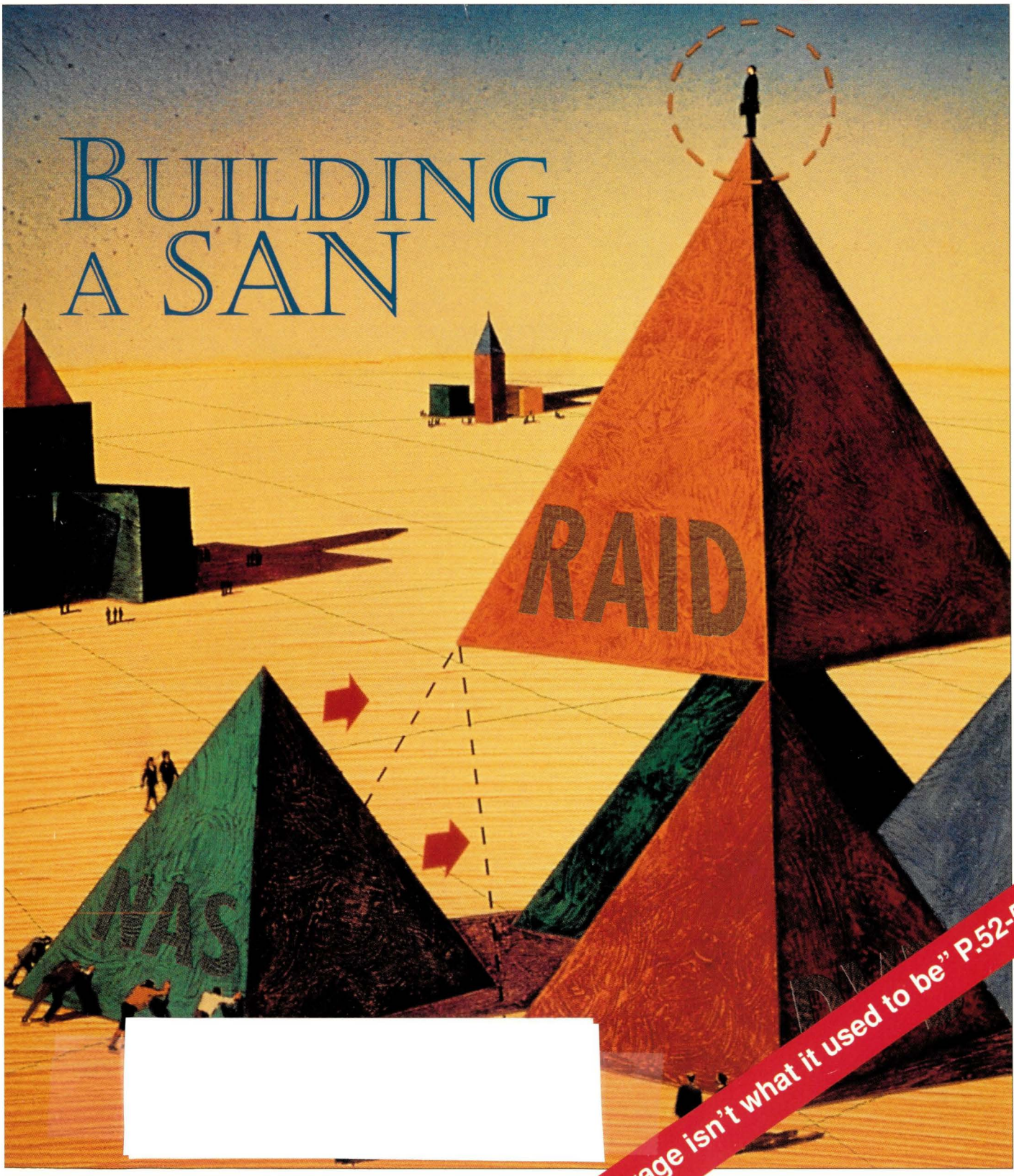
CELEBRATING 10th ANNIVERSARY 1989 - 1999

SUNEXPERT

MARCH 1999
Vol. 10 No. 3 $5.50

The Server/Workstation Magazine



"Storage isn't what it used to be" P.52-53

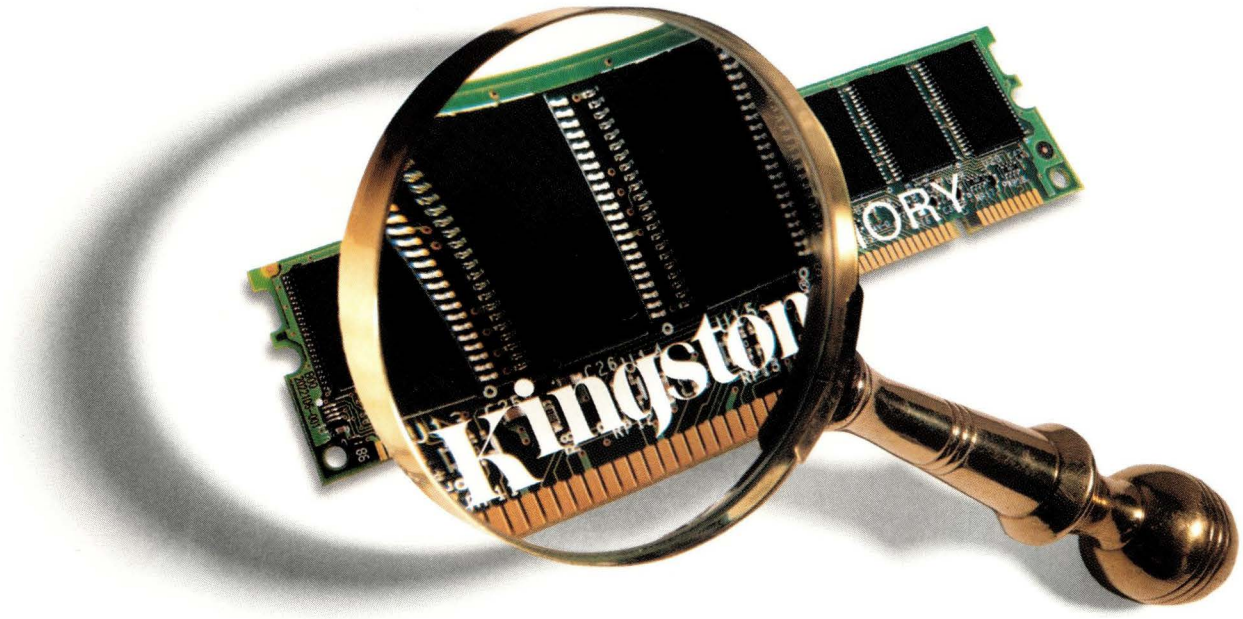
Review: Exceed PC X

Introducing Java Class

www.kingston.com/glass

STILL PREFER MEMORY FROM WORKSTATION MANUFACTURERS?

GUESS WHOSE MEMORY THEY PREFER?



ARE YOU ONE OF THOSE CAUTIOUS SOULS who only buys workstation memory from workstation manufacturers? Well here's a fact that might make you think twice: workstation manufacturers often buy their memory from us. So maybe now you'll finally believe what we've been saying all along—Kingston® gives you 100% reliability and 100% compatibility but costs up to 50% less. That makes Kingston the smart choice. And it's the safe choice, since every Kingston memory module is backed by a lifetime warranty too. Still not convinced? Okay, we'll ship you a 64MB trial upgrade and let you evaluate it for 30 days, free. To see if you qualify call (800) 588-5439. Or for more information go to our Web site at www.kingston.com/glass.

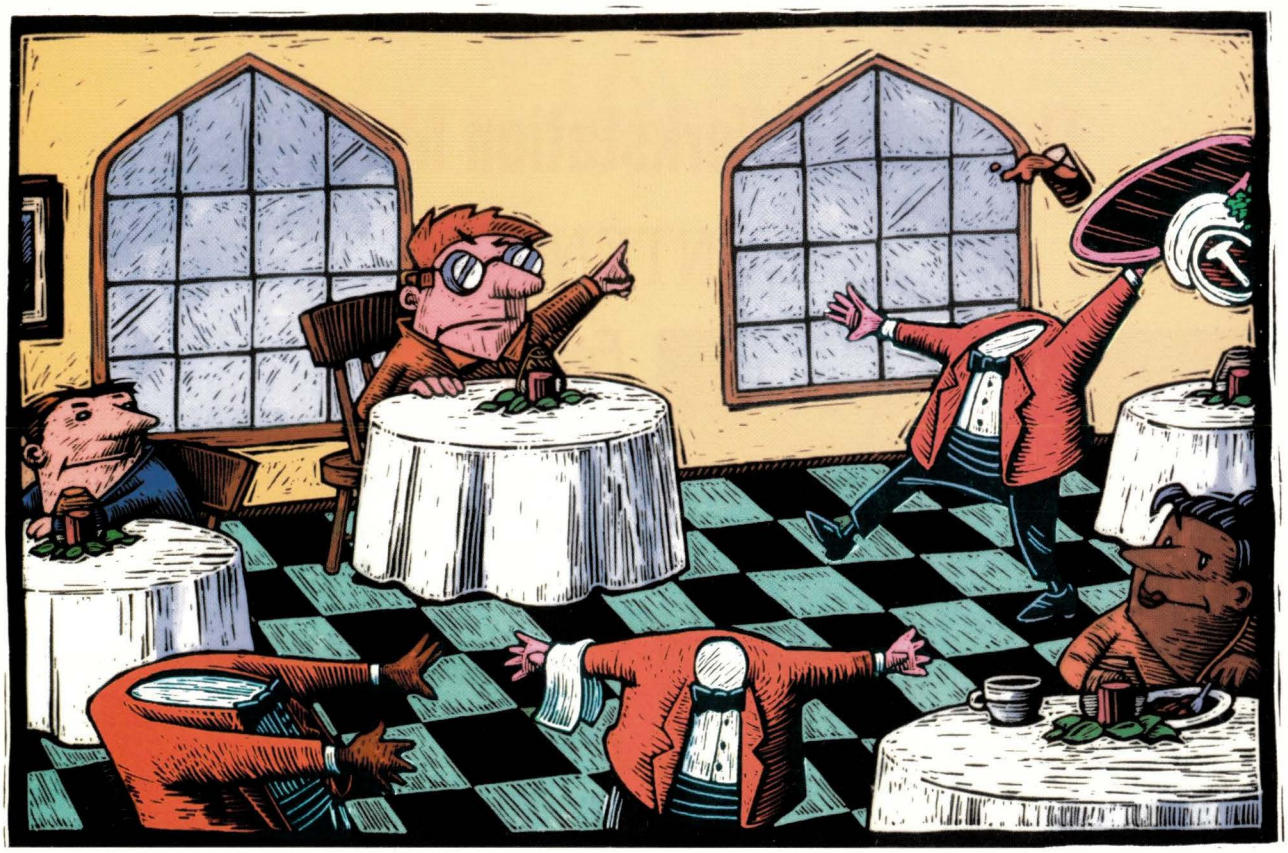
Lifetime warranty for all memory products.

Kingston® TECHNOLOGY

COMPUTING WITHOUT LIMITS.®

ISO 9001 SGS

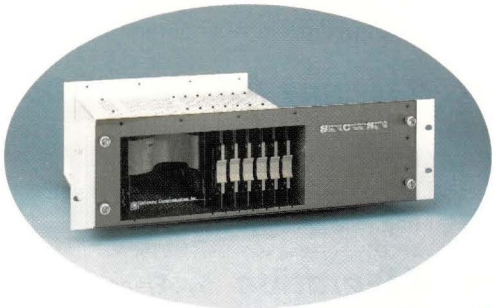
Circle No. 1



Having Trouble Accessing Your Headless Servers?

The SystemConsoleSwitch gives you access to and control of multiple headless servers, from one easy to manage location. Consolidate your server room while saving space and energy by eliminating excess terminals. Access to your headless servers is not limited to the server room - use the SystemConsoleSwitch's modem dial-up or telnet to your servers for off-site access.

More than consolidation, the SystemConsoleSwitch provides you with a contingency that keeps you in control of your systems when devices crash. Alternative access to your servers via the console port ensures that you will always have a contingency for control. And while alternative access is a great tool, it would be incomplete without our audit trail, 32k for each port, telling you why your devices crashed.



SystemConsoleSwitch is a SPARC Verified solution.

800 871-9838

Control
Consolidation
Contingency

Lightwave Communications, Inc.

261 Pepe's Farm Road • Milford, CT 06460 • fax: (203) 874-0157 • sales@lightwavecom.com
www.lightwavecom.com/sun

Circle No. 2

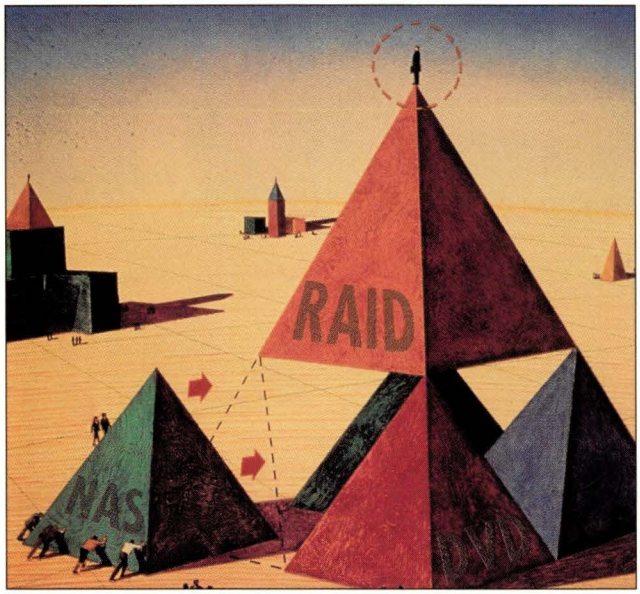
World Wide Web
http://www.cpg.com

SUNEXPERT

March 1999
Volume 10
Number 3

The Server/Workstation Magazine

CONTENTS



COVER BY MICHAEL MURPHY/THE IMAGE BANK

Feature

News

Columns

Product Review

66 Exceed: As Strong as Ever

We take another look at Hummingbird's PC X server and find that in its latest release, Exceed remains as strong as ever and even evolves in functionality.

by Ian Westmacott, Technical Editor

SUPPLEMENT

For Managers of World Wide Web Sites

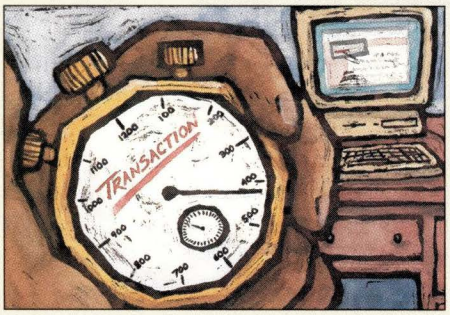
WebServer MAGAZINE

Visit our Web site at
http://webserver.cpg.com

70 Performance Monitoring Complexities

by Paul Korzeniowski

Employees now dial into Internet and intranet servers as often as they pick up the telephone and, increasingly, users download pages filled with graphics and video images. As more and more information flows over corporate networks, network managers must insure there is sufficient bandwidth so downloads take seconds rather than minutes.



74 Caching Out

by Alexandra Barrett, Staff Editor

Are Web sites 'caching' in on the increased access times and reduced bandwidth costs lauded by proxy cache vendors or are they finding themselves under the advertising gun? Administrators are learning that proxy caches wreak havoc with page-count statistics, and page-count statistics are at the heart of how many ad-based sites generate revenue.

77 URL/New Products

New products, services and resources for the World Wide Web market.

Illustrations by ERIN TERRY

Page 79

Departments

BONUS TO ADVERTISERS OF THE MAY ISSUE:

- **USENIX 5th Conference on Object-Oriented Technologies & Systems**
  San Diego, CA
- **NetWorld+Interop**
  Las Vegas, NV
- **Internet World UK**
  London, England

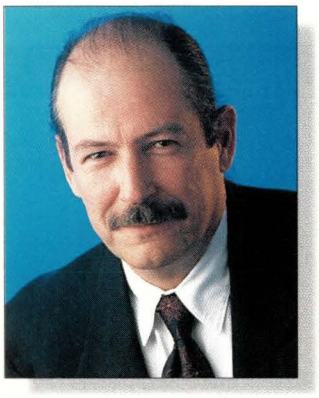
SUNEXPERT Magazine (ISSN 1053–9239) is published monthly by Computer Publishing Group, 1340 Centre St., Newton Center, MA 02459. Telephone (617) 641-9101. Periodicals Postage Rates paid at Boston, MA, and at additional mailing offices. Posted under Canadian IPM #0235873. This publication is free to qualified subscribers as determined by the publisher. Subscription rates are $60 per year in the United States, and $95 (surface mail) and $150 (air mail) outside the United States. Subscription requests can be sent to Circulation Department, *SUNEXPERT* Magazine, 1340 Centre St., Newton Center, MA 02459, or electronically mailed to circ@cpg.com.

POSTMASTER, please send all address changes to *SUNEXPERT* Magazine, Circulation Department, 1340 Centre St., Newton Center, MA 02459. 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@cpg.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

dpryor@cpg.com



SANs: Easy as 1, 2, 3?

While storage area networking is still an emerging technology, many early SAN installations are delivering some measurable benefits to users and administrators. One: They speed up the performance of storage device-to-network data transfers. Two: Connecting RAID and other storage devices over Fibre Channel produces higher bandwidth and faster I/O transfers. Three: These transfers can take place over longer distances than is possible with SCSI interfaces.

That's the grist of this month's cover story, "Building a SAN," by Ron Levine and Michelle Gervais, Page 50. Perhaps it's not as difficult as building the pyramids in the cover illustration, but it is nonetheless hard to find the right mix of hardware, software and networking gear. If you're looking for a way to share storage devices and data over multiple platforms in heterogeneous environments, to centralize remote vaulting, remote mirroring and disaster protection copies without adversely affecting LAN performance, to archive, backup and migrate files without straining LAN resources and to centralize management and administration of storage resources, you'll want to make a beeline for this article.

Also in this issue, technical editor Ian Westmacott takes the latest release of a tried-and-true product for a test drive. Although Windows Terminal Server and browser-based thin clients are getting a lot of attention, many of us who are getting long in the tooth still like our X served up without glitches, bugs and a cacophony of bells and whistles. "Installations needing to provide access to UNIX applications on Windows desktops usually fall into one of two categories: those with power users where the main issues are ease of use and performance, and those with neophyte users where the main issues are transparent integration and management," Ian says. "Whichever category your installation falls in, or even if it falls in both, Hummingbird Communications Ltd. has you covered with its Exceed X server product for Windows."

Watch this space next month for a significant server/workstation announcement from *SunExpert* Magazine.

Doug Pryor

SunExpert
The Server/Workstation Magazine

March 1999 Vol. 10 No. 3

World Wide Web
http://www.cpg.com
Editorial Offices
1340 Centre St.
Newton Center, MA 02459
(617) 641-9101

BPA INTERNATIONAL

Printed in USA

INSIGNIA SOLUTIONS

LOOKING FOR A BETTER WAY TO PUT OFFICE ON YOUR UNIX DESKTOP?

SoftWindows for UNIX 95

Why clutter your desktop when you can put a PC inside your UNIX® workstation? SoftWindows™ 95 from Insignia Solutions is the fastest and easiest way to run Microsoft® Office and Windows® apps *at Pentium® level performance.* A snap to install, SoftWindows 95 peacefully coexists with UNIX on your desktop. Then, you can tap into PC databases, instantly access PC content on the Net, receive PC e-mail attachments and smoothly share files with PC co-workers. It even lets you simply cut and paste text between PC and UNIX. It's simple and it really works! Get what you want without the bulky PC. Call today for your **free** solutions kit. **1-800-906-5607.** Or visit **www.insignia.com/exp.**

Circle No. 3

Code SE2

SunExpert NEWS
Visit Our Web Site http://www.cpg.com

Nothing Succeeds Like Access

Sun Microsystems Inc.'s Java platform is shaping up to be a boon for visually impaired and physically challenged computer users who can't easily navigate a traditional point-and-click interface.

The newest version of Java, Java 2, announced in December, contains several additions that make it easier for developers to create alternate interfaces and enable Java programs to communicate with existing assistant devices such as screen readers.

For example, the Java Swing interface components and Pluggable Look and Feel architecture enable developers to separate an application's user interface from the rest of the program. This permits users to specify different interface components, such as audio or large type, without requiring changes to the basic application. A new Java API–the Speech API, released in October, `http://java.sun.com/products/java-media/speech`–can be used to create a speech-driven interface. For users who want to use existing interface technologies, such as screen readers, braille terminals and voice-recognition software, to communicate with Java programs, Sun also announced the Java Accessibility API and Accessibility Utilities in December.

UNIX, of course, already has a few options for blind users. Emacspeak (`http://simon.cs.cornell.edu/home/raman/emacspeak/emacspeak.html`) is an Emacs-based speech output system for Solaris and a few other flavors of UNIX. Another screen reader, UltraSonix is aimed at X terminals running Solaris 2.5 or Linux. Originally developed at the Georgia Institute of Technology in the early 1990s as a Solaris project, it has since been released into the public domain and ported to Linux (the source code is available at `ftp://multimedia.cc.gatech.edu/pub/UltraSonix.source-7.0.tar.Z`).

While UNIX users do have a few tools at hand, Java is the first platform to actually include a built-in capability to create alternate interfaces. That should make life easier for users who migrate to new or updated operating systems because the same Java application will, theoretically, run on any platform.

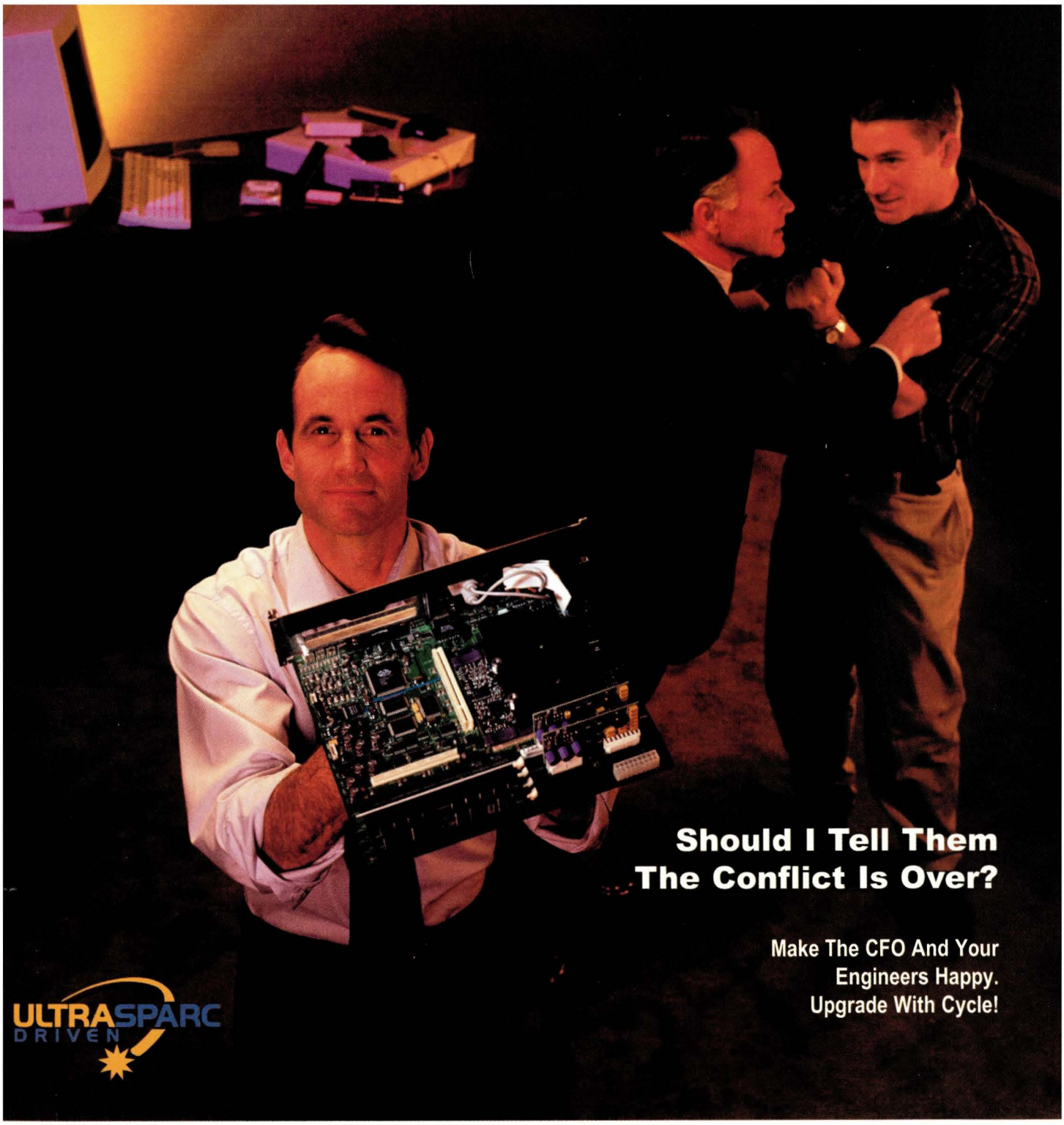
"One area where Java stands out is that such capabilities are designed into the architecture," says Onno Kluyt, senior product manager for the Java component architecture. "That's unique in most computing environments. With most operating systems, access is bolted on afterward, and that leads to a lot less flexibility."

Brian Sellden, a computer science student at the University of Colorado in Denver, agrees. Sellden, who is blind, is a member of the team that worked on the UltraSonix Linux port and has also done some work with Sun's Accessibility API and Swing interface components. "Sun has done a wonderful job of proactively engineering access into Java's Swing components," says Sellden. "Swing's Pluggable Look and Feel architecture, for example, allows non-traditional input and ouput schemes to be handled the same way as traditional schemes." Sellden is planning to use Swing to develop his own "look and feel" interface.

IBM Corp. is also making use of the Accessibility and Speech APIs in its Self Voicing Kit (SVK), a software development kit that allows programmers to create applications that both speak aloud and respond to voice commands. The application is available as a 90-day trial program from IBM's Alphaworks Web site (`http://www.alphaWorks.ibm.com`). A final version won't be released until later this year.

Rich Schwerdtfeger, lead architect for IBM's special needs systems, says early interest in the product is coming from government agencies, corporations and educational organizations that want to accommodate disabled users. Some

JOHN W. KELLEY JR.



Your engineers want new high-performance workstations, but the CFO says budgets are tight. End the conflict now with Cycle's 100% Sun™ compatible upgrades for SPARCstation™ desktops. Your engineers get the power they want and you save 20% to 30% or more off the cost of new workstations. Best of all, you'll help the environment by recycling your older machines.

Cycle's products offer:

- Up to 400 MHz performance
- Complete Solaris™ compatibility
- Sun approved ISO 9000 manufacturing facility
- Quality design by SPARC™ experts
- Sun Enterprise Services support available

Call a truce in your office by calling Cycle at **1-800-672-1200**. Or see us online at **www.cyclecc.com**

Upgrade your old SPARCstations now to 400 MHz

Cycle Computer Corporation
20245 Stevens Creek Blvd.
Cupertino, CA 95014

Circle No. 4

are prodded to invest in such technology by new and existing laws that require accommodation of the disabled. Under the Federal Rehabilitation Act of 1973, educational institutions and federal and state government contractors are required to make federally funded computer technology accessible to disabled users, and the Americans with Disabilities Act of 1992 requires commercial companies to accommodate disabled employees in the workplace.

Others are motivated by a desire to make use of talented physically challenged employees. Schwerdtfeger cites the National Security Agency, which is developing Java software that will allow blind translators to listen to foreign-language conversations and verbally create English transcripts. Because it's in Java, the application will run on the agency's existing Solaris and Windows NT platforms.

Schwerdtfeger believes Java will make it easier for disabled users to migrate from platform to platform. "We want to be able to have disabled users take their accessibility tools with them as they go from job to job, without having to learn a new screen-reading system, for instance, or learn other new assistive technologies. They'll know how to use it right when they sit down."–*sjh*

SGI's Long Good-Bye to UNIX?

Is Silicon Graphics Inc. edging its way out of the UNIX RISC desktop market and into Windows NT? In January, the company took a major step in that direction by unveiling two entry-level Windows NT-based workstations, the Visual 320 and Visual 540, aimed at the multimedia market. While SGI has said it plans to maintain its UNIX product line, experts say this is the first step toward SGI's eventual departure from the UNIX desktop business.

"Fundamentally, I think that SGI sees UNIX as being for the high-end [workstation] and server [markets], with the desktop being predominantly NT. They will, of course, continue current product lines and refresh them to support their existing installed base, but it's a migration strategy. I don't think the volume will be sufficient to really extend it for a long time," says Peter ffoulkes, principal analyst for Dataquest Inc., a market research firm based in San Jose, CA.

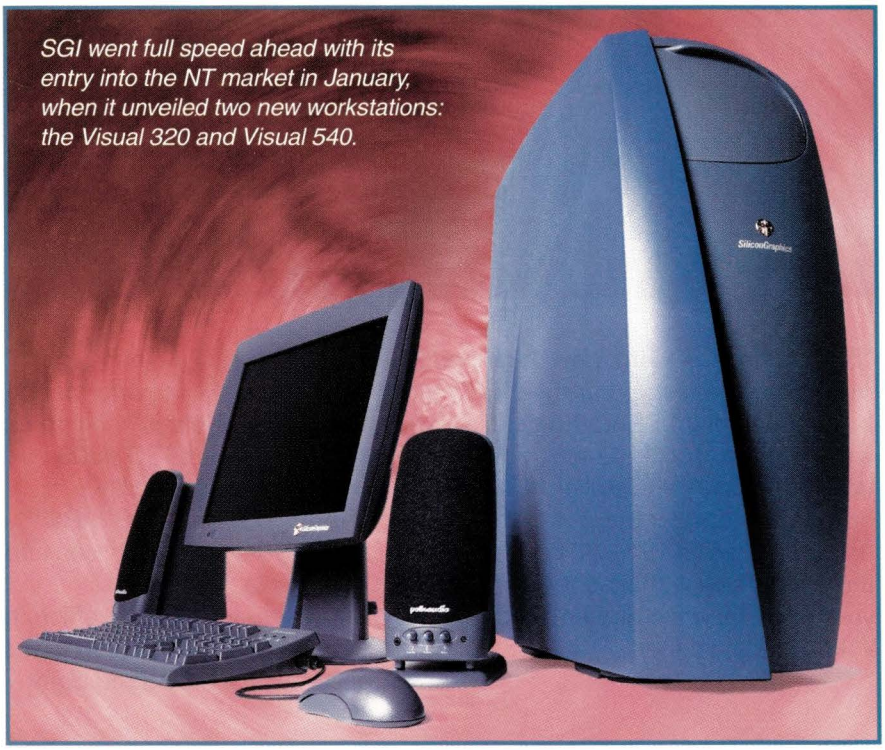
"Clearly, SGI is indicating that their most competitive low-end product is shifting from a UNIX platform to an NT platform," says Greg Weiss, analyst for D.H. Brown Associates Inc., Port Chester, NY.

The new Windows NT-based workstations are expected to help drag SGI's sales out of the doldrums.

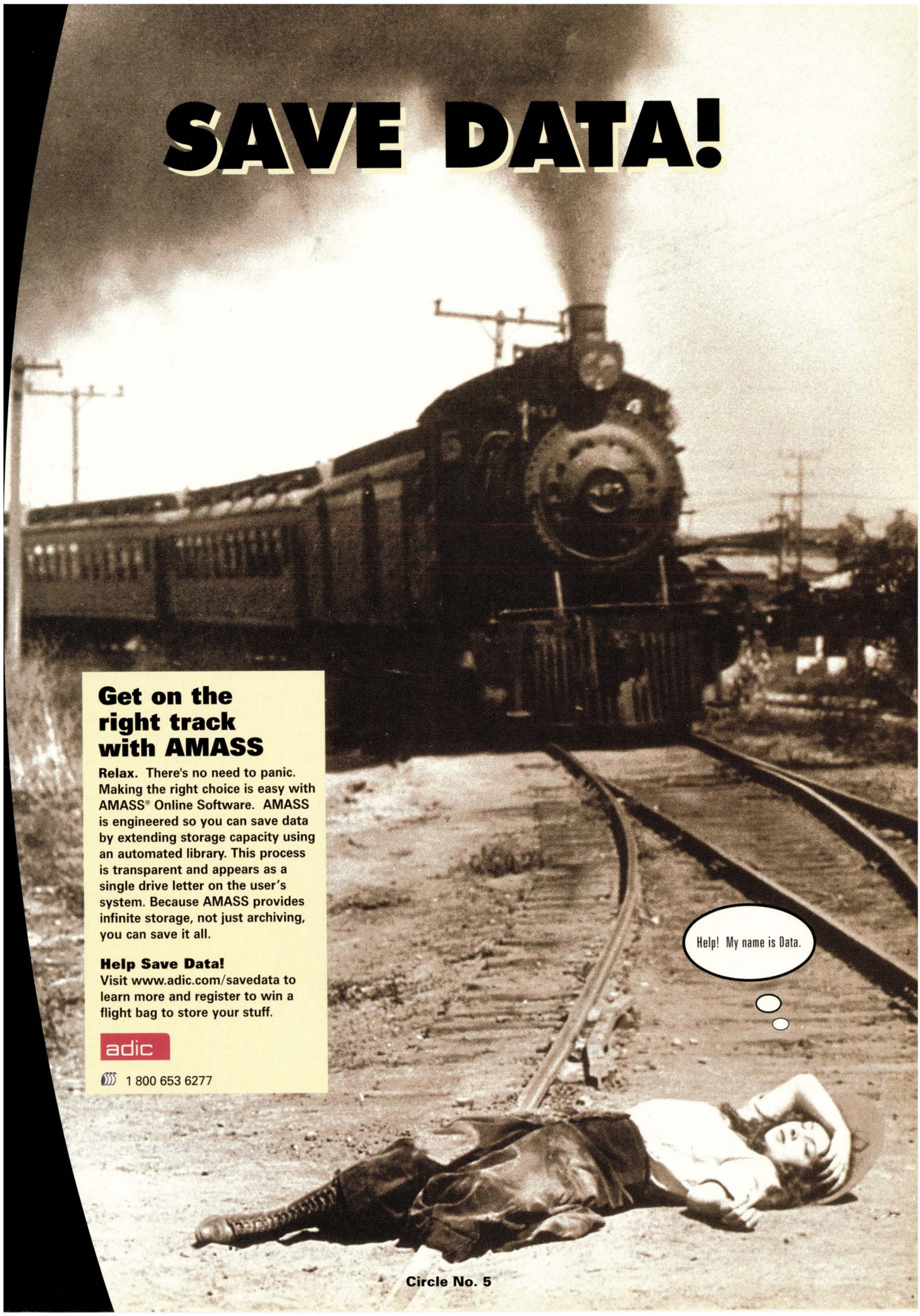
At the same time, SGI announced it would begin to divest itself of its holdings in MIPS Technologies Inc., the Mountain View, CA-based company that manufactures the chips for SGI's line of O2, Octane and Onyx2 UNIX workstations. SGI currently owns 85% of MIPS stock. "The latest Pentium IIs are faster, generally, than the MIPS chips. MIPS are getting long in the tooth," Weiss says.

Indeed, SGI, which announced plans to manufacture NT products nearly a year ago, has seen a decrease in demand for its UNIX workstation products. According to a report from Gartner Group Inc., a market research firm based in Stamford, CT, SGI was in fifth place among UNIX/NT workstation vendors in both revenue and market share in the third quarter of 1998–a decline of 23.4% from the same period in 1997. The new Windows NT-based workstations are expected to help drag SGI's sales out of the doldrums. Indeed, SGI Chief Executive Officer Rick Belluzzo has been quoted as saying that nearly 50% of SGI's revenue could come from NT products by the end of 1999.

The Visual 320 workstation is a dual-processor Pentium II 450-MHz system with up to 1 GB of ECC SDRAM memory and analog video I/O and support for 1,920-by-1,200 resolution. Pricing for the Visual 320 starts at $3,395 for a single-CPU configuration. The Visual 540, which starts at $5,995, is a Pentium II Xeon 450-MHz system with up to 2 GB of ECC SDRAM memory and capable of holding up to four processors. It also supports 1,920-by-1,200 graphics resolution and analog video I/O. The workstations' Integrated Visual Computing architecture, developed by SGI, features a 3.2-GB/s graph-



SGI went full speed ahead with its entry into the NT market in January, when it unveiled two new workstations: the Visual 320 and Visual 540.


SAVE DATA!
Get on the right track with AMASS
Relax. There's no need to panic. Making the right choice is easy with AMASS® Online Software. AMASS is engineered so you can save data by extending storage capacity using an automated library. This process is transparent and appears as a single drive letter on the user's system. Because AMASS provides infinite storage, not just archiving, you can save it all.
Help Save Data!
Visit www.adic.com/savedata to learn more and register to win a flight bag to store your stuff.
adic
1 800 653 6277
Help! My name is Data.

Circle No. 5

ics-to-memory interconnect and a 1.6-GB/s I/O interconnect–features likely to be especially appealing to high-end graphics professionals.

"There is sufficient bandwidth to simultaneously support complex 3D graphics and multiple screens of uncompressed video," says Jay Moore, senior analyst with research and consulting firm The Aberdeen Group, Boston, MA. "That lets you work with very large models of uncompressed data virtually in real time. At this price range, if you were looking at competing products, you'd probably be forced to compress data or sacrifice some of your real-time experience."

Cliff Aspey, director of product marketing for SGI's NT workstation division, says the boxes are aimed at anyone doing visual computing applications such as CAD, multimedia or scientific analysis. "The architecture allows you to pump a lot of data through the system–anything dealing with very large data sets, such as uncompressed video," Aspey says.

The SGI workstations are likely to give Sun Microsystems Inc.'s low-end Ultra 5 and 10 workstations a run for their money, according to D.H. Brown's Weiss: "I'd say these workstations definitely leapfrog the Ultra 10." However, Weiss points out that Sun's low-end products may still have better success appealing to the general CAD market, which doesn't necessarily need all the high-end multimedia capabilities. "SGI has a lot of advanced audio and video capability, but that's not especially useful to CAD guys who make up a third to a half of the market," says Weiss. Customers can pick up a Sun Ultra 5 for $2,495 and higher and an Ultra 10 starting at $4,295. The addition of a Sun Elite 3D m3 graphics accelerator will tack another $3,395 onto the price tag.

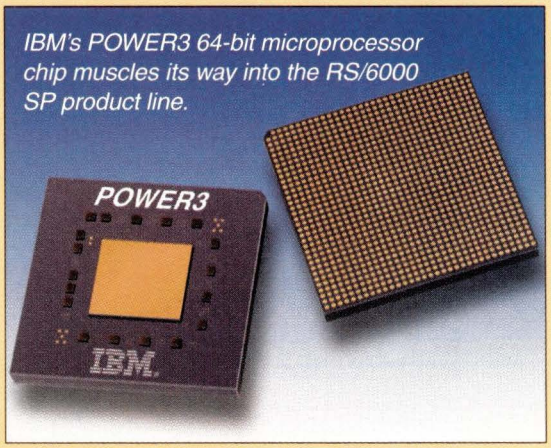
But many customers may not do a straight hardware-to-hardware comparison of the products, says The Aberdeen Group's Moore, because most people are purchasing workstations based on the software they're already using. "For the most part, customers have made up their mind about which platform they're going to go with. I don't think SGI's Intel products will take a lot of market share away from Sun's Darwin series [the Ultra 5 and 10] because a purchaser of Darwin is someone who wants to remain in a UNIX RISC environment."

SGI's Aspey agrees, "Customers are making their [workstation] decisions based on their software needs rather than on hardware comparisons." Because many customers still use UNIX,

SP Adds POWER3

IBM Corp. has added muscle to its RS/6000 SP product line by introducing the POWER3 chip to the supercomputer. "The introduction of the POWER3 is actually the commencement of our POWER3 program on the SP," says Dave Turek, director of technical strategies at IBM. "This is Step One of what should be a pretty long introductory series of steps over the course of time."

The POWER3, a 64-bit, 200-MHz RISC-based microprocessor, made its debut in the RS/6000 43P Model 260 graphics workstation in October. The new chip comprises eight parallel execution units fed by a 6.4-GB memory subsystem that prefetches data from the main memory. And it is now available on the SP, which is known for its headline grabbing stunts such as being used in Deep Blue, the machine that beat chess grandmaster Garry Kasparov.



IBM's POWER3 64-bit microprocessor chip muscles its way into the RS/6000 SP product line.

The SP is also known for its building-block structure, which consists of thin, wide and high processor nodes. The POWER3 is offered as either a thin or wide node and provides increased bandwidth between paired nodes.

"You'll see the connection of these [POWER3] nodes with an adapter technology that will get us up to 160 MB/s," says Turek. "Since the SP architecture is meant to scale, the composite bandwidth of the total system is simply the multiplication of the number of nodes you have by that 160 MB/s."

One of the early benefits of the POWER3 microprocessor is the integration between the strong floating-point capabilities of IBM's POWER2 architecture and the symmetric multiprocessing (SMP) capabilities of the PowerPC. Steven Kellogg, director of advanced information technologies at the Center of Academic Computing at Pennsylvania State University, State College, PA, believes IBM has found the performance sweet spot between the two older microprocessor implementations.

"The PowerPC-based SMPs provided excellent integer performance but were weak on floating point, and the POWER2-based systems gave impressive floating-point performance with mediocre integer and were not SMP-able," he says. "The new POWER3 systems are SMPs with both excellent integer and floating point."

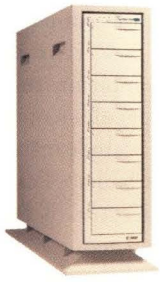
Kellogg says the SP deployed at Penn State is used for a variety of functions, including high-performance engineering, scientific scalar and parallel computing, large-scale Internet services such as email and news delivery services, as well as AFS and DFS file services and databases. "Our initial use of the POWER3 nodes will be exclusively for high-performance computing, so I believe its terrific floating-point capability will be of great benefit to the scientific applications that we will be running," Kellogg says.–*ptc*

ANDATACO® RAISES THE SPEED LIMIT!

Sun SCSI Storage at 80MB/sec Now!

ANDATACO GigaRAID™/8000LVD

- Award winning ANDATACO storage enclosures.
- Host Bus Adapter (HBA) technology designed by Antares Mircosystems® exclusively for ANDATACO.
- IBM® latest generation LVD disk drives.



ur perfect combination to create unparalleled storage performance. Enjoy longer cable lengths (12m) while pporting 15 devices in a single solution. The GigaRAID/8000 LVD provides storage and performance to meet calating requirements for more capacity and faster data movement, up to 288GB per storage system.

40 Mesa Rim Road
Diego, California 92121
-453-9191
619-453-9294
ail: inquire@andataco.com
.andataco.com

Obtain your limits and improve your business investment!

ANDATACO
The Storage Experts

STA IRAB SAN READY

Circle No. 6

1, VAR, Reseller and Volume discounts available.

SE-LVD

SGI will continue to maintain and enhance its line of UNIX workstations for the foreseeable future, says Aspey. "The more complex and specialized the applications, like the sciences, the longer it will take to get to NT... The UNIX market as a whole is still quite a large one."

Nevertheless, SGI–and the low-end UNIX workstation market as a whole–will probably become more NT-focused down the road. "The bottom line is that, over time, the workstation market place will largely go to NT. The decline in UNIX systems sales has certainly slackened off, however, the majority of growth in the future will come from NT-based products," says Dataquest's ffoulkes. "For Sun, that's a mixed bag. I suspect that over time nearly all of Sun's UNIX competitors will move away from the low-end of the UNIX systems and concentrate on mid- to high-end products. That has the potential to leave the UNIX workstation market under Sun's control–but that market will keep decreasing."–*sjh*

Life After Y2K

Last-ditch Y2K projects will benefit from Sun Microsystems Inc.'s new SunScan 2000 auditing tool for Solaris SPARC and Intel Corp. systems. Available as a free `tar` file from Sun's Y2K site (`http://www.sun.com/y2000`), SunScan verifies each Solaris application's version number to see if it is Y2K-compliant. If a product isn't compliant, the tool lists the patches or upgrades required to make it compliant.

SunScan tests "literally thousands" of Sun applications, says Tony Hampel, director of Sun's Year 2000 Project, and about 90% of all Sun software, past and present, has been Y2K-tested and put on the SunScan list. Products still undergoing tests will be included in future releases of SunScan. But the rate of additions isn't expected to be high, Hampel says.

"We think we're in pretty good shape. Earlier in the process, there were new patches coming on fairly frequently, but that has slowed drastically," says Hampel. "That's good news because customers don't want to feel like the system they just tested needs to be tested again in two weeks, or that it's not solid in its Y2K compliance."

While you'll need a SunSolve service account to get help updating your Solaris applications, Sun does offer free help in making older versions of the Solaris operating system Y2K-compliant. Late last year, Sun began offering all of its Y2K operating system patches for free to anyone who wanted to download them. Previously, only patches for Solaris 2.6 were available at no charge. The patches for Solaris 2.3+ and SunOS 4.x are located at `http://sunsolve.sun.com`.

However, relying solely on the SunScan tool isn't enough, experts say. "You can't take the Sun tool and completely finish your Year 2000 project," says Andy Diamondstein, analyst for Giga Information Group, an IT market research firm based in Norwell, MA. "But it will help you figure out what you need to do to your Sun applications in order to bring them into compliance."

SunScan tests 'literally thousands' of Sun applications, and about 90% of all Sun software, past and present, has been Y2K-tested and put on the SunScan list.

SunScan is best used in combination with other testing tools, says Paul Wang, president of SolutionSoft Systems Inc., Santa Clara, CA, maker of a Solaris testing tool called Time Machine. Unlike SunScan, Time Machine actually tests an application's response to new date information, so users can see exactly how a given program will run on January 1, 2000, or any other date. Wang says his product's time-simulation approach will offer a more accurate picture of how an application will perform than a simple auditing tool, such as SunScan, which only looks at the version numbers and updates of applications.

"If you check a version number, it's based on the current knowledge [of the vendor] as to whether the product is Y2K-compliant," says Wang. "They could later discover there's a Y2K bug in it." In addition, SunScan is simply for Sun applications, not for any other commercial or customized code that might reside on a system.

SunScan supports systems running Solaris 2.3+ and is cross-matched with the Sun product compliance sheet located at `http://www.sun.com/y2000/cpl.html`. However, it is a good idea to use both the SunSolve list and the SunScan report, because slight discrepancies may occur. For instance, when Wales Wong of the IT department at the Open University of Hong Kong ran SunScan 1.0, he was told he needed to upgrade from CDE 1.0.2 to 1.2. However, the SunSolve site listed patches purported to make 1.0.2 Y2K-compliant. Sun's Hampel says the latest version, 1.1, released in January, will help fix some of the discrepancies that arose from Version 1.0, which gave users a long list of ideal fixes. This latest version now starts with the minimum requirements and lets users decide if they want to go for a maximum fix.

Providing free audit tools and system patches isn't unique in the industry. For instance, Hewlett-Packard Co. offers free patches and an audit tool for its HP-UX operating system. And in January, Microsoft Corp. announced a free tool, the Product Analyzer, which will perform a Y2K audit of a PC user's hard drive.

But while such free support isn't rare, it also isn't something that all software and hardware vendors are providing. Overall, Diamondstein thinks Sun is being fairly accommodating in providing free Y2K support via SunScan and its operating system patch site. "It's not going to be your solution to your Year 2000 problem... But you can't really expect them to provide too much more than that."

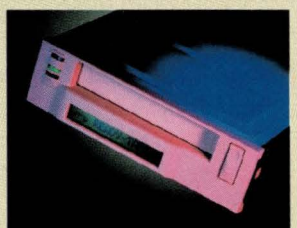
And, of course, for harried IT managers attempting a last-ditch Y2K effort, any free assistance is beneficial. International Data Corp., a research firm based in Framingham, MA, estimates that worldwide corporate spending on Y2K products and services in 1998 reached $87.4 billion–about 6% of the total IT expenditures for that year.–*sjh*

Introducing a Sun system with Mammoth power.

Sun Microsystems offers complete network solutions backed up by powerful Mammoth technology.

Searching for intelligent life in the universe of network backup? Sun Microsystems has the answer. For performance and reliability that are out of this world, back up your Sun Enterprise™ 450 server with an intelligent Sun StorEdge™ L400 library equipped with Mammoth tape drives. Mammoth's 32-bit RISC processor, Adaptive Data Buffering™ and read-while-write technology provide high data availability in Sun systems around the world.

If you need a data storage solution with Mammoth power, contact Sun Microsystems.



Exabyte's high-capacity Mammoth tape drive transfers data at 6 MB/sec

Sun StorEdge L400 library with Exabyte Mammoth drives. Power, performance and reliability.

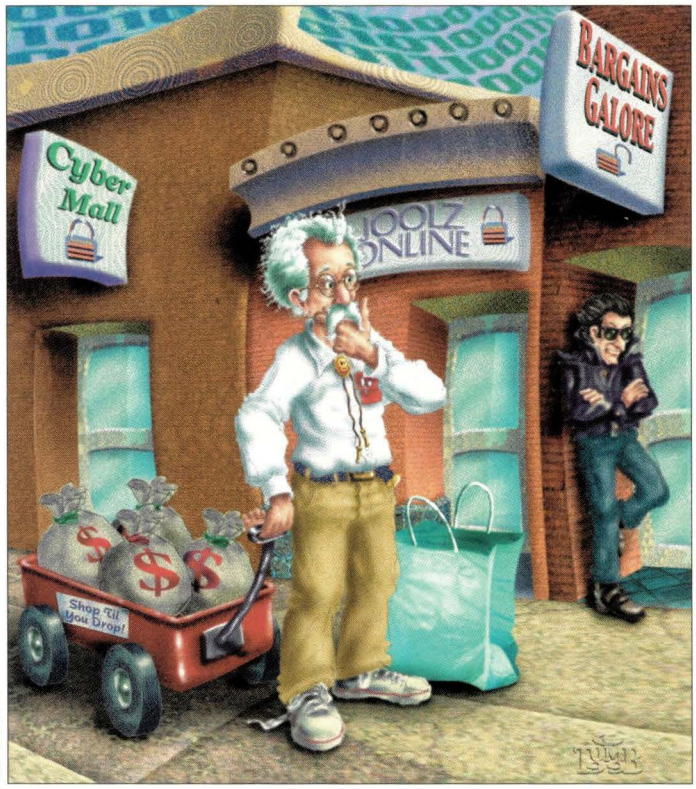
For information about Sun Systems and storage solutions, call 1-800-622-4786 or visit us on the web at www.sun.com.

Exabyte®
www.exabyte.com

Sun microsystems

Ask Mr. Protocol

by Michael O'Brien



TOM BARRETT

"Sign my snarling doggie."
– The Bobs, "Shut Up and Sing"

"Do you know what a ticket to New York costs?"
"Of course not; nobody does. It changes every day."
– "Sleepless In Seattle"

"I've got the best user agent ever. It makes a note of everything I like and figures out how to steal it."
– Internet chat stadium circa 2010

The Bazaar, the Agora and Mr. P.

Q: *Look, can I actually get a question answered this month? I brought a whole case of Big Stuf Ding-Dongs. It makes me feel like a supplicant at the Oracle of Delphi, but I'm worried. Just because my browser shows a blue key or a locked lock or whatever, why should I trust it? How secure is my credit card number and personal information on Web sites that actually claim to be secure? And come to think of it, why is Mr. Protocol replacing all the keys on that cash register with infrared sensors?*

A: Oh, all right. Here, give me those quick before he notices. Now if you want the full treatment, we'll need a python. It *is* the Pythic Oracle, after all. Go out into the back garden and head away from the house. That's right, it's bigger than it looks, isn't it? When you get to the part where the statues are slowly moving, you're on the grounds of the House Absolute. Go to the Hypogeum Amphictyonic and…oh, well, all right then, we'll do the short form. Hand me that garter snake over there. Probably just as well. Last time, the python ate all the Ding-Dongs. Looked like a pearl necklace in a snakeskin bag. Himself was *not* pleased. Oh, you noticed his boots. A bit over the top, aren't they? But flashy, and waterproof to boot, so to speak. Of course, we had to get another python.

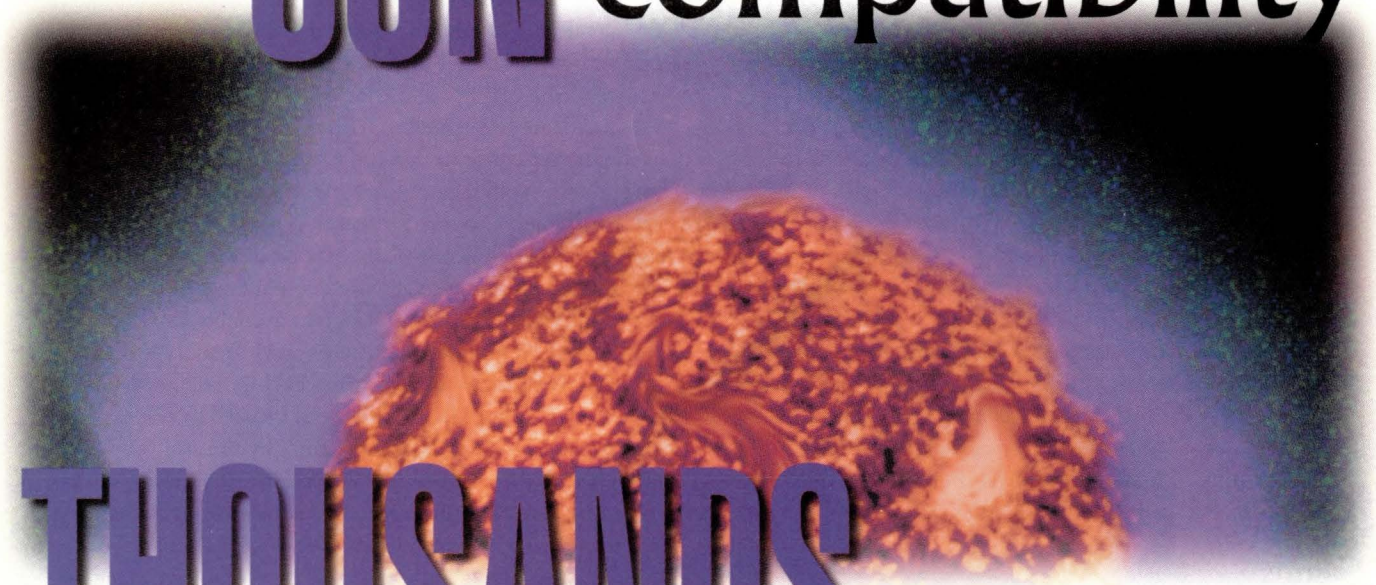
Let's begin. *Iä! Hastur!*

Of course, you know there is no such thing as absolute security. Any commercial transaction contains an element of risk, however small. It is up to the consumer to evaluate that risk and make a personal decision as to its size relative to the benefits to be gained. Which all sounds like a bunch of mush, until you realize that the reason we don't do this for every transaction is that almost all of our daily transactions are learned at an age, so early we can't even remember the occasion. We rarely, if ever, consciously evaluate risks we've grown up with. We can't. If we did it all the time, we'd go berserk just trying to manage a day.

Most of our risk management strategies are subconscious. We don't flash around our credit cards. Some of us, making a trade-off between risk and convenience, gather up all the little bits of carbon paper from credit transactions and carry them away. We don't carry our entire paychecks in cash, mostly. We don't keep all our money on our person, at least not if we have enough to worry about. Some keep it in banks. Others, having had unfortunate experiences with banks, keep it in the mattress. Still others keep it in this funny little compartment they noticed under the…um, never mind.

The point is that it is possible to get burned in the real world. It's why some people go to great efforts to keep their Social Security Number secret, despite everyone's best efforts to spread it as far as possible. Identity theft is a mess to recover from. And, of course, every clerk who handles credit transactions theoretically has the capability to do mischief with the numbers that cross the counter.

full SUN compatibility



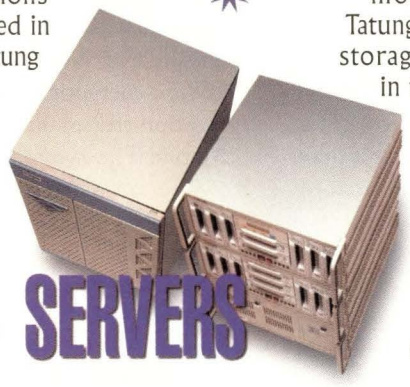
THOUSANDS installed

Single, Dual or Quad

SBUS

With 10's of thousands of high quality workstations and servers installed in North America, Tatung is second only to Sun in SPARC®-based computing. Tatung U-Series workstations feature 100% Sun UltraSPARC™ microprocessors in single or dual processor configurations. And our latest server line offers up to four processors. All systems are fully compatible to Sun and are priced for less.

ULTRASPARC™ DRIVEN

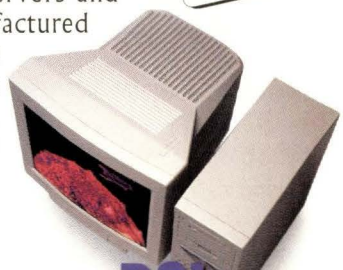


SERVERS

Rackmount Servers and Storage Subsystems.

Tatung was licensed by Sun to manufacture compatible systems more than 10 years ago. All Tatung workstations, servers and storage units are manufactured in the U.S. So call us today to power-up a system for you. 1-800-659-5902

SPARC Compliant SCD 2.1



PCI

Desktop and Rackmount Solutions for Commercial and Industrial Applications

Tatung's full line of UltraSPARC workstations, servers and storage.

TATUNG®
SCIENCE & TECHNOLOGY, INC.

The Intelligent Choice in SPARC Computing Solutions

Phone 1-800-659-5902 or (408) 383-0988
email — mkt@tsti.com
website — www.tsti.com

18GDA

Circle No. 7

Given all that, it's safe to say that most online transactions are probably more secure than the real-life variety, because on the Internet there are likely to be fewer people around and about watching over your shoulder. In order to read your credit information as it moves over the Internet, miscreants would either have to tap your phone line and sniff the packets, infiltrate your Internet service provider (ISP) or backbone provider, or infiltrate the merchant or the merchant's ISP. All of these are usually too much work compared with mounting an attack on the merchant's system and stealing whole lists of credit card numbers. This does happen, though it is rare compared with the more mundane sorts of nonInternet-related credit card fraud.

Further, these methods only work if the thieves can make sense of the numbers, that is, if the transaction is unencrypted. That's what the little lock is for in the corner of a Web browser window. When active, this indicates that the information flowing in both directions is encrypted. If only this were as easy as it sounds. Is the claim always true? How can it be checked?

Mr. Protocol is glad you asked.

In Thee We Trust

In a real-life transaction, verification is usually as simple as making sure someone's picture matches, or their signature matches, or some other extremely complex, nondigital and, hopefully, unique thingie that is difficult to fake matches. Preventing someone from copying the information is as simple as making sure that a) no one else is looking, and b) no physical record of the sensitive stuff remains unaccounted for. On the Internet, bits, as they say, is bits. Some other way of coming to trust the other party is needed.

Currently, that way is fairly complex. The little key or lock icon means that the page you're viewing was encrypted, and that any information included in a Web form that you fill out and submit on that page will likewise be encrypted. The software that does this is known as Secure Sockets Layer, or SSL.

Without going into detail about how it does what it does, which is a mind-numbing sequence of digital certificates, digital signatures and encryption modules, we can say several things. Each secure page is backed up by a certificate, which you can take a look at. Certificates are issued by certificate authorities. Unfortunately, at present, these certificate authorities are not as well-known as, say, the Federal Reserve. Right now, and for a while to come, they are just companies. One must simply become familiar with the companies. Trust is funny. Few of us have ever even looked at a Federal Reserve bank, let alone at anything which legally makes it responsible for backing up our own banks. Most of us don't even know who Visa and MasterCard are, or why they are only likely to rip us off blind in a legal fashion, as opposed to, say, inserting a bogus $14,000 charge on our bill and suing us blind just because the chairman of the board of Visa Inc. needs new Italian shoes. This hasn't happened to anybody we know of, so we trust Visa and MasterCard and the Federal Reserve to at least make a good-faith attempt to keep the books straight and to own up to mistakes.

So it is, finally, with secure Internet transactions. They're backed up by the good name of the certificate authority, even though we've never heard of these authorities before. Life in the fast lane. The point is that every single secure transaction on the Internet can at least be checked beforehand for the names of the certificate authority and the entity to whom the certificate was issued.

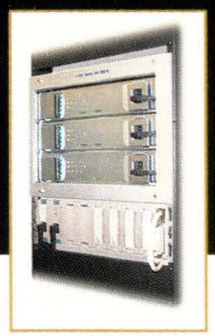
Before we continue, a word about tampering. One could imagine that someone might forge a certificate in order to cause mischief. Certificates possess what's called a "digital signature," which is one of the few pieces of Internet technology that is beginning to acquire enough trust to be wired into the law. Certificate authorities make available what's called a "public key," a number that can be used to encrypt or decrypt messages to or from the authority. Each public key has a corresponding "private key," which can be used to reverse the operation, and which is held in secret by the authority. A digital signature is produced as follows. First, the message to be signed (in our case, the certificate) is run through a hashing algorithm, which creates a short-form "characteristic" of the message. Any change in the message will result in a change of the characteristic. Next, the characteristic is encrypted with the issuer's private key. If the characteristic is decrypted with the issuer's public key, and then checked against the message, it proves that the message is indeed the one that was intended. This proves the certificate is both correct and came from the certificate authority.

Once we have a correct certificate, it is used in the encryption and decryption of the packets in SSL. So far as is known, no one has ever cracked this encryption. Of course, the United States mandates that only 40-bit encryption (an encryption key of 40 bits in length) can be exported, and we know that a machine can be built for around $100,000, which can break such an encryption in a matter of hours (because someone did exactly that to prove the point). Domestically, though, 128-bit encryption can be used and, of course, 128-bit encryption created outside the United States is just as tough. No one is known to have broken 128-bit encryption.

You can watch some of this mechanism go by. Mr. Protocol, in fact, always does. Look at the "Security" menu option on your Web browser while you're looking at a supposedly secure Web page, and you'll be able to get a look at the certificate involved. "View Page Source" is also useful for making sure that the form being sent back is covered by an "https:" type identifier. The "s" stands for "secure." This is especially valuable when you're looking at a site that uses frames. Frames separate the Web page at such a high level that a secure frame may not trigger the "secure" icon in your Web browser. You have to look at the security information and the page source to make sure the frame is actually secure.

Of course, just because a transaction is secure doesn't necessarily mean you still want to go through with it. Assuming you desire whatever goodies are being sold, you still want to get the best price for them. The current state of Internet shopping is so chaotic that it's possible to pay a large spread of prices for the same item. This is mostly because it's nearly impossible to find all the pages that are selling the same item, despite the

When it absolutely positively has to stay up all the time.



Available in Rack Mount

Introducing the Resilient® Ultra fault tolerant server. It delivers when any downtime or data loss is too much.

We created the Resilient® Ultra fault tolerant server specifically for your mission critical network computing applications: firewalls, web, DNS, NIS+, license server, telecom, databases – any job where even a little downtime is too much.

Unlike software-based "high availability" schemes, our triple redundant architecture keeps applications running non-stop even if a logic board fails. Which means you won't experience unrecoverable data loss, service interruptions, high administration costs, reconfiguration delays – or constant worrying about your critical applications.

Resilience fault tolerant servers are based on industry-standard Sun UltraSPARC technology and the Solaris OS, so they integrate seamlessly with your existing network and applications. Their hot-pluggable modular construction offers exceptional ease of maintenance – you can even replace any failed component in under 60 seconds.

So now you can enjoy non-stop availability and the performance of an UltraSPARC server – at a surprisingly low cost. For an informative white paper with more information about the new Resilient Ultra, simply call us at (800) 977-9008 or visit www.resilience.com.

RESILIENCE
Fault-Tolerant Network Computing™

1755 Embarcadero Rd., Suite 120 · Palo Alto, CA 94303 · (800) 977-9008 · (650) 843-3600 VOICE · (650) 843-3609 FAX · email: sales@resilience.com

Circle No. 8

best efforts of the large Internet search engines. One can spend hours looking for the best deal even on items that are commonly available. One has.

Remember the model of the cathedral and the bazaar? The cathedral model is one of centralized software development with little or no outside input, while the bazaar model is of a whole bunch of independent hackers working on a common piece of open-source software. With the Internet, the bazaar model is the only one. All of `.com` is flat, there are no distinguished sites. At that level, all Web sites are equal.

If ever there were a fruitful field for the application of user agents, this is it. It ought to be possible to start one's own intelligent Web crawler to go through the scut work of looking for all the pages that sell the goods one is after, while one is presumably spending time in more profitable (or at least more pleasant) pursuits. One could, in fact, cheerfully commit murder for the privilege, and then use the agents to find the best lawyer to get one off.

Let's Have Some Order!

There have been many attempts to bring commercial order to the free-for-all chaos that is the Internet. Merchants do not have a venue to bring themselves to the attention of potential customers in any organized way. Real-life geography is organized. We know where shopping malls are located. We have an organized *Yellow Pages* that carries ads and simple name-and-address information. Shopping malls have directories. Storefronts are designed in such a way that potential customers know within seconds what the store is all about.

Nothing like this exists for the Internet, yet. Customers have to dig everything up for themselves. In a city with no zoning and no *Yellow Pages*, customers would wander around until they found the minimum number of stores for what they needed, and leave it at that. That's how the Internet is now. Those few people who have staked out a market that makes this chore easier are billionaires. Consider `Amazon.com` for books and `Ebay.com` for online auctions.

User agents would solve a lot of this without requiring a restructuring of the Internet. At first, they would merely assist us in finding a collection of online businesses that fit our profile of what we're looking for. As the technology develops, eventually they'd be able to carry out negotiations on our behalf. Combine this with advances in portable and wearable computers, advances in PDAs and Version 6 of the IP protocol, and things get very interesting.

IPv6 is designed to overcome some of the shortcomings that have cropped up as the current IP, IPv4, begins to show its age. In particular, IPv4 is defined in such a way that some classes of address are getting scarce. IPv6, on the other hand, will allow every atom in the universe to have as many subnets as it wants. This means it's possible for every human being on the planet to own a large number of network devices, with no worries about finding addresses for them all.

In a private communication, Joshua W. Burton of Northwestern University took on what he viewed as certain byways of Libertarian ranting and came up with two very intriguing scenarios.

First scenario: You bop along the street. As you bop, the dozens of computational elements you're wearing or carrying, each with one (or several) IPv6 address, use radio and IR sensors to continually carry on negotiations with the thousands of commercial entities you pass. Lunch is cheaper here, newspapers are cheaper there, this bookstore has the book you want, that bank's offering a discount on network settlements that's so high it has crossed the "I'm-not-interested-but-if-it's-this-high-I'm-not-stupid-either" limit you've defined. All of this takes place under the control of a broad financial plan you've laid out weeks before. Hence, Mr. Protocol and his infrared cash register.

This is "Blade Runner" with a difference. The advertisements, though ubiquitous, aren't specifically aimed at you. They're aimed at your computational environment and don't cross your threshold of awareness unless your own user agents decide you're a likely customer.

So much for Nirvana.

Second scenario: You bop along the street with all your sensors blazing and all your IPv6 machines ticking and all your user agents chugging loyally away on your behalf. But nothing's simple. The merchant network differentially prices everything, depending on how much personal information you're willing to give up, what else you bought last week, what advertising billboards you scanned this morning, what negotiation services you subscribe to and how much you pay your settlement service to get the best rate for the "soft money" settlement that happens after the negotiations are completed in "Internet soft dollars." All around you are people who have user agents so good that they pay only 9% of what you do, but they pay 98% of what they save to the user agent service company, which in turn kicks back 96% to the merchants. You don't find out about this till 60 days later, because that's when you get your settlement statement because you didn't pay an extra 5% to have it appear after only 30 days.

What's the difference between the two? In the first one, 90% of all the sales and marketing vice presidents have been lined up against the wall and shot before the negotiation environment was created.

As Burton puts it, "...markets only operate efficiently *in efficient markets* (or, to put the paradox another way, as Phil Agre did some time ago, markets are efficient only when good information is cheap, but efficient markets only produce good information when it's not cheap)."

General Magic Corp. saw this coming some years ago and created a marketplace where agents could negotiate among several different merchants. Unfortunately for General Magic, the whole notion of negotiation among multiple vendors only favors the consumer. `Ebay.com` is successful in attracting vendors precisely because the negotiations are among consumers: an auction. The only way General Magic was able to attract vendors to its Internet marketplace was by offering them each a guarantee against direct competitors. The entire venture went down the tubes.

The next really big billionaire in online sales, it would seem, will be someone who figures out how to create a

DLT TAPE 4x4

Sport Utility Vehicle For Tough Spots On The Information Highway

MegaFlex™ 4-Slot Tape Array

MegaFlex is the ultimate sport utility vehicle for backing up mid-range servers in tough environments. Fully-loaded with four DLT™ 7000 drives, dual controllers and split backplane, MegaFlex backs up to 280GB at 40MB/sec. Optional RAID software lets you change gears for high performance or wall-climbing availability. All this is backed by Artecon's awesome road service and warranties. Find out how you can hit the road with confidence. Visit our web site or call for your free copy of "Protecting Your Data." MegaFlex — storage for what drives you.

- 4 bays for DLT 7000/4000 tape drives provide 40 - 280 GB capacity
- Dual controllers and split backplane deliver 40 MB/sec. performance
- Built-in RAID capabilities provide maximum flexibility
- Multiple OS support (UNIX, NT, NetWare, OS/2) promotes connectivity
- Hot swap drives, power supplies and fans ensure high availability

Capturing the World in Storage™

Artecon

www.artecon.com/dltpromo.htm

1-800-672-7832 X679

Quantum™

DLTtape and DLT are trademarks of Quantum Corporation. MegaFlex is a trademark of Artecon Inc. Other marks are the property of their respective holders.

Circle No. 9

general marketplace big enough that vendors are attracted in spite of the presence of negotiating agents–a marketplace so big that vendors come because not to come is to be shut out. This is the *agora,* the Greek ideal of an open marketplace. From it comes our word *agoraphobia,* the fear of open spaces.

In that case, it might be, as Burton points out, that there do not seem to be any economic forces at work that would tend to push our second, very consumer-unfriendly scenario, in the direction of the first...at least, no market-based forces. Forces of consumer activism might do so, but so far the Internet's sole pro-consumer force appears to be the extreme conservatism of the "good old boys" who built the Internet toward an entirely socialistic structure driven by a mixture of economic forces and idealism. In fact, as far as user agents are concerned, it looks like the only economic force one could point to would be one that would keep extremely capable user agents relatively affordable in the face of vendor obfuscation.

It strains credibility to believe that current economic theory can adequately model a marketplace formed in the incredibly efficient environment of the Internet. The actual way in which this plays out will strain credibility too, no doubt. ⊸

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 working at an aerospace research corporation.

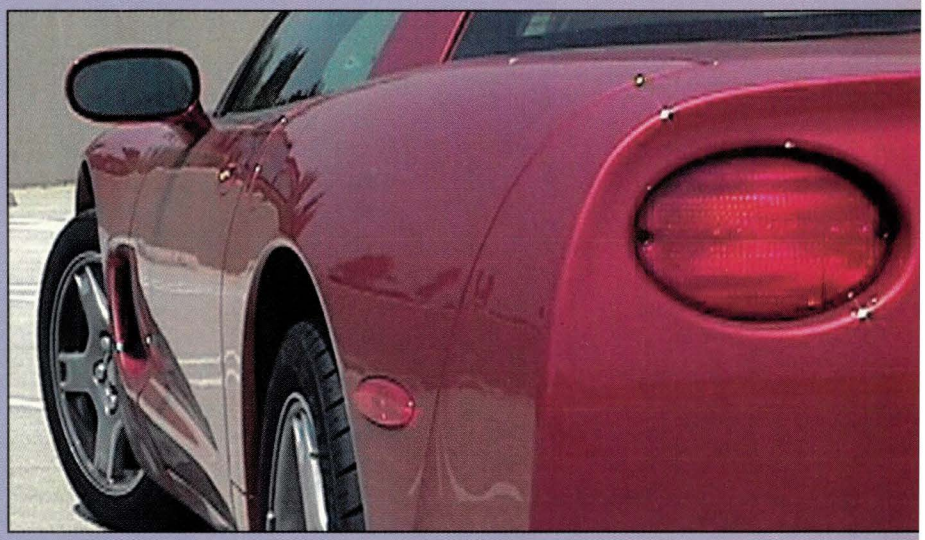
Mr. Protocol *refuses to divulge his qualifications and may, in fact, have none whatsoever. His email address is* amp@cpg.com.

Mission Critical LDAP

providing real performance

for Driving corporate solutions

from the engineers who wrote the standards



Innosoft Directory Services pull together

- our high performance LDAPv3 server
- our unique suite of security and integration tools
- unsurpassed expertise and experience
- 24x7 technical support

Corner-stones for building a complete enterprise directory solution.

IDS Innosoft Directory Services

- LDAPv3 distributed directory servers
- LDAP Proxy firewall
- LDAP/X.500 directory integration
- Java and C client SDK
- LDAP-enabled scriptable administrative tool kit
- SSL/TLS transport layer security
- Directory synchronization

Platforms

- Sun Solaris
- Windows NT
- Red Hat Linux
- IBM AIX
- Digital UNIX
- OpenVMS
- HP-UX

Test drive Innosoft's Directory Services today by calling **1-800-552-5444 for a no cost 30 day evaluation.**

1050 Lakes Drive • West Covina, CA 91790 • USA • www.innosoft.com • sales@innosoft.com • +1.626.919.3600

innosoft international inc.

Circle No. 11

by Peter Collinson, Hillside Systems

JANE MARINSKY

MIME

We think of the Internet as a recent phenomenon, but email interchange on the Internet uses a protocol that was defined in 1982 and hasn't changed substantially since. The email protocol was defined by RFC 822, written by David Crocker (then at the University of Delaware). An RFC is a "Request For Comments" and is the way Internet protocols are documented. RFC 822 revised RFC 733, which had been used on the ARPANET since 1977. The "one-step back, one-step on" correlation between 733 and 822 is simply an accident of history. Actually, there is now a series of "accepted" standards, and mail is documented by STD 11. However, I guess that the magic 822 number will stick around for some time to come.

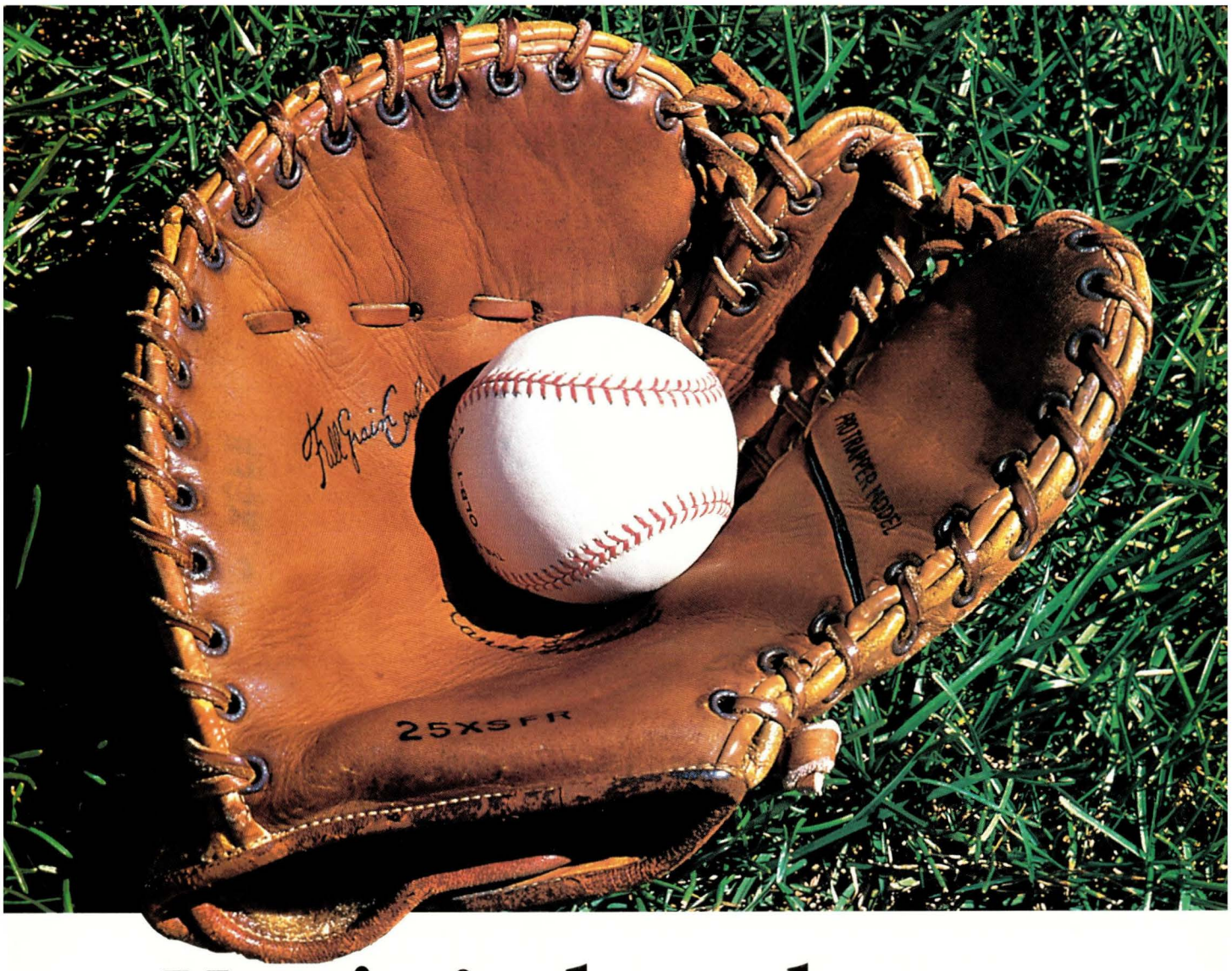
RFC 822 has been very successful. It was very forward-looking, defining the domain-based address structure that we all use today. RFC 822 concentrates on the envelope around the message that is sent, it discusses the headers and their format, but says very little about the format of the message body.

However, the title of RFC 822 is significant: "Standard for the format of ARPA Internet text messages." It's the word "text" in this title that is relevant. The standard was created at a time when computing was largely text-based. Email use spread along with the rise of UNIX, whose basic file format is text and whose tools are designed to process text. Strictly, the word "text" in this case means the 7-bit ASCII character set.

The use of text is also defined by RFC 821, which specifies the Simple Mail Transport Protocol (SMTP) used to move the mail from machine to machine over the Internet. Strictly, SMTP is constrained to use 7-bit characters formed into lines of text that should be no more than 1,000 characters long. Each line is terminated by an end-of-line indicator, which is formed from a Carriage-Return character followed by a Line-Feed.

Actually, many UNIX implementations of email don't enforce the 7-bit restrictions and secretly support 8-bit characters. This has provided some comfort to friends of mine whose languages cannot be written properly in the ASCII character set. At least they can send mail in their own language, which, of course, is "text" to them, but that text needs to be represented by an 8-bit character set. Such mail would probably work between machines in Europe, but there is no guarantee that a gateway somewhere wouldn't strip the mail back to a 7-bit set, creating gobbledegook.

There are still problems with inserting some of my friends' names in the headers of email that strictly use a 7-bit coding. Many people are actually unaware of the problem and just put their names into the headers using the correct character set for their language. Because I run my system in the Latin-1 locale (or more properly, ISO-8859-1), I can see every e-*acute* or c-*cedilla*. However, if you are in the United States, you probably cannot. Of course, access to Latin-1 is of no use to the Japanese or



New isn't always better.

She's a lefty, just like her father. And she wants to play first base.

So you were ready to run out and buy her a brand new glove. Then you remembered your old mitt. The one that dug out that throw in the dirt for the last out in the state championships.

There it was, in the trunk in the attic. And all it needed was a little refurbishing. So you bought a can of oil and rubbed it deep into the leather...until it felt as soft as butter. Then you wrapped it around a ball to form a new pocket.

Now it's every bit as good as new. Maybe even better.

That's how we feel about computers.

Specials of the Month

For OnLine Specials...
www.radiant-resources.com

We Repower Sun & HP Computers With Loving Care

At Radiant Resources, we Repower, refurbish, upgrade, custom configure and certify all systems. Sell memory, disk, tape drives, monitors, processors, printers and software...absolutely everything you need to keep your servers and workstations up and running...and equipped with the newest technology. We also deliver internet and intranet solutions. And sell Cycle Upgrade Boards...plus all major Intel-based systems.

Save Big

Buy new, buy repowered, upgrade, trade-in and trade up...all at incredible savings –sometimes as much as 50%! For cutting-edge performance that is usually *better* than new. Sell us your old equipment and save even more.

Best Warranty Anywhere... 100% Satisfaction Guaranteed

All Radiant systems come with a full one-year warranty...a 24-hour replacement policy on all systems and components *for any reason*...plus a cosmetic guarantee.

Ultra Fast Delivery

Radiant customers are continually amazed at our ability to meet even the most demanding delivery schedules – even over night!

So come to Radiant for all your computer needs. Because, like this great old mitt, new isn't always better. And we're prepared to prove it.

Call Toll-Free–800-500-7675

Radiant Resources, Inc.

Repowered Computers for the Next Generation

10 Small Brook Circle
Randolph, NJ 07869
973-442-5555 FAX: 973-442-5550
sales@radiant-resources.com
www.radiant-resources.com

Major Credit Cards Accepted.

Circle No. 12

the Russians, whose languages require completely different character sets.

Using text as a transport medium causes problems when you want to send a binary file to a friend. I suspect that we are now living in a world where we need to send binary files more and more.

Initially, binary files on UNIX were mostly compiled programs, but you could never make assumptions about file formats. The original `tar` program could be used to encapsulate several files into one archive file, which turned out to be a binary file even if the files that were contained in the archive were simply text. The header that was used between each file was designed to be read easily by the program and contained binary values. The folks at Berkeley changed this to the text header that was later enshrined in the POSIX standard.

If you want to send a binary file to someone in safety, then you need to encapsulate the data into a text form. Probably the most widespread method of turning a binary file into text was to use `uuencode` to create the text stream and `uudecode` to unscramble it. These programs were widely available on all UNIX systems as part of the UUCP suite that was used to form the Usenet network. If you are going to use some kind of encapsulation method, then you need to know that your recipient can decode the information.

The first line of a `uuencode`d file gives the target file name and its associated permissions. The remaining data contains lines of characters. Each line starts with a byte count, encoded as a printable character starting from "A" in the ASCII coding sequence. The value "1" is encoded as "A", "2" as "B," "3" as "C" and so on. Using the ASCII sequence with "A" translating to "1," the space character maps onto zero. So when decoding the data and obtaining the byte count for the line, you'll read the first character, subtract the value of the space character from it and the result is a numeric byte-count value. The text that forms the remainder of the line follows the byte count. Three 8-bit bytes from the source are mapped into four printable characters, only six bits of each input byte is used. Each character is mapped into a visible value using the ASCII coding sequence described above.

In general, using `uuencode` to encapsulate a binary file requires human intervention. Typically, the `uuencode`d part of the mail message would be surrounded by "cut here" text asking the receiver to save the message to a file and then run `uudecode` on it.

Multimedia Mail

At the start of the '90s, Nathaniel S. Borenstein, then at Bellcore, started to look into the problems caused by the limitations of using text as the basic mail transportation mechanism. He wanted to allow people to interchange pictures, video and audio in various formats but still work within the confines of RFC 822. After all, email systems were a way of transporting files from one person to another, the fact that these files were mostly text was an artificial restriction. If the RFC 822 standard could be adapted to carry multimedia mail, then it would have zero impact on the mechanisms for transporting mail that were in widespread use.

However, attempting to introduce multimedia mail capabilities was still a daunting task because, even at that time, there was a huge number of different mail reading programs (the email world calls these *user agents*). Early on, he realized that attempting to disseminate a brand-new, wonderful multimedia mail reading and composing program would not work because people would stick with their existing systems. He needed to generate a system that would bolt onto existing programs in a painless manner. The pain for the user must be negligible. The pain for the implementor would be greater and any system needed to present easy ways for the implementors of user agents to pick up on the new facilities. Borenstein's system, known as `metamail`, became the basis for alterations to several user agents permitting them to handle multimedia mail cleanly. A cornerstone of the approach was the `mailcap` file, which allowed programs to have some centralized way on a specific system of finding what Netscape Communications Corp. later termed a "helper application"–a program on the local machine that could handle image display or play an audio clip. This meant that programmers of user agents didn't need to become audio or graphics specialists, they could leverage other people's work.

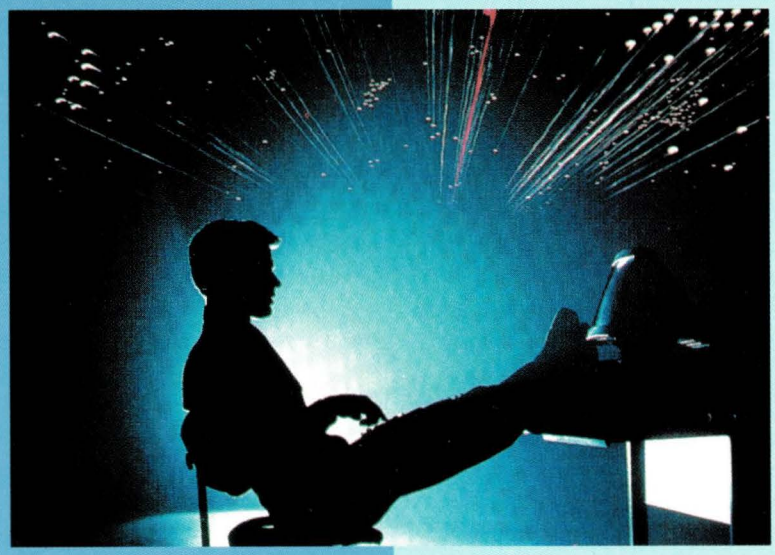
However, for the capabilities to become widely used, something was needed in the RFC 822 protocol that was aimed at this new breed of enhanced user agent. Something that would tell the user agent what type of formatted file the mail contained so that it could be decoded and passed to the relevant helper application. Borenstein and Ned Freed (Freed was then at Innosoft International Inc.) wrote RFC 1341, which defined three new header lines that were to be added to the 822 mail format. Incidentally, RFC 1341 has been superseded by RFC 2045, and you should go there if you are interested in delving into this subject in greater depth.

Being prudent people, the first new header line was designed for future expansion and supplies a protocol version number. The `Mime-Version:` field should be set to 1.0 to indicate that the mail follows the conventions described in the RFC.

The second header line defines the type of content that is to be found in the mail. An earlier RFC (RFC 1049 by M. Sirbu of Carnegie Mellon University) had proposed that mail should contain a `Content-Type:` field, but chose to use argument keywords that were aimed at specific applications or devices. RFC 1341 made the specification considerably more general, allowing the argument field to give a broad type of application, followed by a subtype. There are intentionally only a small list of broad application types: `application`, designed to permit binary data to be sent; `audio` and `image`, which are self-evident; `message`, defining a mail message; `text`, for text of some form or other; and `multipart`, which allows one mail message to encapsulate several other types of message.

The idea of having a broad type followed by a subtype allows mail readers to easily reject message parts with which they cannot deal. So if a mail reader cannot deal with images of a specific type, it still knows that a message flagged as `image/something` contains binary information that cannot be displayed as text. However, the user agent may elect to present other options, perhaps allowing the user to store the

THE RULES FOR SUN SUPPORT HAVE CHANGED



Welcome to the 21st Century!

ON-LINE!

DETECTIVE™ FOR SUN

The **On-Line! Detective for Sun** provides "World Class" support for Sun workstations and servers. **Detective** users enhance their ability to detect and resolve O/S and hardware related problems and issues. The software covers a wide range of topics including part numbers (Sun and third-party), configuration rules and requirements, and the most advanced troubleshooting and problem resolution techniques available. See why AT&T, Lucent Technologies, Lockheed Martin, GTE and other industry leaders are using the **On-Line! Detective for Sun** to provide the ultimate in system support!

For information call SoftTech Solutions at (888) 786-4393
To download a demo, visit our website at http://www.stsolutions.com

SOFT·TECH
SOLUTIONS
TURNING INFORMATION INTO KNOWLEDGE™

Circle No. 13

image as a file somewhere on their local disk.

The third new header line tackles the problem that RFC 822 mail is constrained to printable text. The `Content-Transfer-Encoding:` header gives a standard method of encoding the embedded information. The sender of the mail can automatically turn their data into length-limited lines of text, and have it be reconstituted by the recipient's mail reader without any special knowledge of the encoding.

Of course, transformation of the original data may not be needed. If you've typed in an ASCII message, which contains lines of less than 998 bytes (two bytes are needed for the end-of-line indicator), then there is no need to alter your message. The sender can use `Content-Transfer-Encoding:` values of `7-bit`, `8-bit` or `binary` to indicate that no transformation has been made to the original data.

Should encoding be needed, the RFC provides two styles of encoding. The first, more lightweight, encoding is called `quoted-printable` and is designed to be applied to data that is "nearly ASCII text." The text perhaps contains a few characters like the acute accent in "Café," or perhaps it has very long lines, which need to be broken to ensure that they are not truncated by any restricted gateway.

The `quoted-printable` encoding method attempts to maintain message readability for naive mail readers while allowing correct translation of characters for any mail reader that can decode the message. To this end, all the 7-bit ASCII characters are passed through unchanged. However, any character can be encoded as an equals sign followed by two characters that represent the character form of a hexadecimal value (so the equals sign is encoded as `=3D`). The equals sign can also be used at the end of a line to introduce an end-of-line indicator that can be removed by the reading program. There are some other conversions; see the RFC for the full gory details.

When there are a few characters that need to be hidden from the transport mechanism `quoted-printable` encoding works well, imposing very little size overhead. But it would prove to be very heavyweight if used for pure binary files containing, say, audio or images. The RFC defines `base64` encoding to cope with binary files. The mechanism is very similar to `uuencode`. However, some care has been taken with the encoding of binary values into characters to make that character subset portable into both ASCII and EBCDIC. The encoding/decoding mechanism uses a table rather than the pure ASCII sequence, ensuring that the final representation has good portability across machines.

Content Types

As I said above, there is a very small number of basic broad categories used in the `Content-Type:` field in the mail header. The standards define a very small number of subtypes, and there is now a registration system that allows the registration of new ones. The registration database is quite large now. The types you will mostly see in your mail are:

```
Content-Type: text/plain; charset="us-ascii"
```

This is the default setting for what might be termed "a normal piece" of mail. The `Content-Type:` is `text` and the subtype is `plain`, indicating that the text contains no inherent formatting information. Parameters follow the main argument, separated by a semi-colon. The `charset` parameter defines the character set that should be used to render the text. It's not just `ascii` because the term ASCII has come to represent a multitude of different character sets (RFC 2047 goes on at great length about this). I should have used US-ASCII throughout this article to emphasize that I was talking about a specific standard, but I thought it would confuse you. The `us-ascii` character set points at a specific ANSI standard–the "7-bit American Standard Code for Information Interchange," ANSI X3.4-1986–and so is precise. Alternatives to US-ASCII point to the various ISO standards that define character sets, so mail from my machine says

```
Content-Type: text/plain; charset="iso-8859-1"
```

which is the character set that I call Latin-1.

Recently, browser manufacturers have been pushing HTML as a basic mail interchange standard, and you will see

```
Content-Type: text/html; charset="iso-8859-1"
```

encapsulating an HTML document in the mail message. In December, I interviewed Eric Allman (creator of `sendmail` and founder of Sendmail Inc.) for the U.K. magazine, *EXE*, for which I write regularly, and he said that HTML mail is liked by businesses "because they can find out when you read the mail since their Web server can be hit when you pull a graphic. Also, they can tailor their mail message so that you see what they want you to see when you read the mail, rather defining its contents when they send it."

However, these browsers don't just send HTML hoping that the reader will be able to deal with it; they use the multipart capabilities of Multipurpose Internet Mail Extensions (MIME) to send alternative views of the same mail message. The main header to the mail will contain something like the following:

```
MIME-Version: 1.0
Content-Type: multipart/alternative;
      boundary="++++Boundary_between_messages++++"
```

This tells the mail reader that the message actually contains several alternate views of the same message. Each part will be separated by

```
--++++Boundary_between_messages++++
```

and will start with a new `Content-Type:` and, possibly, a new `Content-Type-Encoding:`. It is assumed that the `boundary` text will not occur "naturally" in the body of the message. Notice that the `boundary` field gains two hyphen characters marking the start of the line. Similarly, the last `boundary` field in a file has two hyphens appended to the end of its text.

RELIABLE OVERLAND DLT™ AUTOMATION

Backup and restore your peace of mind.

Relax. It's Overland. Our full line of DLT tape solutions is designed to make your job easier and more productive. Emphasis on reliability. Industry-leading warranties. Commitment to high performance. Compatibility with all leading backup software. Focus on the right price. Scalability to make your investment last. That is what customers around the world have come to expect from us. And there's more to come. The seven major industry awards for excellence that we have won are just the beginning.

The LXS MiniLibrary™ is cost effective DLT automation for workgroup to enterprise data storage. Recommended for systems with 50 GB to 350 GB of data. Available in either desktop or rackmount. Starting at $10,495.

The DLT LibraryXpress™ offers true scalability. It grows as you grow, offering more capacity and performance options than any other library. For systems from 50 GB to 3,000 GB. Starting at $13,995.

The New LoaderXpress™ provides DLT automation - at a cost comparable to a stand-alone drive. And a 5- or 10- cartridge magazine allows for up to two months of unattended backup. For systems from 15 GB to 100 GB. Starting at $4,995.

OVERLAND™

Relax. It's Overland.

www.overlandinfo.com/d6

1-800-729-8725

Worldwide 619-571-5555 Europe +44 (0)118-9898000

DLT TAPE

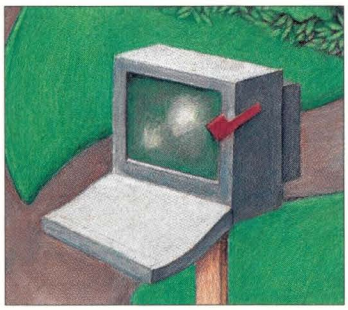
GUARANTEED GUTS OF TIME

99% Up Time.
100% Data Restore.
GUARANTEED!

Circle No. 14

The RFC requests that the least complex type of message should appear first, followed by messages of increasing formatting richness. The idea here is that the message is somewhat more viewer-friendly. If the reader is using a naive mail agent, then they should be able to easily find and see the message as text.

Also, any text "outside the boundary" is ignored. So text before the first `boundary` marker, or after the last, can be used to contain comments. You'll typically see a message like, "This is a multipart MIME message," appearing before the first `boundary`. The comment is aimed at users of naive mail readers, telling them what this odd-looking message actually is.



Another possible multipart type allows for attachments of different types to be added to the message:

```
Content-Type: multipart/mixed;
      boundary="++++Boundary_between_messages++++"
```

I tend to use this when sending Microsoft Corp. Word documents to people. The first part of the message will be some explanatory text and the second will be the Word document, which is basically a binary format, and will generally be encoded using the `base64` technique.

MIME Mail on Your Sun

In general, the PC world has embraced MIME because it needed to find some way of sending binary email, because many PC applications deal with what is essentially a binary file format. Sadly, Sun Microsystems Inc. has been lagging woefully behind these developments. To be fair, I haven't had a chance to look at the Solaris 7 release that has found its way to my office, so things may have changed. The alternatives provided on earlier Solaris releases are pretty poor.

I've been using email for eons. At one point, some years back, I migrated to the Rand MH mail system, and I've been using it ever since. These days, I use Brent Welch's excellent `exmh` interface that sits in front of the command-line programs that are normally used to drive MH. MIME email is handled by `exmh`, and it will also cope with some simple HTML email messages with its own built-in HTML browser. One of the benefits of using MH is that you can still use the basic MH commands when you are far from home and can only log in with `telnet` to read email from a GUI-free zone. I did this once from a public library in Fort Bragg, CA. I wasn't desperate to read my email, but it seemed fun and sounded like a challenge to be able to do it from a small town on the Californian coast. Typing `telnet:` and my machine name into Netscape gave me an interactive login to my computer in the United Kingdom, and MH allowed me to read my messages and reply to them.

However, I suspect that getting and installing all the pieces for `exmh` from scratch is not for the faintheartedly. First, you have to install MH and then Tcl/Tk to support `exmh`. Installing `exmh` is actually the least of your worries, it just slots in. Again, to be fair, installing MH and Tcl/Tk is simply a matter of getting the code and compiling it, and I would expect there to be no problems.

Another alternative is to install Netscape Communicator and use its inbuilt email facilities. Again, I haven't tried doing this. I was put off by the size of the file that was required.

Reading and Software

The sources for this article are all RFCs, actually. I haven't come across a book that explains MIME and its influence on email or the Web. MIME was picked up and used by the designers of HTML to provide data typing for the protocol, which, to me, seems a highly commended case of not reinventing that wheel. RFCs are available using anonymous FTP to `ftp.isi.edi`, although I used a local mirror site to access the information.

You can get `exmh` from `http://www.scriptics.com`, and you will also find the most recent Tcl/Tk sources there as well.

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

Heads you win, tails you win.

HostExplorer and HostExplorer Web. The first two choices for the fastest link to the mainframe.

Hummingbird ***HostExplorer*** and ***HostExplorer Web*** link you to critical business information on your mainframes, AS/400s and UNIX systems using TN3270E, TN5250E and Telnet. With ***HostExplorer*** and ***HostExplorer Web***, you don't need to choose between traditional desktop or Web-to-Host technologies. Both look the same, work the same and are easy to install in your workgroup and throughout your company. And with Hummingbird's unique Java-based centralized management tools, all desktops are administered from anywhere, anytime.

So heads or tails, you can't lose with Hummingbird's superior terminal emulation products. Hummingbird offers a world of connectivity solutions.

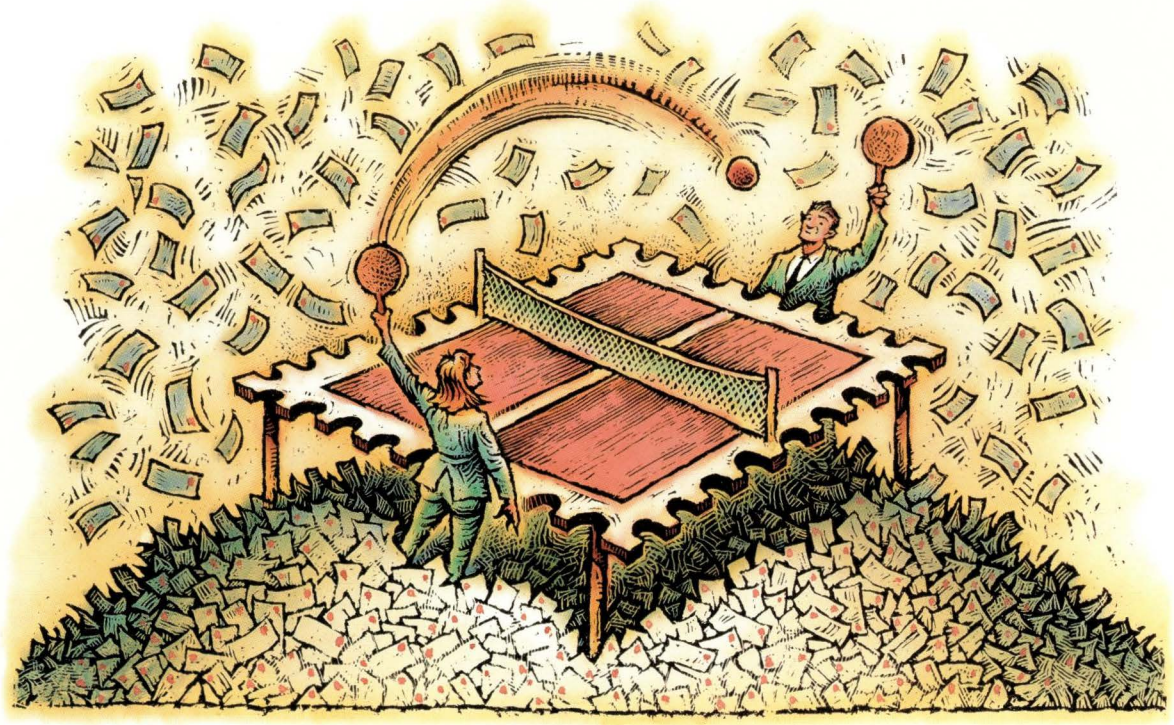
Contact us today for an evaluation copy of HostExplorer or HostExplorer Web.

HUMMINGBIRD®

www.hummingbird.com/sem Email: info@hummingbird.com Tel: (416) 496-2200 Fax: (416) 496-2207

Circle No. 15

by S. Lee Henry



PHIL FOSTER

One of Those Days

The office had been closed for a week and a half. A few of the more responsible members of the staff had me set up vacation email beforehand so that no one would be expecting a reply from them until the break was over. Upon returning, two of them found their inboxes so full they couldn't open them on their desktop systems. They showed up at my cubicle within minutes of each other.

"I can't open my inbox!" the first of my coworkers informed me. When I checked the file and found it to be more than 300 MB in size, I knew something had gone wrong. I had barely finished scratching my head when the second unhappy coworker came to tell me the same story. This time, the inbox was nearly 400 MB. I counted the messages using a simple `grep "^From " inbox` command. There were approximately 700,000 of them. Omigosh! This was going to be one of those days.

A seasoned administrator, I knew the drill. The first step, after taking a deep breath, was to figure out what was happening. No one gets this much email, not even me. Then, the next question: Was it still happening and were these two the only ones affected or was everyone's inbox growing to monumental proportions? I needed to check my mail server quickly and get some answers. Then, I'd have to repair the damage as quickly as possible so that my coworkers would be able to send and receive email as soon as possible. Once the dust settled, I would have time to go through a preventive maintenance stage to guard against a repeat of whatever had happened.

A cursory check of the mail server revealed that a) the problem was still happening, but that b) only the two individuals who had approached me were affected. Further "grepping" on the two inboxes led to a diagnosis.

One of the two individuals had logged on during the vacation and sent an email to the other. The second person's vacation setup responded. Then, the first person's setup responded to the response–and the cycle continued for about 700,000 loops.

I moved both `.forward` files to turn off vacation responses. Both looked roughly set like this:

```
\nici, "|/bin/vacation nici"
```

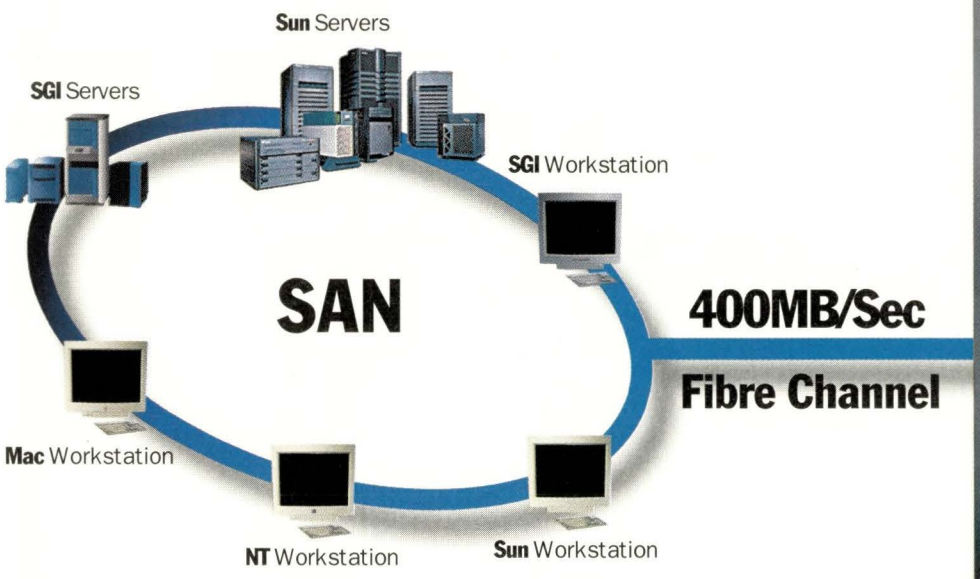
calling the vacation program to respond to messages with the text stored in each person's `.vacation.msg` file, and saving it to the individual's inbox as well.

Now that I had a diagnosis and had stemmed the flow of new vacation responses, I still had to deal with the giant inboxes so that my coworkers could use their email. As a stopgap, I moved each inbox to a similar name:

```
mailserver# cd /var/mail
mailserver# mv nici Nici
mailserver# mv mallory Mallory
```

and told my coworkers they could send and receive new email while I dealt with the backlog.

Megadrive EV-5000 High-Performance
Fiber Channel Network RAID System



Improve Your Workgroup's Performance By Up to 1000%

Introducing Revolutionary Fibre Channel Storage Area Networks from DataDirect Networks

DataDirect Networks' new, award-winning RAID Storage Area Networks (SANs) can significantly increase your workflow *and* reduce your operating costs.

Blazing fast performance

From our dual-channel, eight-drive storage arrays to our revolutionary, dual Fibre Channel multi-terabyte RAID systems, DataDirect SAN solutions redefine the term "high-performance" with:

- Throughputs of up to 2 GB/sec on a single computer.
- True cross-platform SAN data and file sharing.
- System capacities scaling from 36 gigabytes to hundreds of terabytes.
- Ultra SCSI, Ultra-2 LVD SCSI, and Fibre Channel interfaces.
- Simultaneous RAID-level support (0, 1, 0+1, 3, 5).
- Compatible with Sun, SGI, Windows NT, Mac OS, RS/6000, and DEC Alpha.

Rock-solid reliability

With 12 years experience and over 1,500 terabytes installed in the field, we give you proven, integrated SAN solutions that deliver security and stability as well as high-performance:

- Complete system redundancy for data loss protection.
- 7x24 optional on-site technical support.
- Seamless performance and capacity expansion as you grow.
- Remote monitoring features and small physical footprint.
- Costs as low as 10¢/MB.

Real World solutions

Our high-speed SANs meet your most demanding needs: imaging, visual simulation, document production, remote sensing, telemetry, Internet/Intranet, CAD/CAM/CAE, and OLTP.

To find out how you can get the best SAN solutions on the market, call us or visit booth **S2614** at the **NAB99** show.

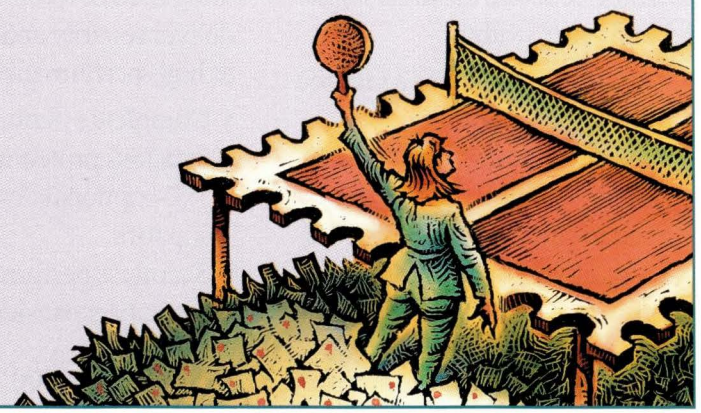
dataDIRECT NETWORKS
formerly MEGADRIVE

sales@datadirectnet.com • 800.322.4744 • 818.700.7600 • fax 818.700.7601• www.datadirectnet.com

Listing 1. mh-screen Script

```
#!/usr/bin/perl
#       mh-screen: removes specified messages from a mail file

$tmp = "/var/tmp/tmp-$$";           # temp file
$mbox = "/var/tmp/mh-$$";           # new mail file
$msg1 = 1;                          # first message (Boolean)
$keepmsg = 1;                       # message to retain (Boolean)

umask(027);


if (!open(TMP,"+>$tmp")) {
   if (open(ERR,">>$errlog")) {
      print ERR "$0: unable to open $tmp for writing: $!\n";
      close(ERR);
   }
}

while (<>) {
    if (/^From[\s] {1,} */i) {              # a From line
        if ($msg1) {                        # if first message
                print TMP $_;
        }
        else {                          # NOT first message
            $fromline = $_;
            print "=====\n";
            close(TMP); # for writing
            if ($keepmsg) {
                &copytmp;
                }
            else {
                unlink($tmp);
                }
            if (!open(TMP,"+>$tmp")) {
                if (open(ERR,">>$errlog")) {
                    print ERR "$0: unable to open $tmp for writing: $!\n";
                    close(ERR);
                    }
                }

            print TMP $fromline;
            }
        $keepmsg = 1;
        }
    else {                                  # NOT a From line
        if (/^Subject:[\s] {1,}away from my mail/) {
            $keepmsg = 0;
            }
        print TMP $_;
    } # if From
    $msg1 = 0;
} # while
close(TMP);
if ($keepmsg) {
    &copytmp;
}
else {
    unlink($tmp);
}

exit 0;

sub copytmp {
print "copying\n";
```

Continued on Page 34

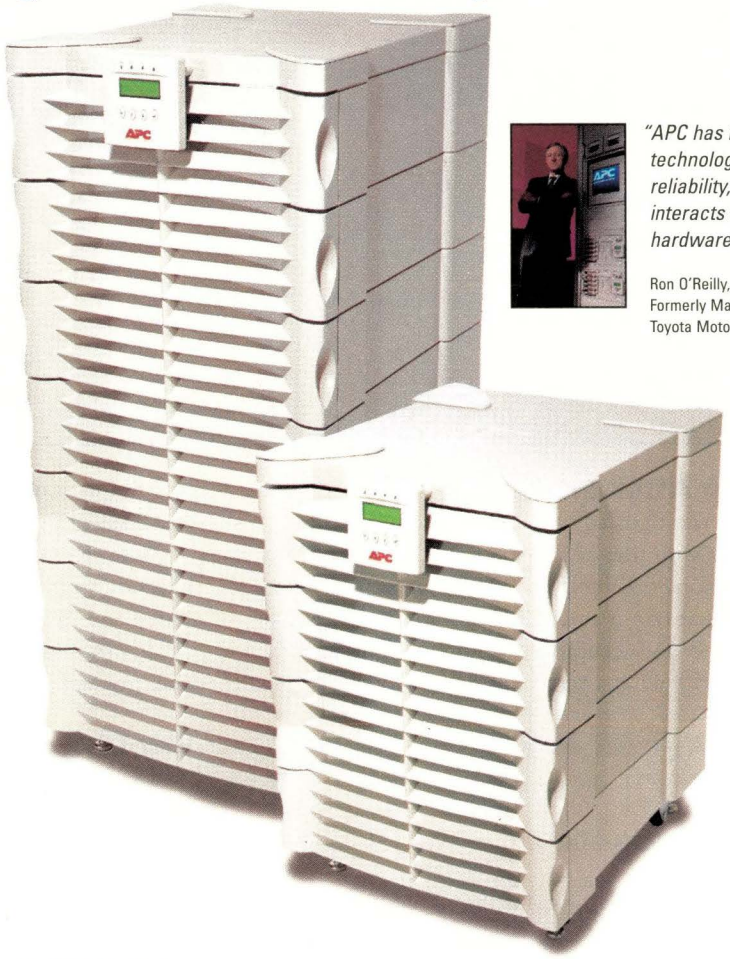


From 20 to 200 servers, only a scalable Power Array gets reliability done *right*

You've survived downsizing and rightsizing. You've seen the mainframe come and go a few times. Users who once demanded the power of distributed client/server are now asking you to take back what you gave them and make it available 99.999% of the time.

APC's Award-winning Symmetra™ Power Array™ can help. Designed to handle complex computing environments, the Symmetra protects 7 x 24 datacenters and enterprise server farms like no other machine. With Symmetra's advanced Power Array technology, you cease to worry about power problems and you focus on keeping your end users happy.

We protect more networks and systems than any other brand. Call APC today for your FREE Enterprise Solutions Kit.



"APC has innovative technology which promises reliability, Symmetra™ interacts smoothly with both hardware and software."

Ron O'Reilly, Field Support
Formerly Manager/IS,
Toyota Motor Sales, USA

Reliability factors

- Downtime risk is reduced through N+1 redundancy
- 4-16 kVA scalability allows modular expansion and reconfiguration as your datacenter grows
- APC is preferred 8-1 for reliability over any other brand (*Computerworld* magazine study)
- Extended battery frames mean virtually unlimited runtime
- Easy manageability through PowerChute® *plus* software improves your crisis response time
- Simple maintenance dramatically lowers cost of ownership

For site-wide protection, ask about the new APC Silcon DP300E with solutions starting at 10 kVA.

Installing or reconfiguring your modular Power Array couldn't be any simpler.

APC®
Legendary Reliability℠

FREE Enterprise Solutions Kit! Learn how to keep up and running today!

Order now *http://promo.apcc.com* Key Code j123z or Call: (888) 289-APCC x1195

Circle No. 17

```
        if (!open(TMP,"<$tmp")) {
                if (open(ERR,">>$errlog")) {
                print ERR "$0: ERROR unable to open $tmp for reading: $!\n";
                close(ERR);
                }
        }
        if (!open(MBOX,">>$mbox")) {
                if (open(ERR,">>$errlog")) {
                print ERR "$0: ERROR unable to open $mbox for appending: $!\n";
                close(ERR);
                }
        }
        while (<TMP>) {
            print MBOX "$_";
        }
        close(MBOX);
        close(TMP);
        unlink($tmp);
        return($i);
}
```

Cleaning Up After the Spill

The next step was figuring out how to clean up the mess. Anytime we work with files of this size, our choice of tools is limited. How can one sift through 700,000 messages, picking out the desirable ones from among the multitude of vacation responses efficiently and accurately? A quick attempt at solving the problem with an awk script failed:

```
# cat Nici | awk -f fix > tmp.$$
awk: record "Hope you are..." has
too many fields
 record number 1.05284e+06
```

Small problems can be managed with a vi session or a quick awk script. Problems of this dimension quickly overpower these tools. Splitting the large files into chunks might break messages in the middle and greatly complicate the number of steps required, and would add to the task of putting the rescued messages back together to form a new inbox. I wasn't sure I wanted to deal with the extra complexity. I had to think of an easier way.

The clear winner was Perl. Great at pattern matching and not intimidated by size, Perl could go through the files speedily as long as I could identify and codify the vacation responses.

I knew there could well be meaningful messages among the plethora of "away from my mail" droppings–even between the two individuals involved. This meant I could simply base the drop/keep decision on the senders. The Perl script I wound up using, shown in Listing 1, used the subject line of the email to determine which messages to drop.

Because I would not know until I had already read a number of lines into each message whether it was one that I wanted to drop or keep, I copied each message to a temporary file. If, when I got to the subject line, I determined that the message was to be kept, I added it to the output file I was creating (a replacement inbox). If, on the other hand, it was one of the many repetitions of the "away from my mail" vacation responses, I simply continued to the next message and, then, closed and released the temporary file.

With the mh-screen script, I was able to cut the two inboxes down to size. All of the vacation responses were removed. I used cat to tack the old mail to the end of the current (still small) inboxes and let my coworkers know I was done. The next step was the postmortem.

Pay Dirt

Though I understood the mechanism of the two vacation setups responding to each ad nauseam, it was clear that something had gone wrong. Were this not the case, this type of problem would have occurred many times over the course of my career. Scrutinizing the man pages led me to realize that I had not been working with a proper vacation setup.

Great at pattern matching and not intimidated by size, Perl could go through the files speedily as long as I could identify and codify the vacation responses.

When an individual issues the vacation command, several files should be created. One is the .forward file, a sample of which was provided earlier. Another is the .vacation.msg file, which holds the text of the message to be sent. If alternative text isn't explicitly provided, the .vacation.msg file looks something like this:

```
From: dummy0 (via the vacation program)
Subject: away from my mail
```

Listing 2. Correct Setup

```
-rw-r--r--   1 worker1   staff          37   Mar  12  16:20   .forward
-rw-r--r--   1 worker1   staff           0   Mar  12  16:18   .vacation.dir
-rw-r--r--   1 worker1   staff         170   Mar  12  16:18   .vacation.msg
-rw-r--r--   1 worker1   staff        1024   Mar  12  16:38   .vacation.pag
```

```
I will not be reading my mail for a while.
Your mail regarding "$SUBJECT" will be read when I
return.
```

Two other files are created, and one of these (or rather its absence) lay at the root of my problem. The `.vacation.pag` file has the job of keeping track of email addresses of people to whom vacation responses have already been sent. Anyone who has already been sent a message should *not* be sent another in the space of a week (this value can be altered with the `-t#` option, where "#" is replaced with something like "3d" for three days or "12h" for 12 hours).

Because we had set our vacation messaging by handcrafting the `.forward` and `.vacation.msg` files, we had not been keeping track of email addresses and, as a result, responded to each message as if it was a new address.

I try to make a point of welcoming any challenge that teaches me something. In this case, I was forced to understand something about the way vacation mail is meant to work and how to set it up correctly. In the future, I will `su -` to my coworkers' accounts and run the `vacation` command as them or, more likely, set up the proper set of files as shown in Listing 2.

The Perl script provided (see Listing 1) can be easily modified to clean out unwanted messages from inboxes, provided you carefully identify them with regular expressions. Unlike the script presented in last month's column, this script works on a mail file and is not restricted to dealing with individual messages the way a mail-handler would. If you're just starting out with Perl and would like a copy of this script, or if you'd like to tell me about one of *your* little disasters, please send email. ➸

S. Lee Henry *learns something new every day. She works as a Webmaster and systems administrator for Web Publishing Inc. and lives on a sailboat in Marin County, CA. Her email address is* `slee@cpg.com`.

by Æleen Frisch

LYNNE CANNOY

Tools for Getting Things Done

In recent months, we have considered several high-level tools for performing various important systems administration tasks under Windows NT. This month and next month, we will take a step back to look at some of the built-in commands that Windows NT provides. These lower-level tools do not have the breadth of scope that some of the other tools have, but they can be very useful for getting a specific task accomplished quickly and efficiently. In some cases, they can also serve the same purpose under Windows NT as familiar UNIX utilities do in that environment.

Naturally, all of these commands are entered via the Windows NT command window. You can start a command window in a variety of ways. The easiest is to use the `cmd` command (for example, in the Run dialog box), but you can also use the **Start=>Programs=>Command Prompt** menu path.

We will begin by looking at some lesser-known uses of familiar NT commands. Hopefully, everyone knows what the `cd` command does, but one of its most annoying features for beginners is that by default, specifying a drive letter within the path given as its parameter merely changes the current working directory on that drive, rather than making that drive and directory the current directory. Thus, a command like the following changes the current directory on drive `f:` to `\user\rchavez` but leaves the current working directory setting unchanged:

```
cd f:\user\rchavez
```

If you want to move to the specified directory on drive `f:`, all you have to do is include the `/d` option on the `cd` command:

```
cd /d f:\user\rchavez
```

We will conclude our look at the `cd` command with another common annoyance. I can't tell you how many times I've typed `pwd` into a Windows NT command window, only to generate the obvious error. If you want to know what the current directory is, use the `cd` command without any arguments:

```
c:\> cd
f:\user\rchavez
```

The Windows NT (and DOS) `mkdir` command has a significant advantage over its UNIX counterpart. If you execute a command like

```
mkdir /a/b/c/newsub
```

the new subdirectory will be creating parents as necessary, regardless of whether or not the parent directories already exist.

Performing Common Tasks

We will now turn to some NT commands that you can use for everyday operations. We'll begin with file compression and expansion. The `compact`

command can be used to compress or expand a file residing in the NTFS file system, which by default has compression enabled. The command takes a list of files as its argument, and the /c and /u options indicate whether a compression or expansion operation is desired, respectively. For example, the following command will compress all the files in the specified directory with the extension .dat:

```
compact /c d:\big_data\*.dat
```

The compact command's /s option may be used to recurse subdirectories in the file list, and you can use the /q option to make its output less verbose.

The compress and expand commands may be used for ad hoc file compression and expansion. Also, the expndw32 command found in the NT Resource Kit may be used to expand compressed files from product installation CDs.

When you need to find something in a file, Windows NT provides the findstr command. It has the following syntax:

findstr *options strings files*

where *options* refers to one or more options specifying details about the file searching operation, *strings* is one or more search strings and *files* is a list of files to be searched. Here's a simple example that looks for the string substr in all files in the current directory with the extension .pl:

```
c:\> findstr substr *.pl
amu.pl: if (substr($ARGV[$arg_ptr],0,1) ne "-") {
amu.pl:     @fields=split(" ",substr($_,2));
findit.pl:   $tapename = substr($file,0,-4);
my_utils.pl:   last if (substr($s,$st,1) ne " "); }
my_utils.pl:  my $thing=substr(&trim($_[0]),0,1);
```

(Here, as elsewhere in this column, we have shortened output lines to conserve space.)

If you include the /r option on the findstr command, the string is interpreted as a regular expression. For example, the following commands will find lines in the same group of files that include the string "if" followed by the string "split":

```
df.pl: elsif ($_=~/[^t]Len/) { ($j,$s)=split; }
df.pl: if ($_=~/Vol/) { ($j,$j,$name)=split; }
```

Most common regular expression constructs are supported, so the first command below would limit the output to lines where "if" appears at the beginning of the line:

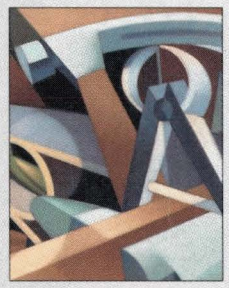
```
c:\> findstr /r "^if.*split" *.pl
```

```
c:\> findstr /b /r "if.*split" *.pl
```

(As expected, we get no matching lines because none of the lines with "if" in them had "if" at the beginning of the line.) The second command uses the /b option to perform the same function. /b looks for strings at the beginning of a line and /e looks for strings at the end of a line. Don't include both of them, however; instead, use the /x option to specify that you want to display only those lines that match in their entirety.

The /p option is quite convenient because it tells the findstr command to automatically skip any files in the file list that contain nonprintable characters (indicating that they are most likely binary files), as in the following example, which searches for the string "roll" among all the files in the current directory:

```
c:\>findstr /p roll *

motd.pl:$text=$main->Scrolled('Text', -relief =>
"sunken",
sample_1.log: rollback.htm  4631  7/18/97  11:02 AM
```



It is perfectly acceptable to specify more than one search string. When you do so, you must separate successive search strings with spaces and enclose the entire list of search strings in quotation marks.

It is perfectly acceptable to specify more than one search string. When you do so, you must separate successive search strings with spaces and enclose the entire list of search strings in quotation marks. Searches involving multiple search strings always use OR-logic–lines which contain any of the specified strings are displayed. For example, the following command would search for "the" OR "end" in all text files in the current directory:

```
findstr "the end" *.txt
```

Note that if you want to perform a search employing AND-logic (meaning find lines containing both search strings), you must use a regular expression as the search string.

The /c option is needed when your search string contains internal spaces. This option takes the desired search string as its argument. For example, the following command searches for the string "the end" in the specified list of files:

```
findstr /c:"the end" *.txt
```

The findstr command has a number of other useful options. The /s option says to recurse any subdirectories in the file list and the /i option performs a case-insensitive search (by default, searches are case-sensitive). /n includes line numbers in the display for each matching line and /v shows only nonmatching lines (as in the case of the UNIX grep command). In addition, the /m option displays only the file names

for files that contain a matching line.

Unfortunately, `findstr` has no option for displaying a count of matching lines within each file (as `grep` can). If you need this functionality, you can use the `find` command instead. `find` is a much simpler command than `findstr`–it does not support regular expressions as search strings, for example–but its `/c` option will display a count of matching lines. For example, the following command displays the number of lines that contain the string "if" in each Perl script file in the current directory:

```
c:\> find /c "if" *.pl
---------- AMU.PL: 164
---------- DF.PL: 13
...
```

As a final example of a command to perform a common everyday task, we'll consider `xcopy`. This command is used to copy entire subdirectory trees. For example, the following command form will copy all of the files in the source subdirectory tree to the location specified by destination, including any empty subdirectories:

`xcopy /e /t` *source destination*

The `xcopy` command has a number of useful options, including `/e`, which copies all subdirectories even if they're empty; `/t`, which copies subdirectory structures (trees) but not the files; `/r`, which automatically overwrites read-only files; `/q` for quiet (less verbose) output mode; and `/h`, which includes system and hidden files in the copy operation.

In addition, the `/u` option tells the command to operate in update mode, in which only files that already exist within the destination subdirectory tree, and are older than the ones in the source tree, are copied. For example, the following command specifies update mode for a copy operation from `d:\date\new` to `f:\depot`:

```
xcopy /e /t /u d:\date\new
f:\depot
```

You can also use the `/d` option to limit the `xcopy` operation to files modified on or after the date specified as its argument (separate the option letter and its argument with a colon as usual: `/d:12-24-98`).

That's all the space we have for this month. Next month, we'll continue this discussion by looking at administrative commands and TCP/IP utilities. ⊸

Æleen Frisch *is systems administrator for a very heterogeneous network of UNIX and NT systems. She is also the author of the books* Essential System Administration *and* Essential Windows NT System Administration *(both from O'Reilly & Associates Inc.). In her (almost nonexistent) spare time, she enjoys painting and lounging around with her cats, Daphne, Susan, Talia and Lyta. Email:* `aefrisch@lorentzian.com`.

by John S. Quarterman

JUDE MACEREN

Internet Growth Rates

The longest running series of data about the Internet is the host data collected by the Network Wizards' Internet Domain Survey (`http://www.nw.com`). As of this writing, the most recent survey was conducted in July 1998.

MIDS takes the Network Wizards' data and localizes domains and hosts per country, rather than just per top-level domain. This is important because there are quite a few countries that have significant numbers of hosts and domains under `.com`, `.net`, `.org` or `.edu`, instead of under their national top-level domain, such as UK for the United Kingdom or FR for France.

Comparing the resulting per-country host data for the period between January 1998 and July 1998 reveals some interesting features of the Internet. For more details, plus maps and scatterplots, see `http://www.mids.org/mmq/503`.

The country with the most hosts in July 1998 was (no surprise) the United States, with about 64% of all Internet hosts. That is actually a slightly higher percentage (very slightly) than in previous surveys. Probably the best thing to say is the United States is still, as it always has been, the Internet world leader.

In hosts per capita, the United States is second. There is only one country with more hosts per capita, but it does have a significant lead (see below).

Europe

In Europe, the most striking change evident in the results of the latest six-month study is the speed with which the former Soviet states of Georgia and Moldova are catching up with the rest of Europe. Armenia and Belarus are also growing faster than the European norm, but not as fast as Georgia and Moldova. Similarly, Bosnia and Macedonia are speeding along the same fast track, but Yugoslavia and Croatia are not.

Meanwhile, Slovenia–which, so far, has been able to avoid the Balkan war–has long been ahead of the Czech Republic and Hungary, and is outperforming its richer neighbor Italy, not to mention Portugal, Spain and even France. Poland more or less defines the mainstream of central European networking, which Moldova, Macedonia, Georgia and Bosnia have now joined, all at a host level that corresponds with their respective per-capita income. Thus, we can expect to see a drop in growth rates for all four countries in the future.

Estonia, Latvia and Lithuania, in that order, have been overachievers for many years now. They have many more hosts per capita than they should, economically speaking.

The European winner, and champion worldwide, remains Finland, with 108 hosts per 1,000 people; more than any other country that is not inflating its figures by selling subdomains. Coming in second, slightly edging out Norway, is Iceland. These three form their own icy class of more than 70 hosts

per 1,000 people. Sweden leads the next pack, where we also find Denmark.

The rest of northwest Europe is clumped together with around 12 to 35 hosts per 1,000 people. The big exception is France, which joins Italy and Spain in a southern European range of five to eight hosts per 1,000 people. Portugal and Greece are a tad lower than that, in the three-to-four range. France ranks low with respect to its per-capita income for one reason: Minitel, the country's proprietary national public information network. Even though France continues to move up, all the other northwestern European countries, including Germany, are growing faster, opening a gap between France and its northern neighbors.

The basket case of Europe remains Russia. Ukraine and Belarus are lower in hosts per capita, but even they are gaining hosts faster than Russia.

Every country in Europe is on the Internet. Even the tiny ones, such as Andorra, Liechtenstein, San Marino, Vatican City, Monaco, Malta and the Faeroe Islands, are onboard. One wonders if we'll need a top-level domain for Scotland soon.

Africa

South Africa has more hosts than the rest of Africa combined. South Africa also has six times as many hosts per capita as the runner-up, the Seychelles. It is not, however, gaining hosts the fastest. That honor goes to Western Sahara, the Comoro Islands and Niger. Of course, when you only have one or two hosts to start with, it's easy to grow rapidly. Of countries that already have a significant presence, Senegal is growing the fastest, jumping more than 200% in the six-month period. Growing nearly as fast were Gabon and Togo. I would bet on Gabon for continuing this rapid growth. This is a safe bet because Gabon is an oil-rich country (a member of OPEC) with a high standard of living (even though much of the money resides in the hands of the president), a stable government (President El Hadj Omar Bongo was just reelected) and a ready source of technology in France.

Egypt and Tunisia continue to disappoint. Egypt has the second highest number of total hosts per country in Africa, but in terms of hosts per capita it ranks low.

It will be very interesting to see if Nigeria will ever live up to its potential. With a large, English-speaking population, oil money and access to U.S. and U.K. technology, it should rival South Africa. It simply needs a stable government and economy; that's not asking much, is it? The latest report was taken before any possible effects from the recent change in government could be felt, so we shall see.

Meanwhile, almost all the new countries on the Internet are in Africa, mainly because that's where most of the previously unconnected countries were. The remaining new countries are all island nations.

Asia Pacific

In East Asia, the leaders in hosts per capita among sizable countries continue to be Hong Kong, Taiwan, Singapore, Japan and South Korea, in that order. This is not a surprise, but we shall see what happens in the next Network Wizards' report, which should show effects of the recent Asian economic meltdown.

Guam shows the same level of hosts per capita as Hong Kong (about 20 hosts per 1,000 people); this is most likely owing to its association with the United States.

Latin America and the Caribbean

Uruguay is the highest ranked country in South America in hosts per capita, but it is behind five Caribbean nations: Bermuda, the U.S. Virgin Islands, Anguilla, the Cayman Islands and the Turks and Caicos Islands. The next big hosts-per-capita winners in this region are Chile, Argentina, Brazil, Guatemala and Mexico, in that order. Brazil and Mexico are the regional leaders in total number of hosts, but their populations are so large that they

rank low in terms of hosts per capita.

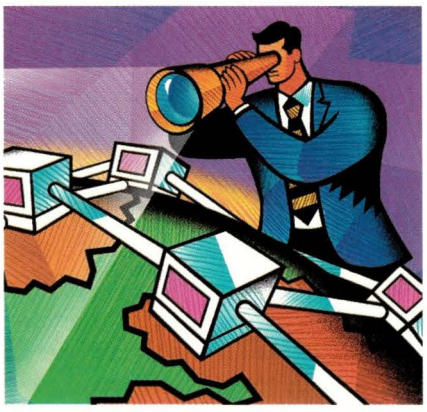
However, Brazil is the fastest growing country in the region. Between January and July 1998, Brazil gained Internet hosts faster than any country in the region, including all of the small island nations.

Worldwide

In some ways, the more things change, the more they stay the same. While the total number of Internet hosts continues to grow apace, and because the human population grows very slowly in comparison, the numbers of hosts per capita per country also increases rapidly. But when you look at the global distribution of countries according to hosts per capita, the picture looks very much like it has for the past five years. All of the countries in the highest tier of hosts per capita (currently more than 32 hosts per 1,000 people) are concentrated in three regions–North America (United States, Canada and Bermuda); northwest Europe (Finland, Iceland, Norway, Vatican City, Sweden and The Netherlands); and Australasia (New Zealand and Australia)–unless you count Antarctica, which has no resident population in the usual sense (how many researchers are there at any one time in Antarctica?), or Niue or the British Indian Ocean Territory (mainly Diego Garcia Island), both of which sell subdomains.

If you look at the distribution of income per capita per country it looks similar. Except for the United States and Canada, the top ranking Internet countries are not the same countries that make up the G7 economic club, which also includes Germany, France, the United Kingdom, Italy and Japan. The United Kingdom is in the second tier, with at least 16 hosts per 1,000 people, along with Hong Kong and Taiwan, among others. To find Germany, you have to go still lower, into the eighth tier, along with Singapore, Israel, Estonia and Ireland. Japan can be found here as well, ranked next to Slovenia. For Italy and France, go on down to the next tier, along with the Czech Republic, Barbados, Uruguay and South Korea.

Almost every country in the world is now connected to the Internet. Most of the remaining unconnected countries are tiny. The rest are either repressive (Myanmar), war zones (the Democratic Republic of the Congo), sanctioned



(Iraq), extremely poor (Chad) or may or may not in fact be countries (the Gaza Strip). Some countries that until quite recently were not connected for the same reasons, such as the People's Republic of China, Bosnia, Cuba, Nigeria and the Isle of Man, are now connected. Of those countries that are connected, almost all of them are rapidly gaining hosts. Japan and Ireland were as densely networked in July 1998 as the United States was in January 1995. Many countries are leaping ahead even faster than that. The main constraints on growth seem to be economic, but Finland and Estonia have demonstrated that may not be as much of a limit as one might think.

The Internet is rapidly becoming the world's communication fabric. To some extent, it is possible to predict which countries will knit that fabric the fastest, and it's certainly possible to observe which ones have done so recently. ⊸

John S. Quarterman *is president of Matrix Information & Directory Services Inc. (MIDS), which publishes* Matrix Maps Quarterly, Matrix News *(monthly) and the* MIDS Internet Weather Report *(daily). John has written or coauthored seven books, but the best known one is still* The Matrix. *For more information, see* `http://www.mids.org`. *He can be reached by email at* `jsq@mids.org`, *by voice at (512) 451-7602 or by fax at (512) 452-0127.*

by Jeffreys Copeland and Haemer

PAUL STODDARD

"I have not kept my square;
but that to come
Shall all be done by the rule."
– William Shakespeare,
Antony and Cleopatra

"What mighty contests rise
from trivial things."
– Alexander Pope,
The Rape of the Locker

Going Through Our Lockers

Last month, we were inspired by an elementary school math class. This month, we'll take you to middle school or junior high, depending on your local school district. Leaving elementary school brings many changes. The one that our daughters seem to attach the most importance to is…lockers!

Here's a problem that a middle-school math teacher gave us over coffee:

Imagine all the students lined up in front of their lockers–Student One in front of Locker 1, Student Two in front of Locker 2 and so on. All the lockers are closed.

We start by having Student One open Locker 1, then open Locker 2, then Locker 3, Locker 4 and so on down the line. When he opens the last locker, he returns to his own locker and stands in front of it.

Next, Student Two closes Locker 2, then Locker 4, Locker 6 and every other locker down to the end of the line, and returns to her place.

Now it is Student Three's turn. Student Three closes Locker 3, opens Locker 6 (which, remember, was opened by Student One and then closed by Student Two), closes Locker 9 and so on, fiddling with the door of every third locker.

If we continue this process through to the last student, which lockers are open, which are closed, and why?

Before we go any further, what's your answer?

What?

Our answer was, "Um…The prime-numbered lockers are open?" (Two great minds in one great rut.) Wrong.

If this was your answer too, don't feel bad. We've given several of our friends this problem, and many of them gave us this same wrong answer. Another frequent off-the-cuff wrong guess is the Fibonacci series. Michael, who works behind the counter in our neighborhood coffeehouse, guessed factorials. That's wrong too.

Instead of guessing, perhaps you tried using paper, a pencil and an eraser. We, of course, wrote a short program (see Listing 1 on Page 44).

Lines 1 through 3 are boilerplate, with a shebang line containing the `-w` flag, and the compulsive, nit-picking strict module that we tend to use because we're poor typists.

Lines 4 and 5 use the first argument as the total number of lockers and exit with a bitter complaint if it isn't present.

Normally, Perl arrays begin at index 0, as in C, but we want our locker numbers to begin at 1, so line 6 says that in this program, all our array indices are going to begin at 1, as in FORTRAN.

Line 7 sets up an array of lockers and starts with them all closed (we'll use `$locker[5] = 0;` to mean Locker 5 is closed and `$locker[5] = 1;` to mean Locker 5 is open).

Lines 8 through 12 perform the openings and closings and lines 13 through 15 print out the numbers of the open lockers.

SunExpert Is Now Online!

Over two years of entire issues are now online for your convenience. All subsequent issues will be available. And it's FREE. No registration is necessary.

The *SunExpert Electronic Archives* are available in the cross platform-friendly PDF format. The free viewing software, Adobe Acrobat Reader 3.0, can also be downloaded from the archive site.

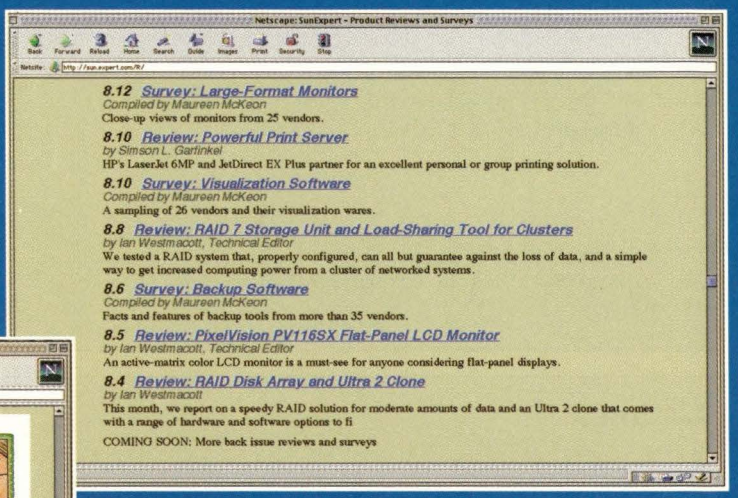
Now you can view the articles as they originally appeared...forward them electronically to coworkers or fellow team members...and know that the information will read clearly in your heterogeneous environments.

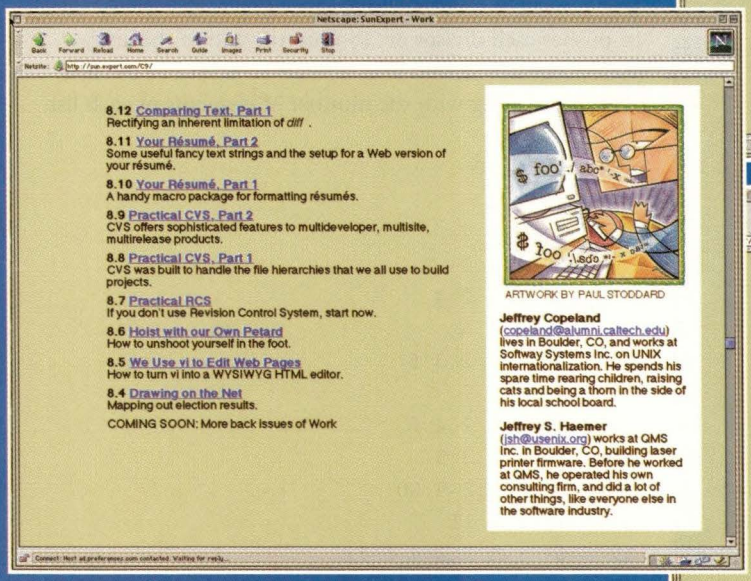
Just click and go!

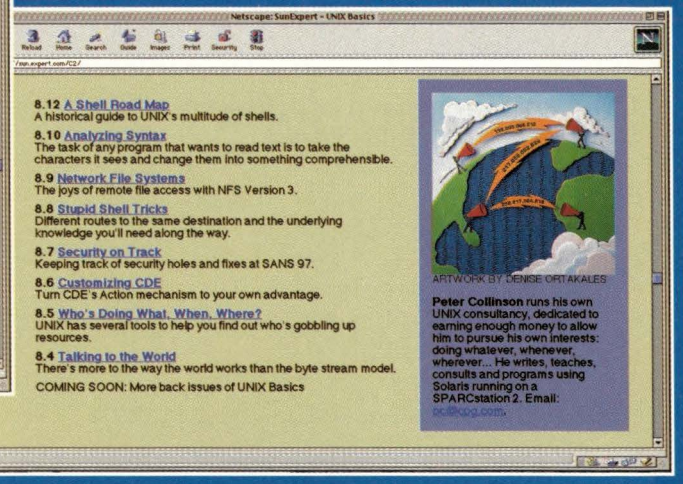
http://sun.expert.com

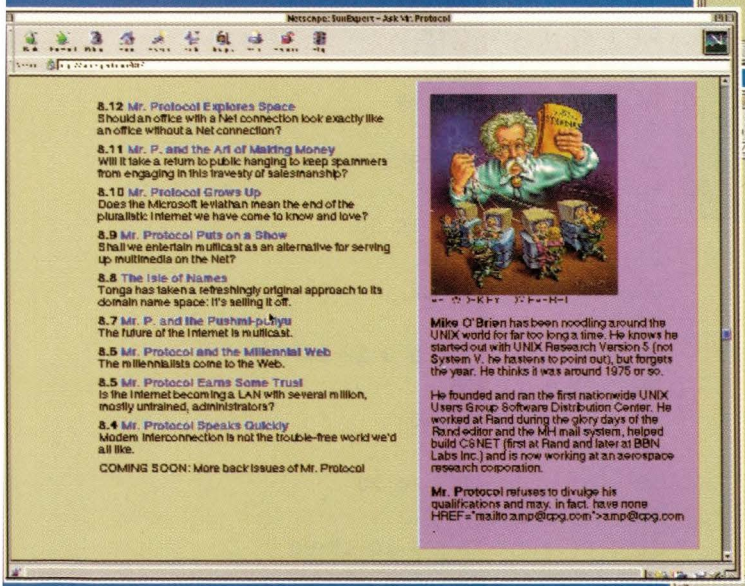
Where didn't you go yesterday!

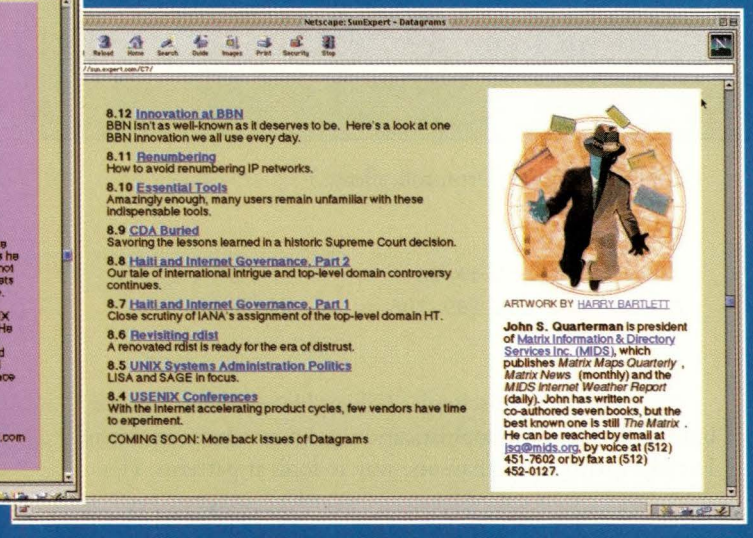
- Did you miss Mr. P's trip to Tonga to investigate its domain name system?
- Have you seen the Jeffrey's column on Practical RCS?
- Looking for Peter Collinson's wisdom on Network file systems?
- Did you read Æleen Frisch's tips on the NT registry?
- Searching for information on OS coexistence?
- Considering new backup software? Or a new RAID system?
- Don't make a move without reading our survey and product reviews first!
- Clusters demystified!











Listing 1

```
1   #!/usr/local/bin/perl -w
2   # $ID: lockers,v 1.1 1998/12/22 01:26:41 jsh Exp $

3   use strict;

4   my $usage = "usage: $0 num_lockers";
5   my $n = shift || die $usage;

6   $[ = 1;
7   my @lockers = (0)x$n;

8   for (my $i=1; $i <= $n; $i++) {
9    for (my $j=$i; $j <= $n; $j += $i) {
10    $lockers[$j] = $lockers[$j] ? 0 : 1;
11   }
12  }

13  for (my $i=1; $i <= $n; $i++) {
14   print "$i\n" if ($lockers[$i]);
15  }
```

Listing 2

```
1   #!/usr/local/bin/perl -w
2   # $ID: divisors,v 1.1 1998/12/22 01:26:41 jsh Exp $

3   use strict;

4   my $usage = "usage: $0 num_lockers";
5   my $n = shift || die $usage;

6   $[ = 1;
7   my @divisors;

8   for (my $i=1; $i <= $n; $i++) {
9    for (my $j=$i; $j <= $n; $j += $i) {
10    push @$divisors[$j], $i;
11   }
12  }

13  for (my $i=1; $i <= $n; $i++) {
14   my $t = scalar @$divisors[$i]};
15   printf "%3d [%2d] : ", $i, $t;
16   print "@$divisors[$i]}\n";
17  }
```

And the output? (Drumroll, please.)

```
$ lockers 200
1 4 9 16 25 36 49 64
81 100 121 144 169 196
```

Yup. Squares.

(Like you, middle-schooler Gillian Haemer said "squares," but that requires the sophistication to know what a square is. Luckily, there's more than one way to look at patterns. Her little sister, Zoe, said "3, 5, 7, 9... I see the pattern." Do you see what she saw?)

But that's only the first half of the answer.

Why?

Last month, when we were talking about elementary-school math, we remarked that computers sometimes raise more questions than they answer. Here's a case where a short program gave us a quick, easy-to-interpret pattern as the answer to an interesting puzzle. This forced us head-on into the question, "Why?"

So, let's think. Well, if you're locker *N*, who messes with your door? Easy. The student corresponding to each of your divisors, including Student One and Student *N*. The locker door ends up being open if, and only if, it has an odd number of divisors.

So squares, and nothing else, have an odd number of divisors? Precisely.

Okay, why's that? Let's take a look at the divisors of each number–another short program (see Listing 2).

This program is just a variant of our program in Listing 1. This time, instead of opening or closing locker doors, line 14 pushes each divisor of `$j` onto the end of the array `@$divisors[$j]`, and lines 15 and 16 print out the lists of divisors, along with the number of elements in each list.

```
$ divisors 30
  1 [ 1] : 1
  2 [ 2] : 1 2
  3 [ 2] : 1 3
  4 [ 3] : 1 2 4
  5 [ 2] : 1 5
  6 [ 4] : 1 2 3 6
  7 [ 2] : 1 7
  8 [ 4] : 1 2 4 8
  9 [ 3] : 1 3 9
 10 [ 4] : 1 2 5 10
 11 [ 2] : 1 11
 12 [ 6] : 1 2 3 4 6 12
 13 [ 2] : 1 13
 14 [ 4] : 1 2 7 14
 15 [ 4] : 1 3 5 15
 16 [ 5] : 1 2 4 8 16
 17 [ 2] : 1 17
 18 [ 6] : 1 2 3 6 9 18
 19 [ 2] : 1 19
 20 [ 6] : 1 2 4 5 10 20
 21 [ 4] : 1 3 7 21
 22 [ 4] : 1 2 11 22
 23 [ 2] : 1 23
 24 [ 8] : 1 2 3 4 6 8 12 24
 25 [ 3] : 1 5 25
 26 [ 4] : 1 2 13 26
 27 [ 4] : 1 3 9 27
 28 [ 6] : 1 2 4 7 14 28
 29 [ 2] : 1 29
 30 [ 8] : 1 2 3 5 6 10 15 30
```

Aha. Well, the first thing we see is something we already knew: only prime numbers have exactly two divisors (one and themselves). What about some of the other compound numbers? The powers are easy: 2 has two divisors, 4 has three, 8 has four, 16 has five and so on. It's easy to see that for any prime, p^n has $n + 1$ divisors: p^0, p^1, ... p^n.

But how about the other compound numbers, like 72? $72 = 2^3 \times 3^2$.

First, we arrange all the divisors in a table, like this:

x	1	3	9
1	1	3	9
2	2	6	18
4	4	12	36
8	8	24	72

Across the top, we have the possible powers of three and down the side, the possible powers of two. Taken together, the table entries constitute all (3+1) x (2+1) = 12 possible combinations.

Similarly, though harder to draw, it should be pretty clear that the divisors of $900 = 2^2 \times 3^2 \times 5^2$ can be laid out in a (2+1) x (2+1) x (2+1) = 3 x 3 x 3 cube. (Okay, okay, "a three-dimensional rectangular parallelepiped.")

Much harder to draw would be the four-dimensional grid of divisors of $4902963250500 = 2^2 \times 3^5 \times 5^3 \times 7^9$, but it's not hard to see how many elements would be in it: 3 x 6 x 4 x 10 = 720.

So which numbers will have a multidimensional array of divisors with an odd number of elements? Only those with an odd number of elements in every dimension; an even number in any dimension would make the product of the dimensions even.

And how many elements are there in each dimension? One more than the power of the prime that dimension represents. (Thus, in our first example above, $72 = 2^3 \times 3^2$, we have four elements in the dimension representing the prime factor 2, and three elements in the dimension representing the prime factor 3.)

But for each axis to be of odd length, each prime factor must be raised to an even power. And if each prime factor is raised to an even power, then the number is a square.

For example, $144 = 12^2 = (2^2 \times 3^1)^2 = 2^4 \times 3^2$ will have (4+1) x (2+1) = 15 factors, and Locker 144 will be open.

Not bad, eh?

Not Again!

Okay, here's another one.

Same students, same lockers, opposite rules. This time, Student One doesn't open his locker or anyone else's. Student Two doesn't open Locker 2, but opens Locker 3, skips Locker 4, opens Locker 5 and so on.

Student Three doesn't open Locker 3, does open Locker 4, closes Locker 5, ignores Locker 6 and goes on changing the state of every locker that is not divisible by three. Now which lockers are open?

("Um...Primes?" No again.)

Listing 3

```
#!/usr/local/bin/perl -w
# $ID: lockers2,v 1.1 1998/12/22 15:29:44 jsh Exp $

use strict;

my $usage = "usage: $0 num_lockers";
my $n = shift || die $usage;

$[ = 1;
my @lockers = (0)x$n;

for (my $i=1; $i <= $n; $i++) {
 for (my $j=$i; $j <= $n; $j++) {
  $lockers[$j] = ($lockers[$j] ? 0 : 1) if $j%$i;
 }
}

for (my $i=1; $i <= $n; $i++)  {
 print "$i\n" unless $lockers[$i];
}
```

Listing 3 shows the code. And the answer:

```
$ lockers2 100
1 2 6 8 9 10
12 14 18 20 22
24 25 26 28 30
32 34 38 40 42
44 46 48 49 50
52 54 56 58 60
62 66 68 70 72
74 76 78 80 81
82 84 86 88 90
92 94 96 98
```

Aha! It's the even numbers. Well, almost.

What's the pattern? And why?

We see the answer to the first question, but not a good proof for the second one. Maybe you have to be a middle-schooler to come up with one; if you have a middle-schooler who does, please pass the proof along and we'll print it. Meanwhile, we'll ask Gillian Haemer and Allie Copeland.

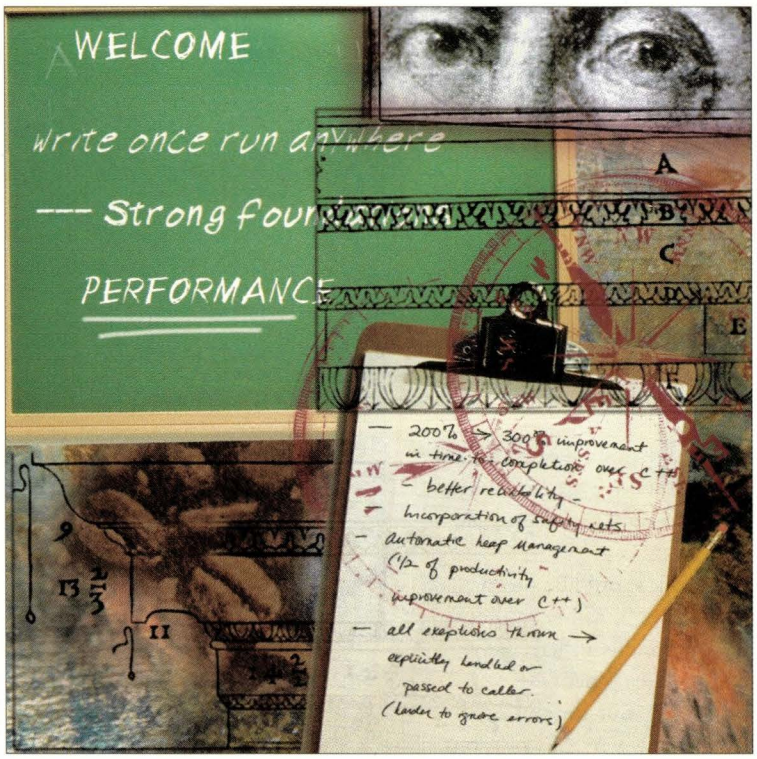
Until we hear from you or them, happy trails. ⊸

Jeffrey Copeland *(copeland@alumni.caltech.edu) lives in Boulder, CO, and works at Software Systems Inc. on UNIX internationalization. He spends his spare time rearing children, raising cats and being a thorn in the side of his local school board.*

Jeffrey S. Haemer *(jsh@usenix.org) works at QMS Inc. in Boulder, CO, building laser printer firmware. Before he worked for QMS, he operated his own consulting firm and did a lot of other things, like everyone else in the software industry.*

Note: The software from this and past Work columns is available at `http://alumni.caltech.edu/~copeland/work`.

by Jim Frost



NAOMI SHEA

Java from the Trenches

Welcome to the first installment of Java Class, a column on Java technology and its practical uses. In the following months, we'll be investigating various components that make the Java language and runtime unique and how they may be used in practical applications. You won't find rehashed marketing hype in these pages, although there will occasionally be opinions on the topic and industry.

Rather than diving headlong into concepts and source code, this first column is dedicated to a real-world look at Java: what it's good at, what it's not and how it is expected to evolve in the near future. I have been working with Java to produce commercial applications since Java Developer's Kit (JDK) 1.0.1 and have seen it evolve from a couple of good ideas and a terrible implementation to a number of great ideas and a mediocre implementation. Like a good Merlot, Java has been improving with age–but it is still young, and its youth shows.

Write Once, Run Anywhere?

The promise of Java, according to Sun Microsystems Inc., has been "write once, run anywhere." Sun shouted it from the rooftops, with magazine ads and even silly radio spots. Unfortunately, like similar technologies before it, Java has been long on hype and short on delivery in this area. Yes, you can produce a single executable that runs pretty much anywhere, but usually you can't just write the code once and be done with it. You write the code, test it everywhere, tweak it for platforms where it doesn't work and repeat until you have something that works everywhere you care about. This has led some developers to quip that Java is "write once, debug everywhere." In Sun's defense, this process is a lot easier for Java than it was for C or C++, but the improvement in the process was only incremental rather than revolutionary. Worse, what you gain in development time you lose many times over in testing costs because you have to test on every Java Virtual Machine (JVM) on every platform–potentially dozens of JVMs on the popular Microsoft Corp. Windows platform alone.

So, if Java's portability isn't all that it's cracked up to be, why is it still making a big splash? In a word, productivity. Java's feature set is such that most developers see a 200% to 300% improvement in time to completion versus C++, and much better code reliability to boot. In some cases, such as server applications, Java productivity is an order of magnitude better than C++, even though the Java tools and runtimes used by most developers are primitive and/or buggy. If you can build an application two or more times as fast, you can spend a lot of time on performance tuning or features and still beat a C++ competitor to market. Java product evolution proceeds at Internet pace, a real business advantage.

Strong Foundations

Where does the improvement come from? Fred Brooks, in his book *The Mythical Man Month* (published by

http://webserver.cpg.com

For technical managers of World Wide Web sites.

WebServer OnLine focuses on hardware/software to implement, maintain and/or upgrade web sites.

Free Online Magazine, No Password Required.

Addison-Wesley Publishing Co. 1995, ISBN 0201835959), suggested that high-level languages were going to make big improvements in programmer productivity because "one avoids an entire of level of exposure to error, a level on which one makes not only syntactic errors but semantic ones."

Java takes the basic C++ language, already a huge improvement over raw assembly code, to another level by providing a number of safety nets for catching errors early and handling errors that make it into production code.

The most oft-cited Java reliability feature is automatic heap management. It is impossible in Java to accidentally free memory that is in use and it is much more difficult to leak memory. Indeed this may account for as much as half of the productivity improvement over C++, but it is not the only big improvement.

In addition to eliminating errors in heap management, Java requires that all possible exceptions must be explicitly handled or passed to the caller. This feature makes it much more difficult to ignore errors that ought to be caught and handled. As a result, first efforts are considerably more robust than is typically seen with C++. In practice, Java applications tend to be so robust that beta testing becomes much more difficult: Most exceptions in GUI-based applications are caught by the GUI package (AWT or Swing), allowing the application to continue operating (albeit with reduced functionality). Often this means that a button or menu item simply does not seem to respond, behavior that is generally not seen as being as serious as dumping core or locking up the whole machine.

In terms of programmer support, Java's insistence on runtime error checking provides yet another big improvement over C++. Simple errors, such as off-by-one errors, are usually caught in the initial development stage. Such checking has long been available to C++ programmers using tools like CenterLine Development Systems Inc.'s ObjectCenter or Rational Software Corp.'s Purify, but these tools were expensive and rarely used. Even when errors make it beyondthe initial development stage, the runtime error reporting includes enough information that a developer can often track down the error even without being able to reproduce it.

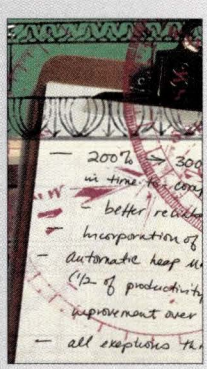
Another oft-overlooked Java feature that significantly improves programmer productivity is incremental linking. With a halfway decent Makefile or smart class builder, a typical Java compile-edit-debug cycle can be managed in a matter of a few seconds, even using the very slow JDK compiler. In contrast, a large C++ application can take minutes just to link. This allows a Java programmer to make many more incremental changes to code over the course of a day.

While none of these features alone makes Java especially interesting, the combination provides a very significant (and much-needed) real-world improvement over C++.

Performance, Performance, Performance

While Java provides excellent programmer productivity and good to excellent portability, it is universally castigated for its poor performance relative to C++. These criticisms are well-deserved. Even recent just-in-time (JIT) compilers barely achieve half the performance of C++ across a typical code base, and Java's GUI libraries are rarely accused of being too efficient.

Some of the popular opinion of Java's poor performance is the result of Sun's exploitation of the exploding Web browser market as a Java launch platform. While this got Java into the hands of thousands of developers and millions of users, applets highlight the worst parts of Java (AWT, code and runtime size and raw performance). The ploy worked as a means of reaching critical mass but it totally destroyed any hope of achieving high degrees of stability anytime soon, owing to the mass adoption of very immature embedded Java technology. Most Java runtime environments on user systems today are still based on JDK 1.0.2 technology that is more than two years out-of-date, and the dependency on the browser vendors to update their technology has seriously impeded the influx of features in newer releases.



The combination of JIT systems and faster hardware has improved Java application performance by as much as two orders of magnitude, making Java practical across many more applications.

Luckily, several developments since Java's introduction have largely mitigated the performance complaint. While JIT systems boosted Java code performance tremendously, Java has benefited even more from hardware performance improvements. Typical desktop hardware, for instance, is easily four times faster today than it was just three years ago and has four times as much memory. The combination of JIT systems and faster hardware has improved Java application performance by as much as two orders of magnitude, making Java practical across many more applications.

Clearly we can expect more hardware performance improvements, but what about software? We stand at the brink of some big developments in that area as well, although the greatest gains have already been seen.

Over the past year or so, a number of native code Java compilers have hit the market, and more are on their way. These provide a way for developers to choose performance over portability (and even safety) and already rival the raw performance of C++. These should become far more prevalent in the future.

One of the most hyped Java performance technologies over the past two years has been Sun's HotSpot. This JVM promises improved performance from three major technological enhancements: improved garbage collection algorithms, automatic profile-based optimization and stream-lined syn-

chronization. Unfortunately, this product's release schedule has made even the much-maligned Microsoft Windows 2000 (aka NT 5.0) seem a paragon of timeliness.

HotSpot appears to have fallen victim to typical programmer optimism: Its complex optimization technology is taking much longer to bring to market than Sun originally anticipated. Unfortunately, the two other benefits of HotSpot, improved garbage collection and synchronization, are being held up as well.

While Sun touts the optimization technologies, I believe that most programs will benefit far more from improved garbage collection and synchronization than further JVM code optimization. The garbage collection algorithm used by Sun's existing JVMs is essentially the same as the one used in the first LISP interpreters–it is mid-1960s technology. Even Microsoft, for all its faults, is using garbage collection technology from the 1980s–and Microsoft's VM shows significant improvements over JDK's JVM, despite few improvements elsewhere. (See `http://java.sun.com/javaone/javaone98/sessions/T103/slide20a.htm` and `http://java.sun.com/javaone/javaone98/sessions/T103/slide20b.htm` for a performance comparison. Notice the different scales used for the JDK and Internet Explorer comparisons.) HotSpot's hybrid garbage collection mechanism is modern technology that should behave much better than that found in any of the common JVMs, and synchronization improvements can't do anything but improve the performance of many commonly used Java classes (particularly the collection classes). Sun should have rolled these technologies into the JDK as soon as they were available, allowing users to take advantage of them as soon as possible.

Even without further performance improvements, the fact of the matter is Java is usable for a lot of applications. Some of the most heavily visited sites on the Internet (including Sun's own) use Java technologies for page rendering. Performance can't be too bad if Java technology can drive Web sites that handle tens of millions of hits per day–and it does.

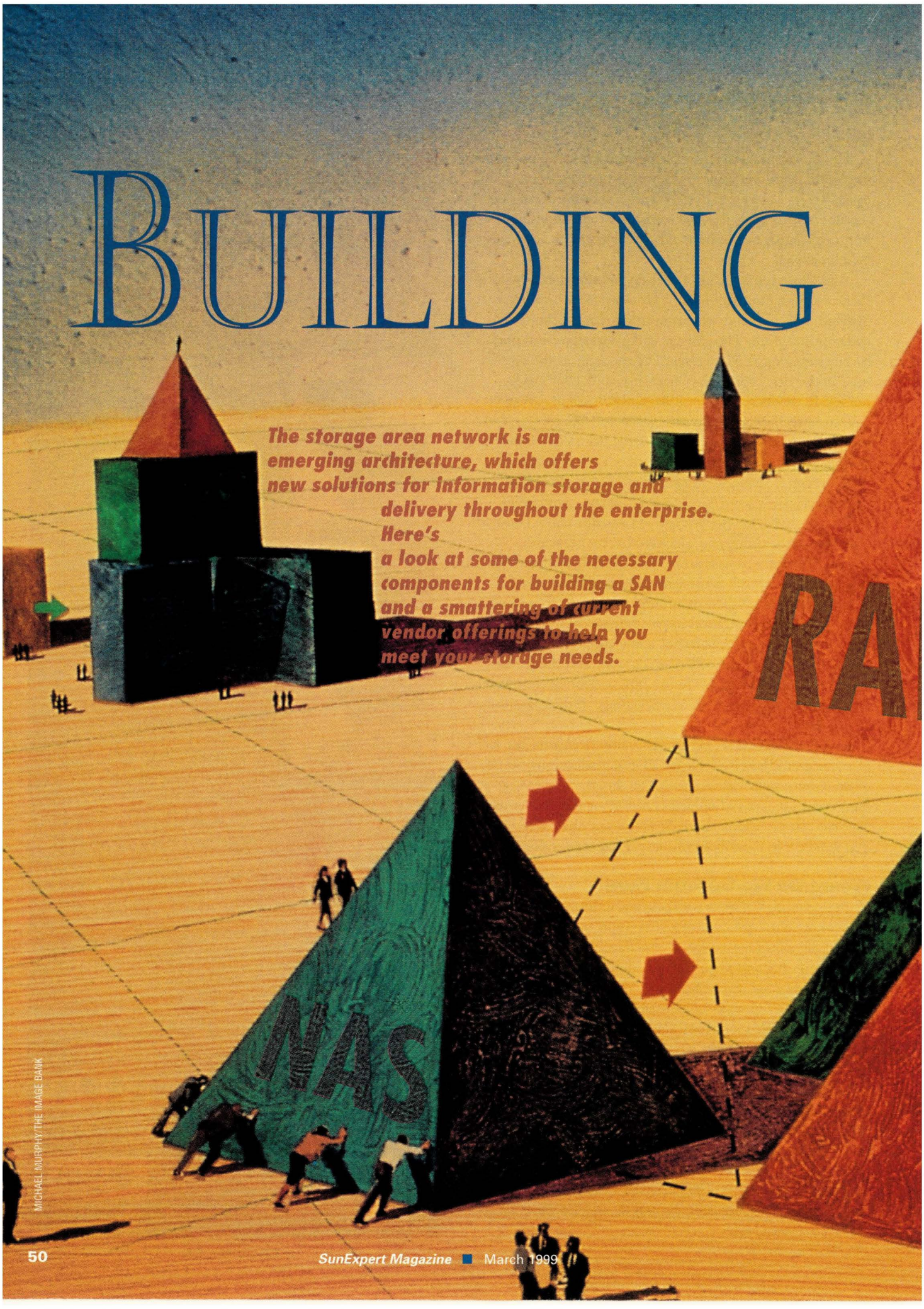
Where Do We Go from Here?

In upcoming columns, we'll eschew industry discussion in favor of cold, hard code. The first topic of discussion, which will continue through several issues, is perhaps the most interesting and potentially revolutionary technology present in Java today: JavaBeans.

A "JavaBean" is easily constructed and Java provides an extremely flexible set of tools for manipulating them–two things that, until recently, have been rare in component technologies. Used properly, they can result in vastly better component reuse and much easier application construction; as we shall see as we delve into what makes up a "bean" and use Java's bean manipulation package to create a bean application framework. ➸

***Jim Frost** is a software engineer specializing in Java technologies and strong opinions. He may be reached via email at* `jimf@frostbytes.com`.

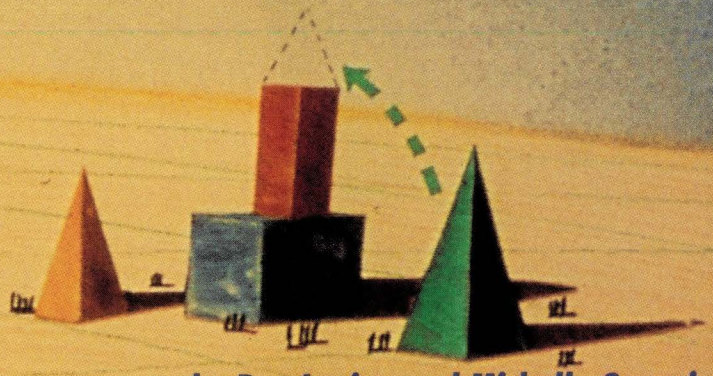
BUILDING



MICHAEL MURPHY/THE IMAGE BANK

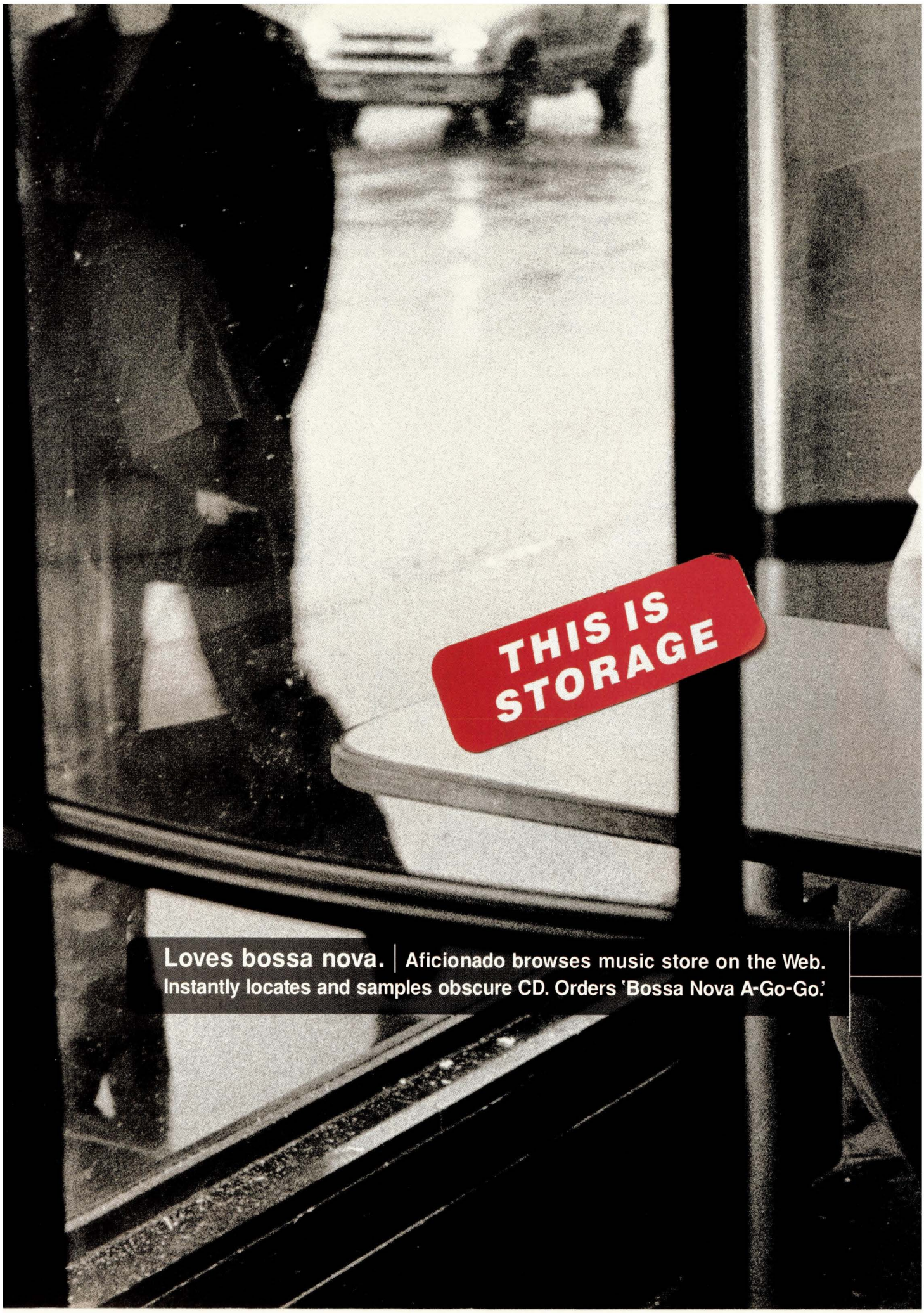
The storage area network is an emerging architecture, which offers new solutions for information storage and delivery throughout the enterprise. Here's a look at some of the necessary components for building a SAN and a smattering of current vendor offerings to help you meet your storage needs.

A SAN

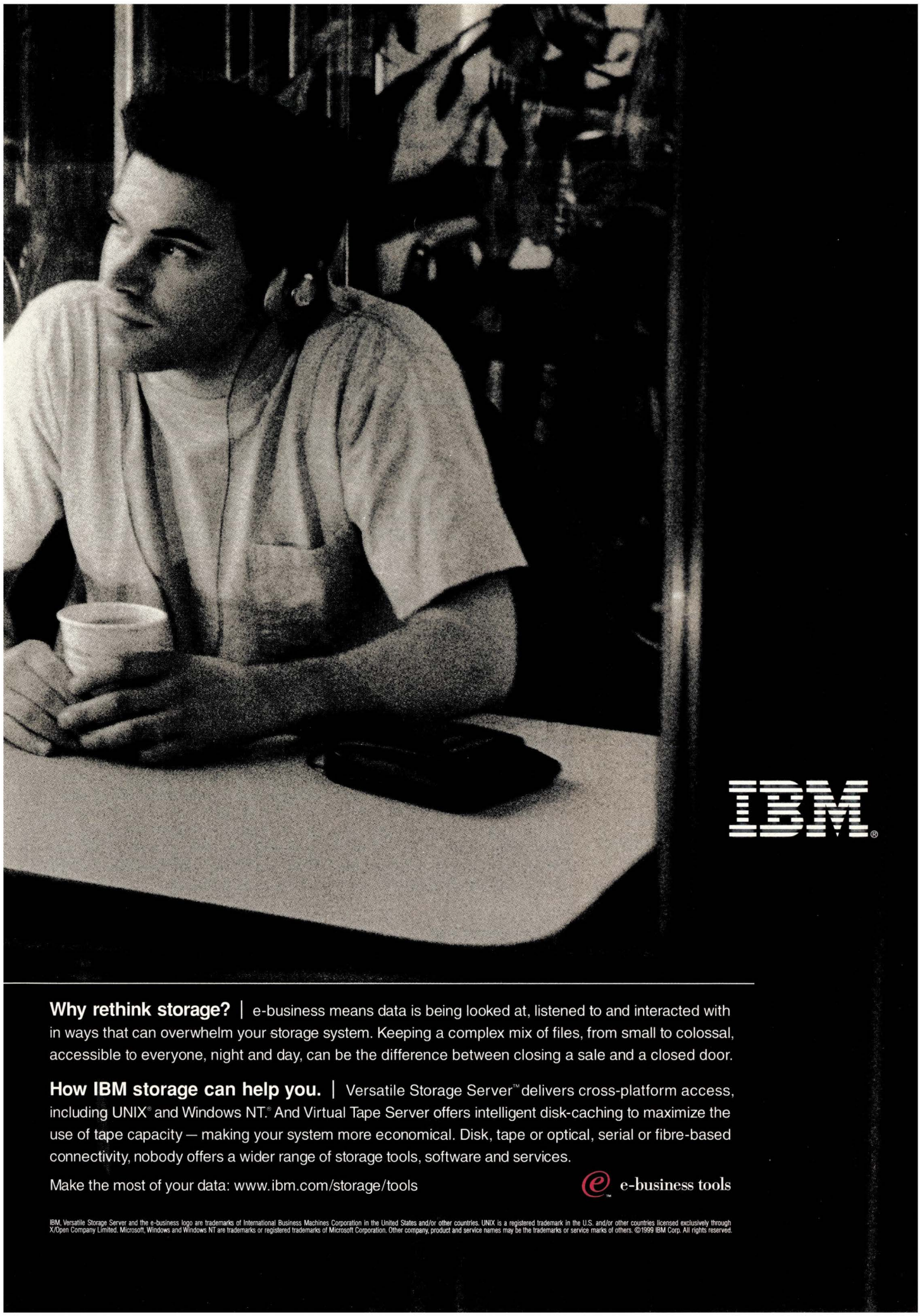


by Ron Levine and Michelle Gervais

Microprocessors continue their power explosion, while shrinking in size and cost—a pattern defined in Silicon Valley as Moore's Law. Soon, there will be similar laws quantifying the metamorphosis of data storage systems. Until recently, the fundamental way stored data was accessed, shared and managed, whether at the desktop or enterprise level, remained relatively unchanged. Today, the storage area network (SAN)



Loves bossa nova. | Aficionado browses music store on the Web. Instantly locates and samples obscure CD. Orders 'Bossa Nova A-Go-Go.'


IBM®
Why rethink storage? | e-business means data is being looked at, listened to and interacted with in ways that can overwhelm your storage system. Keeping a complex mix of files, from small to colossal, accessible to everyone, night and day, can be the difference between closing a sale and a closed door.
How IBM storage can help you. | Versatile Storage Server™ delivers cross-platform access, including UNIX® and Windows NT.® And Virtual Tape Server offers intelligent disk-caching to maximize the use of tape capacity – making your system more economical. Disk, tape or optical, serial or fibre-based connectivity, nobody offers a wider range of storage tools, software and services.
Make the most of your data: www.ibm.com/storage/tools
e-business tools
IBM, Versatile Storage Server and the e-business logo are trademarks of International Business Machines Corporation in the United States and/or other countries. UNIX is a registered trademark in the U.S. and/or other countries licensed exclusively through X/Open Company Limited. Microsoft, Windows and Windows NT are trademarks or registered trademarks of Microsoft Corporation. Other company, product and service names may be the trademarks or service marks of others. ©1999 IBM Corp. All rights reserved.

is an emerging architecture, which offers new solutions for information storage and delivery throughout the enterprise.

SANs promise improvements in data availability, reliability, flexibility and manageability. They are an optimized methodology for dealing with the rapid growth of online storage and data warehousing issues. SANs enable users to access information across any platform, share common storage devices and files, easily scale storage capacity and centralize information management.

Michael Peterson, president at Strategic Research Corp., a Santa Barbara, CA-based research company, is generally credited with coining the term "storage area network." He defines a SAN as a "high-speed network that establishes a direct connection between storage elements and servers." SANs have actually been around for a long time in the form of high-speed dedicated I/O buses, but with the advent of Fibre Channel, these I/O pathways can make use of hubs, switches, routers and bridges to form a network-type infrastructure similar to a local area network (LAN). The SAN is a network that is dedicated to communications between host servers and storage devices. A SAN liberates the LAN from storage-related traffic and places the storage I/O onto an alternate network.

A typical SAN is made up of many building blocks. These include an interface (Fibre Channel, SCSI, ESCON), interconnects (switches, routers, hubs), a protocol (SCSI, IP), software and storage devices (RAID, tape libraries, optical devices) all attached to multiple servers. Of the interfaces, Fibre Channel is the most common when discussing SANs.

The Interface

It's the Fibre Channel interfaces (Fibre Channel Arbitrated Loop, or FC-AL, and Fibre Channel fabric) that are generating excitement about SANs. This high-speed serial pipeline between servers and storage devices provides tremendous performance improvements over the traditional parallel SCSI bus. Fibre Channel supports more devices (126 per FC-AL), over longer distances (10km) and at higher throughput

SAN Components Available Today

Some of the storage area network products and storage devices currently available from a sampling of vendors.

Advanced Digital Information Corp. (ADIC)
11431 Willows Road N.E.
Redmond, WA 98052
Phone: (425) 881-8004
WWW: *http://www.adic.com*
Circle 150

ADIC sells SAN connectivity products. The FCR Series, a complete family of Fibre Channel/SCSI routers, allows legacy SCSI devices to be seamlessly integrated into Fibre Channel SANs. The FCR Series provides a Fibre Channel-to-SCSI and SCSI-to-Fibre Channel interface that can accommodate up to two Fibre Channel connections and four SCSI buses. The routers can be used in conjunction with RAID arrays and hard drive and tape products. Pricing for the FCR Series ranges from $4,725 to $34,000. ADIC also offers tape libraries that connect directly to Fibre Channel SANs. The Scalar 1000 library, which supports multiple tape technologies (including DLT, AIT and 3590), holds up to 788 cartridges, providing more than 80 TB of storage capacity. The average transfer rate per drive is 300 MB/min and file access time averages 60 seconds. Pricing for the Scalar 1000 starts at $52,595.

❖ ❖ ❖

ATL Products Inc.
2801 Kelvin Ave.
Irvine, CA 92614
Phone: (714) 774-6900
WWW: *http://www.atlp.com*
Circle 151

ATL designs, manufactures and services automated DLT library systems. The P3000 library supports dual Fibre Channel host bus adapters and supports the deployment of redundant loops, hubs, switches and I/O paths to the tape library. The library features single-connector, hot-swappable DLT tape drives and redundant power supplies, fans and AC sources. The P3000 includes complete dual Fibre Channel paths so should one switch fail (for example, during backup), the second path will allow the backup to continue within its allotted window. The P3000 also features a 64-bit bridge that allows for simultaneous data throughput for up to 16 DLT7000 drives. The library is designed to support up to 326 cartridges, providing 11.4 TB of storage capacity. The maximum data transfer rate is 288 GB/hour. ATL does not sell products directly to end users; interested buyers should consult their authorized ATL VAR. Pricing starts at around $98,000.

❖ ❖ ❖

Box Hill Systems Corp.
161 Avenue of the Americas
New York, NY 10013
Phone: (212) 989-4455
WWW: *http://www.boxhill.com*
Circle 152

Box Hill's LAN-less backup solution includes products and services specifically engineered for SANs. These include:

- Box Hill's Fibre Channel-based line of RAID systems.
- Legato Systems Inc. NetWorker and SmartMedia backup software.
- StorageTek's selection of Fibre Channel disk, tape and connectivity components.

Box Hill's Fibre Box is a high-performance, hot-swappable dual Fibre Channel Arbitrated Loop (FC-AL) controllerless RAID storage subsystem. The Fibre Box transfers data at more than 200 MB/s, at distances up to 10km and has a storage capacity of 2.27 TB. By integrating FC-AL RAID systems with tape, SAN connectivity and software products, Box Hill provides LAN-less backups, alleviating potential bottlenecks on enterprisewide networks. Contact vendor for pricing.

"Hi, I'm Bob. How would you like 60,000 Windows apps on your UNIX desktop?"

Imagine running PC applications on UNIX desktops *without emulation!* **NCD WinCenter** software delivers Microsoft® Windows applications to UNIX workstations or X terminals across your network. NCD WinCenter installs on Citrix WinFrame or Citrix MetaFrame and integrates seamlessly into existing UNIX environments with no desktop software required.

CITRIX®

NCD WinCenter for MetaFrame delivers access to Windows NT 4.0 and NCD WinCenter Connect is for Windows NT 3.51. Both integrate Windows applications into your UNIX environment, and are a snap to deploy, administer and manage, to reduce your support, time and costs.

But don't just take our word, ***get a free evaluation*** copy for your multi-user NT environment now. Visit **www.ncd.com/eval1098.html.** Or call **1.800.800.9599.**

Windows on UNIX desktops without the PC.
What could be better?

NCD

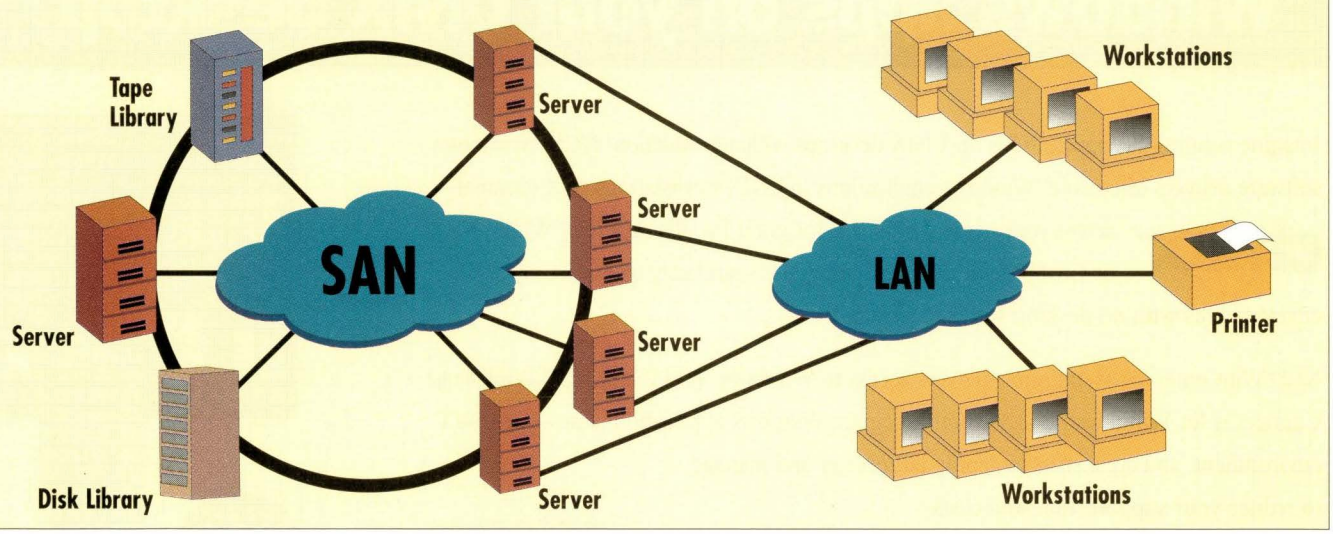
Network Computing Devices

The Thin Client Company™

Bob Gilbertson
President & CEO
NCD

Circle No. 26

Figure 1. Typical Storage Area Network



speeds (100 MB/s) than competing interfaces such as SCSI. Fibre Channel supports SCSI 3 and TCP/IP protocols and point-to-point, loop or switch topology with fiber optic or copper cabling.

Standard SCSI data packets can be carried over fiber optic interconnects, permitting existing SCSI devices (like RAID and disk libraries) to be included in Fibre Channel-based SANs. For example, a disk jukebox can use SCSI connections between the drives and its controller with a Fibre Channel connection between the controller and the server. This protects investment in existing equipment.

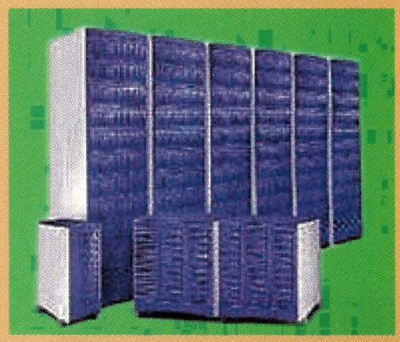
A typical storage area network is illustrated in Figure 1.

The Interconnects

A Fibre Channel I/O bus connects devices either through a direct point-to-point pipeline (similar to a SCSI bus) or attaches them in a network-like configuration through interconnects. These interconnects are usually loops, hubs or switches.

A single loop can attach multiple storage devices to multiple host servers. However, the loop does not provide redundancy or additional performance gains. A hub makes a Fibre Channel loop appear as a series of individual point-to-point connections. If a failure occurs in one node-to-hub wire connection, the hub ignores that portion of the loop; the remaining nodes on the loop remain operational.

CLARiiON
(Data General Corp.'s Advanced Storage Division)
Coslin Drive
Southboro, MA 01772
Phone: (800) 672-7729
WWW: *http://www.clariion.com*
Circle 153



CLARiiON offers the FC5000 Series of disk arrays. The FC5000 holds up to 120 drives for a maximum capacity of 2 TB and supports RAID levels 0, 1, 0+1, 3 and 5. Features include removable, stackable, hot-swappable, lockable storage and redundant components, including power supplies, and both read and write indicators. Throughput ranges from 80 MB/s to 300 MB/s (approximately 30,000 I/Os per second). Base price including the necessary hardware is $30,000.

❖ ❖ ❖

Datalink
7423 Washington Ave. S.
Minneapolis, MN 55439
Phone: (800) 448-6314
WWW: *http://www.datalink.com*
Circle 154

Datalink is an independent information management solutions provider, specializing in the integration of information storage, high-availability and disaster recovery solutions. Datalink's SANs are crafted from RAID, switches, automated tape libraries and storage management software. Datalink provides its clients with comprehensive analysis, design, integration, installation, training, technical support and maintenance–end-to-end service and support throughout the entire technology life cycle. Contact vendor for pricing.

❖ ❖ ❖

Inrange Technologies Corp.
One Waterview Drive
Shelton, CT 06484
Phone: (203) 926-1801
WWW: *http://www.inrange.com*
Circle 155

Running Into Potholes...

On Your Road to NT and UNIX Connectivity?

Running into trouble trying to integrate your UNIX and Windows NT network? TotalNET Advanced Server (TAS) software will smooth the rough road ahead.

TAS enables UNIX computers to become NT file, print and application servers. Setting up and using TAS is quick and easy, thanks to intuitive, browser-based installation and graphical configuration wizards. No additional software is necessary on the NT workstation!

NT File/Print/Application Services: NT users access files and printers residing on UNIX servers using normal NT functions. TAS also enables NT users to access NT applications stored on a UNIX server.

Common File System: Data and applications are stored in a central TAS-based server where NT and UNIX users can easily access the same data.

Transparent to the NT Desktop: The TAS server is seen by NT users as a PC server, so users do not need to know UNIX to access resources on that server. No retraining is involved.

Scalability: TAS provides file/print/application services to thousands of NT and PC workstations.

Is your current solution steering you down the wrong road? Upgrade to TAS and save substantial time and money. Call today for details!

WINNER BEST

PC LABS ANALYST'S CHOICE TAS 5.0 June 2, 1997

SYNTAX

2 5 3 8 3 8 2 6 2 6

http://www.syntax.com

Circle No. 27

Multiple devices can be connected via multiple loops through a Fibre Channel switch. This has the effect of increasing bandwidth because we now have multiple 100-MB/s loops all operating simultaneously. With a switch, bandwidth can be assigned based on an application's needs. Multiple switches create Fibre Channel fabrics. Fabrics provide lofty levels of bandwidth in support of very large Fibre Channel networks. Switches and fabrics furnish increased performance and redundancy for larger environments.

The Software

The successful development of SAN management software will be key to deploying these new networks. For starters, compatibility management software, permitting the sharing of all files and data, and centralized automatic remote backup and archiving across the network (over various platforms, dissimilar protocols and interfaces, and between heterogeneous devices) is necessary for a basic SAN.

Software to allow for the automatic rezoning of storage devices at specified times (for example, temporarily including a tape library in one server's storage pool during a specific backup window for direct-attatched backup and then relocating it to a different zone for remote archiving), the allocation of individual storage segments within a device to allow for selective file sharing among servers and workgroups (known as Logical Unit Numbering masking) and support for high-availability clusters will be required to attain other potential SAN performance benefits.

Some of these software modules are appearing now, some will ship within the year and others are still a few years away. Many of the potential benefits of SANs will not be realized until the software is ready.

Storage Devices

The main goal of the SAN is to create a high-speed, high-availability server-to-storage and storage-to-storage subsystem. The typical SAN today connects servers with multiple RAID arrays and tape libraries. However, optical jukeboxes and network-attached storage

Inrange offers the ESM/9000 Enterprise Storage Manager family of scalable storage management servers. The ESM/9000 line provides turnkey, automated, common platform technology that manages all storage administration throughout an enterprise, from S/390 and UNIX servers to the desktop and mobile user. These servers range in disk capacity from 108 GB to 684 GB, and tape capacity from 1 TB to 52 TB. The servers can hold from 18 to 748 individual DLT tapes. Pricing starts at $79,150 for an entry-level system.

❖ ❖ ❖

LSI Logic Corp.
1551 McCarthy Blvd.
Milpitas, CA 95053
Phone: (408) 433-8000
WWW: *http://www.lsilogic.com*
Circle 156

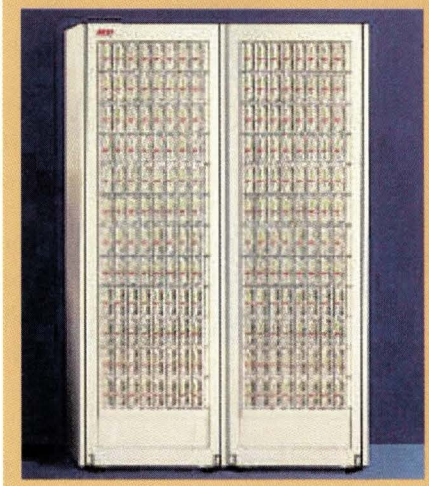
LSI Logic's Merlin Fibre Channel Cores combine with other members of LSI Logic's CoreWare library to form single-chip controllers for use in host adapters, hubs, switches and other devices that allow multiple servers to access groups of storage devices. Merlin cores can be integrated with custom logic and other functions, including RISC processors, memory and digital signal processing (DSP) engines. The heart of the Merlin family is a single-loop protocol controller (LPC), which along with the Fibre Channel protocol engine (FCE) ensures compliance with Fibre Channel standards and interoperability with other components. Contact vendor for pricing.

❖ ❖ ❖

Maxoptix Corp.
3342 Gateway Blvd.
Fremont, CA 94538
Phone: (510) 353-9700
WWW: *http://www.maxoptix.com*
Circle 157

Maxoptix sells the MX6 series of magneto-optical multifunction juke-boxes, which can be configured with 20 to 278 slots and can support up to six drives; this provides near-online storage capacities, ranging from 104 GB to 1.45 TB. MX6 jukebox users get a 20 msec average seek time, a data transfer rate up to 20 MB/s and a 4-MB cache. The SCSI bus interface provides for simple integration with UNIX, NetWare and Windows NT platforms. The MX6 series of jukeboxes range in price from $6,995 to $61,300.

❖ ❖ ❖



MTI Technology Corp.
4905 E. La Palma Ave.
Anaheim, CA 92807
Phone: (800) 999-9684
WWW: *http://www.mti.com*
Circle 158

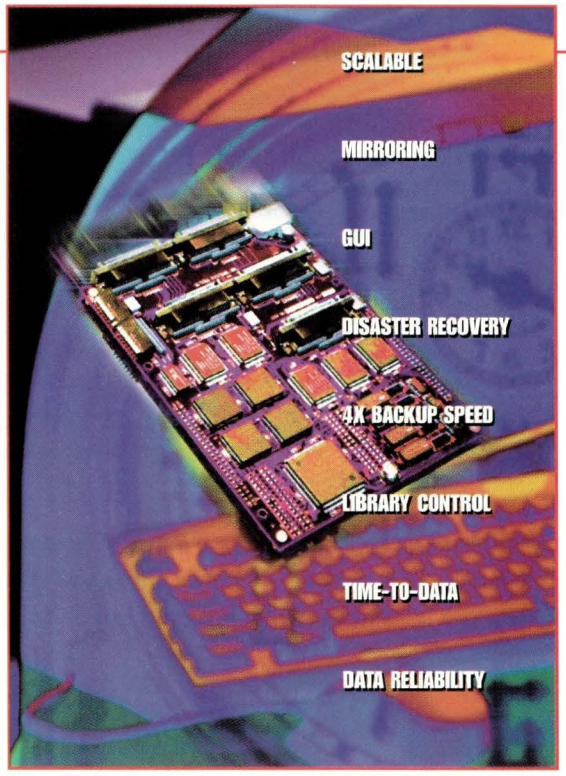
MTI's Gladiator 6700 storage system features Volume Mapping for data consolidation and redeployment to various storage devices on different servers. The system's design is well-suited to online transaction processing (OLTP) environments that require a high rate of random access data requests. The disk system supports two to 32 9.1- or 18.2-GB, 7,200 RPM or 10,000 RPM drives. The Gladiator

Simply the Fastest Most Reliable Tape Array Controllers Available!

With the enormous growth of "Mission Critical" applications and short backup windows, the backup paradigm is rapidly changing. Enterprise computing clients are demanding faster backups, higher data integrity and availability combined with significantly improved "time-to-data".

THE STRIPER SERIES

High-end tape array controllers from Ultera Systems are specifically designed to address today's backup concerns. The Striper 2 & 3 Tape RAID controllers can backup data at peeds of up to 142GB per hour. Successful data restoration is ssured through the generation of a "parity" tape. Time-to data, including single file restorations are decreased by a factor of 4 ince the data is spread across up o four independent tape drives.



THE ART OF BACKUP

THE REFLECTION SERIES

Ultra SCSI mirroring controllers are designed to assist in the implementation and management of Disaster Recovery Plans as well as enhance the automation processes of today's sophisticated autoloaders and libraries. Ultera mirrored autoloaders and libraries create duplicate media inventories at the same time as the original. Ultera's unique implementation adds NO additional overhead while maintaining total software transparency to the host. The result is additional flexibility and performance for automated assisted processes.

Striper and Reflection series controllers may be combined (cascaded) to provide custom-scalable high performance solutions. Contact us for more information.

Ultera SYSTEMS INCORPORATED

26052 Merit Circle, Suite 106 • Laguna Hills, CA 92653 • Phone 949.367.8800 • FAX 949.367.0758 • inform@ultera.com • www.ultera.com

Circle No. 28

(NAS) devices, such as Hewlett-Packard Co.'s SureStore family of optical disk jukeboxes and Network Appliance Inc.'s NetApp Filer products, are also coming onto the SAN scene.

Tape Technology

Tape is the storage option of choice for users that need to back up large amounts of data off-line and then remove the files for safekeeping. When tapes are used with libraries, the data is near-online and easily accessible. Tape is the best choice when quick access to the stored data is not critical and when low-cost, high-capacity storage is crucial. Tape media provide medium- to long-term data retention.

Super Digital Linear Tape (SDLT) from Quantum Corp. and Ultrium from HP are the newest technologies in the tape arena. These products will be available mid-year. SDLT products hold up to 200 GB of compressed data, with at least a 10-MB/s transfer rate (Ultrium will offer lower capacity configurations with transfer rates of 20 MB/s). SDLT and Ultrium are targeting sites that have a tremendously high volume of data to be backed up and a constantly

6700 has a transfer rate of 100 MB/s, with an average seek time of 7.1 to 7.8 msec. On-drive cache capacity is 1,024 KB. Available options include a redundant controller and a global hot-spare. Contact vendor for pricing.

❖ ❖ ❖

nStor Corporation Inc.
450 Technology Park
Lake Mary, FL 32746
Phone: (407) 829-3500
WWW: *http://www.nstor.com*
Circle 159

nStor recently introduced the NexStor 18F RAID subsystem. This rack-mountable enclosure features a cableless, passive dual FC-AL backplane that accommodates up to 18 disk drives mounted vertically in a 19-inch 4U enclosure. The system's air plenum cooling design provides support for both 7,200 RPM and 10,000 RPM disk drives, as well as support for the higher capacity 36-GB drives when available. Other features include data transfer rates up to 200 MB/s, support for 126 devices, dual power cords and redundant hot-swappable disk drives, fans, power supplies and loop resiliency circuits. Pricing for NexStor 18F starts at $8,249.

❖ ❖ ❖

Raidtec Corp.
400 Overlook Business Park, Bldg. 12
1360 Union Hill Road
Alpharetta, GA 30004
Phone: (770) 664-6066
WWW: *http://www.raidtec.com*
Circle 160

The Raidtec FibreArray-HI is a host-independent, fault-tolerant Fibre Channel RAID subsystem, which offers 100-MB/s performance. The subsystem comprises a cache controller, seven hot-swappable FC-AL drive bays, three hot-swappable fans and three

READER FEEDBACK

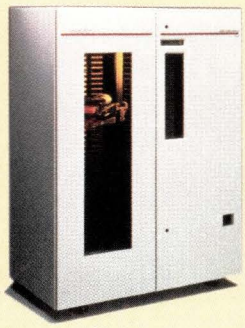
To help *SunExpert* serve you better, take a few minutes to close the feedback loop by circling the appropriate numbers on the Reader Service Card located elsewhere in this magazine. Rate the following column and feature topics in this issue.

	Interest Level		
Features:	High	Medium	Low
Building a SAN	200	201	202
Product Review: Exceed: As Strong as Ever	203	204	205
Columns:			
Ask Mr. Protocol–The Bazaar, the Agora and Mr. P.	206	207	208
UNIX Basics–MIME	209	210	211
Systems Administration–One of Those Days	212	213	214
NTegration–Tools for Getting Things Done	215	216	217
Datagrams–Internet Growth Rates	218	219	220
Work–Going Through Our Lockers	221	222	223
Java Class–Java from the Trenches	224	225	226
WebServer Magazine:			
Performance Monitoring Complexities	227	228	229
Caching Out	230	231	232

StorageTek®

DON'T SURRENDER. BACKUP IS ON THE WAY.

In this battle, the stakes are high. Protecting your company's most valuable asset – its data – is a daunting challenge. Even a temporary loss of access can impact your bottom line. That's why you need Datalink. For over ten years, we've partnered with companies like yours to store, access and protect business-critical information.



With Datalink, you get the best combination of hardware, software and services. Plus an essential ingredient: insight. **Insight that comes from over a decade in the IT trenches.** And hundreds of repeat customers. Put down the flag and pick up the phone. It's time to call in the reinforcements: Datalink. To learn more, call 1-800-448-6314 or visit www.datalink.com.

DATALINK
Delivering The Power Of Information

Your Best Backup

*For unrivaled speed (data transfer rate: 10MB/sec) and access (time to first file: 13 seconds) Datalink offers the **StorageTek** TimberWolf 9710 tape library-configured with 9840 drives*

ISO 9001 REGISTERED COMPANY

Circle No. 29

"shrinking" backup window.

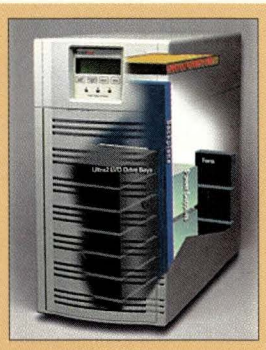
Quantum's Digital Linear Tape (DLT) is the current tape leader in speed and performance. DLT has the capability to store up to 35 GB of compressed data at transfer speeds of up to 5 MB/s. For applications with less volume and a larger window for backup, there's 8mm tape. This less expensive alternative has one major drawback: there is a deviation in "standards" between competing 8mm manufacturers. This has resulted in two types of 8mm drives that use different and noncompatible technologies. Sony Electronics Inc. split off from the older Exabyte Corp. model in order to incorporate its Advanced Intelligent Tape (AIT) features. As a result, when you choose 8mm media, you must also choose a vendor and determine which standard you wish to follow.

SDLT, DLT, Ultruim and 8mm tapes can be used in automated libraries. Enterprisewide, centralized, automated large-scale backup and disaster recovery copies can easily be handled over a SAN without affecting LAN resources. The backup task that once bogged down the LAN is instead off-loaded to the SAN.

Optical Devices

Optical media come in a number of formats, including CD, DVD, write once, read many (WORM) and erasable. Optical jukeboxes have capacities large enough to accommodate almost all network backups, and they include the advantage of providing near-online, relatively fast, random access to all data. By attaching an optical storage device to a SAN, centralized automatic network file migration can occur without stealing bandwidth from daily LAN communications functions.

Digital video disks (DVDs) and CD-ROMs share the same industry standard



hot-swappable power supplies. Users can cascade multiple arrays and other Fibre Channel devices up to 30m apart with copper (or 10km with fiber optics). The subsystem allows for as many as 16 FibreArrays, or 110 drives, to be cascaded together in order to offer multiple terabytes of storage. It is designed specifically for SAN and clustering environments, and works with leading FC-AL host adapters to bring Fibre Channel benefits to almost all mass storage applications. Pricing for FibreArray-HI starts at $18,000.

❖ ❖ ❖

Storage Computer Corp.
11 Riverside St.
Nashua, NH 03062
Phone: (603) 880-3005
WWW: *http://www.storage.com*
Circle 161

Storage Computer sells OmniRAID storage servers. The multihost, concurrent connectivity provides a scalable platform for real-time data sharing in a heterogeneous environment. The OmniRAID line has a maximum capacity of 12 host machines and 48 hard drives. Cache capacity is 256 GB. Transfer time is 30 MB/s for reads and 20 MB/s for writes. Pricing ranges between $100,000 and $1 million.

❖ ❖ ❖

Storage Technology Corp.
(StorageTek)
2270 S. 88th St.
Louisville, CO 80028
Phone: (800) 786-7835
WWW: *http://www.storagetek.com*
Circle 162

StorageTek offers the StorageNet Access Hub–a multiple loop Fibre Channel hub for Windows NT and UNIX SANs. It supports up to 16 concurrent, full-bandwidth 100-MB/s FC-ALs, or an aggregate bandwidth of 16 GB/s. It also supports leading backup applications and offers switch-like access control through point-and-click segmentation of devices onto specific loops. Fully configured, the StorageNet Access Hub costs less than $1,000 per port.

❖ ❖ ❖

Sun Microsystems Inc.
901 San Antonio Road
Palo Alto, CA 94303
Phone: (650) 960-1300
WWW: *http://www.sun.com*
Circle 163

Sun offers the StorEdge A5000 array family of storage products, which incorporates

Continued on Page 64.

120mm format. But DVDs can hold up to 5.2 GB of data, or record 135 minutes of video compared with the CD-ROM's 640-MB capacity or 74 minutes of video capacity. DVDs are superior in multimedia-heavy environments because they output crisper and clearer CD images.

WORMs and erasable optical devices (magneto-optical) furnish near-online archiving and data backup for large system environments. They offer faster file access and higher data transfer rates than tape, although integration into a network can be more expensive. WORM media provides an unalterable audit trail to meet security and/or legal requirements, because each file, once written, cannot be overwritten. By employing WORM, data is permanently recorded and its protection is 100% guaranteed.

RAID

Redundant arrays of inexpensive disks (RAID) is a collection of disks administered by specialized array management software that coordinates their activities. All RAID devices guard against data loss and use a redundancy scheme to guarantee RAID subsystem high-availability. By installing RAID on a SAN, that same type of fault-tolerant operation can be extended from the RAID subsystem out to the channel and server.

NAS Devices

Network-attached storage (NAS) devices such as the NetApp Filers from Network Appliance or the Snap! Server from Meridian Data Inc. provide quick, easy-to-install additions of gigabytes of online hard disk storage capacity without replacing a server's hard drive with a larger unit, installing additional server drives or reconfiguring the network. NAS addresses the growing needs of companywide networks to store online email messages, Web downloads, multimedia files, document images and CAD files that can consume multimegabytes of storage space per file.

NAS, while extending the life of the server's hard disk, can also speed up network operations by segregating data storage tasks from the main server. However, NAS still requires LAN bandwidth and impacts server operations. By placing the added storage device on a SAN, it has no impact on LAN performance and is itself not constrained by server or LAN limitations.

Why Build a SAN?

SANs provide network performance and storage availability benefits over network-attatched (over a LAN) or direct-attached (server-to-dedicated storage device) storage methods. These include:

- The sharing of storage pools (devices and data) across multiple platforms in heterogeneous environments.
- The scaling of storage capacity in accordance with storage needs independent of the server and application.
- Centralized implementation of remote vaulting, remote mirroring and disaster protection copies. These storage tasks are performed without adversely

affecting LAN performance.

- Archiving, backup and file migration without straining LAN resources.
- High availability of the storage subsystem with fault-tolerant operations.
- Multiple server-to-storage and storage-to-storage communications.
- Centralized management and administration of data resources.

A SAN incorporates LAN/WAN concepts into a high-speed, high-bandwidth connection between servers and storage devices. When all of the hardware and software components become available, SANs will offer performance, capacity and reliability improvements to place storage functionality on par with the advances processors have made in recent years.

Ron Levine and **Michelle Gervais** are technology writers with Coast Writing, an independent firm that specializes in computer application articles. They can be reached at (805) 566-9747, or via email at ron@coastwriting.com and michelle@coastwriting.com.

hot-pluggable, redundant components and dual Fibre Channel loops into a modular, networked, building-block architecture. Included are fully redundant RAID configurations and high reliability, availability and serviceability (RAS) hot-pluggable power supplies, fans, interface boards and disk drives. The StorEdge A5000 supports RAID levels 0, 1, 0+1 and 5, and has two configuration options: 14- (A5100) or 22-drive (A5200) subsystem enclosures. Rack-mounted systems range from 45 GB to 1.5 TB. These products support more than 9,400 I/Os per second per loop and 316 MB/s of actual user-data bandwidth per loop. Contact vendor for pricing.

❖ ❖ ❖

Veritas Software Corp.
1600 Plymouth St.
Mountain View, CA 94043
Phone: (650) 335-8000
WWW: *http://www.veritas.com*
Circle 164

Veritas offers a comprehensive set of heterogeneous storage management tools necessary to manage SAN environments. Veritas Volume Manager (GUI interface) and Veritas File System products enable cross-platform storage area networking management and administration. The company's integrated off-line management tools support comprehensive backup, restore, tape management and archival solutions. According to Eric Burgener, group product manager of SAN products at Veritas, and other SAN product vendors we've spoken with, partnerships existing and being formed between platform, storage, interface, fabric and software vendors, and networking integrators will make it possible for storage area networking to rapidly evolve into tomorrow's premier server-to-storage architecture.–*rl and mg*


Got Fibre!
It's good for your system.
It's great for storage.
Greater performance.
Greater scalability.
Greater flexibility.
CLARiiON.®
The market leader
in full Fibre Channel
RAID storage.
CLARiiON
Advanced Storage Division
DATA GENERAL CORPORATION
Circle No. 32
For a thorough introduction to Fibre Channel storage, please
call 1-800-DATA GEN for your complimentary edition of FIBRE CHANNEL: CONNECTION TO THE FUTURE.
And read more about Storage Area Networks (SAN) on www.clariion.com/SANs/
CLARiiON is a registered trademark of Data General Corporation. © Data General Corporation 1998

Exceed: As Strong as Ever

by **IAN WESTMACOTT**, Technical Editor

We take another look at Hummingbird's PC X server and find that in its latest release, Exceed remains as strong as ever and even evolves in functionality.

Installations needing to provide access to UNIX applications on Windows desktops usually fall into one of two categories: those with power users where the main issues are ease of use and performance, and those with neophyte users where the main issues are transparent integration and management. Whichever category your installation falls into–or even if it falls into both–Hummingbird Communications Ltd. has you covered with its Exceed X server product for Windows. A long-time player in the PC X server market, Exceed is now in its sixth major version. The current version, Exceed 6.1, offers performance and management enhancements, and an eye toward the thin-client desktop.

Computer Publishing Lab last looked at Exceed nearly three years ago (see "No Flies on this PC X Server," *SunExpert*, May 1996, Page 58), and in those three years, vendors of PC X server software and X terminals have been contending with the shifting connectivity and client-access market. With Network Computers (NCs), mobile code and the Web changing the way clients access computing resources, these vendors are scrambling to position themselves for the new millennium. Unfortunately, some of these vendors are completely repositioning themselves in new markets, leaving their customers behind. This is not the case with Hummingbird. Although the company is making a foray into new territory with its BI (Business Intelligence) products, Exceed remains as strong as ever and even evolves in functionality. This is good news for PC X server customers.

Management and Security

For the IT staff, Hummingbird has always tried to provide management tools that make it easier to install and maintain the Exceed server. In this release, two tools are provided: Sconfig and Jconfig. Sconfig, a wizard-based setup tool, allows an administrator to customize and package an Exceed installation, including profiles, scripts and default settings. The resulting installation package may then be distributed from central servers for desktop installation. Necessary customization for a site may be performed centrally, *before* installation.

Jconfig is a Java-based remote configuration and management tool. Using Jconfig administrators may remotely connect to Exceed desktops (via a Hummingbird TCP/IP inet daemon running on the desktop) and perform configuration and maintenance tasks for all Hummingbird client-access products (Exceed, HostExplorer and NFS Maestro).

Together, Sconfig and Jconfig can greatly reduce the time spent by administrators on the phone or out at the desktop for installation and problem resolution. Administrators and users may control access to configuration settings by password-protecting the configuration program, which may be done on a per-seat or sitewide basis. Access control lists (ACLs) are used to limit remote access to the desktop, and MIT's Project Athena Kerberos authentication is supported for resource access.

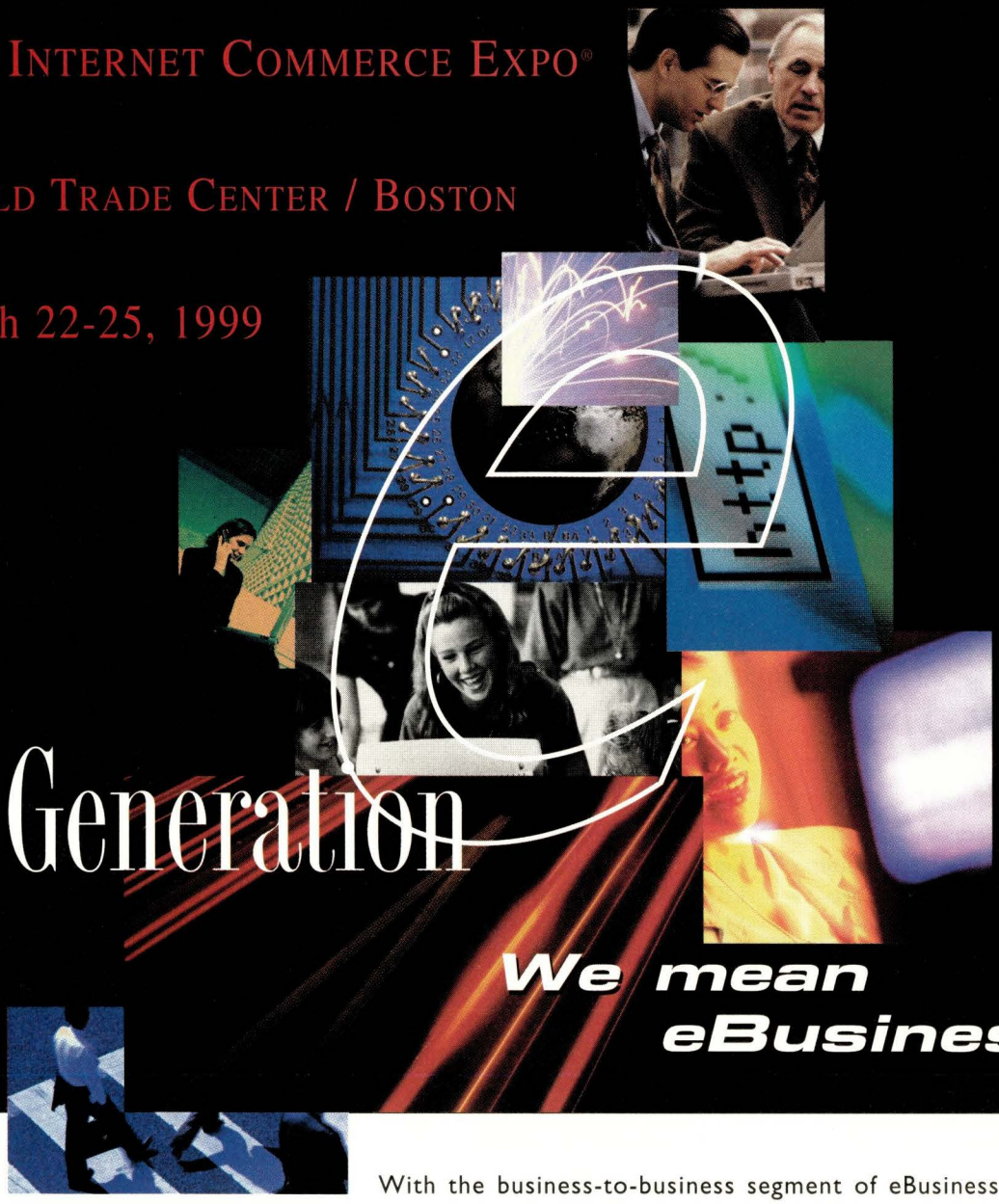
Performance

Exceed 6 is an X Window System Release 6.3 (X11R6.3), or "Broadway" server, as defined by The Open Group (`http://www.opengroup.org`). In addition to the standard X protocols, Broadway provides a framework for finding and launching X clients remotely from within a Web browser. Broadway also includes the Low Bandwidth X (LBX) extension, which uses a combination of compression and caching techniques to more efficiently transmit the X protocol over low-bandwith

ICe. Internet Commerce Expo®

World Trade Center / Boston

March 22-25, 1999



With the business-to-business segment of eBusiness headed towards one-quarter of a trillion dollars in 2001*, there's only one place you should head in 1999: Internet Commerce Expo®, at Boston's World Trade Center. ICe is the world's most comprehensive eBusiness forum. The 4-day conference and 3-day expo features over 200 exhibitors showcasing innovative and emerging eBusiness technologies. There will be in-depth tutorials and an extensive conference program all focused on knowledge management and eBusiness solutions. ICe will also feature keynote addresses by Newt Gingrich, Speaker of the House (1995-1998); Nicholas Negroponte, Founder and Director of MIT's Media Lab; and Tim Berners-Lee, President, W3 Consortium and Inventor of WWW. Plus numerous special events designed to keep you up-to-date on critical trends and developments. Join the eGeneration at ICe '99 in Boston. **Register now at www.iceexpo.com or 800.667.4423.**

*Source: IDC

Owned & Managed by: IDG World Expo

Conference Sponsor: scient.

ICe. Internet Commerce Expo®
www.iceexpo.com

Media Sponsors: BusinessWeek, InfoWorld, SunExpert, solutions integrator, NetworkWorld, INTERACTIVE, SC Magazine, WBZ News Radio 1030

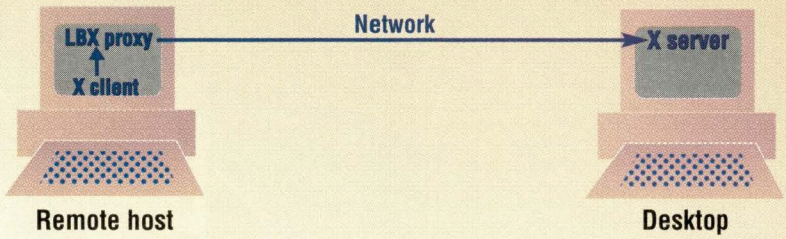
connections, such as dial-up or Internet connections.

Hummingbird is betting on Broadway for its thin-client solution (see `http://www.broadwayinfo.com`), allowing an administrator or user to install only the X Web component of Exceed rather than the entire Exceed package. With X Web, users are able to access (multiple) remote X applications through their Web browser without having to use a lot of disk space (up to 20 MB for the entire application). The advantage to using Broadway as a thin-client solution is that it is based on open standards and uses familiar Web and browser technology. The disadvantage is also that it's based on open standards and vendors relying on it are at the mercy of their sometimes slow evolution. Moreover, the fate of The Open Group and the X protocol standard is uncertain.

LBX is also part of the Broadway framework and is an attempt to solve the problem of running X applications over low-bandwidth network connections. The idea is that you have an X server on your desktop and you want to run an X client on a remote machine. The network connection between your desktop and the remote machine is not very good; perhaps you are dialing into your corporate local area network (LAN) using a modem, or connecting to a remote site via the Internet. To improve performance, LBX caching and compression techniques are used to reduce the number and size of messages sent between the client and the server.

In order for this scheme to work, both sides of the network connection need to implement the LBX extension. On the desktop side, the X server itself (Exceed) implements LBX. On the X client side–in order to allow the extensive number of older X clients to use LBX and to avoid adding LBX code to every new X client–an LBX proxy server is used. The LBX proxy is an X client that connects to the X server on the desktop. In addition, the LBX proxy provides a virtual X display on the remote machine. The X client to be run then communicates with the LBX proxy server using standard X protocol, which the proxy server sends over the network to the X server using the LBX extension (see Figure 1).

Figure 1. Implementing the LBX Extension



While the Exceed package does not include LBX proxy servers, and most commercial UNIX installations do not yet include LBX proxy servers, Hummingbird is distributing binary copies of The Open Group's LBX proxy server for Solaris, HP-UX, AIX and IRIX. These can be downloaded from `http://www.broadwayinfo.com`.

Using `x11perf`, an X11 server performance analyzer, we compared configurations that differed only in whether LBX was used or not. The setup was a Microsoft Corp. Windows NT server with Exceed connecting to a Silicon Graphics Inc. Origin server using a 28.8-Kb/s modem. Although `x11perf` tries to factor network latency into its performance results, we found that LBX did increase performance on some operations by as much as 30 times. Exact performance gains will vary depending on various factors, including the type of X clients used, speed of the network connection and whether packet compression is already being performed (for example, modems with hardware compression).

New to the Exceed server is multiple and virtual display support. It can support up to nine monitors simultaneously and four screens. You can treat multiple monitors as a single contiguous X screen (provided all of the monitors have the same resolution and color settings), divide a single monitor into several distinct X screens or use a combination of these.

Tools

Exceed includes a suite of basic TCP/IP utilities, including tuning and monitoring tools. Also included is Hummingbird Basic, a graphical scripting tool, and several launch tools to ease access of remote applications. The HostExplorer and FTP for Windows Explorer tools, Terminal (Telnet/TN3270E/TN5250E) and FTP clients, have undergone a face lift and now function similarly to the Windows Explorer drag-and-drop interface. There is also an Explorer-based "Hummingbird Neighborhood" interface to the Exceed applications and profiles.

Available separately from Hummingbird is Exceed XDX, an X Window development product, which includes Motif support, Exceed 3D, an OpenGL X development kit and NFS Maestro, a network file system client for Windows and DOS platforms. ⊸

Exceed 6 PC X Server

Company
Hummingbird Communications Ltd.
1 Sparks Ave.
North York, Ontario
Canada M2H 2W1

Phone
+1 (416) 496-2200

Fax
+1 (416) 496-2207

Email
getinfo@hummingbird.com

WWW
http://www.hummingbird.com

Price
$545 for a single-user license; volume pricing available

Best Feature
Enterprise support and functionality

Worst Feature
Installation documentation

Circle 165

Storage problems got you down?

Net Work Your Storage

with ATTO SAN Solutions

ATTO offers a full line of Fibre Channel and SCSI SAN products ready to relieve your bottlenecks and storage woes. Contact ATTO today to hear about our complete line of storage connectivity products.

ATTO FibreBridge™
An intelligent Fibre Channel to UltraSCSI bridge that allows integrators to easily attach any exisiting SCSI product to Fibre Channel.

ATTO ExpressPCI FC
A 64-bit PCI bus to Fibre Channel host adapter for server, workgroup and workstation environments. Drivers available for multiple platforms.

ATTO FibreCenter™
A five-port Fibre Channel hub that serves as a high-speed, central connection point in Fibre Channel Arbritrated Loop Configurations. Available in desktop and rackmount editions.

ATTO SCSI Center™
An UltraSCSI hub that serves as a high-speed, central connection point-allowing users to share common SCSI storage. Available in desktop and internal editions.

ATTO IS SCSI ...and Fibre Channel

ATTO Technology, Inc.
716-691-1999

www.attotech.com
email sales@attotech.com

Visit us at NAB Booth # S4618

The Power Behind the Storage.

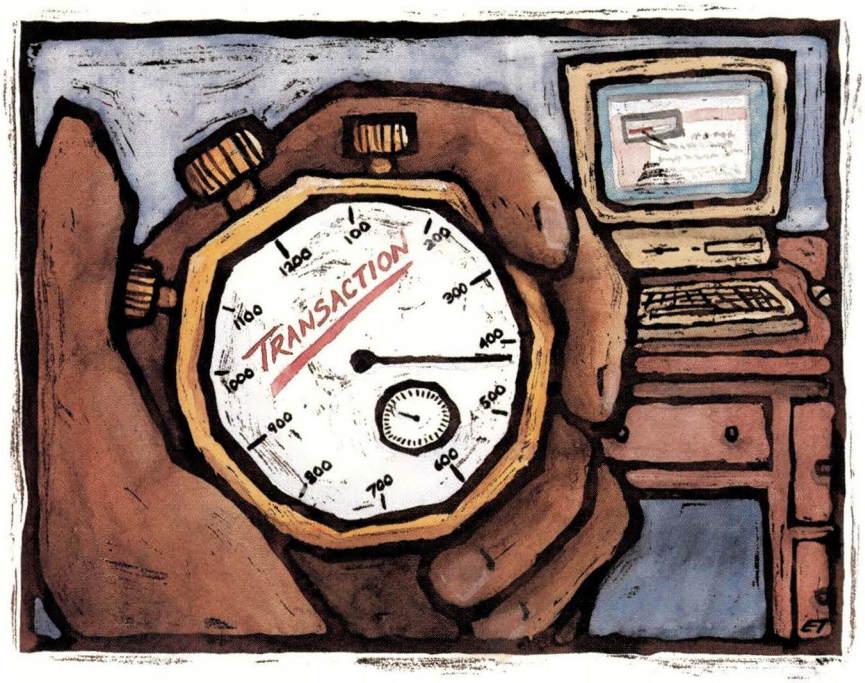
Circle No. 33

by PAUL KORZENIOWSKI

Paul Korzeniowski is a freelance writer based in Sudbury, MA, specializing in networking issues. His email address is paulkorzen@aol.com.

Performance Monitoring Complexities

Employees now dial into Internet and intranet servers as often as they pick up the telephone and, increasingly, they download pages filled with graphics and video images. As more and more information flows over corporate networks, network managers must insure there is sufficient bandwidth so downloads take seconds rather than minutes.



Illustrations by ERIN TERRY

Tools to handle this task, called performance monitoring, have been available for years. Yet they have garnered only limited acceptance because they are expensive, difficult to implement and offer corporations ambiguous business benefits.

The quick rise of the Internet is changing this outlook for several reasons. Applications are becoming the lifeblood of many corporations, therefore, they must insure rapid response times. Performance monitoring tools can help with this task. The number of problem spots is also growing and so more and more companies are finding a need for these kinds of monitoring tools.

Even with a simple dial-up network connection, performance problems can stem from a variety of locations: a desktop application, communications package, modem, wide area network (WAN) link, the receiving system's modem, a remote access concentrator, local area network (LAN), directory server, backbone switch, Web server or Web application. Corporations want performance monitoring tools that can examine each of these components and determine which one is slowing down the connection. But suppliers have been unable to fulfill this desire. Rather than end-to-end performance monitoring tools, they have delivered point solutions, capable of examining only one component on a given network connection.

Consequently, organizations usually work with a hodgepodge of different performance management tools. As such, either the company doesn't review end-to-end performance or it has to clumsily lump together a number of independent tools in order to get that information.

Though imperfect, the performance monitoring tools that are currently available do have some strong points. These products sit passively at certain points on a connection and gather information, such as how many packets flow over a LAN segment or how information is moving in and out of a server during a specific time period, and then place this information into a database. Users work with various reporting tools to produce graphs that indicate usage patterns and illustrate how bandwidth or processing power requirements may be changing. If a company sees a jump in its resource requirements, it can take proactive steps, such as purchasing a new server, adding processors to a server or upgrading a network segment, so the usage growth does not adversely impact its users.

How important these tools are depends on each corporation, and their use is similar to how individuals care for automobiles. For example, certain companies have a "Gas-It-And-Go" attitude. These companies don't want to invest in tools that can cost between $10,000 and $100,000, or the skilled network technicians needed to operate them. Instead, the companies periodically test network connections, guess at future requirements and purchase products with a little extra bandwidth or processing power in case there's a spike in resource usage.

However, this approach can be wasteful. If a company acquires a server that is overkill for its application requirements it may spend $10,000 to $50,000 needlessly, and extra WAN bandwidth could

cost $20,000 or more per month.

Like automobile aficionados, meticulous companies view performance monitoring as a high priority and are willing to invest the time, money and personnel needed to insure that their computer and network infrastructure are in synch with the firm's requirements.

Keeping Watch of the WAN

Usually, corporations start performance monitoring on WAN connections because they are the most expensive portion of a connection. "About half of the performance problems that arise on WANs stem from a company not properly configuring its access equipment, like a router, rather than any involving their carriers' networks," says Hugh Kelly, vice president of marketing at Visual Networks Inc., a supplier of WAN performance monitoring tools based in Rockville, MD. Performance monitoring tools help to identify such problems.

Rapid growth forced Columbia/HCA Healthcare Corp., a Nashville, TN-based health maintenance organization, to search for a WAN performance monitoring tool. The company has 250,000 employees in 750 locations, including 350 hospitals and seven data centers spread across the country (Columbus, OH; Denver, CO; Fort Wayne, IN; Louisville, KY; Nashville, TN; Orlando, FL; and Phoenix, AZ), that run a wide variety of computer systems.

At the beginning of 1998, Columbia/HCA decided to look closely at its WAN–a series of interconnected T1 lines. "The network had become so large and complex that our network management package [Hewlett-Packard Co.'s HP OpenView] had trouble collecting all of the physical network management information," says Curt Vaden, a network engineer at the health maintenance corporation. "So we needed a separate system to keep pace with our performance monitoring chores."

The firm relies on 3Com Corp., Santa Clara, CA, for its networking gear and 3Com recommended the InfoVista service-level management (SLM) solution from InfoVista Corp., Redwood City, CA. Columbia/HCA purchased the package in early 1998 and used it to identify unused and unnecessary communications lines. "The company has gone through a series of acquisitions and reorganizations that have resulted in opening and closing many offices," says Vaden. "There have been occasions when we closed an office but never disconnected all of the communications lines."

The InfoVista package polls the T1 lines daily and identifies those that don't carry any traffic for five consecutive days. Using this technique, Columbia/HCA has found 28 T1 lines–each costing $500 to $1,000 per month to maintain–that were not needed.

Other organizations are concerned about LAN traffic. For instance, Tufts Associated Health Plans Inc., Waltham, MA, has 4,000 nodes on its network, which connect users to HP-UX and Compaq Computer Corp. Windows NT servers. In 1996, the company flattened out its network by replacing wiring hubs and terminal connections with switches. While the change offered users the ability to work with more desktop bandwidth, the number of possible bottlenecks spread from the data center to switches stationed on each of the company building's four floors.

Steve Flis, manager of network engineering at Tufts Health Plan, says that protocol analyzers required manual intervention and only worked with one network segment at a time. The company preferred an automated performance monitoring tool, but few were available at the time.

The health care company selected Network Health from Concord Communications Inc., Marlboro, MA, because it offered reports that would outline how information flowed over various network segments. The reports illustrate which network segments have high usage rates and reveal whenever established thresholds, such as using more than 50% of the available bandwidth, are exceeded. Tufts Health Plan used the tool to examine router and switch performance and tinkered with its network design to improve information flow.

With information moving to a number of different servers, a growing number of corporations desire monitoring tools that offer higher degrees of granularity. Rather than simply seeing how often bottlenecks arise on a network segment, these companies want to determine how much information is flowing from user desktops to the company's mainframe, UNIX servers and PC servers.

This desire lead the Navy Federal Credit Union, Vienna, VA, to look for a performance monitoring tool in the fall of 1997. The firm has 3,000 employees stationed in 87 offices that work with information on IBM Corp. mainframes and PC servers running Novell Inc. NetWare and Microsoft Corp. Windows NT operating systems.

The company began moving from terminal-host to client/server applications and needed a tool that could monitor these systems, as well as its WAN connections and Automated Teller Machines. The firm examined Command/Post from Boole & Babbage Inc., San Jose, CA, Spectrum from Cabletron Systems Inc., Rochester, NH, and TME from Tivoli Systems Inc., Austin, TX. Tom Kelly, manager of network performance at the credit union, selected Command/Post because of its ability to monitor a wide variety of systems and devices. By spring 1998, the organization had installed the software and found it to be a major time-saver. "The Boole & Babbage system will filter through a number of different alarm messages and present only significant ones to a network administrator," Kelly says.

The Navy Federal Credit Union has used its intranet to cut down on technical support calls. The firm has been able to take real-time performance information and place it on its intranet servers so users can dial in and see how the firm's network is performing.

While the tool has delivered a number of functions, the credit union desires one major product enhancement: "When a router goes down, a number of associated devices are affected," Kelly says. "We would prefer that the system make that determination and just tell us the router isn't working."

Web Applications

The rapid success of the Internet is changing the way companies view performance monitoring. Users now have the freedom to grab information at will and download large files that can clog up communications lines. With Web applications, the amount of data traveling between client and server systems can quickly swell, and bandwidth usage rates can jump from 10% to as much as 70%. Rather than upgrading every user's network connection, it would be more efficient if a company could add bandwidth for those users working with the application causing the problem.

Problems do arise quickly. "With client/server applications, a company may encounter performance problems maybe once every couple of months," says Gary Read, senior director of marketing at Boole & Babbage. "With Web applications, a problem could arise in a week or maybe even in a few hours."

Identifying and fixing such problems quickly has become a high priority. "The Web enables companies to tie themselves closely to their customers and their business partners," says Michael Short, a business planning manager at HP's Roseville, CO, office. "Corporations want to make a good impression with them and need to insure that their inquiries are promptly answered."

Top 10 List of Barriers to Improving Performance Monitoring

- Added cost of monitoring hardware
- Experience of staff/training requirements
- Justifying cost benefits to management
- Inadequate manpower/problems of staff turnover
- Internal organization process issues
- Maintenance efforts and costs
- Determining performance monitoring requirements
- Difficulty implementing products
- Underestimating time/effort/cost/scope requirements
- Difficulty monitoring switched environments

Source: International Network Services (INS)

Traditionally, application-level performance monitoring has been a tedious process. A technician would have to sift through operating system, microprocessor, disk storage and peripheral performance data. In certain cases, these components provided only a superficial view of how they were completing their processing chores. In recent years, vendors have started to deliver tools geared toward outlining how well applications are operating.

The University of Illinois in Urbana, IL, has a staff of 400 that oversees a network with 38,000 student, teacher and administrative users. In the spring of 1997, the university searched for a performance monitoring tool that would enable central technicians to examine application-level performance. After examining EcoScope from Farmington Hills, MI-based Compuware Corp., the university purchased a 500-user license for the VitalSuite package from Sunnyvale, CA-based International Network Services (INS), a supplier of performance monitoring tools, because the software was unobtrusive, used up only a small amount of memory on a client machine and wasn't hardware dependent.

The university started using the tool with select users, specifically, those who complained of performance problems. Technicians found that problems were caused more often by user inexperience than bandwidth shortages. "Users were trying to load too many applications on their machines at one time," says Kevin Kelly, manager of network management systems at the university.

While offering potential cost-cutting benefits, performance monitoring tools have garnered only limited acceptance for a number of reasons. One issue is price–these tools are expensive. Performance monitoring tools can cost anywhere from $10,000 to $100,000, depending on the type of tool and the size of the network. "The challenge of building strong performance monitoring tools is not trivial and suppliers have to recoup their investment," says Tim Camper, product manager for Compuware's EcoTools for UNIX.

Firms have difficulty making such investments when the return is unclear. "Performance monitoring problems are in-

sidious and something companies often do not recognize," says Kelly Lanspa, product marketing manager at Compuware. "As long as a system is up, a company will think it is performing well, even though it may be moving at a snail's pace and slowing down response time."

In some cases, corporations are concerned only with specific network and system components. Columbia/HCA, for instance, examines how its WAN is operating, but does not monitor performance on its hundreds of LANs and servers. "Our user base is too large for us to consider LAN and system-level performance monitoring," says Columbia/HCA's Vaden. "The amount of information we would be collecting and trying to examine would be tremendous."

Most companies would prefer to have one tool that would present them with an end-to-end view of system and network performance.

In other cases, firms work with different tools to monitor different components. For example, Tufts Health Plan uses Concord's Network Health for network monitoring, but other tools, such as Santa Clara, CA-based Network Associates Inc.'s Sniffer, for examining server disk space and application response time monitoring.

However, this approach is inefficient. Companies often store performance information in different locations and must train technicians to operate various programs or write their own add-ons to consolidate that information in a meaningful fashion. Most companies would prefer to have one tool that would present them with an end-to-end view of system and network performance.

The rise of the Internet is increasing the pressure on vendors to solve this problem. Corporations want to use Internet connections to carry more of their network traffic, and Internet service providers (ISPs) want to offer private networking services so they don't have to rely too heavily on the competitive, dial-up connection business. Corporations will make the switch only with assurances that bandwidth from the ISP will be available for their important applications.

Service-level agreements (SLAs), which outline end-to-end response time guarantees, would solve this problem. Consequently, performance monitoring suppliers are honing their wares to deliver such information to customers. Thompson Consumer Electronics Inc., an Indianapolis, IN-based consumer goods supplier, has been monitoring SLA developments closely. "Because we have a large network with multiple components, we have been on the lookout for a tool that offers us end-to-end performance monitoring capabilities," says Kevin Dowley, telecommunications manager at the firm.

The company has 20,000 employees in 50 locations connected by frame relay lines to a data center in Indianapolis that supports IBM mainframes, RS/6000 servers and Compaq PC servers. The consumer electronics company has a great deal of equipment from Nortel Networks, Santa Clara, CA, on its network and relies on Nortel's Optivity network management package. When Nortel added an SLA component (Vital Agent) to its line, Thompson Consumer Electronics was interested.

Last fall, Thompson Consumer Electronics purchased the Optivity package, which gathers performance information from various points on a network, identifies possible bottlenecks, then offers possible solutions. The tool's initial finding surprised the company. "The software determined that our Domain Name System [DNS] software was not operating as quickly as it should and that is not an area that we would have examined," says Dowley. In order to solve the problem, the firm upgraded the server from a 90-MHz to a 266-MHz microprocessor and from a 10BaseT shared Ethernet connection to 100-Mb/s Fast Ethernet connection, which solved the problem.

Even though Vital Agent promises to deliver end-to-end performance monitoring information, it still falls short of that goal. While the tool is quite useful in identifying LAN and WAN problems, it offers only rudimentary application monitoring capabilities, so the company supplements the Nortel tool with Compuware's EcoScope.

The Thompson Consumer Electronics case sums up the current state of the performance monitoring tools market. While ISPs and corporate IT groups desire integrated solutions that collect appropriate metrics from every possible point on a network, the tools meet only a subset of that requirement, leaving the customer to cut and paste its performance information together to form a complete picture.

Companies Mentioned in this Article

Boole & Babbage Inc.
3131 Zanker Road
San Jose, CA 95134
http://www.boole.com
Circle 166

Cabletron Systems Inc.
35 Industrial Way
Rochester, NH 03867
http://www.cabletron.com
Circle 167

Compuware Corp.
1440 Northwestern Hwy.
Farmington Hills, MI 48334
http://www.compuware.com
Circle 168

Concord Communications Inc.
33 Boston Post Road W.
Marlboro, MA 01752
http://www.concord.com
Circle 169

InfoVista Corp.
483 Seaport Court, Ste. 101
Redwood City, CA 94063
http://www.infovista.com
Circle 170

International Network Services (INS)
1213 Innsbruck Drive
Sunnyvale, CA 94089
http://www.ins.com
Circle 171

Network Associates Inc.
3965 Freedom Circle
Santa Clara, CA 95054
http://www.nai.com
Circle 172

Nortel Networks
4401 Great America Pkwy.
Santa Clara, CA 95052
http://www.nortelnetworks.com
Circle 173

Tivoli Systems Inc.
9442 Capital of Texas Hwy. N.
Plaza I, Ste. 500
Austin, TX 78759
http://www.tivoli.com
Circle 174

Visual Networks Inc.
2092 Gaither Road
Rockville, MD 20850
http://www.visualnetworks.com
Circle 175

Caching Out

Are Web sites 'caching' in on the increased access times and reduced bandwidth costs lauded by proxy cache vendors, or are they finding themselves under the advertising gun? Administrators are learning that proxy caches wreak havoc with page-count statistics, and page-count statistics are at the heart of how many ad-based sites generate revenue.

Proxy caches and the performance benefits they bring to the Web get a lot of good press. In fact, proxy caches are often cited as the main technology that the current, and future, Web relies upon. Without proxy caches, we are told, the Web would quickly come to a virtual standstill.

Proxy caches make local copies of Web content that end users request. In this way, proxy caches can serve up subsequent requests for that content from a local server, rather than having to send out the request over the slow and unreliable Internet. At the most basic level, proxy caches speed up access times. By reducing the amount of traffic that travels over the Internet–between 30% to 60%, by some estimates–proxy caches also reduce telecommunications costs, as well as minimize the load that Web servers are under. In this way, proxy caches are beloved by end users and administrators alike.

Not everyone, however, is enamored by proxy caches. Many Web site administrators go out of their way to ensure that their site's content is not cached and entire teams of developers are devoted to thinking up new "cache-busting" techniques. How is it that the proxy cache, popular with so many, could be so actively spurned by others?

The problem is proxy caches wreak havoc with page-count statistics, and page-count statistics are at the heart of how many ad-based sites generate revenue. If, for example, one of your Web pages is cached by an America Online Inc. (AOL) proxy, your logs might read that your site was accessed only once by an AOL user, when in actuality 10,000 AOL users may have checked it out. If, perchance, that page also contains an ad banner, which advertisers pay for based on the number of impressions it receives, it's easy to understand why an administrator might object to having their site's content cached.

"The business of serving ad banners and the business of minimizing network traffic are at odds with one another," says Enno Vandermeer, chief technical officer at i33 Communications Corp., New York, NY, creator of AdMaximize ad serving and analysis software.

Therefore, administrators under the advertising gun are continually dreaming up new ways to avoid having their content–and, in particular, their ad banners–cached. This process should, in theory, be relatively easy. One common trick is to set the refresh rate to zero on your Web server so that cached content is "never" fresh. Because more than zero seconds have always elapsed since a page was last requested, the cache is forced to request the stale page again. Or for sites running an HTTP 1.1-compliant Web server, another simple tactic is to configure the server so that a proxy cache is instructed not to cache either individual pages or the entire site.

The bad news is that rendering entire pages uncacheable is viewed as poor netiquette by cache administrators because it increases bandwidth costs and decreases Web performance–in fact, offending site administrators are often taken aside by cache administrators and asked to change their policy.

Not to mention the fact that many caches, for example, the public-domain Squid, can be configured to ignore a Web server's cache-control features, says Duane Wessels, principal investigator for the National Laboratory for Applied Network Research, or NLANR

(http://www.nlanr.net), a group sponsored by the National Science Foundation to develop the Squid cache. "We see this problem a lot in countries such as New Zealand and Australia, which pay for bandwidth by the byte," says Wessels. There, he says, access providers have a tendency to overtune their caches so they completely ignore whether or not a page is considered fresh.

To give cache-shy sites credit, most administrators would willingly cache their content if they could accurately read the number of impressions their ad banners generate.

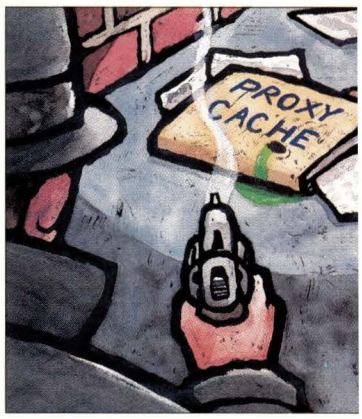
To that effect, some sites have begun to employ less radical cache-busting mechanisms. For example, many sites allow all content except ad banners to be cached. This can be done one of several ways. Again, for sites running an HTTP 1.1-compliant Web server, cache-control features can be applied to individual object types. For example, an administrator might specify that a straight HTML object may be cached, but that images may not. This mechanism alone goes a long way toward making a site more cache-friendly.

Another popular way of making sure an ad banner isn't cached is to have it include some sort of dynamic component, a time stamp, for example. A cache can also be tricked into not caching an ad banner if it appears to be the result of a CGI form, that is, if it contains a "?" character in its name. This method is effective, says i33's Vandermeer, but the problem is no two media sites perform this task the same way. Therefore, writing ad server software that cooperates with each media site's individual way of creating an ad banner can be something of "a colossal effort," Vandermeer says.

Client-side use of Java and JavaScript has also proven to be an effective way of counting ad impressions through a cache while remaining cache-friendly. This technique is used in TrueCount from MatchLogic Inc., Westminster, CO, a supplier of Internet advertising and marketing software. TrueCount works by splitting the request for an ad banner into two transactions. The first, marked uncacheable by a time stamp or a unique number, sends brokers information about the user and context, and allows the server to pick the right ad and count it. This done, TrueCount sends back the requested media, which can then be cached.

However, this approach loses points with many potential advertisers because it assumes the end user has Java and JavaScript enabled in their Web browser. This is not a safe assumption. For example, the AOL browser turns off these client-side technologies by default. Also, says Mike Griffiths, chief technical officer at MatchLogic, JavaScript is a much more dangerous solution than simply sending down an image, because of the potential for sending buggy or malicious code.

On the other hand, Web pages that use advertising networks such as DoubleClick Inc. (http://www.doubleclick.net) to serve up their ads have nothing to worry about, says Kevin Brown, director of marketing at Inktomi Corp., San Mateo, CA. That's because services like DoubleClick rely on HTTP redirects, sending off a request for a banner advertisement to a different server altogether. And because redirects are uncacheable, the exact number of requests made for an ad is preserved.



But, according to Brown, it's not just members of the DoubleClick network that are exempt from cache concerns these days, it's anyone who cares about properly implementing cache technology. "It's true, caching used to present a problem to advertisers," he says, "but I believe the industry has heard those concerns and has moved on."

Not everyone agrees with Brown's rosy assessment of the situation, however. According to i33's Vandermeer, "One of the fundamental challenges you must face as the provider of ad serving technology is the complete lack of standards surrounding caching." In short, there is room for improvement.

In the future, perhaps proxy caches and advertisers will enjoy a more cooperative relationship. Improvement might eventually come in the form of a process called hit metering, whereby caches communicate directly back to media sites with information about how many requests they've received for content cached at their site. In a world where both caches and Web servers support this technology, the pressure would be taken off site administrators to implement inefficient hacks to keep track of site-usage statistics.

Hit metering, documented in RFC 2227 (see http://www.faqs.org/rfcs/rfc2227.html), has yet to catch on and remains unimplemented in either caches or Web servers. "Perhaps the industry thinks that hit metering is too simplistic a solution for the problem," says NLANR's Wessels.

One thing is clear, though, hit metering prefigures the industry's need for a comprehensive, cooperative solution for ensuring that Web sites get the ad revenue coming to them, and that the Web doesn't come grinding to a halt under the weight of inefficient networks. ⊸

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

URL/New Products

RSA Offers Java-Based Security Products

RSA Data Security has announced two new Java versions of its cryptographic security products: the BSAFE SSL-J 2.0 component suite and BSAFE Crypto-J 2.0 software. The new products are designed to help developers strengthen the security of their Java applications and build them more quickly and easily, RSA says.

The BSAFE SSL-J 2.0 component suite is designed to give developers everything they need in a single package to implement the Secure Sockets Layer (SSL) v3 protocol for applications in the banking, financial, Web publishing, consumer and electronic commerce markets. It includes extensive sample code, API libraries, certificate authority components, a full suite of socket libraries and full API documentation.

BSAFE Crypto-J 2.0 is said to implement the core RSA cryptographic algorithms used in major application security standards such as SSL, Secure Electronic Transaction (SET) and Secure Multipurpose Internet Mail Extensions (S/MIME), while adding support for Java Crypt Extensions (JCEs) and Digital Signature Algorithm (DSA). BSAFE Crypto-J is designed to allow developers to use one toolkit for a range of applications, including electronic commerce, home banking, Webcasting and enterprise security, RSA says. It includes source code for sample applications and easy-to-use test modules.

BSAFE SSL-J 2.0 and BSAFE Crypto-J 2.0 are both available for $295.

RSA Data Security Inc.
2955 Campus Drive, Ste. 400
San Mateo, CA 94403
http://www.rsa.com
Circle 177

Resource Management Tool Enhanced

WebSpective Software has enhanced WebSpective 2.1, the company's flagship product used to manage Web application availability and performance. With Version 2.1, the company says, the WebSpective software can be integrated with Cisco Systems Inc.'s LocalDirector to add load-balancing capabilities. Other enhancements include integration with the Tivoli Systems Inc. Tivoli and Hewlett-Packard Co. HP OpenView network management products, as well as overall improvements in reliability. WebSpective 2.1 runs on Solaris 2.51/2.6 and Windows NT. Pricing starts at $2,000.

WebSpective Software Inc.
66 B St.
Needham, MA 02194
http://www.webspective.com
Circle 178

New Switches Lengthen Network Reach

Allied Telesyn has a new line of two-port switches for converting Ethernet to Fast Ethernet. The AT-FS20x family of switches offers large increases in network distances, speed and bandwidth, without necessitating the replacement of existing network hardware, the company says. The line comprises three unmanaged switches, which are designed for the integration of small workgroups with mixed 10- and 100-Mb/s bandwidth, and feature plug-and-play installation and a compact chassis design. The

Power Tools Upgrade

Version 5.0 of Kai's Power Tools (KPT 5) from MetaCreations includes new effects for enhancing digital creative content. The product features 10 new plug-in applications, divided into real-time, three-dimensional tools, particle growth effects and professional blurs, the company says. To offer users more control over these effects, the KPT 5 interface has reportedly been refined to provide them with precise access to numerical values, real-time interactive previews of all operations and user-customizable options. The new plug-ins include ShapeShift for creating shapes with refracting glass edges, 3D light sources on beveled metallic surfaces and curved, lit Web buttons; Orb-It for exploding a source image into thousands of spheres with variations in size, density and realistic 3D lighting; Fiber Optix for creating anything from furry text to green shag carpet; and Noize for adding any of a large collection of sound effects to an image. Version 5 of Kai's Power Tools costs $199 and runs on Windows 95/98/NT 4.0 and Mac OS 7.6.1+.

MetaCreations Corp.
6303 Carpinteria Ave.
Carpinteria, CA 93013
http://www.metacreations.com
Circle 176

AT-FS201, priced at $449, has one port for a 10/100-Mb/s UTP and a second for a 100-Mb/s fiber optic cable ST connector. The AT-FS202, also priced at $449, has one 10/100-Mb/s UTP port and one 100-Mb/s fiber optic SC connector, and the AT-FS203 features two 10/100-Mb/s UTP ports and costs $289.

Allied Telesyn International Corp.
950 Kifer Road
Sunnyvale, CA 94086
http://www.alliedtelesyn.com
Circle 179

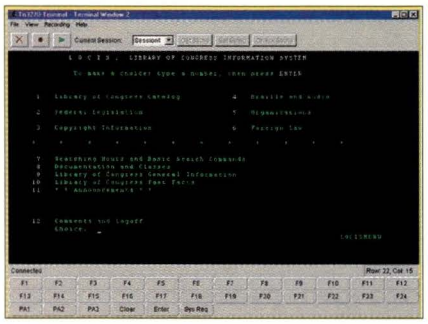
Front Office Software

Siebel 99, from Siebel Systems, is a suite of Web-based front office applications designed to help organizations increase sales and improve customer service with a single, integrated product. Siebel 99 comprises seven modules (Sales Enterprise, Service Enterprise, Marketing Enterprise, Call Center, Field Service, InterActive and Product Configurator) all of which can be mixed-and-matched as needed, the company says. The Siebel 99 modules run on Windows 95/98/NT. The base modules–Sales Enterprise, Service Enterprise and Marketing Enterprise–are individually priced starting at $1,350 per user. Prices for other modules are negotiated on a case-by-case basis.

Siebel Systems Inc.
1855 S. Grant St.
San Mateo, CA 94402
http://www.siebel.com
Circle 180

Tool Connects Java Clients to Mainframe

For organizations that want to re-engineer their legacy mainframe applications for the Web, Blue Lobster Software offers Stingray 1.8, software that reportedly connects Java clients to mainframe data and applications through the use of 3270/5250 terminal emulation. In particular, developers can make use of Stingray's Software Development Kit (SDK), which records host sessions using the terminal emulator GUI and generates Java Legacy Business Objects (LBOs) that encapsulate screen navigation and the getting/setting of screen



data. The LBOs can then be imported directly into Java integrated development environments (IDEs), the company says.

Stingray 1.8 includes support for 3270E, including transfer and print, complete 5250 SDK support and a server component, which features a Secure Socket Forwarder (SSF) with Secure Sockets Layer (SSL) encryption. SDK licenses are priced at $795 per developer and $195 per client connection. It runs on Solaris and Windows NT.

Blue Lobster Software
2005 Hamilton Ave., Ste. 270
San Jose, CA 95125
http://www.bluelobster.com
Circle 181

Load Balancing for the Small Business

F5 Labs has unveiled BIG/ip LB, the company's latest load-balancing tool designed to ensure the availability of Web sites and other applications. BIG/ip LB intelligently allocates Internet and intranet service requests across a group of network servers to ensure high availability of content and IP services for end users, the company says. Specifically, BIG/ip LB load balances IP protocol traffic such as Web, email, Lightweight Directory Access Protocol (LDAP), telephony and multimedia.

BIG/ip LB ships as a 266-MHz Pentium II rack-mount system with 64 MB of RAM, two 10/100-Mb/s UTP Ethernet interface cards and full SNMP management capabilities. BIG/ip LB costs $9,990 and is compatible with Solaris, AIX, HP-UX, Windows 95/98/NT and Mac OS.

F5 Labs Inc.
200 1st Ave. W., Ste. 500
Seattle, WA 98119
http://www.f5.com
Circle 182

NEW PRODUCTS

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

ID Badge Security Solution

With Tri-Sage's Sage-ID, UNIX workstations can be secured automatically once a user steps far enough away from the machine, the company says. Tri-Sage is targeting the wireless, ID badge solution to medical, military, law enforcement, government and commercial users–in short, anyone that maintains sensitive information on a UNIX workstation.

The Sage-ID badge works by sending a radio-frequency transmission from the badge to a base transceiver unit that plugs into the workstation's serial port. When the user is no longer within an acceptable distance of the transceiver, Sage-ID automatically logs the user off the system. Conversely, Sage-ID logs a user back in when they near their workstation.

Components of the Sage-ID package include the Sage-ID badge, the base transceiver unit, cables and adapters for serial port connection, client applications for UNIX/Windows and documentation. Sage-ID runs on Solaris 2.5 and 2.6, as well as Windows 95 and NT. A single Sage-ID package is available for $375. Additional badges cost $99 each.

Tri-Sage Inc.
1333 Butterfield Road, Ste. 300
Downers Grove, IL 60515
http://www.tri-sage.com
Circle 101

Software to Simplify Billing Process

Bell & Howell Mail Processing Systems has unveiled Impact Internet Billing. The new product integrates paper and electronic billing systems into a simple, flexible solution for high-volume billers, the company says.

Impact Internet Billing comprises two components: The TransFormer and e-Route. The TransFormer provides a smooth interface between paper billing operations and the electronic billing Web sites of merchants and third-party consolidators, and allows companies to reformat billing information for maximum impact on paper or on screen, without changing existing applications, Bell & Howell says. e-Route is said to help companies route bills and keep track of customer delivery preferences. It receives customer requests for electronic delivery from a biller's Web site or from consolidators' third-party Web sites and validates the accuracy of the data before storing it. As bills are processed, e-Route sends account information to The TransFormer for paper formatting of each customer's bill based on their delivery preference.

In addition, e-Route automatically records and reports process statistics, such as the number of bills sent by each delivery method and selected bill content for management reporting and marketing analysis, the company says.

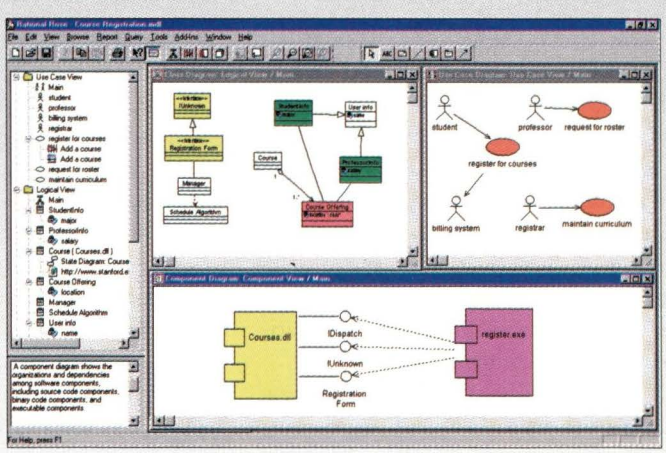
Impact Internet Billing supports multiple bill delivery models to meet both merchants' and consumers' needs, including CheckFree Corp.'s E-Bill electronic bill presentation and payment

Integrated Software Testing Tools

Rational Software has put together a suite of products aimed at developers, called Rational Suite DevelopmentStudio. The tool suite is designed to unify a developer's work with that of analysts and testers on software teams. This is accomplished through the integration of Rational's various testing tools, the company says.

The suite includes updated versions of Rational's developer testing tools, including Rational Purify, which tests for runtime errors; Rational Quantify, which is used for performance profiling and identifies bottlenecks in application code; Rational PureCoverage, which is said to provide detailed application analysis to ensure all code has been exercised and to prevent untested code from reaching the end user; and Rational Rose 98i, which is used for visual modeling applications.

Rational Suite DevelopmentStudio is available on Windows 95/98/NT, Solaris 2.5/2.6 and HP-UX 10.20. It costs $5,295.



Rational Software Corp.
18880 Homestead Road
Cupertino, CA 95014
http://www.rational.com
Circle 100

solution and BillDirect from edocs.

The TransFormer runs on Windows NT and AIX, with versions for Solaris and HP-UX scheduled for late this year. e-Route runs on Windows NT. Pricing for Impact Internet Billing starts at $250,000.

Bell & Howell Mail Processing Systems Co.
P.O. Box 14986
Durham, NC 27709
http://www.bhmailsys.com
Circle 102

Tool to Integrate NT, UNIX

Organizations that are struggling to integrate Windows NT systems into UNIX environments might consider Mortice Kern Systems' MKS Toolkit Update Edition, an upgrade to Microsoft Corp.'s Windows NT Services for UNIX Add-On Pack.

The MKS Toolkit Update is said to include additional features, such as support for Windows 95/98, DOS and OS/2 platforms, a suite of POSIX and Win32-specific tools, and Windows NT and UNIX scripting tools.

MKS Toolkit Update costs $299.

Mortice Kern Systems Inc. (MKS)
185 Columbia St. W.
Waterloo, Ontario
Canada N2L 5Z5
http://www.mks.com
Circle 103

Java-Based OLAP Tool

Zim Technologies International has released O_3, a Java-based online analytical processing (OLAP) software tool for conducting multidimensional data analysis across multiple platforms. Designed for medium to large corporations, O_3 supports interactive, real-time decision making by consolidating corporate data into multidimensional data cubes, which can then be viewed and analyzed in various forms, the company says.

O_3 reportedly allows users to view results from many different angles, customize the order of the data displayed and choose from a number of presentation options, including pie charts and bar graphs. Data can be viewed via aWeb browser or stand-alone Java client.

O_3 can draw data from any source within a distributed network and runs on any platform that supports a Java Virtual Machine (JVM), the company says. It supports multithreading and Lightweight Directory Access Protocol (LDAP), as well as open database connectivity (ODBC), Java database connectivity (JDBC) and native API access to data sources.

Pricing for O_3 is $575 per user for the browser component, $17,250 for a server license and $2,300 for the designer component (for building the data cube).

Zim Technologies International Inc. (ZTI)
20 Colonnade Road, Ste. 200
Nepean, Ontario
Canada K2E 7M6
http://www.zti.ca
Circle 104

64-Bit UltraSPARC

Tatung Science & Technology has announced the release of the COMPstation U10-360, a new workstation powered by the 360-MHz UltraSPARC-IIi microprocessor from Sun Microsystems Inc.

The U10-360 comes with 2 MB of external cache, 64-bit processor support and five 32-bit PCI slots. Vertical add-ons such as Creator and Elite 3D graphics cards can be connected via an additional 64-bit UPA slot. While the U10-360 incorporates the PCI I/O bus to offer access to peripherals, it also maintains full binary compatibility with the application software for Sbus-based SPARC systems, the company says.

The system comes preinstalled with Solaris 7. It features five drive bays that can be fitted with two 3.5-inch hard drives, a 5.25-inch CD-ROM drive, a 4mm or 8mm tape drive and a 5.25-inch slot for another peripheral or a 3.5-inch floppy drive. Standard features include 128 MB of RAM, a 9-GB hard drive, PCI graphics card, dual-channel Ultra Wide SCSI that is built into the motherboard, two serial ports, one parallel port and a 10/100BaseT Ethernet interface. The COMPstation U10-360 costs $4,990.

Tatung Science & Technology Inc.
1840 McCarthy Blvd.
Milpitas, CA 95035
http://www.tsti.com
Circle 105

Back-Office Integration

Financial Information Consulting Services (FICS) has ported its FICS-Electronic Services Delivery (ESD) Server to Solaris. FICS-ESD Server links to back-office processing systems for banks and other types of financial institutions. The server's Common Object Request Broker Architecture (CORBA) is said to act as an interface with back-office applications.

Other features include active load balancing and compatibility with Sun Microsystems Inc.'s SunConnect architecture. In addition, FICS-ESD offers scalability based on a multinode architecture, the company says.

FICS-ESD comes with an administration module that is said to enable operators to manage and view customer information such as audit trails, password management and the introduction of new clients. FICS-ESD also provides functions for transaction-based operations. Contact vendor for pricing.

FICS Group
Excelsiorlaan 87
1930 Zaventem
Brussels, Belgium
http://www.ficsgrp.com
Circle 106

Tool to Automate Oracle Development

Cast Workbench for Oracle, a new line of dedicated tools for designing custom Oracle Corp. Oracle applications, has been introduced by Cast. With Cast Workbench for Oracle, developers can automate time-consuming manual processes, measure the impact of proposed changes and implement those intended changes, the company says.

Through parsers and an open dictionary, Cast Workbench analyzes source

code, offers graphical views and provides impact analysis and an integrated development environment. PL/SQL and 4GL analyzers gather metadata about application objects and the dependencies between them, which is then stored on a centralized data dictionary within the Oracle database. Developers can then examine this information graphically, the company says.

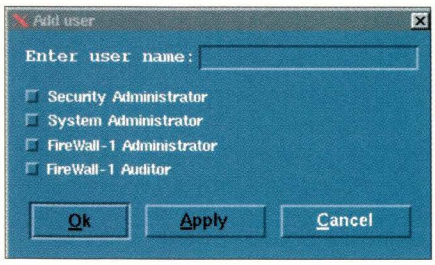
The Cast Workbench PL/SQL coding and testing environment is suited for large group development projects. Features such as colorized code editors and code-building tools let developers modify procedures, functions, packages, views, synonyms and sequences, while SQL-Builder checks PL/SQL syntax and identifies errors. Objects are automatically updated on the Cast server after compilation, ensuring up-to-date information.

Cast Workbench runs in client/server mode with a Windows client and any server that runs Oracle. Pricing starts at $15,000.

Cast U.S. Inc.
500 Sansome St., Ste. 601
San Francisco, CA 94111
http://www.castsoftware.com
Circle 107

Secured Protection for the Web

Memco Software has introduced a new line of products designed to protect content and maintain server availability. The Secured for Internet product line comprises three stand-alone products: Secured for Web, Secured for Email and Secured for Firewalls.



Secured for Web is designed to protect Web sites running on Netscape Communications Corp. and Apache Web servers. Memco says it is capable of preventing unauthorized users from shutting down the server, making unauthorized changes to file content and Web pages, and protecting against the use of "malicious" CGI scripts. Secured for Email is said to protect Sendmail Inc. Sendmail servers and is designed to prevent buffer-overflow attacks from succeeding and only allows access to authorized administrators. The third application, Secured for Firewalls is designed to protect Check Point Software Technologies Ltd. FireWall-1, Memco says.

All three Secured for Internet products support Solaris and HP-UX. Each product is purchased and licensed separately for $1,995.

Memco Software
12 E. 49th St., 32nd Floor
New York, NY 10017
http://www.memco.com
Circle 108

OneWorld Software for Solaris

Enterprise software vendor J.D. Edwards has announced a Solaris version of its OneWorld enterprise software. OneWorld, an object-oriented, network-centric application, includes more than 100 so-called Activators (utilities) for making on-the-fly alterations to enterprise resource planning (ERP) systems. It is designed to facilitate integration with applications based on middleware from the Object Management Group's Common Object Request Broker Architecture (CORBA) and Microsoft Corp.'s Component Object Model (COM), the company says.

The software, which will be available second-quarter 1999, will reportedly take advantage of the 64-bit capabilities of Solaris 7. Other platforms supported by OneWorld enterprise software include Digital UNIX for Alpha, HP-UX, AIX and Windows NT. Contact vendor for pricing.

J.D. Edwards & Co.
One Technology Way
Denver, CO 80237
http://www.jdedwards.com
Circle 109

Automated DLT Library Debuts

ATL Products has introduced the P3000 Series Automated DLT Library. The P3000 features a high availability (HA) design similar to HA servers and RAID systems, the company says. It is designed to support up to 16 DLT drives and 326 cartridges for 266-GB/hour performance and a storage capacity of 11.7-TB.

The HA design offers single-connector, hot-swappable DLT drives, power supplies and fans, as well as redundant power sources. The P3000 features a newly developed cooling system that is said to provide twice the cooling capacity needed for unabated operation and comes with swappable components. Other features include IntelliGrip, a cartridge-handling system, and the Prism Library Architecture, which enables the P3000 to incorporate a PCI expansion bus to support phased implementation of Fibre Channel adapters, network adapters, single-board computers and tape array controllers.

An icon-based touch screen GUI can be used to configure, operate and service the P3000. Remote management is also possible through (optional) WebAdmin software using a Java-enabled browser, ATL says. The P3000 Series Automated DLT Library is available through ATL's VARs. Contact vendor for pricing.

ATL Products Inc.
2801 Kelvin Ave.
Irvine, CA 92614
http://www.atlp.com
Circle 110

Y2K Survival Kit

With only months to go before the next century, BridgePoint Technical Manufacturing has begun offering a Year 2000 Survival Kit for Sun Microsystems Inc. UltraSPARC 5, 10, 20 and 600 MP servers in the form of an Mbus replacement module. Rendering software Year 2000-compliant has a tendency to negatively impact system performance, BridgePoint says, but performance can be dramatically improved with an Mbus module replacement.

When complemented with a Solaris 2.5.1 upgrade, BridgePoint's Y2K Survival Kit guarantees Y2K-compliance in the aforementioned systems, as well as increases in system performance.

The kit comes in quad, dual or single CPU configurations, and mounts directly into the Mbus-connector. The chassis, memory, disk and other peripherals all remain intact. BridgePoint supplies the

Upgrades, Enhancements, Additions...

■ X-Designer, Imperial Software Technology's GUI builder for Motif, Windows and Java, is now in its fifth release. It includes support for thin-client partitioning, triplatform interface portability and Internet connectivity, enabling developers to create a single thin-client GUI regardless of platform. Through the help of a toolkit-independent "smart code" GUI layer, users are able to maintain the same interface to the application server, the company says. An enhanced Legacy Application Migration Path reportedly allows X-Designer to "capture" existing Motif GUIs and restructure the interface for Java. A single developer license costs $3,500 and includes one year of support. Versions are available for Solaris, HP-UX, AIX and IRIX, among others. **Imperial Software Technology**, 120 Hawthorne Ave., Ste. 101, Palo Alto, CA 94301, *http://www.ist.co.uk.* **Circle 111**

■ Enlighten Software Solutions' Distributed Systems Manager 2.7 management package now runs on the Solaris 2.6 operating system. Also new in 2.7 is the ability to run multiple instances of its GUI off a single host, allowing multiple support staff to use a single instance of the software throughout an organization. Other new features include enhanced administrator auditing capabilities to better track changes made by users, enhanced Monitoring and Events tools and propagation of password changes across multiple systems and accounts. EnlightenDSM runs on Solaris, HP-UX, Digital UNIX, AIX, SCO, IRIX and Windows NT. Contact vendor for pricing. **Enlighten Software Solutions Inc.**, 999 Baker Way, Fifth Floor, San Mateo, CA, 94404, *http://www.enlightendsm.com.* **Circle 112**

■ Omtool's latest version of Fax Sr. 5.1 for Solaris is characterized by enhanced Java-based installation, better faxing efficiency and integration to more email systems, the company says. Additional features include least-cost routing, productivity tools such as scheduling, an address book and seamless integration with Fax Sr. for Windows NT. A trial version of Fax Sr., which works on SPARC platforms equipped with internal fax cards from Brooktrout Technology Inc. is available on CD-ROM. Pricing for the base package starts at $1,995. **Omtool Ltd.**, 8 Industrial Way, Salem, NH 03079, *http://www.omtool.com.* **Circle 113**

■ DLT library vendor ATL Products has announced an upgrade to its Web-based remote library administration product, WebAdmin 2.0, allowing systems administrators to access functionality such as library setup, monitoring, eventlogging and event notification via the Web with any Java-enabled browser. New features in WebAdmin include Predictive Failure Analysis based on event triggers, support for non-ATL libraries such as Exabyte Corp.'s 210 and 220 8mm libraries and Hewlett-Packard Co.'s DDS-3 4mm stacker, an SNMP library monitoring module called LibraryAgent 2.0 and support for a wider variety of Java browsers, including Sun Microsystems Inc.'s HotJava 1.1.4, Netscape Communications Corp.'s 4.06 and Microsoft Corp.'s Internet Explorer 4.01. WebAdmin 2.0 comes bundled with any ATL library. **ATL Products Inc.**, 2801 Kelvin Ave., Irvine, CA 92614, *http://www.atlp.com.* **Circle 114**

■ NetBeans Developer 2.0 from NetBeans features support for JavaBeans, the Java Foundation Classes, a Swing-based form editor, an integrated Java debugger, a text editor with syntax coloring, Pluggable Look and Feel Architecture, applet generation support and multiple virtual desktops. NetBeans Developer 2.0 costs $195. **NetBeans Inc.**, Pod Hajkem 1, 180 00 Prague 8, Czech Republic, *http://www.netbeans.com.* **Circle 115**

■ The Trinity 1.2 IT services management suite from Avesta Technologies now includes automatic discovery of sessions in progress, automatic drag-and-drop maps of services and components, real-time map updates and online analytical processing (OLAP) report and analysis. Trinity 1.2 runs on UNIX and Windows NT and is priced starting at $80,000 for up to 500 nodes or IP addresses. **Avesta Technologies Inc.**, 210 Colonnade Road S., Ste. 301, Nepean, Ontario, Canada K2E 7L5, *http://wwww.avesta.com.* **Circle 116**

■ Legato Systems has announced additional platform support for its Legato NetWorker enterprise storage management software. This latest release, Version 5.5, provides support for Solaris 7 and Microsoft Corp.'s Cluster Service (MSCS). In addition, Legato NetWorker 5.5 offers support for Novell Inc. NetWare 5 and Sequent Systems Inc. Sequent as a client, server and storage node.The company is also providing enhanced support for the Hewlett-Packard Co. HP 3000 family and MPE/iX, as a storage node and improved performance for the HP NetServer and HP 9000 product lines. Beyond the added platform support, the product's save set consolidation feature is said to reduce the backup window without compromising on the data recovery time. Legato NetWorker 5.5 is available on additional UNIX platforms and Windows NT. Prices start at $1,000. **Legato Systems Inc.**, 3210 Porter Drive, Palo Alto, CA 94304, *http://www.legato.com.* **Circle 117**

■ Sirrus Internet Solutions has released ClearTrust SecureControl 3.0 unified access management system. New to the software is native Lightweight Directory Access Protocol (LDAP) support and enhancements to its administration features. The added LDAP support is said to provide flexible directory access control and entitlement management. SecureControl 3.0 uses a bundled Netscape Communications Corp. Directory Server to provide integration to Web access control policies. According to ClearTrust, Web users may be authenticated directly from the Directory Server without moving user data. In addition, this release provides native replication of LDAP directories within a corporate network and across firewalls between outside partners. SecureControl also provides access control, single sign-on, authorization, auditing and delegated administration for Web-based applications. SecureControl costs $20 per user and runs on Solaris 2.5+ and Windows NT 4.0. **Sirrus Internet Solutions Inc.**, 609 Mission St., Ste. 600, San Francisco, CA 94105, *http://www.sirrus.com.* **Circle 118**

■ Lotus has launched Release 5 of its Domino server. Domino R5 includes Domino Mail Server, Domino Application Server and Domino Enterprise Server. Lotus says it has made several enhancements to Domino R5, including improved scalability and performance. Specifically, the company claims a six-fold improvement over Release 4.6 in terms of the number of Internet Messaging Access Protocol 4 (IMAP4), Post Office Protocol 3 (POP3) and Lotus Notes Clients supported. In addition, Domino R5 comes with an integrated Public Key Infrastructure (PKI), which supports X.509 certificates, Secure Multipurpose Internet Mail Extensions (S/MIME) and Secure Sockets Layer (SSL). Lotus says it has made the Domain Search feature easier and, furthermore, Domino R5 is able to integrate Web-based workflow and collaboration tools with an enterprise system, including enterprise resource planning (ERP), relational databases and transaction processing systems. A Domino Client Access License costs $40, Domino Mail Server is priced at $695, Domino Application Server costs $1,795 and Domino Enterprise Server is $4,995. Lotus Domino R5 supports Solaris, AIX, HP-UX, Windows NT, OS2 and OS/400. **Lotus Development Corp.**, 55 Cambridge Pkwy., Cambridge, MA 02142, *http://www.lotus.com.* **Circle 119**

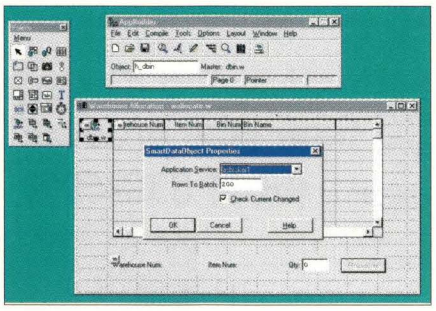
module, as well as boot PROM and kernel patches on CD-ROM. Installing the new Mbus module is a simple task that should take no more than an hour, the company says.

The Year 2000 Survival Kit is available from BridgePoint resellers and distributors listed on the company's Web site. Pricing for a low-end configuration starts at around $1,000.

BridgePoint
Technical Manufacturing
4007 Commercial Center Drive
Austin, TX 78744
http://www.bridgept.com
Circle 120

Major Upgrade to Progress Family

Progress Software has announced a major upgrade to its Progress family of application development and deployment tools, Version 9. Among the upgraded components are the Progress Open AppServer, ProVision Plus development environment and Progress



RDBMS, the company says.

For example, Progress Open AppServer, previously dedicated to serving up applications based on Progress 4GL, is now able to share business logic with applications developed in Java or ActiveX.

With Version 9, the company has merged its ProVision 4GL development tools with its WebSpeed HTML-based development tools. The resulting product, ProVision Plus, can create so-called "universal applications" that work independently of client type. The ProVision environment provides a suite of development, debugging, source-code management, reporting and distributed round-trip testing tools.

The Progress RDBMS, which stores both Progress 4GL and SQL data, is now able to support more than 10,000 users and can handle several thousand terabyte-size databases, Progress says. The product also features a highly optimized SQL-92 engine with native open database connectivity (ODBC) and Java database connectivity (JDBC) drivers, along with an integrated Java Virtual Machine (JVM).

The Progress 9 family is available on all major UNIX platforms as well as Win32 platforms. Progress Open AppServer is priced at $725 for a four-user license, Progress RDBMS costs $1,325 for a five-user workgroup license and Progress ProVision Plus costs $4,400 for a single-user license.

Progress Software Corp.
14 Oak Park
Bedford, MA 01730
http://www.progress.com
Circle 121

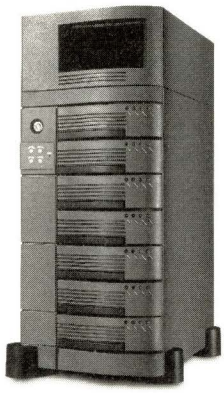
The Server/Workstation Marketplace

The high impact, cost-effective and powerful advertising section reaching over 100,000 technical product specifiers and buyers.

To advertise call Carol Flanagan at **(508) 839-4016** *Email: caflanag@aol.com*

ADS is RAID

ADS is a leading supplier of disk and tape arrays including our complete family of Penquin™ Smart RAID arrays featuring SAF-TE® compliant enclosures. All models include redundant power supplies and fans. Penquin™ arrays are tested and approved for NT, SUN, NOVELL, HP, IBM, SGI and MAC.



800-724-2692
www.adsys.com

APPLIED DIGITAL SYSTEMS INC.
The Leader in data storage since 1984
Rochester • DC • Houston • Chicago • New England

JMR Electronics Inc.

Circle No. 402

Partnerships have their Rewards!

Why take a chance losing a valuable customer with used product?

No worrying about Warranties!

Nu Horizons Electronics Corporation, an **Authorized Distributor**, is your source for new and original product offered by Sun Microsystems, micro-electronics group.
Motherboards, CPU's, Processor Modules, Graphics and Networking Cards, Solaris OS, JAVA OS, and Memory Modules...Also Performance Technologies and Viking Memory.

Sun microsystems
AUTHORIZED MICROELECTRONICS DISTRIBUTOR

NU HORIZONS ELECTRONICS CORP.

Call 1-877-NUHO-SUN
Open from 9:30AM to 8:00PM EST
www.nuhorizons.com/sunsales
EMAIL: sunsales@nuhorizons.com

Circle No. 346

MICHAURA SYSTEMS CORPORATION
...the upgrade specialists

Buy. . . Sell. . .Trade

Sun Microsystems
and more...

- Systems
- Spares
- Lantronix
- Best Power
- Repairs/Advance Replacements
- Peripherals

Contact us today!
Tel: (781) 937-0010
Fax: (781) 937-0808
email: sales@michaura.com
URL: www.michaura.com

Michaura Systems Corporation
2 Henshaw Street
Woburn, MA 01801

All trademarks are the property of their respective owners.

Circle No. 330

UNIVERSAL CAPITAL FUNDING

SUN MICROSYSTEMS
WORKSTATIONS
PRINTERS SERVERS MEMORY
OPTIONS DISK TAPE

800-883-9339

BUY • SELL • RENT • LEASE •
UPGRADE • EXCHANGE

UNIVERSAL CAPITAL FUNDING
15695 Medina Road, Plymouth, MN 55447
VOICE (612) 551-9309 FAX (612) 551-9311
EMAIL: univcap@winternet.com

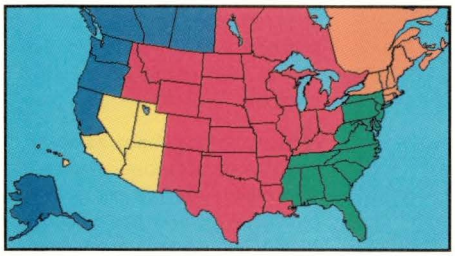
Circle No. 320

The Server/Workstation Marketplace

Employment Opportunities

ADVERTISERS' INDEX

The Ad Index is published as a service to our readers.
The publisher does not assume any liability for errors or omissions.



New England/Upstate New York/ Eastern Canada

CAROL A. FLANAGAN
80 Worcester St., Ste. 9
North Grafton, MA 01536
Phone: (508) 839-4016
Fax (508) 839-4226
Email: caflanag@aol.com

New York/Mid-Atlantic/ Southeast

JOANNA PARKER
18 Stephanie Drive, Ste. 3
Stirling, NJ 07980
Phone: (908) 542-0789
Fax: (908) 542-0782
Email: joanna@cpg.com

Mid-West/Southwest/ Central Canada

LINDA LIEBICH
9600 Great Hills Trail, Ste. 150 W
Austin, TX 78759
Phone: (512) 502-3035
Fax: (512) 502-9988
Email: lindal@concentric.net

Southern California/Arizona/ Nevada/Hawaii/Utah

TARA DUDAS
30 Paseo Alba
San Clemente, CA 92672
Phone: (949) 361-4908
Fax: (949) 361-1564
Email: tara@cpg.com

Northern California/Oregon/ Washington/Western Canada

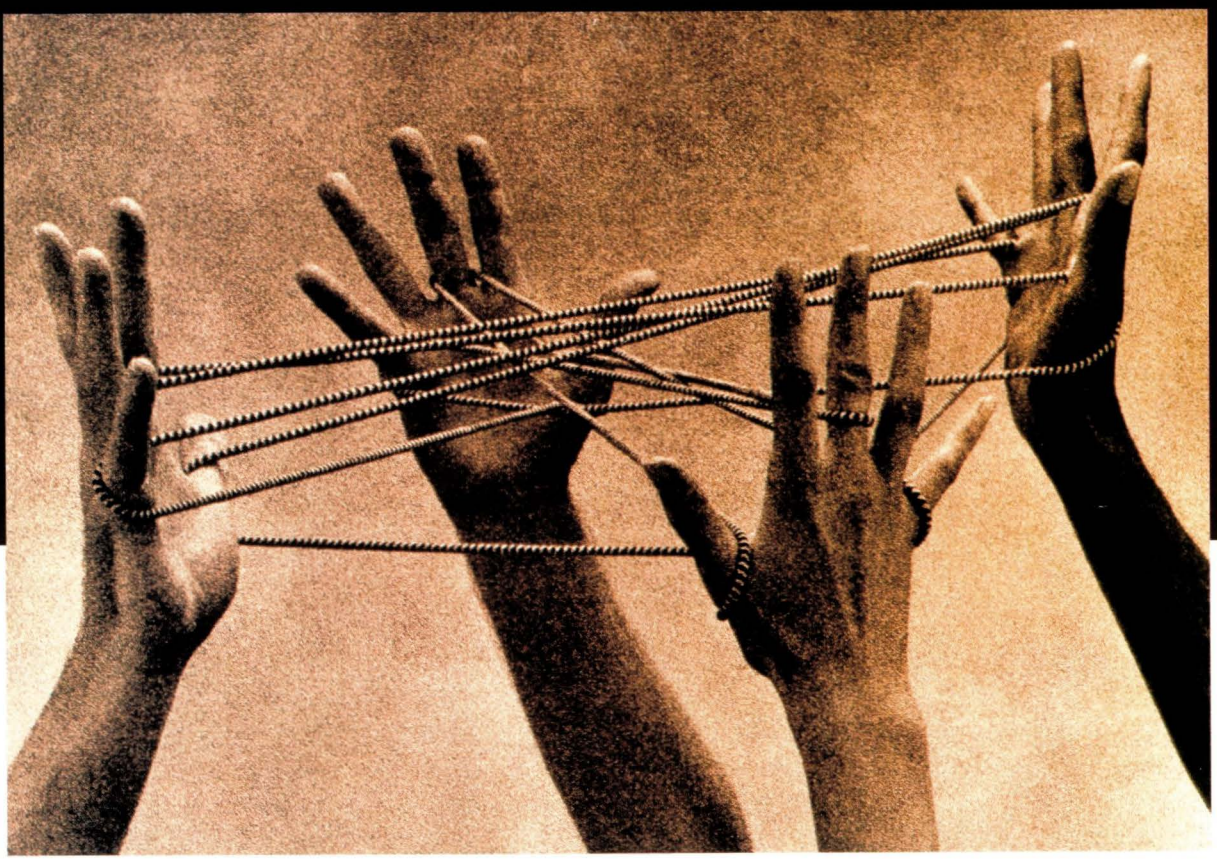
VICKIE MIYAOKA
1935 Mayfield Ave.
San Jose, CA 95130
Phone: (408) 374-9925
Fax: (408) 374-9926
Email: vmiyaoka@cpg.com

The Server/Workstation Marketplace Classifieds/Recruitment Ads

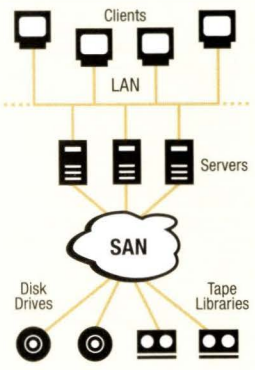
CAROL FLANAGAN Mgr, Telemarketing Sales
Phone: (508) 839-4016
MARY ERICSON
Phone: (508) 839-0720
80 Worcester St., Ste. 9
North Grafton, MA 01536
Fax: (508) 839-4226
Email: caflanag@aol.com

DESIGNING A SAN CAN BE COMPLEX.

TO OUR ENGINEERS IT'S CHILD'S PLAY.



Integrating new technology into your existing environment can be overwhelming. It takes the experience, cooperation and technological know-how of an industry leader like Box Hill to make it work. Our LAN-less Backup SAN solution integrates leading-edge technologies from the industry's top storage providers: Box Hill, Legato, and StorageTek. LAN-less Backup takes traffic off your LAN, increasing production throughput, reducing costs, and virtually eliminating the need for a backup window.



Provide your enterprise with the proven increased productivity benefits of LAN-less Backup coupled with the speed, flexibility, and dynamic resource allocation advantages of a SAN. To put our solutions to work for you, call Box Hill at 1-800-727-3863, or visit us at www.boxhill.com/childsplay.

StorageTek.

BoxHill
BIGGER. FASTER. SMARTER.
STORAGE & BACKUP

LEGATO

Circle No. 39

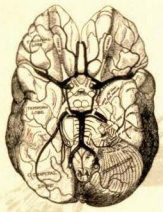
www.boxhill.com/childsplay

T h e

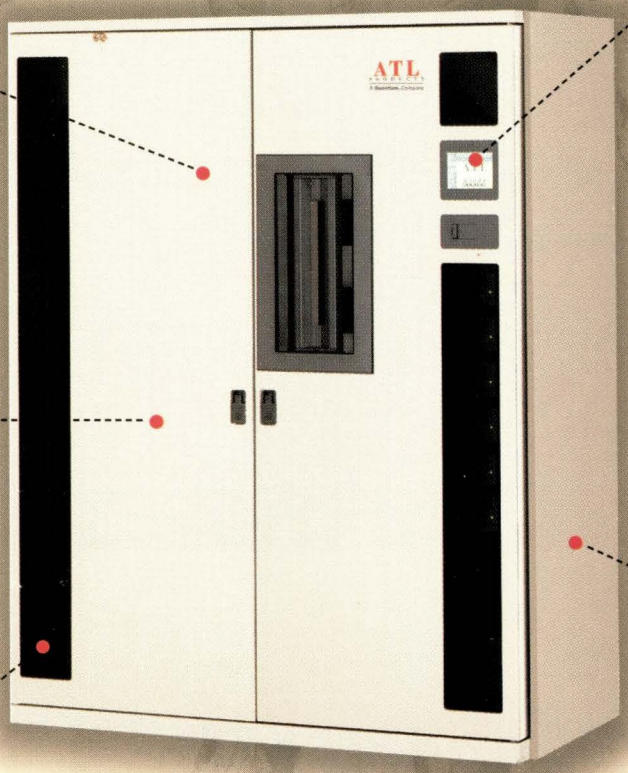
ANATOMY

Of An Enterprise-Class Library

I. The Brain – *Much like "some" human brains, the P3000 has a massive capacity to store and move information. This intelligent library has a native capacity of 11.4 terabytes and blazing performance of 288 gigabytes per hour.*

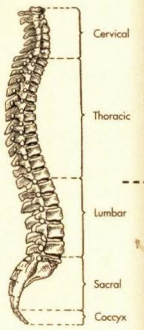


II. The Eyes –*With local and remote browser GUIs, you'll see the industry's most powerful DLTtape library is incredibly easy to use.*



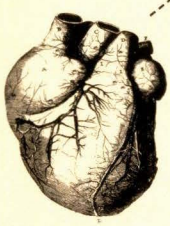
III. The Skeleton –*The human body has two arms and two legs. The P3000 delivers the same high availability (HA) design with redundant AC cords, power supplies and fans. Plus, the power supplies, fans and DLTtape drives can be hot-swapped.*

VII. The Spine – *The backbone of the P3000's design is a PCI expansion bus supporting SCSI interface, Fibre Channel, tape array and server PCI cards –"future proofing" your library with a modular upgrade path.*



Divisions of the Spine

IV. The Nervous System – *The complex nervous system of the P3000 is designed to support multiple concurrent network, SCSI and fibre channel connections, so each library can be shared by NAS, SAN and direct-connect environments.*



VI. The Heart–*The heart of the P3000 is the IntelliGrip precision cartridge handling system which will pick-and-place cartridges for years without skipping a beat.*

V. *Like a well-tuned body, The P3000's reliability, redundancy, ease of use and modular upgrades all add up to low total cost of ownership (TCO).*

ATL PRODUCTS
A Quantum Company

DLT TAPE

DLTTAPE LIBRARIES DESKTOP TO DATACENTER

ATL Products, Inc. 101 Innovation Drive Irvine, CA 92612-3040
Phone: **(949) 856-7800** *Fax:* **(949) 856-7799** *Email:* **atlpsales@atlp.com** **www.atlp.com**

Circle No. 38