# SUNEXPERT

erving the UNIX Client/Server Network

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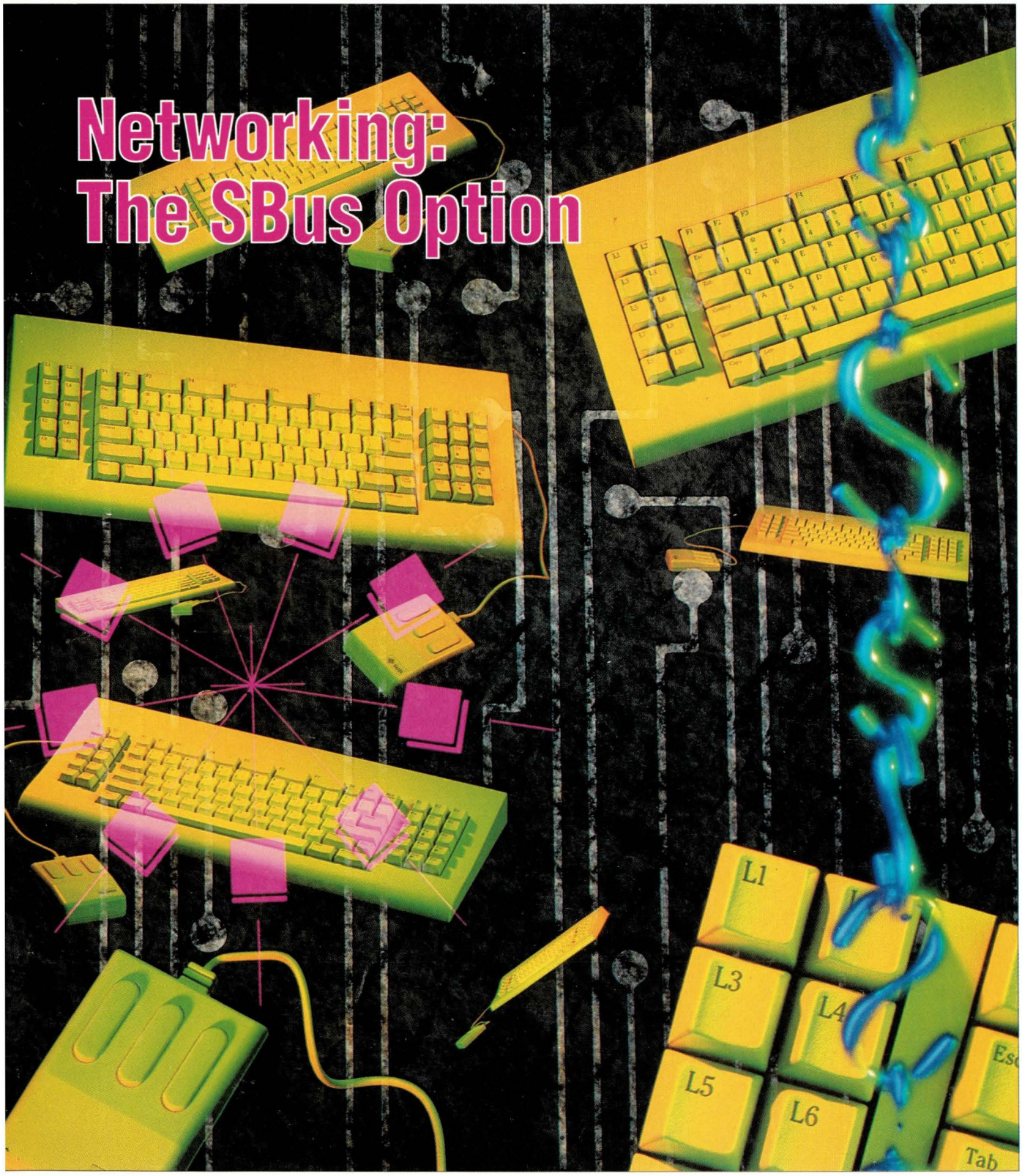


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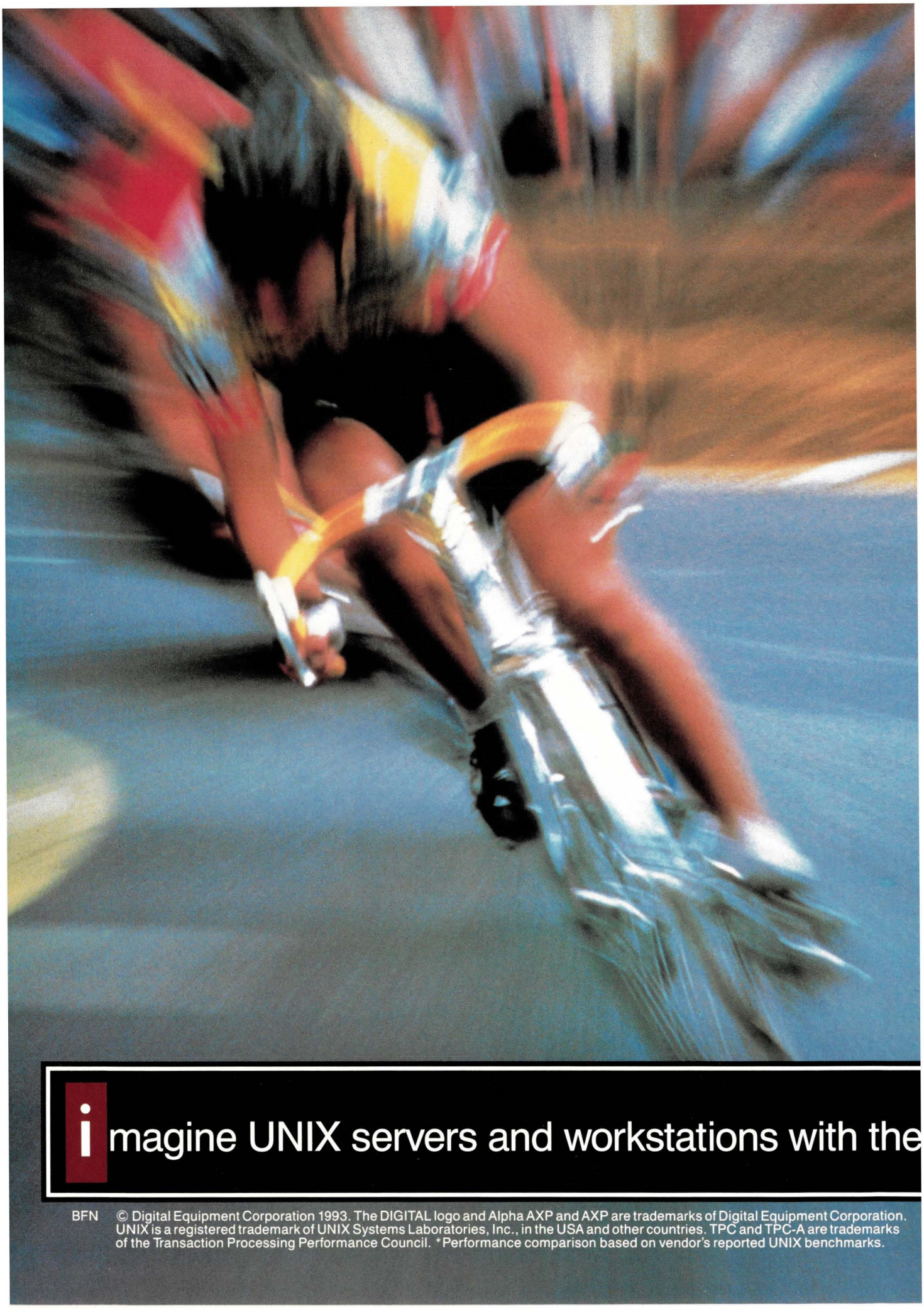

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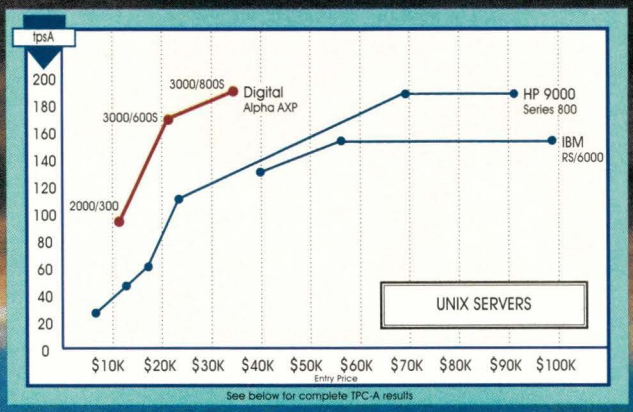


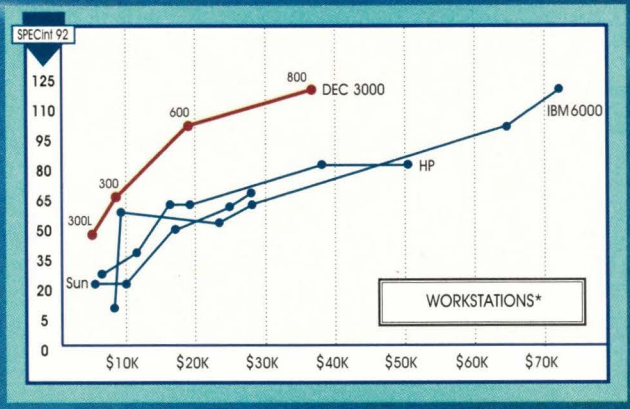


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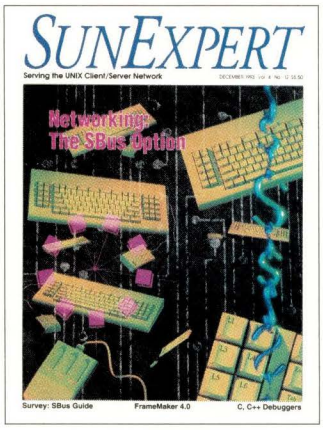


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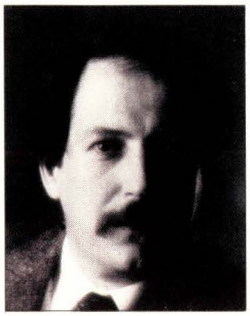
*SUNEXPERT*
serves the UNIX workstation environment, emphasizing Sun, SPARC and Sun-compatible systems.

# Editorial

## Momentum, Momentum

Although the SBus market in no way approaches the variety of the ISA, EISA, MCA, etc., add-ons available in the PC arena, it is larger and more diverse than I expected when *SunExpert* began to look into this month's cover topic–networking through the SBus.



Many of us would argue that card designers are hard pressed to find functionality that's not built into UNIX workstations, but the card developers have some interesting variations up their sleeves. And the momentum abetted by the growing number of SBus slots available to the aftermarket promises to keep things lively. Take a look at Michael Jay Tucker's cover story and the table compiled by Maureen McKeon to see just how rich the choices are.

There's momentum on another front that concerns Sun users in particular and the overall UNIX client/server market in general. In October, the COSE/CDE conference in San Jose, CA, demonstrated the first fruits of the collaboration among Sun, IBM, HP, SCO and Novell/USL. We'll be evaluating the first code from the group next month, but for now suffice it to say that in 1994 you will be able to see the environment running identically–same colors, icons, backgrounds and front panels–on systems from these vendors. Where are DEC and SGI? DEC was late to the party but is expected to board the bandwagon once it gets rolling; however, SGI is still a holdout. (A word of caution for SGI: Remember Sun's Open Look strategy.) Whether or not the Common Desktop Environment will prove to be as significant as NFS or the X Window System only time will tell. But I believe that GUI-based UNIX clients that offer the same look and feel across multivendor servers dedicated to the true network functions of database management, communications, legacy applications service, etc., could put a big hurdle in the way of Microsoft's NT. As one Sun ad puts it, why be a guinea pig for 4 million lines of new code?

*SunExpert* would like to thank Peter Salus for his contributions over the past three years. This will be his last Your Standard Column, but we expect to see his byline from time to time as he pursues his book efforts.

Doug Pryor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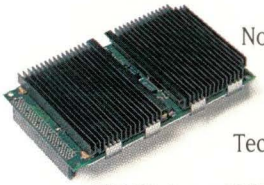

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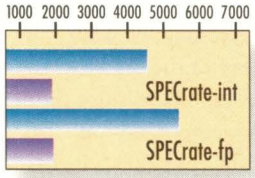


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# NEWS

## Andataco Acquires Xcelerated Systems

Sun aftermarket vendor Andataco, based in San Diego, has acquired Xcelerated Systems, makers of Liken Macintosh emulation software. Liken allows RISC workstations to run Macintosh applications.

The companies were already close. "The two companies have been doing business for over two years now," says Steven McAllister, Andataco's director of marketing. "We're already the largest reseller of their product. About six months ago, we started bundling Liken on our disk and tape drive products."

McAllister says that this remarketing relationship led naturally to a merger. "It became obvious that the best thing to do was to acquire Xcelerated and fold them into our software division." He notes that Andataco, which is known as a hardware remarketer, has a large and growing investment in software development and sales. "Our software division now constitutes 16 people."

The addition of Xcelerated means that division will grow substantially. Most of Xcelerated's staff will become Andataco employees. "I think there are a couple of administration people who won't make the transition," says McAllister.

Which is not to say that everyone is happy with the acquisition. In late September, individuals identifying themselves as being among Xcelerated's creditors contacted *SunExpert*. They claimed that Xcelerated had, in fact, been on the verge of bankruptcy, and that Andataco had acquired the company in a "bulk sale" arrangement.

Under the arrangement, they said, Andataco received the company assets in return for a certain unspecified lump sum. That lump sum will then be divided among the creditors. As a result, most of the creditors will receive only a percentage of what is owed them. One of the creditors to whom *SunExpert* spoke was not displeased by this arrangement, saying, "Better half a loaf," while the other felt that it was unfair and inappropriate.

Andataco does not deny that the situation exists. "The process you describe sounds accurate," says McAllister. However, he says that Xcelerated Systems was not about to go out of business. "I doubt that...they may have had to downsize, but they were still shipping hundreds of copies of Liken every month."

Meanwhile, Andataco has also announced another arrangement. "We have signed an agreement with Axil [Workstations] to resell their workstations," says McAllister. "It is a five-year masterVAR agreement."

Andataco was, until this year, a Sun VAR. However, for reasons that remain somewhat mysterious, the company had its certification withdrawn. The Axil arrangement will take the place of the Sun platform in Andataco's product line.

### Sun Shows Big Picture

Sun Microsystems Computer Corp. (SMCC) has introduced three new systems meant for imaging, multimedia and video functions. The company says that the three systems are meant to compete directly with multimedia PCs and Macintosh systems.

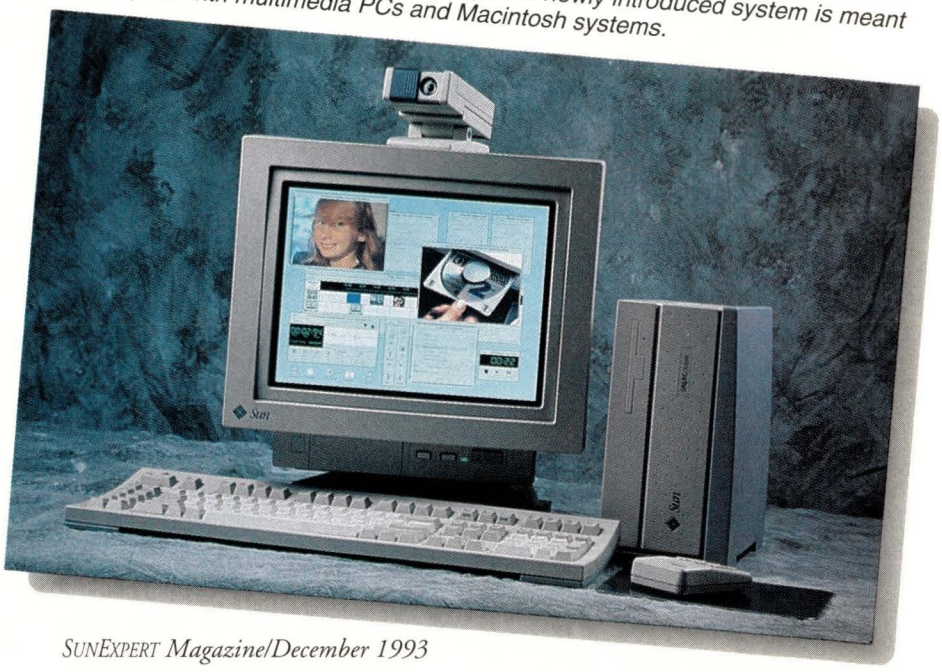
The first of the three is the SPARCstation 10X. This system exploits the SX imaging technology that Sun introduced last year. The SX ASIC is integrated directly into its memory subsystem. This allows it to manipulate images as large as 300 MB in near real time.

In addition, the SPARCstation 10SX offers full 24-bit, Gouraud-shaded, Z-buffered graphics for interactive 3D. It also provides decompressed video playback in hardware. A base-level product, with a 535-MB hard disk, 32 MB of memory, and a 16-inch color monitor, would be priced at $15,495.

The SPARCstation 10M, meanwhile, focuses on videoconferencing and multimedia authoring. It comes with a SunView capture/compression SBus card, a video camera, and a CD-ROM holding licensable video and multimedia programs. Pricing begins at $17,095.

The SPARCclassic M, finally, has everything the SPARCstation 10M has–except that it comes in the smaller and less expensive SPARCclassic. It, too, has a camera, a real-time

*The SPARCclassic M comes with a camera, a real-time video capture/compression card and storage. Sun says the newly introduced system is meant to compete with multimedia PCs and Macintosh systems.*



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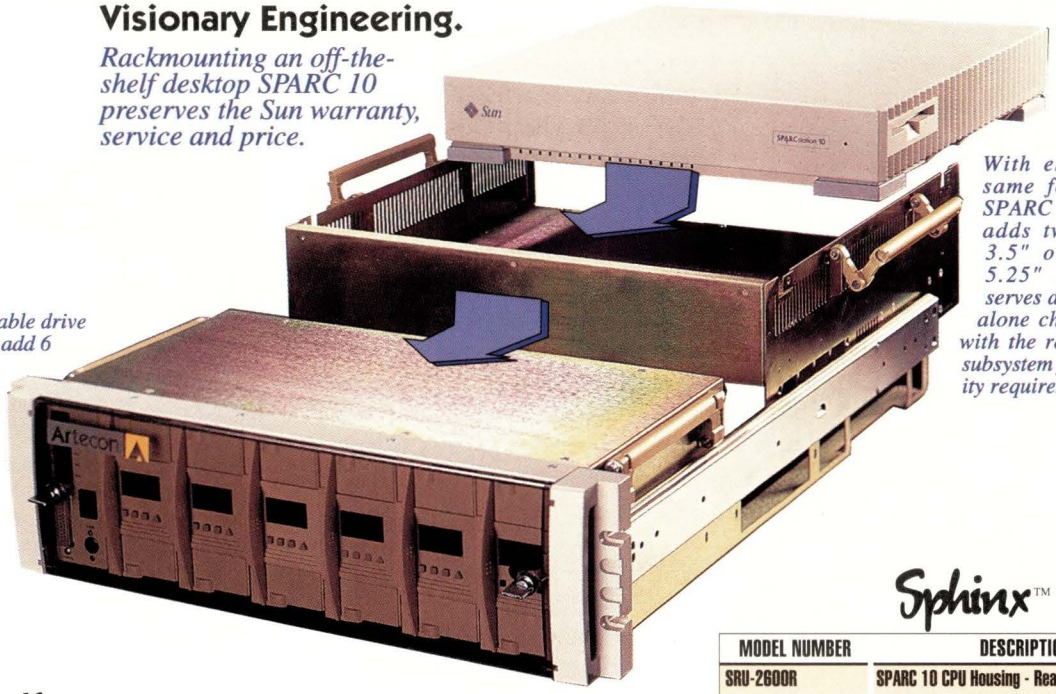


*With essentially the same footprint as a SPARC 10, the Sphinx adds two additional 3.5" or half height 5.25" devices, and serves as either a stand alone chassis or mates with the removable drive subsystem for high capacity requirements.*

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| MODEL NUMBER | DESCRIPTION |
|---|---|
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| SRU-2200F | SPARC 10 CPU Housing - Front Unit |
| RRU3-SS-BS | Rackmount Removable Housing - Disk, Tape |
| RDU3-DSK-S-1.0GB | 1.05GB 3.5" Removable Disk Module |
| RDU3-DSK-S-1.6GB | 1.6GB 3.5" Removable Disk Module |
| RDU3-DSK-S-2.0GB | 2.0GB 3.5" 5400 RPM Removable Disk Module |
| RDU3-DSK-S-2.1GB | 2.1GB 3.5" 7200 RPM Removable Disk Module |
| RDU3-4mm-S-2.06GB | 2-8GB Removable 4mm DAT Module |
| RDU3-4mm-S-4.0GB | 4-16GB Removable 4mm DAT Module |
| RDU3-FLP-S-1.4MB | 3.5" Removable Floppy Module |

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## Off-The-Shelf.

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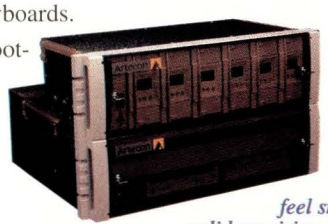

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***Image processing and manipulation is one of the tasks of the newly introduced SPARCstation 10SX. Here, a Kodak Photo CD image has been given a wave effect with a 10SX.***



video capture/compression card, and so on. While it lacks the 10's faster processor, it is priced at only $4,995.

The company has said that the systems in general, and the SPARCclassic M in particular, are meant to provide some radical competition with similar boxes. SMCC released numbers, for instance, showing that a 386 PC with similar functionality would cost at least $8,495; a Mac 840 AV would be $7,300; and a Silicon Graphics Inc. Indy would be $8,000 to $10,000.

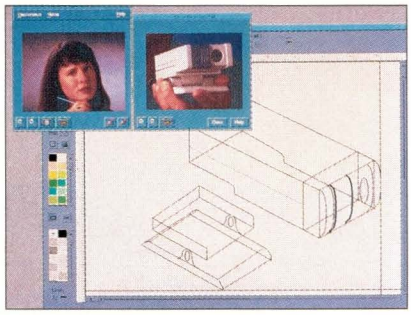
At the same announcement, Eastman Kodak Co. and Adobe Systems Inc. announced their support for the 10SX. Kodak said that it will be incorporating 10SX systems into several of its imaging products that produce Photo CD disks. Adobe, meanwhile, will be running its Photoshop software on the platform. In fact, purchasers of 10SX systems will get a coupon redeemable for a free copy of Photoshop.–*mjt*

## SunSolutions Does Conferences Too

While Sun Microsystems Computer Corp. is touting its new workstations as videoconferencing tools, SunSolutions is offering an upgraded and enhanced version of its ShowMe product, which also does conferences, and a good many other things as well. The original ShowMe had a shared whiteboard product that allowed users to look at drawings and images on their systems while being physically separated from one another.

The new version, ShowMe 2.0, supports audio and video as well. With a camera (which Sun will also be making available), users will now be able to see and hear one another at their systems, as well as exchange charts and drawings. However, video is an option rather than a feature. This means that LAN or WAN administrators will not be forced to support it should they not have the network resources to do so.

Moreover, ShowMe 2.0 has a shared application facility. With it, control of an application running on one machine can be passed to a user on another. This, however, is not a clever way of thinning down the revenue stream of ISVs. The users cannot both use the application simultaneously. "It is exactly as if you and I were both sitting at one workstation," says Rod Tansimore, senior product manager at SunSolutions, "and I happened to pass the keyboard to you. Then, you passed it back to me."



*ShowMe 2.0, which supports video and audio, provides Sun users with conferencing facilities. It also features a white board and a shared-application facility.*

This application-sharing facility is, however, unique in the Sun market. In fact, the feature was the result of a technology transfer arrangement with Sandia National Laboratories, the federal research lab in Albuquerque, NM. The sharing facility was developed there to allow work groups in different physical locations to collaborate on various projects. Sandia then made the underlying technology available to Sun as part of its efforts to commercialize its research.

"For us, it was a question of time to market," says Michele T. Parry, SunSolutions' general manager. Sun could have developed the technology itself, she says, but it was much quicker to make use of the existing Sandia system. "We beat our projections by over a year," she says.

ShowMe 2.0 is available in a variety of configurations and prices. However, the suggested list price for a fully featured version of the product is $3,270 for a single license, and $8,430 for a three-user license. For users who don't want video, there is an audiographics package with ShowMe Audio, Whiteboard and SharedApp for $899 for a single user and $1,650 for three users.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## Software Reuse: Good Idea but Tough to Sell

This year's CASEworld and Objex Exposition, the software development-oriented trade show sponsored by Digital Consulting Inc., Andover, MA, was held in the Hynes Convention Center in Boston. At this year's show, as at several others, one of the topics of conversation was software reuse.

The problem being, this year as before, much of the talk was about how little reuse is actually happening.

Software reuse can be broken down into two categories. The first is when you plan ahead to reuse software that you're developing. The second is more like software salvaging, in which you sift through your own company's files or borrow from other companies where permitted to save yourselves some programming work. Scientists have been doing both styles of reuse for years, and of course reuse is one of the central concepts behind object-oriented programming. There, software objects could be written once, and then reused as often as a developer likes.

So if reuse technology is so great, how come we don't see it catching on like rollerblades?

Greg Aharonian, president of Source Translation and Optimization, explains the problem as a matter of economics. "Most people involved with software reuse have computer engineering degrees, not economics degrees." Upper management doesn't know how to figure the cost and profit of software reuse, he says. Simple accounting problems like depreciation do not apply to software reuse issues as they to hardware issues.

Peter Winston, president of Integrated Computer Solutions, feels the same way. He sees the big question as "once you have an object, how do you sell it, train people on it and maintain it?" One aspect he specifically found to be problematic was the training portion of the whole process. He says, "Programmers really aren't trained in software reuse. They're so busy in what they're doing they don't have time to come up for air and worry about the big picture, or, in other words, learning to use objects to make their programming easier."

Management isn't entirely to blame for software reuse's slow growth in the marketplace. Figuring profit based on reuse issues is not an easy thing to do. Here's one illustration of a case where the profitability and legality of reuse gets complicated, to say the least. John develops a library for reuse, markets it and sells it. Then Susan builds a library, but she likes some of the features she saw in John's library and wants to use her library in conjunction with his. She goes to John, and he licenses his library to her. Then along comes Joe, who builds a library and wants it to work in conjunction with Susan's. Susan is more than happy to license her library to Joe, but what then becomes of John's licensing rights with respect to Joe's library?

Aharonian sees the real problem in what happens next: "In cases where a company doesn't know what to do, the easiest decision is to do nothing; and that's exactly what they've been doing." That effect on the reuse market, or any market, for that matter, can be devastating.

In-house tracking of source code for reuse is also something management doesn't understand the need for. Companies need to do for source code what librarians have done with books. They need to allocate one person to keep meticulous track of details associated with software reuse. That involves keeping track of magnetic tapes, floppies, documentation and, of course, source code. When it comes to paying a "software librarian" a salary similar to what a software engineer would make, companies choke. Aharonian has done work for the U.S. government and illustrates the irony by claiming, "the U.S. Department of Defense spends billions of dollars to develop software and nothing to keep track of it."

Another inhibiting factor is that software is not tangible. It's difficult to keep track of code. Simply put, source code is easy to steal and hard to license. Another problem is the programmers themselves. They may resist reusing code because they get paid per line written. Or if there are incentives for reusing code, then someone has to be responsible for figuring out if it really is reused code that was utilized.

As much as it may sound that way, it's not all bad out there. Aharonian touts Hewlett-Packard Co. as a leader in reuse as it should be handled. He says they even have job titles in their company like "Reuse Manager." GUI development tools, statistical libraries, user-interface management systems (UIMSs) and so on are all examples of reuse ideals that have made it in the market, or in some cases, flooded the market. More application-specific codes are what's hard to sell, and that's where the next step of software reuse will most likely go. Winston sees the move to object computing and distributed object computing as inevitable, and with good cause. "It has to eventually succeed because the economics of software development will push it that way. If for no other reason, faster computers allow us to write bigger and more sophisticated programs. We will end up spending more energy testing than building applications if we don't reuse because applications will become so large that the only way to get around development glitches is to use components that are individually testable."

On the bright side, the problem is not technology. That's all right here and ready to go. For those companies that make it work, the payoff could be incredible.–*mm*

## UNIX is X/Open Trademark (Again)

X/Open Co. Ltd. has announced an agreement whereby the UNIX trademark will be transferred to it from Novell Inc., which obtained the trademark along with UNIX when it purchased UNIX System Labs from AT&T. Under the terms of the agreement, all systems bearing the name UNIX will be tested and branded by X/Open.

This is the same agreement that was almost announced in New York at last September's UNIX Expo. At the time, the agreement fell through–apparently because some UNIX source code licensees objected to the idea that Novell's own UNIXware would be the definition of UNIX System V.4.

The failure of the deal was an embar-

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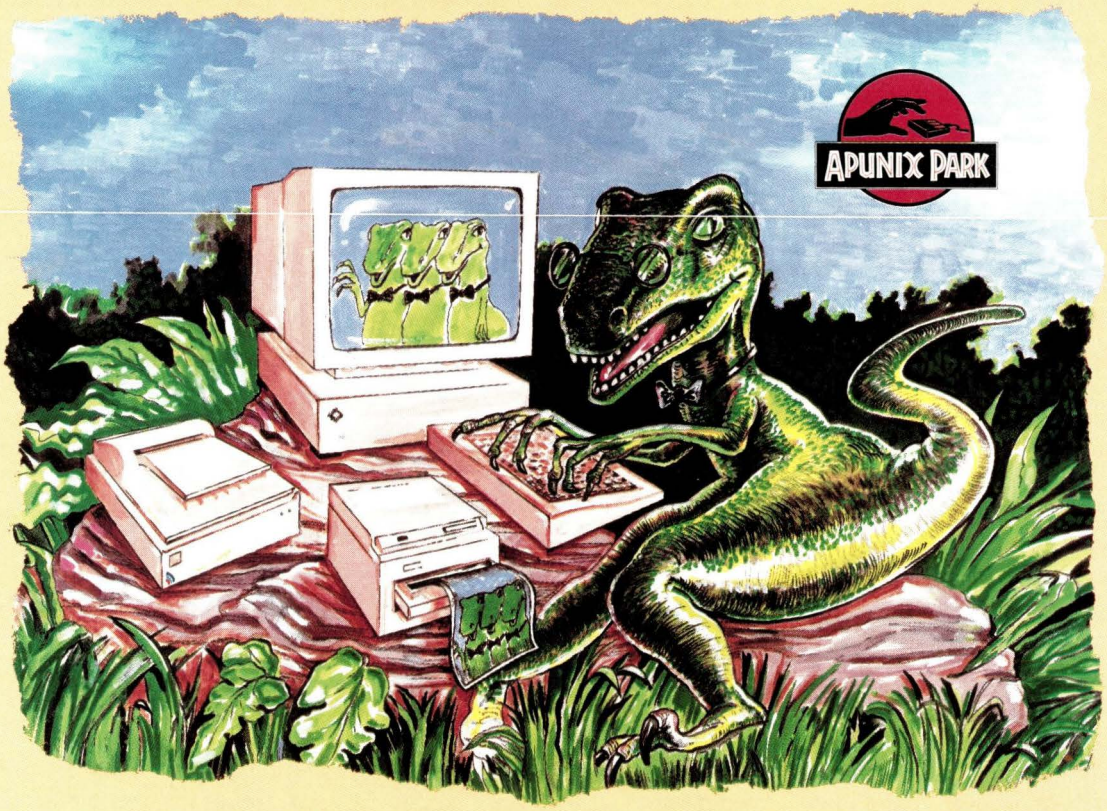


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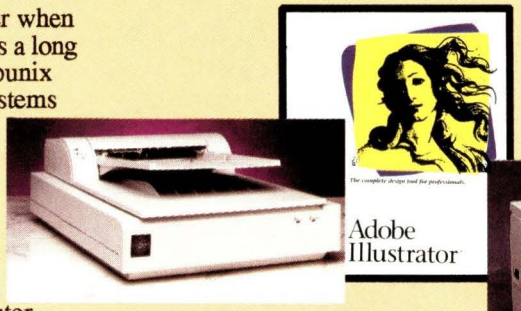


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SunWorld BEST PRODUCT 1992

rassment to Novell, X/Open, and, oddly, to Sun Microsystems Inc.–which was widely blamed for souring the deal. Sun's CEO, Scott McNealy, angrily rejected these allegations, saying that at most he was "flattered" that anyone thought his company had the power to control what Novell did or did not do with its trademarks.

Whatever it was that blocked the deal was overcome as of October. X/Open announced that the UNIX trademark would be available to those vendors whose products conformed with XPG, SVID (Version 2 or 3), and were derived from USL operating system technology.

UNIX as a trademark is one of the longest standing issues, and jokes, in the UNIX community. Initially unconcerned with UNIX, AT&T did not enforce its trademark rights on the name. After divestiture, however, the company entered the software business and guarded the name "UNIX" with a passion. So many vendors, analysts and trade press journalists have been informed that they could not use the name without an identifying "tm" that an industry sprang up to sell comic T-shirts and coffee mugs that read simply "UNIX is a Trademark of AT&T" at trade shows.

## Sun Sells Chips

In a move that is less surprising than it might have once seemed, Sun Microsystems Inc. will shortly begin to sell chips–including SPARC. Prior to this announcement, the company had made its ASICs and CPUs available only through its semiconductor partners, such as Texas Instruments Inc.

Several chips will be made available. Sun announced that it was marketing SuperSPARC, the new microSPARC II, and various imaging and graphics devices. Marketing will be done through the SPARC Technology Business group, which already sells designs and kits.

Does this mean that Sun will be competing with its own suppliers, like Texas Instruments? Not according to Derek Meyer, director of SPARC marketing for SMCC. "We'll be in competition with Motorola [Inc.] and Intel [Corp.]," he says. "People like TI will continue to make the chips. We'll just be setting up an additional channel of distribution."

He adds that TI, Fujitsu Ltd. and other SPARC vendors will continue to sell SPARC. However, now Sun salespeople will also be pushing the processor. "What we're doing is putting a dedicated sales force on the street," he says, "people focused on SPARC."

In addition, Sun hopes that from now on vendors will be able to come to Sun to get everything they need to put together a SPARC-based device. "This will provide a one-stop-shopping alternative."

In effect, Sun will handle SPARC and its other semiconductor technology in much the same way that Digital Equipment Corp. handles the Alpha, or that Silicon Graphics Inc. handles the MIPS processor. This is a radical change from the company's original plans, in which the processor was to be farmed out to semiconductor vendors completely.

## CASE Rivals Unite

A much needed joining of forces was agreed upon by rival standard groups, CASE Communique and CASE Interoperability Alliance. CASE Communique originated in 1991 with support from Hewlett-Packard Co., IBM Corp., Informix Software Inc. and Control Data Corp. CASE Interoperability Alliance was founded in 1992 by Digital Equipment Corp., Silicon Graphics Inc. and SunSoft. Both standards groups have been making steady gains in defining a standard way for software tools to communicate in CASE environments.

Joint work between Communique and Interoperability Alliance began in November 1992 in response to industry demands for a single, framework-independent standard for CASE messaging.

In July of this year, the groups produced a Joint Architecture Document for building standard abstract message specifications called servicegrams. Servicegrams describe information required to create messages for communication of function requests and event notifications among CASE tools. Standard servicegrams may be created to open a file for editing or to notify the system that a build operation has just completed, for example.

The American National Standards Institute (ANSI) Technical Committee for CASE Tool Integration Models (X3H6) accepted the Joint Architecture Document at its July meeting.

CASE Communique and CASE Interoperability Alliance will most likely dissolve now that their mission has been accomplished, but members from each will assist ANSI in its future efforts. The two groups hosted a member/developer's conference in October in Boston, where they were expected to present the new standard and available servicegrams to developers and ISVs.–*mm*

## New Benchmarks AIM for X

Several new benchmarks were announced that may help users of workstations and X Window determine the best system for their buck.

AIM Technology, Santa Clara, CA, has two new benchmarks–the Workstation Benchmark-Suite VI and the Multiuser Benchmark-Suite VII. Each of the benchmarks has four "standard mixes" that

**Typical "General Workstation Mix" Results**

| Workstation X | |
|---|---|
| CPU type | RISC CPU |
| Clock rate | 25 MHz |
| 1st level cache | 8 KB |
| 2nd level cache | 256 KB |
| RAM | 24 MB |
| Disk | 500 MB, 13 msec |
| Display | 1,024 by 768 by 8, 14-inch color |
| I/O buffers | Dynamic |
| Operating system | UNIX |
| File system | FS |
| Compiler | C Compiler |
| Peak performance | 15.4 AIM Workstation Jobs/Minute |
| Sustained performance | 15 AIM Workstation Loads |
| Price | N/A |

Source: AIM Technology

LEE A. BARTELL

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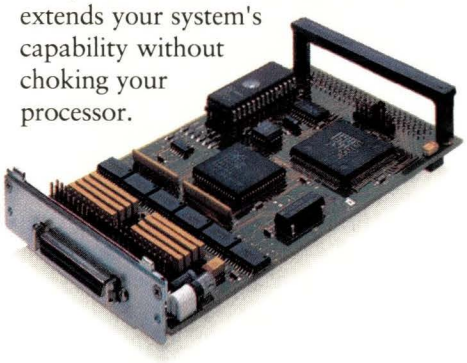

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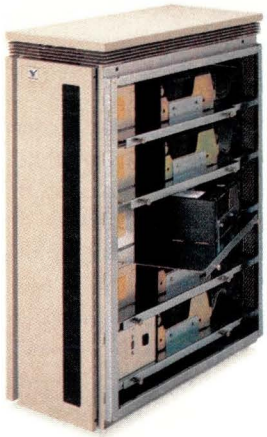

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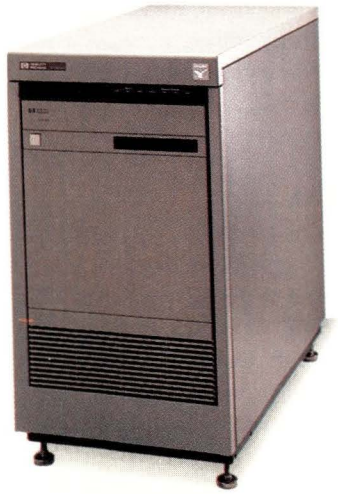

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The X Performance Characterization group, a project group of a National Computer Graphics Association committee, has developed a standard way of comparing X server/hardware systems called Xmark93. It summarizes X11perf results by calculating the ratio between the geometrically weighted mean of the 447 individual X11perf tests for the server/hardware being evaluated and the corresponding results from a Sun Microsystems Computer Corp. SPARCstation 1. The Fairfax, VA-based group includes members from Apple Computer Inc., IBM and Sun. *–Anne Knowles*

## What's WIX?

A marketing tool for certain vendors with a vested interest? Unabashedly yes, but the newly formed Windowing Interface Xchange (WIX) Association does have a user angle, too. The new group intends to help end users safely set out on the shaky path of moving from character mode terminals to graphical X terminal environments without sacrificing their legacy applications (and without the cost of purchasing an X terminal).

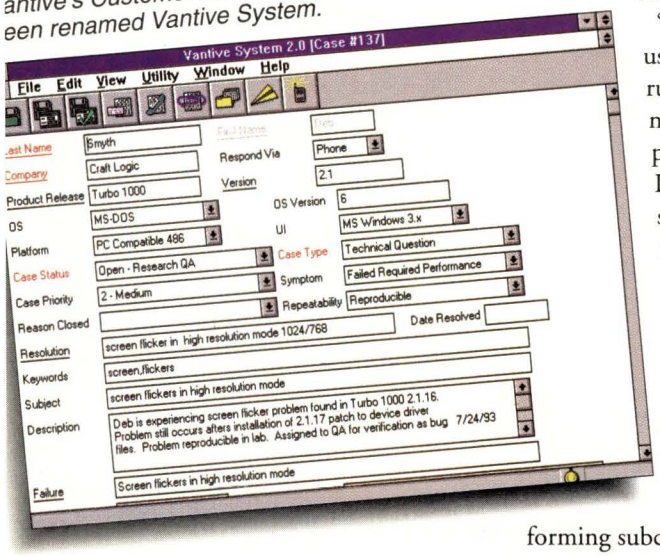
The group is simultaneously administering a slap against the Display Industry Association, another group that formed in 1991 to promote a standard windowing interface for character mode terminals. Manufacturers use the DIA specification to produce AlphaWindow-labeled terminals. Statistically, AlphaWindow terminals haven't been successful against the likes of much cheaper character terminals, which can be spruced up with windowing software, or higher-priced X terminals, which provide the standard X graphical environment that the DIA attempted to sidestep. However, AlphaWindow terminals continue to be produced by such vendors as Applied Digital Data Systems Inc., Microvitec Inc. and Cumulus Technology Corp.

Whether WIX is just another sidestep remains to be seen. The group was formed by Qume Peripherals Inc., a character terminal manufacturer that equips serially connected character display terminals with the X environment; Dickens Data Systems, an RS/6000 remarketer; and Sherwood Inc., a division of Inkel Technology, an audio and video equipment maker. These participating players have defined the WIX protocol, an openly published, vendor-neutral standard that gives character-based displays an X-compliant interface. It is designed to take repetitive information required to display X Window images and condense it into commands that are transferred over RS-232 serial lines.

"The protocol can be used for any product that runs over a serial line," notes Barry Hegwood, a product manager at Dickens and WIX spokesman.

Manufacturers of I/O boards, fax modems and commercial X applications are prospective candidates. Hegwood says the association hopes to gain 50 members, eventually electing an executive director and forming subcommittees. Upcoming plans include defining a color version for the standard, as well as defining a standard for a PC version, says Hegwood.*–Jane Majkiewicz*

*antive's Customer Information Resource System has een renamed Vantive System.*




## What's in a Name?

ProActive Software Inc. is now The Vantive Corp., Mountain View, CA. The company, by whichever name, markets a suite of client/server applications that help companies deliver "superior service, product quality and customer satisfaction," to its HelpDesk functions.

The company's product, meanwhile, has similarly been rechristened. What was before the Customer Information Resource system is now the Vantive System. Again, smelling as sweet by whatever name, the product is composed of five integrated applications: Vantive Support, Vantive Quality, Vantive HelpDesk, Vantive Sales and Vantive Customer.

Vantive has also announced a 2.0 release of its product. New functionality includes support for new servers, clients and databases. Vantive now supports Hewlett-Packard Co. Series 9000, IBM Corp. RS/6000 and NEC 4800 servers as well as Sun Microsystems Inc. platforms running Solaris 1.0 and 2.X. In addition to Windows clients, the product adds Macintosh and X/Motif clients. And now the software supports Oracle 7 and Informix databases as well as Sybase.

Also, three new features enhance core funtionality. Workflow manager adds time-based alarms and service contract validation. Report manager allows parameter-driven reporting and a research agent provides keyword and pattern matching within the database. Vantive 2.0 links with cc:Mail, UNIX mail systems and faxes and supports dial-up remote access.

## This Just In...

• ***Sun Microsystems Inc.*** and Lowell, MA-based ***Wang Laboratories Inc.*** have announced an agreement that will make Wang's Open/Image imaging software available on Sun workstations. Sun Microsystems Computer Corp. will assist in the porting effort. ⊸

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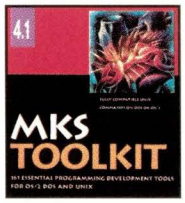


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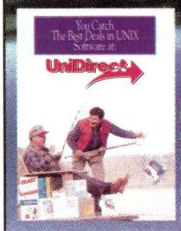


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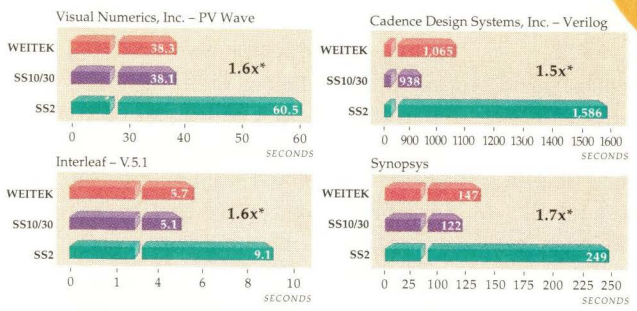


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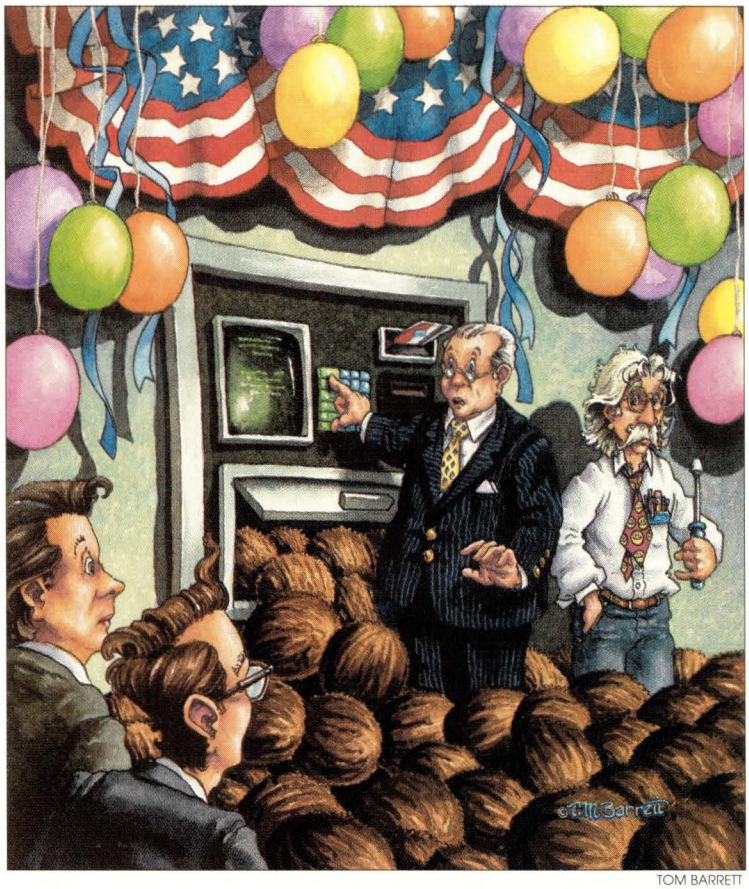
# Ask Mr. Protocol



TOM BARRETT

## You've Got To Have Connections

by MICHAEL O'BRIEN

*"It's not what you know, it's who you know."*

–Old adage

*"It's not who you know, it's what whoever you know, knows."*

–New adage for choosing a network provider

*"Oh, no!"*

–The reality behind the adages. This net is still new.

**Q:** OK! All right. I'm only going to explain this one more time. Over *here*, is a computer. *My* computer. Out *there*, are all the *other* computers in the world. Now, will you quit blithering about the National Information Infrastructure Medical Care No Inhaling Yankee Clipper Trader Encryption Superhighway, and tell me how to connect *this* computer to *those* computers? And *will* you make Mr. Protocol quit fussing around with those stupid boxes and telephones and for heaven's sake answer the question for once?

A: As you may have guessed from the fact that you have to listen to me all the time, Mr. Protocol is not what you might call real long on verbal skills. As usual, he's trying to answer the question by solving the problem, which leaves everybody as much in the dark as they were before, and when they try to figure out how *he* did it, they generally start working on a whole new conceptual level of "dark."

He's big on standards but weak on geography, since that doesn't matter so much on the net. I got him a job with a bank once–thought it might help if he got out a bit more, saw the world, met people, you know the sort of thing. Anyway, he whomped up a whole new ATM for them, even installed the test unit–boy were they happy. He did it all in two weeks flat, and protocol testing didn't come up with a single error, polled like a dream. Problem was, they got the bigwigs out there for the grand opening, the bank president stuck his own personal card in, and the damn thing started prompting him in Fijian. *Spoken* Fijian. None of the buttons had any

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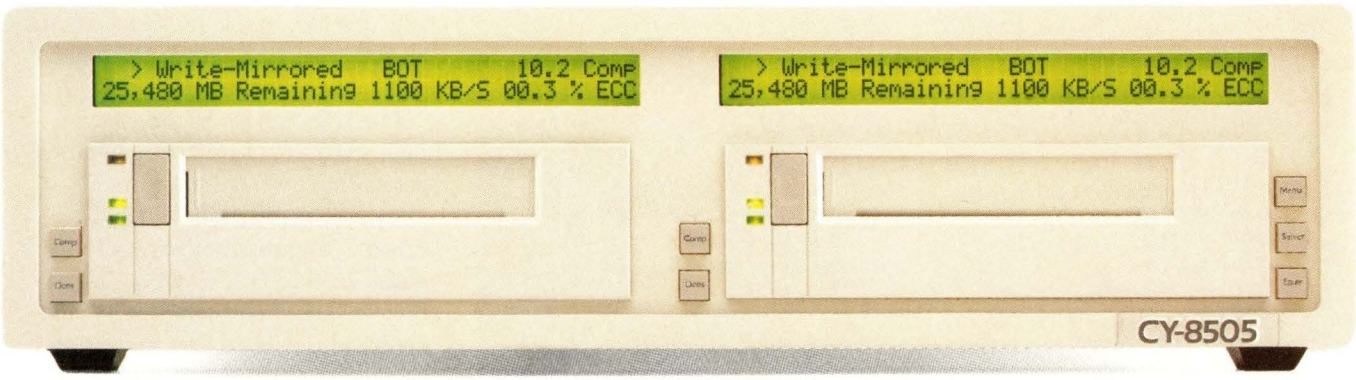


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labels on them. He started hitting around for the cancel button and finally wound up withdrawing what we later figured out was about $187.53 or so, which buys a lot of coconuts, for sure, because that's just what it started dispensing. Wowsers. At least the husks were off.

When things settled down, our Mr. P. was out of a job again and Mr. Big's entire stock portfolio had been converted to these great big stone wheels FOB the island of Yap. Ten thousand coconuts to the wheel, fixed rate, no interest. The last I saw of the guy, they were sort of leading him away, and he was doing this great Herbert Lom impression, twitchy eyelid and all, and sort of giggling "Like a millstone around my neck, like a millstone around my neck," over and over again. Like I say, he just doesn't think geography is all that relevant.

What? Oh, I'm sorry. Um, well, actually geography does have some bearing on connecting up to the Internet. What you do can depend very much on where you live. Let's look at some cases.

Back in the days of the Arpanet, when all this stuff was first being figured out, things were either a lot easier or a lot harder, depending on how you look at it. The backbone was all that existed, and there weren't any regional or midlevel networks. If you wanted on the Arpanet, and if you were able to find someone in a participating government agency who could and would sponsor you, it was all a matter of how close you were to the nearest IMP (or Interface Message Processor, which is what they called the box that connected you to the Arpanet). If you weren't particularly close, whether or not you got on depended on such fine and honorable considerations as how powerful you were and/or how badly the government wanted you on the net. The 56-Kb/s lines that tied together the IMPs on the Arpanet were hideously expensive, and the people who ran the net once rearranged many connections to cut the number of transcontinental links from three to two. A gesture toward those who were far distant was the so-called "very distant host" interface, which acted just the way it sounds: It was a 9,600-baud link running (usually) many, many miles between host and IMP, over a dedicated phone line. Sometimes the magic worked and sometimes it didn't. There were some unfortunate sites whose VDH link never really provided anything like reliable (or even continuous) Arpanet access. Sometimes the good old days really are best forgotten.

When the Arpanet became the Internet, the old hardware stayed in place. People were running their campus networks using 10-Mb/s Ethernet hardware, and the backbone stayed at 56 Kb/s. This was, as Mr. Protocol once heard someone remark, double-plus ungood. Net congestion went through the roof, and there were only two salutary effects: 1) It proved the net was popular and that people needed to be on it. 2) It caused people to pay some serious attention to the research end of network congestion.

However, the method of interconnection remained the same. One of your computers was doubly homed, being connected both to your local-area network and to the IMP. This was easy enough: People left the same old computer connected to the IMP that had always been there, and just put it on the local Ethernet. The software was the big difference. Everything was now running TCP/IP, and the doubly homed host was now running some sort of routing software that tried to figure out which network interface to send packets out on. Mostly this was simple: Anything with an address on the local net goes out on the Ethernet interface; anything and everything else, we hand to the IMP.

When the old IMP hardware went

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away, something had to replace it. Now, the IMPs were entire special-purpose minicomputer systems, in six-foot racks–sometimes multiple cabinets worth of six-foot racks, full of modems. Making the transition to the modern version of the Internet was accomplished by replacing these with router boxes consisting of a single rack unit. (Mr. Protocol sometimes wonders what percentage of all the Internet router boxes are actually in racks, and what percentage just sit on or under the floor, or on top of some old computer that is kept around mostly to allow other pieces of equipment to sit on top of it.)

Why the compression? Mr. Protocol is glad you asked.

To a certain extent, of course, this was because of leapfrogging technology. The IMPs were old and outmoded technology long before they were taken out of service. In fact, some IMPs were built using the BBN Butterfly parallel processor, because the job of being an IMP had by this time become sufficiently complex that it was felt that the Butterfly could be kept busy. The Butterfly IMP could support more local hosts than the ordinary IMP, of course. But perhaps the central fact was that the IMPs maintained routing tables for the entire network in every IMP, and in fact recalculated optimal routes based on link congestion on the fly. This information was exchanged using a special-purpose IMP-to-IMP protocol that the machines "on" the Internet never saw. The old IMPs (most of them Honeywell minicomputers) had run out of room to hold the routing tables; the Butterflies were seen as the next great hope.

(In fact, Mr. Protocol recalls an experiment conducted years earlier to build an IMP using a bunch of Lockheed SUE minicomputers working in parallel. This experiment did not work, serving merely to demonstrate that the problem of developing software for a parallel machine was harder than anyone had imagined.)

As it happened, the development of routing protocols got rid of the IMPs. One reason the current Internet router boxes are so much smaller than the IMPs they replaced is that the routers no longer have to have complete knowledge of the topology of the net. They merely need to know where to send the next packet. These partial routing tables are far smaller than a complete table would be, and do the job as well, although of course the notion of providing a routing solution based on global knowledge went out with the IMPs.

Can the Internet function with only partial knowledge throughout? Not currently. There is a special class of router, the backbone router. These are monsters akin to the old IMPs, and they are just about as big. They consist of IBM RS/6000 computer systems, fitted out with special network interface boards with enough processing power on the board to allow most packets to be forwarded without interrupting the main CPU. These routers have knowledge of every network announced to the

net and, shades of the old IMPs, the number of nets has grown to the point that the router software has had to be reconfigured for bigger tables. The bright light in the current situation is that the RS/6000 has a big enough address space to hold us for a while. Processing power is another matter, but this column is not about the future of routing protocols. That question is bound up with the question of the next generation of IP, anyway.

No, this column is actually about how to get connected to the net, and there are a large number of options. The organizations who replaced their IMPs with router boxes already had, almost to a one, large local networks to connect, and therefore wanted the fastest, most direct, highest bandwidth link they could manage. Telephone company T1 links generally fit this bill quite nicely. It should be noted here that the current success of the Internet is based on the fact that short-haul T1 links are a lot cheaper than the old long-haul 56-Kb/s links. The costs of the long-haul "semi-T3" links used by the ANSNet backbone make up only a small portion of the network transport costs seen by a typical "Old Arpanet" organization that is now paying fees to a regional or midlevel net.

These organizations are set. Any other organization of this size and type will also have few problems getting an Internet connection, as the regionals are well versed in providing this sort of connection. But there are other methods, brought into existence by the recognition of the fact that not everyone is as big as most of the old Arpanet sites were.

The cheapest way to get on the Internet is to let someone else get on the Internet, and use their equipment. Entire companies have become successful providing this sort of access. The cheapest of all such accesses is free. There are some BBSs that provide Internet mail and news to their users, and some of these are free. Some regions have also established FreeNets dedicated to making the Internet available to the local citizenry for as little money as possible. If you are in an area that has a FreeNet, Mr. P. thinks you should check it out.

A different approach is a straight fee-for-service arrangement for similar access. In this approach, a flat fee per month (with maybe a connect-time charge, though some services are truly flat rate) gets you a login account on a host that has full Internet connectivity. The upside of this is that you get a shell, just as if you owned your own machine on the net. The downside is that you get a shell. This is not as easy to use as a BBS system; you must generally learn at least something about UNIX in order to be able to use a service like this. If you are already familiar with UNIX, you're ahead of the game, however. Also, most of the cutting-edge new Internet services are being developed on UNIX systems, so such services may offer a wider variety of Internet services than the BBSs.

Companies that offer this service range from local outfits serving a single city to the largest regionals and midlevels. This sort of service is usually the service of choice for individuals, so if you are interested in this, check out local providers as well as the "big guys."

The next step is to provide full Internet access to a computer that you own. This is a bit trickier, because if you are going to give your computer full Internet access, as opposed to using applications on someone else's computer, there is no way to avoid configuring and running some sort of TCP/IP protocol software on your computer. This can get complex. However, figuring that most such personal machines will be either PCs or Macs, Mr. Protocol is relieved to be able to assure you that there is sufficient commercial software out there to allow you to make this part of the process as painless as possible. Once your machine is configured as an Internet host–and this will usually be done in conjunction with picking a provider, who will supply you with an Internet address–you can choose your own Internet application software, as an alternative to depending on your provider for this, as the people who use dial-up accounts must do.

Usually, this method of Internet access does not provide full-time service but is used as a dial-up resource. Internet services were not initially designed for use in an intermittently connected environment, but the boom in this sort of access has resulted in dial-up versions of at least the more common applications, such as mail, so that they can queue up work until the connection is made.

The two main dial-up protocols used in this type of service are SLIP and PPP. SLIP, which stands for Serial Line IP, is the older of the two, and consequently is much better established in the marketplace. The replacement for SLIP is the Point-to-Point Protocol. This protocol is newer and has provisions for a wider variety of services at the link level, as well as better error control, but it is not nearly as widely deployed. If you have your choice of both, Mr. Protocol counsels you to try PPP first, as it was designed based on the experience garnered from SLIP.

One sterling example of the use of this type of service is the Eudora mailer, originally written for the Mac and now available on a test basis for the PC as well. Eudora allows the user to exchange mail over the Internet in a sort of batch mode. The one problem with getting netmail at an intermittently connected host is that you have to sit there on the net until all the mailers elsewhere on the net have connected to you and exchanged mail. Furthermore, you must do this often enough that the mailer with the shortest fuse does not return mail to the sender on the basis of your being a disconnected bum who never answers the mailer's connection requests.

The solution to this is to use a proxy host that is fully connected to buffer up your mail. This may or may not be difficult to come by, but if you can swing one of these, then Eudora is great. You dial up to your network provider's service, fire up the TCP/IP protocol stack, and start Eudora. Eudora will then suck up all the waiting mail, and send down all the messages you have composed. At your leisure, after you hang up, you read the mail that came in and compose your answers, which Eudora hangs on to until the next time you dial up.

The next step is full-time connectivity of a single host. This will usually be a SLIP or PPP connection over a dedi-

cated line, and represents a good midpoint service for a power user with a single machine. There aren't very many of these, though, so this sort of service is relatively rare.

Beyond this, there is that good old bastion of connectivity that started the Internet in the first place: your own on-site router. This will generally be paid for by you, but provided by your Internet provider, to allow the provider to deal with a single class of routers. Configuring a router can be a heavy job, especially if security considerations mandate the use of the router as a "firewall" insulating the other machines from attack over the Internet. Generally, you can't configure one of these routers from the instruction manual. You need advice from someone who's been there.

Finally, there are the connectivity regimes that are only beginning to put in an appearance, most notably ATM. The Asynchronous Transfer Mode represents a compromise between telephone company types who want to carry real-time voice and video, and data-carrier types, who want ultra-fast TCP/IP (or ISO, let's be fair) protocol stacks. It's fast enough to risk problems with the so-called "fat pipe" syndrome, where TCP's window size is not big enough to allow the full capacity of the "pipe" to be full of packets; i.e., the protocol stack itself becomes a bottleneck. Changes to TCP are being contemplated and played with to get around this.

As you can see, each step up the bandwidth ladder adds complexity to the task of getting connected and staying that way. The fact is that you get what you pay for, and the coin of bandwidth is complexity. Mr. P.'s been playing in that arena for years, and he only expects it to get worse.

*Editor's note: For more information on the how-tos of internetworking, contact the Internet Network Information Center at (800) 444-4345 or send email to* `info@internic.net`.

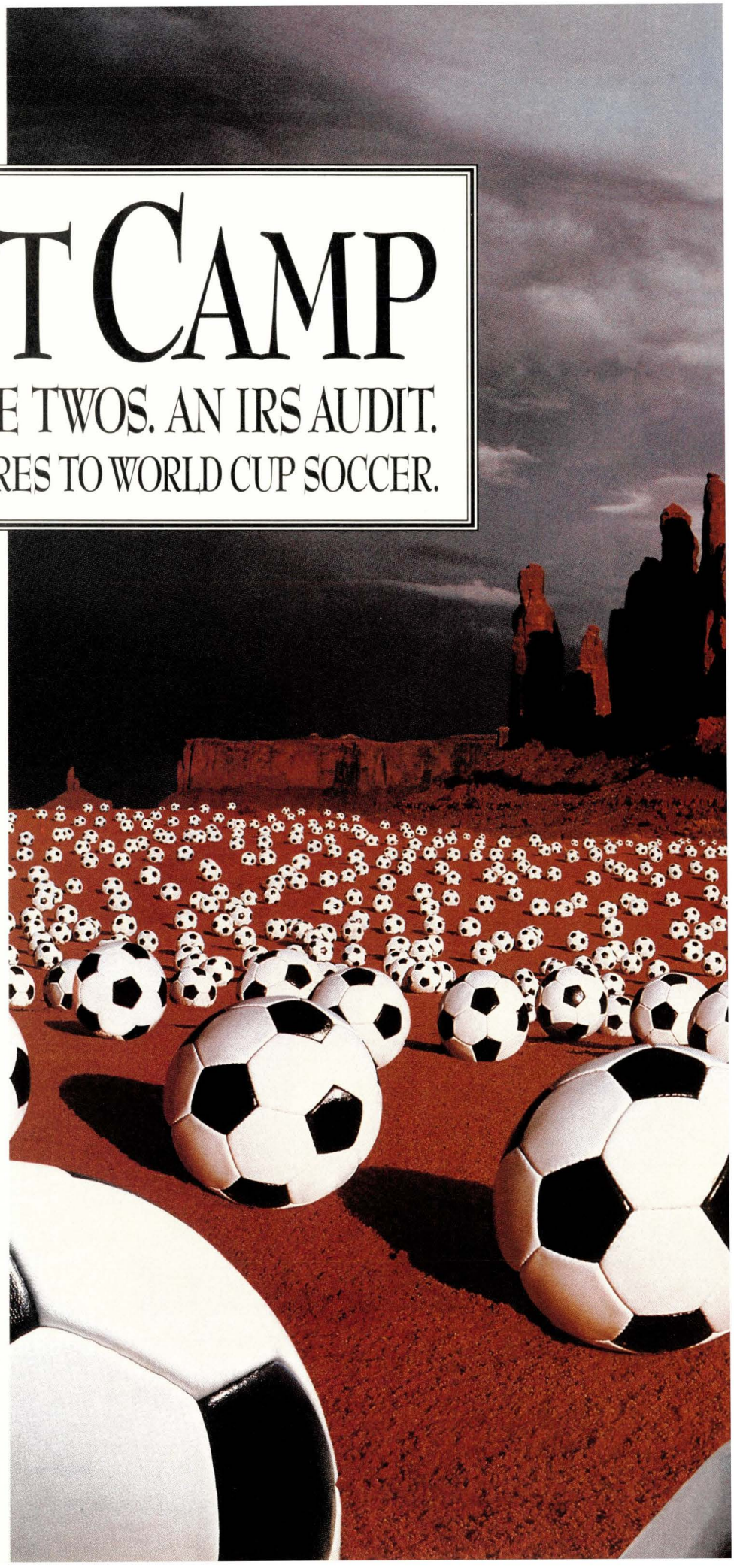
## Chocolate Chip Cookie Hall of Fame Department

Once again, Mr. P. would like to thank Valerie Polichar for coming through in a pinch. ⊷

**Mike O'Brien** has been noodling around the UNIX world for far too long a time. He knows he started out with UNIX Research Version 5 (not System V, he hastens to point out), but forgets the year. He thinks it was around 1975 or so.

He founded and ran the first nationwide UNIX Users Group Software Distribution Center. He worked at Rand during the glory days of the Rand editor and the MH mail system, helped build CSNET (first at Rand and later at BBN Labs Inc.) and is now at an aerospace research corporation.

**Mr. Protocol** refuses to divulge his qualifications and may, in fact, have none whatsoever. His email address is `amp@expert.com`.



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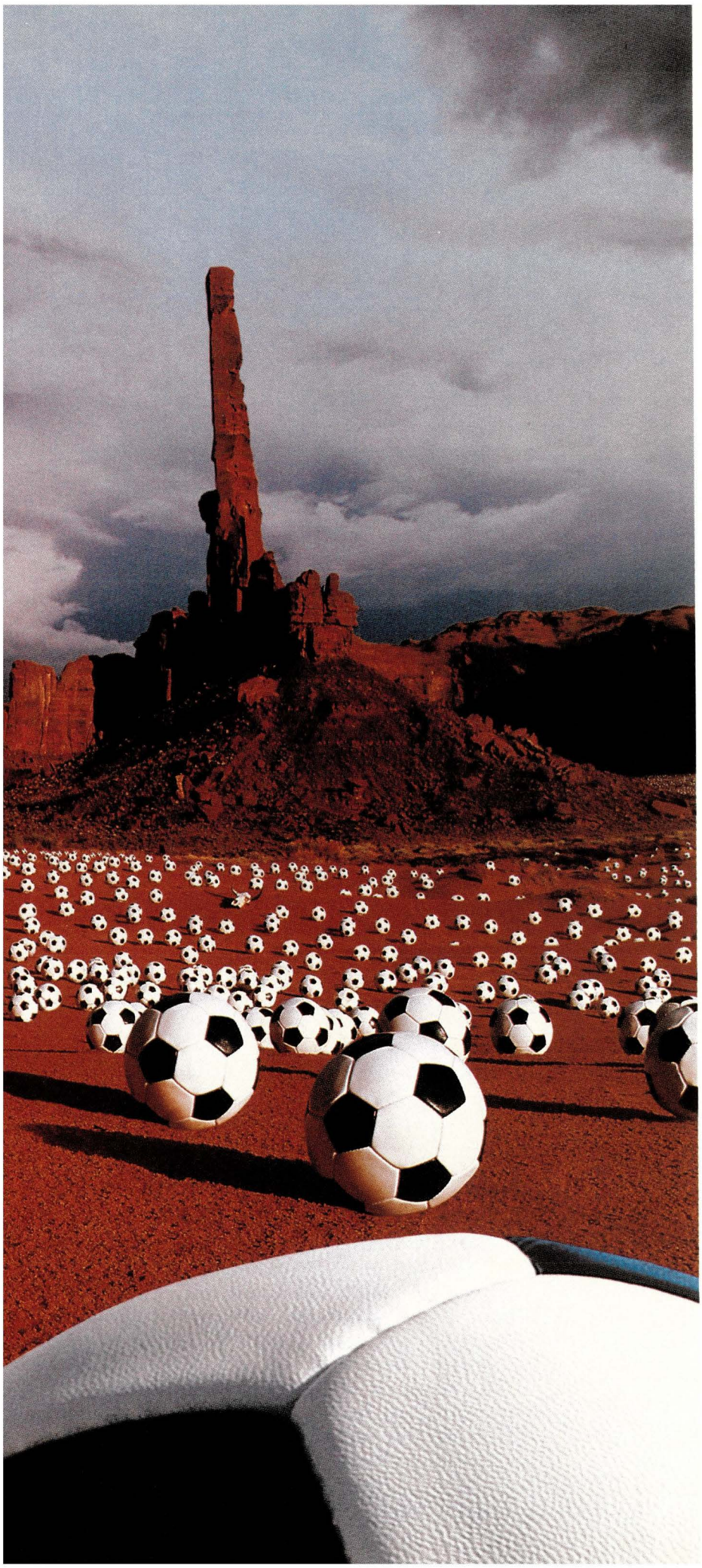

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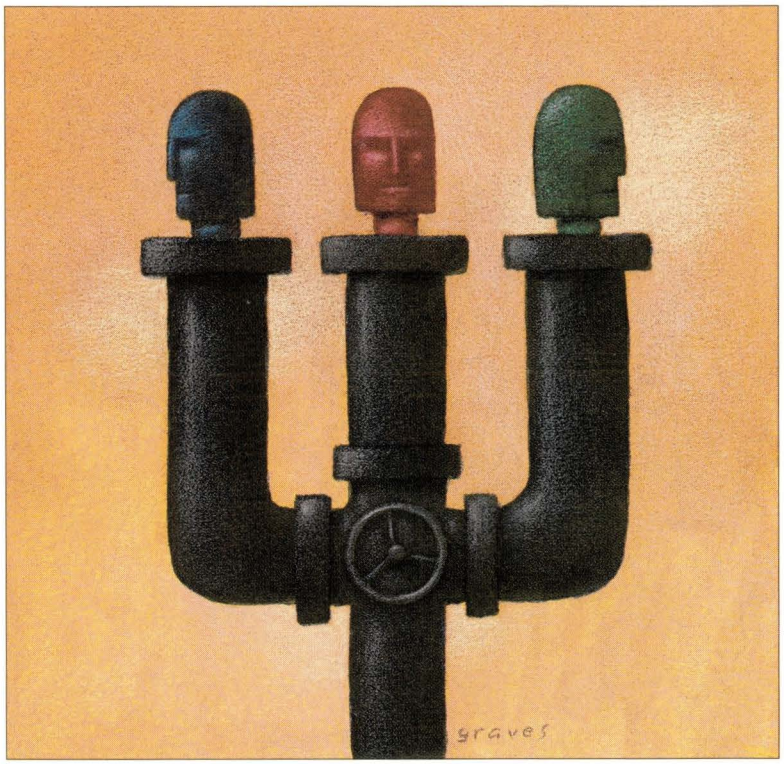


KEITH GRAVES

# Redirecting I/O

by PETER COLLINSON,
Hillside Systems

You all do it without thinking about it. It's a reflex action. You type a command and add the magic greater-than sign after it, meaning send the output of this command to a file rather than the screen:

```
$ ls > opfile
```

or perhaps take data from a file rather than the keyboard with the less-than sign:

```
% mail pc < thisfile
```

or you use the vertical bar symbol to indicate that the output from one program should be piped into the input of another:

```
$ ls | wc -l
```

I suppose I shouldn't be too astonished that we all take this for granted. A long time ago, I was part of the first undergraduate entry to a computer science degree at a U.K. university and was taught that one of the jobs of an operating system was to provide device independence for the programs that it runs.

This is precisely what is going on here. The programs are written (or should be written) with no fixed idea of the type of device that their data is taken from or sent to. When the programs are run, they read and write streams of data. Your shell controls where those streams of data point. The programs themselves are ignorant of the source or destination of their data.

When any program is started, it is assumed to inherit three open files: the standard input, the standard output and the standard error channels. A well-behaved general-purpose program will expect to read its input data as a stream of bytes from the standard input, will write its results to the standard output and will complain to the user on the standard error channel.

Internally, programs use small integer values to refer to open files. These are called file descriptors. The application is returned a file descriptor when it opens a file and will pass it back into the kernel when it needs to reference that file.

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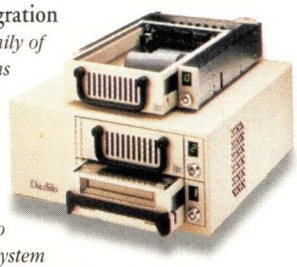

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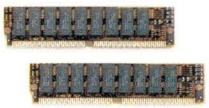

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The kernel maintains a file table for each running process; the file descriptor accesses this to get information about the the file (the vnode for the file) and also the location in the file where the next I/O operation is to occur. A particular application can have several file descriptors pointing at the same file, each indicating a different position.

By convention, standard input is file descriptor 0, standard output is file descriptor 1 and, yes, you guessed, file descriptor 2 is the standard error channel. The key notion here is that the application does not have to open any files to do its job; the files are already set up for it by the shell. To understand how the shell does this, you need to know a little about how UNIX takes the name of a file containing a program image, loads it and sets a new process running.

## fork/exec

UNIX has a couple of primitive operations that are used to start a new program. The first is `fork()`. When called, it creates a clone of the process that made the call. There are now two processes running in the system, executing the same code and holding the same data values. There is one difference. The `fork()` operation returns a different result in the new and old processes. The new process is usually called the child. It knows that it's the new process because it is returned zero from the `fork()` call. The original process, the parent, is returned a nonzero value that is the unique process id number of the child.

The second operation of interest is `exec()`. It's given a filename to load and the program arguments that are to be passed to the new process. It's usually called from the child process after a `fork()`. It loses all the copied program and data areas of the new child and sets up the process from the named file. Once it has loaded the program and data from the file, it starts the new process running.

In (very rough) C, the code sequence to launch a new process looks like this:

```
pid = fork();
/*two processes running */
if (pid == 0) {
  /* child code */
  exec(...);
  /* no return here if OK */
}
/* Parent code */
wait(...);
```

The parent can continue on its merry way, doing some work for you. It's more usual for it to wait for its child to terminate before proceeding; it does this by calling the `wait` system call. Incidently, I have used the ellipsis to mean "there's a bunch of other stuff that goes here." I will use this idea later in the article.

When you add an ampersand to the end of a command line, you are simply telling the shell *not* to invoke the `wait` system call. We think of this as "putting the process in the background." The difference between "background" and "foreground" processes is a slim one; it's mostly a fiction maintained by cooperation between the terminal driver and the shell. What you are really doing is running two processes in parallel.

OK, what of all those open I/O channels in all this? Well, the short answer is that nothing special happens. The `fork()` operation clones all the open channels in the new child. The `exec()` operation carefully looks after the open files and passes them into the new process.

If the parent is an interactive shell then it's likely that the standard input is set to the keyboard and the two output channels will be throwing data at the screen. By default, this situation will be passed through to the child.

The parent will pass all the open files into the new process, not just file descriptors 0, 1 and 2. There was an exciting time in the history of UNIX security when people discovered that the authors of several of the programs that use the exclamation mark to launch new programs had not been too careful about closing files that they had opened. You could type `!cmd` and discover that when `cmd` was run it had access to some file on file descriptor 6 (say). This was particularly exciting if the program you were talking to needed superuser privilege so file descriptor 6 pointed to some file that was normally secure. Shells didn't suffer from these problems.

When you start a command from a shell you can be reasonably sure that only the three default channels will be open in the new process. They will be open in the parent shell too. You might think that there might be a problem because the parent shell and the child process can send data to the same place. But there isn't much of one.

If you start a foreground command, there is no problem because the parent shell is sitting in the `wait()` system call until the command that you have typed terminates.

If you start a background process, you may see the output of the shell and the process appearing on the screen at the same time. This can be inconvenient, especially if you have started another command in the meantime and some long-running background process suddenly decides to inform you of its newfound knowledge all over your screen.

What about input? Well, it used to be the case that things got really confusing if you typed `cat&`. Both your shell and the backgrounded `cat` process would compete for the keyboard input. This is no longer true; mechanisms exist to prevent this competition. Modern shells cooperate with the terminal device driver to ensure that a background process is paused if it needs input from the terminal. It will not be permitted to have any typed input until your shell has "brought the process into the foreground."

## Redirection

If you look back at the example code sequence, you should be able to see where redirection fits into this picture. If you say something like

```
% ls > opfile
```

then the shell sees that you have typed a new command and will fork. In the newly created child process, it adds some steps just before the `exec()` call. This will be done only in

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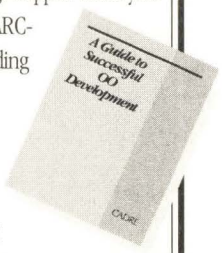


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the child and so will not affect any open files that already exist in the parent.

The child process has access to a copy of all the parent's data space and can see that the `exec()` system call should be invoked with the standard output switched to the new output file. The code will close the existing standard output channel and create the file `opfile`, arranging that this is file descriptor 1. This is not hard because file descriptors are issued sequentially and are reused in order as they are closed. So if file descriptor 1 is closed and a new file is opened, it will be assigned the number 1. The code is something like

```
close(1);
open(file...);
```

Having established the new setup for descriptors 0, 1 and 2, `exec()` will be called to start the new process.

The ability to append to files

```
$ ls >> opfile
```

falls out of this mechanism very easily. It just affects the type of file creation system call that is made. Rather than creating a new file, an existing file is opened and things set up so that subsequent writes to the file will append data. Then `exec()` is called as before.

The Bourne and Korn shells allow you to manipulate file descriptors separately. You can say

```
$ cmd 2> file
```

and have the error output from the command diverted to a file. This is useful if you want to ignore any error messages. You can say

```
$ cmd 2> /dev/null
```

to consign them to the great void. You can send standard output to one place, and the standard error to another.

```
$ cmd > opfile 2> /dev/null
```

puts the standard output to `opfile` and loses the error output.

In `csh`, there is not this level of control. All you can do is redirect standard output and standard error to the same place:

```
% cmd >& op_and_err
```

You can do ingenious things with subshells to split the output into separate files.

```
% (cmd > opfile) >& errs
```

The round brackets make the shell fork and start a new copy of itself. The standard output and standard error channels of this subshell are sent to the same place, the file `errs`. However, the subshell will generate nothing on standard output because in turn it is running a command with diverted output:

```
cmd > opfile
```

placing its output in the `opfile` file.

The `>&` operation needs a system call to manipulate file descriptors. We've already seen how the code in the child process can establish a particular file as file descriptor 1. It just closes channel 1 and opens a new file. To make descriptors 1 and 2 point to the same file, it could use `open()` again and obtain the new descriptor. However, it may not know the name of the file, and so we need a way to duplicate open file descriptors. The `dup()` system call does this. The code sequence to make `>&` work is something like:

```
close(1);
open(opfile...);
/* opfile is opened as 1 */
close(2);
dup(1);
/* 2 is now a copy of 1 */
```

The `dup()` system call is mirrored in the syntax used in the Bourne and Korn shells to point the standard output and error channels to a single destination. The most useful form of the syntax is `2>&1`. It mirrors the `dup` call, saying: close channel 2, duplicate from channel 1. You can replace the "2" and the "1" with any single-digit file descriptor. You don't use this instead of a normal redirection, instead you place it on the line so that it changes the file descriptors:

```
$ cmd >opfile 2>&1
```

You read this left to right: run `cmd`, set the standard output to `opfile`, then close standard error and duplicate it from the standard output. Channels 1 and 2 now point to `opfile`.

I always have found the `>&` syntax to be confusing, and it's best to think of the operator as a way of merging data streams rather than duplicating them. The `csh` syntax is much easier to use for the most common case of pointing the standard output and error channels to the same place.

## Pipes

One form of output redirection that we all use is pipes. The syntax

```
% cmd1 | cmd2
```

runs `cmd1` and sends its standard output into the standard input of `cmd2`.

This uses the same techniques to set up the redirection in the children as I described above. It needs a new system call, `pipe()`. This returns two file descriptors, one for reading from the pipe and one for writing data down the pipe.

If you want to write some data from a parent to a child, you first call the `pipe()` system call and then `fork()`. Both the parent and the child now have copies of both ends of the pipe. The parent will close its copy of the read file descriptor and will send data using the write descriptor. The child will close its copy of the write half and will receive data from the read file descriptor. If the child is going to exec to another program that expects to read standard input, then it will use `close()` and `dup()` to ensure that the pipe read end becomes file descriptor 0.

**still like UNIX. I still avoid the need to run Solaris on my SPARC.**

Things are somewhat more complicated in shells because the parent needs to arrange that the output from one command is sent to the input of another. There are several choices for how this is to happen. The Bourne shell will `fork()` to create the process that is to be `cmd2`. The putative `cmd2` will call `pipe()` and will `fork()` again to create the process that will become `cmd1`. Along the way, file descriptors are manipulated to create the correct data flow.

This method works most of the time, but there can be problems if `cmd2` dies before `cmd1`. The parent of `cmd1` is not the shell; the shell is waiting only for `cmd2` to terminate. When `cmd2` dies, process 1 becomes the parent of the orphaned `cmd1`. This sequence of events sometimes gives curious effects.

The designers of `csh` had job control to worry about and wanted to make both `cmd1` and `cmd2` be children of the shell. So, `csh` calls `pipe()` and forks twice to create `cmd1` and `cmd2` processes. The children will perform the necessary file descriptor manipulation as before. The parent shell will just close both ends of its pipe; its job was to create it and pass it into its children.

If you want to blast the standard output and standard error down a pipe from `csh`, then you just add an ampersand after the vertical bar symbol:

```
% cmd1 |& cmd2
```

This is consistent with the previous redirection syntax.

With Bourne and Korn shells, you use the file descriptor manipulation syntax:

```
$ cmd1 2>&1 | cmd2
```

The *UNIX Power Tools* book from O'Reilly & Associates (ISBN 0-553-35402-7) has a good example where the ability to deal with file descriptors other than 0, 1 and 2 is useful. The problem is simple: How do I send the standard error output from `cmd1` down the pipe to `cmd2` and send the standard output from `cmd1` to the place where the standard error channel was pointing. Basically, I want to swap the actions of the standard output and error channels.

Well, if you think about swapping anything, you need to move one of the things out of the way to make space for the other. You have a single driver, two cars and two parking spaces and want to swap the cars in the parking spots. You need somewhere to put one of the cars while you move the other. This is life. The same thing is true of moving file descriptors.

To swap file descriptors 1 and 2, we need another descriptor to remember where one pointed while we move things. We end up typing

```
$ cmd1 3>&1 1>&2 2>&3 | cmd2
```

Remember that this reads left to right. First, we close 3 and duplicate from 1. This sets up the placeholder, channel 3, to point to the standard output. Now we close 1 and duplicate from 2, so what was the standard output is now the standard error channel. Finally, we close 2 and duplicate from 3, so what was the standard error channel is set up to the original standard output from the placeholder.

We probably should be good citizens and close channel 3. The shells have a syntax for this too: `3>&-`. Insert this just before the pipe symbol.

## Finally

There's a small addendum to my comment about attending university in the United Kingdom. I am a proud holder of a Bachelor of Arts in Computer Science. I neglected to take the step of converting this to a Bachelor of Science when offered the opportunity a few years after I left. I have a Ph.D as well, just for the record.

This is article number 50 for *SunExpert*. Better, it's the first article that I have managed to start with the big letter "Y" for the enjoyment of the Art Department. Here's my score for initial letters to date: "I" is the clear winner with 17 occurrences. "T" is in second place with nine. In third place, each with four articles, we have "A", "L" and "W". Skulking along with two mentions are: "M", "P" and "U". Shamefacedly, with solo entries, come: "J", "N", "O", "R" and "Z". "Z" was the word "Zounds!"–a deliberate attempt to cheat.

I continue to astound myself that I have ideas for articles each month. I still like UNIX. I still avoid the need to run Solaris on my SPARC although it does lurk on a disk if I need to find something out.

There are a couple of people in the office who deserve a big vote of thanks. They do much to make these articles better. They are Mary Anne Weeks Mayo and Lisa Guisbond. Most heartening is the email response from many readers with ideas, suggestions and general encouragement. To all who have mailed: Thanks and keep sending.

---

**Peter Collinson** runs his own UNIX consultancy, dedicated to earning enough money to allow him to pursue his own interests; doing whatever, whenever, where ever... He writes, teaches, consults and programs using SunOS running on a SPARCstation 2. Email: `pc@expert.com`.

PRINCIPLES
FOR NETWORK
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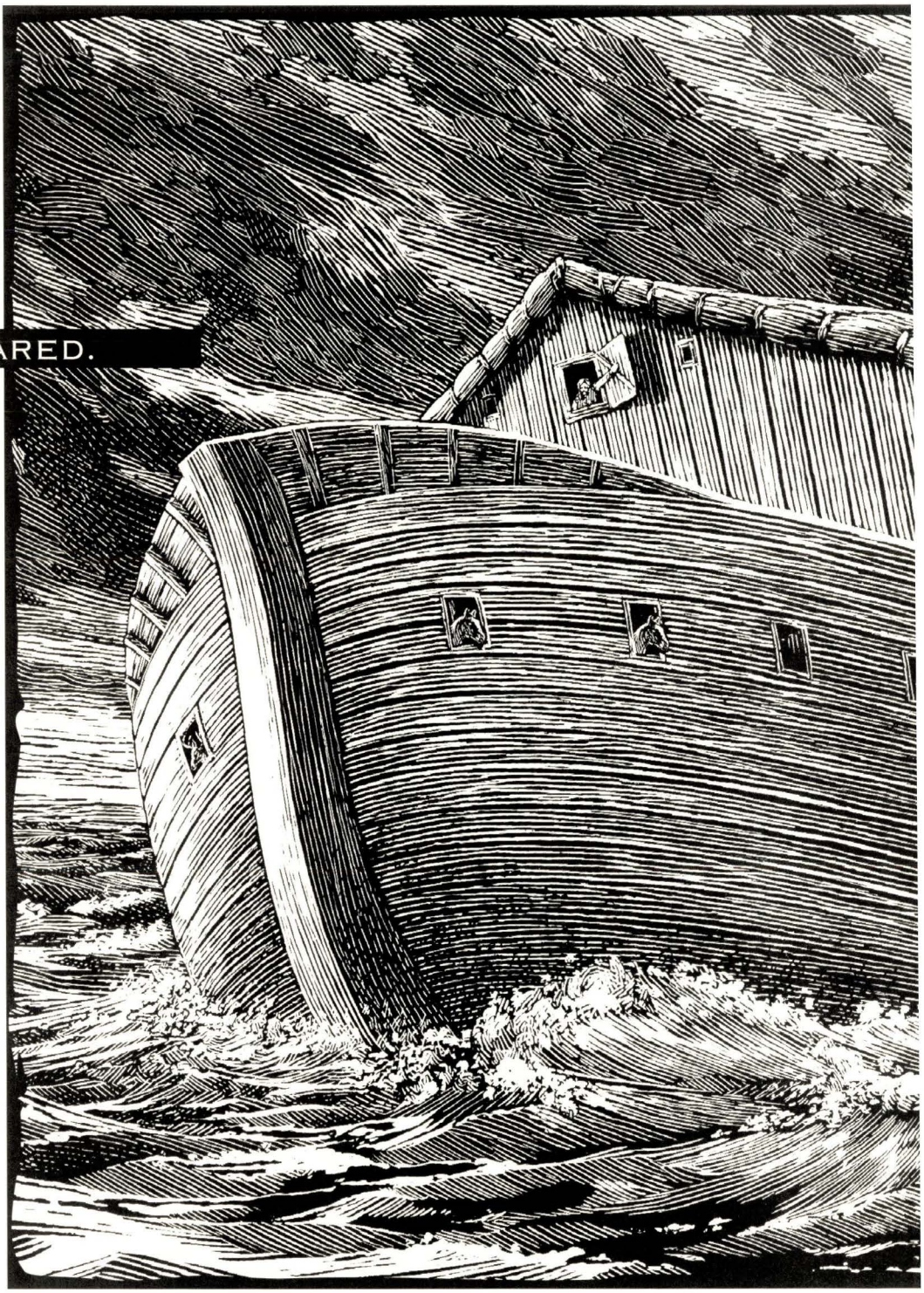
#3

# BE PREPARED.



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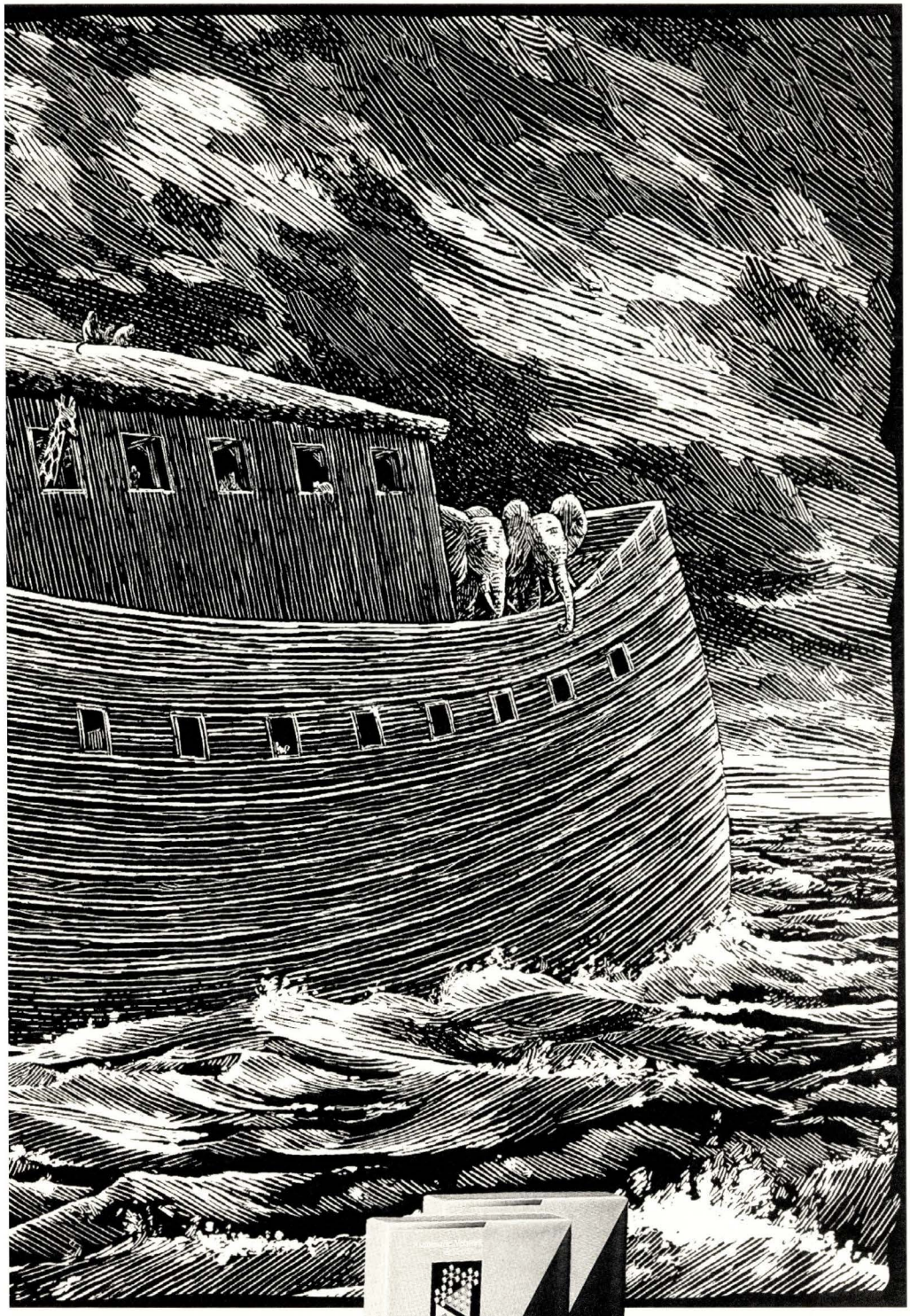

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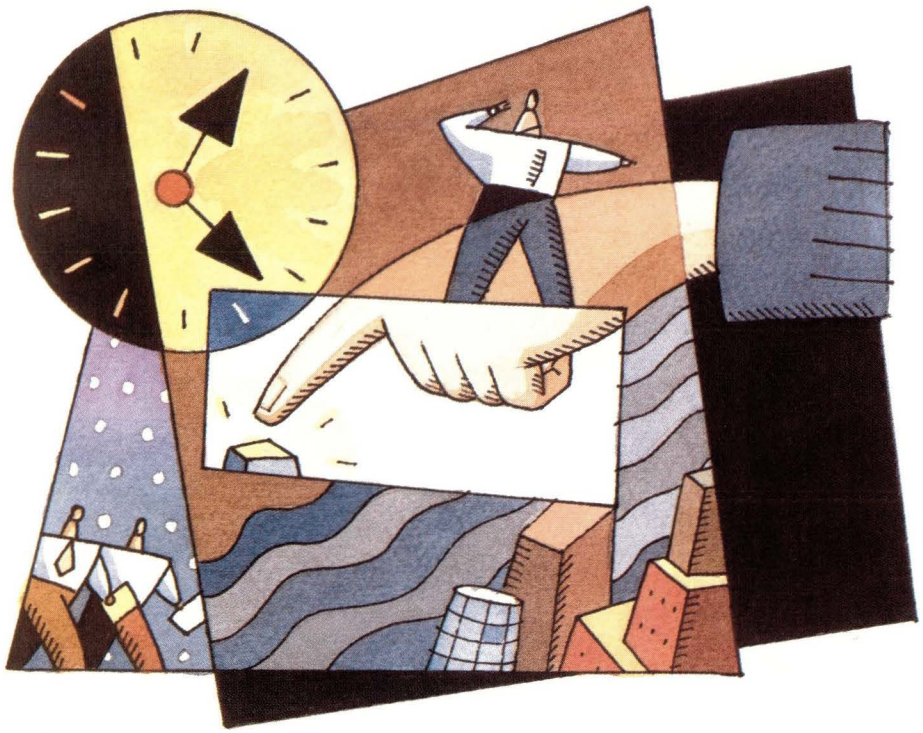


ROBIN JAREAUX

by **RICHARD MORIN**,
Technical Editor

# Redefining Real Time, Redux

Almost two years ago ("What a Long, Strange Trip It's Been," *SunExpert*, February 1992, Page 42), this column touched on real-time programming in general, and Mike Peck's work in particular. Mike has been using Suns for real-time data acquisition for quite a while. In 1983, he was stuffing dedicated processor boards into a hypertrophied Sun-2 Multibus card cage. A decade later, his company (Berkeley Camera Engineering, (510) 889-6960) is still pushing Suns to their limits.

In "Redefining Real-Time" (*SUG Proceedings*, June 1991), Mike defined several levels of real-time performance and described the kinds of hardware and software support needed to achieve them. Redefined once more for this article, the scale maps guaranteed (worst-case) response time to a modified logarithmic scale. In general, level N response guarantees response within $10^{-N}$ seconds.

Levels seven through five (0.1 to 10 µsec) generally require dedicated hardware. Level four (100 µsec) requires a dedicated processor, possibly running a specialized real-time kernel. Levels three through one (1 to 100 msec) can be achieved by general-purpose operating systems with "real-time" support. At level zero, there is no guaranteed worst-case response time.

In the past few years, a number of UNIX kernels with real-time support (LynxOS, HP-UX and others) have reportedly achieved guaranteed response times approaching 10 msec. This is a spectacular change, given the previous (unbounded) performance of UNIX systems.

There are no standard benchmark tests or even conceptual standards for real-time OS performance measurements. The simplest place to start is the obvious: How long does it take an application program to respond to an external event while running under "normal" conditions?

Well, Solaris is supposed to have real-time support. User-mode processes under Solaris 2.X can be given a real-time priority that is below interrupts but above normal system execution and time sharing (user code). A lot of sophisticated work, for instance, was put into Solaris to guarantee that real-time threads would not block. The fully preemptive kernel is also a big win because it guarantees that processes won't suffer arbitrary scheduling delays.

Because of this work, Solaris 2.2 does real time pretty well. Even on a loaded machine, user-mode processes with real-time priority can expect worst-case interrupt latencies under one millisecond. This isn't bad at all for a general-purpose OS like UNIX. Processes under SunOS 4.1.3 (or Solaris 2.2 without real-time priority) get worst-case times approaching a second, about 1,000 times worse.

By putting code into a device driver,

a sufficiently motivated programmer can do quite a bit better. The worst-case interrupt latency in the lower half of a Solaris device driver is about 100 µsec. This brings us down to level four, still working under Solaris.

Add a little specialized hardware, and things can get fast indeed. Mike's SBusDSP card, for instance, can do solid level six (1 µsec) work, just in its Digital Signal Processor (Motorola 56001) chip. It can't do much at that speed, just grab or send a byte or two.

Bring the SBusDSP's in-circuit-loadable gate array (Xilinx 3042) into the picture, and you can get true level seven (0.1 µsec) performance. In one application, the card grabs 8 MB/s on a continuous basis. It folds this down to 2 MB/s, which it passes in to the Sun. The Sun stashes the data on disk, dumps it to a pair of tapes drives, *and* runs MatLab, providing on-the-fly data analysis.

If you're not interested in doing rapid-fire data acquisition or fast real-time support, the numbers above may seem a little less than captivating. Can any of this be used to help the everyday UNIX programmer? Amazingly, it can.

Let's say you want to know how long your program is taking to do its thing. The information has to be *extremely* accurate, and you can't burden the application with a lot of heavyweight tracing code, lest the results get skewed away from reality. Using the SBusDSP, you can do this task rather trivially.

Tell the card to catch and time-tag accesses on a pair of SBus-accessible device registers. A write can start the associated timer; a read can stop and reset it, latching and logging the timing data. Have the card log, say, up to 16-KB events in its internal memory.

Now, map the registers into your application's memory, allowing the program to read (`foo=reg1`) or write (`reg1=0`) them. Put these statements in your code at appropriate points, and you can trace your application with level seven (0.1 µsec.) resolution.

If your application is real time, or at least event-driven, the same technique can be extended in a rather nifty manner. Put your register accesses into the driver (upper and lower halves) and application code. Have the card strobe the system every 50 msec, and run your code for a substantial number of iterations. You'll be able to draw pretty (and very reliable) histograms showing where all your latencies originate.

## Rethinking Solaris

This column has been pretty critical of Solaris in times past (some quite recently :-). It has noted the system's lack of efficiency, bugginess and lack of reasonable development tools. It has also noted that SunOS users, programmers and administrators are forced to learn different, and occasionally deficient, interfaces.

While all of this remains true, it does not tell the whole story. Solaris' real-time features really do work. Guaranteed submillisecond performance for user-mode processes makes real-time systems a *lot* easier to build. Other features, such as reworked (and documented!) kernel interfaces, strong support for threads and tight interprocess communication, make Solaris much more powerful and convenient than SunOS for building real-time applications.

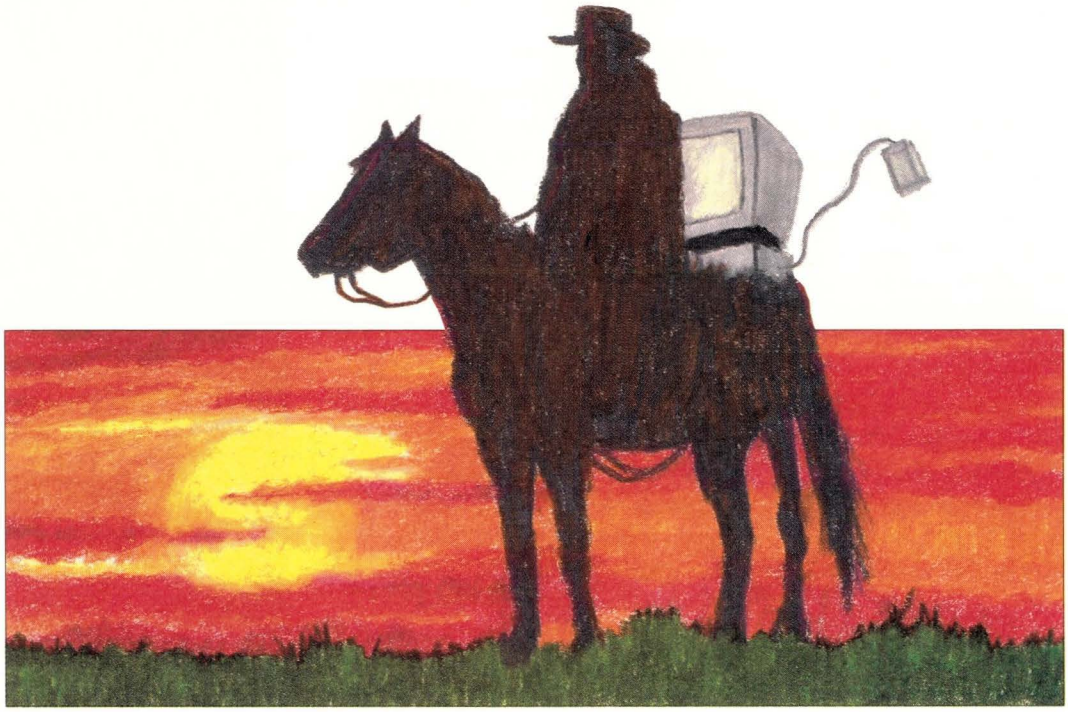
If we want to have really nifty multimedia applications on our desktops, we're going to have to put up with some changes in the way we program. High-fidelity audio and video make severe real-time demands on operating systems. They also use up a lot of general-purpose processing power, which may be most economically supplied by multiple processors.

So, Solaris is clearly moving in the right direction for the systems we will all want a few years from now. In fact, the multimedia applications now showing up for SPARC platforms are only feasible because of this kind of support. Consequently, Solaris, or something like it, will be sitting on my desktop within the next few years. ⊸

---

**Richard Morin** operates Prime Time Freeware (ptf@cfcl.com), which publishes mixed-media (book/CD-ROM) freeware collections. He also consults and writes on UNIX-related topics. He may be reached at Canta Forda Computer Laboratory, P.O. Box 1488, Pacifica, CA 94044 or by email at rdm@cfcl.com.

Your Standard Column



JOHN W. KELLEY JR.

# End of the Line

by PETER H. SALUS

This will be my last column in this space.

I have been writing "Your Standard Column" for more than three years, and that's most likely too long to be doing the "same thing." (No, I am not interested in comments about the fact that I have a 25-year-old daughter, to whose mother I am, indeed, still married.) I have enjoyed writing about the varied standards bodies over the years, and I hope I've both informed and inflamed the readership at times. Before I ride off into the sunset, however, I'd like to make a few points about the process.

To many, POSIX looks out of control. I think that it is. At this moment, when it looks as though Novell may hand the UNIX trademark over to X/Open, XPGn will (by mid-1994) become "standard," and COSE and CORBA may well render other aspects of POSIX largely irrelevant.

As Henry Spencer of the University of Toronto has pointed out, one of the major problems is exemplified by the fact that IEEE's rules don't include the possibility of a group voting "not ready for standardization." Killing a vapid effort is nearly impossible.

I think that everyone's favorite example of this is P1003.4 and its subcommittees. (.4 is Real Time; .4a is Threads; .4b is "a collection of fairly exotic stuff" [Bill O. Gallmeister, vice chair of .4]; .4c is the Language Independent implementation–I assume this will disappear now that LIS has been exterminated.)

Ran Atkinson has pointed out, "The higher the value of n within 1003.n, the higher the probability that standards are being invented rather than relying on standardizing reasonably solid existing practice. The primary exception to this that I am aware of is P1003.12, which is working on networking interfaces. P1003.12 is doing the eminently sensible thing, which is to standardize both the 4.4 BSD sockets interface and the X/Open Transport Interfaces (XTI is a derivative of the SVID's TLI). Both are being specified in as protocol-neutral a manner as is practical."

Jason Zions has defended .4 on historical grounds: "1003.4 is a pathological case, granted. It was sponsored long before PASC created relatively firm rules about invention; PASC treats it as 'grandfathered,' in an attempt to be fair to people who've spent years working on it." This is the same argument that Lyndon Johnson used about Vietnam: We just couldn't walk away. We can and should walk away; those people who "spent years working on it" got paid. The majority of .4 supporters are special-interest companies, like Lynx, that have already marketed what they are now trying to standardize.

On the other hand, and more to Spencer's point, we should not be attempting to standardize in advance of the technology. Prescriptive standardization has never worked. In no field have we had crystal balls available. I think that .4 (a,b,c) is doing everything exactly wrong; the result is likely to be a monstrosity. The (sub)committees are inventing stuff wildly because there *is* no generally accepted, established practice in these areas. This means to me that standardization in these areas is definitely premature.

This brings me back to Henry's basic point: While IEEE has ways for things to be voted up or down, it has no provision for "not ready for prime time." Hal Jespersen, who has spent vast amounts of time and energy on the P1003.n process, has written: "If the general *subject* of the draft is not ready for standardization, because there is no existing practice, the time to block the work is when it is proposed in the sponsoring committee (in the case of POSIX, the Portable Applications Standards Committee, which has its own subcommittee that is dedicated to just such a review for readiness). If there are enough folks who think there should be *some* standard covering a subject matter, and the working group can get it into ballot, then the burden falls on balloters to propose something different, other than blank pages, to replace the draft.

"There are a few things they could do, assuming that they hear about the emerging working group or standard. They could write to the IEEE Standards Board New Standards Committee (Nescom) and provide cogent arguments about why the PAR should not be approved. They could lobby with the big consortia, like X/Open, OSF and UI, who have a lot of participation in, and clout with PASC. They could join the mailing list for the working group and give lots of specific negative (but constructive) feedback on mock ballots. They could send in real ballots with enough specific technical content that others would be persuaded by the force of their argument.

"According to IEEE-CS rules, they cannot refuse to sponsor a PAR (project authorization request); if enough people want to develop a standard in an area covered by the Society, they must be allowed to do so. This acts to prevent vendors in an industry segment which is heavily dominated by proprietary solutions from choosing to stop attempts to produce standards within that domain."

**POSIX.4 is a good example of the need for a way to kill berserk standards committees.**

As one would expect from Hal, this is both cogent and correct. The problem arises where .4 has a PAR, was grandfathered in, and (as has been pointed out) "is heavily dominated by proprietary solutions."

If you look at standards that have worked out reasonably well, such as ANSI C, the areas in which the standards committees engaged in invention (as opposed to selecting and tidying up the best ideas already proven by implementation experience) are exactly the areas that most everyone thinks badly flawed–ISO C trigraphs come to mind. ISO/ANSI C and POSIX.1 are good standards precisely because there is very little "design by committee" in them. POSIX.2 is a little more doubtful. POSIX.4 is a good example of the need for a way to kill berserk standards committees.

## A Few Last Books

Daniel P. Dern has produced *The Internet Guide for New Users*, (570 pp., McGraw Hill, 1993, ISBN 0-07-016511-4, $27.95). More massive than Ed Krol's *The Whole Internet* and more comprehensive than Kehoe's *Zen*, I found Dern easy to read and full of information. Its size may intimidate the genuine new user, but it is the sensible place for a nonprofessional to go after Kehoe (though I think Dern's early chapters are, indeed, suitable for true beginners). There are some inconsistencies: Bourne and Korn get credit for `sh` and `ksh`; no one does for `csh`. But this is not a volume limited to UNIX users, so the cursory history of UNIX and the omission of UUCP aren't that important. I recommend it very highly to those of you who want to spread the gospel. If we ever get to real widespread access from the home, Dern will have a best-seller on his hands.

Prentice Hall has reprinted P.J. Plauger's "Programming on Purpose" columns from (now-defunct) *Computer Language* in three volumes. If you're a Plauger fan (as I am), you'll want them all: ISBN 0-13-721374-3, 0-13-328105-1, 0-13-328113-2, $19.95 each.

Susan Estrada's *Connecting to the Internet: A Buyer's Guide* is just that (O'Reilly & Associates, ISBN 1-56592-061-9, $15.95). Before your Aunt Sadie begins using the Internet, she's going to need a provider. Estrada's book will tell her (and your friend, Tomas) how to find a provider and how to talk to whomever answers the phone.

And a plug: UNIX will be 25 years old in 1994. In May or June, Addison-Wesley will be bringing out my quarter-century history. Buy one and help put my daughter through graduate school!

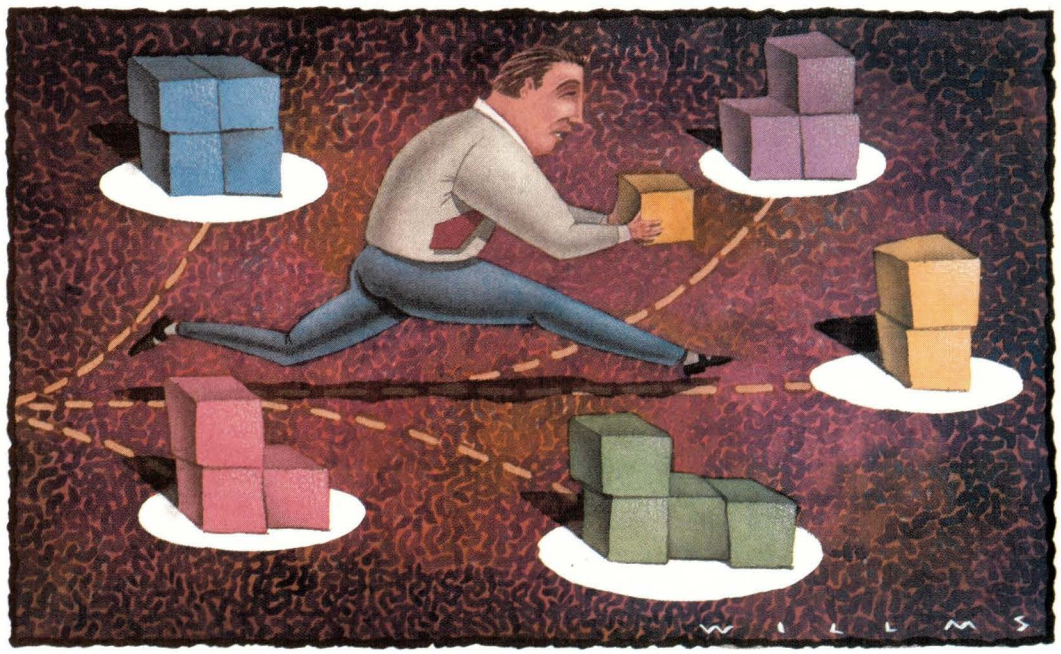
## Thanks

Finally, I'd like to thank Doug Pryor, the editor of *SunExpert*, and the staff–especially Mary Anne Weeks Mayo and Michael J. Tucker–for their support and assistance over the past three years.

Wishing you all a Merry Christmas, Happy Chanukah and a healthy and prosperous New Year.

Happy hacking!

**Peter H. Salus** is currently working on books on internationalization and computer communications. He has attended P1003, P1224 and ISO meetings. He can be reached at `peter@uunet.uu.net`.




RUSS WILLMS

# Managing Man Pages

by S. LEE HENRY

Managers of complex systems often find themselves managing a host of applications–commercial, shareware and home-grown. Keeping your system documentation up to date with your system takes some fastidiousness on your part but pays off in the long run. This month we'll explore the process of maintaining man pages and creating new ones for all those tools that you build yourself and those that arrive at your door without benefit of proper documentation.

## The man Command

The `man` command is undoubtedly one of the first commands that any new user in the UNIX world learns. Even today, I use the command frequently and am always surprised at the number of unfamiliar options I find for otherwise familiar commands. The standard set of man pages is always in demand by both novice and veteran UNIX users. Sometimes cryptic and often incorrect, the man pages are nevertheless consulted frequently.

Keeping your man pages organized is usually straightforward. Most commercial applications and large shareware applications will include man pages that you can install or leave in the application's directory. The best strategy seems to be to keep your non-OS man pages together in one directory. If you leave application man pages in the application directories, you can easily wind up with unwieldy MANPATHs (like that shown below) or, worse, a huge diversity in the paths your users take to search out wisdom on commands and applications.

```
boson% echo $MANPATH
/usr/local/man:/usr/lang/man:/usr/openwin/man:
  /usr/man:/apps/image/oia/man:/usr/local/accts/man
```

Finding the man pages in a shareware application is usually easy. Commercial applications most often come with a script that asks whether you want the man pages installed and where. Most of the time, they will be in a

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```
boson% foreach file (`ls man`)
? set SEC = `echo $file | awk -f getsect`
? cp man/$file /usr/local/man/man$SEC
? echo copied $file to /usr/local/man/man$SEC
? end

#       getsect -- get section from man page filename
#
BEGIN {FS = "."}
{
SECTION = substr($NF,1,1)
print SECTION }
boson% ls -l /usr/local/man/man4
total 7
-rw-r--r--     1 root         6562 Jun 27 1992 ispell.4
```

*Figure 1. Moving Man Pages*

man or doc subdirectory. When they are simply thrown in a directory with other files, the section numbers (e.g., pixwrap.1) give them away. You can also use the `file` command to check the type of the alleged man page. You will get something like this:

```
boson% file pixwrap.1
pixwrap.1:     [nt]roff, tbl, or eqn input text
```

If the files are organized in a single directory, you can copy them into place as illustrated in Figure 1. Here, we are using an `awk` script to determine in which section each man page belongs.

The directory `/usr/local/man` is a good choice for where to keep all of your non-OS man pages; this gives you the benefit of not having to help your users set up long search paths to include all of the possible man pages they might need, and it keeps your OS man pages distinct and separable for easy backup or reinstallation.

An even easier method is to specify the sections that are included. You will not usually have man pages for more than a few of the available sections, as we've shown in the example. Watch out for man pages with extensions like `1c`, which you'll also want to include in your `foreach` line.

```
boson% foreach section (1 2 5 8)
? cp man/*.$section /usr/local/man/man$section
? end
```

If you've been so lucky as to inherit a large server system with man pages strewn across a variety of locations, you can root them out and gather them in a single location with a `find` command. The command below starts looking in `/usr/local` for all the stray man pages belonging in Section 8 and copies them to the appropriate subdirectory in `/usr/local/man`. Of course, it will not copy files already in `/usr/local/man` on top of themselves but give you an "are identical (not copied)" message.

```
find /usr/local -name '*.8'-exec cp {}
   /usr/local/man/man8 \;
```

## Preformatted Man Pages

Preformatted man pages save you the time that you encounter when you say "man something" and the system says "Reformatting page. Wait..." If you don't need your man output to adjust to the size of your windows, preformatting saves you time. These are created with the `catman` command, which, by the way, will use a lot of system resources to reformat all the man pages (so it's better to do this at night). Preformatted pages are also somewhat larger than their `nroff` counterparts since formatting commands turn into white space indents, and page breaks add a lot of extra space.

## One-Liners

Another man page feature that is especially useful for new users is the `whatis` database. The `whatis` command provides one-line explanations of commands. It looks through all of the directories in your MANPATH for a `whatis` file. If it doesn't find one in any of the search locations, it issues a message like that shown below. Clearly, if you use `whatis`, you should use it consistently to avoid messages that will make your system look poorly managed.

```
boson% whatis lpr
/usr/local/cap/man/whatis: No such file or
   directory
lpr (1)        -send a job to the printer
```

`whatis` databases are created with the `-w` option of `catman`. The command shown below would create a `whatis` file in `/usr/local/cap/man`. The `whatis` file (for root-issued `catman` commands) is actually a zero-length file; the file containing the one-liners for the `whatis` command is stored in `/usr/share/man/whatis`.

*Figure 2. Standard Man Page Headings*

```
NAME
SYNOPSIS
DESCRIPTION
OPTIONS
FILES
SEE ALSO
DIAGNOSTICS
BUGS
```

# IF YOU'RE TORN BETWEEN PURCHASING X TERMINALS OR SPARCSTATIONS, CONSIDER THE ALTERNATIVE. TODAY, RIGHT SIZING MEANS LEVERAGING YOUR EXISTING HARDWARE INVESTMENT

## X TERMINALS

**PROS**

- ✓ LOWER COST PER SEAT
- ✓ EASY SYSTEM ADMINISTRATION
- ✓ EASY CONNECTIVITY
- ✓ MULTIPLE SUPPLIERS

**CONS**

- ✓ DOESN'T RUN ALL SUN APPLICATIONS
- ✓ RESPONSE TIME DEPENDS ON NETWORK LOAD
- ✓ INCREASES NETWORK TRAFFIC
- ✓ REQUIRES EXTRA MEMORY FOR LOCAL CLIENTS
- ✓ UPGRADE PATH IS UNKNOWN

GET OFF THE NET AND ON THE BUS!

## SPARCstations

**PROS**

- ✓ RUNS ALL SUN APPLICATIONS
- ✓ HIGH PERFORMANCE
- ✓ LOCAL PROCESSING
- ✓ UPGRADABLE PERFORMANCE

**CONS**

- ✓ TOO EXPENSIVE TO JUSTIFY FOR EVERY USER
- ✓ COMPLEX SYSTEM ADMINISTRATION
- ✓ SUPPORTS ONLY ONE USER

### Leverage Your Existing Hardware By Adding Multiple Users To Your SPARCstation...

The new GXTRAstation allows you to easily add multiple users to your SPARCstations, as you need them, significantly reducing cost per seat and making new higher performance systems more affordable. Extra users can quickly be added to any system with an available SBus slot. Multiple GXTRAstations can be used in any single system, limited only by the number of SBus slots.

Using a direct SBus connection will greatly improve your overall system performance by freeing your network from the burden of X Terminal traffic.

Unlike X Terminals, the GXTRAstation was designed to support all clients locally, just like the SPARCstation, because it connects directly to the local SBus. This direct connection allows your graphic commands to travel at maximum SBus speed, greatly increasing your total system performance.

## GXTRAstations

**PROS**

- ✓ RUNS ALL SUN APPLICATIONS
- ✓ HIGH PERFORMANCE
- ✓ LOWER COST PER SEAT
- ✓ RESPONSE TIME INDEPENDENT OF NETWORK LOAD
- ✓ NO NETWORK TRAFFIC
- ✓ EASY SYSTEM ADMINISTRATION
- ✓ SUPPORTS MULTIPLE USERS ON SPARCstation
- ✓ UPGRADABLE PERFORMANCE

**CONS**

- ✓ REQUIRES AN AVAILABLE SBUS SLOT
- ✓ LIMITED TO 100 FEET FROM SPARCstation

### Leverage Tomorrow's Hardware By Providing Future Versatility...

The GXTRAstation's SBus card, the GXTRA, provides you with total flexibility for meeting tomorrow's upgrade requirements. It leverages your investment by allowing you to fully utilize any existing monitor. And, it has a built-in flexibility to meet the requirements of future monitor designs, including HDTV! It can also be reconfigured to act as the primary graphics accelerator, and turn your headless workstation into a complete SPARCstation, providing an upgrade path unparalleled by any X Terminal.

If you're torn between purchasing X Terminals or SPARCstations, then consider the alternative! Today, right sizing means leveraging your existing and future hardware investments.

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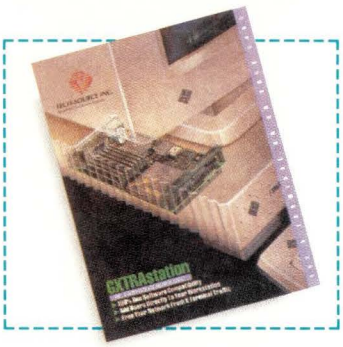


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Circle No. 30 on Inquiry Card

| | |
|---|---|
| .B | bold |
| .BI | bold and italic, alternating |
| .BR | bold and roman, alternating |
| .I | italic |
| .IP | begin indented paragraph (see .TP) |
| .LP | begin left-aligned paragraph |
| .RE | end relative indent |
| .RS | start relative indent |
| .SH | section heading |
| .TH | title and heading |
| .TP | begin indented paragraph |
| .\" | include comments (won't be displayed with man page) |

*Figure 3. Formatting Commands*

If users have man directories and issue the `catman` command, the `whatis` file in the directory will contain the one-liners for their personal man pages.

```
boson# catman -w -M /usr/local/cap/man
```

You should make sure when you support `whatis` that you update your `whatis` database when you add man pages. Otherwise, you will get random errors like this, even if the man page for the command displays properly:

```
boson% whatis mark
man: man entry for mark not found
```

Similarly, you should update man pages if you remove an application or function that is described in your `whatis` database. Simply running the `catman -w` command again will do the trick.

Another good command for beginners is the `man -k` command, which provides one-line summaries containing whatever keyword the user provides. This is helpful when you don't remember the command but can easily provide an important keyword. These one-liners are also derived from the `whatis` database built by `catman -w`.

```
boson% man -k queue
```

## Making Your Own

Building your own man pages can be extremely easy if you just learn a handful of nroff commands. Putting together man pages for applications that you support or system administration scripts that you've built can help you as well

# Reader Feedback

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as other administrators or someone who follows in your footsteps.

Man pages have a standard format that is wise to follow. Standard headings include the command NAME, and the SYNOPSIS or SYNTAX section showing arguments and options. The DESCRIPTION is usually the largest section and details what the command does and how to use it. An OPTIONS section is also fairly common. There is a FILES section that lists files that the command uses (as `lpr` uses the printcap file) and a SEE ALSO section, which lists related commands. A DIAGNOSTICS may be included, but usually only if the command might have a significantly interesting error status. A BUGS section is often included to list bugs or shortcomings.

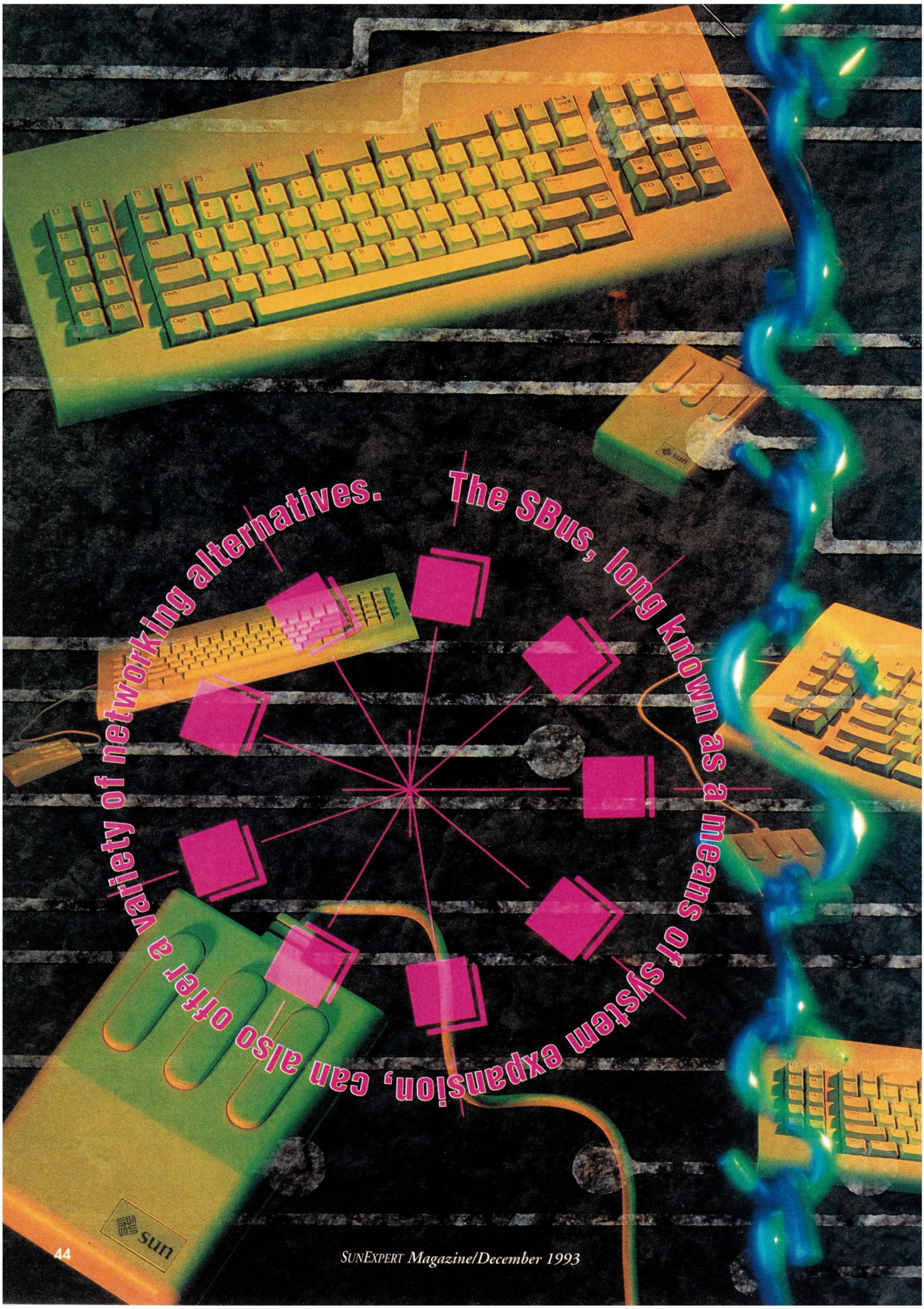
A good place to start if you'd like to build your own man pages is in the output of the command `man 7 man`. This command brings up the man page for `man` from Section 7.

A good place to start if you'd like to build your own man pages is in the output of the command `man 7 man`. This command brings up the man page for `man` from Section 7 and includes a lot of information on the nroff macros that man uses. For any command that has only a single man page, the section identifier is optional.

You can create a skeletal man page from a man page including the sections you are interested in (or I'll send you one if you like) and then replace the text with your own. Once you've created a man page for an application or script that you've developed, copy it to `/usr/local/man` (or your preferred location), run `catman` or `catman -w` if you use the preformatting or `whatis` features of `man` and you're done.

Make sure that you select the appropriate section for your new man page. User commands belong in Section 1, while system maintenance commands belong in Section 8. These sections correspond to the sections in the command reference manual and are standard. ⊸

**S. Lee Henry** is on the Board of Directors of the Sun User Group and manages computer and networking services for the Physics and Astronomy Department at Johns Hopkins University. Send mail to `slee@expert.com`.


The SBus, long known as a means of system expansion, can also offer a variety of networking alternatives.

# Networking: The SBus Option

by **MICHAEL JAY TUCKER**, Executive Editor

Over the past few years, the SBus has emerged as one of the hottest markets in the add-in board business. An astonishing number of SBus-based products are now available–including many that provide additional networking or connectivity functions to SPARCstations and servers.

This month's issue of *SunExpert* will look at some of the SBus options available for networking and connectivity. (See the table following this article for more information.) We'll also look at some of the users who have managed to make the SBus into a communications port.

HARRY BARTLETT PHOTOGRAPH.C

# Deep Seas and Dirt Devils

So you think you know serial ports? You think serial-port technology is for PCs supporting maybe a dozen dumb terminals? And probably in a small-business office?

Think again. One of the first "networking," or at least connectivity, technologies marketed for the SBus was multiport boards. And it is true that very, very many SPARCstations with multiport boards are indeed supporting character terminals in small businesses around the country.

But that's not the whole story. Serial ports can be much deeper than that. Four miles deep, to be exact. At the bottom of the ocean.

"What we've got is a deep-towed sled," says Roger Stokey, a research engineer at Woods Hole Oceanographic Institute, Woods Hole, MA. "As deep as 20,000 feet."

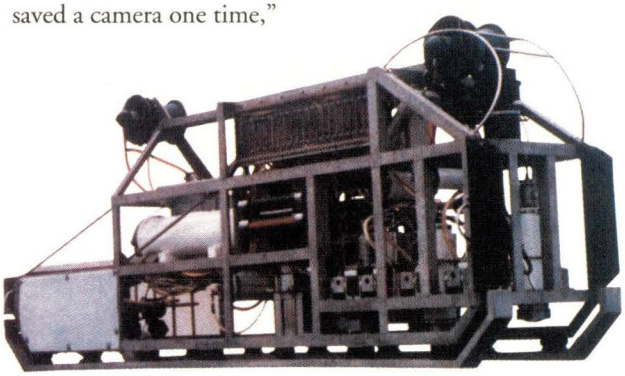
Stokey's project is a remotely piloted device that descends to great depths and is then towed behind a ship. "On the vehicle there are four video cameras, two electronic still cameras, regular 35mm [film] cameras, strobes and flashes for the still cameras, lights for the video cameras, a side scan sonar...and, oh yes, lots of embedded computers."

Sponsored by the National Science Foundation and the U.S. Naval Oceanographic Office, the vehicle's mission is to survey the ocean floor. It communicates with the surface via an armored fiber-optic cable–in effect, via serial lines. "All of this data is coming back into a Sun Microsystems Inc. workstation–actually, a hardened Sun workstation from Texas Microsystems Inc.–on about 25 serial lines," says Stokey. The 25 serial lines, in turn, attach to the Sun via two 16-port boards from Aurora Technologies Inc. The SPARC-based system on-ship is using

*On much drier land, the Dirt Devil vacuum cleaner is produced by Royal Appliance Manufacturing. Royal uses a SPARC-based server and a multiport adapter to run its entire MIS operation.*

those Aurora boards to take the data in for analysis. "It's basically the central clearinghouse for the data," says Stokey. And, via an OpenWindows application with a window for every instrument aboard the sled, it is also controlling the device.

"The Sun looks at all the data," says Stokey. "And a fault window will pop up if something goes akilter. We look for leaks, for instance, in the various bottles. You don't want any of your instruments getting corroded." It's a feature that's kept the sled whole and hale in the face of a very hostile environment. "It saved a camera one time,"



*A deep-sea sled, developed by Woods Hole Oceanographic Institute, is remotely piloted and monitored from the surface with a hardened Sun system from Texas Microsystems. The link between computer and vehicle is an armored fiber cable, and a multiport board from Aurora Technologies.*

he notes. "We had a crack in one of the domes, but we were able to get the sled to the surface in time to save the camera."

The sled presents control and communications problems that would challenge any networking technique. Yet, "simple" serial-line technology manages the task quite handily. "I looked at those tiny chips on the Aurora board and said, 'It'll never be able to handle all that data,'" remembers Stokey. "It was a very pleasant surprise to find that it could."

Still not convinced? OK, how about a major MIS operation?

Since multiport boards were among the first SBus applications, there are today many, many companies offering them. Yet new companies continue to enter the market. One of the most recent is Digiboard Inc., a vendor of serial-port products. Traditionally, it has played only in the ISA, EISA and MCA markets. Recently, however, it introduced its first SBus products, the C/X and EPC/X.

These are actually chassis-based products that connect to the SBus via an interface card and a cable. "We're seeing more and more people using SPARC servers as a client/server platform, and as a multiuser platform," says Joe Toste, Digiboard's product manager. With the Digiboard product, he notes, "you can actually have up to 1,792 users on a single SPARC server."

A company that has tried out the Digiboard multiport devices is Royal Appliance Manufacturing Inc., Cleveland, OH. Royal is the manufacturer of the Dirt Devil line of vacuum cleaners. "We've got a [SPARCserver] 690 with two of

the superSPARC modules, and we've got three of the Digiboard products," says Jim Lipsey, Royal's programmer/analyst and systems administrator. "That gives us about 250 active ports, and they connect to all sorts of things: printers, terminals and so on."

Royal is using it as a classic business computer. "We basically run our business applications off it," says Lipsey. "We've got everything you'd expect: MRP, accounting and so on."

The company had been using an Intel Corp. chip-based minicomputer for its information systems, but that began to run out of power. "We had Suns in our engineering department," explains Lipsey. "And we were familiar with them. And our applications were written in Thoroughbred Software International Inc.'s BASIC. It was easily ported to the Sun."

And the multiport boards have proved to be one of the most reliable parts of his investment. "Oh, we've had a few sleepless nights," he says, but it hasn't been about the serial line connectors. "Most of our issues have to do with the [Solaris] 2.X operating system. Sun should educate their support staff a little better...and then work on their kernel tuning.

# More Than a Token Effort

For Suns and SPARCalikes, networking usually means Ethernet. But there are other networks in the world. And, sometimes, users need access to them.

Like token ring, for example.

Sun, or rather the SunConnect planet of Sun, sells an SBus board to link SPARCstations and SPARCservers with IBM Corp.'s favorite networking approach. So does Aurora Technologies Inc. "The funny thing about token ring is that a lot of people wired their buildings with it," notes Dennis Daudelin, Aurora's preseident and CEO. In the days when IBM was the only safe choice for an MIS officer, thousands of businesses made token ring as much a part of their physical installations as sewer pipe and copper wire.

That means, though, "if you want to add a new machine to the network, you've got to have some way of plugging into token ring," says Daudelin.

It's a problem that more and more companies are going to face as they move away from PCs and mainframes. "Most of our customers tend to be large companies," explains Daudelin. "They are preparing to replace their PCs." The PCs can be swapped out relatively easily, but no one is going to rip wire out of the walls without some serious misgivings.

# When Is an X Term Not an X Term?

What if you need to network...without networking?

Say, for example, you have to put more than one user on a single workstation. But you don't want to generate Ethernet traffic, so you don't want X terminals. By like token, though, you need graphics, so you can't have characters running off a serial port. Maybe, too, you don't want to try running X over a serial line.

There is another option: graphics controllers.

Several companies now offer SBus-based graphics controllers that allow you to drive more than one monitor, keyboard and mouse off of a single workstation. In effect, it's like networking without networking.

Among the companies that offer such products are Megatek Corp., which offers the Esprit board; Intregrix Inc., with its SXT100; and Tech-Source Inc., which sells its GXTRA SBus cards for the purpose.

None of the companies originally intended to be in the business of making multiuser systems out of workstations. All thought they were just selling graphics controllers. But then customers started using them as a cheap, convenient and easy way to add monitors.

There are even good technical reasons for taking this particular route to multiuser systems. "X terminals create network traffic," says Michael Tobias, president of Tech-Source. "We don't create network traffic at all, nor are we affected by it."

The other advantage is speed. "Bandwidth is the big issue," says Jason Lo, president of Integrix. "An X terminal has to use Ethernet, which is 10 Mb/s. The SBus is almost 20 times that fast."

In fact, Tech-Source has just announced that it is selling its SBus card bundled with a monitor and a keyboard. The result is the GXTRAstation, which the company calls an X terminal. "An X terminal is something that executes Xlib calls," he says. "That is what our card does. In that sense, it

*Graphics controllers are one way of offering networking-like functionality without actually networking. TechSource in fact calls its GXTRAstation a networkless X terminal.*

is an X terminal...an X terminal that happens to attach to the SBus rather than an Ethernet network."

Integrix, meanwhile, prefers the term "S-terminal" for monitors driven by its products.

Of course, the graphics controller option will never challenge LANs for either the number of users they can support, nor the distance they can cover. Most can only drive a monitor that is less than 100 feet away from the host. But, even so, for many customers, the technique remains a happy compromise between classic networking and single-user systems.

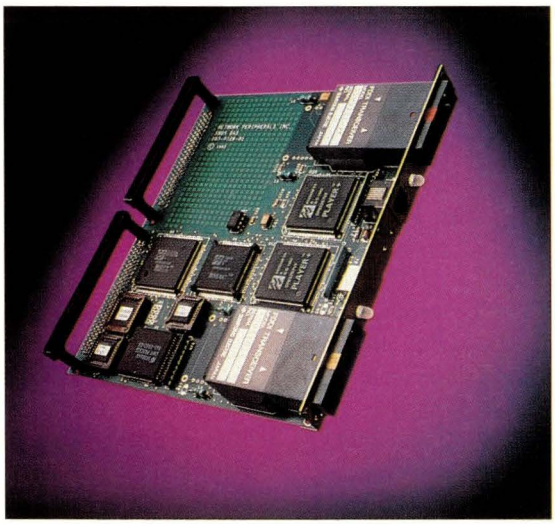
# Today It's on Top? But Tomorrow...

FDDI is the other major networking system to which Sun users frequently want to connect. Its appeal is simple–it is bloody fast, at 100 Mb/s.

"In the high-performance workstation, there is a gross mismatch between the MIPS on the desktop and the bits on the LAN," says Jayshree Ullal, vice president of marketing for the company that used to be Crescendo Communications, but which was recently purchased by Cisco Systems. "It is like having a Porsche and putting tricycle tires on it." Cisco/Crescendo has a large line of SBus FDDI connectors and CDDI connectors, which is the company's method of running FDDI over twisted pair.

There are, therefore, many companies offering SBus boards that link Suns to FDDI LANs. They range from Sun itself to a host of smaller FDDI-oriented companies and their resellers. They all, however, try to take their users beyond Ethernet. "There are two basic categories of users," says Gordon Stitt, vice president of Network Peripherals Inc., which also has a line of FDDI products. "The first is the people who are putting servers on FDDI and keeping their clients on Ethernet."

The other situation is where the end users need to run FDDI right to the desktop, either via fiber-optic cable or copper via Cisco's CDDI scheme. "The classic case is CAD," says Network Peripherals' Stitt. "Though, CAD's a word that covers a lot of ground. The people who need it are moving and using huge files frequently. It is typically something like MCAD, where you have very complex drawings moving about, or chip design."



*FDDI cards, like this one from Network Peripherals, give SBus systems to the 100-Mb/s world of FDDI. But how much competition will FDDI have from emerging standards for 100-Mb/s Ethernet?*

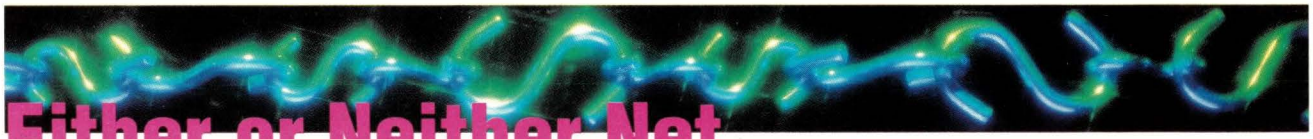
But FDDI isn't the only high-speed transmission scheme about. Ethernet is threatening to catch up. Various schemes for 100-Mb/s "Fast Ethernet" are already beyond the drawing-board stage. Are the FDDI vendors concerned that their business might be in for rough sailing?

"No," answers Cisco's Ullal. "The only analogy I can think of is that everyone used to say that FDDI would be the Ethernet of the '90s. In fact, the Ethernet business took no hit whatsoever." She feels that in the end both technologies will happily coexist, and may not even compete, with FDDI becoming the medium of choice for corporate backbones and Fast Ethernet being the desktop connectivity solution for most (albeit not all) users.

Network Peripherals' Stitt goes further. He thinks that Fast Ethernet may be in serious trouble. "It isn't a product yet, it

isn't really a technology, and there are two competing standards." Currently, there are two groups that have proposed rival standards for Fast Ethernet. One is grouped around AT&T, Hewlett-Packard Co. and IBM Corp. The other is grouped around Grand Junction Networks Inc. and 3Com Corp. "The more people see this battle," says Stitt, "the more people will see FDDI as the safe option."

Which is not to say that FDDI vendors are becoming complacent. "FDDI is not the ultimate," warns M.V.L. Prasad, FDDI product manager at CMC Network Products, the division of Rockwell International Corp. that currently markets FDDI VME boards and is planning an SBus version shortly. "Today, FDDI is the high end. But, tomorrow, it could just as well be something else."



# Either or Neither Net

Ethernet, of course, comes built into a Sun. That's part of the definition of a workstation.

But, even so, there are a host of SBus cards that can provide additional toppings to the old vanilla recipe. Sun Microsystems Inc. and a variety of other vendors offer everything from network accelerators to additional controllers. "For instance," explains Mark Reifler, product marketer at Artecon Inc., which sells a variety of SBus cards, "you could use an additional controller to split one large Ethernet network into two smaller ones–where you'd have a little better performance on both."

Meanwhile, one company has recently introduced an SBus product that takes networking off the shoulders of the workstation CPU entirely. Interphase Corp.'s Interphase 4627 Network CoProcessor offloads networking almost entirely from the native processor.

The company says that typical Ethernet controllers handle only the physical layer and a portion of the link-level protocol processing required for networking. Its product, though, transparently handles all protocol stack processing.

The 4627 comes with two Ethernet ports per SBus card and is based on a 38-MHz Motorola Inc. 689030 processor. It performs on-board NFS protocol processing and is Ethernet 10BaseT- and IEEE 802.3 Revision D-compliant. Pricing begins at $4,950. ➸

## Companies Mentioned In This Article

**Artecon Inc.**
2460 Impala Drive
Carlsbad, CA 92008-7326
**Circle 141**

**Aurora Technologies Inc.**
176 Second Ave.
Waltham, MA 02154
**Circle 142**

**Cisco Systems**
**Workgroup Business Unit**
*(formerly Crescendo Communications Inc.)*
710 Lakeway Drive
Sunnyvale, CA 94086-4058
**Circle 143**

**Grand Junction Networks Inc.**
3101 Whipple Road
Union City, CA 94587
**Circle 144**

**DigiBoard Inc.**
6400 Flying Cloud Drive
Eden Prairie, MN 55344
**Circle 145**

**Integrix Inc.**
1200 Lawrence Drive #150
Newbury Park, CA 91320
**Circle 146**

**Interphase Corp.**
13800 Senlac
Dallas, TX 75234-8823
**Circle 147**

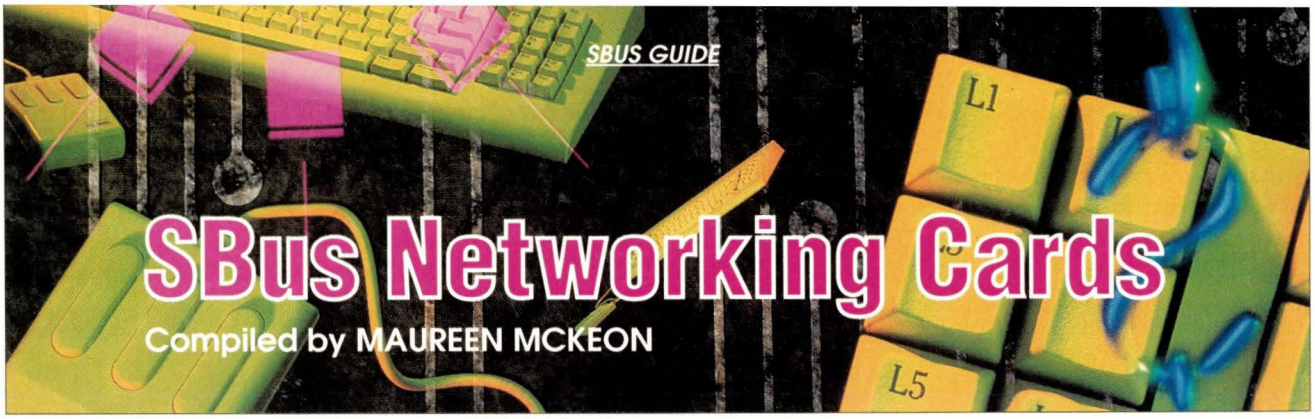
**Megatek Corp.**
9645 Scranton Road
San Diego, CA 92121-3782
**Circle 148**

**Network Peripherals Inc.**
1371 McCarthy Blvd.
Milpitas, CA 95035
**Circle 149**

**SunConnect**
2550 Garcia Ave.
Mountain View, CA 94043-1100
**Circle 150**

**Tech-Source Inc.**
442 S. North Lake Blvd. Suite 1008
Altamonte Springs, FL 32701
**Circle 151**

**Texas Microsystems Inc.**
10618 Rockley Road
Houston, TX 77099
**Circle 152**



# SBus Networking Cards

Compiled by MAUREEN MCKEON

## ADAX Inc.

614 Bancroft Way
Berkeley, CA 94710
**Circle 200**

**Model: APC-SBX**
**Product:** Communications controller
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** ADAX X.25, frame relay, SNA, SNDCF
**Product description:** Provides cost-effective, high-performance layer 2 support for X.25 and frame relay.
**Price:** $2,250

## ANDATACO

10140 Mesa Rim Road
San Diego, CA 92121
**Circle 201**

**Model: Token Ring**
**Product:** Network adapter
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** Device driver
**Product description:** Provides token-ring interface to a Sun workstation for both 8- and 16-bit networks.
**Price:** $1,295

**Model: COALM**
**Product:** Communications controller
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** Device driver
**Product description:** Several different models provide anywhere from 4 to 16 ports for RS-232 communications.
**Price:** $495-$3,495

**Model: FDDI card**
**Product:** Fiber distributed data interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** Device driver
**Product description:** Provides FDDI capabilities for Sun workstations.
**Price:** $2,595

**Model: SCSI Buffer Ethernet Card**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** Device driver
**Product description:** Provides second or alternative Ethernet port as well as an additional SCSI port to any Sun workstation.
**Price:** $1,095

## Antares Microsystems Inc.

160B Albright Way
Los Gatos, CA 95030
**Circle 202**

**Model: Ethernet (with Thin Ethernet & 10BaseT) 20-050-0003/20-050-0007**
**Product:** Ethernet controller
**Sun compatibility:** SPARCstation 1, SPARCstation 1+, SPARCstation 2, IPC, IPX, SPARCstation 10, SPARCserver 600 series
**SunOS compatibility:** SunOS 4.1.X, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** Converts SBus computer into an Ethernet gateway, router or bridge. Comes standard with AUI for use with cable and external transceiver.
**Price:** $295

**Model: SCSI-SNS (slow-narrow/single-ended) 20-050-0008**
**Product:** SCSI host adapter
**Sun compatibility:** SPARCstation 1, SPARCstation 1+, SPARCstation 2, IPC, IPX, SPARCstation 10, SPARCclassic, LX, SPARCstation 10, SPARCserver 600 series
**SunOS compatibility:** SunOS 4.1.X, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** SCSI host adapter has 5-MB/s transfer rate and allows for seven additional devices.
**Price:** $311

**Model: ConServer-ES, SCSI & Ethernet (with Thin Ethernet or 10BaseT Ethernet) 20-050-0005/20-050-0012**
**Product:** SCSI interface with Ethernet controller and transceiver
**Sun compatibility:** SPARCstation 1, SPARCstation 1+, IPC, SPARCstation 2, IPX, SPARCstation 10
**SunOS compatibility:** SunOS 4.1.X, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** SCSI interface with a thin or twisted-pair Ethernet controller and transceiver at 5 MB/s.
**Price:** $383

**Model: FastSerial Interface 20-050-0015**
**Product:** Serial port adapter
**Sun compatibility:** SPARCstation 1,

SPARCstation 1+, IPC, SPARCstation 2, IPX
**SunOS compatibility:** SunOS 4.1.X
**SBus slots used:** One
**Required software:** None
**Product description:** Adds eight serial ports to user's SBus system with data rates up to 230 kilobaud and minimizes load on the host.
**Price:** $525

**Model: ConServer-1053 Buffered TWP Ethernet/Fast SCSI 20-050-0024**
**Product:** SCSI host adapter and Ethernet controller
**Sun compatibility:** SPARCstation 10, LX, SPARCclassic, SPARCserver 600 series
**SunOS compatibility:** SunOS 4.1.3, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** This design allows for a Fast SCSI and buffered Ethernet on an SBus board. SCSI host adapter allows users to add seven SCSI devices and the Ethernet controller converts the user's workstation into an Ethernet gateway, bridge or router.
**Price:** $536

**Model: ConServer-ESP (Ethernet/SCSI/Parallel) 20-050-0022**
**Product:** SCSI host adapter, Ethernet controller and parallel adapter
**Sun compatibility:** SPARCstation 10, LX, SPARCclassic, SPARCserver 600 series
**SunOS compatibility:** SunOS 4.1.3, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** This design allows for a Fast SCSI and buffered Ethernet on an SBus board. SCSI host adapter allows users to add seven additional SCSI devices and the Ethernet controller converts the user's workstation into an Ethernet gateway, bridge or router. Adds a 4-MB/s bidirectional parallel port.
**Price:** $626

**Artecon Inc.**
2460 Impala Drive
Carlsbad, CA 92008
**Circle 203**

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Denver, 303-788-0878

WESTERN SCIENTIFIC
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Circle No. 36 on Inquiry Card

**Model: SB-SE200**
**Product:** Network adapter
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** Solaris 1.X, Solaris 2.X
**SBus slots used:** One
**Required software:** None
**Product description:** Second buffered Ethernet with AUI and TP.
**Price:** $345

**Model: SB-FSSE200**
**Product:** Combined SCSI host adapter and network adapter
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** Solaris 1.1, Solaris 2.X
**SBus slots used:** One
**Required software:** None
**Product description:** Bootable Fast SCSI (single-ended) buffered Ethernet with AUI and TP.
**Price:** $695

## Aurora Technologies Inc.

176 Second Ave.
Waltham, MA 02154
**Circle 204**

**Model: 400S+ SBus Communications Server**
**Product:** Communications/terminal server
**Sun compatibility:** SPARCclassic, LX, SPARCstation 1, SPARCstation 1+, SPARCstation 2, SPARCserver 2, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCserver 1000/2000
**SunOS compatibility:** Solaris 1.X, Solaris 2.X
**SBus slots used:** One
**Required software:** Device driver included (optional communications protocol software)
**Product description:** Four serial port sync/async SBus communications server provides LAN/WAN connectivity with no added traffic to Ethernet nets. On-board 256-KB DMA buffers and RISC processing ensure maximum performance up to 128 Kb/s. Compatible with a wide range of standard communications protocols including X.25, PPP, SNA, HDLC and SDLC. Supports RS-232, RS-422 and RS-485 compatibility and DB-25 or RJ-45 compatibility.
**Price:** $999

**Model: SBus Token Ring Adapter**
**Product:** Network adapter
**Sun compatibility:** SPARCclassic, LX, SPARCstation 1, SPARCstation 1+, SPARCstation 2, SPARCserver 2, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCserver 1000/2000
**SunOS compatibility:** Solaris 1.X, Solaris 2.X
**SBus slots used:** One
**Required software:** Device driver included
**Product description:** Allows Ethernet-based systems to connect with PCs, minis and mainframes on up to four 4/16-Mb/s token-ring networks from a single SPARC system. On-board RAM buffering and optimized device driver ensures peak net performance. System, net and board diagnostics help identify and troubleshoot network problems quickly. Local ring addressing reduces network traffic by prioritizing frame broadcasts.
**Price:** $1,099

**Model: 800S+ Communications Server**
**Product:** Communications/terminal server
**Sun compatibility:** SPARCclassic, LX, SPARCstation 1, SPARCstation 1+, SPARCstation 2, SPARCserver 2, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCserver 1000/2000
**SunOS compatibility:** Solaris 1.X, Solaris 2.X
**SBus slots used:** One
**Required software:** Device driver included (optional communications protocol server)
**Product description:** Eight-port serial sync/async SBus communications server provides LAN/WAN connectivity with no added traffic to Ethernet nets. On-board 256-KB DMA buffers and RISC processing ensure maximum performance up to 128 Kb/s. Compatible with a wide range of standard communications protocols including X.25, PPP, SNA, HDLC and SDLC.

Supports RS-232, RS-422 and RS-485 compatibility and DB-25 or RJ-45 compatibility.
**Price:** $1,699

## BinTec Computersysteme GmbH

Willstaetter Strasse 30
90446 Nuernberg
Germany
**Circle 205**

**Model: BIANCA/BRI-S**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.X, Solaris 1.X, Solaris 2.X
**SBus slots used:** One
**Required software:** ISI/Base, ISI/IP, ISI/Phone, ISI/Fax, ISI/BTX
**Product description:** ISDN Basic Rate Interface for data, voice, fax, modem.
**Price:** $1,682

**Model: BIANCA/PRI-S**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.X, Solaris 1.X, Solaris 2.X
**SBus slots used:** One
**Required software:** ISI/Base, ISI/IP, ISI/Phone, ISI/Fax, ISI/BTX
**Product description:** ISDN Primary Rate Interface for data; 30x64 Kb/s B-channel.
**Price:** $9,637

## Brixton Systems Inc.

125 Cambridge Park Drive
Cambridge, MA 02140
**Circle 206**

**Model: SM2404**
**Product:** Serial communications controller
**Sun compatibility:** SPARCclassic, SPARCstation LX, SPARCstation 1, SPARCstation 2, SPARCstation IPC, SPARCstation 10, SPARCserver 10, SPARCserver 600 series, SPARCserver 1000/2000
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** Brixton driver supplied
**Product description:** Intelligent, high-performance serial line multiplexer that plugs into SBus of SPARC workstations. Includes four high-speed asynchronous serial lines that can be connected to terminals, modems, printers, plotters or other RS-232 devices.
**Price:** $1,150

**Model: SM3508**
**Product:** Serial communications controller
**Sun compatibility:** SPARCclassic, SPARCstation LX, SPARCstation 1, SPARCstation 2, SPARCstation IPC, SPARCstation 10, SPARCserver 10, SPARCserver 600 series, SPARCserver 1000/2000
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** Brixton driver supplied
**Product description:** Intelligent, high-performance serial line multiplexer that plugs into SBus of SPARC workstations. Includes eight high-speed asynchronous serial lines that can be connected to terminals, modems, printers, plotters or other RS-232 devices.
**Price:** $1,900

## CHI Systems/Zitel Corp.

47211 Bayside Pkwy.
Fremont, CA 94538
**Circle 207**

**Model: SBus-HIPPI Interface Board, Part #IF-HIPSBUS-A-P-P25**
**Product:** Network interface card
**Sun compatibility:** SPARCstation 10, SPARCserver 1000/2000
**SunOS compatibility:** Solaris 2.2 and up
**SBus slots used:** Two
**Required software:** None
**Product description:** Dual-slot SBus interface provides a connection between the Sun SBus and a bidirectional HiPPI channel. CHI provides a DLPI level streams driver for TCP/IP, FTP, etc., support.
**Price:** $7,350

## Cisco Systems

Workgroup Business Unit
710 Lakeway Drive
Sunnyvale, CA 94086-4013
**Circle 208**

**Model: C300**
**Product:** CDDI SBus adapter
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCserver 2, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCserver 2000
**SunOS compatibility:** SunOS 4.1.1, SunOS 4.1.2, SunOS 4.1.3, Solaris 2.X
**SBus slots used:** One
**Required software:** None
**Product description:** FDDI adapter card provides full FDDI functionality, performance and interoperability. Utilizes unshielded or shielded twisted-pair wire and Crescendo wiring concentrators.
**Price:** $1,495

**Model: C301M**
**Product:** FDDI SBus adapter
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCserver 2, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCserver 2000
**SunOS compatibility:** SunOS 4.1.1, SunOS 4.1.2, Sun 4.1.3, Solaris 2.X
**SBus slots used:** One
**Required software:** Driver software
**Product description:** Fully standard FDDI adapter card. Includes on-board SMT processor, 128-KB buffer, SNMP agent, downloadable firmware, on-board diagnostics.
**Price:** $1,995

**Model: C305**
**Product:** CDDI dual-attach adapter card
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCserver 2, SPARCstation 10, IPC, IPX, SPARCserver 600 series
**SunOS compatibility:** SunOS 4.1.1, SunOS 4.1.2, Sun 4.1.3, Solaris 2.X
**SBus slots used:** Two
**Required software:** None
**Product description:** When used with Sun SPARC-based machines, implements an FDDI dual-attach station (DAS) using unshielded or shielded twisted-pair wire. Supports dual-homing

and direct connection to dual ring.
**Price:** $1,995

**Model: C306M**
**Product:** FDDI SBus dual-attach adapter
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCserver 2, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCserver 2000
**SunOS compatibility:** SunOS 4.1.1, SunOS 4.1.2, SunOS 4.1.3, Solaris 2.X
**SBus slots used:** Two
**Required software:** None
**Product description:** When used with Sun SPARC-based machines, implements an FDDI dual-attach station (DAS) using optical fiber. Supports dual-homing and direct connection to dual ring for fault tolerance.
**Price:** $2,995

## DigiBoard Inc.

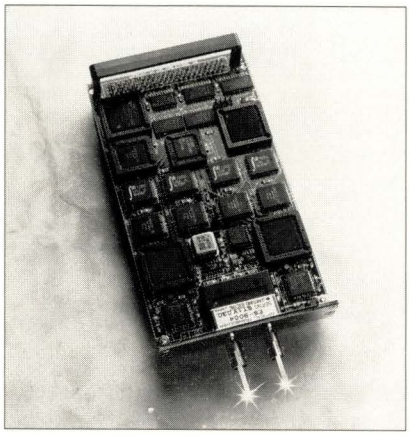
6400 Flying Cloud Drive
Eden Prairie, MN 55344
**Circle 209**

**Model: SBus C/X System**
**Product:** Multiport peripheral adapter
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** Solaris 2.X and higher
**SBus slots used:** One
**Required software:** None
**Product description:** Digiboard's solution to the asynchronous communication needs of high-performance SPARC SBus systems. Designed for multiuser serial need requiring 16 to 1,792 users or for applications requiring multiple high-speed modems or digital communication devices. The C/CON-16 concentrator box supports maximum speeds of 38.4 Kb/s.
**Price:** $2,395

**Model: SBus EPC/X System**
**Product:** Multiport peripherals
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** Solaris 2.X and higher
**SBus slots used:** One
**Required software:** None
**Product description:** Digiboard's solution to the asynchronous communications needs of high-performance SPARC SBus systems. Designed for multiuser serial need requiring 16 to 1,792 users or for applications requiring multiple high-speed modems or digital communications devices. The EPC/CON-16 concentrator box supports sustained bidirectional speeds of up to 115 Kb/s on up to 96 serial lines, 57.6 Kb/s on up to 192 lines and 38.4 Kb/s on 224 lines.
**Price:** $2,895

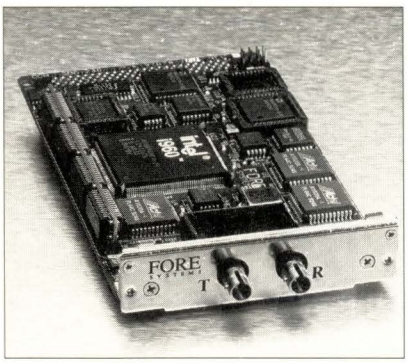
## Fore Systems Inc.

174 Thorn Hill Road
Warrendale, PA 15086-7535
**Circle 210**



**Model: ForeRunner SBA-100**
**Product:** SBus adapter
**Sun compatibility:** SPARCstation 1, SPARCstation 1+, IPC, IPX, SPARCstation 2, SPARCstation 10, SPARCserver 600 series
**SunOS compatibility:** Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** SBus adapter that provides ATM connectivity. Operating at rates of 100/140 Mb/s. Supports audio, video and data over a single dedicated fiber-optic ATM connection. SunOS driver transparently support TCP/IP and AAL 3/4 and 5.
**Price:** $2,995

**Model: ForeRunner SBA-200**
**Product:** SBus adapter
**Sun compatibility:** SPARCstation 1, SPARCstation 1+, IPC, IPX, SPARCstation 2, SPARCstation 10, SPARCserver 600 series




**SunOS compatibility:** Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** SBus adapter that provides high-performance ATM connectivity. Features on-board 25-MHz i960 cell processor and special-purpose AAL 5 and 3/4 SAR and DMA hardware. Operates at rates of 100/140 Mb/s. A SunOS driver transparently supports TCP/IP.
**Price:** $3,495

## Helios U.S.A.

10601 S. DeAnza Blvd. #103
Cupertino, CA 95014
**Circle 211**

**Model: AppleTalk LocalTalk SBus Card**
**Product:** Communications controller
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1, Solaris 2.2
**SBus slots used:** One
**Required software:** SunOS and SLIC
**Product description:** AppleTalk router, printer spooler and terminal server system.
**Price:** $1,850

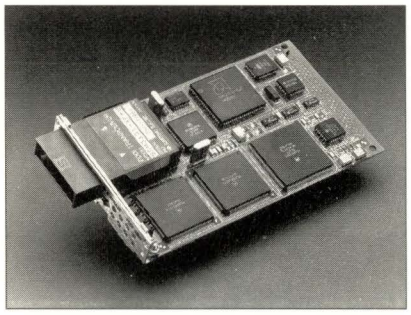
## Integrix Inc.

1200 Lawrence Drive, Suite 150
Newbury Park, CA 91320
**Circle 212**

**Model: SXT100**
**Product:** Graphics board with multiple user capabilities
**Sun compatibility:** SPARCstation 2, SPARCstation 10, LX, SPARCclassic, IPC
**SunOS compatibility:** Solaris 2.X
**SBus slots used:** One
**Required software:** None
**Product description:** Allows users to add a second or third user.
**Price:** $795

## Interphase Corp.

13800 Senlac
Dallas, TX 75234
**Circle 213**



**Model: S/FDDI 4611 SunBird**
**Product:** Network interface card
**Sun compatibility:** SPARCclassic, SPARCstation 2, SPARCstation 10, IPC, SPARCcenter 1000/2000 or any SBus system
**SunOS compatibility:** SunOS 4.X, Solaris 2.2
**SBus slots used:** One
**Required software:** None
**Product description:** SunBird provides high-performance FDDI network connectivity for SBus systems and is available with either fiber, standards-based UTP (TP-PMD) copper or STP copper media.
**Price:** Contact vendor

## Megatek Corp.

9645 Scranton Road
San Diego, CA 92121
**Circle 214**

**Model: ESPRIX, ESPRIX CL**
**Product:** Graphics board with multiple user capabilities
**Sun compatibility:** SPARCclassic, IPC, SPARCstation 2, SPARCstation 10, SPARCserver 600 series
**SunOS compatibility:** Solaris 1, Solaris 2.X
**SBus slots used:** One
**Required software:** Megatek X-Celerator Windows
**Product description:** Supports multiple workstation users on a single SPARC CPU. Each ESPRIX includes keyboard/mouse port and 8-bit color frame buffer.
**Price:** $1,495+

## Network Peripherals Inc.

1371 McCarthy Blvd.
Milpitas, CA 95035
**Circle 215**

**Model: NP-SBus SAS FDDI Adapter (UTP)**
**Product:** Network adapter
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** Single-attach FDDI interface for SBus-based systems. Network connection is made via RJ-45 connector for use with data-grade unshielded twisted pair. Compatible with ANSI X3T9.5.
**Price:** $995

**Model: NP-SBus SAS FDDI Adapter (fiber)**
**Product:** Network adapter
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** Single-attach FDDI interface for SBus-based systems. Network connection is made via a MIC fiber-optic connector, for use with multimode fiber-optic cable. Compatible with ANSI X3T9.5.
**Price:** $1,995

**Model: NP-SBus DAS FDDI Adapter (UTP)**
**Product:** Network adapter
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS, Solaris 1, Solaris 2
**SBus slots used:** Two
**Required software:** None
**Product description:** Dual-attach FDDI interface for SBus-based systems. Network connection is made via a RJ-45 connector for use with data-

grade unshielded twisted pair. Compatible with ANSI X3T9.5.
**Price:** $1,995

**Model: NP-SBus DAS FDDI Adapter (fiber)**
**Product:** Network adapter
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS, Solaris 1, Solaris 2
**SBus slots used:** Two
**Required software:** None
**Product description:** Dual-attach FDDI interface for SBus-based systems. Network connection is made via a MIC fiber-optic connector, for use with multimode fiber-optic cable. Compatible with ANSI X3T9.5.
**Price:** $2,995

## Newbridge Microsystems

603 March Road
Kanata, Ontario
Canada K2K 2M5
**Circle 216**

**Model: SBus T1/E1***
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** None
**Product description:** Provides SBus platforms with T1 or E1 connectivity directly onto workstations or servers.
**Price:** Contact vendor

## Pacific Access Computers

3079 Kilgore Road
Rancho Cordova, CA 95670
**Circle 217**

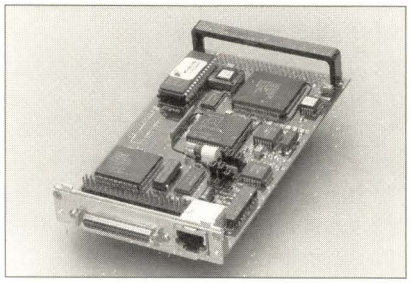
**Model: PAC SPARC SBus Datakit VCS Host Interface**
**Product:** Fiber network interface board and software
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1.2+, Solaris 2.2+
**SBus slots used:** One
**Required software:** None
**Product description:** Direct fiber host interface for Datakit VCS or Datakit II VCS node. Software was designed to support up to 16 SBus boards–one board supports up to 512 channels. Features include remote execution and file sharing and printer/modem pooling.
**Price:** $16,250+ for board and software package

*Product will be available in January 1994.

## Performance Computer

**A Performance Technologies company**
315 Science Pkwy.
Rochester, NY 14620
**Circle 218**

**Model: PT-SBS520A**
**Product:** Network interface card
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCclassic, LX, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCcenter
**SunOS compatibility:** SunOS 4.1.2, Sun 4.1.3, Solaris 2.1, Solaris 2.2
**SBus slots used:** One
**Required software:** Install Script (supplied with product)
**Product description:** PT-SBS520 Ethernet SBus Module provides a second Ethernet port for Suns.
**Price:** $300



**Model: PT-SBS550**
**Product:** Communications/SCSI controller
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCclassic, LX, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCcenter
**SunOS compatibility:** SunOS 4.1.2, Sun 4.1.3, Solaris 2.1, Solaris 2.2
**SBus slots used:** One
**Required software:** PTSCSI Driver (supplied with product)
**Product description:** PT-SBS550

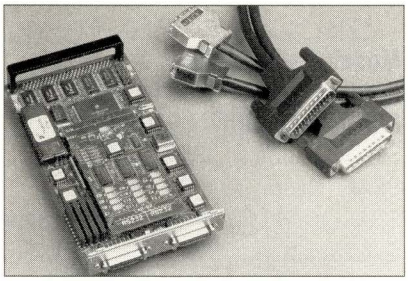
Ethernet/SCSI-2 Narrow/Fast COMBO SBus Module provides second Ethernet port (twisted pair/10BaseT) and a SCSI-2 Narrow/Fast Port in one expansion slot.
**Price:** $636

**Model: PT-SBS515**
**Product:** Communications controller
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCclassic, LX, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCcenter
**SunOS compatibility:** SunOS 4.1.2, Sun 4.1.3, Solaris 2.1, Solaris 2.2
**SBus slots used:** One
**Required software:** PTSIO/PIO Streams Driver (supplied with product)
**Product description:** PT-SBS515 Serial I/O, Parallel I/O SBus Module provides three additional serial ports and a parallel port for Suns.
**Price:** $396

**Model: PT-SBS530**
**Product:** Communications controller
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCclassic, LX, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCcenter
**SunOS compatibility:** SunOS 4.1.2, Sun 4.1.3, Solaris 2.1, Solaris 2.2
**SBus slots used:** One
**Required software:** PTSIO Streams Driver (supplied with product)
**Product description:** PT-SBS530 4 Serial I/O SBus Module provides four additional serial ports.
**Price:** $396

**Model: PT-SBS540A**
**Product:** Communications/SCSI controller
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCclassic, LX, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCcenter
**SunOS compatibility:** SunOS 4.1.2, Sun 4.1.3, Solaris 2.1, Solaris 2.2
**SBus slots used:** One
**Required software:** PTSIO/PIO Driver (supplied with product)
**Product description:** PT-SBS540A Serial I/O, Parallel I/O, SCSI-2 Combo SBus Module provides serial I/O, parallel I/O and SCSI-2 Narrow/Fast expansion in one SBus slot.
**Price:** $636

**Model: PT-SBS525**
**Product:** Communications controller
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCclassic, LX, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCcenter
**SunOS compatibility:** SunOS 4.1.2, Sun 4.1.3, Solaris 2.1, Solaris 2.2
**SBus slots used:** One
**Required software:** PTSIO/PIO Streams Driver (supplied with product)
**Product description:** PT-SBS525 SBus Module is a highly integrated SBus module with three serial I/O ports, a parallel I/O port and an Ethernet.
**Price:** $636



**Model: PT-SBS332**
**Product:** Communications controller
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCclassic, LX, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCcenter
**SunOS compatibility:** SunOS 4.1.2, Sun 4.1.3, Solaris 2.1, Solaris 2.2
**SBus slots used:** One
**Required software:** ComPack or third-party software
**Product description:** PT-SBS332 two-port high-speed serial I/O SBus module is an intelligent synchronous serial communications controller for the SBus, includes 2 MB of memory, CPU32 (Motorola 68020) 16C35 ISSC. Changeable line interface for EIA-232C/449/485/Mil Std 188c/114/V.35/X.21
**Third-Party Software:** X.25, HDLC/SDLC, HDLC LAPB, CD-2, BSC, Teleburg, Market Feed 2000, Reuters Market Feed.
**Price:** $1,116

**Model: PT-SBS334**
**Product:** Communications controller
**Sun compatibility:** SPARCstation 1, SPARCstation 2, SPARCclassic, LX, SPARCstation 10, IPC, IPX, SPARCserver 600 series, SPARCcenter
**SunOS compatibility:** SunOS 4.1.2, Sun 4.1.3, Solaris 2.1, Solaris 2.2
**SBus slots used:** One
**Required software:** ComPack
**Product description:** PT-SBS332 four-port high-speed serial I/O SBus module is an intelligent synchronous serial communication controller for the SBus, includes 4 MB of memory, CPU32 (Motorola 68360). Changeable line interface for EIA-232C/449/485/Mil Std 188c/114/V.35/X.21.
**Price:** $1,708

## Sun Microsystems Computer Corp.

2550 Garcia Ave.
Mountain View, CA 94043
**Circle 219**

**Model: Second Ethernet Controller (X453A)**
**Product:** Network interface card
**Sun compatibility:** SPARCstation 1, SPARCstation 1+, SPARCstation2, IPX, IPC
**SunOS compatibility:** SunOS 4.0.3 and higher
**SBus slots used:** One
**Required software:** None
**Product description:** Ethernet connectivity SBus card.
**Price:** $400

**Model: Sun ISDN Expansion Kit**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** Solaris 2.1 or higher
**SBus slots used:** One
**Required software:** None
**Product description:** ISDN BRI SBus card with associated software.
**Price:** $595

**Model: SBus Quad Ethernet Controller**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** Solaris 2.3 or higher
**SBus slots used:** One
**Required software:** None
**Product description:** SBus card supports 4 fully buffered Ethernet ports (10BaseT).
**Price:** $995

**Model: SBus Buffered Ethernet Card (X1054A)**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** Solaris 2.1 or higher
**SBus slots used:** One
**Required software:** None
**Product description:** Ethernet connectivity SBus card.
**Price:** $1,095

**Model: SBus Fast Differential SCSI-2/Buffered Ethernet Card (X1052A)**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1.3 or higher
**SBus slots used:** One
**Required software:** None
**Product description:** Ethernet/SCSI connectivity card.
**Price:** $1,095

**Model: SBus Fast SCSI-2/Buffered Ethernet Card (X1053A)**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1.3 or higher
**SBus slots used:** One
**Required software:** None
**Product description:** Ethernet/SCSI connectivity SBus card.
**Price:** $1,095

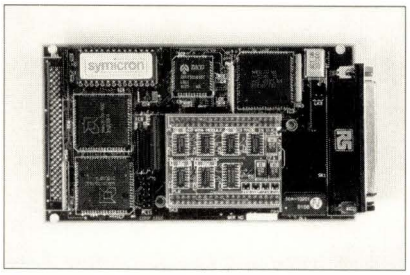
**Model: SunLink TRI/S**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1.2 or higher
**SBus slots used:** One
**Required software:** None
**Product description:** Token ring interface SBus card.
**Price:** $1,495

**Model: SunLink HSI/S**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1.1 or higher
**SBus slots used:** One
**Required software:** None
**Product description:** High-speed serial interface SBus card.
**Price:** $2,495

**Model: SunLink FDDI/S**
**Product:** Network interface card
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1.1 or higher
**SBus slots used:** One
**Required software:** None
**Product description:** FDDI single-attach SBus interface card.
**Price:** $3,495

## Symicron Computer Communications Ltd.

Dufton Business Park
238 Green Lane
Eltham, London
SE9 3TL United Kingdom
**Circle 220**




**Model: DTSX-17**
**Product:** Network interface card
**Sun compatibility:** SPARCclassic, SPARCstation 10, Micromuse
**SunOS compatibility:** SunOS 4.1.1, Solaris 2.1
**SBus slots used:** Two
**Required software:** Symicron SymDriver
**Product description:** WAN communications solution for Sun workstations and servers comprises an intelligent two-port card coupled with software drivers for both the SunOS and Solaris versions of UNIX. Solution allows high-speed communications for LAN-to-LAN, LAN-to-host and workstation-to-host connections using X.25, ICP/IP, SNA and OSI protocols in combination. ISDN support using these products is also available.
**Price:** $3,156

## Tech-Source Inc.

442 S. North Lake Blvd. #1008
Altamonte Springs, FL 32701
**Circle 221**

**Model: GXTRA/1**
**Product:** Graphics accelerator
**Sun compatibility:** SPARCclassic, IPC, SPARCstation 2, SPARCstation 10
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** X11R4, X11R5 or OpenWindows
**Product description:** Provides multi-user capability. These cards operate as independent Sun SPARC-compatible X Window subsystems with their own keyboard and mouse ports, allowing multiple graphics users and/or displays from a single SPARCstation. 1-MB frame buffer included.
**Price:** $1,450

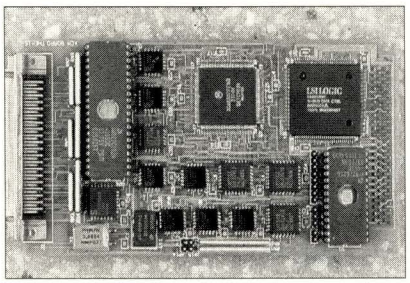
**Model: GXTRA/2**
**Product:** Graphics accelerator
**Sun compatibility:** SPARCclassic, IPC, SPARCstation 2, SPARCstation 10
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** X11R4, X11R5 or OpenWindows
**Product description:** Provides multi-user capability. These cards operate as independent Sun SPARC-compatible X Window subsystems with their own keyboard and mouse ports, allowing multiple graphics users and/or displays from a single SPARCstation. 2-MB frame buffer included.
**Price:** $2,450

**Model: GXTRA/3**
**Product:** Graphics accelerator
**Sun compatibility:** SPARCclassic, IPC, SPARCstation 2, SPARCstation 10
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** X11R4, X11R5 or OpenWindows
**Product description:** Provides multi-user capability. These cards operate as independent Sun SPARC-compatible X Window subsystems with their own keyboard and mouse ports, allowing multiple graphics users and/or displays from a single SPARCstation. 8-bit color with 4-bit overlay frame buffer included.
**Price:** $3,950

**Model: GXTRA/2 DB**
**Product:** Graphics accelerator
**Sun compatibility:** SPARCclassic, IPC, SPARCstation 2, SPARCstation 10
**SunOS compatibility:** SunOS 4.1, Solaris 1, Solaris 2
**SBus slots used:** One
**Required software:** X11R4, X11R5 or OpenWindows
**Product description:** Provides multi-user capability. These cards operate as independent Sun SPARC-compatible X Window subsystems with their own keyboard and mouse ports, allowing multiple graphics users and/or displays from a single SPARCstation. 2-MB double-buffered frame buffer included.
**Price:** $4,500

## Themis Computer

6681 Owens Drive
Pleasanton, CA 94588
**Circle 222**



**Model: SXCM**
**Product:** High-speed serial communications controller
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1, Solaris 1.1
**SBus slots used:** One
**Required software:** Brx X.25, X.25 communications software, Brx PPP, point-to-point router software
**Product description:** Intelligent serial communications controller with three serial ports supporting RS-232/RS-422 on V.35 at data rates up to 2 MB/s. Supports X.25 or PPP allowing TCP/IP packets to be sent over a wide-area network.
**Price:** $1,995

## UconX Corp.

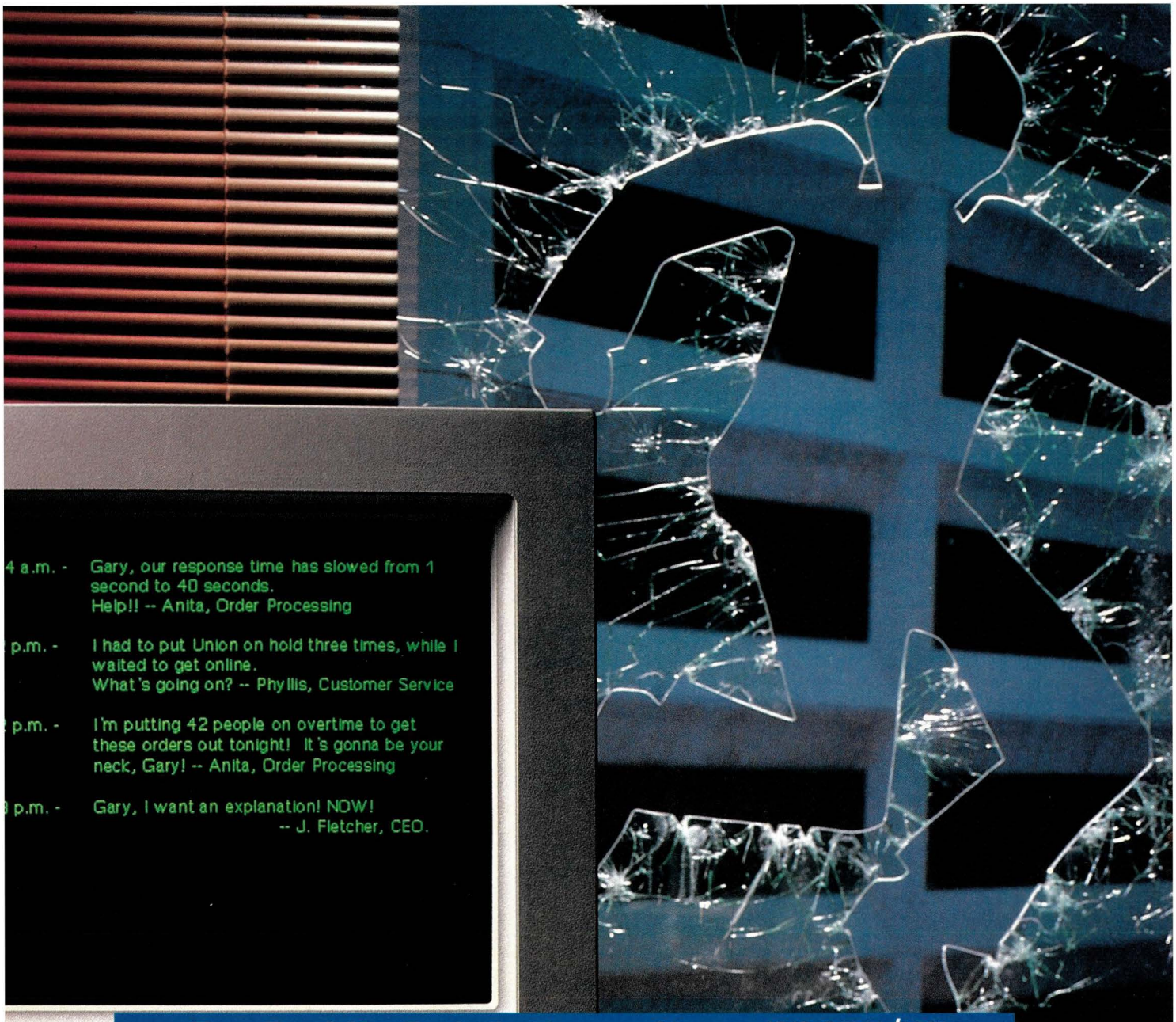
4669 Murphy Canyon Road
San Diego, CA 92123
**Circle 223**

**Model: PT-SBS332**
**Product:** Communications controller
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.X, Solaris 1.X, Solaris 2.X
**SBus slots used:** One
**Required software:** UCP Series software from UconX
**Product description:** Offers an intelligent WAN processor based on the Motorola 68340. Multiple WAN protocols on a single SBus platform can be supported up to a T-1 data rate. An application programming interface (API) and sample client application make interfacing easy. For custom protocols, the UconX ProtoKit provides an industry-standard STREAMS-based real-time development environment.
**Electrical interfaces include:** EIA-232C, EIA-422/449/530 and V.35/Bell306.
**Price:** $975 for hardware, from $200 for software

## Vigra Inc.

6044A Cornerstone Court
San Diego, CA 92121
**Circle 224**

**Model: VS-18**
**Product:** Communications controller
**Sun compatibility:** All SBus-based SPARC systems
**SunOS compatibility:** SunOS 4.1.3, Solaris 2.X
**SBus slots used:** One
**Required software:** SunOS or Solaris driver
**Product description:** Controller for Sharp active matrix color LCD panels. Includes SunOS 4.1.3 driver on floppy, X11R5 and Solaris 2.X.
**Price:** $895

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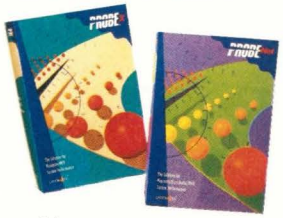

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A situation like this makes the case for advanced debugging tools. Unlike a symbolic debugger, which displays the memory and steps through the code, advanced debuggers monitor memory accesses and point out when they are incorrect.

There is a difference between improper functionality executing correctly and functionality failing to execute correctly. No amount of tuning a program will compensate for a poor design. If a program is running well but produces the wrong results, trying to debug memory accesses is a waste of time.

*Listing 1*

Sentinel will find this problem:

```
/* Dynamic array bounds violation by a libc function */
char *a;
a = malloc(5);
strcpy(a, "12345"); /* Oops - Null termination is a sixth character */
```

But it does not find this one:

```
/* Stack array bounds violation by a libc function */
char a[5]; /* stack memory */
strcpy(a, "12345"); /* Oops - Null termination is a sixth character */
```

Or this one:

```
/* Dynamic array bounds violation through a direct access */
int *a, i;
a = (int *) malloc(5 * sizeof(int));
for (i = 0; i <= 5; i++) /* Oops - six positions */
  a[i] = i;
```

With that in mind, take a look at the following reviews of advanced debuggers. I evaluate Virtual Technologies Inc.'s Sentinel Version 1.4, CenterLine Software Inc.'s TestCenter 1.1 and ObjectCenter 2.0.2 (also sold in a less expensive version for C-only users as CodeCenter 4.0.2), and Pure Software Inc.'s Purify 2.1. My criteria for reviewing these tools are that they support C and C++, are powerful, popular and that my work group uses them. One can easily test out other environments and contrast them with the information presented here. (Editor's note: As we were putting this article to bed, AIB Software Corp., Silver Springs, MD, bought Virtual Technologies, the makers of Sentinel. And, at UNIX Expo, Sentinel 2.0 was announced. Also, Pure has released a Solaris 2.X version of Purify.)

## Sentinel

Sentinel is a library that provides its own versions of standard C library functions that operate on dynamic memory (memory allocated with `malloc`). Most of Sentinel's memory access checking is performed for these functions (see Listing 1).

In addition to its memory access validation, Sentinel also reports on memory leaked during execution and extends regular debuggers so they stop at watchpoints (the access of a particular memory address).

To run a program with Sentinel checking, add the word "sentinel" to the Makefile in front of the compiler in the link step.

Sentinel's warnings are normally sent to the calling shell. Instead, Sentinel can be used inside a debugger for easy bug discovery. Simply stop in the dummy function `SeMsgIssued` to see the context of each warning message that appears in the debugger.

Sentinel is available on many platforms, including Data General Corp., Digital Equipment Corp., Hewlett-Packard Co., IBM Corp., Intel Corp., Sequent Computer Systems Inc., Silicon Graphics Inc. and Sun Microsystems Computer Corp. One license is good for unlimited compilation on a single workstation. Runtime use of binaries with Sentinel checking linked in is not licensed. Thus, you can conditionally enable the debugging features in the field and have the software report runtime problems to you via email.

Sentinel has one flaw that needs to be mentioned. In its current form, it is very sensitive to buggy vendor libraries. Take the code in Listing 2, for example.

XView programmers will recognize that this code creates a subwindow for display of text in a frame. Compile this with Sentinel, run it, then quit; the program crashes. Without Sentinel, it works fine. This is caused by an internal XView bug. The only workaround is to set the `SE_MEMFILL` option to "alloc, boundary" instead of "all." Sentinel stops filling freed memory with a pattern it recognizes during the run and may be unable to find accesses of freed memory.

To be fair to Sentinel, it should be noted that the real culprits here are vendors who put together libraries of code without testing them with these tools and who are unresponsive to

*Listing 2*

```
#include <xview/xview.h>
#include <xview/frame.h>
#include <xview/textsw.h>
Frame frame;
Textsw textsw;
frame = xv_create(0, FRAME, 0);
textsw = xv_create(frame, TEXTSW, 0);
xv_set(frame, XV_SHOW, TRUE, 0);
xv_main_loop(frame);
```

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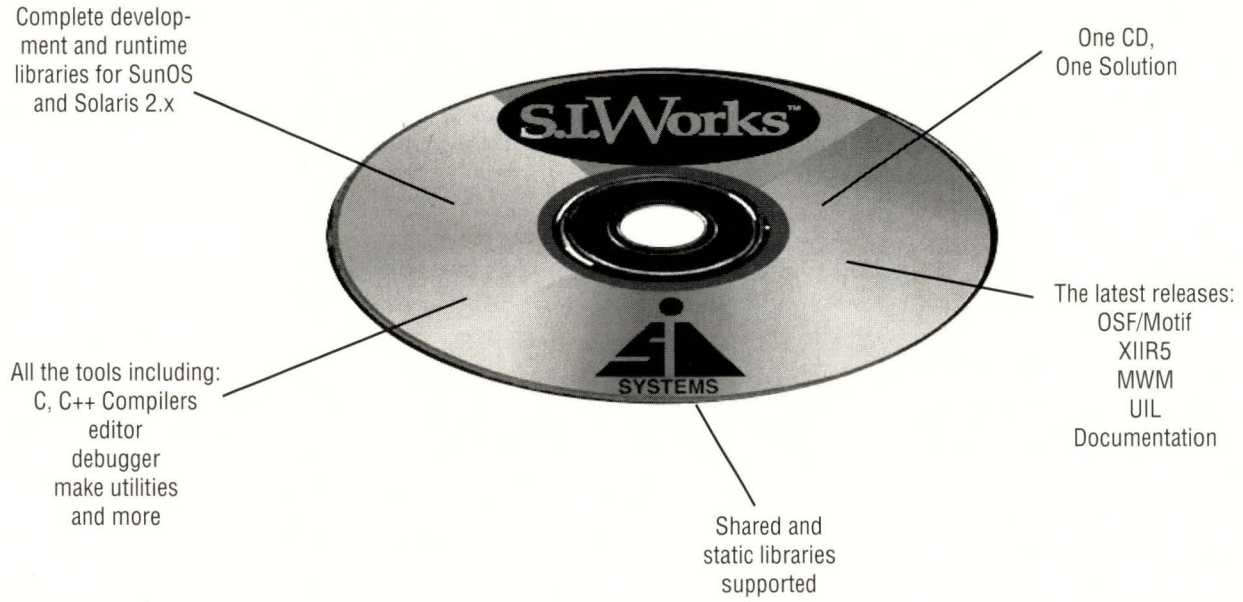


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# DEBUGGING CHECKLIST

| Features/Tools | Sentinel 1.4 | Purify 2.1 | ObjectCenter 2.0.2 | TestCenter 1.1 |
|---|---|---|---|---|
| Company | Virtual Technologies Inc. | Pure Software Inc. | CenterLine Software Inc. | CenterLine Software Inc. |
| Phone | (703) 430-9247 | (408) 720-1600 | (617) 498-3000 | (617) 498-3000 |
| Toll-free phone | (800) 296-3000 | n/a | (800) 669-4165 | (800) 669-4165 |
| Email | info@vti.com | info@pure.com | objectcenter-support@centerline.com | testcenter-support@centerline.com |
| Supported architectures | Many, including AIX, DG UX, HP-UX, Irix, Solaris, SunOS, SVR3.2, SVR4.0, Ultrix | SunOS 4.1.X, Solaris 2.X (9/93), HP-UX (10/93) | SunOS 4.1.X, Solaris 2.X, HP-UX | SunOS 4.1.X |
| Licensing scheme | Unlimited users, one machine using home-grown license management. No run-time licensing. Link time only. | User assigned, using home-grown PureLA. May be reassigned if not used for six months. Run time, not link time. | Floating or user, utilizing FLEXlm. Load and run time. | Floating or user, utilizing FLEXlm. Run time, not link time. |
| List price/ First year support | $595-$1,895, depending on platform, one year free support | $1,298 plus $250 support. Minimum purchase of three | ObjectCenter: $3,995 plus $595 support. CodeCenter: $2,995 plus $450 support | User-based, $1,295 plus $195 support. Floating $2,995 plus $450 support |
| Evaluation program | ✓ | ✓ | ✓ | ✓ |
| **Debugging Capability** | | | | |
| Supports C and C++ | ✓ | ✓ | ✓ | ✓ |
| Leak detection | ✓ | ✓ | ✓ | ✓ |
| General dynamic memory | | ✓ | ✓ | ✓ |
| C library dynamic memory | ✓ | ✓ | ✓ | ✓ |
| General stack memory | | | ✓ | |
| Watchpoints | ✓ | ✓ | ✓ | |
| Warning suppression | ✓ | ✓ | ✓ | ✓ |
| Stop at warning | ✓ | ✓ | ✓ | ✓ |
| Coverage | | | With TestCenter | ✓ |
| Full symbolic debugger | | | ✓ | |
| **Other Features** | | | | |
| Easy to set up a session | ✓ | ✓ | | ✓ |
| Batch usage support | ✓ | ✓ | | ✓ |
| Incremental linker | | ✓ | ✓ | |
| Dormant until needed | ✓ | | | |
| Error report file option | ✓ | ✓ | | |
| Field use reports (by mail) | ✓ | (License required) | | |
| GUI | | | ✓ | ✓ |
| Portable to user sites | (No run-time licensing) | (Licenses are portable) | (Contact required) | (Contact required) |
| **Gotchas** | | | | |
| Memory intensive | | | ✓ | ✓ |
| Disk intensive | | ✓ | | ✓ |
| Large learning curve | | | ✓ | |

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requests for fixes to problems that don't occur outside of a debugging environment. Be certain that your vendor libraries are solid before making a large investment in this tool.

### TestCenter

To use TestCenter, add one command, `proof`, in front of the link statement in your Makefile. TestCenter copies the objects and static libraries an application is made of and inserts code into them to watch memory accesses, memory leaks and coverage; then links them together with its own versions of standard C library functions to form a binary.

TestCenter can check direct dynamic memory accesses (like the array bounds access example in Listing 1). It does not check stack memory accesses. The differentiating feature of this tool is its code coverage ability. Like the SVR4 `tcov`, TestCenter shows you which lines in a program have been executed across one or multiple test runs. This helps to point out untested functionality. Because it inserts code at link time, however, the entire program does not have to be recompiled from scratch. This ability helps you find problems like the code in Listing 3.

*Listing 3*

```
/* Assignment in a conditional if */
int a = TRUE, i;
if (a = FALSE) {
  i = 0; /* No coverage */
}
```

## Compare for Yourself

The easiest way to compare these products is to look at actual bugs and see which tools can discover them.

The examples below demonstrate problems that a typical compiler and symbolic debugger are unable to point out directly. You may or may not see a crash because of them.

Each example is preceded by monograms representing the tools that successfully discovered the problem:

S = Sentinel T = TestCenter
O = ObjectCenter P = Purify

**Leak Detection**
*Simple memory leak:*

STOP

```
char *a;
a = (char *) malloc(6);
a = (char *) 0;
```

**General Dynamic Memory**
*Reading beyond the bounds of a dynamic array:*

TOP

```
char *a, b;
int i;
a = (char *) malloc(5);
for (i = 0; i <= 5; i++)
b = a[i];
```

*Reading freed memory:*

TOP

```
int *a, b;
a = (int *) malloc(sizeof(int));
*a = 1;
free(a);
b = *a;
```

*Writing freed memory:*

STOP

```
int *a;
a = (int *) malloc(sizeof(int));
free(a);
*a = 1;
```

*Reading uninitialized dynamic memory:*

TOP

```
char *a, b;
a = malloc(5);
b = a[0];
```

*Writing beyond the end of a dynamic array:*

STOP

```
char *a;
int i;
a = (char *) malloc(5);
for (i = 0; i <= 5; i++)
  a[i] = 'b';
```

**C Library Dynamic Memory**
*Walking off the end of a dynamic array with a C library function (strncmp):*

P S
T - If you statically link libc.a
O - Not found. Known bug that may be fixed in future releases.

```
char *a, *b;
a = (char *) malloc(8);
b = (char *) malloc(6);
strcpy(a, "fooooo");
strncpy(b, "fooooo", 6);
strncmp(a, b, 7);
```

*Freeing freed memory:*

STOP

```
char *a;
a = (char *) malloc(5);
free(a); free(a);
```

**General Stack Memory**
*Walking off the end of a stack memory array with a C library function:*

O
T - Finds it only if you leave the declaration of c out. The end of the stack frame is overwritten by chance.

```
char c[20];
char b[4];
strcpy(b, "Overwriting.");
```

When the `i=0` statement is never covered, the assignment that should be an equality check is discovered in the if-test. No error is ever flagged because this is legal code. This goes back to the issue of improper functionality executing correctly.

TestCenter can display a Motif or an Open Look user interface to easily view run-time error, memory leak and coverage information.

The user interface doesn't interfere with running the program from within a debugger and using the dummy function `testcenter_stop` to stop at the point where an error is reported.

As a new product, TestCenter has its limitations.

The manual clearly states that it does not check the memory accesses in shared libraries. Since the C library most people use by default is a dynamic library, TestCenter won't immediately catch the "Stack array bounds violation by a libc function" example above. To find this error, simply add the `-Bstatic` compiler flag to force the use of static libraries instead of dynamic libraries. Add this for just the C library with `-Bstatic -lc`.

*Reading uninitialized stack memory with a common C library function:*

```
P
O - Known bug that may be fixed in
future releases

.char a[5], b[5];
strncpy(a, b, 5);
```

*Using uninitialized stack memory:*

```
OP

int a, b;
b = a + 1;
```

*Freeing stack memory:*

```
STOP

char *string = "Foo";
free(string);
```

*Walking outside an array inside a stack structure:*

```
O

struct teststr {
  int a;
  char b[8];
  int c;
} myteststr;
myteststr.b[8] = 0;
```

*Returning a pointer to an automatic variable:*

```
O

int *
foo(void)
{
  int x = 1;
  return &x;
}
foo2();
```

*Writing beyond the end of a stack array:*

```
O

char a[5];
int i;
for (i = 0; i <= 5; i++)
  a[i] = 'b';
```

**Coverage**

*No coverage of a region of code caused by an assignment in a conditional if statement:*

```
T - You can't cover the code and this
draws attention to the assignment.
O - Interpreter reports the assign-
ment in the conditional if statement,
drawing your attention to the cover-
age problem. Lucky break!

int a = TRUE, i;
if (a = FALSE) {
  i = 0;
}
```

Also, it is hard to suppress the reporting of errors. If an error is caused by a vendor library call making a bad call to `strcpy`, the error can't be suppressed for `strcpy` just when it is called by the library function. CenterLine Software has indicated that this problem will be addressed in a future release.

Coverage data for multiple runs can be combined only for the same version of the binary. When a tested binary is recompiled, all the test cases have to be run through again to achieve the same coverage. There is no record and playback feature to help accomplish this.

The run-time results files can get very large for sizable debuggable binaries. It is possible to fill up available disk space before reporting on cumulative coverage testing for multiple runs. Also, the TestCenter GUI seems to use memory proportionate to the total of the sizes of the results files. Try the following strategies for success: Reduce the size of the stack trace stored with every run-time and leak message, reduce the amount of information collected by using the ignore option to restrict objects from being proofed, or globally restrict the information collected to a combination of leak, coverage or run time, as needed.

Best results are achieved testing relatively small tools, small portions of functionality of large tools or by using "resourceful" machines.

## Purify

Purify provides run-time error checking of dynamic memory and reports on memory leaks. To use Purify, add one command, `purify` in front of the link statement in your Makefile.

Purify copies the libraries and objects, inserts code and dynamically links them together with its own versions of standard C library functions to form your binary.

Dynamic linking can be a useful feature. After the first link, the binary is patched with updates. In my environment, this usually results in a 20% to 50% reduction of subsequent link times. If this feature sounds useful, be aware that Pure Software sells PureLink separately as well.

Purify handles dynamic libraries

*Listing 4*

```
/* Array bounds violation on a stack structure field */
struct teststr {
  int a;
  char b[8];
  int c;
} myteststr;
myteststr.b[8] = 0;
```

Or more simply,

```
/* Stack array bounds violation through a direct access */
char a[5];
int i;
for (i = 0; i <= 5; i++)
  a[i] = 'b';
```

properly without any workarounds and links much faster because of it. Purify is available for SunOS 4.1.X, Solaris 2.X and HP-UX. Purify licensing is user-based. A user is defined as anyone who may use the product in the next six months. Licenses may be divided among sites (this feature allows a Purify license to be taken to a user's site).

Purify may be used from within a debugger. To stop at the point where warnings are occurring, use the dummy function `purify_stop_here`. An error may be suppressed only when a certain sequence of function calls has been made prior to that point. Purify dynamically monitors the suppressions file so suppressions take effect immediately after they are entered.

On the downside, it is not possible to turn off library error checking with any means other than suppressions. This presents a problem initially because noise from vendor library problems can obscure run-time warnings from a programmer's code.

## ObjectCenter

ObjectCenter is a full development environment with its own integrated interpreter, debugger, cross-reference browser and class browser (ObjectCenter only). These features are beyond the scope of this article. It also provides run-time stack and dynamic memory checking and leak detection. ObjectCenter is available for SunOS 4.1.X, Solaris 2.X and HP-UX.

To use ObjectCenter, load the program's objects or source into its loader/interpreter. Because it interprets the source code, ObjectCenter understands more of what is obscured by translation to object code. ObjectCenter is the only environment reviewed here that can catch the majority of problems with stack memory accesses (see Listing 4).

The major problem most users seem to have with ObjectCenter is its learning curve. Some users refuse to touch it except in the most dire of circumstances because it is more complicated to start up a memory-debugging session from scratch in ObjectCenter than in the other environments.

Loading files into ObjectCenter is a tricky business and constitutes most of the learning curve of the program. Object files are not as thoroughly checked for run-time errors as interpreted source files. The typical work pattern is to load all of a program's objects, then "swap" particular objects for their sources to enable the detailed memory access checking. This requires a bit of skill, since there is guesswork involved in determining where a run-time problem might be occurring.

To load an application's objects into the environment, write a Makefile target that looks like the link step of the normal compile and use the "#load" ObjectCenter directive in place of the compiler. Object files may be "instrumented" to watch some dynamic memory accesses, including those in libraries, but they are not checked as thoroughly as by the other advanced tools.

If it is impossible to limit the checking to particular files, or all the errors that might occur during a particular test need to be found, all the source files must be loaded to start with. This can be a time-consuming process compared with loading objects. Some applications may be too large to load into the environment as source on the beefiest of machines.

ObjectCenter is sensitive to source-loaded code with egregious memory-walking. It warns when problems may occur, and at times, crashes or resets itself after that point.

ObjectCenter can be integrated with TestCenter so that coverage testing may be performed at the same time as comprehensive stack and dynamic memory checking.

## Conclusion

There is no bug-exterminating transformer that, by itself, works like the one in the Orkin television ads. Sentinel has a restricted view of dynamic memory and is unable to check stack memory. Purify and TestCenter handle dynamic memory well but have a restricted view of stack memory. Though it is a maturing product in comparison with Purify, TestCenter should not be ignored. Its ease of use for generating coverage information fosters proactive software reliability testing. ObjectCenter is clearly the most comprehensive debugging environment but is resource-intensive and has a higher learning curve. An integration of TestCenter (to build cases with sufficient coverage and check dynamic memory accesses) and ObjectCenter (to check the stack memory accesses of those cases) is a powerful partnership.

Make sure to evaluate these products in your environment on your code to see how they perform for you! ⊸

**Cliff Morrison** has worked with InCase Development, now a part of the Antares Alliance Group, Dallas, TX, for the past five years. He has converted Sun-3 SunView code to XView, the 32-bit SPARC architecture, ANSI C, and most recently to Solaris for X86.

# FrameMaker 4: The Whole Picture


**by BARRY SHEIN,** Technical Editor

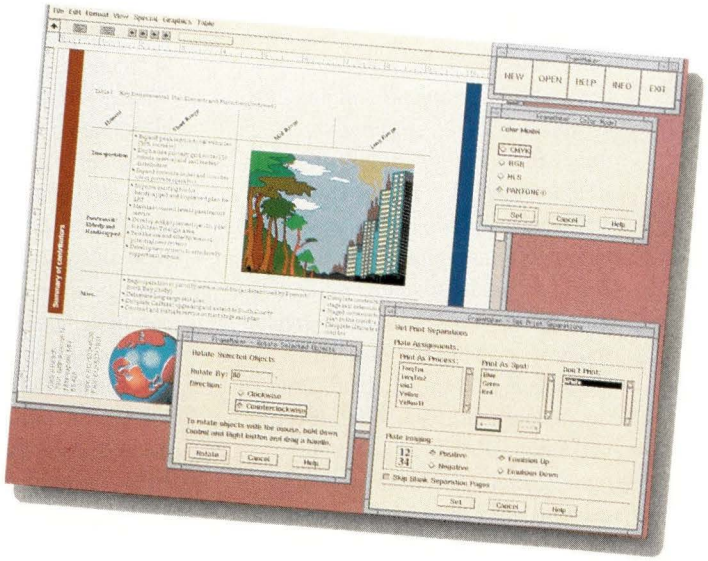
We have reviewed FrameMaker before on these pages, but a major new release warrants an update on what's happening with this important product. For those of you who live in a cave, FrameMaker from Frame Technology Corp. is a WYSIWYG text processor for Sun Microsystems Computer Corp. workstations and other platforms, including most UNIX systems, PCs and Macintoshes. Beyond text processing and desktop publishing capabilities, Frame has added features for on-line document creation, such as mouse-activated hypertext links and color, extensive equation typesetting, graphics (both created within FrameMaker and imported) and table formatting. The company has wrapped it all in a rather rich and user-friendly environment. Frame was one of the first such products in the UNIX market (specifically, Sun workstations) and certainly from the start, one of the closest to what people would point to on their PC and Macintosh systems and say, "Why isn't there anything like this for UNIX?" Well, there was, and there is. It's called FrameMaker.

## What's in a Name?

First, why do they call it FrameMaker? The reason is very simple: FrameMaker's model documents are built out of frames, or rectangular chunks. A simple document might well be only one frame, but when you add an equation or graphic, you generally put that in its own frame and position that within the document. This allows a simple paradigm for letting text flow around other objects, multiple column documents and many other common (and not so common) document features. Much of the time you don't even think about this model and just use the various text-processing features, as you might expect. But developing expertise with this model will make you a FrameMaker power user.

## Basics

When FrameMaker is started, you will get a small window on your screen with the push-buttons New, Open, Help, Info and Exit. Typing New pops up a dialog box of templates that are preformatted document styles such as Business Letter or Book Chapter. You can create your own templates and share them within your organization. This is useful because much of the time you aren't just creating a document out of whole cloth. You're often trying to prepare a standard



***A new look for FrameMaker: In addition to a redesigned interface, Frame Technology has added more than 100 features to Version 4. Among them are a high-performance table editor and enhanced color support.***

document, a memo or technical or budget report or similar. Alternatively, you can choose a blank page of paper, similar to what you get with many other text processors, and do what you like.

Your new, empty document will open up in a window surrounded by the many FrameMaker tools and menus along the edges. On the top are the fairly familiar (even if you've never used FrameMaker) File, Edit, Format, View, Special, Graphics and Table pull-down menu bar items. On the far right of that same menu bar is the Help pull-down menu bar; more about this later. Along the right side of the window, just above the familiar scrollbars, are four small buttons. When clicked, these open up the paragraph formats catalog, character formats, graphics tools and equations dialog box, respectively. Along the bottom is a status box showing the current style being used, the page (which can be clicked to pop up a goto-page dialog), magnification factor, zoom down, zoom up, page forward, page back and finally a horizontal scrollbar.

The paragraph catalog lets you choose among about 15 different paragraph styles, such as footnote or bulleted paragraphs. You can also add your own paragraph format styles through a paragraph designer tool. The character format catalog is similar in spirit. It lets you attach tags (names) to certain character styles to be used within the document. For example, you might choose Palatino 18-point bold with double underlines as a "SHOUT!" style. Later, you could change this definition (make it 24-point and make sure you're heard) but continue using it as a SHOUT! style, by name. These are useful features. Along with the document template styles and other features, FrameMaker allows you to short-cut styles frequently used within documents and standardize these styles within an organization or project, thus assisting when more than one person works on a document project.

For example, suppose your project was designing a recipe book. Recipe books typically have a distinctive ingredients section at the top of each recipe. Rather than having everyone remember that this is a two-column, expanded gutter box set in New Century Schoolbook 14-point italic (whew!), you could instead just set up an "ingredients" paragraph style and an "ingredients" character formats style, or even combine these ideas into a "recipe" page style. A lot of the development effort in FrameMaker is there to help you get the work done in professional desktop publishing settings, particularly where standards need to be set up and adhered to.

## Rich Palettes

The graphics tool palette has the ever-useful line, curve, lozenge, ellipse, polygon (open and closed) and text choices. In addition, there are text box and create-a-new-frame choices. Alongside these are the fill and pen palettes, which contain the usual black and grey screens and a few striped patterns. Below these are line, arrow and dash control palettes. Along the left are a rich bunch of controls such as Group, Ungroup, Bring to Front, Send to Back, Align and so forth. You can now (new in Version 4) rotate graphics arbitrarily, along with scaling and flipping up/down and left/right. Finally there is a Properties item that pops up a dialog box offering to set various aspects of a selected graphical object such as angle, color, dimensions, etc.

The equation typesetting takes a little practice, not a lot, but seems to be very convenient. What you do is create a new equation area (typically right after the current insertion point) and proceed to mix typing and choosing of the many symbols and formats provided. For example, suppose you wanted to set x raised to the yth power. You would click the item that shows a question mark and a superscripted question mark and then in the equation select and edit each question mark, replacing it with x and y respectively. You can recursively specify another element in each position to be edited, so, for example, you could select the stylized d? used in calculus to indicate a derivative for the lower portion of that expression and then again edit each ?, and so forth. This style seems to me to be a very natural way to do this sort of editing, particularly for someone who understands what the equation means–though anyone would get the idea with a little playing around.

The equation palette has several other palettes you can choose from: Symbols, Operators, Large (integrals, product and set symbols), Delimiters (such as parenthesizing or bounding), Relations (greater than, less than and all that), Calculus, Matrices and Functions (trigonometric, transcendental, etc.). The Functions menu also has several pull-down menus that let you evaluate, simplify and perform other symbolic mathematical operations on your equation, reminiscent of a symbolic mathematics package! You can even define your own evaluation rules. Finally, there is a positioning menu that has a few tools in its palette to let you do fine adjustments of your equation. Overall, it's a very rich version of this sort of feature, certainly the best I have seen in a WYSIWYG-style text processor.

## See Below

An interesting feature of FrameMaker is its ability to create sophisticated hypertext documents for on-screen use. The idea is very simple. You can make areas of the text (or graphics) sensitive to mouse clicks, and specify the action to be taken when the mouse is clicked in that area. There are several actions possible, such as go to some other text (in the same file or a different file), run a UNIX command, pop up a menu or alert box, etc.

Creating a hypertext link is fairly simple: You select the area you want to be sensitive to a mouse click, choose the Marker dialogue box and create a new Hypertext marker, type a command into the box such as `gotolink otherfile:digression`, go to the target text and create a `newlink` marker there, and you're basically done. To create a graphical marker, you delineate the area you want sensitive with an invisible text box, add the graphic there, and follow the same steps as I described in the previous example. To finish, you save the document (possibly to a different file) in View-Only format. When this document is opened it will be noneditable and the hypertext links activated. Combine

these devilishly simple ideas with text styles, colors and graphical objects, and the potential for snazzy on-line documentation systems opens up to you. As far as I can tell, the program's own built-in on-line help system was built using this feature, and it seems to work very well.

## A Table with a View

Of all the features of FrameMaker, I'd have to say that its table typesetting abilities are among the strongest I have ever seen. Basically, you choose Table from the menu-bar at the top, tell it to insert a new table, a dialog pops up asking you the obvious, like how many rows and columns, and voilá, a table appears in your document. You can then edit the fields by just switching between them with the TAB key, reminiscent of editing in a spreadsheet. All the formatting features work on a selected field in the table, so there's no problem changing a row label to Helvetica bold 14-point right-adjusted red if you like. You can even set an equation, as described above, into a cell, no problem (I tried it). There's a lot of nice generality like this throughout FrameMaker.

## But Wait! There's More...Much More!

There are a lot of other features. This article could run on for pages and pages just briefly describing each of them, but you would stop reading long before I stopped writing. How about keyboard macros, customizable menus, table of contents support, indexing, importing bit maps, EPS, EPSF and DCS files, Pantone color support, a thesaurus (in several languages!), a spell checker that is actually well designed, and if you act right now we'll throw in this vegetable spinner and a knife guaranteed to survive a direct thermonuclear attack! Perhaps I have gotten carried away; you don't need another kitchen knife anyhow.

## Documentation

The documentation is very good in general. The on-line help does not have everything that is in the printed manual (which perhaps is understandable), but it's enough to keep you working even when the manual isn't handy–once you've mastered the basics. The printed manual and tutorial just barely fit into a standard three-inch binder and is chock full of very useful examples. I would give Frame high marks in this area. The on-line help is rich with hypertext links and includes a clickable index. Another nice feature is context help, which lets you point to the feature in question within the application's window and the on-line help jumps right to the description.

## Nits

Nothing can be perfect, particularly in such a large and complicated system, so here are my nits.

First, every popup should have a dismiss button. There is a real tendency to end up with a dozen or more of these dialog boxes on your screen as you proceed with FrameMaker. This is fairly minor, and I know you can use the Motif close pull-down, but frankly those make me nervous. (How many of you have clicked close in Motif in some product only to have the whole application exit rudely? I have.)

Next, FrameMaker uses control-r followed by two or three letters as keyboard accelerators. For some reason, it didn't work at all on my setup, which I'm not complaining about, per se (it's probably something odd about my setup), but it should be easier and more obvious to customize such things. I want a single keystroke to save my file, not control-r-f-s or some such folderol. How about control-s or escape-s or even the ability to hang it on a function key? There does seem to be some way to completely redefine your keyboard, but because this is one of the first comfort features one needs when using a product like this, there should be another menu or dialog, and I should be able to incrementally customize my keystrokes as I go along. I would change most everything to something similar to Emacs' conventions. That's what my fingers kept hitting anyhow. Actually, this would be a perfect extension of the style concept. How about keyboard styles so I can choose an Emacs style or WordPerfect style or create a new style entirely?

Attention to interchange with various file formats seems weak to me. FrameMaker has several "filters," or conversion programs, but the set seems incomplete and the method not very attractive. For example, you can convert MIF (Maker Interchange Format) files to RTF (Rich Text Format), but there doesn't seem to be any facility to import an RTF file. Similarly, there seems to be no support for SGML (though I'll admit that SGML is hardly a standard). There are filters to convert DCA, Word, WordPerfect and several other formats to MIF, to be fair. The same can be said for spreadsheet formats and more graphics formats. Perhaps the developers should look at Jeff Posner's excellent Portable Bitmap Package, which can convert among a gazillion different graphics formats (all developers have to do is provide a way to import that package's portable formats). Also, even the supplied filters aren't well documented. They're not in the index of their manual.

Perhaps this is picky, but a quick reference guide probably shouldn't be about 80 pages long. I realize that there's a lot here, but I think this guide should be kept and something resembling a quick reference guide designed, something that fits on a fanfold card.

Finally, and I am really nit-picking here, it's time to pretty up that equations menu. Although it's completely functional and probably one of the best in the business for getting the job done, it's plug ugly and doesn't look at all like the rest of the otherwise eye-pleasing dialog boxes. OK, I'll admit it, I'm really reaching, but I know I feel better now!

## Summary

FrameMaker Version 4 is the best yet. It is a very professional and incredibly featured text processing sys-

tem and more. There is an enormous amount of wisdom coded into this package regarding the entire desktop publishing milieu, from book design to equation and table typesetting to on-line hypertext document creation. Even running on our old Sun IPC, performance was fine if not excellent. FrameMaker is powerful enough for most any project I can imagine: newsletters, books, advertising copy, research papers, memos, reports, etc. It's also so easy to use for simple chores that you can give it to most anyone in your organization. About the only major features I can think of that aren't covered are presentation graphics (e.g., pie charts and all that) and view graphs (though it's not hard to do them in a package like this). Frame will send you an unlicensed demo if you ask. Ask! ➸

## FrameMaker, Version 4

**Company**
Frame Technology Corp.

**Address**
1010 Rincon Circle
San Jose, CA 95131

**Phone**
(408) 433-3311

**Fax**
(408) 433-1028

**Email**
comments@frame.com
Anon FTP: frame.com

**Best Feature**
A remarkably rich and well-designed document processor with a lot of attention to the actual practice of creating documents.

**Worst Feature**
See my nits section; nothing serious.

**Price**
$1,495 for a personal license; $2,595 for a floating license

**Circle 154**

# NEW PRODUCTS

The product descriptions are compiled from data supplied by the vendors. To contact them for more detailed information, circle the appropriate reader service number on the card located elsewhere in the magazine.

## IP Accelerator

A device that can accelerate TCP/IP networks by 200% to 600% has been introduced by WHR. Called the Mini-IP Accelerator, the product is a LAN segment device that accepts packets routed to it, compresses the packets and then routes them to a destination. It can do this for up to 16 different destinations, with each destination being either an IP address or a subnet. It can also compress the packet when directed to do so, though it will only direct compressed packets to another WHR product.

In addition, the Mini-IP can be used on any IP internetwork. It can compress traffic between Ethernet or token-ring LAN subnets connected by a backbone, such as Ethernet or FDDI. It can also be used over frame relay, X.25 and PPP. Pricing begins at $4,000.

**WHR Corp.**
204 Spencer Ave.
East Greenwich,
RI 02818
**Circle 101**

## Harborview Visual Application Builder

A software application builder that allows developers to produce client/server database applications without coding has been introduced by Harbor Software. With the product, which is called Harborview, applications are developed by building a graphical representation of the procedure on the screen. In effect, the company says, applications are produced by describing the business logic of a situation, and then forms and reports are automatically built from the logic.

The product differs from traditional 4GLs not only in that it is entirely visual but also because applications written in it are modified visually as well. Rather than a developer or MIS officer having to modify code, the end users can themselves modify the applications by changing forms and reports.

Currently, Harborview runs on Sybase Inc., Digital Equipment Corp. Rdb, and Borland International Inc. InterBase relational databases. It is available for Sun, Hewlett-Packard Co., IBM Corp. RISC System/6000 and Santa Cruz Operation Inc. systems. An Oracle database driver was under development as of press time. Pricing for a development license is $3,900 and each database driver is $700. There are no run-time fees. A bundled version with the development license, one database driver, media, manuals, two days of training and 30 days phone support is $4,800.

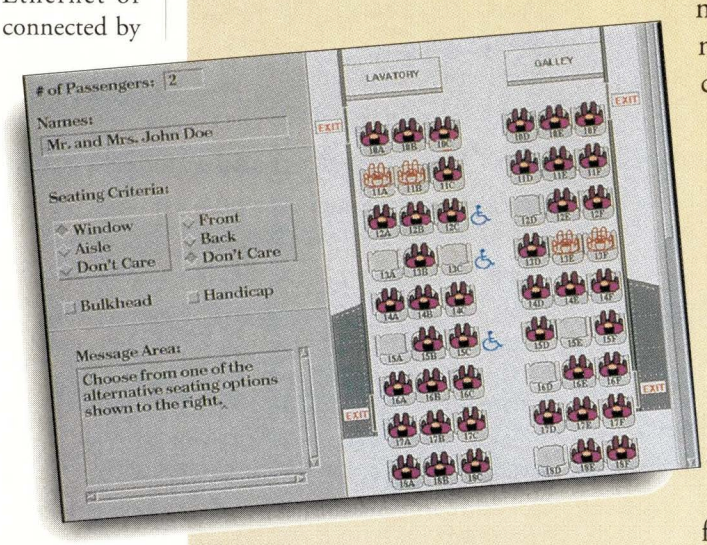
**Harbor Software**
40 Beach St.
Manchester, MA 01944
**Circle 102**

## Slim-Line SPARC

RDI has introduced a SPARC-based "slimline" laptop. Called the PowerLite, the machine is based on a 50-MHz microSPARC providing up to 60 MIPS. The system can be con-

## TAE GUI Builder

Century Computing has announced a commercial version of TAE Plus, a software development environment for creating GUIs that was originally developed by NASA. Century Computing is marketing the product as a quick and convenient way for developers and even end users to produce GUIs on top of Motif, without having to know Motif or the X Window System. The company says that TAE Plus can make GUIs without any coding.




The product is made up of several smaller modules. These include a Workbench, which allows users to lay out the interface and offers a palette of such features as buttons and menus; a Code Generator that automatically produces the user interface code in C, C++ or Ada; and an automated scripting facility that allows for automated testing, on-line demos and tutorials.

Currently, the product is available for SunOS. The company says it plans to have the product on Solaris 2.X in the near future. Pricing for a single-user copy begins at $2,250.

**Century Computing Inc.**
1014 West St.
Laurel, MD 20707
**Circle 100**

figured with up to 80 MB of memory and 1 GB of internal disk. It comes preloaded with Solaris 1.1.C. The screen is a 10.4-inch diagonal LCD.

There are two options on the screen. One is a 640-by-480 resolution Color-plus screen that provides a palette of 262,000 colors. For users requiring still higher resolution, there is a 1,024-by-768 option that gives the machines the resolution of the SPARCclassic. A PowerLite with the standard screen is priced at $9,995. The high-resolution screen version is $15,995.

In addition, the PowerLite can snap onto a Peripheral Expansion Unit. This PXU can be configured to include extra hard disks, SBus slots, and/or SCSI peripherals. The expansion unit with a single 450-MB hard disk and two SBus slots is $2,950.

**RDI Computer Corp.**
6696 Mesa Ridge Road, Bldg. A
San Diego, CA 92121
**Circle 103**

## SoftWindows Opens

Insignia Solutions has unveiled SoftWindows, an emulator that allows UNIX workstations (including Suns) to run Windows applications at 486-based PC levels of performance. In fact, Insignia has licensed Windows technology from Microsoft Corp., and SoftWindows actually contains copies of Windows 3.1 and MS-DOS. The company says that when a user opens a SoftWindows window on a UNIX display, that window is indistinguishable from a PC screen.

In terms of performance, the company says that SoftWindows runs Windows applications at speeds equivalent to a 486 PC running at 25 MHz. In addition, it supports several forms of networking, including client support for Novell Inc. NetWare, TCP/IP and Microsoft LAN Manager, among others. The company says that this makes it easy for UNIX systems to join PC networks.

SoftWindows is available on Hewlett-Packard Co., Digital Equipment Corp., IBM Corp., Silicon Graphics Inc., NeXT Inc. and Sun workstations. Pricing begins at $549 for a single-user license.

**Insignia Solutions Inc.**
1300 Charleston Road
Mountain View, CA 94043
**Circle 104**

## Motif User Interface Builder

A GUI builder that allows developers to create OSF/Motif GUIs for database applications has been introduced. Called TeleUSE/DB, from the CASE division of Alsys, the product provides Motif widget support and simultaneous support of interfaces for multiple databases when used with the TeleUSE User Interface Management System.

The company says that TeleUSE/DB can be used with any SQL-compliant

database, though currently it is available for Sybase 4.9.2. Ingres Corp., Oracle Corp. and Informix Software Inc. databases are to be supported in the near future.

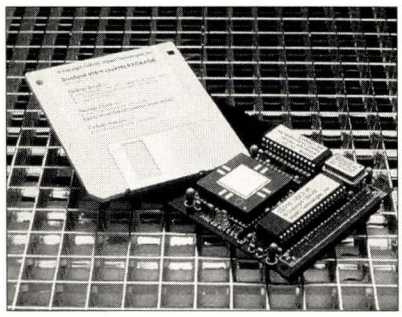
TeleUSE/DB provides a configuration editor to select fields from the database table and data cells of a table. For each field in the table, users can select an identifier, a value selector and a validator function to check for valid entries. Users can designate SQL functions for performing common database operations such as add, delete, query, home, previous, update and end.

TeleUSE/DB is currently available for Sun SPARCstations running SunOS 4.1.2 Pricing begins at $1,990 for a single-user licenses.

**Alsys CASE Division**
Alsys
5959 Cornerstone Court West
San Diego, CA 92121
**Circle 105**

## FFT Board for SPARCstations

An SBus board that provides very high-speed Fast Fourier Transforms (FFT) and Inverse Fast Fourier Transforms (IFFT) has been introduced by Impact Technologies. Called



the SunSpot 916, the product is a single SBus card that is capable of performing a 1,024-point Complex FFT in under 100 msec. This makes the product useful for a wide variety of signal processing applications. It is not based on a digital signal processor but rather on dedicated FFT silicon that has a top speed equivalent to 450 MIPS–though this is somewhat misleading in that MIPS is measure of general-purpose computing, whereas dedicated FFT engines are not general-purpose machines.

The product comes with device driver software and a library of functions. Moreover, the product supports what the company calls "imaginary devices." This is a software concept rather like pseudo-devices, wherein a single physical device can be subdivided into many imaginary ones. Each of the imaginary devices can then be dedicated to single operation. The SunSpot 916 might be broken up, for example, into many different imaginary FFT engines, each operating on some data-flow path. The company says that imaginary devices differ from similar concepts in that imaginary devices do not require changes in application or OS code.

The SunSpot supports Solaris 2.1 and 2.2. Pricing begins at $9,950.

**Impact Technologies Inc.**
2082-B Walsh Ave.
Santa Clara, CA 95050
**Circle 106**

## Raster Accelerator Card

Visual Information Technologies (VITec) has announced an SBus card that enhances imaging processing and adds 24-bit color display to Sun SPARCstations and compatible SPARCalikes. The Rasterflex 24 is a raster accelerator card that provides 16.7 million colors to a Sun system. It supports Solaris 2.X and SunOS 4.1.X.

The Rasterflex uses a standard Sun-compatible video connector. It supports monitor resolutions of 1,152-by-900 at 66 Hz, 1,152-by-900 at 76 Hz or SVGA (1,024-by-768) at 76 Hz. Pricing begins at $1,995.

**VITec**
3460 Lotus Drive
Plano, TX 75075
**Circle 107**

## Pocket Ethernet/Modems

Sun users frequently have workstations at the office and inexpensive DOS laptops or notebooks as their portable machines. For such people, who may need small modems when they're in the field and Ethernet connectivity when they return, Xircom has introduced a pair of devices that provide both Ethernet connectors and fax/modems for small systems.

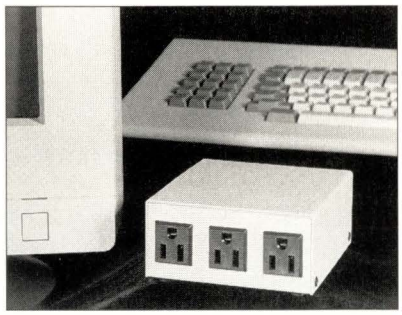
The first of the two is the Xircom CreditCard Ethernet+Modem. This device attaches to a notebook computer's PCMCIA connector. As an Ethernet connector, it provides 10-Mb/s performance when connected to a 802.3 Ethernet LAN. As a modem, it can transmit at up to 14,400 Kb/s.

The second is the Pocket Ethernet+Modem. Its performance characteristics are similar to that of the CreditCard. However, it connects to a notebook via the parallel port. The Pocket and the Credit Card are priced at $699 each.

**Xircom Inc.**
26025 Mureau Road
Calabasas, CA 91302
**Circle 108**

## Energy Saver

A device that automatically switches off unused computer equipment has been introduced by Artek Innovations. The EnergySaver connects to a computer, its keyboard and a standard AC



outlet. If there is no activity on the keyboard, the EnergySaver turns off the peripherals after a specified delay. The delay can be set for one, two or four hours.

The company says this can cut users' energy bills by as much as 75%. The product can be used with up to 15A at 110 VAC, which the company says is enough for two 19-inch monitors, a tape drive, a CD-ROM drive and a printer. Pricing begins at $149.

**Artek Innovations**
5824 Tan Oak Drive
Fremont, CA 94555
**Circle 109**

## NCR X Terminal

In an X-related announcement, NCR has introduced a new X terminal, the NCR 3534 XLa X-Station. The terminal is based on a 25-MHz

i960, though customers have the option of specifying a 33-MHz version of the same processor. In addition, the product features hardware cursor control, which improves performance by offloading that function from the server's software.

The X-station 3534 has two RS-232 serial ports, one parallel port and various Ethernet ports. It comes with flash memory (2, 3 or 4 MB) for local storage, but does not have a fan, for quieter operation. In terms of software, meanwhile, the product comes with NCR's xEasy environment, which is meant to manage the installation, operation and remote administration of X terminals.

As another option, the product features a Telnet 3270 local terminal emulation application. This allows the 3534 to communicate with 3270 mainframes over a TCP/IP LAN. Pricing begins at $4,195 for a system with a 19-inch color monitor, 4 MB of memory, a mouse and keyboard.

**NCR Corp.**
1700 S. Patterson Blvd.
Dayton, OH 45479
**Circle 110**

## Low-Cost FDDI for SBus

Adapters that deliver inexpensive, fiber-based FDDI to desktop systems have been introduced by Alfa. The company's line of FDDI concentrators and connector cards provide optical fiber cable links to SBus systems. Traditionally, in those situations where FDDI is used on the desktop level, it is carried over twisted pair, since optical cable technology has been perceived as being expensive. However, Alfa says that the system, which is based on light that is 820 nanometers in wavelength (as opposed to 1,300 nanometers for standard cable), provides most of the benefits of fiber-based FDDI at a cost that approaches copper-based FDDI.

Specifically, concentrators are $4,500, which the company says is about $562 per port. Adapter cards, meanwhile, range from $795 to $1,495. The company says that its system supports devices at distances of up to 500 meters, whereas copper-based solutions top out at about 100 meters. Standard 1,300-nm cable systems, meanwhile, are effective to about two kilometers.

**Alfa Inc.**
110 Breeds Hill Road
Hyannis, MA 02701
**Circle 111**

## New Tek X

Tektronix has announced a new line of X terminals. The XP100 Series of displays are based on the LSI Logic 33020 GraphX processor. The company says that the new machines will compete with their rivals on price/per-

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S. Henry Sacks
Publisher

formance. The new terminals range in price from $1,495 to $4,695 and offer between 1.51 and 1.90 Xmarks.

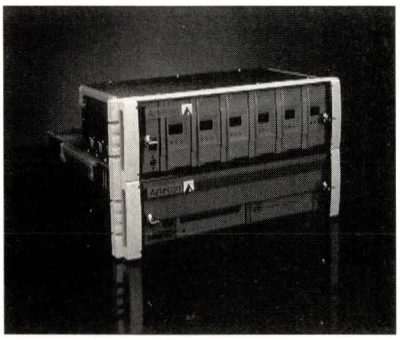
There are five models in the line. The XP115M has a 15-inch monochrome display, a 25-MHz CPU, a resolution of 1,024-by-768 and 1.51 Xmarks. The XP119M has a 19-inch monochrome display, a 33-MHz CPU, 1,280-by-1,024 resolution and 1.90 Xmarks. The XP114C has a 14-inch display, a 25-MHz CPU, 1,024-by-768 resolution and 1.60 Xmarks. The XP117C has a 17-inch display, a 25-MHz CPU, 1,152-by-900 resolution, and 1.60 Xmarks. The XP119C has a 19-inch display, a 25-MHz CPU, 1,152-by-900 resolution, and 1.60 Xmarks.

The machines also have a variety of features in common. They all ship with 4 MB of memory standard and can support up to 20 MB. The terminals all have two serial ports and have the option of a parallel port as well. In addition, the XP100 line features Flash Boot ROM and autoselect circuitry for connecting thick, thin or twisted-pair Ethernet cables.

**Tektronix Network**
**Display Division**
Tektronix Inc.
P.O. Box 1000
Wilsonville, OR 97070
**Circle 112**

## Artecon's Sphinx

A set of enclosures that allow standard, unmodified Sun SPARCstations to be rack-mounted has been introduced by Artecon. Called Sphinx, or



SPARC Rackmount Unit (SRU), the enclosures can hold a SPARCstation 10 and up to 16 GB of fixed and removable fast SCSI-2 disk. The Sphinx enclosures can be then mounted in any standard rack.

There are two models of the Sphinx. The first is the SRU-2400F, which can house any SPARCstation Model 10 and up to two 3½-inch or half-height 5¼-inch fixed disk or removable media devices–including quarter-inch tape, 4mm DAT, 8mm tape, CD-ROM disk and magneto-optical media. The enclosure is 17¼ inches wide, 16 inches deep, and 5¼ inches high.

The second Sphinx is the SRU-2600R. Rather than holding a SPARCstation, it can contain up to six 3½-inch disk or tape devices for a total of up to 16 GB of storage. It is 16¼ inches wide, 24 inches deep and 5¼ inches high.

**Artecon Inc.**
2460 Impala Drive
Carlsbad, CA 92008-7236
**Circle 113**

## Visual Basic for TCP/IP

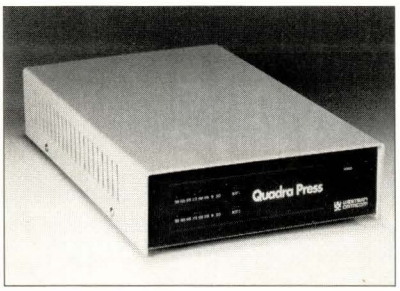
For users who need to link MS-Windows to TCP/IP, NetManage has introduced a set of Microsoft Corp. Visual Basic development tools for its TCP/IP protocol stack. Called NEWT SDK, the development kit supports either a Berkeley 4.3 BSD Socket API or a Windows Sockets API. With it, developers can produce Visual Basic applications linked to NetManage's NEWT (the company's TCP/IP) without having to deal with the actual complexities of networking.

The company says that the product allows developers to produce network-aware Visual Basic applications without a detailed knowledge of either Windows internals or the Sockets interface. Pricing begins at $500.

**NetManage Inc.**
20823 Stevens Creek Blvd.
Cupertino, CA 95014
**Circle 114**

## Data Compression Device

A device that can compress synchronous HDLC/SDLC data on existing networks has been introduced by Western DataCom. The 810 Quadra Press compresses synchronous data so that networks may handle more of it, more quickly, without being physically upgraded.




The 810 provides an average compression data rate of 1.024 Mb/s over 128-Kb/s Fractional T-1 lines, and 512 Kb/s over 56/64-Kb/s Digital Data Service (DDS) or 56-Kb/s switched digital lines. It uses the ASH data compression algorithm. Pricing begins at $2,795.

**Western DataCom Co. Inc.**
959 Bassett Road
Cleveland, OH 44145
**Circle 115**

## Magic Development Tool

Magic Software Enterprises has released Version 5.5 of Magic, the company's rapid application development tool for client/server and host environments. This version supports concurrent, multiuser development and offers support for embedded structured query language, two-phase commit, transaction processing and support for RDBMS.

Magic's table-driven development methodology allows developers to describe applications visually and allows for development of applications without writing code. Magic supports UNIX, DOS, CTOS and VMS platforms and provides interoperability with leading RDBMS and file managers. Licenses begin at $2,000.

**Magic Software Enterprises Inc.**
1200 Main St.
Irvine, CA 92714
**Circle 116**

## Neural Net Software

Propagator, a neural network development system, has been released by ARD. The product provides a number of variations of the backpropagation learning algorithm. The company says, though, that the product is also extremely easy to use. Three dialog boxes control the setup of the network parameters, such as learning rate, number of layers, initial weights and so on.

The product also comes with two support programs. The first is a scale program that can be used to scale the network input data. The second is a source code generator that creates C code implementations of trained networks for use in custom applications.

Propagator runs on Sun SPARCstations under Solaris 1.X or Solaris 2.X. Pricing begins at $499.

**ARD Corp.**
9151 Rumsey Road
Columbia, MD 21045
**Circle 117**

### FYI

For those who wish to contact Patrick Stirling concerning his article "Creating Packages for Solaris 2" (*SunExpert*, October, Page 64), his email address is patrick@netcom.com.

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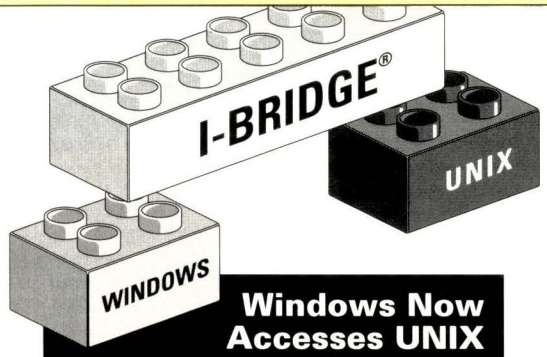


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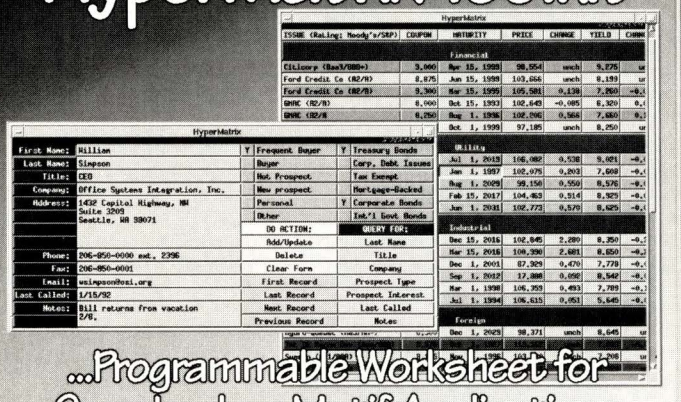

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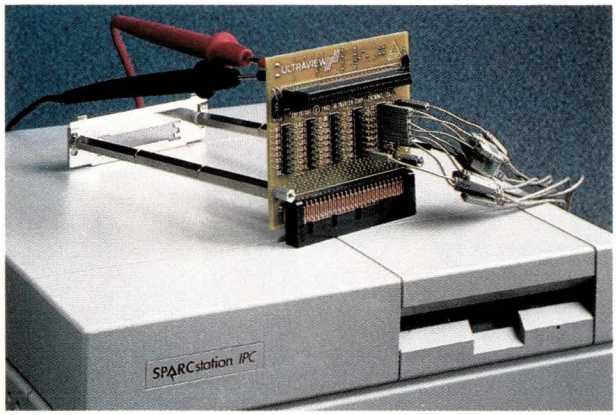


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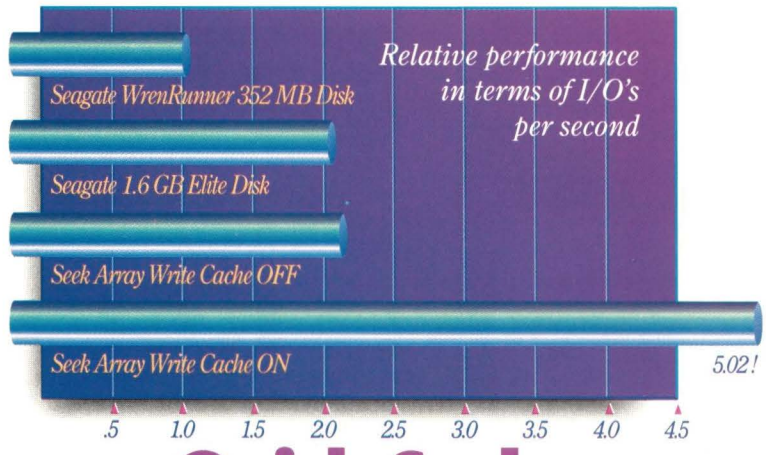


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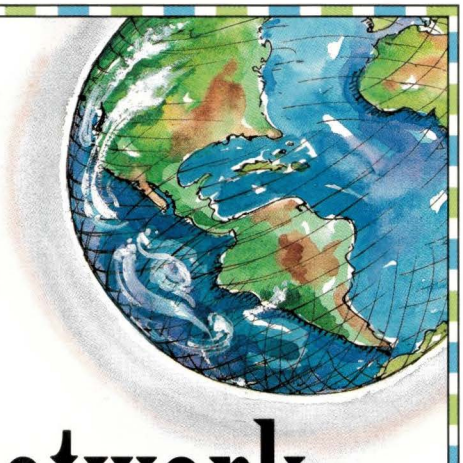

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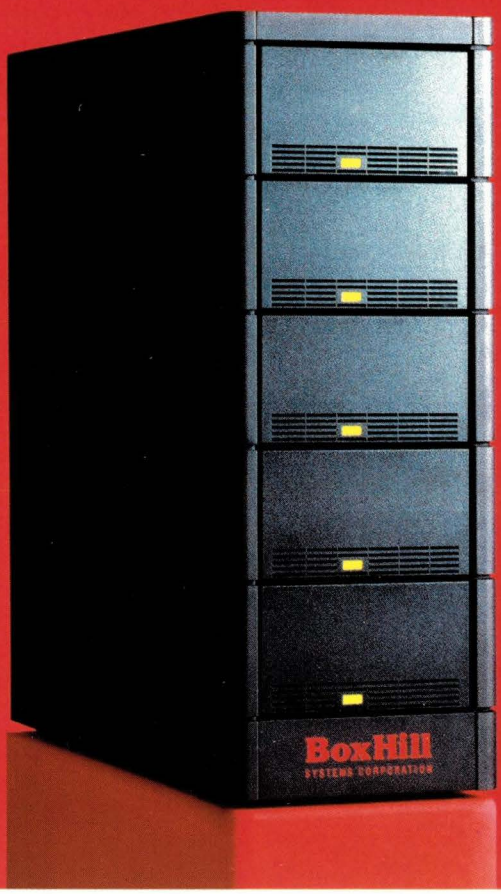


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