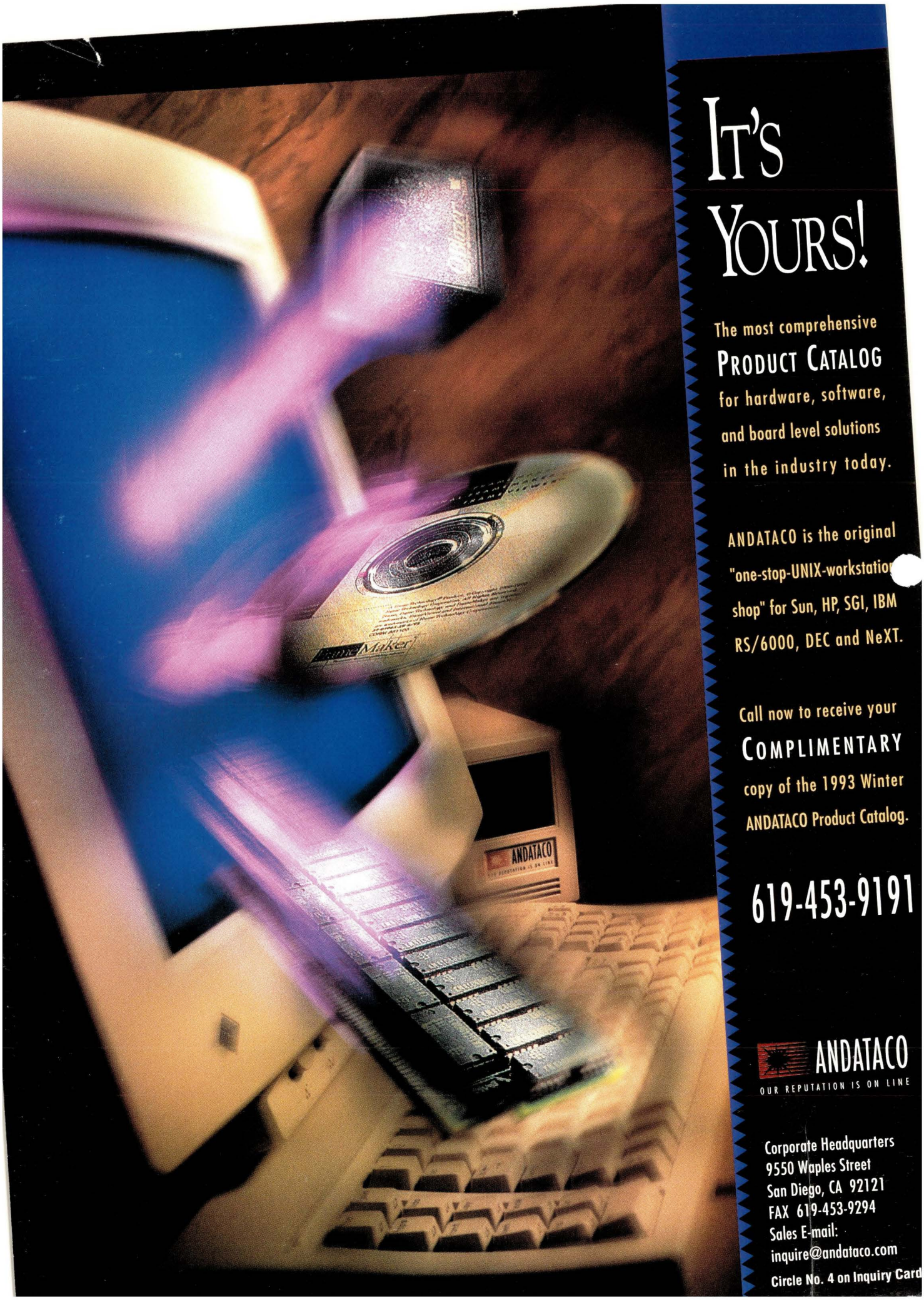
SUNEXPERT

Serving the UNIX Workstation Network

OCTOBER 1992 Vol. 3 No. 10 $4.50

News: SunExpress Revamp

Survey: Routers



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Any knowledgeable, sophisticated technical leader in business today is at least mildly familiar with the phrase "object-oriented analysis"---OOA.

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You can receive a complete, unabridged video of my five part strategy entitled "OOA: An Entertaining Training Video™." In fact, before creating this new video, I developed another video program at the request of a major US software engineering organization to help them expose thousands of the engineers they advise on this new, leading edge approach to doing analysis work. The video was designed to provide accelerated, simplified learning for their engineers.

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This video normally sells for $595 each. **But for a limited time, you can get it for just $29---less than the best-selling OOA book itself.** (And no postage or handling charges, either.)

Why would I do this? Well, many of my colleagues might think I'm crazy. But I think it's a very intelligent proposition to make.

Here's why. If I all but "shamelessly bribe" you into sitting down and sending for the material...and get you oriented...teach you how to think in objects...teach you how to make your very own OOA model...show you how to use this inevitable paradigm change to your advantage...and then get you to finally realize why everyone's so excited about OOA, one of four things will probably happen:

1. You'll decide you want everybody in your company or department to learn it and learn it to the nth degree...and when you perform your due diligence to identify who the most appropriate company or person is to teach them, guess who'll you choose?

2. You'll get to a point and see how much further you could progress...but you'll need some expert advice. Guess who you'll probably call?

3. You'll find as you go along that you need more than paper and pencil ...you need an effective tool to really multiply your efforts so you really get the job done. And I bet you can't imagine who produces the most effective tool on the market.

4. Or perhaps you'd like to come and spend a week with me at a seminar in Austin---hands-on. Join an industry leader in showing people how to really get the work done (rather than make little progress with trivial classroom examples, like others with less understanding and experience end up using).

As you can now see, my downside, as well as yours, is remarkably low on this transaction. I've decided to lower yours to zero. You see, I'm offering you this $595 introduction video for only $29 on an unprecedented risk-reversed, 100%, 90-day money-back guarantee.

Simply put, if you're not exhilarated or highly favorably provoked...if your own understanding hasn't become vastly expanded...and if you aren't starting to see all of the time-saving and quality-increasing aspects this paradigm offers our industry...I don't want you to even keep the video. I'll be only too happy to immediately refund your purchase price. No questions asked. No hard feelings either.

Is object-oriented analysis appropriate for your team? Maybe...maybe not. One thing is for certain...with so many documented cases of companies like yours competing in the world marketplace...bringing out new products with breath-taking speed... progressing w-a-y ahead of their competition...establishing industry-wide prestige for their excellence ...gaining market leadership, it's something you really need to seriously consider and investigate. The upside is big. The downside is that you'll expend a mere 84 minutes of your time. You owe it to yourself to at least investigate it, particularly since all the risk is borne by me.

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With top regards!

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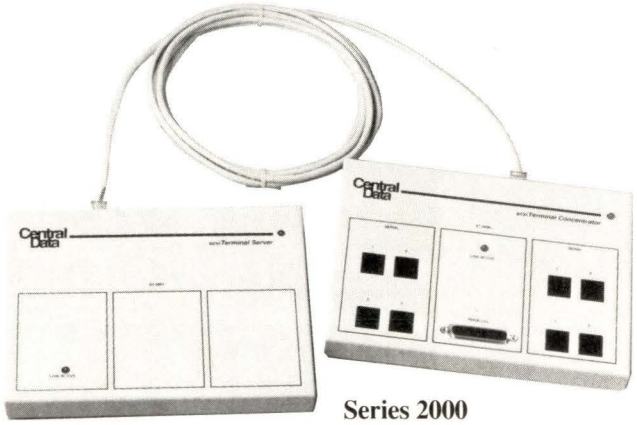

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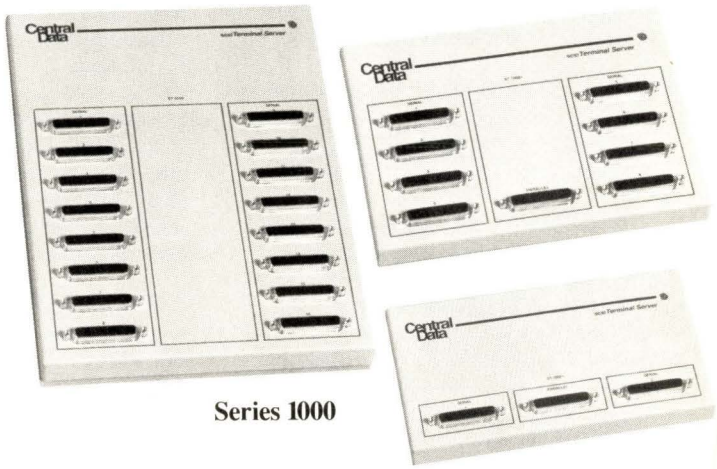

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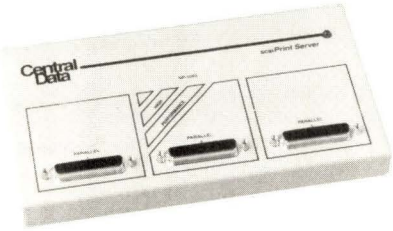

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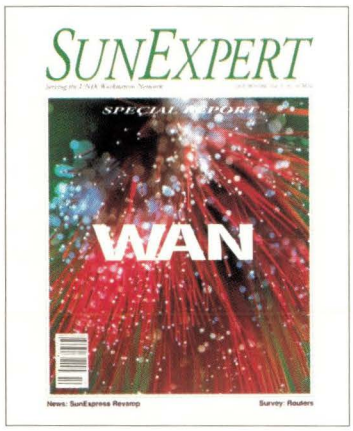

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NEWS

COLUMNS

DEPARTMENTS

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

SUNEXPERT Magazine (ISSN 1053–9239) is published monthly by Computer Publishing Group, 1330 Beacon St., Brookline, MA 02146-3202. Telephone (617) 739-7001. Second-class Postage Rates paid at Boston, MA, and at additional mailing offices. This publication is free to qualified subscribers as determined by the publisher. Subscription rates are $49.50 per year in the United States, and $70.00 abroad. Subscription requests can be sent to: Circulation Department, *SUNEXPERT* Magazine, 1330 Beacon St., Brookline, MA 02146-3202 or electronically mailed to circ@expert.com.

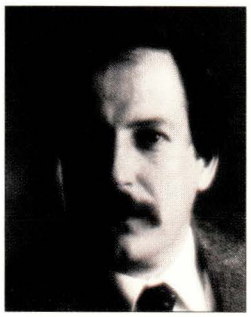
POSTMASTER, please send all address changes to *SUNEXPERT* Magazine, Circulation Department, 1330 Beacon St., Brookline, MA 02146-3202. Please allow 6-8 weeks for change of address. Include your old address as well as new–enclosing, if possible, an address label from a recent issue.

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

Editorial

'Wild World'

This month Senior Editor Mary Jo Foley takes on the subject of wide-area networking and discovers "it's a wild world" (apologies to Cat Stevens, but that's another conversion story). The articles in this Special Report on WANs deal with at least three forces shaping the net today and for the foreseeable future: exponential growth, the clamor for bandwidth and the need to support diverse topologies and protocols.



The people in charge of workstations wear two hats: The same wizards who use or keep workstations up and running often also wear the hat of network guru. Because networking is so ingrained in the UNIX philosophy, it isn't all that surprising that the same folks who keep the machines in the pink as part of their day-to-day routine also do network planning and administration.

And if you are a software developer you have to be net aware. Networks mean software will be distributed–á la client/server configurations–or at the very least, applications will be shared by multiple users via some type of network-licensing scheme. Plus, today, nearly all software is written by teams of programmers connected over a–you guessed it–network.

Because a lot of nice friends out there pitched in, the WAN Special Report looks at the topic from many different perspectives. But if you wanted to draw some moral from the tale, I suppose you could say that developers, administrators and users ought to be well acquainted with the alphabet.

New this month, and related to networking, is a feature we're calling "Fax Facts." If you could set aside the time, we would very much appreciate your responses to the ten questions. You can photocopy it–please–and send it to (617) 739-7003. "Just take good care…"

Doug Pryor

Doug Pryor

SUNEXPERT Magazine
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OCTOBER 1992 VOL. 3 NO. 10

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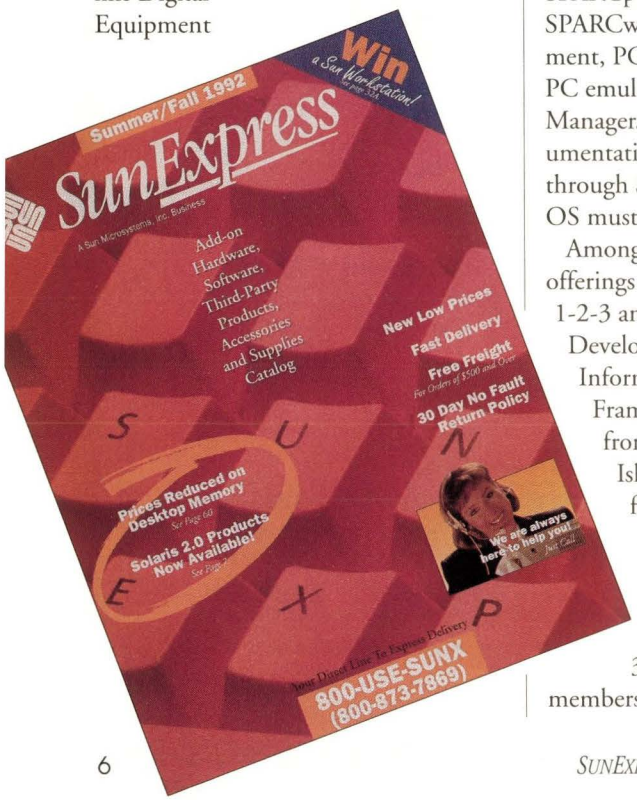
NEWS

Priced on the Street

Users, take note: SunExpress is open for *your* business.

The Lincoln, MA-based Sun Microsystems Inc. subsidiary is still catering to VARs and other resellers, but to a far lesser extent than it did previously. Now, says director of marketing Charles Laing, end users are the primary target customers of SunExpress. SunExpress plans to entice them with "street-level" pricing, i.e., prices 10% to 35% less than list, for all products that it distributes. (Discounting has been discontinued, says Laing.) And it has stepped up the number of products it is carrying, adding a substantial number of third-party-provided applications and tools.

"Sun is coming late to the [express-distribution] party," acknowledges Laing–at least later than rivals like Digital Equipment Corp. and Hewlett-Packard Co. "But we're unique in that we're offering street-level, rather than corporate-level, pricing, and in the number of third-party products we're selling."



SunExpress provides no post-sales support for the products its sells. Instead, it focuses on "presales" support. Currently, more than 99% of all orders are delivered in five business days or less, Laing says. To attract new customers, SunExpress is forgoing freight charges for all orders of $500 or more and charging a $9 fee for orders under $500. The subsidiary has also added a 30-day, no-fault return policy to its list of benefits.

Among the products that SunExpress is now making available to users is the Tadpole Technology Inc. SPARCbook. A bare-bones, gray-scale system with an 85-MB hard drive and 8 MB of RAM goes for $4,950; a fully configured color model, with two 120-MB drives and 32 MB of RAM, is available for $15,700.

The SPARCbook is the only system-level product that SunExpress is selling at present. The rest of its products, nearly all of which sell for $5,000 or less, tend to be from the various Sun planets (SunConnect, SunPro, SunPics, etc.) or from ISVs. SunExpress now sells Sun memory, storage and spares, Sun's SPARCprinter and NeWSprint, the SPARCworks programming environment, PC-NFS, NetWare SunLink and PC emulation products and SunNet Manager. Solaris upgrade licenses, documentation and media are available through SunExpress, but the complete OS must be purchased from SunSoft.

Among the new third-party software offerings available from SunExpress are 1-2-3 and cc:mail from Lotus Development Corp.; WingZ from Informix Inc.; FrameMaker from Frame Technology; WordPerfect from WordPerfect Corp.; IslandWrite, Draw & Paint from Island Graphics Corp.; Aster*x from Applix Inc.; Rapport from Clarity; and Draw from Corel.

SunExpress relies on its 35 or so telemarketing staff members to move product. It publishes the SunExpress catalog three times a year in the United States and Europe (in three different languages). In August, it mailed the 145-page catalog to more than 200,000 Sun users. With next month's catalog mailing, it plans to expand its reach beyond the Sun installed base, says Laing.

By June of next year, SunExpress plans to have implemented an "electronic store" model of ordering. Customers will be able to submit orders electronically by filling in screen-based order forms. Ultimately, Laing says, SunExpress hopes to offer demos and software that are orderable over the network.

The new contact number for SunExpress is (800) USE-SUNX ((800) 873-7869).–*mjf*

SWAN: ATM by '95 or Bust

Sun Microsystems Inc. is no slouch when it comes to adopting new technologies. In house, Sun engineers are already dabbling on an experimental basis with asynchronous transfer mode (ATM), says Shyam "Sam" Rangole, director of network services. "We think by 1995 that ATM will be the right solution for us, with frame relay possibly figuring as an interim solution," he says.

If anyone is able to predict the networking future of Sun, it's Rangole. He, along with his staff of approximately 30 dedicated network administrators, is responsible for maintaining the Sun wide-area network (SWAN)–what may be the largest commercial TCP/IP network in the United States.

At present, SWAN makes use of the TCP/IP protocol nearly exclusively, Rangole says. Even connectivity to the few IBM Corp.-compatible mainframes on the administrative side of Sun is done over TCP/IP. On a small scale, Sun is exploring the uses of OSI and ISDN over SWAN.

SWAN will provide a rigorous test ground for ATM. It consists of more than 20,000 hosts, 920 subnets, 140 routers, 30 PBXs and 26 video-conferencing units. The network supports traffic volumes in excess of 200 GB of data, 4,000 minutes of voice conversations and 1,000 minutes of video conferencing–*daily*. SWAN currently

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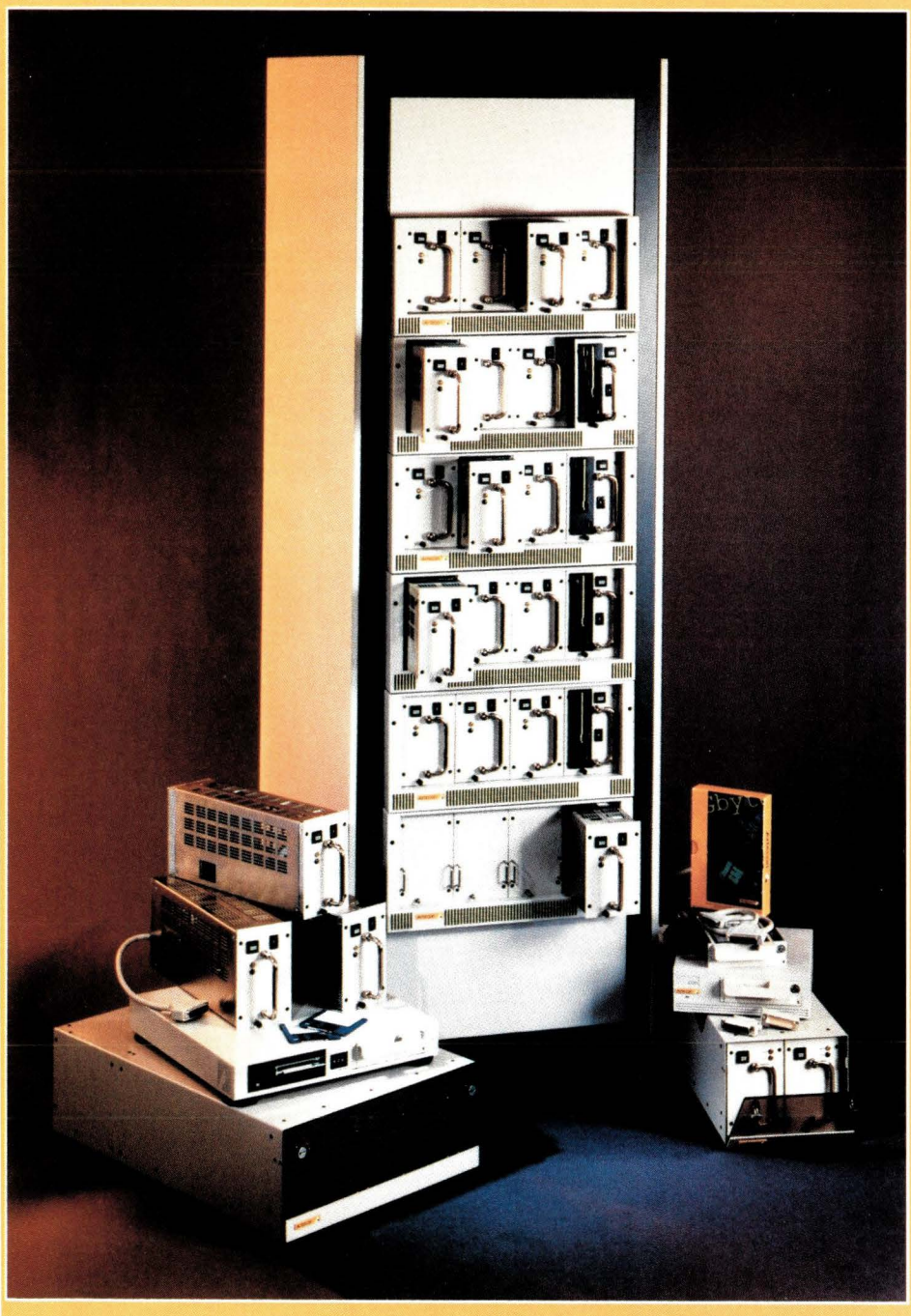

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interconnects more than 120 Sun sites throughout the world, up considerably from the six or eight locations it linked a mere four years ago.

The SWAN U.S. backbone is a dual T-1 ring, connecting Mountain View to Dallas, to Marysfield, VA, to Boston, back to Mountain View. Another ring interconnects the 18 or so Pacific Rim sites, and another, the 12 European Sun sites. Sun users can send data, voice and/or video over these T1 lines. At the campus level, networking is handled over fiber; within Sun buildings, twisted pair is the order of the day.

"There are no IBM controllers on this network. We run Sun's 3270 terminal-emulation packages on Sun servers" to link to the mainframes, Rangole explains. As one might expect, Sun employs Sun networking equipment and software whenever possible.

Also not surprisingly, SWAN is managed using SunNet Manager. A handful of complementary packages, such as Concord Communications Inc.'s Trakker, are used to manage specific devices (PBXs, in Trakker's case). Sun's overriding consideration in choosing net-management applications: SNMP compatibility.

The far and away No. 1 application that is run over SWAN is email. "Sun is an email culture. And for it, everybody is dependent on SWAN," Rangole says. There are roughly 25 sun.com names listed within the domain naming service, and 28,000 or so entries in the sun.com space–although not all of these are active accounts, according to Rangole.

Despite SWAN's complexity and overwhelming size, Rangole and his crew are keeping it ticking. Average daily availability for SWAN stands at 99.9%, he claims.–*mjf*

Sun Sees the Light on Imaging

Sun Microsystems Inc.'s SunSoft division has announced an application programming interface (API) for imaging applications. The new API, which is to be called XIL ("a name, *not* an acronym" according to SunSoft), is meant to provide software and hardware developers with a standard interface for imaging and full-motion video products. In theory, such products that write to XIL would be portable and scalable across all Solaris-based systems, including those based on the SPARC and X86 processors.

XIL is described as a software interface for imaging applications that resides between higher-level programming interfaces and system hardware. It consists of a programming interface specification for basic imaging functionality, a high-performance implementation of the same specification but tuned for the SPARC, and a hardware-interface specification for vendors wishing to build XIL imaging accelerators.

Among other things, XIL will provide 30-frames-per-second, 640-by-480 video windows on standard SPARCstation 2 workstations. It also has compression and decompression technology supporting the JPEG standard. XIL will ultimately be part of all Sun system software. In the shorter term, however, a developer's kit is to be available in the first quarter of 1993.

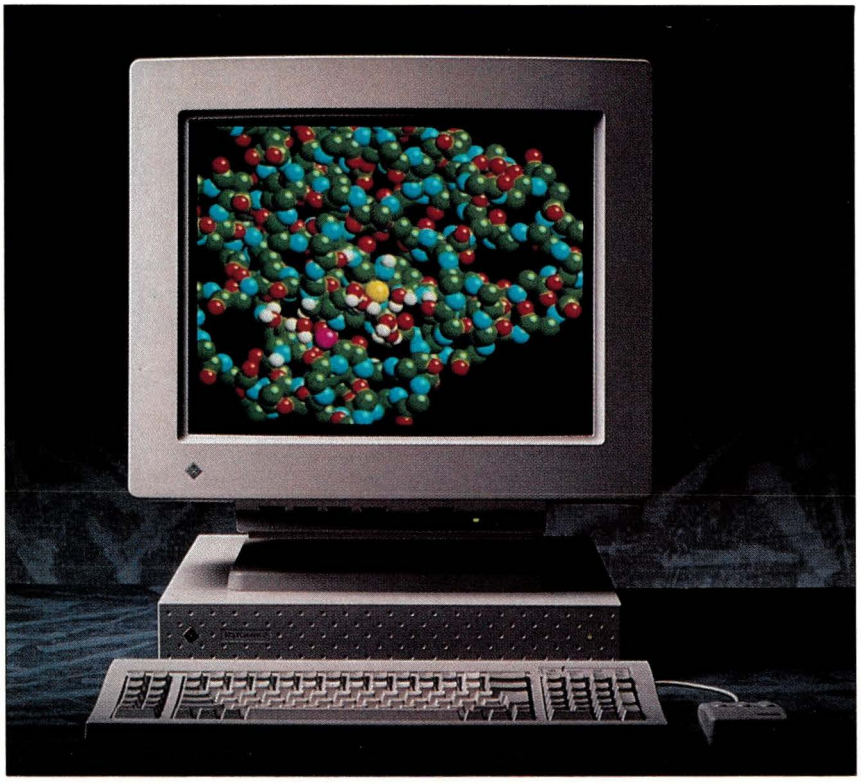
"It [XIL] augurs well for Sun," says Robi Roncarelli, editor and publisher of Ontario-based graphics and imaging newsletter *Pixel*. "Sun wasn't strong in imaging, but they've realized they had to get into it...because everything uses imaging now." He argues, in fact, that the API's real importance may be in that it allows an application to run on both X86 and SPARC-based machines. "Anything that lets people move back and forth between processors is good for the industry, he says."–*mjt*

Made in the U.S.A.

You really know the SPARCalike business is becoming cutthroat when a company counts as its biggest selling point that it's the "last American SPARC clone manufacturer in the United States." Welcome to 1992, and meet Super Workstation Inc., San Jose, CA.

Super Workstation modestly claims to be the No. 1 SPARCalike vendor, by "selling more than all of the other SPARC clones and compatibles combined," in the words of the company's director, Jim Chan. Super Workstation has the capacity to manufacture 500 SS2 and GX boards per month, he says. But how many the company currently is turning out is anyone's guess.

Super Workstation Inc. hopes cut-rate pricing on its SPARCalike boards will woo customers. An SS2 CPU board sells for as little as $7,600.



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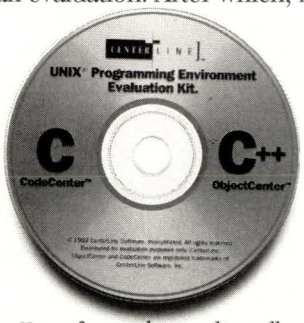

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Still Growing, But Slowing

Fiscal Year	Actual Revenues ($ Millions) Q1	Q2	Q3	Q4	Year	Revenue Growth (%) Q1	Q2	Q3	Q4	Year
1990	539	595	632	700	2,465	24.9	46.8	27.1	62.4	39.7
1991	677	754	848	943	3,221	25.7	26.7	34.1	34.6	30.6
1992	755	909	952	973	3,589	11.5	20.7	12.3	3.2	11.4

Source: Sun Microsystems Inc.

Growing Pains

Compared with most of the other major systems manufacturers, Sun Microsystems Inc. had a stellar fiscal year. For the year ended June 30, Sun topped the $3.5 billion mark. Sun Microsystems Computer Corp. claimed to have shipped a record 56,000 revenue units. And SunSoft said it distributed a record 78,000 UNIX licenses.

But the inevitable has happened. Double-digit growth has at last yielded to single-digit increases at Sun–at least in the quarterly figures. Revenues for the fourth fiscal quarter grew 3.2%, to $973 million, compared with 34.6% for the previous year's fourth quarter. In large part, this "downsizing" in sales growth rates can be attributed to price reductions on existing systems in order to make room for new products, according to Sun.–*mjf*

Two-year-old Super Workstation is a newcomer to the SPARCalike world, but not the PC printed-circuit-board one. The company got its first big SPARC break in 1991, when–under the name of 3C Systems–it signed on Goldstar Co. Ltd. as an OEM customer for its SPARC 2 motherboard and add-on GX graphics board. More recently, Super Workstation became one of Goldstar's U.S. sales reps. (Currently, the Goldstar GWS SPARC-based line is sold only in South Korea and Europe. Goldstar is beginning to ramp up its U.S. sales effort, says Benny Yoo, technical staff member of the company.)

Since signing on Goldstar, Super Workstation has inked deals with "several" other OEMs, "all of which are household names," says Chan. *SunExpert*'s repeated attempts to identify these partners were to no avail.

Chan also is claiming a very impressive end-user customer list for Super Workstation's boards and complete SPARCstation 2 clones. Among the names Chan cites are AT&T, the Pentagon, Boeing and NASA. He says that his company's "Made in the U.S.A." label attracts many federal customers.

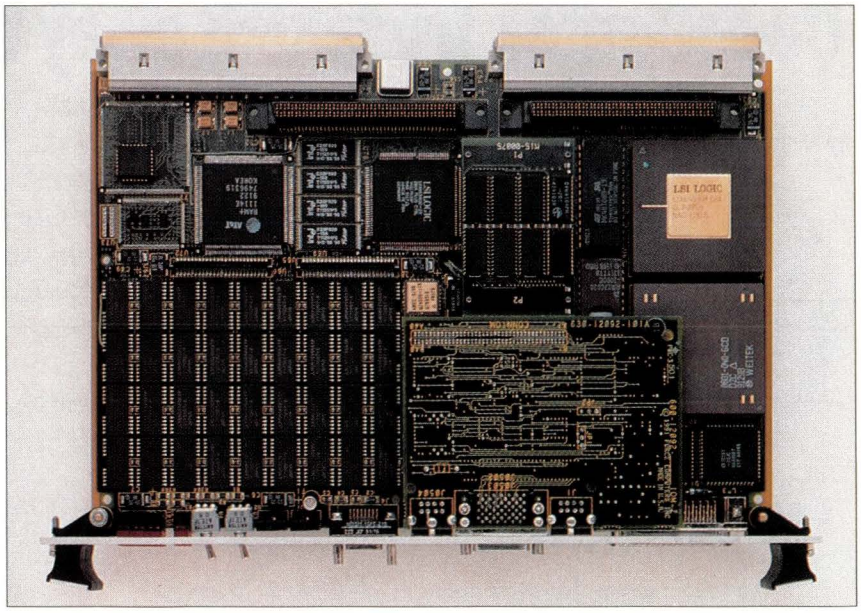
Two additional "major" Super Workstation customers contacted by *SunExpert* had purchased one motherboard each. Both say they are happy with their purchases, yet neither has any plans to buy more. An applications engineering manager at one Super Workstation customer site–an East Coast EDA software developer–says he had bought the Super Workstation board when a budget crunch necessitated his company's cutting corners. Unless funds dry up again, he says, he expects to buy his next SS2 motherboards from Sun Microsystems Inc.

But Super Workstation is hoping against hope that its cut-rate pricing ("lower than EISA 486 [PC] systems," in Chan's words) will be enough to woo users. A Super Workstation SS2 CPU board can be had from the company for $1,600. A Super Workstation SS2 clone, sans monitor, sells for $2,350; with a 16-inch color monitor and color frame buffer, it goes for $4,255; and with a 19-inch color monitor, GX frame buffer and 500-MB hard disk, it lists for $6,565. Discounts bring these prices down even further, Chan boasts. "We are not competing with Sun's price," Chan says. "Rather, we are directly competing with IBM clone PC prices." Next on the company's priority list: launching an SS10 clone before the end of this month.–*mjf*

Keeping VME Alive

The first SPARCstation 2-based VMEbus systems and CPU boards to become available in the United States were unveiled by Force Computers Inc. on October 1. And within the next few months, it looks as if Force

Force Computers Inc.'s CPU-2CE is a single VME board computer designed for embedded and real-time applications.



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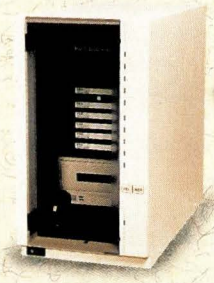

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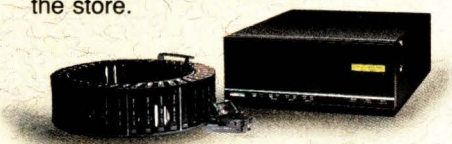

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will be taking over the engineering and manufacturing support of Sun Microsystems Inc.'s SPARCengine 1E VME-based systems.

The SPARC CPU-2CE is a single VME board computer designed for embedded and real-time applications. The board uses the Sun S4-VME chip to provide a 32-bit VMEbus interface. It features two serial interface ports, a keyboard/mouse serial port, an audio port, an Ethernet port and SCSI-2 port. The CPU-2CE also includes three connectors for add-on cards: a memory card adapter and two SBus connectors. A SPARC CPU-2CE with 16 MB of DRAM is $7,995; with 32 MB of DRAM, it sells for $9,495; and with 64 MB of DRAM, $12,490.

Force introduced three new systems: the two-slot microforce; four-slot miniforce; and 19-slot teraforce. All three are hardware- and software-compatible with the SPARCstation 2. All systems come loaded with SunOS 4.1.2 (Solaris 1.0.1) system software with two right-to-use licenses.

The microforce is based on the SPARC CPU-2CE processor board, with 16 MB of DRAM, a 3½-inch floppy drive and a 420-MB SCSI hard drive. The system is powered by a 40-MHz SPARC processor. The miniforce, designed to be mounted in a 19-inch rack, is also based on the CPU-2CE processor board. A standard system includes a 3½-inch floppy drive and a 385-MB SCSI hard drive. The system ships with two SBus slots. The teraforce is a ruggedized system based on the CPU-2CE board, with 16 MB of DRAM, a 385-MB SCSI hard drive and a 320-MB streaming tape. Two SBus slots are available with the teraforce.

Configuration options are available with all three systems. All may be configured with a 765-MB hard drive and up to 64 MB of on-board DRAM. All systems may be configured with a color frame buffer, which employs one SBus slot. Other options include a 650-MB SCSI CD-ROM drive or 320-MB streaming tape drive (for the miniforce and teraforce). Force also makes available add-on peripherals, including a 19-inch color monitor, Sun Type-4 keyboard and mouse.

The microforce, quantity one, lists for $9,950. The miniforce is priced at $11,990, and the teraforce begins at $19,500.

As to Force's future as the 1E manufacturer and support provider, most of the details were expected to be ironed out by late last month, according to Tom Griffiths, Force's product marketing manager. "Sun will continue to provide VME interfaces to their servers," he says. "But we'll be doing all the future work on VME-based systems for them." Force also is plodding ahead with its FutureBus+ work. "We're currently at the end of our exploratory stage," Griffiths says. "We expect to release product in 1993."–*mjf*

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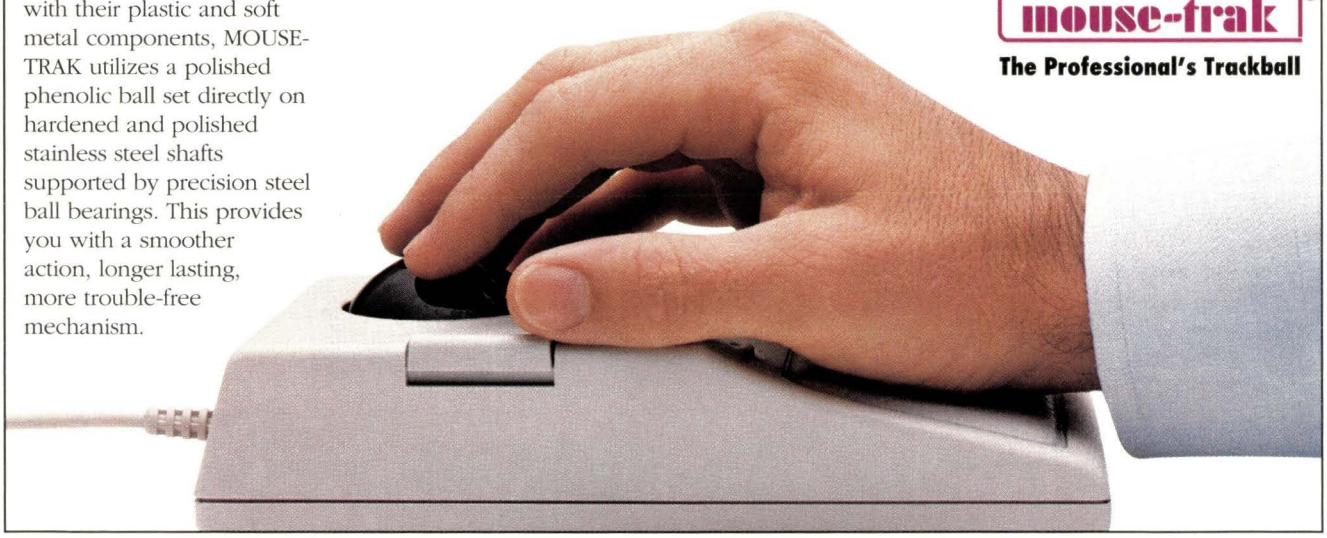

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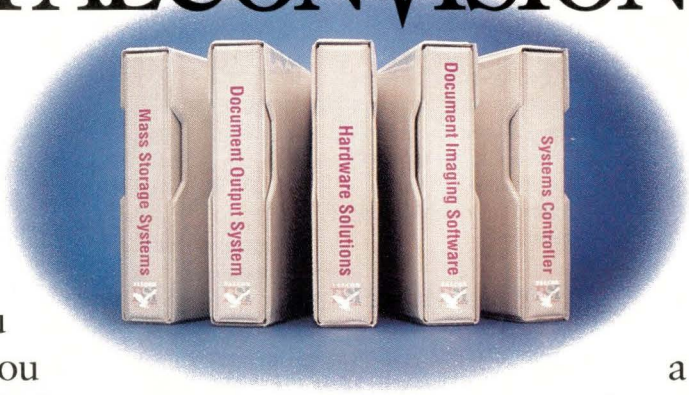

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This Just In...

• The hot, new vertical market is customer information systems. A handful have recently debuted on Suns. **ProActive Software Inc.**, Mountain View, CA, has rolled out CIR, its customer information resource system–a set of client/server applications and tools. The system will support multiple SQL relational databases (including Sybase, Informix and Oracle), multiple UNIX platforms and several user interfaces (Windows 3.1, X Window System and Macintosh). At press time, the Support Advantage module and ProActive toolset were shipping and the Quality Advantage module was in beta. **Clarify Inc.**, San Jose, CA, has developed what it's calling its Customer Service Management System (CSMS). Like CIR, CSMS is a modular product. It currently ships with Sybase as its underlying database, but Clarify is working on making the product database-independent. The Clarify product handles bug tracking, dispatching, call tracking, inventory tracking and other service and support functions.

• In a related support announcement, **Sun Microsystems Computer Corp.** has introduced two products designed to make supporting and using Suns easier. SunSolve gives SPARCstation users instant, on-line access to service information, such as technical bulletins and problem/resolution databases. It is provided free to all Personal AnswerLine, AnswerLine and Software Update Service software contract customers. Sun HelpDesk is a service product that assists Sun resellers who are part of the SunPartners service programs in setting up their own help desks. SunSolve is available on a single CD-ROM and offers answers to the most commonly asked Sun technical support questions. Sun HelpDesk includes all of the features of SunSolve and provides resellers with the tools, support and documentation they need to establish in-house help desks. One of these tools is TechEscalator, a feature that lets HelpDesk users access Sun's support engineering staff directly via email to receive back-line assistance. Both offerings may be optionally integrated with Sun's AnswerBook on-line documentation.

• **Sun Microsystems Computer Corp.** has developed a new SPARCstation IPX configuration, employing a midrange, 16-inch color monitor. The newly configured and lower priced system will appeal to all but the most technical customers, who might prefer the existing Sun 16-inch Premium Color Monitor, says SMCC. The SPARCstation IPX with the 16-inch midrange monitor, 16 MB of RAM, a 207-MB SCSI disk and a 3½-inch floppy lists for $8,995.

• Speaking of low prices, how about a color SPARC-based workstation for less than $4,000? **Tatung Science & Technology Inc.** has introduced a new version of its micro COMPstation, complete with a 25-MHz CPU, 14-

inch color monitor with 1,024-by-768 resolution, 8 MB of RAM and Solaris 1.0.1 for $3,990 list. Equally appealing are the newly announced TSTI color upgrade options for existing monochrome monitor customers. For $2,990, a single-slot CG3 frame buffer card with a 19-inch color monitor is available. TSTI also is offering a single-slot, GX-type graphics accelerator card with a 19-inch color monitor for $3,990. TSTI is based in San Jose, CA.

• Move over, Solaris on X86? Yet another vendor has jumped into the 32-bit OS fray. And this one doesn't even have the benefit of a big name. **Mark Williams Co.**, Northbrook, IL, has rolled out Coherent 4.0. The company claims Coherent is "only the third 32-bit operating system, after IBM's OS/2 and The Santa Cruz Operation's SCO UNIX System V/386 Version 3.2, to be released." Coherent costs only $99 and runs on "virtually any" 386- or 486-based PC. The company claims to have sold nearly 10,000 copies to date.

• The **Sun User Group** 1992.2 CD-ROM has gone to press. The disk emphasizes information sources (i.e., archives of useful textual information) and includes plug-and-play SPARC binaries for libraries and programs. In total, the disk consists of 650 MB of material that supplements–meaning "does not entirely replace," according to SUG–the 1992.1 CD. The 1992.2 CD is an ISO9660 disk with Rock Ridge Extensions, which can be used on PCs and many workstations in addition to Suns. To order, call SUG at (617) 232-0514 and charge the $150, plus $10 shipping (to SUG members) fee to your VISA or MasterCard, or fax your credit card order to 617-232-1347. Both the 1992.1 and 1992.2 are available as a package for $200 plus $10 shipping.

• A boost for recession-plagued Beantown: **Sun Microsystems Inc.** has announced that it will consolidate its Massachusetts offices in Chelmsford, MA, and has licensed an additional building and adjacent land. Sun's 1,100 Massachusetts employees working for SunExpress, SMCC, Sun Microsystems Laboratories, SunSelect and SunSoft will relocate to Chelmsford by the end of 1993.

• **UNIX International** is making available for free or a nominal charge a number of white papers, a catalog of System V software and a slew of migration guides. System V roadmaps, general information on UI and white papers are all available free of charge. The software catalog is $15. The migration guides–which include porting guides for BSD, Xenix, SunOS, AIX, Ultrix, DOS and VMS developers, among others–sell for $50 a piece. To order, contact UNIX International Inc., Waterview Corporate Centre, 20 Waterview Blvd., Parsippany, NJ 07054.

• Another standards group is hatched: Five companies, including **Sun Microsystems Computer Corp.**, have created "an alliance to jointly promote the development of international standards for service and support information in distributed computing environments." The group, called the Distributed Support Information Standards (DSIS) Group, also includes **Bell Atlantic Business Systems Services Inc., Hewlett-Packard Co., ICL PLC** and **Microsoft Corp.** Exactly what these kinds of standards will look like is still up in the air. But the group is talking about open Management Information Bases (MIBs), which will provide a "consistent view of heterogeneous networked systems," accessible via systems/network management products, such as SunNet Manager, HP OpenView or ICL's Open Systems Management Center. For more on DSSI, contact Raymond Edgerton, Bell Atlantic Business Systems Services, 50 East Swedesford Road, Frazeer, PA 19355, or call Edgerton at (215) 296-6159.

• Despite the recent purchase of Gain Technology Inc. by Sybase Inc., **Sun Microsystems Inc.**'s future access to Gain technology looks to remain relatively certain. Sun already has released the first in a series of on-line interactive training tools based on Gain's GainMomentum product. The resulting on-line course, called "SunTutor: OpenWindows Environment for Users," allows users–via audio, video, text, graphics and simulation–to pace themselves in learning basic tasks in the OpenWindows environment, such as logging on, creating passwords and using the mouse.

• **Tivoli Systems Inc.**, Austin, TX, has rolled out new software applications that extend the capabilities of the Tivoli Management Environment. Among these new apps are a developer's toolkit called Tivoli/Advanced Development Environment (Tivoli/ADE), which is the first commercially available programmer's kit for building systems-management applications that will be compatible with the Open Software Foundation's Distributed Management Environment (DME), according to the company. Other new applications include Tivoli/Works, Release 1.5, Tivoli/Courier and Tivoli/Sentry. Works is a consolidated and updated version of Tivoli's core applications for primary resource and security management. Courier is designed to automatically distribute software throughout a network. And Sentry is designed to help remotely monitor systems.

• **Silicon Graphics Inc.** has officially begun licensing its OpenGL 1.0 Specification, Conformance Test and Sample Implementation. Simultaneously, SGI announced eight new licensees of the OpenGL application programming interface: Daikin Corp., Harris Computer Systems Division, Intergraph Corp., Kubota Pacific Computer, miro, NEC Corp., pellucid inc. and Sony Corp.

• **Silicon Graphics Inc.** has also signed an agreement with five hardware and software vendors, allowing its Iris Explorer visual application builder to operate on eight additional platforms. The licensees are Control Data Systems Inc., Du Pont Pixel Systems, Kendall Square Technology, Intel Corp. and Numerical Algorithms Group Ltd. On SPARC platforms, Du Pont Pixel Systems will provide the Iris Explorer application, in conjunction with its PX/Iris GL. The agreement with NAG also opens the Iris Explorer software to Digital Equipment Corp., Hewlett-Packard Co., IBM Corp. and Sun Microsystems Inc. users. ⊸

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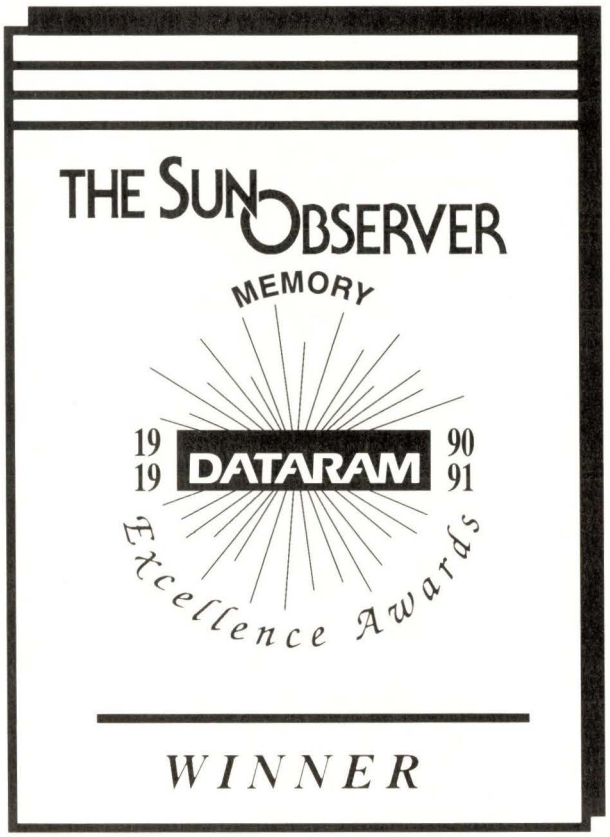

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TOM BARRETT

Tales from the Other Side

by MICHAEL O'BRIEN

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–Stepan Chapman

"The Agora and the Ecstasy"
–A book we'll never see but probably should

"The PN48 Notebook Printer is designed to work easily with all major software packages... The applications covered are Lotus 1-2-3, Microsoft Windows 3.0 and WordPerfect 5.1."
–PN48 printer manual, which is apparently not designed to be used with SPARCstations

Q: All right–so tell me this. If Suns are so wonderful, why is it that Sun users only ever seem to get into religious wars with Mac users? After all, the PC users seem to regard Macs as minor annoyances, and most of 'em have never even heard of Sun.

A: Houseflies haven't heard of eagles, either, but their greater numbers don't make them superior. Mr. Protocol will admit, though, that the analogy breaks down if carried too far. He would far rather be infested with houseflies than with eagles. Infestations of PCs, however, are considerably harder to cure than infestations of SPARCs, because PCs are easier to explain away to upper management.

What Mr. P. finds fascinating is the great difference in the marketplaces. That's why he'd like to examine the PC and the SPARC, and find out why there are so many of the former running around loose in the world.

Let it be announced to all, then, that Mr. P. has at some time or other been exposed to the IBM PC, and survived. In fact, he definitely believes that they have their uses. And if you haven't thrown this magazine away after reading that last one, he'll proceed.

The fact is that both the Sun and the IBM PC show their ancestry, in some cases rather hideously. In the case of the PC, the ancestry is obvious: The dead hand of the 8086 still hangs heavy over the land, and the magic number 640 is the mark of the beast. If this sounds like something from the *Book of Revelations*, it is. That's the most reliable work Mr. Protocol has

yet found on PC architecture.

The IBM PC was, of course, not the first personal computer–far from it. It wasn't even the first commercially successful unit, in fact. But the appearance of the IBM PC caused a very peculiar phenomenon...peculiar in the eyes of Mr. Protocol, at least. The choice of the 8086 as the computational engine seemed peculiar even then and still appears to have had more to do with the business relations between IBM and Intel than with engineering perspicacity. However, the "endorsement" of the entire notion of a personal computer by IBM (and that was the word used: endorsement) "legitimized" the market (another commonly used and very curious term of the time). This immediately caused the sudden and vast penetration of the PC into the world of business, which in turn resulted in the first real appearance of the economy of scale in the PC world.

Now, the other PCs in the world were not great works of art and genius. Like most important developments, there was nothing profound about them. Semiconductor technology–the simple ability to put more and more components onto a single silicon wafer–demanded that someone eventually put an entire processor on a chip. In fact the first such attempt, the 4004, was used as a controller, not as a CPU. But once the 8008 and then the 8080 put in appearances, it became evident that something major was under way.

This is not the place to go into the entire bloody history of the rise and fall of the Altair and the S-100 bus, or just who thinks it should be called the Altair bus instead, or why. Those wars are over and belong to history, like the bus itself. But once the IBM decision was made, suddenly all other architectures for a PC were declared irrelevant. Big Blue had spoken, and that was that.

The prophecy was self-fulfilling, of course. It has always been difficult for purchasing agents to defend a purchase from a second-string player. IBM was the safe choice. They weren't one of

these fledgling start-ups. What's amazing is how long some of the others managed to stay in business, though this was not the thinking of their supporters at the time. The thinking of the supporters of the other processors, running with alternative architectures, was that no matter how big IBM was, they couldn't conceal the fact that the architecture of the PC was decidedly inferior to what they, the true believers, were running. And, in some sense, they were right. IBM didn't kill them. Everyone else did.

Because IBM's market penetration of the business world was so strong and so immediate, others jumped into the fray. Thus was born the clone market. And that's what did in the competitors: price and margin. Gradually the clone market became so competitive that it no longer mattered how superior the other machine architectures were, because no one was writing software for them. Bare hardware was useful only to the hobbyist, and for a hardware/software combination, the PC clone was and is awfully hard to beat.

This market has always run on adrenochrome. The marketers with Type A personalities, who only wanted to work in the largest market, all came crowding into the same market, infusing large amounts of research dollars into building ever more capable software and hardware. The bugaboo has always been that most indispensable of marketing points, backward compatibility. The demand that the biggest, hottest, most advanced system still behave just as the original IBM PC behaved when it came out of the box has done more to cripple the PC industry than anything else. The 80386 and i486 are not really such bad processors–or, at least, they can be convinced to be livable. But once placed inside a PC clone, the magic number 640 continues to rear its head all over the place, and systems with 16 MB of main memory are still rejoicing over ridiculously small amounts of memory salvaged out of the magic 640K region by highly arcane memory-management systems, which are as likely to break software as to help it to run.

So, the origins of the machine are still very evident. The hardware architecture has been modernized, but the image of the ancestor lives on in the software. What kind of software is it that would do this?

Nothing very inspired. The original PC operating systems, if they can be called that, evolved in the same manner as the operating systems for the large mainframes, years before. They were in-memory libraries of I/O routines, barely sufficient to get a program into memory and start it running, and, if you were lucky, provide a file system and a console terminal. If you were very lucky indeed, and if the wind was in the east, the file system wouldn't break very often, either.

The two main systems in those days were, of course, CP/M and DOS. CP/M was a reasonably good single-user system for the "standalone hacker." DOS, on the other hand, was forced to grow up, and become MS-DOS. Heaven help us.

MS-DOS is still, for the most part, an in-core bunch of library routines. However, it has been forced to grow some appurtenances usually found only in more advanced operating systems, such as multitasking, without in any way changing its behavior in supporting programs that don't know that it's much later than 1972. This hasn't helped matters very much. See the *Book of Revelations* for further details on this tactic.

Well then, if the world's most popular personal computer still thinks it's running standalone on an architecture 20 years out of date, what does UNIX have to offer? Mr. Protocol is glad you asked.

UNIX hasn't won many friends in the marketplace, because, it's claimed, it is too arcane and hard to use. Mr. Protocol finds this indictment hysterically funny, because MS-DOS, in turn, tried to deflect some of the charges laid against it by UNIX adherents by adding many of the features of the UNIX command language...without backing those up with similar additions to the actual OS.

UNIX, of course, was constructed along completely different lines, for

completely different reasons, in a somewhat, but not completely, different environment. The original operating systems for personal computers were constructed more or less out of whole cloth. They borrowed some general concepts from other operating systems, but at base, they had to be extremely small to begin with, because of the small amounts of memory available in a personal machine. This limited the sophistication of the services that could be provided. UNIX operated under similar constraints, but further along the scale.

UNIX was written because Ken Thompson and Dennis Ritchie did not enjoy being deprived of the MULTICS environment in which they had worked, in the days before Bell Labs pulled out of the MULTICS development consortium. Therefore, they knew the sorts of services they wanted to provide, and it was a fairly sophisticated set. They implemented these services on the machines available in the lab environment, and these were not personal computers–they were minicomputers. Minicomputers are still manufactured today, but for an increasingly narrow niche having more or less to do with real-time laboratory data collection. Certainly the minicomputers of that day were far more capable than the personal computers. Even their operating systems were in somewhat better shape, though only somewhat. Minicomputer operating systems were, for the most part, team efforts led by marketing constraints rather than by a coherent design vision. They were not beautiful, and they crashed a lot. But, for all that, they were more capable than the operating systems on the personal computers of the day, because they had been developed on and for larger machines. UNIX was far, far better than either.

At this point a chorus from the peanut gallery, consisting of grey-bearded old men who grew up on TENEX and TOPS-10, will be heard to wheeze, "That wasn't hard!" Mr. Protocol will tend to agree with them. He might even have preferred to "grow up" on a TENEX machine instead of a UNIX machine, but there were a lot more PDP-11s out there than PDP-10s.

Whatever the reason, the UNIX operating system was a multiuser system from the very beginning, even when it ran on a PDP-11/20, which had no memory-management hardware, and which therefore required its users to sit in a single room so that anyone who wished to test a program could warn the others to save their work before he ran a program that might potentially scribble on all the memory in the machine.

Anyone who thinks that the beauty of UNIX led to its takeover of the workstation world is full of moonshine.

UNIX took over the workstation market because workstation manufacturers had watched the minicomputer manufacturers go down in flames trying to write vendor-proprietary operating systems from the ground up. When they saw that UNIX had, by the time of Version 7, transformed itself into a portable operating system, they were prepared to port it, no matter what it looked like. And they did. It was only after enough people had been doing this for a while that it became apparent that an open system had evolved into a standard, more or less by accident. Then came the rest of the "on-purpose" work, which caused POSIX to come into existence and ruin all its members' lives for a few years.

When personal workstations came into existence, they proceeded to position themselves into a completely different marketplace: one that sprang directly from the minicomputer and midicomputer world that its customers were used to. This affected everything from product offerings to pricing policy. These machines were being sold into large organizations, which expected to pay large prices for large pieces of software. For the most part, they still do. Prices for such packages as Objectworks\Smalltalk and ArborText Publisher sit at around $3,500 per seat, though they do offer a network license to allow a cluster of machines to buy according to the number of simultaneous users instead of the number of total users, and this is surely a large help.

In the PC world, though, things are very different. There, overall system prices and the size of the software offerings started small, and since system prices have remained low, and in fact dropped dramatically, the software offerings, which are now quite large, are having difficulty in climbing. Once again the economies of scale allow software publishers to keep prices low while writing large software packages. The tremendous numerical advantage of PCs over Suns and similar workstations is the only real advantage that PC software manufacturers have. The market grew up cheap and insists on remaining so.

In the workstation world, prices remain very high. However, network licensing does mean that the price per total user drops to near-PC levels. The trouble is that this pricing structure assumes a large organization, running a network of machines. It is obvious that the workstation market is just not competitive in the individual-user market, which is so common in the PC world.

But it may be, in the future. It may have to be. The workstation market is being increasingly crowded from below by the increasing power of PC-based systems, which in certain limited markets may even outstrip it in sheer power. Consider the vertical CAD/CAM market, where processor-assist boards and specially tricked-out math co-processors are providing workstation-class PCs for less than workstation prices. Not much less than a normal workstation, depending on the degree of customization, but still far less than a similarly customized and specially outfitted workstation.

Which brings us to a very interesting marketplace that is only now emerging: laptops. Products such as RDI's Britelite and the Tadpole SPARCbook now offer users the ability to lug a Sun SPARC environment around with something like the same ease as a standard Toshiba or Dell laptop–though at considerably greater price! What possible market could these things fill?

Well, Mr. Protocol, fascinated, went poking around these things, and found out a few things. First, the portable SPARCs are as fast as the desktop units. If one considers the "standard" desktop PC today to be something like a 386/33DX, or a 486DX, then

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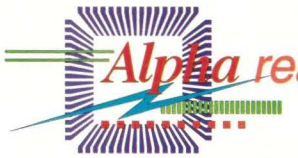

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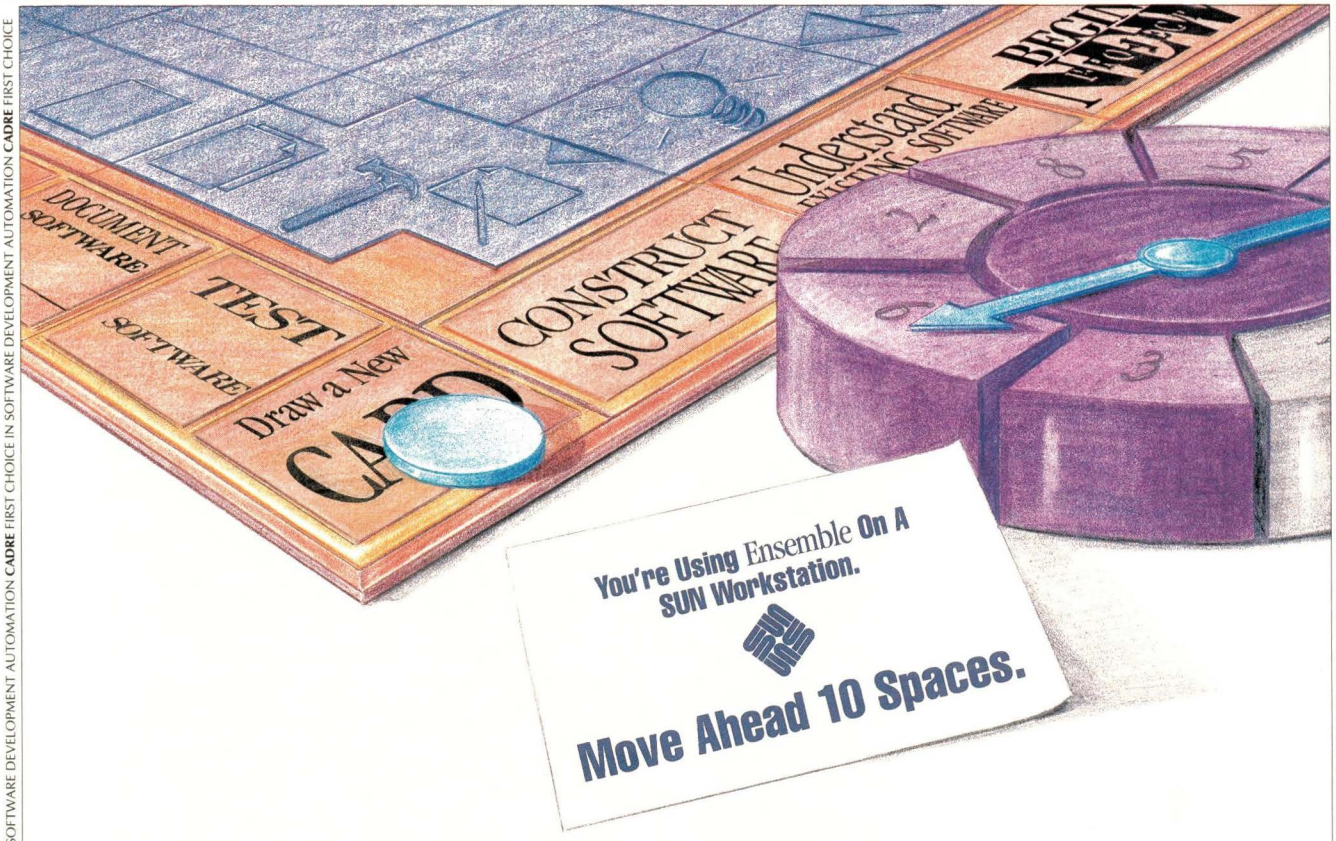
certainly the standard laptops are slower, being only SX machines. The SX limitation is primarily one of power: The faster the machine, the more power-hungry it is. SX machines have narrower paths to memory, and the processors use less power overall, though at a consequent reduction in speed. There is no equivalent "SX SPARC chipset," so all SPARC laptops are as fast as the desktop models. This means that they are power-hungry like nobody's business; the Britelite in particular has the largest "portable" battery system Mr. P. has ever seen. This is the battery pack to have with you if you go into a dark alley. You could film a Ninja movie using this thing as a weapon and it would suffer no damage whatsoever.

Therefore these laptops are fast. And they run SunOS. If you need SunOS in the field, then these are the laptops for you! Why would you want SunOS in the field? Well, for software demonstrations, for one thing. Mr. P. doubts that an entire workstation market could be supported just for the comfort and convenience of giving demos, however. Therefore, why in the world would you want SunOS in a laptop when regular PC laptops cost about one-tenth as much? Obviously there's a hidden need here, somewhere. Mr. Protocol wonders what it is. He thinks he's going to find out. ⊷

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

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

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



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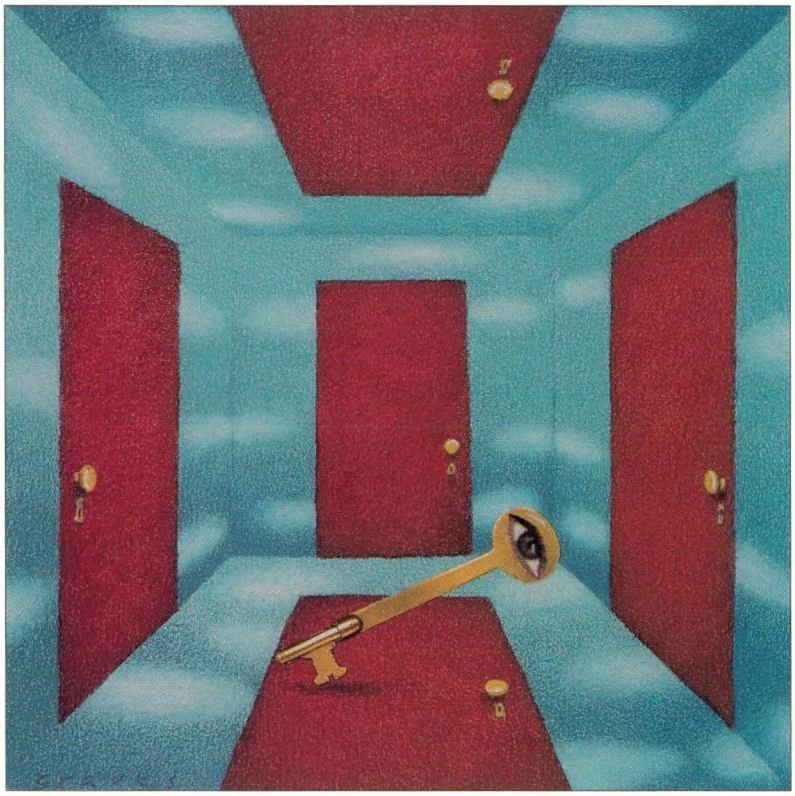

KEITH GRAVES

UNIX haters often cite the `find` command as a good example of why UNIX is unfriendly to use, saying that the command syntax is always idiosyncratic and cranky. There was a time when I leapt to the defense of UNIX, dripping vitriolic words about why the haters were just wrong. Life seems too short for vitriol now, and anyway I think that we must slyly agree with them. The `find` command *is* plainly idiosyncratic and very cranky. This is perhaps the reason why the command is not used as much as it deserves. It is an important program in the UNIX tool chest, and we should all know how to drive it.

I suppose that it's hard to decide if one command is more important than another. I would guess that I use `find` every other day, so it's not a "primary" tool like my editor, but it's important to me. Certainly, it is a program that I miss greatly on DOS systems. These days *that* particular need is fulfilled by the MKS toolkit version of the command.

Having penned the eulogy, what does the command do? The `find` command descends the file system hierarchy looking at each file in turn and applies a set of tests on each file. Don't get me wrong, the file is not opened, it's the name and system information on each file that is examined. The simplest useful command is perhaps:

```
% find . -print
```

This runs `find` in the current directory, "dot," and prints the relative pathnames for all the files that it finds. Here is the command being run in the `/usr/spool` directory on my machine:

```
.
./mqueue
./mail
./mail/root
./mail/pc
./cron
./cron/crontabs
./cron/atjobs
./cron/queuedefs
./cron/at.deny
./cron/cron.deny
./cron/FIFO
./rwho
```

etc. etc.

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Notice that it prints the names of all the files it finds. Remember that directories are files, so you are looking at both directories and plain files. All files are printed in the order that `find` sees them. No sorting is done.

You can replace the starting-point parameter by any pathname on your system:

```
% find / -print
```

will list all the files on the system. Please try to avoid systemwide file searches if you wish to remain friends with your system administrator. Typing this command on a system with many files can seriously damage performance by saturating the disks.

It is occasionally useful to be able to generate lists of files. But it is probably more common to be looking for a particular file, or more precisely, a file with a particular name:

```
% find . -name core -print
```

starts scanning the directory hierarchy at the current directory. In each directory, each file name is compared with the string `core` and the next argument is executed if the test is true. Here the next argument is `-print`, and it will print the full pathname of the matched file.

The real key to understanding the syntax is to realize that we are stringing together a set of tests that return a Boolean value "true" or "false." The `-name` predicate tests whether the name that we have found in the directory is equal to the particular string, *and* if this is true, the next predicate is invoked. This is `-print`; so the name is printed. By convention, the `-print` test always returns true.

The key word in the previous sentence is *and*. This is a logical operation depending on the result of the test. On early UNIX systems, you were forced to specify the *and* operation explicitly. So on a UNIX Version 6 system, you needed to say:

```
% find . -name core -a -print
```

The `-a` means *and*. However, when UNIX Version 7 came out, the `-a` operator had been dropped because it is usually redundant.

However, you can still use `-a` if you wish. If you need to say *or*, then you use `-o`:

```
% find . \( -name core -o -name '*.o' \) -print
```

This finds files that are either named `core` or anything ending in `.o` and prints their pathnames. Notice that I have had to escape the round brackets to get them past the shell. I have also had to put the `*.o` parameter into quotes to prevent the shell from expanding it in place. The `find` command uses the standard shell syntax for expanding file names, so we need to get that past the shell and into the `find` command itself. Finally, don't forget that there is an implied `-a` operator after the closing bracket.

You can also use a *not* operator, the exclamation point.

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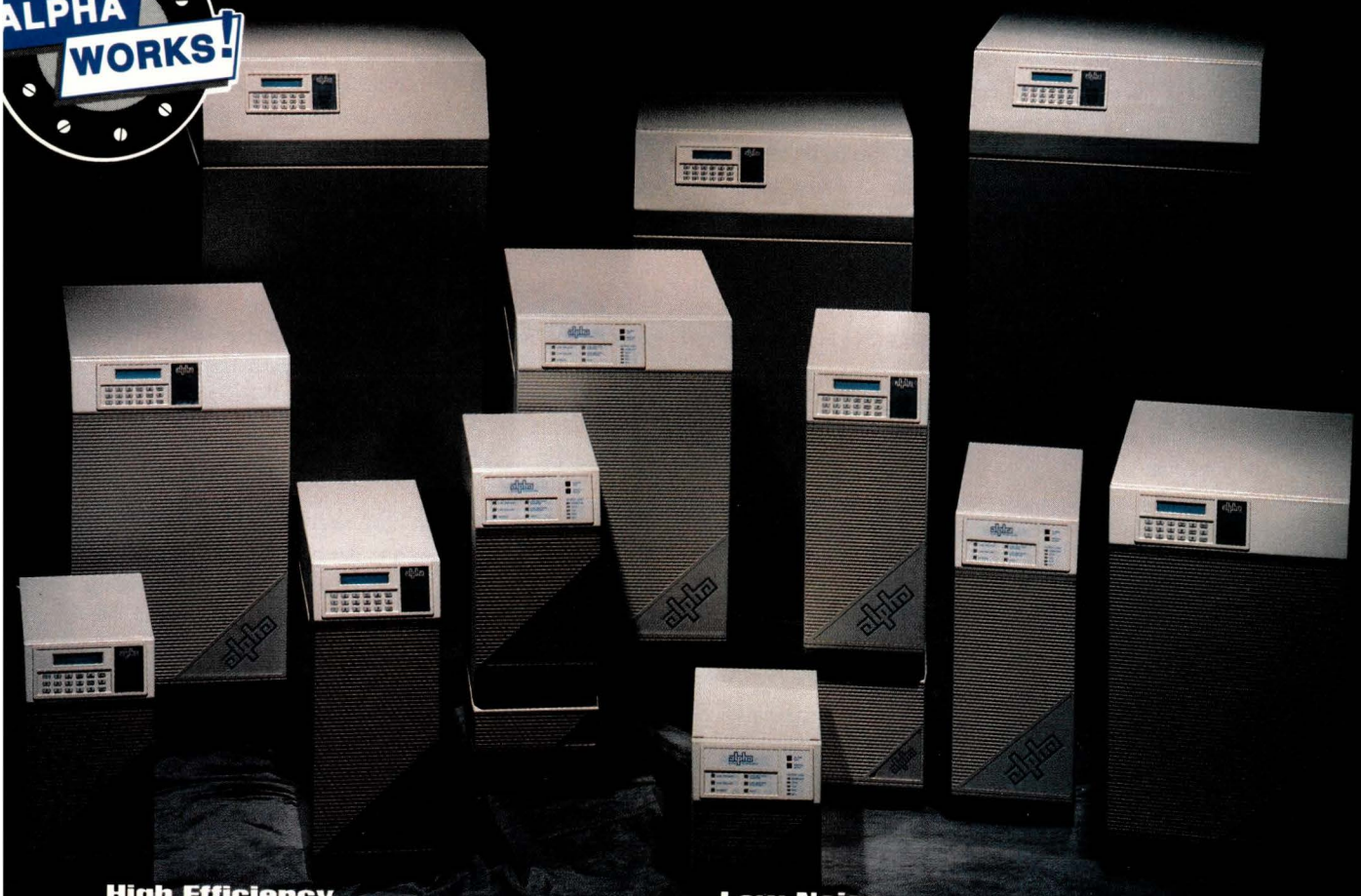

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This is a pain if you are a csh user, since it's used for history. Yet another character escape is needed:

```
% find . \! -name '*.c' -print
```

finds any file *not* called something ending in .c and prints the pathname of each file.

Other Predicates

We may want to do more than just look for the name of a file. Files have types, have size, are owned by a user, are in a group, have a set of file permissions, were created at a known time, were last accessed at a known time, were last modified at a known time, are sitting on a particular physical disk and, finally, have a known number of links.

If we can access all these properties, we can find the answer to complicated questions. Perhaps: "find me all the files that are over 10 MB and have not been accessed in five years"; "find me all the files belonging to a user"; "find me all the directories and change their permissions so that groups can write to them." These complicated requests become one-line find commands. By the way, I don't intend to go through all the options to find in this article; look at the manual page on your machine.

We have already seen that predicates consist of an option name (-name) followed by some optional parameter (core). This general structure is always followed in other tests. To select the type of a file, use the -type operator:

```
% find . -type f -name ',*' -print
```

starts in the current directory and selects only the plain files called comma-something. It then prints the name. Several systems use a name starting with a comma as a temporary file, and this one-liner can be used to delete them:

```
% rm -f 'find . -type f -name ',*' -print'
```

This uses the backquote convention to take the output from the find command and insert the list of files back into the command line as a set of arguments to rm. Actually, there are better ways to do this; see later. We must include the -type f test because we must ensure that we are dealing with files. The rm command is not too happy about deleting directories.

We can select directories by using -type d:

```
% find . -type d \! -name SCCS -print
```

finds all the directories under the current one that are not called SCCS. This command can be used as the basis for batching up a set of files for tar where you don't want to send the SCCS history for some end user. Actually, many versions of tar have an option that does this anyway for SCCS. However, using find does present a more general solution.

Several find tests take parameters that are numeric values. Let's look at the three operators that test for time. The -atime argument tests the access time on the file. The time of last modification of the file is tested by the -mtime argument. Finally, -ctime tests the time that the file last changed. The word "changed" here means that either the file has been altered or some attribute of the file has been altered, its permissions or owner, for example.

Each of these predicates take a numeric argument that is the number of days that have elapsed, so:

```
-mtime 5
```

tests whether a file has been altered exactly five days ago. It's more usual to want to find things that have changed in the last few days or perhaps have altered more than some number of days ago. This is done by adding a minus or plus character before the argument. Saying:

```
-mtime -5
```

tests whether a file has been altered in the *last* five days. You should read the minus sign as "less than five days." You might guess that a plus sign prefix means "greater than." You can combine these:

```
-mtime -10 -mtime +1
```

will pick all the files that have altered in the last 10 days and have changed more than one day ago. Generally, when I am removing temporary files automatically, perhaps by using cron, I only remove files that are older than one day. I do this in case I happen to be using the machine when the background script runs. It can be a little distressing to find that the temporary file you have just created is suddenly removed from the system.

```
% find . -type f -name ',*' -mtime +1 -print
```

I have added the line that tests whether the file is older than one day to my original script. This can sometimes be counterintuitive, not picking files that were created "yesterday." Remember that a day is 24 hours from the time that the command is run.

The idea of using a plus, a minus and an unadorned number is also used when you are testing for size.

```
% find . -type f -size +1048575c\
  -atime +730 -print
```

finds all files bigger than one megabyte that have not been accessed in two years (or so). The output from this can be waved under people's noses to say: Can't we remove or compress this file? Notice that you have to add the letter "c" after the -size; otherwise the test works in 512-byte blocks.

Executing Commands

I showed earlier that one use of the find command is to generate a list of files that can be plugged into parameter lists using the backquote operator. This is certainly one way of generating commands on specific files. The other is to use

the built-in execute option. Our previous deletion example can be written:

```
% find . -type f -name ',*' -mtime\
  +1 -exec rm -f {} ';'
```

The -exec argument is followed by a plausible-looking delete command. The curly brackets {} are a magic symbol. The pair is seen by find, and they will be replaced by the name of the currently matched file before executing the command. The final semicolon is magic too; it signifies the end of command to the find command. Again I am quoting it to get it past the shell. It could just be preceded with a single backslash as a quote character.

The effect of this is easy to understand: Whenever a day-old plain file starting with a comma is found, the -exec argument will be executed. This will start a shell that will run the rm command to delete the named file. It's this powerful functionality that I really miss on DOS systems.

An alternative to the exec command is ok. So:

```
% find . -type f -name ',*' -mtime\
  +1 -ok rm -f {} \;
```

will ask for a "y" or an "n" before the command is executed. This allows interactive control of the deletion process.

Using the -exec option can be time-consuming because of the load placed on the system by the need to create a new process for each file that is to be processed. Using find to generate a list of names that are passed using the backquote operator will often be much faster but will also occasionally fail owing to size restrictions in arguments lists. There are alternatives that can help here, xergs for example. Most people don't worry about the load and just embed the command into find using the -exec operator.

I have always felt that there are some inconsistencies in the way that the argument to -exec parameter is specified. It would make more sense to pass the command to be executed as a single argument; something like:

```
-exec 'rm -f {}'
```

The terminating semicolon would then not be needed since the argument is self-contained in a single string passed into the program. This would be a good thing because then the -exec option could take embedded semicolons, allowing it to perform more than one command. Unfortunately, this method of doing things was not selected by the original author, and we are now stuck with the current behavior.

Another idiosyncrasy relates to the curly bracket operator. It is only replaced when it appears by itself. Let's say you wanted to change the mode of all the files in a directory structure (and we'll forget about the -R option to chmod for the moment). You can obviously find all the files and change the mode using an -exec option. You might rightly think that this will be a heavy system load and want to reduce that. You know that the chmod command can take a number of

parameters, and you might think to try:

```
% find . -type d -exec chmod g-w '{}/*' \;
```

reasoning that things might be faster if you changed the mode on all the files in a directory using the filename expansion of the shell. You are hoping that `find` will execute:

```
chmod g-w dir1/*
chmod g-w dir2/*
chmod g-w dir3/*
```

Unfortunately, this won't work because `find` will not expand the `{}/*` "properly." Solutions to this using `find` exist, but they aren't that elegant. Instead, many commands have acquired a `-R` option making the command do its own recursive descent.

Permissions

There are problems too with scanning for particular sets of file permissions. First we have to convert the file permissions into octal. You may be used to doing this with the `chmod` command; you may not. Remember that the basic set of file permissions are written as:

```
rwxrwxrwx
```

The first set of three letters refers to the owner of the file, the second to the group and the final set refers to all other people on the machine. A typical permission set on a data file is:

```
rw-r--r--
```

allowing read/write access by the owner but only read access by both the people in the same group as the owner and also by all the other people on the machine. We can set this using octal 644, binary 110 100 100.

If this is still confusing, here is an octal translation table:

#	Binary	Meaning
0	000	`---`
1	001	`--x`
2	010	`-w-`
3	011	`-wx`
4	100	`r--`
5	101	`r-x`
6	110	`rw-`
7	111	`rwx`

If we wanted to find files with a particular permission set, then we can say:

```
% find . -perm 644 -print
```

This finds all the files with `rw-r--r--` permission. This is done by taking the permission that is supplied to the perm parameters and comparing it numerically with the value that is associated with the file.

Actually, this is not often what we want to do. It's more usual to be asking a question that inspects certain bits in the data field while ignoring others. Perhaps we are looking for

ear in mind when looking at permissions that the high octal digit, the high three bits, has a special meaning.

all the files with the owner execute bit set or all the files with group write permission. It's not easy to do this if we are just limited to numeric comparison of permissions. If we insert a minus character before the permission, then the `find` command does a bit-wise match for us:

```
-perm -111
```

This takes the permissions on each file and says that this is true if:

```
(permission) & 111 = = 111
```

Here the bitwise *and* operator selects only the "x" bits, and the final result is compared with the mask. This is much more useful because we just don't worry about the state of the other bits in the file permissions.

The other thing to bear in mind when looking at permissions is that the high octal digit, the high three bits, has a special meaning:

#	Binary	Meaning
1	001	Sticky bit
2	010	Setgid bit
4	100	Setuid bit

These bits are accessible when the permissions are prefixed by the minus sign. It's possible, then, to find all the executable files on the machine with setuid bit set:

```
-type f -perm -4100
```

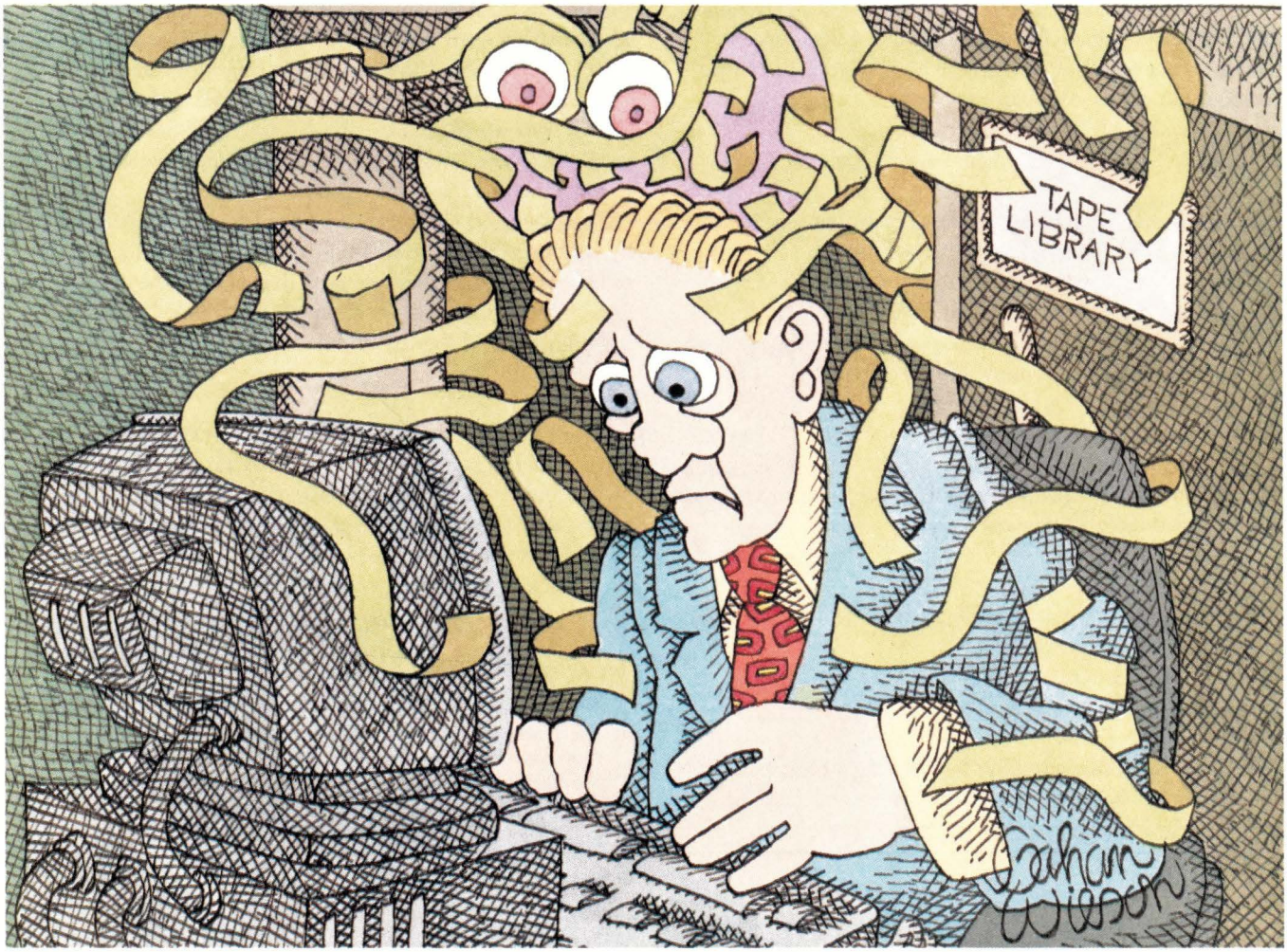
finds all the files on the machine that are setuid and executable by their owner.

Odds and Ends

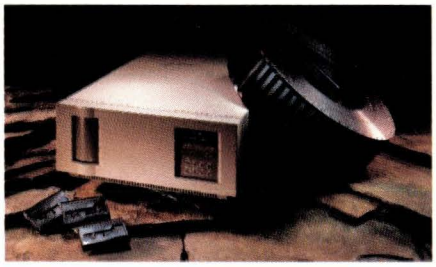
It's occasionally useful to be able to limit the scan that `find` does to particular parts of the file system. If you want to limit the search to a particular file system, then you can use the `-xdev` operator.

```
% find / -xdev -print
```

If your data is getting hard to manage...



it's time for the Lago DataWheel.



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lists the files that exist on the root file system only. This is useful if you are worrying about occupancy of a partition. It's more common to want to stop searching at a common subdirectory. This can be done using the `-prune` option, which will cause `find` to stop searching when a directory name is found, for example:

```
% find . -name SCCS -prune -o -print
```

This command has two "arms." The first recognizes the name SCCS and calls `prune` when the name is found. This stops any further investigation of the subdirectory. If SCCS is not found, then the *or* arm is executed, listing the file name.

The `prune` operation can also be used to inhibit expensive searches of remote nfs-mounted file systems:

```
% find . -fstype nfs -prune -o -print
```

Finally, on some systems it's possible to use `find` to search a precompiled table of file names, say:

```
% find ls.1
/usr/share/man/man1/align_equals.1
/usr/share/man/man1/ls.lv
/usr/share/man/man1/othertools.1
/usr/share/man/man1/suntools.1
```

The result is generated quickly by scanning a file created on the system by the script `/usr/lib/find/updatedb`. Of course, the system can have altered since the file was created, so the files that it shows may have been deleted or new files that match the name may have been added. That being said, I find that on most systems there are many files that alter rarely; perhaps they contain program source or other data.

You will find that Sun systems are installed with an empty file list so you will need to run `updatedb` on your system to get this to work. After that, put an entry into root's `crontab` to run the script regularly.

This particular use of `find` was implemented in Berkeley by Kirk McKusick. On their most recent systems, the BSD folks have renamed the command that accesses the database `locate` because POSIX.2, the shells and utilities standard, has not sanctified this use of the `find` command. ⊷

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+. He is the Usenix Standards Liaison. Email: `pc@expert.com`.

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I/Opener

ROBIN JAREAUX

by RICHARD MORIN,
Technical Editor

May These Events (Part I)

Three Prayers to Bree Amal, Goddess of Keepers of Disorderly Houses:
May These Events Not Involve Thy Servant.
May These Events Not Cost Thy Servant Money.
May These Events Leave No Trace of Themselves in Thy Servant's Memory.
–Casting Fortune, John M. Ford

This was going to be a hardware column. I promised you one, and I had every intention of writing one. Unfortunately, events got in the way. Look for a hardware column in a month or two (unless I give up on UNIX and switch back to VMS in disgust).

This month, I'm going to talk about some noise and confusion that seems about to paralyze much of the UNIX community. There are a lot of players involved, including some names that may be quite familiar: Adams, Bostic, Jolitz, Karels, Kolstad, McKusick, AT&T, BSDI, CSRG, UC Berkeley, USL, UUNET, Usenix... (I won't go into detail right now on who these folks are, but you'll see all these names explained as this series continues.)

In case you've been on Mars or something, USL (AT&T's UNIX distribution subsidiary), is suing BSDI and the University of California at Berkeley for copyright infringement, trade secret violation, breach of contract, etc. Things are quite messy as I write this, and I suspect they will get messier before long. I'm going to try to give you an overview, complete with my own opinions. I'll try not to get too religious, but I make no promises.

For purposes of simplicity and clarity, I also plan to simplify the explanations somewhat. For instance, I refer to both AT&T and USL as AT&T. This may not yield an absolutely accurate column, but the alternative is chaos.

Finally, by way of full disclosure, my own involvement is that of an interested observer. I almost became a participant; if I had put the disputed code onto Prime Time Freeware 1-2, I might have received some legal papers by now. Fortunately, the PTF issue was delayed somewhat, and the lawsuit became noisy enough to attract my attention. Hence the name ("May These Events") of this column.

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Some History

First, let's review how we got here. The origins of UNIX are well known. Briefly, Ken Thompson was part of AT&T's foray into MULTICS. When AT&T dropped out, Ken was left with the rather unappetizing prospect of returning to a batch processing environment and decided to craft an alternative, primarily to support his hobby, a space travel program.

He did not, however, create the new system out of thin air. "The UNIX Time-Sharing System" (D. M. Ritchie and K. Thompson, *Bell System Technical Journal*, July-August 1978), notes, "The `fork` operation, essentially as we implemented it, was present in the GENIE time-sharing system. On a number of points we were influenced by MULTICS, which suggested the particular form of the I/O system calls and both the name of the shell and its general functions. The notion that the shell should create a process for each command was also suggested to us by the early design of MULTICS, although in that system it was later dropped for efficiency reasons. A similar scheme is used in TENEX."

Note that 1) Ken had personal experience working on other operating systems, 2) UNIX used techniques and experience gained from other operating systems, and 3) AT&T was under a legal order to stay out of the computer business. These points will come up later in this series; I would not be surprised to have them come up in court.

Berkeley UNIX

UC Berkeley was one of the first sites outside of AT&T to get a copy of UNIX. Ken came out for a while, installed V6 UNIX on a local PDP-11, and generally got things going. When V7 became available, it got sent to Berkeley, as well.

The Berkeley folks, most notably William (Bill) Joy, wrote and collected assorted pieces of additional software. Upon request, Bill would send out tapes to other UNIX-licensed sites. Eventually, the effort became large enough to justify a formal distribution, and 2BSD was born.

The PDP-11 had no virtual memory and could not handle arbitrarily large programs. DEC's production of the virtual-memory VAX solved this, leading very quickly to a variant of the famous seventh edition called "UNIX/32V Time-Sharing, System Version 1.0" (32V). Although 32V ran on the VAX, it lacked proper virtual memory support.

Bill Joy and Ozalp Babaoglu added the needed features, allowing substantial programs (e.g., the emerging Franz Lisp system) to be run. The result was released to the world as 3BSD. Eventually, 4BSD was born, including a major rewrite of the file system, memory management and other subsystems. Most "Berkeley UNIX" systems (e.g., SunOS, Ultrix) are derived from 4.2BSD; many include 4.3BSD features, as well.

You may remember that the square bracket construction in `sh` is a special shorthand for the `test` command.

The AT&T educational license allows certain universities to participate for a relatively negligible amount of money. Nonetheless, there are problems with the arrangement. Many schools (e.g., high schools and junior colleges) do not qualify for the license and cannot participate at all. Independent scholars (Yo!) are certainly excluded.

Even at qualifying institutions, access is drastically limited. Only staff, faculty and graduate students can realistically be asked to sign nondisclosure agreements. Consequently, undergraduates are excluded from access to UNIX source code.

These factors motivated Berkeley's Computer Science Research Group (CSRG) to explore the development of license-free BSD releases. Several factors made this plausible. Most of BSD, by volume, was non-32V code. Many parts of BSD (e.g., networking code) had no equivalents in 32V. Much of the original 32V code was no longer present, having been supplanted by new and (generally) improved versions.

In addition, many of the UNIX user-mode utilities and subsystems had been replicated by independent developers. (Incidentally, the Free Software Foundation's GNU project has had little direct impact here, in that CSRG wished to avoid the Copyleft restrictions. By leveraging this independent effort, CSRG could avoid rewriting masses of user-mode code.)

So they took a stab at it. They edited hundreds of utilities, adjusting them to fit CSRG guidelines. As they touched modules, they classified them as to ownership. Three different copyright notices were developed, corresponding roughly to Yes (AT&T), No (non-AT&T) and Other. It must be said that part of the motivation for the copyright clarification effort was the blatant use, without notices, of large amounts of BSD code in assorted commercial distributions. The AT&T-licensed 4.3BSD-Tahoe release was distributed during this period. CSRG staff then extracted the non-AT&T modules and made them available for public access via FTP from UUNET. Over time, new and/or modified modules were uploaded, keeping UUNET's directories up-to-date with the current state of the CSRG work.

AT&T was by no means unaware of these efforts. CSRG's staff made a number of announcements about what they were doing, both at Usenix conferences and in the press. In addition, they sent letters to all previous BSD licensees, including portions of AT&T.

CSRG also attempted to use an AT&T copyright-checking service that certified modules for freedom from AT&T code. John Gilmore had used the service to verify that the public-domain UUSLAVE program did not violate any AT&T rights. CSRG submitted `csh`, receiving a verbal OK

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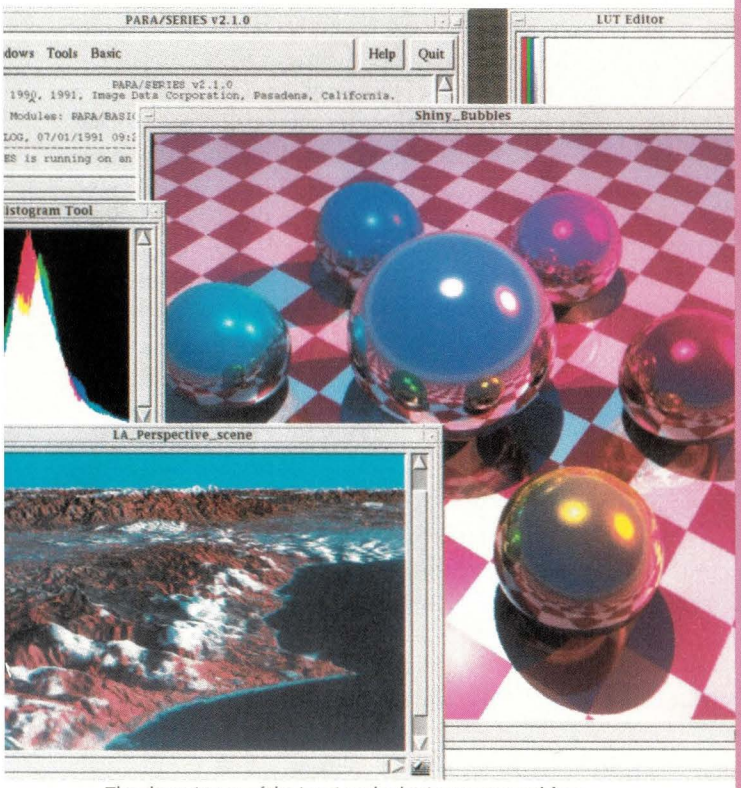

The above image of the Los Angeles basin was merged from Landsat satellite data and USGS terrain elevation data on Silicon Graphics' 4D/240 system. It took 128MB of main memory and 2GB of disk storage.

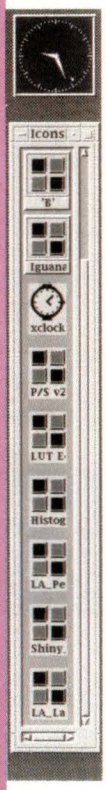

Photo courtesy of Image Data Corporation, Pasadena, California. 818-796-9155

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on all but a small portion of the code. When they asked for a written confirmation, however, they were informed that the service had been shut down.

The reasons are unclear, at least to me. Cost cannot be cited as a factor; AT&T is huge, and the effort involved in code-checking was minuscule. Perhaps AT&T was even then having second thoughts about its intellectual property strategy.

If AT&T wished to claim only that portion of BSD code which was derived from the original UNIX system, the service should have been continued. By clarifying which code did not belong to AT&T, it buttressed AT&T's position on the remainder. On the other hand, if AT&T had decided to grab everything that had any ties to UNIX at all, such a service would not be in its best interest.

At any rate, AT&T took no positive actions to protect the code that CSRG was releasing and UUNET was making available. There were no warning letters, requests for restraining orders or other indications that AT&T thought its rights were being trampled. Just silence.

So CSRG went forward, releasing the NET/1 and NET/2 releases as license-free code. They released NET/2 more than a year ago, having given plentiful notice of their intentions. Still silence from AT&T. Finally, in April, AT&T sued BSDI for "trademark infringement, false advertising and unfair competition." The "trademark infringement" issue is largely settled, but it is still interesting.

(800) ITS UNIX

The telephone suffix 8649 is unusually common in our industry. This stems from the fact that it spells out UNIX on the Touch-Tone keypad. A quick look in the 1992 *UniForum Directory* yields:

(408) 748-8649	Aim Technology
(408) 296-8649	ALM Operations Inc.
(416) 225-8649	Analysis Synthesis Consulting Inc.
(800) 827-8649	Apunix Computer Services
(403) 263-8649	Athena Software Corp.

Out of 198 companies whose names start with "A," five use the 8649 suffix. There are 10,000 possible suffixes, so random selection would yield 198/10,000, or about 0.02 companies. The actual usage is thus 250 times the expected usage. Statistically speaking, this is a smoking gun. Clearly, AT&T isn't restricting use of the suffix, and a number of UNIX-related companies have taken advantage of their hospitality.

BSDI's choice is a little more awkward than most, however. If "ITS UNIX," as BSDI's number claims, BSDI can't sell it. If it's not, they shouldn't say that it is. Their claim is contrary to fact, as AT&T notes: "BSDI's use of the 'ITS-UNIX' telephone number is intended to and likely to cause confusion, or to cause mistake, or to deceive in that BSD/386 is not a 'UNIX' product nor is BSDI authorized or licensed to use the UNIX trademark in connection with any of its products or services."

The AT&T claim goes quite a bit further, however: "BSDI's unauthorized use of the UNIX trademark has caused AT&T to sustain damage to its business, and to the value of its trademark and the goodwill associated with that mark. BSDI's conduct constitutes infringement of a registered trademark in violation of Section 32 of the Lanham Trademark Act, 15 U.S.C. 1114."

Now really. Did the five companies listed above receive authorization and/or licenses to use the suffix? How about the dozens (hundreds?) of others in the rest of the alphabet? Do the advertisers in this and other industry magazines get AT&T's blessing before they use the U-word? I know I don't, and I note that AT&T hasn't stepped on the magazines (e.g., *Open Systems Today*) that consistently capitalize the word in its traditional but unofficial form ("Unix").

For that matter, I'd love to think that AT&T did authorize the number. I mean, who does control the 800 numbers, anyway? Unfortunately, the (800) 487 (ITS) numbers belong to Sprint, so I lose. In any event, AT&T has made its point; BSDI agreed to stop using the UNIX mark to identify its telephone number. AT&T should drop the trademark issue and move on to more substantive issues.

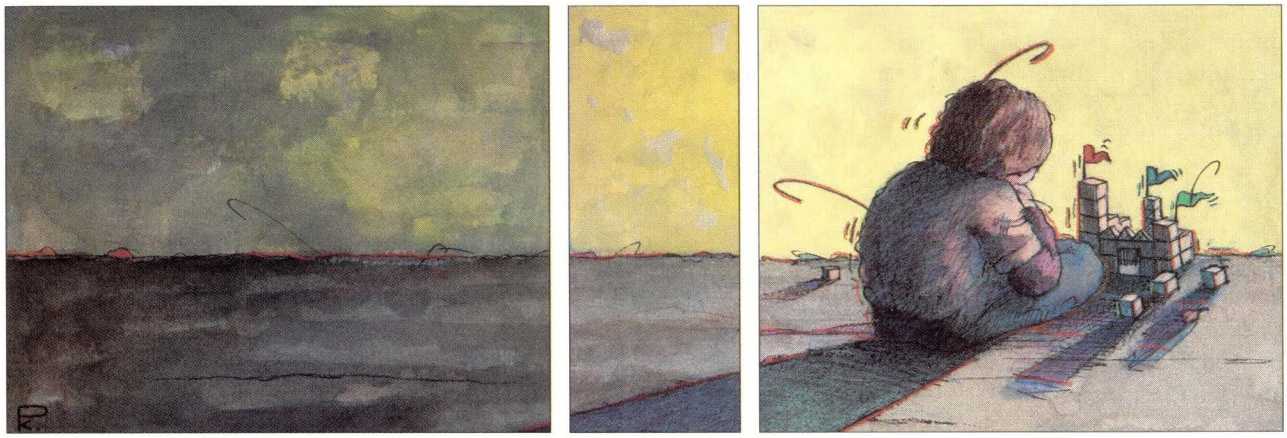
Lies, All Lies...

AT&T also claimed "false advertising," asserting that BSDI was lying when it said that customers would not need AT&T licenses to use BSD/386. Note that AT&T had not (and still has not) proven that the customers would need AT&T licenses. I think the technical term for this is "proof by assertion."

Nor has AT&T (even at this writing) given any specific indication of which AT&T code is being infringed and which NET/2 modules are tainted. Their legal argument is still unclear (at least to me). They may try to claim just the code segments that are recognizably derived from UNIX.

Alternatively, they may try to claim any code embodying the "methods or concepts utilized therein" mentioned in their license agreement. Taken to the limit, AT&T might be asserting that anything written by someone familiar with AT&T source code is now UNIX. The mind boggles. And the show continues. Stay tuned; next time, we will discuss later events in the saga and talk about AT&T's assertions about CSRG's motivations in releasing NET/2. ⊸

Richard Morin produces Prime Time Freeware, a semi-annual CD-ROM collection of redistributable, UNIX-related source code. Between releases, he consults, writes and teaches on UNIX topics. He may be reached at Canta Forda Computer Laboratory, P.O. Box 1488, Pacifica, CA 94044 or by email at rdm@cfcl.com.



PETER KALABOKIS

Master Raster

by S. LEE HENRY

The rasterfile is Sun's file format for raster images, the "native" image format on the Sun. Both the Snapshot tool and the `screendump` command store images in this simple, fairly efficient format. In this month's column, we'll take a look at what rasterfiles are and how you can manipulate them.

Get'er Header

The system file that describes the format of raster files is `/usr/include/rasterfile.h`. You will note its inclusion in a program we will look at later with the line:

```
#include <rasterfile.h>
```

A rasterfile is composed of three sections: first, a header containing eight bytes that describe the image file; second, a (possibly empty) set of color map values; and third, the pixel image itself, stored in a left-to-right, top-to-bottom fashion. As we shall see later, each line of the image is rounded up to the nearest two bytes (16 bits).

Figure 1 displays this structure in a block format.

The header is defined by the following structure:

```
struct rasterfile {
     int ras_magic;
     int ras_width;
     int ras_height;
     int ras_depth;
     int ras_length;
     int ras_type;
     int ras_maptype;
     int ras_maplength;
};
```

The `ras_magic` field always contains the following constant:

```
#define RAS_MAGIC 0x59a66a95
```

This constant, or magic number, identifies rasterfiles as such to the `file` command and to the desktop tools like File Manager so that it can appropriately iconify and operate on them. The other fields are used by programs that display or manipulate the contents of these files, like Snapshot and rasfilter8to1, which changes color rasterfiles to

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8501: Well, I wouldn't go that far. But DP managers sure love it. It tells you if there's enough unused tape in a cartridge to complete your backup. It lets you know if the tape is in good condition. And it even reminds you when it's time to install a cleaning cartridge.

Sun Enquirer: That's terrific! But fill us in on some basics. What's your speed and capacity?

8501: I can hold five gigs on a standard 8mm cartridge and my sustained data transfer is up to 500 kilobytes per second.

Sun Enquirer: How about your average seek time?

8501: In high-speed search mode I can find any file on a tape that contains 5,000 megabytes in about 60 seconds.

Sun Enquirer: That's fast! But I think our readers would really like to know if you're still doing work with some of the top CPUs in the business?

8501: You better believe it! I'm compatible with all kinds of SCSI-based systems. Not to drop names, but some of my best friends are VAXes, Sun SPARCstations and servers, IBM PCs and RS/6000s, HP/Apollos, and Macs.

Sun Enquirer: Boy, you really do get around! Is it hard to get along with so many different hosts?

8501: Not really. You see, the engineers at TTi designed me with 12 little switches on my back panel. By changing the settings I can speak almost any language.

Sun Enquirer: That must really come in handy in a multi-host environment. Do those switches do anything else?

8501: Of course! Besides setting the emulation, they change my SCSI address and let the user choose options like fast file search, short file mark enable and more!

Sun Enquirer: I suppose those switches also help you get along with 2.3 gigabyte 8mm drives?

8501: You got it. I can read tapes that were written by 2.3 gigabyte drives and write tapes in EXB-8200 mode, so they can be read by any 2.3 gigabyte drive.

Sun Enquirer: Mr. 8501, thank you for talking with us today. If folks want to learn more about you, what should they do?

8501: Either call (714) 693-1133 or drop me a line at TTi. I take all my calls and I always answer my mail. Well, gotta' go, but I hope I'll be talkin' to you soon!

Backup so easy, you can do it with your eyes closed.

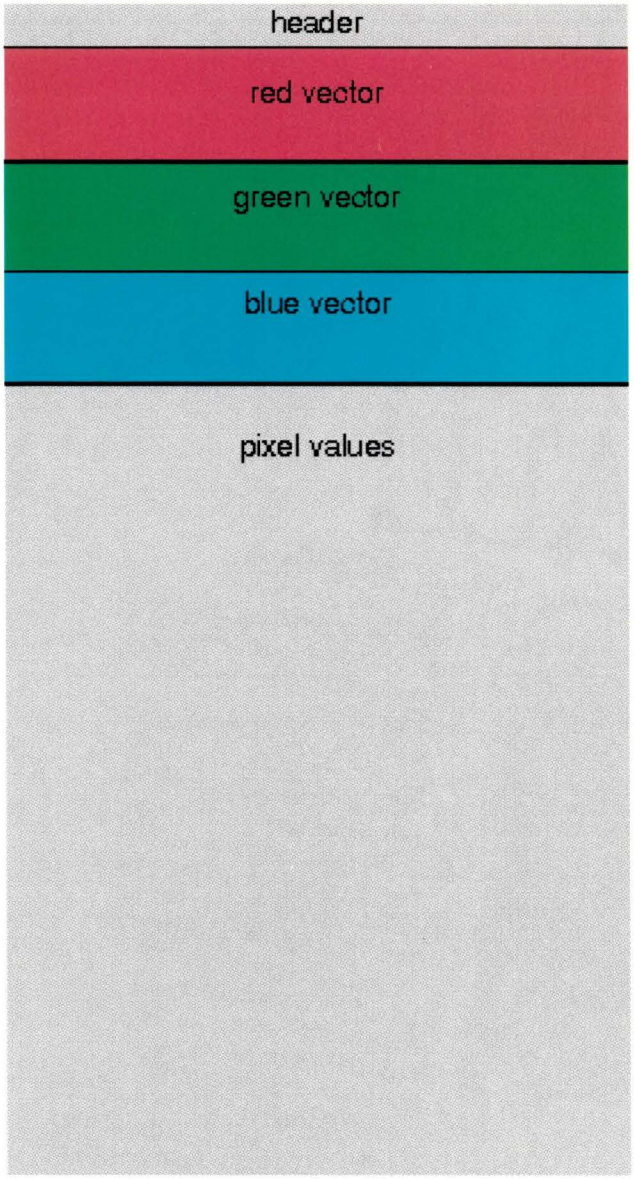


Figure 1. The Raster Format

monochrome. If you look at a dump of the top of a rasterfile, you would see the magic number in the first four bytes and the rest of the header in the 12 bytes that follow:

```
od -bh snapshot.rs | head -12

0000000 131 246 152 225 000 000 001 051 000 000 002 140 000 000 000 010
          59a6    6a95    0000    0129    0000    0260    0000    0008
0000020 000 002 303 300 000 000 000 001 000 000 000 001 000 000 000 025
          0002    c3c0    0000    0001    0000    0001    0000    0015
0000040 137 000 317 377 000 000 317 137 000 317 000 377 347 317 137 000
          5f00    cfff    0000    cf5f    00cf    00ff    e7cf    5f00
0000060 317 000 042 377 317 000 000 000 000 000 000 000 000 000 000 000
          cf00    22ff    cf00    0000    0000    0000    0000    0000
0000100 000 000 000 000 000 000 000 000 000 000 000 000 000 000 000 000
          0000    0000    0000    0000    0000    0000    0000    0000
*
0000520 000 000 000 000 000 000 000 000 000 000 000 000 000 000 013 000
```

The header of the rasterfile, in addition to identifying it as a rasterfile, contains the width and height of the image, the depth of the image (e.g., 8-bit color, monochrome). It also provides the length of the image data, the type of raster, and a type and length for the optional color map. The little C program provided in Figure 3 reads and displays information in the rasterfile's header.

```
wizard> rd_hdr rasterfile.rs
ras_magic     150407848 sun raster format
ras_width     297    ras_height     608
ras_depth     8      ras_length     181184
ras_type      1          raw pixel values
ras_maptype   1
ras_maplength 21

Do you want to see a list of the color table? [y/n] n
wizard> ls -l rasterfile.rs
-rw-rw-r- - - 1 slee 181237 Aug 14 07:58 rasterfile.rs
```

A portion of this information is displayed through the file command:

```
wizard> file rasterfile.rs rasterfile.rs:
rasterfile, 297x608x8 standard format image
```

The length of the file makes sense if we remember that the file will be padded to bring it up to an increment of 16 bits for each image row. Though the image is 297 pixels wide, 298 bytes will be stored per row. The file length, 181,237, comes from the calculation (298 * 608) + 32 + 21, or data plus header plus color map.

The color map that is optionally included in the raster file is separated into three vectors, one for each of the primary colors of light–red, blue and green. When a color map is included in a rasterfile, each of the data bits in the pixel values that follow is not a color value, but an index into the color map. In the hex dump we just looked at, the first byte of the red vector is 137. The first 32 bytes, 0 through 31 octal, contain the header.

This particular rasterfile has a color map of only 21 bytes or seven colors. If we ran the rd_hdr program (provided in

Figure 3) against it, we'd get the following output:

```
ras_magic       1504078485      sun raster format
ras_width       297
ras_height      608
ras_depth       8
ras_length      181184
ras_type        1               raw pixel values
ras_maptype     1
ras_maplength 21

Do you want to see a list of the color table? [y/n] y

COLOR TABLE

        red             green           blue
0       95              95              95
1       0               0               0
2       207             207             207
3       255             0               0
4       0               255             34
5       0               231             255
6       207             207             207
```

The 137 (octal) or 95 (decimal) is repeated for the first positions of each element in the color map, creating a dark gray. Each pixel in the data section of the file with a value 0 indexes into these values in the color map and, therefore, appears gray. As a matter of fact, this rasterfile is Figure 1. The dark gray color in the background is described with this color value.

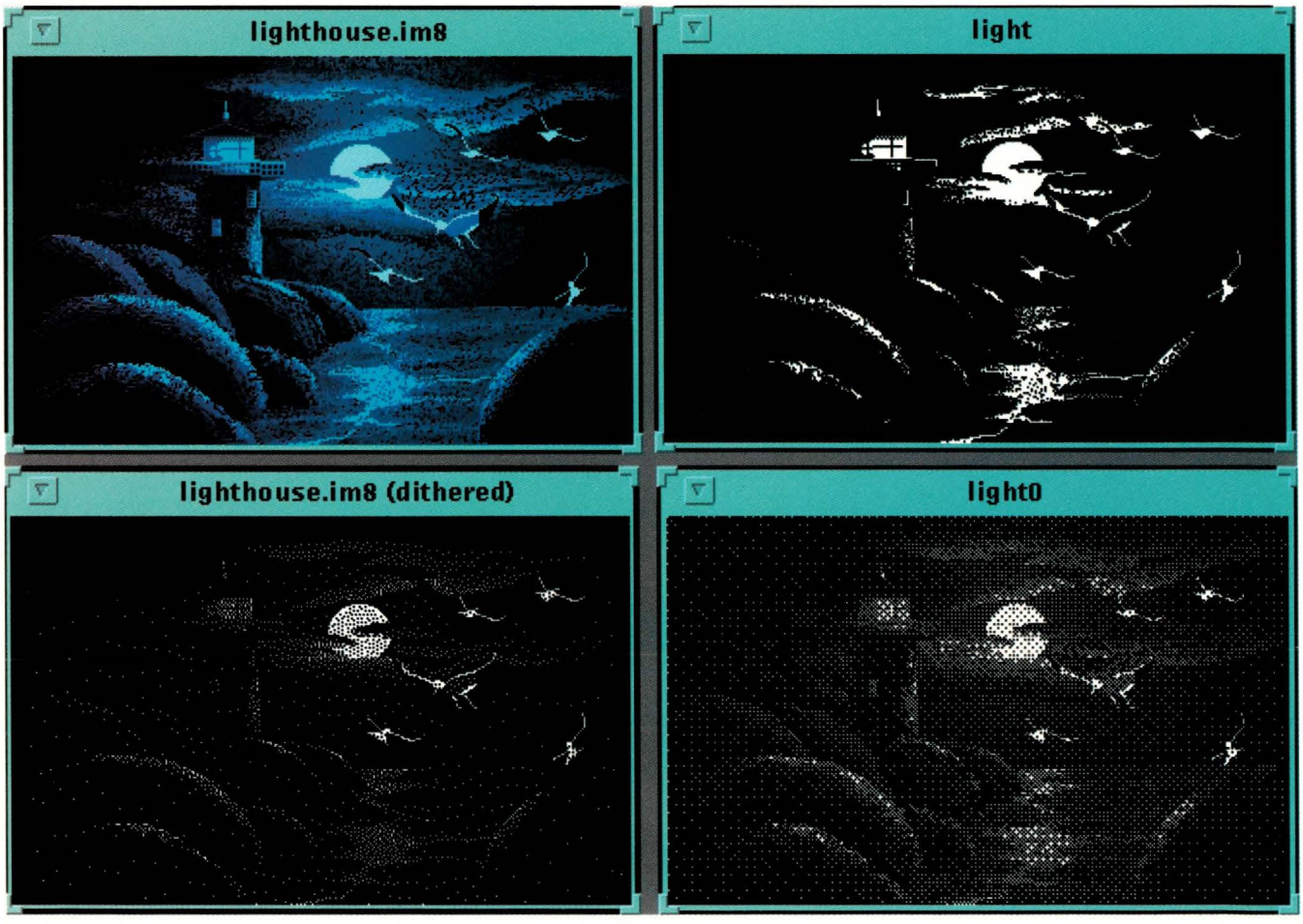
Raster Roulette

Rasterfile manipulation routines included in OpenWindows Versions 2 and 3 include the Snapshot tool, which captures windows or portions of the screen and saves them as rasterfiles. We also have the rasfilter8to1 tool in `/usr/bin` that takes a color rasterfile and makes a monochrome image. There is a difference in the snapshot tool between the two versions of the windowing systems which affects this tool. Snapshot in OpenWindows Version 2 saves a full 256 colors in its color map (maximum colors for an 8-bit frame buffer), while the tool in OpenWindows Version 3 is more conservative and stores only the colors that it uses in the particular screen capture. As a result, the rasfilter8to1 of SunOS 4.1.X balks on rasterfiles created with Snapshot in OpenWindows Version 3 with the following message:

```
rasfilter8to1: input has unsupported colormap
  type or length
```

Not to worry. A new version of rasfilter8to1 may already

Figure 2. Color, Monochrome and Dithered Files



```
/* rd_hdr.c -- slee & bak 1992
program reads header from raster file, displays header information, and optionally displays color map */


#include <stdio.h>
#include <rasterfile.h>
#define COLORS 256

struct rasterfile header;

main(argc, argv)
int argc;
char *argv[];

{

     int x;
     int grays;

     char in_name[BUFSIZ];
     unsigned char red[COLORS];
     unsigned char green[COLORS];
     unsigned char blue[COLORS];

     FILE *fp1;

     if(argc == 1) {
          printf("enter name of image file: ");
          gets(in_name);
     }
     else{
          sprintf(in_name, "%s", argv[1]);
     }

     fp1 = fopen(in_name, "r");
     if(fp1 == NULL) {
          /* perror(*fp1); */
          printf("Cannot open file\n");
          exit(1);
     }

     fread(&header, sizeof(header), 1, fp1);
     printf("ras_magic \t %d",header.ras_magic);
     if(header.ras_magic == RAS_MAGIC) {
          printf("   sun raster format\n");
     }
     else {
          printf("\n");
     }
     printf("ras_width \t %d\n",header.ras_width);
     printf("ras_height \t %d\n",header.ras_height);
     printf("ras_depth \t %d\n",header.ras_depth);
     printf("ras_length \t %d\n",header.ras_length);
     printf("ras_type \t %d",header.ras_type);
     if(header.ras_type <= 1 && header.ras_magic == RAS_MAGIC) {
          printf("   raw pixel values\n");
     }
     else if(header.ras_type == 2 && header.ras_magic == RAS_MAGIC) {
          printf("   run-length encoded\n");
     }
     else {
          printf("\n");
     }
     printf("ras_maptype \t %d\n",header.ras_maptype);
     printf("ras_maplength \t %d\n",header.ras_maplength);
     if(header.ras_magic == RAS_MAGIC && header.ras_maplength > 0) {
     printf("\n Do you want to see a list of the color table? [y/n] ");
     if(getchar() == 'y') {
          grays = header.ras_maplength / 3;
          fread(red, sizeof(char), grays, fp1);
          fread(green, sizeof(char), grays, fp1);
          fread(blue, sizeof(char), grays, fp1);

          printf("\n COLOR TABLE \n");
          printf("\n \tred\tgreen\tblue\n");
          x = 0;
          while(x < grays) {
               printf(" %d\t%d\t%d\t%d \n", x, (int)red[x],
                    (int)green[x], (int)blue[x]);
               ++x;
          }
          }
     }

     fclose(fp1);
}
```

Figure 3. The rd_hdr Program (Thanks to Brian Keith for his contribution to the program presented here.)

be available by the time you read this column. If you see the above message, make sure that you request a new version from Sun.

Whither Dither

The rasfilter8to1 tool as well as the very nice public domain xloadimage software allow you to dither your images. Unless told to dither, rasfilter8to1 will use a threshold of pixel brightness; anything above this threshold will turn white and anything below black. This threshold can be set with a parameter:

```
rasfilter8to1 [ -d ] [ -rgba threshold ]
        [ infile [ outfile ]]
```

The `-rgba` parameters will move the threshold up or down like the darkness control on your copier. Grab a portion of your screen with Snapshot and experiment with this setting.

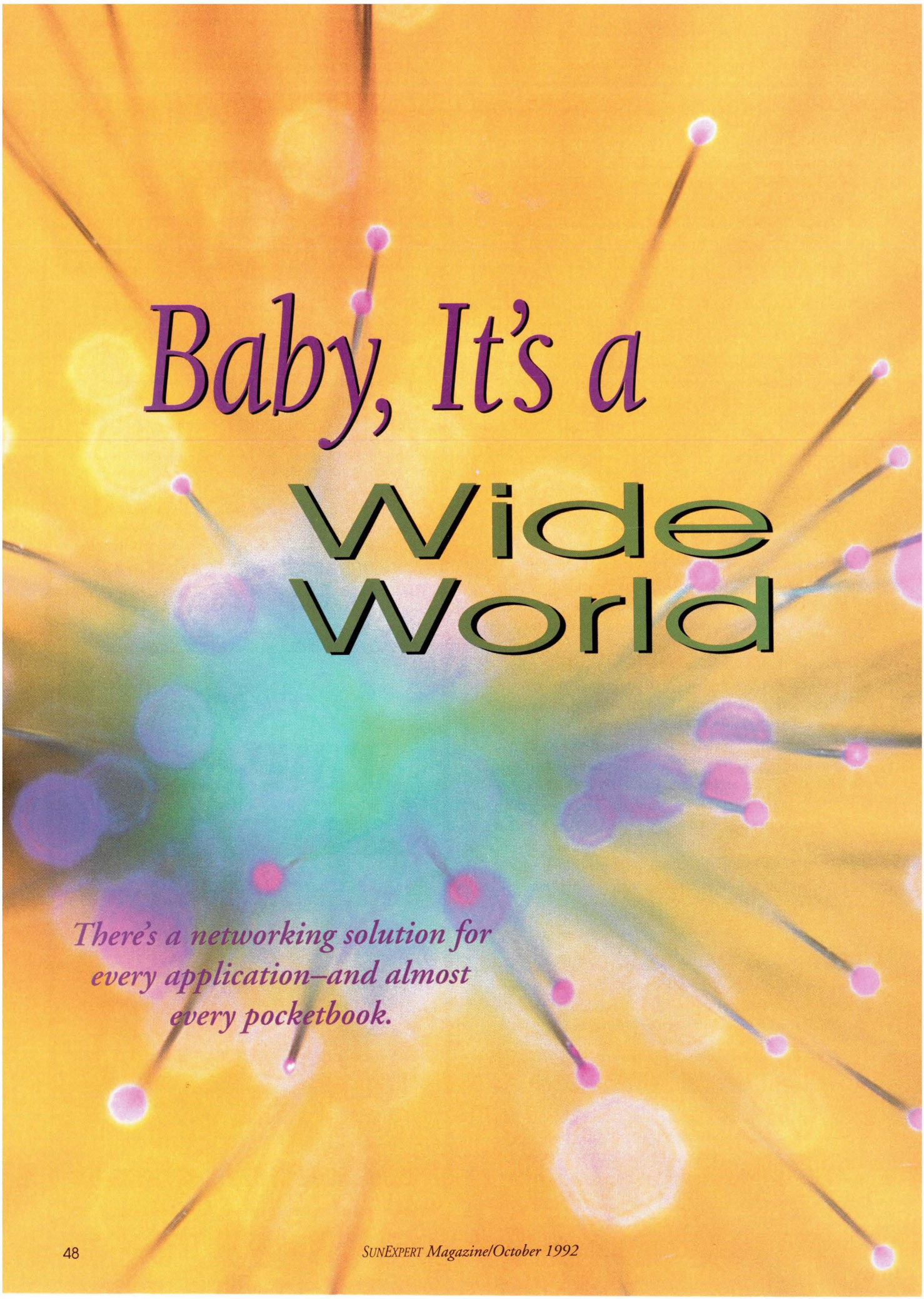
```
wizard> rasfilter8to1 -a 200 lighthouse.im8
> dark.lighthouse
wizard> rasfilter8to1 -a 100 lighthouse.im8
> light.lighthouse
```

In these examples, we set the average threshold. The red, green and blue thresholds could have been set individually.

Think of the parameter as a threshold under which the value is dark; thus, the higher the value, the darker the image will be.

Dithering, on the other hand, replaces sections of color with patterns of black and white that approximate the brightness of the color. Many dithering algorithms are possible, with varying results. The dither of choice probably depends on the type of image that you are dealing with. To contrast some options, I've included an instance of dithering with xloadimage (lower left) and rasfilter8to1 (lower right) in Figure 2. Dithering is more complicated than it might appear because the perceived brightness of light is not linear and we are not as sensitive to some colors (e.g., red) as others (e.g., green). As a result, the RGB components of a color should be weighted differently in deriving a brightness measure. ➸

S. Lee Henry is on the board of directors of the Sun User Group and is a systems administrator for a large network of Suns in the federal government. She also heads The Next Page Inc., which specializes in software documentation.



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SPECIAL REPORT

WAN

INTRO

Wide-area networks (WANs) cover a lot of territory, figuratively and literally. In this special report, *SunExpert* examines some of the pieces of the far-flung technologies that fall into the WAN category.

Stan Hanks, president and principal scientist with Technology Transfer Associates, sets the stage by wading through the worlds of T-1, T-3, frame relay, Switched Multimegabit Data Service (SMDS), Asynchronous Transfer Mode (ATM) and Multimegabit Data Service (MDS)–without leaving you feeling unable to digest the acronym onslaught. On the IBM Corp. token-ring and SNA connectivity fronts, Robert Ciampa, director of local-area networking for Brixton Systems Inc., gets into the bits and bytes of configuring SBus network-interface cards. Proving you don't have to go into orbit to provide solid DECnet-to-TCP/IP links, Gregg Phillips, systems manager for Vexcel Corp., details how his company achieves access to the VAXes, Suns and other multivendor systems and devices on its network.

Last but not least is our buyers guide to Ethernet routers. Scott Bradner, manager of the Harvard Network Device Test Labs, offers potential and existing customers a checklist of router features and pitfalls to be aware of.

by MARY JO FOLEY, Senior Editor

UNIPHOTO, NY

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Breaking the Off-Campus Bottleneck

by **STAN HANKS**, Technology Transfer Associates

Building a LAN is basically pretty easy. You can use some combination of concentrators, repeaters, bridges and routers to hook your collection of LAN segments together in a manner that is aesthetically pleasing. Religious wars have sprouted over exactly what the best way to do all this might be. Suffice to say, things get complicated when you have to go off-campus. And for most of us, such connectivity is a daily reality.

In a romp through acronym land, our intrepid author demystifies the 'science' of choosing among the available MAN and WAN technologies.

Off-campus–in the domain of metropolitan-area networks (MANs) and wide-area networks (WANs)–the rules change. No longer can you just run some cable out to where you need the new connection. Constrained by what seems at first to be an alternate reality, you have basically three choices. You can build a private network, either by actual physical construction or by leasing lines from someone else. You can use standard dial-up telephone lines and high-speed modems. Or you can use an advanced switching service such as frame relay, Switched Multimegabit Data Service (SMDS) or others.

Any time your network leaves your property, you must use either a private network or a common carrier, such as the phone company. If you take the private network approach, you open up a very, very large can of worms. In effect, you wind up having to justify that it's less expensive for you to own and maintain your own electronics and cable plant than to buy service from someone who also owns electronics and cable plant, but who buys at significantly lower prices than you and who has a huge economy of scale to make things like round-the-clock service possible. This rapidly becomes difficult for all but the largest companies.

If you use a common carrier, you have another set of problems. While dial-up voice-grade service is ubiquitous and fully interconnected, if you choose to lease lines from the phone company, and you need service across local access and transport area (LATA) boundaries, you may have to deal with two local service phone companies and a long-distance company. Admittedly, you can get the long-distance carrier to handle the local access part for you, but still, the moving-parts count starts to go up.

And there is another issue: If you buy service from the phone company, you basically get to buy what they're selling. And what they sell is mainly voice-grade service, so all of their leased-line facilities come in sizes that are whole multiples of voice-grade lines, and not in LAN-sized pieces.

Specifically, for data you typically consider regular voice-grade dial-tone lines; digital voice-grade lines at either 56 or 64 Kb/s (called DS-0 lines); the next level up, which at 1.544 Mb/s is 24 DS-0 lines (called a DS-1 or T-1); or the next level up, which at nearly 45 Mb/s is 28 DS-1s or 672 DS-0s (called a DS-3 or T-3). Beyond that, you start talking about whole digital fiber-optic transmission systems. Note that you jump from 1.5 to 45 Mb/s without the more common LAN speeds of 4, 10 or 16 Mb/s being available. And the prices jump up correspondingly.

Don't Just Stand There–Guess

So what's a LAN gal or guy to do? Well, the first thing you really need to do is decide how much bandwidth you need between sites. If you currently don't have any intersite connectivity, you get to do something really

Bringing the Fiber to Mohammed

Metropolitan Fiber Systems was started a few years ago when Peter Kiewit and Sons, the construction company that was building the fiber-optic networks for a number of alternative access providers, decided that the business of bypassing the local phone company for leased-line business looked pretty attractive and decided to buy its customers and consolidate them into a single national company. A rather unconventional approach, but one that seems to have worked well.

The core business for MFS is to provide high-quality stopless leased-line service between buildings roughly in the central business district of a metropolitan area. The first buildings to be targeted are always long-distance carrier points of presence, so they can provide access to the wide area, but MFS is not in the wide-area business itself.

In some cases, where there are really multiple business districts, this means big networks and lots of fiber-optic cable. In other cases, the networks are smaller. In no case can they be considered ubiquitous, and MFS makes a clear distinction between customers in buildings to which it has fiber (called "on-net" buildings) and everyone else ("off-net").

At the present, MFS has operations in Baltimore, Boston, Chicago, Dallas, Houston, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh, San Francisco, Washington and its newest city, Atlanta.

Having all this fiber in the ground, connected to where customers are instead of to central offices or the like, made it possible for MFS to recognize the possibility for a new business–that of providing native and reduced-speed LAN interconnectivity. The project, which led to the MDS services, was started in early 1991, and the service was announced in August 1991–with customers already attached.

To insure that MFS would be able to continue to do business without affecting its existing telephony business, it formed a new company, MFS Datanet, earlier this year. So far, MFS Datanet has been relatively quiet about its long-range plans.

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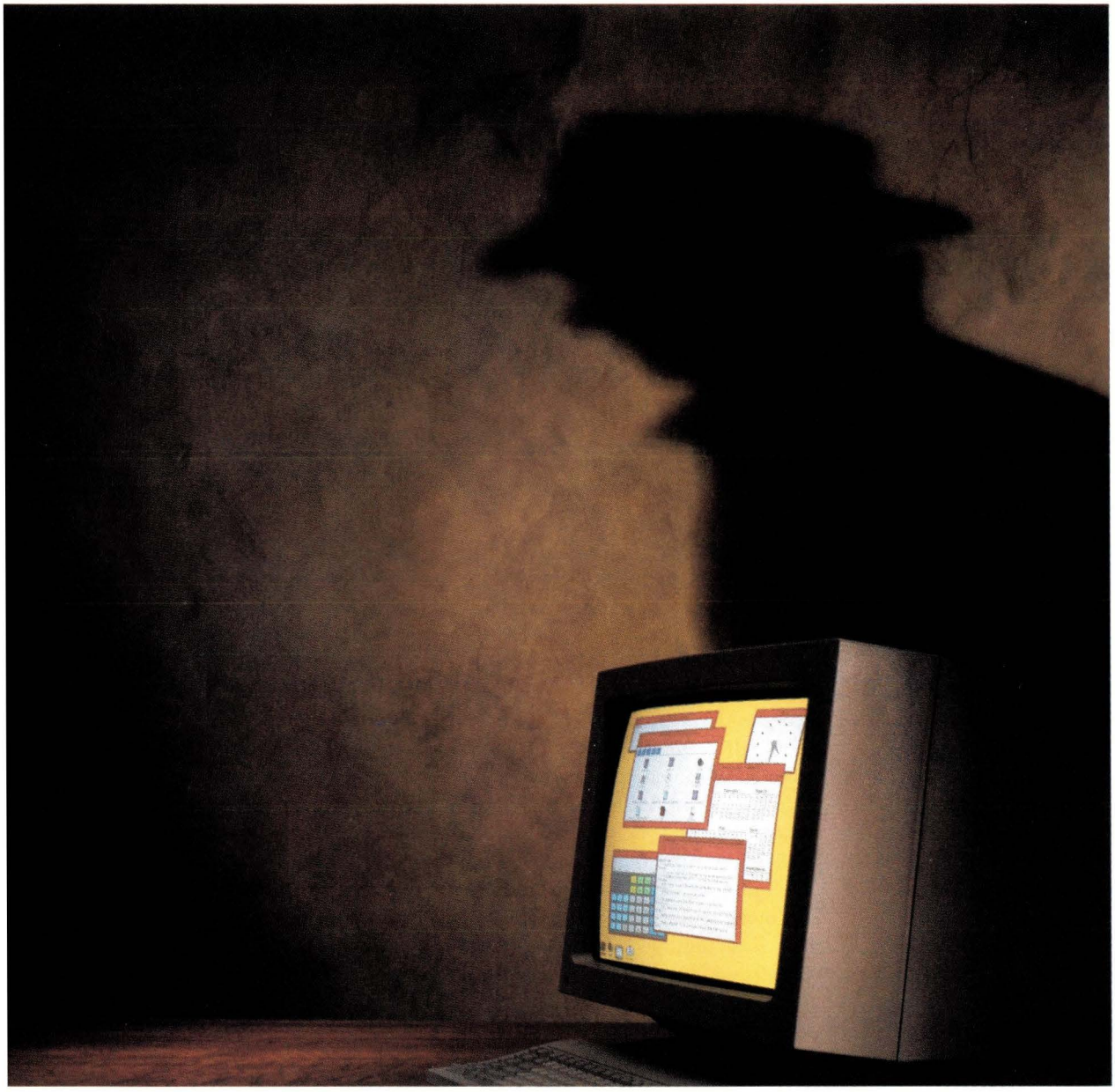

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Speeds of Transmission

Size of File in MB	Transmission Rate	Seconds to Transmit	Minutes to Transmit
0.1	56 Kb/s (DS-0)	14.29	0.24
0.1	1.544 Mb/s (T-1)	0.52	0.01
0.1	Ethernet	0.08	0.00
0.1	token ring	0.05	0.00
0.1	45 Mb/s (DS-3)	0.02	0.00
0.1	FDDI	0.01	0.00
1	56 Kb/s (DS-0)	142.86	2.38
1	1.544 Mb/s (T-1)	5.18	0.09
1	Ethernet	0.80	0.01
1	token ring	0.50	0.01
1	45 Mb/s (DS-3)	0.18	0.00
1	FDDI	0.08	0.00
100	56 Kb/s (DS-0)	14,285.71	238.10
100	1.544 Mb/s (T-1)	518.13	8.64
100	Ethernet	80.00	1.33
100	token ring	50.00	0.83
100	45 Mb/s (DS-3)	17.78	0.30
100	FDDI	8.00	0.13

Source: Technology Transfer Associates

dangerous: guess. And here's why guessing is dangerous: If you don't have facilities, you don't know how they may be used; if you guess too small, performance will be so bad that no one will make more than limited use of the network; if you guess too big, you may be shot by your boss for "wasting money" on the network that no one has figured out how to really use yet.

There are some rules of thumb: If you are only using the link for electronic mail and maybe network management, you can probably get away with a DS-0; if you even think about anything else, you probably really want at least one T-1; if you are doing serious distributed file sharing or cooperative processing, you really want LAN speed. Of course, you can use routers to limit information flow and multiple parallel lines to increase overall throughput. But even doing this doesn't solve one of the other problems, which is latency.

The laws of physics being what they are, if two pieces of data leave Point A heading for Point B at the same time on different speed lines, the first bit of each datum will arrive at about the same time. However, the *last* bit will not, and the faster line will arrive first. From the time the first bit is sent until the last bit arrives is called latency and ultimately determines how useful a transmission line is for LAN purposes. One analogy I happen to like is that a DS-0 is like a garden hose, a T-1 is like a bundle of garden hoses all tied together, but a LAN is more like a water main. And you just can't do the same thing with a bunch of garden hoses that you can with a water main, any more than nine women can have a baby in a month.

To fix this problem in constructing networks, there are a variety of new technologies emerging. And, when you slice away all the buzzwords, there are really three worth looking into: frame relay, SMDS and the Multimegabit Data Services (MDS) from MFS Datanet.

Frame Relay: The LAN-Like Option

Frame relay is a technology that has been somewhat available for about a year. It is very LAN-like, using variable-length packets that are routed from a source to a destination address. It is a packet- (or frame-) forwarding technology that provides a "data cloud"-like structure to which you attach end points. Unlike a point-to-point network of leased lines, you don't have to worry about how the data will be sent, how failures are recovered from or the other things that keep network managers up at night, any more than you worry about such things for dial-up voice traffic. However, there are some problems with it.

For starters, while frame relay is available from a number of vendors–including Sprint, Williams Telecommunications Group (WilTel) and CompuServe Inc., to name a few–as a long-distance service, it is quite rare in the local loop. So while it may be attractive for WANs, it doesn't really play in the MAN scene. Second, frame relay is only available at T-1 speeds and below. It should eventually be available at up to DS-3 speeds, but no one is sure when. So it's not really useful for LAN-speed connectivity. (Note: All the Bell companies have filed tariffs for frame relay to be offered later in the year.)

Finally, there is the issue of congestion control–or the lack thereof. Frame-relay switches have capacity planned on the basis of your

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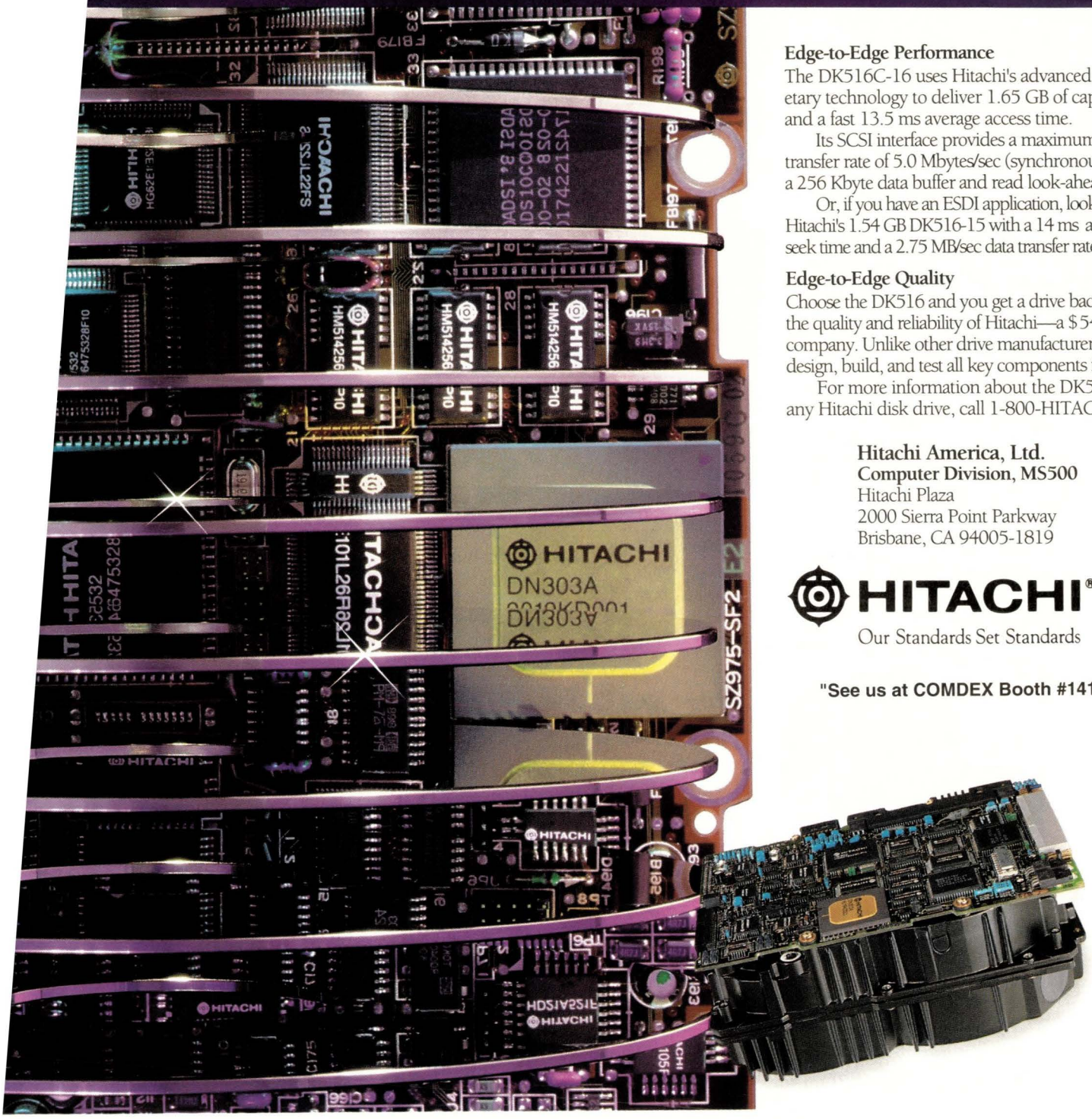

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committed information rate (CIR), which is the minimum data rate you will be guaranteed. Data arriving more frequently than your CIR is tagged as "Eligible for Discard." Since you have to use a common carrier to connect you from your site to the frame-relay service, you will wind up using either a DS-0 or maybe a full T-1 and can in theory use the whole bandwidth of that link if there is no congestion in the network. However, if the switch gets congested, all packets above your CIR get thrown away and must be retransmitted. And since it is hard to know when a frame-relay switch is going to congest, some carriers just routinely throw away data over your CIR.

One last note: Frame-relay networks internally support a 16-bit address field. As a result, carriers have to be careful about how their networks are built and how customers are connected. And, of course, the various carrier frame-relay networks *do not* interconnect or even interoperate, so you get stuck with a single vendor solution, which is always a cheery prospect.

SMDS: Somewhere Over the Rainbow

SMDS is a proposed service specification from Bellcore that is being widely adopted by the regional Bell operating companies (RBOCs). It is currently in trials in a number of areas and has even been tariffed as a regular service by at least one RBOC.

SMDS is quite a bit like frame relay in some respects. It also provides a data cloud to which you attach and uses a packet-forwarding technology. The difference is that it is built on a technology that is supposed to be forward-compatible with Broadband Channel Integrated Services Digital Network (B-ISDN), Synchronous Optical Network (SONET), Asynchronous Transfer Mode (ATM) and all the other cool buzzwords. Also the SMDS service specification says that it will be available in a variety of speeds between T-1 and DS-3, including the popular LAN speeds of 4, 10 and 16 Mb/s.

Unlike frame relay, SMDS is currently pretty much a local service offering. At this time, none of the long-distance carriers offer SMDS service, although some clearly have plans to do so. So you can build MANs out of SMDS in some areas, but it may be a while before you can connect them together. But (as another ray of good news) when you can connect SMDS networks together, everything should work fine. SMDS uses something called E.164 addressing, which is international in scale and has desktop-level resolution. Between that and the fact that all of the switch manufacturers are working from the same service specification, things *should* interoperate fairly well.

It will be a long and very expensive undertaking to get widespread availability of full-band SMDS.

Still, there are some problems. Currently, to go faster than T-1 speeds, SMDS requires dedicated fiber-optic paths. And while there is a lot of fiber in the ground, almost all of the RBOC fiber is dedicated to linking their central offices together and to the long-distance carrier points of presence. As a result, it will be a long and very expensive undertaking to get widespread availability of full-band SMDS. Second, the SMDS switches are very expensive. Even a small switch in a minimal configuration is several hundred thousand dollars. By the time you get something that will be usable in a metropolitan service area, you're starting to talk about some *serious*

money. This leads to another problem: Federal Communications Commission (FCC) and state regulation of the RBOCs.

Since it's clearly going to be very expensive to build full-band SMDS networks, the RBOCs will likely be required to price service in a way that avoids something called cross-subsidization. That is, the revenue gained from SMDS pricing must pay for the costs of building and operating the network, taken over some time frame. This is to prevent the folks at home using plain old telephone service (POTS) from seeing rate increases to help the phone company pay for its fancy new technology. It's all political, messy and generally unpleasant for all parties involved when such issues arise.

The bottom line is that while SMDS is very attractive and holds promise for the future, it won't make a big difference in your life soon. At least not at speeds greater than T-1.

MDS: Fiber in the City

Which brings us to the Multimegabit Data Service (MDS), available from Metropolitan Fiber Systems and its sister company, MFS Datanet (see "Bringing the Fiber to Mohammed").

The basic MDS services are Ethernet and token ring, with Fiber Distributed Data Interface, Channel Extension and "Special Services" (i.e., custom-engineered stuff) available as well. The Ethernet and token-ring services come in a reduced rate service at less-than-LAN speed, a dedicated service that guarantees that you always have 4, 10 or 16 Mb/s available and a switched service that provides a lower cost service through a switched fabric, much like SMDS or frame relay does.

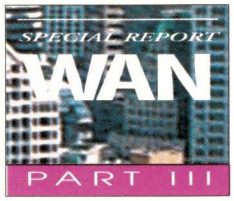
Unlike leased lines, frame relay or SMDS, the MDS services don't require special interconnection equipment like Channel Service Units (CSUs) or the like. The hand-off from the MDS network to the customer is a LAN connector–an Ethernet Attachment Unit Interface (AUI), for example– to which you can connect the same type of equipment used internally. This simplicity of service seems to have great appeal because you no longer have to be a telephony expert to design a MAN–you just treat the network like all of the segments are in one building and order MDS segments to link the buildings up like a LAN backbone.

There are some disadvantages, though. If you are not in a city served by MFS, you are out of luck. If you are in an MFS city, but not in a building which is linked via fiber, you may or may not be able to have service (MFS may elect to add your building to its network). And if you need service outside of your metropolitan area, MFS can help you design your network to most effectively use its service and provide very low-cost leased lines to the long-distance carrier of your choice, but it currently doesn't do customer WANs as a service.

There's Always Fedex

So concludes our romp through WAN land. If you need a low-speed network, there are a variety of options available. If you are looking for something small today that has a growth path to higher speed networking, then you'd probably be best off choosing SMDS or MDS if it is available in your area. If you know that you will need high-speed networking sometime in the next year or two, then you can plan on things being very different than they are today. SMDS, frame relay and MDS will probably still be with us, but there may be other better alternatives. Or you could just let Federal Express be your network. Never underestimate the bandwidth of a box of Exabytes!

Stan Hanks is president and principal scientist with Technology Transfer Associates, a Houston-based consulting group that specializes in advanced information technologies. He is interested in high-capacity distributed computing systems, particularly in high-speed networking. He is the current president of the Sun Users Group and is active in the UNIX community.



Token Ring: The Missing Link

by **ROBERT A. CIAMPA,** Brixton Systems Inc.

Token ring was initially developed for use in business-oriented computing environments, while Ethernet traditionally has been the net-working medium of choice for workstation users. Increasingly, however, token ring is emerging as a respectable choice in both the commercial and scientific/engineering realms.

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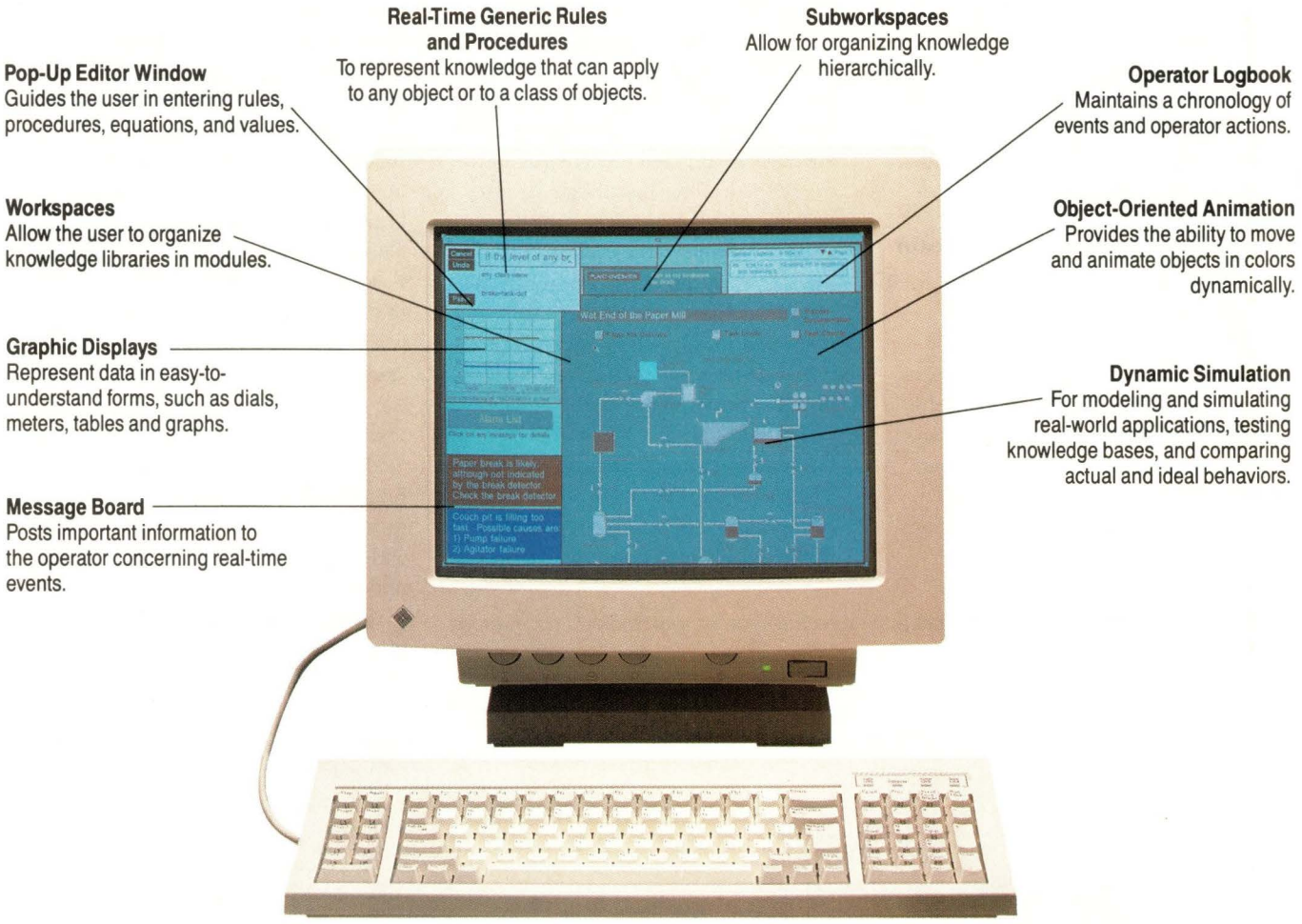

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Currently, token-ring, add-in board solutions available for SunOS are somewhat limited in number, but not in functionality. There are solutions for both SBus- and VME-based system. Installation is similar, regardless of the bus architecture. Upon purchasing token-ring solutions for SPARC-based workstations, users receive a network-interface controller card, a disk or tape containing device drivers and network support software and, of course, documentation.

Installation and Configuration

Implementation of the network itself may include a single multistation access unit (MAU) with connector cables (lobes) for the workstations, or intelligent networking hubs available from a variety of vendors. Users can now obtain MAUs, lobes and other token-ring network paraphernalia from the many data-communications supply houses.

The installation procedure is fairly consistent among the available products: Extract the software from the distribution media; install the device driver for the token-ring card into the operating-system kernel; configure the network-interface parameters such as addressing and source routing; and install the token-ring network-interface controller card. Extraction of the software and updates for the OS kernel are fairly automated tasks that tend to query the user for installation directories and whether or not to save the previous kernel in the event of problems. Installation of the token ring is much like that for any other card and is covered in the system documentation. Novice users should have no problem reaching this point.

Configuration is where the real fun–and oftentimes, anguish–begins. The major flash points of token-ring configuration are addressing, frame size and source routing support. Some implementations of SPARC-based token-ring solutions go so far as to include such parameters as sublayer frame size, route discovery times and retry counts. This article will focus on the major aspects only; more advanced users should consult the appropriate documentation for their system.

Putting the configuration issues in perspective first requires a discussion of token-ring protocol formats. A token-ring network has two basic formats for transmitted information, known as frames, shown in Figure 1. The first format, known as the Token Format, consists of three bytes of data that represent a free token. Included within this frame are two bytes for starting and ending frame delimitation, and one byte for access control, used to represent the free token.

The second format, known as the Frame Format, is used for the transmission of network management and end-user data. This frame also consists of delimiters and access control, as well as the following: frame control to identify the type of underlying information; destination address to identify the recipients; source address to identify the sender; routing information to optionally include source route paths; information to include the user data; frame check sequence to include a cyclic redundancy check (CRC); and frame status to designate the actions performed on the frame by the remote stations to which it was addressed.

Two types of frame information are identified by the frame control field. The first type is Media Access Control (MAC), which is used for network management and low-level token-ring operation–the IEEE 802.5 specification presents the functionality. The other type of information in Frame Format is Logical Link Control (LLC), which defines frame formats and protocols for the transmission of connectionless (Type 1) or connection-oriented (Type 2) services. TCP/IP protocols use Type 1 LLC, and SNA uses both Type 1 and Type 2. Information generated by these protocol suites is transmitted within LLC Protocol Data Unit (PDU) frames. LLC is defined in IEEE 802.2.

LLC frame information is of more

Figure 1. A token-ring network has two basic formats for transmitted information: token and frame.

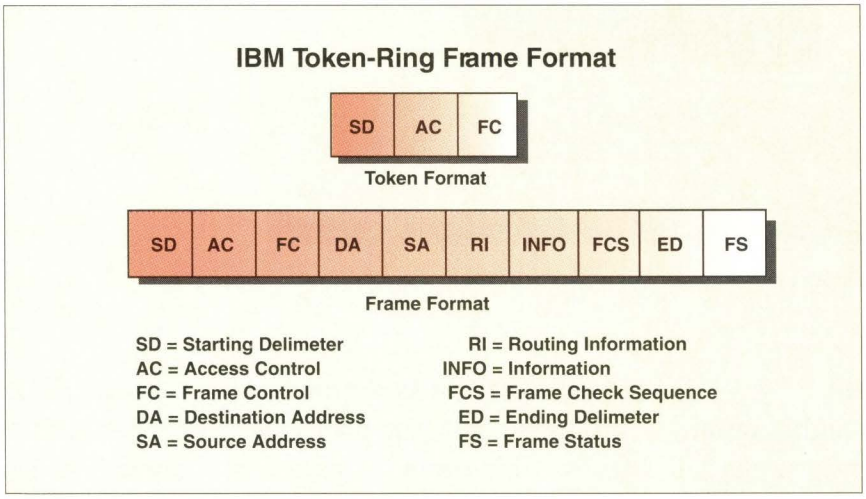
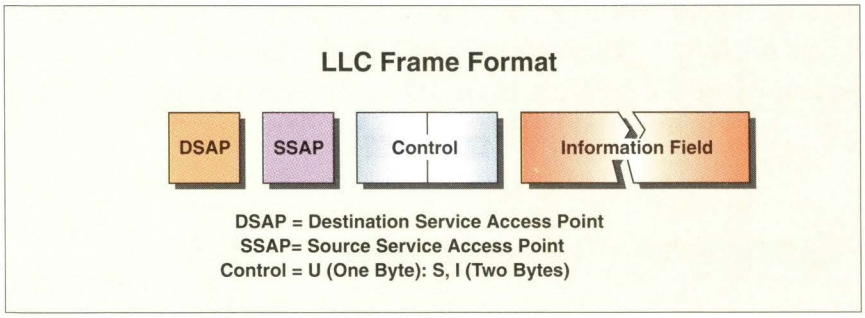


Figure 2. Communicating between two entities on a token-ring network will be from one MAC/LLC entity to another.



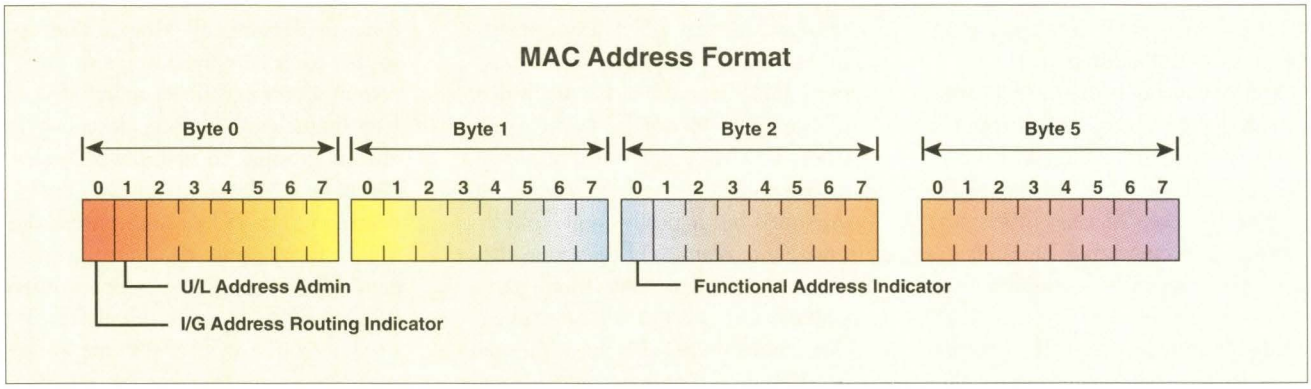


Figure 3. All notes on a network must use the same addressing scheme. Most implementations use the six-byte format shown above.

value to end users of token-ring connectivity products. LLC Frame Format is shown in Figure 2. LLC frames consist of a destination service access point (DSAP), a source service access point (SSAP), one or two bytes of control information, and zero or more bytes of data information. Service access points (SAPs) are used as logical ports from the LLC sublayer into the MAC sublayer. Communication between two entities on a token-ring network will be from one MAC/LLC entity to another.

MAC Addressing

The IEEE 802.5 standards provide two forms of address for token-ring networks, 16-bit (two-byte) and 48-bit (six-byte). All nodes on a network must use the same addressing scheme. Most implementations use the six-byte format shown in Figure 3. Three forms of addresses are used on a token-ring network.

The first is the ring station address, which is used to uniquely identify stations on the token ring. Ring station addresses are represented by a "0" in bit 0 of byte 0. A "1" in this bit position would indicate that the address is a group address. When the ring station address is a source address, this group address indicator bit is no longer relevant, since a frame can only be sent from an individual ring station. Instead, a value of "1" in this field means that there is optional source routing information in this frame. Source routing is described later.

Bit 1 of byte 0 is used to indicate whether the address is being managed by a network administrator–locally administered–or whether the addressing scheme is defaulting to those values that have been assigned by the IEEE and are guaranteed to be unique–globally administered. Choice of locally or globally administered addresses is a decision of the network manager, and it is recommended that only one of the two schemes be used. In general, globally administered addresses have the benefit of ensuring that all the MAC addresses are unique, while locally administered addresses are useful when various network management facilities are in use. All SBus- and VME-based token-ring cards for SPARC-based workstations provide default, unique, globally administered addresses; however, these cards also allow the ability to set locally administered addresses.

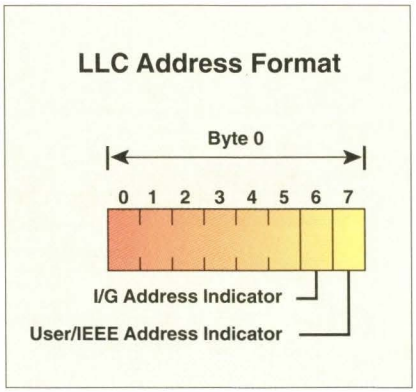
The second type of ring station address, group address, occurs only within the destination address field and is used to identify multiple stations on the token ring. Default group addresses, known as broadcast addresses, are X'C000FFFFFFFF' and X'FFFFFFFFFFFF,' along with those that the user may choose to define.

The final type of ring station address, functional address, is a special type of group address and is identified by bytes 0 and 1 being set to X'C000,' bit 0 of byte 2 being set to "0," and one or more of the remaining 31 bits in bytes 2 through 5 being set as necessary. Each of these 31 bits represents network management functions, in addition to other optional features that may be supported, such as token-ring bridges.

Logical Link Control and Source Routing

LLC addresses are represented by SAPs and are one byte in length. The format is shown in Figure 4. Each LLC PDU consists of two SAPs, one destination and one source. The first six most significant bits of the address, bits 0 through 5, consist of the actual address. The next bit, bit 6, identifies whether the SAP address is user-defined–set to "0"–or defined by the IEEE–set to "1." Bit 7 identifies whether the SAP is an individual SAP (set to "0") or a group SAP (set to "1"). Like group MAC addresses, group SAP addresses must occur in the DSAP field. Bit 7 in the SSAP field distinguishes an LLC command from an LLC response; this is controlled internally so the user must specify a value of "0" for this bit when specifying a local SAP address. TCP/IP protocols adhering to RFC 1042 use SAP

Figure 4. LLC addresses are represented by one-byte service access points (SAPs).



address X'AA', while SNA generally defaults to SAP address X'04'.

Source routing is the mechanism by which devices on one token-ring network communicate with those on another. Token-ring network setup and bridges are discussed in the next section. Source routing allows devices to control the path by which frames will be transmitted over token-ring bridges to remote rings. Devices that operate over a single token-ring network need not use source routing. Source routing information contains parameters that specify whether the frame is to be broadcast to all networks or to take a specific route over various networks and bridges to the destination device. The source route field will contain a list of the bridges and networks that were used on their way to the destination.

The Big Setup

Contributing greatly to the acceptance of token ring has been the extensive documentation regarding network planning. Even prior to the formal introduction of token ring, IBM introduced a wiring scheme that was incorporated by many organizations into the layout of both their existing buildings and those that were being planned. The wiring scheme managed the layout of networks, wiring closet setup and attachment units.

For those users who do not need extensive setups, the use of MAU is often sufficient to set up a token-ring network. MAUs, which are actually token-ring networks in a small, rack-mountable box, allow the attachment of of eight or 16 devices to the network. The MAUs may also be connected with one another, forming an expanded but logically single token ring. More than 250 devices may be attached to a single ring. Intelligent network hubs also provide for token-ring connectivity, with the additional functionality of network management. Finally, single rings may be geographically expanded through the use of repeaters, some of which use fiber-optic technology.

As mentioned previously, token rings may be further partitioned into connected, but logically separate networks by the use of token-ring bridges. A bridge is a specially configured device (which may be a PC) that is connected to two token rings. Bridges look for specially designated frames that it will copy and transfer from one ring to another. Newer bridges, known as transparent bridges, efficiently forward all relevant, non-source rated frames. Additionally, special devices, known as remote bridges, connect to one another over telecommunications lines, allowing interconnection of token-ring networks nearly anywhere in the world. Through the use of bridges, a user on one network can access the services of those devices on another, transparently.

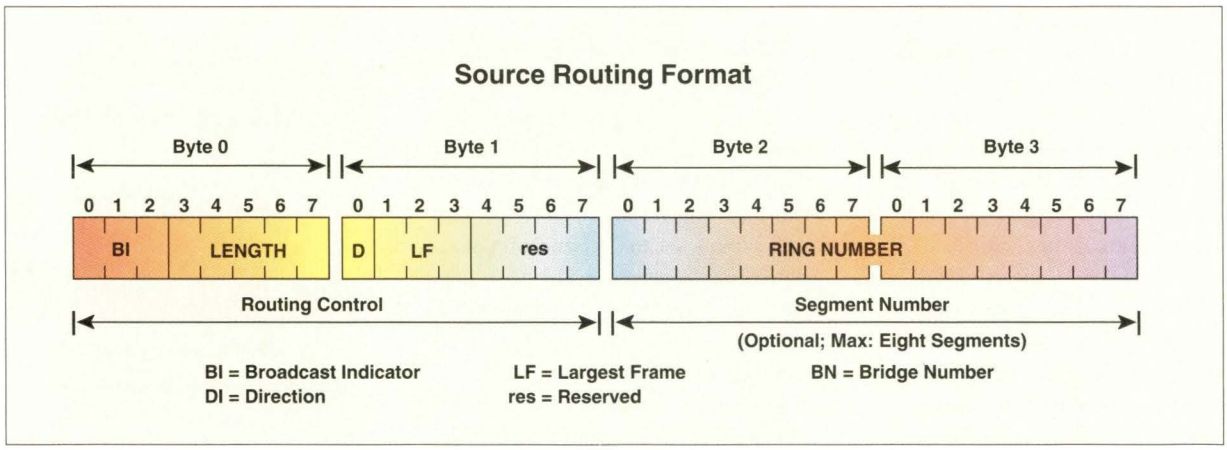
The indication for a bridge to forward a frame is determined by the values that are set in the frame's source route field. Generally, rings are set up so that users who need frequent inter-system access may do so quite efficiently; such sets of users are known as affinity groups. An example of this would be a MIS group and an engineering group. When users within the same affinity group communicate, generally no bridging or source routing is involved. Conversely, when there is a need, a request will traverse the bridge using source routing–the format is shown in Figure 5. During high volumes of data transfer, token-ring bridges may be unable to forward frames due to processor speed and buffer capacity. Although the network itself automatically recovers from this scenario, it is recommended that devices with a need to extensively communicate be co-located on the same network.

Very often, multiple rings are connected to a backbone ring. This backbone ring is usually a higher speed network of 16 Mb/s. Bridges compensate for any disparity in data rate between the rings that they attach, allowing 4 Mb/s on one side and 16 Mb/s on the other. All devices on the same physical ring, however, must operate at the same data rate.

Internetworking with Token Ring

SPARC-based workstations connected over a token-ring LAN operate almost identically to those over Ethernet networks. Aside from differences in speed between the 4- and 16-

Figure 5. The indication for a bridge to forward a frame is determined by the values that are set in a frame's source-route field.



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Mb/s token rings and 10-Mb/s Ethernet, coupled with the existence of a token-ring network-interface card in one of the I/O bus slots, the operation is seamless. File systems can be mounted over token rings with the Network File System (NFS), and processes can be invoked across the network with remote procedure calls (RPC).

Entries found in `/etc/hosts` and `/etc/networks` need no modification. For some implementations, configuration of the hardware address, i.e., the 12-digit/six-byte MAC address, can be done with the the interface configuration command `ifconfig`. Other implementations, such as those based on System V STREAMS–a kernel-based message handling system– make use of network configuration files. Either of these approaches can be implemented in system startup files such as `/etc/rc` so that the end users need not be concerned with the details of network configuration. Source routing may be configured in a number of ways also: Some implementations define it at kernel compilation time; others explicitly define it in the network definition configuration file.

Hardware address determination of remote machines is done with the Address Resolution Protocol (ARP). When a machine knows the Internet address of another host (defined in `/etc/rc`), but not the MAC address, it will broadcast an ARP request to the network. Proper implementations will broadcast to the local ring first, and if no response is received, to all rings by use of source routing; this reduces overall network traffic.

Interconnection of Ethernet networks and token-ring networks is merely a matter of defining two network interfaces and invoking a background daemon process such as `routed` to handle internetwork routing. Like network-interface definition, routing can also be configured in the system start-up files. For low-layer network interconnections at the MAC level between Ethernet and token ring, no SPARC-based workstation solutions exist. Instead, users should look to intelligent hubs.

SNA Connectivity with Token Ring

There are a couple of SNA protocol implementations that currently run over SBus-based token-ring network-interface cards available from Brixton Systems Inc. and SunConnect. Such SNA implementations provide terminal emulation, remote job entry, file transfer and transaction processing. Some of these require the use of a shared-IP token-ring driver, while others operate standalone. When operating with IP, SNA protocols must share the same MAC address, a functional restriction related to the architecture of the cards. Both IP and SNA distinguish their access to token-ring services through different LLC SAPs. Note that some implementations do not allow the use of SNA and IP simultaneously over token ring, so check with the appropriate vendors for more information.

Since SNA operations differ from IP in that they are connection-oriented over the token ring, MAC addresses of partner nodes are usually required; there is no equivalent of ARP in SNA. This address information is usually part of a product's configuration information.

Token-Ring Transitions

For the administrator and end users of SPARC-based workstations, the transition to token ring should be fairly easy. This "new" network has not changed any of the UNIX and internetworking models that now exist. The support for token ring may, in fact, make the introduction of UNIX workstations into traditional corporate environments much easier, given that the network itself is already in place.

Robert A. Ciampa, M.S., a member of the IEEE 802.2 and 802.5 balloting groups, is the director of local-area networking for Brixton Systems Inc., a Cambridge, MA-based UNIX workstation communications and networking company specializing in SNA, TCP/IP, X.25, frame relay and network management. He can be reached at `rob@brixton.com`.


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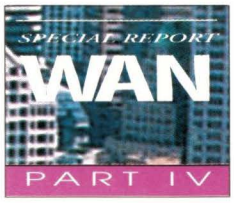


'This is VAX Control to NFS'

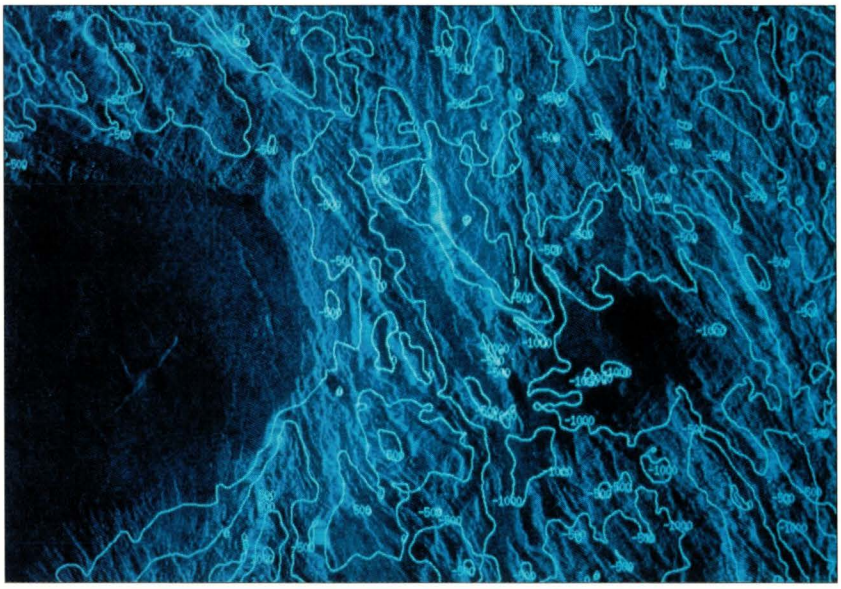
by GREGG PHILLIPS, Vexcel Corp.

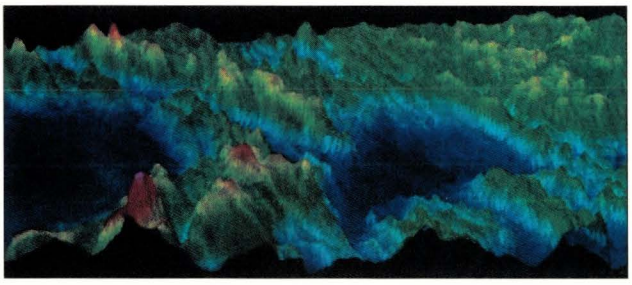
Every application is ideally suited to one specific operating platform. However, regardless of whether you are in client/server or file-transfer mode, these platforms have to be able to share data.

Vexcel Corp., an engineering company specializing in developing topological imaging software and creating computer-generated topological maps, found itself face-to-face with this networking truism. Vexcel's contract with Jet Propul-sion Laboratories (JPL) of Pasadena, CA, calls for the company to set up a network system capable of reading data taken from the Magellan satellite's radar system and other sources, and then create accurate topographic maps of the planet Venus using Vexcel's computerized

One company solves the DECnet-to-TCP/IP connectivity dilemma.

stereo imaging system. That means creating a system capable of exchanging data among the network's Sun Microsystems Inc. SPARC, Digital Equipment Corp. VAX and Stardent Titan machines, in addition to supporting access to various vendors' CD-ROM and tape drives. Vexcel also needs to integrate its IBM Corp. PCs and Apple Computer Inc. Macintosh computers, which are used primarily for administrative purposes and are interconnected on their own Sitka Corp. TOPS network.





Vexcel Corp. has developed a network system that creates these kinds of topographical maps of Venus.

What makes this task especially challenging is that the source data used to generate the 3D topographical images is provided in both VMS- and UNIX-compatible forms, and much of the image preprocessing has to be performed on the VAX prior to processing using X Window System-based software. Vexcel needed a method to seamlessly consolidate data for centralized processing. The company opted to set up a system around TCP/IP and build in support for Sun's Network File System (NFS) to mount remote drives.

Mixing Media

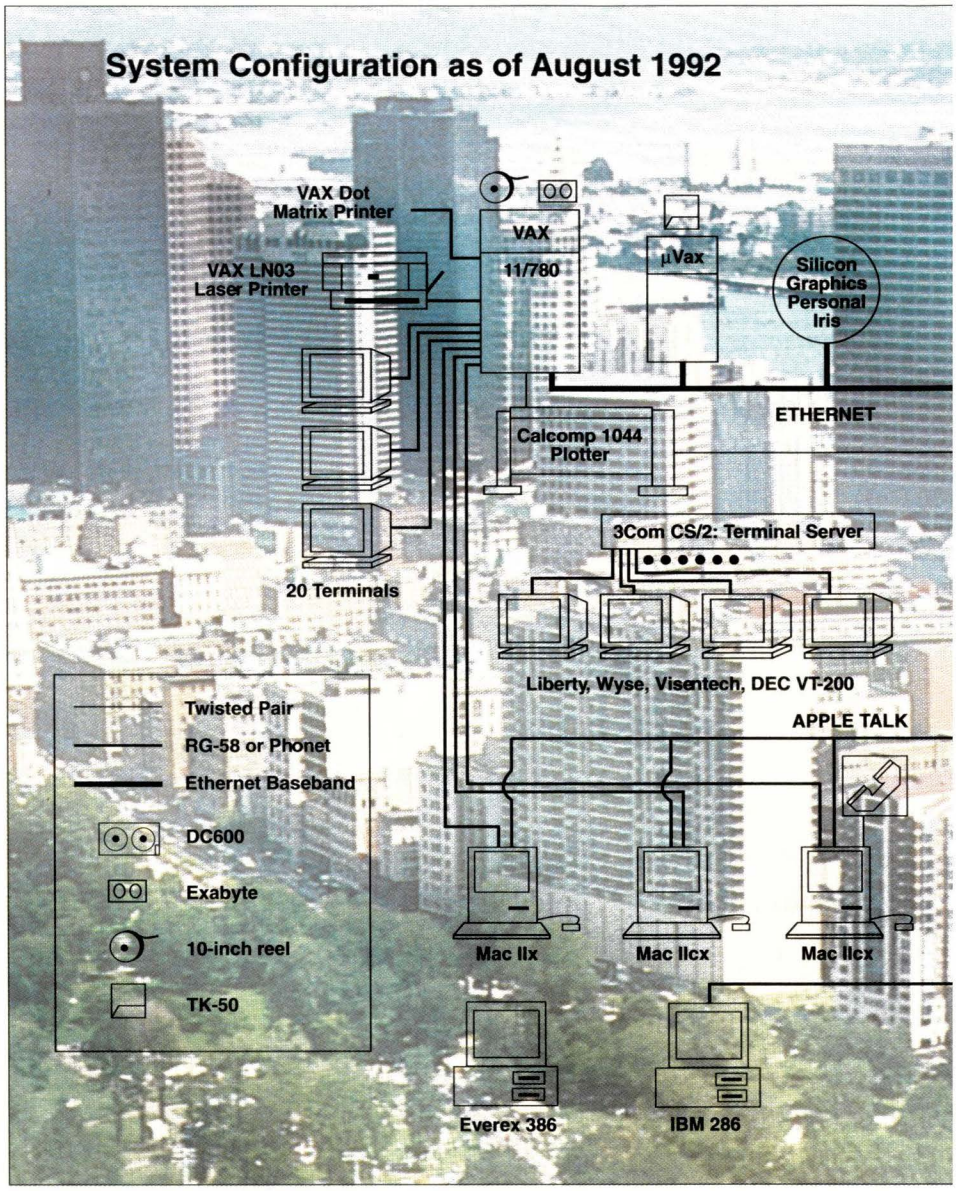
To create topological maps of Venus, Vexcel relies on data that arrives in two primary formats. Older data that was gathered during the Magellan satellite's first orbits of Venus is stored on CD-ROM disks, along with additional data from the Russian Venera satellite missions and Earth-based observatories. All of this data is stored in a UNIX-compatible format. The more up-to-date information, which is generally no more than a week old, is received from JPL on 9-track tape stored in VMS backup formats. Both the VMS data and the UNIX data have to be integrated before the information is forwarded for processing by LT and VX-Edit, Vexcel's topographic imaging software.

Vexcel needed to find an effective way to transfer the data from these different formats so it could be read by the computers that are doing most of the graphics processing work, namely its Sun and Stardent systems. The company purchased a CD-ROM drive for its Sun-4/370 to read data coming in on CD-ROM disks. The Sun-4 allows Vexcel to publish the CD-ROM as a read-only disk using NFS. The fact it also has 2.3 GB of disk storage is a big help.

The 9-track VMS backup tapes are read onto a VAX 11/780 from a TU81 tape drive for preprocessing. The VAX, albeit old, does a good job of reading the 9-track VMS backup tapes and, with its 3 GB of storage, it is able to hold the largest of the images.

Making the VAX Connection

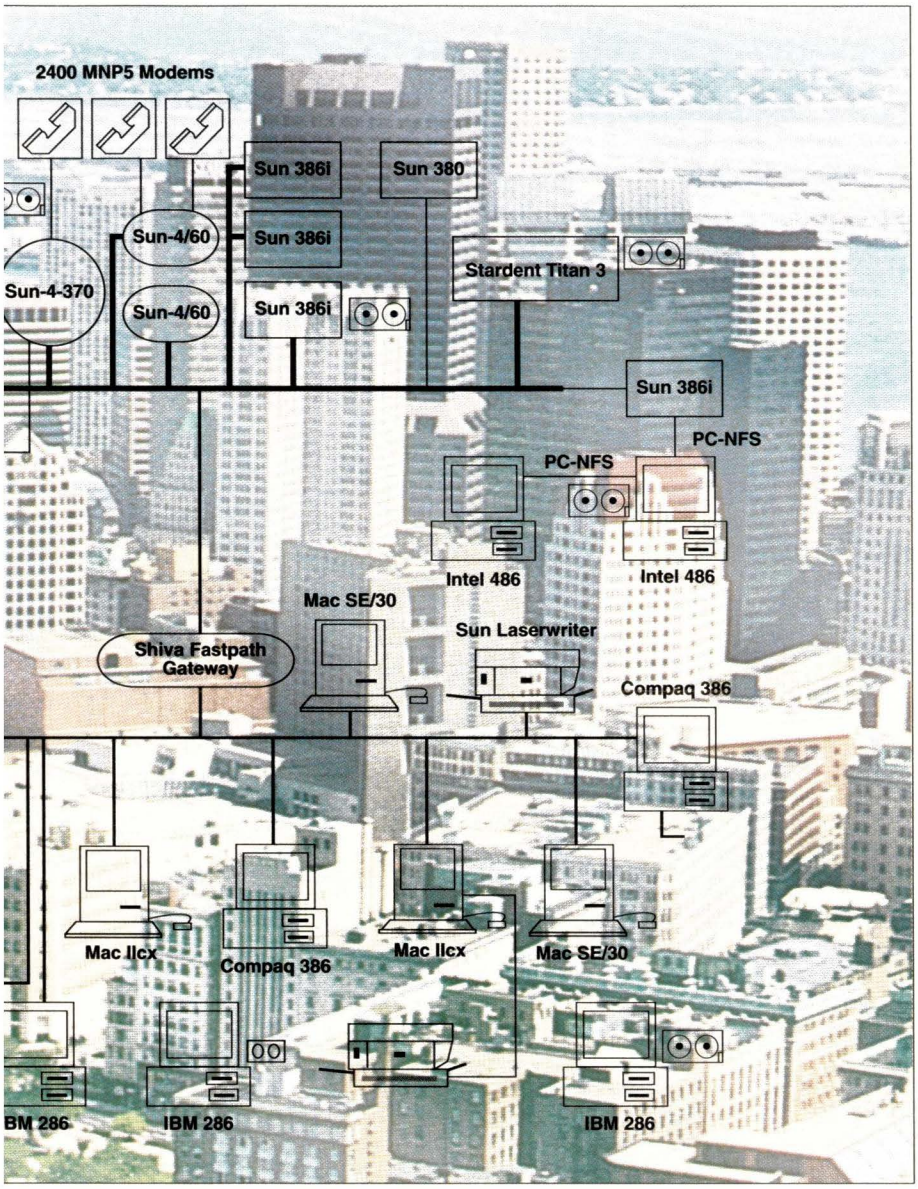
The next major challenge is to access the data once it was stored. The CD-ROM drives show up as just another disk. But what about the data on the VAX?



Vexcel decided to link the VAX to the rest of the system using TCP/IP and NFS. Although there are different TCP/IP-for-VMS solutions available on the market, the company had heard good things about MultiNet, the TCP/IP solution for VMS offered by TGV Inc., of Santa Cruz, CA. MultiNet provides the TCP/IP connectivity Vexcel was looking for. In addition, TGV offers MultiNet NFS Client for VMS, so Vexcel can publish VMS volumes to UNIX networks, making those VMS volumes look just like another remotely mounted UNIX file system.

In fact, MultiNet solves another problem as well. The preprocessing of the VMS data has to be done on Vexcel's VAX 11/780 using a program written some time ago in FORTRAN. (The company is currently porting this program to Vexcel's Sun workstations.) This preprocessing helps make the data a more uniform record size that is compatible with LT and VX-Edit. Using MultiNet, the VMS data can be preprocessed to accommodate Vexcel's imaging software, then it can be offloaded to the Sun workstations using File Transfer Protocol (FTP), or using MultiNet NFS Client to actually publish the VAX disks on the Sun systems.

Once the data has been loaded and



any VMS preprocessing is complete, the digital imaging data is transferred to the Stardent Titan 3000 computer. Some of these file systems are mounted using NFS, so they look like just another disk drive, but usually, to save time, the data is transferred directly using FTP for local storage and processing. Once the data is accessed by the Stardent, it is placed into Vexcel's LT, a digital light table program that provides visualization and coordinated data collection to generate large-format stereo and monoscopic topographic images. It runs under the X Window System on the Stardent and supports both color and gray-scale images.

Unfortunately, even with this sophisticated imaging technology, no map is perfect the first time. The company edits these images using VX-Edit, an editing program Vexcel developed to create and revise terrain maps. The VX-Edit data is then run through Radian Corp.'s CPS-3, a software package that creates digital elevation models from X, Y and Z axis points. CPS-3 takes the data and makes it uniform, noting changes at set distances, like every four feet, to register changes in height to create the necessary contour. This editing is done on the Sun-4/370, which is a common platform for CPS-3, VX-Edit and the monoscopic version of LT.

The final output at Vexcel is sent to a Calcomp 1044 plotter, which plots the contours of the topographical images. The rest of the imaging information is sent back to JPL in digital format, either on a magnetic tape using an Exabyte tape drive or via the Internet, for final color processing and output. MultiNet's rshell support is useful at this point, since it makes it possible to run a remote command from the VAX to automate image offloading from the Exabyte 9-track tape drive.

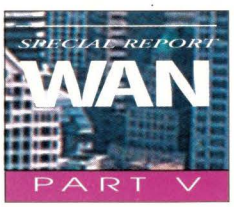
MultiNet plays a role in supporting our print services as well. Using the `lpd` print services supported in MultiNet, Vexcel can send data from the Sun workstations to the dot-matrix printer connected to the VAX 11/780.

Back Up and Round Up

Of course, when you are dealing with images that are this large and consume this much memory, some kind of comprehensive backup plan is necessary. Vexcel decided to use MultiNet for this as well. MultiNet provides access to a tape drive on the VMS system using the Remote Magnetic Tape protocol (RMT) for backup purposes via an `rdump` command on the Sun. Using RMT, Vexcel can back up images, digital elevation models (DEMs), contour data and everything else onto an Exabyte drive on the VAX system. The files on the Stardent are backed up on a QIC-150 tape drive on the Stardent, which is fully compatible with the QIC-150 tape drive on the Sun-4/370.

In Vexcel's case, Sun's NFS has proven itself to be an ideal solution to intermix computer media. The company can use its installed VAX system for storage and to read VMS data and still do all of its processing on Sun and Stardent hardware running UNIX and X Window System software. NFS, with a little help from MultiNet's NFS Client to provide VMS support, provides seamless access throughout the entire system.

Gregg Phillips is the systems manager of Boulder, CO-based Vexcel Corp., which is currently working on a contract to create a topological map of Venus for Jet Propulsion Laboratories.

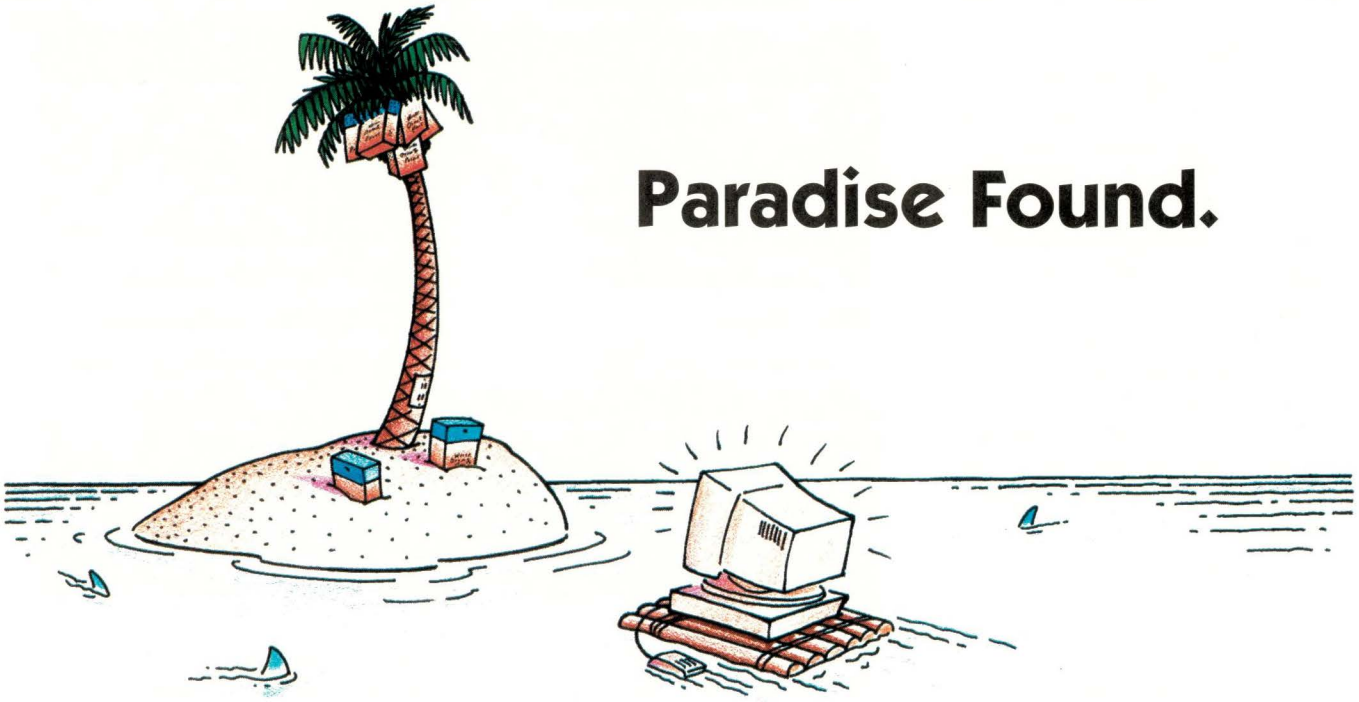


Rooting Out the Best Routers

by SCOTT BRADNER, Harvard Network Device Test Lab

The buyers guide on the following pages is a listing of Ethernet routers and brouters. It includes everything from dial-up routers to plug-in routers on PC-AT cards. It lists hardware-interface specs, protocols and routing algorithms supported and prices for more than 50 vendors' products. But there's more than specsmanship to consider when choosing routers. Here are a few other criteria you might want to evaluate:

There are more than just specs to consider when evaluating routers.



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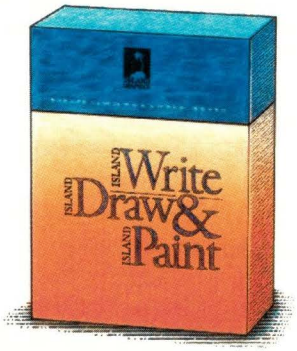

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Circle No. 27 on Inquiry Card

- *Basic configuration needs:* Does the router offer support for the transport and routing protocols and the interface types that are needed in the network? If there are already a large number of products from one vendor in the current environment, it may be hard to switch to another vendor.
- *Performance:* In most cases small packet forwarding performance is an overrated criteria. A well-designed Ethernet based network will rarely, if ever, exceed a rate of 5,000 packets per second (pps). (The theoretical limit for 64-byte packets on Ethernet is 14,880 pps.) On the other hand, the same network could often get close to the theoretical 812 pps for 1,580-byte packets. A good router should be able to handle close to N times the full theoretical frame rate for maximum sized network packets and N times 5,000 minimum-sized network packets per second, where N is the number of ports in use on the router. Performance numbers should come from an independent test lab and not just from the vendor's own tests.
- *Security:* Does the router support the type of access lists or filters that will be needed to provide the required level of security?
- *Rebooting requirements:* If the router must be rebooted after changing configuration, is the service interruption long enough to cause user sessions to be lost? (If so, it decreases the incentive for the network manager to implement changes.)
- *Reliability:* Is the router's mean time between failure (MTBF) and mean time to repair (MTTR) compatible with the required network reliability?
- *Vendor support:* Does the vendor's (or OEM's) support organization have a good reputation? Get some references. Does the vendor accept bug reports and questions over the Internet?
- *Management:* Does the router implement the full relevant Simple Network Management Protocol (SNMP) management information bases (MIBs)?
- *Documentation:* Can you find things in the documentation? And if you can, are they understandable?
- *User interface:* Once you find the information in the documentation, can you figure out the user interface to make the required changes?
- *Standard tracking/participation:* What is the vendor's history in implementing new standards? You should ask for a full checklist of compliance with RFCs concerning host requirements. Also request the same for router requirements, after they have been adopted by the Internet Architecture Board. RFCs can be obtained via anonymous ftp from `NIC.DDN.MIL` Use `get` to request rfcN.Ext. N is the RFC number. rfc-index.txt contains a list by topic.
- *Generational migration:* Will the vendor give any guarantees on the maximum cost of upgrading to new versions?

Router Checklist:

- ☑ Fast enough?
- ☑ Documentation OK?
- ☑ Interfaces needed?
- ☑ User interface OK?
- ☑ Transport protocols needed?
- ☑ Routing protocols needed?
- ☑ SNMP support?
- ☑ Out-of-band control port?
- ☑ Host req. checklist?
- ☑ Router req. checklist?
- ☑ Fast restart?
- ☑ Vendor service OK?
- ☑ Internet access to vendor?
- ☑ Standards participation?
- ☑ Vendor tracks standards?
- ☑ Upgrade guarantee?
- ☑ Security filters OK?
- ☑ MTBF OK?

Scott Bradner is a consultant at Harvard University. He was a founder of NEARnet and is the manager of the Harvard Network Device Test Lab. He also gives tutorials on data networks for Interop from time to time.

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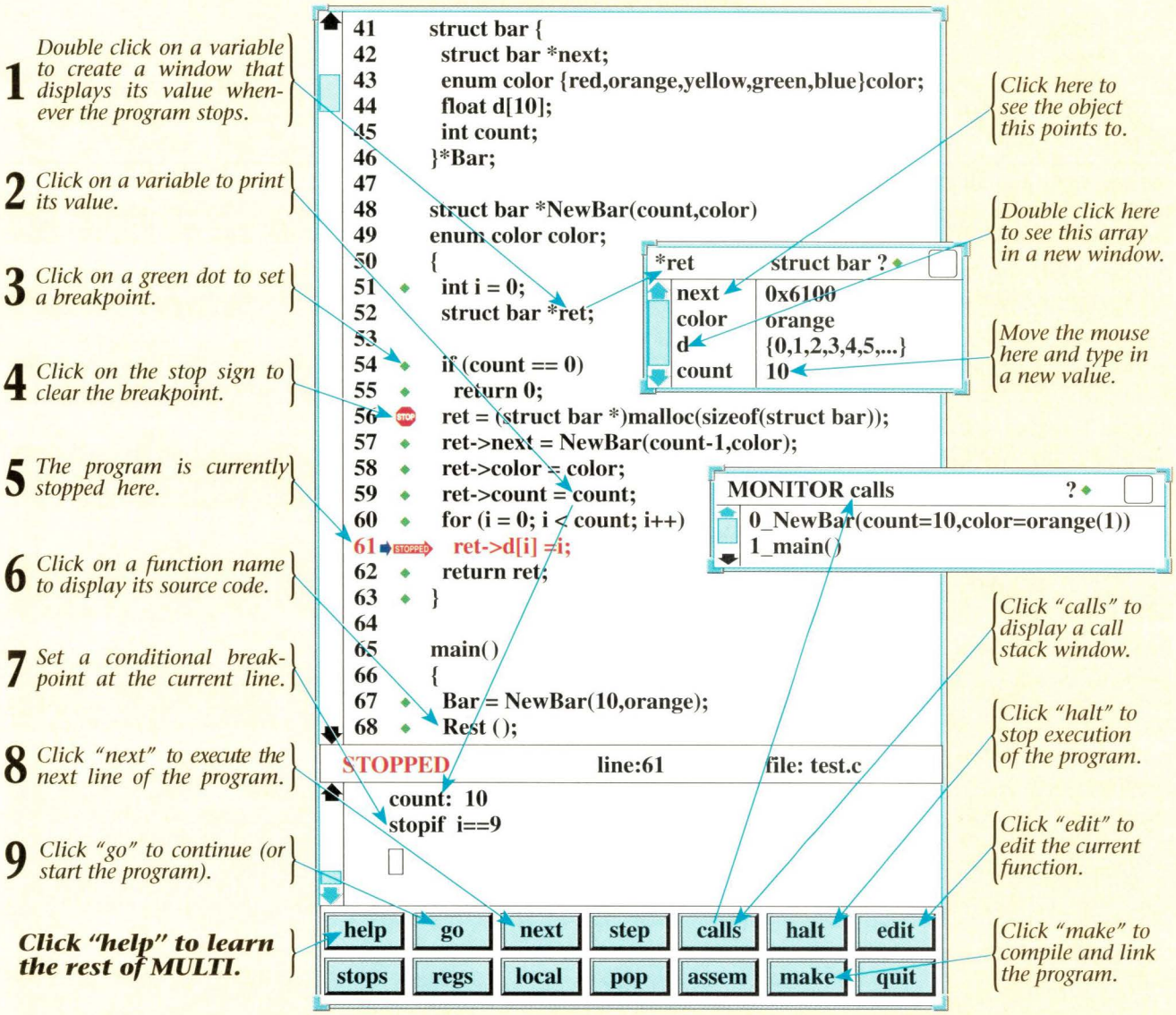

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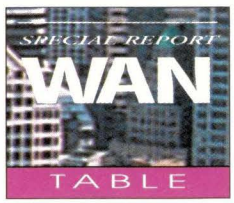
A Sampling of

Ethernet Routers and Brouters

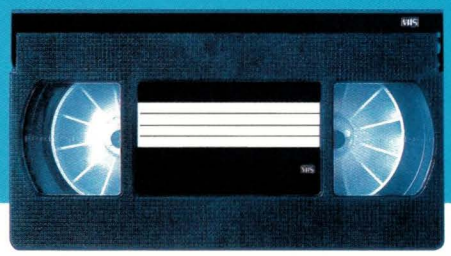


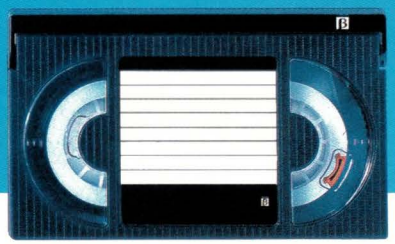
compiled by MAUREEN MCKEON

Company/Manufacturer Model	Hardware Interface and Number of each	Telenet (yes/no)	X.25 Hookup	Routable Protocols	Routing Algorithms	Protocol Conversions	Network Management Agent	Throughput (pps)	Packet Size (Bytes)	Benchmark Used	Rack Mountable	Software Downloadable from Host on LAN	Auto Firmware Updates	Price ($)
Advanced Computer Communications, 315 Bollay Drive, Santa Barbara, CA 93117. **Circle 200**														
4500	Ethernet, token ring, FDDI, 20 WAN	—	raw	IP, XNS, DECnet, IPX, AppleTalk	RIP, OSPF, RTMP	—	yes	50,000	64	—	yes	yes	yes	—
Alantec, 2380 Bering Drive, San Jose, CA 95131. **Circle 201**														
PowerHub	12 Ethernet, 2 FDDI	yes	no	IP	RIP	no	SNMP	62,000	64	Harvard	yes	no	yes	17,800
Apple Computer Inc., 10500 N. DeAnza Blvd., Cupertino, CA 95014. **Circle 202**														
AppleTalk Internet Router V.2.0	8 Ethernet, LocalTalk, token ring	no	no	AppleTalk	RTMP	no	no	—	578	—	no	no	no	399
Ascom Timeplex, 400 Chestnut Ridge Road, Woodcliff Lake, NJ 07675. **Circle 203**														
TIME/LAN 100 Router*Bridge	up to 12 LAN and/or WAN ports	yes	yes	IPX, IP, XNS, DECnet, AppleTalk	RIP, OSPF, IPX, PPP remote RIP/SAP, EGP, DECnet, RTMP	—	SNMP, SMT	27,000	64	internal	yes	yes	yes	7,995
Avatar Corp., 65 South St., Hopkinton, MA 01748. **Circle 204**														
Netway 2000	2 Ethernet,4 LocalTalk, 2 token ring, 4 SDLC	no	no	AppleTalk, IPX	RTMP, RIP	AppleTalk-TCP/IP, SNA-AppleTalk, SNA-IPX	proprietary, NetView	2,000	4	proprietary	yes	yes	yes	2,495-13,995
Basic Networks Corp., 175 Cabot St., Lowell, MA 01854. **Circle 205**														
*Ethernet/T1 Basic Router Card	—	—	—	TCP/IP, IPX/SPX, WAN protocols, X.25, PPP, frame relay	—	TCP/IP, Novell IPX, STB	SNMP	14,000	—	—	—	—	—	3,995
BBN Communications Inc., 150 Cambridge Park Drive, Cambridge, MA 02140. **Circle 206**														
T/10 IAD Model 1	—	yes	PAD, native, gateway	X.25, TCP/IP	TCP/IP, UDP, ICMP, PPP, SPF, ARP, EGP, BGP, SPF, IPX	SDLC-X.25, X.25-IP, IP-X.25	SNMP, X.29, local console	2,000	128	—	yes	yes	—	—
T/10 IAD Model 2	—	yes	PAD, native, gateway	X.25, TCP/IP	TCP/IP, UDP, ICMP, PPP, SPF, ARP, EGP, BGP, SPF	SDLC-X.25, X.25-IP, IP-X.25	SNMP, X.29, local console	2,000	128	—	yes	yes	—	—
Cabletron Systems Inc., 35 Industrial Way, Rochester, NH 03867. **Circle 207**														
CRM-L	2 Ethernet	yes	PAD	Ethernet, DECnet, TCP/IP, IXP, DEC LAT, AppleTalk, IEEE 802.3, X.25, SLIP, PPP, OSPF, XNS, frame relay IS-IS	RIP, IDRP/BGP, IGRP	—	SNMP	14,000	64	—	yes	yes	yes	5,945
CRM-R	1 Ethernet, 1 WAN	yes	PAD	Ethernet, DECnet, TCP/IP, IXP, DEC LAT, AppleTalk, IEEE 802.3, X.25, SLIP, PPP, OSPF, XNS, frame relay IS-IS	RIP, IDRP/BGP, IGRP	—	SNMP	14,000	64	—	yes	yes	yes	6,445

*Router on a PC card.

What can Sun users learn from the battle between VHS and Betamax?





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Circle No. 29 on Inquiry Card

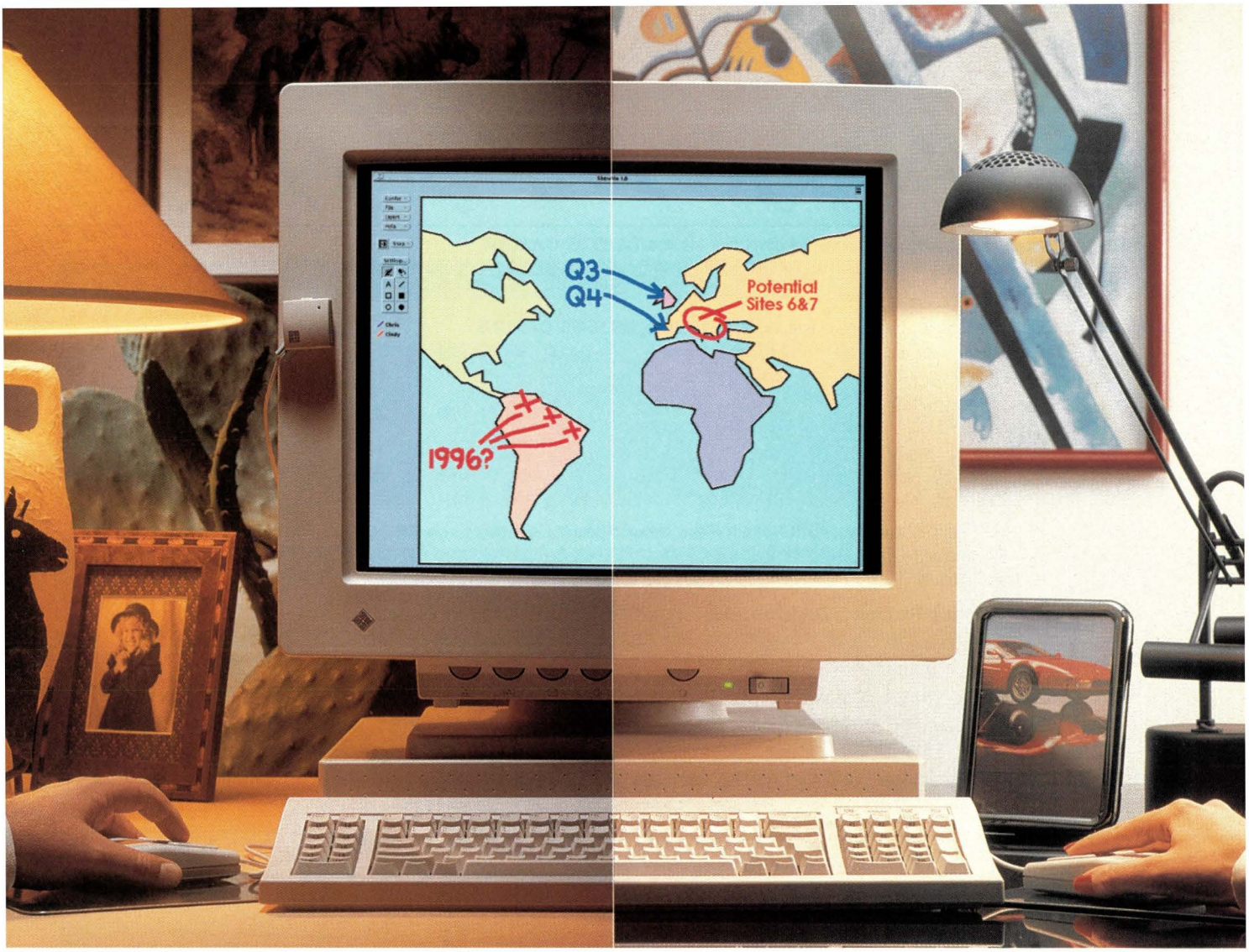
Company/Manufacturer Model	Hardware Interface and Number of each	Telnet (yes/no)	X.25 Hookup	Routable Protocols	Routing Algorithms	Protocol Conversions	Network Management Agent	Throughput (pps)	Packet Size (Bytes)	Benchmark Used	Rack Mountable	Software Downloadable from Host on LAN	Auto Firmware Updates	Price ($)
Cayman Systems Inc., 26 Landsdowne St., Cambridge, MA 02139. **Circle 208**														
GatorBox CS	1 Ethernet, 1 LocalTalk	yes	no	IP, AppleTalk DECnet	RIP, RTMP, KIP	AppleTalk-TCP/IP, AppleTalk-DECnet	SNMP	—	—	—	yes	yes	yes	2,795
GatorStar GX-R	1 Ethernet, 24 LocalTalk	yes	no	IP, AppleTalk, DECnet	RIP, RTMP, KIP	AppleTalk-TCP/IP, AppleTalk-DECnet	SNMP	—	—	—	yes	yes	yes	3,895
Chesapeake Systems Inc., 905 Huntsman Road, Baltimore, MD 21204. **Circle 209**														
Gateway+	1 Ethernet, 2 LocalTalk	yes	—	AppleShare, AppleTalk, DEC Pathworks, DECnet, NetWare, etc.	RIP, etc.	TCP/IP, DECnet	SNMP, DECnet, AppleTalk, IP tunneling, etc.	—	—	—	no	yes	yes	2,195
Chipcom Corp., 118 Turnpike Road, Southboro, MA 01772. **Circle 210**														
5102R-EE	2 Ethernet	yes	—	IP, XNS, DECnet, IPX, XNS, Apollo, 3Com, PUP, CHAOSnet, TCP/IP, VINES, AppleTalk, UB	RIP, IGRP, RTMP, BGP, EGP, OSI ES-IS, OSPF, PPP	—	SNMP, NetView, NetCentral	6,000	64	—	yes	yes	yes	6,350
5102R-ES	1 Ethernet, 1 WAN	yes	—	IP, XNS, DECnet, IPX, XNS, Apollo, 3Com, PUP, CHAOSnet, TCP/IP, VINES, AppleTalk, UB	RIP, IGRP, RTMP, BGP, EGP, OSI ES-IS, OSPF, PPP	—	SNMP, NetView, NetCentral	6,000	64	—	yes	yes	yes	6,850
5102R-ESX	1 Ethernet, 1 WAN	yes	yes	IP, XNS, DECnet, IPX, XNS, Apollo, 3Com, PUP, CHAOSnet, TCP/IP, VINES, AppleTalk, UB	RIP, IGRP, RTMP, BGP, EGP, OSI ES-IS, OSPF, PPP	—	SNMP, NetView, NetCentral	6,000	64	—	yes	yes	yes	7,150
Cisco Systems Inc., 1525 O'Brien Drive, Menlo Park, CA 94025. **Circle 211**														
Cisco 3000	2 Ethernet, 1 Ethernet & 1 serial, 1 token ring & 1 serial	yes	—	TCP/IP, OSI CLNS, OSI CMNS, DECnet, IPX, AppleTalk, VINES, XNS, UB, Domain, PUP, CHAOSnet, HP Advancement	IGRP, RIP, OSPF, BGP, EGP, ES-IS, IS-IS	Telnet-TCP/IP, DECnet Phase IV-DECnet V	SNMP, Telnet remote access, MOP, etc.	7,000	64	—	yes	yes	yes	4,000-7,000
CGS	2 Ethernet, 2 serial, 2 token ring	yes	—	TCP/IP, OSI CLNS, OSI CMNS, DECnet, IPX, AppleTalk, VINES, XNS, UB, Domain, PUP, CHAOSnet, HP Advancement	IGRP, RIP, OSPF, BGP, EGP, ES-IS, IS-IS	Telnet-TCP/IP, DECnet Phase IV-DECnet V	SNMP, Telnet remote access, MOP, etc.	20,000	64	—	yes	yes	yes	7,000-12,000
MGS	6 Ethernet, 6 token ring, 10 serial	yes	—	TCP/IP, OSI CLNS, OSI CMNS, DECnet, IPX, AppleTalk, VINES, XNS, UB, Domain, PUP, CHAOSnet, HP Advancement	IGRP, RIP, OSPF, BGP, EGP, ES-IS, IS-IS	Telnet-TCP/IP, DECnet Phase IV-DECnet V	SNMP, Telnet remote access, MOP, etc.	65,000	64	—	yes	yes	yes	10,000-18,000
AGS+	28 Ethernet, 14 token ring, 28 serial, 4 FDDI or HSS	yes	—	TCP/IP, OSI CLNS, OSI CMNS, DECnet, IPX, AppleTalk, VINES, XNS, UB, Domain, PUP, CHAOSnet, HP Advancement	IGRP, RIP, OSPF, BGP, EGP, ES-IS, IS-IS	Telnet-TCP/IP, DECnet Phase IV-DECnet V	SNMP, Telnet remote access, MOP, etc.	65,000	64	—	yes	yes	yes	12,300-60,000
Clearpoint Research Corp., 35 Parkwood Drive, Hopkinton, MA 01748. **Circle 212**														
Auriga	4 Ethernet, 1 WAN	yes	raw, frame relay	IP, IPX, XNS	RIP, EGP, HELLO	—	SNMP, Telnet	59,000	64	—	—	no	—	3,995+

Company/Manufacturer Model	Hardware Interface and Number of each	Telenet (yes/no)	X.25 Hookup	Routable Protocols	Routing Algorithms	Protocol Conversions	Network Management Agent	Throughput (pps)	Packet Size (Bytes)	Benchmark Used	Rack Mountable	Software Downloadable from Host on LAN	Auto Firmware Updates	Price ($)
Clearpoint Research Corp. (continued)														
Carina	4 Ethernet, 1 WAN	yes	raw, frame relay	IP, IPX, XNS	RIP, EGP, HELLO	—	SNMP, Telnet	59,000	64	—	—	no	—	4,995
Pyxis	4 Ethernet, 1 WAN	yes	raw, frame relay	IP, IPX, XNS	RIP, EGP, HELLO	—	SNMP, Telnet	59,000	64	—	yes	no	—	5,995
Little Dipper	8 Ethernet, 2 WAN	yes	raw, frame relay	IP, IPX, XNS	RIP, EGP, HELLO	—	SNMP, Telnet	90,000	64	—	yes	no	—	7,500-18,000
Compatible Systems Corp., P.O. Box 17220, Boulder, CO 80308. **Circle 213**														
Ether*Route/TCP	1 Ethernet, 2 LocalTalk	no	—	AppleTalk, TCP/IP, DECnet	RIP, RTMP	AppleTalk-TCP/IP, AppleTalk-DECnet	SNMP, proprietary	600	600	internal	no	yes	yes	1,895
Coral Network Corp., 734 Forest St., Marlboro, MA 01752. **Circle 214**														
CX1600	20 Ethernet, 14 token ring, FDDI, 28 T1, frame relay	yes	—	IP, DECnet, AppleTalk	RIP, EGP, OSPF, BOP	—	SNMP	400,000	64	—	yes	yes	no	20,000-100,000
CrossComm Corp., 450 Donald Lynch Blvd., Marlboro, MA 01754. **Circle 215**														
ILAN Universal Router	1-4 Ethernet, 1-4 token ring, 1-5 WAN	no	yes	IP, NetWare, AppleTalk	RIP, SPF	IP, NetWare, OSI, 3Com	SNMP	—	—	—	yes	no	yes	6,000-13,000
David Systems Inc., 701 E. Evelyn Ave., Sunnyvale, CA 94088-3718. **Circle 216**														
655X-00	5 serial	yes	raw, PAD	IPX, IP	RIP	—	SNMP	3,500	1,024	—	yes	yes	yes	4,445-5,445
Digital Equipment Corp., 146 Main St., Maynard, MA 01754-2571. **Circle 217**														
WANrouter 250	1 Ethernet, 8 Telco	no	—	TCP/IP, OSI, DECnet	IS-IS, RIP, EGP, DECnet, IS-IS	TCP/IP-DECnet	SNMP, CMIP, DECmcc, NCL	—	—	—	yes	yes	no	4,000
WANrouter 500	1 Ethernet, 4 Telco	no	no	TCP/IP, OSI, DECnet	IS-IS, RIP, EGP, DECnet, IS-IS	TCP/IP-DECnet	SNMP, CMIP, DECmcc, NCL	500	—	—	yes	yes	no	6,500
DECNIS 500	2-4 Ethernet, 4-16 Telco	no	raw, converter	TCP/IP, OSI, DECnet, AppleTalk, IPX	IS-IS, RIP, EGP, DECnet, IS-IS	—	SNMP, CMIP, DECmcc, NCL	22,400	64	—	yes	yes	no	10,000-25,000
DECNIS 600	7-14 Ethernet, 14-56 Telco, 3 FDDI	no	raw, converter	TCP/IP, OSI, DECnet, AppleTalk, IPX	IS-IS, RIP, EGP, DECnet, IS-IS	—	SNMP, CMIP, DECmcc, NCL	61,000	64	—	yes	yes	no	15,000-45,000
Dowty Communications, 555 Twin Dolphin Drive, Redwood City, CA 94065. **Circle 218**														
ScaNet System Center Router Module	1 Ethernet, CSU/DSU	yes	raw	IP, DECnet, IPX, OSI	RIP	—	SNMP	—	—	—	—	yes	yes	—
DuPont Electronics, Electro-Optic Products Group, P.O. Box 13625, Research Triangle Park, NC 27709. **Circle 219**														
Paragon Model LBR-0501	4 Ethernet, 1 WAN, 1 serial	yes	raw	IP, IPX, XNS	RIP, EGP, HELLO	—	SNMP	6,000	64	—	yes	no	no	8,495
Emerging Technologies, 900 Walt Whitman Road, Melville, NY 11747. **Circle 220**														
ETROUTE 386	4 Ethernet, 4 serial	yes	raw	IPX, IP, transparent	RIP	—	SNMP	12,000	60	—	yes	no	yes	795+
Engage Communication Inc., 9053 Soquel Drive, Aptos, CA 95003. **Circle 221**														
call for models	1 Ethernet, 4 WAN	no	no	EtherTalk	RTMP	no	—	1.54	600	internal	yes	yes	yes	2,995+
Fibronics International Inc., Communications Way, Hyannis, MA 02601. **Circle 222**														
FER2600	1 Ethernet, 2 T1, 4 serial, 1 fiber optic	no	yes	IP	SPE	—	—	6,000	64	—	yes	yes	yes	6,000+
FX8210	1 Ethernet, 1 FDDI	no	no	IP, DECnet	RIP	—	SNMP, SMT	8,000	64	—	yes	yes	yes	15,000
Gandalf Systems Corp., Cherry Hill Industrial Center, Bldg. #9, Cherry Hill, NJ 08003-1688. **Circle 223**														
Infotron 4000 Series	4 Ethernet or token ring, 8 WAN	yes	raw	IP, XNS, IPX/SPX, DECnet, AppleTalk	RIP, EGP, OSPF	—	SNMP	5,000	64	—	yes	no	no	5,500

Company/Manufacturer Model	Hardware Interface and Number of each	Telenet (yes/no)	X.25 Hookup	Routable Protocols	Routing Algorithms	Protocol Conversions	Network Management Agent	Throughput (pps)	Packet Size (Bytes)	Benchmark Used	Rack Mountable	Software Downloadable from Host on LAN	Auto Firmware Updates	Price ($)
Gandalf Systems Corp., (continued)														
Access Router	2 Ethernet, 2 T1/E1, 2 token ring	yes	raw	IP, XNS, DECnet, IPX/SPX, VINES	RIP, OSPF, OSI ES-IS	—	SNMP	5,000	64	—	—	no	no	6,200
Helios USA, 10601 S. DeAnza Blvd., #103, Cupertino, CA 95014. **Circle 224**														
*EtherShare	Ethernet, token ring, Telco, CSU/DSU	no	raw, PAD, converter	AppleTalk	RTMP, ASP	—	SNMP, NetView	—	—	—	no	yes	no	4,995
Hewlett-Packard Co., Roseville Networks Division, 8000 Foothills Blvd., Roseville, CA 95678. **Circle 225**														
HP Router ER HP27285A	2 Ethernet, 2 WAN	yes	raw	IP, XNS, DECnet, IPX, AppleTalk	RIP, OSPF	—	SNMP	11,900	64	—	yes	yes	no	8,000
HP Router TR HP27286A	1 Ethernet, 2 WAN, 4-16 token ring	yes	raw	IP, XNS, DECnet, IPX, AppleTalk	RIP, OSPF	—	SNMP	11,900	64	—	yes	yes	no	8,500
Hughes Network Systems, 11717 Exploration Lane, Germantown, MD 20876. **Circle 226**														
LANswitch	4 Ethernet, 16 frame relay, 2 token ring	yes	no	IP, IPX	RIP, frame relay	IP, DECnet, OSI,SNA	SNMP	14,000	64	—	no	yes	yes	7,000-25,000
International Transware Inc., 1503 Grant Road, Suite 155, Mountain View, CA 94040. **Circle 227**														
EtherWay EL	1 Ethernet, 1 LocalTalk	no	no	AppleTalk	RIP, RTMP, HELLO	—	—	—	—	—	no	yes	no	999
EtherWay	1 Ethernet, 1 LocalTalk	no	no	AppleTalk, IP, DECnet	RIP, RTMP, HELLO	—	—	—	—	—	no	yes	no	1,499+
Larabie Distributing Inc., 609 Old County Road, San Carlos, CA 94070. **Circle 228**														
Net Builder II	8 Ethernet, 8 FDDI, high-speed serial	yes	raw, PAD, converter	IP, XNS, DECnet, etc.	RIP, Standing Tree	TCP/IP,IPX, DEC-net, AppleTalk	SNMP, SMT	50,000	512	—	—	yes	call	5,000+
Livingston Enterprises Inc., 6920 Koll Center Pkwy., #220, Pleasanton, CA 94566. **Circle 229**														
PM2	1 Ethernet, 10 serial	yes	no	IP	RIP	—	SNMP, proprietary	—	—	—	yes	yes	yes	2,495
IR-4	1 Ethernet, 4 serial (CSU/DSU)	yes	no	IP	RIP	—	SNMP, proprietary	—	—	—	yes	yes	yes	3,295
PM2e	1 Ethernet, 10-30 serial	yes	no	IP	RIP	—	SNMP, proprietary	—	—	—	yes	yes	yes	3,750
Microcom Inc., 500 River Ridge Drive, Norwood, MA 02062. **Circle 230**														
+MBR/6000	1-5 Ethernet, 1-3 token ring, 1-4 WAN	no	—	IPX, IP	RIP	—	SNMP	—	—	—	—	yes	yes	3,499-14,695
+MBR/6500	1-3 Ethernet, 1-3token ring, 1-4 WAN	no	raw	IPX, IP	RIP	—	SNMP	—	—	—	—	yes	yes	3,999-7,599
Microtest Inc., 3519 East Shea Blvd., Phoenix, AZ 85028. **Circle 231**														
Dial-Up Router	4-16 Ethernet, Telco, 8 token ring, CSU/DSU	no	—	IPX	proprietary	—	—	112	512	—	no	yes	yes	1,995-2,595
NCR Corp., 1334 S. Patterson Blvd., Dayton, OH 45479. **Circle 232**														
450	28 Ethernet	yes	PAD, switch	IP, IPX, XNS, DECnet, CLNS, AppleTalk, VINES, 5 DLC, etc.	RIP, ES-IS, IGRP, RTMP, EGP, BGP	TCP/IP, LAT, X.25	SNMP	20,000	64	—	yes	yes	—	40,000-60,000
Network Application Technology, 1686 Dell Ave., Campbell, CA 95008. **Circle 233**														
LANB/280 Remote Bridging Router	1 Ethernet, 1 Telco	no	—	IP	RIP	—	SNMP	109/2510	1518/60	—	yes	no	yes	2,995

*Software - only solution.

+PC-based LAN and WAN cards



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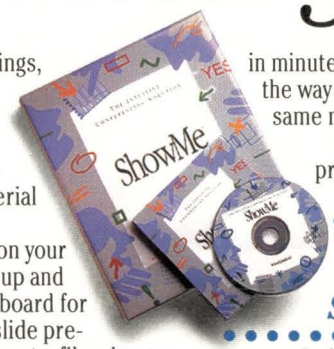

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SunSolutions, Sun Technology Enterprises, Inc. 2550 Garcia Avenue, MS: MTV02-208, Mountain View, CA 94043 USA. Fax: (415) 962-9421

Circle No. 48 on Inquiry Card

Company/Manufacturer Model	Hardware Interface and Number of each	Telenet (yes/no)	X.25 Hookup	Routable Protocols	Routing Algorithms	Protocol Conversions	Network Management Agent	Throughput (pps)	Packet Size (Bytes)	Benchmark Used	Rack Mountable	Software Downloadable from Host on LAN	Auto Firmware Updates	Price ($)
Network Resources Corp., 736 South Hillview Drive, Milpitas, CA 95035. **Circle 234**														
MG2-24	3 Ethernet, 3 WAN, Telco	yes	—	IP, AppleTalk	RIP, RTMP, PPP	AppleTalk-TCP/IP	SNMP	16,000	64	—	yes	yes	no	5,995
Network Systems Corp., 7600 Boone Ave. North, Minneapolis, MN 55428. **Circle 235**														
6600	1-4 Ethernet,1-4 WAN, 1-3 token ring	yes	—	IP, IPX, XNS, AppleTalk	RIP	—	SNMP	20,000	64	in-house	yes	yes	no	6,950+
6400	4-20 Ethernet, 4-20 WAN, 1-2 FDDI	yes	—	IP, IPX, XNS, AppleTalk, DECnet	RIP	—	SNMP	20,000	64	Harvard	yes	no	no	17,500+
6800	4-20 Ethernet,4-32 WAN, 1-5 FDDI	yes	—	IP, IPX, XNS, AppleTalk, DECnet	RIP	—	SNMP	20,000	64	Harvard	yes	no	no	23,500+
Newport Systems Solutions Inc., 4019 Westerly Place, Newport Beach, CA 92660. **Circle 236**														
LAN2LAN	Ethernet, token ring, Arcnet, WAN, serial	yes	raw	IP, AppleTalk, IPX	RIP	—	SNMP	—	—	—	yes	yes	no	$2,490
Novell Internetworking Products Division, 2180 Fortune Drive, San Jose, CA 95131. **Circle 237**														
+Netware MPR V.1.0	4-16 WAN	yes	raw	TCP/IP, IPX, OSI, AppleTalk, NetBIOS	RIP, RTMP, IS-IS	—	SNMP	5014	64	Novell LANQuest	—	yes	no	$995
Penril Datacomm Networks, 1300 Quince Orchard Blvd., Gaithersburg, MD 20878. **Circle 238**														
Series 2000	1 Ethernet, 4 WAN, 24 10 BaseT	—	no	IP, DECnet, IPX, XNS	OSPF, RIP, EGP	—	SNMP	29,000	64	—	yes	yes	yes	13,500+
Plexcom Inc., 2255 Agate Court, Simi Valley, CA 93065. **Circle 239**														
8029-5	2 Ethernet	no	—	TCP/IP, IPX, SPX	RIP	—	SNMP	8,500	64	—	yes	yes	yes	3,495
8039	2 token ring	no	no	TCP/IP, IPX, SPX XNS, DECnet	SRT	—	SNMP	2,000	64	—	yes	—	yes	4,495
Proteon Inc., 9 Technology Drive, Westboro, MA 01581. **Circle 240**														
DNX 300m Bridging Router	2 Ethernet, 4 T1, 2 token ring	yes	raw, PAD, etc.	IP, IPX, OSI, DECnet, XNS, AppleTalk, SRT	RIP, OSPF	—	SNMP, NetView Gateway	7,000	64	independent	yes	yes	yes	4,995-7,995
4100+ Bridging Router	8 Ethernet, 8 T1, 8 token ring	yes	raw, PAD, etc.	IP, IPX, OSI, DECnet, XNS, AppleTalk, SRT, VINES	RIP, OSPF	—	SNMP, NetView Gateway	7,000	64	independent	yes	yes	yes	5,995-9,995
CNX 500 Bridging Router	6 Ethernet, 6 token ring, 12 T1, FDDI	yes	raw, PAD, etc.	IP, IPX, OSI, DECnet, XNS, AppleTalk, SRT, VINES	RIP, OSPF	—	SNMP, NetView Gateway	25,000	64	independent	yes	yes	yes	7,995-20,995
RAD Network Devices Inc., 7711 Center Ave #270, Huntington Beach, CA 92647. **Circle 241**														
REB	1 Ethernet, 4 WAN	no	no	IP	SPF	—	proprietary	2,600	64	—	yes	no	yes	3,995-8,950
LTE	1 Ethernet, 1 token ring	no	no	IP, XNS, IPX, AppleTalk, NetBIOS	Spanning Tree	—	SNMP, LAN Manager	2,600	64	—	yes	no	yes	5,995
XEB	1 Ethernet, 4 WAN	no	raw	IP	SPF	—	proprietary	2,600	64	—	yes	no	yes	7,950-12,845
CEB	2 Ethernet, 4 WAN	no	no	IP	SPF	—	proprietary	2,600	64	—	yes	no	yes	7,535-10,995
OpenGate	12 Ethernet, 24 WAN	no	no	IP, XNS, IPX, DECnet	Spanning Tree, SPF, RIP	—	SNMP	—	64	—	yes	yes	yes	10,000-60,000
Retix, 2401 Colorado Ave., Santa Monica, CA 90404. **Circle 242**														
4760	2 Ethernet	yes	—	IP	RIP, Spanning Tree	—	SNMP	7,8000	—	—	yes	yes	yes	3,250
4941	1 Ethernet, 1 WAN	yes	—	IP, IPX, DECnet	RIP, Spanning Tree	—	SNMP	14,880	—	—	yes	yes	yes	4,950

+PC-based routing software.

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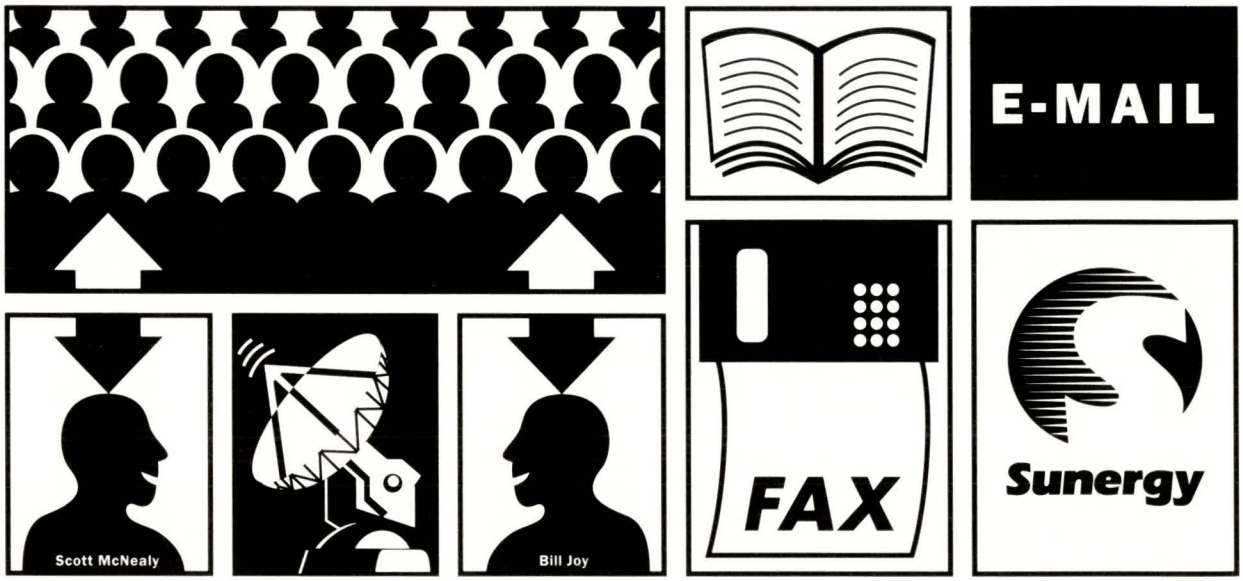

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Circle No. 47 on Inquiry Card

Company/Manufacturer Model	Hardware Interface and Number of each	Telenet (yes/no)	X.25 Hookup	Routable Protocols	Routing Algorithms	Protocol Conversions	Network Management Agent	Throughput (pps)	Packet Size (Bytes)	Benchmark Used	Rack Mountable	Software Downloadable from Host on LAN	Auto Firmware Updates	Price ($)
Retix (continued)														
4942	1 Ethernet, 2 WAN	yes	—	IP, IPX, DECnet	RIP, Spanning Tree	—	SNMP	14,880	—	—	yes	yes	yes	5,950
4982	1 Ethernet, 2 WAN	yes	—	IP, IPX, DECnet	RIP, Spanning Tree	—	SNMP	14,880	—	—	yes	yes	yes	6,950
ROUTERXchange	Ethernet, WAN	yes	—	IP, IPX, DECnet, OSI	RIP, OSPF, Spanning Tree	—	SNMP	—	—	—	yes	yes	yes	9,200+
Shiva Corp., One Cambridge Center, Cambridge, MA 02142. **Circle 243**														
Fastpath 5	1 Ethernet, 1 LocalTalk	no	—	IP, DECnet, AppleTalk	RIP, RTMP	TCP/IP-AppleTalk	SNMP	—	—	—	no	yes	yes	2,799
Fastpath 5R	1-2 Ethernet, 1-2 LocalTalk	no	—	IP, DECnet, AppleTalk	RIP, RTMP	TCP/IP-AppleTalk	SNMP	—	—	—	yes	yes	yes	2,799-5,399
Sigma Network Systems Inc., 25 Walkers Brook Drive, Reading, MA 01867. **Circle 244**														
TCS/1	20 Ethernet, FDDI, token ring	no	—	IP, Concurrent Bridge/Router	RIP, OSPF	—	SNMP	59,433	64	Harvard	yes	yes	no	18,000-33,000
St. Clair Systems Corp., 2680 Marshfield Drive, Pittsburgh, PA 15241. **Circle 245**														
SN3700	4-8 Ethernet, 4-8 token ring, 4-8 FDDI, 2-4 Telco, CSU/DSU	yes	PAD	TCP/IP, OSPF, EGP/OSI, ES-IS, IS-IS, XNS, DECnet, AppleTalk	RIP	TCP/IP-DECnet	SNMP, SMT	900,000	64	3Com	yes	yes	yes	3,000+
SynOptics Communications Inc., 4401 Great American Pkwy., P.O. Box 58185, Santa Clara, CA 95052-8185. **Circle 255**														
LattisNet 3383/3384	Ethernet	yes	—	NFS, IP, XNS, IPX, DECnet, AppleTalk, VINES, 3Com	RIP, IGRP, OSPF, BGP, EGP, OSI, ES-IS, IS-IS	TCP/IP-DECnet, DECnet IV-DECnet V	SNMP	15,000	64	—	yes	yes	yes	5,895-6,295
LattisNet 3386	Ethernet	yes	raw	NFS, IP, XNS, IPX, DECnet, AppleTalk, VINES, 3Com	RIP, IGRP, OSPF, BGP, EGP, OSI, ES-IS, IS-IS	TCP/IP-DECnet, DECnet IV-DECnet V	SNMP	15,000	64	—	yes	yes	yes	6,495-7,195
Technically Elite Concepts Inc., 2615 P.C.H. Hwy., Suite 322, Hermosa Beach, CA 90254. **Circle 246**														
NI-BDEN-04/960 RISC	4 Ethernet	yes	—	—	—	—	SNMP	29,760	64	W&G Tester	yes	yes	yes	9,995
TEKnique Inc., 911 N. Plum Grove Road, Schaumburg, IL 60173. **Circle 247**														
100	4 Ethernet, serial	—	raw, PAD, converter	IP	RIP, OSPF	X3-TELNET, TCP/IP-X.25vc, TCP/Ip-Wireless	SNMP, INF/Telematics	3,000	64	—	no	yes	—	3,000-4,000
240	4 Ethernet, serial	yes	raw, PAD, converter	IP	RIP, OSPF	X3-TELNET, TCP/IP-X.25vc, TCP/Ip-Wireless	SNMP, INF/Telematics	400	512	—	yes	yes	—	8,000-15,000
Telebit Corp., 1315 Chesapeake Terrace, Sunnyvale, CA 94089. **Circle 248**														
NetBlazer ST	CSU/DSU	yes	—	IP, IPX, AppleTalk	RIP	—	SNMP	—	—	—	yes	yes	no	2,999
NetBlazer 40 Dial-Up Router	CSU/DSU	yes	—	IP, IPX, AppleTalk	RIP	—	SNMP	—	—	—	no	yes	no	5,198
Themis Computer, 6681 Owens Drive, Pleasanton, CA 94588. **Circle 249**														
*SXCM	V.35, serial	yes	raw, PAD	IP	RIP	—	SNMP	—	—	—	no	yes	no	1,795
3Com Corp., 5400 Bayfront Plaza, Santa Clara, CA 95052. **Circle 250**														
NETBuilder	Ethernet	yes	X.25	IPX, TCP/IP, XNS, DECnet, VINES, AppleTalk, OSI	RIP, OSPF, IS-IS, IS-ES	—	SNMP	10,000	64	Harvard	yes	yes	yes	4,500
NETBuilder II	Ethernet, FDDI	yes	X.25	IPX, TCP/IP, XNS, DECnet, VINES, AppleTalk, OSI	RIP, OSPF, IS-IS, IS-ES	—	SNMP	10,000	64	Harvard	yes	yes	yes	10,495

*SBus add-in card.

Company/Manufacturer Model	Hardware Interface and Number of each	Telenet (yes/no)	X.25 Hookup	Routable Protocols	Routing Algorithms	Protocol Conversions	Network Management Agent	Throughput (pps)	Packet Size (Bytes)	Benchmark Used	Rack Mountable	Software Downloadable from Host on LAN	Auto Firmware Updates	Price ($)
Tran Network Systems, 40 Johnson Drive, New Providence, NJ 07974. **Circle 251**														
Intellinet Router	1 Ethernet, 32 WAN	no	—	IP	RIP	—	SNMP	—	—	—	yes	yes	yes	2,500+
Ungermann-Bass Inc., 3900 Freedom Circle, Santa Clara, CA 95054. **Circle 252**														
ASM 5361	1 Ethernet, 1 FDDI, 1 Plusbus	no	raw	IP, IPX, AppleTalk, DECnet, LAT, TCP, SPX, XNS, LAPB, SDLC, frame relay	RIP, OSPF	Spanning Tree, source routing	SNMP	5,000	64	IP forwarding	yes	yes	yes	5,225-19,995
ASM 8300	1 Ethernet, 1 serial	no	raw	IP, IPX, AppleTalk, DECnet, LAT, TCP, SPX, XNS, LAPB, SDLC, frame relay	RIP, OSPF	Spanning Tree, source routing	SNMP	5,000	64	IP forwarding	yes	yes	yes	5,225-19,995
ASM 8320	1 Ethernet, 2 serial	no	raw	IP, IPX, AppleTalk, DECnet, LAT, TCP, SPX, XNS, LAPB, SDLC, frame relay	RIP, OSPF	Spanning Tree, source routing	SNMP	5,000	64	IP forwarding	yes	yes	yes	5,225-19,995
ASM 8500	1 token ring, 1 serial	no	raw	IP, IPX, AppleTalk, DECnet, LAT, TCP, SPX, XNS, LAPB, SDLC, frame relay	RIP, OSPF	Spanning Tree, source routing	SNMP	5,000	64	IP forwarding	yes	yes	yes	5,225-19,995
ASM 8520	1 token ring, 2 serial	no	raw	IP, IPX, AppleTalk, DECnet, LAT, TCP, SPX, XNS, LAPB, SDLC, frame relay	RIP, OSPF	Spanning Tree, source routing	SNMP	5,000	64	IP forwarding	yes	yes	yes	5,225-19,995
ASM 8310	2 Ethernet, 2 serial	no	raw	IP, IPX, AppleTalk, DECnet, LAT, TCP, SPX, XNS, LAPB, SDLC, frame relay	RIP, OSPF	Spanning Tree, source routing	SNMP	5,000	64	IP forwarding	yes	yes	yes	5,225-19,995
ASM 8510	1 Ethernet, 1 serial, 1 token ring	no	raw	IP, IPX, AppleTalk, DECnet, LAT, TCP, SPX, XNS, LAPB, SDLC, frame relay	RIP, OSPF	Spanning Tree, source routing	SNMP	5,000	64	IP forwarding	yes	yes	yes	5,225-19,995
Vitalink Communications Corp., 48761 Kato Road, Fremont, CA 94538. **Circle 253**														
6600	1-4 Ethernet, 1-3 token ring, 1-3 FDDI, 1-4 WAN	yes	—	IP, IPX, XNS, AppleTalk	RIP	—	SNMP	20,000	64	in-house	yes	no	no	6,950+
TransPATH	1 Ethernet, 1 WAN	yes	—	IP, XNS, DECnet, AppleTalk, IPX	RIP	—	SNMP	7,000	64	in-house	yes	yes	no	13,500+
6400	4-20 Ethernet, 1-2 FDDI, 4-20 WAN	yes	—	IP, XNS, DECnet, AppleTalk, IPX	RIP	—	SNMP	20,000	64	Harvard	yes	no	no	17,500+
6800	4-20 Ethernet, 1-5 FDDI, 4-32 WAN	yes	—	IP, XNS, DECnet, AppleTalk, IPX	RIP	—	SNMP	20,000	64	Harvard	yes	no	no	23,500+
8800	2-20 Ethernet, 1-3 FDDI, 2-36 WAN	yes	—	IP, XNS, IPX, AppleTalk	RIP	—	SNMP	390,000	64	Harvard	yes	no	no	—
Wellfleet Communications Inc., 15 Crosby Drive, Bedford, MA 01730. **Circle 254**														
FN 1000	1-4 Ethernet, 1-4 Telco, 1-2 token ring	yes	X.21	IP, IPX, XNS, DECnet, AppleTalk, OSI	RIP, OSPF	—	SNMP	14,500	64	Harvard	yes	yes	no	6,995
LN 2000	1-16 Ethernet, 1-16 Telco, 1-16 token ring, 1-8 FDDI, 1-4 DSU	yes	X.21	IP, IPX, XNS, DECnet, AppleTalk, OSI	RIP, OSPF	—	SNMP	58,000	64	Harvard	yes	yes	no	11,500+
CN 3000	1-52 Ethernet, 1-52 Telco, 1-26 token ring, 1-13 FDDI, 1-13 DSU	yes	X.21	IP, IPX, XNS, DECnet, AppleTalk, OSI	RIP, OSPF	—	SNMP	188,000	64	Harvard	yes	yes	no	20,000

Company/Manufacturer Model	Hardware Interface and Number of each	Telenet (yes/no)	X.25 Hookup	Routable Protocols	Routing Algorithms	Protocol Conversions	Network Management Agent	Throughput (pps)	Packet Size (Bytes)	Benchmark Used	Rack Mountable	Software Downloadable from Host on LAN	Auto Firmware Updates	Price ($)
Wellfleet Communications Inc. (continued)														
BLN 72000	1-16 Ethernet, 1-16 Telco, 1-8 token ring, 1-4 FDDI, 1-4 DSU	yes	X.21	IP, IPX, XNS, DECnet, AppleTalk, OSI	RIP, OSPF	—	SNMP	188,000	64	Harvard	yes	yes	no	25,000
BCN7300	1-52 Ethernet, 1-52 Telco, 1-52 token ring, 1-26 FDDI, 1-13 DSU	no	X.21	IP, IPX, XNS, OSI, DECnet, VINES, AppleTalk	RIP, OSPF	—	SNMP	480,000	64	Harvard	yes	yes	no	37,000+
Xyplex Inc., 330 Codman Hill Road, Boxboro, MA 01719-1708. **Circle 254**														
3710 Local Router	2 Ethernet	yes	—	IP, IPX, DECnet	RIP, RIP-IPX, SAP, OSPF, EGP	—	SNMP, Xyplex, RCP, Telnet local port	—	64	—	yes	yes	—	2,995
6710 Remote Router Card	1 Ethernet, 1 WAN	yes	—	IP, IPX, DECnet	RIP, RIP-IPX, SAP, OSPF, EGP	—	SNMP, Xyplex, RCP, Telnet local port	—	64	—	yes	yes	—	2,995
3210 Local Router	2 Ethernet	yes	—	IP, IPX, DECnet	RIP, SAP, EGP, OSPF, RIP-IPX	—	SNMP, Xyplex, RCP, Telnet local port	—	64	—	yes	yes	—	3,695
6220 Remote Router	2 Ethernet, 2 WAN	yes	—	IP, IPX, DECnet	RIP, SAP, EGP, OSPF, RIP-IPX	—	SNMP, Xyplex, RCP, Telnet local port	—	64	—	yes	yes	—	3,995

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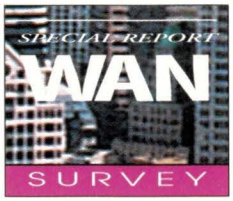

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Thank you

1. How do you use your network to consolidate resources? (Check all that apply.)

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- ❑ File Transfer
- ❑ Remote Host Access
- ❑ BBS, e.g., Usenet
- ❑ Games, e.g., MUD
- ❑ Customer Support
- ❑ Telecommunications
- ❑ Commercial Information Services, e.g., Dialog

2. What are the devices shared on your network? (Check all that apply.)

- ❑ Backup Devices
- ❑ Disk Farms
- ❑ CD-ROM
- ❑ File Servers
- ❑ Database Servers
- ❑ Optical Jukeboxes
- ❑ Dial-up Modem Pools
- ❑ Fax Modems or Servers
- ❑ X terminals
- ❑ Terminal Servers
- ❑ Scanners
- ❑ Printers
- ❑ Plotters

3. Please define the scope of your networking involvement.

- ❑ Workgroup
- ❑ Department
- ❑ Sitewide
- ❑ Multiple Sites
- ❑ International

4. Which of the following best describes your involvement in networking at your organization? (Check all that apply.)

- ❑ Planning
- ❑ Design
- ❑ Development
- ❑ Purchasing
- ❑ Implementation
- ❑ Operations
- ❑ Testing
- ❑ Management
- ❑ Service/Support
- ❑ Monitoring
- ❑ Other_____

5. Which network protocols are used in your organization? (Check all that apply.)

Protocol	Installed	Planned for Purchase
DECnet	❑	❑
TCP/IP	❑	❑
X.25	❑	❑
SNA	❑	❑
Novell IPX/SPX	❑	❑
VINES	❑	❑
AppleTalk	❑	❑
XNS	❑	❑
MAP/TOP	❑	❑
OSI	❑	❑

6. Which network management protocols and products are used in your organization? (Check all that apply.)

Protocol/Product	Installed	Planned for Purchase
SNMP/SMP	❑	❑
CMIP	❑	❑
CMOT	❑	❑
SunNet Manager	❑	❑
HP OpenView	❑	❑
DECmcc	❑	❑
IBM NetView	❑	❑

7. What size is your company?

- ❑ Under $50 million
- ❑ $50 million to $250 million
- ❑ $250 million to $500 million
- ❑ Over $500 million

8. How many employees are at your site?

- ❑ 1-100
- ❑ 101-250
- ❑ 251-500
- ❑ 501-5,000
- ❑ Over 5,000

9. What is your job title? _____

10. Rank the following in order of importance with 6 being highest priority and 1 lowest.

____Mac/PC Connectivity
____Mainframe Connectivity
____LAN Integration
____LAN-to-WAN Connectivity
____WAN-to-WAN Connectivity
____Multiprotocol Support

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General Manager, UNIX Products Group

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SUG notes

Get Out the Vote

by PETER H. SALUS,
Executive Director

We're busy, as we are every autumn.

Annual elections will be going on when you read this, though at this point I don't know who the candidates will be. Nonetheless, as the Board of Directors runs the User Group, its constituency is important to all of us.

We're also busy with a birthday: The 1992 Sun User Group Conference and Exhibit in San Jose, December 7-10, will be our 10th. I'm looking forward to it, as it should be quite an exciting conference and the exhibit already promises to be larger than last year's.

Our keynote, on the morning of December 8, will be delivered by Dr. Stephen R. Bourne, who was the developer of the Bourne Shell and the ADB debugging tool at AT&T before moving on to DEC and then to Sun. Dr. Bourne is the director of Systems Architecture for SunSoft and heads up the SVR4 (Solaris) development efforts.

At lunch the next day, Michael Tiemann of Cygnus Support will talk about GNU, HURD and other alternatives to Solaris 2.0, and on Thursday morning, December 10, Rob Kolstad of BSDI will discuss BSD on the SPARC. Those of you interested in operating systems won't want to miss these talks.

Preceding this, on Monday, December 7, SUG will offer a wide range of tutorials, listed below.

These will be all-day tutorials, except for Chapman's, which will be a morning half-day, and Baldwin's, which will be the afternoon half-day. You will have to register for both as a set. While I don't yet know what will be on the technical program, I do know that Rob Gingell will be conducting his ever-popular Developers' Panel on Wednesday evening. This year, Rob is requesting questions in advance. As with all the product transitions, he has told me he expects "it'll be livelier than usual." Email your questions to `developers-panel@sug.org`. Finally, we will have our 10th-birthday celebration on Tuesday, December 8. I hope to meet many of you there.

Products

SUG has released two CDs this year. 1992.1 ($50 plus shipping and handling) contains X11R5 and GNU software; our most recent disk, 1992.2, supplements this with over 600 MB of useful software ($150 plus shipping and handling). For full tables of contents and ordering information, call (617) 232-0514; fax (617) 232-1347; or email `office@sug.org`. Another member benefit is *SunExpert* magazine: Every member receives a free year's subscription.

Discounts

One of the most interesting member benefits of the Sun User Group is the ever-growing list of companies giving member discounts. Among the book publishers, Addison-Wesley, O'Reilly Associates and Prentice Hall all offer discounts; Dataram, Qualix, Software Moghuls, SPARC International and the Usenix Association also offer discounts to SUG members, as does *The SunObserver.*

Donations

Over the past few months, SUG has been the happy recipient of hardware donations from Tatung, NCD, QMS, Livingston Enterprizes and Telebit. We are most grateful to them and to Island Graphics for the software with which we produce *README.*

Future Events

In March 1993 we will again be participating in Sun Open Systems Expo in Chicago and future Sun Open Systems Expos.

1992 SUG Conference Tutorials

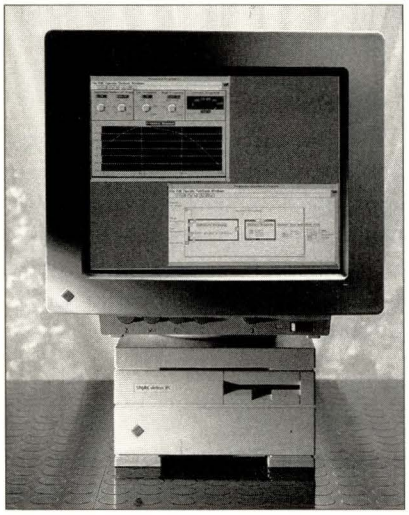
1.	*Advanced UNIX Security*	**Matt Bishop**	Dartmouth College
2a.	*Preparing for Disaster*	**Brent Chapman**	Great Circle Associates
2b.	*Why have Computer Security*	**Bob Baldwin**	Tandem Computers
3.	*Sun Network Debugging*	**Smoot Carl-Mitchell**	Texas Internet Consulting
4.	*Topics in Perl*	**Tom Christiansen**	Convex Computer
5.	*Programming in POSIX*	**Jeffrey S. Haemer**	Canary Software
6.	*UNIX Programming Tools*	**Kenneth Ingham**	Consultant
7.	*The Internet and its Protocols*	**William LeFebvre**	Northwestern University
8.	*Introduction to UNIX System Administration*	**Dinah McNutt**	Tivoli Systems
9.	*Integrating C Code and Xt Widgets*	**Craig Rudlin, MD**	Medical Software and Computer Systems

NEW PRODUCTS

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

LabView on Sun

LabView, the famed graphical environment for scientific and technical engineering applications from National Instruments, has been ported to the Sun SPARCstation and compatibles. LabView, which before had been available only on the Apple Computer Inc. Macintosh, allows the user to

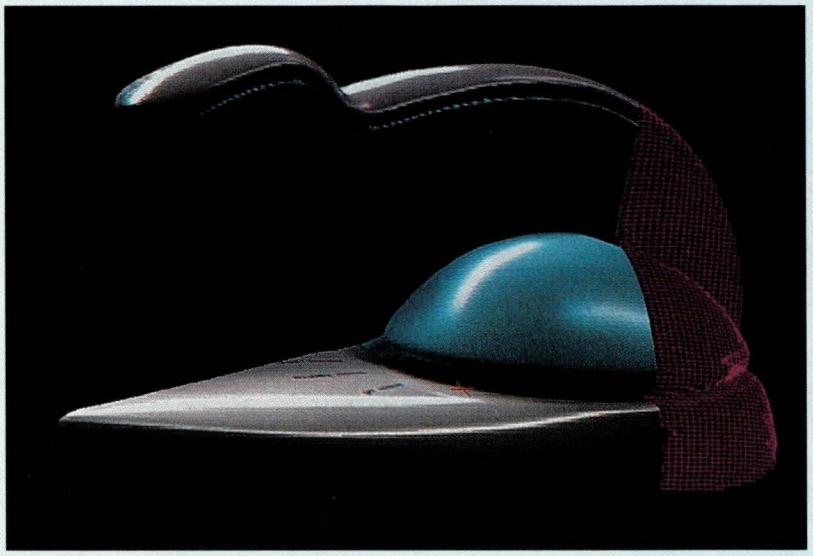


build a variety of virtual instruments for such applications as laboratory automation, automated testing, automotive and aerospace engineering, process control and so on. To this end, the product comes with libraries for data acquisition, instrument control, data analysis and data presentation. In addition, the product comes with a number of ready-to-use controls, graphs and strip charts.

The company says that LabView on Sun maintains the product's traditional strengths in ease of programming. LabView allows users to assemble programs from block diagrams instead of using text-based programming techniques.

The minimum configuration for LabView for Sun is a SPARCstation compatible with 24 MB of main memory, 32 MB of disk swap space and 10 MB of disk space. The product runs under the X Window System, Version 11, Release 4 or 5; or OpenWindows Version 3. It does not require either Motif or Open Look. Pricing had not been determined as of press time.

National Instruments Corp.
6504 Bridge Point Parkway
Austin, TX 78730-5039
Circle 101



High-Res 3D Scanner

A 3D scanner that offers 75 points per inch has been introduced by Cyberware. The 3030/HIREZ scanner is said to have twice the resolution of the company's previous products. It is able to capture such details as small wrinkles on a face or tiny features of products under development. It supports a variety of platforms, including Sun workstations and SPARCalikes.

The 3030/HIREZ uses a video camera to capture an object's image in 13 seconds. The image can then be displayed, resized, measured or edited on the host system. The company notes that scanned objects can also be reproduced using automated milling machines or rapid prototype systems. Prices start at $54,500.

Cyberware
8 Harris Court
Monterey, CA 93940
Circle 100

Wind River Flows to SPARClite

Wind River Systems has successfully ported its real-time operating system, VxWorks, to Fujitsu Ltd.'s SPARClite family of embedded system processors. This makes it one of the few real-time operating systems present on SPARC-derived systems. VxWorks is an open-architecture operating system that networks a UNIX development platform and the real-time target in an integrated environment. It comes with facilities for multiprocessing, debugging, distributed processing and performance monitoring.

In a related announcement, Wind River introduced a Board Level Support Package (BSP) porting kit that real-time developers can use to port VxWorks to their own board-level products. There are BSP kits for sys-

tems based on SPARC and SPARClite, Motorola Inc. 680X0, MIPS Computer Systems Inc. R3000, Intel Corp. i960, and, surprisingly, for the Gmicro 100, 200 and 300. Collectors of computer trivia will remember that the Gmicro processor was one of the products of the Japanese "Tron" project, an attempt to create a common processor architecture from micros to mainframes. While Tron never caught on in America or Europe, the company says that Gmicro has a reasonable following in Japan. Pricing on the BPS kits varies.

Wind River Systems Inc.
1010 Atlantic Ave.
Alameda, CA 94501
Circle 102

SBus Extender

An SBus extender board that dynamically measures current consumption and voltage on a board under test is now shipping from Ultraview. The SBext-82 automatically lights LEDs if the current or voltage of the board being tested exceeds specifications. The product brings all 82 SBus signal lines to standard test posts for connection to logic analyzers or test equipment. Users can then hook up probe leads rather than use more conventional bus connector-pin-ordering for testing purposes.

The company says that the SBext-82 comes with an integral 0.033-ohm shunt with an on-board differential amplifier, allowing continuous automatic readout of +5V current consumption on any board. A 33mv drop per amp current draw is the only load. Pricing begins at $495.

Ultraview
475 Yampa Way
Fremont, CA 94539
Circle 103

The Nobility of Distribution

NobleNet has released EZ-RPC, a compiler toolkit for software developers writing distributed applications or rewriting existing applications in distributed versions. The developers provide a description of the subroutines to be distributed, and EZ-RPC replies with the C language-based code necessary to create the necessary remote procedure calls. The company says this allows the developer to focus on the application, rather than on making it work on a network.

The product can be used to produce new programs, or to turn older ones into distributed versions. It is available on Sun systems, Hewlett-Packard Co./Apollo machines, Digital Equipment Corp. DECstations, the IBM Corp. RS/6000, Silicon Graphics Inc. machines and PCs under Interactive UNIX. Pricing begins at $10,000 per initial installation of three seats.

NobleNet Inc.
12 Braemore Road
Natick, MA 01760
Circle 104

Spyglass Sighted!

Spyglass Transform, the popular and inexpensive scientific visualization package formerly restricted to Macs and SGI machines, has been ported to the Sun SPARCstation and SPARC-alikes. The product allows Sun users to create color raster images, line graphs, surface plots, contour plots and vector

plots from 2D data arrays with point-and-click operations.

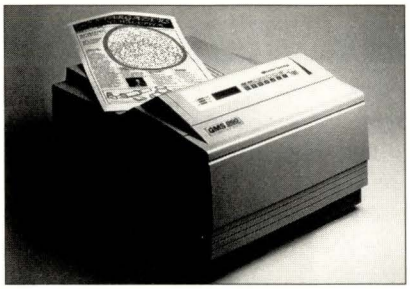
The program reads and converts a variety of data and image file forms–including but not limited to ASCII 2D and X-Y column data; 2D and 3D byte, integer, long integer and float; TIFF and FITS image files; HDF image files; and 2D and 3D HDF datasets. The product also comes with a Notebook window that provides a set of trigonometric and mathematical functions, FFTs, array manipulation functions and kernel convolutions.

The product requires an 8-bit display, 16 MB of memory and OpenWindows or Motif. Pricing begins at $895.

Spyglass Inc.
701 Devonshire Drive, C-17
Champaign, IL 61820
Circle 105

Laser Printer at $4,495

QMS has announced a network laser printer based on the Canon U.S.A. Inc. LBP-BX engine, which supports up to 11-by-17-inch printers at 600-



by-600 dpi. The 8-ppm QMS 860 supports emulations of several industry-standard print and graphics languages, including PostScript Level 1, PostScript Level 2, HP PCL IV, HP-GL and LN03 Plus. It can also operate on multiple networks and has optional network interfaces for Ethernet (in such forms as NetWare, EtherTalk, TCP/IP) and Token-Ring NetWare. The printer's input capacity is 350 sheets, expandable to 850. The printer comes standard with a 250-sheet paper feeder.

The QMS 860 is based on the Intel 960 processor and has its own operating system–QMS' Crown. This is a multitasking OS that provides multiple language and protocol support, simultaneous interface operation, configurable input buffers and Emulation Sensing Processor (ESP) technology. ESP analyzes incoming file data from any of the printer's interfaces and selects the appropriate printer language from those available to deal with it. The standard configuration includes 8 MB of RAM. Pricing begins at $4,495.

QMS Inc.
One Magnum Pass
P.O. Box 81250
Mobile, AL 36689-1250
Circle 106

Symbolics Lives

Symbolics, the MIT spinoff that rode the artifical-intelligence fad to a brief period of success in the early

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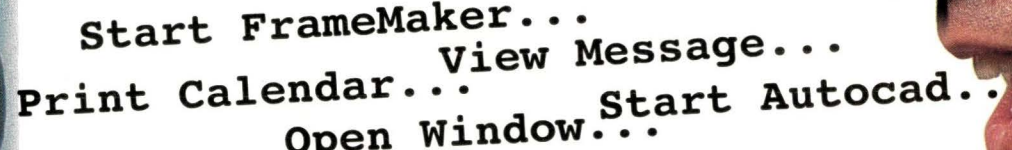

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Circle No. 54 on Inquiry Card

1980s, has introduced a new product. Called the Symbolics NXP1000, this is a hardware/software package for application developers who want to exploit the company's Genera software development environment. Specifically, the NXP1000 is a chassis containing one of the company's Lisp engines (based on its proprietary Ivory chip), which then links to UNIX workstations (including Suns) or X terminals via NFS and TCP/IP. Developers can then dip into the Genera environment to develop "business and research applications."

The company says that this is the

Upgrades, Enhancements, Additions...

• An enhanced and multilingual version of the Aster*x integrated software package has been introduced by Applix. The new version features increased functionality in its word-processing, email and spreadsheet modules. Moreover, it now comes in German, French and Italian translations. **Applix Inc.**, 112 Turnpike Road, Westboro, MA 01581. **Circle 107**

• VMark Software has added a GUI to its Pick-inspired database and application environment, UniVerse. Called NewLook, the GUI will allow users to incorporate interfaces from a variety of different device environments, including the X Window System. **VMark Software Inc.**, 30 Speen St., Framingham, MA 01701-1800. **Circle 108**

• An undated version of Cayman Systems' GatorMail has shipped. GatorMail-M Release 2.1 allows QuickMail and Microsoft Mail users on LocalTalk or Ethernet to exchange mail with workstation users on Ethernet using SMTP. **Cayman Systems Inc.**, University Park at MIT, 26 Landsdowne St., Cambridge, MA 02139. **Circle 109**

• Cisco Systems has introduced a "header compression" feature for its internetworking routers. The compression feature is based on the Internet Engineering Task Force (IETF) RFC 114 standard and increases the speed of interactive TCP/IP sessions over serial lines slower than 56 Kb/s. **Cisco Systems Inc.**, 1525 O'Brien Drive, Menlo Park, CA 94026-1435, P.O. Box 3075. **Circle 110**

• A price cut on the Micro Annex ELS terminal server has been announced by Xylogics. The 8-port Micro Annex drops from $1,895 to $1,595, while the 16-port model goes from $2,495 to $1,995. **Xylogics Inc.**, 53 Third Ave., Burlington, MA 01803. **Circle 111**

• Text-recognition capabilities have been added to Mercury Interactive's XRunner automated testing system. XRunner will now recognize text characters as opposed to merely comparing bit-map images for software errors. **Mercury Interactive Corp.**, 333 Octavius Drive, Santa Clara, CA 95054. **Circle 112**

• Solbourne has introduced a 256-MB memory board upgrade for users of the company's Series 5E/700 and 5E/900 servers. This gives the machines up to 1.25 GB and 2.25 GB respectively, which the company says is the largest memory of any existing SPARC system. **Solbourne Computer Inc.**, 1900 Pike Road, Longmont, CO 80501. **Circle 113**

• Aurora has announced major enhancements to its high-speed parallel SBus cards. The new versions of the 10S and 210 S cards offer 50% faster output for printing and plotting. In addition, the company has reduced the price of its intelligent serial SBus multiplexer products, with Model 1600S dropping 25% to $1,495 and the Model 800S dropping 33% to $995. **Aurora Technologies Inc.**, 176 Second Ave., Waltham, MA 02154. **Circle 114**

first step of a process by which it will eventually move its software to standard hardware platforms–something that critics of the company suggested almost five years ago. Symbolics, which used to occupy a huge building in the Cambridge area (a building that is now, symbolically, used by the Open Software Foundation), has been cursed by what analysts perceived as a strategy of proprietary systems. Now, though, the company says it is willing to compromise with the market and in time will offer its products on Digital Equipment Corp. and Intel-based systems. Perhaps significantly, the most standard and open RISC platform in the market, SPARC, has not been mentioned in company literature.

The NXP1000 offers a 40-bit Ivory processor, 20 MB of ECC memory, a 500-MB disk and Genera software Release 8.2 or later. Pricing begins at $18,700.

Symbolics Inc.
6 New England Tech Center
555 Virgina Road
Concord, MA 01742-2727
Circle 115

Andataco's Double Debut of Storage

Andataco hits the market with two new families of optical and tape library storage products. Ensemble, the family of optical libraries, features read/write optical solutions with multiplatter autochanging optical libraries with 1 GB to 2 TB of on-line storage capacity. It also features integrated file management software, which enables transparent file access across multiple users and multiple applications.

The Ensemble 10 is a 10-platter optical file system with up to 10 GB of storage capacity. The high-speed drives have an average seek time of 35 ms and can be configured with one of two preinstalled file-management software drivers. The unit comes custom configured to fit the specifications of the computing environment, including the appropriate amount of cache preinstalled on an internal Winchester drive.

The second family, called Encore, is an autochanging, 8mm tape library with 2.3 GB to 50 GB of unattended archival and storage backup capacity. Encore also features preinstalled file management software and random-access capabilities.

Both families come complete with everything needed for immediate installation, including drives, media, cables, autochanger and file management software.

Andataco
9550 Waples St.
San Diego, CA 92121
Circle 116

Fax Software for Sun

V-Systems has entered the emerging market for fax software on Suns. The company's product, FxServer 2.0, is meant for developers who wish to incorporate fax functions with their own software. It schedules fax transmission and manages fax receipts. In the process, FxServer provides such functions as file conversions, directory management, scheduling and fax activity logging. ASCII and image files can be combined in any document to be faxed. Moreover, the product allows users to produce customized pages with company logos, personal signatures, and so on. Pricing on FXServer begins at $795.

In addition, the company provides the product with the option of two other program modules. The first of these is FxVision, which allows the user to easily view, send, receive, print, archive and manage fax documents using pull-down menus. The second is FxScript, a PostScript-compatible interpreter that allows users to fax PostScript documents. Pricing on FxVision begins at $495 and at $295 for FxScript.

V-Systems Inc.
39 Brookhollow Drive
Santa Ana, CA 92705
Circle 117

Crossroad Gives New Direction

Boston-based Crossroad Systems has introduced a development environment for programmers who wish to link standalone applications into an integrated whole. Called Crossroad 1.5, the product is described as a development framework for the inte-

gration of heterogeneous application software in UNIX networks. It consists of three components. The first is CrossFrame, an interface builder for constructing Motif-compliant GUIs for integrated applications. The second is CrossScript, a programming environment that is said to support rapid prototyping and the implementation of complex integrated applications.

The third component is CrossLink, a programming environment that allows the developer to establish peer relationships between applications. Currently, the product runs on SPARC-based platforms, plus the IBM Corp. RS/6000 and Hewlett-Packard Co. RISC systems. Pricing for a development system license begins at $7,500, with run-time licenses at $500. Site licenses are available.

Crossroad Systems Inc.
113 Bay State Road
Boston, MA 02215
Circle 118

Six-Headed Surge Protector

A line of six-outlet surge protectors has been announced by Intermatic. Called the Intermatic EP63 line, the devices monitor the incoming power line and react to a surge or spike in less than a nanosecond. In addition, several models in the line come with audible alarms that alert users when the protector needs to be replaced.

The lines consists of EG63C, for heavy-duty protection and broadband noise filtering; the EG63A, which is the same product but with an alarm; the EG63EC, which has built-in coaxial-cable protection; and the EG63TC, which has built-in modular phone jacks to provide protection for modems, fax machines, electronic phone systems and so on. The products are available retail.

Intermatic
Intermatic Plaza
Spring Grove, IL 60081
Circle 119

Oliver North Coulda Used It

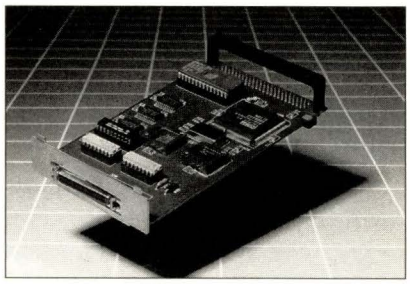
A suite of media-erasure applications that remove files forever has debuted. Called UniShred, from Full Source Software, the product irrevocably deletes files and obliterates the data contained in them. Once deleted, the files cannot be retrieved in any form. UniShred works with disks, tapes, floppies and all writable media.

The company says that UniShred conforms to all government and commercial standards–including the Department of Defense's DOD 5200.28-STD, the National Computer Security Center's NCSC-TG-O25 and CSC-STD-005-85, the Air Force's pending FSI 5020 guidelines and the assorted National Security Agency requirements. Pricing is $149 per license.

Full Source Software
346 Costello Court
Los Altos, CA 94024-4707
Circle 120

New SBus SCSI-2 Adapter

Antares Microsystems has brought out a SCSI-2 SBus adapter. The product offers a transfer rate of up to 10



MB/s. It also has a 16-byte burst DMA method of system data transfer. It supports up to seven SCSI devices, which may be SCSI I or SCSI II, and has an Active SCSI Termination type.

The board occupies a single SBus slot and is 83.82mm wide and 146.70mm long. Pricing begins at $995.

Antares Micro Systems
160B Albright Way
Los Gatos, CA 95030
Circle 121

RAM-Rich DSP Board

British Columbia-based Spectrum has announced an SBus board for DSP applications that need to read and write data without consuming all the disk resources of a Sun workstation. Built around the more-or-less industry standard Texas Instruments

Inc. TMS320C30 digital signal processor, the board provides up to 512K words of SRAM. In addition, the product comes with a SCSI controller, providing expansion to a variety of peripherals.

The TMS320C30 SBus card's SCSI interface provides for high-speed digital I/O from a disk at 2 MB/s. The company says this is useful for applications that need to record and replay data without consuming all or most of a Sun's disk during record mode. There are also two serial I/O ports on the board and options for analog I/O via a daughtercard. Pricing begins at $4,799.

Spectrum Signal Processing Inc.
8525 Baxter Place
100 Production Court
Burnaby, BC
V5A 4V7, Canada
Circle 122

Bluestone Says It's Rock Steady

A product that allows character-based applications to be updated with a GUI has been introduced by Bluestone Consulting. Called Onyx, the product is a development tool kit that supports such GUI functions as windows, drop-down menus, push buttons, scroll bars, dialog boxes and resizable windows. The company claims that with Onyx all these features can be added to existing character-based applications without writing any code.

In addition, the company has recently announced that it will provide and support SAIC VUE, a graphical user environment derived from Hewlett-Packard Co.'s VUE by Science Application International Corp. (SAIC) The SAIC VUE product simplifies UNIX for novice users and is said to enhance the efficiency of experts. Pricing information was not available at press time for either product.

Bluestone Consulting Inc.
1200 Church St.
Mt. Laurel, NJ 08054
Circle 123

Take the Cheapest Route

Cisco Systems brings a new router platform to the market with its Cisco 3000, a three-member family of fixed configuration, multiport devices offering standard Flash EPROM memory for easy updating and increased memory expandability to accommodate network growth.

The Cisco 3000 will provide the platform that enables Cisco to support ISDN technology, and future versions will incorporate an ISDN Basic Rate Interface into the router chassis. The three available versions include one with two Ethernet ports, a version with one Ethernet and one synchronous serial port, and a version with one token ring and one serial port.

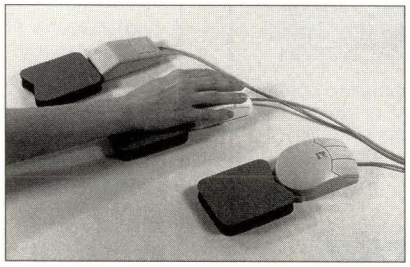
Memory can be expanded from the standard 4 MB of DRAM to 16 MB. The routers support speeds up to 4 Mb/s and access to wide-area network services such as dedicated T1/E1 facilities, packet-switched networks (X.25, frame relay, SMDS) and circuit-switched networks. All three models are based on a 20-MHz MC68030 processors and are housed in a compact chassis measuring 13 by 14 by 4 inches.

Cisco's 20% price reduction establishes a price point for a full-function multiprotocol router/bridge below $4,000.

Cisco Systems Inc.
1525 O'Brien Drive
Menlo Park, CA 94026-1435
Circle 124

Mouse Paws Might Be the Cure

The Mouse Paw, a patent-pending invention, is now available from Marty's Computer Workshop.



The Mouse Paw is a wrist support for mouse users that slides with the mouse, thanks to a velcro attachment. The Mouse Paw's universal design has one edge that is straight to attach to

flat-backed mice such as those from Sun and Apple Computer Inc. The other side is V-shaped to attach to round-backed mice such as those from Microsoft Corp. and Logitech.

Continuous support allows mouse user to work longer and more comfortably, especially with programs that rely heavily on mouse use, and it can also help users to avoid Carpal Tunnel Syndrome by improving wrist posture.

The Mouse Paw is priced at $7.95.

Marty's Computer Workshop
P.O. Box 550
Cambridge, MA 02142-0004
Circle 125

Tractor-Fed with Laser Quality

Facit has introduced a new continuous feed laser printer incorporating a straight paper path designed for feeding tractor-fed paper and pressure-sensitive labels. The D7160 is ideal for many industrial-grade applications including shipping, warehousing, material handling and packaging.

The printer features a high-performance 32-bit RISC-based graphics controller and delivers 16 ppm on continuous, tractor-fed media, independent of text size, bar codes, graphics and variables. The D7160 is shipped with Facit Magic Mode for Microsoft Windows software, which offers printing of bar code labels and WYSIWYG convenience, allowing the operator to view the label on the computer screen exactly as it will be printed. The program runs under Microsoft Windows.

Pricing is $5,999.

Facit Inc.
400 Commercial St.
Manchester, NH 03101-1107
Circle 126

Driver for Color Printers

Gammadata Computer announced the introduction of a new, improved version of their Monesca software print driver for color printers. Monesca 2 is available for Hewlett-Packard Co./Apollo 9000 Series 400 and 700 workstations and UNIX workstations from Sun and Silicon Graphics Inc.

This new version can be installed on heterogeneous networks to give all users access to a central color printing resource. Monesca offers the ability to generate high-quality digital screen dumps, PostScript and HPGL plots from color graphics applications running on UNIX workstations.

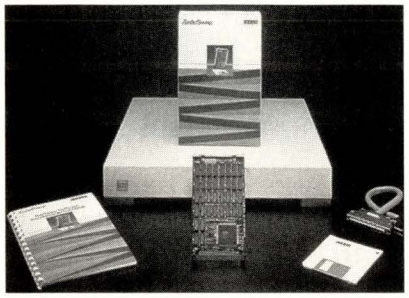
All print functions of Gammadata's color printers can be controlled via Monesca's GUI. The software allows the manipulation of printing parameters including print color, size and position, full or partial digital screen dump.

Pricing for the software starts at $1,790.

Gammadata Computer Ltd.
Worting House, Worting Road
Basingstoke RG23 8PY
England
Circle 127

TurboSwap Additions

Ceram announced additions to its TurboSwap product line that extend capacity to 960 MB for Sun SPARCstations and SPARCservers. TurboSwap is based on Ceram's Page Addressed Compressed Zero Latency



solid-state storage technology.

Additions include the TS1600, a single-slot SBus card that provides 160 MB of storage capacity, and the TSE series of external chassis configurations, which provide from 240 to 960 MB of fast storage in a standard "pizza box" form factor.

The TurboSwap line of PACZ systems interfaces to the SBus and includes software that allows support to be easily configured into the SunOS/Solaris kernel to provide transparent, seamless operation. High-speed, zero-latency swap space and temporary file systems enable significantly higher performance from large data set and response-time-critical applications.

Pricing is $30 to $42 per megabyte, depending on configuration.

Ceram Inc.
2260 Executive Circle
Colorado Springs, CO 80906
Circle 128

15 GB of RAID

A 15-GB compact tabletop RAID unit has hit the market. Unbound introduced its newest product, which incorporates 3½-inch disk drive technology and storage capacity of up to 15 GB. The RAIDSTOR-T3 is a multiplatform data storage system for software-transparent operation on the SCSI port of a wide variety of computer systems including those from Sun, Digital Equipment Corp., Apple Computer Inc., Hewlett-Packard Co., IBM Corp. and more.

It uses either 600 MB or 1 GB of 3½-inch SCSI drives to provide from 3 GB to 15 GB of data storage capacity, with the flexibility of user-configurable RAID 0, RAID 3 or RAID 5 operating modes.

The new unit can be used as an Ethernet RAID server node with the proper front-end platform. It uses a 25-MHz Intel Corp. 80960-CA and has a 32-bit wide microprocessor bus and 1 MB of RAM to control all operations. A 640-KB flash memory module permits easy update of system firmware via floppy disk or modem downloading.

List price ranges from $23,800 to $65,700.

Unbound Inc.
17951 Lyons Circle
Huntington Beach, CA 92647
Circle 129

Correction

The article "Klingons and Federation," *SunExpert,* August, Page 57, contains an error. According to Puzzle Systems, SoftNet Utilities does allow a SPARC system to be used as a file server. For more information, contact Puzzle Systems Corp., 16260 Monterey Road, Suite 250, Morgan Hills, CA 95037.

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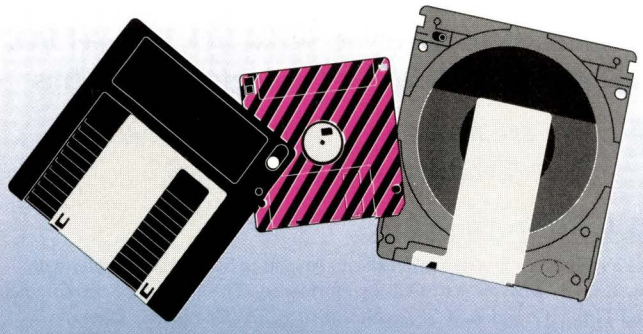

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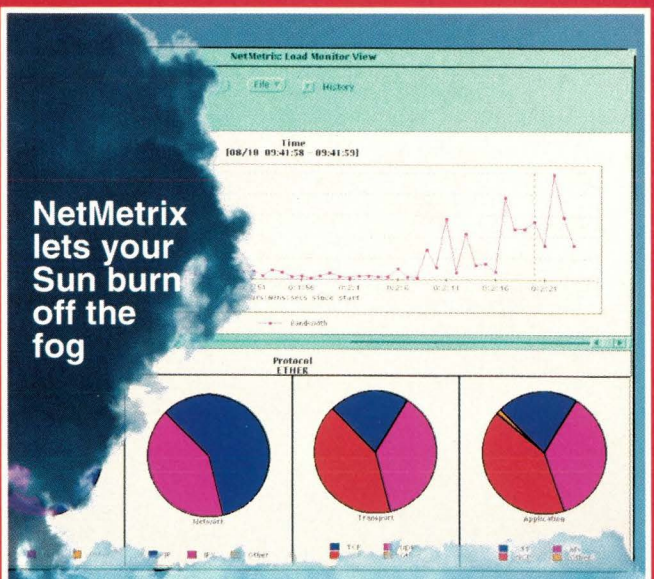

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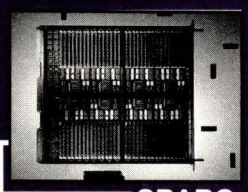

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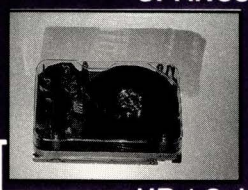

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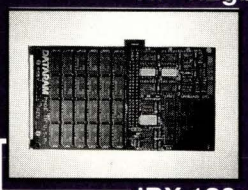

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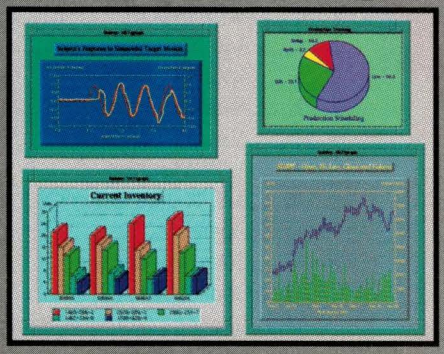

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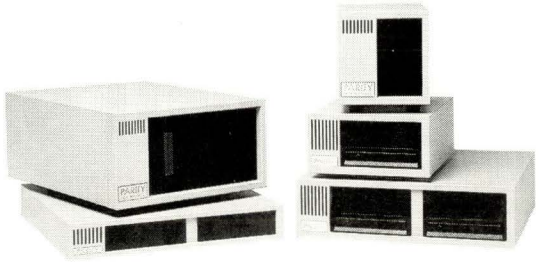

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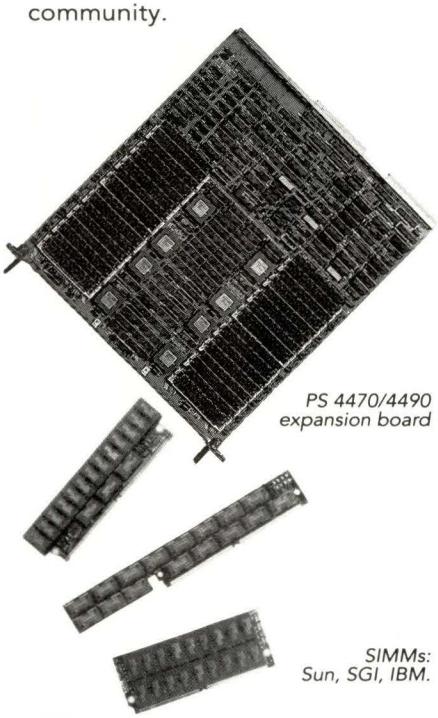

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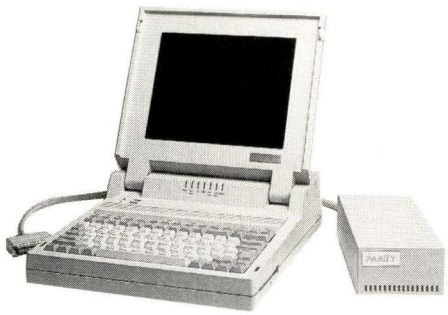

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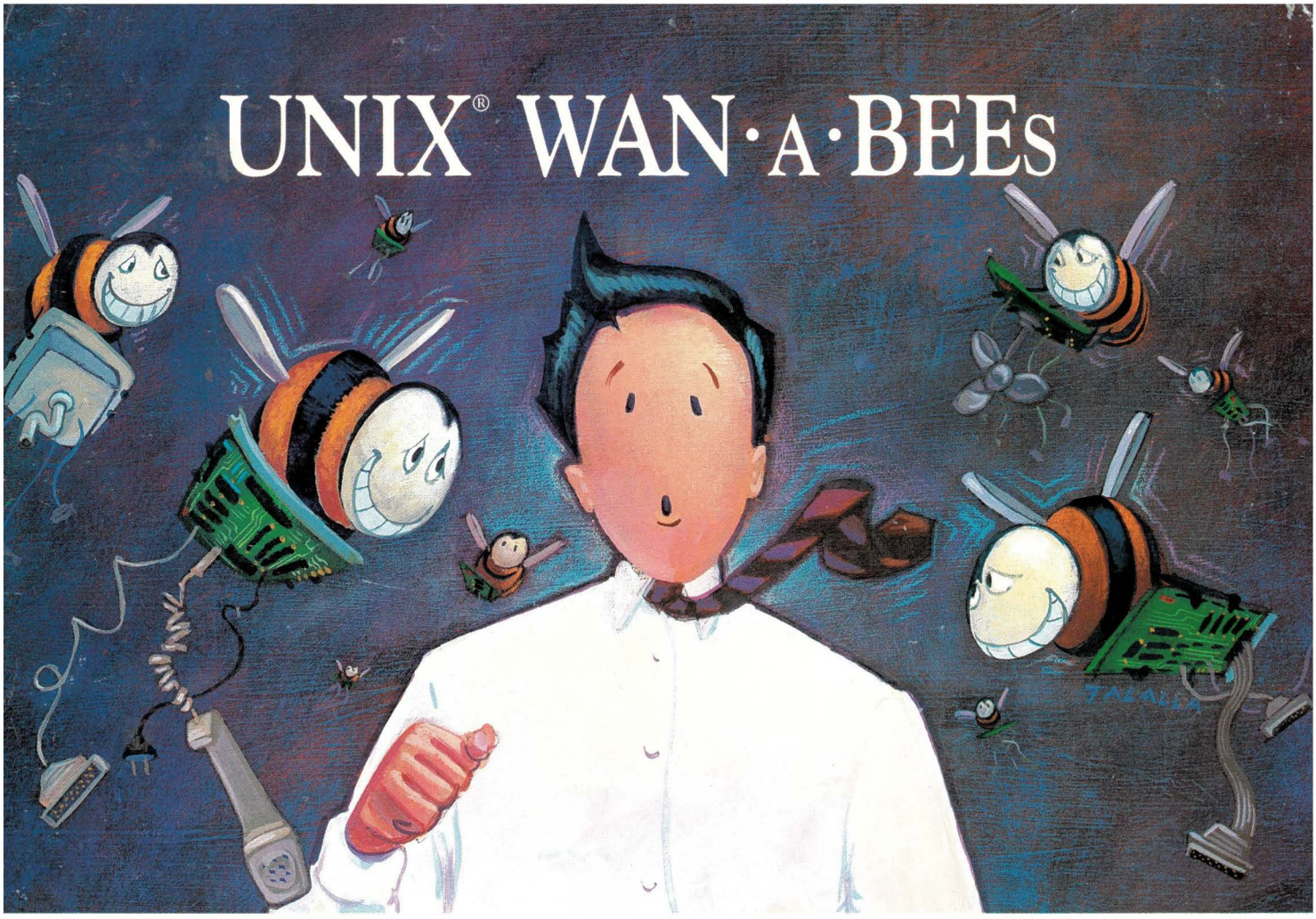

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