

SUN EXPERT

An Independent Forum for Open Systems

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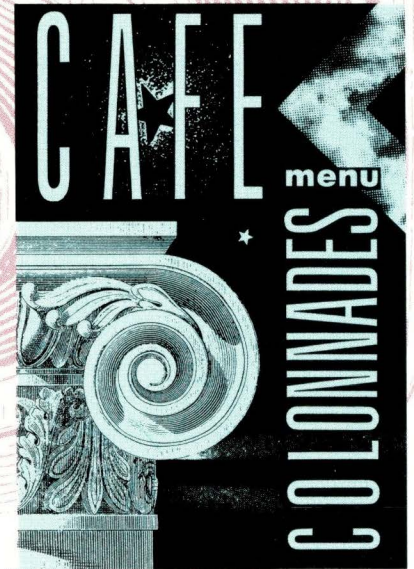
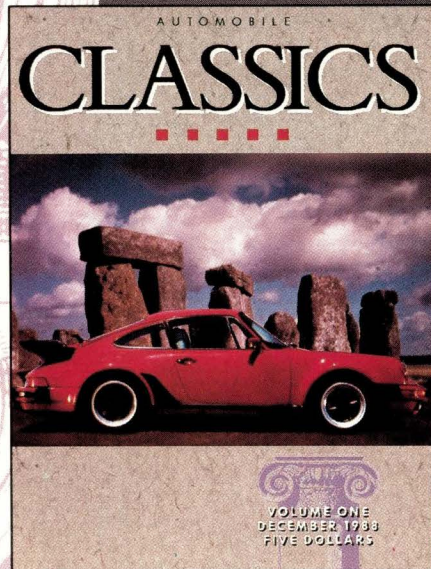
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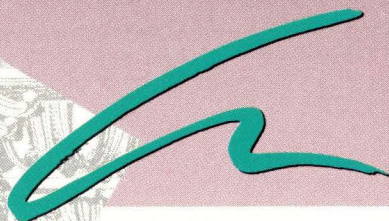
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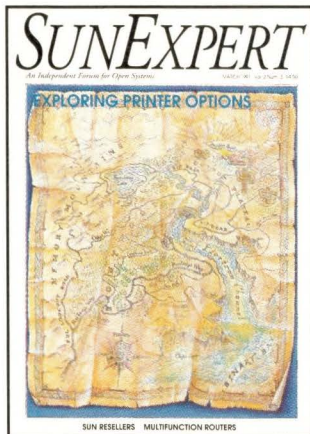
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Sun-compatible
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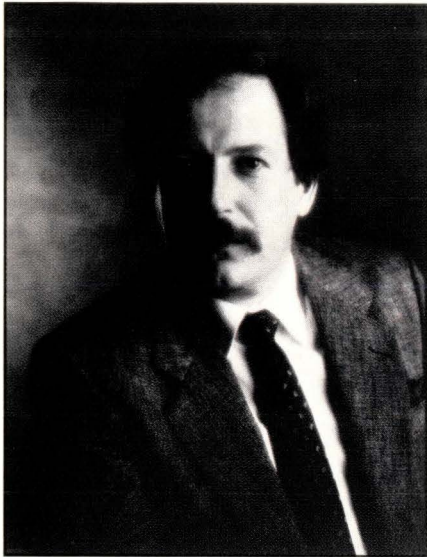
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Editorial

Exploration

From the deep blue sea to the currents of the reseller channel, this month's leitmotif (forgive the expression) is exploration. Mr. Protocol explores the communications systems and capabilities of the world's deepest UNIX system, the *Alvin* submersible, owned and operated by the Woods Hole Oceanographic Institution. His column was submitted from the seven-foot sphere over some crackling communications lines. Well, that's the explanation he gave us for the sound effects.

Although Sun Microsystems Inc. gets high marks for its effort in the technical reseller channel, it's living off the demand for its hot systems, not its ability to handle indirect sales issues. Sun is learning how to create and nurture relationships with the reseller breed in order to spur the volumes of traffic it will take to put a SPARC on every desktop. And for those of us who have to buy Sun equipment, we should benefit from higher availability and discount competition—we can hope. For an in-depth look at how you may be buying workstations in the future from the reseller market, take a look at this month's special report, "Everything you wanted to know but were afraid to ask about...Resellers."

Our product survey this month, "Exploring Printer Options," examines the new and innovative printing model offered in Sun's NeWSprint products. The article also includes a listing of about 50 companies in the page-printer market. Check them out and let us know if we missed any.

Doug Pryor

Doug Pryor

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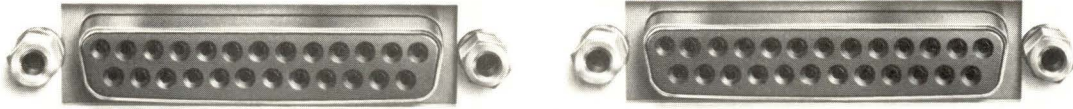
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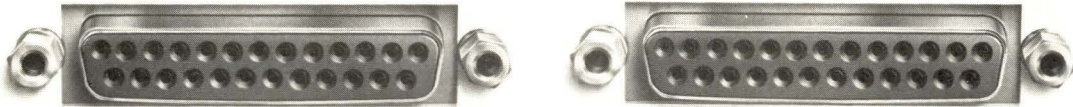
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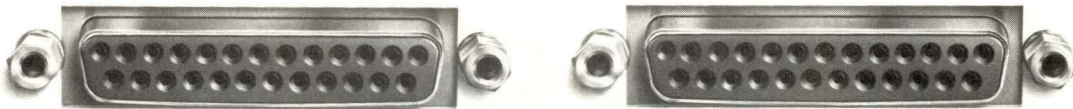
This is your current SPARCstation SCSI port.



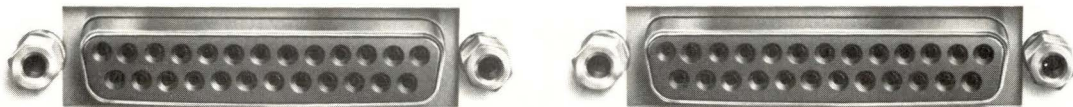
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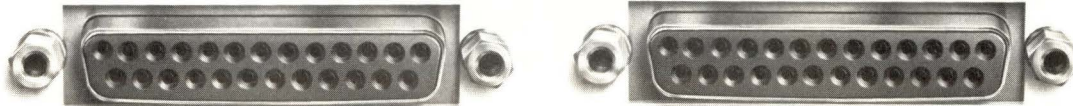
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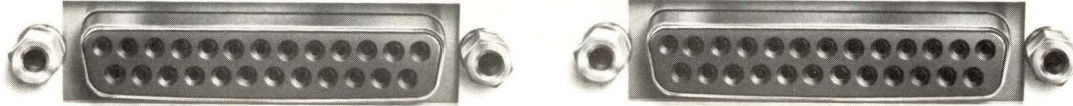
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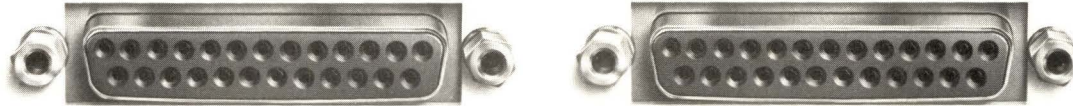
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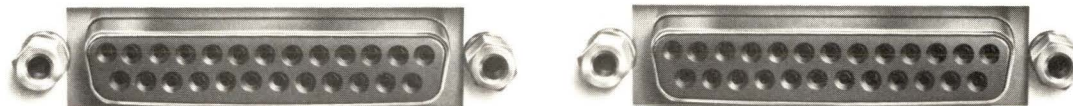
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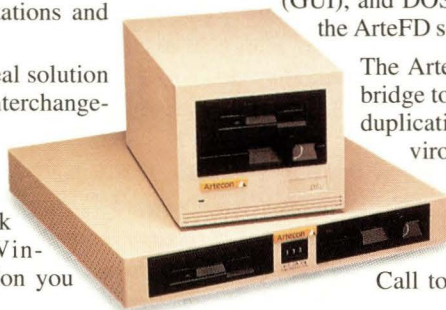
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An Escape Hatch

Dear Peter Collinson:

The escape sequences (*SunExpert*, November 1990, Page 29) to set the title bar also set the icon label. Is there a way to disassociate the two, so that the icon label can keep, say, the hostname only?

Gabor Melli
Simon Fraser University
British Columbia, Canada
melli@cs.sfu.ca

Mr. Collinson replies: Yes... Remember the sequence to set the icon name and title to a new value is `^[]0;string^G` where `^[` is really escape and `^G` is Control-G. To set the icon name only, replace the zero above by 1. To set the title bar only, replace the zero above by 2.

Loop the Loop

Dear Peter Collinson:

I was reading your column, "Shell Prompts" (*SunExpert*, November 1990, Page 29), with some interest since I'm always looking to improve my mastery of all the weird and (generally) wonderful trickery that is UNIX. I haven't gone through the entire article yet but one statement you made caught my eye; you say it is "not possible to alias `cd` to itself otherwise dreadful continuous looping takes place." I question this statement, but only because I've had `cd` successfully aliased to itself for quite a while now.

```
alias cd "cd \!* ; set \
prompt=' $cwd\ ' "\!\""
```

I am not writing to beat you up over this point; rather I'm curious as to whether I've been doing something harmful that hasn't yet bitten me in the tuchus.

Thanks for the control chars for putting a string in the title bar of a window. I have wanted that information for quite some

time but not badly enough to go look for it!

Sue Miller
smiller@raynet.com

Mr. Collinson replies: My comment about looping shells was based on bitter experience rather than manual reading. Sun's csh manual says about aliases: "Except for the first word, the name of the alias may not appear in its definition, nor in any alias referred to by its definition. Such loops are detected, and cause an error message." So, your example is OK because the first word is `cd`. In my example, the `cd` would appear somewhere in the middle of the string and so would loop. I should have read the manual, sorry.

Simplify, Simplify

Dear Peter Collinson:

I modified your `csh` prompt (*SunExpert*, November 1990, Page 29) as follows. The prompt format very roughly follows an IP format, with fields separated by periods, and fields descending in order from left to right. Also, the `pr_s` environment variable can be dropped.

```
if ($?prompt) then
  alias prmt_s 'set prompt="\
  `hostname`.$cwd:t% "`
  alias cd 'chdir \!*;prmt_s'
  prmt_s]
endif
```

Chuck Herrick
cnh5730@calvin.tamu.edu

Mr. Collinson replies: Thanks for making it a little simpler. My actual one copes with the need to become super-user from time to time and so is a little more complicated than the one that I published.

A Question of Motif

Dear Editor:

I was alternately amused and appalled by Mary Jo Foley's news brief titled "Sun and Motif: It's

Only a Matter of Time" in your January 1991 issue. I was astounded by the gross inaccuracy in this article, and hope you will permit me to set the record straight regarding the ongoing OPEN LOOK/Motif GUI war.

Your editors should know that your GUI survey, which revealed that 90 percent of those responding wanted Motif, is statistically invalid and shows nothing about real user trends in the GUI marketplace. The survey respondents are self-selected, which means they are not a valid cross-section of the marketplace. A real survey would sample a true cross-section of the user population in a random manner. At best, your survey indicates that Motif users, by a margin of 9 to 1, are more likely to respond to surveys.

For some reason, you claim that Motif is updated on a more timely basis than Sun's OpenWindows product. To my knowledge, both systems have released two versions: 1.0 and 1.1 for Motif, and 1.0 and 2.0 for OpenWindows. You also claim that Motif is more portable and bug-free, then later quote Quest Systems as saying that 30 percent of the Motif patches induced further bugs! You also quote several vendors saying that Motif, as shipped from OSF, is inadequate and requires extensive third party support to become a usable window system. I find these statements at odds with your claim of bug-free and portable.

By far, your largest gaffe comes when you compare the licensing of OpenWindows source code with Motif source licensing. Briefly, OPEN LOOK is an interface definition, the XView toolkit is one implementation of that interface, and OpenWindows is an X11R4-based window system that also offers PostScript imaging and a set of OPEN LOOK-compliant desktop tools. Motif is both an interface standard and a toolkit. The correct comparison is between the licensing

of the XView and Motif toolkits.

To compare: The Motif toolkit is available in source form from OSF for \$1,000. If you develop and sell Motif tools using this toolkit, you must pay licensing fees ranging up to \$50 for each copy of your product that you sell. The XView toolkit is available in source form from the MIT X distribution for free. Any tools developed with this toolkit may be sold without any licensing fees. To sum up, OSF charges for both source and usage, Sun charges nothing. In a truly open environment, one wonders why OSF continues to make Motif a profit center, rather than a publicly available toolkit.

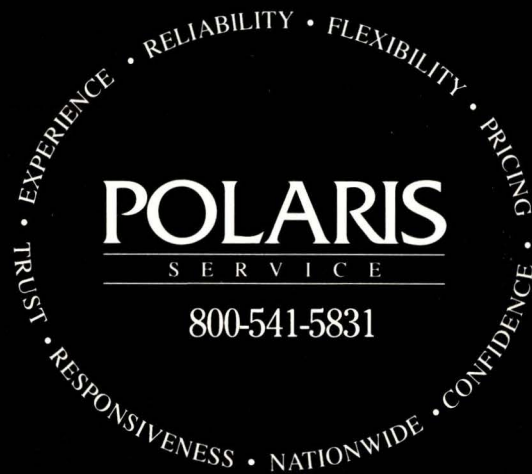
Sun licenses the OpenWindows source code to third-party VARs and OEMs who would like to provide an enhanced OpenWindows-compatible window system to their customers. I do not believe that it was ever intended that normal end users obtain and use this source code. For the paltry sum of \$995, a vendor gets a complete PostScript imaging engine, an X11R4-based window system, a suite of desktop tools and some twenty volumes of documentation. This is the deal of a lifetime for someone trying to enter the window systems marketplace in a timely manner.

I question your application counts (250 for Motif, 100 for OPEN LOOK) since they are completely out of line with *Personal Workstation's* monthly application tally (60 for OPEN LOOK, 28 for Motif). Perhaps you could enumerate these tools in a future issue, to clarify these numbers.

Your pie charts indicating ISV preferences are also misleading. Beyond the fact that ISV opinions have nothing to do with the reality of the marketplace, your pie charts are not drawn to scale, giving a misleading impression of which window system ranks higher. In particular, slices representing 2.7 and 5.9 percent are the same size, as are slices totalling 8.1 and 14.7 percent. Such inaccuracy should not be tolerated in a magazine of your caliber.

You take some delight in pointing out that vendors are offering Motif for Sun, as if this indicates a failure on Sun's part. Why do you refuse to

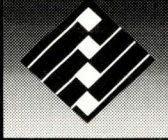
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acknowledge the vendors developing OPEN LOOK for DEC, HP and IBM machines? Surely this is just as serious an indictment of Motif on those platforms.

You also brush off one of the best arguments for OPEN LOOK's survival: Sun's massive market dominance. Sun will deliver close to 200,000 SPARC platforms to end users this year, and each machine will run OPEN LOOK right out of the box. While some users will elect to switch to a third-party Motif package, many more will stick with what they have. Even if DEC, IBM and HP were all shipping the same user interface (and they aren't), they will not begin to approach Sun's impressive market dominance.

It is frustrating to see Motif and OPEN LOOK represented as equivalent interfaces. Even Motif developers have admitted, in network postings, that OPEN LOOK is technically superior. OSF has promised three big features in Motif 1.2, due out this summer: drag and drop, context-sensitive help, and tear-off menus. OPEN LOOK users know that these features have been present in OPEN LOOK since its creation three years ago. Moreover, while Motif struggles to catch up with OPEN LOOK, OPEN LOOK has gone on to provide internationalized versions of its interface, including the first Kanji interface for use in Japan. OPEN LOOK is a clear technical winner over Motif.

It is obvious that users have a need for both OPEN LOOK and Motif, and that both interfaces are here to stay. If the press would concentrate less on political rivalry and press releases, and more on technical concerns, perhaps we could all learn a little more about surviving in a multiple GUI world.

I apologize for the length of this letter, but felt it necessary to address, point by point, the inaccuracies in Ms. Foley's article. I hope you find the space to present this alternative viewpoint.

Chuck Musciano
Harris Corp.

uunet!x102a!trantor!chuck

The editor replies: We do agree with

Chuck's closing thought: "A good newspaper is never good enough, but a lousy newspaper is a joy forever."—Garrison Keillor

Corrections

In the "News" section of the December 1990 issue, we erroneously stated that Augment Systems Inc. of Bedford, MA, markets FDDI products; they produce fiber-optic products.

In the January issue, U.S. Design was listed with an incorrect address. The address is: U.S. Design, 4311 Forbes Blvd., Lanham, MD 20706.

Omission

Due to an oversight, the article "Backup Strategies" in the January issue of *SunExpert* failed to mention the Network Backup Daemon software from Apunix Computer Services. *SunExpert* regrets the error. For information, readers may contact Apunix directly at 9330 Carmel Mountain Road, Ste. C, San Diego, CA 92129, or they may use the following reader service number: **Circle 205**.

My View

In the FYI box of your magazine's "Letters" section, you say "Letters to the Editor" views expressed "are those of the author and the author alone."

This is not necessarily true; I agree with some of the letters. I think the phrase should be re-worded ("not necessarily those of *SunExpert*," etc.)

Jim Battan
Sequent Computer Systems
uunet!sequent!battan

F Y I

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NEWS

Where Have All The SPARCalikes Gone?

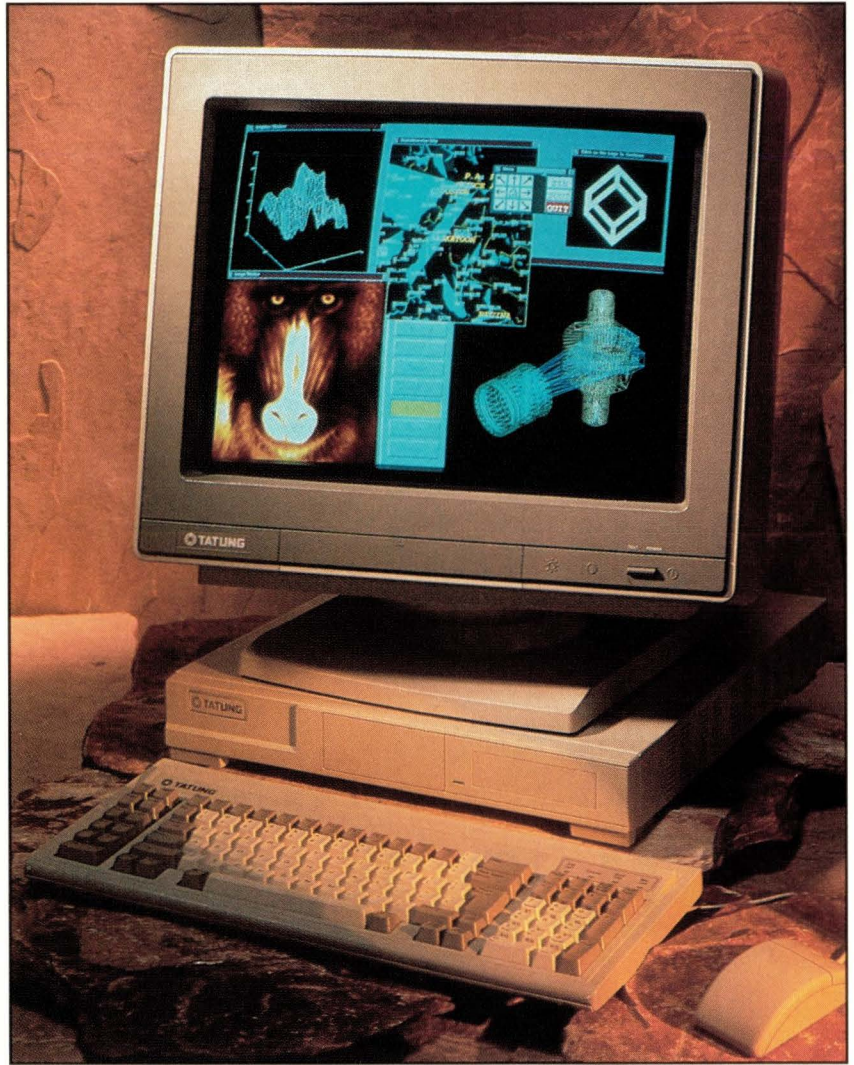
Not all of the SPARC-compatible systems—or, as we call them, SPARCalikes—that made their much celebrated debuts last fall will emerge to see the light of day. The fact that most of the announced SPARCalikes are compatible only with Sun Microsystems Inc.'s SPARCstation 1, or at best, SPARCstation 1+, finally seems to have caught up with Sun's competitors.

Solarix Systems, Fremont, CA, for example, has put its Solarix/4 Personal Workstation/20 on the shelf for the time being. Solarix formally announced the 20-MHz, 12.5-MIPS system in early December 1990. It was to be an entry-level machine, positioned below its Personal Workstation Plus. Base system prices were pegged at \$5,295 for a monochrome, 19-inch model and \$6,295 for a 16-inch, color model. But Solarix wants to make sure there are distribution channels—not to mention demand—for the PW/20 before it puts its muscle behind it, according to Pamela Sloane, director of marketing.

Some vendors already have decided that a market for 20-MHz-processor SPARCalikes does *not* exist. Twinhead International Corp., which first demonstrated its 20-MHz Twinstation 1 at the Fall 1990 Comdex, has a bunch of these machines it is trying to unload to make room for its 25-MHz models, which it plans to introduce at Spring 1991 Comdex.

According to vice president of sales and marketing, John Bryan, the Taiwanese SPARCalike vendor is offering its 12.5-MIPS, diskless, monochrome Twinstation 1 for \$5,595. Twinhead is expecting only limited demand for this model, and instead, is gearing up to make a big splash with its new machine.

At the same time, TriGem Corp.—best known as the manufacturing partner of RDI Computer Corp. and co-



Tatung Science and Technology Inc. has added yet another member, the TWS-5020-CX, to its SPARCalike family.

creator of the Britelite SPARC-based laptop—quietly has killed off its entry-level desktop system, the SDT-100. The 20-MHz system, which was due to have shipped some time this first quarter, has been superseded by the Korean company's SDT-200, a 25/20-MHz system that operates at 12.5 to 15.8 MIPS. Base price for the 17-inch color system is \$8,995.

Not all of the SPARCalike vendors are throwing in the towel, however. Tatung Science & Technology Inc., the San Jose, CA, subsidiary of Tatung Co., has added a graphics-enhanced model to its family of SPARCalikes. The new TWS-5020-CX desktop sys-

tem includes a graphics coprocessor board from Megatek Corp., which supports resolutions up to 1280 by 1024. With a 19-inch color monitor, the system sells for \$9,995.

In other news, Opus Systems Inc., Mountain View, CA, has signed on distributor/systems integrator R Squared of Englewood, CO, to carry its board- and system-level SPARCalikes. Among the products R Squared will distribute is Opus' Personal Mainframe, a desktop machine that competes directly with the SPARCstation 1+. A 19-inch color model of the 12.8-MIPS system lists for \$12,495. Since most SPARCalike

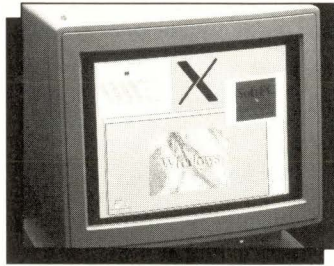
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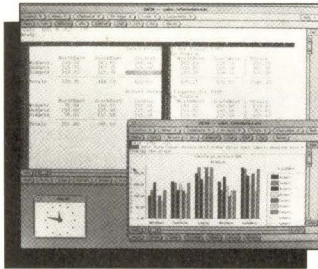
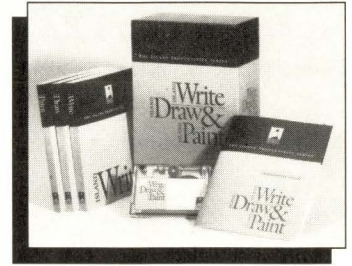
SoftPC from Insignia Solutions, Inc.

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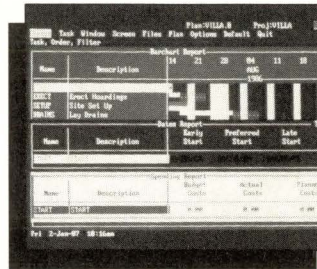
Island Graphics Productivity Series

Includes Island Write, IslandDraw, and IslandPaint. This is an affordable, streamlined set of publishing and graphics tools that let you create and illustrate memos, letters, specifications, and newsletters. Choose from SunView or new OpenLook version for Sun 3,4 and 386i-single user.



Access 20/20 for OpenLook

20/20 OpenLook for Sun is a joint engineering effort between Sun and AccessTechnology and the only fully implemented OpenLook spreadsheet available on Sun workstations. 20/20 makes full use of push buttons and pull-down menus. Database connections are available. This is the very latest in spreadsheet technology and comes highly recommended.



Pertmaster Advance from Projectronix, Inc.

Pertmaster Advance is a sophisticated tool for project management. It packs the power to handle serious project management any way you want. It has very easy to use "Lotus like" menus and a very rich selection of project management features. There is nothing better available in this price range.

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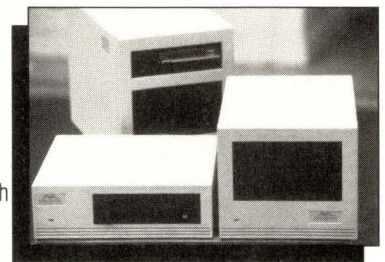
Texas Instruments microLaser Printer

A true POSTSCRIPT laser printer available with either 35 fonts (PS35) or 17 fonts (PS17). Both print up to 6ppm at 300 dpi and come standard with 1.5 MB of memory. An excellent value. Includes cable. microLaser PS35, **\$1699**, microLaser PS17, **\$1359**.



Hewlett-Packard SCSI Hard Disk Subsystem

From Bridgeway Technology comes this 793MB HP SCSI hard drive. The drive is packaged in an advanced enclosure with forced air cooling, power cable, and an easy to set SCSI ID switch on the back of the unit. Tested and formatted with Sun OS and includes a 5-year warranty. 24-hour replacement of drive, at an additional cost. **\$2699** including cable.

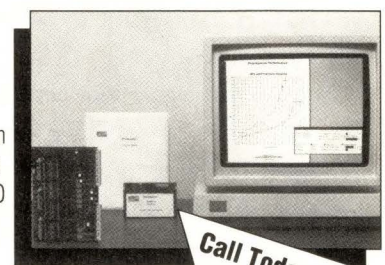


XP27 TekXpress XWindow Terminal by Tektronix

The XP27 is the new performance standard for color Xstations from the leading manufacturer of color Xstations—Tektronix. It offers Sun-compatible high-quality 1152 X 900 resolution in a 19" 256-color display. Comes standard w/5MB memory (expandable to 21 MB), dual processing architecture, X11 R.4 server, 8-bit planes and great international 3-year warranty. Other models available.

Legato-Prestoserve NFS Accelerator

The Prestoserve is an accelerator board that significantly enhances the throughput and responsiveness of Sun NFS file servers. It provides 50% more NFS server throughput by reducing I/O bottlenecks. This product could save you the cost of an additional server.



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Other Open Systems News

Data General Corp.

DG is quietly and subtly repositioning. The word in Westboro, MA, is that DG doesn't—and never did—compete head-to-head with Sun Microsystems Inc. and others in the UNIX workstation market. Instead, say company insiders, DG is in the server business. Product announcements that reflect the new DG (and hopefully reduce this confusion) are coming.

Digital Equipment Corp.

DEC and Uniface Corp.'s parent company, Uniface International (Alameda, CA), have signed a complementary technology agreement under which the two companies will share information and alpha versions of new products. Uniface's 4GL products allow users to combine data from DEC's Rdb and RMS, as well as from other relational database systems, across VAX, Ultrix and DOS.

Hewlett-Packard Co.

Following close on Sun Microsystems Inc.'s heels, HP has announced that it will distribute its HP-UX operating system and subsystem software, as well as third-party applications, on CD-ROM. CD-ROM versions will be available for HP 9000 Series 300 and HP Apollo 9000 Series 400 workstations. The CD-ROM option will be available to customers starting this spring, with base prices for the OS and related software beginning at \$495 per disk. CD-ROM drives integrated into workstations will start at \$1,000.

Further confirming the move of workstations into commercial markets, HP and Lotus Development Corp. have signed a joint marketing and development agreement to bring Lotus 1-2-3 to HP's Apollo 9000 Series 400 and HP 9000 Series 300 lines. Lotus also will port the DataLens Developer Toolkit to the HP platforms. Lotus 1-2-3 for HP will be available by mid-1991 and will be distributed exclusively by HP through its direct and indirect channels. Among HP's first expected customers for the product: the Singapore Stock Exchange, U.S. West and BellSouth.

IBM Corp.

Sun Microsystems Inc.'s XView Toolkit is now available for the IBM RS/6000 family, as a result of a port done by UniPress Software Inc., Edison, NJ. The XView Toolkit is delivered with the XView 2.0 libraries, Open Look interface, Lucida fonts, conversion utilities and sample X programs. The toolkit can be used to create new applications for Open Look on RS/6000 machines, as well as to run existing Sun applications on IBM systems. In addition to being available for the RS/6000, the UniPress product is available for the Digital Equipment Corp. DECstation family and Hewlett-Packard Co. 9000/300 series. Pricing: binary code goes for \$2,495 and a development license (which includes internal and commercial distribution rights) sells for \$10,000.

MIPS Computer Systems Inc.

MIPS and Wang Laboratories Inc. have cemented an OEM agreement under which Wang will market systems from MIPS to expand Wang's Dynamix Series. The relationship gives MIPS a leg up in the commercial market, as Wang continues to position its UNIX products there. Wang's existing Dynamix products are based on 80X86 processors.

Etc.

Motorola Inc. has reconfigured its Delta Series 8000 UNIX systems to offer greater performance and flexibility. The Cupertino, CA-based Computer Group has added three new models, all based on the 88000 processor. They are: the desktide Model 8440, office pedestal Model 8640 and data-center-sized Model 8840. Motorola claims the 8440 offers nearly four times the price/performance of the SPARCstation 370. Other enhancements include: improved processor performance and memory, increased disk capacity and a new SCSI controller.

Sequoia Systems Inc., Marlboro, MA, and *ASK Computer Systems Inc.*'s Ingres division have announced that the Ingres relational database system will be ported to the Sequoia Series 300. ASK will provide sales and support for the fault-tolerant version of the Alameda, CA, division's product.

vendors have done little more than talk about their marketing plans, Opus' concrete agreement becomes particularly noteworthy.

And at Uniforum in late January, two new SPARClike vendors tossed their hats into the ring. AFE Computers Ltd. and Fusion Microsystems Inc. introduced new SPARC-based systems. (For more details, see story below.)

Industry watchers still expect the total of SPARClike systems to top 25 by the middle of 1991. And they're still predicting that the number of casualties will surpass the number of survivors.—mjf

Keeping Up With The SPARClikes

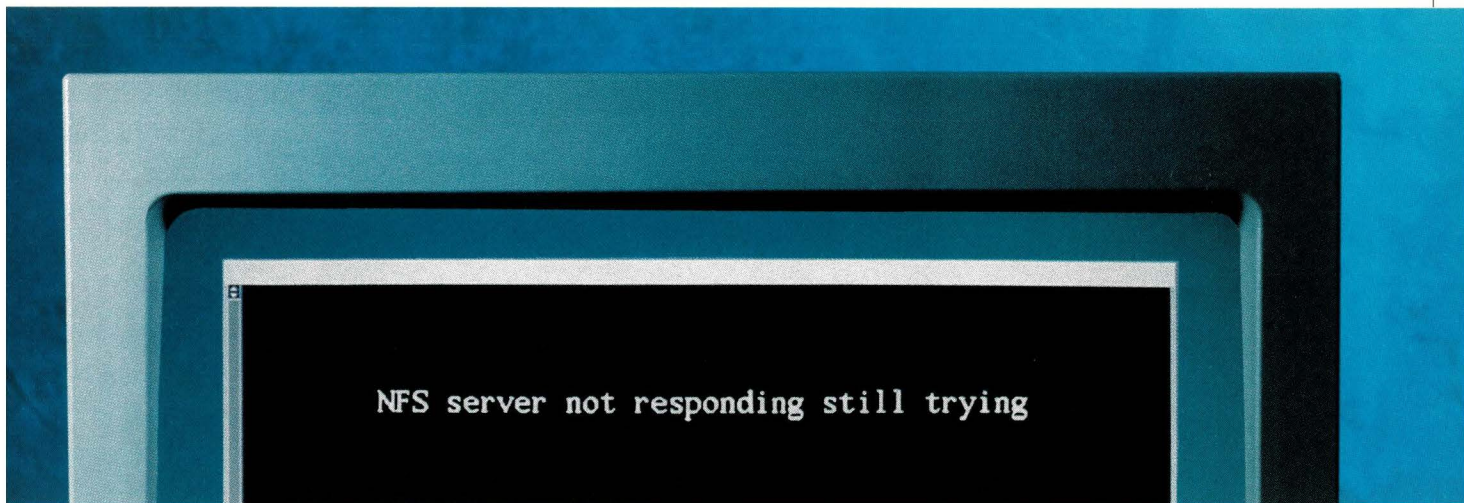
At the same time as some SPARClike vendors are postponing or killing off their early SPARC-based product entries, other new SPARClike vendors are joining the fray. Two of the most recent entrants are Fusion Microsystems Inc., Los Altos, CA, and AFE Computers Ltd., Sutton Coldfield, U.K.

Fusion, a company formed by a group of former Fujitsu Microelectronics Inc. employees, unleashed its first product, the Fusion 1, at Uniforum in late January. Fusion is OEMing the product from TriGem Corp., Seoul, Korea, the co-manufacturer of the Britelite SPARC-based laptop. The Fusion 1 is a desktop system based on the LSI Logic 20-MHz SPARC processor. A base-level configuration, with 8 MB of RAM and a color monitor, sells for \$8,695. Volume shipments will begin in the second quarter.

According to chief operating officer Gregory Leonard, Fusion plans to market the product entirely through indirect channels—primarily VARs and systems integrators. Already, it has established a network of 15 sales offices throughout the United States and United Kingdom to market to these value-added vendors.

And Fusion is planning its next slew of introductions, including SPARC laptops, a VME-bus server and 33-

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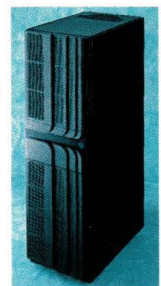
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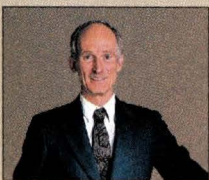
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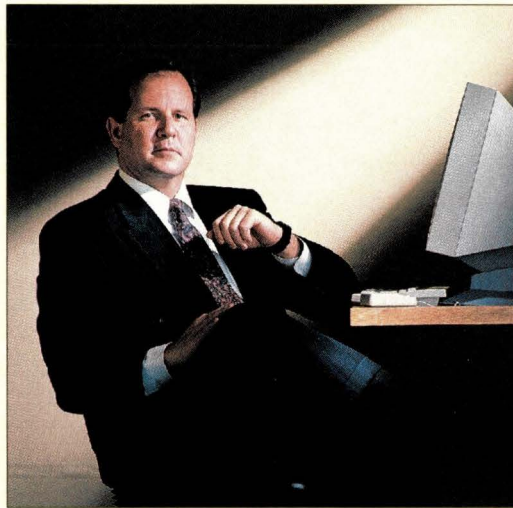
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NEWS



Sony Microsystems Co.'s NEWS 3250 laptop workstation is the first MIPS-based portable. But RDI may not be far behind with its own MIPS-like.

and 40-MHz upgrades to its desktop product, Leonard says. All of these could be introduced by the end of the year, he says.

AFE Computers is a 10-year-old company founded to build industrial systems. In keeping with its mission, AFE has launched a family of SPARC-based machines, which it calls its OpenStation series, specifically for the design automation and manufacturing markets.

Its first SPARC-like—which the company claims is also Europe's first desktop SPARC-based workstation—is the OpenStation S20. The product is based on LSI's 20-MHz SPARC processor. AFE offers users two plug-in cards: the OpenVision S007 graphics accelerator, a double-width SBus board for 2/3-D graphics applications, and the PCi, an 80386-based board for running DOS applications.

Later this month, AFE is due to ship a ruggedized member of its OpenStation line, custom-made for factory-floor applications, according to Ian Smith, sales and marketing director. AFE is also working on an SBus-based multimedia system, which

it could ship as early as the third quarter, Smith says.

In the meantime, AFE is continuing its work with the ASIC division of Fujitsu. The company was an early signer-on with Fujitsu for its three-board VME-based SPARC system—an implementation that never really took off. AFE is likely to be one of the first SPARC-like vendors to develop systems using the new, single-board 40-MHz SPARC processor upon which Fujitsu is putting the finishing touches.—*mjf*

RDI Makes Good On Promised Technologies

RDI Computer Corp., San Diego, is delivering on the technological promises it made at Fall Comdex in connection with its SPARC-based laptop. Consequently, the San Diego, CA-based company is attracting attention from some powerful parties, among them, Apple Computer Inc. and Sun Microsystems Inc.

RDI is now offering to other vendors and end users the Macintosh emulation software that it sells as an

option for its Britelite laptop. Called Companion, the emulation software runs under Sun's SunView or OpenWindows user interfaces. Companion emulates the 68000 processor, yet allows the use of any SPARC-compatible display, keyboard, mouse, hard disk, floppy disk or CD-ROM drive. Britelite users now can run SunOS, Mac OS and DOS applications.

RDI also has announced that it has signed an OEM agreement with Sun, enabling it to use SPARCstation IPC boards in its Britelite systems. Rumor has it that Sun soon could sign another agreement with RDI and its manufacturing partner, TriGem Corp. under which Sun would resell Britelite systems through its various channels. Apple, likewise, has shown interest in the 13-pound, \$10,800 portable, says RDI president Rick Schrameck.

On other fronts, RDI has signed an DATAco Computer Peripherals, a San Diego-based Sun reseller, as a master VAR. And, according to Schrameck, the company is finalizing work on a MIPS Computer Systems

Inc.-based portable computer. RDI won't be first out of the gate with such a system, since Sony Microsystems Co., San Jose, CA, announced a 20-MHz, R3000-based laptop at Uniform in late January. (Whether or not a 17-lb., 12-oz. system qualifies as a laptop is another matter.) RDI's MIPS-based laptop will be one of eight new-product announcements from the company this year, Schrameck claims.—*mjf*

You, Too, Can Be 'On The Net'

For many of us, being "on the net"—having user-level email and newsgroup connectivity to the Internet/Usenet—is not merely a perk of being in the high-tech scene, but borders on essential, professionally or emotionally. Losing that access, through job change, graduation, or whatever, has meant scurrying around for another account, perhaps a guest account, or, for the lucky with their own UNIX machine, becoming a "leaf" off the Usenet hierarchy.

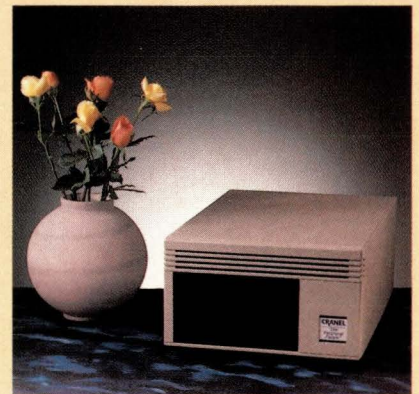
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Public Access UNIX Resources

Lists are available from any of the following:

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Long list: /usr/spool/uucppublic/nixpub
Short list: /usr/spool/uucppublic/nixpub.short
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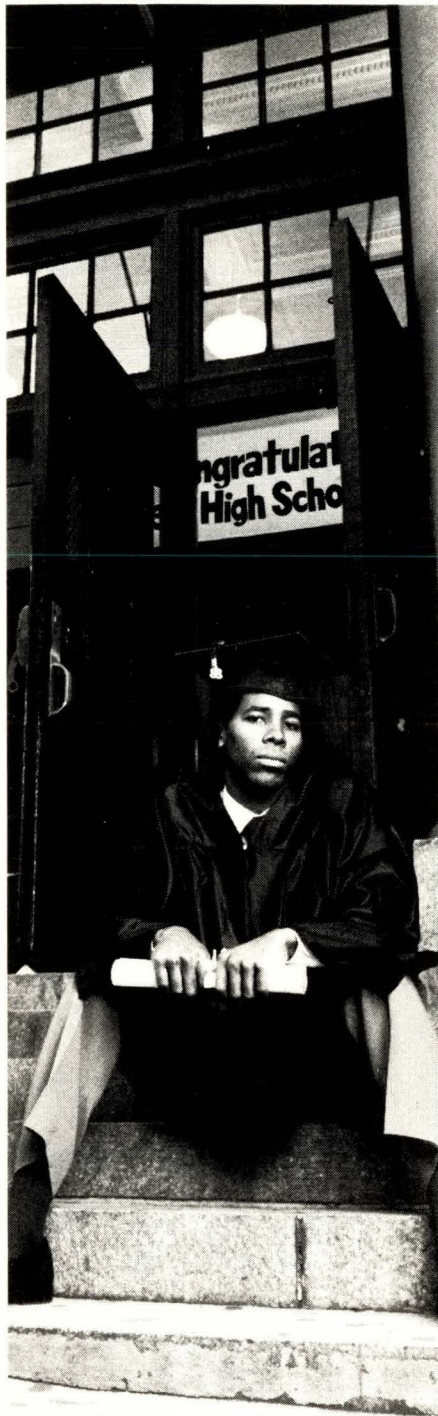
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A Mind Is A Terrible Thing To Waste. 

SunExpert, December 1990, Page 37). And, happily, for individual end users as well—through the mechanism of “open” or “public access” UNIX systems. Public-access UNIX systems are a phenomenon of the past several years, arising from affordable UNIX hosts (including, I suspect, numerous surplus machines), and the dropping price of the home computer with modem to well under \$1,000.

What public-access UNIX systems do is eliminate the once-high membership requirements to the club. Anyone with a modem and computer (or terminal) can access Usenet groups and email. Cost: anywhere from free to an average of \$10 and up.

At present, there are over 100 such systems listed in the current “nixpubs” (Nix-based public access systems) list—and I’m sure there are many, many more besides these. Older, well-known systems include Portal (Cupertino, CA) and the Well (San Francisco), with probably thousands of users between them. The World (Brookline, MA), a relative newcomer (where I have an account) already boasts 500 users. Nixpubs lists systems everywhere from across the United States to France, England, Germany and New Zealand.

Public-access UNIX systems occupy a mugwump niche in the still-growing electronic universe. Like CompuServe, GENie and others, they are part of a continent/worldwide community of overlapping SIGs (Special-Interest Groups).

Like many bulletin board systems (BBS), they support substantial locally interacting populations. Like the regional NSF nets and the commercial IP networks (PSInet, Alternet), they provide varying degrees of Internet access. Most carry Usenet feeds, ranging from specific groups to the full panoply, including ClariNet and other pay feeds.

Many support local troves of public-domain software sources and databases, or access to archives maintained on hosts such as Uunet. And some, such as The World, can be used for plain old timesharing, i.e., for users needing perhaps a week or two of SPARCstation

time—“available from home,” as World leader Barry Shein notes. It also supports SIGS, “chat/CB channels,” games, UPI feeds and so on.

Because the systems serve predominantly users within their local areas, the rate structures can be very different from network-oriented conferencing/ BBS like CompuServe. Some are free (often with limited hours and numbers of ports), or ask for a donation. Others suggest fees of \$4 to \$10 per month.

The World, one of the systems run by and as a business, sells its service currently for \$2 per hour (plus \$5 per month administrative fee)—or, for \$20 per month, you get 20 hours, and no admin fee. Assuming your call is local, that’s \$1 per hour, which beats the heck out of CompuServe or GENie. You can even join the World directly via modem; the registration software will take MasterCard and Visa. Many support access at 9600 baud; some support access remotely via X.25 (which costs extra).

The downside of a public UNIX system versus something like CompuServe or Bix, for some: Be ready to learn at least something about UNIX and email syntax. (There are usually help files, although you may not know enough UNIX to find, read and understand them.) But once you’ve mastered one UNIX system, you can usually figure out the next. (To find the nearest available system, if you don’t already have some form of network access, ask someone who does.)—*dpd*

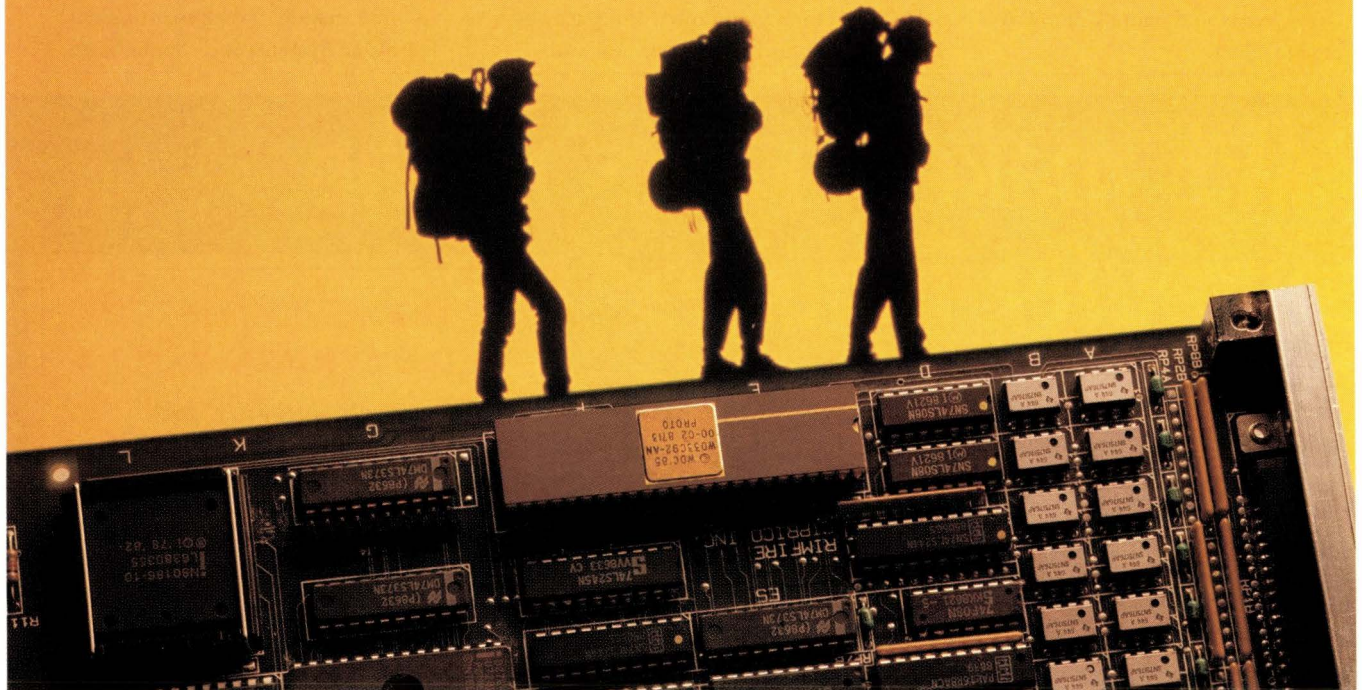
Eakins Named Sun VAR

Eakins Open Systems, the Mountain View, CA-based system integrator, has been named a Sun VAR. This consummates a long relationship between EOS and Sun. EOS is reported to have sold Sun its first DEC VAX.

Initially, EOS will sell Sun products into the technical and engineering markets. However, says company president, Gilbert Eakins, “the opportunity exists to take these products into the commercial marketplace.”

EOS joins an increasingly large

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number of active Sun VARs. There has been some speculation that there will be too many VARs for the market to support. However, Eakins says that the workstation market is more than big enough to support everyone, plus Sun's own direct salesforce. "The market is expanding at such a rate that the biggest opportunity is just to get out there," he says.—*mjt*

...This Just In

- Bringing together two complementary technologies—document-retrieval systems and optical-character-recognition systems—**Verity Inc.** and **Calera Recognition Systems Inc.** have created a marketing partnership. Customers are already using Verity's Topic document-retrieval system with Calera's TopScan Professional and TrueScan recognition systems, which can handle text in DOS, OS/2, UNIX and Mac/OS environments. The agreement cements the cooperation between the Mountain View, CA-based Verity and Santa Clara, CA-based Calera.

- **AGE Labs** has established a test lab, where vendors of X terminals, X PCs, X workstations and X application software can evaluate their X Window systems. AGE Labs will offer interested parties the personnel and equipment necessary to do product testing, benchmarking and/or analysis. Currently available test platforms include: Digital Equipment Corp. DECstations and VAXstations; Hewlett-Packard Co. 3XX and 8XX systems; IBM Corp. RS/6000s; Sun Microsystems Inc. Sun-3s and SPARCstations; as well as systems running 386/Interactive UNIX, 386/SCO UNIX and Open Desktop. The San Diego-headquartered AGE Labs is operated independently from the development teams at the X-Window-System-server software vendor, according to AGE officials.

- Enhanced UNIX bulletin board services are available from Manhattan Beach, CA's **MMB Development Corp.** with its new TEAMate Release 2.0. The utility software includes a "dual" menu windowed interface and modules for full text retrieval and

interactive and deferred discussion groups. TEAMate software typically operates on single host servers, with users accessing the system over high-speed networks, X.25 networks or PC modems. TEAMate is available for systems including: SPARC, IBM Corp. RS/6000, Hewlett-Packard Co. Domain, Motorola Corp. 88000 and 68000, AT&T Corp. 3B2, Groupe Bull DPX-2 and Intel Corp. 386/486.

- **Interactive Development Environments Inc.** (IDE), the Software Through Pictures people, are busy working with Hewlett-Packard Co.'s SoftBench CASE tool-integration product in the Sun Microsystems Inc. SPARCstation environment. IDE expects the SoftBench port to be completed by April. Between three and six months later, IDE, which is based in San Francisco, CA, expects to ship Software Through Pictures integrated with SoftBench for SPARCstations. Software Through Pictures is currently available on all Sun platforms and HP's 900 Series 300 and 400 workstations.
- More software development news: **TeamOne Systems Inc.**, Santa Clara,

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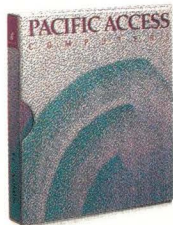
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CA, has introduced an upgrade to its TeamNet concurrent engineering environment. TeamNet 2.0 supports three new features: distributed heterogeneous development support, a Motif-based point-and-click interface, and data-compression support. Like its predecessor, the newest TeamNet version can support any system that's on a Sun Microsystems Inc. Network File System (NFS). The product includes a distributed, object-oriented database; repository change management; version control; and database-query systems. Prices range from \$100,000 to \$175,000 for 50 to 100 seats.

• **Signal Technology Inc.** has announced version 1.0 of N!Power, an object-oriented application development environment for scientific and engineering data and signal analysis, digital signal processing and presentation. N!Power operates in X Windows workstation and client-server network environments. The Goleta, CA, company's product employs the Motif interface, and is designed to incorporate add-on modules from third parties to extend applications in areas

such as mechanical and electronic component design, test and measurement, communications systems and the like. The product initially is available on Sun Microsystems Inc. SPARCstations. A Digital Equipment Corp. VAX/VMS version is slated for Q1 1991.

• Thanks to the VISTA 3270/Cluster Controller option card from **Datability Software Systems Inc.**, TCP/IP Telnet or Digital Equipment Corp. LAT terminal users can access more easily and directly IBM Corp. hosts. The New York, NY, vendor's SNA gateway product operates with Datability's VISTA VCP-1000 Communications server. The cluster controller card provides 3270 emulation for terminals, and enables IBM systems to be defined as unique IP addresses or LAT services. The product requires no changes to networks, IBM host hardware or software, according to Datability. List price for the card: \$4,999.

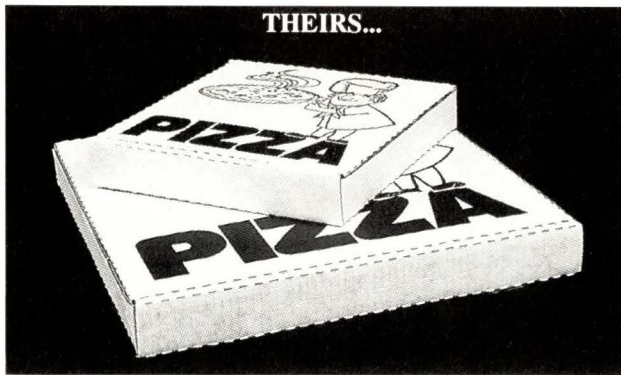
• A lower level, simpler gateway between workstations and IBM Corp. 937X or 4361 mainframes or 3X74

cluster controllers is available from **I/O Concepts Inc.** The Seattle, WA, company's Mustang 5 is a modem-sized device that looks like a tape unit to a workstation, and like a terminal to an IBM host. The device uses coaxial cable for connections and can support up to five workstations simultaneously anywhere on a network.

• Looking for a way for your DOS-based PCs to access TCP/IP networks over dial-up, serial line connections? Check out the point-to-point protocol implementation of PC/TCP for DOS from **FTP Software Inc.** The Wakefield, MA, vendor's new version eliminates the need for dedicated lines.

• Solidifying their commitment to the development of the Japanese market for high-level integrated-circuit and electronic-system design tools, **Synopsys Inc.** and **Sumitomo Corp.** have announced an investment agreement. The Tokyo-based Sumitomo invested \$5 million in the Mountain View, CA-headquartered Synopsys, bringing its equity-capital investment total in Synopsys to \$14.5 million. ➔

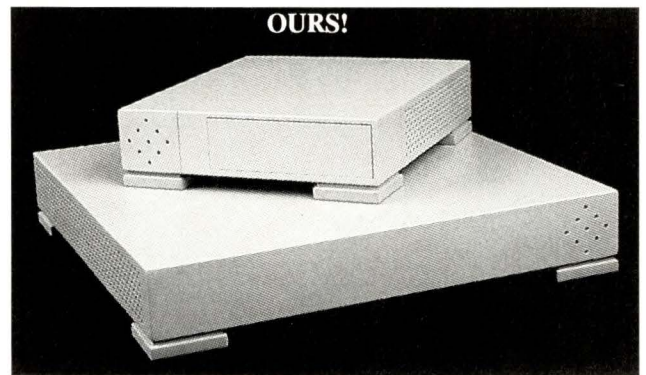
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Circle No. 17



ILLUSTRATION BY TOM BARRETT

by MICHAEL O'BRIEN

MR. PROTOCOL DOES SOME DEEP THINKING

"You may wonder why the switches on the explosive bolts don't have any protective covers on them."

—Tom Tengdin

"Battle not with monsters, lest ye become a monster, and if you gaze into the abyss, the abyss gazes also into you."

—Friedrich Wilhelm Nietzsche

"NO SHOES"

—Deep Submergence Vehicle 2 *Alvin*

Q: < **CLANG**>
< **CLANG**>
Come out of that thing, willya! You were gonna tell me more about networking on the edge, remember? You gonna eat all those cookies and then hide in that big metal toy till I go away? Well, forget it! I'll clear your ears for ya! < **CLANG**>
< **CLANG**>

A: Test the traverse on the left robot arm, will you? < **WHOP**> Thank you. Now then, let's see, where were we? Well, as you can see, I'm not anywhere near the usual milk-and-cookie supply barn. In fact, Mr. Protocol is

seated next to me in the Deep Submergence Vehicle 2 *Alvin*, also known as the World's Deepest Chipmunk. The *Alvin* is owned and operated by the Woods Hole Oceanographic Institution, Woods Hole, MA, and is hosted aboard the research vessel *Atlantis II*. Mr. Protocol is aiding me in preparing this column on the submersible's computer, from which it will be submitted directly. Both of us feel that this is a pretty neat trick, considering that the space we are sitting in is a sphere seven feet in diameter, most of which is filled with electronic equipment sufficient to make a Hollywood producer foam at

the mouth, except of course that there is no room to place a camera.

The *Alvin* is not for claustrophobes.

Alvin is an independent submersible, capable of diving to 13,142 feet. At 13,143 feet the world presumably comes to an end. For obvious reasons, this has not been checked except in a pressure chamber.

In shape, the *Alvin* looks almost like a toy submarine that has been inflated to the size of a very large panel truck. It is shaped like the common conception of a submarine, but a very, very stubby one. There are three very tiny portholes in the front, and one on the bottom. At the rear are a set of small turbine-shaped propellers, and in the front are two robot arms. Most of the hull looks like slabs of white plastic fitted loosely together. However, the actual pressure hull is a titanium sphere seven feet in diameter—hence the cramped quarters Mr. Protocol and I are sharing with Mr. Tom Tengdin, who is both a qualified *Alvin* pilot and the main computer guru for both *Alvin* and the *Atlantis II*.

The computer aboard the *Alvin* qualifies as the World's Deepest UNIX System. This computer, or one of its ancestors, has seen such things as the thermal vents on the ocean bottom and the Titanic. One thing it has not yet seen is the Internet, and that forms the basis for this case study.

The computer system aboard the *Alvin* is used to drive a variety of data displays throughout the *Alvin* cabin. Since the cabin is a pure sphere, holding three people (who had better be very good friends), one picks one's bodily position carefully, as one will be in it for up to ten hours, mostly in the dark. The primary consumable is not air, but electrical energy. *Alvin* holds two gigantic lead-acid batteries that form the sole power for propulsion, lighting (of which the *Alvin* has a large amount: Sea water eats light rapidly), the manipulator arms and all onboard instrumentation. When battery power gets low, a return to the surface is called for. The *Alvin* takes about an hour and a half to reach the ocean bottom, and about two hours to return to the surface.

Since the *Alvin* is a true submarine, there is no umbilical cord running to the surface. Communication runs over a radio link. At present there is no computer-to-computer surface connection, though such is planned, via acoustic modems. FTP Software Inc. will provide SLIP software to make this work. Use of digitized voice will allow use of a common radio channel. Since sea water is not friendly to radio waves, the link is actually a sonic link with a carrier frequency of 8 kHz, which is in the audible range. It sounds peculiar indeed. On deck, the computer aboard the *Alvin* is connected directly to the main UNIX system aboard the *Atlantis II* via a UUCP connection.

On the main vessel, life becomes interesting, for data as well as for the

The computer aboard the *Alvin* qualifies as the World's Deepest UNIX System.

crew. The main link with "the beach" is via INMARSAT, which costs \$10 per minute. Handling fax and phone traffic is bad enough without putting data over it as well (Mr. Protocol feels it is obvious that a full Usenet feed is right out). Hence, one would like to use something cheaper. It turns out that there are a couple of geosynchronous satellites called ATS-1 and ATS-3 which are, in effect, free, having been turned over by their original owners. However, they have some peculiar characteristics. Currently, they run a full-duplex VHF radio connection to a single shore-based ground station. This in turn provides what is essentially a permanent Telnet connection to a local VMS VAX at the ground station site. Now for the clinker: There is *NO*, repeat *NO* error cor-

rection on the link. This link is used to execute VMS command files that transfer files and mail via Kermit.

That's why this column describes a case study in progress rather than a *fait accompli*, as it usually does. Let us examine the various possibilities, and the rather unique conditions under which any possible solution must operate.

One possibility that springs to mind was described a couple of months ago: packet radio. Now, amateur packet radio is probably not a legal solution because no commercial business may be transacted over the amateur service, and while this operation is not-for-profit, it still has enough of a commercial flavor to make this solution unlikely. However, other frequencies are available. The problem with this solution is that the ship is often in a position which makes it impossible to communicate reliably via regular radio—satellite communications are almost a necessity for reliable communications. And ATS is free, and works over almost half the globe. In fact the half of the globe covered by the ATS satellite is the half that oceanographers are most interested in, from the Mid-Atlantic Ridge over to most of the Pacific Ocean.

[At this point in the column, Mr. Protocol would like to mention that a seven-foot sphere, especially one full of electronics, is not the optimum environment for writing. Contemplating a ten-hour session in this thing, especially at the freezing temperatures at the bottom of the ocean (*Alvin* is unheated except by the electrical power converters below the floor), fills Mr. Protocol with a great sense of no enthusiasm. (Tom Tengdin says Mr. Protocol is a wimp. No cookies and no packets for Mr. Tengdin this week.)]

Well, you may ask, you already have a satellite circuit—what more could you want?

Mr. Protocol is glad you asked. What you could want is nothing more nor less than a reliable link-level protocol. Currently, the circuit, while full-duplex, simply sends 16-bit packets in each direction whenever there happens to be data, and the modems at each

end require several full seconds to synchronize. Also, the circuit is not multiplexed—of the several ships at sea that use the ATS satellite link, only one can use it at a time.

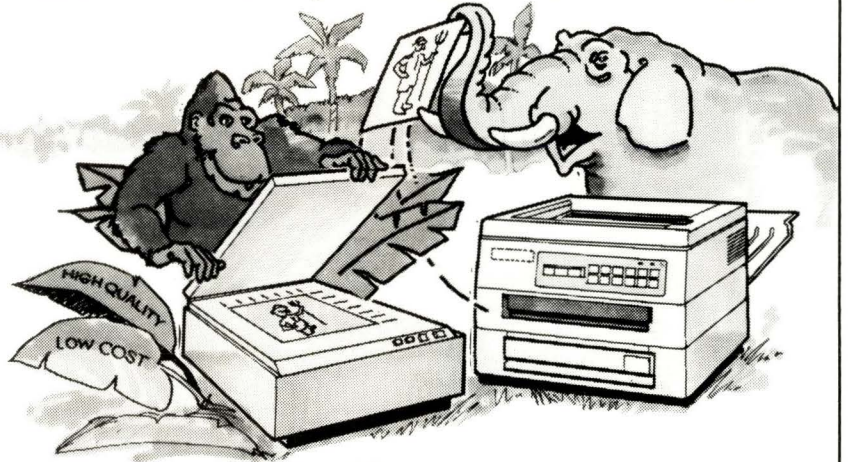
This, Mr. Protocol sadly admits, is where everyone becomes an expert. There is a large number of people who believe that because no solution has actually been implemented, their solution is therefore patently the superior one. Naturally, after a solution—any solution—has been implemented, there is no shortage of second-guessers, but their numbers are miniscule compared to the number of instant experts before the fact. Mr. Protocol points this out not to complain, but to set a lesson before those who may find themselves in similar cutting-edge situations: Sift your answers carefully as they come in.

Most of the machines on shore one would want to talk to speak TCP/IP; hence, a TCP/IP protocol would seem to be the easiest solution to seek. Also, while things such as SLIP and PPP (Point-to-Point Protocol) have been evolved for low-cost links in the TCP/IP suite, Mr. Protocol is unaware of equivalents in the X.25 world.

The satellite link, with its 16-bit packets, has one peculiarity in data transmission: While the modems may take up to 15 to 20 seconds to synchronize at the start of a transmission, they remain in continuous communication after that until the contact is broken. If they have no real data to send, they send null packets. This means that a null byte can't be sent over the link directly, and that would kick any number of useful applications in the head. Mr. Protocol generally gets a pained look on his face and hides his face behind a cookie or five whenever something like this comes up, then points at the Telnet protocol and mumbles something unintelligible in a spray of crumbs.

What he means is the old trick, used in the Telnet protocol among other places, of defining an escape character that is its own escape. Pick some character—it doesn't matter which one so long as it isn't very common, to cut down on excess traffic—and define it as

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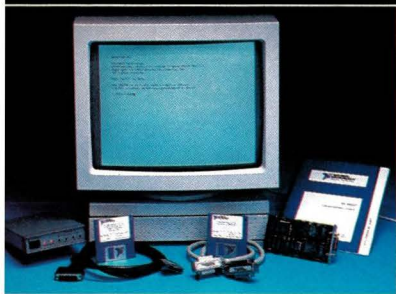
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Circle No. 27

ASK MR. PROTOCOL

the escape character. Call it EC. Then, to send an EC across the link, send EC EC. Both will go across the link just fine. At the other end, throw one away. Then, say that EC 01 sent together means NUL. When a NUL has to be sent, send EC 01 again, and turn that combination into NUL at the other end. There is a SYN character which is also gobbled up by the modems, which could be rendered as EC 02. Throw away any other ECs that you might see...you shouldn't see any since you shouldn't send any.

This is a case where ideals may have to compromise with the real world. In an ideal world, this byte-oriented fan dance would be confined to the low-level driver software, one step up from the modem. However, in this world of commercial software, this may not be possible. In such a case, the conversion would have to take place at a higher level—ideally, the lowest level possible. Ideally, the modems wouldn't do this in the first place, so the fix should be located as closely as possible to the problem. In a world without sources, however, only the criminals will have source. Ah, well.

Woods Hole is building the acoustic modems which the *Alvin* will use to communicate with the surface (remember the 8-kHz audio link?). Josko Catipovitch, who is building the modems there, claims that he will be able to squeeze 1200 or 2400 baud out of the modems. This is enough, though just barely enough, to allow the *Alvin* to communicate with the surface via a TCP/IP data link. Given that the Ultrix system on board the ship, being based on BSD UNIX, can act as a gateway, the *Alvin* should be able to communicate directly with the Internet, once the shore-based system is given TCP/IP capability. Seeing as how this magazine is supposed to be about Sun systems, let us suppose that the shore-based VMS system is given a Sun front end. Certainly it should be possible to give it both a TCP/IP ATS satellite link and a DECNet link.

Of course, Sun source is not cheap. And Karen Seo, et al, of BBN Communications Corp. have shown that TCP/IP needs some tuning to

work optimally with satellite delays. Therefore, it may be best if the Sun is configured to run the KA9Q TCP/IP package rather than its native package, so that the timing and null-escape-character processing can be done. Of course, there is always the possibility that, as this link would look like a SLIP link, the translation might be done in the SLIP code before it gets to the Sun's own TCP/IP layers. Time and much fiddling will tell, as Mr. P. is fond of saying.

As I remarked earlier, this is a case study of work in progress. If one of you folks out there gets a talk herald from `alvin.whoii.edu`, pay attention—the person on the other end may be 13,000 feet below the surface of the ocean. You will bear with any transmission delays, won't you? Good. I thought so. Pass the cookies, would you Mr. P? Now let's take a look at that ATS link again... . ↔

This column was entirely written and submitted from within the Alvin submersible, currently undergoing refitting at the Scripps Institution of Oceanography, Nimitz Marine Facility, San Diego, CA.

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, back when an 11/40 with two RK-05 disk drives and two TU-10 tape drives seemed the perfect setup for such a task. He worked at Rand during the glory days of the Rand editor and the MH mail system, dabbled in graphics, helped build CSNET (first at Rand and later at BBN Labs Inc.) and is now at an aerospace research corporation trying to figure out if Smalltalk is going to become as baroque as UNIX.

Mr. Protocol refuses to divulge his qualifications and may, in fact, have none whatsoever.



ILLUSTRATION BY MANUAL KING

by PETER COLLINSON,
Hillside Systems

D e v i c e s

All operating systems aim to offer their users some measure of device independence. Programs should be written so that they are independent of the environment in which they are to be run. If they read data, they should be oblivious of its source. Any output should simply be sent on its way without regard to its final destination.

This is very familiar in UNIX. Shells support the notion of standard input, output and error I/O channels that are passed automatically into processes. Device-independent programs simply deal with open *file descriptors* without worrying about opening specific files. The combination of both these things allow us to write simple shell commands like:

```
sort < unsorted > sorted
```

using the `sort` command on the source file `unsorted` to create a sorted file `sorted`. UNIX users instantly know that the names `unsorted` and `sorted` refer to files somewhere in the file tree. We know this from the context. We also know that the names are not fixed; we can choose any string that means something to us.

Of course, the world is not simply composed of files. Most computers have peripherals attached to them, and these devices need to be integrated into the system. Ideally, they should be added in a way that divorces their name from the physical port to which they are attached. For instance, we might have a printer sitting on either a serial or a parallel connection. Life is easier if we can just refer to the "printer" rather than being forced to know where the printer is connected and accessing it using some oddly named physical port onto the machine.

The designers of UNIX decided to add the devices into the filesystem tree. The existing file namespace is used to address the device and this allows the decoupling of device names from their physical connections. The designers invented the notion of the *special file*. Special files are read or written by the same system calls that are employed to access normal disk files, but requests to read or write result in some I/O activity on the associated device. Special files sit in the file system tree, usually in the `/dev` directory, although this is a convention and is not imposed by the design of the system.

The idea is that special files behave like normal files. They are opened, read or written and ultimately closed

using the same system calls that operate on disk files residing in the filesystem tree. The normal filesystem-protection mechanisms can prevent users from accessing devices that they shouldn't; we want to stop mortals from having access to protected data or perhaps inhibit uncontrolled meddling that will crash the system.

Special File Types

Special files come in two flavors: *character* special files and *block* special files. The names here are somewhat confusing. They really represent two different sets of layered routines. The code for block device special files supports the file system. Its job is to move disk blocks between addressable devices and the levels of the kernel that deal with the complexities of the file system implementation.

All other devices are *character* devices. In his 1977 paper in *The Bell System Technical Journal*, Ken Thompson says "while the term *block I/O* has some meaning, *character I/O* is a complete misnomer." He would prefer the term *unstructured I/O* to be applied to character devices and *structured I/O* to block devices. If you hold fairly tightly onto the idea that block I/O supports the file system and everything else is done using character I/O, then you will not get terribly confused.

So, there are two special file types: block and character. If you leap into the `/dev` directory and use `ls`, you can see examples of both (we have removed some spaces from the normal output so that we can fit things across the column).

```
% ls -l sd3g
brw-r-- 1 root 7, 30 Nov 16 10:50 sd3g
% ls -l ttyb
crw-rw-rw- 1 root 12, 1 Jan 4 10:30 ttyb
```

The `sd3g` entry is a block device giving access to part of one of my disks. Notice that read/write access is only allowed to `root`, but read access is permitted to users (or programs) in the same group as the device. If you look at programs like `df`, you will find that they are *setgid* to this group.

The `ttyb` entry is the name given to the second RS232 port on my machine. You can see that these names are really part of the file system by using the `-i` switch to print the number of the inode that stores the relevant information on my machine.

```
% ls -li ttyb
1562 crw-rw-rw- 1 root 12, 1 Jan 4 10:50 ttyb
```

Device names can be linked with hard links, and I generally do this to assign a constant name to the printer on my system.

```
% ls -l lw ttya
crw--w--w- 2 root 12, 0 Jan 4 10:34 lw
crw--w--w- 2 root 12, 0 Jan 4 10:34 ttya
```

The "2" in the second column shows that the inode is pointed at by two directory entries, one called `lw` and the other `ttya`. I have my laser printer attached to the first RS232 port on my machine. This effect is obtained by the command:

```
% cd /dev
% ln ttya lw
```

We can see that the world is split into two sorts of devices, but there appear to be some odd character entries in `/dev/` that bear the names of disks, like:

```
% ls -l rsd3g
crw-r----- 1 root 17, 30 Dec 7 22:44 rsd3g
```

Entries like this are "raw" device entries, and conventionally start with the letter "r" to show this. They permit programs to access the disk without going through the software levels in the kernel designed to support the file system. They allow a program to treat the disk as if it were one single file. The program can open the disk and read or write data using `lseek` for positioning.

Why not simply use the block device entries? There are two main reasons: speed and size. The raw-device entry copies blocks directly from the device into the address space of the user process. The block-device entry will copy data into a kernel buffer and from there into the address space of the user. Of course, the reverse is true if the process is writing. The block device entry is co-operating with the normal disk-caching mechanism. This ensures that blocks are held in memory for as long as possible to minimize access to the physical disks. It also ensures that blocks that are needed by more than one process have consistent contents.

There are many occasions where the caching simply gets in the way, where you want to read blocks from a disk into process address space and perform a task. Disk hardware generally allows you to ask for the transfer of large numbers of contiguous disk blocks into the memory of the machine, and if this memory can be in the address space of your process then things will work much faster. Perhaps you are doing a disk to disk copy where you can read huge chunks of disk into memory and write them out again. Perhaps you are treating a disk partition as if it were a tape, and writing a `tar` image using 20-KB blocks onto the raw disk.

You should also realize that raw devices do not tend to buffer input data and programs need to be written to read at *least* one block at a time if data is not to be lost. A block here is device dependent; for a disk, it can be 512 bytes. For conventional 9-track magnetic tape, it is the amount of data that was originally written as a record on the tape. The size of a record written on the tape is conventionally dictated by the size in bytes of the write system call that wrote the record.

In some ways, I have always felt that this is all a little nasty since it is silently imposing a record structure on a byte stream. If you like, it is imposing some semantics on the

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byte count in the write system call that doesn't occur elsewhere. I find this inconsistent. However, it works and is flexible as long as you understand how to use tools like `dd` where you can impose read/write block sizes.

Major/Minor Numbers

The other bit of magic shown on the `ls` output above is the comma separated pair of numbers that are printed where the file size generally appears. What is meant by 12, 1; 7, 30; or 17, 30?

These numbers are contained in the inode for the special file. The first integer of the pair, the major number, is the internal number used by the kernel to define a device class. It refers to a set of routines that implement the various system calls for the particular device or interface controlling several devices. It is actually an offset in a table of structures. There are two sets of major numbers: one set for the block devices and one set for the character devices.

The second integer, the minor number, is passed into the device open routine and may be used as it sees fit. Generally, the number is used as an offset into a table of structures. So `ttya` has minor number zero and `ttyb` has minor number one. Other devices may subdivide the minor number into groups of bits. For example, the bottom three bits on SCSI disk drives indicate a particular partition on the disk itself, and the remaining bits give the SCSI address of the device. So `sd3g` is major device 7, and minor device 30 decimal. This is 036 in octal, SCSI device 3 partition 6. Please bear in mind that the *name* of the device, `sd3g`, is a randomly chosen string. It just makes sense to make this bit of randomness map onto the SCSI offset number and the partition name.

You can see the tables that access specific devices if you examine the file `/sys/sun/conf.c`. This file contains `bdevsw`, a table of structures controlling block devices. It also holds `cdevsw`, controlling character devices. The definitions for these two structures can be found in `/sys/sys/conf.h`.

These structures mostly hold addresses of specific routines, and these routines are called when the user process performs some I/O system call on the device. This allows the kernel to be tailored to support some devices and not others. If a system does not need a particular device driver, then the entry in the relevant device switch table will be filled with routines that return errors or no-ops.

Device Drivers

To pursue the story a little further, I need to slide down the layers of software and talk about device drivers. These chunks of code sit on top of the hardware, smoothing out the particular idiosyncrasies of the coffee maker or whatever is being driven and presenting a consistent interface to the higher levels of the kernel. There are differences between block I/O and character I/O devices at this level, so let's consider character devices first.

Devices running on a UNIX machine are mostly driven by interrupts. This means that when the device becomes

ready, perhaps it has printed that character or the user has typed something, then the hardware interface signals the CPU to say, "Hey, look at me." The CPU stops what it is doing, stores its current state and will eventually begin to execute a particular routine for the interrupting device.

The other method of driving peripherals is to start them up and loop, waiting for them to finish. The CPU constantly polls the interface in an impatient manner saying, "Aren't you done yet?" We don't really want to use the CPU in this way because UNIX is a multiprocessing system and we should have better things to do with the CPU cycles. This is often debatable, but that's another story. So, most peripherals are driven by saying "start and interrupt when something significant happens."

Because these interrupts can happen at any time, we like to think that the kernel has two levels: the "top level" that communicates with user processes via the system call interface and the "bottom level" that is started when an interrupt occurs. These two levels run asynchronously.

These structures mostly hold addresses of specific routines, and these routines are called when the user process performs some I/O system call on the device.

The CPU will run much faster than peripherals, and output processes will generate data much more quickly than devices can deal with it. The kernel buffers some data but will make the process sleep until the buffers have drained. The buffering is normally a linked list that the interrupt routine interrogates. If there is anything to do, the routine will restart the I/O interface.

The interrupt routine may decide that the user's occupancy of the kernel list has reached some acceptable level (often zero) and may restart the user process. So, there can be a considerable discrepancy between what the user has seen on a display and what the process generating the data has really output. But the buffering makes sense; it means that devices are kept working as fast as possible.

For input devices, the interrupt routine will place the incoming byte onto the end of a linked list and then decide whether to wake the user process or not. If the list is full, then the byte is often simply thrown away because there is not much else that can be done with it.

Mostly, a user process will have executed a `read` system

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call and will be patiently waiting for the user to type something. This is the state of most processes that take input from users on a UNIX system. In normal *cooked* state, a terminal interface will retain all the characters that a user has typed until the return key is hit. The whole input line is sent to the user process. In this case, echoing of characters and character/word deletion is done in the kernel. Contrast this with *raw* state, where every character that the user types is sent into the process that is executing the `read` system call *as soon* as the interrupt is taken by the CPU.

System Call Entry Points

The *bottom* half of the device driver is usually one single interrupt routine. The remaining code in the device driver copes with the various calls that may be made from user processes via system calls. If you look at the `cdevsw` definition in `conf.h`, you will find the entries for character devices that map onto various system calls.

The `open` routine in the device driver is called when an `open` system call is made for the device. The job of the device driver `open` routine is to initialize the device ready for action. This mostly means setting internal state in the device driver. Many devices only permit a single process to access them at any one time and the `open` routine will return failure if the device is already in use. Sometimes, the `open` routine will put the user process to sleep pending some event. If you have a terminal line listening for a modem, then the program that starts terminals up, `init`, will spend most of its time waiting for carrier to be asserted by the modem. It will be sleeping in the `open` routine for the device.

The `close` routine in the device driver is called on the *last* close of the device. This allows the device to be closed down when everyone has stopped using it, and also ensures that we have a time when we can clear internal state bits, flush buffers and sundry other jobs.

The operation of the `read` routine will vary slightly from device to device. The user process asks for a certain number of bytes to be returned. The device drivers can treat this as a maximum and return not more than the requested count. This is common practice with character-based devices. Alternatively, the device driver can treat the number as a mandatory request and wait indefinitely until the correct number of bytes are present.

The `write` routine takes data from the user's address space and sends it to the device. As we have seen, the process will be forced to sleep if there is insufficient space in the kernel buffers. For character devices, the `write` routine will place the data on the output list and will wake up the device if it is not already functioning. Control will be returned to the user process when the data has been written.

I haven't said much about the `ioctl` system call. This system call performs specific device-dependent actions. It can alter the behavior of the device driver, perhaps changing its action from "cooked" to "raw" mode. Alternatively, it can affect the hardware that the device driver talks to, perhaps changing the baud rate of the interface. The device driver

may or may not provide a special routine that intercepts the `ioctl` system calls and changes its operation.

There are several other entries in `cdevsw` that I am choosing to ignore for the purposes of this article.

Block Device Drivers

Device drivers for block devices are not called directly by system calls. They are used by the levels in the kernel that manage the file system. The main entry from the user level code is a `strategy` routine; this is passed a control block saying "I want you to read/write these bytes from/to the disk at this offset." The word "disk" is used loosely here to mean any block-structured device. The `strategy` routine will generally map the block within a disk partition into some real address on the disk and then put the request on a list of things to be done.

Block-device drivers have interrupt routines that will dequeue the list element relating to the action that has just finished and then start a new transfer. Block-device drivers do have the ability to have `open` and `close` routines, but often these do little except establish initial settings on various data structures.

Finally

The I/O structure is one of the strong points of UNIX. Most I/O actions fit into the UNIX notion of byte stream I/O, and the addition of the `lseek` system call permits randomly accessed objects like memory or device frame buffers to be modelled as an I/O device.

There are several "funny" device drivers that do not *really* support physical devices. For instance, `/dev/null` is a data sink and null source. The two memory devices, `/dev/mem` and `/dev/kmem`, access the physical memory on the machine and kernel virtual memory respectively. Pseudo terminals provide a connection through the kernel. They behave like a standard UNIX terminal at one end and a byte stream at the other.

The naming structure makes access to devices unsurprising. You don't have to remember some odd name when accessing a device. If you have forgotten the name, a quick `ls` on `/dev` soon jogs the memory.

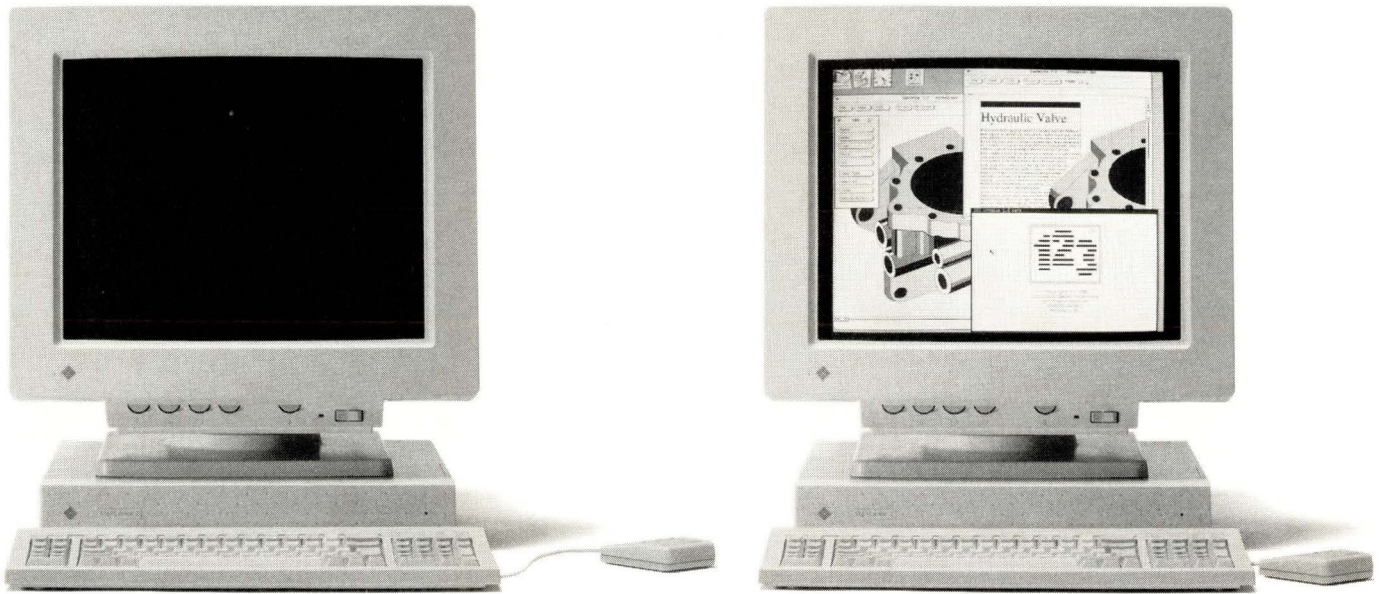
Reading

If you want to pursue this, then the source papers are found in *The Bell System Technical Journal*, July-August 1978, Vol. 57, No. 6, Part 2. This is the first UNIX edition and is often called the "Blue Book" because of its cover.

Secondly, look at the excellent MINIX book, *Operating Systems: Design and Implementation* by Andrew S Tanenbaum, published by Prentice-Hall. ➡

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 1+. Email: pc@expert.com.

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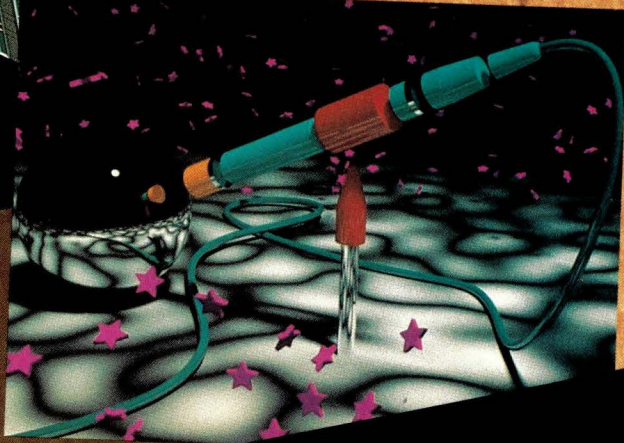
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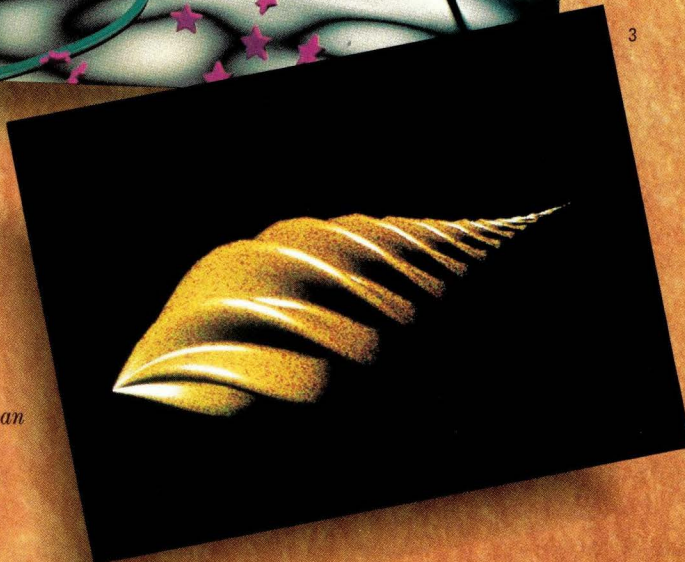
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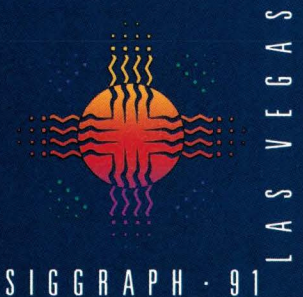
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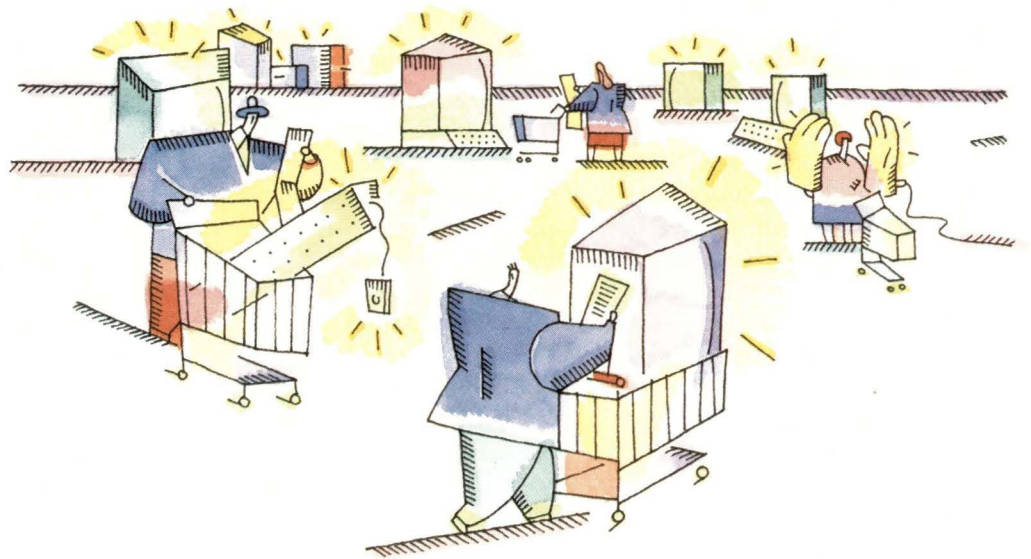


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A Workstation Wish List – Part 1

by **RICHARD MORIN**, Technical Editor

Today's workstation buyer is faced with a mind-boggling array of hardware. Limits on budgets, desk space and interface buses constrain the ultimate configuration, but one can still get a lot of performance on a reasonable budget. This column discusses some of the possibilities, giving arguments for (and against) various technologies.

A workstation *must* have certain components. The typical definition includes a high-resolution display, a pointing device (typically a mouse), a CPU and a reasonable amount of memory. In addition, however, there must be access to online storage and some way to back up and exchange data.

Displays

Workstations always have high-resolution displays; a million pixels is typical. This allows the user to display a number of windows at the same time,

easing such tasks as comparison of documents. It also allows the detailed display of charts, graphs and other images.

Displays vary, however, in their physical size and in the amount of data that can be encoded into a single pixel. Each pixel can be set to a given intensity and color, and can vary over time to give dynamic cues.

Monochrome displays are the simplest and cheapest option. They have one bit per pixel, which specifies either black or white. This makes them quite suitable for text applications, and for many forms of charts and graphs.

Grayscale displays have a range of intensity levels (typically 256). They do everything that monochrome displays do, but add image display and shaded graphics. The bad news is that they cost more than monochrome displays, and can be slower.

Color displays select from a large palette of colors (typically 16 million).

Color-mapped (8-bit) displays are limited to a small subset (typically 256) of the palette's colors at any one time. Full-color (24-bit) displays can use the full palette, limited only by the number of pixels on the screen.

Color-mapped displays tend to be cheaper and faster than full-color displays. They can be used with grayscale images, and work well for color charts and graphs. Their main disadvantage is that they are poorly suited to manipulation of color images. Multiply all of the values in a 24-bit image by two, and you get a brighter image. Do the same with a color-mapped image, and you get garbage.

All color displays, however, suffer from a lack of resolution when compared to monochrome or grayscale displays. Each color pixel is actually a triplet of (red, green, blue) pixels. Despite heroic efforts by the manufacturers, the three pixels cannot be "converged" to a single crisp pixel.

Consequently, I prefer monochrome or grayscale displays for most text applications.

If desk space is not an issue, consider installing two displays. The cost is not that high, and the benefits (crisp text, color, *lots of room for windows*) are substantial. My Sun-3/60, for instance, has an 8-bit color display and a monochrome display.

For time-based information display (animation, etc.), the display should have multiple frame buffers. This allows a new image to be created while the user is viewing the old one. More buffers can be added to allow overlaying of images, Z-axis clipping and so forth.

None of this is cheap, however, due to the need for memory and specialized support hardware. Sun is just starting to get into this arena and their offerings may well lower the entry price. It would be wise, however, to compare their features and performance with those offered by vendors such as Silicon Graphics and Stardent.

Pointing Devices

Sun provides a three-button mouse, which serves most users quite well. Some specialized applications can benefit from alternatives, however. Digitizers are useful for cartographic, drafting and other applications needing precise specification of locations. Most can be set to give either absolute position (digitizer mode) or relative motion (mouse mode).

Touch screens are useful for rapid selection of menu items. Unlike mice, they do not require the user to be sitting down. They do not have very precise control, however, and can cause fatigue and "touch-screen elbow" if used for prolonged lengths of time.

Track balls fill the same role as mice, but require less space and a smaller range of motion. A track ball uses smaller motions than a mouse, but requires more of them. The choice is really one of personal taste, rather than one of usage type.

Several 3D pointing devices are now available, including digitizing pens, space balls, and data gloves. Try them out with an actual application, deter-

mining whether they match its needs for precision, speed and comfort. Also, talk with other users, getting their feedback on the devices. Finally, make sure that you can return a pointing device if it doesn't work well for you.

CPU and Memory

The type of CPU may or may not be critical, depending on the need for purchased or vendor-supplied software. If all programs are locally developed and the coding style is portable, any processor will serve. Otherwise, choose a processor with a large selection of available software.

Most of the time, for most users, CPU speed is not an issue. If an interactive response takes less than a tenth of a second, it doesn't much matter how much less it takes. Longer tasks, if infrequently executed, may not be a severe problem.

There are important exceptions, to be sure. CAD users cannot afford to wait around for the screen to be redrawn. Software developers need rapid compiles and links, and perform them on a frequent basis. Scientists need prompt responses to their inquiries, and a great deal of computation may be involved.

Compute power can be critical in large batch applications as well, although this use strains the definition of a "workstation." The bottom line, however, is that one may be able to get along with far less than the maximum available compute power. The savings can be substantial, allowing more to be spent on memory, peripherals, software, etc.

Lack of memory is frequently a cause of poor system performance. Computers with too little memory spend their time waiting for swapping and other I/O to complete, instead of doing productive work. The `perfmom` utility, unfortunately relegated to `/usr/old`, gives a very useful overview of system activity. Use it, along with `perfmeter`, to determine whether your system needs more memory.

Disk Storage

The advent of small, inexpensive SCSI disks has transformed the

appearance of UNIX systems. The rack-mounted, 8-inch and 14-inch disks are gone, replaced by 5-, 3- and even 2-inch diameter drives. The access times are low, the transfer rates are quite acceptable and the reliability is now up to very respectable levels.

The cabinetry, power supply, assembly and testing cost the same for any 5-inch drive. After this initial offset, costs go up linearly with storage capacity. It is thus cheaper to buy a large drive than to buy several small ones. In addition, each drive consumes power, takes up space and uses a SCSI ID. This argues for buying disk storage in large chunks, rather than small ones.

An argument can be made, however, for multiple disks. With two disks, you have two sets of heads moving to the data. This reduces overall access times, and can increase system performance. For most applications, however, large disks (and sufficient memory) are the right choice.

Disk Alternatives

Some applications require occasional access to large amounts of data. One example might be a build tree for an infrequently modified package. Tape storage is too inconvenient and disk storage too expensive for the task at hand. Magneto-optical storage technology (MOST) drives offer an alternative, providing economical and convenient random-access storage.

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The drives are not blindingly fast, particularly when writing, but I have not found speed to be a problem. Navigation on the MOST (`cd`, `ls`, etc.) is acceptably fast. Compiles and links are compute-bound on a Sun-3/60; on a faster machine, disk speed might be a greater concern.

Another technology, CD-ROM, is being forced upon the Sun community. Buy a CD-ROM, we are told, or you won't be able to get new software.

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This is not such a bad deal, however: Only one drive is needed per site, and a multitude of disks may well emerge to take advantage of this large new market. Wait a while before faulting Sun's judgement on this one...

Tape Storage

Sun has changed the rules on backup devices nearly as often as they have on CPUs. They have supported QIC-11 (20 MB), QIC-24 (60 MB) and QIC-150 (150 MB), with occasional nods to 1/2-inch tape (1600 and 6250 bpi) and 8mm video cartridges (2.2 GB). Unfortunately, the picture is still quite unclear, leaving users in a quandary.

Some things are quite clear, of course. With CD-ROM becoming Sun's official software distribution medium, tape is relegated to data interchange, third-party software distributions and system backup.

The size of tape reels, combined with their limited capacity (~150 MB), makes them poor choices for backup storage. Nor do many software vendors like to distribute on open-reel tapes. If you really need to interchange 1/2-inch tapes, buy a dual-density (1600/6250) drive. Otherwise, forget it.

The tape cartridge picture is less clear. QIC-11 cartridge drives are gone from the scene, never to return. Neither QIC-24 nor QIC-150 offers a viable backup strategy for any but very small systems. Consequently, their real use lies in software and data interchange.

Most software vendors use QIC-24 format, which can be read by either QIC-24 or QIC-150 drives. Similarly, most Sun sites have at least one QIC-24 drive, making QIC-24 a useful data-interchange format. If you are only going to buy a single cartridge drive, today's best choice might well be a QIC-24.

Unfortunately, things are not that simple. Sun no longer sells QIC-24 drives, having moved on to QIC-150. Consequently, many new sites will have only QIC-150 drives. Although the QIC-150 can read both QIC-24 and QIC-150 formats, it can only

write QIC-150 tapes. Sites with frequent interchange requirements may thus need to purchase a QIC-24 and a QIC-150 drive (sigh).

None of this solves the backup problem, of course, which is why 8mm drives are popular. The EXB-8200 drive, found in most current 8mm offerings, stores 2.2 GB on a single 8mm video cartridge. The new (EXB-8500) drive offers double this capacity, along with rapid access to individual files.

With compression, these numbers typically can be doubled. (Some vendors tout larger gains, but compression rates are highly dependent on the input data.) In any case, an 8mm cartridge can store between 2 and 10 GB of data, making it very suitable for system backup. As a bonus, the cartridges are cheap (\$6 to \$9) and small (about the size of an audio cassette).

Sun now supplies 8mm drives on its large servers, and many sites have bought them as add-on devices. Digital-audio tape and other formats may be coming, but 8mm has a substantial share of the workstation market, and it won't disappear without a fight. Consequently, 8mm has become a de facto standard for interchange of large amounts of data among workstations.

Resource Sharing

Most workstations live on networks, so some of these devices (most notably tapes, disks and quasi-disks) will be found only on some of the workstations at a site. Larger sites will find uses for devices such as disk and tape changers. The basic needs and technologies will be the same, however, as will the decision-making process. Next month, we will look at optional peripherals, ranging from the prosaic (printers, modems) to the exotic (no peeking). →

Richard Morin may be reached at Canta Forda Computer Laboratory, P.O. Box 1488, Pacifica, CA 94044. His electronic address is apple.com!cfcl!rdm, or he can be reached at rdm@expert.com.

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by **PETER H. SALUS**

NIST and FIPS

Once upon a time the U.S. Department of Commerce ran the National Bureau of Standards. Over the years, however, the tasks of the NBS expanded far beyond national standards and, at the end of the Reagan administration, the name was changed to the National Institute of Standards and Technology, NIST.

One of the things that NIST does is sponsor workshops. As of now, there have been six semi-annual workshops on the Applications Portability Profile (APP) and its application to the Open Systems Environment (OSE). The

APP Users' Forums are designed to give both users and "providers" an opportunity to get information and to provide feedback on NIST proposals. The current APP defines seven functional areas:

- 1) operating-system services;
- 2) program services;
- 3) data-management services;
- 4) data-interchange services;
- 5) user-interface services;
- 6) graphics services; and
- 7) network services.

Last November's NIST workshop

provided a status report on standards and activities in the APP, OSE, IEEE and JTC1 areas, and solicited users' opinions of what priorities should be applied to future work items.

Another of the things that NIST does is issue Federal Information Processing Standards, or FIPS. As the U.S. government is the largest consumer of computer software and hardware in the world, comprising between 20% and 25% of the American market, FIPS are of great importance. The current estimate is that the U.S. government will purchase about \$17 billion worth of POSIX systems in FY

1991. The theory is that setting up a FIPS avoids vendor-specific requirements like SVID or XPG/3. The larger the number of vendors that can meet a specification, the lower the cost to the taxpayer.

Once NIST has established a FIPS, purchases by government agencies are required to adhere to it. As very few manufacturers want to eliminate the possibility of selling to the government, the FIPS have a great deal of force in the marketplace.

Take FIPS 158 as an example. In mid-1989, NIST announced that it would propose X11R3 as a FIPS for user interface systems. There was a great flurry of objection—much of it from Sun Microsystems Inc. and other UNIX International supporters. There was an extremely strong letter sent by Scott McNealy to the Secretary of Commerce. There were also a large number of letters in support of the proposed FIPS, most (though not all) from OSF and its sponsors. The objection deadline passed; several months passed. Finally, last spring, the Secretary of Commerce authorized the publication of the FIPS, adopting “X11 Release 3 X Protocol, Xlib, Xt, and bitmap distribution as a non-compulsory standard for use by Federal agencies,” effective May 1, 1990, with NIST anticipating “updating the standard as appropriate...Release 3 was specified rather than Release 4 because Release 3-based products are much more widely available.” The standard was effective November 1, 1990—six months after publication.

There have been many other FIPS over the years. And there have been a number of complaints—not all from manufacturers—that in promulgating FIPS the U.S. Government is usurping the province of standards bodies. NIST points out that FIPS 151 certainly accelerated the IEEE's production of 1003.1-1988. NIST's pushing of a “Shell-and-Tools” FIPS is their way of goading 1003.2 to approve Draft 10.

One of the goals of NIST is to satisfy the real needs of the U.S. government. A standard operating system is certainly necessary, and it is politically

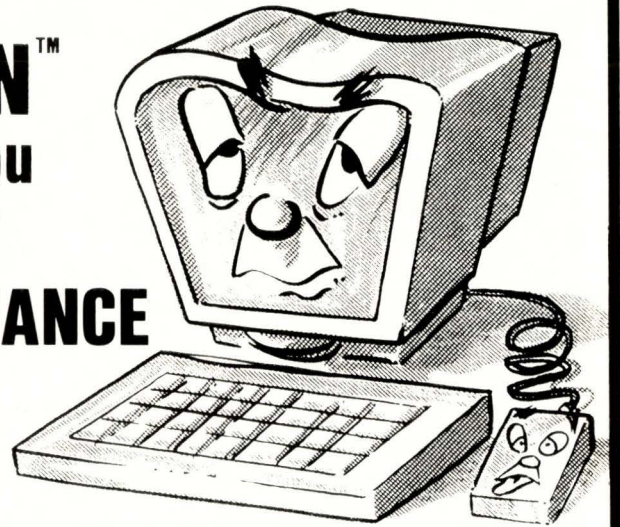
unacceptable for the government to opt for System V.n.

On another front, as a U.S. agency, NIST has been saddled with the job of providing technical support to the Internal Revenue Service in its redesign of the American tax administration system. The project is an immense one, involving NIST technical evaluations of hardware and software, architectures and technologies. The current Plan calls for completion in October 1991.

For those of you interested in NIST's activities, I recommend their “special publication,” *Research Reports*; call (301) 975-2762 to get on the mailing list. ➔

Peter Salus is the executive director of the Sun User Group. He has attended both ISO and P1003/P1201 meetings and expects remission of time in purgatory as a result. Email: peter@sug.org.

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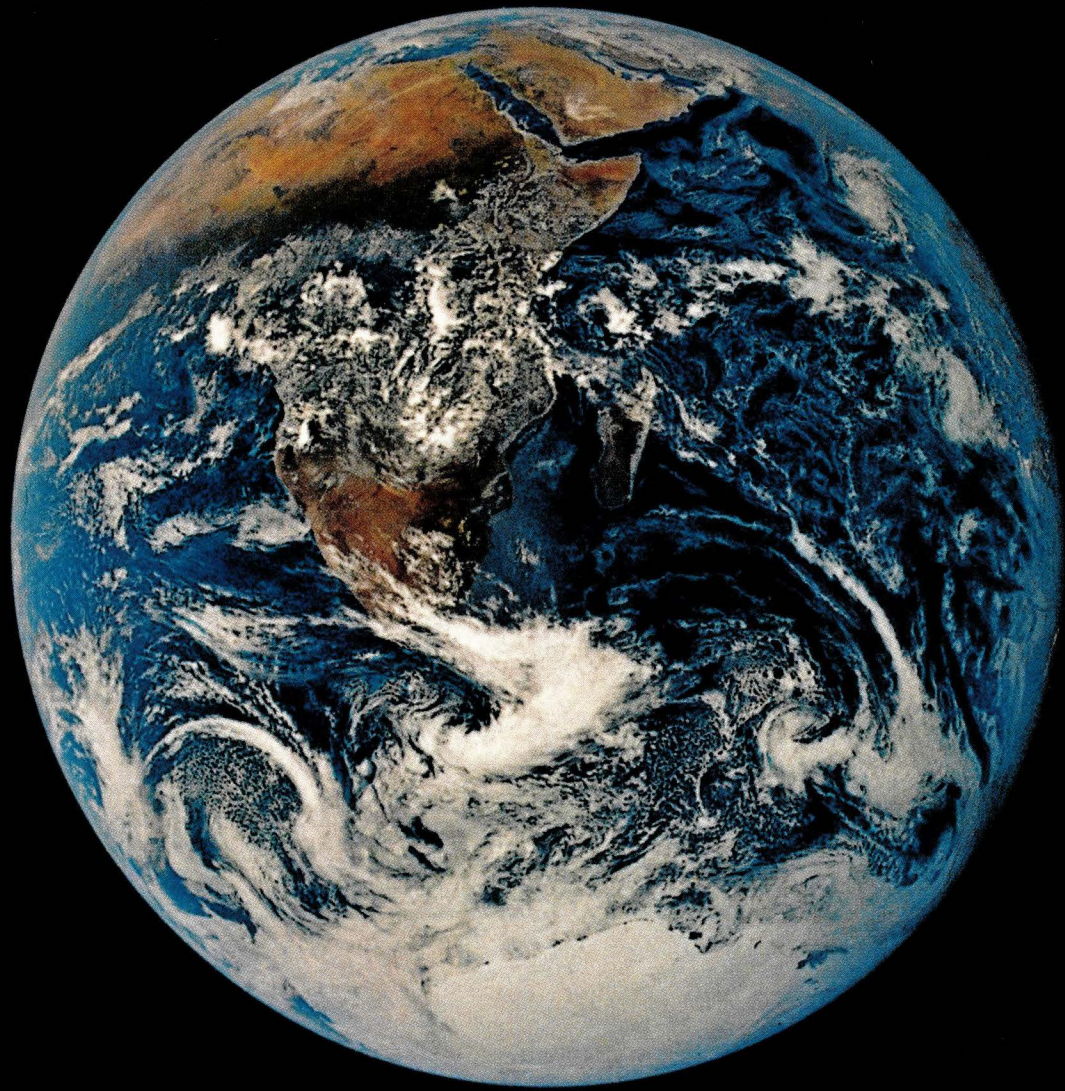
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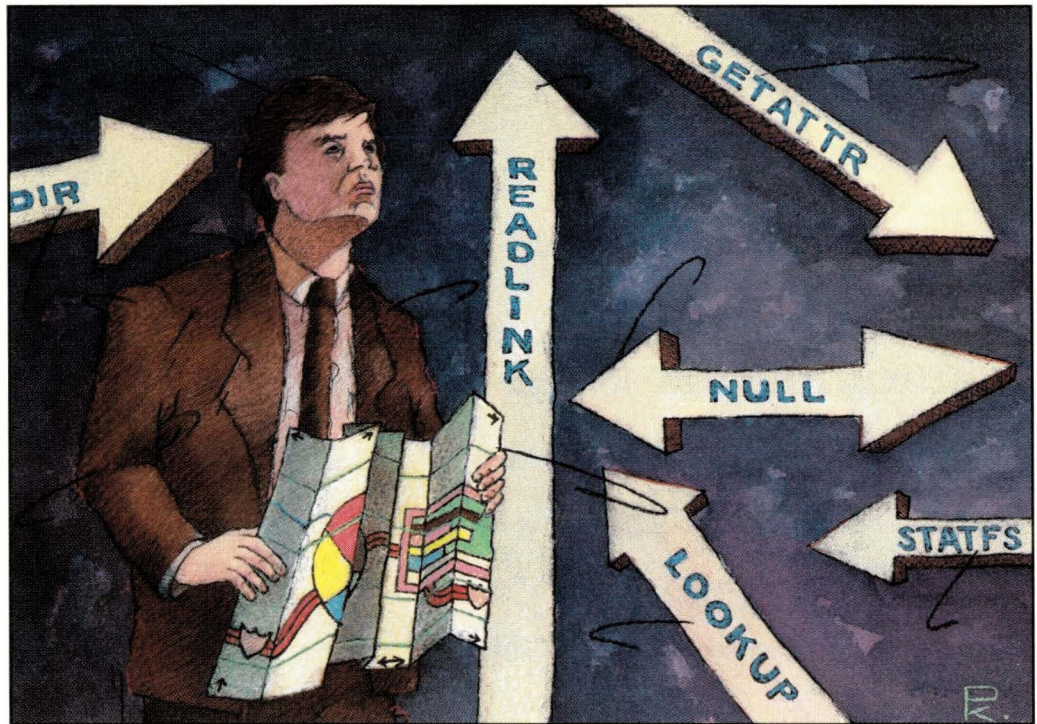


ILLUSTRATION BY PETER KALABOKIS

The Automounter – Part II

by DINAH MCNUTT, Technology Transfer Associates

Last month I gave an overview of the automounter, a useful utility for managing your network of NFS filesystems. I included enough information to get you up and running. This month, I will describe in more detail how the automounter works including some special map features.

Functional Overview

The automounter is a daemon that provides NFS service via RPC calls from the UNIX kernel. At startup, the automounter opens a UDP socket and registers with the portmapper as an NFS server. To the kernel, the automounter looks just like any other NFS server, except it runs locally on the same machine as the kernel and uses loopback RPC to communicate with the kernel.

Since the automounter mainly provides mount and naming services for filesystems it only needs to support a small subset of the NFS protocol commands: NULL, LOOKUP, GETATTR, READDIR, STATFS and READLINK. All of these commands are required to provide naming services to the kernel to locate files and directories. The automounter never sees the other NFS requests since the kernel uses the symbolic link provided by the auto-

mounter to directly access the file or directory.

Built-in Maps

There are two built-in maps recognized by the automounter: `-hosts`, and `-null`. The `-hosts` map uses the file `/etc/hosts` or the NIS map `hosts.byname` and does not require an explicit automounter map. Simply start the automounter with:

```
automount /net -hosts
```

Then, a user issuing the command,

```
cd /net/karazm
```

causes the automounter to mount all exported filesystems of host `karazm` under `/tmp_mnt` with symbolic links pointing to the appropriate location under `/net/karazm`. (Normal restrictions to accessing the exported filesystems still apply.) This is a convenient way for users to access remote filesystems without having to `rlogin` or `rsh`.

The automounter pings the remote host to see if it is alive. If so, it requests a list of exported hierarchies from the host

and sorts the list according to the length of the pathname. (i.e., /usr, /usr/local, etc.). Then, the automounter proceeds down the sorted list, mounting all the filesystems at the appropriate mount point under /tmp_mnt creating mountpoints as needed (i.e., /tmp_mnt/karazm/usr, /tmp_mnt/karazm/usr/local, etc.) The automounter then returns a symbolic link to the kernel that points to the top of the hierarchy (/tmp_mnt/karazm).

One of the big advantages of the automounter is the ability to define multiple locations for a single map entry.

There are several problems with using the `-hosts` map. Mounting many exported filesystems from a slow file server can take a while. You may only be interested in one specific filesystem, but have to wait for all of the filesystems to be mounted. If this is the case, mount the filesystem of interest via an indirect map instead.

Also, not all filesystems may be exported to your system. Required mount points for some filesystems that are exported may not be accessible. Finally, the automounter must unmount the filesystems from the bottom up and if one of the directories at the top of the hierarchy is busy, the automounter must remount the hierarchy and try again later.

The `-null` map cancels any subsequent map for the indicated mount point. For instance,

```
automount /home -null
```

cancels the entry for /home in the `auto.master` file.

Multiple Mounts

A map entry may contain multiple mounts. The mount root is the top of the hierarchy mounted under /tmp_mnt. For simple map entries, the mount point relative to the mount root is omitted since the automounter assumes the mount point to be at the mount root (or /). In other words,

```
source -rw,soft bighost:/export/source
```

is equivalent to:

```
source / -rw,soft bighost:/export/source
```

The mount root must only be specified for multiple mounts:

```
devel \
/bin -rw,soft bighost:/export/devel/bin/sun4
/obj -rw,soft bighost:/export/devel/obj/sun4
/src -rw,soft bighost:/export/devel/src
```

The advantage of using multiple mounts is that now when /home/devel is accessed (assuming the above entry came from the `auto.home` map file), all three filesystems are mounted. References between these trees will work:

```
cd /home/devel/bin
cd ../src
```

The second command would not work if you had listed each mount as a separate entry. As with single mounts, all three filesystems will be unmounted together.

Replicated Filesystems

One of the big advantages of the automounter is the ability to define multiple locations for a single map entry. Note that this is probably only practical for read-only filesystems since changes would not automatically be propagated to the other filesystems. Man pages are a good candidate for this type of mount entry:

```
man -ro,soft karazm:/usr/man whosit:/usr/man
```

or

```
man -ro,soft karazm,whosit:/usr/man
```

At mount time, the automounter selects a server from the list by translating the IP addresses of the hosts and trying to make an educated guess about which hosts are on the local network. (It does not know about subnets, however.) It then pings the local hosts and issues a mount request to the first server to respond. If this mount request fails, the automounter will delete that server from the list and send another ping request to the remaining local hosts. If the list of local hosts becomes exhausted, the automounter will use the remainder of the hosts in the mount list.

Once the filesystem is mounted, if the fileservers goes down, the filesystem will become unavailable. The automounter will not unmount the unavailable filesystem and try to mount one from one of the alternate servers. The redundancy feature is only effective at mount time.

Substitutions and Metacharacters

The automounter will substitute environment variables when the map is read. Architecture-dependent filesystems can be mounted using the automounter and `$ARCH` as follows:

```
exec karazm:/export/exec/$ARCH
```


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If there is no environment variable `ARCH` defined, the automounter will use the output of the `arch` command.

Environment variables may be defined directly on the command line with the `-D` option:

```
automount -D SRC=4.0 /home /etc/auto.home
```

Then, the map entry in `/etc/auto.home`

```
source karazm:/usr/local/src/$SRC
```

will cause the filesystem `karazm:/usr/local/src/4.0` to be mounted when the user accesses the directory `/home/source`.

Running one automounter process instead of several requires less system overhead.

An ampersand “&” will substitute the value of the key in the map entry. This feature allows you to use either of the following two entries to mean the same thing:

```
karazm karazm:/export/karazm
karazm &:/export/&
```

A catchall entry will match all entries of the same format:

```
* &:/home/&
```

Note that any entries after the catchall key will never be matched.

Mounting Home Directories

The automounter can be used to mount users' home directories. This has several benefits:

- Home directories are only mounted when needed,
- Users can log into different systems and have their home directories automatically mounted, and
- The tilde “~” expansion can be used to locate home directories for users outside your NIS domain without having to know the location of the user's home directory.

To mount home directories with the automounter, use the `/etc/auto.home` map:

```
automount /home auto.home
```

Entries in `/etc/auto.home` on your NIS server will look like:

```
dinah karazm:/home/karazm/dinah
jet karazm:/home/karazm/jet
stanh wilkins:/home/wilkins/stanh
```

Even though `stanh` is in another NIS domain, I can now

```
cd ~stanh
```

without having to know the fully qualified pathname of `stanh`'s home directory. In order to prevent multiple mounts of the same filesystem, you could rewrite the first two entries as:

```
dinah karazm:/home/karazm:dinah
jet karazm:/home/karazm:jet
```

If you do use the automounter to mount home filesystems, tell your users to

```
alias pwd 'echo $PWD'
```

This ounce of prevention will keep `pwd` from returning `/tmp_mnt/home/whatever` as the path, which can cause endless confusion for users.

Command Line Options

You can start one automounter daemon that can handle several different mount points:

```
automount /home auto.home /net -hosts
```

Running one automounter process instead of several requires less system overhead and makes it obvious which process to use.

The `-M` option can be used to specify an alternative directory from `/tmp_mnt` and you can use the man pages to learn about all the other options available.

Hints and Miscellaneous Problems

Make sure that you do not have a filesystem mounted under an automounter mount point. Just as regular filesystem mounts issued with the `mount` command will successfully complete, obscuring the original filesystem from view, so will mounts issued with the automounter. If you want to use the `auto.home` map to mount filesystems under `/home`, move any existing mounts to `/export`.

Programs that cache symbolic links may have problems if they are using the actual mount points under `/tmp_mnt` because these mounts are volatile and may not be available the next time the program accesses them. Programs and users should use the paths recognized by the automounter (i.e., `/home/dinah` instead of `/tmp_mnt/dinah`).

Remember that new entries in direct maps will only be recognized at initialization time. Existing direct map entries may be changed at any time.

You may find that the default time (five minutes) for unmounting an inactive filesystem may be too short. Because there is a small delay in accessing an unmounted filesystem versus accessing one already mounted, you may want to increase it to as much as one hour.

The automounter only reads the `/etc/mtab` file whenever it performs a `mount` or `umount`. To unmount an automounted filesystem, issue the `umount` command and then obtain the process id of the automounter:

```
kill -1 <pid>
```

This command will cause the automounter to reread the `mtab` file and receive the information that the filesystem is no longer mounted. This is a good reason for only running one automounter process.

You can use the automounter as a way to let workstations within the same server group access different versions of the same software. I use the `auto.home` map and create a convenient symbolic link from `/usr/XYZsoftware` to `/home/XYZsoftware`. Then, I decide which is going to be the most common version of the software and add an entry in the `auto.home` file on the NIS server:

```
XYZsoftware karazm:/usr/XYZsoftware_version_2.0
```

Then, in the local `/etc/auto.home` file of each worksta-

tion that wants to use the non-standard version of the software, I simply add the following lines:

```
XYZsoftware karazm:/usr/XYZsoftware_version_2.1
+auto.home
```

The last line tells the automounter to go to the NIS map file for the rest of the entries. Note that the first entry of the keyword is the one actually used. Once the automounter finds a match, it stops reading the file.

References

For more information on the automounter, I suggest the following reading:

1. `man 8 automount`.
2. Chapter 15—"Using the Automounter" from the *Network and Communications Administration* manual in the SunOS 4.1 documentation set.
3. Brent Callaghan and Tom Lyon, "The Automounter," *USENIX Winter Conference Proceedings*, pp. 43-51, 1989.
4. Brent Callaghan, "The Automounter—Using It Effectively," *Sun User Group Eighth Annual Conference Proceedings*, pp. 31-70, December 1990. ➔

Dinah McNutt is senior staff scientist at Technology Transfer Associates. She has had six years of system and network administration experience and is on the board of directors for the Sun User Group. Email is dinah@expert.com.

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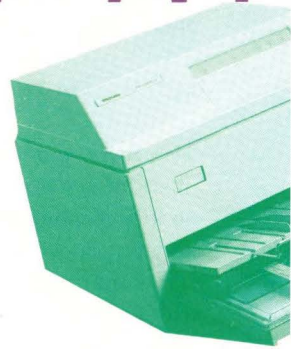
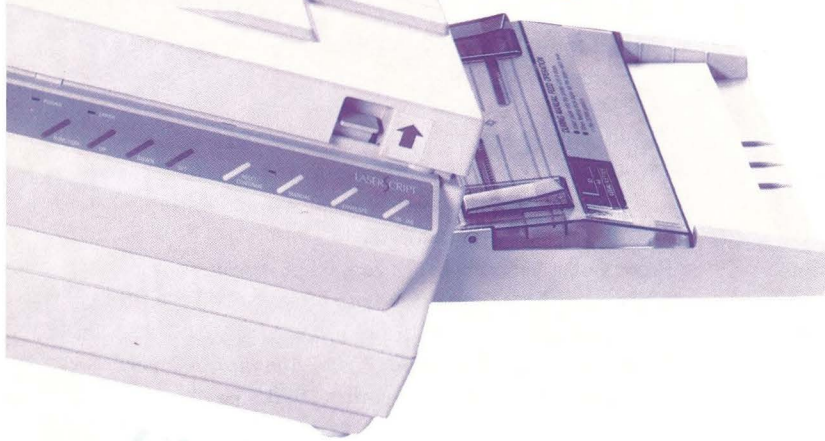
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HARDWARE SURVEY

EXPLORING PRI



by **MARK NUNES**, Contributing Writer

Back in 1985, Adobe Systems Inc. released PostScript, a page-description language (PDL) that functioned independently of the printing device, making it possible to print output which combined text and graphics on the same page. PostScript soon became an industry standard.

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PostScript had offered users exceptional font integrity through a technique of outline font handling called "hinting." Sun Microsystems Inc.'s F3 font format, and both Hewlett-Packard Co.'s and Microsoft Corp.'s new PDLs all incorporate this technique to produce equally exceptional character integrity. As companies like HP and Microsoft develop PDLs that are unique yet compatible with PostScript, end users can choose from a wider array of fonts, font handlers and page-printing capabilities. Printer devices have also progressed in both technology and affordability. While "clones" once ran slower than PostScript-fitted printers, many PostScript-compatible and PostScript alternative printers now

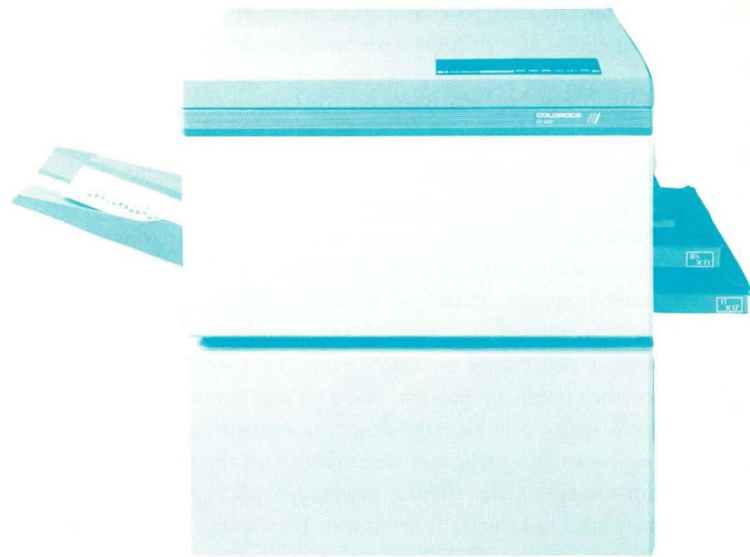
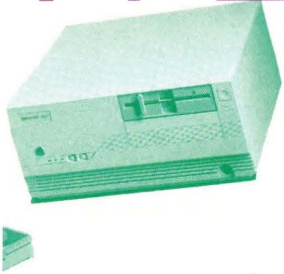
run at speeds comparable to true PostScript printers.

Attempts by companies to reduce costs of devices have also meant that laser and color printing have become more accessible than ever. Meanwhile, Adobe has announced the release of PostScript Level II, while Sun has introduced an entirely new printing model that is fast, flexible and makes the most out of a company's existing printing devices. The new message in the page-printer scene is flexibility and versatility, and the race is already well underway.

Font Control

As with Adobe's Type 1 hinting, one of the advantages of PostScript had been its ability to manage fonts, printing in various rotations and orientations. The new PDLs and PostScript emulators, however, now offer comparable font control. HP's PCL 5, the printer-control language featured in the new LaserJet III, provides font scaling, vector graphics, raster compression and expanded control over print direction, as well as allowing developers to specify font fills and overlays. PCL 5 also provides font metrics automatically through AutoFont Support, eliminating the need for software developers to provide metric codes. Microsoft also announced a PDL

PRINTER OPTIONS



alternative last year, the TrueType-TrueImage system. TrueImage includes font rasterizers for both Adobe Type 1 and TrueType fonts. Microsoft says that the PDL and font handler will be available in both Windows and OS/2 environments.

Sun's newly released NeWSprint (see below) also provides several Sun alternatives to PostScript font control, including TypeScaler, which interprets and fills the F3 hinted fonts in any orientation and point size, rather than storing separate orientations as separate font sets. Sun hopes to keep its font system open and expandable, providing developers with TypeMaker, to aid in the production of quick and accurate outline fonts.

RISC-y Printers

The implementation of reduced instruction set computing (RISC) in new printers has allowed PostScript-compatible devices to function at a faster rate, and at a significantly less expensive price. By using a RISC microprocessor, bottlenecking problems are drastically reduced, raising the limit on a printer's processing speed. RISC processors do present some problems, however, namely with software packages that are specifically designed to download 68000 code. Several monochrome laser printers, such as Qume Corp.'s

CrystalPrint series and Epson America Inc.'s EPL 7500 make use of RISC chips. Seiko Instruments Inc. announced last summer the release of ColorPoint PS, the first thermal color transfer printer to make use of a RISC processor. According to the company, the Intel I960 chip allows the ColorPoint PS, which uses PhoenixPage emulation (see below), to function up to 60% faster than CISC-based (complex instruction set computing) printers. CalComp Inc. announced in January the ColorMaster Plus series, a color, thermal, PostScript-compatible printer that also uses a RISC controller. ColorMaster Plus comes in versions that include vector-to-raster conversion and RGB screen capture.

The Laser+Options Model

Several manufacturers now sell upgradable low- to mid-range laser printers. Users can add PostScript compatibility, memory expansion and font cartridges. The strategy behind this kit design is to provide both a reduction in cost and an increase in flexibility. Both Texas Instruments Inc. and IBM Corp. offer similar upgradable printers. TI's microLaser and the faster microLaser XL have a plug-in board design, allowing for easy upgrade to PostScript, 4.5 MB of memory and

35 fonts. IBM's Laser Printer E offers two PostScript options, as well as 35 fonts and 4.5 MB of memory. Fujitsu America Inc. and Okidata America Inc. have followed the same strategy with their LED printers. Fujitsu's upgrade of the RX7100, the new RX7100/S2, comes standard with several emulations, and is capable of add-ons including 4.6 MB of memory, 35 fonts and PostScript compatibility. The Okidata OL800 is capable of similar upgrades.

Phoenix Technologies Ltd. provides another alternative through PhoenixPage, a cartridge that, in effect, translates the incoming PostScript file into a set of functions that can then be processed by the HP LaserJet II and other devices. PhoenixPage does not, however, provide the file compression and font handling of PostScript level II. Meanwhile, both HP and Adobe are undertaking to supply add-on cartridges that will retrofit LaserJet II and compatible devices, effectively providing older printers with new features.

The New NeWSprint Model

According to the company, Sun's new NeWSprint, SPARCprinter and SBus Printer Card trio "redefines the printing model for networked workgroups." With NeWSprint, networked users are no longer limited by the memory and processor capacities of the printer itself, since raster-image processing occurs at the SPARCstation. NeWSprint actually eliminates the need for dedicated hardware in the printer. By making use of the workstation's power for the rasterizing process, Sun says that not only can NeWSprint provide page-description printing at a lower cost, but it can also make any raster device on the network—from dot-matrix to laser plotter—produce PostScript-compatible output. Since the 57 fonts and its page queueing are stored at the workstation, NeWSprint also eliminates the need for large memory boards in the printing device. Because NeWSprint's architecture consists of a series of filters that convert data to various file formats, Sun says that, although the package does not support some of the less popular PDLs, developers can custom design filters to fit unique company needs. NeWSprint currently emulates PostScript level I specifications, and according to Sun, will meet PostScript level II specifications in the future.

"One of the key advantages we see over PostScript and the PC-based printer model is that you only need to update your software. We expect that in the '90s, the architecture model will move to this set-up. By moving toward general-purpose hardware, you can provide a lost-cost, more flexible way to print," says Sun product manager Charles Anderes.

Image processing at the workstation level gives NeWSprint WYSIWYG screen output. In addition, the open-system design allows for the distribution of fonts over the network, making literally hundreds of fonts accessible from anywhere in the network. NeWSprint comes standard with both serial and parallel I/O drivers. With the SBus Printer Card, a single workstation can connect in parallel to several printing devices. Since NeWSprint eliminates the need to download fonts and master pages, networked printing is faster—about 12 pages per minute (ppm) at 300 dots per inch (dpi). Sun also says that while many printers vary greatly from their estimated printing

speed when printing complex graphics, the NeWSprint-SPARCprinter combination remains rather consistent. The workstation practically eliminates bottlenecking during the rendering process.

The SPARCprinter is effectively a dumb printer, and comes with built-in 400-dpi capability. Since images are stored at the workstation, Sun says that NeWSprint is capable of handling up to 1200 dpi for devices of that resolution.

Both Z Microsystems Inc. and Océ Graphics USA Inc. have developed similar software-based models. Z Microsystems' ImageJet.PS resides on the workstation, and is available in both Open Look and SunView environments, providing both PostScript-compatible and raster-image output to any color or laser device. Océ Graphics USA's G5232 ScreenRender system is designed primarily for high-resolution RGB screen dumps of complex CAD models in both 2D and 3D. The 300-dpi, plastic-ink, thermal-transfer device functions as a dumb printer, and all rasterizing occurs at the workstation through the ScreenRender software package. According to the company, Océ plans soon to introduce new NeWSprint-compatible products, and will be working on more products that function in the NeWSprint environment.

Network Problems—Emulation

In a recent *PC Week* poll, corporate buyers rated compatibility as one of the highest priorities in printer satisfaction. One such compatibility problem occurs specifically in the networked environment, where a printer can be driven by several different machines running different software packages. Problem one: What kind of device does the software package expect to find? Problem two: Are we running PostScript or not? Several new printers and applications address these needs. Gold Key Electronics Inc. announced last summer the release of its SWITCHmate PS printer switch. This intelligent device is specifically designed for multi-mode printers and will set the printer emulation mode based upon the content of the incoming print job, be it PostScript or another format. The SWITCHmate series also allows LaserJet III users to print using either HP's PCL 5 or the plotter oriented HPGL/2 without issuing mode-select commands.

Several new printers now provide intelligent switching. Through both hardware and software, TI's microLaser allows switching into and out of PostScript mode without a printer reset. QMS Inc. introduces a new printer architecture with the PS 410, which provides automatic mode switching through an AI process called ESP—Emulation Sensing Process. Parallel, serial and AppleTalk interfaces come with configurable buffers, and are always active to provide additional versatility in a networked environment.

Let There Be Color

Three options exist for color printing: laser, ink jet and thermal transfer. The cost of laser printing, although still expensive, has dropped, and is expected to continue dropping over the next few years. But while color laser is still developing into a cost-effective alternative, with devices by Canon USA Inc. and Coloroc Corp. still running upwards of

\$30,000, printer vendors and users are looking for less expensive, high-quality alternatives. In the ink-jet market, Howtek Inc., HP and Canon Inc. have all recently announced or are about to announce 300-dpi ink jets. But, for speed, quality and cost, at least for the time being, the most popular color choice is the thermal-transfer device.

Thermal-transfer technology provides a high-quality, inexpensive alternative to laser printing, yet is capable of complex page description in a PostScript environment. Supporters of thermal transfer say that the images created have a greater color brightness, and, because of the wax or plastic-based transfer process, the images produced are glossy, rather than matte. The process also allows relatively rapid printing, compared to color ink jet. Advances in thermal-transfer technology include improvements in head design and operating software, producing consistent 300-dpi resolutions.

"Thermal-transfer printing is elegant in its simplicity. It's the technology of choice for color proofing today," says Kevin MacGillivray, Océ's marketing director. Océ recently announced a PostScript color printer targeted toward the networked environment. OcéColor, a wax-based, thermal-transfer printer priced under \$9,000, produces full-bleed prints (8.5 inches by 11 inches) and offers Pantone color matching (which eliminates banding problems) as well as continuous toning for scanned image applications, at around 50 seconds per print. Seiko's ColorPoint PS, also a thermal-transfer color printer with certification by Pantone, uses Phoenix's PhoenixPage Language interpreter to achieve PostScript compatibility. ColorPoint PS also offers full-bleed size prints. Tektronix Inc. has also announced a thermal, color PostScript printer—the Phaser II PXN—an A-size, 1-ppm printer with an Ethernet interface.

**Non-Page Description Output:
Plotters and Imaging**

CAD users often need a high-resolution hardcopy download of screen images that may not involve a complex layout of both text and graphics. New thermal plotters now provide a

fast, accurate and affordable alternative to large electrostatic plotters. Océ's new high-resolution raster plotters produce relatively fast monochrome 406-by-406-dpi output on both paper and film through direct thermal imaging. The result is that only the media is consumed, eliminating both the cost and hazard of toner waste. According to Océ, the G9844 and G9845 were designed for use in a networked environment with high-volume CAD needs. Both come with a 20-MB hard drive for plot queueing, spooling and image handling, as well as a floppy drive to serve non-networked users. Other features include a built-in vector-to-raster converter, and standard serial, parallel and AppleTalk-compatible ports.

A major concern with imaging systems is producing photographic-quality hardcopy. Two issues are important—color gradation and resolution. Deep color, through thermal-dye sublimation or some other process of varying the amount of dye on the page, provides a range of densities, up to 16 million per color. Developed primarily for the Mac II environment, Nikon Inc. this fall announced the release of its complete Image Management System (IMS). The company said that it is concerned with developing a complete system—from image capture through output and distribution—that will be open, upwardly expandable, and provide an industry standard. Part of Nikon's IMS is the CP-3000 full-color printer that uses thermal sublimation dye transfer to reproduce scanned photographs at a 1024-by-1280 resolution. The IMS also uses image compression for faster, more efficient processing, producing prints in under three minutes. IRIS Graphics Inc. has announced the release of the SmartJet 4012, a desktop version of the same variable-dot printing system. The SmartJet is recommended for both CAD and photo-image needs, and can operate unattended in a networked environment. All four colors are printed in a single pass, and a 10.6-by-17.2-inch print is ready in about six minutes. ➔

Mark Nunes is a technology and business freelance writer living in Charlottesville, VA.

Companies Mentioned In This Article

Adobe Systems Inc.
1585 Charleston Road
Mountain View, CA 94039
Circle 124

Howtek Inc.
21 Park Ave.
Hudson, NH 03051
Circle 127

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
Circle 130

Z Microsystems Inc.
2382 Faraday Ave.
Carlsbad, CA 92008
Circle 133

CalComp Inc.
2411 West La Palma Ave.
Anaheim, CA 92801
Circle 125

Intel Corp.
3065 Bowers Ave.
Santa Clara, CA 95051
Circle 128

Nikon Inc.
1300 Walt Whitman Road
Melville, NY 11747
Circle 131

For more information on companies delivering page printers, see "A Page Printer Sampler," page 56.

Gold Key Electronics Inc.
18 Lamy Drive, P.O. Box 186
Goffstown, NH 03405
Circle 126

IRIS Graphics Inc.
6 Crosby Drive
Bedford, MA 01730
Circle 129

Phoenix Technologies Ltd.
846 University Ave.
Norwood, MA 02062
Circle 132

A Page-Printer Sampler

compiled by MOJCA RIJAVEC

Company Model	Print speed (ppm)	Engine	Emulations	Interfaces	Resolution	PostScript	Print method*	Color, grayscale?	Monthly duty cycle (pgs./mo.)	User service	Price
Abaton , a subsidiary of Everex, 48431 Milmont Dr., Fremont, CA 94538. Circle 151											
LaserScript	6	TEC	HP LaserJet Series II	AppleTalk, Centronics, RS232C	300	yes	laser	grayscale	-	drum, toner, drum counter	\$2,995
Advanced Technologies Int'l , 355 Sinclair Frontage Road, Milpitas, CA 95035. Circle 152											
LC-6015	15	LP-4150	AutoCAD ADI; DEC LN03; Diablo 630; Epson FX-80; HP-GL, LaserJet	Centronics; Dataproducts; IBM coax, twinax, channel; RS232C; Versatec	300	no	EPL	grayscale	15K	toner, OPC	\$9,500
LC-6020	20	Ricoh LP5100	see above	see above	300	no	EPL	grayscale	40K	toner, drum	\$15,995
LC-6050	50	Fujitsu M3773	see above	see above	240, 300	no	EPL	grayscale	500K	toner, developer, drum	\$105,995
American Computer Hardware Corp. , 2205 South Wright St., Santa Ana, CA 92705. Circle 153											
LZR 660	6	Canon	Adobe PostScript	parallel, serial	300	yes	laser	-	3K	toner, developer	\$1,400
BDT Products Inc. , 17152 Armstrong Ave., Irvine, CA 92714. Circle 154											
ERGOPRINT 610	10	Xerox 4045	Diablo 630, HP LaserJet 500 Plus, Xerox 2700	Centronics; RS232C	300	no	laser	-	20K	toner	\$17,500
BGL Technology , 451 Constitution Ave., Camarillo, CA 93012. Circle 155											
LaserLeader Mark IT	12	LZR 1200	DEC LN03, LN03 Plus; HP-GL, LaserJet Series II; Sixel Graphics; Tektronix 4010, 4014; Versatec	AppleTalk, Centronics, Dataproducts, RS232C, RS422, Versatec, IEEE 488, Ethernet	300	yes	EPL	grayscale	25K	toner, fuser, developer, drum	\$8,995
LaserLeader Mark IV	26	LZR 2600	see above	see above	300	yes	EPL	grayscale	100K	toner, developer, drum	\$14,995
Brother International Corp. , 200 Cottontail Lane, Somerset, NJ 08873. Circle 156											
HL-8e	8	Canon	Diablo; Epson; HP-GL, LaserJet Series II; IBM	parallel, serial	300	opt.	laser	-	3K	toner	\$2,393
HL-8PS	8	Canon	HP LaserJet Series II	parallel, serial	300	no	laser	grayscale	3K	toner	\$4,495
Bull HN Information Systems Inc. , Technology Park, MS MA02-313N, Billerica, MA 01821-4199. Circle 157											
BPX-508	8	Sanyo	HP LaserJet Series II	parallel, serial	300	-	EPL	grayscale	5K	toner, developer	\$2,095
Colorocs Corp. , 2805 Peterson Place, Norcross, GA 30071. Circle 158											
CP4007	5	Color-ocs	HP-GL	AppleTalk, parallel, serial	300	yes	EPL	color	5K	toner, belts, developer	\$29,995
CPT Corp. , 8100 Mitchell Road, Eden Prairie, MN 55344. Circle 159											
RX7300, RX7200, RX7100	18	Fujitsu	Epson FX-80, Diablo 630, HP LaserJet Plus, IBM ProPrinter	Centronics, RS232C, RS422	300	no	laser	-	50K	-	-
CSS Laboratories Inc. , 1641 McGaw Ave., Irvine, CA 92714. Circle 160											
OAW153	15	Ricoh	Xerox 3700, HP-GL, LaserJet II, KMW, Epson	proprietary	300	opt.	laser	grayscale	25K	belt	\$9,250
Data Systems Hardware Inc. , 22560 Glenn Dr., Ste. 112, Sterling, VA 22170. Circle 161											
VX013	26	Toshiba	PostScript	AppleTalk, Ethernet, parallel, serial	300	yes	laser	grayscale	100K	none if under maint. contract	\$8,500
VX020	12	Toshiba	HP LaserJet	Apple Talk, Ethernet parallel, RS232C	300	yes	laser	grayscale	25K	developer, fuser, drum	\$4,995
VX023	30, 45	Delphax	HP LaserJet, LR03	AppleTalk, Ethernet, parallel, RS232C, RS422		opt.	ion deposition	grayscale	250K	none if under maint. contract	\$24,995

* EPL = electrophotographic laser



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Mitsubishi's quality begins with the G370-10 and G650-10 color thermal transfer printers. These high-resolution printers deliver 300 DPI output on cut sheet paper or transparency film in sizes from letter

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Call or write Mitsubishi today and we'll show you how our high quality color printers can make your Sun shine brighter. For referral to the nearest authorized Mitsubishi Electronics sales representative, call 1-800-843-2515.

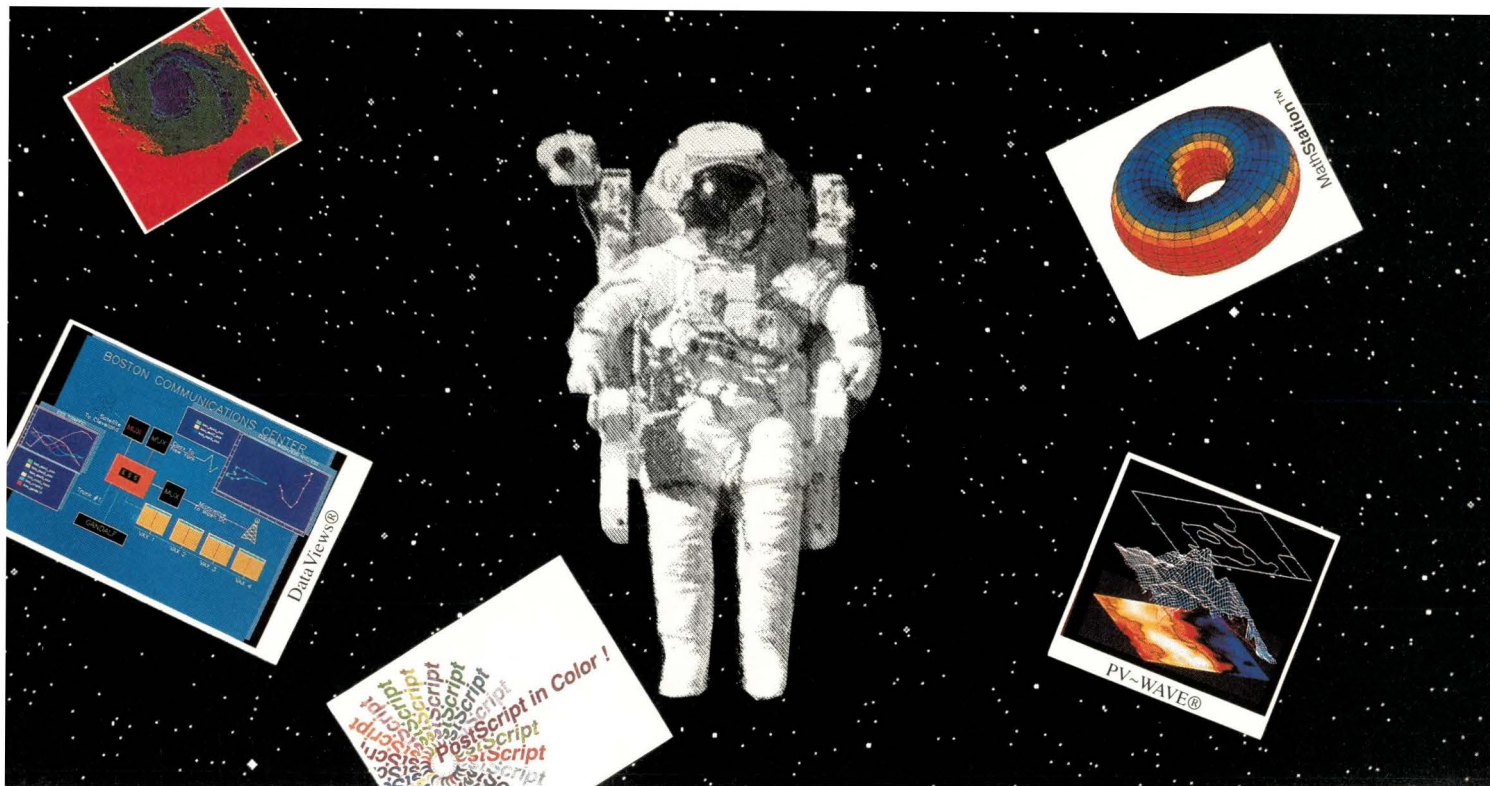


Mitsubishi Electronics America, Inc., Information Systems Division, 991 Knox Street, Torrance, CA 90502
Mitsubishi Electric Sales Canada, Inc., 8885 Woodbine Avenue, Markham, Ontario L3R 5G1

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Company Model	Print speed (ppm)	Engine	Emulations	Interfaces	Resolution	PostScript	Print method*	Color, grayscale?	Monthly duty cycle (pgs./mo.)	User service	Price
DCS/Fortis , 1820 W. 220th St. #220, Torrance, CA 90501. Circle 162											
Qume Crystal Print VIII	8	Casio	HP LaserJet Plus	parallel, RS232C	300	no	EPL, LCS	grayscale	1K	toner, drum	\$650
Derex Inc. , 3650 Coral Ridge Dr., Coral Springs, FL 33065. Circle 163											
S4500 MS	45	Delphax	LN03, HP-GL, LaserJet II, Diablo 630, Tektronix 4014,	DpC parallel, Centronics, SCSI, RS232C, RS422	300	opt.	ion deposition	-	250K	ion cartridge, erase rod	\$29,995
Digital Design Inc. , 8400 Baymeadows Way, Jacksonville, FL 32256. Circle 164											
Plus Micr 636	8	Ricoh	user-definable	RS232C; Centronics; IBM coax, twinax	-	yes	laser	grayscale	10K	n/a	n/a
Plus Micr 656	15	Ricoh	user-definable, HP PCL5-compatible	see above	300	yes	laser	grayscale	25K	n/a	n/a
Digital Equipment Corp. , 6 Technology Park Dr., Westford, MA 01886. Circle 165											
PrintServer 20	20	Ricoh	ANSI 3.64, DEC ANSI, Tektronix	DEC NET, Ethernet, TCP/IP	300	yes	laser	grayscale	40K	toner, drum	\$24,045
Digital Laser Systems Inc. , 8400 Baymeadows Way, Jacksonville, FL 32256. Circle 166											
Plus 121	4	Canon	user-definable	RS232C; Centronics; IBM coax, twinax	-	yes	laser	grayscale	6K	n/a	n/a
Plus 141	8	Canon	HP-GL; Epson FX; Diablo 630; IBM Proprint, AFP; Xerox 9700; DEC LN03	RS232C, Centronics	300	yes	laser	grayscale	25K	n/a	n/a
Plus 181	20	Canon	user-definable	RS232C; Centronics; IBM coax, twinax	300	yes	laser	grayscale	70K	n/a	n/a
Eastman Kodak Co. , 343 State St., Rochester, NY 14650. Circle 167											
Kodak XL 7700	-	-	-	IEEE, SCSI	200	opt.	thermal dye trans.	grayscale	-	-	\$24,800
Electronic Form Systems , 2395 Midway Road, Carrollton, TX 75006. Circle 168											
Formwriter 2E, 2EX, 2EXD	8	Canon	Epson	proprietary	300	no	EPL	-	5K	toner	\$3,995-\$5,495
Formwriter 8	15	Ricoh	Epson, Micr	proprietary	300	no	EPL	-	25K	toner, belt	\$6,995
Formwriter 10, 10X, 10XD	20	Canon	Epson	proprietary	300	no	EPL	-	30K	toner	\$12,995-\$21,995
Epson America Inc. , 20770 Madrona Ave., Torrance, CA 90509. Circle 169											
EPL-7000	6	Minolta	HP LaserJet Series IIP; Epson FX, LQ	parallel, serial	300	opt.	laser	-	3K	imaging cart., ozone filter	\$1,399
EPL-7500	6	Minolta	HP LaserJet Series II	parallel, serial, AppleTalk	300	yes	laser	-	3K	see above	\$3,299
Facit Inc. , 400 Commercial St., Manchester, NH 03108. Circle 170											
P6060	6	TEC	HP LaserJet Series II	serial, parallel	300	no	laser	grayscale	4K	toner, drum	\$1,599
P8100	10	IBM	HP LaserJet Series II, IBM PPDS, plotter	serial, parallel	300	opt.	laser	grayscale	20K	toner, drum	\$2,849
Fujitsu America Inc. , 3055 Orchard Dr., San Jose, CA 95134. Circle 171											
RX7100PS	5	Fujitsu	HP LaserJet Series II, Epson FX-80, IBM-ProPrinter, Diablo 630	Centronics, RS232C, AppleTalk	300	yes	LED	grayscale	3K	drum, toner	\$3,190
RX7100 S/2	5	Fujitsu	HP LaserJet Series II, IBM ProPrinter, Epson FX-80	Centronics, RS232C	300	opt.	LED	grayscale	3K	drum, toner	\$1,395
Genicom Corp. , 1 Genicom Dr., Waynesboro, VA 22980. Circle 172											
6145	8	Canon SX	HP-GL, LaserJet Series II; IBM graphics printer; Diablo 630	Centronics, RS232C, AppleTalk	400	yes	EPL	-	5K	toner	\$5,495

* EPL = electrophotographic laser



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- **Applications:** ImageJet.PS comes standard with the same 35 fonts found on the Apple LaserWriter™ and an onscreen PostScript® image previewer. Almost any Sun color application like Data Visualization, CAD or Desktop Publishing can be printed to a low-cost (non-PostScript) printer.

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tion and more. Use a convenient WYSIWYG interface, or load the commands into your root menu. ImageJet.PS software is available unbundled, so you can use it with your existing printers, or buy one of our complete systems, with full on-site service from the manufacturer.

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(619) 431-5290

Company Model	Print speed (ppm)	Engine	Emulations	Interfaces	Resolution	PostScript	Print method*	Color, grayscale?	Monthly duty cycle (pgs./mo.)	User service	Price
Hewlett-Packard Co. (inquiries), 19310 PruneRidge Ave., Cupertino, CA 95014. Circle 173											
33449A LaserJet III	8	Canon SX	Adobe PostScript	serial, parallel, AppleTalk	300	opt.	EPL	-	16K	ozone filter, toner	\$2,395
33459A LaserJet IIID	8	Canon SX	PostScript	see above	300	opt.	EPL	-	20K	see above	\$3,595
33471A LaserJet IIP	4	Canon LBI-LX	IBM ProPrinter, Epson FX	see above	300	opt.	EPL	-	6K	toner	\$1,495
IBM Corp. , 101 Paragon Dr., Montvale, NJ 06745. Circle 174											
4019/ 4019E	10/ 5	IBM	IBM PPDS, GL; HP-GL, LaserJet Series II	IBM PC parallel, RS232C	300	opt.	laser	grayscale	20K/ 12K		\$2,395/ \$1,495
4072-001	6	-	IBM ProPrinter, Quiet-writer III, Epson LQ1050	IBM PC parallel, RS232C, RS422	360	no	ink jet	grayscale	1K	-	\$1,099
IDEA , 1515 W. 14th St., Tempe, AZ 85281. Circle 175											
IDEA 13412-06	6	Ricoh	IBM, HP LaserJet II	IBM coax, twinax; parallel, serial	300	no	EPL	-	5K	consumables	\$3,395
Image Systems Inc. , 2515 McCabe Way, Irvine, CA 92714. Circle 176											
MegaLine	30, 45	Olym- pus	line printer	parallel	300	no	ion deposition	-	250K	toner, ion cartridge	\$12,995
MegaPro	30, 45	Olym- pus	Diablo, HP LaserJet Plus	see above	300	no	see above	-	250K	see above	\$16,995
MegaServe	30, 45	Olym- pus	HP-GL, LaserJet II; DEC LN03; Diablo	serial, parallel, Ethernet	300	opt.	see above	-	250K	see above	\$21,995
IRIS Graphics Inc. , Six Crosby Dr., Bedford, MA 01730. Circle 216											
3024	0.20	IRIS	DNA	Versatec	300	no	ink jet	color,	16K-17K	ink	\$84,500
3047	-	IRIS	see above	see above	300	no	ink jet	see above	15K-16K	ink	\$123,000
SmartJet 4012	-	IRIS	see above	SCSI	300	no	ink jet	see above	11K-12K	ink, cleaning fluid	\$39,000
Kentek Information Systems , 2945 Wilderness Pl., Boulder, CO 80301. Circle 217											
K2+	15	-	DEC LN03, Diablo 630, HP LaserJet IID	Centronics, RS232C, RS422	300	no	EPL	-	40K	photoconductor, toner, developer	OEM only
K3	24	-	see above	parallel, RS232C RS422	300	opt.	EPL	-	120K	see above	see above
K4	24	Duplex	see above	see above	300	opt.	EPL	-	120K	see above	see above
Kyocera Electronics Inc. , 100 Randolph Road, Somerset, NJ 08875. Circle 177											
F-800A	8	Kyocera	Diablo 630, Epson FX-80, HP LaserJet Series II, IBM graphics, line printer, etc.	parallel, RS232C	300	no	EPL	-	10K	toner, drum	\$2,295
F-2000A	10	Kyocera	see above	parallel, RS232C	300	no	EPL	-	10K	see above	\$4,695
F-3000A	18	Kyocera	see above	parallel, RS232C	300	no	EPL	-	30K	see above	\$6,995
Mannesmann Tally Corp. , 8301 S. 180th St., Kent, WA 98032. Circle 178											
MT906PS	6	TEC	HP LaserJet Series II, Apple LaserWriter IINT	parallel, serial, AppleTalk	300	yes	laser	-	4K	toner, drum, developer	\$2,995
Miltope Business Products , 1770 Walt Whitman Road, Melville, NY 11747. Circle 179											
Series 30 M	30	Image Syst.	Dataproducts BP-1500, HP LaserJet Series II	Centronics, Dataproducts	300	no	ion de- position	-	250K	ion cartridge, erase rod, drum	\$26,950
Series 37	37	Image Syst.	see above	see above	300	no	see above	-	250K	see above	\$39,950
Series 75	75	Delphax 6000	none	Dataproducts	240	no	see above	-	1M	see above	\$49,950

* EPL = electrophotographic laser

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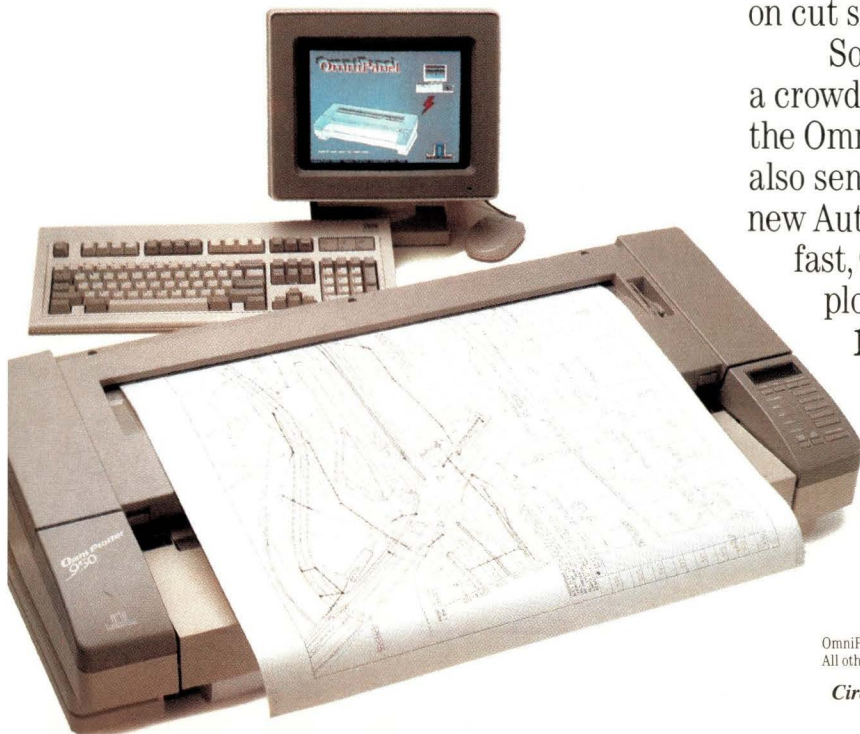


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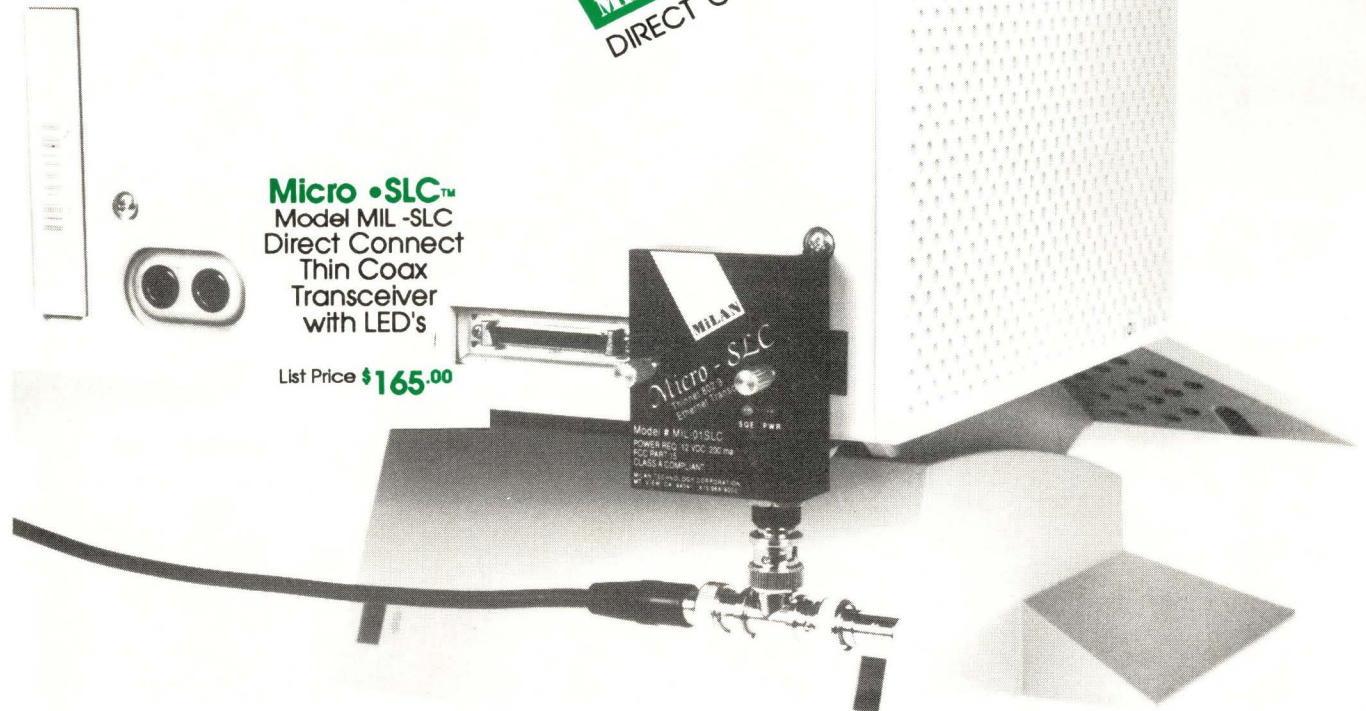
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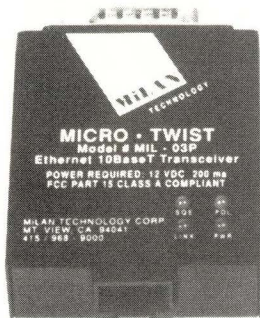
Company Model	Print speed (ppm)	Engine	Emulations	Interfaces	Resolution	PostScript	Print method*	Color, grayscale?	Monthly duty cycle (pgs./mo.)	User service	Price
Minolta Corp. , 101 Williams Dr., Ramsey, NJ 07446. Circle 180											
SP130	12	Minolta	Diablo 630, Epson FX-80, HP LaserJet Series II	Centronics, RS232C	300	no	laser diode	-	5K	drum	\$3,895
M2000	4	Canon LBP-LX	Quick Draw	SCSI	300	no	laser	-	-	imaging cartridge	-
NBS Southern Inc. , 11451 S. Belcher Road, Largo, FL 34643. Circle 181											
3840D	40	Hitachi	none	ANSI; Centronics; Dataproducts; DMF 32 Vax; Ethernet; etc.	300, 240	no	laser	grayscale	200K	toner	\$54,950
3880	80	Delphax	none	see above	240	no	ion deposition	grayscale	800K	toner	\$54,950
NewGen Systems Corp. , 17580 Newhope St., Fountain Valley, CA 92708. Circle 218											
TurboPS/400P	4	Canon	HP-GL, LaserJet IIP	AppleTalk, Centronics, RS232C	400	yes	EPL	grayscale	2.5K	toner	\$2,995
TurboPA/480	8	Canon	Epson LQ-800; HP-GL, LaserJet Series II	see above	-	yes	EPL	grayscale	5K	toner	\$7,495
TurboPS/1200T (Tabloid)	12	Copal	HP-GL, LaserJet Series II	AppleTalk, Centronics, RS232C, SCSI	1200	yes	EPL	grayscale	10K	toner	\$16,995
Nissho Electronics Corp. , 17320 Red Hill Ave., Ste. 200, Irvine, CA 92714. Circle 182											
LN-2248B	20	Minolta	HP-GL, LaserJet Series II; Epson	serial, parallel, AppleTalk	480	yes	laser	grayscale	60K	toner	\$18,700
Oce Graphics , 385 Ravendal Dr., Mountain View, CA 94039. Circle 219											
G5241-PS	1	-	Adobe PostScript	AppleTalk, Centronics, serial	300	yes	thermal transfer	color	-	none	\$8,990
Office Automation Systems Inc. , 9940 Barnes Cannon Road, San Diego, CA 92121. Circle 183											
90/8	8	TEC 1306	Diablo; Epson FX-80; HP-GL, LaserJet Series II; IBM ProPrinter	Centronics, RS232C	300	opt.	laser	-	5K	drum	\$1,285
90/22	22	Minolta SP300	Epson FX-80; HP-GL, LaserJet Series II; IBM ProPrinter	see above	300	opt.	laser	-	60K	drum	\$9,699
1510 Plus	15	Ricoh 4150	Diablo, Epson FX-80, HP LaserJet Plus, IBM ProPrinter	see above	300	no	laser	-	25K	drum	\$3,547
Okidata , 532 Fellowship Road, Mt. Laurel, NJ 08054. Circle 184											
OL800	8	Okidata	Diablo 630, HP LaserJet Series II, IBM ProPrinter	parallel, serial	300	opt.	LED	grayscale	6K	toner, drum	\$1,395
OL820	8	Okidata	Diablo 630, HP LaserJet Series II, IBM ProPrinter, OkiXpress font scaling	parallel, serial	300	opt.	LED	grayscale	6K	see above	\$2,399
OL840	8	Okidata	Adobe PostScript	AppleTalk, parallel, serial	300	yes	LED	grayscale	6K	see above	\$2,995
Olivetti Office USA , 765 U.S. Highway 202, P.O. Box 6945, Bridgewater, NJ 08807-6945. Circle 185											
PG 306	6	TEC	HP LaserJet Series II, IBM ProPrinter	parallel, serial	300	opt.	laser	-	3K	toner, drum	\$1,495
Output Technology Corp. , 9922 E. Montgomery Dr., Spokane, WA 99206. Circle 186											
LaserMatrix 1000 Model 1	16	-	HP 2563B, LaserJet II; IBM ProPrinter; Ruggedwriter	Centronics, RS232C	300	no	laser	-	25K	toner, developer, drum	\$7,995
LaserMatrix 1000 Model 2	16	-	DEC, LN03 Plus; IBM ProPrinter	see above	300	no	laser	-	25K	see above	\$7,995
LaserMatrix 1000 Model 3	16	-	HP PCL 4	see above	300	no	laser	-	25K	see above	\$5,995

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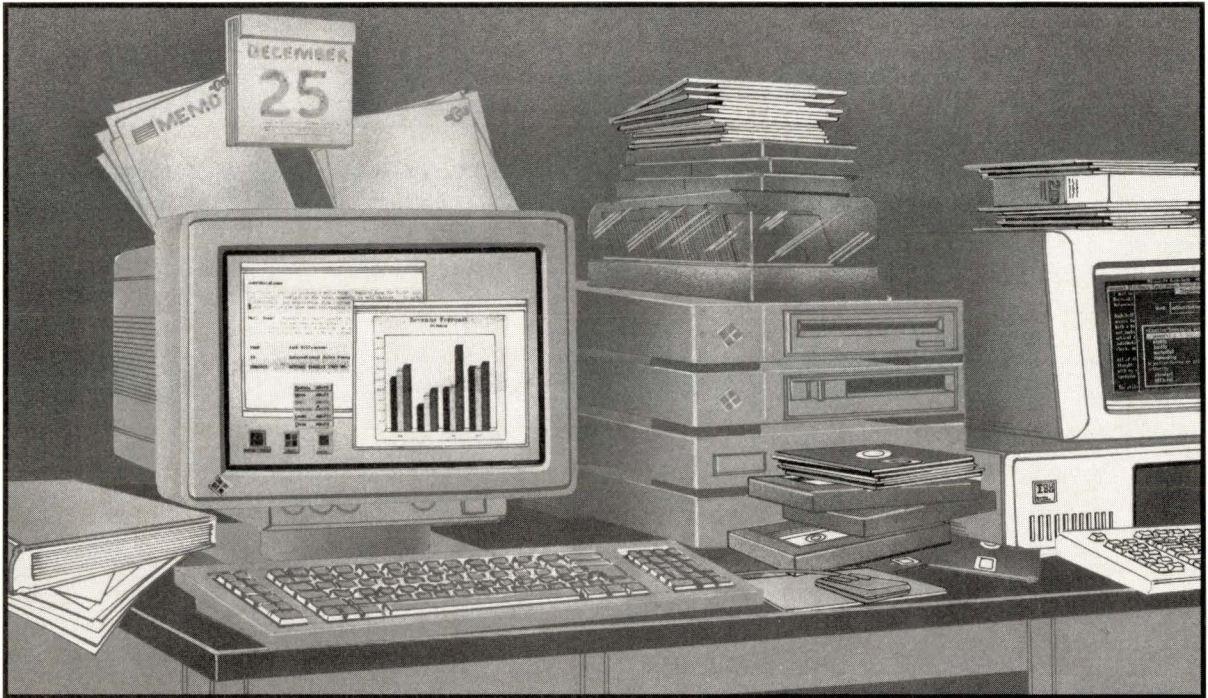
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Company Model	Print speed (ppm)	Engine	Emulations	Interfaces	Resolution	PostScript	Print method*	Color, grayscale?	Monthly duty cycle (pgs./mo.)	User service	Price
Panasonic Communications & Systems Co. , Office Automation Group, Two Panasonic Way, Secaucus, NJ 07094. Circle 187											
EPL-8543	.66	Panasonic	LL driver, Quick-Draw, Targa driver	Centronics	203	opt.	thermal transfer	color, grayscale	-	3-color ribbon, roll paper	\$7,995
KX-P4450i Laser Partner	11	Panasonic	Diablo 630, Epson FX 86e/800, HP LaserJet II, IBM ProPrinter II, Panasonic KX-P1180/91	parallel, RS232C	300	no	EPL	-	5K	toner, developer, drum	\$2,095
KX-P4455 Laser Partner	11	Panasonic	Diablo 630, HP LaserJet Series II	AppleTalk, parallel, RS232C, RS422A	300	yes	EPL	-	5K	see above	\$3,495
Pentax Technologies , 100 Technology Dr., Broomfield, CO 80021. Circle 188											
Laserfold 240	16	Pentax	Epson FX-80	RS232C, Centronics	240	no	EPL	-	-	toner, developer, drum	\$3,995
Personal Computer Products Inc. , 10865 Rancho Bernardo Road, San Diego, CA 92127. Circle 189											
LaserImage 1030	6	Ricoh	Diablo 630; Epson FX-80; HP-GL, LaserJet Series II, Plus; IBM ProPrinter II	parallel, serial	300	opt.	laser	grayscale	3K	toner, belt	\$2,395-\$2,995
LaserImage 2020	8	Ricoh	Diablo 630; Epson FX-80; HP-GL, LaserJet Plus; IBM ProPrinter II	parallel, serial	300	opt.	laser	grayscale	10K	toner, belt	\$3,595-\$4,395
LaserImage 2500	11	Fujitsu, Xerox	Diablo 630; HP-GL, LaserJet Series II	Centronics, RS232C	300	opt.	laser	grayscale	20K	toner, belt	\$3,995-\$4,995
Printronix , 17500 Cartwright Road, Irvine, CA 92713. Circle 190											
L1016	16	Pentax	line printer, P-series line printer, IPDS	RS232C; RS422; Centronix; IBM twinax, coax; Dataproducts	300	no	laser	grayscale	15K	drum, fuser	\$8,995
L1212	12	Mita	PostScript language-compatible interpreter	Centronix, RS232C, AppleTalk	300	-	laser	grayscale	25K	drum	\$6,995
Q/COR , One Meca Way, Norcross, GA 30093. Circle 191											
QuadLaser	8	Ricoh	HP-GL, LaserJet Plus; Qume Sprint5; Epson FX-80; IBM ProPrinter	Centronics, RS232C, AppleTalk	300	opt.	laser	-	10K	toner, belt	\$1,995
QMS Inc. , One Magnum Pass, Mobile, AL 36618. Circle 192											
3320 ImageServer XP	20	Canon	Diablo 630; Epson LBP-20 FX-80, 100; IBM 5152, 1403 line printer; Tektronix 4010/4014	Centronics, Dataproducts, Ethernet, RS423, Versatec	300	yes	laser	grayscale	70K	toner, developer, drum	\$18,995
ColorScript 100 Model 30i	1	Mitsubishi G650	HP-GL	AppleTalk, parallel, SCSI, serial	300	yes	thermal transfer	color, grayscale	5K	-	\$12,995
PS 2210	20	proprietary	HP-GL, PCL	see above	300	yes	laser	grayscale	20K	developer, toner, drum	\$9,995
Qume Corp. , 500 Yosemite Dr., Milpitas, CA 95035. Circle 193											
CrystalPrint Express	12	Sanyo	HP LaserJet Series II	AppleTalk, parallel, RS232C, RS422	300, 600	yes	laser	-	10K	toner, drum	\$5,595
CrystalPrint Publisher II	6	Casio	see above	see above	300	yes	LCS	-	6K	see above	\$3,995

* EPL = electrophotographic laser

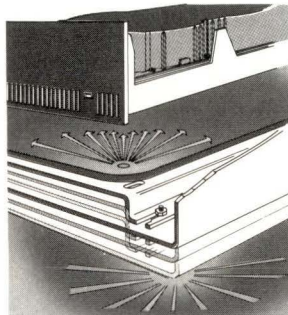
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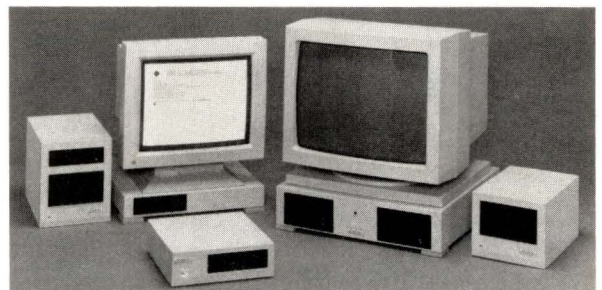
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Company Model	Print speed (ppm)	Emulations	Interfaces	Resolution	PostScript	Print method	Color, grayscale?	Monthly duty cycle (pgs./mo.)	User service	Price
Seiko Instruments USA Inc. , 1130 Ringwood Court, San Jose CA 95131. Circle 194										
CH5504/5514	1/-.75	none	Centronics	300	no	thermal transfer	color, grayscale	n/a	ink sheet	\$5,995/ \$9,995
ColorPoint PS Model 4/14	1/-.75	PostScript compatible	AppleTalk, Centronics, RS232C, SCSI	300	yes	thermal transfer	color	n/a	n/a	\$6,999/ \$9,999
Star Micronics , 420 Lexington Ave., New York, NY 10170. Circle 195										
Laserprinter 4	4	Canon Epson FX-850, HP LaserJet Series IIP	Centronics, RS232C	300	opt.	EPL	-	2.5K	toner	\$1,395
Sun Microsystems Inc. , 2550 Garcia Ave., Mountain View, CA 94043. Circle 196										
SPRN-400	12	Xerox PostScript: Troff	Sun SBus	300, 400	yes	EPL		5K	toner, drum, fuser wick	\$2,695
Syntrex Inc. , 246 Industrial Way West, Eaton Town, NJ 07724. Circle 197										
PG 306 (Olivetti)	6	TEC HP Laser Jet Series II, IBM ProPrinter	Centronics, RS232C, RS422A	300	opt.	diode laser	grayscale	3K	toner, drum	\$1,495
Talaris Systems Inc. , 6059 Cornerstone Ct. W., San Diego, CA 92121. Circle 198										
1590/1590-T	15	Ricoh ANSI 364, DEC LN03 Plus, HP LaserJet Series II, Tektronix 4014	Centronics, RS232C	300	opt.	laser	grayscale	25K	belt	\$9,290/ \$9,990
2090	20	Ricoh LPM20 see above	see above	300	opt.	laser	grayscale	40K	charger, drum	\$19,990
3093/5093	30/50	Olympus see above	see above	300	opt.	ion deposition	grayscale	150K/250K	ion cartridge	\$21,490/ \$29,990
Tandy Corp./Radio Shack , 1800 One Tandy Center, Fort Worth, TX 76102. Circle 199										
Tandy LP 950	6	Sharp Diablo 630; Epson FX-80; HP LaserJet Series II; IBM graphics, ProPrinter	serial, parallel	300	no	EPL	-	n/a	toner	\$1,599
TEC America Electronics Inc. , 20 Walnut St., Wellesley Hills, MA 02181. Circle 200										
LB-1305B	6	LB-1305 HP LaserJet Series II	parallel, RS232C, RS422	300	opt.	laser	-	3K	toner, drum	OEM only
LB-1306C	8	LB-1306 see above	see above	300	opt.	laser	n/a	5K	see above	see above
LB-1321C	4	LB-1321 see above	see above	300	opt.	laser	-	2.5K	see above	see above
Tektronix Inc. , Graphics Printing and Imaging Division, MS 63-583, P.O. Box 1000, Wilsonville, OR 97070. Circle 201										
Phaser II DXN	-	Tektronix Tektronix 4692, 4693	Centronics, Ethernet, SCSI	300	no	thermal wax trans.	color	n/a	thermal transfer ribbon	\$11,995
Phaser PXN	-	Tektronix HP-GL	AppleTalk, Ethernet, RS323C	300	yes	see above	color	n/a	see above	\$10,995
Phaser II SX	-	Tektronix none	Centronics, SCSI	300	no	see above	color	n/a	see above	\$4,995
Texas Instruments , Peripheral Products Division, 12501 Research Blvd., P.O. Box 149149, Austin, TX 78717-9149. Circle 202										
MicroLaser	6	Sharp IP-1C HP PCL4	parallel	300	opt.	laser	grayscale	10K	toner, developer, drum	\$1,449
MicroLaser XL	16	Sharp IP-1C see above	parallel	300	opt.	laser	grayscale	25K	see above	\$3,449
Toshiba America Information Systems Inc. , 9740 Irvine Blvd., Irvine, CA 92713. Circle 220										
PageLaser 6	6	TEC HP LaserJet Series II, IBM X24	parallel, serial	300	opt.	EPL	-	4K	toner, drum	\$1,549
Varietyper , 11 Mt. Pleasant Ave., East Hanover, NJ 07936. Circle 203										
600P/600W	10	n/a PostScript printer	AppleTalk, Centronics, RS323C, RS422	600	yes	EPL	-	12K	n/a	\$16,995/ \$22,995
XPoint Corp. , 3100 Medlock Bridge Road, Norcross, GA 30071. Circle 204										
XP 1500	15	Ricoh IBM 3812/2, 5219	IBM twinax	300	no	laser	-	25K	toner, drum	\$6,495

* EPL = *electrophotographic laser*

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illustration by Peter Gorski

Everything you wanted to know but were afraid to ask about...

Resellers

by **MARY JO FOLEY**, Senior Editor
and **MICHAEL JAY TUCKER**, Executive Editor

Never let it be said that because Sun Microsystems Inc. is younger than most computer vendors, it lags them in its struggles to sell UNIX workstations through indirect channels.

Like the biggest and best of them, Sun has suffered from the reputation of leaping before looking when it comes to indirect sales strategies. Inter-channel competition continues to rear its ugly head. Uneven discounting is a sore spot. And, while improving, the relations between Sun's direct salespeople and its resellers are still nothing to write home about.

Finally, just when you think Sun has done all the channel fine-tuning it can do, it announces a major reseller-program overhaul. Take, for example, modifications Sun made to the channel last summer. In the span of a few short months, Sun:

- created a new category of resellers, national value-added dealers (NVADs), designed to move products on a mass, commercial scale;
- removed geographic restrictions on value-added resellers (VARs), thus enabling all VARs, as long as they made their initial contact face-to-face with a customer, to sell anywhere in the United States; and
- reclassified so-called software OEMs as VARs, thus upping its VAR count to 300, and reducing its "pure" (embedded system) OEM total to 100.

Existing resellers screamed bloody murder when these changes were made.

They cried nasty things like "channel competition," "gray marketing," and "unfair discounting." The furor has died down somewhat. But the wisdom of these reseller-program modifications is still being questioned by industry pundits and channel participants.

As we were going to press with this issue of *SunExpert*, Sun was about to make yet another substantial change in its indirect sales strategy: It was to select a master reseller/distributor to supply its commercial VARs with products, much the same way Access Graphics Technology Inc. has been doing on the technical side since September 1990. Last we heard, Sun had narrowed its choice to Access Graphics or Tech Data Corp., one of the largest PC distributors. Sun's final decision will say a lot about where its indirect channel strategy will go in the coming years.

Access Graphics has barely been able to keep up with the number of technical Sun resellers that have wanted to sign up. The fulfillment house, which once acted as Digital Equipment Corp.'s primary workstation distributor, wins praise from Sun resellers in the areas of product availability and technical expertise. At the end of 1990, according to John Ramsey, vice president of sales and marketing, Access Graphics had finalized contracts with 100 technical Sun VARs. This includes a number of VARs which, due to sales volume, could have continued to deal with Sun directly if they had desired.

A number of commercial Sun VARs have been after Access

Graphics to act as their distributor, Ramsey says. And there are some areas of commercial/technical overlap—such as technical publications, for instance—where Access Graphics would be a natural. But the \$100 million, 105-employee company probably would have to do some expanding to keep up with commercial reseller demand.

The \$348 million, 500-employee Tech Data, on the other hand, is a master of mass marketing. But it would need to make some serious investments in improving its technical support capabilities before it would be able to keep Sun resellers happy. But, at least on the PC front, Tech Data has the fulfillment game down pat.

Where Sun Wins Points

Despite its ups and downs, Sun is still revered by many resellers—for some obvious and not-so-obvious reasons. Sun is, after all, the No. 1 UNIX workstation vendor. "Sun is the market leader. And there are more popular packages available for Sun than any other workstation," says Richard Martini, president of Diamond Micro Solutions, the parent company of Workstations Plus, one of Sun's newest VARs. Workstations Plus will act as a horizontal VAR, providing Sun systems and after-market peripherals and software for its customers.

Workstations Plus isn't alone in its perceptions. Sun now sports 250 to 300 large and small VARs, 100 hardware OEMs, four commercial systems integrators (Arthur Andersen and Co.,



'Sun has gotten much better.'

—Mike Ragusa, director of sales and technical resources, ERI

Andersen Consulting Division; Electronic Data Systems Co.; Nynex Inc.; and Science Applications International Corp.), three NVADs (with approximately 100 Sun-authorized locations), one master VAR (Novadyne Computer Systems Inc.), and one (maybe soon to be two) master resellers/distributors (Access Graphics and the as-yet-unnamed commercial distributor). More than half of Sun's indirect business is attributable to OEMs—companies like General Electric Corp.'s Medical Systems subsidiary, Eastman Kodak Inc., Prime Inc./Computervision, Teradyne Corp. and Xerox Corp., to name a few. Only about 20% of Sun's indirect sales come from the vastly more numerous VARs.

According to Curt Fisher, director of reseller channels at Sun, resellers currently contribute between 40% to 50% of Sun's worldwide revenues. (The indirect channel contributes 35% to 40% of Sun's U.S. sales.) Within a couple of years, according to Fisher, these percentages could flip-flop, so that the indirect channel supplies more than half of Sun's revenues.

When Sun began its reseller push in earnest, around the mid-1980s, the 386i was, far and away, the reseller platform of choice. Since then, the SPARCstation 1, 1+ and now 2 are the primary indirect-sales moneymakers. Yet, a number of VARs, OEMs and systems integrators say they benefit from being able to offer a complete workstation/server line.

Resellers also seem to like some of the unusual, new programs that Sun established last summer as part of its reseller development fund. While Sun's co-op marketing terms are fairly standard, some of the changes it made in its "infrastructure" are unique, says Pat Shanks, president of BASIS Inc., a

commercial/government VAR. Infrastructure funds (which accrue at 2% of monthly net sales) may be applied to cover tuition and travel expenses for Sun-sponsored technical courses for resellers. Infrastructure monies also may be used to help cover fees that resellers incur from hiring Sun Consulting Service personnel temporarily to help with technical chores, as well as those salary expenses resellers incur in employing their own, dedicated Sun technical people (up to \$3,000 per month).

Shanks also speaks highly of the discounts that Sun offers resellers buying systems for demonstration and development purposes. "We think Sun has improved its [reseller] programs quite a bit from when we signed up two years ago, or so," Shanks says.

"Sun makes the best computer in its class in the world," adds Ken Kalb, vice president of GNP Computers, one of Sun's largest resellers. "But they're weak in their reseller market dealings, and they recognize this." This acknowledgement, too, seems to endear Sun to its resellers.

...And Where Sun Needs Help

But while it's encouraging to resellers that Sun has recognized its flaws, "It's bad that they've brought in folks that will force many smaller VARs out of business due to their steep discounting," Kalb continues. These "folks" are the much maligned NVADs, a force that many in Sun's resellers channel have come to see as a necessary evil (see "A Fine Line Separates VADs From VARs"). You don't have to go very far before you run across VARs with NVAD horror stories. Typical tales of woe come from anDATAco Computer Peripherals.

According to anDATAco president, W. David Sykes, the NVADs don't

Worldwide Workstation and Workstation/Server Market

	Direct	VAR/SI*	OEM	Dealer	Other**	Total
1989	66%	32%	2%	0%	0%	\$6.1 billion
1994	43%	39%	5%	10%	3%	\$16.4 billion

Source: International Data Corp.

*SI = Systems Integrator

** Other = Consumer, merchant and mail order.

exactly suffer from a level playing field. "What they [Sun] have done is give the MicroAges the deepest discount," says Sykes. "Between 40% and 42%, while they lowered mine."

But the real problem, says Sykes, was just after MicroAge (Inc.) finalized its deal with Sun. All anDATAco customers started systematically getting phone calls from MicroAge sales people offering prices lower than anDATAco could give. Sykes complained to Sun itself. "Finally, Sun

called them off," he says. But, by then, the damage had been done. "It exposed the fact that there was more margin available to the end user."

Sykes thinks the NVAD program will not benefit Sun because the company will be forced to supply the service and support that VARs would otherwise provide. "They gave the PC places a deep discount," he says, "but that means the less intelligent sales organizations will be selling their machines. That means there will be a

deep drain on Sun's technical resources. It is going to cost them much more than they expect."

But, if there are conflicts with other resellers, then the biggest headache comes from friction with Sun's justly famed direct salesforce. "We have a major client," says anDATAco's Sykes. "They had bought over a hundred Suns from us." The client wanted to buy still more Suns from anDATAco. But, when Sykes went to Sun for the devices, the machines were curiously

Lucas, Sun and Videotape

Among the most dramatic of all Sun resellers is LucasArts Editing Services, a division of the series of entertainment-oriented companies headed up by George Lucas. Among LucasArts' products is Editdroid, a high-end film- and video-editing system based on a Sun-3/80 workstation.

"Editing is mostly a nasty database problem," says Tom Scott, general manager of LucasArts Editing Services. "And that's what we handle." In film or video editing, a director or editor will take reel after reel of images and painstakingly turn them into a coherent whole. The editor has to judge which shots will be used and which discarded, and to keep track of each. It's a backbreaking task that cries out for a computer assist.

Several companies have answered the call. LucasArts, though, is one of the first to bring a Sun-based solution to market. Its product, the Editdroid, consists of the workstation, proprietary software, assorted video peripherals and an optical disk drive. A director shoots film or video and then drops the images directly to the WORM disks. With it, the editor can literally pick and choose shots, taking this image from here and that image from there, and link them together as easily as a writer might use a word processor to assemble a document from multiple sources.

From the Editdroid, the motion picture can drop directly to video tape. Or, if the director is working in film (which has to be physically cut and pasted together), the machine will output a list of instructions for the physical cut of the film. "What you have," says Scott, "is an assistant in the next room working with the film itself."

There aren't a whole lot of Editdroids in the world—"We've only built about 30 of them," says Scott—but those that exist are in some pretty impressive places. "Oliver Stone just finished cutting a movie on it," says Scott. "And Steven Soderbergh—the fellow who did 'Sex, Lies and Videotape'—is cutting his new film on it." In fact, says Scott, Soderbergh has the machine at his home. "His wife is

expecting and he didn't want to be away from her. So, he said, 'Fine, I'll do it at home.'"

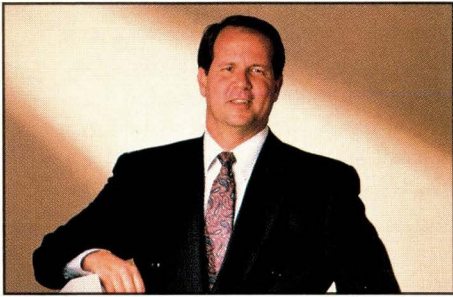
At \$185,000 a pop, Editdroid is not likely to be a big player in the mass market. But, LucasArts is looking at producing a less expensive model. "I think there could be a market for a scaled-down version," says Scott, "for corporate video."

If a lower-priced, corporate-video version of the Editdroid should appear, LucasArts would look a lot more like a traditional reseller, shipping relatively large volumes of product. In the meantime, though, should the company be classified as a Sun VAR? That's not an easy question to answer. The company buys and resells only small numbers of Sun products, yet it gets them directly from Sun, as would an end-user or a large-volume reseller. There seems to be no hint of the company going through Access Graphics.

But then, LucasArts has an ancient friendship with Sun. "There are not a lot of people left around who remember it," says Scott. "But we have a long relationship with Sun. Basically, we took UNIX, put it on the Motorola 680X0 processor and gave it to them."—*mjt*



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'What can I lose?'

—W. David Sykes, president,
anDATAco Computer Peripherals

unavailable. At about the same time, though, the client received a phone call from another division of Sun—one based in Grand Rapids, according to the client, who spoke to *SunExpert* on condition that he not be named. This division's spokesperson offered the machines to the client at a deep discount—deeper than anDATAco had been given before.

The client assumed that Sykes would be doing the installation and called him. But, it was news to Sykes, and he phoned Sun itself. "I said to them, 'This discount is great,'" remembers Sykes. "If the client is getting the machines at 40%, I must be getting them at 50%, right?"

Wrong. "The Sun rep told me, 'Oh, Dave, I'm sorry. There isn't any room for you in this deal,'" says Sykes.

Sykes was livid, "To say the least, I'm furious." But he wasn't as angry as his client, who didn't want the boxes from Sun directly. In fact, the workstations themselves were wholly secondary to the purchase. What the client wanted was anDATAco's particular expertise in

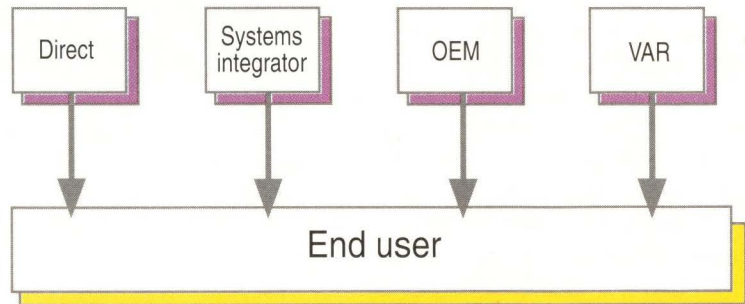
installing and maintaining systems in the client's unique niche. As far as the client was concerned, Sun was peddling dead iron.

So, the client went to the clones. It brought in two Mars Microsystems Inc. Mariner 4i SPARClikes for evaluation. It is thinking seriously about buying more. Sykes is, in fact, beginning to wonder if he won't be forced to carry and support clones in addition to Sun hardware. "I was absolutely against them," he says. "I didn't think it was worth ruining my relationship with Sun to have them...but, now my view is changing. Sun already views me as the enemy. What can I lose?" He says that he would never abandon Sun entirely, but he will be supplementing his position with SPARClikes.

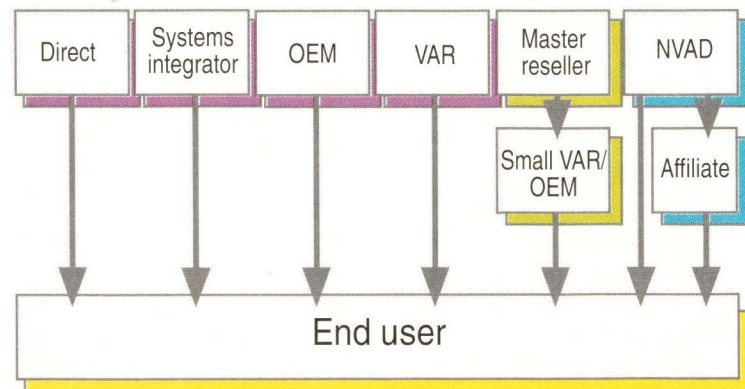
Sykes, or any other reseller for that matter, is taking a risk by even talking about considering a clone. "One of the things a reseller must do before they pick up a [SPARC] compatible is consider what that will do to the relationship they have with the Sun direct

Sun's Changing Distribution Channels

Pre 1991



Today



Source: Sun Microsystems Inc.

salesforce," cautions Fisher. "It's their choice, but it's something we encourage them to evaluate before they make any decision on that."

Controlling and Patrolling the Channel

Despite the warning from Sun, similar words about SPARClikes come from James Carney, president of Workgroup Technologies Corp., a VAR that sells Sun-based document-management systems.

Workgroup, too, has concerns about the discounts available from Sun—particularly now that low-priced SPARC-

likes are available to his customers. "I feel that given the clones in the market," he says, "the discounts are going to have to change. There's going to be additional discounts needed for us to compete." If there isn't, he warns, "I may have to look at something else..."—by which he means SPARClikes.

Like Sykes, Carney says he would never go to SPARClikes exclusively. "We wouldn't abandon Sun," he says, "but they [SPARClikes] would be complementary." He doesn't worry too much about such a move damaging his relations with Sun. "If you can't make a profit on the margins of

the product you've got," he asks, "what does it matter?" Besides, he doesn't think Sun would or could retaliate, "I don't think anyone can police the channel that much."

But he also doesn't think it will come to that. He likes Sun. "Basically, we just carry Sun," he says. "We buy directly from them...to the tune of 500 plus machines a year." He has had problems with delivery. "It is a real problem," he says. "We just can't accept 45- to 60-day delivery times. But, on the other hand, 'I'd rather have that problem than a product that wasn't accepted in the market place.'"

A Fine Line Separates VADs from VARs

When is a value-added dealer (VAD) not a VAD? When it's already a Sun VAR. There are about 50 or so of these ambiguous VAD/VARs currently among Sun Microsystems Inc. resellers. Their presence demonstrates why Sun is either being cautious or reckless—depending on your interpretation—in hewing out its indirect channel strategy.

In July, Sun announced it was adding three national VADs (NVADs) to its reseller sales mix. These companies—Intelligent Electronics, MicroAge Inc. and Nynex Business Centers—operate via various dealer and franchise locations throughout the United States.

To date, Sun has authorized to carry its desktop products all 77 of the Nynex Business Centers; 30 of the 732 worldwide MicroAge stores; and 21 of Intelligent Electronics' 934 Entre, Connecting Point and Today's Computer Business Centers locations. Currently, half or fewer of these authorized locations are actually stocking and selling Sun products.

Just as it does with its VARs, Sun requires NVAD locations to have experience with UNIX hardware and software, if not with Sun specifically. Sun also expects NVADs to provide the same level of software and/or hardware value-add that it exacts from its VARs. And it requires them to do face-to-face (as opposed to telemarketing) sales, on-site installation and support, and end-user training.

Even before Sun made public its NVAD plans, quite a few of the individual NVAD locations and franchisees were acting and competing as Sun VARs. Yet, other Sun resellers didn't appreciate one iota Sun's NVAD announcement. Some complained that these dealers would turn Sun workstations into marginless retail products. Others were miffed that Sun was giving NVADs, which traditionally provide less value-add than VARs, bigger discounts.

"We still ask them [NVADs] to add value to a sale like the VARs do," says Curt Fisher, director of reseller channels for Sun. But "they're finding that they're playing in a different segment than the typical VAR/OEM is. Nynexes aren't out there selling CAD and CAE solutions; they're selling high-end graphics and desktop publishing,

4GLs, and network solutions. So, instead, what we've seen is quite the opposite: They (the NVADs) are creating more recognition of Sun products in the marketplace. In this case, it's actually helped some in the VARs' businesses."

VARs—as well as some of the NVADs—might beg to differ. The Gaithersburg, MD, MicroAge franchise, for one, is selling Suns into CAD, CAE and electronic publishing, says vice president Steve Granek. "The definition of value-add is like moving sand," Granek adds. Even though his franchise, which originally was authorized as a Sun VAR, is now considered an NVAD, terms of his Sun contract have changed little.

The centrally owned and managed Nynex Business Centers chain stores are focusing on selling Suns into the imaging, complex network integration, office automation and productivity, and technical publishing markets, says Roy Appelbaum, director of marketing. Although the Nynex chain has done considerable work with PCs in these areas, Suns and UNIX are fairly new to them, Appelbaum acknowledges.

For the most part, however, it looks like slow and steady are Sun's watchwords. Even though NVADs, like other resellers, are eligible to carry the entire Sun line—IPCs through 490 servers—few are carrying anything above a SPARCstation 2. And Sun and the NVAD parent offices are making certain that NVAD locations demonstrate financial and technical prowess before they're considered to be candidates for Sun authorization.

In fact, it seems that Sun's scheme to authorize 200 NVAD locations by July 1991, may end up as more talk than reality. While Nynex and Sun have trained 650 of Nynex Business Centers' technical and sales personnel on Suns, not all of the NVADs have managed as well. Because of a reported head-count freeze at Sun, dedicated account reps and engineers that Sun promised its NVADs are in short supply, says Colleen Gibbs, product marketing manager at Intelligent Electronics' Exton, PA, headquarters. As a result, plans for Sun-provided training are on hold.—mjf

‘It’s not perfect, but I do believe that there’s an effort to do better.’

—James Carney, president,
Workgroup Technologies Corp.

All in all, Carney gives Sun credit for trying. “Every year, it is getting better,” he says. “It’s not perfect, but I do believe that there’s an effort to do better.”

The theme of gradual improvement shows up in comments from Sun reseller and system integrator ERI, as well. “They [Sun] have gotten much better,” notes Michael Ragusa, ERI’s director of sales and technical resources. “When we signed up, Sun’s idea of value added was CAD.” Now, he notes, his own company—which focuses on commercial applications—has a \$20 million contract with Sun.

He does have some complaints of channel conflict. “Account control,” he notes. “You can still find a few sales reps who can’t deal with your selling in their accounts.” However, he says, most of Sun’s salespeople are beginning to be won over. “The smart ones realize that by bringing us in, they have more feet in the street for them.”

Sun VAR and integrator Artecon

Inc. also says kind things about Sun. “We don’t do DEC. We don’t do IBM. We don’t do MIPS,” says Mitchell D. Becker, Artecon’s manager of corporate communications. “We have found [Sun products] to be the best UNIX platform for the applications we require.”

He says that he isn’t particularly troubled by channel conflict. “The situation has occurred,” he admits, “but we try to avoid it. We take a very non-competitive position regarding Sun.” And he says his company has no interest in SPARClikes. “We’re abreast of them, but we don’t intend to carry clones. Our best friends are Sun sales reps. We don’t want to compromise that relationship.”

All in all, he says, he has few complaints with his supplier. “Perhaps it would be nice to be included in a few deals that required less work on our part,” he jokes. “But, that’s about it. There’s not too much that I can say that’s critical.”

Sun is well aware of channel conflict problems. “If somebody feels there’s gray marketing or sales that are brokering going on, we have a contract compliance board,” says Sun’s Fisher. “Whenever we get any complaints, we investigate them. Ninety-nine percent of the time [our] investigators have found a clean sale.” Nonetheless, last year Sun disbarred three VARs.

Where Things Get Bloody

Computervision, and particularly Computervision’s Personal CAD/CAM Business Unit, has several CAD/CAM products that run on Suns. Several of its VARs resell Sun equipment. “They’re our better VARs,” says Michael Gale, director of North American sales for the Business Unit. “The top 20% of our VARs are also their VARs.” His company is classified as a hardware OEM for Sun. But, for his VARs, he does see problems with Sun. “If you talk to them,”

he says, “you’ll hear that Sun needs to improve its relationship with the resellers.” In particular, he believes, Sun needs to regularize the means by which it communicates with its VARs. “They find it [Sun] highly disorganized...very confusing.”

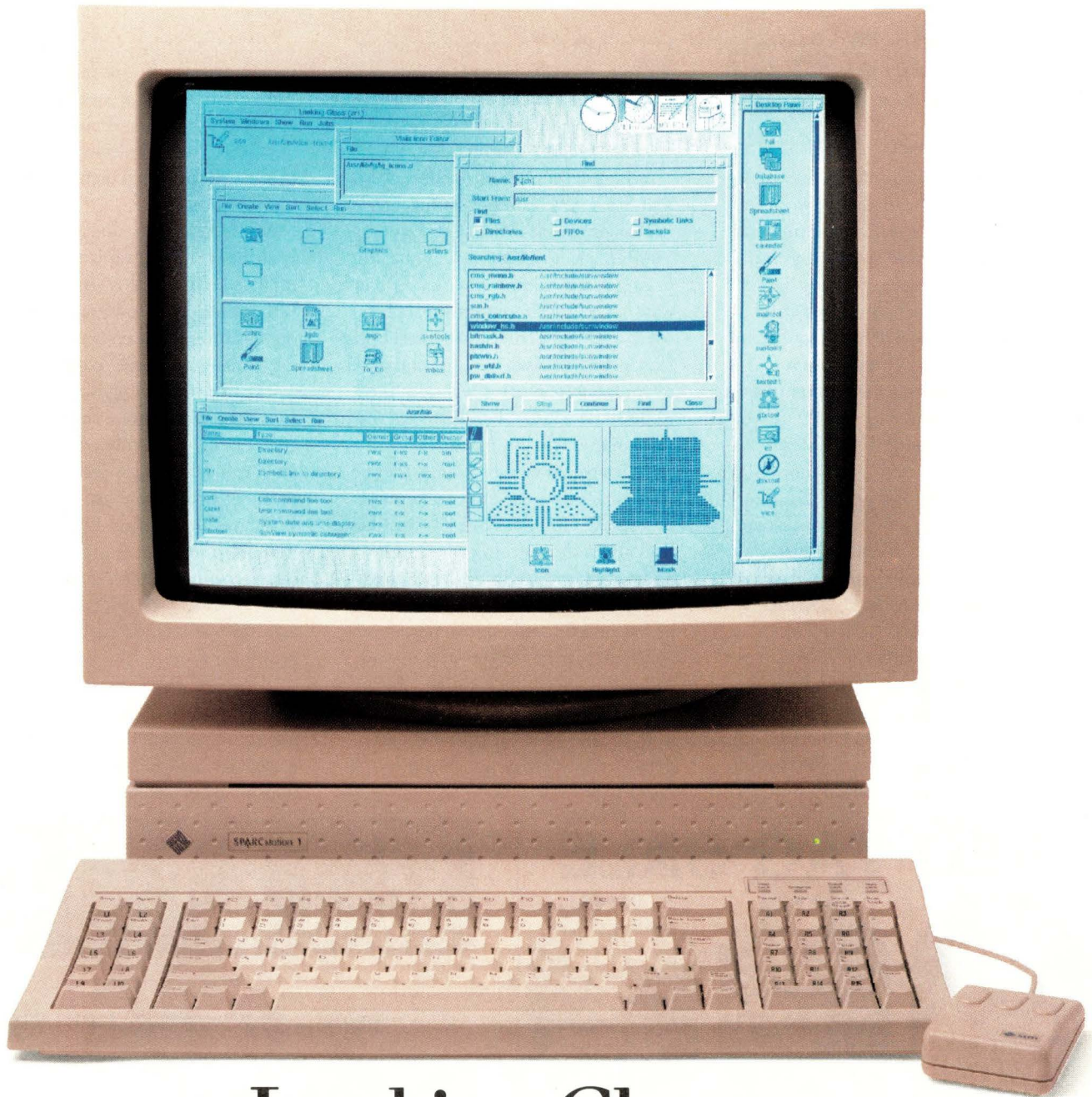
He has much less concern about channel conflict. “Every vendor has channel conflict,” he says. He thinks, in fact, that at least some VARs are more to be censured than pitied. “You never see these clashes at the low end,” he says. “It’s in the large sales that things get bloody.” He believes that channel conflict is rare when the sales are small in terms of the number of boxes shipped, and that the VARs’ value added is very high. “That’s why VARs came into being.”

In the end, in fact, he thinks they may have considerable motivation to stay with Sun. “The VARs sign up with Sun for one simple reason,” he says. “The product sells.”

A newly minted master VAR who agrees is Novadyne. Formerly a McDonnell Douglas division, Novadyne provides a number of Sun-oriented products and services. Among these, it has a line of Sun machines that support emulators that allow SunOS to run Pick applications. “We have an exclusive with Sun to market the Sun product line into the Pick marketplace,” explains Richard Haas, Novadyne’s national manager for VAR programs. “Our master VAR agreement states that we have to sell a VMark or Unidata license with every Sun box we ship.”

Novadyne’s own VARs then resell the machines with their own Pick-based applications. “We distribute through our VARs,” says Haas. “We don’t have a direct salesforce.”

The reason that Novadyne went with Sun was its salability. “It is a well-known



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product," says Haas. "We settled on Sun partly because of the name." He doesn't think he would go with a SPARClike.

Plays In Peoria

So, what kind of play is Sun making in indirect? For the answer to that, let's go the critics—the industry analysts. Everyone agrees that Sun needs indirect sales, perhaps desperately. "Indirect channels are critical for Sun," agrees Michael Goulde, an analyst with the Open System Advisor market-analysis organization based in Boston, MA. "It has to be, because the cost of direct sales is so immense."

But, everyone also agrees that Sun has problems in indirect. For instance, notes Lee Levitt, director of distribution channel research at the Framingham, MA-based market-research firm, International Data Corp., "Traditionally, Sun VARs had to pay for leads from Sun, which is very, very unusual." Sun's Marketing Assistance Program (MAP) effectively made a VAR pay the commissions of direct salespeople when they brought

in a joint deal. This is now no longer the case, though. "After October, as far as I can tell, this was no longer true," says Levitt, but citing conflicting reports, he adds, "but who can tell?"

Indeed, a number of resellers claim that Sun's new "compensation-neutral" sales plan is little more than MAP in sheep's clothing. "We're still paying direct salespeople in a different way," says GNP Computers' Kalb. MAP and compensation-neutral both "force the VAR, who is least equipped to compensate Sun's direct salesforce to do so," he says. "I'd like to see them [the programs] eliminated."

"With the low-end systems, they've tried to get into the dealer channel," says OSA's Goulde. "But I'm real skeptical about that. I think the future bodes well for Sun in the VAR channel, but not the dealer." In particular, he has questions about the dealers' ability to provide service and support. "The dealer channel is tough," he adds. "The whole Japanese computer industry has been incapable of entering...[because] they just found it inscrutable."

On the other hand, IDC's Levitt sees some value in the dealer program. "Sun expects their dealers to take them into the commercial markets," he notes. "And the dealer is actually better tied into the Fortune 1000 than Sun could be."

Where he has his concerns, though, is in the way that Sun is managing its indirect channel. "My understanding is that there used to be an umbrella organization that managed indirect sales, direct sales and rest-of-the-world." But following the reorganization, "these three were split apart and each can go off in different directions. Each can act without the knowledge of the other...that's bad."

Where Sun does get high marks, though, is in effort. In spite of everything, Sun has made a good faith effort. Good, bad or indifferent, Sun is in the indirect channel, and plans to get bigger there.

"They are taking steps," says Robert Segal, a principal with the channel-marketing consultancy Frank Lynn & Associates Inc., Chicago, IL. "Baby steps, maybe, but steps." ⇐

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LucasArts Editing Services
3000 W. Olympic Blvd., Ste. 1550
Santa Monica, CA 90404
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MicroAge Inc.
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Circle 144

Novadyne Computer Systems Inc.
1775 E. St. Andrew Place
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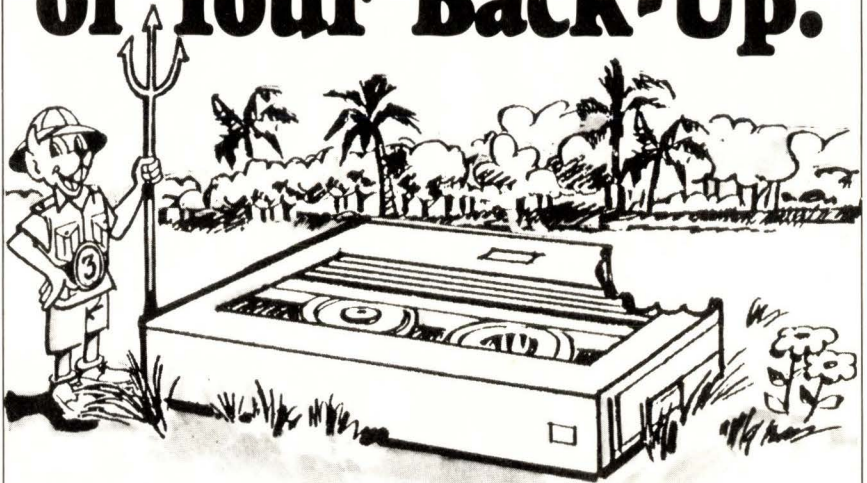
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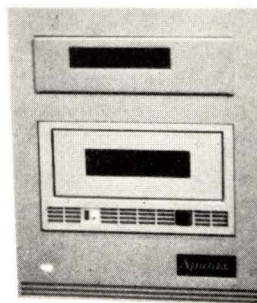
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by DANIEL P. DERN

Routers and bridges are the stuff of internetworking—the joining of individual LAN segments by LAN, WAN and enterprise connections. And LANs, in turn, are a de facto part of Sun (and other) workstation environments.

The LAN-workstation connection is hardly a coincidence, it should be noted. The strong synergy between workstations and LANs harks back to the pair's original conceptualization at Xerox PARC.

"The workstation, with its data-intensive bitmapped images, needed the LAN to 'amortize' the relatively expensive costs of file storage and printing services over many users," according to Bernard Hayes, a LAN maven from Digital Equipment Corp. currently posted to Project Pilgrim, the "next-generation Project Athena" being developed at the University of Massachusetts' Amherst campus. The same cycle, Hayes notes, has subsequently occurred with PCs.

Recapitulating the evolution of wide-area networks, LAN owners strove to add more devices to individu-

al LAN segments, and likewise to boldly internetwork these LAN segments across backbones and across wide-area distances (see "ISO's Open Door"). Further, many organizations sought to internetwork across organizational boundaries.

This effort led to several types of LAN connectivity devices, each with capabilities and limits. The leading players, in more or less increasing order of price:

- *Repeaters* extend the length of a continuous LAN segment, by amplifying the attenuating signal back to full strength into the next piece. A repeater forwards *all* traffic, and manages timing and collision issues. Think of it as network superglue.
- *Bridges* connect one LAN segment to another LAN segment, forming one larger segment. A bridge forwards along all traffic not local to its own segment, based on the Layer 2 Media Access Connection (MAC) source and destination Ethernet-level address. DEC LAT and IBM SNA traffic can be bridged, but can't be routed (at least, not without major diddling—a good question for Mr. Protocol).

• *Routers* (a.k.a. gateways) forward each non-local packet out to the port leading to the next "hop" of the route across the internetwork to its final destination. The router defines the boundary of a LAN segment. Servers often live within their segment, so that swapping, paging and humongous files won't clutter up the backbone unnecessarily.

Routers connect LAN segments (workgroup, department) to organizational backbones, backbone segments to each other and organization internets to other internets. Your neighborhood NSF regional network, for example, allows your Sun workstation to access a fileserver across campus, run an X window session to a supercomputer, query databases, etc.

Routing and bridging, like many network functions, can be done on general-purpose hardware (old PDP-10s, PCs, Suns, VAXs, etc.), but dedicated special-purpose hardware makes more sense. This has given rise to more niche network industries, namely, router/bridge vendors, now mature enough to hybridize their stuff with terminal servers, frame relay switches

	ISO Model	Widget	Benefits
7	Application	Application Gateway	Value-added connectivity
6	Presentation		
5	Session		
4	Transport		
3	Network	Routing	Filtering, "firewall," segment/backbone links
2	Data Link	Bridging	Speed, protocol-independent
1	Physical	Hardware Repeaters	Extend LAN segment connection length

network communication can be viewed as the effort required to let a pair of computer devices (such as a user workstation and a server, or two peer devices) exchange information. This transaction can be divided into a number of functional layers, or protocols—in the ISO model, a stack of seven layers, with interfaces between each set of protocols.

Jack Haverty, Internet Architect at Oracle Corp, Belmont, CA, offers an architectural analogy: "Imagine your network's user population as a set of seven-story buildings, with each story corresponding to a layer of the ISO stack—the physical medium at ground level, and the application (user) at the top in the penthouse (Layer 7). Each building has its own set of interfaces, acting as an elevator between each floor; a network of roads, glass walkways and tightrope wires running between similar floors, always parallel to the ground.

"Routers, bridges and the like are the doors and windows that let information get in and out of the buildings. Each operates at a specific level, and always moves information to a corresponding level in another building—although some may have elevators' to first move it down and back up again on the other side. What's not so obvious is that all these different devices exist because there are so many different ways to connect your stacks. You get to make this choice at almost every connection—and each choice has its technical, administrative, and organizational pros and cons. For example, you could choose to interconnect at the penthouse—application gateways. Or in the basement—a global bridged Ethernet, for example. Each provides connectivity with different characteristics."

and other network functions.

This article is mostly about routers, but organizations often get bridges and repeaters, and make choices between device types as much as between routers from different vendors, so it's important to understand and remember the turf.

Routers Muscle In On Bridge Speeds

Until recently, bridges had the performance edge over routers. Because all a bridge does is forward or not forward packets, which doesn't take much thinking, bridges could be smaller and cheaper. The savings in device costs by buying bridges, however, were often offset by the higher traffic loads passed by bridges, and the loss of the "firewall effect" of router versus bridge-segment connections.

But today's new routers have the muscle to route at bridging speeds—cycles and memory muscle that may be needed in any case. Equally, the new generation of routers can often do more than route, offering the variety of network functions today's multiprotocol, multimedia, multisegment inter-networks can't leave home without, like joining token ring to Ethernet, bridging DEC LAT traffic while routing those TCP/IP packets, and other hot combos.

Many new routers, such as the p4100 from Proteon Inc. are also software-configurable to do bridging, selectively on a per-protocol basis. Hence the name "bridging router" (as opposed to a "routing bridge," a.k.a. "brouter," which is a high-end bridge providing certain low-end routing functions like load-sharing and dynamic reconfiguration (but no true Layer 3 routing functions), a "bridging router" is a router that can bridge selective traffic.

Many Protocols, Side By Side

A bridging router that can handle IBM source routing traffic will let IBM users on a token LAN access other LANs, plus IBM mainframe hosts. It also means DEC terminal users can connect to DEC hosts located across local and remote Ethernet segments. You could connect your VAX networks to IBM mainframes, your IBM token-ring LANs to your VAX WANs...all at 16M bps.

Good stuff—but first make sure your router has what it takes to route.

There are a dozen or so communications protocols in use by leading computing platforms at present: TCP/IP, DECnet, SNA, XNS (used by 3Com Corp., Xerox Corp. and others), AppleTalk, IPX (Novell Inc.) and more—and your router needs to support any stacks it's expected to route. UNIX environments will clearly have TCP/IP, but VMS/VAXen may add DECnet, and those pesky DOS- or Apple-oriented LANs may add yet more protocols to support.

Unlike bridges, which are protocol-independent, never peering below the MAC layer, a router has to examine a packet more intimately to know where to send it. Further, your routers have to speak one or more routing protocols, so they can exchange urgent gossip regarding the state of the internetwork, the best way to get from each point to the next.

All routers in your internetwork involved in routing a given protocol stack have to be running the same routing protocol, or they won't work. To complicate matters further, in an internetwork, the odds of having routers from two or more vendors are good.

Many communications protocols include their own routing protocol. Some router vendors use proprietary algorithms—Cisco Systems Inc. has one called IGRP; Vitalink Communications Corp., one called SPF.

Most UNIX systems include an old, low-functionality interior gateway protocol (IGP) called Routing Information Protocol (RIP). RIP is, well, alive, but people use the protocol only when there's no alternative. For example, until recently, RIP was the only way that routers from different vendors could be used in a common internetwork unless Vendors B and C had also implemented Vendor A's proprietary IGP.

A mixed-vendor router environment is common, because that's the way internetworks grow. Also, companies internetwork, and you can't expect them to all pick the same router vendor. To address this, the routing wizards in the Internet community have developed

a vendor-independent protocol called the Open Shortest-Path First Interior Gateway Protocol (OSPF IGP). OSPF-speaking routers can be mixed and matched. (RIP still gets used for "end systems," which OSPF can talk to.)

Supporting Multiple Stacks

OSPF supports IP traffic. (Not unreasonable.)

If your net is running multiple stacks, e.g., TCP/IP and DECnet (perhaps you're running Suns and also some VMS/VAXen), your routers need either a) to run a routing algorithm for each protocol stack, b) to run an "integrated stack" which can support the routing for all the relevant protocols (TCP/IP and OSI, de facto), or c) a combination of (b) plus (a)'s not included in (c). (As if matters weren't already messy enough, there are two, very different, methods of implementing routing algorithms: distance vector, such as RIP, and Cisco's IGRP; and link state, used in OSPF and OSI IS-IS.)

To run each routing protocol stack chews up more of a router's memory and CPU cycle resources—not counting the actual work of forwarding packets. Benefit: You can run a multiprotocol backbone. Drawback: Plan to have higher-end routers, or take a *big* performance hit.

Most of today's routers will support a choice of protocol and/or routing stacks, loadable in software. This simplifies the router purchase. It also means that nets which already have their routers can most likely internetwork, e.g., Proteon with Wellfleet Communications Inc. with Cisco with Vitalink, etc.

Along with choice of protocols, these requirements suggest routers with faster, more powerful and possibly multiple processors, to run these multiple protocols and other protocols all at top speed. After all, supporting computer and network requirements is much less expensive—and much easier—than redoing your computer systems to fit your network.

Many net gurus believe that the number of routing and network protocols will drop down to three or four—IP, OSI (including DEC and per-

haps IBM?), and one or two others. But even that's enough to keep your routers multifunctioning. Even integrated IP/OSI routing won't necessarily handle your DECnet Phase IV traffic, for example. (There's at least another six-pack of issues here beyond the scope of this article.)

Furthermore, routers aren't just for routing (and bridging) anymore.

But Wait, There's More...

You'd think that routing multiple protocols concurrently plus the occasional foray into bridging would be enough. Answer: You should know better.

The newest LAN function—so new it has no spiffy name—connects once-disparate media and technologies. The more significant combinations are Ethernet to token-ring (hot news for IBM and DEC networkers), and Ethernet to FDDI. Token ring is more suitable for backbone speed networking, like the hundred megabytes per second flowing over fiber optics.

Another function being built in is application gateways, with APIs (Application Programming Interfaces) to let the gateway speak, say, to an X.400 mail server, or to an X.25 PDN/VAN.

Pursuing yet another dimension of opportunity, what was previously a box may turn into a chassis. Rapid-swap cards reduce that ever-important MTTR (Mean Time To Repair), and sparing becomes an n+1 matter for each board time, plus you get the further economy of fewer power supplies—assuming you can get what you want on boards that fit, of course.

A New Lease On Dial-Up

So far, all the routers we've been chatting about have been communicating over LAN connections or permanent leased links. But what about the rest of us: telecommuters, travellers and sporadic connectors who want to dial in and get serious IP connectivity—none of this terminal emulation, Xmodem and Kermit jazz. Why can't my home or briefcase system talk host-to-host, or my net to your net, just because we don't have a permanent LAN connection?

At Interop '90, the *sine qua non* of IP events (held this past October in San Jose), Telebit Corp. delivered the answer: NetBlazer, a stand-alone router (and terminal server) that hooks to some combination of:

- Ethernets (three maximum),
 - 56K-bps leased line,
 - Dial-up asynch serial ports (26 maximum), which can then connect to stand-alone (Telebit) modems.
- In other words, on-demand dial-in and dial-up IP routing connectivity (among other things).

This is a natural progression for Telebit, whose Trailblazer modems have become a de facto standard for UNIX *uucp* users. Now you can get IP internet-working connections, e.g., from another NetBlazer, in turn routing from its

Ethernet segment(s). Or from a portable PC running TCP/IP, or from the Sun workstation you brought home. It can now be a remote or mobile IP node. Remote offices who want to periodically poll for mail, do remote login and file transfer, but not spring for a leased line, are another good example.

Expect to see *lots* of NetBlazers—in the regional and commercial IP networks (PSInet, Altnet), public-access UNIX systems, and probably in your office, too.

Speaking of routing over leased and dial-up lines, Interop '90 also had demos

of PPP, the new Point-to-Point Protocol. PPP is the next step beyond SLIP, the Serial Line IP protocol, capable of negotiating IP addresses on demand rather than needing them to be pre-defined for a given connection and user. PPP also handles option negotiation between end points, ensuring "maximum common denominator ad hoc networking." This means PPP figures out what capabilities the devices at each end support in common, and uses 'em.

The new protocol adds the much-needed data link layer of interoperabil-

Companies Mentioned In This Article

Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
Circle 206

cisco Systems Inc.
1525 O'Brien Drive
Menlo Park, CA 94025
Circle 207

Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
Circle 208

IBM Corp.
Old Orchard Road
Armonk, NY 10504
Circle 209

Novell Inc.
122 East 1700
South Provo, UT 84606
Circle 210

Proteon Inc.
Two Technology Drive
Westboro, MA 01581
Circle 211

3Com Corp.
3165 Kifer Road
Santa Clara, CA 95052
Circle 212

Telebit Corp.
1315 Chesapeake Terrace
Sunnyvale, CA 94089
Circle 213

Vitalink Communications Corp.
6607 Kaiser Drive
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ity, necessary in wide-area networking so devices like routers and terminal servers can speak a common link layer protocol. Previously, you could not connect different routers over serial links (T1 line, 56K bps, etc.). PPP provides the necessary vendor-independent standard protocol, just as OSPF provides a vendor-independent routing protocol.

Translated, this means that different vendors' routers (who run PPP) can now be connected via leased lines (56K bps, T1, etc), not just LANs. "With PPP and OSPF, you can create a multi-vendor router wide-area environment," notes Ron Hoffman, assistant network manager for network services at the Massachusetts Institute of Technology in Cambridge, MA.

At Interop, synchronous PPP demonstrators included Telebit, 3Com and Cisco. For desktop users and dial-up schleppers, asynch PPP will give better connections, and simplify dial-in management—and there are PPPs available for DOS, Macintosh and UNIX systems.

Combine PPP with dial-in IP devices and commercial IP service PoPs (Points

of Presence), and personal networking takes on a whole new meaning.

Buying Routers

"We have crossed the threshold of critical flexibility in LAN devices," suggests Nick Lippis of Northeast Consulting, Boston, MA. "A network can now combine a wide range of physical media and interconnect technologies, from fractional and full T1, to FDDI, Ethernet, and more.

"Now that you can route as fast as you can bridge, and bridge between token and Ethernet environments," he observes, "network planners can design and adapt the network to the organization's needs, versus choosing within the network's capabilities."

"A single backbone supporting many user communities is much easier to manage, service and expand," adds Karen Barton, director of product marketing for Wellfleet Communications. "A smaller number of boxes, reconfigurable in software, makes this viable."

But while a single hardware choice can serve multiple network functions,

there are still important decisions to make. Which routing protocol? Which network stacks? Bridge or route?

To pick your path through the raft of available routers, remember you're trying to balance the pros and cons, not only for when things go right, but as or more important, for when things go wrong, and for when things change—both of which are inevitable.

→

Daniel P. Dern is a Watertown, MA-based freelance writer, specializing in technology, business and marketing. He particularly likes writing about Internet technologies. He is also a computer humorist, UNIX instructor, science-fiction writer and substitute jitterbug instructor (which he feels are highly similar). To better empathize with the vendor experience, he has been experimentally marketing personal fiber networking products on a small-scale basis, in the form of loud ties. Dern can be reached at ddern@world.std.com, or uunet!world!ddern.

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April

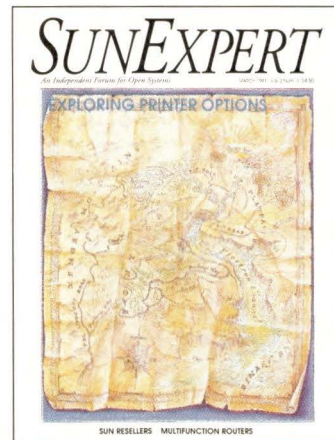
- Real-time Systems
- OS options under UNIX
- Embedded systems
- Robotics
- Vision systems

May

- Distributed Databases
- Client-server update
- SQL interfaces
- Object-oriented environments
- Multimedia technologies
- Survey of database vendors

June

- Mapping the UNIX Landscape
- System V, Release 4
- Mach
- OSF
- BSD futures
- Toward shrink-wrap UNIX



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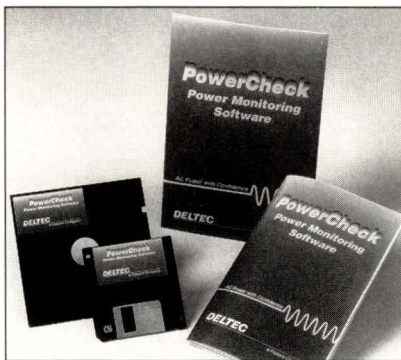
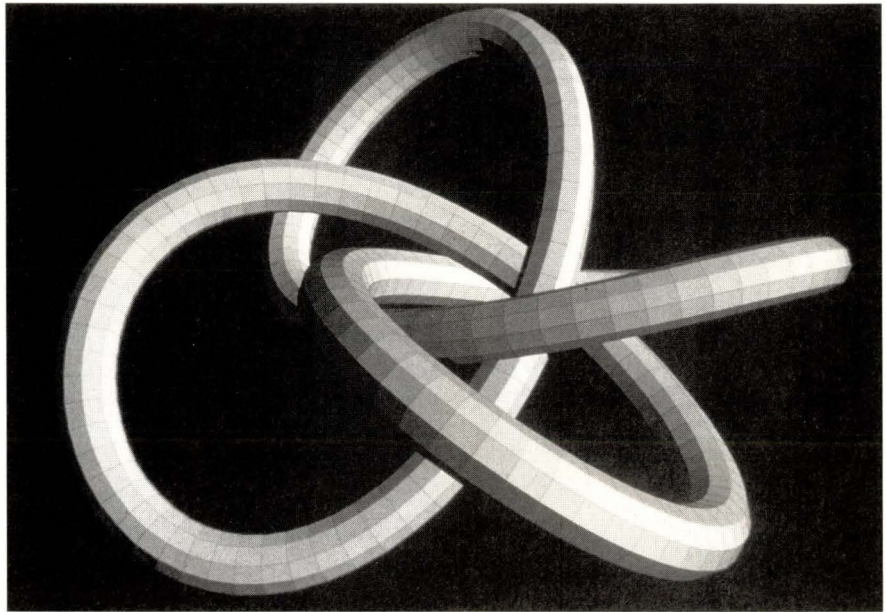
NEW PRODUCTS

New Release of Mathematica

Wolfram Research offers Mathematica 2.0, a new release of its software for numeric, symbolic and graphical computation.

The new version adds several new capabilities, including—on Sun systems at least—sound. The new Mathematica supports 843 different functions, up from the 560 of Release 1.0. Moreover, the product supports a variety of tools to provide easy migration of dusty-deck FORTRAN programs to the Mathematica environment.

Pricing varies according to processor. **Wolfram Research Inc.**, 100 Trade Center Drive, Champaign, IL 61820. **Circle 100**



Power-Checking Software

Software to monitor power supplies has been introduced by Deltec. The PowerCheck software package interfaces Deltec's 2000 Series and Watchman II UPSs to UNIX based systems, as well as PC local area networks.

PowerCheck provides a programming environment for the UPS, allowing the operator to define system parameters.

Pricing for the UNIX version is \$250.

Deltec Corp., 2727 Kurtz St., San Diego, CA 92110.

Circle 101

Ada Tool Released

IDE offers Object-Oriented Structured Design/Ada (OOSD/Ada), a CASE tool for Ada developers working on Sun and other workstations. OOSD/Ada includes a graphical design editor to automate the OOSD notion for the architectural design of software systems.

OOSD/Ada also includes two data modeling editors, a central repository, document preparation, and version control. The product features Ada-specific drawing rules and the Ada Reuse Library and Browsers.

The single license price for OOSD/Ada is \$8,500.

Interactive Development Environments Inc., 595 Market St., 10th Floor, San Francisco, CA 94105.

Circle 102

New DSP Board

The S-32C DSP board for SBus systems is a single-slot device based on the AT&T DSP32C DSP chip. It operates at a peak rate of 25

MFLOPS and is fitted with up to 4 MB of zero wait-state SRAM.

Pricing on the product begins at \$2,995, with volume discounts.

Ariel Corp., 433 River Road, Highland Park, NJ 08904.

Circle 103



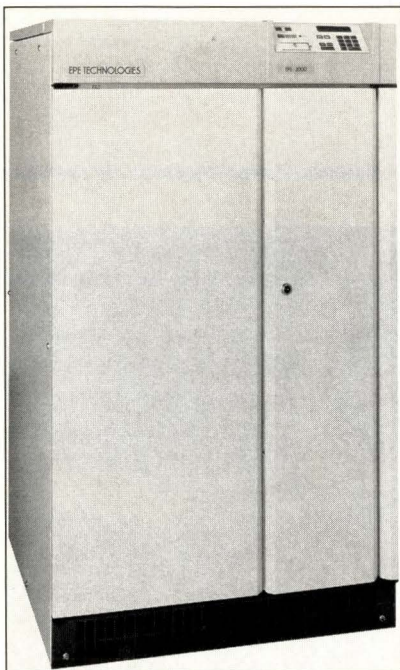
Tape/Disk Subsystems

Into a market previously restricted to DEC, Dilog introduces several new disk and tape peripheral subsystems for Sun workstations.

The products include the DATstacker 4mm cassette handling robot that provides 10.4 GB at \$5,628 and an 8mm table unit that provides 2.3 GB per cartridge at \$5,095. Both are SCSI devices.

Dilog Corp., 1555 S. Sinclair St., Anaheim, CA 92806.

Circle 104



11-kVA UPS

EPE Technologies has released an 11-kVA uninterruptible power supply for midrange computer systems.

The EPS 2000 line of UPS systems includes transistorized, pulse-width modulation inverter switching technology, support for 100% switch-mode power loads, and on-board microprocessors for greater precision in operation control. Price is \$24,000.

EPE Technologies Inc., 1660 Scenic Ave., Costa Mesa, CA 92626.

Circle 105

Deep-Dish Pizza

An "extra-large pizza box" style enclosure has been introduced by Dyna Five. The Model PE200 peripheral enclosure furnishes mounting for up to four full-height, 5 1/4-inch disk or tape drives.

Each disk or tape drive is powered by an individual 65W power supply. There are two fans, and I/O connector panels accommodate such standard interfaces as ST506 and SCSI. The PE200 measures 4.63 inches high by 19 inches deep by 19 inches wide.

Dyna Five Corp., 173 Freedom Ave., Anaheim, CA 92801.

Circle 106

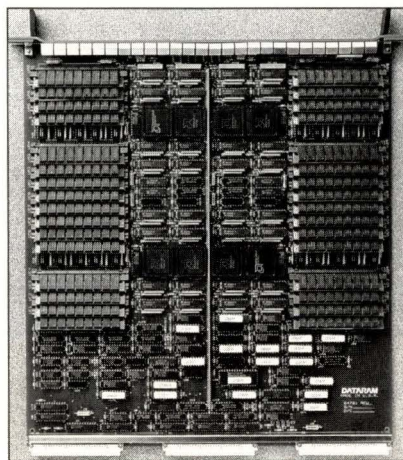
VAX 6000 Memory

Dataram has released 32-MB, 64-MB and 128-MB upgrade memory boards for DEC VAX 6000 computers. Called the DR-600 line, the memory boards are priced at \$22,000 for 32 MB, \$43,000 for 64 MB, and \$85,000 for 128 MB.

The DR-600 series is being offered as a replacement for DEC's standard MS62A-AB memory product.

Dataram Corp., P.O. Box 7528, Princeton, NJ 08543-7528.

Circle 107



SPARCstation Memory

Dataram announces a memory module for SPARCstation 470s and SPARCserver 470/490s. The DR-470 comes in a 32-MB model at \$10,500 and a 128-MB model at \$32,000.

The DR-470 is based on 80ns 1-MB and 4-MB page mode dynamic RAMS and is organized into four banks of memory, with each bank containing eight SIMMs.

Dataram Corp., P.O. Box 7528, Princeton, NJ 08543-7528.

Circle 108

Memory Upgrades for RS/6000

Kingston Technology presents memory-upgrade kits for the IBM RISC System/6000 workstation.

There is a 16-MB upgrade kit, the KTM 16/RISC, at \$3,395; a 32-MB kit, the KTM 32/RISC, at \$8,995; and a 64-MB product that had not been priced as of press time.

Kingston Technology Corp., 17600 Newhope, Fountain Valley, CA 92708.

Circle 109

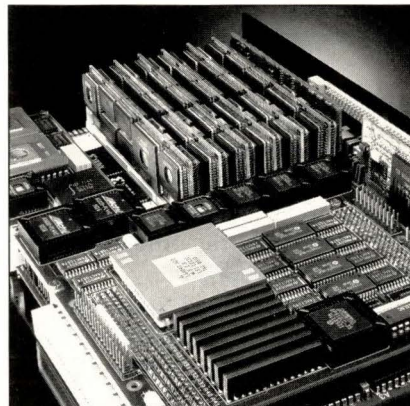


Image-Processing System

Datacube has announced an image-processing system for OEMs and volume end users.

A two-slot 6U VME module, the Maxvideo 20 is based on a custom 250,000-transistor chip that provides the equivalent of 3500 MIPS to image-processing applications.

Pricing begins at \$24,000, with OEM quantity pricing as low as \$10,000.

Datacube Inc., 4 Dearborn Road, Peabody, MA 01960-3851.

Circle 110



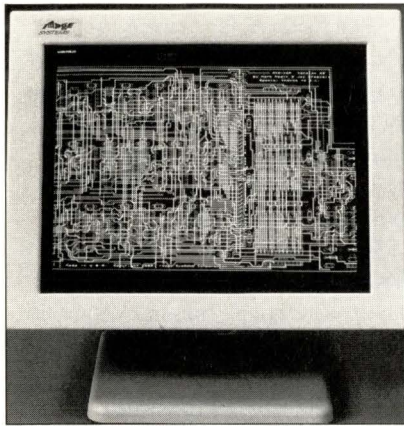
Transceiver Pair

Lantronix offers two miniature Ethernet transceivers. The LTX-T connects terminal equipment (terminal servers, workstations, etc.) to twisted-pair Ethernet LANs. The LTX-2, meanwhile, connects the same devices to thin-coax Ethernet.

Both are 2.5 inches by 1.7 inches by 0.9 inches and are priced at \$249.95.

Lantronix, 26072 Merit Circle, Ste. 113, Laguna Hills, CA 92653.

Circle 111



High-Performance Monitor For Suns

A high-performance monitor for Sun workstations has been introduced by Image Systems.

The M24LMAX 24-inch, monochrome/greyscale and the C21LMAX 21-inch, flat-screen color monitor are said to be fully compatible with Sun's own products, but offer any pixel count from 1024 by 768 to 1600 by 1280.

The M24LMAX is \$1,995; the C21LMAX is \$3,895.

Image Systems Corp., 11543 K-Tel Drive, Hopkins, MN 55343.
Circle 112

Writable CD-ROM

The CD-Maker desktop writable CD-ROM system for Sun workstations combines the company's Makedisk CD-ROM formatter and driver technology with the Sony write-once drive.

With it, Sun users can prototype and test low-cost, low-volume CD-ROM production drives. CD-Maker supports the ISO 9660 standard for CD-ROM. Pricing begins at \$6,995.

Young Minds Inc., 308 W. State St., Ste. 2B, Redlands, CA 92373.
Circle 113

SunGKS 4.0 Ships

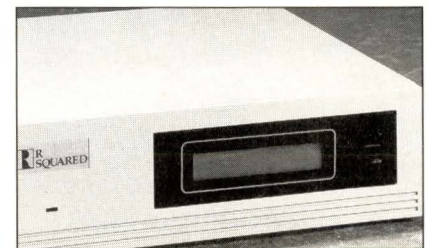
The SunGKS 4.0 on OpenWindows for SPARC-based systems includes support for such industry standards as X.11 windows. Features include 4-bit plane masking and multi-primitive batching. The latter makes it possible

for SunGKS to group graphics-oriented primitives and perform them all at once as a batch process.

The bad news is that the product is for OpenWindows and SPARC systems only. Sun-3 machines, 386i's and SunView customers cannot use the new version. However, the older version SunGKS can still be purchased by those who own the older, CISC-based machines.

Sun Microsystems Inc., 2550 Garcia Ave., Mountain View, CA 94043-1100.

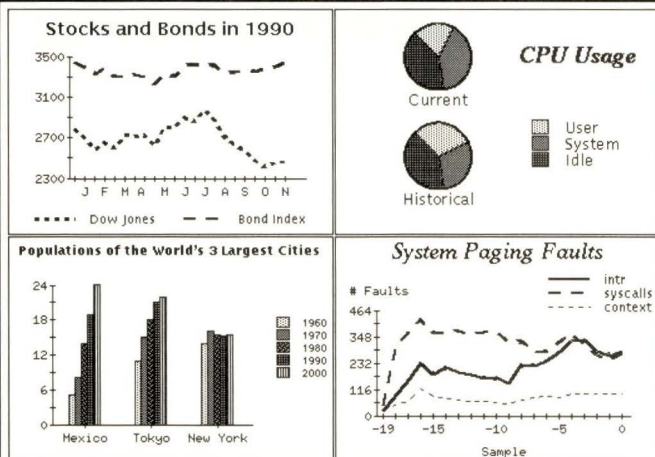
Circle 224



SCSI Tester

A SCSI monitor has been released by R Squared. The STM-100 monitors SCSI status for any SCSI periph-

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Aurora offers new expansion options for SPARC™ workstations.

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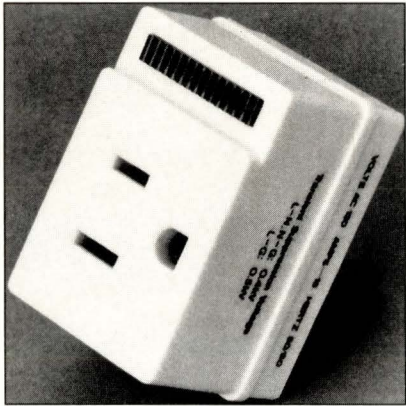
eral—disks, tapes, optical media, etc.

Information about the status of the peripheral can be displayed on a front-panel LCD display, or relayed to a host computer via a RS232 port.

Price is \$1,295.

R Squared, 11211 E. Arapahoe Road, Ste. #200, Englewood, CO 80112.

Circle 114



Surge Suppressor Introduced

A low-cost, wall-mounted surge suppressor has been introduced by Intermatic.

The Electra Guard EG3C surge suppressor plugs into a standard outlet and the equipment to be protected—such as workstations—can plug into it. The device provides protection on all three lines—hot, neutral and ground.

Pricing begins at \$9.95.

Intermatic Inc., Intermatic Plaza, Spring Grove, IL 60081-9698.

Circle 115

5080 Emulator for Suns

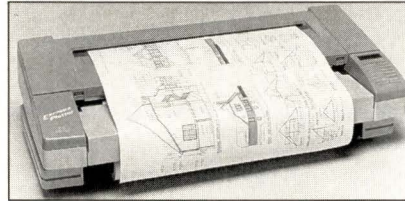
Sun has debuted a new release of Sun58TE, a product that allows SPARCstations to emulate the IBM 5080 terminal. Known as the Sun58TE Version 1.1, the emulator now supports the GX graphics accelerator.

The product requires SunWindows, SunOS 4.0.3 or 4.1, the Sunlink Channel Adapter, and the Sunlink Local 3270 Terminal software. For the server end of the product, the company recommends a Sun VME system with six or more slots and a minimum of 8 MB of disk. For the client, Sun suggests a Sun-4-level machine with

the GX accelerator.

Sun Microsystems Inc., 2550 Garcia Ave., Mountain View, CA 94043-1100.

Circle 223



Large Format Thermal Plotter

A D-size thermal plotter has been released by Japan Digital Laboratory. Called the JDL ExpressPlotter, the device has a one-minute plot-output time at 200-by-200-dpi resolution.

There is also a 200-by-400-dpi mode. A FastPlot driver is currently available for Autodesk's AutoCAD software. The plotter also supports the HP-GL command set, emulating the HP line of pen plotters.

Pricing begins at \$7,995.

Japan Digital Laboratory Co. Ltd., 4770 Calle Quetzal, Camarillo, CA 93012.

Circle 116

Yacc++ For Sun

Yacc++ from Compiler Resources is a successor to yacc and lex. Yacc++ provides direct translation of regular right expression and produces efficient LR(1) tables.

Lexers and parsers created by yacc++ have a call-back mode for Open Look, SunView and other event-driven systems. The software comes with the Languages Objects library and a set of sources for developing language processors. Price is \$995.

Compiler Resources Inc., 3 Proctor St., Hopkinton, MA 01748.

Circle 117

Multiplexer Runs From RS232C

Vector Technologies has introduced a multiplexer for Sun workstations that allows up to seven serial and parallel devices to run from each workstation's RS232C port.

The VPX-128 thus allows a

SPARCstation 2, for example, to become a multiuser system or support multiple devices without expending an SBus slot. The product is compatible with all SPARCstations, Sun-3 machines and Sun 386's running SunOS 4.0 or greater.

Pricing begins at \$1,195.

Vector Technologies, 3289 E. Hemisphere Loop, Tucson, AZ 85606.

Circle 118

DXT Subroutine Libraries

Far Bit Research has released a library of DXF subroutines for generating AutoCAD DXF drawing files. The package includes all source code for subroutines written in FORTRAN, C, BASIC and QuickBASIC. Routines for 2D and 3D drawing entities include line, text, arc, circle, point, polyline, trace, layer and 3D face.

Pricing is \$195.

Far Bit Research, 607 Beacon St., #11, Oakland, CA 94610.

Circle 222



Advanced Terminal Server

Annex three, an advanced terminal server, has been introduced by Xylogics. The product is an upgraded version of the company's Annex II. Like the older system, the three supports multiple protocols—including TCP/IP and LAT.

It further offers increased programmability and flexibility due to a new Intel microcontroller.

There is an 8-port model at \$3,995 and a 64-port model at \$6,995.

Xylogics Inc., 53 Third Ave., Burlington, MA 01803.

Circle 119

Software Measurement For UNIX

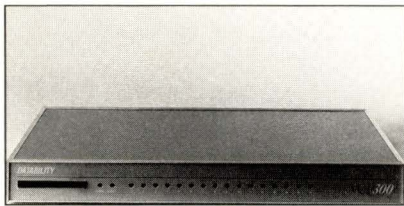
SET Laboratories presents Version 2.0 of its UNIX-Metric line of soft-

ware measurement tools for Ada, C and C++.

UX-Metric attempts to measure the complexity of a program via a number of specialized measures. Version 1.0 supported the software science, cyclo-matic complexity and span of data reference measures. Version 2.0 adds the number of blank lines, number of comments and average variable name length measures

It is priced at \$450.
SET Laboratories Inc., P.O. Box 868,
Mulino, OR 97042.

Circle 120



Low-End Terminal Servers

The VCP-200 and VCP-300 low-end terminal servers from Datability Software Systems support both DEC LAT and UNIX TCP/IP.

The VCP-200 provides 8 ports at

\$2,399. The VCP-300, meanwhile, provides 16 ports at \$2,999.

Datability Software Systems Inc., 322 Eighth Ave., 11th Floor, New York, NY 10001.

Circle 121



XView for VMS

XView for VMS is a development tool kit that allows the porting of Windows-based applications written for Sun platforms to the DEC VAX running VMS. Xview for VMS includes pull-down and/or cascading menus, dialog boxes, and full keyboard and mouse support.

The product requires VAX/VMS V5.2 or higher. Pricing had not been established as of press time.

TGV Inc., 603 Mission St., Santa Cruz, CA 95060.

Circle 122

New SunPHIGS For SPARC

Sun has debuted a new PHIGS release for SPARC processors. SunPHIGS 1.3 is said to be up to 65% faster than SunPHIGS 1.2. Moreover, Release 1.3 applications can link dynamically to PHIGS libraries and offer several other performance advantages.

However, there are limits. Release 1.3 obsoletes Release 1.2 for SPARC workstations only. The product will not support the GT accelerator and is for SunView only.

Sun Microsystems Inc., 2550 Garcia Ave., Mountain View, CA 94043-1100.

Circle 221

FYI

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 at the end of the magazine.

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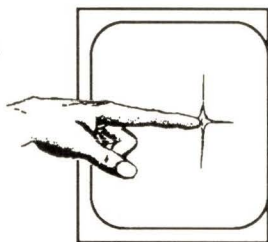
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Circle No. 29

At the Talent Identification Program at Duke University, Guerry Semones installed 32 megabytes of Clearpoint memory in their SPARCstation 330 with startling performance results. *"I had no idea we could get that kind of enhancement by adding memory,"* said Guerry. *"Last year TIP staff had to plan their computer use around the time requirements for running our 300,000 plus-record database. Now we support multiple database users, and we don't even notice the impact on our system performance."*

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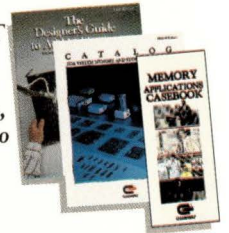
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Circle No. 13

"With Clearpoint memory in our SPARCstation 330, database sorts went from 2-3 hours to 1.3 minutes."

Guerry Semones, (at left, with Dubie Dubendorfer, Information Services Specialist, center, and Russell Beardall, Systems Analyst)

Assistant Director, Information Services
Duke University Talent Identification Program
Durham, North Carolina

The Talent Identification Program (TIP) provides educational programs and support to gifted and talented students, Grades 7-12, in a 16-state region. The TIP Information Services Division runs memory-intensive database programs, managing over 300,000 active records on a SPARCstation 330.

