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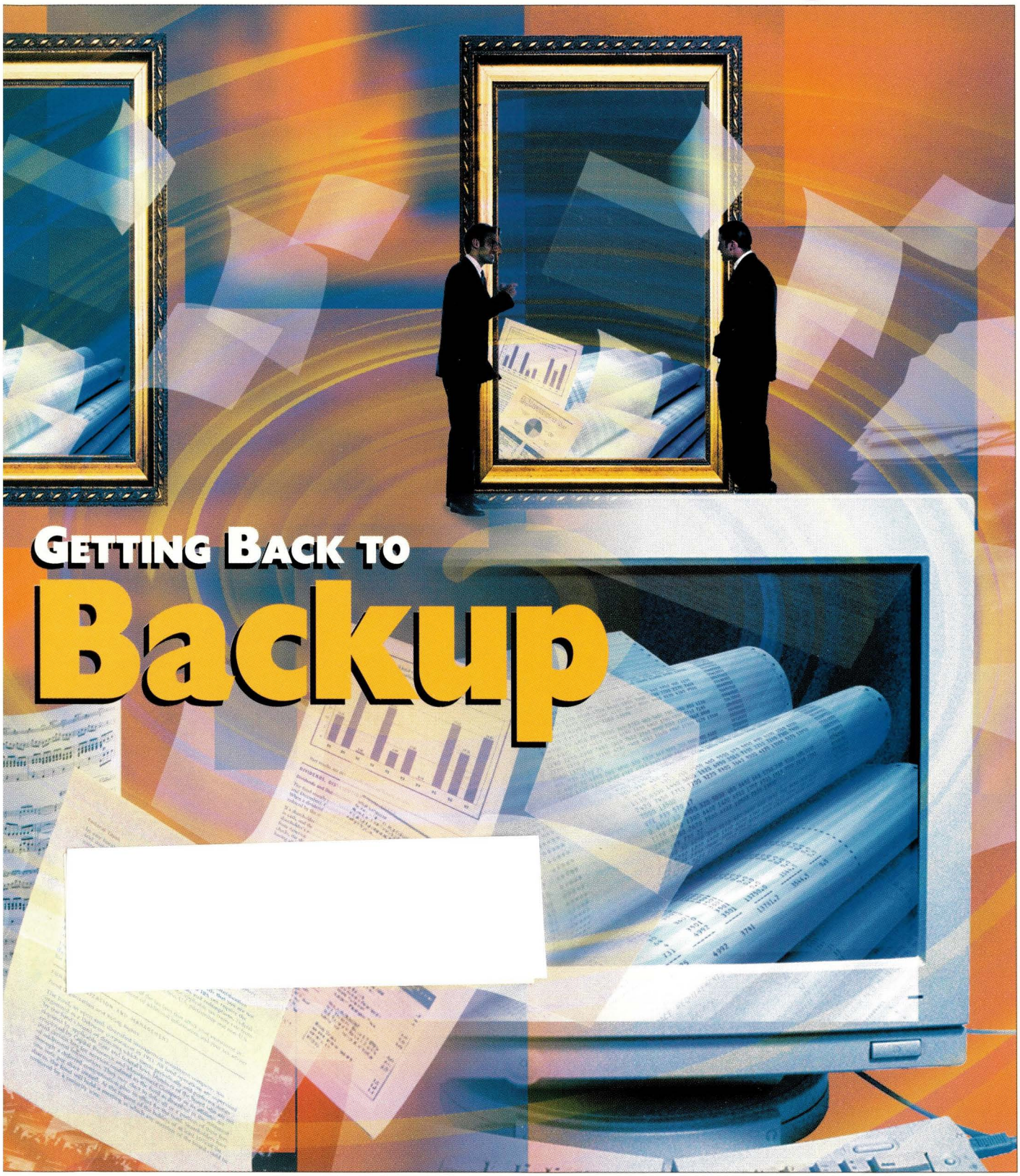
# The Server/Workstation Magazine



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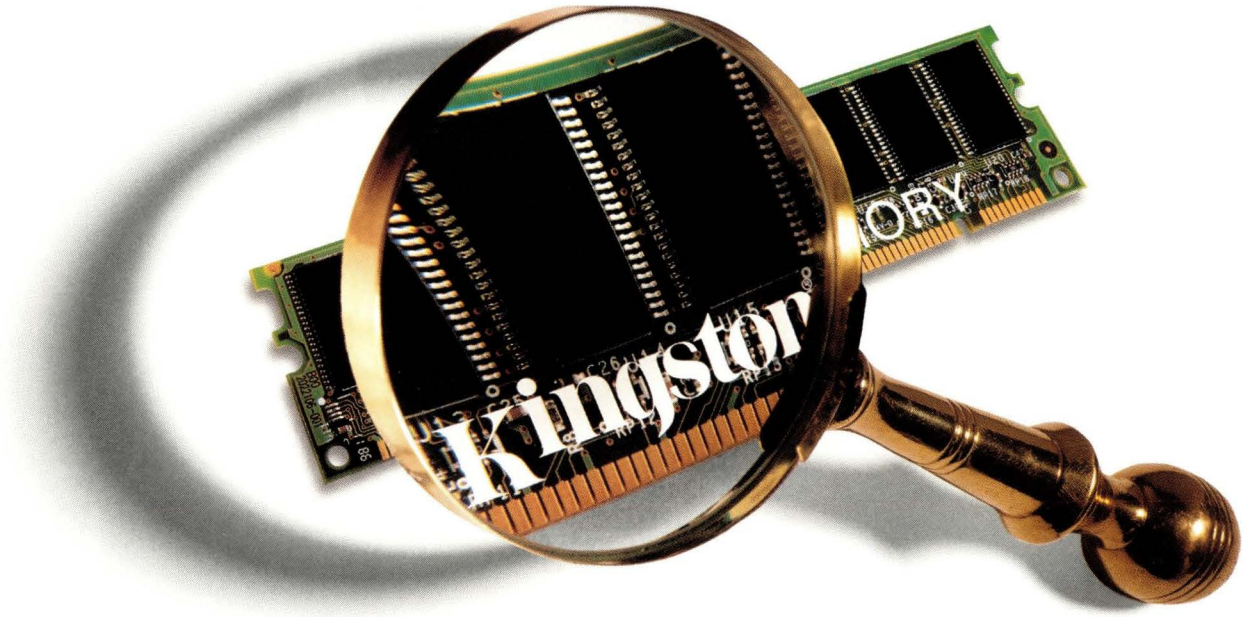

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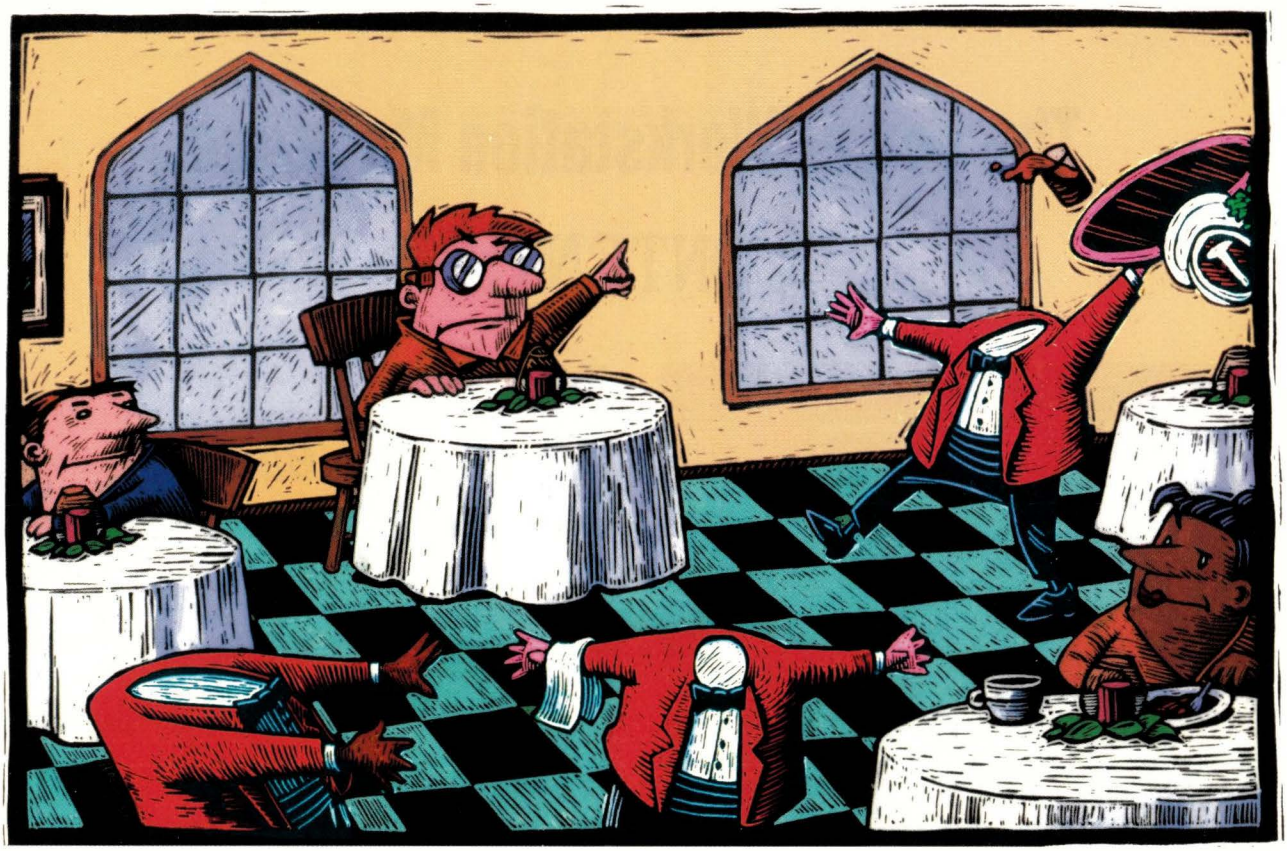

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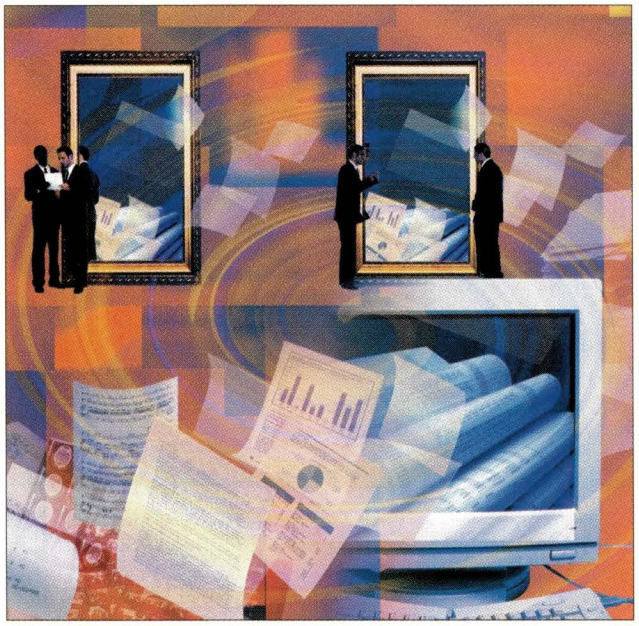
November 1998
Volume 9
Number 11

# CONTENTS



COVER BY MICHELLE FRIESENHAHN WILBY

## Feature

**64 Getting Back to Backup**

As the data glut grows and backup windows continue to shrink, choosing the right strategy ... now, there's the backup rub.

by Gode Davis

## News

**6** Includes: **Will Seven Prove Lucky for Solaris Users?; The Future of UltraSPARC; To NT or Not To NT, That's the Question; WBTs-2, NCs-1.**

## Columns

**18 Ask Mr. Protocol** *by Michael O'Brien*
**Mr. P. and the Internet Red Shift**
That annoying phenomenon generally known as email spam has Mr. P. seeing red and battening down the hatches.

**26 UNIX Basics** *by Peter Collinson*
**Resource Access**
With any multiuser system, we want to be able to control when certain actions are performed; the degree of control depends on the circumstances.

**34 I/Opener** *by Richard Morin*
**Perl Conference Report 2.0**
Taking a cue from the Perl Mongers' table at the second annual Perl Conference, we should welcome a little chaos here and there.

**38 Systems Administration**
**Variable-Length Subnet Masking**
*by S. Lee Henry*
A look at variable-length subnet masking, a simple extension of standard subnet masking that makes it possible to define subnets of varying sizes.

**42 NTegration** *by Æleen Frisch*
**An NT Bookshelf**
This month, we take a break from hardware and software to consider some useful reference works on Windows NT.

**46 Q&AIX** *by Jim Fox*
**Trace'ing Signals**
How do you trace signals and system calls on AIX?

**50 Datagrams** *by John S. Quarterman*
**Starr Day**
How did the Internet fare when Independent Counsel Kenneth Starr's report on President Clinton was released?

**54 AIXtensions** *by Jim DeRoest*
**A Penny Earned**
Regularly gathering system accounting information is a good idea even if you aren't interested in billing for services.

**58 Work** *by Jeffreys Copeland and Haemer*
**A Short History of Reading**
Consider the book. It has been with us since the dawn of civilization. But why is it in this form now? And what form will it take in the future?

## 73 Survey: Backup Software Packages

A sampling of more than 30 commercial backup/recovery software products currently on the market.

compiled by Maureen McKeon, Research Editor



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## 77 Managing Traffic with VPNs

*by Paul Korzeniowski*

Now that the Internet has become a common communications vehicle in many organizations, companies are on the lookout for ways to improve and manage its use. To do so, many companies are turning to Virtual Private Networks (VPNs).

## 82 Network Uptime all the Time

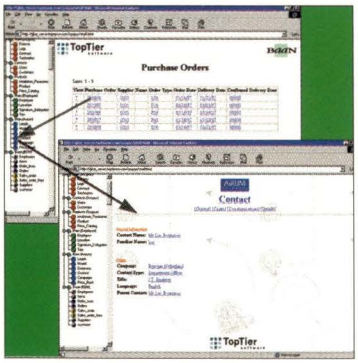
*by Suzanne Hildreth, Staff Editor*

In an effort to ensure a basic level of Internet service, more and more corporate customers are demanding guarantees on uptime and performance from their Internet service providers (ISPs). However, no ISP has guaranteed 100% uptime–until now.

## 84 URL/New Products

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

Illustrations by ERIN TERRY




Page 87

## Departments


**4** Editorial
**76** Reader Feedback
**87** New Products
**91** Server/Workstation Marketplace
**104** Advertisers' Index



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# EDITORIAL

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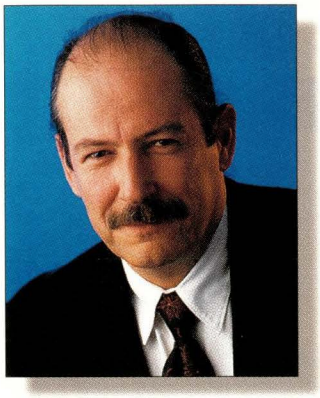

# Backup Is a Full-Time Job

This month's cover story involves what for many IT shops has become a tale of woe: backup. As the window for performing backups has shrunk, the demand for higher and higher capacity has skyrocketed. In fact, it seems that backup–a chore done in off-hours just a few years ago–has become a 24x7 job in and of itself. Contributor Gode Davis takes a look at the current state of the market for products devoted to backup.

"Currently, the most common approach to backup is bulk data movement (over the network in some cases) from disk to tape," says Mark Nicolett, research director of storage technology operations and resources for the Stamford, CT-based Gartner Group. This is not state of the art today. It is the state of IT investment in backup. Unfortunately, farms of tape libraries tilled by cadres of tape minders, no matter how diligent, have become too cumbersome and slow. That's why Gode also looks forward to new strategies and storage architectures–enter the storage area network, high-speed interconnects, replication and so on–to deal with this dilemma. According to Gode, "Serverless backup–performed without the help of the server in an environment where enough intelligence is embedded in the storage system–is really the key to backup's future." For the foreseeable future, though, storage will be achieved through a combination of the new and the old. To get a clearer picture of how the two coexist, take a look at "Getting Back to Backup," Page 64. We've also included a survey, compiled by Maureen McKeon, of many of the current backup software vendors. It begins on Page 73.

I would also like to call your attention to this month's WebServer Supplement. If you're looking to outsource an intranet, you'll want to read "Managing Traffic with VPNs," Page 77. *SunExpert* editors would like to hear from you if you're considering a VPN as an alternative to handling network management chores on your own. Drop me a line at dpryor@cpg.com. We hope we can live up to the accolades of a recent email message. It read: "*SunExpert* is the best magazine I get. From tutorials to political comment, your no-nonsense tell-it-like-it-is approach is enlightening and refreshing. A veritable technical Mother Jones." Thank you Tom Hixson.

Doug Pryor

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Publisher S. Henry Sacks shs@cpg.com

Editor-in-Chief Douglas Pryor dpryor@cpg.com

Managing Editor Lisa Bucher lisab@cpg.com

Technical Editors Ian Westmacott ianw@cpg.com
Richard Morin rdm@cpg.com

Contributing Editors Michael Jay Tucker
Simson L. Garfinkel
Mark Seiden

Research Editor Maureen McKeon mm@cpg.com

Staff Editors Alexandra Barrett alex@cpg.com
Patrick T. Coleman pat@cpg.com
Suzanne Hildreth sjh@cpg.com

Production Editor Michael Letts mletts@cpg.com

Art/Production Director John W. Kelley Jr. jwk@cpg.com

Senior Designer Jerry Cogliano jerry@cpg.com

Designer Brad Dillman bdillman@cpg.com

Production Assistant Camille L. Dastoli cld@cpg.com

Circulation Director Deborah Moore dm@cpg.com

Promotion Manager Melanie DeCarolis melanie@cpg.com

Accounting Manager Robin Yearwood robin@cpg.com

Office Manager Tina Jackson jamal@cpg.com

Business Manager Susan R. Sacks srs@cpg.com

Systems Administrator Mark Petrie petrie@cpg.com

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Editorial Offices
1340 Centre St., Ste. 102-103
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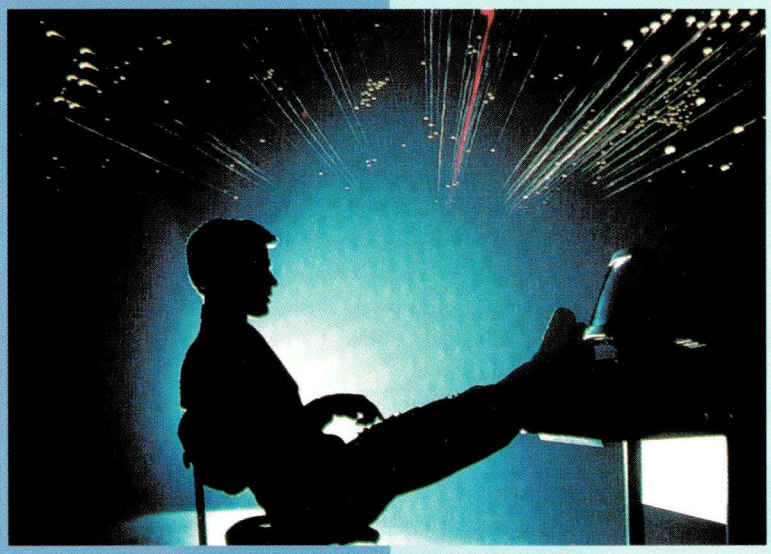

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# Will Seven Prove Lucky for Solaris Users?

Sixty-four-bit support, enhanced clustering capabilities, improved integration with Windows NT systems and a more user-friendly interface are some of the features to be found in the next release of Solaris (Solaris 2.7) unveiled at a press conference held by Sun Microsystems Inc. in New York City on October 27.

JOHN W. KELLEY JR.

One of the chief goals of the new release is to broaden the appeal of Solaris in both the high-end data center and low-end departmental markets, says Brian Croll, director of marketing for Solaris products at Sun.

Improved integration with Windows NT is the focus of Sun's reach into the departmental market. To appeal to NT users, this latest version of Solaris is getting a name change as well. It has officially been christened Solaris 7, with future versions to be Solaris 8, Solaris 9 and so forth.

"We're trying to get out of the UNIX numbering system and go toward something that we think is more accessible to a broader base of people," Croll says.

Sun's appeal to the high-end market will rest on its beefed-up reliability, availability and serviceablity features, mainly in the form of improved clustering capabilities and enhancements to core operating system utilities.

"We want to move Solaris upstream into the data center," says John Finelli, product line manager for Solaris servers. "To do that, we've added significant capabilities to Solaris to address that market. We think we're the only OS other than MVS that's really attacking that market...and we think it's an area where we can do some major damage."

Solaris 7 includes new or enhanced features in areas such as network management, ease-of-use and Internet utilities. Most are incremental capabilities that will help Sun polish Solaris' functionality on a number of fronts, says George Weiss, vice president and research director of hardware and operating systems for research firm Gartner Group Inc., Stamford, CT. "Sun has covered its bases very well with this release. If you look at it holistically, it's a well-rounded operating system."

How "well-rounded" an individual customer's version of Solaris 7 will be depends on how they choose to purchase the product. Solaris 7 will come in four parts: a base operating system and three extensions that customers will need to purchase if they want to add specific types of functionality. For example, enterprise customers who want a full range of reliability, availability and serviceability features will need to buy the Solaris Enterprise Server, a set of services designed to sit on top of the operating system. The two other extensions are the Easy Access Server 2.0, a revamp of the Sun Intranet Server, which will provide NT interoperability features, and the ISP Server 2.0, another revamped Sun product that will offer services specific to the needs of Internet service providers (ISPs) and large enterprises. (Sun is not releasing pricing information on either the extensions or the core operating system at press time.)

## Options Sold Separately

The Solaris Enterprise Server will comprise two Sun products currently sold separately: SunCluster and Bandwidth Allocator. It will include the latest version of SunCluster (Version 2.2), providing support for two- to four-node clustering, 64-bit computing, multiple file systems (UFS, SDS, VxFS and VxVM) and High Availability (HA) applications such as parallel databases. Enterprise Server will also include a group of functions dubbed the Solaris Resource Manager. Theses functions will enable administrators to prioritize resources among applications, users and processes, and track resource usage.

For customers who opt not to buy Enterprise Server, the core Solaris operating system will include several new features, such as an enhancement to the System Crash Dump utility, which will enable faster system data capture and the

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ability to dump data to a specified partition at the time of a crash, and UFS logging to allow the system to recover more rapidly from file system errors. It will also include Dynamic Reconfiguration and Alternate Pathing. Both capabilities are typically found on mainframes and Sun has already begun offering them in its high- and mid-range servers, including the Enterprise 3500-6500 line. Dynamic Reconfiguration allows an administrator to off-load a process from a faulty component and replace that component without bringing down the system. Alternate Pathing provides multiple paths to an I/O space so that an I/O path can be redirected without interrupting an application.

Solaris 8, slated for release in the second half of 2000, will offer additional clustering capabilities such as single-system image, making it possible to manage multiple networked nodes as a single IP address, Sun says.

For ISPs and large enterprises, the ISP Server 2.0 extension is said to offer utilities such as FTP and news. It will include several functional groupings: Sun Internet Administrator for access control and administration of distributed services; Internet Services Monitor for tracking performance data; SunScreen Simple Key management for Internet Protocols (SKIP) for encryption and key management; Sun Directory Services to provide support for LDAP, HTTP, NIS, Remote Access Dial-In User Service (RADIUS) and automatic data replication; and the Sun WebServer, Internet News Server and Internet FTP Server products.

And for Windows NT aficionados, the Solaris Easy Access Server provides NT integration capabilities as well as an NT administrative user interface. It will include Sun's Cascade technology for enabling Solaris servers to take over the administrative tasks of an NT network (see "To NT or Not To NT, That's the Question," Page 12), although that functionality–to be called the SunLink Server–won't appear in the initial release of Solaris 7, it's scheduled to be included in versions of Solaris 7 to be released in spring 1999. The Easy Access Server will also include the SunLink PC, an existing Sun product that allows PC desktops to access files and network services on Solaris servers.

Finally, for IS managers who prefer an NT-based interface, Easy Access Server will include InstallShield technology. InstallShield Software Corp., Schaumburg, IL, maker of the omnipresent blue setup wizards that appear in almost all Microsoft Corp. Windows software installations, has agreed to partner with Sun to develop browser-based wizards for Solaris. Already included in 2.6 distributions, the agreement will also enable third-party Solaris vendors to include InstallShield technology in their software.

## Getting Your 64-Bits Worth

While Gartner Group's Weiss thinks Sun has done a nice job of improving its NT integration and ease-of-use features, he says Sun would be better off focusing on the high-end of the UNIX market, instead of the departmental. "That's where UNIX is going–upstream. I don't think the UNIX market is going to be profitable for vendors who are making the lower end of the market their target."

Tony Iams, analyst with D.H. Brown Associates Inc., a research firm based in Port Chester, NY, agrees that it's the high-end reliability, availability and serviceability features Sun ought to emphasize. "Differentiation from NT is critical, of course, and the way you do that as a UNIX supplier is to leverage those areas where UNIX has clear advantages over NT, and that's related to things like reliability and scalability," Iams says.

Sun does plan to increase its focus on scalability and reliability issues in Solaris 8, with the inclusion of single-system image clustering capabilities.

Reliability and NT support aside, the most notable feature of Solaris 7 is support for 64-bit computing–something Sun has long promised in Solaris 2.7. Billed as Sun's first full 64-bit operating system, Solaris 7 will expand on Version 2.6's support for 64-bit files by adding 64-bit virtual addressing and arithmetic. With the addition of 64-bit virtual addressing, applications will have larger process address spaces to speed execution. Sixty-four-bit computing is particularly attractive to users who want to run computationally sophisticated or graphics-intensive applications, such as visualization and simulation packages or data warehousing and analysis applications. Scientific users who need to build large models or work with complex mathematical equations will also find 64-bit computing useful. Milan Kratka, an instructor of financial mathematics at the University of Chicago is looking forward to 64-bit Solaris for his own applications. "For instance, I solve partial differential equations and was hoping that could speed things up."

D.H. Brown's Iams says 64-bit support, while important, does not put Sun ahead of other UNIX vendors. "Sun is, in fact, the last leading UNIX vendor to announce this. This just brings them to parity with everyone else. But Sun is committed now to introducing technology conservatively to minimize the risk to commercial server users."

It might not be conservative enough for everyone. Eric McCann, a consultant with MCGeoNET UNIX Consulting, Menomonee Falls, WI, says existing Solaris users are likely be wary of upgrading to 64-bit Solaris until their software vendors opt to support it. "Customers who are still running older SunOS operating systems aren't doing so necessarily by choice, but because of third-party application support requirements. Customers mostly will not migrate their OS unless they have support for the new environment all the way around," McCann says.

Sun, however, insists that all existing 32-bit applications will be binary-compatible with the new operating system and that the only real difference customers will see is a boost in performance with some of their 32-bit applications. "We have seen some applications run faster without recompilation. Those are ones that are heavily kernel- or I/O-intensive because the drivers are all 64-bit as well," Sun's Finelli says.

In Solaris 9, Sun says it will add support for ccNUMA for the Intel Corp. architecture. ccNUMA, or cache coherent nonuniform memory access, is a multiprocessing architecture that holds the promise of extending the processing capabilities of Symmetrical Multiprocessor systems (SMPs), without having

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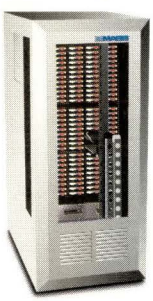

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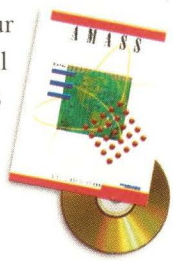


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to make substantial changes to existing SMP applications.

All in all, says Gartner Group's Weiss, the various changes should give Solaris 7, and Sun, a better footing against Windows NT and other UNIX operating systems. "Solaris is still a work in progress, but can be considered without hesitation a premier UNIX operating system in the market. And, of the two or three strong UNIX survivors that will probably still be here by 2001, Solaris will be one."–*sjh*

## Jini: Sun's Latest Genius

Just when you thought you had a handle on what Java is and what it can do for you, along comes Jini, Sun Microsystems Inc.'s latest technological whatsit. News of Jini broke this summer thanks to a calculated leak by Sun cofounder and Jini visionary Bill Joy. The new technology spurred a slew of news stories, including coverage in *The New York Times* and on CNN, with headlines suggesting the second coming of network technology and visions of home supercomputing, "federations" of Jini-enabled devices and so on.

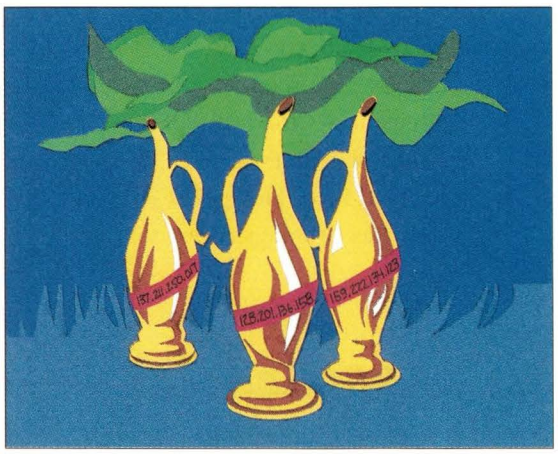
All this excitement begs the question: What exactly is Jini? In a nutshell, Jini is a Sun research and development project that enables "spontaneous networking," or the ability to dynamically add hardware or software to a network. Ultimately, by equipping all network elements with Jini capabilities, Sun hopes to arrive at its long-awaited "network dial tone," where all a user needs to do to hook a device up to the network is plug it in.

Technically speaking, Jini is a Java-based technology, comprising a small amount of Java code in class library form. By adhering to a few conventions, Jini can gather Java Virtual Machines (JVMs) on the network into a so-called "federation." To do this, Jini relies on the basic Java infrastructure programming model and services, but adds to it new features such as discovery, lookup, distributed security, "leasing" and two-phase commit. An overview of Jini can be found at `http://java.sun.com/products/jini/whitepapers/`. Specifications detailing particulars of the Jini architecture, namely JavaSpaces, Leasing, Transactions and Distributed Events, are also available on this site.

It turns out that Jini has been in development for a long time–just as long as Java, in fact–and was part of Bill Joy's original Java proposal. According to a Sun white paper, the original Java idea comprised three parts: a programming language that would run on all platforms; a virtual machine to run the language; and a networked system to allow distributed virtual machines to run a single system. The first two parts of the proposal were introduced as the Java programming language and JVM with which we are all familiar. The third part, put on hold while Sun waited for Java to take off, is Jini.

With Jini, Sun says, on arriving at a hotel, a business traveler will be able to simply "plug in" his laptop to link with the home office or reset a home surveillance system via an airport pay phone. Jini should also help ease more mundane tasks, for example, simplifying the task of connecting a printer to a network.

In order to encourage innovative Jini development, Sun says it will make Jini freely available to the developer community, including source code, under the so-called Jini Public License (JPL). A draft of the JPL was promised for the beginning of August, but as of press time it hasn't appeared.–*ab*



JOHN W. KELLEY JR.

## The Future of UltraSPARC

In the past couple of months, Sun Microsystems Inc. has made several important announcements concerning its Solaris-on-Intel capabilities. But lest these cast doubt on Sun's commitment to its own microprocessor technologies, Sun recently unveiled its road map for the UltraSPARC chipset. The message is clear: Sun is "unwaveringly committed" to SPARC, says Mike Gallagher, Sun Group Marketing Manager for Microelectronic Enterprise Products.

Indeed, the UltraSPARC road map suggests that Sun engineers will be very busy for the next couple of years. Sun expects its high-end S series UltraSPARC to achieve the 1-GHz level by 2001 and 1.5-GHz the year after.

In fact, Sun has big plans for all three chipsets: the "scalable" S series, found in high-end N-way servers, such as its Enterprise line; the "integrated" I series found in "low-end power workstations," such as Darwin; and in the "embedded" E series, which Fujitsu America Inc. manufactures as the SPARClite chip and is used in devices such as digital cameras.

The UltraSPARC road map may be ambitious, but, according to analysts, Sun has a fair shot of keeping on schedule. "Yes, it's a realistic road map," says Nathan Brookwood, microprocessor analyst with Dataquest Inc., San Jose, CA, "but it will require very good delivery–they can't afford any major screwups." Fortunately, Sun has a good track record in this respect, which boosts analysts' confidence.

According to both Sun and Brookwood, the main threat to SPARC's success is Intel Corp.'s forthcoming IA-64 ("Merced") chip, which is scheduled for release in 2000. Microsoft Corp., Redmond, WA, as well as traditional UNIX vendors such as Hewlett-Packard Co., Palo Alto, CA, and Compaq Computer Corp., Houston, TX, (formerly Digital Equipment Corp.), all see IA-64 in their future. This establishes the still embryonic chip as a contender in the high-end server market.

Sun, however, rejects the notion that IA-64 is enterprise-ready. "Merced is moving into a space where people are

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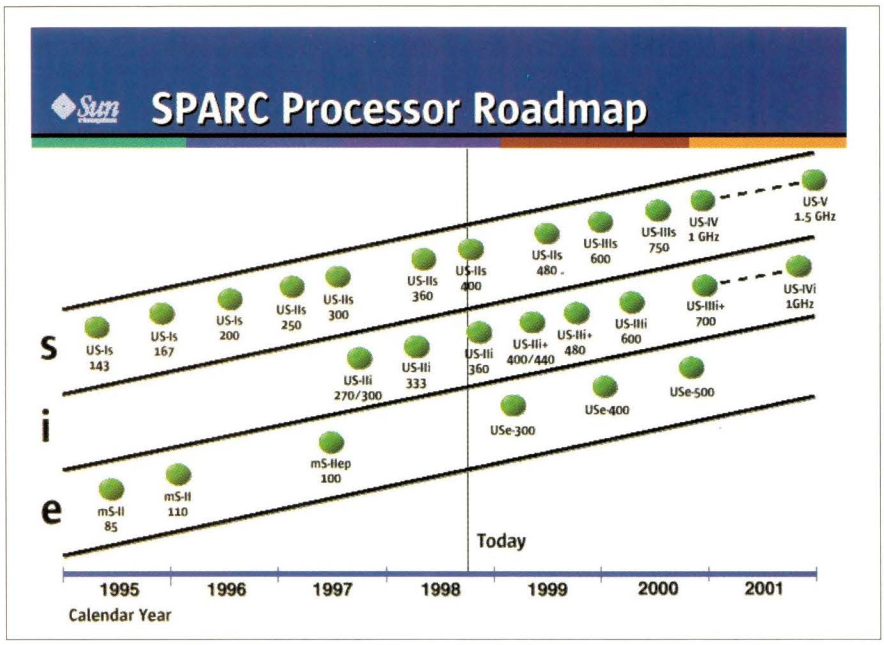


*Although it can't afford any major setbacks, industry analysts feel Sun's ambitious UltraSPARC road map is a realistic one.*

betting their business on the fact that their systems are running," says Sun's Gallagher. "People need to ask themselves if Merced is really the processor for the job."

Among Merced's perceived faults is the fact that the 64-bit chip will not be binary-compatible with many of the 32-bit x86 applications already on the market. Merced will, however, run 32-bit applications through an emulator. Sun's Gallagher wonders about the wisdom of purchasing a new IA-64-based system if it is going to run 32-bit applications slower than an existing 32-bit system.

But, Dataquest's Brookwood says Sun is understating Intel's binary-compatibility theory. He says Intel promises that IA-64 will deliver 32-bit emulation at speeds at least as good as those found on a mainstream Pentium. Not all applications will require 64-bit performance, Brookwood says, only those that need to run especially fast.

Nevertheless, Sun argues that at a time when most organizations will be busy fighting Year 2000-related fires, porting applications to the 64-bit chip will take some time. "You just don't know what you're going to get the first time you do that kind of port," says Gallagher. UltraSPARC, meanwhile, promises to maintain full backward compatibility throughout its line, from antiquated UltraSPARC Is to 1.5-GHz UltraSPARC Vs. In addition, Sun's design team will reportedly minimize the risks involved in moving to a new microprocessor design by only altering either the pipeline architecture or the process in any one release. And, in any case, Sun says the underlying SPARC instruction set, which the programmer interacts with, will stay the same.

UltraSPARC's future is "relatively rosy," says Brookwood. But in the event that Sun engineers fall hopelessly off course with UltraSPARC development, Sun will have established a credible Solaris-on-Intel capability to salvage the situation. "If all else fails, they bought a good insurance policy with Solaris x86," Brookwood says.–*ab*

## To NT or Not To NT, That's the Question

Early next year, IT managers will finally be able to halt Microsoft Corp. Windows NT server proliferation within their company. That's because first-quarter 1999 is when Sun Microsystems Inc. has promised to begin shipping a new product that will enable Solaris servers to take over most of the NT administrative services normally hosted on NT servers. The technology, code-named "Cascade," will enable administrators to consolidate the administration of an NT network onto one or two Sun servers instead of multiple NT servers. Sun plans to ship early access versions of the technology later this month.

Sun already has two products that aid in Solaris/NT interoperability: SunLink PC, which enables Solaris servers to handle file, print and application services for Windows clients; and SunPCi card, announced in September as part of the Cascade announcement, which allows users to run Windows and DOS applications natively on Sun Ultra workstations.

Cascade is expected to go much further, expanding the usefulness of Solaris servers in an NT network by enabling them to act as NT domain controllers and to authenticate logins by Windows clients. Cascade will include the Windows NT Directory Service (NTDS), the NT File System (NTFS) and the NT authentication model for authenticating Windows clients. With it, Solaris servers will be able to act as Primary Domain Controllers (PDCs) for NT networks–which hold the security and network resource information for a given domain–and to establish "trust" relationships between different domains hosted on NT or Solaris. Trust relationships are how NT administrators enable users in one domain to gain access to network resources in another.

The type of IT manager who would benefit the most from this technology, according to Bill Moran, research director for D.H. Brown Associates Inc., a research firm based in Port Chester, NY, is "someone who's using Solaris, but also has a huge number of NT machines that are primarily used for handling directory services and other administrative stuff, and who wants to consolidate those onto fewer servers."

That could potentially represent a very large market. In fact, more than half of all NT server licenses sold are used exclusively to support file and print services, according to "Server Operating Environments: 1998 Worldwide Markets and Trends," a report published by research company International Data Corp. (IDC), Framingham, MA.

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Rob Enderle, analyst with the Giga Information Group, Norwell, MA, says Cascade could slow the rate of Solaris-to-NT migration by anywhere from 25% to 75% in the next few years. However, he doesn't think existing NT shops, or companies with firm plans to migrate to NT in the near future, will be swayed in their allegiance to Windows. "NT [users] are not likely to go to Sun, primarily because NT servers are currently deployed where Sun servers are not cost-effective."

The technology behind the Cascade project is an implementation of AT&T Corp.'s Advanced Server for UNIX (AS/U), which was developed under an agreement with Microsoft and enables UNIX servers to host Microsoft client software. AS/U originated as a UNIX implementation of Microsoft's LAN Manager and is based on actual NT source code, rather than a reengineering of the code. That means Cascade, or any product based on AS/U, is likely to operate much more smoothly within an NT framework than, say, a product that has been reverse-engineered. "With the best will in the world, you'll never get something to be 100%-compatible [through reverse engineering]," D.H. Brown's Moran says.

Sun isn't the first UNIX vendor to port AS/U. In fact, Sun follows a long line of leading UNIX vendors who have opted to license it. Digital Equipment Corp., Maynard, MA, Hewlett-Packard Co., Palo Alto, CA, and The Santa Cruz Operation Inc. (SCO), Santa Cruz, CA, have all released versions of AS/U technology in the past two years. "Sun's the last one to the party, so they're not exactly trailblazing here," Moran says.

But he adds that Sun may well pull into the lead by putting extra effort into developing its product and making it a best-of-breed solution. This is mainly because Sun, unlike the other UNIX vendors, doesn't have an NT offering and therefore needs to focus harder on making its UNIX servers NT-compatible. "The other vendors have their own NT offerings, so they've been very quiet even though they had this thing–they haven't pushed it very hard," Moran says.

To that end, Sun plans to include value-added enhancements with the next version of Cascade slated for release in late 1999. The second release will have directory synchronization between Sun and NT directory services, full multithreading capabilities for improved performance and a feature called UNIX Workstation Authentication, which enables UNIX clients to be authenticated by NT servers as well as Solaris servers, the company says.

There could be problems for Cascade, however. In fact, Sun may not have access to future versions of the NT source code owing to a lawsuit brought against Microsoft by AT&T earlier this year concerning AT&T's right to license Windows NT 5.0 source code. While terms of a recent settlement have not been disclosed, industry reports suggest the settlement involves money, not access to the NT 5.0 code. That's likely to make it much harder for Sun to create new implementations of Cascade that support NT 5.0–particularly as Microsoft plans to scrap the domain directory model used in NT 4.0 in favor of a new one, called Active Directory, which is a combination of Lightweight Directory Access Protocol (LDAP) and Domain Name System (DNS).

Marcia Kennedy, group product manager for backup server software at Sun, says the company will provide support for Windows NT 5.0 in future versions of Cascade but concedes that it hasn't yet settled on a strategy. "The deal we have with AT&T is for NT 4.0. We're evaluating different options available to us [for NT 5.0]. Since Active Directory uses industry protocols like LDAP, we might be able to provide interoperability using that alone," Kennedy says.

However, worries over support for NT 5.0 are probably premature. It could be two to three years after the release of 5.0–currently in beta–before most customers migrate to it. In the meantime, resellers are hopeful that the Cascade technology will give Solaris an edge over NT, says Scott Zahl, manager of Sun product marketing at Access Graphics, a distributor and value-added reseller based in Boulder, CO. "It accentuates Sun's ability to sell into the workgroup market," says Zahl. "I've talked to several resellers who are very excited about it, and about how it will help them sell into that [workgroup server] market more effectively."

Sun has yet to announce pricing for Cascade, but similar products from other vendors start at around $1,000.–*sjh*

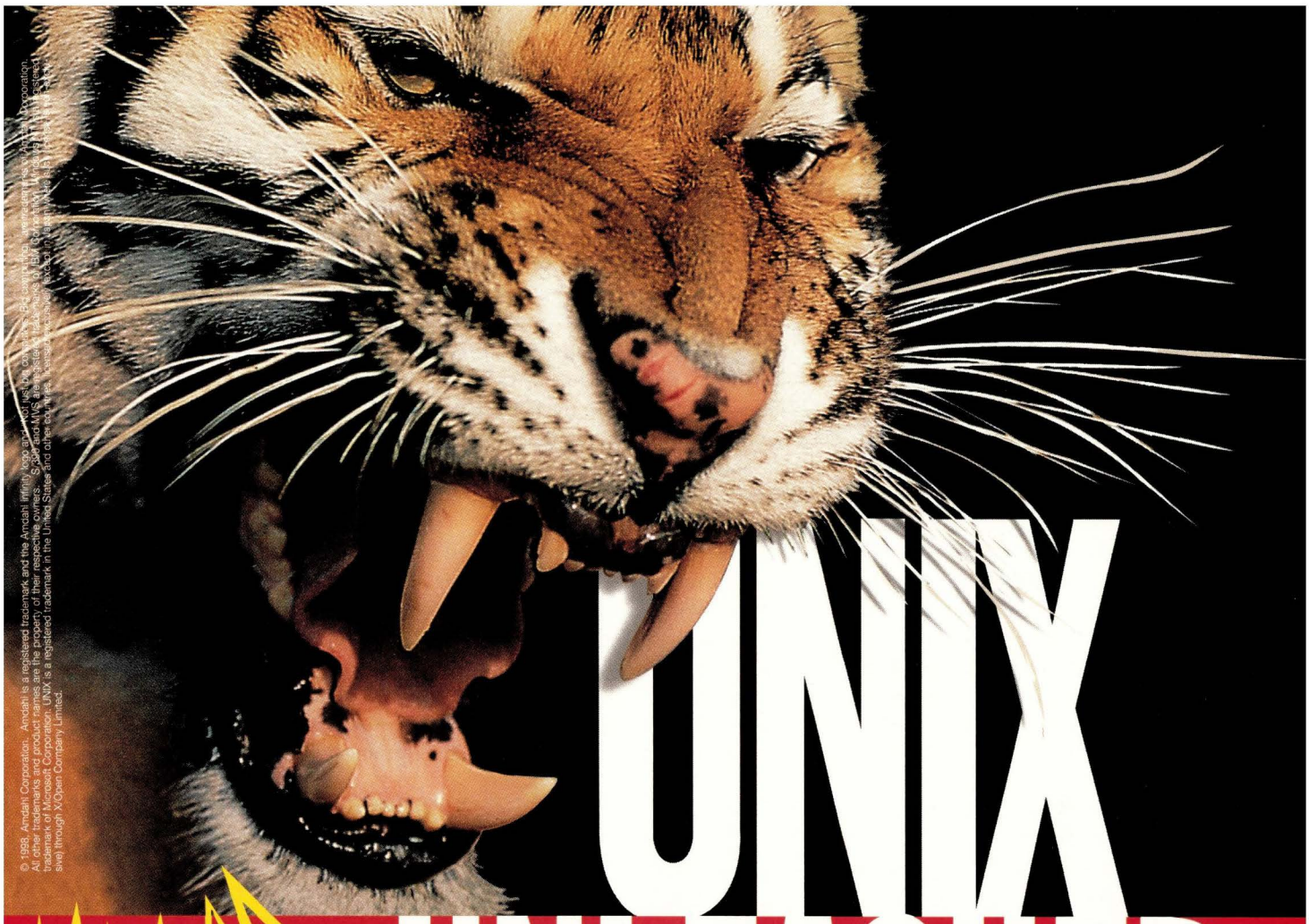
## WBTs–2, NCs–1

At the beginning of 1998, industry analysts were calling it a "make or break year" for the Network Computer (NC) market. Now, 11 months later, it's obvious that prediction didn't quite pan out. Despite incursions from Microsoft Corp. Windows-based terminal (WBT) products that have encouraged many users to stay with NT rather than migrate to Java, the Java-based NC hasn't left the battlefield just yet.

Reports of the NC's death are definitely premature, says Greg Blatnik, vice president of Zona Research Inc., a consulting firm based in Redwood City, CA. "Two years ago, when everyone was beating their chest about NCs and saying they would sweep PCs off the face of the earth, I said that was nonsense. And I think that the opposite opinion, that Windows-based terminals are going to take over, is also not a given," says Blatnik. He cites a survey conducted by Zona in August that shows NCs ranked a close second to WBTs on corporate buyers' shopping lists. "A lot of customers have not had much experience with any of these products and don't have enough knowledge to make a clear determination," Blatnik says.

The multiuser Windows camp did, however, manage to pelt the NC market with a few well-aimed rocks in the past few weeks. In September, Citrix Systems Inc., Fort Lauderdale, FL, released new versions of its Independent Computing Architecture (ICA) protocol for accessing its WinFrame and MetaFrame multiuser Windows server software. The new editions, for the Linux and SCO UNIX operating systems, join Citrix's existing ICA versions for Solaris, HP-UX, AIX, Digital UNIX and IRIX.

Also in September, several companies made significant WBT announcements at the Orlando Thinergy show, hosted by Citrix Systems. Two notable WBT vendors, Network Computing Devices (NCD) Inc., Mountain View, CA, and



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**Circle No. 6**

Boundless Technologies Inc., Hauppauge, NY, both introduced new products. Boundless unveiled its Viewpoint TC Software Suite, which enables WBT users to "hot key" between Windows and text terminal sessions. Network Computing announced it was beginning full-volume shipments of the NCD ThinSTAR 200 terminal. In addition, Oracle Corp.'s Network Computer Inc. subsidiary–long a vocal proponent of NCs–announced it will add the ICA protocol to its NC Desktop software.

A handful of smaller firms also used the show to launch new WBTs. VXL Instruments Ltd., headquartered in Bangalore, India, and Javeline Systems Inc., Irvine, CA, both released new WBTs. Affinity Systems Inc., Lansdale, PA, introduced two ultra-thin (both the size of a video cassette case) WBTs, while, ClienTec Corp., Reno, NV, and Key Tronic Corp., Spokane, WA, jointly unveiled a keyboard that doubles as a Windows terminal–it contains a Citrix ICA-supporting CPU and Ethernet port.

How might this influx of WBT products affect the Java-based NC market? According to Eileen O'Brien, director of NC research for International Data Corp. (IDC), Framingham, MA, Windows terminals will claim the lion's share of the thin-client market in the next few years. She forecasts Windows terminal shipments will grow from 241,000 this year to 791,000 in 2000.

"I'm more bullish on Windows-based terminals. I think it's an easier sell [than Java NCs]. With an NC, you first have to find folks that are making a big buy into Java, and not everyone is doing that yet," O'Brien says.

But NC shipments will continue to grow, albeit more slowly than WBT sales, O'Brien says. She forecasts 542,000 Java NC shipments in 2000, up from 265,000 this year.

But perhaps the most astute assessment comes from the actions of the NC vendors themselves, many of whom seem to be hedging their bets with products on both sides. San Jose, CA-based Wyse Technology Inc., a leading maker of Windows terminals, plans to enter the NC market by the end of the year with a product it calls the Network Terminal. "We're seeing the market growing on both sides," says Steve Kuenzli, product manager for network terminals at Wyse. Although the company aborted a similar effort to get into the Java-based NC arena in 1997, opting instead to expand its line of Windows-based terminals, Kuenzli says the market now looks much better. "The whole thin-client market is taking off," he says.–*sjh*

## The Last of the SPARC Laptops?

A small industry just got smaller. The two remaining vendors of SPARC-based portables, RDI Computer Corp., Carlsbad, CA, and U.K.-based Tadpole Technology plc, have merged to form a single company, Tadpole-RDI, with its U.S. headquarters in Austin, TX.

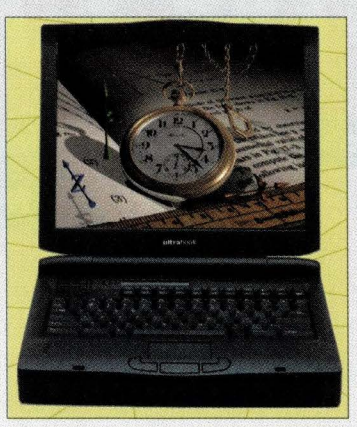
Tadpole's RDI acquisition reflects several market dynamics, not the least of which is the financial crisis affecting Asia. RDI had been majority-owned by Korean firm TriGem Computer Corp., but financial problems forced the company to seek a buyer, says Carl Baldini, Tadpole-RDI President.

Global economic factors aside, this acquisition calls into question the validity of the SPARC-based portable market. "It's a very niche market," says Baldini. Most SPARC portable sales go to either corporate customers that need a SPARC portable for software demonstration purposes or to government agencies that "need to deploy quickly," he says.

Recent efforts to penetrate the UNIX developer market have also failed, in part because of Sun Microsystems Inc.'s aggressive low-end pricing strategies. "It has been really hard to compete with Sun's latest price points," Baldini says. For example, pricing for an RDI 170-MHz Ultrabook with 12.1-inch thin-film transistor display, 64-MB RAM and 1.5-GB hard disk starts at $12,000. By comparison, a Sun Ultra 5 Darwin desktop workstation with a 270-MHz UltraSPARC IIi processor, Solaris 2.6, 64-MB RAM and 4-GB disk lists for less than $3,000.

Another option for would-be SPARC portable customers is to install Solaris x86 on an Intel Corp.-based laptop. EIS Computers Inc., Moorpark, CA, for example, sells three models of Toshiba America Inc.'s Tecras preinstalled with Solaris x86 for between $2,400 and $6,300. Its top-end model, the Tecra 750, comes with a 233-MHz Pentium processor, 14-inch display, 8-GB drive and 80-MB RAM.

Running Solaris on an Intel-based laptop has become even more compelling since Xi Graphics Inc., Denver, CO, released Accelerated-X server for Solaris. Xi General Manager, David Methvin says, Sun simply could not keep up with the onslaught of new graphics chipsets that have inundated the market. "But X servers are our cup of tea," he says, claiming that Xi Graphics supports more than 500 graphics chipsets. "It's safe to say that we support just about any laptop out there." The Accelerated-X server costs around $200 for a Solaris laptop version.



*RDI SPARC-based laptops, such as the Ultrabook (above), have had a difficult time competing with Sun's low-end price points.*

RDI sales staff also report an increase in the number of UNIX developers running the freeware Linux operating system on its portables. "For those who can deal with the inconsistencies of a noncommercial operating system, Linux has been a very good solution," Baldini says.

"It's my impression that the SPARC-based laptops are pretty hot machines," says Xi's Methvin. "But you'd better really need one in order to justify the cost difference."

At first glance, the future looks grim for the newly formed Tadpole-RDI. However, Baldini insists the merger represents a positive step forward for the two companies, which will result in some collective growth. "Before we merged, we were busy slugging away at one another in this niche market, and it was challenging for either company to succeed. We're much stronger now."–*ab*

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**Circle No. 7**

# Ask Mr. Protocol

*by Michael O'Brien*

TOM BARRETT

*"Attention spammers: If you spam me at this address I'll mailbomb the **** out of you with my T1."*
– One popular reference site on the Web (asterisks missing in the original).

*"<dead silence>"*
– Ninety-five percent of all overseas ISPs when notified that they have been used to relay spam email.

*"Until you contribute to our bottom line, SHUT UP!"*
– Paraphrasing a domestic ISP's response when notified that it had been used to relay spam email.

# Mr. P. and the Internet Red Shift

**Q:** *I admit, I'm astounded. I came over to ding you again about email spam and here I see Mr. Protocol has taken an interest in gardening! He's built a very nice garden shed out there, and now he's working on fence rails. I had no idea he had such green thumbs.*

**A:** If you look closely, you'll discover that he has no thumbs at all. Nor does any other part of his anatomy have what you could call real existence. You're right, I do think he enjoys gardens, when he can find a Web site dedicated to a particularly good one, but when he finds one he mostly just burbles about whether or not they've chosen the right compression strategy for the giant image files.

That's not a garden shed he's built out there. It's a border guard station. And if you look closely, you'll see that he's painting diagonal black and white stripes on that "fence rail." It's supposed to be a customs barrier. Some recent trends on the Internet have him worried, apparently, and as usually happens, it has caused his bunker mentality to set in. He'll be better in a week or so, and after that I'll have a nifty garden shed and at least one really good zebra-striped fence rail.

This problem started when Mr. Protocol noticed a change in tone in some of the replies from Internet service providers (ISPs) who'd been caught redistributing email spam. Mr. P. has this whole semi-automated response to spam. I don't know how he does it. Mostly, he seems to use cartoon physics. He spots spam coming in, yells "Incoming!," puts on a hard hat he found at a caving convention, grabs a great big u-shaped pipe and ZIP! the spam's headed back where it came from. Thing is, it doesn't go back to the "From:" address. That's why I don't know how he does it.

Mr. Protocol's grip on the contents of almost all email spam is, well, foggy. Take the infamous "Make Money Fast!" He doesn't really get it about money, except in certain online secure transactions. Where it comes from and where it goes are closed books to Mr. P. He used to depend on me to provide it by purveying translated and highly expurgated versions of his maundering in these columns. Then Computer Publishing Group, the publisher of this fine magazine, decided to put its money where its Web publishing coverage was, and transferred all of its accounts to a Web-based Internet bank. Suddenly, Mr. P. discovered he didn't need me anymore except as "the guy who makes the Big Stuf Ding-Dongs appear."

It's still edifying for me to watch CPG's Henry Sacks go into his "I have a family!" routine on a monthly basis, when Mr. P. makes his run. Of course, it just leaves Mr. Protocol puzzled, as his family is a protocol family and keeping it fed is a matter of updating the standards every so often. Doesn't cost him a thing.

So, while Mr. Protocol doesn't actually understand the content of email spam, he still finds its uselessness and general network-clogging properties annoying. His bent-pipe solution manages to encapsulate the spam into the body of a forwarded

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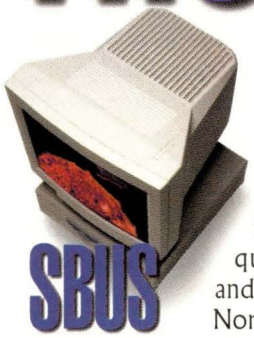

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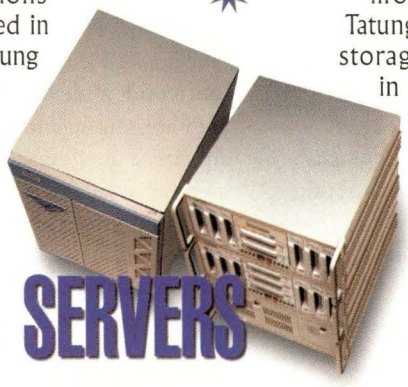

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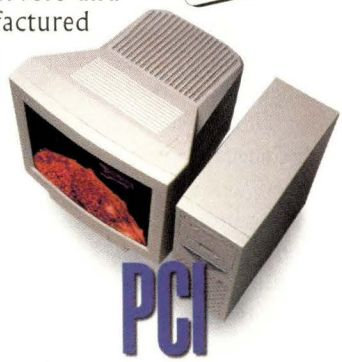

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**Circle No. 8**

message, including all the headers, and sends it on to the contact address of the last site that had it before it hit us, according to the "Received-From:" lines. Mr. P. never looks at the "From:" address, as he hates lies, and just about 98% of all spam has several big lies in the "From:" address, including a nonexistent host.

These days, about half of all spam is redistributed from some hapless site outside the continental United States, often from a country whose two-letter top-level domain is unfamiliar enough that I have to ask Mr. P. which country it is. In such a case, Mr. P.'s bent piece of pipe seems to use the Domain Name System (DNS) to find the Start of Authority (SOA) record for the domain, which includes a contact address. On Suns, the `nslookup` command is good for this sort of work.

It is the practice of most spammers to hit a site for redistribution a couple of hours after the close of business in whatever country the hapless site resides. This way, they are assured that email delivered to the systems manager will not be read until all of their spam has been redistributed, which generally takes a few hours. This certainly explains why Mr. Protocol almost never gets a response from these sites. Another strong possibility is that there may be no English speakers at these sites. For example, despite universal education in English, few Japanese can muster even basic English communications skills. This is mostly because the extremely rigid Japanese school system has never used modern linguistic instruction methods. This is delightful news to a certain class of peripatetic native English speakers, who have found they can visit Japan for an extended stay while working on contract for companies who make it their business to aid employees of various Japanese corporations in overcoming their earlier misinstruction in English.

But we digress. Experience shows that any attempt to contact the managers of overseas sites regarding spam is pretty much doomed. Going outside and shouting loudly generally has an equal rate of success, as does going into one's closet at midnight and whispering a complaint into one's shoe. (Email smells better, though.)

There are exceptions. Countries with a high rate of English literacy and a proven track record of international cooperation often generate surprisingly helpful responses. Sweden is a shining example. On the other hand, the entirety of South America is pretty much a black hole.

But what about the "Postmaster" address? Isn't this supposed to work anywhere?

Mr. Protocol is glad you asked.

This question takes us into a smarmy little area no more palatable than the worst kind of IRC channel: the world of Internet standards in the real world.

In some regimes, such as radio, international standards have the force of law, thanks to treaties and enabling legislation in the signatory countries. It is against the law for an amateur radio operator to transmit outside the ham bands (except when life and/or property are in imminent danger), for instance, because it is against international standards that determine who can broadcast where. These standards are given the immediate force of a treaty.

Internet standards are not. The Internet has always run as a cooperative federation of independently run networks. During its early days, this worked well, but in latter days, a few cracks have begun to appear in the superstructure.

The lower levels of the Internet protocol suite have mostly to do with moving packets to the next system in line. For the packets emerging from most ISPs, the next system in line is one of the big backbone systems. Therefore, these backbone providers, who all subscribe wholeheartedly to the Internet's federated approach, amount to a de facto network protocol police force–you don't abide by the rules, they don't pass your packets. At this level, the Internet is holding together well, and the strains are those of too-rapid growth and technical challenge.

## World Wide War?

At the application layer, which means the Web, email and other such services that users actually see, things are not so copacetic. These services, unlike the lower-level protocols, operate end-to-end. Thus, the backbone networks neither see nor care about the contents of these application-layer protocols. As a result, some services have started to deviate from the standards and some to fragment, as self-interest, incompetence and, in some cases, apparent lunacy cause some providers to go their own way.

The Web is the most infamous example of this. Although the World Wide Web Consortium (W3C) continues to work hard at promulgating standards for the Web, which will allow all service providers and all browsers to interoperate, the profit motive has made the construction of a truly compatible Web site a difficult proposition. Netscape Communications Corp. and Microsoft Corp. are battling it out in the marketplace and, from time to time, one company's browser will support a service or a widget that breaks the other company's browser outright. Any complex Web site must be crash-tested against several versions of both companies' browsers. This is not a standards-based effort: It's a war zone.

Email is in somewhat better shape, but the flood of spam is

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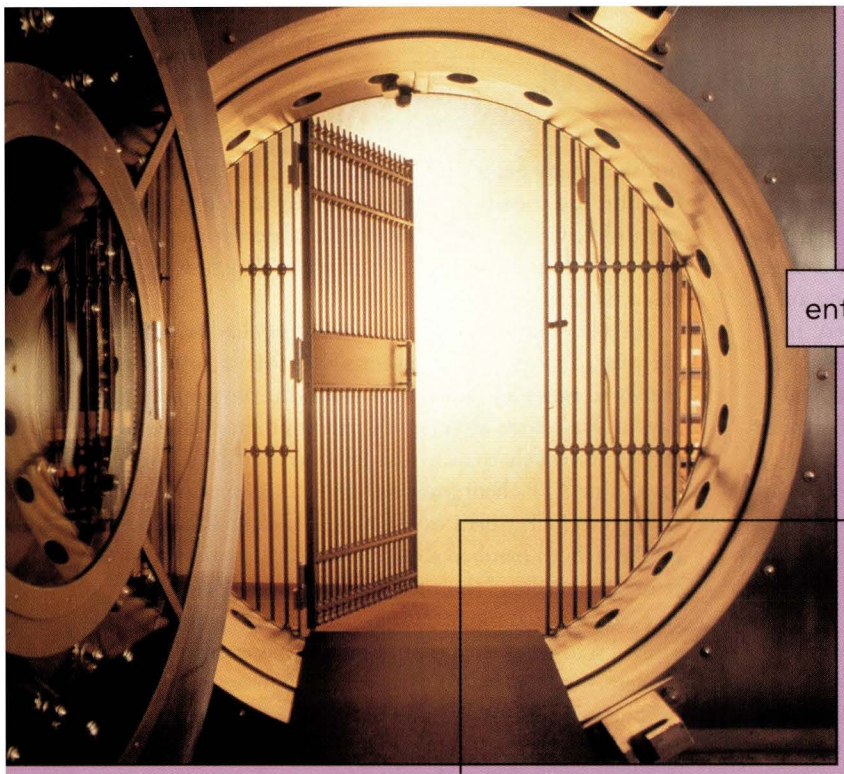

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**Circle No. 9**

rapidly eroding standards adherence. Take the "Postmaster" mailbox, as mandated by RFC 822 and RFC 1123, both of which are as mandatory and official as the Internet is capable of getting. Every site that runs a receiving SMTP service must support a "Postmaster" alias. In the real world, some do and some don't. Again, overseas sites are the worst offenders. In fact, many overseas sites, and a fair number of domestic ones, are completely incommunicado. They not only refuse mail to "Postmaster," but the email contact addresses given in their InterNIC information are invalid too. One can only wonder what will happen when the InterNIC emails them a bill for their domain name and turns it off when there's no response.

In the case of overseas sites, this is probably due to the stress of trying to keep a big site running at all, when all of the standards and reference works are written in a foreign language. Many of these sites probably run in a subculture, which is largely isolated from whatever mainstream culture the Internet may have, so that what's important from a global perspective is not entirely obvious to them. The consequences can be severe.

In the case of spam, an indication of anything other than active opposition can lead to the entry of the offending site's IP network number onto a real-time list of networks that appear to support or condone email spam. Many sites use this list to prime their routers and do not route packets to or from such networks. While the backbone providers do not use this list, enough other people do to make it obvious to anyone so listed that large parts of the Internet are suddenly inaccessible.

Many more sites support a "Postmaster" alias but automatically discard any mail sent to it. I once heard Mr. Protocol paraphrase Charles Babbage in this regard: "I am unable rightly to comprehend the type of confusion of mind that might result in such an action."

Most sites that take this action do so because the volumes of mail sent to that address, automatically generated by delivery failures, are profoundly uninteresting to a small staff who is unable to do anything about any of them. Most of them represent accounts that have been closed by other providers. This attitude also neatly does away with messages intentionally sent to "Postmaster" asking about the proper address for someone (a use of "Postmaster" explicitly called out in the standards), complaints about spam either redirected through the site or originating at the site, or announcements from someone temporarily driven insane by nonresponse that they are about to be flooded by a rogue T3 connection if they don't come up with some answers. The bit bucket doesn't care; it'll trash it all. The site's staff usually believes that anyone who really wants to get in touch with them will look them up at the InterNIC (assuming their entry hasn't been hijacked to point to Santa Claus) or read their Web site, and Internet standards be damned.

It is worth noting that older standards such as Telnet and FTP do not appear to have these problems, probably because not that many people use them. Telnet is full of additional options, specified in a whole raft of RFCs, which don't make any difference anymore now that most people are using the Secure Shell protocol, `ssh`, if and when they bother to establish a terminal connection at all.

FTP is a different and much more peculiar matter. Over the years, a number of extensions have been proposed to FTP, merely to make life easier. FTP is also in common use to this day, unlike Telnet, although the client program these days is much more likely to be a Web browser than an old-style command-line FTP client program. RFC 1123 specifies several changes to FTP, which would make life easier. Other changes that have been bandied about include automatic restart on error, "hole-filling" (transferring only the missing part of a file) and record-based file updating. Of these, only one, restart of a failed transfer at the point of failure, has ever been widely implemented and that only in one FTP program (`ncftp`).

The main reason for this lack of activity appears to be inanition. The current scheme is "good enough," and there isn't the same kind of user churn and demand that one sees in the Web arena. Still, the fact that there is any progress is a good thing and holds out hope that we may someday see some progress in this arena before someone comes up with a completely independent and nonstandards-based way for Web browsers to transfer and update files.

This leaves us with a set of providers who can only be termed "peculiar." In its older sense, "peculiar" meant "unique to, or underwritten by, a particular person or group." Westminster Abbey, for example, does not have a membership-based support organization, as St. Paul's Cathedral does, because of its status as an "Old Peculiar," which means that instead of being owned and run by the Church of England, it is "peculiar" to the Crown, which is responsible for its upkeep.

When the Internet first became commercial in a big way, the ISPs that appeared were like so many cookie-cutter duplicates. They all represented entrepreneurs who were trying to be first to market with a standard product to serve their area. Some distinguished themselves by concentrating on commercial accounts, others pushed the Web server part of their business, but there was little to distinguish the players.

Today we're seeing more variability, which is both good and bad. Now that it looks like the Internet is here to stay, at least for a while, we're seeing more overtly colorful characters. One interesting variation was an ISP that received one of Mr. Protocol's patented email spam turnarounds, sat on it for a month and a half, then sent back a one-line flame advising Mr. P. to "SHUT UP!" until he could help defray the ISP's expenses.

A vigorous conversation ensued, in which a calm tone of voice (combined with mention of the router blacklist) elicited the following information about this provider: 1) It was real militia material, distrusting the press (particularly its local press), and wondering why people didn't rise up and overthrow the liberal media along with most everything else that was trampling their rights; 2) it didn't seem to think a "Postmaster" address was necessary or desirable, despite what the RFCs said; 3) it thought Windows NT was a very secure

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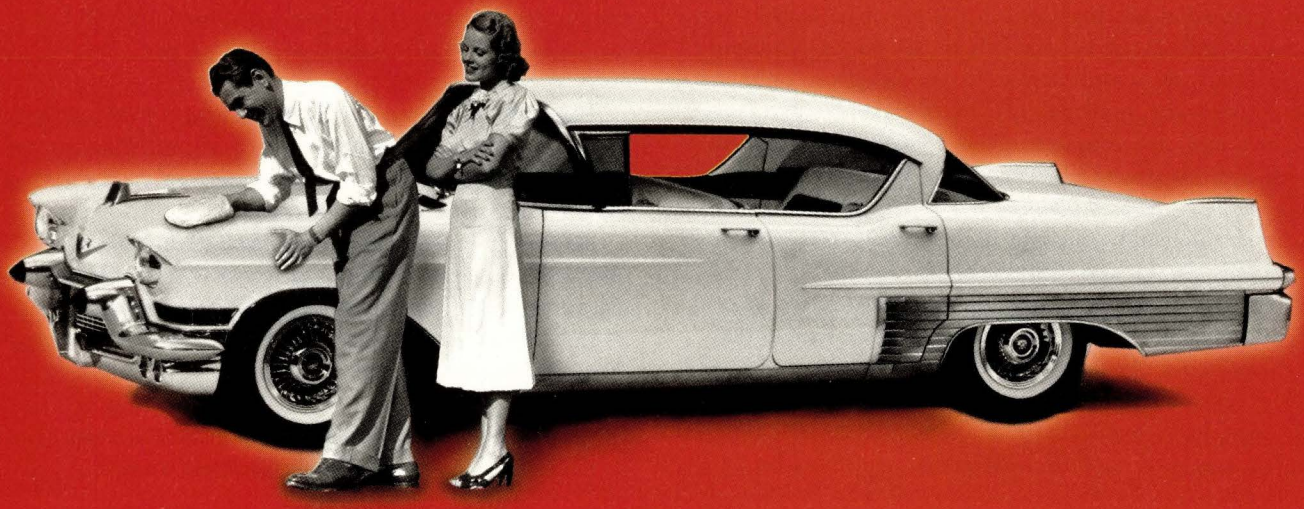

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**Circle No. 10**

system because its local expert said so; and 4) it didn't want to be directly quoted or identified.

One is tempted to label such ISPs "fantasy-based." This would be a mistake.

It is possible to run an ISP on Windows NT with many patches and without a "Postmaster" address. It is possible to run just about any sort of a business while holding extreme, and extremely loud, political opinions. It is also possible to do so while flaming any outsider who comes in with a complaint or an observation.

But, and this is the point, it is only possible to survive this experience if you are not a cutting-edge pioneer. You must have a stable matrix to absorb such odd behavior. One or two flamers could always be seen hanging around the Internet's early days, because the Internet in its earliest, precommercial days was largely populated by colorful characters. But once the marketplace became a free-for-all, nobody had time to be bizarre. They were all just trying to figure out how to make money, when everybody else was trying to do exactly the same thing and, generally, in the same geographical area, competing for the same customer base.

The only market that can support a full-throttle, take-no-prisoners bunch of political extremists is a market that has stabilized to the point that variations can be supported. In fact, this points the way to a whole new mode of business. For example, the banks have already sold about all the VISAs and Mastercards people are willing to accept. Now the big thing is to get a card which benefits your local charity. Well, why shouldn't you start buying your ISP services from the ACLU, where a portion of every bill goes to support the defense of our civil liberties? Or, more to the point for these guys, why not support your local patriot movement the same way? Or the NRA's new president, Charlton Heston: Let Moses be your ISP! Support the Second Amendment while you surf the Web!

It's coming folks, and you heard it here first.

Hmmm. What better ISP could you possibly have than Mr. Protocol? The only being on the planet who can follow your packets all the way to their destination and make sure they get there safely. Please line up to the right, folks, and my assistant will be handing out applications. ⊷

***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.

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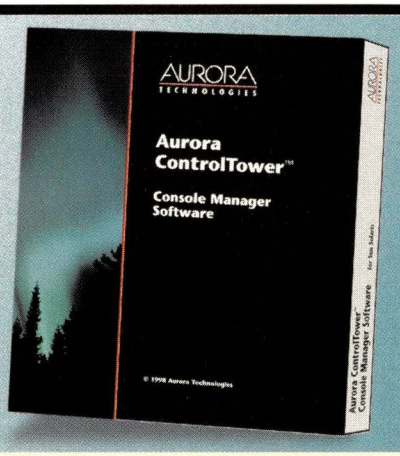


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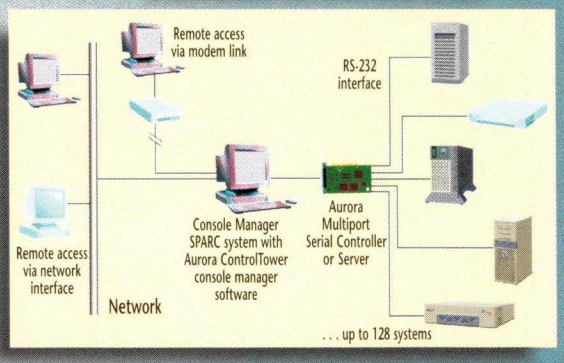


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**Circle No. 12**

*by Peter Collinson,* **Hillside Systems**

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# Resource Access

Every operating system is designed to provide protection for some of its hardware or software. The protection can be slight. MS-DOS, for example, doesn't stop a program from writing to the part of the memory that's occupied by the operating system nor does it prevent a program from writing random data to sensitive parts of its disks. This lack of protection allows people to subvert the operating system, creating the phenomenon of computer viruses.

We want to prevent people from doing things on the system that will cause it to stop functioning correctly. We also want to prevent programming errors caused by human mistakes. On MS-DOS, it's possible for a program to unintentionally write data to some memory that is occupied by code owned by another application. The randomly written data will probably cause problems later.

Incidentally, don't think that MS-DOS provides no protection at all. It does have file permission bits and will not allow the user to delete or change a file that is marked "read-only." Having read-only files can help prevent users from accidentally deleting important files.

Of course, there are occasions where users need to delete those files. If you've installed an application, then it's reasonable to set its files to be read-only and doing so will provide protection against accidental deletion or overwriting. All is well until you want to remove the application from the system or install a new version that will replace some of the files. Then you need to provide an installation program that reverts each of the files to a read/write state, allowing their replacement or removal.

This example of read-only files demonstrates the fundamental problem with protection mechanisms–we need to be able to work around them in some circumstances. A software package has the requirement of being "installed," "reinstalled," "updated" and "deleted." These actions will happen rarely and, most of the time, we just "use" the package. For any specific object on the computer system, there is a set of actions that can be applied. In general, we want to be able to control when certain actions are performed; the degree of control depends on the circumstances.

## Another Example

Let's consider another example: a line printer spooling system on a multiuser system. First, we want to ensure that normal users cannot send data directly to the printer device, bypassing the spooling system. We humans are taught to wait in line and take our turn. We also know that given half a chance someone will always leap to the front of the queue, and so we want to establish a system that will prevent this.

A good spooling system allows users to queue files and then processes the files according to a predefined policy. The policy could be first-come, first-served, but doesn't have to be. For example, I worked at a university in the late '70s and we used spoolers that were implemented to discriminate against large files, causing

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**Circle No. 13**

small files to be printed first. Small files were generally student output, and we wanted to give them priority. Other policies or combinations of policies are possible.

We want users to be able to inspect the queue so they can find out if their print job is done, discover where they are in the print queue or estimate how much longer they will need to wait if other work is in the queue ahead of them. Users will also expect to be able to remove items from the queue and we want to ensure that they can only delete their own print jobs.

So, the set of normal user actions for a spooler is: queuing a file for printing; inspecting the queue; and deleting your own job from the queue. The queue will be a set of files somewhere on the system and we need to protect these files against the normal commands that users use to do their work. We cannot have people copying data willy-nilly into the spooling area or deleting someone else's file. Our spooler control programs require special privilege to gain access to the queue. We want to give users that privilege for the time it takes them to operate the spooler: to queue the file or delete it.

Back when computers were ensconced in machine rooms, there was another set of actions that we might wish to consider for our spooling system. The folks who managed the printers were often given tools to control the queues, perhaps diverting a queued file from one printer to another, advancing the position of some work in a queue or deleting a job that was unnecessary or bad in some way.

A set of spooler control commands for computer operators produces some more requirements that need privilege, but notice that the operators require a different level of privilege from the normal user commands. We don't want all users to be able to perform these control operations because that would give them the ability to circumvent the spooler policies. Users must fit in with the extant policies that are used to run the system.

The need to supply different levels of privilege has been well understood for around 30 years. Early computers were expensive and there were never enough resources to go around, whether those resources were CPU cycles or space on the printer queue. Much work was put into sharing out the resources fairly, or at least allowing them to be shared according to some policy. Sharing resources means protecting them from unauthorized use.

When I was studying Computer Science in the late '60s, the key idea used in operating systems was that of "rings" of protection, which you can visualize by thinking of it in terms of an onion. The kernel of the operating system is the center of the onion; it has the most privilege. User programs run in the outside layer (the skin) and have the least privilege. Moving from the skin of the onion to the center takes you past several layers, each of which has increasing privilege.

When the user program running with least privilege wishes to take some action, it makes a system call that runs code in the next inner ring. Making a system call means the program is now executing some code that's running in a higher priviledged environment. Using a system call allows the operating system to intervene and apply a protection policy.

So, our user-level spooler queuing programs would run on the outermost ring, passing data and information requests through to system code running at a slightly higher privilege. The operator commands would be provided in one of the inner rings. Both the user commands and the operator commands interact with the spooler that is running on a still higher privileged inner ring. The spooler needs privilege to access the user's files and talk to the code sending information to the printer that is supported by the kernel running at the center.

This type of ring protection system was employed on MULTICS, which was the system on which Ken Thompson and Dennis Richie had been working prior to the design of UNIX. The name UNIX is itself derived from MULTICS–it was supposed to be a single-user MULTICS, a UNI-ICS or UNICS, hence UNIX.

UNIX retains some of the ideas of rings of protection but is much simplified, having only two layers. The outer layer runs programs as processes, but when the processes wish to take some action, they issue a system call and switch into the kernel. The process runs code in the kernel and that code will check on the privilege of the process before taking any action. Privilege on UNIX depends on ownership and the particular action a process wishes to take.

When a system call is made, the process is suddenly running in the kernel in a completely different environment from that of the user processes. For example, the kernel can access physical devices or the full address space of the machine.

The kernel uses the memory management hardware on the machine to control access to its own memory space and the memory spaces of all the processes it is controlling. When a user process is running, the memory management system is set up so that the process can only access its own address space. Therefore, a UNIX process cannot trample randomly on the memory space of other processes or the kernel. When the process switches into the kernel, the memory management setup is altered so that the kernel code can access its own memory. If we think about a process running along as a linear path through some code, parts of the process will be running in user space able to access the address space of the process, while other parts will be running in kernel space, where a set of tried-and-true primitive operations permit the copying of data to and from the user process.

## Ownership

On a multiuser system, we are concerned with ownership. I wish to prevent users from reading my email, but I am happy for them to look at some of my data files. However, I am uneasy about allowing others to change any files. I'd like users to be able to give me files from time to time. For my files, I want to adopt a policy depending on the nature of the file.

To permit the concept of ownership, we need some way of identifying users and the files they own. The ability of a UNIX process to access a certain file is determined by a pair of numbers that are set up when the user logs in. The first of these, the user ID, or UID, is unique to that system. The second, the group ID, or GID, identifies a collection of users to which the user belongs. Actually, these days, most UNIX systems allow a user to be "in" several groups at the same time. This was origin-

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**Circle No. 14**

ally implemented to make groups more usable. I am going to ignore this ability for the purposes of this column.

A user will log in with a name and password and the `login` program will translate that information into a (UID, GID) pair that is loaded into the process. Every process the user starts will contain these two numbers and their values are checked against the numbers stored with the files in the file system.

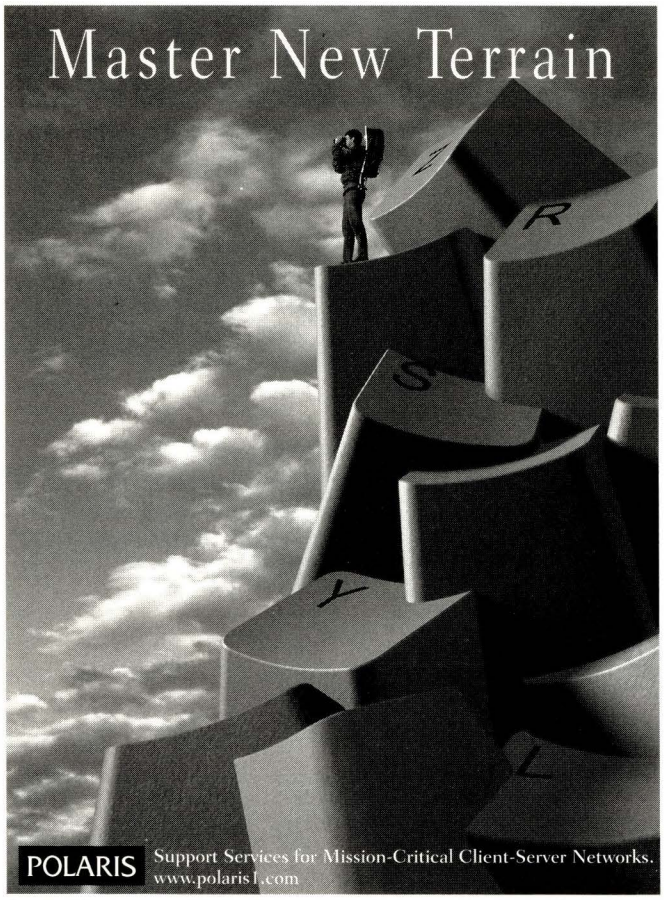
Of course, everything on a UNIX system (or nearly everything) is represented by a file in the file system, so by providing permission checking on files we are also enabling or preventing access to system resources. UNIX extended the need to support file ownership into a mechanism that supplies privilege. There is a set of operations, or system calls, that can be used with files. In general, to gain access to a file, a process must use the `open` system call. When the kernel code that implements the `open` call is executed for a file, it checks the (UID, GID) pair owned by the process against the pair stored with the file.

Each file has three attributes: read, write and execute. Three sets of these attributes are stored with the file and a specific set is checked, depending on the match that can be made between the (UID, GID) pair of the process and the duple stored with the file. If the UIDs match, the leftmost three bits are checked, if the GIDs match the middle three bits are checked, if neither ID values match, then the last three bits are checked. Note that if the user is in the same group as the file, and group permissions denies them access, then the "other" permissions are not checked.

Once the set of three bits has been selected, a test is made to see if the action the process wishes to make is supported by the permissions. Actually, the execute attribute is used by the `exec` system call to see if the user is allowed to load data from the file as a new program. It's also used to allow access to directories, because it doesn't make sense to want to execute a directory.

This mechanism is simple, both to understand and to implement. However, it doesn't provide for any special privilege. There are occasions when it's necessary to bypass the normal protection mechanisms to take some special action. Ownership is augmented by the notion of the superuser, whose UID is zero. If the code doing the testing discovers that the UID of the process is zero, then access is (nearly) always granted. Therefore, UNIX has two classes of user: the "superuser" and the "rest." In *Animal Farm* terms: one user is more equal than the others.

Incidentally, the superuser is also vested with the power to execute some system calls that mere mortals cannot. For example, we don't generally want users to have the ability to become other users by setting the (UID, GID) pair in their shell, so only the superuser can use the `setuid` and `setgid` system calls to establish the initial identity of a user when a user logs in.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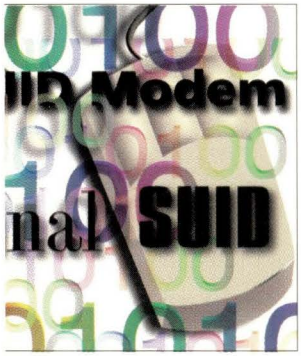
## setuid on Files

Given that many UNIX system management and interrogation programs are actually user processes, and these programs often need to have superuser rights to access certain key files, how do we provide these programs with the necessary superuser privilege? Well, the answer is the notion of the `setuid` bit in the file permissions, and this was worth a patent that was granted to Dennis Ritchie.

To start a new command, a process will first *fork*, creating a clone of itself. The new process (the child) will then generally use the `exec` system call to load a new process and, by doing so, will completely replace its memory and data with information from the file. Part of each process is a collection of *process state* that survives the `exec` system call. For example, any files that are open in the old process will remain open after the `exec` system call. The (UID, GID) pair also survives the `exec` system call and this is the way ownership is normally passed from process to process.




However, the (UID, GID) pair is not preserved if the file permission contains an enabled `setuid` or `setgid` bit. In this case, when the new program is `exec`'d, its ownership values are set from the values stored with the file being loaded. To confer special privilege on a command, I create a file whose owner is `root` (a UID of zero) and whose group is `bin` (a GID of two on my machine). Now, I turn the `setuid` bit on and the program will run with a UID of zero, owned by `root`. If I turn on `setgid`, the program will be placed in the group with a GID of five.

We now have a mechanism where we can set the (UID, GID) pair of a file containing the command and ensure that when the process runs it will have file access that matches the owner of the file. If you look around your system, you'll find several processes that take advantage of the ability to temporarily switch to another user. Many of these programs require special access to devices. For example, `df` and `ps` both require special access to physical devices to do their job. For normal use, these devices are protected against access by being owned by `root` and bearing appropriate file permissions. When the `setuid` programs are run, they are run *as* `root`, conferring the right of access to the devices.

The mechanism is slightly more complicated than I have described above, the (UID, GID) pair is not actually replaced because we'd like to provide the process with the ability to revert to the original (UID, GID) pair. The process state actually contains an effective (UID, GID) pair that is used to check file permissions, and it is this effective pair that is set by the `exec` system call when appropriate `setuid` or `setgid` bits are turned on.

## Security

The notion of having a superuser and allowing users to become "temporary" superusers creates a single target for hackers who want to subvert the system. If a hacker can become superuser, then they have the keys to the kingdom. The problem is that the integrity of the system relies on the skill of all the people who have written `setuid` programs.

For example, I want to provide a mechanism whereby a user can edit a protected file owned by superuser. So, I create a program that is `setuid` to `root`. As `root`, the program opens the file and places the user into an editor to change it. Sound OK? Well no. What I've forgotten is that most editors contain shell escapes, allowing the user to start an interactive shell. This subshell will inherit the rights of its parent and will be owned by superuser. Thus, I've managed to give all users a way to become superuser.

I need to code my program so that it creates a file that is owned by the actual user, and reverts to the (UID, GID) pair of the user before starting the editor. I load the original ownership value in the child before I use `exec` to run the editor, while preserving the superuser capabilities in the parent. When the editor exits, my privileged program can inspect the changes the user has made and apply them appropriately.

The notion of superuser and the idea of `setuid` programs are used to provide extra privilege to specific programs, enabling them to have controlled access to resources that would otherwise be unavailable. The ideas have also widened the ability of the hacker to break into the system and, in recent years, many UNIX software suppliers have gone from one panic to the next, plugging holes in various `setuid` programs as new subversion methods came to light.

One thing to note is that it is easy to become `root` on your system if you provide users with a shell script that is `setuid` to `root`. Many people do this to "make it easy on their users." The problem is that it's too easy to subvert shell scripts without changing them. For example, if you create a script that contains a command `fred`, I can create a command called `fred` and make your shell script run my command by setting the `PATH`. If I can get your shell script to run my command when your shell script is running as `root`, then I too can become `root`. There were several other holes that now appear to have been plugged on my Solaris 2.6 system. However, don't do it. Don't create `setuid` scripts that change to be the superuser.

## Further Reading

One of the sources for this article is the excellent *Advanced Programming in the UNIX Environment* by W. Richard Stevens (part of the Addison-Wesley Publishing Co. Professional Computing Series, 1992, ISBN 0-201-56317-7). This book is a classic. The other is *Operating Systems, Design and Implementation* by Andrew S. Tanenbaum, Prentice-Hall Inc., 1986, ISBN 0-13-637406-9. Well, 1986 doesn't seem all that new, but this book defined the MINIX operating system, which (I understand) is deemed to be the parent of Linux. ⊸

***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`.

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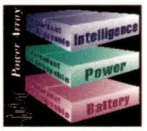


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Circle No. 17

*by Richard Morin*, **Technical Editor**

KEN CONDON

# Perl Conference Report 2.0

This time last year, Vicki Brown (coauthor of *MacPerl: Power and Ease*, Prime Time Freeware, 1998, ISBN 1-881957-32-2) joined me in reporting on the first O'Reilly Perl Conference (see "Perl Conference Report," November 1997, Page 36). This year, I have been left to report on Perl Conference 2.0 by myself; Vicki will be reporting her findings via another publication. Vicki's move is in tune with the current flavor of events in the Perl and open source worlds. As opportunities arise, folks find new ways to collaborate on projects. It's all very healthy, if somewhat chaotic.

And, taking a cue from Larry Wall's keynote speech, we should welcome a bit of chaos now and again. The universe is chaotic; our activities and languages (both human and machine) must allow for this.

## The Perl Mongers' Table

One of the more chaotic (read: unplanned by O'Reilly & Associates Inc.) events at this year's conference, held in August in San Jose, CA, was the Perl Mongers' table.

The Perl Mongers is a volunteer support organization that has no members, no dues and vanishingly little bureaucracy. Led by energetic volunteer, Brian d foy, the Perl Mongers assist local Perl chapters (typically unstructured, informal entities) in doing what they do best–listening to speakers, eating pizza and drinking beer–while taking on some of the more onerous tasks that might otherwise plague the chapters' leaders (for more information on the Perl Mongers, see `http://www.pm.org`).

On arriving at this year's conference, the Perl Mongers found an unused set of tables around the corner from the O'Reilly sales area. Seizing the moment, the Mongers proceeded to set up shop. The O'Reilly staff tolerated this transgression gracefully, allowing a fine level of cooperation to occur.

The Mongers are solely dependent on voluntary donations and fund-raising activities. The Perl Mongers' table at this conference was typical of these kinds of activities. The organization sold T-shirts and various products provided by sponsoring vendors. The revenue helped the Mongers, and the visibility served as free advertising for the vendors.

Initially, the Mongers set up shop on a single table, laying out sign-up sheets for current and prospective chapters in assorted geographic locations. The table also contained small amounts of literature about the Mongers, as well as the aforementioned T-shirts.

Prime Time Freeware then added its own literature to the Mongers' table, some books and yet more T-shirts. The table became a little too crowded, but creative means were found to make everything fit.

Then, Jon Orwant, editor of *The Perl Journal* (`http://www.tpj.com`), arrived with some magnetic Perl poetry kits and back issues of *The Perl Journal*. These items sold quickly; Perl users have come to realize that *The Perl Journal* is an excellent (nay, essential) publication.

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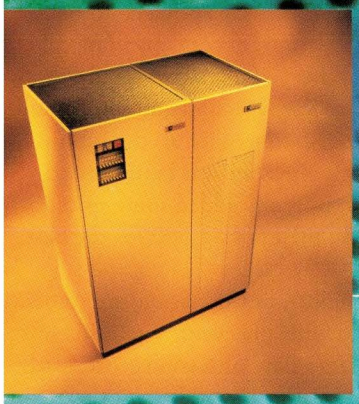

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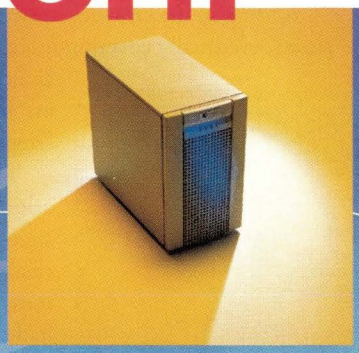

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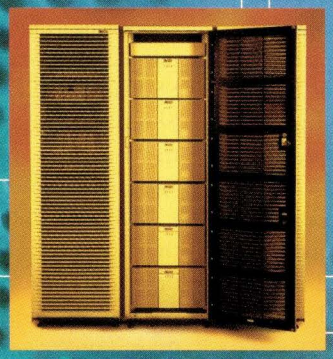

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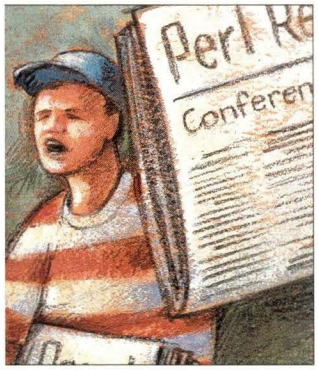
The folks from FreeBSD Inc. (http://www.freebsd.org) also arrived with some free (in both senses: *libre* and *gratis*) CD-ROMs. Red Hat Software Inc. (http://www.redhat.com) added some Linux CD-ROMs, augmenting the ones included in the conference handout. GeekWare (http://www.geekware.net) contributed some Linux baseball hats (sporting a penguin, the Linux mascot). Other vendors may also have taken part, but you get the idea.

Adding to the crowded table, the pile of completed sign-up sheets, eventually covering more than 60 geographic areas, continued to grow. In short, the Mongers' bazaar got a bit too bizarre and "steps had to be taken."




The first step was the colonization of a second table for the sign-up sheets. This worked reasonably well, but looked a little messy. In addition, the Mongers had now occupied two of the circular tables that were nominally reserved for breaks and lunches. So, in the next (and final) step, the hotel provided a pair of tables just for the literature, leaving the Mongers with its original table. This held all the materials quite capably through the end of the conference.

Far from objecting to this activity, O'Reilly & Associates got into the spirit of it all. O'Reilly staff members stopped by to chat and offer useful suggestions, and at the end of the conference, O'Reilly donated a substantial set of books to the Perl Mongers, which were then raffled off.

In short, by being open to a bit of chaos, everyone came out ahead. Larry Wall (anointed Chief Monger by Brian d foy) should be pleased.

## The Perl Cookbook

O'Reilly also gave away numerous copies of Tom Christiansen and Nathan Torkington's *Perl Cookbook*, 1998, ISBN 1-56592-243-3. I'm not sure how Vicki plans to protect her copy; mine is going to have to be chained to my desk!

In all seriousness, if you want to be conversant in Perl, this is *the* book to have. It contains thousands of useful code snippets accompanied by hundreds of pages of clear explanatory text. But don't take my word for it:

*"Precious few books can meet the needs of novices and experts simultaneously. The* Perl Cookbook *does, and on nearly every page. It has the perfect mix of instruction, revelation and attitude–exactly what I expected from Tom and Nat, pillars of the Perl community."* – Jon Orwant

*"I have to confess that I learned quite a few things I didn't know before I read this book."* – Larry Wall (Foreword, *Perl Cookbook*)

My personal suggestion is that you get multiple copies. Keep one by your desk for reference and another in a place where you can browse it in a casual manner. The recipes aren't things you can memorize by and large, but repeated exposure (or a single exposure at a critical moment) should allow you to accumulate a great deal of useful lore.

## The Conference

Oh yeah, there was a conference. As expected, the papers were authoritative and interesting, the hallway conversations were fascinating and occasionally useful, the BOFs were boffo and the machine room was very handy.

The frenetic schedule with which last year's conference was assembled meant that the papers were largely drawn from folks that O'Reilly already had on hand: Malcolm Beattie, Tom Christiansen, Nick Ing-Simmons, Doug MacEachern, Jon Orwant, Randal Schwartz, Lincoln Stein, Larry Wall and so on. They are all strong speakers, to be sure, but little or no formal selection process was in place.

In contrast, there was time this year for a real "Call For Papers" process: submission, review, selection and so on. And, to hear program cochair Chip Salzenberg tell it, the submissions were so good the review committee was hard-pressed to make some of its decisions. O'Reilly added some spice to the process by awarding several prizes of $1,000 for the best papers received.

Lest I give too glowing a report, however, here are some nitpickings I (and others) had with the event. First, this was not a cheap event to attend: Two days of sessions cost nearly $800 and a full (two-day) set of tutorials added another $800, totaling $1,600 for the four-day event. In addition, the conference hotel was pricy ($170+ per night) and Summer airfares are not economical.

USENIX and other organizations hold excellent events that are far cheaper to attend. If O'Reilly persists in charging these kinds of prices, it won't be long before some competition develops. An East Coast event, for instance, might draw a pretty good crowd. On the other hand, I am concerned about the prospect of dividing the Perl community's resources–speakers, attendees and so on–at a critical juncture in its development.

Exhibit space was both expensive and unimpressive. It cost $1,500 for the use of a draped table for two days and $1,800 if one required electrical power. No provisions were made for security or storage of merchandise. Meanwhile, O'Reilly allocated several hundred square feet of display space for its own sales area.

Again, I would like to see O'Reilly examine the practices of USENIX and similar organizations. I would, for instance, like to see O'Reilly offer a secure room with semi-enclosed booths. Provisions for some free exhibits, for example, the Perl Mongers, would also be a nice touch.

However, I would like to emphasize that I enjoyed (and learned a great deal from) the conference. I would not hesitate to recommend Perl Conference 3.0 (August 21-24, 1999, Monterey, CA, http://conference.perl.com) to anyone who is seriously interested in keeping up with the language. ⊸

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

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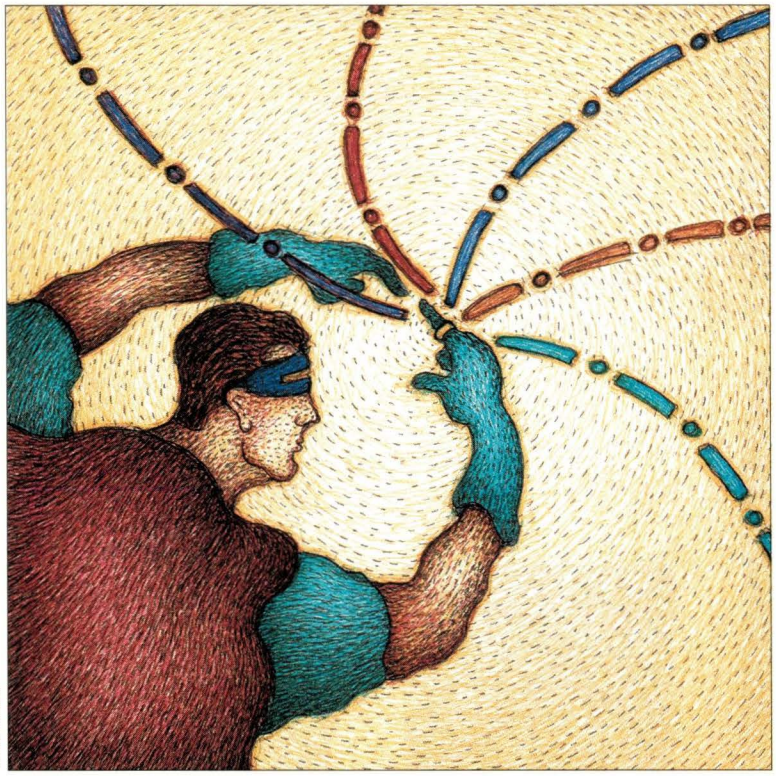
by S. Lee Henry



DAVE RIDLEY

# Variable-Length Subnet Masking

Several months ago, I described subnet masking (see "Demystifying Netmasks," May 1998, Page 43). I looked at the way a mask defines which bits in an IP address are used to specify a single host on a particular subnet and how it determines the total number of hosts in a subnet. To review by example, the subnet mask `255.255.255.240` (in which the rightmost 4 bits are set to zero) defines a subnet with up to 16 ($2^4$) available addresses, two of which are reserved for the subnet address and the subnet broadcast address.

Dividing a network into a number of same-size subnets is relatively easy, but the concept of a mask is often misunderstood. The exercise of selecting the correct number of bits to use is as easy as running up a list of powers of two to determine the size of subnet required. Subnets for a class C network, for example, will each have from 2 ($2^2$ - 2) to 126 ($2^7$ - 2) available hosts addresses.

The appropriate subnet size depends entirely on your organization. Because subnet masks are used to effect proper routing with respect to the individual subnets, the size of each subnet (with standard subnet masking) is determined by the size of the largest group to which you want to route. Not that all the subnets will reserve the same number of possible addresses. For instance, if you were an Internet service provider (ISP) using standard subnet masking, you might offer customers subnets capable of supporting up to 16 addresses each. However, consider the address space that is wasted if most of them have fewer than six systems.

## Introducing VLSM

To conserve address space, making it possible to define subnets of varying sizes, Variable-Length Subnet Masking, or VLSM, was introduced. VLSM is, in concept, a simple extension of standard subnet masking. With VLSM, a number of subnet masks are defined for a single network and used as needed to create different-size subnets. A class C network might, for example, be broken into subnets containing 16, 32 and 64 host addresses. What are the steps?

The first step is to define the individual subnet masks. The subnet mask `255.255.255.240`, as we've mentioned, reserves the rightmost 4 bits for host addresses and defines subnets with up to 16 available addresses, 14 of which can be used for the host. The subnet mask `255.255.255.224` reserves 5 bits for host addresses and, thereby, defines subnets with 32 addresses and up to 30 hosts each. The third subnet mask we need requires one more bit of address space to accommodate up to 64 addresses and 62 hosts; that subnet mask is `255.255.255.192`.

With these three subnet masks (`255.255.255.240`, `255.255.255.224` and `255.255.255.192`), we can now define subnets of all three sizes. The only "trick" left is to determine how to break off each subnet and associate it with the correct subnet mask for its size.

# MULTIPLE CHOICE

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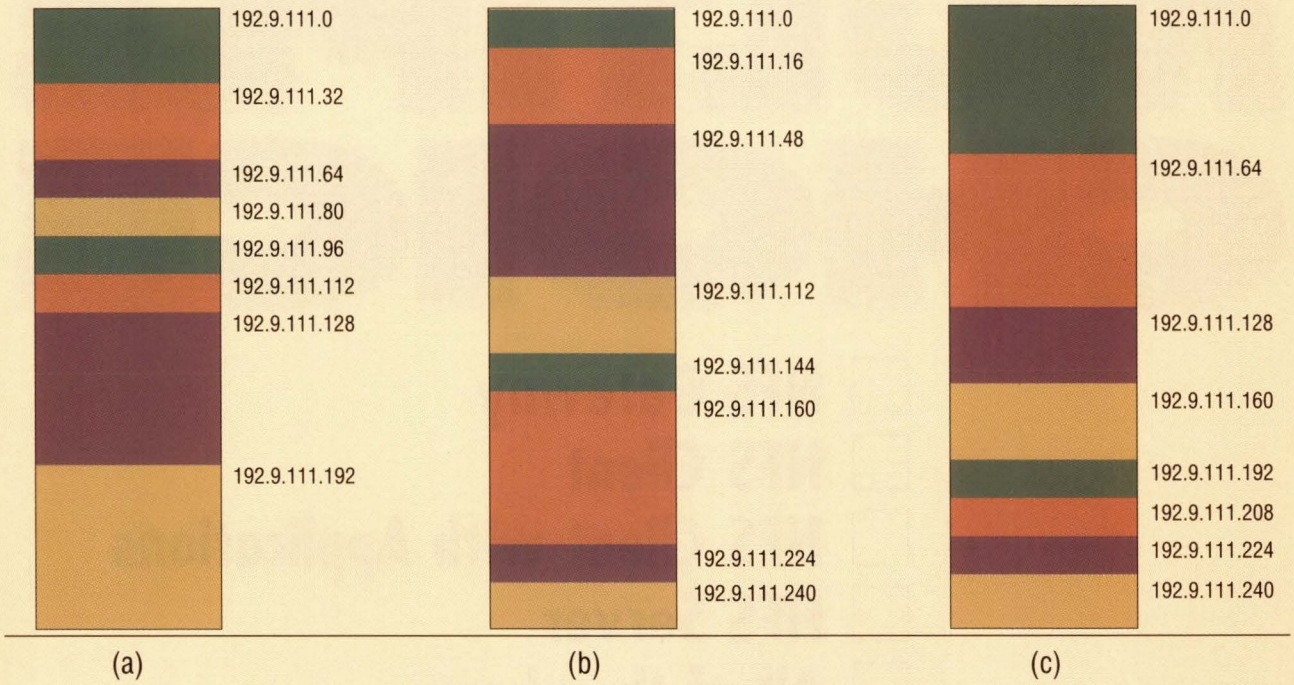
## Figure 1. Possible Arrangements of Subnet Addresses




Breaking the network address space into variable-size chunks means that we must define nonoverlapping address spaces. The address space of a class C network allows for up to 254 (256 - 2) hosts. If we break this into subnets, we lose a small portion of the address space in order to accomodate the additional subnet and broadcast addresses. If we break this space into two subnets of 64 addresses each, two of 32 each and four of 16 each, then 16 addresses are reserved for the subnet and subnet broadcast addresses, 14 more than normal.

The subnets can be arranged in any way that is convenient to you. Any of the arrangements shown in Figure 1, or many others for that matter, are correct. The most important factor is what is easiest to manage.

Listing 1 shows us what the first subnet for each arrangement in Figure 1 would be if our class C network address was `192.9.111.0`.

The addresses `192.9.111.31`, `192.9.111.15` and `192.9.111.63` might not *look* like broadcast addresses, because we are used to seeing addresses like `192.9.111.255` used for this purpose, but they are. Keep in mind that the rightmost bits of each address are an appropriately-sized (for the subnet) string of `1`'s.

Listing 2 shows the subnets in Figure 1 (b) alone.

I think I got that right! If not, keep in mind that the process of calculating subnet addresses is tedious even if it isn't terribly difficult, and tedium is the mother of mistake. Be sure to double-check your addresses or build a script to calculate them for you. If you're dividing a class B network into subnets, instead of a class C as we've shown here, then there will be many more opportunities for error. ⊸

## Listing 1. First Subnet for Each Arrangement in Figure 1

| | First Subnet | Subnet Mask | Hosts (from-to) |
|---|---|---|---|
| (a) | 192.9.111.0 | 255.255.255.224 | 192.9.111.1-192.9.111.30 |
| (b) | 192.9.111.0 | 255.255.255.240 | 192.9.111.1-192.9.111.14 |
| (c) | 192.9.111.0 | 255.255.255.192 | 192.9.111.1-192.9.111.62 |

## Listing 2. Subnets for Arrangement (b)

| | Subnet | Subnet Mask | Hosts (from-to) | Broadcast |
|---|---|---|---|---|
| (1) | 192.9.111.0 | 255.255.255.240 | 192.9.111.1-14 | 192.9.111.15 |
| (2) | 192.9.111.16 | 255.255.255.224 | 192.9.111.17-46 | 192.9.111.47 |
| (3) | 192.9.111.48 | 255.255.255.192 | 192.9.111.49-110 | 192.9.111.111 |
| (4) | 192.9.111.112 | 255.255.255.224 | 192.9.111.113-142 | 192.9.111.143 |
| (5) | 192.9.111.144 | 255.255.255.240 | 192.9.111.145-158 | 192.9.111.159 |
| (6) | 192.9.111.160 | 255.255.255.192 | 192.9.111.161-222 | 192.9.111.223 |
| (7) | 192.9.111.224 | 255.255.255.240 | 192.9.111.225-238 | 192.9.111.239 |
| (8) | 192.9.111.240 | 255.255.255.240 | 192.9.111.241-254 | 192.9.111.255 |

***S. Lee Henry*** *has been performing UNIX parlor tricks for approximately 15 years. She currently lives with her stepfamily on a sailboat in Marin County, CA. You can reach her at* `slee@cpg.com`.

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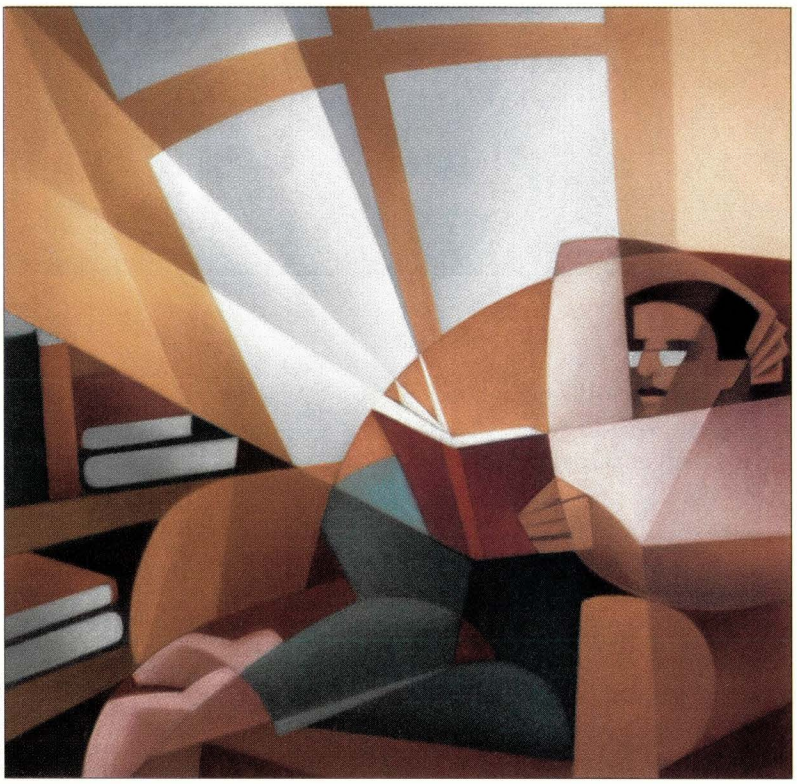
*by Æleen Frisch*



LYNNE CANNOY

# An NT Bookshelf

This month, we'll take a break from hardware and software to consider some useful reference works on Windows NT. Longtime readers might consider this an NT version of the "Wrangler's Bookshelf" that appeared from time to time in my Systems Wrangler column. As I did then, I'll be focusing on what I feel is the best book available from each category, rather than trying to provide a comprehensive guide to everything that's out there. (If you've looked at the size of the NT section in your local bookstore lately, you'll know why the latter is not practical.)

## General Works

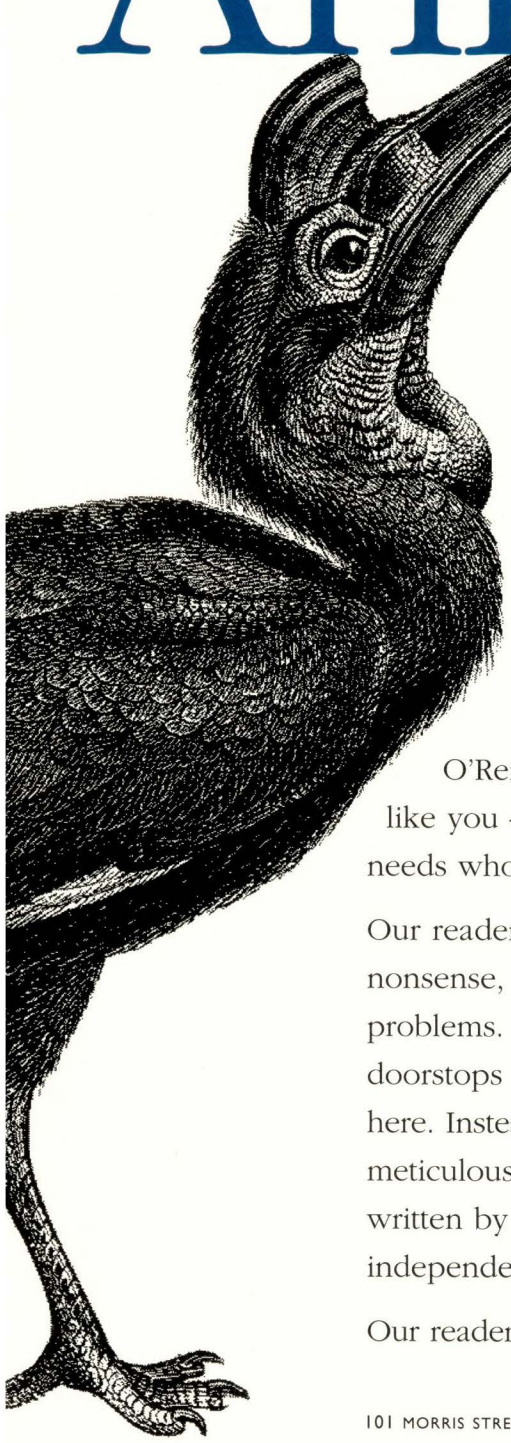
My own work, *Essential Windows NT System Administration* (O'Reilly & Associates Inc., 1998, ISBN 1-56592-274-3), is a good source of important Windows NT information for both systems administrators and advanced NT users. My goal was to treat topics in greater depth than most general NT books and to point out both the high and low points of the various operating system features. I'm satisfied that I've succeeded, but modesty prevents me from extolling its virtues at any greater length.

If you want a general, all-inclusive reference on Windows NT, there are a plethora of titles to choose from. While they do, in general, discuss every feature of the operating system, most tend to suffer from two faults:

- Forest/trees syndrome: The big picture is often lost because no detail is too obvious or too trivial to mention. For example, readers can figure out what is going on the first time they select the `Find` option within a help file, without needing a detailed explanation of the dialog box.
- Excessive reverence for NT and/or Microsoft Corp.: At times, the authors twist their logic like pretzels in order to rationalize some less-than-optimal aspect of the way something works (which can be quite entertaining to observe). However, the more serious manifestation of this trait is an exclusive focus on the "normal" conditions the NT developers had in mind, to the extent that only these scenarios are covered and any gotchas that may arise in other contexts are ignored.

If an all-inclusive reference is what you're looking for, the best of these by far is *Windows NT Server 4 Unleashed* by Jason Garms et al. (SAMS, a division of Macmillan Computer Publishing, 1997, ISBN 0-67231-002-3). A second edition of this book is also available, which I have not yet seen (SAMS, 1998, ISBN 0-67231-249-2), as well as a combined server and workstation edition. Although, to some extent, it suffers from the flaws noted above, it does so to a lesser extent than most of its competitors. The book's strength is its comprehensiveness–every Windows NT facility is in there somewhere. The book is also generally well-written, though its multitude of authors make the quality of individual chapters inevitably uneven. The sections on networking facilities and services for Macintosh are especially good. The book also includes a CD-ROM of free and demo

# A Different Kind of Animal



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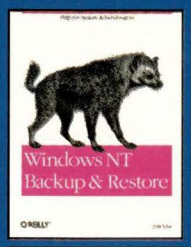


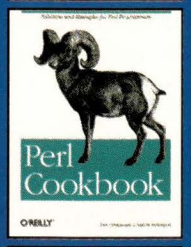


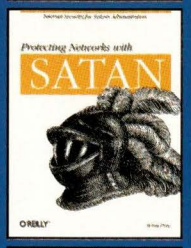


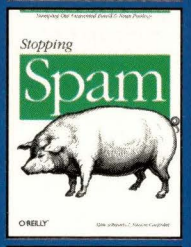


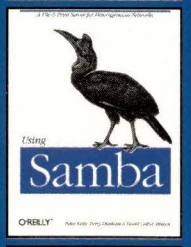


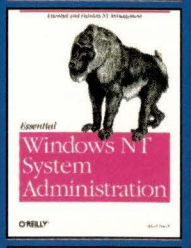


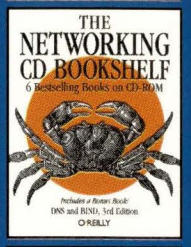


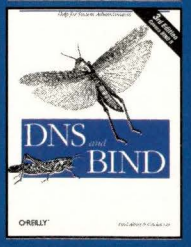


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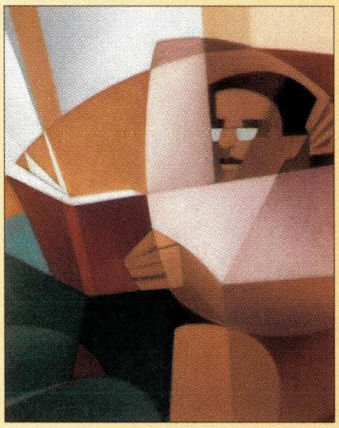
software, but I found this to be of limited value.

I've mentioned the *Microsoft Windows NT Server 4.0 Resource Kit* (Microsoft Press, 1996, ISBN 1-57231-344-7) in previous columns. It comprises three books and a CD-ROM of add-on software for Windows NT Server 4.0 in a variety of categories; most of them are of significant use to systems administrators and program developers. The original version of the *Resource Kit* costs around $150 (although you

**Operating system internals are of natural interest to systems programmers, but they are relevant to other classes of users as well.**



can get it for closer to $120 from many sources). However, this is not what you should buy. Instead, purchase *Microsoft Windows NT Server Resource Kit Version 4.0, Supplement 2* (Microsoft Press, 1997, ISBN 1-57231-626-8), which sells for $30 to $40. Although it sounds like an upgrade, this supplement is in fact the entire *Resource Kit*, and you don't need an earlier version to install it. It comprises two CDs, one containing an up-to-date set of software tools, as well as online versions of the printed manuals included in the original set (of the latter, the guide to NT networking is the most useful), and the other contains NT-related technical information (it is, in fact, a sample from Microsoft's TechNet program). All in all, it's a bargain for people who haven't gotten around to buying the *Resource Kit* yet. On the other hand, if you do have the *Resource Kit*, I doubt you'll find the few updated utilities worth the money; grab the free updated versions from the Microsoft Web site (`http://www.microsoft.com`) instead.

## Specialized Windows NT Topics

The books in this section are devoted to a single NT topic. The four books I mention here were chosen for their wide applicability to different kinds of Windows NT users as well as their quality.

We'll begin with Stephen Sutton's *Windows NT Security Guide* (Addison-Wesley Publishing Co., 1996, ISBN 0-20141-969-6), the best book devoted to this topic that is currently available. Experienced Windows NT users may find some of the material a bit elementary, but the book provides an excellent introduction to the operating system's security facilities. The section on access control lists (ACLs) is especially good. There have been rumors of a second edition of this book for more than a year, but apparently it's still in preparation.

Performance monitoring and tuning are important concerns for all systems administrators and several books on tuning Windows NT systems have appeared recently. I recommend *Optimizing Windows NT* by Sean K. Daily (IDG Books Worldwide, 1998, ISBN 0-7645-3110-7). This book covers both single system performance (CPU, memory, disk I/O and so on) and networkwide performance, and its discussion of the latter is especially strong. In both cases, the book contains information about operating system features and registry settings that is hard to find on your own. Its opening discussion of the ramifications of various hardware selection choices is the best treatment of this topic I've seen. It also looks at system crashes under Windows NT and how to interpret the blue screen that results.

Anyone who takes care of NT systems will also want a book that focuses on networking in this environment. For this topic, *Windows NT TCP/IP Network Administration* by Craig Hunt and Robert Bruce Thompson (O'Reilly & Associates Inc., 1998, ISBN 1-56592-377-4) is a comprehensive, detailed reference full of real-world experience and practical advice. It covers the entire range of Windows NT networking topics, beginning with the basics of TCP/IP under NT and moving through the various networking facilities: Domain Name System (DNS), Windows Internet Naming Service (WINS), Dynamic Host Configuration Protocol (DHCP), Internet Information Server (in its most recent incarnation) and the new Remote Access Services (RAS). In the latter two cases, the book provides installation information in addition to its discussion of configuration and management of the subsystem, which is particularly helpful because they are add-ons to the default, out-of-the-box Windows NT configuration.

The Windows NT backup system is one of the operating system's least effective facilities. Jody Leber's *Windows NT Backup and Restore* (O'Reilly & Associates Inc., 1998, ISBN 1-56592-272-7) provides a wealth of information to enable you to fill this gap. It covers the native NT facility as well as various third-party alternatives. The book also provides an excellent discussion of high-end, enterprise-level backup scenarios and solutions–information that is not readily available elsewhere–including backup-related capacity planning in such contexts.

## NT Internals and System Programming

Operating system internals are of natural interest to systems programmers, but they are relevant to other classes of users as well. Systems administrators, for example, generally find a basic understanding of virtual memory management and process scheduling helpful when they are trying to diagnose and solve system performance problems.

If you are interested in operating system internals for a proprietary operating system, unfortunately you must depend on the vendor to provide the necessary information. Some companies have been very forthcoming with such information–for example, Digital Equipment Corp. (DEC) provided excellent, detailed information on VAX/VMS internals–while others have been less so. The first edition of the official Windows NT in-

ternals book, *Inside Windows NT* by Helen Custer (Microsoft Press, 1995, ISBN 1-55615-481-X), was quite poor because it was short on information and long on hype; it was far more of a marketing document than a true internals book.

The book's second edition, written by David A. Solomon (Microsoft Press, 1998, ISBN 1-57231-677-2), is a vast improvement on the first. Its 600 pages cover the various NT subsystems in detail. It is a very useful reference for anyone looking to gain an understanding of how NT works at its core level. My only quibbles with the book are that the security chapter is a bit weak and it still contains too much marketing hype. (For example, Windows NT is lauded as a "robust, reliable operating system that is impervious and resilient to application errors.")

If you want a similar sort of conceptual understanding of the Windows NT file system (that is, NTFS), then the opening chapters of *Windows NT File System Internals* by Rajeev Nagar (O'Reilly & Associates Inc., 1997, ISBN 1-56592-249-2) are an excellent source of information. This book is incredibly detailed and contains coherent explanations of not only the file system itself, but all the operating system subsystems that interact with it. In this sense, the title suggests a more limited range than the book actually covers. Although its principal audience is system programmers wanting to write device drivers and other kernel-mode programs, it is nevertheless useful to any Windows NT user who wants a deep understanding of this part of the operating system.

To round out your Windows NT internals library, you'll probably want a book on Win32 system services. The best offering in this category is Marshall Brain's *Win32 System Services: The Heart of Windows 95 and Windows NT* (Prentice-Hall Inc., 1996, ISBN 0-13-324732-5). It discusses the various Win32 system calls and provides numerous examples of how to use them in system programming and applications development contexts.

By far, the single best source of Windows NT internals information for systems programmers is *NT Insider*, a free newsletter published by Open Systems Resources (for more information, see `http://www.ntinsider.com/insider/insdr.htm`).

## Preparing for the MCSE Exams

The final category we'll consider includes books aimed at helping the reader pass the Microsoft Certified System Engineer (MCSE) examinations. Once again, there are many books from which to choose.

Michael Moncur's *MCSE: The Core Exams in a Nutshell* (O'Reilly & Associates Inc., 1998, ISBN 1-56592-376-6) is an excellent source for experienced Windows NT users and systems administrators who need to prepare for these exams. It differs from other books in this category in three main ways: It excludes most introductory-level material; it covers the core tests as a unit, pointing out the large amount of overlap between them; and it focuses on the material that is actually covered on the exam instead of throwing in lots of extraneous and irrelevant topics. Note that this book is designed for people already very familiar with Windows NT, networking and the other items upon which the tests focus. It is not suited for people who need to learn the material for the first time because it doesn't begin at a sufficiently elementary level.

If you need an introductory course for any of the topics on the MCSE exams, I've found *MCSE Training Guides* from New Riders Publishing, a division of Macmillan Publishing, to be the best available (don't confuse them with the other series from the same publisher). These books include test preparation software as well, but they have limited value because they don't very accurately capture what the test is like. Better practice tests are available for free from Microsoft at `http://www.microsoft.com/Train_Cert/mcp/examinfo/practice.htm`. Additional questions are also available for a fee from Self Test Software Inc., see `http://www.stsware.com`, and from Transcender Corp. for about $150 to $180 per test (quantity discounts are available), see `http://www.transcender.com`. I found the latter to most accurately reflect the questions on the actual tests. ⊸

***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`.

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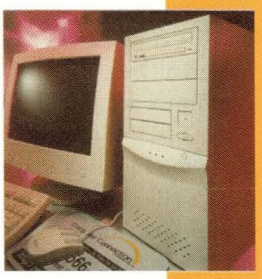

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# Trace'ing Signals

**Q:** Is there any way to tell which process is sending my process a signal on AIX? On Solaris, I can use `truss`-trace system calls and signals. Is there a similar tool on AIX?

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**A:** You can use the system event trace to do this job. The AIX trace facility records and displays system events. It's kind of like a very fast `syslog` tool, usually used by kernel programs and device drivers that cannot use `syslog`. All kinds of events are sent to the event log, including system calls, `exec`s of programs and signals. In addition, your program can define and write trace events of its own.

A trace daemon receives event information from various routines and records these first in memory buffers and then into a trace file. Events are recorded only when this daemon is active. A report program, `trcrpt`, interprets and displays the raw data that trace outputs.

Trace identifies events using a "trace hook identifier," a three-digit hexidecimal number. The hook for catching signals, for example, is `0x119`. A complete list of hooks can be found in the `/usr/include/sys/trchkid.h` file. You can also list them with the `trcrpt -j` command.

There are actually eight channels through which processes can record trace events. Channel zero is used for all system events. The other seven are available for users, although a user process can send events to the system channel as well. Each channel can only have one active daemon at a time, so you may need to coordinate tracing with other users. Channels one through seven are also known as generic channels.

## Trace from Command Line

Most of the commands that start and stop tracing can, by default, be run by nonprivileged users, but I suspect most sites remove these routines from the domain of ordinary users. You'll probably need root access to perform event tracing.

The following command-line tools control and report the event trace:

- `trace` Starts the trace daemon.

The most useful parameters include:

| | |
|---|---|
| `-a` | Runs trace as a detached background process. This is usually how the daemon is run. |
| `-d` | By default, the trace daemon starts recording events immediately, this option overrides that. Event recording will not start until trcon. |
| `-l` | Records events in a circular memory buffer. When the daemon is stopped it writes this buffer to disk. This is most useful when you have to run trace for a long time, waiting for a particular event. (You'll use less disk space this way, but you may lose some process history information.) |
| `-g` | Starts a generic (user) trace. The return code indicates which channel has been started. |

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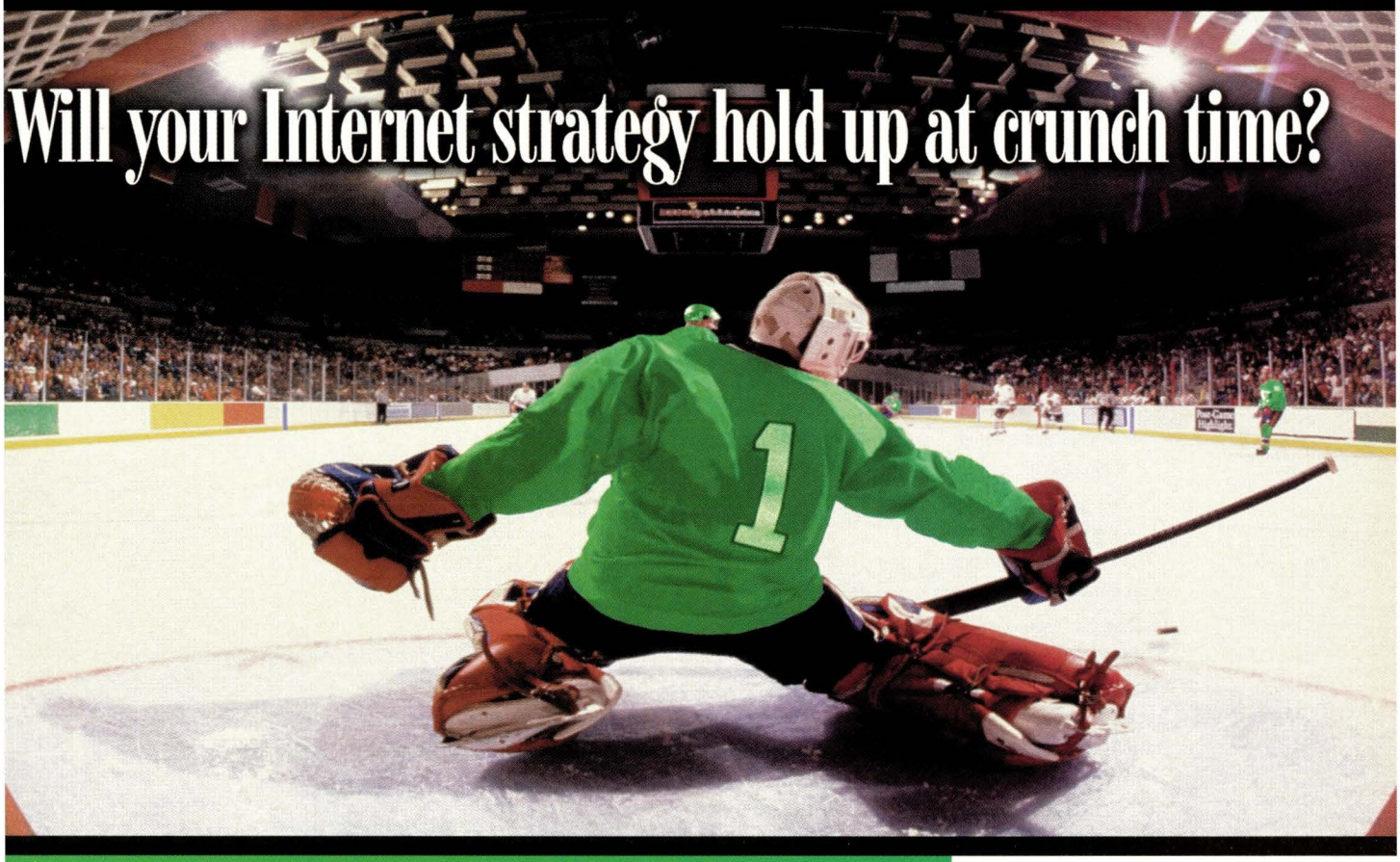

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| | |
|---|---|
| `-j` *hooks* | Only records events whose hooks are specified in the comma-separated list of event hooks. |
| `-k` *hooks* | Excludes events whose hooks are specified in the comma-separated list of event hooks. |
| `-L` *size* | Specifies the maximum log file size in bytes (default is 1 MB). |
| `-o` *file name* | Specifies the output file for trace information (default is `/var/adm/ras/trcfile`). This can be a dash (`-`) to send trace output to standard output. Performance monitoring tools often run trace this way. |
| `-s` | Stops tracing when the output file is full. Default is to wrap. Wrapping the trace file can cause the report program to be unable to identify processes. |

- `trcon` If the trace daemon is running and not recording events, this will start event recording. Specify *-n* to start channel *n*.
- `trcoff` If the trace daemon is running and recording events, this will stop event recording. Specify *-n* to stop channel *n*.
- `trcstop` If the trace daemon is running, this stops collection and kills the trace daemon. If trace was started with `-l`, this command also causes the trace file to be written. Specify *-n* to kill the daemon for channel *n*.
- `trcrpt` This is the trace log report program. It reads and interprets the file written by trace.

The most useful parameters include:

| | |
|---|---|
| `-d` *hooks* | Displays only events whose hooks are specified in the comma-separated list of event hooks. |
| `-o` *file name* | Writes the report on the named file instead of standard output. |
| `-O` *options* | This specifies a comma-separated list of formatting options. |

- `2line=on` Displays trace entries in two-line format, making it easier on the eyes, but harder for a program to parse.
- `exec=on` Includes `exec` path names in the report.
- `pid=on` Includes process IDs in the report.
- `tid=on` Includes thread IDs in the report.

## Controlling Trace from a Program

It is often convenient to start and stop tracing from within a program. The procedures listed below allow you to do this. Some of them take a channel argument. Channel zero is the normal system trace channel. These procedures are functionally identical to the corresponding command-line tools.

- `trcstart` (*opts*) Starts the trace daemon. The single argument is a character string of options to the trace command. The return value is the channel number that is started.
- `trcstop` (*channel*) Kills the trace daemon.
- `trcon` (*channel*) Turns trace recording on.
- `trcoff` (*channel*) Turns trace recording off.
- `trcgen`(*args*) Records a trace entry (refer to the man page if you need to do this).

There are other entries used by kernel processes, but you won't need them unless you're writing a device driver.

## Looking for that Signal

To find the process that's sending you a signal, you could record and report all events. However, the trace log will be smaller if you are more selective. You will at least want to record the following trace hooks:

| | |
|---|---|
| `106` | Process thread dispatch |
| `10c` | Idle process thread dispatch |
| `134` | `exec` routine |
| `139` | `fork` routine |
| `119` | Send signal routine |

Here's a trace report of one process sending another a `SIGUSR1`:

```
$ trace -a -j '106,10c,134,139,119'
...
$ trcrpt -O svc=on,exec=on,pid=on

...
119 ksh  14592  29.419325070 1.182723
    pidsig:   pid=18090 signal=SIGUSR1
...
```

where process `14592` is the sender and process `18090` is the target.

If you include the hook `14e` (kill routine), you'll see the initial `kill` command from the initiating process:

```
$ trace -a -j '106,10c,134,139,119,14e'
...
$ trcrpt -O svc=on,exec=on,pid=on
...
14E ksh 14592 kill 2.312057308 0.004260
    kill: signal SIGUSR1 to process 18380 ksh
119 ksh 14592 kill 2.312076808 0.019500
    pidsig:   pid=18380 signal=SIGUSR1 lr=29900
```

For more information on the trace facility, consult the AIX documentation, *General Programming Concepts: Writing and Debugging Programs* (for AIX 4.3, IBM redbook number SC23-4128). There is also an excellent treatment in *AIX Performance Tuning*, by Frank Waters, published by Prentice-Hall Inc., 1995, ISBN 0-13-386707-2.

***Jim Fox*** *works as a systems programmer for the University of Washington. He writes and maintains distributed applications that run on a variety of UNIX systems–and some non-UNIX ones. He is also the deputy manager for the Interoperability Project for SHARE's Open Systems Group. Email:* `fox@cac.washington.edu`.

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by John S. Quarterman

# Starr Day

As most of you (unless you live in a cave) are aware, on Friday, September 11, (aka Starr Day), the U.S. House of Representatives released Independent Counsel Kenneth Starr's report about President Clinton. The report was released via the Internet before it was released through traditional news media. News agencies like Agence France-Presse and CNN speculated that this would cause the collapse of the Net. The Internet did not collapse. I, and probably you as well, am not surprised by this prediction or result; see "Imminent Death of the Internet?" a column I wrote in 1996 (`http://www.mids.org/mn/606/death.html`). Some parts of the Internet were affected by this incident, but its nature is such that even if a segment goes down–as was the case following the Loma Prieta and Northridge earthquakes, or when someone with a backhoe cuts a line or a falling tree severs a cable–other connections come into play and traffic is routed around the damaged area.

Nonetheless, this case raises some interesting issues. First, let's examine what effect Starr Day actually had on the Internet.

## The Data

My company, Matrix Information & Directory Services Inc. (MIDS), collects data concerning the overall performance of the Internet, as those of you who are familiar with *MIDS Internet Weather Report* (`http://www.mids.org/weather/`), or the new *Matrix Internet Quality, IQ* (`http://www.miq.net/`), are aware. To examine Starr Day, we will use data collected at our longstanding San Francisco-based beacon (courtesy of Alexa Internet, `http://www.alexa.com/`) on Friday, September 11, the day the report was released, and on the preceding Friday, September 4 (see Figure 1).

The data shown here represents the median–the average favored by Internet performance researchers for this type of data–across all scans collected that day from a set of approximately 650 Web servers scattered around the Internet. The averages are of latency, or round-trip time from our beacon to the destination nodes, for ping (ICMP ECHO), as indicated by the left index (in milliseconds).

We also compute various other "measures of central tendency," such as the arithmetic average, and descriptive statistics, such as the first quartile (Q1), third quartile (Q3) and standard deviation. These metrics, especially Q1, indicate that the data for these days are not perturbed by local effects in the vicinity of the beacon or its network connection.

## The Spike

While Friday, September 4, shows a peak in the morning, tapering off in the afternoon and evening, Starr Day shows a tremendous peak at 3 p.m. EDT (12 p.m. PDT). The report was "officially" released at 2:30 p.m. EDT (11:30 a.m. PDT). Of course, we cannot say for sure that this spike in Internet Web server latencies was caused by the release of the report because, for example, there could have been some other popular information

released at about the same time. However, we can say that such a spike does not normally occur and the coincidence of timing is unusual enough to be interpreted as correlation. We observed the same spike from other beacons, so it is not an artifact of that particular beacon. The spike indicates a real Internet event.

It was an unusual event. Nothing in recent times has caused a spike quite like this: not the Olympics (Nagano or Atlanta) nor the 1998 World Cup.

There is a secondary peak at 5 p.m. PDT and the arithmetic mean of the latencies (not depicted) shows another at 7 p.m PDT. These may indicate people retrieving the report after business hours or on arriving home from work. The data for the previous Friday shows no similar increase at 5 p.m. and traffic, in general, appears to wane through the afternoon and evening.

## Perspective

Let's put these load spikes into perspective. One could say the Starr Day spike is 35% higher than normal for that time of day and day of week. But it stands out because load was otherwise low on that day. In addition, the first and later peaks did not last. Load returned to normal levels within an hour or two after each peak.

Some of the media predicted that it would be difficult for people to retrieve the report because it was available from only a few Web sites, analogous to callers flooding a telephone number to order tickets to a concert or sporting event. But this held true for only a few minutes. Copies were quickly retrieved by a number of television networks, newspapers, radio stations, Internet service providers (ISPs) and individuals, many of whom immediately made copies available on their own Web servers. Thus, the number of servers supplying the information increased rapidly to cope with the demand. In this way, the Internet is different–we might even say better–from traditional media.

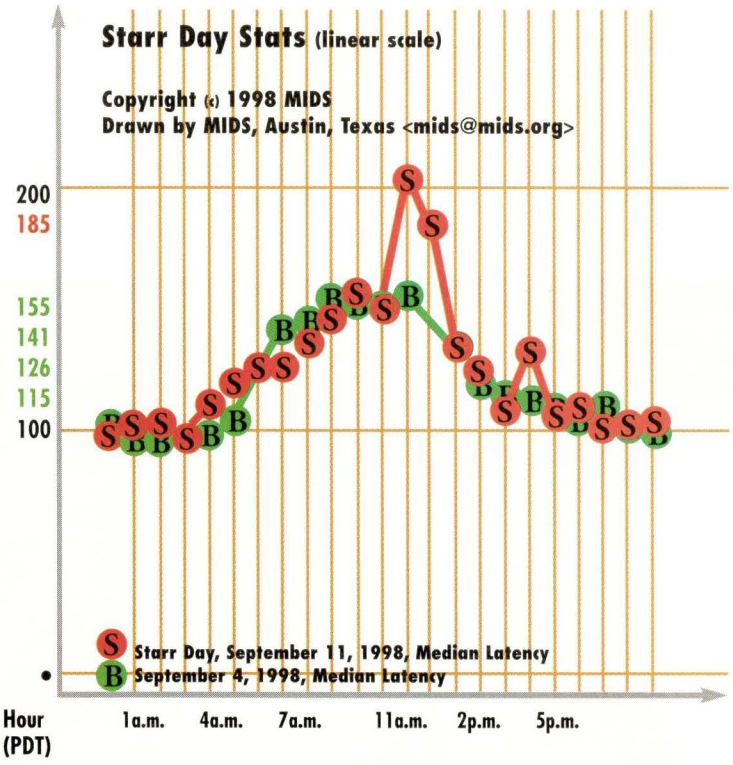
Of course, the initial Web servers carrying the report were briefly overloaded. And even the initial mirror servers were overloaded for a short time, as reflected in our data. But that did not last. The data shown in Figure 1 are representative of a set of Web servers, not the whole of the Internet. Most of the Internet infrastructure and servers and clients for other services were not significantly affected. It is useful to remember that the World Wide Web is only one communications service carried by the Internet and the affected Web servers are only part of the WWW.

For that matter, perhaps the news media could plan better for the next such event. The Web was not designed to be a broadcast medium, although in this case, it quickly turned into one. The Internet does host a broadcast medium, Usenet news, and most Web browsers these days include a newsgroup browser. Why not release news of this sort via a newsgroup?

It's true that the method and timing of this particular release were determined

Circle No. 25

**Figure 1. Comparing Web Server Latencies**




by Independent Counsel Kenneth Starr and Speaker of the House Newt Gingrich. Nonetheless, the media could have picked up a copy of the report and posted it to Usenet immediately. In the future, perhaps they will do that.

One moral to this story is that the traditional news media are still learning how to deal with the Internet and are still shy of it. Another moral is that the continuing exponential growth of the Internet has brought it to the point where it is a major facet in news and politics.

## Politics

Does anyone else find it ironic that many of the very same members of Congress who voted for the Communications Decency Act (CDA) of 1996 (see `http://www.mids.org/mn/707/cda.html`), which was designed to keep pornographic material off the Internet and out of the hands of children, also voted to release Starr's "pornographic" report via the Internet? This may give new meaning to the old saying, "politics makes strange bedfellows."

Personally, I'm glad the Starr Report was released via the Internet, because now we can all read it for ourselves instead of getting partial versions filtered through the traditional news media.

While there were discernible slowdowns at the Web sites where the report was first posted, Internet traffic on a nationwide basis was not significantly impacted by its release. In fact, the release of the Starr report did not indicate any flaws with the Internet; it illustrated both the increased use and the resilience of the Internet.

Thanks to Peter Salus, Hannah Kerby, Mikki Barry and Andy Scherrer, among others, for their input on this column.

***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.*

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DANIEL C. O'CONNOR

# A Penny Earned

Last month, we discussed how to collect resource usage statistics for the purpose of tuning AIX. This month, we'll capitalize on this theme by employing some of the same information for resource accounting and chargeback. Let's see, that's 10 minutes of CPU time, 3 MB of disk space, 50 pages of hard copy and nine hours of connect time. Will that be cash, check or credit?

Regularly gathering system accounting information is a good idea even if you aren't interested in billing for services. As we saw last month, general accounting data can provide a reasonable overall profile as to how the system is being used. Who are the really big users? Are you running out of CPU, disk or I/O capacity? This is the information you're going to need in order to justify that upgrade from a Model 43P to a 500-node SP2.

## AIX Accounting System

The AIX accounting system is very UNIX System V in flavor. For those of you with a preference for BSD, AIX also provides a set of the standard BSD accounting commands layered onto the System V environment. This makes it relatively easy to port custom accounting applications from other UNIX systems. For the less adventurous, you'll find a full set of commands and scripts in the base operating system that will automate data collection, report generation and periodic housecleaning. Most of the commands and scripts can be found in the `/usr/sbin/acct` directory (see Table 1). Data collection and configuration files reside in the `/var/adm`, `/etc` and `/etc/acct` directories (see Table 2).

Before you start recording resource information, you need to create some empty files for collecting and storing the data. You can create these files using the `touch` and `nulladm` commands, as illustrated in the example below. The `nulladm` command will ensure that the correct file permissions are set and that they are accessible by the `adm` user and group. (Other accounting configuration options are related to the type of data to be collected and will be explained later.)

```
# touch /var/adm/{wtmp,pacct}
# chown adm /var/adm/{wtmp,pacct}
# chgrp adm /var/adm/{wtmp,pacct}
# chmod 644 /var/adm/{wtmp,pacct}
# /usr/sbin/acct/nulladm wtmp pacct
```

Next, make sure the report summary subdirectories, `nite`, `fiscal` and `sum`, exist with `adm` permissions in `/var/adm/acct`:

```
# cd /var/adm/acct
# mkdir nite fiscal sum
# chown adm nite fiscal sum
# chgrp adm nite fiscal sum
# chmod 644 nite fiscal sum
```

Data collection begins when system accounting is turned on and stops when it is turned off. AIX samples and records process usage and session data for each user and process in the system.

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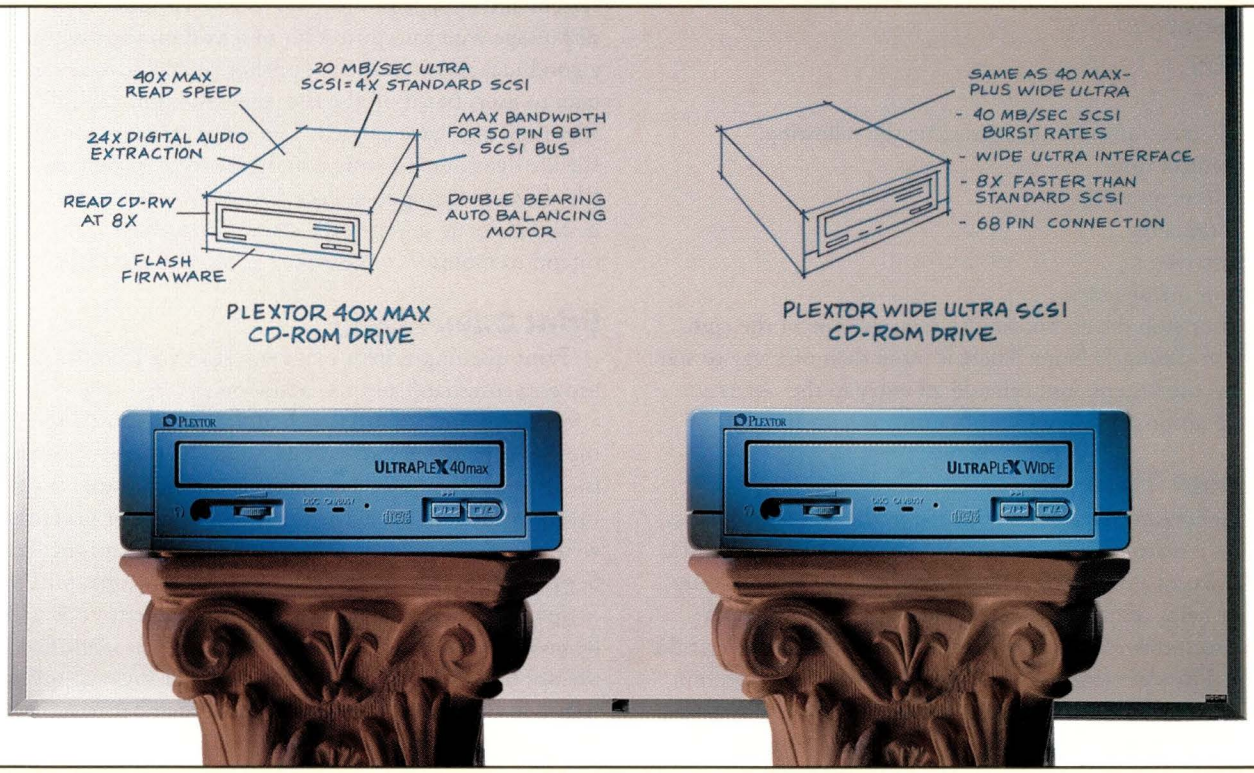


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**Circle No. 36**

**Listing 1. Start/Stop Accounting Commands**

*Start Commands*

```
# startup
# runacct 2> /var/adm/acct/nite/accterr &
# turnacct on
# accton /var/adm/pacct
```

*Stop Commands*

```
# shutacct
# turnacct off
# accton
```

The collected information represents the following:

- Connect time
- Process resources
- Commands
- Disk usage
- Print queue usage

To start or stop the accounting system, use one of the commands in Listing 1. Note: There is more than one way to start and stop the system. You can add an entry to the `/etc/rc` script to automatically start accounting at boot time.

## Connect Time

Connect time data is accumulated in the `/var/adm/wtmp` and `/etc/utmp` files. Each time you log into AIX, the `login` process writes a record to `wtmp` and `utmp`. The data indicates the user name, date, time, port and connecting address. A similar record is written by the `init` process when you exit the system. This data represents the duration of your connection to the system. The `acctwtmp` command also records system boot and shutdown times into the `/var/adm/wtmp` file. This data provides an audit trail concerning the comings and goings of users on your system.

## Process Resources

Resource usage information for each process run by the operating system is recorded in the `/var/adm/pacct` file at process exit. The bad news is no information is run for processes that don't exit! Each process accounting record indicates the user name, user ID, group ID, elapsed wall clock time, CPU time, memory use, character I/O and disk block I/O. The `pacct` file also provides an audit trail of command and application usage. This information can be used to profile application use or assist in tracking security incidents.

## Disk Usage

You can periodically collect disk usage information for the system and store it in the `/var/adm/dtmp` file. Collecting disk usage data can cause a bit of a load on the system, so it's a good idea to run it during off-hours. AIX assigns disk usage data to users based on the files they own and any links to files they may have created. The usage statistics for a linked file are distributed evenly among the users with links to the file. If you're going to collect disk usage information, add an `account=true` entry to the stanza for each file system you intend to monitor in the `/etc/filesystems` table.

## Print Queue Usage

Print queuing system usage statistics are recorded with the `enq` command and the `qdaemon` process. `enq` writes a record for each print job it handles. The record indicates the print job owner, job number and file name. When the file is printed, `qdaemon` writes another record that includes this information, as well as the total number of pages that were printed. There are public-domain back ends for PostScript queues that will supply accounting records for PostScript conversion and attributes. Print usage records will be saved if an account file destination path is identified by the `acctfile = <file-name>` parameter for each queue stanza in the `/etc/qconfig` table. Remember to refresh the binary mirror of the `qconfig` table, `/etc/qconfig.bin` after each update by invoking the `refresh -s qdaemon` command.

## Earning a Penny

The `chargefee` command can be used to add work unit entries for each user on the system into the `/var/adm/fee` file. This data is merged with other accounting files using the `acctmerg` command. `chargefee` can be incorporated into the system accounting scripts to implement a chargeback system.

You will also want to configure the `/etc/acct/holidays` file to reflect your prime-time shift and scheduled holidays. The first line in the file indicates the year and the start and end times for the prime-time shift. Subsequent lines indicate the date and description of each holiday scheduled during the year. Each

**Listing 2. crontab Files**

```
#=============================================================================
#       PROCESS ACCOUNTING:
#  runacct at 11:10 every night
#  dodisk  at 11:00 every night
#  ckpacct every hour on the hour
#  monthly accounting 4:15 the first of every month
#=============================================================================
10 23 * * 0-6 /usr/lib/acct/runacct 2>/usr/adm/acct/nite/accterr > /dev/null
0 23 * * 0-6 /usr/lib/acct/dodisk  > /dev/null 2>&1
0  * * *    * /usr/lib/acct/ckpacct > /dev/null 2>&1
15  4 1 *   * /usr/lib/acct/monacct > /dev/null 2>&1
#=============================================================================
```

holiday entry includes the integer day of the year, three-character month name, integer day of the month and a free-form text string that names/describes the holiday.

## Reports, Statistics

At any time, you can take the pulse of your system or look back through accounting history from the command line. You can also use the following set of commands to create ad hoc reports by directing `stdout` to a file:

- A general summary of data stored in the `/var/adm/pacct` can be displayed using the `sa` command. `sa` supports a number of flags the can be used to filter and restrict output. Two of the most useful are the `-m` flag (which summarizes by user) and the `-s` flag (which summarizes by command). The `-s` flag can also be used to merge a summary with an existing history file.
- Connection histories can be displayed using the BSD `ac` and `last` commands or the System V `acctcon1` and `lastlog` commands. The `ac` and `acctcon1` commands tally connection times by day or for any time interval covered by the `/var/adm/wtmp` file. The `last` and `lastlog` commands can be used to display user login times.
- Exhaustive command usage information can be generated using the BSD `lastcom` command. Like `sa`, this command supports a large number of flags to filter output. Beware that it will also use significant system resources when invoked!
- A standard set of reports is produced at intervals by the `runacct` and `monacct` commands. These commands are run by the default `adm` and `root` crontabs (see Listing 2). The summaries and reports are recorded in the `/var/adm` subdirectories listed in Table 2.

**Table 1. Data Collection/Reporting Commands**

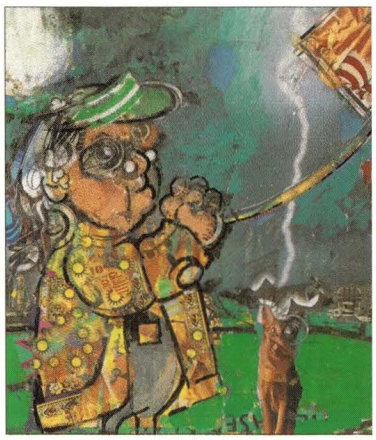
| | |
|---|---|
| runacct, turnacct on, accton | Start system accounting |
| shutacct, turnacct off, acctoff | Stop system accounting |
| sa | Filter account data |
| ac, last, lastcom | Display history data |
| acctmerg | Merge data into tacct |
| acctwtmp | Output utmp record to stdout |
| dodisk | Initiate disk usage accounting |
| monacct | Monthly/periodic accounting |
| ckpacct | Check pacct size for close |

**Table 2. Data Collection/Configuration Files**

| | |
|---|---|
| /var/adm/wtmp | User/system events |
| /etc/utmp | User access times |
| /var/adm/pacct | Process account file |
| /var/adm/dtmp | Disk usage |
| /var/adm/Spacct.<mmdd> | Daily process data from runacct |
| /var/adm/qacct | Print usage data |
| /var/adm/ctmp | Connect session data |
| /var/adm/fee | Work unit entries |
| /etc/holidays | Holidays/shifts |
| /var/adm/acct/{nite fiscal sum} | Accounting summaries |
| /var/adm/nite/lineuse | Serial port line usage |
| /var/adm/nite/dacct | Daily disk records |
| /var/adm/nite/reboots | System reboot times |
| /var/adm/sum/tacct | Total accounting summary |
| /var/adm/sum/cms | Command use summary |
| /var/adm/sum/loginlog | Last use time |
| /var/adm/sum/rprt[mmdd] | Daily summary report |
| /var/adm/fiscal/cms[n] | Fiscal command summary |
| /var/adm/fiscal/tacct[n] | Fiscal total accounting summary |
| /var/spool/cron/crontabs/adm | Accounting crontab |
| /etc/qconfig | Print accounting configuration |
| /etc/filesystems | Disk accounting configuration |

## Automating the Process

Turning on system accounting is a little like opening the flood gates. On an active multiuser system, accounting can generate a large amount of data that must be filtered, formatted and archived as part of your regular system housecleaning activities. The default accounting procedures specified in the `adm` and `root` crontabs periodically close and rename accounting files and generating reports. It is up to the systems administrator to implement procedures to archive and clean up old data files. It's a good idea to restart the accounting system daily to prevent accounting files from becoming too large and unmanageable.



To enable the default accounting procedures, remove the comments from the `adm` and `root` crontab files. You can edit the crontab files using `crontab -e`.

Now comes the hard part. You'll need to decide what information should be collected, how long it should be saved and which reports to generate. You can take the conservative approach and save everything, or throw caution to the wind and delete files on a daily basis. Moderation suggests it might be wise to periodically compress and archive the summary files and keep a copy of the previous day's data files online for short-term history queries.

Finally, you need to set your rates. Define a cost structure for information resources. This reminds me of a quote from Thomas Hobbes' *The Leviathan*, which seems appropriate: "For words are wise men's counters, they do but reckon by them; but they are the money of fools." ⊷

***Jim DeRoest*** *has been involved (for better or worse) with IBM UNIX offerings from the IX/370 days, through PC/IX, AIX RT, AIX PS/2, AIX/370, PAIX, AIX/ESA and AIX V3. He is employed as an assistant director supporting academic and research computing at the University of Washington, and is the author of* AIX for RS/6000–System and Administration Guide *(McGraw-Hill). He plays a mean set of drums for the country gospel band Return. Email:* `deroest@cac.washington.edu`.

*by Jeffreys Copeland and Haemer*

PAUL STODDARD

*"[T]ake no riffe raffe bookes for such would prove a discredit to our Librarie."*
– Thomas Bodley in a letter to Thomas James, as James was organizing the Bodleian Library at Oxford University

# A Short History of Reading

Consider the book. It is an object of remarkable ubiquity that follows us through our lives. In our houses, we have examples ranging from thick pasteboard with the teeth marks of infants and dogs to sympathy books from family members' funerals. They have been with us, in one form or another, since the dawn of civilization. But why are they in this form now? And what form will they likely take in the future?

## Parchment to Paper

"Littera scripta manet" – The written word remains. And it has. There are examples of ancient manuscripts dating back thousands of years, the most famous of which are the Dead Sea Scrolls. (Aside: How are these ancient scrolls connected to modern rock music? Through Miles–no relation–Copeland, father of rock impresario Ian and drummer Stewart, who was the CIA Station Chief in Beirut during the '50s. When the Dead Sea Scrolls were found, he was the first person to whom they were offered for sale.) Some of those ancient examples didn't survive because they were printed on an invention from the Nile river valley, paper, which was not durable; others failed to survive because they were housed in the ancient library at Alexandria, whose destruction was the most vile act of terrorism to occur before the current century.

But paper was vital. Because pre-Renaissance Europe didn't have the technology to produce it, books were written on parchment, which was much more difficult to manufacture. On the other hand, Islam had paper, which allowed the Moorish library at Cordova to house 400,000 volumes in 1085, while Europe's knowledge was still hidden in monasteries during the plague.

Through the Middle Ages, books were created by skilled scribes, who painstakingly copied the text at the rate of one or two books per year. But by the mid-1400s, craftsmen in Northern Europe had independently invented a trick that had been known in Korea and China for some time. By making molds of letters, lining them up, inking them and pressing paper against them, Johannes Gutenberg invented printing with movable type. The type used by Gutenberg was designed to emulate the handwriting of scribes in the monasteries. For the next 500 years, the purveyors of Western knowledge toiled at places like the Clarendon Press in Oxford, England.

By 1469, the printing press reached Venice, and by the end of the century, Aldus Manutius was printing large editions there. In those days, we hasten to add, "large edition" meant more than 200 books. Again, the absence of paper prevented larger press runs. But what made Aldus a success was type cut for him by Francesco Griffo. Because the workload in the papal chancery at the Vatican had become so heavy, the scribes developed a cursive style of handwriting that allowed them to write quickly and to pack more words per piece of parchment. Griffo's design was based on this style of handwriting and became known as italic type.

It allowed Aldus to print on smaller pages and, as a result, he began producing octavo editions–books containing sheets that were folded into eighths before cutting–which fit conveniently into saddle bags and, thus, became easily portable to other cities in Europe.

In 1603, the Bodleian Library opened in Oxford, endowed by King James I with income from land in Berkshire and London. (King James, of course, later commissioned the English translation of the Bible that bears his name.) The Bodleian Library was open six hours a day, six days a week and was one of the first libraries with a catalog of its holdings.

By the time of the American Revolution, paper was being mass-produced in places like Italy and Holland, and printing presses had become so numerous that books were common–if not as widespread as today. Thomas Jefferson owned the largest library in the American colonies, which housed 6,000 volumes in eight languages, including Russian. Jefferson's library became the foundation for the Library of Congress after the initial library was destroyed during the War of 1812.

But the spread of knowledge was continuing. From our childhood, we remember a drawing in a Time Life book about the volume of scientific knowledge. In 1750, there were about 10 scientific journals in the world, represented in this drawing by a scientist in a tricorn hat holding a stack of paper under his arm; by 1830, the number had increased to about 100, represented by a waist-high stack next to the scientist; by 1970, the number had increased to 10,000–of which 300 were abstract journals–illustrated by a pile towering over the heads of the other two scientists. Douglas Copland (also no relation), in his novel *Microserfs*, echoes this growth by having one of his characters observe:

*"We've reached a critical mass point where the amount of memory we have externalized in books and databases (to name but a few sources) now exceeds the amount of memory contained within our collective biological bodies. In other words, there's more memory 'out there' than exists inside 'all of us.' We've peripheralized our essence."*

We don't know if this is actually true, but it sounds plausible.

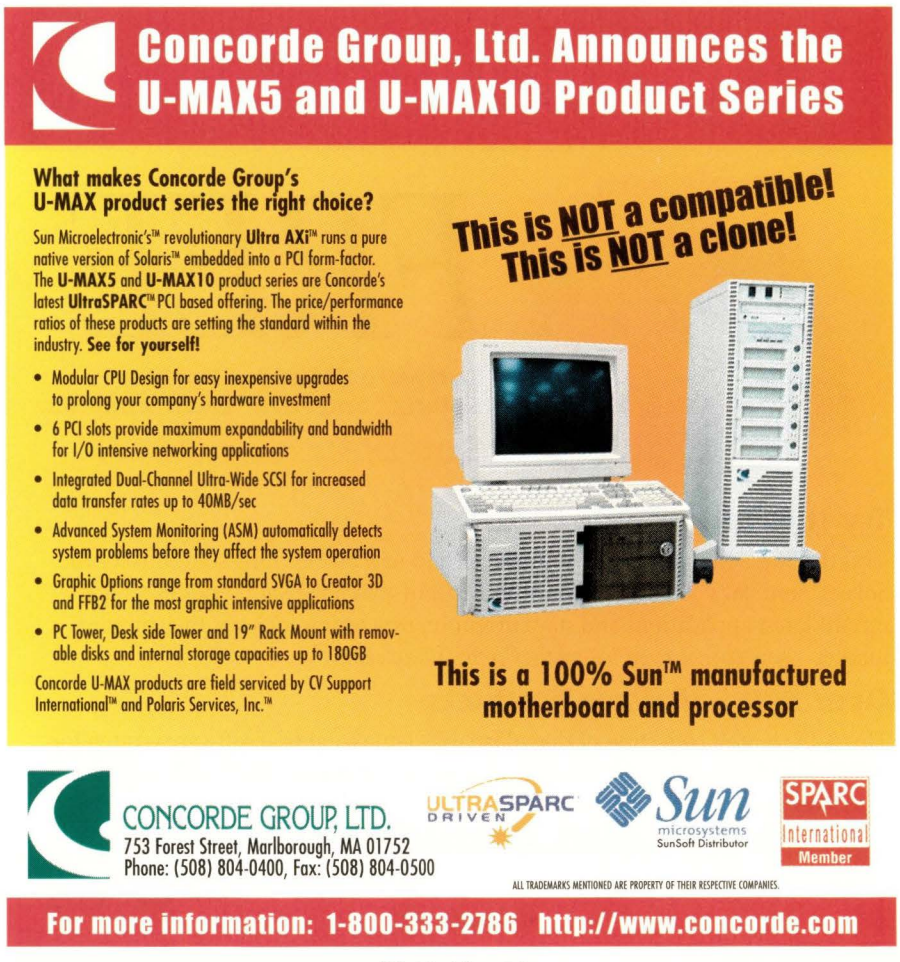
By the 20th century, the technology for producing print media had undergone a change. The five centuries from 1450 to 1950 were the renaissance of movable type. At the end of the 19th century, the invention of the Linotype and Monotype machines allowed movable type to be set mechanically. By the middle of the 20th century, phototypesetting became practical and began to take over. In the early 1960s, computer-driven phototypesetting began to appear at newspapers and large publishing houses, driven by mainframes. The advent of the cheap laser printer coupled with the cheap personal computer in the 1980s effectively killed movable type as a production medium. (There are some pockets of resistance: The county newspaper for Saguache in Colorado's San Luis Valley still uses a Linotype machine.)

## The Book or the Text?

In his book of essays *Being Digital*, Nicholas Negroponte repeatedly explores the difference between physical artifacts and their computer representation. His mantra is "bits or atoms?" When Negroponte places a value of $2 million on his laptop computer, does it reflect the value of the physical object, which cost about $2,000, or the value he places on the data stored on its hard disk? Is it the atoms of the book or the data contained within it that are actually important?

While we consider some books to be important as physical objects–there is the Robert Frost first edition with a dust jacket by Alan Haemer on one of our shelves and a century-old edition of *Alice's Adventures in Wonderland* on another–we have to agree with Professor Trefusis, whose amanuensis, Stephen Fry, captured him explaining in *The Liar*:

*"Books are not holy relics. Words may be my religion, but when it comes to worship, I am very low church. The temples and the graven images are of no interest to me. ...The world is fond of saying that books should be 'treated with respect.' But when are we told that words should be*

Circle No. 26

*treated with respect? From our earliest years we are taught to revere only the outward and visible."*

Clearly, it's the contents of a book that are important, which is one of Ray Bradbury's lessons in *Fahrenheit 451*. We need the data, not the object. What does this mean for us?

## Appearing on an Internet Near You

Because the bits are more important than the atoms of a book, we've already started seeing some interesting developments. One of the first was Project Gutenberg, based at Illinois Benedictine University (`http://www.gutenberg.net`), which has been working since 1971 to make great texts that are in the public domain available online. We carry around copies of various texts from Project Gutenberg to read on the road. This month, it's *Moby Dick*. In a similar vein, Alexandria Digital Literature (`http://www.alexlit.com`) is a commercial project to bring modern fiction, mostly science fiction, to the Internet. (Other ventures in the online world are literary, but have nothing to do with digital literature: The ever-present Amazon.com and Barnes and Noble online bookstores are examples.)

Indeed, there appears to be a small movement by authors who aren't interested in dealing with large publishing houses to put their work up on the Web. Libertarian science-fiction writer J. Neil Schulman has done so (`http://www.pulpless.com`). The updated edition of Bruce Sterling's *The Hacker Crackdown* is available in electronic, rather than printed form (`http://lonestar.texas.net/~dub/sterling.html`). Peter McWilliams' *Ain't Nobody's Business If You Do* is available in both print and Web editions (`http://www.mcwilliams.com`).

This sort of samizdat is important and has a long tradition. Indeed, we'd argue that not only does information want to be free, but that political freedom is a product of information freedom, which is how the Founding Fathers understood it.

Furthermore, self-publishing has interesting implications for edition creep. As far back as 1985, Marsh Heinrichs at Addison-Wesley Publishing Co. expressed concern about editorial review and the lack of clear edition markings when scholarly publishing began to appear on the Internet.

Online publishing also has interesting implications for copyright law. Only now, and in fits and starts, are legislators starting to come to grips with differing needs for the protection of digital representations of intellectual property. How do we protect online literature and scholarly work? Certainly, it is not feasible for all of it to be protected (or unprotected) under terms similar to that of the GNU software license. It is not acceptable to wait for all work to fall into the public domain either–certainly in the fields of science and technology, by the time 50 years have passed the content is important more for historical purposes. Unfortunately, the U.S. Congress seems more concerned with extending intellectual property protection for Mickey Mouse than worrying about copyright in cyberspace.

All concerns about content aside, we as software people want to have some knowledge of what form that content will take. There are a number of ways we could present our online books and each has its shortcomings.

Flat ASCII is the obvious choice (it's certainly the form used by Project Gutenberg) except that it doesn't allow for illustrations, or easily handle different-width displays or reformatting on the fly.

We could adopt a proprietary format, like the ones used by the what-you-see-is-what-you-get word processing programs from Microsoft Corp. and Corel Corp., except you've already heard our rants about closed formats that require you to have commercial software. (Indeed, Haemer's response to receiving such data is to silently return it to the sender using `procmail`.)

PostScript has several advantages. It's actually a page description format, rather than claiming to be a markup language, like the word-processing tools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(attempt). It also has cheap (or free) interpreters available, such as GhostScript. Furthermore, given the electronic text in PostScript, the publisher's intentions about rendering into print are very clear. But PostScript is really a printing standard, not a display one.

A step beyond PostScript is Adobe Systems Inc.'s Portable Document Format (PDF), supported by the Acrobat Reader and other freeware readers. It is more compact and is intended to be read online, while supporting all the features of PostScript. However, we keep seeing examples of PDF that are nothing more than scanned images of printed pages, which seems to defeat the purpose of the technology.

On the other hand, the original open-standard format for the reading of formatted text online is HTML, which we use every day when we retrieve data from the Web. We have the advantage of being able to change HTML formatting on the fly when we render it in a window of a different size, for example. But because the reader (or browser in this case) is tunable, it's possible the publisher's (or author's) intentions on how the information is to be displayed will be ignored. Worse, because HTML is a lightweight markup language, there are no standards for displaying equations and little support for layout more complicated than running text with interspersed pictures. Designer David Siegel suggests a raft of workarounds to these and other problems on his Web site (`http://www.dsiegel.com`). Follow-ons, like eXtensible Markup Language (XML), also address some of HTML's limitations.

Last, there are the open, intermediate formats from our favorite text-processing programs such as typesetter-independent `troff`'s intermediate form (also used by `groff`) and TeX's device-independent (DVI) file format. But using any of these for an online reading format requires some interpretation and font standardization.

The overall problem with each of these is annotation. None of them easily supports bookmarks, marginal notes, dog-eared corners or little yellow sticky notes on the pages.

The problem is worse than just format. Portability becomes an issue. Think of all the different things you read. This magazine. The newspaper. The Web. The latest Tom Clancy novel. A Supreme Court decision. Bruce Schneier's *Applied Cryptography*. The Camel book. *Hamlet* via Project Gutenberg. *Hamlet* in book form. The `sendmail` documentation. Your email. A textbook. And that's not even counting the stuff you could have "read" through other means, like listening to Jon Krakauer's *Into Thin Air* on tape in your car. It would be convenient if they could all be read using the same tools and if those tools could change mode, so you could read a book, or it could read itself to you, or you could just look at the pictures. (A technical audio book sounds like an oxymoron, but T.V. Raman, a blind computer science student, completed his Ph.D. dissertation at Cornell University four years ago in which he explored techniques for having a voice synthesizer read mathematics from technical text.)

***The existence of any of the electronic forms for reading books would change the economics of publishing. It would be possible to have a large backlist because there would be no tax consequences. Indeed, nothing would ever go out of print.***

However we choose to render our online books, we need to heed the observation of Stephen Walli, vice president of research and development at Softway Systems Inc. (who has the thankless task of being Copeland's boss): "Every useful application outlives the platform on which it was originally developed and deployed." In other words, any form we choose is going to be one we'll be stuck with for quite a while.

A useful statistic at this juncture, so that you can understand where the marketing effort might be spent: According to *Fotune* magazine, textbooks account for roughly one quarter of the total book sales in the United States–low-volume, high-cost specialty books, for the most part–and audio books account for one tenth. We wish we could ignore the huge collection of celebrity gossip we see at our local bookstore and the appearance of books of comic strip cats on *The New York Times* best-seller list, but those seem to be a staple of the bookselling industry.

The existence of any of the electronic forms for reading books would change the economics of publishing. It would be possible to have a large backlist because there would be no tax consequences, that is, there would be no inventory of physical books at the warehouse to be taxed. Indeed, nothing would ever go out of print. The new economics of publishing would also make it possible for there to be midlist authors again, a nice feature of publishing that disappeared about the time Messrs. Harcourt and Brace stopped running the firm that bears their names. Similarly, it would mean that the quarter of all books represented by textbooks would not weigh quite so much on our shelf or in our children's backpacks.

Nonetheless, there's a more serious problem. How do we actually read text in any of these forms?

## Software Requires Hardware

We've come the long way 'round to briefly talk about the Dynabook, the notional computer developed by Alan Kay at Xerox PARC to provide a self-contained, personal database of books and information about the size of a three-ring notebook. In the Dynabook, the bits are the thing. Books can be read at the same resolution in print as on the high-resolution screen. New data and

annotations can be added using a keyboard. While it's not exactly Kay's vision, the laptop computer has filled the niche for personal data retrieval he had in mind.

But Moore's Law, which tells us that computers will cost half as much in 18 months, marches on. And we can use the ideas of science fiction to make some guesses about where technology can take us.

Certainly, Arthur C. Clarke's novel *Imperial Earth* is as much about his notions for a global computer and communications system as it is about politics or exploration. Most of the features of Clarke's pocket-size user access device can be found in off-the-shelf personal digital assistants (PDAs) today. And many of those PDAs have add-on software to load and read free text.

Similarly, Neil Stephenson's *The Diamond Age* features wafer-thin touchscreen displays. Stephenson's displays are being prototyped by an MIT Media Lab spin-off, which hasn't yet gotten them to the resolution we need for them to display the daily newspaper.

Douglas Adams' famous contender for an electronic book is *The Hitchhiker's Guide to the Galaxy*, which is more commercially successful than the *Encyclopedia Galactica* not only because it fits in your pocket, but because it has the words "Don't Panic" emblazoned on the cover in big, friendly letters.

(On the retro side, we have Isaac Asimov's send-up of *The Double Helix* in his short story, "The Holmes-Ginsbook Device," in which he postulates the invention of paper folded into piles, which can then be read, so that the hero won't miss pretty girls walking past him in the library because he's got his head stuck in a microfilm reader. The formal name of the invention is given in the title, but it's often simply referred to as the "book.")

In the present, we've written some software to emulate the process we want to use for reading text on the screen (more about that later). But, given the prevalence of the technology used in laptop computers, the full problem appears to be on the road to a solution with commercial products expected by the end of the year.

## Commercial Reader Hardware

We must confess that Liz Copeland (finally, a relation–Jeff's wife) had the idea for stand-alone reader hardware about two years ago. We couldn't see how the publishing deals would work out, nor did we understand how the economies of scale could allow the finished boxes to be sold at a reasonable price. So, now we owe Liz a couple million dollars and an apology, because by the time you read this, there should be special-purpose electronic book hardware available. And if you're wondering what to get us for Christmas...

The main offerings are the Rocket eBook by NuvoMedia Inc., Palo Alto, CA (`http://www.rocketbook.com`), and the SoftBook System from SoftBook Press, Menlo Park, CA (`http://www.softbook.com`). Both offerings provide storage for books, a high-resolution LCD screen, connection to the outside world and a source of text to read.

The Rocket eBook is the lighter of the two, weighing in at 20 ounces, or the weight and size of a 200-page trade paperback. It claims to have a 20-hour battery life. You can browse an electronic bookstore on the Web and download the text through your PC into the Rocket eBook using the serial cable connected to its recharging cradle.

The SoftBook is a bit larger, with a bigger screen and weighs in at just under three pounds, featuring a 9.5-inch screen and a five-hour battery life. The additional weight results from being self-contained, with a built-in modem and firmware to connect directly to the SoftBook Web site.

Both products have touch screens. Both companies have methods of downloading arbitrary text to their hardware, so you can load documentation or text from Project Gutenberg with equal ease. Both boxes store large amounts of text–4,000 pages, in the case of the Rocket eBook.

It's unclear how online distribution of books from major publishers will shake out. SoftBook intends to act as a bookstore for its publishing partners, which includes Random House Inc. and Simon & Schuster. NuvoMedia will act as a book distributor; its investors include German publishing giant Bertlesmann, which also owns Random House and Barnes and Noble Inc.

Clearly these boxes fill an interesting niche: It's much easier to curl up in bed with a box that weighs half a kilogram and is the size of a paperback than with a laptop computer. *Fortune* magazine quotes Michael Hart, the founder of Project Gutenberg, as saying, "The thing I really want is the paperback-sized text reader you can buy at Kmart for $20." He's exactly right. Most people don't want to carry a laptop computer around with them. Once the reader hardware is a commodity product, we will finally have truly ubiquitous electronic text. The good news is that day appears to be nearing.

## Finishing Up

We'd like to thank our friends Steve Hughes, recently retired from Nova Financial Services, and Gary Brown on the editorial staff of the *Palm Beach Post*, who started us thinking a little more seriously about the notion of online reading. Also a tip of the hat to Guy Lillian, an attorney in New Orleans who took the Luddite view in favor of paper and made us rethink some assumptions.

Next time, we'll show you the reader for ASCII text that we originally developed to allow us to read back issues of the RISKS Digest during boring parts of standards meetings.

Until then, happy trails.

***Jeffrey Copeland*** *(`copeland@alumni.caltech.edu`) lives in Boulder, CO, and works at Softway 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`.

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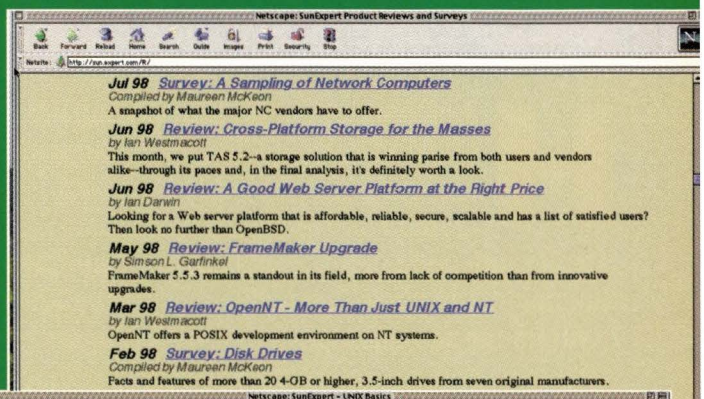
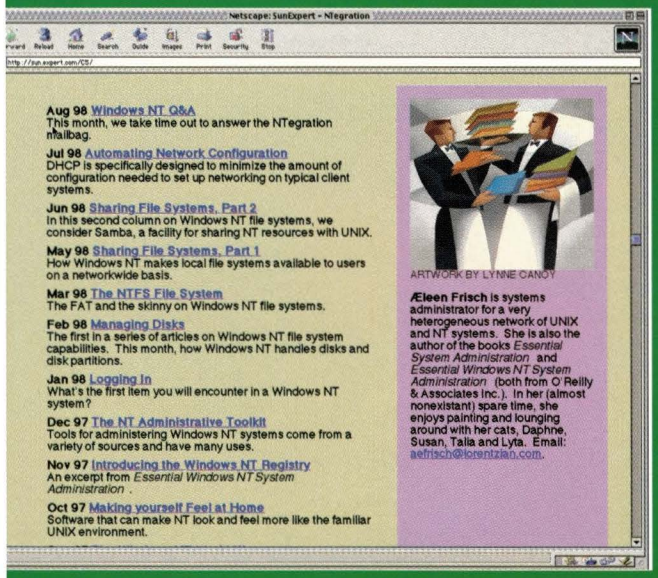
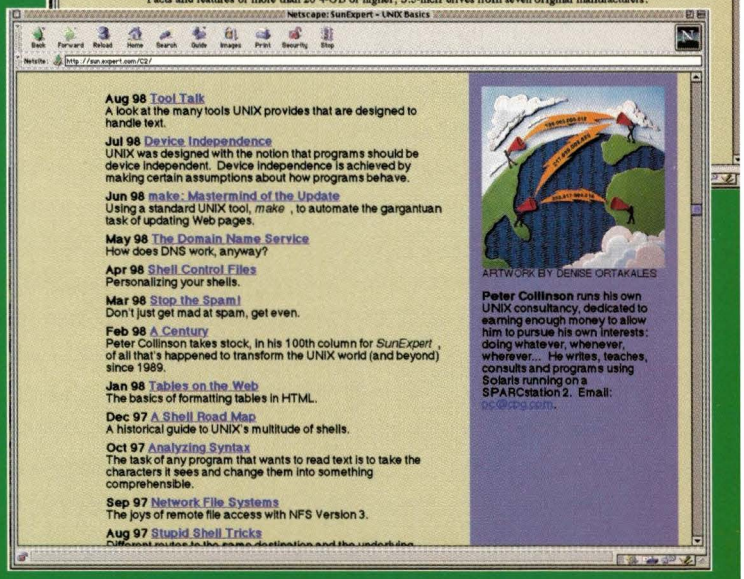
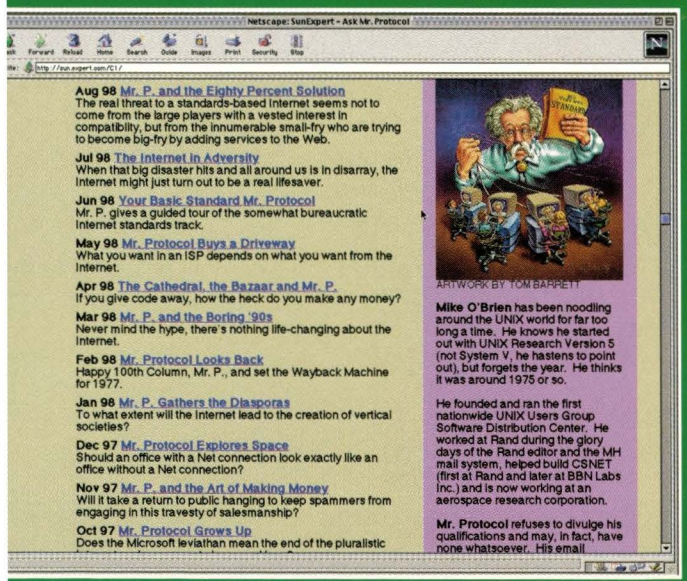
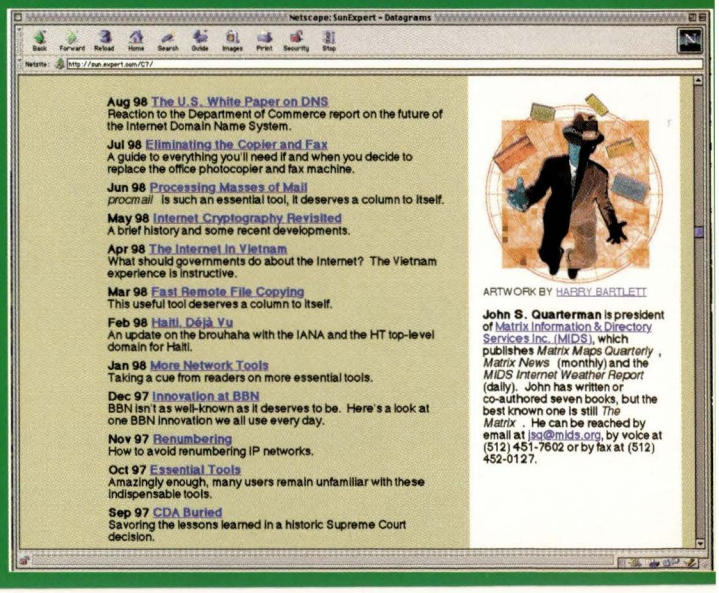


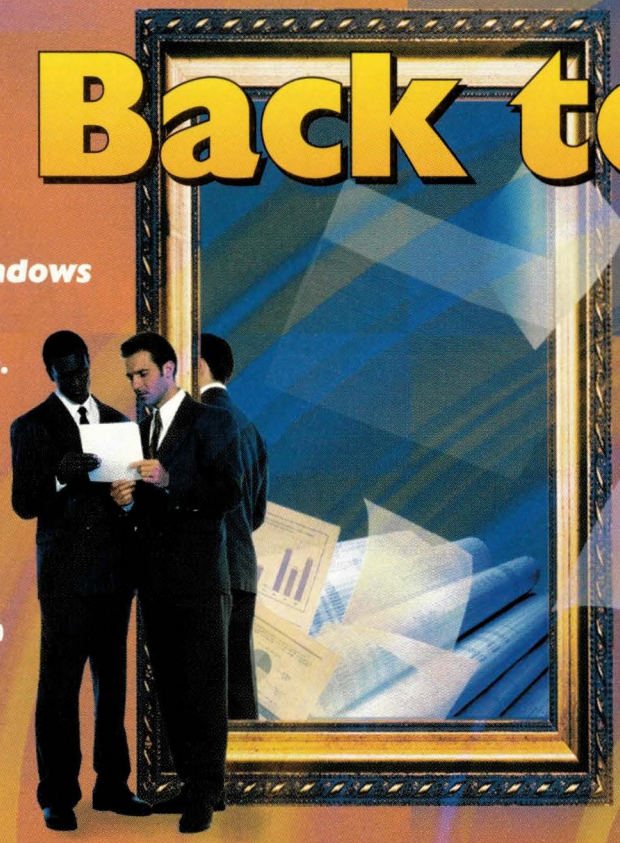



# Getting Back to

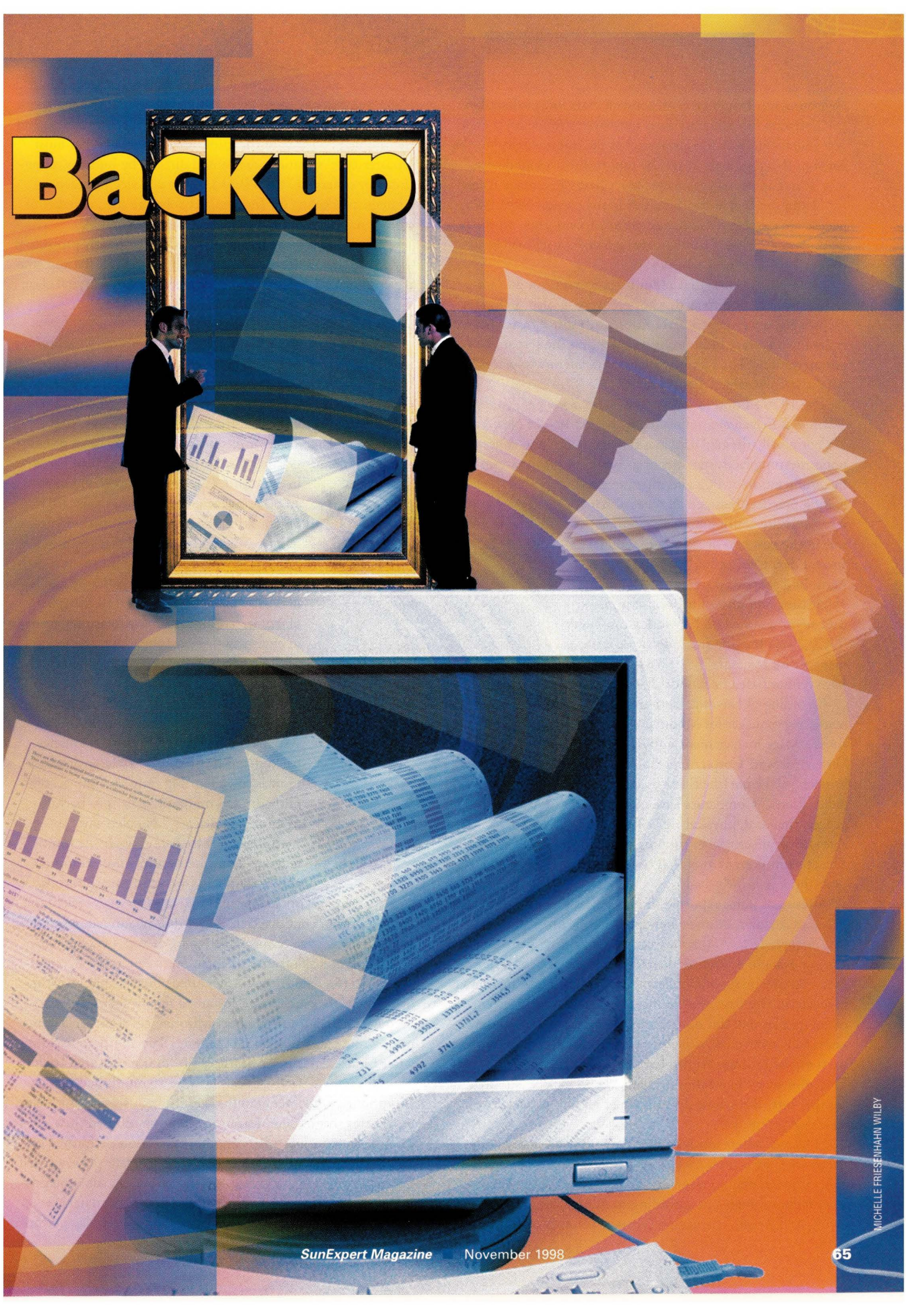


***As the data glut grows and backup windows continue to shrink, choosing the right strategy ... now, there's the backup rub.***

Headquartered in Hounslow, England (outside London), DataSave Services plc was formed in 1994 to provide storage and archiving services to small- and medium-size businesses in the United Kingdom. The basic technique used by DataSave to perform off-site backups is relatively simple, reliable and, perhaps, more secure than most backups performed in the United States. Overnight, all changes to a customer's data are automatically encrypted and incrementally transferred via modem to the central DataSave site, where they are saved onto Digital Linear Tape (DLT) cartridges provided by Quantum Corp., Milpitas, CA. "This not only automates the backup process and provides convenient online restoration facilities for the end user, but also ensures that data is off-site in the event of theft, fire or other disaster," says Peter Hough, administrative manager at DataSave. "[The software tools used to create the backups] were specifically developed in conjunction with IBM Corp. for datasaving," says Hough. DataSave's process includes encryption. The firm's storage configuration supports assorted flavors of UNIX, all Microsoft Corp. Windows platforms, Apple Computer Inc. Macintosh and Novell Inc. NetWare servers. Yet its software functionality resides in the server–an adequate management of storage for most applications, but not all. For certain sophisticated enterprise-level

**by Gode Davis**

# Backup





MICHELLE FRIESENHAHN WILBY

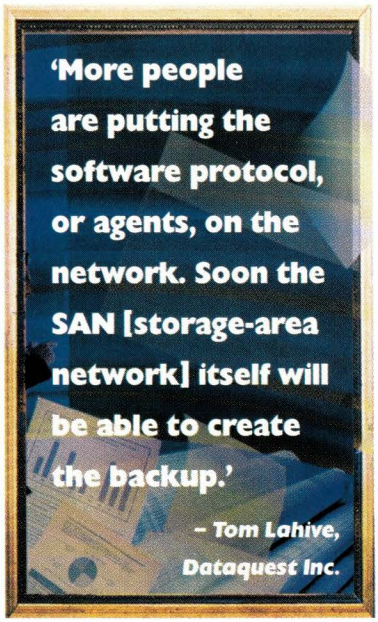
environments, being server-dependent is no longer desirable.

"Software functionality does not have to reside on the server. The server does not always act as the intermediary for the backup. It can go right from the user to the backup device," says Tom Lahive, senior analyst specializing in storage issues for Dataquest Inc., a San Jose, CA-based consultancy. "More people are putting the software protocol, or agents, on the network. Soon the SAN [storage-area network] itself will be able to create the backup," Lahive says.

Backup's flip side–that ubiquitous restoration of data sometimes referred to as disaster recovery–is also no longer exclusively server-centric. Traditionally, most disaster recovery solutions were built around protecting the server. Well, not anymore. "The fact is while servers are now replaceable, data is irreplaceable," Lahive says.

The 1975 edition of Harry Shaw's *Dictionary of Problem Words and Expressions* (published by Pocket Books, New York, NY) originally defined data as a singular and plural collective noun meaning facts, statistics or a "body" of information. With the proliferation of PCs and intricate data-linking practices between all types of hardware/software configurations becoming the rule in the past two decades, a preponderance of data is assuming "mission-critical" status in disparate corporate environments. "Increasing amounts of mission-critical data are now stored on Network Computers [NCs]," says Ira Goodman, software services manager for Syncsort Inc., a backup software vendor based in Woodcliff Lake, NJ.

According to David Ballard, product marketing manager for Mountain View, CA-based storage management software vendor, Veritas Software Corp., in the Spring 1998 issue of *Vox Veritas* (the firm's quarterly trade publication), "Companies have many assets, people, financial, physical etc. All are valuable and all are crucial to running a business. The most important asset that companies own, though, is their data."




A series of items reported in November 1996 by *Globe and Mail*, a Canadian business newspaper, and culled from *SC Info Security News Magazine* (`http://www.infosecnews.com`) appears to epitomize the inflated value of data. The snippets read like marketing bullets: "Companies begin meltdown in less than five days after losing critical data. Fifty percent of companies that did not recover their data within 10 days never fully recovered. Ninety-three percent of those companies went out of business within five years." Veritas' Ballard writes, "Tangible items like computers are easy to replace–simply buy another one. But where do companies go to buy back lost intellectual property?"

In fact, disasters can rear their ugly heads in many guises. Large-scale adversities such as floods, fires and earthquakes come immediately to mind–as do power outages and even terrorist bombings–but according to Ballard, accidental loss owing to deletion, corruption (viruses) or other software errors is the number one cause of system outage.

Today's complex computing environments only compound the problem. "Those in the know are quite aware that most 'disaster-type' situations are caused directly by humans, intentional or otherwise," says Paul J. J. Payack, vice president of strategic marketing for Intelliguard Software Inc., a maker of storage management solutions based in Dublin, CA.

Factor in attacks upon sensitive (but often poorly protected) data by hackers and the necessity for having viable backup strategies in place *before* something happens becomes crystal clear.

## Tale of the Tape

While the variations that exist point-to-point in backup implementations seem inexhaustible, much of the backup being done today remains tape-driven. "Currently, the most common approach to backup is bulk data movement, over the network, in some cases, from disk to tape," says Mark Nicolett, research director of storage technology operations and resources for Gartner Group Inc., a research firm based in Stamford, CT. Yet backup is no longer an occasional remedy born of crisis. "Many organizations are finding that such deployment is an ongoing project that requires a more or less permanent commitment to support resources," Nicolett says. Continuous data growth is also incidental to the types of storage configurations increasingly seen in enterprise-level business environments.

According to Nicolett, in central IT organizations, there is typically a mix of "raised" floor UNIX servers running applications like data warehouses. With these systems the problem is high-performance backup and recovery of very large databases. How is so-called "big time" backup accomplished? "Common practice is to backup to local tape devices," Nicolett says.

But is tape efficient enough? As multi-terabyte databases become more common and backup windows continue to shrink, a new urgency exists for speed. How fast is fast? A scalability demonstration conducted in May 1997 by Sun Microsystems Inc., Oracle Corp., Storage Technology Corp. (aka StorageTek) and Veritas Software Corp. at Sun's Enterprise Technology Center in Palo Alto, CA, featured a hot (online) backup of an Oracle7 database at a sustained rate of 941 GB/hour. Writes Sun Technical Engineer Miroslav Klivansky in a company white paper describing the test, "The ability to backup a live Oracle database at nearly 1 TB/hour means that backup of multiterabyte databases can now be accomplished in a few short hours, while maintaining continuing user access to data."

Yet this sort of demonstration was soon eclipsed. Just a few months later, in July 1997, another exhibition performed on an Oracle database, this time involving different players (IBM, Legato Systems Inc. and Silicon Graphics Inc.), subsequently shattered the "one-terabyte-per-hour barrier" for database backup. Perhaps more relevant is real-world, everyday perfor-

mance. Can comparable speeds be achieved across different databases simultaneously?

Actually, yes. For instance, the Sun-touted demo was accomplished with a variant of Veritas' NetBackup, which can act as an intermediary between databases such as Oracle, Sybase or Informix while directing parallel backups to a single storage device, as well as directing parallel transfers to multiple drives.

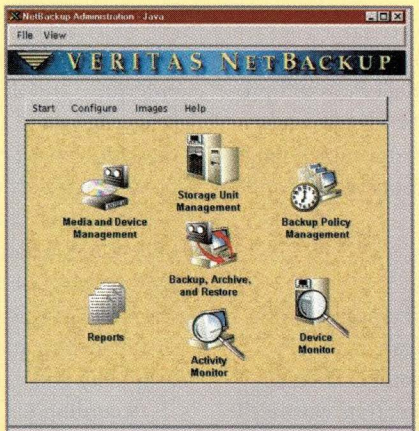
Along this vein, Farid Neema, president of Peripheral Concepts Inc., a Santa Barbara, CA-based consultancy, emphasizes that higher speed parallel backup with arrays of tapes, as well as data replication on disk drives (as opposed to traditional backup on tape), is becoming pervasive enough that "really fast" backup is now more the rule than the exception.

There's also a variation of replication: disk hardware triple mirroring, a technique whereby three mirror copies of data are made on disk. Although it is expensive, Gartner Group's Nicolett expects such point-in-time replication to become a common technique for the rapid recovery of very large databases. He also expects aggressive online data reduction (that is, block- or byte-level incremental, duplicate file elimination) to spread from the enterprise to the low end to facillitate backup of mobile PCs, desktop PCs and application servers.

## Remotely Backup

Another recent trend has been the ascendancy of fixed, remote workstations (desktops) and mobiles (notebooks and laptops) in the storage management arena. According to research firm Gartner Group Inc., Stamford, CT, the number of "remote" users is expected to more than double from 50 million in 1998 to 108 million in 2002. It also predicts that by 2000, 55 million users will work outside the boundaries of the enterprise at least 20% of the time, and that within a few years, by 2003 or 2004, more than 75% of so-called "knowledge workers" will be remote.

But who is backing up all the remotes? A profile on "Network Backup Markets" taken in March by Strategic Research Corp., Santa Barbara, CA, reports that only 18% of more than 200 sites performing server backups actually backed up their workstations. Of those performing workstation backups, only 12% of PCs on-site were backed up regularly. When users choose to backup data, finding simple, comprehensive and automated data protection of distributed systems–especially for networked workstations, mobile computers and stand-alone desktops–can be likened to the search for the Holy Grail. In fact, the mobile storage management market is, according to Gartner Group, "very immature," with few complete electronic vaulting (remote backup) solutions available. "Many solutions exist in the marketplace today, but most fail to offer complete system recoverability," says Michael Peterson, president of Strategic Research.




*According to Veritas, integration with TeleBackup's TSInfoPRO will extend NetBackup's backup/restore capabilities to the remote Windows market.*

For instance, several small companies are primarily dedicated to the development of remote backup technologies, including Atrieva Corp., Seattle, WA, Connected Corp., Framingham, MA, CoreData Inc., Phoenix, AZ, and Stac Inc., San Diego, CA. Of these companies, only Stac sells software that offers remote customers full system backup and recovery capabilities. The others offer only data file set backup and recovery. Unfortunately, Stac must implement two disparate product lines to enable full system backup and recovery, Replica (the company's object replication technology) and Replica Sequoia.

Fortunately, there's another option. Peterson refers to the product line developed by Canadian firm TeleBackup Systems Inc., Calgary, Alberta, as "best of the breed." Peterson says, "All other competing products in this market lack the ability to perform a full system backup over a dial-up line in a reasonable period of time." TeleBackup's flagship product, TSInfoPRO, was introduced in 1996 and operates on a Santa Cruz Operation Inc. (SCO)-based backup server. Able to support Windows-based clients (a July 1997 enhancement enables the backup engine to run on a Windows NT host server), the solution comprises a client agent operating on the protected client, an administrative console managing all clients protected by the central repository and a backup server with its client profile databases. But TSInfoPRO achieves its touted efficiency through comparing a protected client with a profile database and identifying unique files and data. "By allowing only unique data to be transmitted, it saves time and storage space," Peterson says.

According to Byron Osing, president and chief executive officer of TeleBackup Systems, TSInfoPRO might even be a "value-added" investment for large IS environments. "In those environments, there is no need to displace the current server backup solution," he says. "Instead, the TSInfoPRO server becomes a 'slave' or 'client' to the current server backup product. The TSInfoPRO host covers all the desktop, mobile and remote units in the company that have traditionally been ignored. The TSInfoPRO host server then becomes a 'client' to the server backup product [Veritas Software Corp.'s NetBackup], which acts as a secondary backup of the host unit." Adds Osing, "Both units can share a storage repository, for example, a DLT tape library or disk farm."

While TSInfoPRO currently occupies a premier spot in the remote storage management scheme of things, Gartner Group expects that by the end of 1999, IS managers should see a huge jump in the availability of tools. Strategic Research's forecasts are rosy, too. It estimates total revenue for remote backup software will escalate to $81.2 million by the year 2000 and to $232.6 million by 2002.–*gd*

While backups can be run hot (online) or cold (off-line), hot is preferable. "Hot backups offer continuous data protection, usually through the utilization of snapshot techniques that create an instantaneous point-in-time copy of data that can be backed up while the application continues to run," Peripheral Concepts' Neema says.

Although hot backups are trendy, storage managers and administrators are beginning to look past the server to accomplish backup. The concept of "serverless" backup, performed without the help of the server in an environment where enough intelligence is embedded in the storage system, is fast becoming vogue. "If you have to go back to the LAN [local-area network] to complete the backup, it defeats the purpose of the high-speed storage network," says Neema. The highest-speed storage networks (for example, Fibre Channel) are perfect conduits for SANs–those versatile new architectures that are rapidly emerging in open system environments. SANs seem tailor-made for serverless backups. "With the emerging SAN technology, it is critical that backup be performed within the high-speed storage network, off-loading the LAN and minimizing host intervention," Neema says. Under such circumstances, the sharing of libraries and jukeboxes (optical devices) within SAN environments can sometimes become advantageous–as might dynamic storage sharing. But while sheer speed meshed into a SAN enables improved data flow and protects more data by volume, it's not meant to be a panacea. In fact, for many environments, ranging in scope from mid-range to enterprise-level, only customized combinations of new and old strategies are getting the job done.

*Procom Technology, maker of high-end tape/CD-ROM libraries, has equipped its CDFORCE and DataFORCE (above) products with its own form of encryption.*

## The Backup Arena

Loaded with jargon amid a jigsaw of specific applied technologies, the world of data backup is an intricate hierarchy of commercial niches within computerized storage. Even the word "storage" is often used by vendors and analysts within the industry to mean both hardware and software combined, just as the term "storage management" has come to imply "software" in a similar vein.

According to a report published in January by Strategic Research Corp., Santa Barbara, CA, the storage management software market brought in $980 million in revenue in 1997 and the market is growing at an average annual rate of 30%. By 2002, the market is projected to grow to $3.5 billion. Strategic Research segments the market into three: workgroup, network and data center. "The workgroup market focuses on server backup and was driven by companies such as Cheyenne [a division of Computer Associates International Inc.] and Seagate [Software, Scotts Valley, CA] with point-level solutions," says Ed Cooper, corporate director of strategic communications for Legato, a developer of storage management software for the network computing market based in Palo Alto, CA. "Going forward, this market will grow far slower than the other two and will be $900 million in size by 2002."

The network market focuses on networkwide data protection, including tight integration with applications and databases and central management. According to Strategic Research, this market will be the largest of the three by 2002, reaching $1.4 billion. "Legato is the leader in this market followed by IBM and HP [Hewlett-Packard Co.]," Cooper says.

The data center market focuses on protecting data on large, high-end servers. Dominated by vendors such as EMC Corp., Hopkinton, MA, Sun and Veritas, Strategic Research expects this market to be the fastest growing, reaching $950 million by 2002.

Such explosive storage management growth is attributed to the increasing importance and to the proliferation of open systems. According to Strategic Research, for the first time (as of January), more than 65% of all mission-critical data is on open systems, not on mainframes. "The mainframe world is a legacy–what was versus what will be," says Legato's Cooper. "The rule, and not the exception, is now highly distributed data in mixed environments."

But hierarchy can also define storage management according to products sold, based on specific needs as much as on an environment's size and complexity. Gartner Group divvies the software arena (encompassing backup and recovery products) into two segments, enterprise and departmental, both extremely relevant to corporate buyers. "The enterprise segment consists of vendors that address the platform coverage, product function and product support requirements of central IT organizations in medium to large companies," says Gartner Group's Nicolett. (These organizations need to standardize their storage management processes across UNIX, Windows NT and NetWare servers.) "In this segment, deployment flexibility, comprehensive reporting and performance potential are valued above simplicity and a quick install."

According to Gartner Group, the departmental segment comprises vendors who are focused on the needs of individual LAN administrators. Here, platform coverage requirements are narrower (typically NT and NetWare, no UNIX) and easy installation is valued over advanced functions that add to deployment flexibility. "The buyer is also much more sensitive to acquisition and support costs," Nicolett says.

Many of the leading enterprise vendors initially developed products for UNIX environments. All have since extended storage management server support to include NT and some have had to expend significant resources to improve support capabilities and product stability. "Vendors like Legato, Veritas, IBM and HP have been most successful selling to the enterprise segment," says Nicolett. He also mentions EMC and CommVault Systems Inc., Oceanport, NJ, as vendors building a presence in this space.

While Nicolett points to Seagate and Computer Associates International, Islandia, NY, as dominant departmental segment

vendors with a larger NT installed base than the vendors mentioned above–while also alluding to the overlap between the two segments–Dataquest's Lahive divides the complex backup and recovery marketplace among software vendors (including Seagate, Cheyenne, Legato, Veritas and Intelliguard Software), hardware vendors (including HP, Sun and IBM) and vendors offering backup products from a tape perspective, in particular libraries featuring DLT (including StorageTek, ATL Products Inc., Irvine, CA, and Breece Hill Technologies Inc., Boulder, CO).

## Product Talk

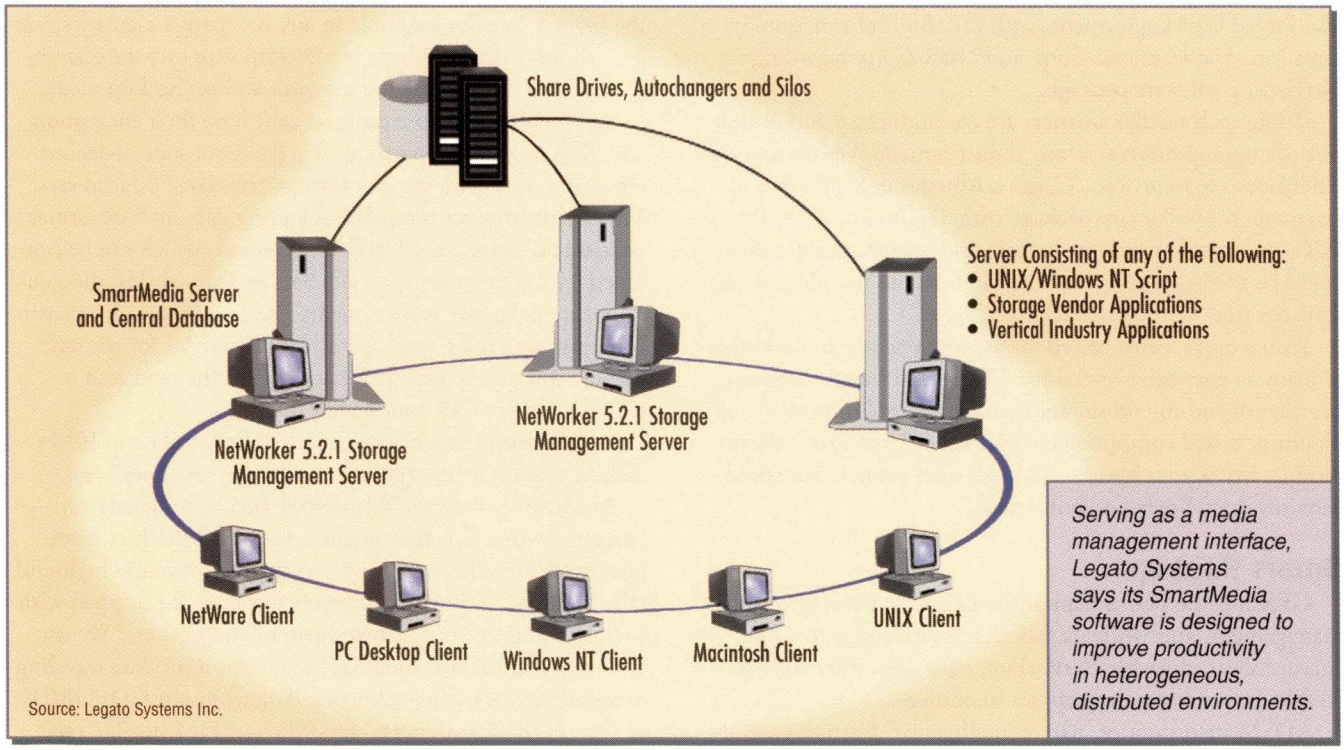
In August, Legato announced the general availability of SmartMedia, yet one more software product intended to uncomplicate storage management. Serving as a media management interface, Smart Media is designed to improve productivity in heterogeneous, distributed environments. "It enables dynamic storage sharing, meaning that servers can now access and take advantage of any available storage space, as opposed to traditional storage sharing where drives and space are dedicated to an application," says Peripheral Concepts' Neema. "In traditional storage space, drives may sit idle while other applications are in need of storage space." Another way to describe SmartMedia is as a proposed Institute of Electrical and Electronics Engineers (IEEE) standard that would establish a common interface for both storage hardware and storage software companies to write to. "It's able to be installed as an add-on to Legato NetWorker customers, non-Legato backup solutions, or it can be used to replace UNIX scripts," Legato's Cooper says.

This certainly sounds good, and the list of vendors supporting SmartMedia in the storage management arena reads like an industry who's who: Advanced Digital Information Corp. (ADIC), Ampex Corp., ATL, Breece Hill, Emass Inc., Exabyte Corp., HP, Overland Data Inc., Qualstar Corp., Quantum, Spectra Logic Corp., StorageTek and more.

Even Sun Microsystems is considering jumping on the SmartMedia bandwagon. "We're currently defining what media management software we'll support in the future," says Victor Nemechek, product marketing manager for Sun's backup and tape library solutions. "SmartMedia is under evaluation, but we haven't made any decisions yet." Sun already buys and resells another Legato product, Solstice Backup. "That's our low-end to mid-range [backup] solution," Nemechek says. "It's an easier-to-use package, but has limited capabilities." However, at the enterprise level, Sun has opted for an alternative to NetWorker, Legato's flagship product geared to enterprise customers. "For our enterprise-level clients, our solution is NetBackup which we OEM from Veritas," Nemechek says.

NetWorker is the foundation of Legato's three-pronged approach to storage management–a potential software product triumvirate that also includes SmartMedia and Global Enterprise Management of Storage (GEMS). GEMS is a framework for managing distributed data in a centralized way. For a base investment of about $25,000, and $2,000 to $3,000 more per managed node, customers can get an additional level of storage management control. By the way, a bare bones entry-level NetWorker package costs about $3,000, although with desireable features and options this figure soon jumps to the $15,000-to-$30,000 level for a typical installation and can soar as high as six figures for something more elaborate. Such a complicated price structure is comparable to Veritas' NetBackup–and so is its functionality.

The only other product that competes on an equal playing field with Legato's NetWorker and Veritas' NetBackup is IBM's ADSTAR Distributed Storage Manager (ADSM), although other niche-dwellers such as Spectra Logic's Alexan-

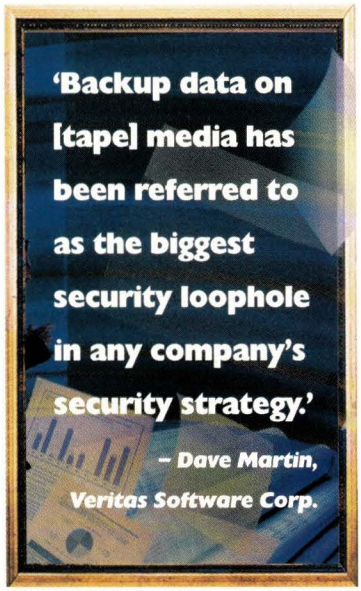



*Serving as a media management interface, Legato Systems says its SmartMedia software is designed to improve productivity in heterogeneous, distributed environments.*

dria, HP's OmniBack, Intelliguard's BudTool, EMC's Symmetrix Remote Data Facility (SRDF) and Computer Associates' (formerly Cheyenne's) ARCserveIT compete for virtually the same customers.

## Disaster Recovery

Nemechek talks up NetBackup's disaster recovery feature as if the product were Sun's own. "I think that a lot of the backup software vendors usually don't adequately address the area of disaster recovery," Nemecheck says. "Most of them, in order to recover from a disaster, require you to reinstall the operating system and also some form of their backup software. One exception is Veritas. They have a very nice feature, which allows the data that is backed up to be stored in a TAR [Tape Archive] format, a protocol that's viable across all UNIX flavors." TAR is a standard UNIX program that encodes a UNIX file system on a tape (or other linear-storage device) using a standard format. By implementing such a program following a disaster, administrators can recover data directly from the tape, without having to install the backup application software (which saves time) or worry about obtaining the special license key that many competing backup software products require.




Sun's relationship with Veritas was substantially enhanced in September. "We have signed a new agreement, which supersedes any previous agreements we had," says Nemechek. "In a nutshell, it will give us the ability to offer Veritas products across all platforms and provide a heterogeneous solution as opposed to what we were previously doing, which was only supplying the Sun [-brokered] software." Veritas has also forged OEM agreements with HP, Bull Information Systems Inc., Data General Corp. and NCR Corp. regarding its NetBackup software package.

While such reseller alliances are commonplace and indicative of ongoing survival in any industry niche, Veritas acquired TeleBackup Systems Inc., Calgary, Alberta, in September to integrate its NetBackup package with TeleBackup's TSInfoPRO–an ingenious remote backup and restore product–that could be the beginning of a "little big" rise in mobile product fortunes (see "Remotely Backup," Page 67).

Such a move seems geared toward low-end users, but Veritas remains an enterprise-level force. "We're positioned as the only provider of end-to-end storage management solutions for multiplatform, mixed computing environments," says Dave Martin, product manager at Veritas–although such a statement would certainly draw fire from Veritas rivals.

## Smart Backup

GEMS is the brains behind the Legato approach to storage management, and while its function is analogous to what "master slave" does for NetBackup, equating either to IBM's ADSM is like comparing apples to oranges.

ADSM incorporates "native intelligence" features embedded into the system. "With ADSM, customers can have a single backup and recovery strategy across all of their systems and can manage it with fewer people, which lowers their total cost of ownership," says Karen Dutch, ADSM product manager at IBM. ADSM's most compelling feature, however, is that it uses block-level increments to perform backup, a strategy that Veritas plans to emulate in future NetBackup releases. "ADSM uses a backup model called progressive backup, which means that once a base backup is made of all data, we only backup new or changed files from that point on," says Dutch. Usually configured for direct-attach tape in very large database (VLDB) environments where higher throughput rates are required, ADSM can also operate efficiently using network backup connections.

Do so-called progressive backups mean secure data? Not necessarily. While the IBM product provides data compression during the backup, that's where its anonymity ends. "ADSM doesn't encrypt the data being backed up," says Dutch. "We have not implemented anything yet because of export rules on using decent encryption key [algorithm] lengths. And 50% of ADSM sales are nonU.S."

Veritas, via NetBackup, is more proactive in terms of security. "Data security is becoming a major concern for the global 1,000 customer base," says Veritas' Martin. "Data is becoming more and more critical to the business and much of that data is being backed up outside firewalls. In addition, data is often stored in clear text on tape in industry-standard formats. Backup data on [tape] media has been referred to as the biggest security loophole in any company's security strategy." To solve this problem, NetBackup supports the encryption of data both across the network and on backup media.

Ah, but NetBackup customers can't have their encryption and TAR too. "You have to make a decision: state-of-the-art recovery versus extra security for sensitive data," Martin says. The Veritas product is capable of storing data in TAR format or standard proprietary NetBackup format, which can be combined with encryption. "For the best of both worlds, the solution is to make two copies: one in TAR, one not," says Martin. "You just have to be very careful with that TAR format tape because if someone gets their hands on it, they can read it with a standard TAR command."

At least the choice exists. Legato's NetWorker and IBM's ADSM won't have encryption capabilities until next year.

Meanwhile, Procom Technology Inc., a designer firm based in Irvine, CA, that manufactures and markets enterprise-wide "intelligent storage" solutions (primarily high-end tape libraries) and network-attached products equipped with backup solutions, has its own form of encryption. "We use RSA [Rivest, Shamir, Adelman] encryption for data traveling over the network when accessing data from our CDFORCE or DataFORCE products," says Michael H. Khoyilar, tape

product manager at Procom.

Another company offering data peace-of-mind is Lone Star Software Corp., a tiny vendor headquartered in Mount Airy, MD (also goes by the name of Cactus International Inc.). Lone Star boasts "basic encryption" for its Backup Professional 1.3 product while also supporting "full crash recovery" for Solaris servers. "When data is traveling from client to server on a LAN connection, at least prying eyes cannot see it. Also, high-level administrators do not want sensitive data traveling through the network in bare form," says Jeffrey Hyman, Lone Star President.

Despite a budding appreciation for privacy, such security-minded measures are not quite a given in the backup world, especially with U.S.-based companies. SunGard Data Systems Inc., Wayne, PA, has specialized in handling worst-case scenarios since 1978 without any mention of encryption in its literature. "Historically, power outages are the greatest cause for concern," says John Sensenich, director of product strategy at SunGard.

Perception also figures prominently in how customers actually use backup software. In a study of large-scale UNIX data center users where the volume of data managed exceeds 100 GB (all respondents were customers of Spectra Logic), conducted by Phillip H. Goodwin for his Masters of Technology Management degree (completed last April) at the University of Denver, the findings were revealing. On average, each company surveyed said it deployed servers and workstations from more than three UNIX vendors (3.24 per respondent). Major UNIX vendors (in this case, HP, IBM and Sun) accounted for 68% of all systems deployed. In addition, respondents deployed nearly three backup packages (2.65 per user). Apparently, when it comes to choosing the right backup solution, confusion reigns and many administrators feel locked into vendor, end-to-end solutions only until something goes wrong.

## Backup for the Future

EMC is a leading supplier of intelligent enterprise storage systems and software for mainframe and open systems environments. Its relevant offering, Symmetrix Remote Data Facility (SRDF), is a future-minded system for replicating data to remote sites. Although replication is expensive when used on a gigabyte- or terabyte-basis, it is also serverless, working independently of the host processor or server. "Online remote data mirroring ensures that data is current and data recovery is immediate and seamless," says Ken McDonnell, senior public relations consultant at EMC.

While greater numbers of data-pressed, enterprise-level environments will likely find it necessary to duplicate their backup efforts using various replication strategies, a better bet for futuristic backup might be SANs pulsating with Fibre Channel.

"Various people have point-to-point solutions in place right now; little, niche solutions," says Kris Jensen, senior applications engineer for Box Hill Systems Corp., an independent client/server storage vendor based in New York City. "As the whole SAN environment evolves we're going to see smaller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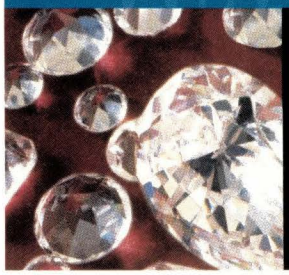

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pieces come into play." Currently, there are no Fibre Channel-based tape products on the market, so corresponding backups must use Fibre Channel-to-SCSI conversion devices with SCSI-based tape drives such as DLT or Exabyte's Mammoth (to gain access from a Fibre Channel bus to a SCSI device). Those will most likely be integrated with emerging software technologies. "For instance, Legato is adding new features to NetWorker to make it adaptable into a SAN environment as SANs become more prevalent," Jensen says.

And what of tape? Jensen envisions a myriad of Fibre Channel products providing "greater ease of access" to data residing on Fibre Channel disk drives. "In a way, the Fibre Channel disk products will become a part of SAN architecture," Jensen says.

But if you ask Dataquest's Lahive, the future of backups will certainly be pragmatic, if also vaguely visionary. "The network will be responsible for managing the backup," he says. "Not the storage device or the server. Maybe a switch or a hub." ⊸

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**Gode Davis** is a Rhode Island-based freelance writer who specializes in computer industry topics.

## Companies Mentioned in this Article

**Advanced Digital Information Corp. (ADIC)**
11431 Willows Road, N.E.
Redmond, WA 98052
*http://www.adic.com*
**Circle 140**

**Ampex Corp.**
500 Broadway
Redwood City, CA 94063
*http://www.ampex.com*
**Circle 141**

**ATL Products Inc.**
2801 Kelvin Ave.
Irvine, CA 92614
*http://www.atlp.com*
**Circle 142**

**Atrieva Corp.**
One Union Square
600 University St., Ste. 911
Seattle, WA 98101
*http://www.atrieva.com*
**Circle 143**

**Box Hill Systems Corp.**
161 Avenue of the Americas
New York, NY 10013
*http://www.boxhill.com*
**Circle 144**

**Breece Hill Technologies Inc.**
6287 Arapahoe Ave.
Boulder, CO 80303
*http://www.breecehill.com*
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**CommVault Systems Inc.**
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Oceanport, NJ 07757
*http://www.commvault.com*
**Circle 146**

**Computer Associates International Inc.**
One Computer Associates Plaza
Islandia, NY 11788
*http://www.cai.com*
**Circle 147**

**Connected Corp.**
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Framingham, MA 01702
*http://www.connected.com*
**Circle 148**

**CoreData Inc.**
4114 E. Wood St., Ste. 2
Phoenix, AZ 85040
*http://www.coredata.com*
**Circle 149**

**DataSave Services plc**
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Hounslow, Middlesex
U.K. TW3 3HW
*http://www.datasave.co.uk*
**Circle 150**

**Emass Inc.**
10949 E. Peakview Ave.
Englewood, CO 80111
*http://www.emass.com*
**Circle 151**

**EMC Corp.**
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Hopkinton, MA 01748
*http://www.emc.com*
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**Exabyte Corp.**
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Boulder, CO 80301
*http://www.exabyte.com*
**Circle 153**

**Hewlett-Packard Co.**
3000 Hanover St.
Palo Alto, CA 94304
*http://www.hp.com*
**Circle 154**

**IBM Corp.**
Contact local sales office
*http://www.ibm.com*
**Circle 155**

**Intelliguard Software Inc.**
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*http://www.iguard.com*
**Circle 156**

**Legato Systems Inc.**
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Palo Alto, CA 94304
*http://www.legato.com*
**Circle 157**

**Lone Star Software Corp.**
509 E. Ridgeville Blvd.
Mount Airy, MD 21771
*http://www.lone-tar.com*
**Circle 158**

**Oracle Corp.**
500 Oracle Pkwy.
Redwood Shores, CA 94065
*http://www.oracle.com*
**Circle 159**

**Overland Data Inc.**
8975 Balboa Ave.
San Diego, CA 92123
*http://www.overlanddata.com*
**Circle 160**

**Procom Technology Inc.**
2181 Dupont Drive
Irvine, CA 92612
*http://www.procom.com*
**Circle 161**

**Qualstar Corp.**
6709 Independence Ave.
Canoga Park, CA 91303
*http://www.qualstar.com*
**Circle 162**

**Quantum Corp.**
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Milpitas, CA 95035
*http://www.quantum.com*
**Circle 163**

**Seagate Software**
920 Disc Drive
Scotts Valley, CA 95067
*http://www.seagatesoftware.com*
**Circle 164**

**Silicon Graphics Inc.**
2011 N. Shoreline Blvd.
Mountain View, CA 94043
*http://www.sgi.com*
**Circle 165**

**Spectra Logic Corp.**
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Boulder, CO 80301
*http://www.spectralogic.com*
**Circle 166**

**Stac Inc.**
12636 High Bluff Drive
San Diego, CA 92130
*http://www.stac.com*
**Circle 167**

**Storage Technology Corp.**
2270 S. 88th St.
Louisville, CO 80028
*http://www.storagetek.com*
**Circle 168**

**Sun Microsystems Inc.**
901 San Antonio Road
Palo Alto, CA 94303
*http://www.sun.com*
**Circle 169**

**SunGard Data Systems Inc.**
1285 Drummers Lane
Wayne, PA 19087
*http://www.sungard.com*
**Circle 170**

**Syncsort Inc.**
50 Tice Blvd.
Woodcliff Lake, NJ 07675
*http://www.syncsort.com*
**Circle 171**

**TeleBackup Systems Inc.**
609 14th St., Ste. 400
N.W. Calgary, Alberta
Canada T2N 2A1
*http://www.telebackup.com*
**Circle 172**

**Veritas Software Corp.**
1600 Plymouth St.
Mountain View, CA 94043
*http://www.veritas.com*
**Circle 173**

# Backup Software Packages

**Compiled by MAUREEN MCKEON**
**(based on information supplied by the vendors)**

**Key**

HW = Hardware
SW = Software
S = Standard feature
O = Optional feature
N/O = Feature not offered
N/A = Information not available

| Company address model | Disk space required (MB) | Workgroup class | Storage devices supported | Server requirements | Platforms supported | Parallel backup/recovery | Cloning | Autochanger support | Archive service support | Online cataloging | Data encryption | GUI-based interface | Command-line interface | Centralized control/monitoring | Price ($) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Amdahl Corp., 1250 E. Arques Ave., Sunnyvale, CA 94088, *http://www.amdahl.com.* Circle 200** | | | | | | | | | | | | | | | |
| NetWorker | 63 (UNIX), 50 (NT) | Large | Tape drives, autochangers, jukeboxes, more | SunOS, Solaris, AIX, HP-UX | SPARC, RS/6000, HP 9000 | S | S | S | O | S | N/A | S | S | S | Contact vendor |
| **Apunix Computer Services, 9555 Chesapeake Drive, Ste. 105, San Diego, CA 92123, *http://www.apunix.com.* Circle 201** | | | | | | | | | | | | | | | |
| Network Backup Daemon | 20 | Small | Tape libraries, jukeboxes | SunOS, Solaris | SPARC | N/O | N/O | S | S | S | N/O | S | S | N/O | 995+ |
| **ATL Products Inc., 2801 Kelvin Ave., Irvine, CA 92614, *http://www.atlp.com.* Circle 202** | | | | | | | | | | | | | | | |
| WebAdmin | N/A | Small, large | Wide range of ATL libraries, including P1000, 520, 7100, 2640 | HTTP server and Solaris | Netscape, Windows 95/NT | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Contact vendor |
| **BMC Software Inc., 2101 CityWest Blvd., Houston, TX 77042, *http://www.bmc.com.* Circle 203** | | | | | | | | | | | | | | | |
| SQL-BackTrack for Informix, Sybase, Oracle, Oracle NT, Oracle Parallel Server (5 separate products) | 25 | Large | 4mm, 8mm, DLT | Solaris, AIX, HP-UX, SINIX | SPARC, RS/6000, HP 9000, Siemens Nixdorf | S | N/O | S | N/O | S | SW | N/O | S | S | Contact vendor |
| **Box Hill Systems Corp., 161 Avenue of the Americas, New York, NY 10013, *http://www.boxhill.com.* Circle 204** | | | | | | | | | | | | | | | |
| Legato NetWorker | 20 | Large | 4mm, 8mm, DLT, autochangers, more | Solaris, AIX, HP-UX, Windows NT | SPARC, RS/6000, HP 9000, Intel | S | O | S | S | S | N/A | S | S | S | Contact vendor |
| **Cactus International Inc., 509 E. Ridgeville Blvd., Mount Airy, MD 21771, *http://www.cactus.com.* Circle 205** | | | | | | | | | | | | | | | |
| Backup Professional | 20 | Small, large | 4mm, 8mm, DLT, mini cartridges, autoloaders, jukeboxes, more | Solaris, AIX, SCO UNIX, Alpha, DG-UX, NetWare, SVR4, Windows 95/98/NT | SPARC, RS/6000, Pentium | S | N/O | O | S | S | N/O | S | O | S | 720+/server, 90-360/client |
| **CommVault Systems Inc., 2 Crescent Place, Oceanport, NJ 07757, *http://www.commvault.com.* Circle 206** | | | | | | | | | | | | | | | |
| Vault98 | 10 | Large | DLT libraries, 0.5-inch libraries, magneto-optical jukeboxes, more | SunOS, Solaris, AIX, HP-UX, Digital UNIX, SVR4, IRIX, NetWare, Windows NT on Intel/Alpha, Windows 95/98, Pyramid, VMS, more | SPARC, RS/6000, HP 9000, Auspex, Intel, Alpha, Windows 95/98/NT | S | O | S | S | S | SW | S | S | S | 30,000+ |
| **Computer Associates International Inc., One Computer Associates Plaza, Islandia, NY 11788, *http://www.cai.com.* Circle 207** | | | | | | | | | | | | | | | |
| ARCserveIT | N/A | Small, large | All popular tape devices | UNIX, including Solaris, AIX, HP-UX, OpenServer, UnixWare, Windows NT | SPARC, RS/6000, HP 9000, Intel | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Contact vendor |

# Backup Software Packages

| Company address model | Disk space required (MB) | Workgroup class | Storage devices supported | Server requirements | Platforms supported | Parallel backup/recovery | Cloning | Autochanger support | Archive service support | Online cataloging | Data encryption | GUI-based interface | Command-line interface | Centralized control/monitoring | Price ($) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dallastone Systems Solutions Inc., 9428 Baymeadows Road, Ste. 131, Jacksonville, FL 32256,** *http://www.mv.com/dallastone.* **Circle 208** | | | | | | | | | | | | | | | |
| **FlashNet 5** | 25 | Small, large | DLT, 8mm, 0.5-inch SCSI-based tape drives and libraries, all StorageTek silos, all SCSI jukeboxes | Solaris, AIX, HP-UX, IRIX, Windows NT | SPARC, RS/6000, HP 9000, SGI, Intel | S | N/O | O | S | S | N/O | S | S | S | Contact vendor |
| **EMC Corp., 171 South St., Hopkinton, MA 01748,** *http://www.emc.com.* **Circle 209** | | | | | | | | | | | | | | | |
| **EMC Data Manager** | 9 GB | Large | HP ST+ FX optical libraries, ATL DLT, STK DLT, Sony Petasite | Solaris, AIX, HP-UX, IRIX, Digital UNIX, SCO UNIX, DYNIX, more | SPARC, RS/6000, HP 9000, SGI, Sequent, more | S | O | S | N/A | S | SW | S | S | S | 250,000 |
| **Hewlett-Packard Co., OpenView Software Business Unit, 3404 E. Harmony Road, Fort Collins, CO 80528,** *http://www.hp.com.* **Circle 210** | | | | | | | | | | | | | | | |
| **OmniBack II** | 200 (UNIX), 140 (NT) | Large | 4mm, 8mm, DLT, QIC, magneto-optical, 3590, 3490, SD-3, AIT, more | SunOS, Solaris, AIX, HP-UX, IRIX, Digital UNIX, NetWare, OpenServer, DYNIX, Sequent, SVR4, Windows 95/98/NT | HP 9000 | S | S | S | S | S | HW, SW | S | S | S | 3,900 (UNIX), 995 (NT) |
| **IBM Corp., Contact local sales office,** *http://www.storage.ibm.com.* **Circle 211** | | | | | | | | | | | | | | | |
| **ADSTAR Distributed Storage Manager for AIX** | 78 | Small, large | Most SCSI devices, including tape, libraries, optical drives, jukeboxes | AIX | Solaris, AIX, HP-UX, AS/400, OS/2, MVS, VM, Windows NT | S | N/O | S | S | S | HW | S | S | S | 1,595/single server |
| **ADSTAR Distributed Storage Manager for HP-UX** | 64 | Small, large | Most SCSI devices, including tape, libraries, optical drives, jukeboxes | HP-UX | Solaris, AIX, HP-UX, AS/400, OS/2, MVS, VM, Windows NT | S | N/O | S | S | S | HW | S | S | S | 1,595/single server |
| **ADSTAR Distributed Storage Manager for Solaris** | 64 | Small, large | Most SCSI devices, including tape, libraries, optical drives, jukeboxes | Solaris | Solaris, AIX, HP-UX, AS/400, OS/2, MVS, VM, Windows NT | S | N/O | S | S | S | HW | S | S | S | 1,595/single server |
| **ADSTAR Distributed Storage Manager for Windows NT** | 16 | Small, large | Most SCSI devices, including tape, libraries, optical drives, jukeboxes | Windows NT | Solaris, AIX, HP-UX, AS/400, OS/2, MVS, VM, Windows NT | S | N/O | S | S | S | HW | S | S | S | 795/single server |
| **Intelliguard Software Inc., 6200 Village Pkwy., Dublin, CA 94568,** *http://www.iguard.com.* **Circle 212** | | | | | | | | | | | | | | | |
| **BudTool** | 70 | Large | Most conventional backup devices with SCSI | SunOS, Solaris, AIX, HP-UX, IRIX, Auspex, Digital UNIX, SCO UNIX, Sequent, Tandem, Cray, Pyramid, Windows NT | SPARC, RS/6000, HP 9000, SGI, Auspex | S | S | S | O | O | N/O | S | S | S | 2,495+ |
| **Legato Systems Inc., 3210 Porter Drive, Palo Alto, CA 94304,** *http://www.legato.com.* **Circle 213** | | | | | | | | | | | | | | | |
| **NetWorker 5** | 50 | Small, large | 4mm, 8mm, DLT, more | SunOS, Solaris, AIX, HP-UX, Windows 95/98/NT | All popular UNIX and Windows platforms | S | S | O | O | S | SW | S | S | S | 3,600-19,500 (UNIX) |
| **Lone Star Software Corp., 509 E. Ridgeville Blvd., Mount Airy, MD 21703,** *http://www.lone-tar.com.* **Circle 214** | | | | | | | | | | | | | | | |
| **Lone-Tar** | 2 | Small | Any device supported by the operating system | SunOS, Solaris, AIX, HP-UX, DG-UX, UnixWare, OpenServer, Linux, BSDI, Alpha | SPARC, RS/6000, HP 9000 | S | S | S | S | S | N/O | N/O | S | N/O | 470 (Intel) 485 (nonIntel) |

# Backup Software Packages

| Company address model | Disk space required (MB) | Workgroup class | Storage devices supported | Server requirements | Platforms supported | Parallel backup/recovery | Cloning | Autochanger support | Archive service support | Online cataloging | Data encryption | GUI-based interface | Command-line interface | Centralized control/monitoring | Price ($) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Luminex Software Inc., 6840 Indiana Ave., Ste. 130, Riverside, CA 92506,** *http://www.luminex.com.* **Circle 215** | | | | | | | | | | | | | | | |
| **Fire Series CD-R** | 5 | Small | CD, DVD recorders, libraries, jukeboxes | SunOS, Solaris, AIX, HP-UX, IRIX | SPARC, RS/6000, HP 9000, SGI | S | S | S | S | S | N/O | S | S | S | 4,995+ |
| **NovaStor Corp., 80B W. Cochran, Simi Valley, CA 93065,** *http://www.novastor.com.* **Circle 216** | | | | | | | | | | | | | | | |
| **NovaBackup** | 5 | Small | Most SCSI tape drives, autoloaders | Windows 95/98/NT, DOS, OS/2 | Intel | N/O | N/O | N/O | N/O | N/O | SW | S | S | S | 49.50 |
| **NovaNet-WEB** | 4 | Small, large | Server disk storage | Windows 95/98/NT | Intel | N/O | N/O | N/O | N/O | N/O | SW | S | N/O | S | 1,195/ 25 users |
| **NovaNet 7** | 3 | Small, large | Most SCSI tape drives, autoloaders, jukeboxes, libraries | Windows 95/98/NT, DOS, Novell | Intel | S | N/O | 0 | N/O | N/O | N/O | S | S | S | 299/single server, 1,599/unlimited servers |
| **Open Systems Management Inc., 1111 Third Ave., Ste. 2500, Seattle, WA 98101,** *http://www.osmcorp.com.* **Circle 217** | | | | | | | | | | | | | | | |
| **COSbackup** | 17 | Small, large | 4mm, 8mm, jukeboxes, more | Solaris, AIX, HP-UX, Digital UNIX, IRIX, Windows NT | SPARC, RS/6000, HP 9000, SGI, Sequent | S | 0 | S | S | S | HW | S | S | S | 1,000 (UNIX), 500 (NT) |
| **Platinum Technology Inc., 1815 S. Meyers Road, Oakbrook Terrace, IL 60181,** *http://www.platinum.com.* **Circle 218** | | | | | | | | | | | | | | | |
| **NetArchive** | 3.5-4.5 | Small, large | 4mm, 8mm, DLT, libraries, jukeboxes | SunOS, Solaris, AIX, HP-UX, IRIX Digital UNIX, Windows NT | SPARC, RS/6000, HP 9000, SGI | S | S | S | S | S | N/O | S | S | N/O | 5,000+ |
| **ProVision Database Backup & Recovery** | 5-15 | Small, large | 4mm, 8mm, DLT, third-party vaulting software | Solaris, AIX, HP-UX, IRIX, Digital UNIX | SPARC, RS/6000, HP 9000, SGI | S | 0 | 0 | S | S | S | S | N/O | S | 6,000+ |
| **SCH Technologies, 895 Central Ave., Cincinnati, OH 45202,** *http://www.sch.com.* **Circle 219** | | | | | | | | | | | | | | | |
| **REELbackup** | 25 | Large | Stand-alone tape devices, libraries, autoloaders | Solaris, SunOS, AIX, HP-UX, Digital UNIX, IRIX, Pyramid, NCR SVR4.3, Unisys SVR4, DYNIX, Windows NT | SPARC, RS/6000, HP 9000, SGI, Pyramid, NCR, Sequent, Unisys | S | S | S | S | S | N/O | S | S | S | Contact vendor |
| **Seagate Software, 400 International Pkwy., Heathrow, FL 32746,** *http://www.seagatesoftware.com.* **Circle 220** | | | | | | | | | | | | | | | |
| **Backup Exec 8.0** | 20 | Small, large | 4mm, 8mm, DLT, QIC, DC6000 | Solaris, AIX, HP-UX, Digital UNIX, IRIX, NetWare, Windows 3.1/ 95/NT, Macintosh | SPARC, RS/6000, HP 9000, SGI, Windows 3.1/95/NT | S | N/O | S | S | S | SW | S | S | S | 695+ |
| **Spectra Logic Corp., 1700 N. 55th St., Boulder, CO 80301,** *http://www.spectralogic.com.* **Circle 221** | | | | | | | | | | | | | | | |
| **Alexandria Backup and Archive Librarian** | 40-125 | Large | Over 30 tape libraries and jukeboxes | Over 20 operating systems, including SunOS, Solaris, AIX, HP-UX, Digital UNIX, IRIX, SCO UNIX, DG-UX, Pyramid, NCR SVR4, Auspex | SPARC, RS/6000, HP 9000, SGI, Alpha, AViiON, Unisys, more | S | S | S | S | S | HW | S | S | S | Contact vendor |
| **Sun Microsystems Inc., 901 San Antonio Road, Palo Alto, CA 94043,** *http://www.sun.com.* **Circle 222** | | | | | | | | | | | | | | | |
| **StorEdge Enterprise NetBackup** | N/A | Large | Most devices, including automated devices | SunOS, Solaris, AIX, HP-UX, Digital UNIX, NCR UNIX, Pyramid Reliant UNIX, IRIX, DYNIX, Auspex, Digital OSF, Network Appliance, Pyramid DCOS, Windows NT | SPARC, Intel, Alpha | S | S | S | S | S | HW, SW | S | S | S | See vendor's Web site |

# Backup Software Packages

| Company address model | Disk space required (MB) | Workgroup class | Storage devices supported | Server requirements | Platforms supported | Parallel backup/recovery | Cloning | Autochanger support | Archive service support | Online cataloging | Data encryption | GUI-based interface | Command-line interface | Centralized control/monitoring | Price ($) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Syncsort Inc., 50 Tice Blvd., Woodcliff Lake, NJ 07675,** *http://www.syncsort.com.* **Circle 223** | | | | | | | | | | | | | | | |
| **Backup Express** | 40 | Large | Libraries, autoloaders | Solaris, AIX, HP-UX, IRIX, DG-UX, Digital OSF, Windows NT | SPARC, RS/6000, HP 9000, SGI, AViiON, Siemens, Power PC, Intel, Alpha | S | S | S | N/O | S | SW | S | S | S | 5,550+ (UNIX) |
| **Unisolutions Associates, 33586 Via Lagos, Dana Point, CA 92629,** *http://www.unisol.com.* **Circle 224** | | | | | | | | | | | | | | | |
| **Bart** | 10 | Small | Most devices | Most UNIX platforms | SPARC, RS/6000, HP 9000, Sequent Alpha, MIPS, more | S | N/O | O | S | S | HW, SW | S | S | S | 995+ |
| **Unisource Systems Inc., 1409 N. Cove Ave., Longwood, FL 32750,** *http://www.unisrc.com.* **Circle 225** | | | | | | | | | | | | | | | |
| **Perfect BACKUP+** | 4 | Large | Jukeboxes, autoloaders, 0.5-inch tape libraries | Solaris, Linux, SCO, UnixWare, FreeBSD | SPARC, Intel | S | S | O | N/O | S | HW, SW | S | S | S | Free, 198/autochanger module |
| **UniTrends Software Corp., 1601 Oak St., Ste. 201, Myrtle Beach, SC 29577,** *http://www.unitrends.com.* **Circle 226** | | | | | | | | | | | | | | | |
| **CTAR** | 2 | Small, large | Most SCSI tape devices, including 4mm, 8mm, DAT, DLT, QIC, magneto-optical drives, jukeboxes | Over 26 UNIX platforms, including SunOS, Solaris, AIX, HP-UX, Digital UNIX, UnixWare, DG-UX, SCO UNIX, Linux, NCR, Digital OSF | SPARC, Intel, RS/6000, HP 9000 | S | N/O | O | S | S | N/O | O | S | S | 195-650 |
| **Veritas Software Corp., 1600 Plymouth St., Mountain View, CA 94043,** *http://www.veritas.com.* **Circle 227** | | | | | | | | | | | | | | | |
| **NetBackup** | 15 | Large | Most SCSI, including tape, libraries, jukeboxes | SunOS, Solaris, AIX, HP-UX, Digital UNIX, IRIX, DYNIX, NetWare, Windows 95/98/NT | Sun 3, Sun 4, SPARC, UltraSPARC, RS/6000, HP 9000, NCR, Pyramid, SGI, Sequent, Motorola, Alpha, Cray, Intel | S | S | S | S | S | SW | S | S | S | 8,500+ (Sun), 5,000+/ database extensions |
| **Workstation Solutions Inc., 5 Overlook Drive, Amherst, NH 03031,** *http://www.worksta.com.* **Circle 228** | | | | | | | | | | | | | | | |
| **Quick Restore** | N/A | Small, large | Most SCSI, including 4mm, 8mm, DLT | SunOS, Solaris, AIX, HP-UX, IRIX, SCO UNIX, NCR, Ultrix, Windows NT | SPARC, RS/6000, HP 9000, SGI, Alpha, Intel | S | N/O | S | N/O | S | HW, SW | S | S | S | Contact vendor |

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| ***Feature:*** | | | |
| Getting Back to Backup | 230 | 231 | 232 |
| ***Columns:*** | | | |
| Ask Mr. Protocol – Mr. P. and the Internet Red Shift | 233 | 234 | 235 |
| UNIX Basics – Resource Access | 236 | 237 | 238 |
| I/Opener – Perl Conference Report 2.0 | 239 | 240 | 241 |
| Systems Administration – Variable-Length Subnet Masking | 242 | 243 | 244 |
| NTegration – An NT Bookshelf | 245 | 246 | 247 |
| Q&AIX – Trace'ing Signals | 248 | 249 | 250 |
| Datagrams – Starr Day | 251 | 252 | 253 |
| AIXtensions – A Penny Earned | 254 | 255 | 256 |
| Work – A Short History of Reading | 257 | 258 | 259 |
| ***WebServer Magazine:*** | | | |
| Managing Traffic with VPNs | 260 | 261 | 262 |
| Network Uptime all the Time | 263 | 264 | 265 |

PAUL KORZENIOWSKI

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

# Managing Traffic with VPNs

*Now that the Internet has become a common communications vehicle in many organizations, companies are on the lookout for ways to improve and manage its use. To do so, many companies are turning to Virtual Private Networks (VPNs).*

Illustrations by Erin Terry

VPNs, in effect, convert the public Internet into a private communications channel and promise three value-added services: security, increased bandwidth availability and network management.These features enable companies to move more applications from their corporate network to the Internet. In doing so, a firm can send sensitive data and be assured that its transmission is safe and secure. Corporations can also replace expensive dial-up or leased-line connections with lower-cost, local-access lines and, at the same time, they can off-load network equipment purchases and network management functions to Internet service providers (ISPs).

While VPNs have potential benefits, the underlying technology is nascent and in need of fine-tuning. In addition, security features associated with VPNs can add network overhead and force companies to purchase more bandwidth–and the network availability guarantees that ISPs offer are by no means rock solid–so they may not want to move mission-critical systems to a VPN just yet. Unlike most technologies, VPNs are not a specific type of network service. Corporations can use a VPN to replace a variety of network services, including dial-up links, leased-line connections or wide-area networks (WANs).

Rick Malone, principal at Vertical Systems Group, a Dedham, MA-based market research firm, says, "When examining their dial-up connections, companies often see compelling reasons to move to VPNs because they are less expensive and easier to maintain."

Companies generally have two ways of connecting remote users to a corporate network: 800 services or dial-up connections, each of which can potentially cost hundreds of dollars per month. By using the Internet to allow users to send and receive information, a firm can lower these monthly charges to around $20 per employee. In an April survey, Forrester Research Inc., a Cambridge, MA-based market research firm, found that on average a company with 1,000 or more remote users can reduce its annual remote-access costs by as much as 60% by moving to a VPN (see Figure 1).

Such savings intrigued Teletrac Inc., a Kansas City, MO-based fleet vehicle management firm. Until this year, the company relied on 800 lines, laptop computers and a PC running Microsoft Corp.'s Windows NT Remote Access Server to provide its 200 users with remote access to the corporate network. The connections provided employees

**Figure 1. Remote User Access Costs**

| Annual cost (in dollars) | To Support 1,000 Remote Users | Traditional Remote Access VPN |
|---|---|---|
| Access charges | 1,080,000 | 540,000 |
| Capital expenses | 300,000 | 0 |
| User support | 104,000 | 22,400 |
| T1 lines | 24,000 | 34,200 |
| Total | 1,508,000 | 596,600 |

Source: Forrester Research Inc., Cambridge, MA

with information such as vehicle availability and access to daily business applications.

Craig Johnson, a data communications specialist at Teletrac, says every time an employee picked up the telephone it cost his company six cents per minute, plus equipment maintenance and long-distance charges. Johnson found that moving to a VPN would lower that cost to two cents per minute and eliminate the additional charges altogether. This is because VPNs have a different usage model than traditional telephone services. Historically, the user purchased, installed and maintained remote-access servers. With a VPN, those functions are largely taken care of by an ISP. Long-distance charges are eliminated because ISPs charge customers only for local access, not long-distance services.

To take advantage of these benefits, Teletrac decided to sign up with Concentric Network Corp., a Cupertino, CA-based ISP, in February. By April, Teletrac's 200 remote users were able to access the corporate network via Internet connections. The transition was not smooth, however, and there were more than a few bumps. Teletrac relies on Novell Inc.'s Internetwork Packet eXchange (IPX) protocol as well as TCP/IP to move information on its network. Initially, Concentric's services did not support IPX, a limitation that took 30 days to fix, Johnson says.

But once the transitional bumps were smoothed over, the system proved to be so popular that Teletrac now plans to upgrade its network access speeds. Currently, users work with 28.8-Kb/s modems, but the firm plans to upgrade to 56-Kb/s modems in the coming months.

Dial-up connections are an early area of emphasis in the VPN space because remote access has become such an important application for today's corporations. To increase productivity, companies have become flatter and less hierarchical. Increasingly, employees work in branch offices, travel to customer sites or telecommute from home. With information becoming the fuel that drives business, employees need passage to the information stored in servers on the corporate network now more than ever before.

The quest for better remote access pushed Auto Europe LLC, a Portland, ME-based company that offers services such as car rentals and hotel accommodation to European travelers, toward a VPN. In the past few years, Auto Europe has allowed its application developers to work from home. However, its network supported only dial-up modems, which the programmers scoffed at. "In our area, cable television companies have aggressively deployed cable modems, so our engineers had become quite comfortable with high-speed Internet access," says Mark Bickford, Internet services coordinator at Auto Europe.

The firm's remote-access system, Microsoft's Remote Access Server, had other limitations too. Auto Europe felt it wasn't powerful enough to support high-speed connections and that the system's security features were weak.

This spring, the firm decided to examine its VPN options. It first looked at Microsoft's Point-to-Point Tunneling Protocol (PPTP), which would have addressed the security issue; however, Auto Europe felt more comfortable with a hardware-based VPN than a software-based system. "We did

## Tunneling and Encryption

Corporations wishing to ensure that information sent via Virtual Private Networks (VPNs) is not open to intruders have two choices: tunneling and encryption. Each has its strong and weak points and is therefore suited to a specific type of transmission.

Tunneling is a technique that hides information in a communications line so nearby users do not know it's there. Although far from foolproof, it makes hacking more difficult and is perhaps the best current alternative to encryption. The most common tunneling technique is the Layer 2 Tunneling Protocol (L2TP), which is based on a combination of Microsoft Corp.'s Point-to-Point Tunneling Protocol (PPTP) and Cisco Systems Inc.'s Layer Two Forwarding (L2F) technique.

One advantage with L2TP is it can simultaneously support multiple protocols, such as Novell Inc.'s Internetwork Packet eXchange (IPX) and TCP/IP, but L2TP lacks integrated security features. Therefore, if a user happens to tap into a nearby communications link, there's nothing to prevent them from reading sensitive information.

Encryption programs scramble information before it travels along a link and decode it when it reaches its destination. The most common VPN encryption technique is IPSec, developed by the Internet Engineering Task Force (`http://www.ietf.org`), which protects data by encrypting each packet, signing it and then sending it along a network link.

IPSec uses packet headers, called Authentication Headers, to validate users and Encapsulating Security Payloads (ESPs) to encrypt data. IPSec supports multiple simultaneous remote-access connections, so that a user can maintain one connection to the corporate office and another to the Internet.

This technique is often combined with Internet Key Exchange (IKE), also developed by the IETF. IKE is a key-management scheme that monitors the exchange of cryptographic keys between devices. While IPSec encrypts information, IKE locks up data and makes sure it has not been tampered with en route to its destination.

When evaluating these options, a company must determine at which point in the transmission it wants to secure information. L2TP is usually implemented at an Internet service provider (ISP)'s connection point, which means there is the possibility of a security breach between the user's desktop and the ISP's network. On the other hand, IPSec is designed to work at a client's desktop and guarantees secure communications over the entire length of the link. L2TP is easier to implement and more flexible than IPSec, but IPSec offers a higher level of security.–*pk*

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**Circle No. 31**

not want to take away processing cycles from our servers," Bickford says.

So the company examined products from InfoExpress Inc., Los Altos, CA, Compatible Systems Corp., Boulder, CO, Extended Systems Inc., Boise, ID, and Information Resource Engineering Inc., Baltimore, MD. It found that Compatible's IntraPort 2 product line offered a couple of attractive pricing features: free client software and lifetime technical support at no extra charge. Auto Europe installed the system in July and has only one complaint: The product's documentation is weak. Now, Auto Europe's developers regularly use the VPN to access information stored on the corporate local-area network (LAN).

## The Promise of Security

In addition to lower costs, security is a prime attraction when it comes to VPNs. "Companies want to be sure that sensitive information is protected as it travels along the Internet," says Martha Young, principal at Cutting Edge Information Group, a market research firm based in Golden, CO.

Traditionally, ISPs had trouble meeting this need. On the Internet, information flows over communications lines shared by a variety of users. Consequently, there is the possibility that an unauthorized third party could tap into a neighboring connection and read confidential information. VPNs can solve this problem in one of two ways: tunneling or encryption (see "Tunneling and Encryption," Page 78).

One year ago, Methodist Healthcare Inc., Memphis, TN, examined how a VPN might improve communications on its 5,000-device internal network. Richard Smith, director of technical and network services at the company, says the organization wanted to cut down on the cost of client communications software that enabled users to access information stored on a Unisys Corp. mainframe. "Every time we turned around, an end user was downloading another $99 package," he says.

The health care firm relies on networking equipment from Bay Networks Inc., Billerica, MA, and purchased the company's Contivity VPN system early this year. The installation was a snap and around 30 users now rely on the VPN for their network connections.

However, this number is much lower than anticipated. Methodist Healthcare works closely with physicians and teachers at the University of Tennessee, which is located only a few miles away in Knoxville, and wanted to allow users there to examine patient information, but legal issues thwarted those plans. "Currently, it is illegal to transmit patient information over an Internet connection," says Smith. The U.S. Congress plans to formally address this issue, but until that occurs, the company has shelved its deployment plans.

While much of the initial interest has come from companies looking to improve internal communications, VPNs can also support the exchange of information with business partners (applications called "extranets") or the selling of products and services (so-called "electronic commerce"). "We have been surprised at the number of firms willing to use VPNs for extranet applications," says Richard Kagan, vice president of marketing at VPNet Technologies Inc., San Jose, CA, a maker of VPN hardware.

VPNs enabled Transaction Network Services (TNS) Inc., Reston, VA, to extend its service repertoire. The firm sells communications services to retailers, telephone companies and financial firms. It relies on an internal network that now offers connections to customers in 42 cities in the United States and three cities in the United Kingdom.

In early 1997, TNS considered adding a new service that would enable Wall Street financial firms to complete stock trades. John Schanz, general manager for financial services at TNS, says VPNs offered the needed security. The company decided to add encryption features to the security features inherent in Cisco IOS, an operating system used in routers and switches from Cisco Systems Inc., San Jose, CA.

TNS began offering the new service in spring 1997. Initially, customers were limited to dial-up connections when transmitting data, but the company now offers dedicated, fractional T1 services. And at first, only a handful of companies took advantage of the service, but that number has now passed 100.

## Hidden Costs

While they can enhance corporate networks, VPNs also come with hidden costs and limitations. Training is an often-overlooked issue. In many organizations, users, comfortable with their existing communications software, are often required to become familiar with a different package in order to use a VPN.

In addition, the new security features can add a lot of network overhead. Frank Fuller, business line manager for remote network solutions at 3Com Corp.'s office in Boxborough, MA, says sophisticated encryption techniques can eat up as much as 3.3 Mb/s on a 10-Mb/s Ethernet line. To combat this problem, equipment vendors have been integrating onboard microprocessors that perform data compression and off-load all encryption functions from a switch's main microprocessor.

Suppliers must also prove that their equipment can scale to support large networks. "The first round of VPN systems were only suited to small and medium-size companies," says Cutting Edge Information's Young, so vendors have been working to increase their products' maximum connections from hundreds to thousands.

Guaranteed bandwidth availability is another tricky issue. On private networks, bandwidth is set or assigned to specific users. On the Internet, bandwidth is parceled out on a first-come, first-served basis. As a result, users may encounter busy signals or delays as they surf the Net. While companies want to move daily business applications to VPNs, they will do so only if they are certain that users will not encounter delays. Vendors have worked feverishly on Quality of Service (QoS) standards–the term used to describe the various techniques employed by equipment suppliers and ISPs to ensure bandwidth availability–however, VPNs have not yet come close to matching the QoS features found on traditional networks.

Ideally, bandwidth would be set aside for important applications at every point along an Internet connection. For this to occur, network equipment must adhere to a common set of standards that recognize different transmission types and

assign bandwidth priority to them accordingly.

Unfortunately, two standards, rather than one, have emerged as possible solutions: Asynchronous Transfer Mode (ATM) QoS, which works well on WAN connections, and Rerservation Protocol (RSVP), which is designed to operate on LANs running TCP/IP. Neither approach has gained significant market share, so it's too early to determine which, if either, will become the de facto standard.

Rather than wait for the standards issue to crystallize, some vendors are adding proprietary features to their products that set aside bandwidth for important applications, such as Cisco-Assure Policy Networking from Cisco Systems, which provides these capabilities for its routers and switches. However, because these features (dubbed "class of service") are vendor-specific, it's difficult for users and ISPs to build networks that offer QoS for all end-to-end connections–and it's near-impossible over the Internet.

Network availability is a key issue for corporations. As a result, carriers have started to offer service-level agreements (SLAs), contracts that guarantee a certain level of performance and bandwidth availability. However, early drafts of such agreements have their limitations. ISPs are only willing to guarantee service for information that flows on their networks. If a user enters by way of the public Internet, then any performance guarantees disappear.

How often users need to access the public Internet is unclear. "Most companies move information from set locations: a branch office to a corporate headquarters," says VPNet's Kagan. "In those instances, it is simple for an ISP to keep that traffic on its network." But, if users travel extensively and access the network from different locations, it becomes more difficult to route data on one network.

ISPs have been developing ways to work around the problems caused by Internet connections. John Lawlor, VPN product line manager at Concentric Networks, says his firm has peering arrangements with leading ISPs. Consequently, traffic that needs to pass from Concentric's network to, say, Fairfax, VA-based Uunet Technologies Inc.'s network, goes through a gateway at Concentric rather than traversing the Internet. This cuts down on the number of hops a transmission has to make and improves response time, Lawlor says.

In addition to security and guaranteed bandwidth, VPNs present carriers with network management challenges–the flexibility offered by these networks makes management more difficult. Because users can dial-in from any location, carriers may have trouble tracking which users are logging into the VPN, how long they are logged into the network and how much data they transmit. While users are content to hand management functions over to a carrier, they still desire some control over their network and the ability to see how it is performing. Therefore, ISPs have to deliver strong management reporting systems that enable users to examine historical performance as well as current network usage.

Finally, carriers are finding that they have to increase their service reach. "Because the underlying technology is new, carriers have been able to roll out VPN services only in select locations; few offer nationwide VPN access," says Vertical Systems Group's Malone.

Despite the potential problems, interest in this area is high and vendors are moving quickly to address limitations. "VPNs are not like voice mail or other technologies where it was difficult for firms to see a return on their investments," says VPNnet's Kagan. "Because the benefits are simple to see and the infrastructure needed to support those services is falling into place, VPN usage should increase dramatically during the next few years." ⊸

## Companies Mentioned in this Article

**Bay Networks Inc.**
1 Federal St.
Billerica, MA 01821
*http://www.baynetworks.com*
**Circle 174**

**Cisco Systems Inc.**
170 W. Tasman Drive
San Jose, CA 95134
*http://www.cisco.com*
**Circle 175**

**Compatible Systems Corp.**
P.O. Box 17220
Boulder, CO 80308
*http://www.compatible.com*
**Circle 176**

**Concentric Network Corp.**
10590 N. Tantau Ave.
Cupertino, CA 95014
*http://www.concentric.com*
**Circle 177**

**Extended Systems Inc.**
5777 N. Meeker Ave.
Boise, ID 83713
*http://www.extendsys.com*
**Circle 178**

**InfoExpress Inc.**
425 First St., Ste. E
Los Altos, CA 94022
*http://www.infoexpress.com*
**Circle 179**

**Information Resource Engineering Inc.**
8029 Corporate Drive
Baltimore, MD 21236
*http://www.ire.com*
**Circle 180**

**Microsoft Corp.**
One Microsoft Way
Redmond, WA 98052
*http://www.microsoft.com*
**Circle 181**

**Uunet Technologies Inc.**
3060 Williams Drive
Fairfax, VA 22031
*http://www.uunet.com*
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**VPNet Technologies Inc.**
1530 Meridian Ave.
San Jose, CA 95125
*http://www.vpnet.com*
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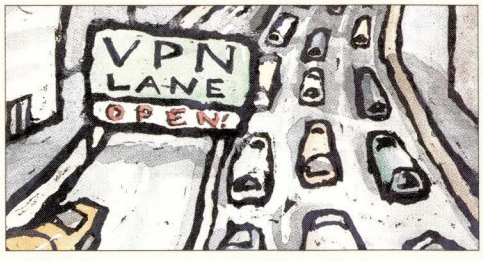


# Network Uptime all the Time

*In an effort to ensure a basic level of Internet service, more and more corporate customers are demanding guarantees on uptime and performance from their Internet service providers (ISPs). However, no ISP has guaranteed 100% uptime–until now.*

Uunet Technologies Inc. (http://www.us.uu.net) based in Fairfax, VA, has set a new precedent by promising a 100% network uptime guarantee to customers who have purchased dedicated Internet access. The promise doesn't include scheduled downtime for maintenance, however, and is not an automatic guarantee–in order to receive credit to their account, customers must first request that Uunet calculate the monthly downtime. Nonetheless, the new policy is the first of its kind in the Internet access market.

"Offering 100% availability is something you don't see a lot of out there," says Zia Daniell, analyst for Jupiter Communications' Telco and Cable Internet Strategies Group in New York City. "The typical guarantee is 99.5% and up."

The service-level agreement–announced in August–applies to U.S. customers with frame relay, dedicated 56 Kb/s, T1, T3 or OC3 Internet access. As well as the promise of no downtime, Uunet's guarantee includes an average monthly latency of no more than 85 msec round-trip within Uunet's backbone in the contiguous United States and no more than 120 msec between New York and Uunet's international gateway in London; customer notification within 15 minutes of an outage; and a guarantee that installation will not exceed 60 business days for T3 customers in the United States or 40 business days for all other dedicated-access customers.

The penalty for not meeting the uptime guarantee is one free day of service for every hour of calculated downtime. For not meeting the latency guarantee two months in a row, Uunet promises a credit good for one day of service. And if installation promises aren't met, customers receive a refund for half the installation fee.

However, it's the 100% uptime guarantee that has received the most attention from industry observers, mainly because it's the first such promise made by an access provider and because 100% uptime isn't likely to be 100% achievable.

"My first thought is they don't intend to actually achieve 100% service, because achieving 100% of anything is pretty much impossible," says James Eibisch, senior analyst for Input, a market research firm based in Mountain View, CA.

Jupiter Communications' Daniell adds that the penalties Uunet has agreed to if it misses service guarantees aren't particularly steep. "If they were confident that this was going to happen in only a very small percentage of instances, I think they'd be willing to risk more," Daniell says.

Nonetheless, Daniell and Eibisch agree that Uunet's 100% promise is–if not a guarantee that customers will actually see 100% uptime all the time–at least a positive step for both Uunet and the overall improvement of service in the Internet access industry.

"I think it will give them a leg up," says Daniell. "Other competitors may hold out for a bit, just to see what happens, but I expect you'll see them copying it in the near future."

And, of course, a 100% guarantee has a great deal more marketing appeal than guarantees of 99.5% or 99.7%–numbers that, practically speaking, represent equivalent levels of service but don't quite have the same unconditional ring to them.

"We decided, why not go for the number that's absolute," says Ralph Montfort, manager of network products at Uunet.

Right now, large ISPs, such as Uunet, ANS Communications Inc. (http://www.ans.com), Purchase, NY (a subsidiary of America Online Inc.), AT&T Corp. (http://www.att.com), Basking Ridge, NJ, and Exodus Communications Inc. (http://www.exodus.com), Santa

Clara, CA, all offer service-level guarantees of 99.5% or higher. Since October 1997, AT&T has given its Internet customers a 99.5% guarantee and its virtual private network (VPN) customers a 99.7% guarantee. However, Rob Marschall, marketing manager for AT&T business IP services says the uptime rate for AT&T customers is closer to 99.99%.

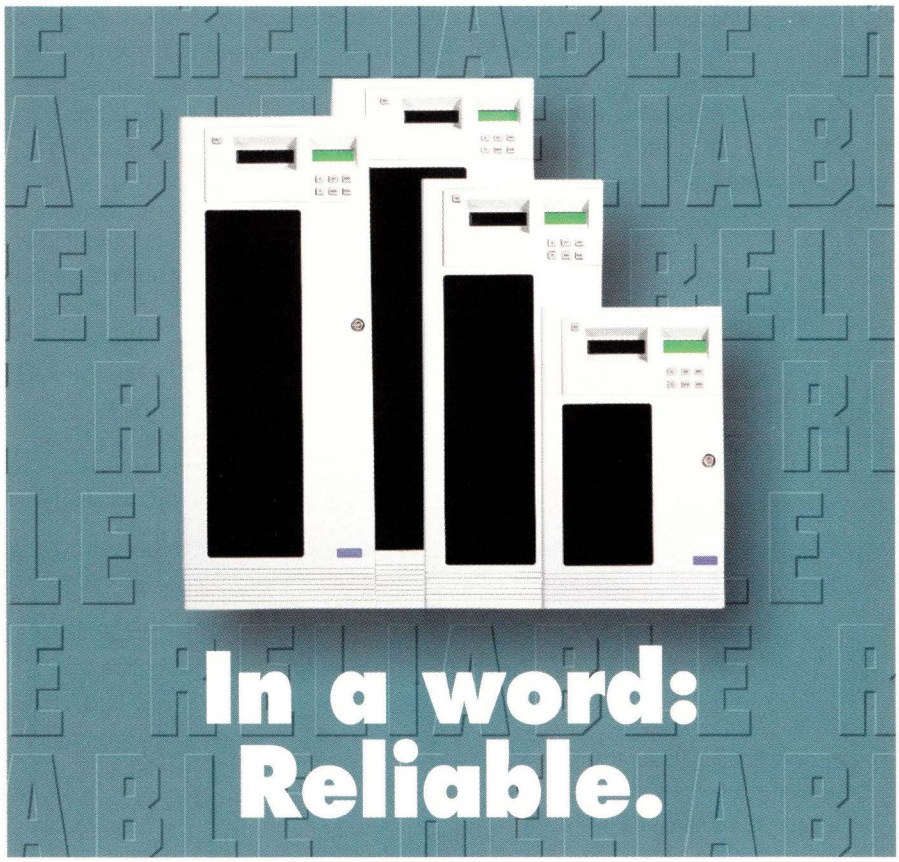
Despite the service-level offerings of top-tier ISPs, customers of most other access providers are far less likely to receive such guarantees. A study of European and U.S. companies with revenues in excess of $100 million, conducted by Input in August, found that 40% of U.S. firms with dedicated Internet access have no service guarantees of any kind. The survey also found that companies worldwide experience actual service levels that are significantly less than 100%: Forty percent of those surveyed reported getting less than 99% uptime, while 10% reported less than 95%.

Input's Eibisch says even 1% downtime equals approximately 3.5 days per year–a substantial loss for companies that conduct a lot of business over the Internet. ISPs that do offer a guarantee typically don't start at anything less than 95%. "Though I can't see network managers falling all over themselves with gratitude for a 95% guarantee," Eibisch says.

Certainly, Internet customers want guarantees. A survey conducted in February by research firm TeleChoice Inc., Owasso, OK, found that 94% of business customers consider a service-level guarantee to be "critical" or "very important" in selecting an ISP. Of that 94%, 90% said they're even willing to pay extra for such a guarantee. Customers rate network availability and connection uptime (measured by the number of dropped connections) as most important, according to the survey.

Over time, demand for service guarantees will force more ISPs to provide them. And that will put smaller, regional providers at a distinct disadvantage, says Eibisch. Because only those providers that actually control their own network hardware can guarantee availability, small regional providers that get national and international access from upstream providers cannot offer similar guarantees. "The more of the Internet that runs over your network, the more autonomy you have and the better able you are to make guarantees. That polarizes the market in a way, because it's something that smaller, independent ISPs simply can't offer," Eibisch says .

According to "The Internet Access Market: Opportunities for ISPs, Telcos and Content Providers," a study published in August by Boston, MA-based telecommunications and IT analysis firm, Ovum Inc., the ISP market is dividing into network-focused and content-focused providers. Those that want to do business as network-focused providers will have to offer guarantees. Only providers who can do that, as well as provide the infrastructure, technical support and financial compensation to customers who experience service failures, will remain competitive.

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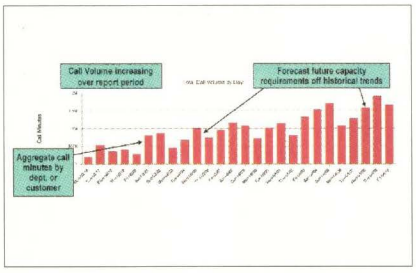
*The product descriptions are compiled from data supplied by the vendors. To contact them for more detailed information, circle the appropriate reader service number on the card located elsewhere in this issue.*

# URL/New Products

## Reporting Solution for IP Networks

Network Health - Remote Access from Concord Communications is said to provide performance reporting and analysis capabilities for optimizing the usage of remote access equipment. It delivers reports that assist Internet service providers (ISPs) and large corporations in managing the rapid growth of remote access usage, the company says.




Network Health - Remote Access helps reduce the number of blocked calls by providing early warnings of problems and by tracking how many modems or ISDN interfaces are in use at any given time. It can reportedly identify unproductive usage patterns by comparing modem connect times against actual data traffic to help identify users who dial in and establish a connection but who never transmit data. In addition, it reports on connection times and failed connection attempts for modem pools, remote access services (RAS) devices and individual modems. Point-and-click report capabilities let users quickly select what elements to monitor, the frequency of the report and the choice of output format, such as HTML, PostScript or PDF, the company says.

Network Health - Remote Access costs $6,000 and runs on Solaris, HP-UX and Windows NT.

**Concord Communications Inc.**
33 Boston Post Road West
Marlboro, MA 01752
*http://www.concord.com*
**Circle 186**

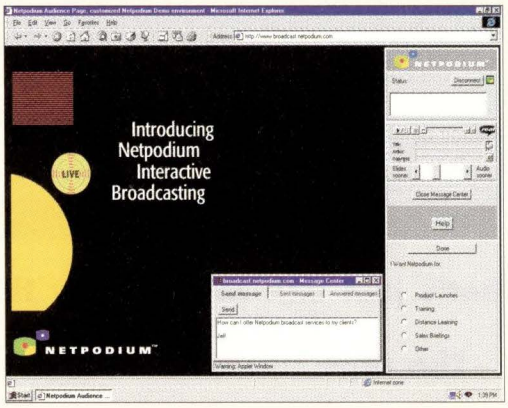
## A Model for Web Application Security

Version 2.0 of Unified Access Management (UAM) security model for Web applications is now available from Sirrus Internet Solutions. UAM reportedly manages security by integrating existing infrastructure elements, such as directories and digital certificate systems, defining a unified security policy in terms of access control, authentication, authorization and auditing, and enforcing the policy across the enterprise. New in Version 2.0 are strategies for securing Web technologies such as CORBA/IIOP, server-side Java and Web application servers. The UAM model can be used in conjunction with Sirrus' ClearTrust SecureControl software. A copy of the white paper detailing the UAM model can be downloaded for free from the company's Web site.

**Sirrus Internet Solutions Inc.**
609 Mission St., Ste. 600
San Francisco, CA 94105
*http://www.sirrus.com*
**Circle 187**

## Group Interaction Over the Net

Live, interactive broadcasts, such as online seminars or live customer support sessions, are now feasible, according to Netpodium, thanks to Version 1.5 of the company's Interactive Broadcasting Suite. At the heart of the suite is the Netpodium Interactive Broadcast Server. Running on a Microsoft Corp. Windows NT server and in tandem with a streaming media server such as RealNetworks Inc.'s RealMedia or Microsoft's NetShow, the Netpodium server manages the volume of content, messages and interactions during online broadcasts. Audience members can participate via any standard Java-enabled browser. The suite also includes Netpodium Broadcast Builder for assembling Microsoft PowerPoint slides and HTML pages. A single Netpodium server requires a Pentium Pro 200 with 128 MB of RAM running Windows NT 4.0 to serve an audience of up to 400 members. Pricing for Interactive Broadcasting Suite 1.5 starts at $795 for a 20-user license.




**Netpodium Inc.**
2101 4th Ave., Ste. 310
Seattle, WA 98121
*http://www.netpodium.com*
**Circle 185**

## AS/400 Opens to the Web

Lansa, a provider of application development tools for IBM Corp.'s AS/400 platform, has announced that Lansa for the Web now serves 100% Pure Java, thanks to integration with Java integrated development environments (IDEs) such as Inprise Corp.'s JBuilder and IBM's Visual Age for Java. Prior to the enhancement, Lansa for the Web was equipped to serve only HTML; now, AS/400 server code is easily reusable on

Internet-based platforms thanks to a new JavaBeans interface, the company says. Pricing for Lansa for the Web ranges from $15,000 to $50,000, depending on the number of developers.

**Lansa Inc.**
1520 Kensington Road, Ste. 110
Oak Brook, IL 60523
*http://www.lansa.com*
**Circle 188**

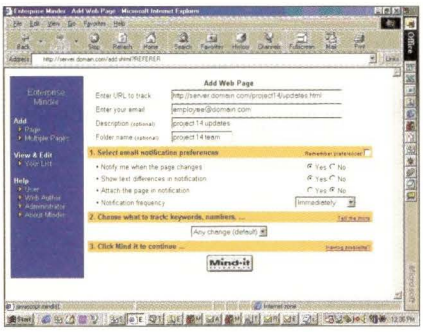
## Secure Server Out

For sites that need added security, Red Hat Software now offers Secure Web Server. Based on the Apache Web server, Secure Web Server runs on the Red Hat Linux operating system. With it, users can protect sensitive information such as credit card numbers, user names/passwords and any other data deemed private, the company says. The server is equipped with 128-bit encryption, Secure Sockets Layer (SSL) 2.0, CGI support, virtual hosting capabilities, the public-domain Squid Web Cache and Proxy, a Netscape Communications Corp. Web browser and log analysis software. A single license (with full source code and technical support) costs $99.95.

**Red Hat Software Inc.**
4201 Research Commons, Ste. 100
Research Triangle Park, NC 27709
*http://www.redhat.com*
**Circle 189**

## Tracking Tool Detects Web Page Changes

NetMind has updated Enterprise Minder, a Web-based information tracking tool that notifies site administrators of any changes via email or pager. Enterprise Minder 2.0 eliminates much of the overhead needed to regularly scan Web pages for additions and changes and can help cut bandwidth usage by 25% to 50%, NetMind says. Version 2.0 adds several new features, including Differential Minder, which can be used to specify what information has changed on a Web page; Number Minder, which notifies users when numbers (such as stock prices or inventory levels) cross a certain threshold; and Keyword Minder, which enables users to specify which keywords they wish Enterprise Minder to search. Enterprise Minder runs on Solaris




or Windows NT servers and comes with its own HTTP/SMTP server. Pricing for Enterprise Minder starts at $45 per seat, depending on the number of users.

**NetMind**
1885 S. Winchester Blvd., 1st Floor
Campbell, CA 95008
*http://www.netmind.com*
**Circle 190**

## Search Engine Offers Multiple Features

ht://Dig, a new high-performance search engine for Tenon Intersystems' WebTen Apache-based Web server, reportedly allows users to search multiple servers on a network and customize output using HTML templates. The depth of the search can be limited to a set of machines, a set of documents or database subsections. Email notification, boolean expression searches and fuzzy searching via configurable algorithms are all supported, the company says. A preliminary version of the search engine, developed at San Diego State University, is available for free to existing WebTen customers via the company's Web site.

**Tenon Intersystems**
1123 Chapala St.
Santa Barbara, CA 93101
*http://www.tenon.com*
**Circle 191**

## Sandbox for Shared Server Web Hosting

Web developers maintaining sites hosted on a shared server have typically been limited in the kinds of scripts they could run from their site. Web hosting companies argue that in a shared server environment, untested CGI scripts can wreak havoc on performance and increase security holes. Now, Concentric Network is offering Web hosting companies a way to circumvent these limitations with the introduction of its ConcentricHost Virtual Domain Environment (VDE), which, according to the company, provides each customer on the ConcentricHost Shared Server hosting platform with a virtual machine. Ultimately, this will allow Web developers to freely use complex CGI scripts on their site without having to submit them to their host provider first.

More information about Concentric's Web hosting services and pricing can found on the company's Web site.

**Concentric Network Corp.**
10590 N. Tantau Ave.
Cupertino, CA 95014
*http://www.concentric.net*
**Circle 192**

## Open Market Updates Acquired Software

Open Market has added new features to ShopSite Manager and ShopSite Pro, the company's online store-development software obtained from its May acquisition of iCentral. ShopSite Manager is a page-creation and site-management package with secure commerce features designed for small businesses. It costs $495.

ShopSite Pro is a page-creation and site-management tool designed for the experienced Web designer, hosting service or merchant who wants to build an online store, Open Market says. It provides all the features of ShopSite Manager, plus a fully integrated in-store search engine and tracking program. It costs $1,295. With ShopSite Pro Version 3.4, Open Market says it has improved the product's indexing and sorting capabilities and has increased its search speed. In addition, enhancements have been

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17. I certify that the statements made by me above are correct and complete.

S. Henry Sacks

S. Henry Sacks
Publisher

made to its page-updating and button-customization capabilities. Open Market has also added Diners Club/Carte Blanche and CyberCash Inc. payment options to both products.

**Open Market Inc.**
1 Wayside Road
Burlington, MA 01803
*http://www.openmarket.com*
**Circle 193**

## Web Management Tool

Platinum Technology has announced Raveler, a Web infrastructure management solution that addresses content creation, deployment and production. Raveler is intended to help Web site managers, editors and IT staff collaborate more effectively and minimize time spent on maintenance and project management, the company says. Some of the functions Raveler provides includes version control, comprehensive project status reports and the tracking and analysis of Web site performance and usage information. It is available for Windows NT to support Web sites on NT and UNIX servers and for authoring tools running on Windows 95/98/NT. It supports Netscape Communications Corp., Microsoft Corp. and Apache Web server software. Pricing for Raveler starts at $24,000.

**Platinum Technology Inc.**
1815 S. Meyers Road
Oakbrook Terrace, IL 60181
*http://www.platinum.com*
**Circle 194**

## Embedded Web-Based Management System

Rapid Logic has introduced the WebControl 2.0 Software Development Kit (SDK), an embedded Web-based management tool. WebControl 2.0 features several new capabilities, which are designed to improve network element management via any Web browser, the company says. WebControl SDK combines a visual integration tool with an extensible, platform-independent Web server specifically designed for use with embedded systems. New features include dynamic inheritance of SNMP MIB objects, support for SMTP-based email alerts and updates, and enhanced HTTP security through the support of digest authentication and user time-outs. WebControl 2.0 costs $45,000 per product platform; existing customers can purchase an upgrade for $11,250.

**Rapid Logic Inc.**
1040 Marina Village Pkwy.
Alameda, CA 94501
*http://www.rapidlogic.com*
**Circle 195**

## Web Time/Project Tracking Tool Out

Journyx has announced Version 2.0 of WebTime, its time and project tracking solution. WebTime 2.0 features several enhancements, including support for Microsoft Corp. Windows NT servers for data storage, new GUI choices for data entry, enhanced security features and support for Object Database Connectivity (ODBC), the company says. WebTime 2.0 runs on Solaris, AIX, Linux, FreeBSD and Windows NT Server 4.0. It costs $999 per server for five users; additional users cost $29 each.

**Journyx LLC**
11507 N. Lamar Blvd., Ste. A
Austin, TX 78753
*http://www.journyx.com*
**Circle 196**

## Test Your Web Server Performance

Midnight Networks, a division of Teradyne Inc., has unveiled Avalanche/Web, a Web server performance testing tool. With Avalanche/Web, developers can simulate Internet traffic by emulating up to 1,500 Web and FTP clients from a single server–that is, each of the 1,500 clients can be given its own IP address, the company says. Users can control the rate (in bits per second) of traffic sent by the client, the latency of the client's responses and the number of TCP errors introduced into the connection. Avalanche/Web costs $39,995 and comes with a 200-MHz Intel Corp. Pentium-based hardware platform, two 10/100-MB Ethernet ports and Midnight Networks' performance and stress testing software.

**Midnight Networks**
200 Fifth Ave., 1st Floor
Waltham, MA 02451
*http://www.midnight.com*
**Circle 197**

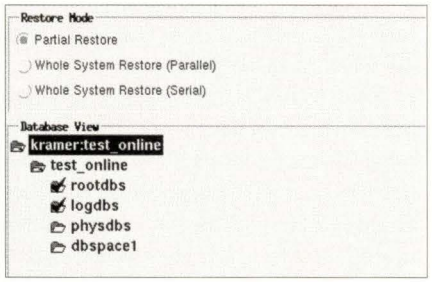
# NEW PRODUCTS

*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.*

## Storage Management for Distributed Environments

CommVault Systems has announced a new backup and restore software product, DBVault Magnum, which is integrated with database protection utilities EBU and RMAN from Oracle Corp. and ON-Bar from Informix Systems Inc. By integrating these vendor-sanctioned utilities, administrators can eliminate the need to restore data in order to recover a database following a system failure, the company says.

Magnum works in distributed environments, streamlining the backup of various databases by sharing back-end storage media. To this end, CommVault uses its proprietary DataPipe technology and end-to-end software architecture, which optimizes how data is sent over the network by breaking it down into multiple streams. CommVault says it has clocked Magnum delivering "real-world" performance of 15 GB/hour per Digital Linear Tape (DLT) drive over fast TCP/IP networks. In addition, DBVault Magnum can reportedly reinstall an entire database by integrating Oracle's and Informix's own recovery procedures. This, CommVault says, translates into substantial time savings for an administrator.




DBVault Magnum is offered as an extension to CommVault's Vault98 storage management suite and runs on a dedicated, centralized Sun Microsystems Inc. server. It supports Quantum Corp.'s DLT4000 and DLT7000 tape formats and the Redwood tape formats from Storage Technology Corp. DBVault Magnum supports a wide range of clients, including UNIX, Microsoft Corp. Windows 95/NT, Microsoft Exchange and SQL Server, Novell Inc. and Banyan Systems Inc. systems. Support for Sybase Inc. and IBM Corp. DB2 databases will be added to future releases. Contact company for pricing.

**CommVault Systems Inc.**
2 Crescent Place
Oceanport, NJ 07757
*http://www.commvault.com*
**Circle 101**

## Product Suite Offers Information Integration

TopTier Software has announced TopTier Product Suite, which includes server, client and development products aimed at addressing many of the integration issues facing IT managers.

TopTier features HyperRelational technology, which employs a form of hypertext based on HTML to facilitate navigation and access to databases, file systems and HTML documents, the company says. HyperRelational technology can be deployed on top of existing data

## User-Friendly Surge Protectors Unveiled

Newpoint, a division of Fiskars Inc., has announced its Surge Manager series of power surge protection products. The new product line comprises four models–A505TC, A502T, A102T and 101T–and is specifically engineered to protect high-performance, advanced multimedia computer systems and peripherals from power disturbances caused by lightning, power surges and spikes, the company says. Surge Manager reportedly offers protection against system crashes, corrupted data files, disk drive errors, computer lock-ups and hardware failures.

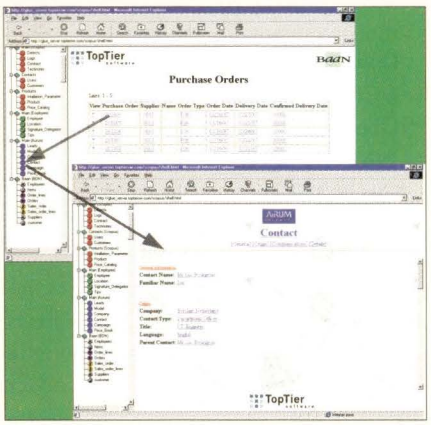
To make Surge Manager more user-friendly, Newpoint says it has incorporated several design enhancements into the product, including extra-wide spacing for two AC adapters, protected outlets to prevent accidental unplugging, a special right-angle plug to allow surrounding furniture to comfortably fit flush against the wall and an integrated cord management feature to keep cords and wires organized.

Other key features include six covered outlets (in addition to the two AC adapter outlets), Newpoint's ComGuard protection to guard against power disturbances on data phone lines, noise protection and three-line fusing for surge

safety. Pricing for the Surge Manager product line ranges from $59.95 to $99.95.

**Newpoint**
5950 Nancy Ridge Drive
San Diego, CA 92121
*http://www.newpoint.com*
**Circle 100**

sources without requiring additional coding and is said to provide navigation and correlation among independent data sources without changing the existing IT infrastructure. Using the product's Point of View navigation interface, users can find and examine information from any angle and compare data from disparate sources, the company says.




In addition, the TopTier Server correlates data from multiple, disparate and independent data sources. It supports user-, schema-, table- and column-level security without circumventing operating system, Web server or DBMS security levels. The client-side products, Data Navigator for the Desktop and Data Navigator for the Web, enable HyperRelational navigation via popular browsers or through Microsoft Corp. Windows-based client platforms.

TopTier Product Suite runs on Solaris and HP-UX platforms; pricing starts at $15,000.

**TopTier Software Inc.**
6203 San Ignacio Ave., Ste. 240
San Jose, CA 95119
*http://www.toptiersw.com*
**Circle 102**

## Relief for Overstressed Networks

Bottlenecks resulting from overstressed networks can be avoided, according to Allied Telesyn International, with the help of its new family of Gigabit Ethernet switches.

Allied Telesyn's switches are reportedly fast, easy to use and reliable. The switches provide wire-speed latency performance of Layer 2 MAC switching along with Layer 3 IP routing and Gigabit bandwidth. The switches are equipped with a common, nonblocking architecture that provides scalability in terms of speed, bandwidth, network size and quality of service.

The first models to be released are the AT-9108 and AT-8518. The AT-9108 is designed for backbone and server-farm applications. An eight-port, full-duplex Gigabit Ethernet backbone switch, it is equipped with six 1000BaseSX ports and two 1000BaseX ports, configurable as SX or LX. New features include fault-tolerance and management tools. The AT-9108 costs $16,995.

The AT-8518 is designed for high-performance workgroups that would benefit from Gigabit uplink connections, the company says. Two Gigabit Ethernet ports, configurable as LX or SX, and 16 10/100-Mb/s autosensing Ethernet ports help link power users to the server farm. The AT-8518 costs $9,495.

**Allied Telesyn International Corp.**
950 Kifer Road
Sunnyvale, CA 94086
*http://www.alliedtelesyn.com*
**Circle 103**

## RADIUS Server for UNIX

Bay Networks has introduced Version 2.1 of its BaySecure Access Control (BSAC) Remote Authentication Dial-In User Service (RADIUS) Server for UNIX. BSAC incorporates user authentication, authorization and accounting solutions for Inter/intranet environments.

Bay Networks calls BSAC the industry's only RADIUS server optimized for Solaris, Windows NT and NetWare environments. It differentiates itself by offering SQL database interfaces, IP/IPX address pooling, support for competitive vendor-specific attributes and integration with various external authentication regimes, such as Solaris NIS users and groups, NetWare NDS users and groups, NetWare Bindery users and groups and NT Domain users and groups, the company says.

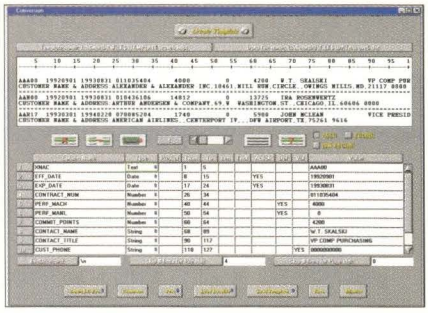
In addition, BSAC reportedly uses secure tunnels over the Internet to access the enterprise network. Working in conjunction with the Bay Networks Connectivity Extranet Switch, BSAC becomes a fully functioning security/policy engine by supporting the company's DVS or Layer 2 Tunneling Protocol (L2TP). BSAC can also help Internet service providers differentiate their virtual private network (VPN) offerings by deploying tiered VPN services, charging for service based on the number of secure tunnels used, Bay Networks says.

A single BSAC 2.1 RADIUS Server costs $4,500 and a single server with backup costs $8,500.

**Bay Networks Inc.**
4401 Great America Pkwy.
Santa Clara, CA 95054
*http://www.baynetworks.com*
**Circle 104**

## Data Conversion Software Unveiled

SmartDB Workbench 4.0, a data conversion product from SmartDB, is designed to speed and simplify the application integration process. Workbench 4.0 extracts data from source databases and files, then transforms, validates, maps and loads the converted information into any target application, the company says.



Workbench tracks activity at both the individual record and data set (groups of records) level and ensures that data is not duplicated when systems are restarted after a failure. The product's State Management and Refresh Loader capabilities are said to provide thorough tracking and reporting of individual records and data sets. State Management can also compare source and target data, then insert, update or delete records based on incremental changes. Refresh Loader, when combined with State Management, provides a complete monitoring and recovery solution in the event of a data processing failure, the company says.

A Task Manager feature is said to make it possible to coordinate various tasks, such as data extraction, data transformation and notification of task status and errors to administrators via email. While Workbench can extract data from (and convert data to) any application, an optional set of templates helps automate data conversion between Oracle Corp. programs. The SmartDB Oracle Financial & Manufacturing Application templates are portable across all supported runtime environments, including Solaris, HP-UX, AIX and Windows NT, SmartDB says.

A development license for SmartDB Workbench 4.0 costs $47,500 for four concurrent users and $9,000 for each additional user. Runtime licenses cost $7,500 per server and the prebuilt Oracle templates cost $3,000 per module.

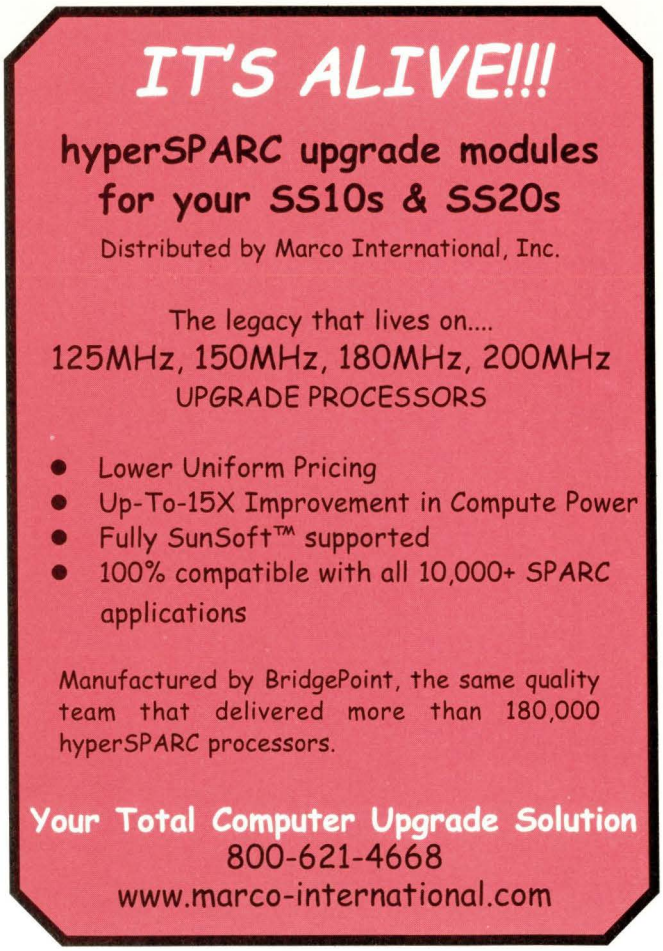
**SmartDB Corp.**
1121 San Antonio Road, Ste. B101
Palo Alto, CA 94303
*http://www.smartdb.com*
**Circle 105**

## Upgrades, Enhancements, Additions...

■ The ICE.TCP Pro Windows-to-UNIX Software Development Kit (SDK) from J. River now includes an API that can reportedly help developers extend the life of their legacy UNIX applications. ICE.TCP Pro includes a terminal emulator that can be embedded as an ActiveX control, allowing developers to customize and control terminal emulation within a Telnet-enabled application. In this way, UNIX applications can be linked to Microsoft Corp. applications such as Word or Excel, without forcing developers to reinvent the entire program, the company says. A full-featured 30-day trial version is available from the company's Web site; the full version costs $495. **J. River Inc.**, 125 N. First St., Minneapolis, MN 55401, *http://www.jriver.com.* **Circle 106**

■ Version 5.0 of Builder Xcessory PRO (BX PRO 5.0) from Integrated Computer Solutions allows UNIX developers to easily deploy their applications on multiple client platforms, including the Internet and Microsoft Corp. Windows 95/98/NT. New features include enhanced support for managing large projects, easier integration of third-party components, extensive support for C++ GUI development, simplified migration from other GUI builders and support for Java AWT 1.1. BX PRO 5.0 runs on Solaris, HP-UX, AIX, Digital UNIX and IRIX. A floating license with one year of technical support costs $6,495. **Integrated Computer Solutions Inc.**, 201 Broadway, Cambridge, MA 02139, *http://www.ics.com.* **Circle 107**

Circle No. 32



Circle No. 33

## Connect 128 Devices to a Single Server

The SX family of high-performance serial device concentrators from Specialix is said to allow customers to connect up to 128 serial devices to a single UNIX or Windows NT server. Thanks to new firmware and a customized Application Specific Integration Circuit (ASIC), the SX line achieves data throughput rates of 921 Kb/s–a 700% performance increase compared with the company's previous line of SI/XIO concentrators.

The SX family comprises a serial adapter card, which resides on the server, and an external eight-port SX device concentrator, which is available in the following configurations: eight RJ45, eight DB25 or seven DB25 ports and one parallel port. Up to four SX concentrators can be installed on one serial adapter card. This means that with four cards per server, the SX line can scale from eight to 128 serial ports.

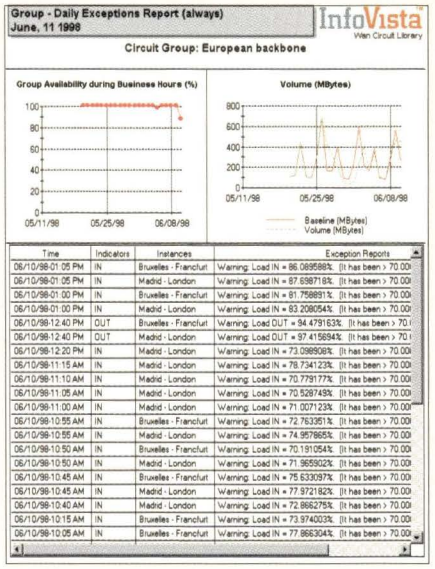
In addition, Specialix says the SX line is reliable and easy to install. Its custom firmware and ASIC manage data flow, ensuring balanced throughput on all ports, while full modem control and hardware/software flow control ensure data integrity. It comes with the Handy-Web CD-ROM support package, a browser-based tool, which automates installation and management and provides device drivers for all the supported operating environments, Specialix says.

The SX line supports SCO UNIX, Linux and Windows NT, among others. Pricing starts at $495.

**Specialix**
745 Camden Ave.
Campbell, CA 95008
*http://www.specialix.com*
**Circle 108**

## Plug-and-Play Network Management

InfoVista has announced a new family of plug-and-play applications that enable real-time reporting and analysis of enterprise networks. The VistaView applications are turnkey products designed to provide flexible real-time and historical reporting and analysis on the enterprise IT environment, the company says.




The first member of the new product line is VistaView for Networks, which includes VistaView for Network Service Levels, VistaView for WAN Circuits, VistaView for Routers and VistaView for LAN Segments. VistaView for Network Service Levels provides reports on node access, proxy "ping" path, node group and proxy "ping" path group; VistaView for WAN Circuits offers generic reporting on frame relay, ATM and leased-line serial link wide-area networks (WANs) through circuit evolution, circuit group evolution and circuit group summaries; VistaView for Routers includes reports on global router performance, router group performance and router group exceptions; and VistaView for LAN Segments features RMON Ethernet segment summaries, local-area network (LAN) loads, daily group summary loads and daily segment group exception reports.

VistaView for Frame Relay (an optional add-on) features eight reports, including a manager's daily network overview and a virtual circuit traffic distribution report. It costs $7,500. VistaView for Networks costs $27,000 for Solaris and $20,000 for Windows NT.

**InfoVista Corp.**
483 Seaport Court, Ste. 101
Redwood City, CA 94063
*http://www.infovista.com*
**Circle 109**

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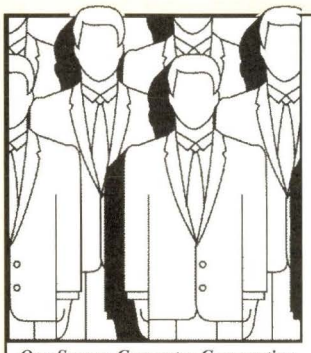

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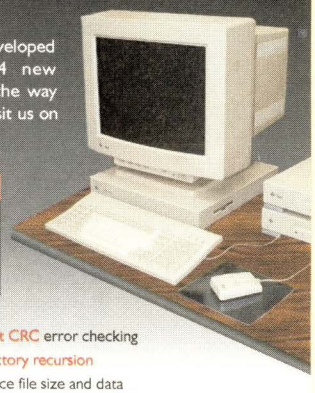

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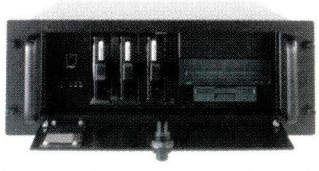

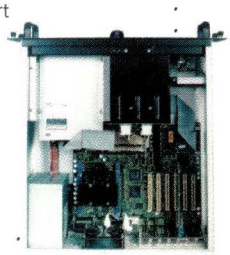

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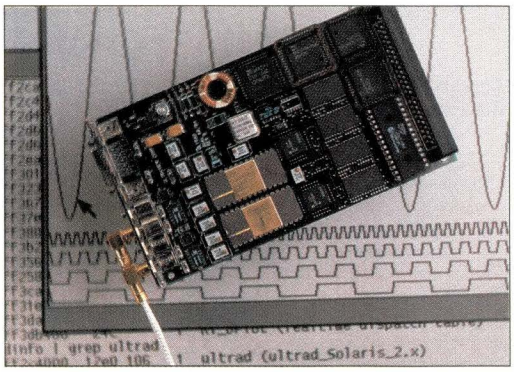

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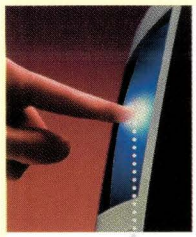

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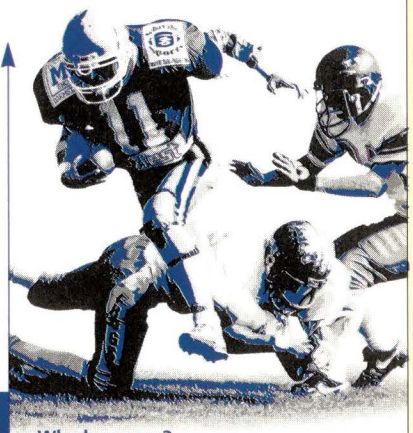

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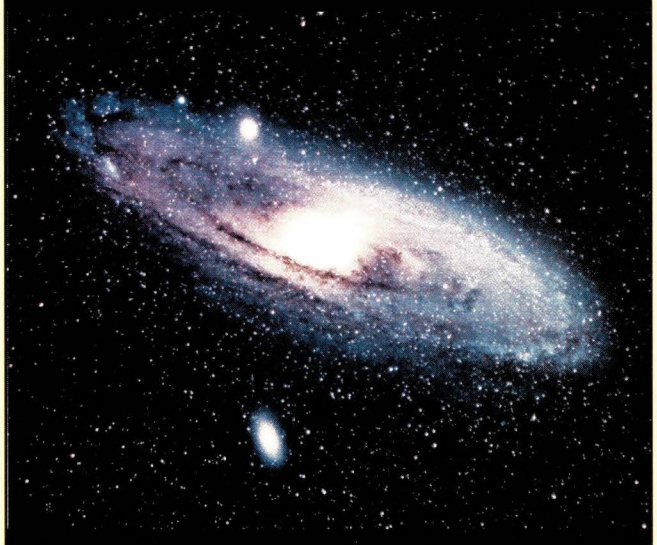

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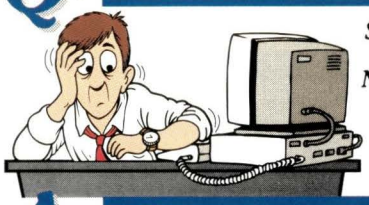

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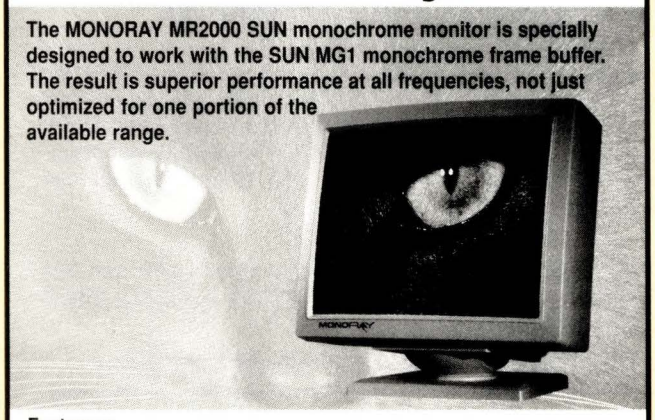

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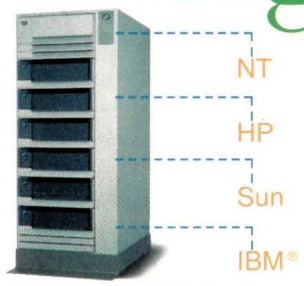


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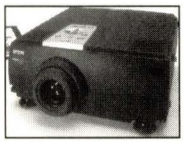

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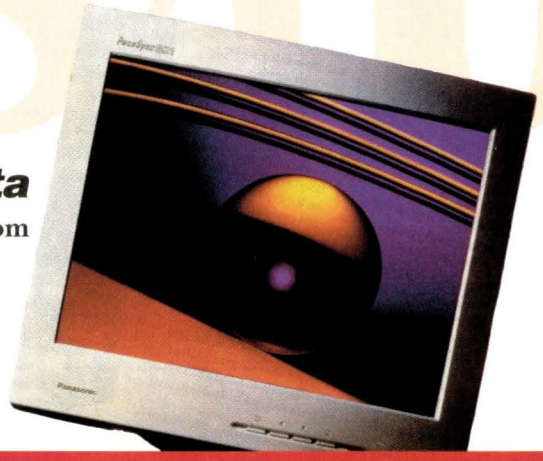

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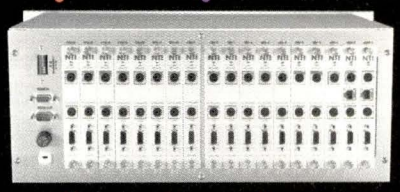

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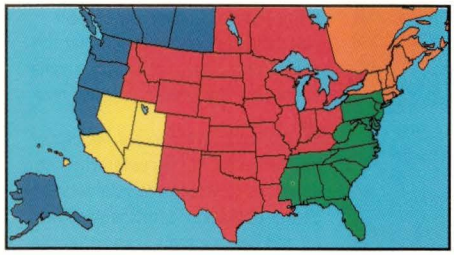

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|---|---|
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| 367 | Ames Sciences | 96 |
| 17 | APC | 33 |
| 40 | APC | 33 |
| 442 | Apcon | 95 |
| 3 | Artecon | 7 |
| 376 | Ascent Solutions | 93 |
| 333 | ASR Solutions | 96 |
| 348 | Atlantic Peripherals | 92 |
| 11 | Aurora | 24 |
| 19 | AVCOM | 37 |
| 431 | Boffin Ltd. | 97 |
| 35 | Box Hill Systems | BC |
| 5 | Chip Coolers | 11 |
| 361 | Clearpoint Enterprises | 96 |
| 317 | Coastal Computer Products | 92 |
| | Comdex/Java | C3 |
| 23 | Computer Connection of CNY | 45 |
| 26 | Concorde Group | 59 |
| 447 | Confluent | 99 |
| 374 | Cube | 93 |
| 362 | Cybertech Station Inc. | 96 |
| 420 | Datalease | 92 |
| 453 | Datalease | 96 |
| 322 | Datalease | 98 |
| 455 | Datalease | 99 |
| 358 | Datalease | 101 |
| 421 | Elektroson | 94 |
| 454 | Eli Systems | 97 |
| 4 | EMASS | 9 |
| 316 | Enhance 3000 | 98 |
| 422 | Enterprise Cable | 103 |
| 352 | Evolving Solutions | 100 |
| | Exabyte | 13 |
| 404 | Express Computer Systems | 100 |
| 372 | Express Point | 102 |
| 342 | Facet Corp. | 102 |
| 413 | GSH Systems | 92 |
| 379 | GSH Systems | 100 |
| 391 | Gulfcoast Workstation | 94 |
| 18 | Hitachi | 35 |
| 20 | Hummingbird | 39 |
| 28 | InLine | 52 |
| 9 | Innosoft | 21 |
| 331 | Innovative Computer Solutions | 98 |
| 16 | Insignia | 31 |
| 368 | International Systems Group | 100 |
| | Internet World/Canada | 47 |

| *Reader Inquiry Number* | *page* |
|---|---|
| 357 | Kingmax | 101 |
| 1 | Kingston | C2 |
| 369 | League Technologies | 100 |
| 2 | Lightwave | 1 |
| 392 | Livingston Electronics | 94 |
| 33 | Marco International | 89 |
| 313 | MCA | 96 |
| 330 | Michaura Systems | 91 |
| 343 | National Data | 101 |
| 12 | NCD | 25 |
| 324 | Network Information System | 92 |
| 366 | Network Technologies | 103 |
| 340 | Nordisk | 98 |
| 346 | Nu Horizon | 91 |
| 402 | One Source | 91 |
| 353 | Open Systems Express | 92 |
| 22 | O'Reilly & Associates | 43 |
| 13 | Overland Data | 27 |
| 29 | Personal Productivity Tools | 71 |
| 36 | Plextor | 55 |
| 15 | Polaris | 30 |
| 37 | Qualstar | 83 |
| 24 | Radiant Resources | 49 |
| 25 | Rave | 51 |
| 32 | Rave | 89 |
| 7 | Resilience | 17 |
| 363 | Richardson Electronics | 97 |
| 31 | RND Networks | 79 |
| 314 | Security Computer Sales | 93 |
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| 19 | SharkRack | 37 |
| 38 | Soft Tech Solutions | 5 |
| 411 | Solar Systems | 99 |
| 10 | Straightline | 23 |
| 27 | SunSoft | 60 |
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| 8 | Tatung Science & Technology | 19 |
| 30 | Transcend | 71 |
| 378 | Trident Systems | 94 |
| 375 | Ultraview | 93 |
| 345 | Universal Capital Funding | 96 |
| 428 | West Coast Computer Exchange | 95 |
| 21 | Western Scientific | 41 |
| 320 | Workstations International | 91 |
| 370 | Worldwide Technology | 99 |
| 388 | Worldwide Trade Corp | 100 |
| 14 | ZZYZX | 29 |

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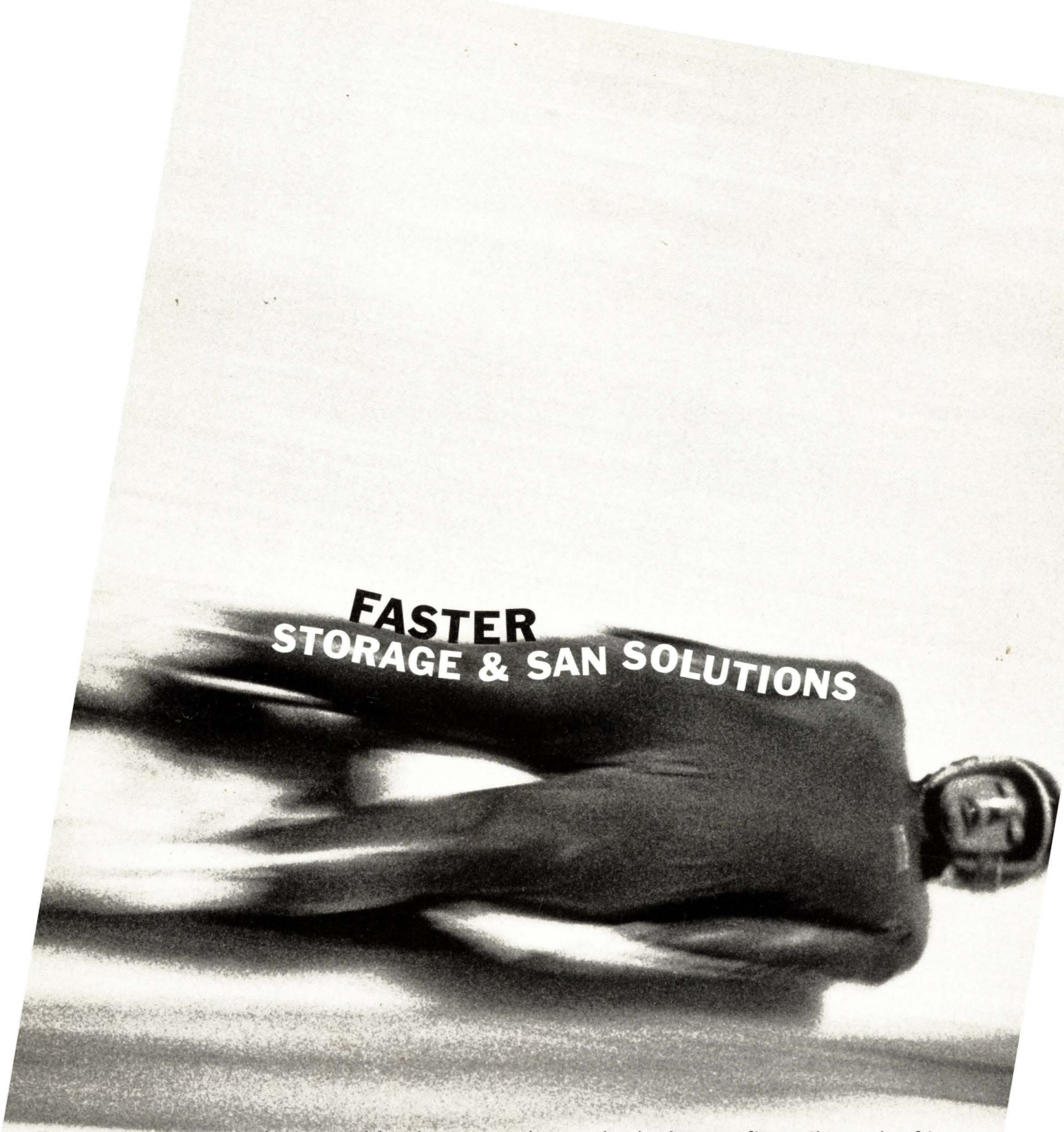


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