regardless of the video mode. I still can shrink their windows and scroll around, but I can't see the whole thing.

The Mac II and MultiFinder

But I was becoming a bit flustered with Graph Plus by this point. (I really wasn't mad at Graph Plus, I just thought I was—kind of like blaming the map when you make a wrong turn. I'll get to that in a little while.) Even with 4 Mbytes of memory, simple operations like drawing a legend on the screen were still taking a long time. When I needed to print eight graphs that I'd already created, it took me all morning.

One day my managing editor passed along the pronouncement from our production department that Cricket Graph files from a Macintosh would have to be supplied for all graphs due to problems with importing Graph Plus files. I didn't want to change the way I did business again, and I especially didn't want to go to a Mac. I know the difference between preemptive schedulers and the scheduler for MultiFinder, and I laughed at the idea that MultiFinder was a multitasking operating system.

To my chagrin, however, Cricket Graph on the Mac was lightning fast! The longest part of the process was importing my data files from the PC. I had to print Quattro files to a disk file, transfer them to a Mac disk, read those into the Cricket Graph worksheet, move the titles to the appropriate places, and reformat the columns. This took about half an hour. But drawing graphs from the data was nearly instantaneous. Compare this to Graph Plus, which imported Quattro files directly but could take 3 minutes to draw each graph.

Printing was even more impressive. On the Mac, I could get control and start the next graph within 10 seconds. Under Graph Plus, it was more like 5 minutes. What a difference on comparably configured machines (4 Mbytes of RAM). The only configuration difference besides the CPU and operating system was that the Mac was not on our network. This should have tipped me off to something, but the computers are so dissimilar that I chalked it up to differences in user interfaces or CPU capabilities.

I had obviously underestimated the power of the Macintosh for graphical applications. While I might never recommend one to an engineer, for my line of work it is actually a very advanced computer. We have a large monitor on it, so I can see several applications at a time. But most of my work has to do with 386's and their applications, so I really can't transfer to the Mac. When DOS operating systems can use megapixel screens for regular use, perhaps OS/2 PM will offer me what the Mac can.

The Network

I've hinted several times that there's another problem with my configuration that took me a while to discover. In fact, I've hit up against one last bottleneck that's both big and, at the moment, insurmountable. It's also the reason I owe an apology to Micrografix and Microsoft for thinking badly of their software.

In a recent review of the 33-MHz Zenith computer, I tried to get a feel for how my day would improve if I swapped my 20-MHz for a 33-MHz 386 AT. (Unfortunately, I wasn't allowed to make the swap permanent, but I did get pretty high on the power.) In the course of experimenting, I discovered that Graph Plus on my computer was being cheated. Graph Plus was getting over 220 Kbytes of memory on the Zenith with nearly the same configuration as my computer. But on my computer, Graph Plus was getting only 75K. The configuration difference? My computer was linked with the 3Com LAN to give me access to printers and a file server.

I finally paid attention to how much that LAN was costing me. It was more than just the 128K of memory—it's the use I could have been making of that 128K. Graph Plus will put whatever it can in memory. When the memory runs out, it goes to disk for that storage. When I had only 75K free, I was hitting the disk with every operation. With 220K free, I could do most of the work in memory. While Graph Plus on the 386 is still not quite as lightning fast as Cricket Graph on the Mac, with enough memory it is no longer the slow, lumbering beast I had been putting up with.

Unfortunately, in order to take advantage of this extra memory, I have to reboot the computer without the LAN. And when I want to print my file, I have to reboot with the LAN. All this rebooting takes far too long, but the LAN is what makes the printing take 5 to 7 minutes.

I am stuck in this catch-22, which is not making me fond of the 3Com network. I just don't want to lose the time. Perhaps I'll dive into exactly how many of those device drivers I really need to do my usual work.

What I'd Really Like

So what's next? Well, I've looked at VM/386, which I'm told can have one screen running DOS with the LAN installed and one screen running DOS without. But VM/386 supports multiple screens, not multiple windows on one screen, so I'm not crazy about the idea. I'm told it's very robust, but I want the windows.

SCO is about to release Open Desktop for its 386 Unix. That will offer a GUI called Motif and will run multiple DOS windows. In addition, I'm told that megapixel screens and larger will be easily supported. If Open Desktop gives me access to my LAN, it may just be the answer to all my needs. ■

William L. Rinko-Gay is a MIPS *technical editor.*

E Pluribus Unix?

Will OSF and Unix International fix Unix or fracture it?

BY SIMSON L. GARFINKEL

It all started at Bell Labs in 1969 on a Digital Equipment Corp. PDP-7, a computer few people have ever heard of, let alone used. Today the Unix operating system is running on more than 1.2 million computers across the country, and Unix variants run on nearly every computer in existence, from lowly IBM PC XTs to Cray supercomputers.

Much of Unix's popularity, in fact, has been attributed to the ease with which it is ported from one hardware base to another. This is possible because only a tiny portion of the operating system is written in assembly language—the native language specific to each computer system. The rest of Unix is written in C—the high-level language whose popularity has grown hand-in-hand with the growth of the operating system. Unix's popularity has also been attributed to the fact that the source code for the operating system was made available to universities at a low cost.

But ever since 1979, when the University of California at Berkeley took Unix Version 7 release 32V for the DEC VAX and modified the operating system to use paging for virtual memory instead of swapping, there have been two major versions of Unix. Berkeley's hackers set about altering and improving Version 7, adding such features as job control, a faster file system, and TCP/ IP networking support. In the meantime, AT&T released Unix System III and System V.

Meanwhile, Microsoft had been ship-

ping a version of Unix called Xenix, originally based on AT&T System III in 1980. Microsoft also followed the AT&T additions to Unix and merged them into Xenix.

By the beginning of 1987, there were three major Unix variants —and more than 225 flavors, according to one estimate — running throughout the world.

AT&T is now in the process of bringing together those three principal Unix strains into one new all-encompassing operating system that will be upwardly compatible with each of its roots, says Dick Muldoon, a spokesman for AT&T Data Systems. Muldoon calls this the "reunification of Unix."

When people buy an operating system labeled Unix, Muldoon says, "We want [them] . . . to know that it is going to have the kind of continuity that has come to be the hallmark of the Unix system." People have to be assured, he says, that the applications they use to run their businesses are not going to break with each successive release of the Unix operating system.

So far, AT&T's reunification plans are right on schedule. Unix System V/386, release 3.2, incorporates all the functionality of traditional Unix System V and Xenix. Microsoft was chosen to do the development effort, and the system was released in August 1988 for 80386-based computers.

The next step in the reunification of Unix, one that promises to be much more complicated, is to incorporate the Berkeley improvements back into the AT&T distributions. That development effort is in the hands of Sun Microsystems, a major workstation manufacturer in Mountain View, California, because, Muldoon says, Sun is the company with the most experience in working with Berkeley Unix.

An early version of the release 4.0 source code was shipped in late March, Muldoon says, and should be available from vendors in the fall. It is now in system test.

One person who has been following V.4 closely is Marshall K. McKusick, head of the computer systems research group at Berkeley and one of the authors of the original Berkeley Unix distribution. "System V release 4 is essentially, as far as I am concerned, Sun force-feeding Sun OS down AT&T's throat, whether they like it or not," says McKusick, adding, "They don't seem to like it very much."

Nevertheless, V.4 will include nearly all the major Berkeley and Sun enhancements to the Unix operating system, including Sun's Network File System (NFS), Remote Procedure Call (RPC) mechanism, and External Data Representation (XDR). V.4 will have the Berkeley TCP/ IP networking code, including support for sockets and the `rsh` and `rlogin` commands. Release V.4 will include support for the fast file system and will implement soft links.

One of McKusick's reservations about V.4 is the system's scheduler, which has been rewritten to provide several new features such as real-time support. Being brand-new, McKusick says, the scheduler is "untested."

Many observers and participants in the field believe that OSF may simply be a ploy to introduce confusion into the efforts to create a single Unix standard.

The Open Software Foundation

For a group of major vendors of workstations, the growing acceptance of Unix was accompanied, paradoxically, by a tightening of the terms in the Unix software license.

"The licenses for Unix were becoming more restrictive," observes Barbara Shelhoss, group manager for system software product marketing at Apollo Computer. The System V release 3 contract, she recalls, specified dates by which the operating systems had to be SVID (System V Interface Definition) compliant. And the final arbiter of compliance was AT&T itself —a company that had recently entered into fierce competition with the very companies to which it was licensing Unix.

At the same time, explains Alex Morrow, Open Software Foundation's vice president for strategic planning, an increasing number of government contract bids were specifying Unix System V compatibility as a requirement, the largest of these being a billion-dollar contract for the Air Force.

Then, says Shelhoss, AT&T announced that "it was going to go off to a lab in Menlo Park with Sun and develop System V release 5 and the rest of the industry was going to be excluded from the process." (Release V.5 is a future version of the Unix operating system currently under development.) Next, AT&T announced that it was purchasing a 20 percent stake in Sun Microsystems.

It looked to many as if AT&T and Sun were carving up the future of Unix and attempting to keep major pieces from the rest of the industry. By gaining early access to the new system source code, Sun might obtain as much as a two-year jump over its competition.

For seven of the companies —Apollo Computer, Digital Equipment Corp., Hewlett-Packard, IBM, and three major European computer manufacturers —AT&T had gone too far. The angered companies formed the Hamilton Group, which in May 1988 evolved into the Open Software Foundation, an organization with a charter that reflected point by point the problems that the founding companies had been having with AT&T.

"We, along with another number of major computer companies, felt that to respond to market demand, we needed, at least for system software, a single independent software company to provide technology in a real open manner that is accessible to everybody," says Donald McInnis, DEC's vice president of engineering systems.

OSF is supposed to become a self-sufficient software house, employing upwards of 400 —it hired 75 people in just its first three months of operation. Its products are to be sold to its members, who will in turn sell them to end users, each sale generating a royalty payment to OSF.

Many observers and participants in the field, however, believe that OSF may simply be a ploy to introduce confusion into the efforts to create a single Unix standard. Members of the academic computing community have noted repeatedly that all of OSF's initial founders had their own proprietary operating systems that were competing with Unix. Furthermore, corporate executives like IBM chairman John F. Akers have said that their company's commitment to OSF does "in no way diminish our commitment to proprietary environments."

Barbara Shelhoss believes that any such conjecture is "completely inaccurate." Apollo, she says, had been shipping an operating system that could be configured to be compatible with either System V or Berkeley Unix for many years. "While some of the [founders of OSF] had proprietary operating systems as part of their offering, they all also offered Unix-based implementations, and we were all licensees of AT&T for Unix for many years."

OSF, Shelhoss and others contend, was created so that the founding members would have a supplier of system software that was not also in the business of selling computers in competition with them.

Since then, more than 85 members have joined OSF (see **Table 1**). With a few notable exceptions, such as AT&T and Sun, the list of members reads like a Who's Who of the computer industry. Together, OSF's members have committed more than $130 million in development for the next three years. And the company is beginning to ship preliminary versions of its products to its vendors.

OSF's first product offering is called Motif, a window-management and application interface system that runs on top of the popular X Window System that was developed at MIT. Motif will run on any Unix computer that supports X.

Motif consists of two principal parts: a toolkit library that is linked with an application to perform functions such as creating windows and control panels, and a window manager application that manages the location and appearance of windows on the screen of the workstation. Having the X Window system operational on a workstation is a prerequisite to run-

ning Motif, but since Motif runs on top of X, other X-based applications can run simultaneously.

I saw Motif demonstrated on an Hewlett-Packard 9000 series workstation at OSF's headquarters in Cambridge, Massachusetts, running the HP-UX operating system.

Motif combines technology from X, Microsoft Windows, and the HP Windows interface into a system that feels strangely natural. Motif uses X to display windows, text, and graphics. It then surrounds each application's window with a window management frame, which has a command bar on top that is identical to the one on Microsoft Windows or Presentation Manager: the leftmost button exposes commands for the window manager; a button on the right "iconifies" the window, and another expands it to cover the entire screen. A window can be pushed around the screen by clicking and dragging the window management frame.

Motif's windows, menus, buttons, and all other "widgets" use shading and coloring to achieve a three-dimensional effect. The scroll bars look surprisingly similar to those on the NeXT computer; the windows scroll smoothly as the corresponding scroll bar is dragged.

OSF didn't write Motif. Instead, it issued a "Request For Technology" to its members describing what functionality Motif should have. The RFT for the graphical user interface was surprisingly short — just two pages. The proposals that OSF received were then evaluated by a panel of computer scientists and artists, which arrived at a decision by taking the best parts from each technology submitted. The final work on the software was subcontracted to DEC and HP.

OSF members can license the source code for Motif for $1000 per CPU per year, says Kathryn Birkbeck, product manager for Motif. A university site license costs $2000. That purchases a series of "snapshots" of the code on a particular day. OSF employees will be responsible for technical consulting, documentation, and support. A corporation that uses Motif in a product will have to pay a royalty of between $10 and $40 to OSF for each copy of the product sold, Birkbeck says.

OSF is committed to releasing Motif on the HP9000 and DEC workstations by July, Birkbeck says. The Santa Cruz Operation, one of the major suppliers of Xenix for 386 systems, has promised to release a version of SCO Xenix with Open Desktop, which is based on Motif, by this month.

The rest of OSF's Unix-like operating system, code-named OSF-1, should be available by December 1989, Morrow says. The operating system will be based on AIX, IBM's Unix offering, which is itself a derivative of AT&T's System V release 2. OSF-1 will be both Posix and X/Open compatible, Morrow states. Posix and X/Open are emerging standards that define the syntax and behavior of basic operating services such as "open file" and "get time of day." Furthermore, OSF-1 is promised to have a "streamlined, modular, and completely re-engineered kernel, making it a stable and powerful platform for current and future applications," according to OSF publicity materials.

Morrow states that OSF-1 should run on any computer that has virtual memory and at least a 32-bit addressing architecture. "It's unlikely that it will be put on a segmented architecture like the 286," he says. It is equally unlikely, he adds, to be ported to massively parallel computers such as Thinking Machines Corp.'s Connection Machine, although an ongoing OSF research project will be to port the operating system to a multiprocessor environment. Indeed, OSF has committed 10 percent of its annual operating budget to research projects.

On the horizon, OSF hopes to solve many of the problems that now plague the computer industry. One of the most pressing problems, says Morrow, is distribution. Morrow wants workstation users to be able to purchase shrink-wrapped software in a store, take it home to their workstation, and have it run on their OSF-1 computer regardless of what CPU is actually in their system.

Morrow hopes to do this by distributing software in an intermediate format — either a dialect of C, encrypted and stripped of comments, or some sort of intermediate code —which would then be compiled for the particular OSF operating system by a native compiler. Companies would then have to supply just a single binary object on their distribution disks, which would be usable by the entire spectrum of computers that support the OSF operating system.

Other problems that OSF hopes to address are copy protection and universal licensing of technology. "Big vendors think that they should get a special arrangement," Morrow says, but so far OSF has given everybody the same deal.

Membership in OSF is $25,000 per year for profit-making corporations, $5000 for nonprofit, and $2000 for university departments. Sponsoring organizations have each committed to give OSF a total of $13 million over three years.

TABLE 1. Major vendors participating in OSF, UI, both organizations, or neither.

Open Software Foundation
- Adobe Systems, Inc.
- Altos Computer Systems
- Apollo Computer, Inc.
- Canon, Inc.
- Convex Computer Corp.
- Digital Equipment Corp.
- Groupe Bull
- Hewlett-Packard Co.
- Hitachi Ltd.
- IBM Corp.
- Micom-Interlan, Inc.
- MIPS Computer Systems, Inc.
- National Semiconductor Corp.
- Nixdorf Computer Corp.
- Philips TDS
- Siemens AG

Unix International
- Amdahl Corp.
- AT&T Unix Support Group and Data Systems Support Group
- Control Data Corp.
- Fujitsu Ltd.
- Fuji Xerox Company, Ltd.
- Gould Computer
- Motorola Inc.
- NEC Corp.
- NCR Corp.
- Oki Electric Industry
- Ing. C. Olivetti & Co., Inc.
- Prime Computer, Inc.
- Pyramid Technology Corp.
- Ricoh Company Ltd.
- Stellar Computer, Inc.
- Sun Microsystems, Inc.
- Unisys Corp.

Vendors in both OSF and UI
- 88 Open Consortium Ltd.
- Data General Corp.
- Informix Software, Inc.
- Intel Corp.
- Interactive Systems, Inc.
- Oracle Corp.
- Phoenix Technologies Ltd.
- Relational Technology, Inc.
- The Santa Cruz Operation
- Sony Corp.
- Stratus Computer, Inc.
- Texas Instruments, Inc.
- Toshiba America, Inc.
- Wang Laboratories
- Xerox Corp.

Suspiciously Missing
- Apple Computer, Inc.
- Compaq Computer Corp.
- NeXT, Inc.

Unix International

Six months after the announcement of the Open Software Foundation, another group of Unix computer users announced the formation of another multivendor organization to watch over the development of open operating systems: Unix International.

Although Unix International may seem to be an AT&T response to OSF, representatives both inside UI and at the founding companies claim it isn't so. "A number of us," recalls Len Halio, vice president of Prime Computer's commercial systems group, "approached AT&T about fixing problems with the way we were doing business with AT&T." Unix International, Halio contends, was an outgrowth of those discussions.

But members of OSF think otherwise. They point to the fact that many of Unix International's goals, such as fair and equitable licensing and equal access to early source code, were the very differences that forced them to create OSF in the first place.

Unix International is a nonprofit organization "open to all parties who have

Project GNU

Less than a mile from the Open Software Foundation, working in a loaned 130-square-foot office and in part of a borrowed hallway, is a group of self-proclaimed computer hackers who are trying to alter the course of operating-systems history.

In many ways, this group is similar to OSF. The members are fed up with the way AT&T has exercised control over the Unix operating system —in particular, its source code —and they are writing their own competing operating system. The key difference is that this new operating system, GNU (standing for GNU's Not Unix), will be free.

A free operating system, argues Richard M. Stallman, president of the Free Software Foundation, will allow computer users to run the operating system on as many machines as they wish without worrying about site licenses or royalty payments. Likewise, vendors of turnkey systems will be able to incorporate the operating system in their products without added cost. And since the operating system will be distributed in source-code form, people will be free to add features or fix bugs.

Ordinarily, there wouldn't be much reason to take a group like Project GNU seriously, except for the fact that Stallman is acknowledged by friends and enemies alike to be one of the best programmers in the United States. Already major parts of the GNU system are being used on hundreds of thousands of computers across the world, Stallman estimates, and are being shipped as standard equipment by a growing number of companies, including Digital, MIPS Computer Systems, NeXT, and Convex.

The first GNU program to be made available was a version of the popular programmer's editor called EMACS. Stallman knew a lot about EMACS —he had written the first version of it when he was a staff member of the MIT Artificial Intelligence Laboratory in the early 1970s. He looked at many versions of the program that had been written since and incorporated the best features of each into GNU EMACS. The program, released in March 1985, has spread like wildfire in the workstation and mainframe world, being widely ported to different flavors of Unix, different hardware bases, and even different operating systems.

Since then, Stallman has written a C compiler called GCC that, by many accounts, produces object code that is faster and smaller than many other commercially available products. There is a C++ native front-end for the compiler, as well as GNU replacements for the `ld`, `nm`, `size`, `gprof`, `strip` and `ranlib` utilities. There is also a GNU debugger.

The software license, which Stallman calls a "copyleft" in contrast to the computer industry's "copyrights," requires that any individual who distributes GNU EMACS or a modified version of it distribute it with the source code. Moreover, if parts of GNU EMACS are included in a larger program, the entirety of the larger program becomes "free" according to Stallman's definition.

Stallman is quick to point out that companies may sell copies of the editor — and any other piece of software that FSF owns —at any price they wish. Companies can simply not restrict their customers from turning around and selling the software again or giving it away for free.

In many ways, GNU is a community effort. In the FSF's Cambridge, Massachusetts, office, there is a 2-inch-thick file of copyright assignment forms — each one from a programmer who has written a program that is included in the operating system. Contributions to the project are sent back to Cambridge, where they get incorporated into FSF's "official release" after they are tested. The Foundation's full-time staff includes four paid programmers and a bookkeeper.

Of course, not everyone is enamored of Project GNU. Perhaps most pronounced with its criticism is Unipress software, an Edison, New Jersey, software house that sells a version of EMACS for VMS-, Unix-, and MS-DOS-based computers. The thrust of Unipress's attack has been that because people don't pay for free software, the Free Software Foundation is under no obligation to offer support for its products.

But users of FSF products say that Stallman and his coworkers are often more responsive to fixing bugs than are commercial vendors. "We use GCC extensively," says Donn Seeley, a senior systems programmer at the University of Utah. "We ship a distribution of Unix for the HP9000 on which GCC is the standard compiler. We've basically replaced the vendor compiler completely. Not only have we not heard any complaints, but most people are quite happy to see this."

But the real advantage of GCC, Seeley says, is having the source code. "There are bugs in vendor-supplied compilers that go on unfixed for years. In the case of GCC, we often fix the bugs ourselves, and if we can't, we send mail to RMS and he fixes them for us, usually within a day."

Indeed, says Len Tower Jr., one of FSF's five directors, new versions of GNU software are typically released every month. "You are lucky if you get a release every six months to a year from a typical vendor."

As for support, Tower says, "I would be very surprised if someone didn't come up with a company to do GNU support." To make his point, Tower points to the success of Mt. Xinu, a California company founded to support Berkeley Unix. There is also a growing number of computer consultants who offer to support GNU software. FSF maintains a registry of them.

FSF sustains itself through donations and the sale of computer tapes containing the latest versions of its software. Last year, the foundation grossed over $200,000, compared with $23,000 just two years before.

The hallway where much of the work on Project GNU takes place is littered with equipment on loan from various computer companies. Hewlett-Packard has promised FSF $100,000 in funds and $350,000 in equipment. FSF has even received a $25,000 grant from the Open Software Foundation.

With work on the C compiler winding up, the last piece of the operating system that Stallman needs to complete is the kernel. Stallman has his eye on the Mach kernel being developed at Carnegie-Mellon University. Although Mach has been operational for some time —indeed, it is what runs at the heart of the NeXT computer —parts of the program still contain proprietary AT&T source code and must be written. If that doesn't happen in time, another kernel developed at MIT is waiting in the wings. After that, the last major piece that needs to be plugged in is the file system.

"The GNU system will be more or less Posix compatible," says Richard Chassell, the company's treasurer. "It will probably not be 100 percent Posix compatible, because Richard [Stallman] will probably make improvements."

The first system that GNU will run on, says Tower, will most likely be a Sun workstation, "mostly because that's the machine sitting in Stallman's office." GNU will probably be running on a second hardware base six months after that and "easily ported to a dozen machines within a year or year and a half of the initial release."

a vested interest in Unix System V, or who want to help directly influence its future evolution." Unlike OSF, UI has affiliate memberships for individuals and students. In many ways, it could be thought of as a user group that is able to arrange special favors for its members from AT&T.

Allen Nemeth, who is both Unix International's director of technology and the president of Usenix, a Unix users group, calls Unix International the "product plan-

ning arm for the AT&T Unix Software Operation." Unix International does no development itself; instead, UI is supposed to make sure that AT&T develops the operating system—and its licensing arrangements—in a way that best suits Unix's users.

While AT&T is still working in a lab in Menlo Park with Sun, says AT&T's Muldoon, that development effort is only one of many that are under way—developments that will be shaped by input from Unix International. In the past, says Nemeth, important decisions about features that the operating system would or would not support had found themselves "on some manager's desk way down at the bottom of the organization." That isn't going to happen any more, he says; Unix International will have substantial power over which features are included and which are excluded.

AT&T will grant early access to Unix source code to those companies that pay Unix International's annual general membership fee of $100,000. That fee does not, however, purchase a source code license; that must still be negotiated with AT&T.

The Impact

Just what the impact on the computer industry will be from the "new" AT&T, OSF, and Unix International remains to be seen. Both AT&T and OSF are committed to making their operating systems compatible with the emerging Posix standard, which defines the behavior of operating system calls for application programs. They are also committed to implementing the standards formulated by the X/Open group and will work with standards organizations to iron out the differences between Posix and X/Open.

The effect of Posix, says McKusick, is that the many different flavors of Unix operating systems "will be much more alike than they have been in the past, which is good, as far as I am concerned."

The areas in which the two operating systems are different are likely to be minor. For example, AT&T recently began shipping beta versions of Open Look, a graphical user interface similar to OSF's Motif. Like Motif, Open Look runs on top of the X Window System. Although it has a different look and feel than Motif, Muldoon says, the differences are not major.

Companies who are members of the OSF consortium say they hope to begin using parts of the OSF-1 operating system as soon as it becomes available. "We will be replacing most, if not major parts of Ultrix with the OSF developments as they come out and get tested," says DEC's McInnis. "It's not unlike trying to track Berkeley Unix or AT&T Unix, as we have in the past."

"We now have desktop workstations with a de facto standard," he adds, referring to Motif, "which is what everybody in the workstation business has been crying for, especially the software developers." If the industry decides that two operating systems are better than 225, McInnis says, it might decide that one is better than two and make OSF-1 the only Unix within a few years.

Perhaps to leave their options open, perhaps because the price of admission isn't that high, a growing number of companies are members of both OSF and Unix International, including Toshiba, whose advertisements often stress that its 386-based laptop is a portable Unix workstation, and The Santa Cruz Operation; there are 23 dual members, Unix International's Nemeth says.

"We don't see system software as a religious war," says David Bernstein, SCO's manager of systems product marketing. "We see system software as a challenge to provide all the different components. . . . . Our philosophy has always been to include multiple interfaces in the same Unix. For example, Unix 3.2, with the Xenix way of doing record locking, is something we had a long time ago in SCO Xenix. When interesting operating system technology comes out of OSF, we'll probably incorporate it, if appropriate."

Bernstein sees the OSF vs UI debate revolving more around issues of licensing than technology. "There are many software companies whose business it is not to track OSF, UI, Posix, ANSI, and ISO," Bernstein says. What these companies want to do, he says, is build their compilers or applications software. Echoing AT&T's Muldoon, Bernstein says that the most important commitment that a supplier of an operating system must make is that underlying binary compatibility between versions of an operating system be preserved. ■

Simson L. Garfinkel is a freelance writer and computer consultant living in Cambridge, MA.

Next month in *MIPS*...

Good floating-point performance is critical for numerically intensive applications in engineering, science, statistics, modeling, and other fields. In the September issue, science columnist Al Cameron will look at processors and techniques that yield top floating-point performance in personal systems.

Next month's issue will also bring an update on unified imaging models, the serious, long-term solution to the problem of achieving WYSIWYG. Unified imaging models, such as PostScript and Display PostScript or Presentation Manager and PMScript, drive the screen and the printer in the same way, assuring that what you see on screen is what you get on paper. This article will examine the progress being made in developing these imaging models for displays and printers.

Also slated for September are articles on OS/2 device drivers, using TCP/IP to connect Unix systems, and reviews not only of new 80386 machines but of several 386 motherboards that form the basis of many high-performance systems.