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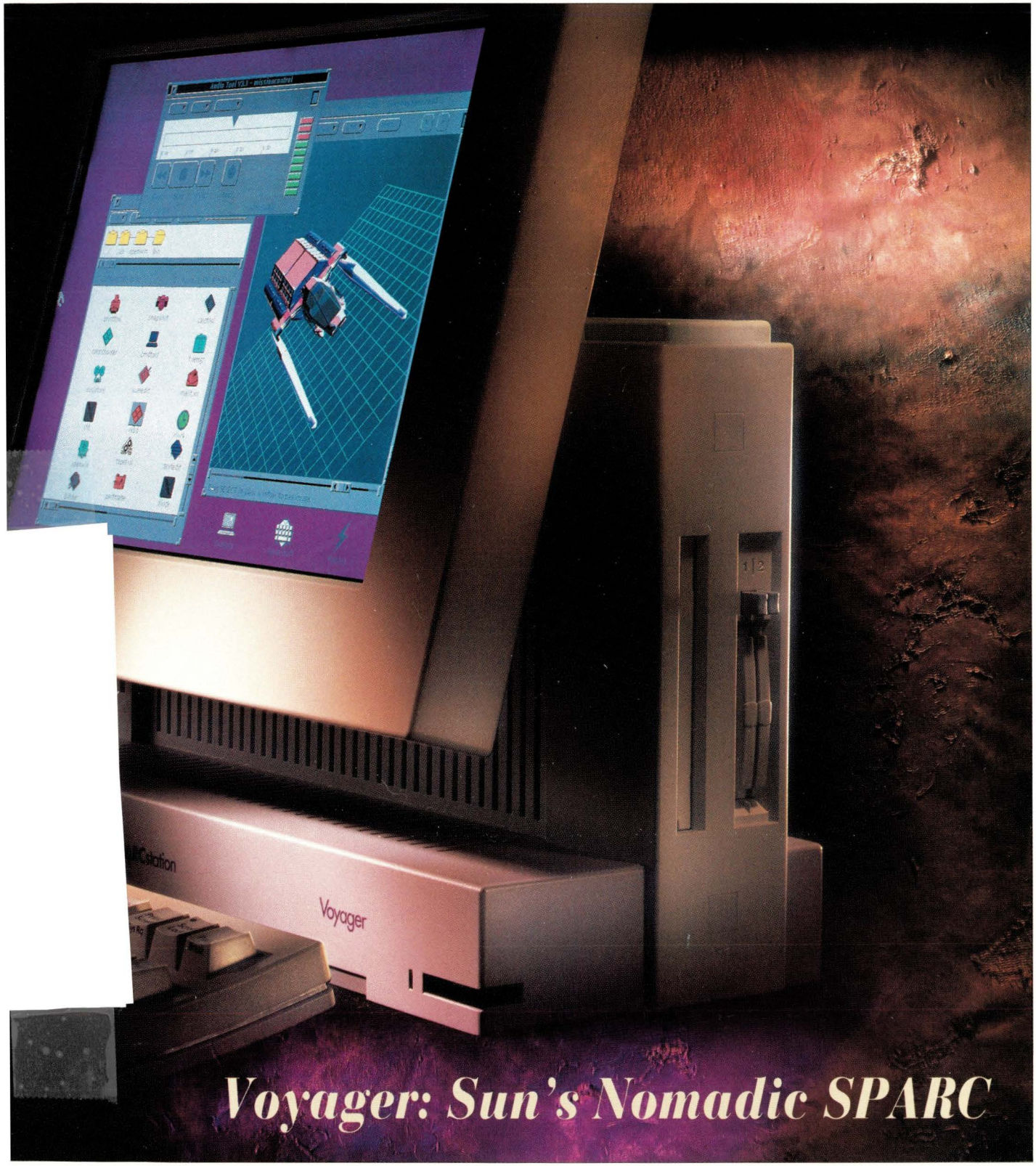
Serving the UNIX Client/Server Network

APRIL 1994 Vol. 5 No. 4 $5.50



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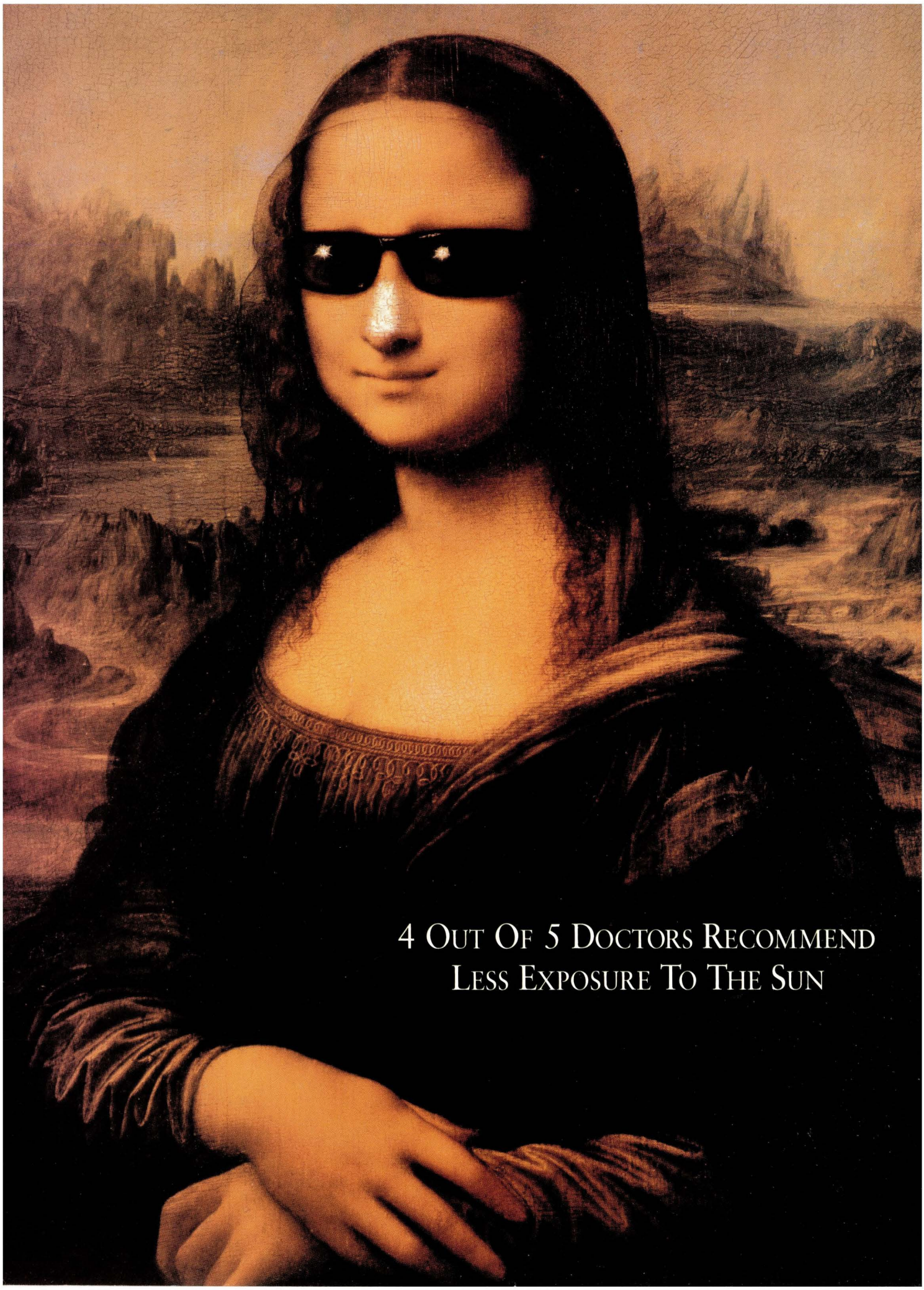
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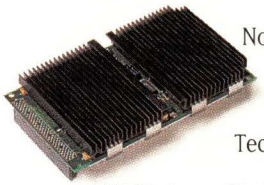

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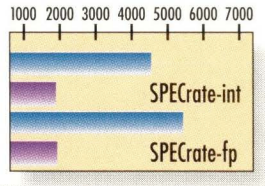

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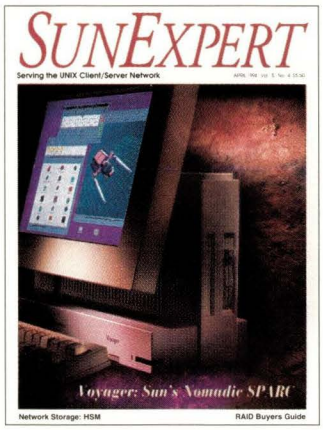

Cover photograph courtesy
Sun Microsystems

Voyager, Power µP, ScreenPlay p. 70

FEATURES

NEWS

COLUMNS

DEPARTMENTS

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

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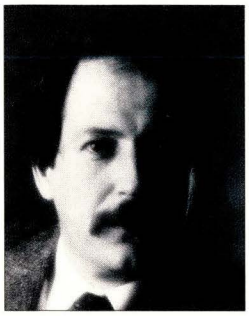
Material for publication should be sent to the attention of: Doug Pryor at the above address or electronically mailed to dpryor@expert.com. Letters sent to the publication become the property of the publication and are assumed to be intended for publication and may be used so. *SUNEXPERT* Magazine is not sponsored or endorsed in any way by Sun Microsystems Inc. All information herein is believed to be accurate to the best of our ability.

Editorial

Loopity Loop

It seems that the network is trying to prove the old adage that what goes around comes around. In the dim past, glass-house MIS minions spent much of their time loading and unloading, labeling and tracking, winding and tensioning tapes. System mass storage was a hermetically sealed, centralized function. Heterogeneous systems were anathema and not something MIS managers of the '70s and early '80s had to handle.



Data storage appears to be on its way once again to being a centralized function–this time in the hands of network systems administrators and network managers. The odious chore, yet critical craft, now gets parceled out to one or two people on the systems administration team. What a difference a decade makes. The "network" is no longer one site with one data type, one mainframe with a collection of DASD channels and devices. Networks today span the globe and are constantly evolving. Not only is the number of different platforms expanding, but the number of data formats is exploding–MVS and VMS machines, LANs of all kinds, Windows desktops, Macintoshes, UNIX servers from this company, from that vendor, etc.

This month *SunExpert* takes a look at two product categories that might lighten the load for a few systems and network administrators–HSM and RAID. Vendors of products like hierarchical storage management software, network file servers, optical jukeboxes, automated tape handlers and RAID arrays claim that their handiwork makes it not only possible, but practical for one systems administrator to oversee network storage. To learn more about HSM, see "The Great Data Migration" by Jane Majkiewicz and, for a roundup of some unusual suspects, see the buyers guide for RAID compiled by Maureen McKeon. Note that, for the first time, Sun Microsystems is included among the RAID vendors. See "Sun Shows Storage Array" in this month's News section for more information about the SPARCstorage systems.

Doug Pryor

SUNEXPERT Magazine
Serving the UNIX Client/Server Network
APRIL 1994 VOL. 5 NO. 4

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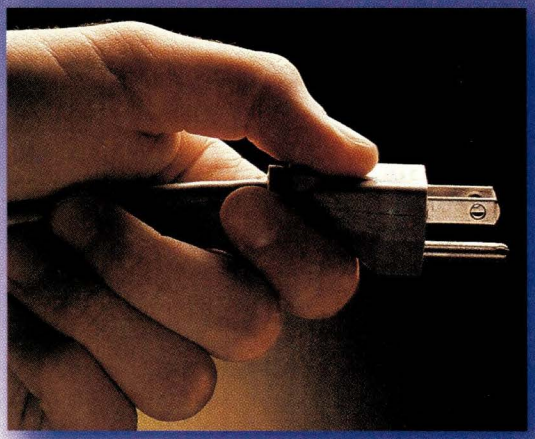

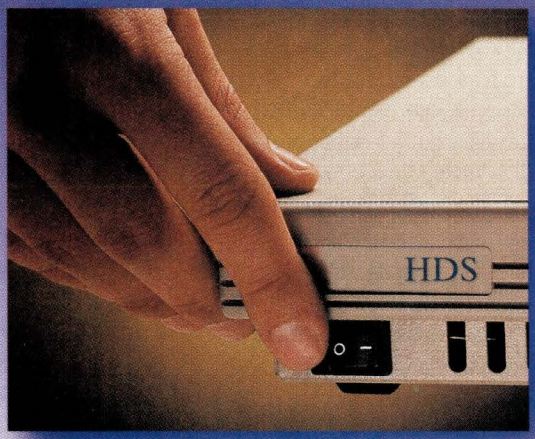

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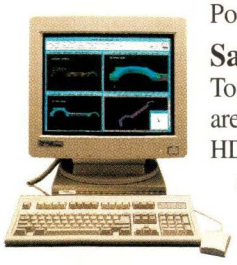

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LETTERS

"Letters to the Editor" may be edited to conform to SUNEXPERT style-guide and space requirements. The views expressed are those of the author and not necessarily those of SUNEXPERT

HSM: Look, No Hands

Dear Editor:

The article you ran on hierarchical storage management (HSM) software packages (*SunExpert*, January, Page 48) has something in common with other articles I've read on the subject. There is a lot written about technical features of each package, but a key benefit of these tools is being glossed over: the advantages HSM offers the system administrator.

As an enabling technology, HSM software (if properly designed) allows the system administrator to automate the handling of "stale" data in a seamless manner. A single HSM package should also allow an administrator to automate the handling of a multitude of storage applications necessary for the network in new and creative ways.

HSM can do much more than just store and manage an archive. We've oriented the development of our HSM products as tool kits for the "superuser" to free our customers' valuable time to tackle other tasks. With the current "downsizing" trend, we all know how overburdened current or prospective HSM users are.

We hope you will consider this aspect of the HSM market in future articles.

Dennis Edwards
Vice President
HIARC
3 Corporate Park, Suite 250
Irvine, CA 92714

FrameMaker Follow-Up

Dear Editor:

On Page 74 of December 1993's *SunExpert*, in the review of FrameMaker 4.0, bottom line of the middle column, the name of the creator of PBM is incorrect. The author's name is Jeff Poskanzer, not Jeff Posner.

This could be a spell checking-induced error. If so, Poskanzer is fine for your on-line dictionary.

Dylan McNamee
uunet!cs.washington.edu!dylan

Dear Editor:

A rather well-written review of FrameMaker 4.0 by Barry Shein had its credibility eroded by a faux pas.

In his "Nits" section, in the context of describing various data in/data out capabilities, Mr. Shein made the off-hand comment "...though I'll admit SGML is hardly a standard..."

Although Microsoft, WordPerfect, Frame, Interleaf and even Wang would have us believe their proprietary data formats represent some kind of "standard," there is in fact only one internationally recognized standard for text encoding mentioned in this article. That is, of course, SGML (ISO Standard 8879).

The respective industry initiatives in semiconductors, automotive, telecommunications, legislative and regulatory branches of the federal government, air transport...(the list goes on), all of which endorse ISO-8879 SGML as a standard, would likely appreciate an accurate representation of the importance of their work in this area.

George Kondrach
Director, Highland Consulting
(Highland Digital SGML Services)
4455 LBJ Freeway, #804
Dallas, TX 75244
george@dallas.highland.com

The Time of Day

Dear Peter Collinson:

I've written before to express my appreciation for your concise and clear writing style. Yours is always the first column I read.

Your article "Running Commands from the Clock" (*SunExpert*, January, Page 24) makes reference to the difficulty of running commands on the last day of the month. I came across a neat trick some time ago. Enter this one-line command in your `crontab` file (my time zone is PST; yours may vary):

```
H M 28-31 * * [ `TZ=PST-16
date +d` = 01 ] &&
do_this_command
```

and it will only run on the last day of the month. It resets the TZ for this invocation of the date command, tests if the date 24 hours in the future is the first and if so, runs the "do_this_command" script. It could run every day, but it is only necessary to check the 28th through the 31st.

Tom Henderson
tch@tim.com

Dear Peter Collinson:

I just read your article, "Running Commands from the Clock" in the January issue. I have a few comments/corrections that you may wish to consider. Most relate to `sh` considerations. I presume from your bio after the article you are principally a BSD user. I'm just the opposite.

BTW, my background is 18-year UNIX user/11 years in training, including systems administration. I've done quite a few Usenix/UniForum tutorials, though none recently.

1. Page 26, bottom of second column. You give a `crontab` entry:

```
7 1 * * * 2>&1 daily >log
```

will divert both the output channels to the log file.

This immediately caught my eye as an error, but I must admit that testing on my two systems confirmed the accuracy of your statement. Both worked from within `crontab` files and on direct execution on an `sh` command line.

However, I believe it works due to a defect in the `sh` program (on both my systems–SVR4.0 on a PC and Solaris 2.2 on a SPARCstation 2). If I am correct, code dependent on the defect should not be perpetuated, especially when the correct

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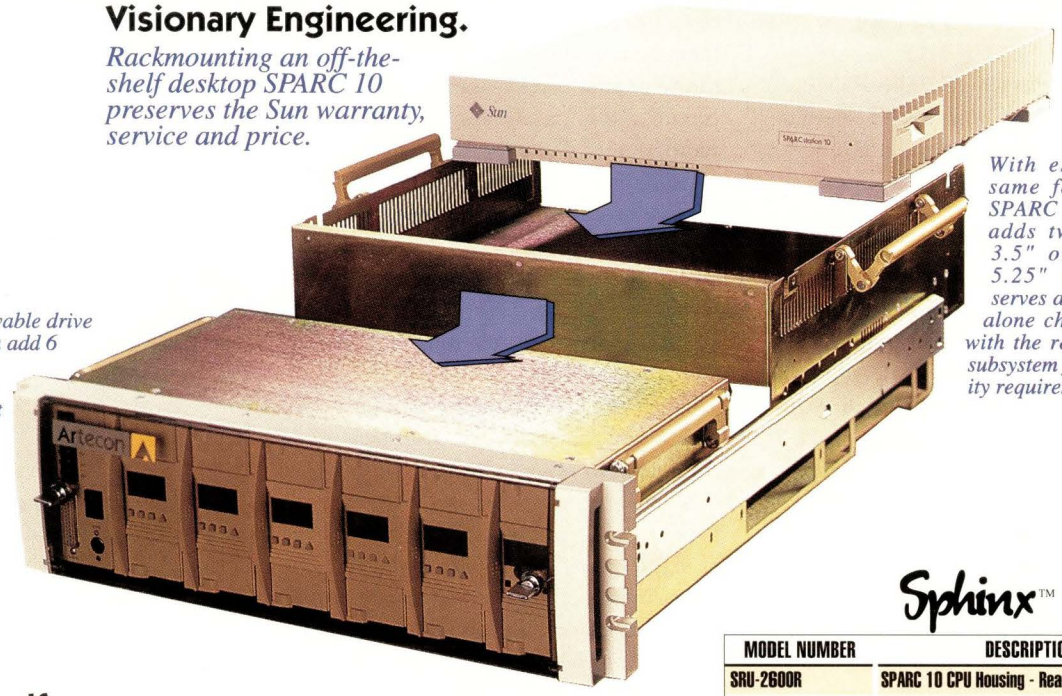

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RDU3-DSK-S-2.1GB	2.1GB 3.5" 7200 RPM Removable Disk Module
RDU3-4mm-S-2.06GB	2-8GB Removable 4mm DAT Module
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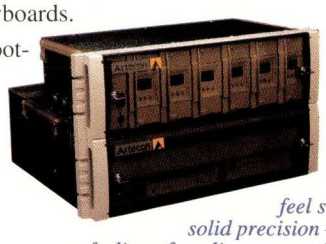

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syntax is available. (Note, ksh on both systems exhibits my expected behavior.)

Here is the reason I feel the example you present is wrong. Redirection in sh/ksh is done in a left-to-right order and is based on the files open at the time of the redirection. The relevant section of the sh manual page follows:

"The order in which redirections are specified is significant. The shell evaluates redirections left to right. For example:

```
. . . 1>xxx 2>&1
```

first associates file descriptor 1 with file xxx. It associates file descriptor 2 with the file associated with file descriptor 1 (that is, xxx). If the order of redirections were reversed, file descriptor 2 would be associated with the terminal (assuming file descriptor 1 had been) and file descriptor 1 would be associated with file xxx."

Thus, despite my testing documenting the validity of your example in two real-world systems, I think your example should show the documented syntax, which also works.

2. Page 30, next to last paragraph, column 1. My first experience with at(1) was on an AT&T system to which BSD's at(1) was added. This version indeed worked the way you describe for jobs missed during a down period. Later, AT&T added its own version, incorporated into the cron system as you describe. I was disappointed in the new version for two reasons: the syntax of the time portion of the command line and the lack of execution of "missed" jobs. I have not had the opportunity to test the current versions of at(1), but I would be surprised if that feature was retrofitted. I'd love to be proven wrong. When the new version (about seven years ago) was introduced, it broke my backup scripts that were at(1) jobs self-restarting as you describe. With the BSD version, missed backups were done immediately after the reboot. With the new AT&T version, they were never done again. I had to add some check code to the rc scripts to see if a backup was missed, if one was scheduled for the future, and reissue an at command if not.

3. Page 28, end of "at" paragraph dealing with self-repeating at jobs: The syntax of the at command in the script should not contain the "now" argument. It should contain an explicit time. Otherwise, the execution time of the repeated command will creep. If the command takes two minutes to execute, "now" is later for each reinstantiation of the job.

Also, if you are correct that missed jobs are executed upon a reboot, then "now" becomes the time it is executed after the reboot, not the expected time. So backups planned for 3 a.m. could all of a sudden start executing daily at 10 a.m.

4. Page 30, first paragraph dealing with use of the SHELL environment parameter. In several teaching and primary environments, I've never seen the SHELL parameter used for execution of at, or cron, jobs. These environments have included my current systems SVR4.0 on a PC and Solaris 2.2 and client systems running AIX, HP-UX, System V at Bell Labs, etc. Also, all these systems give a "warning" message if the crontab(1) or at(1) commands are given from a shell other than sh(1), saying that sh will be used for the execution. In classes, this warning message is a serious source of consternation for the students. They are certain they have done something wrong.

5. Page 30, middle of first column. You have a paragraph and example that reads: "This is a little simpler in Bourne and Korn shells; the backslash here means 'include the newline.'" Correct redirection sequence here. But the backslash is the problem. The meaning is not "include", but "ignore". Thus, as presented, an equivalent command line is:

```
( cmd1 cmd2 ) > log 2>&1
```

and the sequence "cmd1 cmd2" is a syntax or usage error.

The proper syntax is to eliminate the backslash entirely. For both appearance and ease of editing, I recommend separating the delimiters and redirection from the enclosed commands:

```
(
   cmd1
   cmd2
) > log 2>&1
```

Do with these notes what you will. I look forward to your future articles. I like to see what my training "competitors" present.

Jon H. LaBadie
jon@jgcomp.com

Mr. Collinson responds:

Sadly, this article was hit by dubious proofreading and some basic errors on my part. However...

1) Stream redirection

```
2>&1 command >log
```

After a little investigation on my SunOS 4.1.3 system and also on Solaris 2.2, it looks like using sh *allows*

```
2>&1 command >log
```

and

```
command >log 2>&1
```

to mean the same. This is a "feature" I guess. However, as you say, this appears to be "fixed" in ksh.

2) at *jobs running "late." On my SunOS 4.1.3 system,* at/cron *will run jobs that were due to be run when the system is down. Your comments about System V seem to be yet another reason for not running Solaris on my machine.*

3) Use of "now" in self-repeating jobs. Again, on SunOS it appears to work correctly. Those System V folks seem to have done a really great job in making at *"work." But point taken about advisability of use.*

4) Use of SHELL parameter. This comment again was derived from SunOS experience, by inspecting the file that at *generates.*

5) Backslash. Yes, I am now walking around with an axe in my head. This WAS bogus junk, thanks for spotting it. I should have.

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Circle No. 11 on Inquiry Card

A Question of Trust

Dear Ian Darwin:

I enjoyed your article, "Birth of a Desktop" (*SunExpert*, January, Page 59) immensely! I found it informative and insightful. I feel I can trust your opinions.

I may finally have to give up MacX and really use a native UNIX desktop. (Just kidding: I use SunOS and OpenWindows or Motif depending on who configured what and when and for what person and in what time frame and where and what phase the moon is in...)

Keep up the good work.

Steve Sidner
Eppley Institute
University of Nebraska
Medical Center
600 S. 42nd St.
Omaha, NE 68198-6805

Robots Redux

Dear Editor:

I would like to commend you on your article, "Rise of the Robots," (*SunExpert*, January, Page 44) and coverage of Epoch in the HSM section. However, although we are one of the leading backup vendors in the UNIX market, it has been difficult to gain mind share among journalists. On occasion we are excluded from backup and storage management articles that reference our competition. Unfortunately, we were omitted from the main body of your article when you paraphrased a quotation from Mike Peterson that mentioned our competition and excluded Epoch. I'm sure this was simply an oversight, but I am calling it to your attention in this letter.

Andrew Hettinger
Marketing Manager
Epoch Systems Inc.
8 Technology Drive
Westboro, MA 01581-1751

Which Came First?

Dear Editor:

Regarding your editorial, "The Chicken and Egghead Enigma" (*SunExpert*, January, Page 4): Bravo!

You hit the nail on the head. You would think that the rest of the pack would have learned a lesson from IBM about how well their Motherhood method of keeping the apron strings tied around their customers' throats works.

PCs and Macs are a fact of life, and if UNIX developers are going to succeed, they need to lower their prices.

Enough said.

Aaron R. Ionta
`uunet!icnt.com!aaron`

"Letters to the Editor"

Letters may be edited to conform to *SUNEXPERT* style guide and space requirements. The views expressed are those of the author and the author alone.

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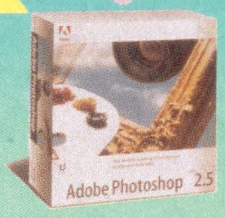

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NEWS

Apple Takes It to the Workstation

In a series of dramatic introductions, Apple Computer Inc. has announced a set of emulator products that will allow the Macintosh environment to run on Sun Microsystems Computer Corp. SPARCstations running Solaris 2.3 and Hewlett-Packard Co. workstations running HP/UX 9.0. The company says this is the first time Apple has ever shipped products that bring Mac functionality to systems from anyone other than Apple itself.

Meanwhile, in a separate arrangement, Apple has teamed with Insignia Solutions Inc. to put Insignia's DOS and Windows emulators on PowerPC-based Macintoshes.

As of press time, Apple's Mac environment for RISC was called Macintosh Application Environment, with the tag line, "the virtual Macintosh for open systems." The product is also known, however, by the code name Silver Bullet, and its final name seems to have been up for discussion to within a few weeks of the introduction.

Regardless of its name, the product is effectively a virtual Macintosh that happens to reside on a workstation. Silver Bullet is said to be a run-time layer of software on top of UNIX. Macintosh applications can then run unmodified on that Macintosh-in-an-X Window. Apple says that a user would not notice any substantial difference between the way those applications would run on the Sun and in native mode, except that they would be able to take advantage of the workstation's higher performance.

Moreover, Silver Bullet allows users to take advantage of the Mac interface to manage their UNIX files. The UNIX files appear as Mac icons. Users can then manipulate them exactly as they would Mac files–delete them by dragging them to the Mac trash can, duplicate or move them from one directory to another by moving the icon from one folder to another, and so on. Moreover, the user can cut and paste data and graphics from UNIX to the Mac and back again if need be.

In addition, Silver Bullet is a networked product. It can use workstation-oriented file systems such as Network File System. It can, therefore, access both local and remote UNIX and Macintosh files and take advantage of file services across a network.

The product complies with the X Window System Version 11, Release 3 and later, and operates with Motif and Open Look. It comes with a set of configuration tools that let users set up their mouse, keyboard and so forth so they function as they would on a Mac. It requires 16 MB of RAM, with 24 MB recommended. As of press time, pricing had been set at $549.

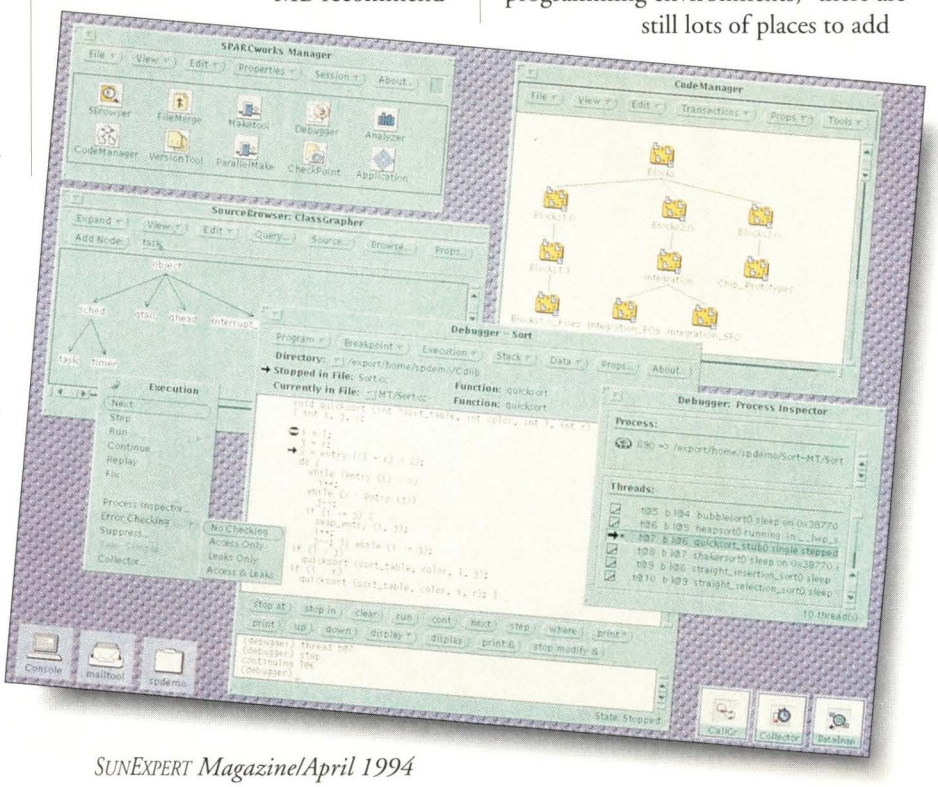
Apple made it clear that the Macintosh Application Environment for SPARC and HP is distinct from, albeit related to, its efforts to put the Macintosh environment on its PowerPC-based machines. However, it is a little uncertain where one begins and the other ends.

But a month before the Silver Bullet introduction, Apple and Insignia Solutions announced an agreement under which Insignia's SoftWindows PC emulation would be bundled with at least some of Apple's PowerPC Macs. SoftWindows PC allows Mac users to run MS-Windows and DOS applications on their machines, in much the same way that Silver Bullet allows workstation users to run Mac applications on theirs.

Sun Shows Software Tools

In a move that has pleased some customers but might bring Sun into competition with some of its software partners, SunPro has announced a new suite of software development tools. Called the SunPro WorkShop, the product could compete with such traditional software development vendors as CenterLine Software Inc. and Lucid Inc.

However, says CenterLine's Bob Chatham, product line manager for programming environments, "there are still lots of places to add



SunPro Workshop is a collection of different developers' tools. It contains new tools, such as a direct C++ compiler, and enhancements of older ones.

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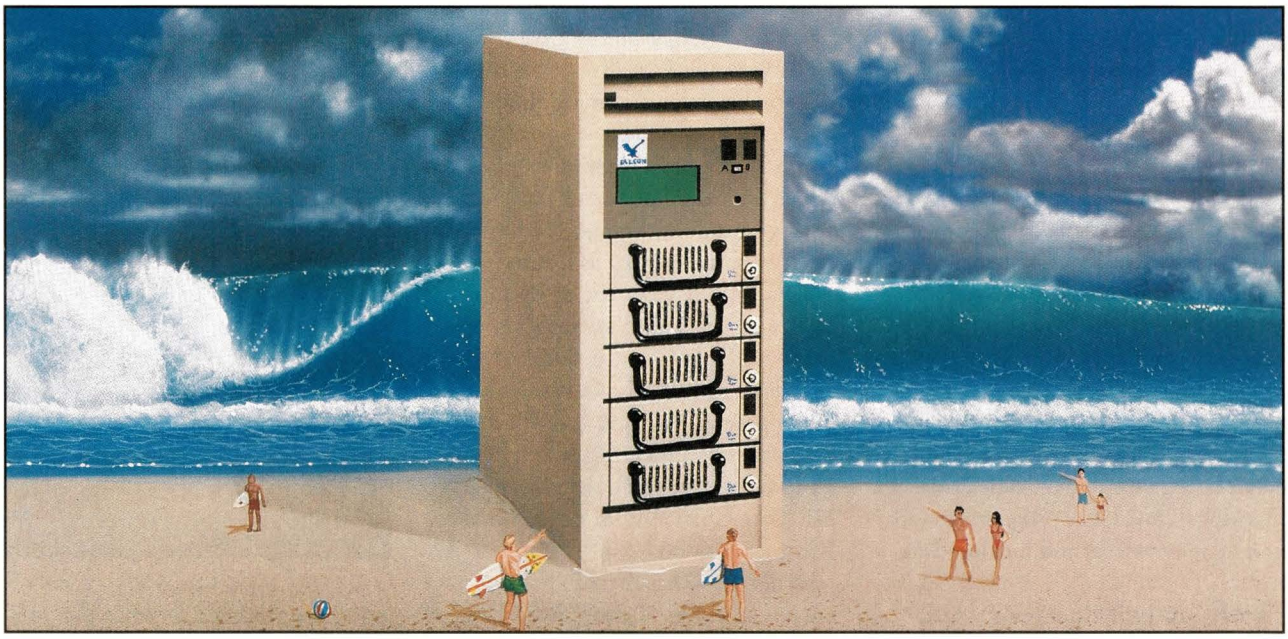

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value on top of the Sun stuff."

SunPro is an integrated product suite for software developers working on Solaris 2. There are three versions, one for C, one for C++ and one for FORTRAN. All three contain an enhanced version of SPARCworks, the SPARCcompiler for C (which is available even for the non-C kits, for developers doing cross-language projects), an assortment of code management tools, and SPARC/iMPact, which is a set of development tools for programmers working in a multiprocessor environment. All these support tool integration through ToolTalk, the COSE standard for interapplication communication.

At the introduction, SunPro announced that SPARCworks had itself been enhanced. The new version features, for example, a debugger with several new capabilities. These include "fix and continue," which allows a programmer to execute a program, stop it when it encounters a serious bug, then fix the bug and continue the program without having to relink the program.

Another debugging feature in the new SPARCworks is run-time error checking. This allows programmers to find memory access and memory leak errors.

SPARCworks/iMPact, meanwhile, provides multithreaded development tools. It has, for example, a "thread-aware debugger" for people working on multiprocessor applications. It also extends the SPARCcompiler for FORTRAN to automatically parallelize FORTRAN applications.

SunPro WorkShop for C is $2,195. The C++ version is $2,995 and SunPro WorkShop for FORTRAN is $3,195. SPARCworks is bundled with WorkShop, but it can also be had as part of SPARCworks Professional C, which contains SPARCworks with the SPARCcompiler for C, for $1,195. SPARCworks/iMPact too is available separately at $995.

The effect of the introduction is to make SunPro much more a competitor with the development vendors that have traditionally sold into the Sun market. Sun's product literature makes pointed comparisons with CenterLine, Liant Software Corp. and others.

Equally telling, SunPro is offering a program by which CenterLine, Lucid and Hewlett-Packard Co. SoftBench users can trade in their existing tools for WorkShop. Pricing on the trade-ins is very attractive. The regular price for WorkShop for C, for example, is $2,195. But, with a trade-in of a CenterLine CodeCenter or Lucid Entergize C, the cost is only $1,295.

But development environment vendors claim to be unconcerned. "It isn't like things have changed substantially," says CenterLine's Chatham. "It has always been our policy to add value over the tools that Sun ships."

He thinks, in fact, that the third parties still have significant advantages over Sun. In particular, he notes, his company supports multiple platforms, which is clearly not as true for Sun. "Sun's attitude is that you can have any box you want, so long as it runs Solaris," he says. But the problem is that most developers are working on many different boxes, including those that don't run Solaris, and may need development tools that span their hardware investment. "Ask Sun about its commitment to put its tools on HP," says Chatham, "or on the IBM [Corp.] RS/6000."

He also says that the Sun products are not as technically sophisticated as his own. "What they've done is not particularly innovative," he says. "It is basically an attempt to bring SPARCworks up to the level that CenterLine has been at for the last five years."

Another company that says it is unconcerned is Pure Software Inc., whose product, Purify, is also known for its ability to find memory leaks. Pure's CEO, Reed Hastings, says there may be no real competition between his company's product and SPARCworks, even with the new memory leak features. "They're actually doing us a great service," he says. "They've created enormous interest in run-time error checking."

He argues the two products are not really competitors in that Sun's offerings tend to be more traditional debuggers, whereas his are more in the business of assuring good code before bugs turn up. "The compiler/debugger loop is always going to be owned by the OS vendor," he says. "That's why we've stayed away from it."

But he is far less confident about the future of some of the development environment vendors who do play in that compile/debug loop. "I think SPARCworks has the potential to be the dominant product in that market," he says.

Sun and the Nomad

Sun Microsystems Computer Corp. has introduced a new, small-footprint workstation for users whose space requirements are particularly demanding, or who need a full-featured workstation that is transportable. Called Voyager, the product is reviewed in the Feature section of this month's issue of *SunExpert*.

The product may reflect important technical directions within Sun. It uses, for example, the PCMCIA rather than the SBus for expansion purposes.

A transportable rather than a portable, the Voyager from Sun is described as a nomadic computer. It is meant to be a desktop system that is easily transported from one office to another, or even to a tent in the field.

Voyager comes with a flat, active-matrix screen and is hardly bigger than a standard-size airline carry-on. However, it is not a laptop, and Sun is not selling it as a portable computer. Instead, it is to be marketed as a transportable or "nomadic" system for workstation users who may travel to different locations, but who will have lengthy stays at those locations.

"Consider professional photographers," explains Greg Munster, product line manager for SMCC. "Their cameras and lights are not called 'portable,' but they were designed to be transported. That is about as close as you can get to how we expect peo-

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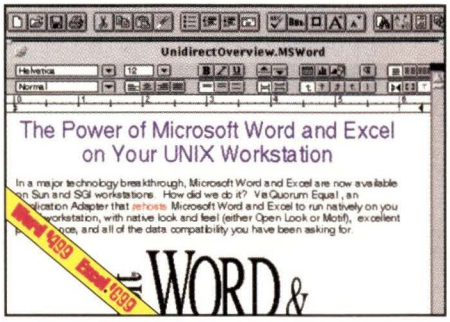

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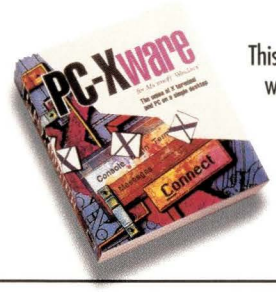

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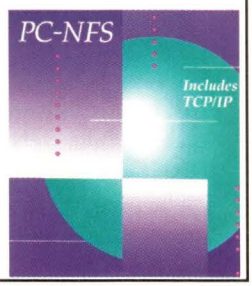

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ple to use Voyager."

Sun works hard to explain how this nomadic user differs from the person who might instead buy a Tadpole Technology Inc. or RDI Computer Corp. laptop. Munster describes this individual as someone whose office may change location every six to eight months–people in construction, for instance, or in oil exploration, or in the military. In any case, this user doesn't need a system that can be used in an airplane or a boardroom, but rather needs one that can be picked up and moved easily from office to office, or even into a tent in the field.

"You aren't going to be using a workstation to play solitaire on an airplane," explains Munster. "This [Voyager] is a primary-use machine. It is a desktop system, but if I need to go someplace, I can take it with me."

The other customer that Sun targets with Voyager is the individual for whom desktop real estate is very expensive. "Many users are just interested in a compact solution," says Munster. There is an entire class of user who needs a very compact device–financial services users, for example–but they also need a large screen." He cites in particular the Japanese market, where office space is very expensive. Solbourne Computer Inc.'s parent company, MEI, has been selling a similar flat-screen SPARCalike in Japan for a year now.

As a workstation, Voyager is very much a SPARCstation. It is a standard, full-featured Sun computer, in other words. However, there are some technical differences between it and its tube-cousins. First, it handles memory expansion via add-in cards. "They're not PCMCIA cards," says Munster, "but they are like them." Sun says that the cards are not proprietary and is working to standardize the interface.

However, Voyager does use PCMCIA for other forms of expansion. It has two PCMCIA slots and does not have an SBus in the machine at all. Although, says Munster, there is a graphics interface that can do SBus signaling if necessary.

The company says that it picked PCMCIA over SBus because of its advantages in size and weight for a portable computer. Perhaps significantly, on February 22, Sun's SPARC Technology Business (STB) group announced that it would be releasing a single-chip PCMCIA controller.

Voyager is based on a 60-MHz microSPARC II, making it one of the first microSPARC II products on the market, and has a performance of 43 SPECint 92 and 37 SPECfp. It comes with 16 to 80 MB of RAM, a floppy drive, a 2½-inch 340-MB hard drive, TurboGX 8-bit color graphics acceleration, the two PCMCIA lots, an infrared serial interface and an assortment of standard Sun I/O interfaces (twisted-pair Ethernet, ISDN, etc.). Voyager's price ranges from $10,000 to $15,000, depending on configuration.

Sun Shows Storage Array

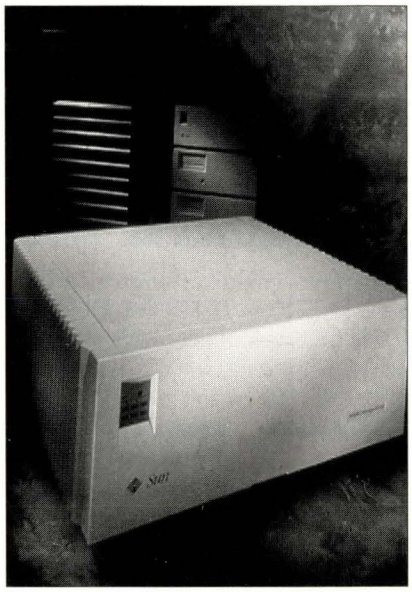
Sun Microsystems Inc. has introduced two new mass storage subsystems. The SPARCstorage Array Model 100 can contain up to 30 1.05-GB, 20-MB/s SCSI disks, while the Model 200 can support up to 72 2-GB drives. Both SPARC-based systems operate via Fibre Channel, a high-performance I/O channel that provides 25- to 50-MB/s transmission speeds.

The Fibre Channel cable, which can be up to two kilometers long, attaches to an SBus card in the host system. The SBus card can support two such connections, so each card could connect to two arrays. A single SPARCstation could thus support 60 platters and still have SBus slots left over.

The product is designed for high availability. Indeed, the company claims 99.99% data availability. To this end, the product is designed to be simple. There are no cables in the chassis, for example. Rather, everything–the drives, which can be slipped in and out like bread into a toaster, the chassis controller and the power supply–connect via backplane technology.

The chassis controller is a board with a microSPARC processor, six intelligent 16-bit SCSI processors, and 4 MB of RAM for write response and caching. Like everything else in the box, it can be changed in the field.

The product's disks can be configured for different tasks. Some might function as part of a RAID device (and



Sun's new SPARCstorage Array is a mass storage subsystem that can hold up to 30 1.05-GB SCSI disks. It connects to an SBus system via a Fibre Channel Interface cable.

Array supports RAID 5, 1 or 0+1), or as independent spindles, or as simple mirrors. Up to six of the disks can set up as a hot spare pool, taking the place of a disabled drive in the event of a malfunction.

A 6.3-GB Array is priced at $24,900, or about $3.95 per megabyte. A 31.5-GB Array would be $50,900, or about $1.62 per megabyte.

Lotus Ships Notes for Sun

Lotus Development Corp. has announced that its Notes product will be available for Solaris 1.1–a k a SunOS. Notes is a communications product that combines features of email, groupware and database facilities.

The announcement is not a surprise. Lotus has been saying it would put Notes on Sun for months. However, it is welcome news to Sun and Sun users, who had wanted access to the award-winning software. Notes has been one of the most successful PC-oriented communications products of the decade.

For Lotus, however, the introduction may be something of a leap of faith. The company has not done well with Sun-based products. In 1990, Lotus introduced 1-2-3 for Sun. The Sun community and the Sun-oriented press

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(including *SunExpert*) proclaimed that introduction one of the most important of the decade, saying that it legitimized the workstation as a business platform.

In fact, 1-2-3 for Sun sales lagged. In the real world, customers continued to happily do their spreadsheeting on PCs and then turn to a workstation for more technical projects. Or, when they did use Suns for a commercial purpose, it was as a mainframe substitute.

However, Sun's defenders say that Notes is a very different case. If workstations aren't used for spreadsheets, for example, they are used for communications. Email remains a popular Sun application. Lotus has quite successfully sold another communications package, the cc:mail email package, on Suns for some time.

Moreover, Sun is itself pushing Notes. SMCC has announced that a coupon for Notes software–one server license and five clients–will be bundled with all SPARCservers shipped in the United States through June of this year.

The Solaris version of Notes requires a Sun workstation (an IPC or above), running Motif 1.1. It requires a minimum of 16 MB of RAM, 32 MB of RAM for servers. Pricing begins at $495.

Solbourne to Remarket Oracle Financials

Solbourne Computer Inc. has announced an agreement whereby it will remarket Oracle Corp.'s financial applications. The SPARC-based system vendor is Oracle's only official Oracle Financials reseller. "We are the first and so far the only vendor to be doing so," says Lisa Drake, Solbourne's vice president of marketing.

Drake says the company envisions itself providing a single source for MIS departments that want to downsize to UNIX systems but don't want to pay to have someone painstakingly handcraft a system from assorted bits and pieces. "With that approach, you get low prices and lots of a leading-edge technology, but you don't get tight integration," says Drake. "What we're doing is announcing single-source integration from one vendor. We'll integrate it and, when something goes wrong, you call us."

Solbourne has had an interesting history. It was among the first companies to market SPARC-based computers successfully, in competition with Sun. It had a multiprocessor SPARC system long before Sun itself did. There was a time, in fact, when it was expected to become Sun's Compaq Computer Corp., the company that could take an open architecture and outperform that architecture's creator.

In fact, Solbourne ran into problems in the early 1990s. Sun's own multiprocessor machines appeared and provided stiff competition to Solbourne's servers. There were reports of troubles with the company's parent firm, Matsushita Electrical Industrial Co. Ltd., of Japan. A widely promoted single-chip SPARC implementation proved unsatisfactory. An attempt to market Solbourne's workstations failed. The company's president and founder, Scott McGregor, resigned in '92, to be replaced by Carl Herrmann.

As part of its efforts to regroup, the company decided to focus on MIS in general, and in particular on the part of MIS that had opted to use The Oracle Financials line of accounting software. Solbourne has even tuned its hardware and software to optimize Oracle Financials' performance.

Solbourne has thus become a hardware vendor that looks and acts a bit like a software VAR–even to the point of taking the VAR-like tactic of specializing in accounts too small to interest Oracle's own consulting service. "We are not competing with Oracle Consulting," says Drake. "They are much more interested in the larger deals. We can focus on the smaller company."

Solbourne has thus decided to become a niche player. Readers with long memories will recall that very similar strategies were announced in the 1980s by minicomputer vendors facing technical obsolescence and depressed revenues. Companies like Prime Computer Corp. and Wang Laboratories Inc. became resellers of other vendors' hardware, and in some cases, their software as well.

The track record of those companies has not been good. However, Drake says that Solbourne's case is different. For one thing, she says, Solbourne will never give up making hardware. "First, we find we are really good at making hardware," she says. "And second, the scalability and I/O of systems is very useful with Oracle."

She, in fact, thinks that focused, niche-oriented, integrator-like hardware vendors are the way of the future. "This is a new business model," she says. "I think it is going to set a trend."

Personnel Changes at Sun

Sun Microsystems Inc. has announced a number of personnel changes. First, Sun Microsystems Computer Corp. has a new president. J. Phillip Samper, former vice chairman of Eastman Kodak and a member of the Sun board of directors, has been appointed president of SMCC. In his new role, he will report to Chairman and Chief Executive Officer Scott McNealy. Samper will step down from his position on the board of directors.

Meanwhile, Dr. Eric Schmidt has been named to the newly created position of chief technology officer. In his new role, Schmidt will be responsible for coordinating all aspects of Sun's core and emerging technologies. In addition, Chet Silvestri has been made president of Sun SPARC Technology Business, an organization meant to promote the use of SPARC outside Sun.

But, in terms of the corporation, the biggest change may be at Sun Technology Enterprises (STE). This is a group of organizations within Sun developing what the company calls "middleware software, such as development tools, networking, PC interoperability and printing for the Solaris environment." This group will now be headed up by Ed Zander, who is also president of SunSoft.

And, finally, Sun's CFO, Kevin Melia, has announced plans to leave Sun. He will be replaced by Michael Lehman.

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No kidding. One of the hottest markets in cable right now is running Ethernet over cable TV networks, and from there, providing things like Internet right to people's homes, small businesses and even schools.

"Cable [TV] is a major, major golden opportunity that hasn't been exploited," says Rouzbeh Yassini, president of LANcity Corp., Andover, MA. LANcity is one of the companies that makes bridges that allow computers to connect to cable and run Ethernet on it. "We're adding a new customer every week."

LANcity's products are being remarketed by Digital Equipment Corp., among others. Its customers tend to be towns and cities that have cable in place and now long to use it for something other than just providing *Lassie* reruns and shopping shows to couch potatoes. "The communications advantage that American business achieved in the '80s, we are hoping to help communities achieve in the '90s," says Yassini.

He adds that the communities mostly want to link the formidable investment in computing equipment that already exists in even the smallest towns. Right now, those computers connect either by modem, or by having someone carry a tape or floppy from place to place. "Instead of sending a messenger, or having many, many phone lines, they could use the cable network...which already exists," he says.

Most communities have more than one cable network...and may not know it. In the 1980s and early '90s, when most of the country was wired up, one of the perks that cable companies offered towns for their business was the Institutional Loop, or ILoop for short. This was a smaller, sophisticated two-way network that linked a town's major institutions–its police departments, town or city hall, schools and so forth.

In many towns, the ILoop was installed and then promptly forgotten. Now, communities are rediscovering the ILoop and are attempting to use it as a sort of citywide LAN. Yassini notes Winchester, MA, for example, which is using its ILoop as part of an effort to link the town's schools.

LANcity's products are at the high end of the market, costing thousands of dollars, depending on the configuration, but there are also lower cost, lower performance options. Late last year, for example, Zenith Electronics Corp., Glenview, IL, showed its Homeworks system. "It's an interactive gateway for personal computers to connect with cable TV systems," says Edward Zylka, director of LAN product management at Zenith. "It's not a speed burner. It isn't meant to send graphics around. But it is meant to send Internet around."

In fact, that is what Zenith envisions as its market–home users who are pressuring or have pressured their cable operators to provide access to Internet on one cable channel. He thinks that cable operators are increasingly discovering the Internet as a means of increasing the value of their product. "It is helping drive new business for them," he says. "It's a valuable service that cable operators can provide."

Getting a connection to the Internet can be hard, but getting around it once you're there can be a lot harder. For this reason, Zenith is also partnering with Spry Inc., Seattle. Spry makes the Internet AIR Navigator. In addition, though, Spry itself has recently become a partner with the book publisher O'Reilly & Associates Inc., Sebastopol, CA, to produce and market a new product called Internet-in-a-Box for PCs and, later, Macintoshes.

"It's easy-to-use Windows software that makes the Internet a point-and-click environment," says David Pool, president of Spry. "Its components include things like a network file manager, a Windows News reader, a Windows Gopher, a Windows mail package and so on."

In addition, buyers of Internet-in-a-Box automatically become subscribers to O'Reilly's Global Network Navigator. This is a free on-line source of information about what's available on the Internet.

Initially, the customers for things like Homeworks and Internet-in-a-Box will probably be telecommuters who want some way to reproduce their office environment. But, in the longer run, Pool thinks that quite different

markets will become enamored of the Internet.

"What do you need to sell the concept?" he asks. "Just have your school board watch a kid do a research project in five minutes...by typing in a key word and getting an answer...from a server in Germany."

This Just In...

• Morgan Stanley & Co., the financial firm, has bought a global site license for the Expo spreadsheet qua decision support environment from *Leading Market Technologies*, Cambridge, MA. This is a fairly dramatic change from Morgan's usual behavior. Before, the company rarely bought anything off the shelf.

Expo is a graphical environment for global traders, analysts and other financial services types. It is available on Suns, among other UNIX platforms. Leading Market Technologies, meanwhile, has also recently introduced a product called TickBase, which is a data server and manager for the rapid storage and retrieval of time-critical transaction data.

• The *SPARC Technology Business* (STB) group of Sun Microsystems Computer Corp. has licensed the SPARCstation LX board to a Chinese workstation maker. ***Beijing Huasun Computer Co.*** will use a microSPARC-based board design to produce LX compatibles for the Asian market. Currently, Huasun has 21.2 % of the workstations in China, according to IDC China/Hong Kong Ltd.

• In other Sun news, ***Sun Microsystems Computer Corp.*** has announced that it is shipping 20-CPU versions of its SPARCcenter 2000 server. In this 20-processor version, the server is capable of 4,002 jobs per minute on the AIM III benchmark. Sun says this makes it the fastest UNIX RDBMS server on the market, with 734.1 tpsA at $4,346 per tpsA.

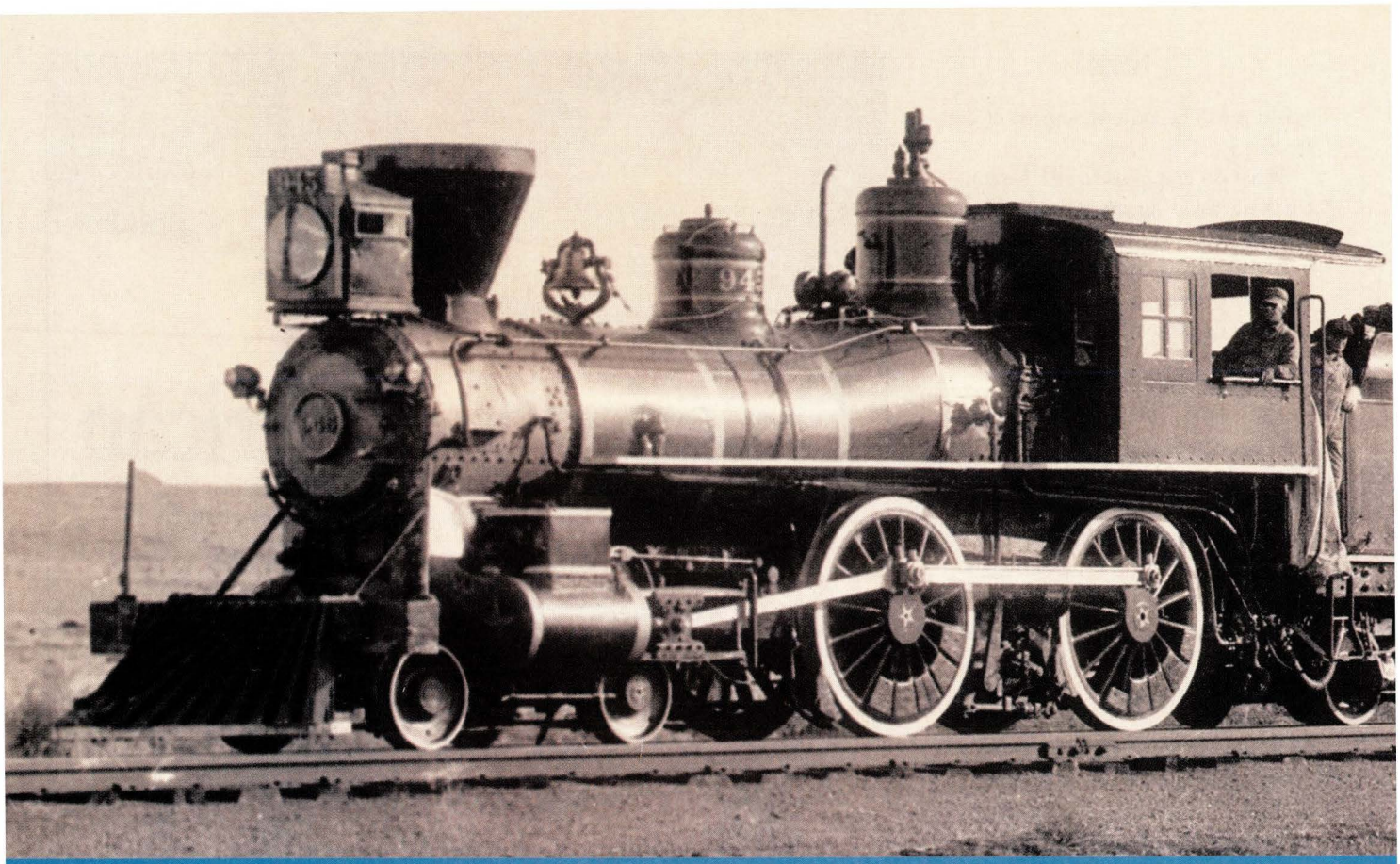
• And in still more Sun news, ***Sun Microsystems Federal Inc.***, SMCC's federal systems group, has filed a formal protest with the Government Accounting Office. Sun Federal was originally awarded a plum contract to provide computing to the National Security Agency. However, the contract, the NSA High Performance Workstation (HPW2), was recently put out for rebid after significant changes in the specifications. Sun says that the Maryland Procurement Office violated Federal Acquisition Regulations by substantially changing the requirements of the new specification.

• ***Vmark Software Inc.***, Framingham, MA, has announced plans to acquire ***Constellation Software Inc.***, also of Framingham. Vmark sells a number of database-oriented products on UNIX, including Pick-like tools and environments. Constellation Software, meanwhile, sells HyperSTAR, which the company describes as a group of object-oriented client/server interoperability products. Vmark has been a distributor of Constellation's products in the past.

• Two visual data analysis packages will shortly be a good deal closer. ***Advanced Visual Systems Inc.*** (AVS) and ***Spyglass Inc.*** have announced that future versions of Spyglass will use AVS technology. AVS is a scientific visualization company that emerged from the demise of the Stardent Corp., a high-end workstation vendor that was itself the result of the merger of the Stellar and Ardent companies. Spyglass, meanwhile, sold a lower end, lower cost product for visualization on cheaper platforms, like Macintoshes. Now, Spyglass will incorporate aspects of AVS into itself to produce a new product, Spyglass Slicer.

• ***3Com Corp.***, the Santa Clara, CA-based networking company, has announced its intent to acquire ***Synernetics Inc.***, North Billerica, MA. Synernetics is a vendor of Ethernet and FDDI products.

• ***Chipcom Corp.***, Southboro, MA, and ***NetLabs Inc.***, Los Altos, CA, have announced an agreement under which the former will use the latter's Vision Application Development. NetLab's product is a 4GL-like language for the design of graphically managed applications. Chipcom will use it to produce a suite of network management packages for its line of bridge and switching hub products. ⊸



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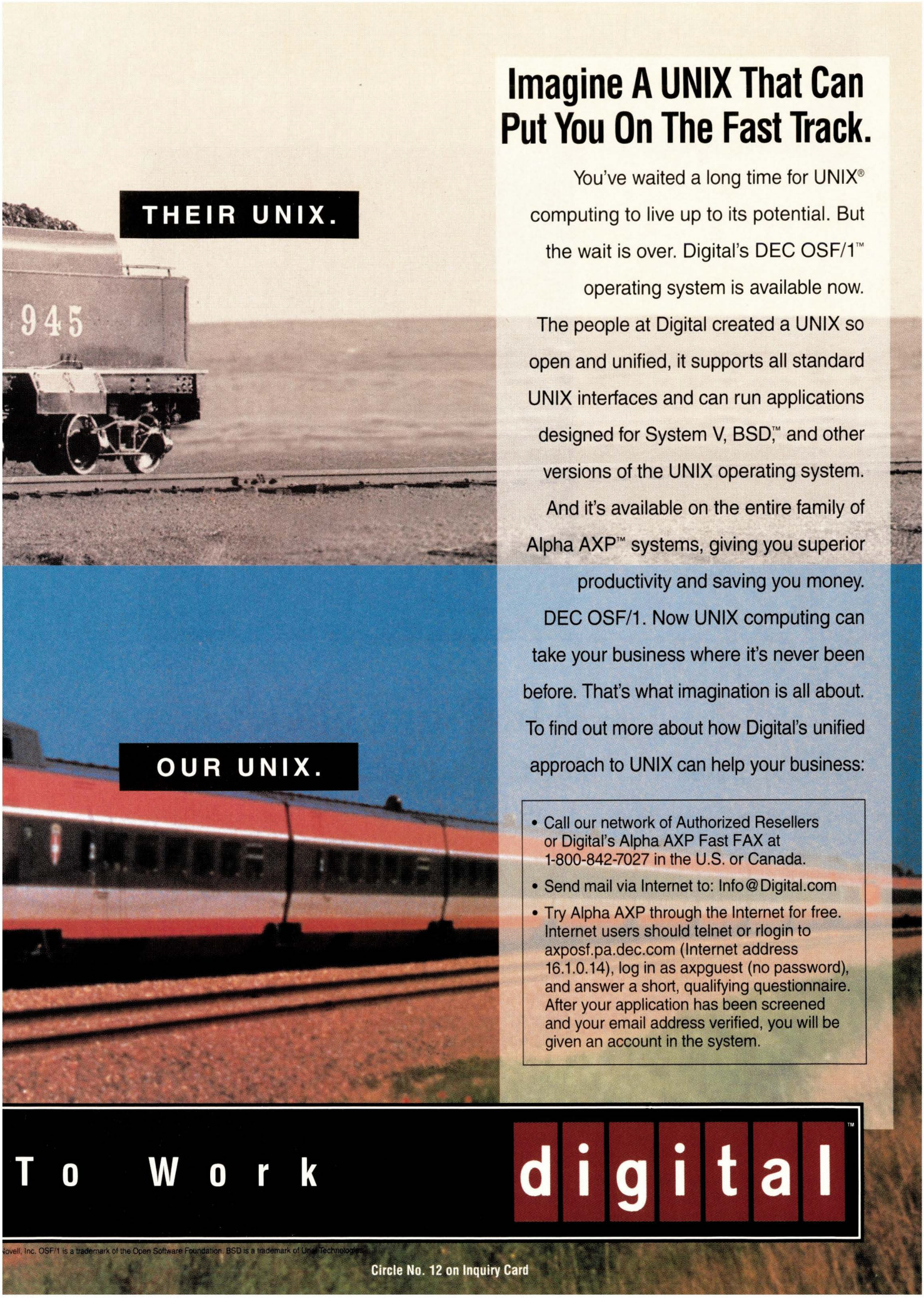

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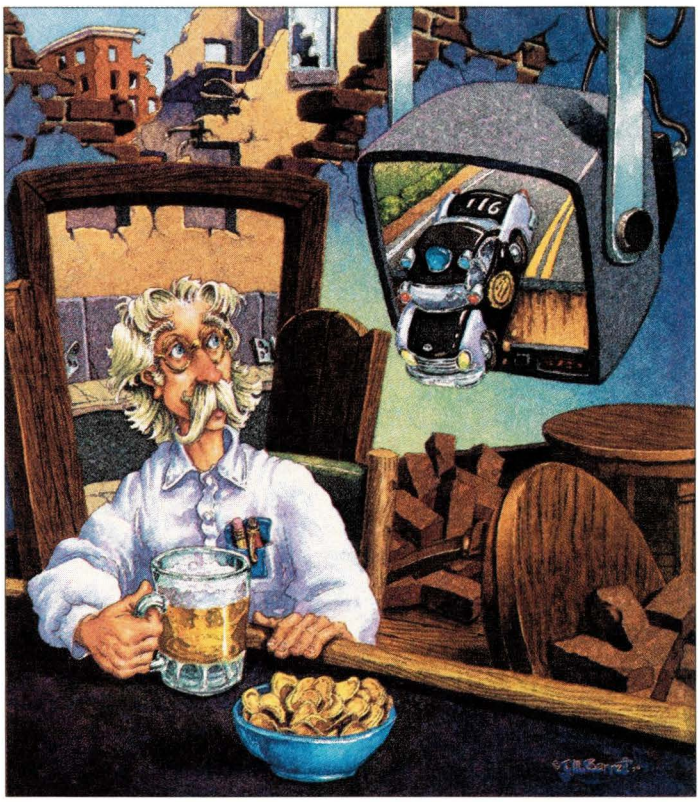


TOM BARRETT

Mr. Protocol Heads for the Corner Bar

by MICHAEL O'BRIEN

"Reach out and touch this beautiful 3-carat simulated diamond zirconium beauty, and it's yours!"
–One possible nightmare on the National Information Infrastructure

"So what happened then?"
–The most-often asked, and least-often answered, question directed at the 6 o'clock news

")%$#$%!!!!!!"
–California Highway Patrol officer

Q: What is *with* you people? This place looks like an earthquake hit it!

A: It did. We're still picking up around here. Turns out there was only one lousy mountain chain between us and the latest thrust fault to make its presence known. There's a fair amount of plaster yet to be rearranged, but the place seems to be gradually reacquainting itself with its own foundation.

In the immediate aftermath, Mr. P. was of course to be found jacked in to the net, exchanging "I'm still here" messages with many folks hither and yon. Once again, the Internet proved invaluable in moving health-and-welfare traffic during a medium-scale disaster. During a large-scale disaster, of course, it will be flat out, along with everything else, and it's as well to remember that. But while the entire Los Angeles basin lost power in the immediate aftermath of the quake, in an area about a hundred miles on a side, power to almost all of that area was restored within about two to four hours, bringing back with it not only the Internet, but everything else…including that sturdy precursor of the National Information Infrastructure (NII), television. So while Mr. P. burned up the wires, the rest of us were watching local news coverage, and that's the takeoff point for this month's exegesis.

It is impossible to watch a scene of such devastation and maintain a proper sense of horror. The emotion comes and goes fitfully, especially if

one is a survivor. We were propped around the remains of a fallen floor-to-ceiling bookcase which we had not actually gotten around to putting back into place, figuring we'd get a good dose of just how bad off everyone else was before feeling sorry for ourselves. Mr. P. did not join in this sentiment. The net was up and running, so as far as he was concerned, nothing had ever happened. He has a peculiar perspective.

As I say, it is impossible to maintain any one frame of mind under such circumstances, especially when one of the fundamental principles of the universe is in operation: Fiction has to be believable, but in reality, anything can happen. This implies more than just the fact that Mother Nature has a lousy sense of dramatic timing. It implies that sometimes, comic relief isn't confined to the stage.

Much of the footage on television was devoted to the shattered nature of the freeway system. In particular, one stretch of the Santa Monica Freeway, spanning Fairfax Boulevard, looked as if someone much too large and slightly too heavy had sat on it. It bowed ever so gently down in the middle, and rose at each end back to the original level of the roadway. Mostly. Actually, one end was still connected to the original roadway, but the other end had been shifted upward six feet, leaving a six-foot cliff between the buckled span and the continuation of the roadbed. No actual gap, mind you, just a six-foot cliff.

Television choppers were circling this site, probably in a merry-go-round formation, when onto the damaged section of freeway rode a black-and-white California Highway Patrol car. It was moving along at about 30 miles an hour, minding its own business. The endlessly gabbling reporters remarked, in puzzled announcerese, "What the **** is he doing?"

To this day, we have no idea what he was doing. We could only watch what he did. Along the span he came, barump-bump over the bend at the low point in the middle of the span, up the other side, and off into space over the cliff. The patrol car landed on its nose at the base of the cliff, the rear wheels still hanging onto the upper edge, holding the car in a completely vertical position.

Eventually the officer exited the car, obviously unhurt, and proceeded to walk up and down, waving his arms and generally behaving exactly as you would expect someone to behave who had received a terrible shock, racked up his patrol car, and generally ****ed up on live television in front of millions of people.

And that's the point, you see.

We never saw that officer again. The news media, in a conspiracy of silence occasioned, apparently, by a rare modicum of compassion, not to mention a plethora of more important things to talk about, showed that clip once on the evening news and left it alone after that. We have no idea what the officer was doing. We have no idea who he is. We have no idea what became of him. We have no idea whether he was disciplined, sympathized with, or merely allowed to acquire one of those deadly locker-room monikers which live on for the remainder of one's career ("Hey Evel!

Pass me the towel!"). And because the news media are a one-way proposition, we never will find out any of this stuff.

Enter the NII.

The NII is a wonderful national effort that is not yet even loosely defined. Nobody, and I mean absolutely nobody, knows what it will look like or what it will do. However, there are a large number of powerful, and powerfully interested, organizations that believe they know what the component technologies will be. That is why the current efforts of the parties most closely concerned are devoted to the building of consortiums deemed likely to put their constituents in the best position to launch whatever integrated services turn out to be important.

The fact that such large forces are arrayed, ready to invest substantial percentages of the GDP in something so nebulous, amplifies almost to absurd proportions the efforts and voices of those already involved in the area. The effect is like dropping a crystal into a supersaturated solution. This is why the Internet is making headlines. Compared with almost any imaginable scenario for the NII, the entire Internet is vanishingly small. And, as Brian Santo points out in the January 17 issue of *Electronic Engineering Times*, the Internet is not infrastructure. It is a service, mounted on a hodgepodge of existing transmission services, ranging from fiber-optic links down to twisted pair, with forays into packet radio.

Mr. Protocol feels that while this is certainly true, the peculiar amplification seen by the Internet due to its position tends to drive the design of the next generation of almost every part of the hodgepodge. Consider the fact that in the case of the current top-of-the-charts network transmission standard, ATM, the size of the cell was chosen as a compromise between the voice'n'video boys and the packet transmission boys. The detailed specifications of just how the ATM will fit into the Internet are still being hammered out, but from the beginning of the design of ATM, it was certain that it would fit in, not only into the Internet but into the entire packet-switched world that the Internet represents. And, since the Internet is currently the biggest game of that sort in town...

It is not that the range of technologies being pushed for integration into the NII is startlingly large. What is interesting are the proposed combinations of those technologies. In the current regulatory circus we have the regional Bell operating companies and the local cable television companies. Each is now being touted as a likely entrant into the other's sphere of influence. The cable company will be allowed to provide dial tone on your telephone, and the telephone company will be able to provide movies on demand. Mr. Protocol points out that these predictions seem safe because in some sense, they ruffle no one's feathers. No real imagination is needed in order to foresee these services. What is hard to imagine are services that make real bidirectional use of network connections.

What's the fuss? Mr. Protocol is glad you asked.

The problem is that no one knows what the back-channels are going to carry. No one ever really asked the American public for input and waited around for an answer.

Much noise is made about "participatory democracy" in the NII. The local equivalent of public access television channels is highly touted. Mr. Protocol probably even believes this. Others, however, believe that real participatory democracy depends far less on the existing public access channels and far more on the neighborhood bar. And if you ask what the neighborhood bar has to do with the NII, the correct answer is, "Bingo! Absolutely."

Viewed from the inside, the current Internet bears very little resemblance to the original ARPAnet. Services and usages have changed drastically. Viewed from the outside, though, it still has a strong flavor of research laboratories and academia. Viewed from a marketing perspective, the NII has a strong flavor of the Home Shopping Network.

Hollywood and the television networks meet their critics gingerly, when they meet them at all. Public taste is so famously fickle that the people involved rarely have the courage to speak their minds, and in fact, have been chasing the public taste for so long that many seem to have lost any taste of their own that they may have had. Some few maintain both a sense of perspective and a willingness to speak, however, and they point out at every opportunity that they do not put mindless drivel on the tube and in the theater because they wish to force people to watch it, they produce mindless drivel because that is what people watch. If more people watched Bach and Botticelli than watched Madonna and Matlock, then the airwaves would be filled with, as one great man once put it, "Bach, endless Bach."

And that is why the neighborhood bar will come to characterize the NII. Consider not only Gibson's *Neuromancer*, but more recently, Neal Stephenson's *Snow Crash*. Not to mention *Star Wars*. All three have bars in them. Not your normal, everyday bars, but bars full of action, adventure, excitement and above all, *interesting people*. People read these books, or see the movie, and say "*Yes! That* is the bar I want to go into, just once in my life, if I could be sure I'd survive it."

People watch QVC not because of intellectual content, but because it is like Aladdin's Lamp. They see (apparently) gorgeous stuff on television, and one phone call later, it appears on their doorstep. It becomes addictive. Mr. Protocol would not be surprised to learn of the existence of a twelve-step program for recovering Home Shopping addicts.

People crave maximal experience for minimal investment of time, money and energy. That's why Adventureland and Star Tours and Toon Town are so popular at the Disney theme parks. More people have ridden the Disney jungle river than will ever visit the real Amazon. No bones about it, the real Amazon is still there and people still visit it, and it beats Adventureland eight ways from Sunday. It's also sickened and killed a lot more people than Disney ever will.

So, if people like to get together in the neighborhood bar, one of the first things that will happen when people can talk back to the TV in terms more sophisticated than "gimme one of them things" will be Archie Bunker's Bar. Or the *Star Wars* cantina. Or whatever you want: participatory democracy.

Some pundits believe that because current networks are symmetric, that the NII will, or should, allow anyone to originate the same sort of material that they receive, and further make the claim that because video production facilities are plummeting in price, there is no reason why home-produced video should look any worse than what the networks put out. There is one very good reason why not: talent. Most people can't tell a story to save themselves. In previous centuries, home-grown talent, in music, painting, writing or what have you, stood together with the best that society could produce, because society couldn't produce enough to fill the hours. If you wanted more music, or paintings, you "improved" yourself and learned to produce your own. This arguably produced more and better talent per capita than at any other time in history, but today's society certainly doesn't look like yesterday's, and Mr. Protocol thinks that while independent production will mushroom, home-grown video will never become the norm.

For similar reasons, neither will home-grown software. But software is different from video. Video is personal, but software will work as well for one person as another. If you imagined that once a car was designed, it could be replicated indefinitely, then the function of Detroit would be relegated to excellence in design and aftermarket service, and a lot of really weird cars would be on the road. Similarly, Mr. Protocol believes that in both the areas of telepresence and information retrieval, telepresence programs, like those in *Snow Crash*, and information agents will be commercial items to be traded.

Returning to our example of the unfortunate patrolman in the suddenly vertical patrol car, consider what the situation would be like if the news were bidirectional. The bare story is presented for free, but all sorts of hooks hang from it in all sorts of directions: most standard and canned, some specific to the story. Suddenly the viewers can ask questions: Who *is* this guy? Why was he there? How often do cops drive blithely into disaster areas like that? What's gonna happen to him?

Certainly there will be societal protections in place, particularly in the case of such people as peace officers. But the fact is that the two-way nature of the NII will be taken full advantage of, Mr. Protocol feels. What most seem to have missed is that commercial interests will provide much of what goes into the network from the consumer's end, as well what goes toward the consumer from the net. People will purchase their own interface to the net in the same way, and in

about the same proportions, as they buy clothes. Some will make their own, some will go into a cottage industry of providing interface software to others, most will buy commercial, supported packages–something like an inverted cable service.

In fact, Mr. Protocol ventures that before the next N years are up (N=10 if you're adventurous, 15-20 if you're a pessimist or a government regulator), you'll be able to go down to the corner bar and hang out with Mr. Protocol. Not Mr. O'Brien, but Mr. Protocol. And don't worry–you won't look like anybody recognizable either!

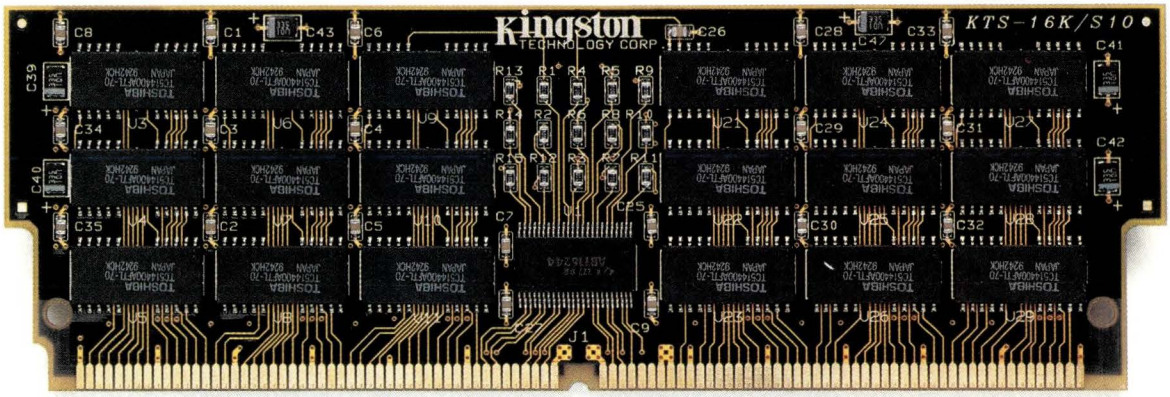
Clipper Revisited

Some of you may remember Mr. Protocol's diatribe on the Clipper Chip some months ago. Apparently due to the fact that no one in the White House reads this column, the Administration has decided to proceed full-bore with the Clipper proposal. Mr. Protocol himself is barely aware that politics exist (though he can get mighty pointed when the sales tax on Big Stuf Ding-Dongs goes up, let me tell you!), but you may nevertheless wish to link up with the Electronic Frontier Foundation and make your views on the matter known, whether you agree with the EFF stance or not. Participatory democracy, indeed. ⊸

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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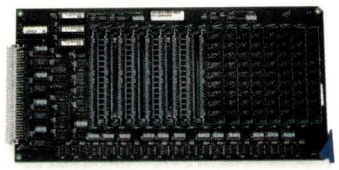

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KEITH GRAVES

Sendmail

by PETER COLLINSON,
Hillside Systems

Back in the dim and distant days before networking, mail was internal to the machine that you lived on. On UNIX, there was a single program, `mail`, that was the interface to the mail system. It was used for sending mail, taking data from the user and placing it in the recipient's mailbox. It was also used for reading mail, taking data from the mailbox and printing it on the screen.

As networks have grown, that single program has needed to get more complex. From necessity, we have also seen a split in functionality. There are now a great many different programs and suites of programs that handle mail interaction with the user. The X.400 standard has taught us to call these Mail User Agents, or MUAs. The job of the MUA is to handle all aspects of the interface between the mail system and the user. These are programs like `mail`, `Mail`, `mailx`, `mailtool`, `elm` and the `mh` suite of programs.

There are also a smaller number of programs that ship mail from the MUA to the mailbox of the user on the current machine or elsewhere in the world. These are called Mail Transfer Agents, or MTAs. For UNIX derived from BSD systems, the most widespread MTA is `sendmail`, by Eric Allman from Berkeley. Other MTAs for UNIX are the `mmdf` suite, developed to support CSnet and supplied as standard on SCO UNIX; and `pp`, developed in the United Kingdom to support X.400 protocols but also capable of other types of mail delivery. Since you will find `sendmail` on your Sun, I am going to concentrate on that program.

Before you start reaching for the terminal to send me mail saying, "My mail user agent program also delivers mail," I should say "Yes, I know that some programs do that." The split between MTAs and MUAs is sometimes not clear-cut.

Sending Mail

If we take a look at the path of a single mail message, then we can begin to get some idea of the role of the `sendmail` program. First, you sit and type your message into your favorite mail composition program. The message will contain two parts: the header and the body of the message. The header contains "administrative" information used by mail systems to determine who sent the message, where the message is to go, the date of transmission and so on. All this is familiar and perhaps looks like this:

```
To: mam@expert.com
From: pc@hillside.co.uk
cc: reviewer
Subject: Demo header
Date: Wed, 02 Feb 1994 09:24:13 +0000
```

The body of the mail will follow the header, separated by a single blank line.

Some MUAs allow you to have nearly complete control over the header format; others permit you only to set the content of fields. When you send the message, the `sendmail` program is run in mail submission mode. Exactly how this is done depends on your MUA. Some will fork and execute `/usr/lib/sendmail` directly; they will supply various command-line options to get `sendmail` to format the header and send the mail on.

Some will use Simple Mail Transfer Protocol (SMTP) internally on the machine to connect to a `sendmail` daemon. A copy of `sendmail` is usually running on your machine, listening for SMTP connections from the outside world. It's possible to connect to this service from a local program, and some MUAs do this.

Either way, a copy of `sendmail` now has your mail. Its job is to decide where to send it. It does this by looking at the destination address (or addresses). This "looking" is controlled by a file containing various rules of address transformation, usually stored in `/etc/sendmail.cf`. Because of this, it's hard for me to say what exactly will happen on your machine.

The `sendmail.cf` file controls all aspects of the operation of `sendmail` on your machine. In addition to rules for address transformation, the file will contain various other bits and pieces of information used by `sendmail`. The file is complicated and hard to understand. It's designed to be read quickly by the `sendmail` program and so is not particularly human-friendly at first glance. However, as with all complex programming languages, things get easier once you understand what is being said and how it is expressed.

The `sendmail` program will use rules in the control file to inspect and possibly transform the addresses in the mail that it is processing. It may change your sender address so that the mail appears to come from a central mail hub. It may change the destination addresses in the mail to add parts of domain names that you have omitted. It may work hard on the addresses to generate "canonical" forms. For example, it may change a UUCP-style address of

```
machine!user
```

into an at-style domain address:

```
user@machine
```

It uses the destination address to determine the route that it will use to send the mail. The `sendmail` program does not send the mail directly; it will call a program to do that job. So its first task is to identify which program should be used to send the mail, the name of the destination system and the user on that system.

The complexity of this task depends on how well connected your machine is. The task is easier if your machine is a client on a large network that uses a mail hub to do most of the work. If the mail is not for local delivery, then it will be sent to the mail hub machine. The task is more complicated for `sendmail` in the mail hub machine, or a machine connected to the Internet. The strength of the program is that it can cope with these different scenarios

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using the same binary. All the complex tailoring is placed in the text `sendmail.cf` file.

In our example, one copy of the mail is addressed to a local user. The local delivery program is invoked to do this. It appends the mail to the appropriate file. Let's imagine the other copy is to go to a destination machine that is contacted over the Internet. SMTP transmission and reception is built into `sendmail`, so the process dealing with your mail will do the business of starting an Internet connection to a remote machine and sending it. This contradicts what I said a few paragraphs ago about `sendmail` using other programs to deliver mail. I make no apology. `sendmail` is bursting with pragmatic exceptions to the standard behavior.

Let's suppose the remote machine is running `sendmail` too. The `sendmail` daemon will have been started in listening mode, waiting for someone to connect with SMTP. It will capture the mail we are sending it and will go through the whole business again, trying to find the mailbox that belongs to the user. Again, the `sendmail` here may be connected to an extensive local-area network, can be connected by UUCP to some machines or may just be a simple standalone system with a number of local users.

Eventually, the mail we have sent will end up in the mailbox of the user on the destination machine. This is usually a file in `/var/spool/mail` named for the user's login name. They will use their own mail user agent to read it.

Local Mail Delivery

Well, that's the basic operation. Let's look a little more at local mail delivery. We would like `sendmail` to do more than just place incoming mail in the mailbox file of a user.

We'd like to be able to expand mailing lists; run mail through programs, perhaps to inject mail into the news system or return a standard help message; or automatically pass mail for one user to another. All this is controlled by the alias file, `/etc/aliases`. The file contains lists of keys and values:

```
postmaster: root
MAILER-DAEMON: postmaster
baggins: frodo, bilbo
flist: :include: /usr/lists/file
nobody: /dev/null
help: |/usr/local/bin/sendhelp
```

The file can be long, and we want to avoid having to scan through it looking for names. To speed things up, it is stored in a DBM database so that `sendmail` can do a fast lookup of the local name to see if it is an alias. It's possible to arrange for `sendmail` to automatically rebuild the aliases database when it changes, or the DBM database can be built by hand using the command `newaliases`. This command is actually `sendmail` in disguise, when called using the command name, `newaliases`, it behaves as if it were called with the flag `-bi` telling it to rebuild the alias file. For security, the alias files are writable only by root, so changing things needs root access permission.

The first couple of lines in the examples show that aliases can be self-referencing. When mail is received addressed to `postmaster`, it is sent to `root`. The `MAILER-DAEMON` name is the address our `sendmail` will use as a sender when it bounces mail back to another user because of some problem or other. Since this mail is sent automatically, there is often a chance that the reply address is bad and it will be bounced back to us. We would like to accept it and send it somewhere. The entry in the file sends this to `postmaster`, and that in turn is sent to `root` after another lookup in the file.

All systems should have the name `postmaster` defined. The idea is that there is always a known address on a machine people can use to send problems to. Pointing this at `root` can be a bad idea if no one ever looks at `root`'s mail. Anyway, the first line is probably the default on your machine.

The third line expands a single delivery name to a list. The elements of the list can be a local name, a remote address, a file or a command. It can be inconvenient to have lists embedded in the `aliases` file. So it's possible to expand a list from a file of names using the `:include:` syntax shown by the fourth line in the example. The included file can contain lines with comma-separated names or can have entries on separate lines. I prefer using one name per line. The versions of `sendmail` currently available on your Sun do not allow comments (lines starting with "#") to appear in the included file.

The include file allows a mailing list to be maintained by a mortal without the need for `root` access permissions. I generally manage lists of more than a few people like this; it is simpler to edit a file somewhere than mess with changing the `/etc/aliases` file.

It's possible to send mail to a file using the `aliases` file too. The `nobody` alias demonstrates this. It *is* sending to a special file, `/dev/null`, and this will black-hole the mail. It's possible to put any disk file here, so the inbound mail will be appended to it. There are huge potential problems with security here, and `sendmail` works hard to avoid them by being careful about ownership of the file. If you are going to put files in the `aliases` file, you should look at the rules on this.

Finally, you can pass mail into a program. This is introduced by starting the name with a vertical bar. The full pathname to the command must be given. This has a great many uses, from injecting mail into the news system to filtering mail before storage.

However, if you are adding random commands in here, think about the potential ability of someone to do harm to your system. Recently, Eric Allman has distributed a small program called `smrsh` (sendmail restricted shell) that is used to control the commands that `sendmail` can run. The use of `/bin/sh` was found to be too flexible; it allowed people to break into the system. If you are using the standard shell, you are well advised to get hold of `smrsh`. Try anonymous FTP to `ftp.cert.org`. You can find the files in `/pub/tools/smrsh`.

The .forward File

The `/etc/aliases` file is designed to be used for the administration of the system. It's also convenient for users to be able to have personal control of mail that is sent to them. This is done using a special file, `.forward`, stored in the home directory of the user. This file must be owned by the

user (or root) and be readable by all. It can contain any alternatives that can be put in the systemwide aliases file.

The simplest use of this is to permit mail for you to be delivered elsewhere: Just create a `.forward` file containing the address that you want it to go to. When `sendmail` finds your `.forward` file, it treats it like an alias and will send the mail to the address it finds there. When you get the mail on the other machine, you won't be aware of the forwarding unless you look hard at the `Received` lines that are added at the start of the header for every machine the mail has crossed. If you are trying to wind down an account on one machine and move somewhere else, watch these lines.

Be careful that you don't make loops between machines by using `.forward` files. If you do, then mail being sent to you will travel quickly around the circuit. Eventually, some `sendmail` process will decide the mail has traveled through too many hops and will refuse to send it further. It will end up in the `postmaster`'s mailbox. Your mail will appear to have dried up. This may be a welcome relief for some. Eventually, the management will come along complaining that their mailboxes are stuffed with your mail and their machines appear to stop working whenever you get mail.

Another use of the `.forward` file is made by the `vacation` program. When you run this, it asks you to create a message. It then creates a `.forward` file containing something like this:

```
\pc, "|/usr/ucb/vacation pc"
```

The backslash in front of the `pc` prevents any other aliasing of the `pc` string, forcing the inbound mail to be placed in my mailbox. In addition to storing the mail, the `vacation` command is run, sending my stored message to the originator of the mail. It will also remember to whom mail was sent, so only one copy of the "I am away" message is returned. Notice that the `vacation` program is clever enough to spot that it is being run from a `.forward` file and acts differently when called interactively.

When you return from the trip, you should remove your `.forward` file. The `vacation` program may do this for you if it is run interactively and a `.forward` file exists. This is SunOS 4.1.3 behavior. If `vacation` doesn't delete the file, then you need to remove it yourself (it's easier anyway). It's also a good idea to delete the message and storage files:

```
% rm .forward .vacation*
```

The `sendmail` program has been responsible for the growth of the worldwide network that we call the Internet. The program has proved adaptable enough to support simple mail systems and complex mail hubs. It has taken us from the point where most mail systems were store-and-forward UUCP sites addressed by machine names, to the point where the domain naming system is accepted worldwide and machines are effectively all connected.

People often underestimate the complexity of the worldwide mail system. Not all systems *are* on the Internet. There still is a need for store-and-forward mail systems, bridges between networks, protocol conversion, and all the problems that make sending mail considerably more complicated than it seems.

There are also a great number of broken mail systems out there. The `sendmail` program has always been kind to such systems, preferring not to be pedantic about standards. This is good for the users of broken systems but perhaps doesn't focus their minds on getting them fixed. It's a trade-off.

It's inevitable that `sendmail` should be a constant source of attack by hackers. As a result, `sendmail` seems to have acquired a bad name. This is generally unwarranted. The program needs access to various parts of the system and requires to run as `root` to get it. No program that does this is ever likely to be completely secure. Until that helpful and inquisitive person finds a way to break the system, we don't know what is and isn't secure. Who would have guessed, for example, that shared libraries would allow someone to compromise the security of the `sendmail` program? No one, until it was done.

That being said, you are well advised not to run a vanilla `sendmail` from any current Sun distribution if your machine is accessible by a wide area public network. In the last year or so, there have been a number of security holes found in `sendmail`. Sun makes these patches publically available: Look on `uunet`. You can also find out about them by using anonymous FTP to `cert.org`.

Further Reading

In middle of last year, I wrote two articles about electronic mail in *SunExpert*. The one in August was about addressing: "Addresses in Electronic Mail." The September one was called "Mail Message Format." It talked about the contents of the data that we call an email message.

If you want *the* definitive book on `sendmail`, then you need *sendmail*, by Brian Costales with Eric Allman and Neil Rickert. It's published by O'Reilly & Associates Inc., ISBN 1-56592-056-2. This book is perhaps not for mortals, but is certainly required reading for systems administrators.

If you are interested in `pp`, then contact Nexor Ltd., 12020 Sunrise Valley Drive, Suite 100, Reston, VA 22091; phone: (703) 391-2717, fax: (703) 476-2217, email: `info@nexor.com`. For World Wide Web users, try: `hhtp://web.nexor.co.uk/nexor/contact.html`.

Last Month's Article

The article last month on macro processors was hit somewhat by printing problems. All the parameters to macros that are quoted should be quoted with the pair of character open quote and close quote, as in

```
define(`wrong', `get it right')
```

Apologies about the confusion that must have been caused.

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`.

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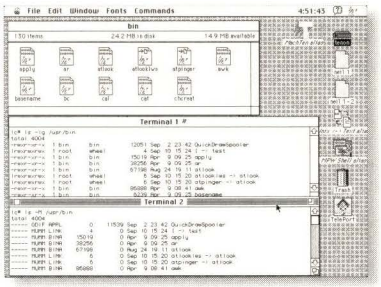

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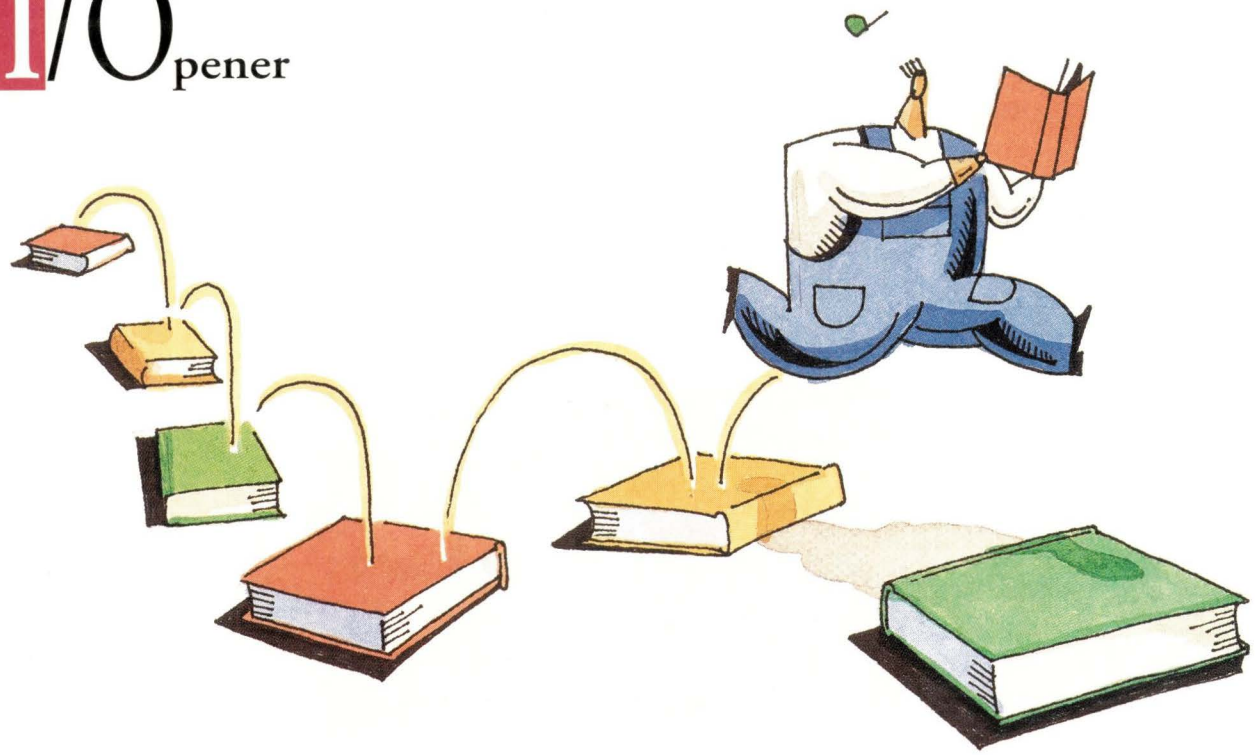

ROBIN JAREAUX

A UNIX Reading List (Take 2, Part 1)

by RICHARD MORIN, Technical Editor

Almost four years ago (October 1990), I presented my suggestions for the definitive UNIX bookshelf. Here's an updated version, split into two parts. This month's column (Part 1) examines books for users and administrators. Part 2 will examine books for programmers. Happy reading!

Getting Started

The shelves are full of introductory UNIX textbooks. Most are adequate, if a bit boring. Books over three years old should normally be skipped, since things change pretty rapidly in UNIXland. Other than that, pick one with a writing style you like.

If you are new to both computers and UNIX, take a look at the introductory SunOS (*Getting Started with...*) or Solaris (*Solaris... User's Guide*) documents. They cater to the needs of new users and are very well tuned to Sun's flavor(s) of UNIX.

Computer-savvy users should get a copy of *The UNIX Programming Environment*. Frequently billed as a programmer's introduction to UNIX, the book is also a treatise on UNIX philosophy. It is also a guided tour of UNIX programming tools, and a very handy supplementary reference document.

For historic coverage, it is hard to beat the two *Bell System Technical Journal* issues on UNIX (July-August 1978, October 1984). The first of these is a "must have," and the second isn't far behind. Now republished as *UNIX System: Readings & Applications*, they are gold mines of early UNIX thought.

The 4.3 Berkeley Software Distribution manual set is another good source for authoritative UNIX papers. The set contains the BSD versions of the manual pages, which are often useful as alternatives to Sun's "cleaned up" versions.

The "Supplementary Documents," however, are the real strength of the set. They contain papers by the originators of the UNIX system. Names like Allman, Bourne, Elz, Feldman, Joy, Karels, Leffler, McKusick, Nowitz, Ritchie and Weinberger should be familiar, but many of the other contributors are just as readable (and valuable). Usenix is running out of stock on the 4.3 sets (at least one volume is already out of print), but the 4.4 sets will be available Real Soon Now, so don't despair.

System Administration

If your site uses SunOS, get the *UNIX System Administration Handbook*. It covers the range of BSD administration issues and manages to shed a significant amount of light on

most. I would also recommend *A System Administrator's Guide to Sun Workstations.*

If your site uses Solaris, you will need some updated documentation. The *Solaris System Administrator's Guide* is practical, well-organized and clearly written. *All About Administering NIS+* and *UNIX System V NFS Administration* also look useful, depending on your site's configuration.

For more general administration lore, I would suggest *Essential System Administration* and/or *UNIX Systems.* Both books attempt to cover a wide variety of systems, which somewhat dilutes their utility for Sun administrators. Their breadth of coverage is useful, however, in this world of mixed (and mixed-up) computing environments.

Most sites should also get copies of *sendmail, Managing NFS and NIS, TCP/IP Network Administration* and the *X Window System Administrator's Guide.* In fact, for detailed coverage of assorted administration topics, it is hard to beat O'Reilly's wide range of topical UNIX books.

They cover a variety of specialized subjects, and the writing and organization are generally good. The authors (e.g., Allman, Spafford, Wall) are frequently acknowledged experts in the field. While you're at it, keep an eye on Addison-Wesley and Prentice-Hall; both publishers also have good topical books on UNIX.

Security

I really wish this topic weren't so important, but I'm afraid it is. *Computer Security Basics* is a readable and reasonably complete introduction to computer security issues. *Practical UNIX Security* is an authoritative how-to book. I recommend getting both. *UNIX Installation Security & Integrity* also looks like a good buy. It is cleanly written and contains a wealth of useful information.

Document Production

Despite massive incursions by TeX (see "Tangled up in TeX," *SunExpert*, October 1993, Page 42), the `troff` system is still the de facto standard for batch mode document produc-

Reading List

4.3 BSD Manual Set
CSRG, UC Berkeley
Usenix Association, 1986

A System Administrator's Guide to Sun Workstations
Becker & Slattery
Springer-Verlag, 1991
ISBN 0-387-97250-1

All About Administering NIS+
Ramsay
Prentice-Hall Inc., 1993
ISBN 0-13-068800-2

Computer Security Basics
Russell & Gengemi
O'Reilly & Associates Inc., 1991
ISBN 0-937175-71-4

Document Processing & Typesetting on the UNIX System, V1
Gehani
Silicon Press, 1986
ISBN 0-9615336-0-9

Document Processing & Typesetting on the UNIX System, V2
Gehani & Lally
Silicon Press, 1988
ISBN 0-9615336-3-3

Essential System Administration
Frisch
O'Reilly & Associates Inc., 1991
ISBN 0-937175-80-3

Life With UNIX: A Guide for Everyone
Libes & Ressler
Prentice-Hall Inc., 1989
ISBN 0-13-536657-7

Managing NFS and NIS
Stern
O'Reilly & Associates Inc., 1991
ISBN 0-937175-75-7

Practical UNIX Security
Garfinkel & Spafford
O'Reilly & Associates Inc., 1991
ISBN 0-937175-72-2

sendmail
Costales, et al.
O'Reilly & Associates Inc., 1993
ISBN 1-56592-056-2

Solaris System Administrator's Guide
Winsor
Ziff-Davis Press, 1993
ISBN 1-56276-080-7

TCP/IP Network Administration
Hunt
O'Reilly & Associates Inc. 1993
ISBN 0-937175-82-X

The C and UNIX Dictionary
Christian
John Wiley & Sons, 1988
ISBN 0-471-60929-3

The UNIX Programming Environment
Kernighan & Pike
Prentice-Hall Inc., 1984
ISBN 0-13-937681-X

The Whole Internet User's Guide & Catalog
Krol
O'Reilly & Associates Inc., 1992
ISBN 1-56592-025-2

Typesetting Tables on the UNIX System
McGilton & McNabb
Trilithon Press, 1989
ISBN 0-9626289-0-5

UNIX in a Nutshell: A Desktop Quick Reference for System V & Solaris 2.0
Gilly, et al.
O'Reilly & Associates Inc., 1992
ISBN 1-56592-001-5

UNIX Installation Security & Integrity
Ferbrache & Shearer
Prentice-Hall Inc., 1993
ISBN 0-13-015389-3

UNIX System Administration Handbook
Nemeth, et al.
Prentice-Hall Inc., 1989
ISBN 0-13-933441-6

UNIX System V NFS Administration
Herman, Ed.
Prentice-Hall Inc., 1993
ISBN 0-13-016411-9

UNIX System: Readings & Applications, V1, 2
AT&T
Prentice-Hall Inc., 1986
ISBN 0-13-938532-0 (Vol 1)
ISBN 0-13-939845-7 (Vol 2)

UNIX NROFF/TROFF: A User's Guide
Roddy
Holt, Rinehart and Winston, 1987
ISBN 0-03-000167-6

X Window System Administrator's Guide
Mui & Pearce
O'Reilly & Associates Inc., 1993
ISBN 1-56592-052-X (w/CD-ROM)
ISBN 0-937175-83-8 (w/o CD)

tion under UNIX. Unfortunately, there is very little useful documentation on `troff`, and none of it is very recent.

The two volumes of *Document Processing & Typesetting on the UNIX System* belong on any `troff` user's bookshelf. They cover the processors, a range of macro packages, and most of the common preprocessors.

UNIX NROFF/TROFF: A User's Guide is also quite useful and is sometimes easier to read. It will be particularly useful to folks who want to create their own macros. *Typesetting Tables on the UNIX System* contains several hundred pages of useful advice, examples, hints and reference information on `tbl`.

Miscellanea

Life With UNIX is an interesting and useful, if dated and sometimes inaccurate, collection of UNIX folklore and trivia. (Maybe I'd feel better about the book if they gave me credit for Sun's "The Joy of UNIX" button–I did give John Gage the idea back in 1982.)

The C and UNIX Dictionary is accurate, clear and comprehensive. It should go on the shelf of any technical writer dealing with UNIX. Other readers might wish to have its help in filling in details left hanging in other references.

System administrators should consider buying a copy of *UNIX in a Nutshell*, at $10 a copy, for each one of their users. The investment will repay itself *very* quickly in saved time and hassle. While you're at it, get a copy or two of *The Whole Internet User's Guide & Catalog*. It is an easy, interesting and informative way to get users started on using the Internet. ⊷

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`.

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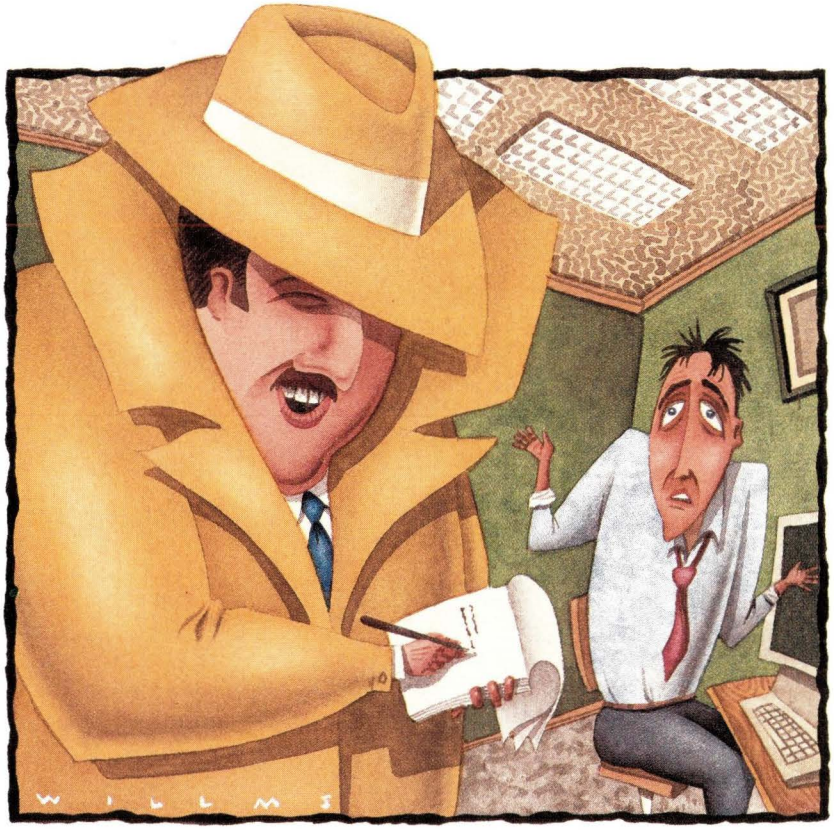
Reconnecting Connie

by S. LEE HENRY



RUSS WILLMS

You get a call from Connie on the third floor. "My email isn't working." The voice is tinged with mild desperation. "Can you help me?" "Of course," you reply instinctively, while you're thinking, "Oh, no, not another one of those connectivity problems."

You've seen enough of this type of problem to know that sometimes the simplest problems can be the most time-consuming to correct. The voice on the third floor belongs to one of your PC users who reads email on your Sun file server by using a terminal emulator. The number of things that might be at fault make you feel a bit tired even before you begin trying to track down the problem.

Describing the Problem

The first task is defining the problem. The place to start whenever a user has a problem is to recognize that users almost never view their problems the same way you do. "My email isn't working" could mean many different things. Users generally care only if something works or not–almost never why it works or doesn't work and almost never how it works or doesn't work. To determine the nature of the problem, you need to ask a lot of pointed questions just to determine what "email not working" means.

Is the user losing mail? Is mail bouncing back with unnerving error messages? Is the mail tool not starting or is it crashing? Ask the user to describe what is happening in as much detail as possible. Prompt with possible meanings if necessary. Often, you simply have to go and take a look. Users often don't know what information will help you figure out what is wrong and don't know how much or little to tell you. They may also be reluctant to start spewing forth all kinds of details that may have no significance. They don't want to seem stupid or to annoy you. Let them off the hook if they're embarrassed to be complaining or they think they caused the problem.

After talking to the user in more depth, you discover that there is no response within the terminal emulation software.

Where there is normally a prompt from the terminal server, there is nothing but a cursor. Hitting the return key, nothing happens. OK, we're getting somewhere.

Backtracking

Any details you can gather about how and when the problem started are golden. "When did this happen?" "What were you doing?" "When did it last work?" "Is anyone else having the same problem?"–all these questions try to find a shortcut to the solution. The answer is usually hazy. The last time the user read email was two or three days ago, and everything was OK then. The only other person with a similar setup isn't in her office. Little help here.

Try to have enough extra cables, spare terminal server ports, etc., to take the easy debugging route–swapping components.

When you start listing possible suspects for your "what might be wrong" list, always be sure to include those components that are most easily broken or changed first, followed quickly by those things that are most easy to test. In Connie's case, the communications parameters within the terminal emulation software were a likely candidate, as were any exposed connectors. I have sometimes carted a terminal to the site of the problem to check out the connection. I know the terminal is set up correctly. If the terminal works and the PC doesn't, I have good reason to believe the problem is in the PC. It's also useful to use the terminal on a cart to test the terminal server port. I've built myself the proper cables for plugging a terminal directly into one of the terminal server ports. Verifying as much as possible should get you quickly to a few suspect components.

Sketching the Wires

Despite the fact that this may seem like a very trivial problem, there are enough components involved to make it take a long time. With proper redundancy, you can usually play some mix-and-match games and make it easier to reduce the number of things that might be at fault. You should always try to have enough extra cables, spare terminal server ports and spare terminals to take the easy debugging route–swapping components. With enough spares, you might also be able to defer the problem to a time when it is more convenient for you to work on it.

Sketching out all the components in this current connectivity problem, we have terminal emulation software, the PC serial port, a modular plug that plugs into the serial port on the PC, a flat modular cable leading to an outlet under the floor, a twisted-pair cable that runs into a communications closet on the same floor and terminates in a "66 block" punch-down panel on the wall, another connector that connects between this panel and provides a modular (RJ-45) outlet, another modular cable that runs into the terminal server. And we have the parameters on the terminal server port itself. Phew. That gives us a lot of suspects.

So, where do we start? The most obvious thing would be the communications parameters on the PC or the terminal server. You check these against the "standards" that you use–say 9,600-baud, no parity, XON/XOFF. You've memorized these, and it looks right. Mismatched parameters can result in no output as well as garbage. You should check to make sure that the cable is seated well and that the correct port is specified. "When you can't be brilliant, be thorough," you think, as you run down your list of things to check.

An easy thing to check, if you've got the flexibility, is to swap ports on the terminal server with one that you know is working fine. Just be careful not to kick someone else offline. It's ideal if you have spare ports and can easily tell which port belongs to which user. It's important to be able to change parameters from another port. I once had a user inadvertently change the speed on his terminal server port to 117 baud. This made it impossible for him to reset it. With my newer terminal servers, I can easily modify the parameters on any port. The older terminal servers are cranky; I moved him to a different port. If I need his old port before I've replaced the terminal server, I'll have to wrestle with the syntax and change it. Now I have more pressing problems.

The port change didn't make any difference. The terminal emulator on that PC still isn't responding. We can verify the port using our terminal or assume that this probably isn't the problem. Let's do some more checking.

Maybe It's the Cable?

One relatively easy way to check out the cable is to do a loopback. Anyone who's had to build RS-232 cables probably has the important pins memorized. The send and receive data lines, pins 2 and 3, can be connected to each other so that data sent out comes back immediately. This allows you to verify that data really is going out and data really is coming back. Once you've checked the port, you can attach your loopback much further down the cable and test connectivity, say, to the communications closet. If data gets all the way there and back, your cable is probably intact. If you use XON/XOFF, you won't need to check the nondata wires. If data gets out and back *without* the loopback, however, you do have a problem–maybe a short somewhere.

To make loopback testing easy, I've built a very simple modular loopback using parts that were sitting around my lab. Since I use modular connectors, building a loopback plug was trivial. I took one of the little modular tap boxes (with a RJ45 plug and inside wires going to six or eight terminals) and simply connected each pair of terminals with paper clips. The cheapest loopback is simply to strip the wires on a short cable and twist the data lines together. I like the modular boxes since they also provide a nice place to use my digital voltmeter if the simple loopback doesn't tell me all I need to know. Resistance measurements give me a rough idea of how long the wires are and whether they are intact.

In standard modular wiring, your data will be on the middle two wires of the flat cable. If you don't use modular wiring, you can build a loopback with a DB25 connector by soldering or crimping a connection between pins 2 and 3.

Using Resistance Measurements

A modification of the loopback test that can be very useful when you're not sure which wire is which is one that includes several resistors of different values. Attach a resistor with values like those shown below to each of the pins, solder them all together with a wire to pin 7 (ground) and you've built yourself a cheap and very useful tool. If you're not sure that the wire you think is the receive data line really is the receive data line, you can measure the resistance between pins 3 and 7 with this connector plugged in somewhere downstream and you should get a resistance reading in the neighborhood of what is specified (the line itself will add some resistance, so don't expect it to be precise).

2	50 ohms
3	100 ohms
6	500 ohms
20	1K ohms
7	ground

All you need to build this tool is a DB25 connector and four resistors. You should put a plastic hood on the thing both to protect your work and to keep your boss from thinking you're weird–bosses inherently distrust anything with wires and electronic components hanging out for everyone to see.

Trusting Your Tools

As much as I think myself fairly thorough, I've been bitten a number of times by assumptions that were incorrect. Recently, I spent several hours trying to fathom some cables that I tried unsuccessfully to use to connect a couple of terminals, only to learn that the cable that I was using between my terminal and the wall was bad. Distrust anything you haven't checked out. You can waste a lot of time testing with broken tools!

Happy Endings

Cable problems will always take up too much time. They will almost always leave you wishing the solution had been as obvious at the beginning as it was once you tracked it down. Nevertheless, a regimen of tests and a few simple tools can make your sleuthing a bit more rewarding. In Connie's case, a connector was at fault. Her email is working now. ➸

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`.

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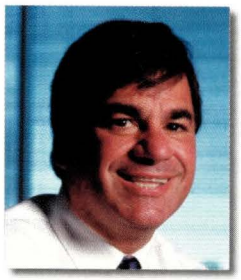

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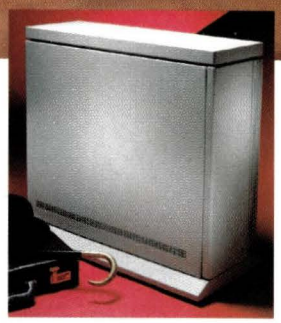

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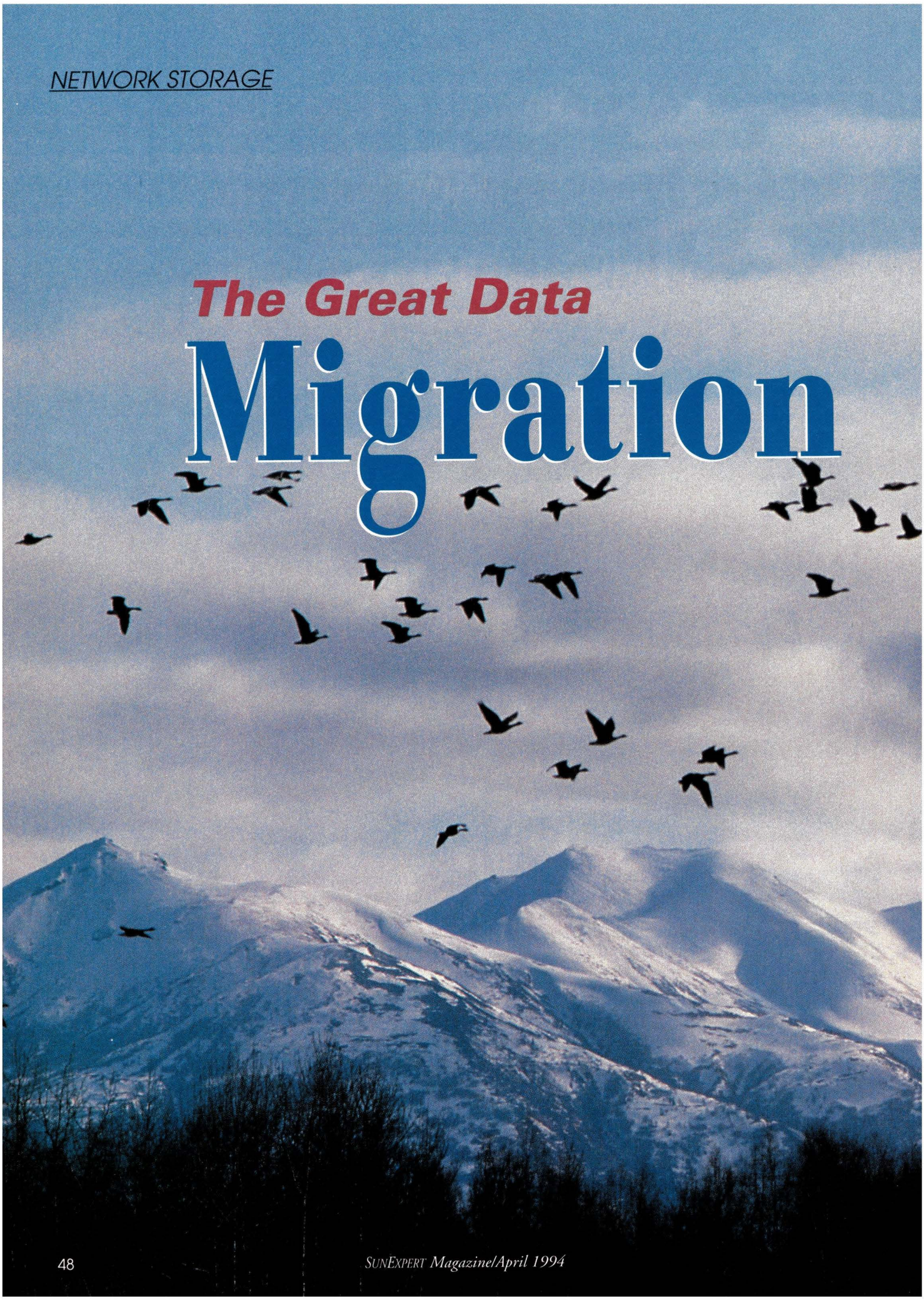
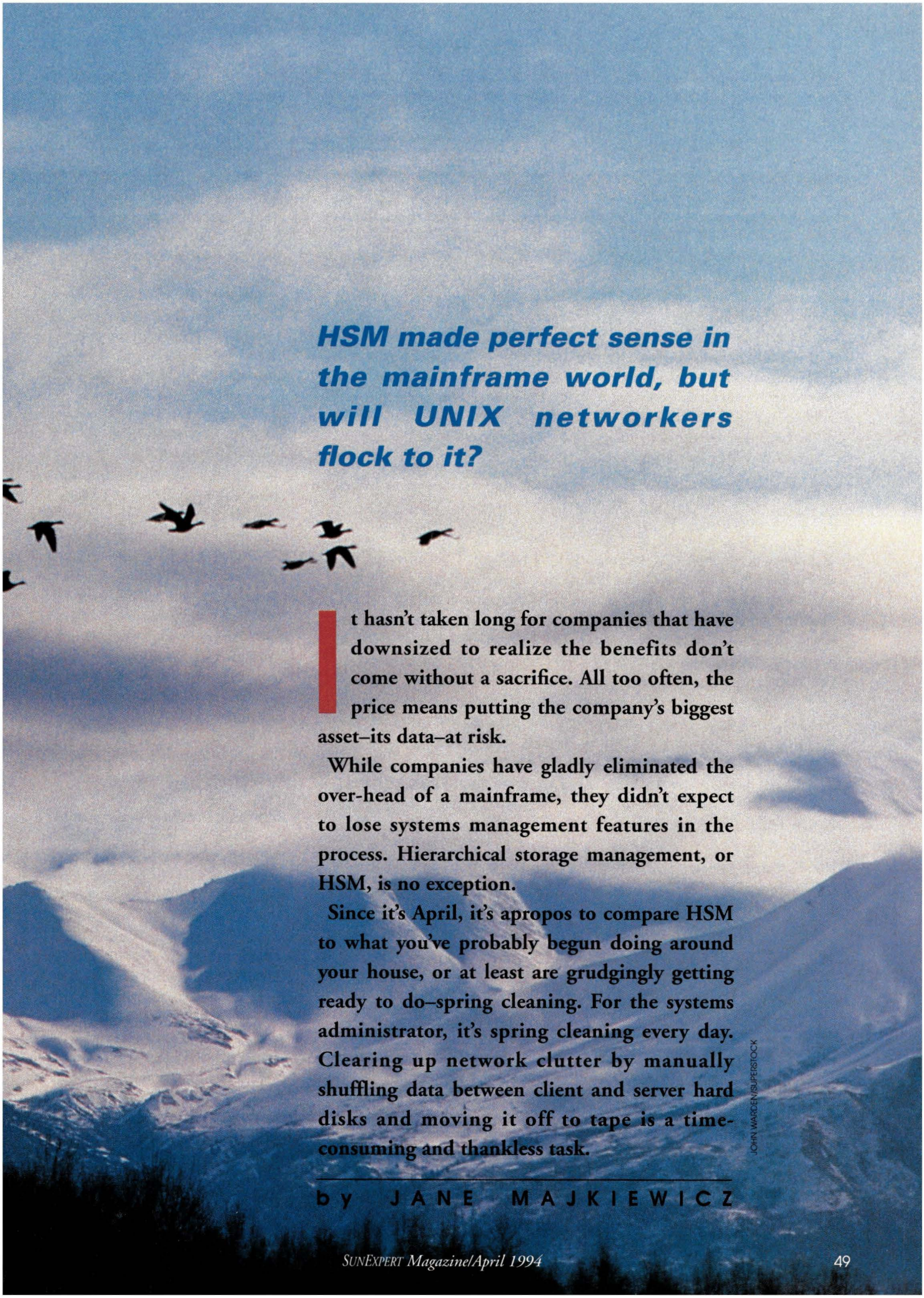


The Great Data Migration



HSM made perfect sense in the mainframe world, but will UNIX networkers flock to it?

It hasn't taken long for companies that have downsized to realize the benefits don't come without a sacrifice. All too often, the price means putting the company's biggest asset–its data–at risk.

While companies have gladly eliminated the over-head of a mainframe, they didn't expect to lose systems management features in the process. Hierarchical storage management, or HSM, is no exception.

Since it's April, it's apropos to compare HSM to what you've probably begun doing around your house, or at least are grudgingly getting ready to do–spring cleaning. For the systems administrator, it's spring cleaning every day. Clearing up network clutter by manually shuffling data between client and server hard disks and moving it off to tape is a time-consuming and thankless task.

JOHN WARDEN/SUPERSTOCK

by JANE MAJKIEWICZ

HSM takes the burden of spring cleaning away from administrators while operating transparently to end users. As disks fill up faster than the attic, data is migrated based on age and frequency of access to less expensive near-line and off-line storage media, typically optical disks or juke-boxes and tape libraries. The idea is to migrate the data that users will least likely need to retrieve. If users do need the migrated data, it simply appears as if it's on the hard disk.

But if distributed HSM is so useful, why isn't much of it shipping yet? "HSM is a good idea, but the actual implementation is a bit difficult," says Matthew Goldbach, president and CEO at Transitional Technology Inc., Anaheim, CA. "The general problem tends to be having HSM handle all different types of workstations on these heterogeneous networks."

Last year, an estimated 750 distributed HSM packages shipped from roughly 20 to 30 vendors, according to Michael Peterson, president of the Santa Barbara, CA-based research firm Peripheral Strategies Inc. Much of those shipments were bundled with document and image management applications using optical storage devices, he says.

The low shipments are indicative of a few things. Although mature in the mainframe world, HSM is in its infancy in the distributed world. Networks add the complication of data residing on multiple platforms in multiple locations. Besides that, some distributed HSM vendors point out that systems administrators typically aren't the same folks who come from the MIS department. They have a different level of skills, not to mention a different mentality.

It doesn't help, either, that the term HSM is being liberally used to describe a wide variety of features and products, often products that meet quite different needs. As a result, users are confused about what HSM can do, says Peripheral Strategies' Peterson. To assist users, Peterson is promoting a list of levels–analogous to RAID–to categorize HSM functions (see "Categorizing HSM").

Getting to Distributed Data Management

Mainframe data management combined backup, archiving and migration. For the network, these functions have been handled by point products. Companies that have deployed point products for distributed environments are now faced with the task of tying them together. Unlike mainframe data management products, those in the distributed world need to be modular, but integrated, to help users incrementally scale up to meet changing needs over time.

Vendors are responding by broadening and integrating their point product lines. Legato Systems Inc., for example, developer of NetWorker backup software, is bringing out this year NetWorker Archive and NetWorker HSM software. But Legato isn't talking about HSM alone, as other vendors are doing, says Ed Cooper, vice president of marketing. Instead, the company is discussing the three products as part of an overall solution to provide data management services using a client/server architecture.

"By focusing solely on HSM, vendors aren't taking a holistic view," agrees Brian Ritchie, vice president of marketing for HSM and backup vendor Alphatronix Inc. HSM is a phrase that's hot in the marketplace right now, says Ritchie, but recent hype about it doesn't address many of the "real problems."

One real problem is getting the glue to integrate products, which will

Categorizing HSM

Evaluating hierarchical storage management products is a challenging task. Features to consider include bundled or unbundled solutions, operating systems and storage media supported, and support for existing backup solutions. Another major distinction is whether the software uses native or proprietary file formats and drivers. Sun users also need to be alert to which HSM products support SunOS 4.x and which support Solaris 2.x. Currently, Introl Corp. claims its FLEXstor is the only HSM product that supports Solaris 2.x.

User confusion about what to look for in an HSM solution has driven Michael Peterson, president of market researcher Peripheral Strategies Inc., to propose a list of definitions for categorizing HSM. He has received input from 20 vendors and has begun promoting the list in the press and in his own publications.

"My task is to help in the market development process," says Peterson. He wants users to be able to easily determine which products will meet their specific application requirements. "My personal soapbox is educating the user community that it costs a lot of money to manage storage. On average PC networks, a company spends $358,000 per year managing storage," he says, which will be a higher number for UNIX networks.

The following list describes the HSM levels Peterson has defined. The levels are RAID-like in that they don't have to be done sequentially, he says.

Level 0 – Automated archiving with manual retrieval
Level 1 – Transparent retrieval
Level 2 – Dynamic load balancing of disk space based on multiple thresholds; ability to manage two or more levels of a storage hierarchy
Level 3 – Support for three hierarchies, including optical disk, tape and volume management
Level 4 – Migration based on file classification with support for distributed data on multiplatform clients and servers
Level 5 – Object-level management including working closely with database management systems

(Currently, no products meet the Level 5 specification, says Peterson.)

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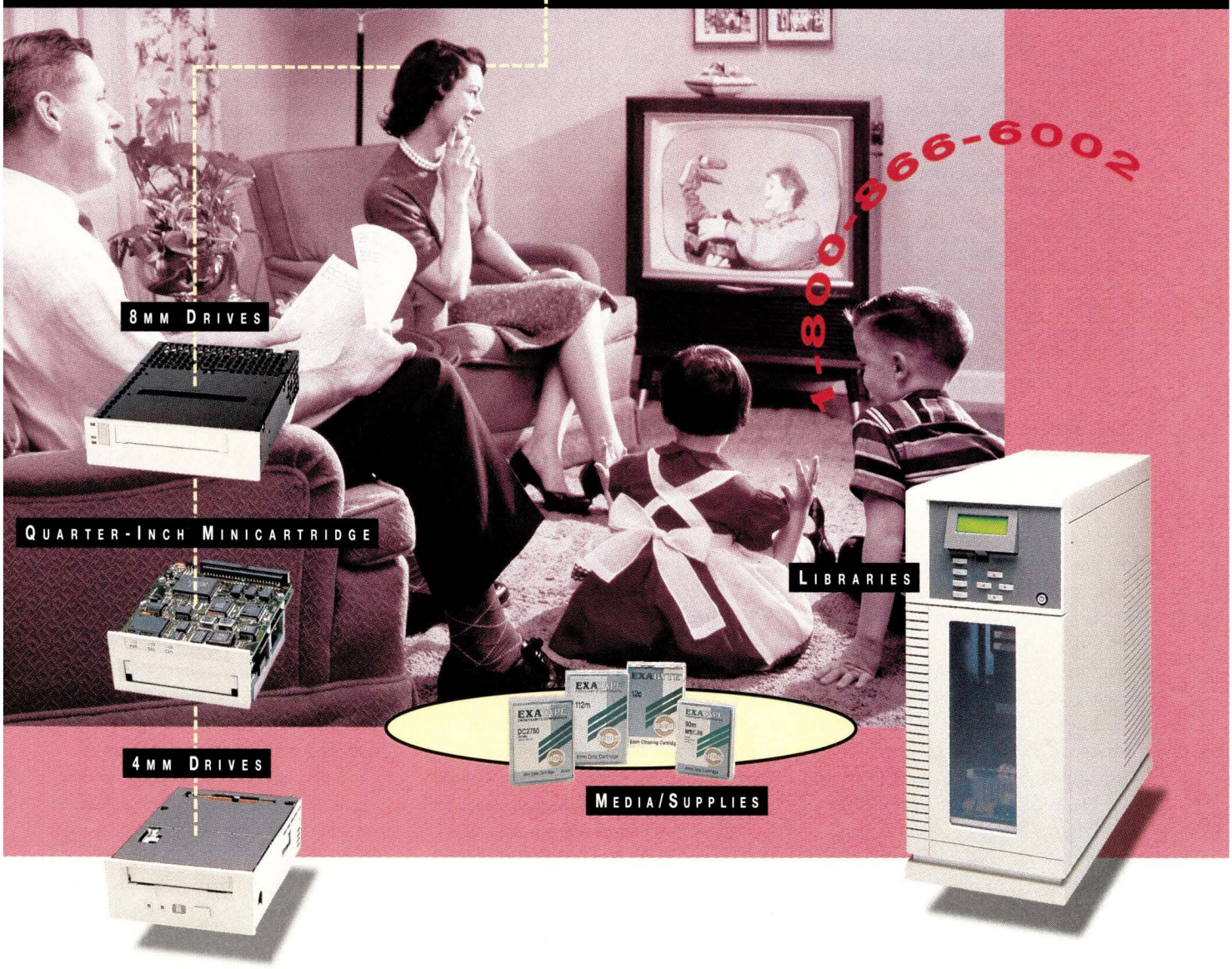

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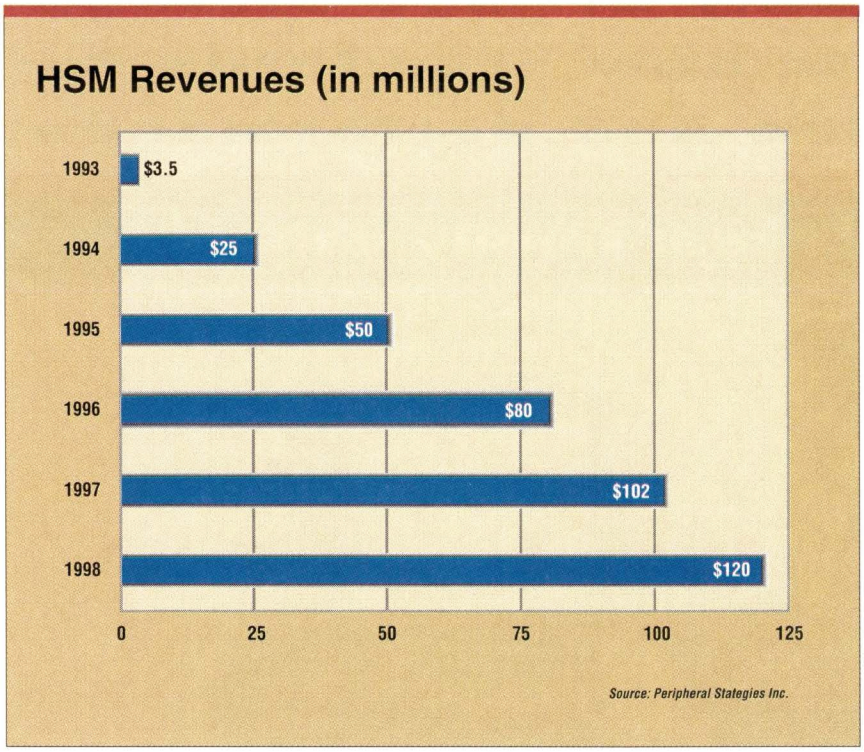


Figures represent unbundled hierarchical storage management software sales. Revenue is actually larger because products are often embedded into other applications or bundled with hardware solutions. By 1999, Peripheral Strategies predicts HSM (bundled and unbundled products) will represent a $1.2 billion market.

increasingly rely upon emerging standards. In the UNIX world, the Data Management Interface Group (DMIG), a consortium formed last year by 33 vendors, is evaluating two proposed specifications for a standard API. It will help users integrate point products in a plug-and-play fashion. The interface will also eliminate the vendors' need to modify software every time an operating system is updated.

But when the actual DMIG spec will emerge is still anybody's guess. "I'd be hesitant to think about DMIG coming out before 1995," says Terri Griffin, marketing manager at E-Systems, which sells bundled hardware and software storage solutions including the FileServ HSM software. "There are too many major players. For all of them to agree, almost everyone has to change. Everyone is willing and participative in the committee, but all are reluctant," she says.

Getting the UNIX side of the house in order should be an improvement, especially because downsizing has increasingly made UNIX the focal point of the network. But what about PCs? To date, PC and UNIX efforts remain separate. Novell Inc.'s Storage Management Services, or SMS–a set of APIs for NetWare environments–is facilitating PC point product integration, but PC and UNIX data management coexistence is still sketchy at best. "We'll have two or three standards," predicts Alphatronix's Ritchie. But how everything will work together is the million-dollar question, he says.

Leading PC players like Conner Peripherals Inc., however, don't yet see the separate PC and UNIX intitiatives as an impediment. "We found that the enterprises were not as heterogeneous as we thought," says Rick Luttrall, product marketing manager for advanced network products at Conner. Luttrall says that although Conner sees workstation clients at customer sites (Conner HSM supports workstation clients on NetWare networks), the bigger problem remains with getting PC storage management automated. UNIX at least "started out right," he says, by including backup utilities like `tar` and `cpio` built into the operating system.

Other PC players, such as Cheyenne Software Inc., do believe adding workstation support is important, as evidenced by its recently announced ARMS, or Architecture for Reliable Managed Storage, strategy. On the server side, Cheyenne's ARCserve software will support NetWare, Macintosh and UNIX platforms. The company plans to add support for HP-UX, AIX and Sun Solaris to its current SCO and Interactive UNIX support.

Companies are also wrestling with how best to use existing mainframe resources. "The mainframe is the greatest repository for storage data. [Mainframe] storage management is mature and well understood. It already has a wide range of sophisticated storage devices on which data can be moved," remarks Legato's Cooper.

Mainframe players such as Computer Associates International Inc. and Sterling Software Inc. are expected to bring capabilities over to distributed environments, with current support for host servers and UNIX clients. IBM's Adstar Distributed Storage Manager (ADSM) is a step ahead, with support for both mainframe and AIX servers, with HP-UX, SunOS, Solaris and OS/400-based server support available in the next half of this year. But not all users want workstations to access storage by using host cycles or facilities, says Frantz Corneille, director of product marketing at Network Systems Corp. NSC is working with tape silo vendor Storage Technology Corp. to attach storage media directly to networks to let the mainframe act as a client accessing workstation servers. Corneille says mainframe client capability from NSC and StorageTek will be available sometime during this half of the year.

To date, Corneille says, no company offers the capability to recognize the mainframe, workstation and PC through an enterprisewide view of network data and storage management. To effectively do network-attached storage, Corneille says the solution has to be scalable, it has to support an enterprise repository, and smaller hierarchies must be able to sit at remote user locations. "We see this as the chal-

lenge for the next few years. By 1997 or 1998, PCs, workstations and mainframes will all work as equal partners with access to data," predicts Corneille.

Application Integration

Besides integration between point products, the point products themselves have traditionally suffered from lack of integration with applications critical to distributed environments. Foremost on the list is databases. The lack of an effective way to handle database storage management in the distributed environment has kept commercial sites from making a wholesale move to client/server computing, believes Andrew Hettinger, marketing manager for Epoch Systems Inc.

Every special application may use its own unique file system in order to work properly, explains Scott Barnett, director of technical sales at AT&T's CommVault Division, which offers an integrated data management solution for UNIX environments.

Although database vendors supply their own backup schemes, "the products aren't feature-rich," says Hettinger. Users started dealing with the problem of on-line catalogs getting too fat, but having no way to break them up to move some data off-line. As a result, database and data management vendors needed to collaborate, says Hettinger.

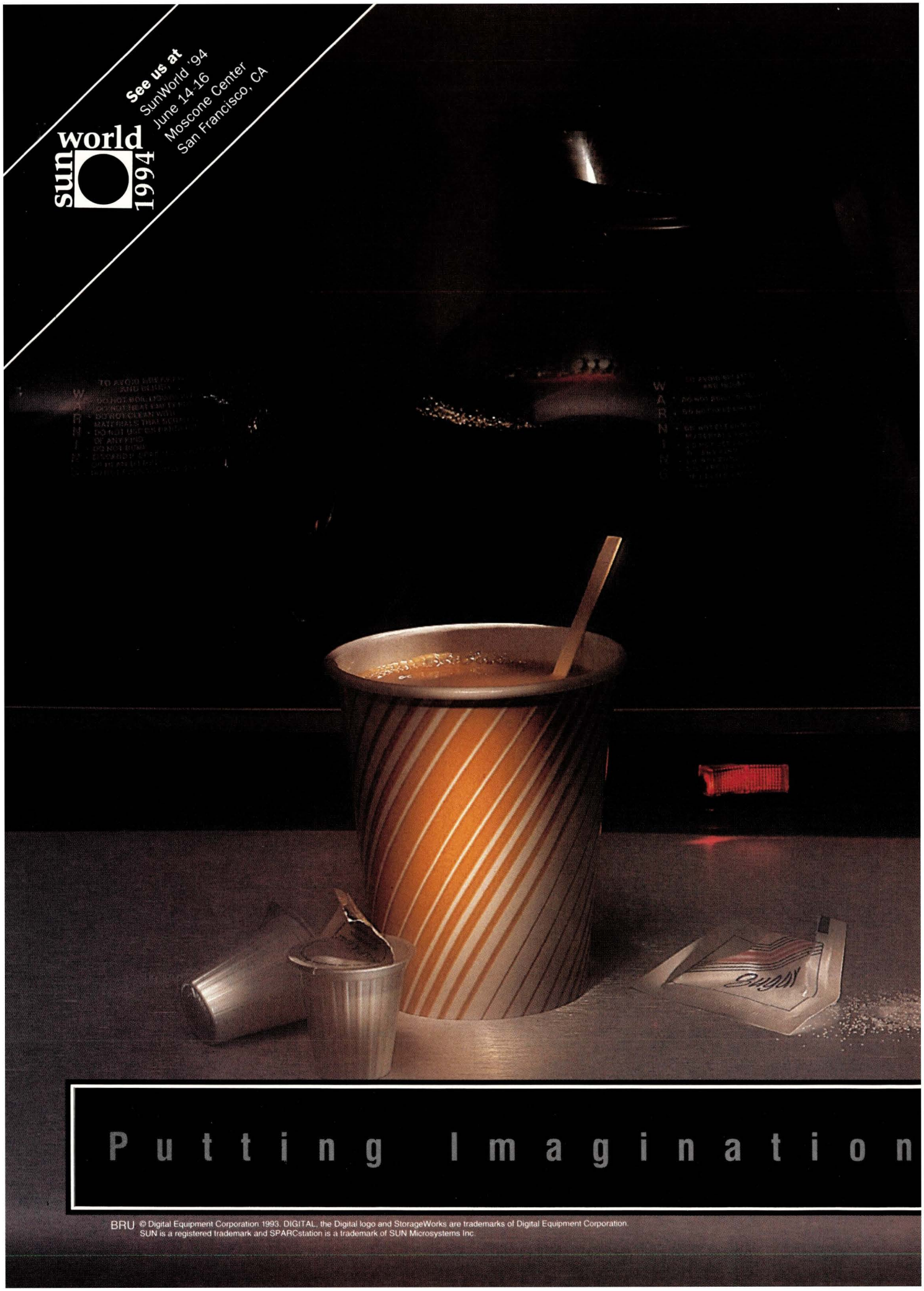
Epoch signed an agreement with Oracle Corp. last year, and this year other vendors are following suit. Legato recently announced an interface to Oracle. AT&T now offers a product called DBVault to provide backup and recovery services for major UNIX databases. IBM's Storage Division, whose ADSM will add HSM functionality this year, according to Scott Drummond, manager of business development, will also add support for Oracle databases on top of its current DB2/6000 support. Drummond says support for other major databases will follow.

Others point out that merely backing up certain database files to near or off-line storage may not be what customers want to do, although they would still like to maximize storage space. "What if you want to run a large database on secondary storage like an optical jukebox?" asks Chris Kokias, director of marketing for Advanced Archival Products Inc. AAP offers a product called AMASS, which provides direct access to near-line files by making migrated data appear as though it's located on one infinitely large disk. Alphatronix also offers a direct access product called Emissary in addition to its Emissary/HSM software.

The Systems Management Gap

Once distributed data management point products are integrated, the question still remains how data management will be integrated within the larger concept of systems and network management.

"Information management is always missing in the standard systems management packages [for UNIX]," says Philip Jamieson, president of Software Partners/32 Inc. A player in the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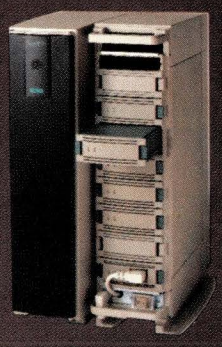

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Digital Equipment Corp. VAX/VMS market for 10 years, Storage Partners recently released the first components of its StorageCenter suite of integrated offerings, which will run across multiple UNIX platforms. Jamieson says many of the company's customers have downsized from proprietary midrange and mainframe systems, but their requirements haven't downsized. Users still need to protect data with mainframe-like security features and auditable methods, he says.

Companies such as AT&T and Epoch have inked agreements with Tivoli Systems to work under Tivoli's systems management environment. IBM's Drummond says the Storage Division is working on integrating ADSM with SNMP to support things like network monitoring alerts under NetView. Software Partners is examining how to run on top of the Distributed Computing and Management Environments from the Open Software Foundation, comments Kyle Lucas, director of engineering at the company.

"The whole idea of managing storage is to manage its location. It's like real estate–location, location, location," says Lenny D'Amico, OpenVision's product marketing manager. OpenVision offers a suite of management products based on technologies purchased from existing companies.

For data management, OpenVision offers several products based on core technology acquired from Control Data Systems Inc. At press time, OpenVision was also in negotiations with IBM's Federal Systems Co. to acquire marketing rights for Unitree, the HSM software developed by the National Storage Lab, a consortium of seven vendors and the U.S. Department of Energy.

"Competitors provide one piece of the puzzle," says D'Amico. "But what happens if you back up a tape and that tape holds company salaries? What will stop the operator from walking out with it?" Because OpenVision integrates a variety of services through APIs, functions including security, event management, license management and error reporting are all tied together. The larger question is how systems management will address all platforms on the network. OpenVision is investigating ways to expand its UNIX management strategy to support PCs, as well as figure out how to integrate with existing mainframe solutions.

Meanwhile, what about Sun Microsystems Inc.? Does it ever intend to bring out an HSM product on its own platforms?

"We did have an HSM project going for a while," says Edward Turner, director of peripheral products marketing at Sun Microsystems Computer Corp. "But, we had a look at the volumes involved and decided that it might be better to leave that to the third parties." In other words, there simply wasn't enough return from Sun's point of view to justify the necessary investment.

But SMCC is actively encouraging the third parties. In March, the company planned to introduce a new RAID storage array (see "Sun Shows

Storage Array," in the News section). At the same announcment, SMCC revealed the first of several products resulting from its long-standing partnership with Amdahl Corp.

Among these is the Enterprise File Manager (EFM), a distributed file management system that includes HSM functions. Originally developed for Amdahl's mainframe storage solutions, EFM has been ported to Solaris.

Amdahl will be selling EFM into the Sun market. As of press time, it was not clear whether Sun would be doing so as well. It does, however, have Sun's corporate blessing.

And none of this, of course, precludes Sun from doing something else with HSM in due course. There have been rumors, for instance, that the company has toyed with the idea of putting data management agents into Sun NetManager, though Turner says those are just rumors. "It would make sense," he says. "But we haven't done it. It might, however, be something for the future."

Getting the Right Configuration

Utimately, enterprisewide data management is only as good as a company's ability to effectively configure the software to match its business rules and processes. Says Epoch's Hettinger: "We can't dictate what a customer has to do...they have to understand their data and environment."

Peripheral Strategies' Peterson says of the majority of sites he has surveyed, about 80% of the files migrated within an HSM scheme get retrieved in about two weeks. That means distributed HSM users aren't making the most of the software. "Retrieval is a function that requires thresholds. In the ideal system–the mainframe model–the number of retrievals are at a low enough level that they don't bog down throughput," explains Peterson.

The Anchorage, AL, office of British Petroleum is a case in point. Systems administrator Roy Hoggard says the company began using Epoch's migration software on Sun workstation servers about two years ago, with about 100 interactive workstation clients from Sun, IBM, Hewlett-Packard Co. and Silicon Graphics Inc. serving 300 to 400 engineers. (Since then, Epoch has unbundled its software from Sun servers and now supports other operating systems for both clients and servers.) In its initial implementation, BP used the Epoch software to migrate large amounts of engineering data to a near-line optical jukebox. Unfortunately, Hoggard says, the engineers were always calling asking why it was taking so long to get files. The delay in retrieval time became unacceptable, says Hoggard.

After explaining the migration process, BP decided it was best to let the engineers make their own decisions about which data to keep on disk and which data to move to optical. That alone has improved the problem of not having "infinite magnetic [disk] space," claims Hoggard. It's worked well enough that BP also installed an Epoch solution in the company's legal department to manage imaging data. Fortunately, the legal department hasn't suffered performance degradation similar to engineering. As Hoggard puts it, "Anything is an improvement over manually digging through boxes of paper."

It is sites like British Petroleum that make Vinod Gupta, the president of backup vendor Software Moguls Inc. ask: "Am I missing something?" He wonders whether HSM adds any value if the migration to secondary storage ends up creating more problems or if users end up intervening and doing it manually anyway. What Gupta believes is a better solution is automating backup and archiving, which still protects older data while "policing" hard disk drive space.

Using this solution, companies would simply avoid doing the second step of moving to near-line storage devices, whose data Gupta says still ends up being backed up and eventually archived.

"Distributed processing is getting more and more on-line with applications such as email. Basic databases are all on-line, and data is required every day. These will never be candidates for HSM. The best place for this data is to always be on disk," says Gupta. Besides, adding disks is cheaper than installing the equipment typically required for an HSM solution, he says. Adding software, a jukebox and dedicated server puts extra baggage on the network, besides being expensive. "I don't know if people have that kind of luxury," Gupta says.

Disk Drive Decisions

Disk drive costs have dropped enough to make it feasible for systems administrators to continue adding disks as storage needs expand, says analyst Peterson. Administrators are easily able to "sneak in" one or two disks at a time without making much of an impact on expenditures, he says. Also, "If a company is spending $5,000 a year buying disk drives and $5,000 managing that storage, then why go buy a $30,000 [HSM] system?" he asks.

But managing more and more disks "is a big hairy mess" for the administrator, stresses Chris Smith, technical director at Comtec Automated Solutions, a distributor that will soon be offering an HSM product. Besides, Smith says, disk technology can only go so far in storage capacity. Tape capacity and performance rates have quadrupled every two years, which can't be said for disk technology, Smith maintains.

While there's still a large gray area for determining whether HSM pays off, one thing is clear: Network data is growing at exponential rates. In a study conducted for Epoch, Peripheral Strategies found that respondents' networks grew on average 60% to 80% per year. Typically, 50% of that data was not accessed in over 90 days. "The usage of disk space is going up faster than the price of disk is going down," says Jim Christie, Ph.D., senior vice president of marketing, research and development at Irvine, CA-based disk drive manufacturer Sanyo Icon.

It seems as if growing networks are dictating the need for HSM. "Storage demands are going through the roof and data needs to be stored somewhere other than just on hard disks," says Dennis Edwards, vice president of sales and marketing at HIARC Inc. "They're just too hard to manage and take too long to back up." Edwards sees HSM as a management aid for overburdened systems and network administrators.

Even small sites have HSM, whether they want to admit it or not, notes Kevin Horigan, vice president of North American sales for QStar, an optical drive vendor that also offers HSM software. "Every organization...has data on magnetic disk, and they have a vast array of data off-line on tape. It's a question of how it gets automated," he says.

"The reality is that the system should take responsibility," not people, says analyst Peterson. "As users, we have to lose the notion of physical storage." In the future, Peterson believes data management functions like HSM won't be an issue, mainly because they will be an integral part of the system, operating transparently. "Today we care about where data is stored because we don't trust the system," he believes. ⊸

Jane Majkiewicz is the senior editor of *RS/Magazine*. Additional reporting by Maureen McKeon.

HSM Software Suppliers

Advanced Archival Products Inc.
14 Inverness Drive East
Suite D144
Englewood, CO 80112
AMASS, AMASS-DataMgr
Circle 141

Advanced Software Concepts
2430 Vineyard Ave.
Suite 205
Escondido, CA 92029
NetArchive
Circle 142

Alphatronix Inc.
4022 Stirrup Creek Drive
P.O. Box 13687
Research Triangle Park, NC 27709
Emissary, Emissary/HSM
Circle 143

Amdahl Corp.
1250 E. Arques Ave.
P.O. Box 3470
Sunnyvale, CA 94088-3470
Enterprise File Manager
Circle 144

Artecon
P.O. Box 9000
Carlsbad, CA 92018
FileTrek
Circle 145

AT&T CommVault Systems
1 Industrial Way, Box C
Eatontown, NJ 07724
DataMigrator
Circle 146

Cheyenne Software Inc.
3 Expressway Plaza
Roslyn Heights, NY 11577
ARCserve
Circle 147

Computer Upgrade Corp.
1921 Sampson Ave.
Corona, CA 91719
Computer Upgrade HSM
Circle 148

Conner Storage Systems Group
Conner Peripherals Inc.
36 Skyline Drive
Lake Mary, FL 32746
Conner HSM
Circle 149

Delta Microsystems Inc.
111 Lindbergh Ave.
Livermore, CA 94550
MigTool
Circle 150

Digital Equipment Corp.
OEM Storage Business
146 Main St.
Maynard, MA 01754
Polycenter HSM
Circle 151

Epoch Systems Inc.
8 Technology Drive
Westboro, MA 01581
EpochServ, EpochMigration
Circle 152

E-Systems Inc.
P.O. Box 660023
1200 Jupiter Road
Dallas, TX 75266
FileServ, VolServ
Circle 153

HIARC Inc.
3 Corporate Park, Suite 250
Irvine, CA 92714
SPARCUS
Circle 154

IBM Storage Systems Division
Contact vendor
ADSTAR Distributed Storage Manager

Introl Corp.
2817 Anthony Lane South
Minneapolis, MN 55418
Flexstor HSM
Circle 155

Legato Systems Inc.
3145 Porter Drive
Palo Alto, CA 94304
NetWorker HSM
Circle 156

NetStor Inc.
11400 Rupp Drive
Burnsville, MN 55337
NETstor HSM
Circle 157

OpenVision
7133 Koll Center Pkwy.
Pleasanton, CA 94566
*OpenV*HSM, OpenV*Migrator, UniTree*
Circle 158

QStar Technologies Inc.
Jefferson Plaza
600 E. Jefferson St.
Fifth Floor
Rockville, MD 20852
MastarMind
Circle 159

Raxco Inc.
2440 Research Blvd.
Rockville, MD 20850
Distributed Systems Management (including *Storage Management*)
Circle 160

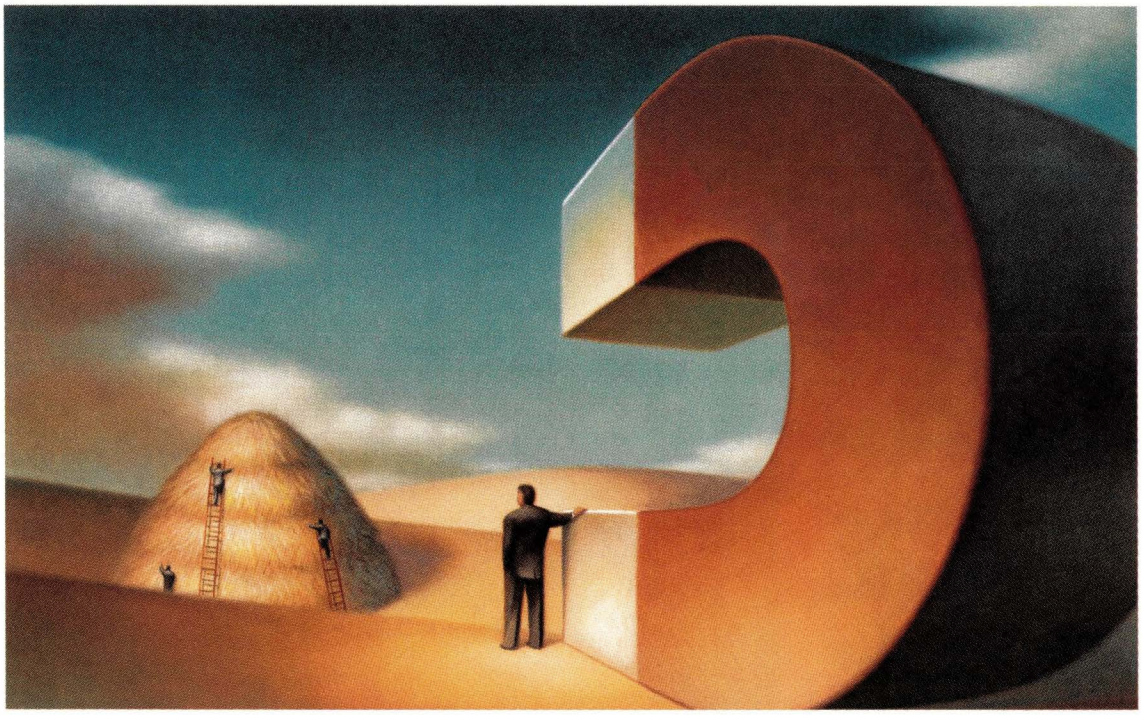
Software Partners/32 Inc.
447 Old Boston Road
Topsfield, MA 01983
StorageCenter
Circle 161

Storage Technology Corp.
2270 South 88th St.
Louisville, CO 80028
NearNet
Circle 162

Serious Development Deadlines?

(!)

[SERIOUS ASSISTANCE]



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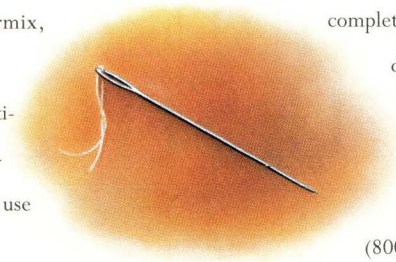

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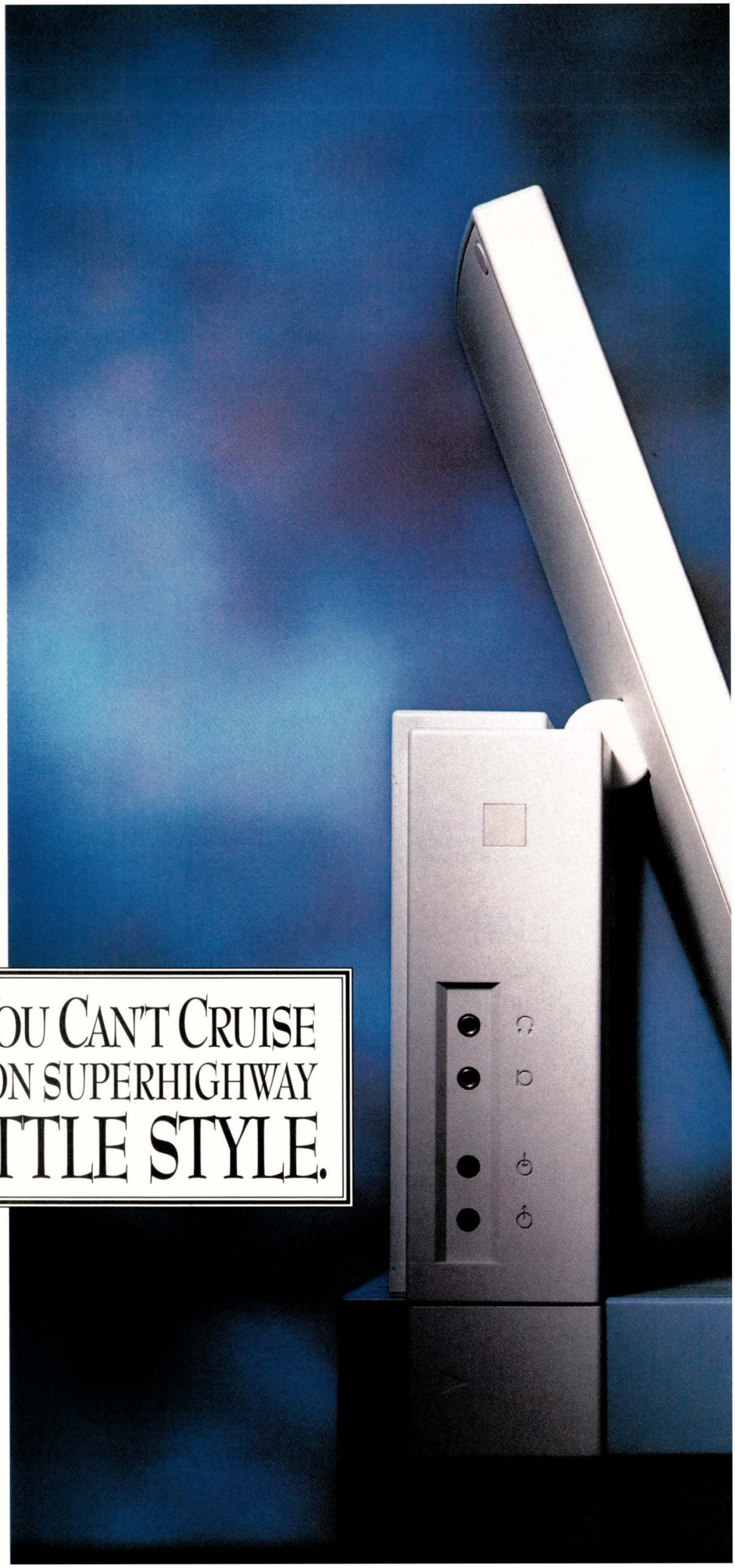

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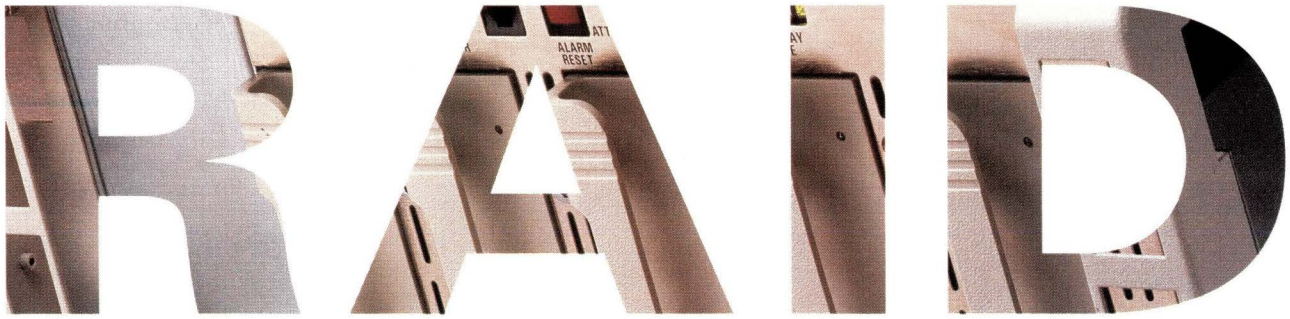
Buyers Guide to UNIX



Company/Manufacturer Model	Host interfaces; Connector type	RAID levels supported; Form factor	Software provided for host; OS versions available	Sustainable data rate (Mb/s)	Maximum RAID strings per cabinet; Drives per RAID string	Hot spare drives per string	Maximum usable capacity per host (GB)	Drive capacity, formatted (GB)	Disks hot swappable	Price ($)*
Adjile Systems, 5816 Roseville Road, #2, Sacramento, CA 95842. **Circle 200**										
Panther Series RAID	Fast/wide SCSI-2 on the host side, fast SCSI-2 on the drive side; 50-pin Micro SCSI	0, 3, 5; 5¼, 3½	UNIX drivers supplied, currently testing Solaris 2.3	10 (f), 20 (w)	5; 1-7	—	8.5	2.1	Yes	17,599
Cuda High-Performance RAID-Tower	Fast/wide SCSI-2 on the host side, fast SCSI-2 on the drive side; 50-pin Micro SCSI	0, 3, 5; 5¼, 3½	No software required	10 (f), 20 (w)	4; 7	1	48	2.1	Yes	72,999
ADS International, 434 Cloverleaf Drive, Baldwin Park, CA 91706. **Circle 201**										
DAC900D	SCSI, SCSI-2; 50-pin Centronics	0, 3, 5; 3½	No software required	10 (f)	7; 4	1	20	3	Yes	20,000+
ANDATACO, 10140 Mesa Rim Road, San Diego, CA 92121. **Circle 202**										
GigaRAID/TS	SCSI-2, narrow/wide, single-ended or differential; Micro SCSI-2, 50- or 68-pin	0, 3, 5; —	No software required	8.5 (f), 16 (w)	4; 5-7	1	1 TB	0.5-4	Yes	15,000-145,000
GigaRAID/TSL	SCSI-2, narrow/wide, single-ended or differential; Micro SCSI-2, 50- or 68-pin	0, 3, 5; —	No software required	8.5 (f), 16 (w)	4; 7	1	1 TB	0.5-2	Yes	15,000-145,000
GigaRAID/TSR	SCSI-2, narrow/wide, single-ended or differential; Micro SCSI-2, 50- or 68-pin	0, 3, 5; —	No software required	8.5 (f), 16 (w)	4; 7	1	1 TB	0.5-4	Yes	18,000-150,000
GigaRAID/RS	SCSI-2, narrow/wide, single-ended or differential; Micro SCSI-2, 50- or 68-pin	0, 3, 5; —	No software required	8.5 (f), 16 (w)	1; 7	1	240/ rack	0.5-4	Yes	15,000-180,000
ShadowDISC/TS	SCSI-2, narrow, single-ended or differential; Micro SCSI-2, 50-pin	1; —	No software required	3 (f)	8; 2	—	1 TB	0.5-4	Yes	15,000-80,000
ShadowDISC/TSL	SCSI-2, narrow, single-ended or differential; Micro SCSI-2, 50-pin	1; —	No software required	3 (f)	12; 2	—	1 TB	0.5-4	Yes	15,000-80,000
ShadowDISC/TSR	SCSI-2, narrow, single-ended or differential; Micro SCSI-2, 50-pin	1;—	No software required	3 (f)	8; 2	—	1 TB	0.5-4	Yes	18,000-85,000
ShadowDISC/RS	SCSI-2, narrow, single-ended or differential; Micro SCSI-2, 50-pin	1; —	No software required	3 (f)	4; 2	—	320	0.5-4	Yes	15,000-85,000
ShadowDISC/DS	SCSI-2, narrow, single-ended or differential; Micro SCSI-2, 50-pin	1; —	No software required	3 (f)	3; 2	—	180	0.5-4	Yes	5,500-45,000
Artecon, P.O. Box 9000, Carlsbad, CA 92018-9000. **Circle 203**										
Lynx-LX 1500 Series (desktop/deskside)	SCSI-2; standard SCSI-2	0, 1; 3½	No software provided; recommend Sun Soft Online-disk suite for Solaris 1.x, 2.x	8.3 (f)	User configurable	User configurable	20	1.05-2.1	Yes	995-4,145

(f) fast SCSI
(w) wide SCSI

* Pricing reflects a range suggested by the vendor. RAID systems are very flexible in configuration. Ask vendor price/megabyte to compare systems.

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Artecon, (continued)										
Sphinx-SRU Series (rack mount)	SCSI-2; standard SCSI-2	0, 1; 3½, 5¼	No software provided; recommend SunSoft Online-disk suite for Solaris 1.x, 2.x	8.3 (f)	User configurable	User configurable	20	1.05-2.1	Yes	1,995-7,695
RSU4 Series Data Vaults	SCSI-2; standard SCSI-2	0, 1; 5¼	No software provided; recommend SunSoft Online-disk suite for Solaris 1.x, 2.x	8.3 (f)	User configurable	User configurable	30	4	Yes	4,295-4,895
AT&T Global Information Solutions, 1700 S. Patterson Ave., Dayton, OH 45479. **Circle 204**										
AT&T 6298 Disk Array Subsystem	Fast SCSI-2 differential; standard SCSI 68-pin	0, 1, 3, 5; 3½	RAID Manager sold separately, available for: UNIX, Windows NT, NetWare, AIX, Planned Solaris 2.x release in 3rd quarter	14 (f), 14 (w)	4; 5	—	294	1.05-2.1	Yes	26,890-75,975
Box Hill Systems Corp., 161 Avenue of the Americas, New York, NY 10013. **Circle 205**										
The RAID Box/ The RAID Box 530	Fast SCSI-2,single-ended SCSI SCSI differential; DB-25	0, 1, 3, 5; 3½, 5¼	SunOS 4.1.x, Solaris 2.x, HP-UX 9.x, AIX, OSF, NEC, SGI, Novell, Cray CS6400	8 (f), 15 (w)	4; 3-7	1-4	50	2-9	Yes	$10,000+
Cambex Corp., 360 Second Ave., Waltham, MA 02154. **Circle 206**										
Certainty Series Array 6000 Model 510	SCSI-2; standard SCSI-2	0, 1, 3, 5; 3½	Certi-Build (configuration and driver), AIX 3.2.3 and higher	16 (f), 16 (w)	3; 5	—	1.5 TB	2.1	Yes	—
Certainty Series Array 6000 Model 910	SCSI-2; standard SCSI-2	0, 1, 3, 5; 3½	Certi-Build (configuration and driver), AIX 3.2.3 and higher	16 (f), 16 (w)	3; 5	—	1.5 TB	2.1	Yes	—
Ciprico Inc., 2800 Campus Drive, Plymouth, MN 55441. **Circle 207**										
Rimfire 6700 Family of Disk Arrays	SCSI-2; standard SCSI	0, 3; 3½	Solaris 2.x	10 (f), 20 (w)	—; 9	1	224	16	Yes	15,325
CLARiiON Mass Storage Subsystems, 4400 Computer Drive, Westboro, MA 01580. **Circle 208**										
Series 2200 Disk Array SCSI-2 standard	SCSI-2, 16 bit; 68-pin 3, 5; 3½	0, 1, 1/0, (DASSMGR)	Disk Array Subsystem Manager supporting SunOS 4.1.2, 4.1.3, Solaris 2.1, 2.2	20 (f); 20 (w)	4; 5	4	640	1, 2, 4	Yes	18,000
Computer PS Inc., P.O. Box 775470, Steamboat Springs, CO 80477. **Circle 209**										
CPS-R5235	SCSI-2; Centronics	0, 3, 5; 3½	No software required	10 (f), 10 (w)	1; 5	0	—	1, 2	Yes	15,375
CPS-R523A	SCSI-2; Centronics	0, 3, 5; 3½	No software required; AIX	10 (f), 10 (w)	2; 5	2	—	1, 2	Yes	18,075
CPS-R5255	SCSI-2; Centronics	0, 3, 5; 5¼	No software required; AIX	10 (f), 10 (w)	1; 5	0	—	4	Yes	29,050
CPS-R525A	SCSI-2; Centronics	0, 3, 5; 5¼	No software required	10 (f), 10 (w)	2; 5	0	—	4	Yes	31,675
Computer Upgrade Corp., 1921 Sampson Ave., Corona, CA 91719. **Circle 210**										
CUC-6080/H	SCSI-2, fast/wide; standard SCSI	0, 3, 5; 3½	Solaris, AIX, OSF/2, IRIX, ULTRIX	10 (f), 20 (w)	7; 5	1	56	1.6	Yes	40,000
Concorde Technologies Inc., 6370 Lusk Blvd., Suite F100, San Diego, CA 92121. **Circle 211**										
Disk Array 9000	SCSI, SCSI-2; standard SCSI or fast SCSI	0, 1, 3, 5; 3½	Microsoft DOS 5.0/Windows 3.1, SCO UNIX 3.2.4/ODT 2.0, Novell NetWare 3.11, Apple Macintosh System 7/AUX 3.0, Solaris 1.1, 2.2, HP-UX, AT&T UNIX 5.4	—	2; 6	1	—	2.1	Yes	—
Conley Corp., 420 Lexington Ave., 10th Floor, New York, NY 10017. **Circle 212**										
Conley SR-2 Tower	SCSI-2 fast and wide; standard SCSI	0, 1, 3, 5; 5¼	Robust RAID manager utility software to set up, monitor, control, broadcast drive status for MacOS and A/UX; SunOS; Solaris 2.x; DEC Alpha OSF/1; AIX 3.2.x; Novell NetWare 3.1.x	Up to 20 (f/w)	—	—	1.05 TB	2.8	Yes	16,995
Conley SR-2 Desktop or Rackmount	SCSI-2 fast and wide; standard SCSI	0, 1, 3, 5; 3½	Robust RAID manager utility software to set up, monitor, control, broadcast drive status for MacOS and A/UX; SunOS; Solaris 2.x; DEC Alpha OSF/1; AIX 3.2.x; Novell NetWare 3.1.x	Up to 20 (f/w)	—	—	840	2.1	Yes	16,995

(f) fast SCSI
(w) wide SCSI

* Pricing reflects a range suggested by the vendor. RAID systems are very flexible in configuration. Ask vendor price/megabyte to compare systems.

Company/Manufacturer Model	Host interfaces; Connector type	RAID levels supported; Form factor	Software provided for host; OS versions available	Sustainable data rate (Mb/s)	Maximum RAID strings per cabinet; Drives per RAID string	Hot spare drives per string	Maximum usable capacity per host (GB)	Drive capacity, formatted (GB)	Disks hot swappable	Price ($)
Consan Inc., 7676 Executive Drive, Eden Prairie, MN 55344. **Circle 213**										
RAID Box	SCSI-2 ; standard SCSI	0, 3, 5; 5¼	No software required	10 (f)	7; 35	—	84	3	Yes	13,900
CORE International, 7171 N. Federal Highway, Boca Raton, FL 33487. **Circle 214**										
MICRO ARRAY MA-500	SCSI-2; standard SCSI	3, 5; 2½	No software required	5 (f), 5(w)	2; 5	—	14.28	0.13 MB	Yes	4,795
MICRO ARRAY MA-800	SCSI-2; standard SCSI	3, 5; 2½	No software required	5 (f), 5 (w)	2; 5	—	23.52	213 MB	Yes	5,995
MICRO ARRAY MA-1300	SCSI-2; standard SCSI	3, 5; 2½	No software required	5 (f), 5 (w)	2; 5	—	37.8	0.34	Yes	7,995
LAN ARRAY LA-2000	SCSI-2, SCSI; standard SCSI	3, 5; 3½	No software required	5 (f), 5(w)	1; 5	—	56	0.540	Yes	15,495
LAN ARRAY LA-4000	SCSI-2; standard SCSI	3, 5; 3½	No software required	5 (f), 5(w)	1; 5	—	112	1	Yes	19,995
LAN ARRAY LA-8000	SCSI-2; standard SCSI	3, 5; 2½	No software required	10 (f), 10 (w)	1; 5	—	37.8	2	Yes	27,995
Dataram Corp., P.O. Box 7528, Princeton, NJ 08543-7528. **Circle 215**										
DATARAID DTM900	SCSI, fast SCSI-2 (single-ended and differential), DSSI; DB50	1; 3½	None; VMS, Open VMS, OSF/1, SunOS, Solaris, HP-UX, AIX	10 (f)	3; 2	1-3	12	1.05/2.1/ 4.2	Yes	15,000-25,000
DATARAID DTM1000	Fast/wide SCSI-2, Fast SCSI-2 (single-ended and differential), DSSI; DB50, DB68	0, 3, 5; 3½	Data ESP and DATARAID Warning System (DWS); VMS, Open VMS, OSF/1, SunOS, Solaris, HP-UX, AIX	10 (f) 20 (w)	1; 4 to 7	1-3	28	1.05/2.1/ 4.2	Yes	20,000-30,000
Digital Equipment Corp., 334 South St., Shrewsbury, MA 01545. **Circle 216**										
StorageWorks for Sun RAID Array 110	SCSI-2, fast differential; standard High Density	0, 1, 0+1, 3, 5; 3½	—	10 (f), 20 (w)	20; 6	—	1 TB	2.1	Yes	18,894
Direct Connect Systems Inc., 2260 Northwest Parkway, Suite O, Atlanta, GA 30067. **Circle 217**										
GUARDIAN RAID Server	SCSI, SCSI-2, fast/wide SCSI; all SCSI connectors	0, 1, 3, 5; 3½, 5¼	No software required	—	4; 28	1	115	4.3	Yes	1-4/MB
SENTINEL IO Processor	SCSI, SCSI-2, fast/wide SCSI; all SCSI connectors	7; 3½, 5¼	No software required	—	1; 48	1	200	4.3	Yes	1-4/MB
Dynamic Computer Products, 233 Greenwood Ave., Bethel, CT 06801. **Circle 218**										
RT-5X21GS	SCSI, SCSI-2; Centronics	1, 3, 5; 3½	No software required	4 (f)	1; 5	0	16	2.1	Yes	12,500
RT-CTRL	SCSI, SCSI-2; Centronics	1, 3, 5; 3½ 5¼	No software required	4 (f)	5; 5	0	120	9	Yes	—
DynaTek Automation Systems Inc., 200 Bluewater Road, Bedford, Nova Scotia, Canada B4B 1G9. **Circle 219**										
XRAID/ST	SCSI-2; standard SCSI	5; 3½	No software required	10 (f)	1; 5	—	48	2	Yes	17,995
ECCS Inc., 1 Sheila Drive, Building 6A, Tinton Falls, NJ 07724. **Circle 220**										
RAID Module MicroDFT-1	SCSI-2; standard SCSI	1, 10; 5¼	Status Monitor; SunOS 1, 2	7 (f)	open; 2	—	open	0.5, 1, 2.1	Yes	4,495
RAID Module FFT-1	SCSI-2; standard SCSI	1, 10; —	Status Monitor; SunOS 1, 2	7 (f)	7; 6	—	open	2.1	Yes	24,490
Enhance Systems Inc., 999-8th St. S.W., Suite 406, Calgary, Alberta, Canada T2R 1J5. **Circle 221**										
RAIDBOX	SCSI, SCSI-2, fast SCSI-2; standard SCSI	0, 3, 5; 5¼	No software required	4 (f)	1; 7	1	37.8	2.1	Yes	19,000+
SHADOWBOX	SCSI, SCSI-2, fast SCSI-2; standard SCSI	1; 5¼	No software required	4 (f)	2; 6	—	12.6	2.1	Yes	17,700+
MIRRORBOX	SCSI, SCSI-2, fast SCSI-2; standard SCSI	1; 5¼	No software required	4 (f)	2; 6	—	12.6	2.1	Yes	10,700+
RAIDBOX	SCSI, SCSI-2, fast SCSI-2; standard SCSI	0, 3, 5; 5¼	No software required	4 (f)	1; 7	1	37.8 GB	2.1	Yes	19,000+
Falcon Systems, 1417 W. North Market Blvd., Sacramento, CA 95826. **Circle 222**										
FalconRAID 70	SCSI-2; fast, wide, single-ended standard/differential; micro-d, Centronics, others	0, 3, 5; 5¼	No software required; SunOS 4.1.x, Solaris 2.x, HP-UX 9.x, AIX 3.1, IRIX 4.x	9.5 (f), 19.3 (w)	2; 5	2	256	8.88	Yes	—

(f) fast SCSI
(w) wide SCSI

*** Pricing reflects a range suggested by the vendor. RAID systems are very flexible in configuration. Ask vendor price/megabyte to compare systems.**

Company/Manufacturer Model	Host interfaces; Connector type	RAID levels supported; Form factor	Software provided for host; OS versions available	Sustainable data rate (Mb/s)	Maximum RAID strings per cabinet; Drives per RAID string	Hot spare drives per string	Maximum usable capacity per host (GB)	Drive capacity, formatted (GB)	Disks hot swappable	Price ($)*
Falcon Systems, (continued)										
FalconRAID 100	SCSI-2; fast, wide, single-ended standard/differential; micro-d, Centronics, others	0, 3, 5; 3½	No software required; SunOS 4.1.x, Solaris 2.x, HP-UX 9.x, AIX 3.1, IRIX 4.x	5 (f), 19.3(w)	8; 7	2	256	1.99	Yes	—
Fujitsu Computer Products of America Inc., 2904 Orchard Parkway, San Jose, CA. **Circle 223**										
DynaRAID SCSI Disk Arrays	SCSI-2; single-ended standard, differential option	3, 5; 3½	UNIX	10 (f), 20 (w)	7; 28	7	35	1.08	Yes	20,995
Hitachi America Ltd., 2000 Sierra Point Parkway, Brisbane, CA 94005-1835. **Circle 224**										
HitRAID-5/-11	SCSI-2 fast, SCSI wide optional; standard SCSI	3, 5; 3½	No software required	10 (f), 12.8 (w)	2; 5	—	156.8	1.4	Yes	32,000-48,000
HitRAID-12	SCSI-2 fast, SCSI wide optional; standard SCSI	3, 5; 5¼	No software required	10 (f), 13 (w)	1; 5	—	159.6	2.87	Yes	39,000-
HitRAID-34	SCSI-2 fast, SCSI wide optional; standard SCSI	3, 5; 3½	No software required	10 (f), 20 (w)	2; 8	1	481.6	2.87	no	82,000-
IBM Storage Systems Division, 5600 Cottle Road, San Jose, CA 95193. **Circle 225**										
3514 High Availability Disk Array	SCSI-2 differential; 68-pin high-density connectors	0, 5; 3½	AIX 3.2.4, Solaris 1.x, 2.x	10 (f)	1; 8	1	27.5, 30.4	1.9	Yes	19,400+
7135-110 RAIDiant Array	SCSI-2 differential; 68-pin high-density connectors	0, 5; 3½	AIX 3.2.4, or HACMP/6000 1.2	10 (f)	6; 5	—	768	2	Yes	35,000+
9570 Disk Array Subsystem	HIPPI; ANSI standard HIPPI/IPI-3	5; 3½	AIX/ESA, RISC System/6000, AIX 3.2, MVS/ESA PIOAM	50+ (HIPPI)	80; variable	variable	232	2	Yes	150,500+
JEMS Data Unlimited Inc., 300 Ballardvale St., Suite 112, Andover, MA 01810. **Circle 226**										
StorageWorks RAID Array	SCSI-2 fast/wide differential; standard SCSI, 68-pin	0, 1, 5; 3½	No software required	7 (f), 7 (w)	1; 5	2	User configurable	2.1	Yes	19,900
Legacy Storage Systems Inc., 25 South St., Hopkinton, MA 01748. **Circle 227**										
SmartArray/XE	SCSI-2; standard SCSI	0, 1, 3, 5; 3½, 5¼	Solaris	20 (f), 40 (w)	6; 4	1	26	21	Yes	20,000
Marner International Inc., 14524 61st St., Court North, Stillwater, MN 55082. **Circle 228**										
Data Storage Vault 50	Fast SCSI-2, fast/wide SCSI-2 single-ended or differential; standard SCSI 50-pin or 68-pin high-density	0, 3, 5; 3½	No software required	10 (f), 20 (w)	1; 4+1	Yes	Host dependent	1.2, 2.1	Yes	—
Data Storage Vault 52	Fast SCSI-2, fast/wide SCSI-2 single-ended or differential; standard SCSI 50-pin or 68-pin high-density	0, 3, 5; 3½	No software required	10 (f), 20 (w)	1; 6+1	Yes	Host dependent	1.2, 2.1	Yes	—
Data Storage Vault 201	Fast SCSI-2, fast/wide SCSI-2 single-ended or differential; standard SCSI 50-pin or 68-pin high-density	0, 3, 5; 3½	No software required	10 (f), 20 (w)	2; 6+1	Yes	Host dependent	1.2, 2.1	Yes	—
Data Storage Vault 202	Fast SCSI-2, fast/wide SCSI-2 single-ended or differential; standard SCSI 50-pin or 68-pin high-density	0, 3, 5; 3½	No software required	10 (f), 20 (w)	4; 6+1	Yes	Host dependent	1.2, 2.1	Yes	—
Mega Drive Systems Inc., 489 So. Robertson Blvd., Beverly Hills, CA 90211. **Circle 229**										
MR/5 RAID Fault Tolerant Disk Array Tower	SCSI-2, fast wide; wide SCSI	0, 3, 5; 3½	No software required	10 (f), 20 (w)	1; 5	1	8	1-8	Yes	9,600
MR/5 Rack Mount RAID Disk Array	SCSI-2, fast wide; wide SCSI	0, 3, 5; 3½	No software required	10 (f), 20 (w)	1; 5	1	8	1-10	Yes	10,400
MR/10 RAID Fault Tolerant Disk Array Dual Tower	SCSI-2, fast wide; wide SCSI	0, 3, 5; 3½	No software required	10 (f), 20 (w)	2; 11	1	16	2-20	Yes	14,400
Morton Management Inc., 12079 Tech Road, Silver Spring, MD 20904. **Circle 230**										
GB4RD-15000	SCSI-2; SCSI-2, standard SCSI	0, 3, 5; 3½ 5¼	No software required	10 (f), 20 (w)	5; 7	0	490	2	Yes	55,000

(f) fast SCSI
(w) wide SCSI

* Pricing reflects a range suggested by the vendor. RAID systems are very flexible in configuration. Ask vendor price/megabyte to compare systems.

RAID SURVEY

Company/Manufacturer Model	Host interfaces; Connector type	RAID levels supported; Form factor	Software provided for host; OS versions available	Sustainable data rate (Mb/s)	Maximum RAID strings per cabinet; Drives per RAID string	Hot spare drives per string	Maximum usuable capacity per host (GB)	Drive capacity, formatted (GB)	Disks hot swappable	Price ($)
MTI, 4905 E. LaPalma Ave., Anaheim, CA 92807. **Circle 231**										
Raider's Edge 3415-16 or 64	SCSI-2; standard SCSI	3; 3½	Raider monitor for Sun 4, Solaris	10 (f)	5; 5	1	20.5	1.025	Yes	34,375-45,000
Raider's Edge 3745-16 or 64	SCSI-2; standard SCSI	3; 3½	Raider monitor for Sun 4, Solaris (optional)	10 (f)	5; 5	1	37	1.850	Yes	46,250-56,875
Raider's Edge 5100S-16 or 64	SCSI-2; standard SCSI	3; 5¼	Raider monitor for Sun 4, Solaris (optional)	10 (f)	4; 5	1	40	2.500	Yes	53,125-63,750
National Peripherals Inc., 1111 Pasquinelli Drive, Suite 400, Westmont, IL 60559. **Circle 232**										
NPDAS Series 3000	Fast SCSI-2	0, 1, 5; 31/2	Solaris 1.x on VME Solaris 2.x	10 (f)	—;—	—	80	1.05-4.1	Yes	—
NPDAS Series 5000	Fast SCSI-2	0, 1, 5; 5¼	Solaris 1.x on VME Solaris 2.x	10 (f)	—;—	—	180	2.9 -9	Yes	—
NPDAS Series 7000	Fast SCSI-2; fast/wide SCSI-2	7; 3½ 5¼	No software required	10 (f), 20 (w)	—;—	—	141	1.05 -9	Yes	—
NPDAS Series 1000	Fast SCSI-2; fast/wide SCSI-2	0, 3, 5; 3½ 5¼	No software required	10 (f), 20 (w)	—;—	—	72	1.05 -9	Yes	—
Pacific Micro Data Inc., 3002 Dow Ave., Bldg. 140, Tustin, CA 92680. **Circle 233**										
MAST VII Disk Array System	Fast SCSI-2; standard SCSI	0, 1, 3, 5; 3½	Utilizes built-in drivers and third-party RAID software	10 (f)	2; 3	1	14	2.15	Yes	1,500+
Parity Systems Inc., 110 Knowles Drive, Los Gatos, CA 95030. **Circle 234**										
PS 7000 RAID Subsystem	SCSI, SCSI-2, fast/wide, fast/wide Differential; All connector types	0, 3, 5; 5¼, 3½	No software required	10 (f), 20 (w)	2; 7	1	28.5	4.1	No	7,000-30,000
Full Featured RAID Tower	SCSI, SCSI-2, fast/wide; fast/wide Differential; All connector types	0, 3, 5; 3½	No software required	10 (f), 20 (w)	1; 7	1	112	4.1	Yes	8,000-40,000
PS5900 RAID Tower	SCSI, SCSI-2, fast/wide; fast/wide Differential; All connector types	0, 3, 5; 5¼, 3½	No software required	10 (f), 20 (w)	1; 5	1	100	9.8	Yes	8,000-50,000
PEAK Technologies Group Inc., 8990 Old Annapolis Road, Columbia, MD 21045. **Circle 235**										
MESA FA-7040/S	SCSI-2; standard 50-pin SCSI or P-Type wide	0, 3, 5; 3½	No software required	7 (f), 13 (w)	5; 1	1	28	1	Yes	19,455
MESA FA-7140/S	SCSI-2; standard 50-pin SCSI or 68-pin P Type	0, 3, 5; 3½	No software required	10 (f), 20 (w)	5; 1	1	28	1	Yes	20,500
MESA FA-7080/S	SCSI-2; standard 50-pin SCSI or 68-pin P Type	0, 3, 5; 3½	No software required	7 (f), 13 (w)	5; 1	1	58.8	2.1	Yes	28,152
MESA FA-7180/S	SCSI-2; standard 50-pin SCSI or 68-pin P Type	0, 3, 5; 3½	No software required	10 (f), 20 (w)	5; 1	1	58.8	2.1	Yes	29,300
Peripheral Solutions, 108 Dubois St., Santa Cruz, CA 95000. **Circle 236**										
Unbound	SCSI;50-pin Centronics	0, 1, 3, 5	No software required	10 (f), 20 (w)	—	—	—	—	—	20,000
Procom Technology, 2181 Dupont Drive, Irvine, CA 92715. **Circle 237**										
LANForce-5	SCSI-2, fast; high-density 50-pin SCSI-2	0, 1, 3, 5; 3½	No software required	10 (f)	3; 2-7	0-4	14	2.1	Yes	—
R-Squared, 11211 E. Arapahoe Road, Suite 200, Englewood, CO 80112. **Circle 238**										
Ultima	SCSI-2; standard SCSI	0, 3, 5; 3½	No software required	10 (f), 20 (w)	4; 7	1	48.8	2.1	Yes	1.50-3.00/MB
RAIDTEC Corp., 105 Hembree Park Drive, Suite C, Roswell, GA 30076. **Circle 239**										
RUAC IX (RAIX-0)	SCSI, SCSI-2; standard SCSI	0, 1, 3, 5; 3½	No software required; supports Solaris 1 & 2	10 (f)	1; 35	—	48	2	Yes	2,795
FlexArray IX (FAIX-0)	SCSI, SCSI-2; standard SCSI	0, 1, 3, 5; 3½	No software required; supports Solaris 1 & 2	10 (f)	1; 5	—	Host dependent	2	Yes	4,950

(f) fast SCSI
(w) wide SCSI

* Pricing reflects a range suggested by the vendor. RAID systems are very flexible in configuration. Ask vendor price/megabyte to compare systems.

Company/Manufacturer Model	Host interfaces; Connector type	RAID levels supported; Form factor	Software provided for host; OS versions available	Sustainable data rate (Mb/s)	Maximum RAID strings per cabinet; Drives per RAID string	Hot spare drives per string	Maximum usable capacity per host (GB)	Drive capacity, formatted (GB)	Disks hot swappable	Price ($)*
Sanyo Icon, 18301 Von Karman, Suite 750, Irvine, CA 92715. **Circle 240**										
LANser MRX Intelligent Disk Subsystem	SCSI, SCSI-2 fast and fast/wide; SCSI, SCSI-2 fast and fast/wide	0, 1, 5; 5¼, 3½	LANser MRX OS provided; full support for Solaris 2	10 (f), 10 (w)	15; 6	1	1.44 TB	1, 2, 4	Yes	30,000
SEEK Systems Inc., 11014-120th Ave. NE, Kirkland, WA 98033. **Circle 241**										
Xcelerator	Fast and wide SCSI-2; SCSI, SCSI-2	0, 3, 5; 5¼, 3½	Operating system independent	10 (f), 20 (w)	2; 10	2	160	2	Yes	25,000
Storage Computer Corp., 11 Riverside St., Nashua, NH 03062. **Circle 242**										
RAID 7 Desktop	SCSI, SCSI-2; high-density standard SCSI (50- or 68-pin)	—; 3½, 5¼	Supports all host OS using Sun or IBM's standard SCSI drivers	8 (f), 18 (w)	—; 12	User config- able	99	—	Yes	20,000+
RAID 7 Intergrated Rack-Mount	SCSI, SCSI-2; high-density standard SCSI (50- or 68-pin)	—; 3½, 5¼	Supports all host OS using Sun or IBM's standard SCSI drivers	8 (f), 18 (w)	—; 27	User config- able	234	—	Yes	27,000+
RAID 7 Console	SCSI, SCSI-2; high-density standard SCSI (50- or 68-pin)	—; 3½, 5¼	Supports all host OS using Sun or IBM's standard SCSI drivers	8 (f), 18 (w)	—; up to 48	User config- able	420	—	Yes	40,000+
Storage Concepts Inc., 2652 McGaw Ave., Irvine, CA 92714. **Circle 243**										
Concept 750-5	SCSI, SCSI-2; standard SCSI	3, 5; 3½	—	7 (f); 14 (w)	4; 5	1	235	2.1	Yes	22,000
Concept 750-7	SCSI, SCSI-2; standard SCSI	3, 5; 3½	—	7 (f), 14 (w)	4; 7	1	350	2.1	Yes	27,500
Storage Solutions Inc., 550 West Ave., Stamford, CT 06902. **Circle 244**										
RACa-ray Model 5, Model 10, Model 30	Wide/fast SCSI-2; standard 68-pin	0, 3, 5; 3½	No software required; RACa-ray is OS- and platform-independent	10 (f), 20 (w)	3; 5	1	240	2	Yes	19,495- 62,495
Sun Microsystems Inc., 2550 Garcia Ave., M/S PAL1-505, Mountain View, CA 94043. **Circle 245**										
SPARCstorage Array Model 100 Series	Fiber Channel; Fiber Optic	0, 1, 0+1, 5; 3½	Solaris 2.3	15 (f)	15; 2-30	Un- limited	630	535 MB- 1.05	Yes	24,900
Systems & Software Inc., 16233 Westwoods Business Park, Ellisville, MO 63021. **Circle 246**										
S6321F/8	Single-ended or differential SCSI-2; standard SCSI or SCSI-2	0, 3, 5; 3½	No software required	10 (f)	2; 7	1	200	2.1	Yes	25,000
S6321W/8	Single-ended or differential SCSI-2; standard SCSI or SCSI-2	0, 3, 5; 3½	No software required	20 (w)	2; 7	1	200	2.1	Yes	26,000
Total Tec Systems Inc., 2 Gourmet Lane, Edison, NJ 08837. **Circle 247**										
TRAID35	SCSI-2; standard SCSI	0, 3, 5; 3½	No software required	7-10 (f)	4; 7	User config- urable	Host depen- dent	2.1	Yes	15,500
Transoft Corp., 1150 Coast Village Road, Suite H, Santa Barbara, CA 93108. **Circle 248**										
DataDock T-1000/ DataDock T-2000	SCSI, SCSI-2; standard SCSI	0, 1, 3, 5; 3½	—	7.8 (f), 17.3 (w)	4; 5-20	0	210	7-32	Yes	19,500- 99,500
Tripac Systems Inc., 7423 Washington Ave. South, Minneapolis, MN 55439. **Circle 249**										
RAIDStor DataDock T-2000	SCSI-2 fast, SCSI-2 fast/wide; 50/68-pin high density	0, 1, 3, 5; 3½	SunOS 4.4, Solaris 2.1, 2.2, Sun Disk Suite	7 (f), 15 (w)	5-7;4	0	216	1, 2, 9	Yes	—
Unbound Inc., 17712 Mitchell North, Irvine, CA 92714. **Circle 250**										
RAIDSTOR	SCSI-2 fast/wide; standard SCSI	0, 3, 5; 3½ 5¼	No software required	10 (f), 20 (w)	5; 7	—	82	—	Yes	7,000+
Western Microsystems, 12900 Saratoga Ave., Saratoga, CA 95070. **Circle 251**										
Series 2200 Disk Array	SCSI-2, 16 bit; 68-pin SCSI-2 standard	0, 1, 1/0, 3, 5; 3½	Disk Array Subsystem Manager (DASSMGR) supporting SunOS 4.1.2, 4.1.3, Solaris 2.1, 2.2	20 (f); 20 (w)	4; 5	4	640	1, 2, 4	Yes	18,000

(f) fast SCSI
(w) wide SCSI

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A Luggable, a CPU Doubler and Instant Replays

This month we look at a curious new SPARCstation configuration, a SPARC CPU upgrade and an easy-to-use package that captures screen interactions for replay.

Now, Voyager?

by **BARRY SHEIN,**
Technical Editor

If you're one of the many people who has been pining away for a mobile computer all these years...Excuse me? You in the front. What is a mobile computer? Well, I suppose we'll just have to begin at the beginning then, won't we. Imagine a computer that is somewhere between a portable and a workstation. No, that doesn't quite capture it. Imagine a computer somewhere between, well, how can one average computers anyhow? Imagine a computer with a small, upright body and a flat-panel, active-matrix display attached. You will have imagined Sun's new Voyager (internal code name: Gypsy) computer. The Voyager is not something you would want to take on a plane to use during flight, and I doubt it's something you would take to your hotel room, though that's possible. It is a computer you might take with you to a customer site you need to camp out at for a few days, or perhaps use as a second system with a small footprint on your desk. Or, for folks who find desktop real estate scarce for other reasons (simple lack of it comes to mind) this might be a machine to look at. But there's a lot more for us to look at before making any conclusions.

The Voyager is a SPARC workstation made by Sun Microsystems Inc. It runs Solaris 2.3 and OpenWindows and all that software you have become accustomed to. I can find nothing surprising about its software soul: It's a SPARC workstation.

Appearances Can Be Deceiving

What is unusual is its packaging, which is unique if nothing else. The color flat-panel active-matrix LCD screen (it also comes in monochrome) is rather high quality for an LCD screen. I would guess that, after using it for a while, you will forget it's an LCD screen at all unless you're very sensitive to the slight persistence noticeable when you move the

Sun's Voyager offers high performance in a space-saving package.

mouse. I measure the screen at 9½ by 7 inches, or 12 inches diagonally, if you prefer. This is large by LCD screen standards. Colors are also exceptionally bright, and images and text very clear. Resolution is 1,024 by 768, which is also outstanding for this type of display (most notebooks are 640 by 480). The color screen supports 8 bits of "depth" (256 simultaneous colors).

The keyboard is different and is called either the Sun Compact I or the Hobo (perhaps an internal name). It's distinctly smaller than a typical Sun keyboard (15 inches by 5½ inches versus 17 inches by 6½ inches). The keys are about the same as keys you are accustomed to, but they're arranged a little differently, and there are fewer of them. For example, the numeric keypad is gone. There is a top row of function keys, F1 through F12, plus a few more to control audio volume, screen brightness and power. The usual left-hand function keys (STOP, AGAIN, PROPS, UNDO, etc.) are all there. There is also the expected six-key pad with INSERT, HOME, PAGE-UP and so forth, and below it the usual arrow keys in inverted-T formation. There is only a backspace key on the main keyboard, no delete key (there is one in the six-key pad), and above the backspace are the backslash/pipe and backquote/tilde keys. If you prefer delete when you press the backspace key, the usual `xmodmap` command works fine to customize this. Overall, it's a usable keyboard though not luxurious, but compactness is the goal here, isn't it?

The mouse plugs into the keyboard, and the keyboard plugs into the back via a long enough cord. I keep wondering if there is some law or FCC regulation that mandates that keyboards plug into the back of a system unit; that's a lot of extra cord even for a small system such as this.

The back of the system unit sports the power switch, an external mini-SCSI connector, twisted-pair Ethernet (TPE), parallel interface (very small D connector with adapter cable), external monitor port, ISDN connectors, one full-size D connector for a serial port, keyboard port and an AC power input port. The left side of the system unit has audio ports (headphone and microphone), and line-in and line-out micro connectors for external audio equipment. The right side of the system has a 3½-inch floppy disk unit and something quite unexpected: two Type-II PCMCIA slots! This unit came with a V.32bis (14.4-Kb/s) modem plugged into the PCMCIA slots. PCMCIA (which is sometimes spelled out as People Can't Memorize Computer Industry Acronyms) is a standard popular in the notebook computer world, which supports credit card-size peripherals such as modems, Ethernet or token-ring interfaces and even small hard disks.

The system we reviewed had 48 MB of memory installed and a 340-MB internal hard disk. The standard system comes with 16 MB, and this is expandable by the addition of either 16- or 32-MB cards, so the maximum is 80 MB. This is not bad for such a small system. To get a feel for CPU performance, I ran Dhrystones 2.1 (500,000 runs) and got just over 48,000 Dhrystones, or around 40 MIPS or so. For the sake of comparison, a 486DX50 with 32 MB and running BSDI gives me a little more than 35,000 Dhrystones on the same test,

Voyager

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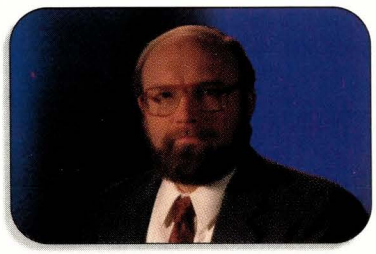

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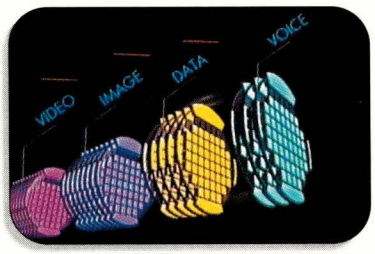

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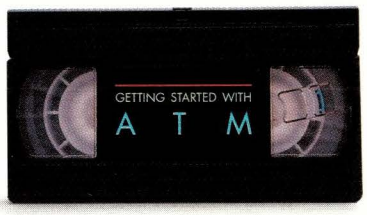

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so the Voyager is about 35% faster than that fairly high-end Intel Corp. system on this particular benchmark.

Wherever You Roam

But wait, there's much more! The system unit, viewed from the side, is L-shaped, and in the bottom portion of the L is the power supply. This area can also hold an optional battery, and the power supply acts as an external battery fast charger (you remove it and plug it all together to recharge). The battery can also be charged while in the system unit and will slow charge if the system is plugged into an AC outlet and the system is on, or fast-charge if the system is off. So the Voyager can be used where there is no plug. Sun's documentation claims that the battery lasts 45 minutes with a color screen and 90 minutes if you have a monochrome screen. As portable systems go, that's a short lifetime, but you can always bring more than one charged-up battery along with you. To help support this nomadic mode, the Voyager comes with power-management software. This includes a battery indicator for on-screen use to check the battery's current charge and the ability to turn off the screen and spin down the disk if the system is idle (idle times for each are set through an OpenWindows Power Manager tool). When the battery runs low, a window will pop up alerting you that there are only about 10 minutes of battery power left. It pops up again when there are 5 minutes remaining.

To further help support the nomadic computing concept, the Voyager comes with features such as PPP (point-to-point protocol, used to establish TCP/IP connectivity over a modem or serial line), UUCP and something new: a mail program called ROAM. ROAM uses the IMAP protocol, which can fetch all your mail in one swoop so you then can read it locally on the Voyager (and batch-send any mail messages you create back). This feature would be useful, for example, to let you make a quick long-distance phone call, pick up your email at high speed, hang up, read and respond to your mail and then make one more quick call to send any new messages you want delivered. You can, of course, also do this sort of thing with UUCP (and people have for more than a decade), but ROAM is accessible and managed through an extended version of the familiar Sun Mailtool, which no doubt some will prefer.

The entire system weighs 17.7 pounds; with carrying case (we didn't see one of these), the documentation says it will all weigh 23.5 pounds. The documentation also assures us that it is safe to put the Voyager through an airport X-ray security check, but Sun recommends not checking it as luggage due to some sort of mistrust of airport baggage-handling personnel. Further, we are told that the Voyager with case will fit in a typical airline overhead compartment. This can make that fast dash for the gate both an aerobic and strength-training exercise!

If all that is not enough, the manuals tell us that the system is attractive because it is green. No, not green-*colored*, green-*souled*, meaning that its power management and other features are kind to the environment by reducing power consumption.

So, what do we think about all this? Well, it's certainly designed for a particular niche, and I don't think someone who can manage to make use of a more conventional workstation will leap at this model unless they are particularly sensitive about desktop real estate or are swayed by the environmental claims. Certainly there are parts of the world outside the United States where space is at a premium (a friend just back from Hong Kong informs me that commercial office space goes for 10 times and more the cost of our rather immodest prices here in Boston). There are also parts of the world where electricity is at a greater premium than the United States, and I suspect these types of systems will penetrate large office complexes there first. The more obvious use of a system like this is for someone who is intermittently nomadic–for example, someone who goes to others' company sites and has to set him or herself up for a few days or more and

finds bringing his or her own almost-full-sized system, all set up with whatever software they use, more useful than a small notebook computer. There are such people–auditors and accountants come to mind, as well as systems and software consultants, industrial field personnel and various governmental functions (perhaps this is the right computer for the EPA to show up with for environmental audits).

My final recommendation would be that you need to see one and if possible try it out if you think you want one. Trade shows are one idea, or perhaps your Sun salesperson can get you a loaner. The Voyager is unusual enough that I don't think you will be able to fully judge this product from a review like this one, but I hope we got you started and interested (or not, as the case may be). Overall, I found the Voyager to be an interesting product, certainly a fully capable, high-performance SPARC workstation that should find some appeal for its unusual packaging.

Power µP your SPARCstation 2 or IPX

by IAN F. DARWIN

In my dream, I had become Scott McNealy, sitting behind a huge oak desk in Mountain View, CA 94043. The phone fleeped gently and L., my faithful assistant-to, said with an edge in her voice, "There's a delivery for ya, boss, and I think you'd better take this one yourself." The messenger, robed in black, plunked a dark package on my desk and shoved a clipboard under my nose. "Here," he sighed, "sign your life away." He laughed maniacally, jaws clattering. Heart pounding, I signed for the package. Inside were tiny replicas of 250,000 SPARCstation 2s and IPXs whose owners were suddenly unwilling to upgrade them to SPARCstation 10s. I woke up in a sweat. To my surprise, there was a dark package on my desk. But the nightmare turned to a pleasant dream when I saw the return address in one corner. Nothing demoniacal. Weitek Inc. It was my new CPU upgrade!

Weitek made the original CPU chip in the SPARCstation 2 and IPX. It's fitting, then, that they be the logical supplier to provide a "CPU-doubler" chip for it. Familiar to many in the PC world, "CPU-doubler" chips such as the Intel Corp. 486DX/2 series run the CPU clock at twice the rate of the system bus, allowing you to nearly double your CPU power without replacing the motherboard and peripherals. That's the good news. The downside is that CPU isn't everything. If your system is still constrained by a slow disk or insufficient memory, it will still be disk-bound or memory-bound. It will, however, do compute-intensive work twice as fast.

In the process of building the Power µP CPU, Weitek incorporated several speedups to the floating point, so maximum floating-point performance is more than doubled.

Installation

When you open the Dark Package, you find several bits of equipment.

Most important are the instructions. Second most important is a static-discharge wrist strap. Next in importance is the actual chip installation tool, a large custom-made chip installer. Forget what you think you know about large-chip installers, and read the manual on this one, Binky! There is a Phillips screwdriver you'll need for opening your SPARCstation 2 or IPX system cabinet. There is even a low-cost flashlight (batteries included!) that you may need to see in some tight corners during the installation. They thought of everything. Oh yes, I almost forgot. Right in the middle–farthest from the remote possibility of shipping damage–is a large, expensive-looking integrated circuit chip with heat sinks and a Weitek logo.

Your SPARCstation 2 or IPX is an expensive piece of equipment, and you may be reluctant to rip its heart out yourself. Accordingly, the folks at

Figure 1

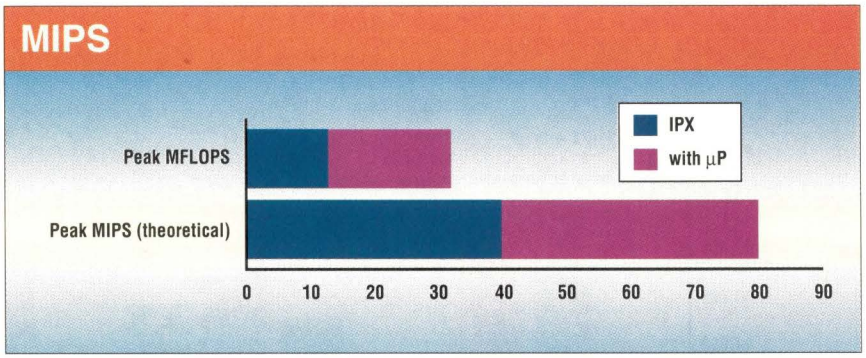


Figure 2

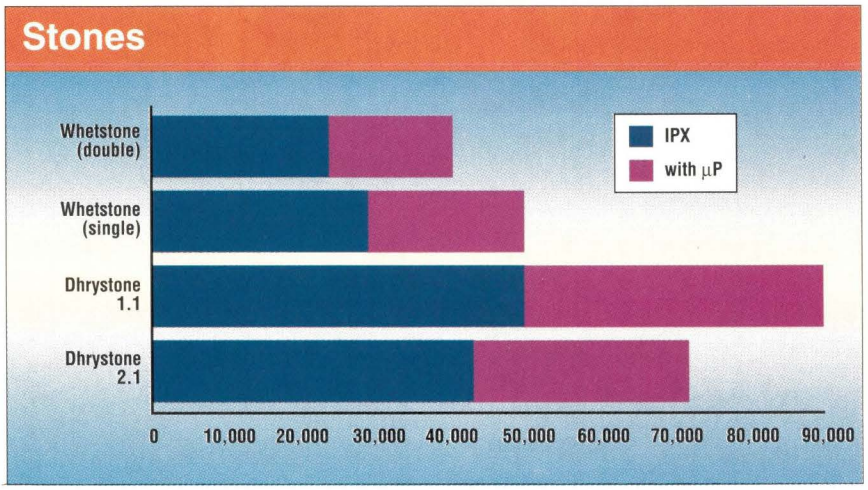
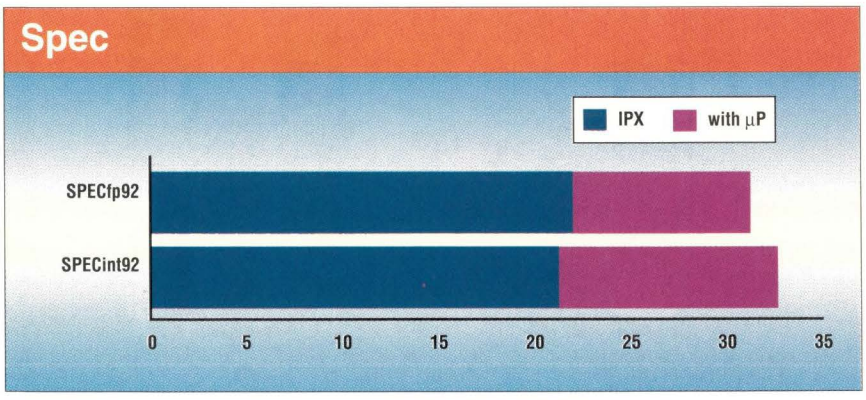


Figure 3



Weitek have worked very hard to make this product easy and foolproof to install. The instructions are detailed and well organized. And, unlike many products in the computer industry, this product has obviously been extensively beta-tested (or "human factors tested") under close supervision. There are several places where the instructions say "Don't start [this step] Yet!"–presumably some early testers started to get impatient there. If you read and follow the directions, you will be able to remove your old CPU chip and install the new Weitek chip in its place. On the other hand, if you like to rush through things, or if you believe in the old refrain, "When all else fails, read the manual," then save yourself fifteen hundred bucks and hire somebody competent to do the installation. For the rest of us, the instructions are fine.

Fine, but not incapable of being improved upon. In one place, they suggest that you use "halt" rather than "shutdown" to halt the machine. Well, it works. But it can be a little drastic if your machine is on a network and others may be logged in or using file systems. Shutdown is a tad more graceful. Experienced superusers would know this, but the documentation should be changed.

Also, they made no mention in the "taking your machine down" of the purple CPU stands popular with IPX users, even though they discussed pulling off all the cables. Again, this is minor. The instructions, I repeat, are in general excellent.

I was a little surprised to find that my early-production IPX had a Fujitsu CPU chip in it, rather than a Weitek. I did a doubletake but went ahead with the instructions anyway. It worked.

One time I gave myself quite a surprise. I had had the Weitek in for a month or so and had to put back the original CPU, just as you might have to do when returning the unit for service. Actually, now you won't have to, because Sun has certified the Weitek CPU replacement as acceptable for SunService.

Anyway, the Fujitsu labeling is oriented differently than the Weitek, so there was a tiny doubt in my mind about which way to insert the chip in the socket (though pin 1 was clearly marked by an indicator–always believe the indicators, not the lettering!). I powered it up and...nothing. The screen was totally blank. For several minutes. The words, "If you do not orient the chip correctly with the socket, it can be destroyed when you turn on the system" came back to haunt me. But I was sure I had done the re-installation correctly. I had. Finally, it turned out that the keyboard cable and "tty a" cable had been interchanged. The boot PROM, seeing no valid keyboard present, was busily sending the PROM and boot messages out on the serial port, but there was nothing there capable of displaying them. First, fie on the SPARCstation designers for using the same kind of connector for keyboards

Figure 4

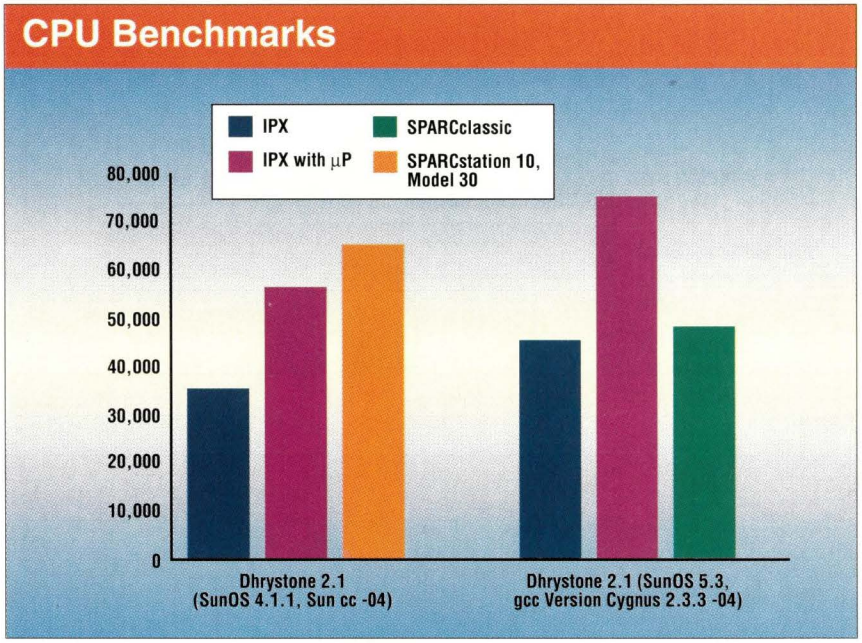
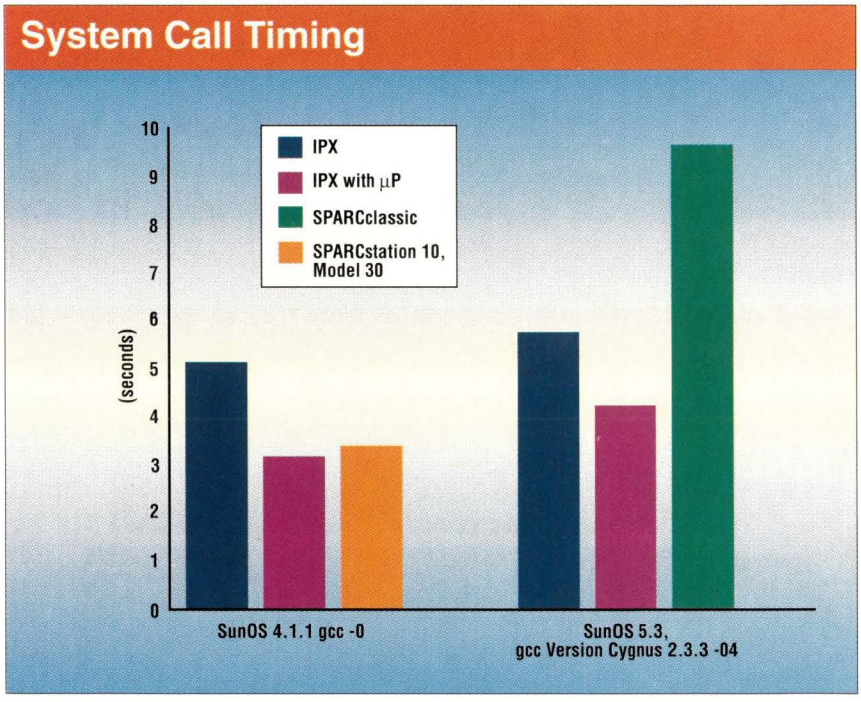


Figure 5



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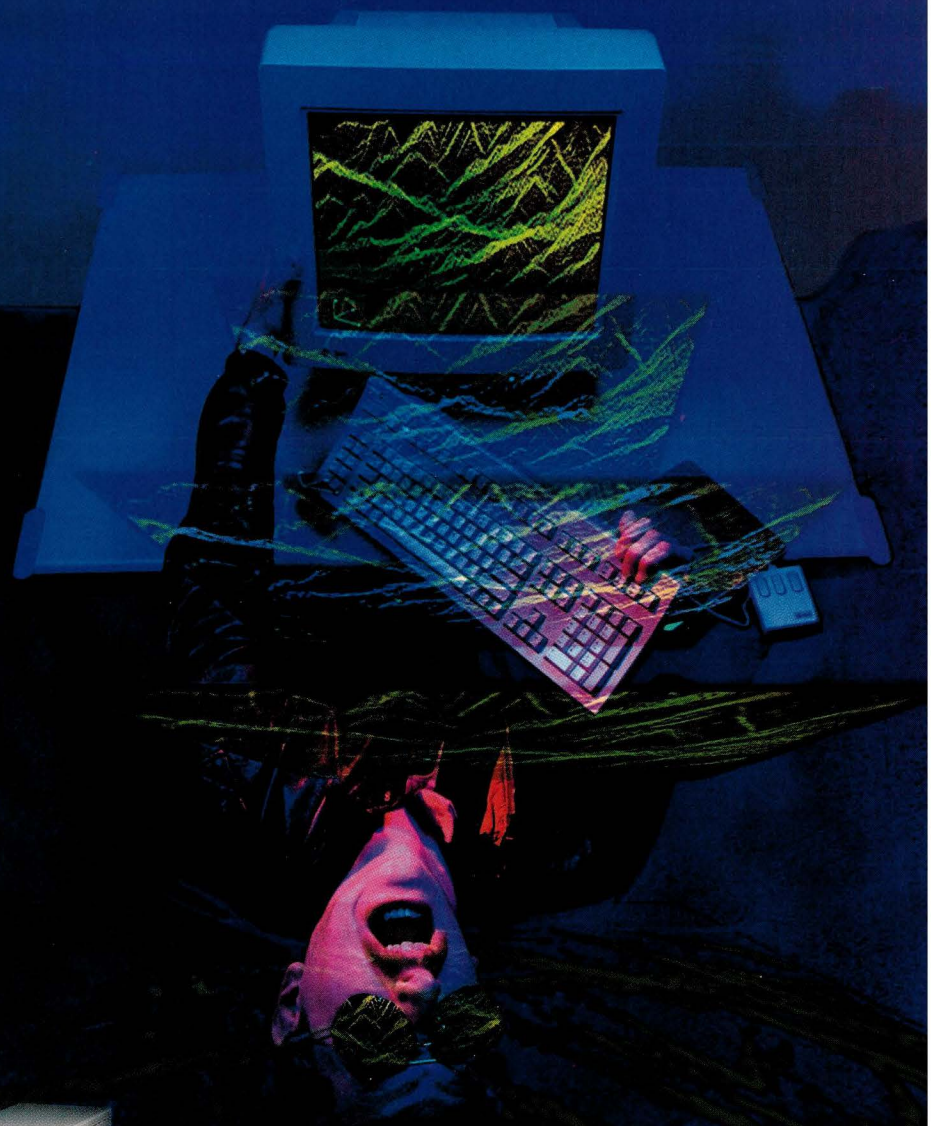

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and serial ports! Second, *label your connectors* before you dismantle the machine, so you'll be able to reconnect everything the right way, first time, and avoid this sort of scare.

The first time through, it took about seven minutes to read the instructions, and about 20 minutes to swap the chips. The third time it took longer, because I was explaining everything to my curious 6-year-old as I went along. The third time, the swap took about 10 minutes. But remember: It is most definitely not a race. In the case of electronics work, your motto should always be: Don't Hurry, Be Happy. Hum that to yourself–it's a catchy tune.

Benchmarks

In addition to the performance benchmarks provided by Weitek (Figures 1, 2, 3), to give you a measure of how the upgrade might affect you, I ran two kinds of measurements. The first are traditional CPU-intensive measures, such as the well-known Dhrystone benchmarks. The second are less exact but in some ways useful; I measured the start-up time of some interactive X-based applications.

Figures 4 and 5 show my results from some traditional CPU-intensive benchmarks. Dhrystone is well-known in the computing community; it is a measure that tries to show an "average" mixture of high-level language instructions. I used the C-language Dhrystone 2.1, compiled with normal optimization (-O or -O4). While the results for SunOS 4.1 and Solaris 2.3 are quite different, pay attention only to their ratios between the Sun CPU and the Weitek CPU. Part of the OS-based difference is that I had two quite different compilers (gcc Version 1.39 on SunOS 4.1, gcc Version Cygnus-2.3.3 on Solaris 2.3), and the optimization may have been performed differently. In *all* cases, no recompilation was done; the same binary was run with both CPUs in place (well, one at a time). Of course, I recompiled between SunOS 4.1 and SunOS 5.3.

The test called "Test5" is a system-call timing tester; it simply measures the time needed to write a certain quantity of data to `/dev/null` in chunks of 512 bytes. I originally wrote it to measure system call efficiency (and note that SunOS 5.3 is within about 10% of SunOS 4.1.1 on this test). However, it shows a speedup of about 1.4 from the Sun IPX CPU to the Weitek Power µP on each system.

I also ran some of the tests on a Classic and a SPARCstation 10/30 running 5.2 and 4.1.3, respectively.

A word about the test results provided by Weitek: The vendor's results on Dhrystone 2.1 agree almost exactly with mine, so the others can be expected to be in line.

The "subjective" tests measure things that we do every day. For example, booting SunOS from a slow SCSI disk takes about the same length of time for either CPU, because most of the time the CPU is waiting for the disk. Similarly, starting a given configuration of OpenWindows shows an increase of only 15%. Does this mean that your overall performance will increase by only 15%? First, many of you will have faster SCSI and/or more RAM than I, so the system will be disk-bound much less. I don't have the resources to run timing tests on a large number of interactive X-based applications. Information provided by various vendors, and accumulated by Weitek, indicates that the average interactive application performance is increased by a factor of about 1.5. This information is available from Weitek.

In terms of reliability, no problem. I've used the Power µP in my IPX for several months, and it has been rock-solid.

Only SS2/IPX, You Say? Pity!

How can you get this upgrade for machines other than the SS2 or IPX? You can't, at least not from Weitek. It is unlikely they will make such a chip doubler for older machines such as the SS1 or IPC. But such an upgrade is surely too good for owners of these machines to pass by. Accordingly, the market (in the person of Pinnacle Data) has provided a solution: Owners of such machines can trade in their old CPU board for a nominal fee (in most cases, not a lot more than the retail cost of the chip from Weitek) and get back an upgraded board with the Weitek chip already in place, ready for installation back in your system. A colleague of mine upgraded an ELC this way. He says the board swap took only a few minutes and he's quite happy with the result. He thinks the performance increase is in line with what I've outlined here.

A Midlife Kicker

The Weitek Power µP is a good investment for the SS2 or IPX owner who wants a good low-cost "midlife kicker" upgrade. It boosts raw CPU power by a factor of two, with actual benchmark performance about 1.7. Although failure to follow directions can easily destroy the chip or your motherboard, it is easy to install if you follow the clearly written and illustrated directions. Alternatively, you can have a service shop install the upgrade for you. If you have another SPARC-1 class machine, you can get a motherboard swap from Pinnacle Data.

Motherboard Swaps

If you don't have the heart to rip out your own CPU or you want to extend the useful life of a SPARC 3/80, SPARCstation 1 or 1+, ELC, IPC or SLC, you can still get a Weitek perfor-

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mance boost by arranging to get a board swap from Pinnacle Data. You order a motherboard; move your memory and SBus cards to it when it arrives; install it; then send them your old board within five days. Prices range from $3,195 for a 3/80 or SPARCstation 1 to $3,495 for an IPC. Contact:

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Ian Darwin has been using SunOS since about 1985, and has used lots of other UNIX versions before and since. He would like to write his own operating system but is much too busy using existing ones in order to pay the bills. You can sometimes reach him via email at ian@sq.com.

ScreenPlay

by BARRY SHEIN,
Technical Editor

People have asked me from time to time: Is there any software package for Suns that can capture a session and replay it as a demo or training session? I didn't know of one until just now, ScreenPlay 2.0 from RAD Technologies Inc.

The idea of ScreenPlay is very simple. You pop up its control window, tell it to start recording what you will do on the screen and then stop it and save the session. The package also has a previewer and editor for finishing up the job. These are not just snapshots, they're entire interactions, sort of like recording something on videotape.

ScreenPlay also has the ability to merge audio with the captured video and to integrate all this with documents. So, as one example, you can prepare an on-screen help package that pops up a visual demonstration in response to a mouse-click in a document and even has voice-over or music, if you like.

The ScreenPlay editor lets you do handy things such as zoom portions of the captured interaction, take single-frame snapshots out for other uses (saved as a Sun Raster File), clip, touch up colors on the screen, etc. You can also use the editor to adjust the volume of the sound portion.

For those who worry about such things, ScreenPlay files are stored in Microsoft Corp.'s RIFF format. The Audio and Video uses the Microsoft AVI (Audio/Video Interleaved) format, which is compressed using RLE (Microsoft Run Length Encoding). Release 2.0 is available for Solaris 1 and 2 and supports playback on PCs running Windows or Apple Computer Inc. Macintoshes.

To integrate with text (e.g., as hyperlinks), suggestions are given for firing up the playback program from a FrameMaker hypertext document. It's really rather simple: You just fire up ScreenPlay's command-line interface on a saved interactive session. Although very simple, it's a nice idea.

The software was easy to install. Pull it off the CD and install. It's even easier to use. The control panels are mostly extended versions of familiar VCR control panels. Forward, reverse, step frame, stop and so forth. The good news is that you won't have to figure out how to set the time, and it won't flash 12:00 at you (unless you want it to). It's really very simple to use. You barely need the manual except to get an overall idea of what the software is capable of doing and some hints about preparing slide shows and other ideas.

The manual is short and to the point. As I said, there's not a lot to explain here; the software is doing all the hard work. All you are doing is mostly telling ScreenPlay where to start and stop, and a little on-screen editing.

Overall I'd say this nifty little package performs a useful, easily recognized task. RAD can even send you a demo if you like, but I suspect you get the picture.

ScreenPlay 2.0

Company
RAD Technologies Inc.

Address
2639 Terminal Blvd.
Mountain View, CA 94043-9984

Phone
(415) 968-4800

Email
info@rad.com

Best Feature
An easy-to-use package that does a useful task well.

Worst Feature
This is primarily a Sun limitation, but audio does not work when viewing a session on a remote workstation.

Price
$1,295 per license

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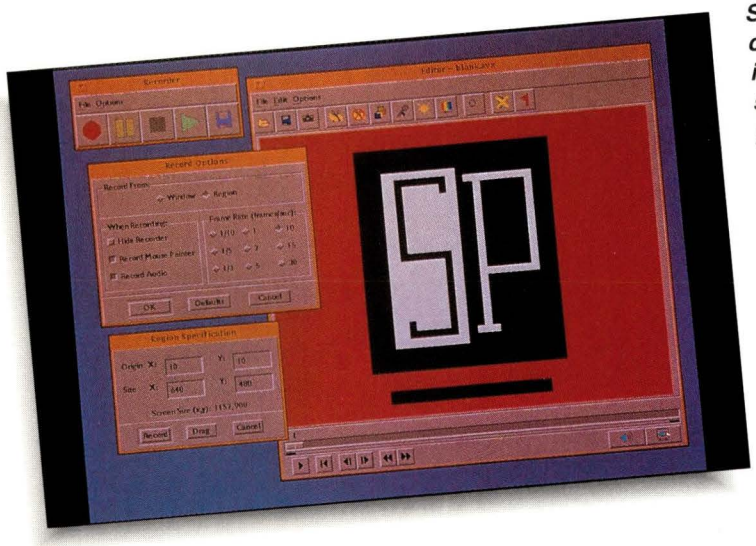
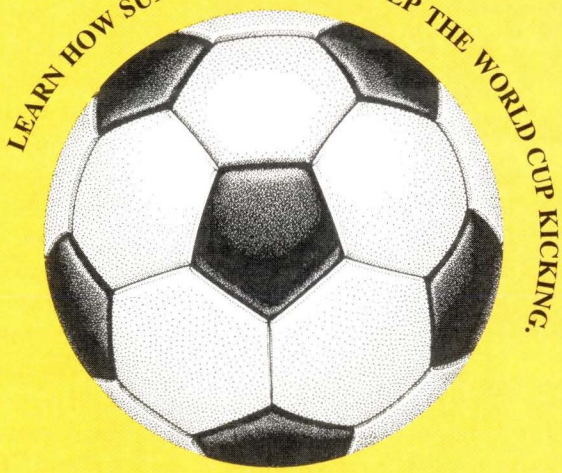
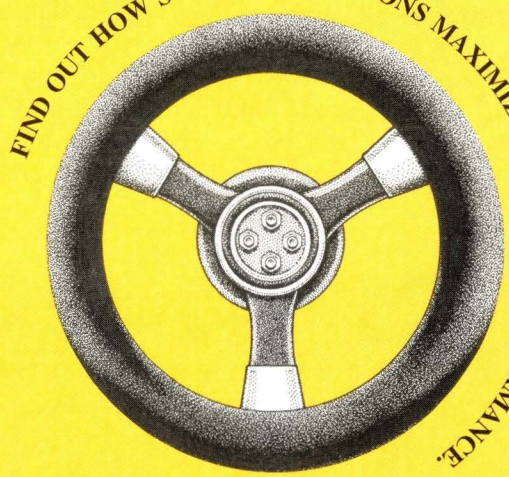
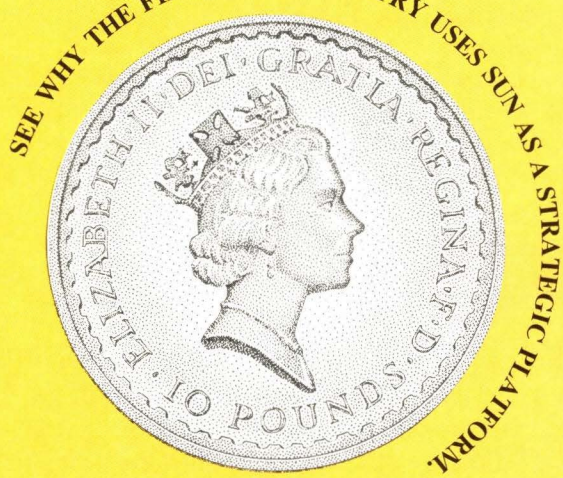


ScreenPlay captures interactive sessions for playback on UNIX systems, PCs and Macintoshes.







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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.

SNA to TCP/IP

Interlink Computer Sciences has released a set of software products that allow TCP/IP networks to link transparently with mainframe resources. The products implement TCP/IP as a native facility on IBM mainframes (and plug-compatibles) running MVS. Thus, SNA-oriented machines can have a role on TCP/IP networks. (Long-time observers of the industry will remember that not long ago, most analysts and pundits said that UNIX machines should instead become SNA nodes. This alone says much about the changed nature of computing.)

The Interlink suite consists of several different products. The core service is SNS/TCPaccess 2.0, which resides on the mainframe and provides fundamental TCP/IP communications services between MVS and other systems. Then there is Enterprise Print Services 2.0, which delivers bidirectional access to printers across SNA and TCP/IP environments. SNS/NFS, finally, is an implementation of the Sun Network File System and allows NFS clients to use MVS data sets as if they were local file systems.

Pricing on the products is dependent on the nature of the machine running them. However, prices range from $18,000 to $62,000 for SNS/TCPaccess 2.0; $10,000 to $30,000 for Enterprise Print Services 2.0; and $6,000 to $21,000 for SNFS/NFS 2.0.

Interlink Computer Sciences Inc.
47370 Fremont Blvd.
Fremont, CA 94538
Circle 101

SailFrog Ships FrogFax 2.0

SailFrog Software has announced Version 2.0 of FrogFax, a complete fax product for the Sun environment.

Because it is integrated into the OpenWindows environment, FrogFax supports drag-and-drop for files and raw text.

Other features include support for Class 1 and Class 2 fax modems; support for PostScript, Sun raster, ASCII and TIFF Class F files; a modular architecture, which allows users to add their own filters to support other file

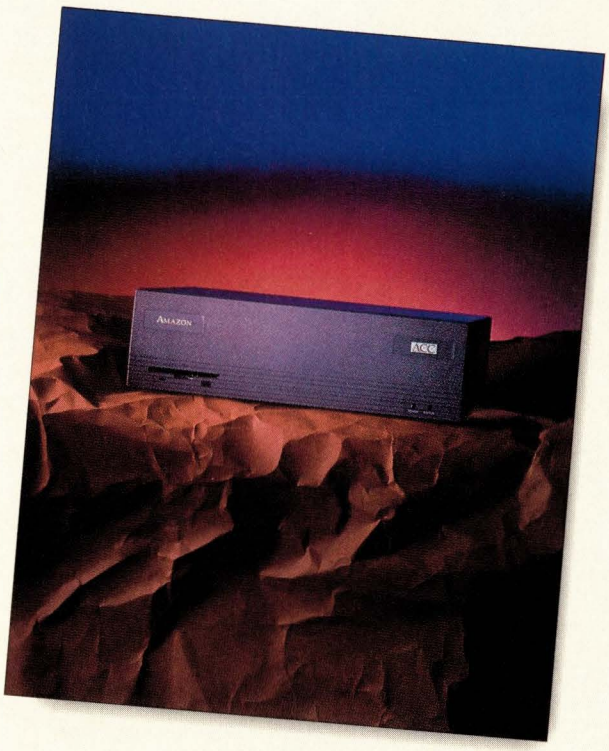
ACC Shows Amazon

A high-performance bridge/router that supports both wide- and local-area connections through plug-in interface modules has been introduced by ACC. Called Amazon (the company names its products after rivers), the bridge/router supports up to five LAN and up to 18 WAN connections and can be tailored to fit different network configurations using field-installable interface modules.

The product's main board has two Ethernet ports into which LAN interface modules might fit and support either 10BaseT, 10Base2 or 10Base5. Amazon's backplane, meanwhile, can support three more LAN or WAN interface cards so that users can mix and match connections, e.g., two Ethernet ports and 18 WANs, or two Ethernet, two token-ring and six WAN ports.

The product features ACC's existing Bandwidth Optimization technology, which reduces WAN costs via a data-compression scheme. In addition, it supports a variety of communication protocols and standards, including: PPP, frame relay, ISDN, X.25, HDLC/LAPB and SMDS. It also supports such routing protocols as TCP/IP with OSPF, RIP and EGP; Novell IPX with RIP/SAP; DECnet Phase IV; AppleTalk Phases I and II, and XNS.

Amazon contains a Motorola Inc. 33-MHz 68040. It also comes with 4 MB of DRAM, expandable to



10 MB. Amazon's prices begin at $7,500 for a two-Ethernet configuration. Interface modules range in price from $570 to $4,000.

Advanced Computer Communications
10261 Bubb Road
Cupertino, CA 95014
Circle 100

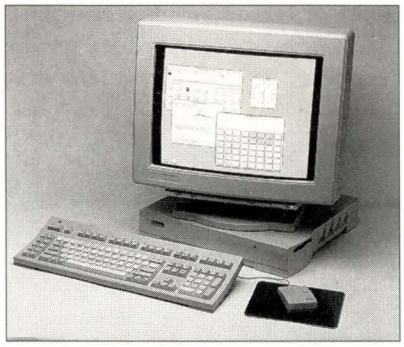
formats; integral phone book for storing frequently called numbers; a comprehensive command-line interface; email notification for incoming faxes; fax scheduling with automatic retry; and customized cover sheets. It also allows users to archive frequently sent faxes.

FrogFax is available for evaluation or purchase directly from SailFrog Software, or through anonymous FTP from `sailfrog.com` in the directory `pub/sailfrog/frogfax`. FrogFax is $495 for a single floating license; four floating licenses are $595; eight floating licenses are $695. A life-time money-back guarantee is offered.

SailFrog Software Inc.
20863 Stevens Creek Blvd., Suite 200
Cupertino, CA 95014
Circle 102

EOS Shows SPARCalike, Board

EOS Technologies has introduced a SPARCalike with two Texas Instruments Inc. 40-MHz SuperSPARC CPUs. In a standard configuration, the



EOSstation comes with 32 MB of DRAM, expandable to 512 MB. The system also has a standard disk of 1.05 GB, expandable to 2.1 GB, or up to 41 GB with external drives. The company offers monitors in several sizes and resolutions ranging from a low-end 15-inch color display to a high-end 20-inch multisync color display.

The product has two MBus slots, four SBus slots, two serial ports, one parallel port and 16-bit audio capability. It also supports AUI Ethernet, twisted-pair Ethernet or ISDN. Pricing begins at $16,650.

EOS has also introduced a board-level version of the same architecture. The EOS/10402/402 module is a dual SuperSPARC device with which users can convert existing workstations into multiprocessor devices. Contact company for pricing.

EOS Technologies Inc.
41 East Daggett Drive
San Jose, CA 95134
Circle 103

S-Plus for UNIX

MathSoft's StatSci division has released S-Plus Version 3.2 for UNIX. S-Plus is an interactive data analysis and programming environment for scientific and technical applications. It is used in such applications as data analysis, statistical modeling, graphical exploration and visualization, and mathematical computing.

While the product has been available on several platforms before, the new version for UNIX has several upgrades. These include new statistical functions–such as multivariate statistical

methods, cross tab analysis functions, general linear models and a new debugger. The product is currently available for $2,800 per user license on Sun SPARC SunOS 4.x, Sun SPARC Solaris 2.x (a k a SunOS 5.x) and several other UNIX environments, including the RS/6000.

MathSoft Inc.
StatSci Division
1700 Westlake Ave. N, Suite 500
Seattle, WA 98109-9891
Circle 104

Remote X Terminal

GraphOn has announced the 14S X terminal, designed for remote use. The product supports the Windowing Interface Exchange (WIX) Standard

set by the WIX Association for serial line X. The WIX standard is based largely on technology developed by GraphOn.

The 14S has a flat 14-inch CRT with an 800-by-600 window in a virtual bit-map display of 1,280 by 1,280. The refresh rate is 78 Hz, with overscan. The product has a built-in VT100/220, Wyse 60 and PCTerm emulations. There is also a three-button mouse. Pricing begins at $695.

GraphOn Corp.
544 Division St.
Campbell, CA 95008
Circle 105

BBN Talks Language

BBN Software Products has announced the BBN/Cornerstone Extension Language (CEL), a development environment that lets programmers and end users customize BBN's Cornerstone data-analysis software for specific needs. CEL is composed of an object-oriented programming language and a suite of development tools. The programming language is said to be based on C++, but with assorted shortcuts and fire-breaks to shelter users from C++'s complexities.

The tool suite, meanwhile, includes a GUI builder that allows developers to alter the look and feel of BBN/Cornerstone. There is also an object browser for point-and-click access to on-line information about object classes.

CEL is available as a separately priced option to BBN/Cornerstone analysis software. Pricing for CEL begins at $995 for a fixed license and $1,995 for a floating license.

BBN Software Products Corp.
150 Cambridge Park Drive
Cambridge, MA 02140
Circle 106

Ptech Version 3.3

Ptech has announced Version 3.3 of its Ptech tool set. The product is a business-process design tool with which business professionals can model their enterprise and discover areas within it that might be improved. Moreover, Ptech is also (though not exclusively) a CASE tool for object-oriented programming. With it, the various business processes it represents might be dropped ultimately to code and automated.

The new version has several new features including a concurrent multiuser database, what the company calls a "knowledge base," of business processes and features multiple users can access. Ptech now also supports popular relational databases via an SQL facility. And, finally, the product now has a facility to import and export business models between different users. Pricing begins at $7,000 for a single-user system.

Ptech Inc.
2 Westborough Business Park
Westboro, MA 01581-3199
Circle 107

Borland Ships dBASE for UNIX

A new version of dBASE, the popular personal database tool, is now available for Sun workstations. Borland has announced that dBASE IV Version 2.0 for UNIX, which is fully compatible with dBASE IV Version 2.0 for DOS, has been released for Solaris on the SPARC and on the X86. dBASE's users can now port their dBASE applications to Sun workstations.

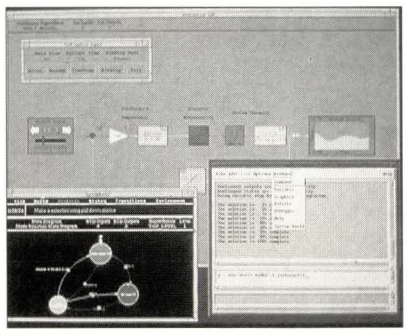
Version 2.0 offers a number of new features. These include mouse support, high-performance filters for queries and 60 new language enhancements. The product can support up to 40 database work areas and up to one billion records per table.

Pricing on the product begins at $795 for a single-user license, with additional user licenses at $495 apiece. Customers can get a five-user terminal license for $995. Registered owners of dBASE IV for UNIX Version 1.1 can upgrade to the new version for $199.95 for a single-user license and $749 for a five-user terminal license.

Borland International Inc.
100 Borland Way
P.O. Box 660001
Scotts Valley, CA 95067-0001
Circle 108

Documentation Tool for Embedded Systems

Integrated Systems has announced AutoDoc, an automatic documentation generator for embedded systems developers. The product, which ships



bundled with the company's Matrix line of development tools, extracts information from block diagrams of the program and outputs it into a number of documentation formats. Among these are the federal government's MIL-STD-2167A. AutoDoc is also compatible with FrameMaker and InterLeaf electronic-publishing software.

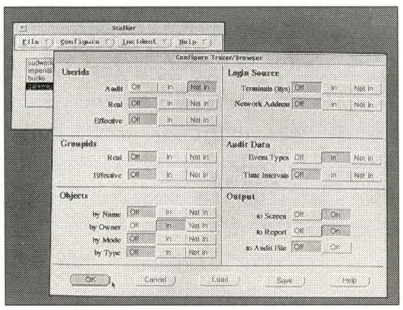
Other components of the Matrix product line include the Xmath math analysis package, the SystemBuild modeling and simulation tool, the AutoCode automatic source code generator and the AC-100 prototyping

tools. Pricing on Matrix 4.0, with AutoDoc, begins at $2,495.

Integrated Systems Inc.
3260 Jay St.
Santa Clara, CA 95054-3309
Circle 109

Stalker Security

The name may sound like the beginning of a horror movie, but Stalker from Haystack Labs is meant to make you feel more, not less, at ease. Stalker



is security and accountability software for detecting system misuse, intrusions and abuse. The company says it is meant to provide a record of who did what and when, by what means, on a system.

Stalker comes in three parts. The Tracer/Browser filters audit data to let the user focus on specific incidents. Then, there is a Misuse Detector that uses a database of typical system assaults to identify attacks or misuses of the system. The Detector can also run as a background process and report its findings to an administrator by email. Finally, the last part of Stalker is an Audit Control facility.

Stalker runs on SPARC workstations under SunOS 4.1.x and Solaris 2.1 using Open Look. It works with either operating system using Sun's Basic Security Module. Pricing begins at $15,500.

Haystack Labs Inc.
8920 Business Park Drive
Austin, TX 78759
Circle 110

SPARC on VME

A VME board that incorporates multiple SuperSPARC processors has been introduced by General Micro Systems. The V64-SS is a Eurocard VME board split into two separate processor-board sections–as an accelerator, or preprocessing, section that handles incoming data at speeds up to 200 MB/s, and a main section for actual processing. The V64-SS in its standard configuration might support two SuperSPARCs and an Intel Corp. i860 coprocessor. This would yield a device capable of 240 MIPS and 140 MFLOPS.

The V64-SS can support up to six SPARC processors, using the Cypress Semiconductor Inc. dual SPARC processor design. The board can make use of other chip architectures as well. In addition to the SPARC and i860 versions, the company says it has a Motorola Inc. 68040 version and that IBM Corp. PowerPC and Intel Pentium versions are planned as well. Pricing begins at $7,590.

General Micro Systems Inc.
8358 Maple Place
Rancho Cucamonga, CA 91730
Circle 111

Unidirectional Microphone

SMCC has introduced a microphone, SunMicrophone II, to ship with current and new Sun desktop platforms.

The SunMicrophone II is a unidirectional microphone that allows direct voice input with reduced interference from background ambient noise. It will be available as an option on the SPARCclassic, SPARCstation LX and SPARCstation 10s, and separately through SunExpress.

The product is not compatible with the following: SPARCstation 1, SPARCstation 1+, SPARCstation 2, SPARCstation IPX, SPARCstation IPC, SPARCstation ELC, SPARCstation SLC systems and SPARCclassic X X-terminal (compatible with SPARCclassic X upgrade).

The SunMicrophone requires the Sun audio cable to work, which can be ordered through SMCC as a spare or through SunExpress. Pricing begins at $20; the audio cable, at $35.

Sun Microsystems Computer Corp.
2550 Garcia Ave.
Mountain View, CA 94043
Circle 112

SBus Frame Buffer

Integrix has introduced a new frame buffer for the SBus. The S20VGA is a single-slot SBus device with Video Electronic Standard Association (VESA)-compliant timing. The company says the product is also Sun VGA register-compatible and that it will support any PC VGA monitor on the market.

The S20VGA's monitor timing allows VGA PC monitors to operate at workstation resolutions of 640 by 480, with a refresh rate of 60 Hz. The product will attach to LCD flat-panel monitors via a standard DB15 connector. The S20VGA can display 256 colors from a palette of 16.7 million. Pricing begins at $395.

Integrix Inc.
1200 Lawrence Drive, Suite 150
Newbury Park, CA 91320-1316
Circle 113

International Versions of Solaris 2.3 Available

SMCC has announced the availability of international versions of the Solaris 2.3 operating environment for SPARC systems. The international versions of Solaris 2.3 consist of localized SunOS 5.3, ONC+ and localized OpenWindows V3.3, which includes localized DeskSet productivity applications.

A variety of languages are currently available including Japanese, Korean, Italian and Dutch. Sun says this provides a number of benefits, not least among them that multinational corporations can more easily standardize on

Upgrades, Enhancements, Additions...

• Communications vendor 3Com has enhanced its chassis product, the LinkBuilder MSH, with an FDDI concentrator, an Ethernet-FDDI LAN switch and a token-ring module. The company says the FDDI concentrator and switch will bring FDDI's 100 Mb/s to the desktop. **3Com Corp.**, 5400 Bayfront Plaza, P.O. Box 58145, Santa Clara, CA 95052-8145. **Circle 114**

• Release 3.0 of Z-Mail has been announced. The email package from Z-Code now supports the Multipurpose Internet Mail Extensions (MIME) standard for multipart attachments in email messages and the Post Office Protocol (POP3). It also supports Motif. **Z-Code Software Corp.**, 4340 Redwood Highway, Suite B-50, San Rafael, CA 94903. **Circle 115**

• The SuperNova 4GL application development environment and the 4S-Report report writer from Four Seasons Software are now available on Solaris 2 for both SPARC and X86. **Four Seasons Software**, 2025 Lincoln Highway, Edison, NJ 08817. **Circle 116**

• ECCS has enhanced its RAID Module FFT-1. The new version uses Fast SCSI-2 and 2.1-GB disk drives. **ECCS Inc.**, 1 Sheila Drive, Building 6A, Tinton Falls, NJ 07724. **Circle 117**

• In yet another move to the Intel Corp. version of Sun's operating system, Elan Computer Group has ported its Elan License Manager to Solaris X86. The product is a software licensing tool kit for application developers that controls multiuser access to programs in a network. **Elan Computer Group Inc.**, 888 View St., 3rd Floor, Mountain View, CA 94041. **Circle 118**

• The Opti/Max jukeboxes from Unison Information Systems have been upgraded. The optical disk systems now have access times of 5.1 msec and a storage range of 10.4 to 200 GB. **Unison Information Systems Ltd.**, 21 Walsh Way, Framingham, MA 01701. **Circle 119**

• A new version of the HeliosCom+ internal SBus fax modem has been announced by Helios Systems. Release 2.0 of the product features multiuser network support. **Helios Systems**, 1996 Lundy Ave., San Jose, CA 95131. **Circle 120**

• Tatung has two new add-on graphics options for its SPARCalikes. The Turbo GX and Turbo GX+ cards can perform in excess of one million 2D vectors per second and 440,000 3D vectors per second. **Tatung Science & Technology Inc.**, 1840 McCarthy Blvd., Milpitas, CA 95035. **Circle 121**

• MathSoft has introduced not one but two new versions of its MathCAD product. Saying that it wants to address different user levels, the company has divided its math software into MathCAD 5.0, which stresses ease of use, and MathCAD Plus 5.0, which features advanced math functions. **MathSoft Inc.**, 101 Main St., Cambridge, MA 02142-1521. **Circle 122**

• Gemstone, the object-oriented database from Servio, has been enhanced with improved C++ support, as well as with new CASE facilities. Servio has announced relationships with ProtoSoft Inc., of Houston, for that company's analysis and design software, and with CenterLine Software Inc., of Cambridge, MA, for development facilities. **Servio Corp.**, 2085 Hamilton Ave., Suite 200, San Jose, CA 95125. **Circle 123**

an operating environment that crosses national boundaries. Pricing, to upgrade from Solaris 1.x to the international version of Solaris 2, begins at $425.

Sun Microsystems Computer Corp.
2550 Garcia Ave.
Mountain View, CA 94043
Circle 124

System Analysis and Performance Tool

A new product called ASAP (Andataco System Analysis Program) gathers system performance statistics collected during the daily operation of any workstation. In addition to recording and displaying system performance data, ASAP includes an analysis module to help systems administrators identify system bottlenecks. According to the company, ASAP recommends hardware or software solutions to tune system performance.

GUI-based ASAP helps administrators determine the efficiency and CPU utilization of workstations on a network by recording and presenting daily information about disk utilization, load average, NFS activity, as well as swapping, paging and memory usage. ASAP has a list price of $495.

Andataco
10140 Mesa Rim Road
San Diego, CA 92121
Circle 125

Incognito Engine

Coprocessor vendor Opus Systems has introduced a PC-board based on the microSPARC II. The company says this gives the common PC the ability to act like a workstation. The company, which has sold such add-in boards based on a variety of processors, says the product's main customer will be the user or remarketer who needs to bring one or two specific Sun applications to a desktop that is otherwise well-served by a DOS system.

Called the InBoardEngine/MS2, the product is part of the company's Incognito line. Incognito consists of both hardware, such as the Inboard Engine, and a suite of software that makes it possible for a PC to support a UNIX environment within a Windows- or DOS-oriented display.

The new board runs at 70 MHz, which the company says is a 60% boost in performance over its microSPARC-based device. It also has an improved AT bus interface that supports throughput between the PC and the board at up to 2 MB/s. It supports Solaris 1.1.1 and 2.3 and comes with up to 128 MB of memory. Pricing begins at $4,995.

Opus Systems
3000 Coronado Drive
Santa Clara, CA 95054
Circle 126

Custom Cables

Next-day turnaround and free UPS ground shipment for small orders has been announced by Custom Computer Cables. Every cable Custom fabricates is visually and electronically inspected, and the engineering staff draws on documentation for thousands of computer systems and types of communications gear to build cables for unique installations and interfaces. Among the varieties of connectors Custom provides are token-ring, 10BaseT, Ethernet, RS-232, SCSI, Telco and V.35. According to

the company, prices are competitive with off-shore suppliers.

Custom Computer Cables Inc.
1607 Capital Ave.
Plano, TX 75074
Circle 127

Sun Introduces 4mm Tape Auto Loader

SMMC has introduced a 20-GB Tape Auto Loader. It can be either a stand-alone, desktop unit, an internal option for the SPARCcenter 2000 system, or a version meant for an expansion chassis. The system cabinet can accommodate up to three auto loaders, providing up to 60 GB of backup capacity internal to the system. The expansion rack tray can house up to four auto loaders that provide up to 80 GB of backup capacity in a single tape tray.

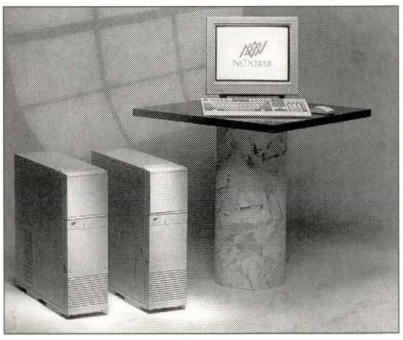
The 4mm tape drive has built-in data compression that automatically and transparently compresses data sent by the host system to the device. In native or noncompressed mode, this drive can store up to 2 GB on a standard 90-meter 4mm tape, or 8 GB per stacker cartridge. The drive also features a data transfer rate of 366 KB/s. With data compression, customers can get two to four times the native capacity on a single piece of 4mm media. Typical user data compresses at a ratio of 2.5:1, the data transfer rate of the drive scales with the compression ratio. With a compression ratio of 2.5:1, the new auto loader will provide 20 GB of storage.

Pricing begins at $5,000 for the internal backup version. The desktop is $5,100. The Data Center Tray version is $6,000.

Sun Microsystems Computer Corp.
2550 Garcia Ave.
Mountain View, CA 94043
Circle 128

RISC-based NT Systems

A line of workstation-like machines and servers that are based on the MIPS processor and run Microsoft Corp.'s personal computer operating system, NT, have been introduced by NeTpower. There are two servers, the first being the NeTpower Server 200, which can support up to two R4400 150-MHz processor modules. The 200 comes with 1 MB of cache per CPU, 5 GB of RAM and a 14-inch monitor. Pricing begins at $28,160.



The second server is the smaller, single-processor NeTpower 1000. It comes with a 133-MHz R440, 128 KB of cache, 32 MB of RAM and a 14-inch monitor. Pricing begins at $8,370.

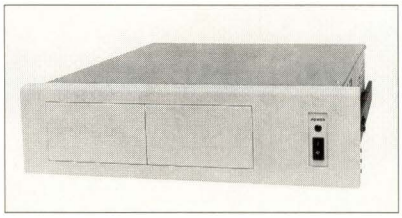
The company also showed two workstations. These are the NeTstation 100 and 300. The 100 comes with R4400-100, 128 KB of secondary cache, a base memory of 32 MB, 525 MB of disk, a 17-inch color monitor with 1,024-by-768-by-8 resolution, and an Ethernet port. The 300, meanwhile, is based on a R4400-150 and has the features of the

100 plus a 21-inch color monitor with a resolution of 1,280 by 1,024 by 24. The 100 is $7,200; the 300 is $12,795.

NeTpower Inc.
1080 E. Arques Ave.
Sunnyvale, CA 94086-4621
Circle 129

Rack-Mount Enclosure

Sigma Information Systems has announced a rack-mount enclosure that can support a SPARCstation 10 motherboard and up to four half-



height 5¼-inch or 3½-inch drives. The SA-H316 comes with internal data and power cables, a rear I/O panel and three fans. It also has its own 200-watt switching regulated power supply. The chassis is 5¼ inches high, 19 inches wide and 20 inches deep. Pricing begins at $1,052.

Sigma Information Systems
5775 Polaris Ave.
Las Vegas, NV 89118
Circle 130

Phase X Shows More X

Phase X Systems has introduced a new line of X terminals. Based on a MIPS processor, the terminals have a performance rating of over 100,000 Xstones. In addition, they have a minimum memory of 4 MB (expandable to 52 MB) and can support up to 2 MB of PROM as well as up to 2 MB of Flash ROM.

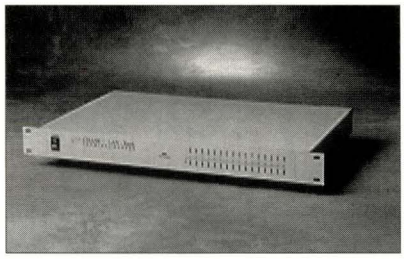
There are several models in the line. They include the PX17CE1, which has a 17-inch, 1,024-by-768-resolution color display and a price of $2,495. The PX17CE2 has a 17-inch color 1,280-by-1,024 display for $2,995. The PX19CE2 is a 19-inch 1,280-by-1,024 system for $3,395. There is also a 20-inch model for $3,495, which comes in two flavors: the PX20CE2T, which uses a Trinitron display, and the PX20CE2I, which uses Invar Shadow Mask Technology.

The new models feature one serial and one parallel port. They have direct thin, thick and twisted-pair cable connectors.

Phase X Systems
19545 NW Von Neumann Drive
Suite 210-1
Beaverton, OR 97006
Circle 131

Rack-Mount Communications Server

A rack-mount terminal and communications server has been introduced by Chase Research. The Iorack provides eight to 16 RJ45 asynchronous



ports for connecting modems, terminals, printers or data-acquisition devices to TCP/IP networks.

Each port is individually monitored and provides baud rates of up to 115.2 KB/s. Iorack also features BNC/AUI connections, SNMP, SLIP, `telnet`, `rlogin` and `tftp`. Pricing begins at $2,495.

Chase Research Inc.
545 Marriott Drive, Suite 100
Nashville, TN 37214
Circle 132

SunFastEthernet Adapter

A 100-Mb/s fast Ethernet adapter has been introduced by Sun. It is meant for current Ethernet users who want to move up from traditional Ethernet 10-Mb/s speeds, but who are not ready for the mysteries and cost of more exotic solutions, such as ATM.

The product, called SunFastEthernet, uses the core Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol of the existing Ethernet standard (IEEE 802.3). The company says this allows customers to preserve their investment in network infrastructure, application base and expertise.

The SunFastEthernet adapter features auto-sensing of 10-Mb/s or 100-Mb/s speeds, allowing users to run their applications at the speed of the network connection, totally transparently. The adapter conforms to the interoperability specifications defined by the Fast Ethernet Alliance. As a result, the SunFastEthernet adapter will work with all switch/hub products conforming to these specifications from the other members of the alliance, including Grand Junction Networks, 3Com Corp., SynOptics Communications and several others. Pricing begins at $795.

Sun Microsystems Inc.
2550 Garcia Ave.
Mountain View, CA 94043
Circle 133

SunTutor

SunService has introduced the latest addition to its SunTutor line of interactive learning products: Solaris 2.x System Administration. This method allows users to learn a range of system administration skills at their own pace and then serves as an ongoing reference tool on the desktop. The product teaches by fully engaging the student with practice exercises and providing feedback on the user's performance. A progress map shows students what they've accomplished and allows them to pick up easily where they've left off.

The package is CD-based and designed to support the Solaris Certification testing program offered by SunService. Volume One provides instruction on topics including installation and backups, and Volume Two offers courses on user accounts and security. It is priced at $495 for Volume One and $695 for Volume Two.

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Correction

Regarding the February issue of *SunExpert* ("BOPS and Beyond"), Peter Harris is the founder and CEO of The Bristol Group Ltd., 100 Larkspur Landing, Suite 200, Larkspur, CA 94939, not Bristol Technology Inc. *SunExpert* regrets the error.

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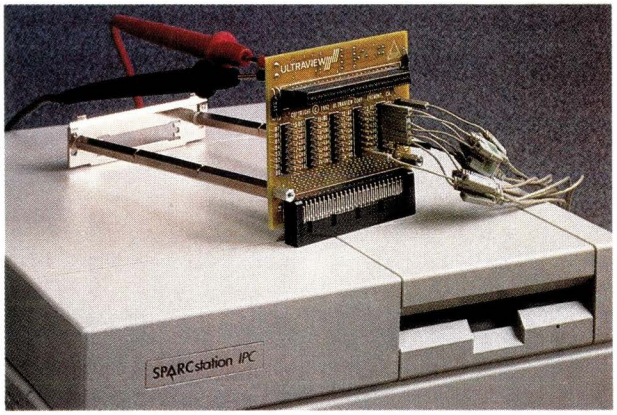

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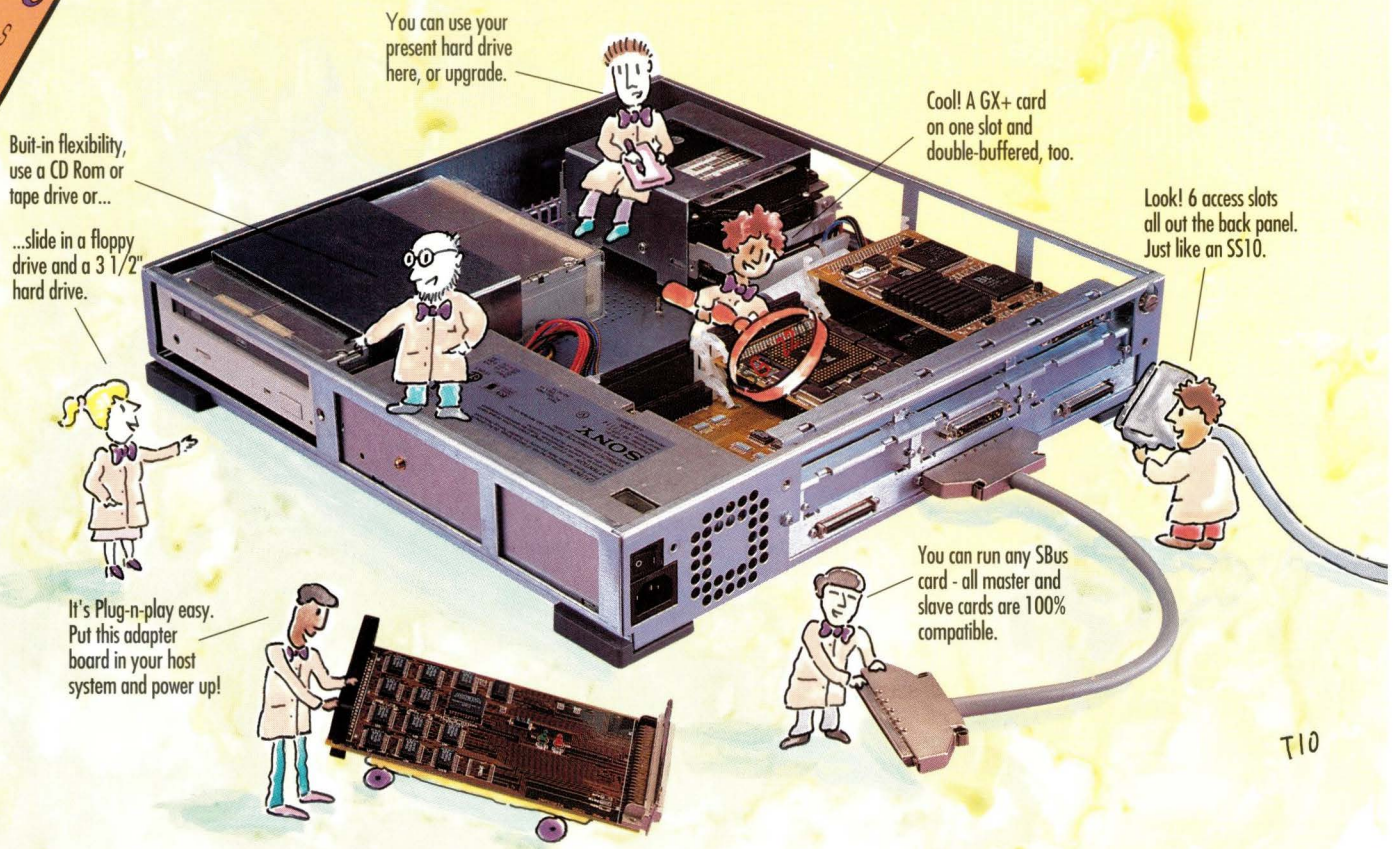

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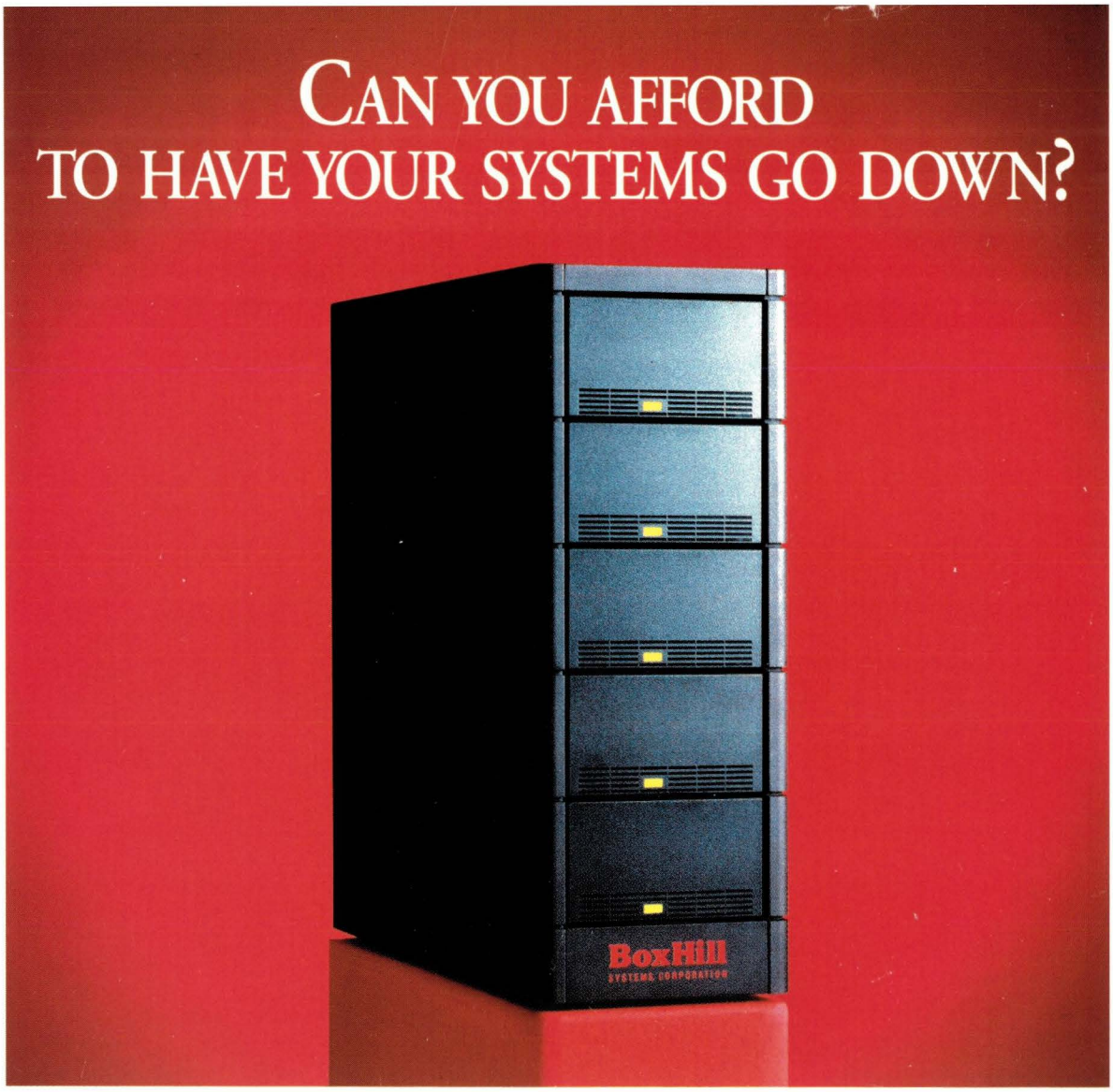

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