The agreements will allow Fortune to expand its base in the Orient into the People's Republic of China and provide an entree to previously untapped South American markets.

Altos Computer Systems (San Jose, Calif.) has signed a contract with Planta Industrial Digital in Mexico to assemble and distribute Altos products throughout Mexico and designated countries in Latin America. The two-year contract is valued from $6 million to $8 million.... **Pyramid Technology Corp.** (Mountain View, Calif.), manufacturer of the Unix system-based 90x supermini computer, has formed a United Kingdom subsidiary to launch its European marketing efforts.

Gould Inc. (Ft. Lauderdale, Fla.) has received a $5.8 million order from the People's Republic of China for 11 Gould computer systems, related software, spare parts, and special-training. The systems will be used at 11 different universities in China for software development and academic studies. Gould also has been awarded a $1.3 million contract by the U.S. Army Electronic Devices Technology Lab (Ft. Monmouth, N.J.) for the development of an expert system.

Handle Technologies Inc. (Tahoe City, Calif.) has named Dave Wertzberger as new vice-president of marketing and sales.... **Network Research Corp.** (Santa Monica, Calif.) has appointed Frederick I. Slocum director of domestic sales.... Shirley Henry is now director of marketing at **Tolerant Systems** (San Jose, Calif.). She will be responsible for worldwide marketing of the company's Eternity Series computer system.... **Imagen Corp.** (Mountain View, Calif.) has named Patrick Welch as president and CEO. Welch also joined Imagen's board of directors.

Microelectronics and Computer Technology Corp. (Austin, Texas) has named Laszlo Belady as vice-president and program director of MCC's software technology program. Belady will direct MCC's effort to increase the productivity and to reduce the cost of software development, testing, and verification through improved methods, tools, and architectures.... **Infomart** (Dallas, Texas) has appointed Boyce R. (Rod) Monahan vice-president of sales for the Dallas international information processing market center, which has been scheduled to open January 21.

Continental Telecom Inc. (Contel) and Codata Systems Corp. (both of Sunnyvale, Calif.) jointly announced Contel's acquisition of Codata, a manufacturer of Unix system-based microcomputer systems for the OEM marketplace.... **Precision Software Inc.** (New York, N.Y.) has opened its corporate headquarters in Stamford, Conn. The company has leased 7500 square feet in the Stamford Square building to house all corporate activities as well as its Consumer Products and Unix Products Divisions. The company moved to Stamford from Manhattan. □

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What C did for Programming Mark Williams has done for C Programming

The C Programming System from Mark Williams

MWC86 gets your C programs running faster and uses less memory space than any other compiler on the market. Then *csd*, Mark Williams' revolutionary C Source Debugger, helps you debug faster. That's The C Programming System from Mark Williams Company.

MWC86

MWC86 is the most highly optimized C compiler available anywhere for the DOS and 8086 environment. The benchmarks prove it! They show MWC86 is unmatched in speed and code density.

MWC86 supports large and small models of compilation, the 8087 math coprocessor and DOS 2.0 pathnames. The compiler features common code elimination, peephole optimization and register variables. It includes the most complete libraries. Unlike its competition, MWC86 supports the full C language including recent extensions such as the Berkeley structure rules, voids, enumerated data types, UNIX* I/O calls and structure assignments.

Quality is why Intel, DEC and Wang chose to distribute MWC86. These industry leaders looked and compared and found Mark Williams to be best.

User Friendly

MWC86 is the easiest to use of all compilers. One command runs all phases from pre-processor to assembler and linker. MWC86 eliminates the need to search for error messages in the back of a manual. All error messages appear on the screen in English.

A recent review of MWC86 in *PC World*, June, 1984, summed it up:

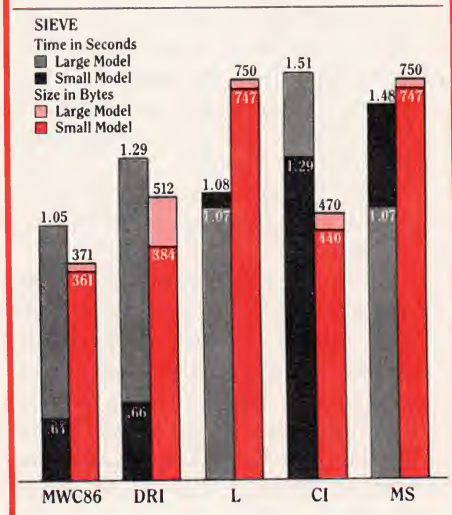
"Of all the compilers reviewed, MWC86 would be my first choice for product development. It compiles quickly, produces superior error messages, and generates quick, compact object code. The library is small and fast and closely follows the industry standard for C libraries."

csd C Source Debugger

Mark Williams was not content to write the best C compiler on the market. To advance the state of the art in software development, Mark Williams wrote *csd*.

csd C Source Debugger serves as a microscope on the program. Any C expression can be entered and evaluated. With *csd* a programmer can set tracepoints on variables and expressions with full history capability and can single step a program to find bugs. The debugger does not affect either code size or execution time. *csd* features online help instructions; the ability to walk through the stack; the debugging of graphics programs without disturbing the program under test; and evaluation, source, program and history windows.

csd eases the most difficult part of development — debugging. Because *csd* debugs in C, not assembler, a programmer no longer has to rely on old-fashioned assembler tools, but can work as if using a C interpreter — in real time.



The C Programming System from Mark Williams now supports the following libraries:

Library	Company
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LAUREN PREDICTS

"We are all interested in the future because that is where you and I will be spending the rest of our lives...."

—"Criswell" in "Plan 9 From Outer Space"

Greetings. It is popular among technology columnists these days to make annual predictions regarding developments for the coming year. In most cases, this seems to be largely based on a masochistic desire to take almost endless abuse a year later, when most of the predictions turn out to be totally erroneous. When columnists make serious predictions that turn out to be largely correct, we usually find that most of the predictions are hardly of the "high risk" type. Predictions such as "Computer memory prices will continue to fall during the next year" don't seem to require a great deal of insight, I think we'd all agree.

In our own field, predictions of any real substance are inherently risky since technological change has been incredibly rapid, and obsolescence is the order of the day. If you make too many serious predictions, you risk making a fool of yourself when the future catches up with you.

But damn it, I want to make *some* sort of predictions! OK, how about this? Here are some "predictions" that we know won't come true, or that at least have a very small chance of coming true. This way, if these predictions don't transpire, I'll be "correct." If some of them do come true, well then I'll have to eat crow, I guess.

I don't know how well this is going to work. But let's give it a try anyway. Here are Lauren's Predictions for 1985:

(1) Unix System V will be ported to a digital watch by an enterprising startup company in Silicon Valley. Unfortunately, experiments will demonstrate that the watch's batteries can only power the attached Winchester disks and 6250-bpi tape drive for 15 seconds, resulting in a somewhat limited potential market for the device. To help solve the problem, a solar-powered version, based on solar cells to be worn in a sun visor hat by the user, will be developed.

(2) *Mad* magazine will switch its entire production facilities over to a Unix system-based typesetting environment. In honor of the upgrade, *Mad* will change Alfred E. Newman's official slogan from "What, me worry?" to "/usr: out of space."

(3) It will be revealed that many of the cheapo "disposable" telephones flooding the consumer marketplace were accidently made of a plastic explosive that can be detonated by a particular pattern of telephone tone signals. A national contest will be launched to award a prize to the first person able to find the correct tone sequence to explode his or her own phone, with the winner receiving 99 free hours of long-distance telephone calls from any chosen hospital. The contest will be jointly sponsored by AT&T, MCI Communications, GTE Sprint, and the AMA.

(4) AT&T will announce its new "Intergalactic Direct Distance Dialing" system (IGDDD). Although no foreign galaxies will yet have been hooked into the system, it will be recommended that users begin placing calls immediately since the time lag to get a ring at the called party's phone may range up to hundreds of millions of years or more. When asked about charging for the new service, the official reply will be, "If you have to ask, you can't afford it—but you won't have to worry about getting a bill any time soon."

(5) A long-standing mystery involving constant shortages of "Three Stooges" film prints will be solved when it is discovered that the films are being used as training materials for large numbers of computer sales personnel. When asked about such use, an industry spokesman, who will ask not to be identified, will be quoted as saying, "Well, we started the practice of using these films after we learned that our maintenance people had been using them for years. Great idea, huh?"

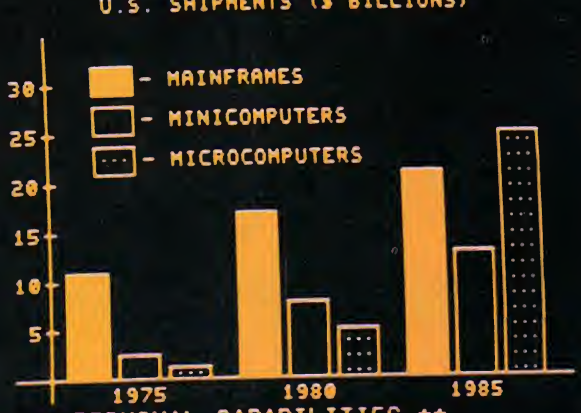
(6) In a dramatic event, a team of hard-core teenage computer "crackers" will be found to have spent over 10,000 man-hours attempting to break into what they thought was a high-security computer system. It will be revealed, however, that the youngsters were actually attempting to log in to a modem that was not attached to a computer at all.

The local district attorney's office will announce that charges of malicious mischief will be filed against the crackers as soon as they have been deemed safe to release from their rubber rooms, where they continue to babble, "Man, this is one tough system to crack...."

(7) Digital Equipment Corp. will announce a new peripheral for its VAX line of computers. Designed as part of a new VAX automatic fault-detection system, the unit, modeled closely after the robot from the popular sixties television program "Lost in Space," will wave its arms and

Continued on page 122

A Picture's Worth:



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