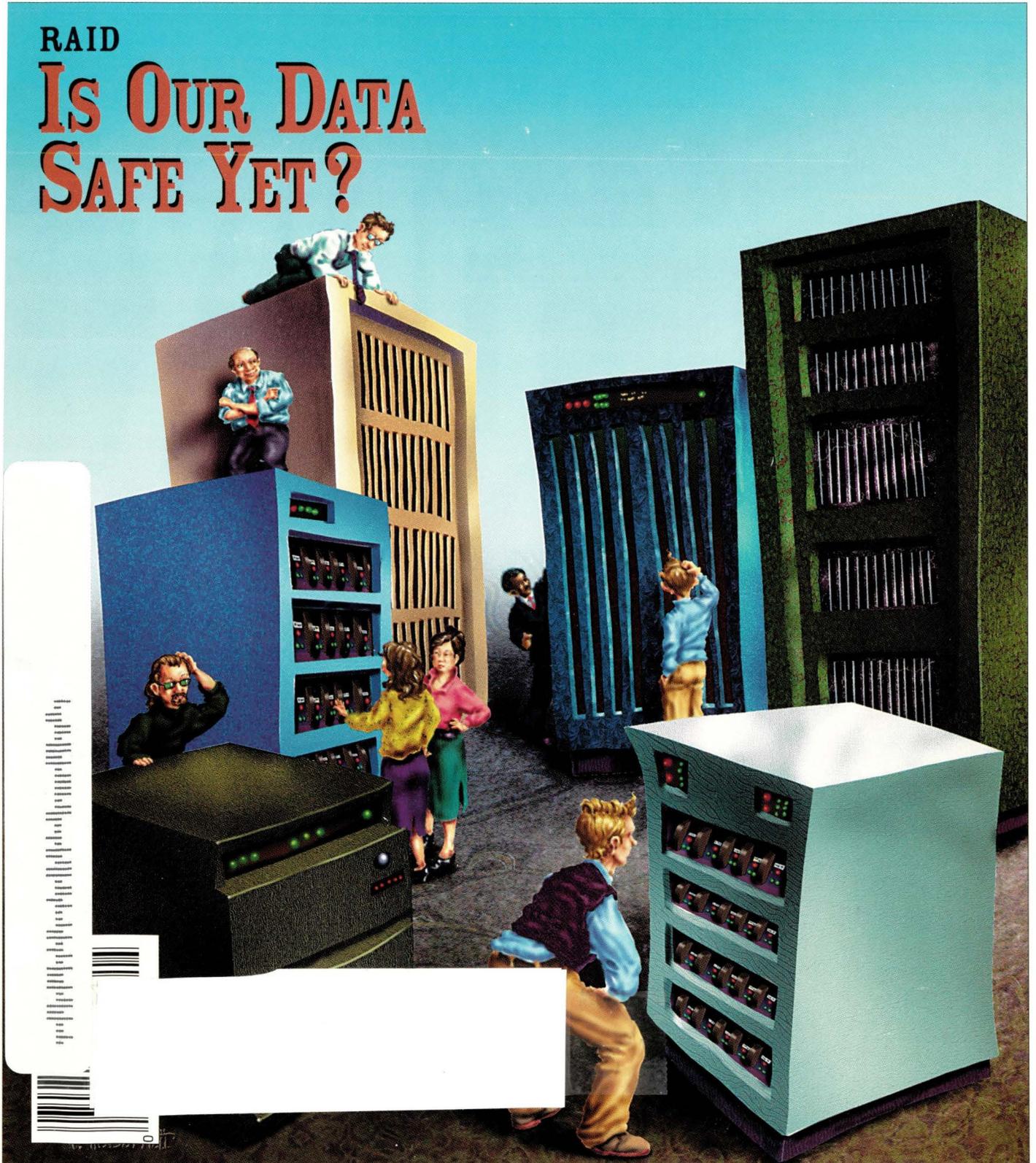


# SUNEXPERT

The Server/Workstation Magazine

RAID

## IS OUR DATA SAFE YET?



Review: FrameMaker 5.5.3

UNIX Basics: The Domain Name Service

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The Server/Workstation Magazine

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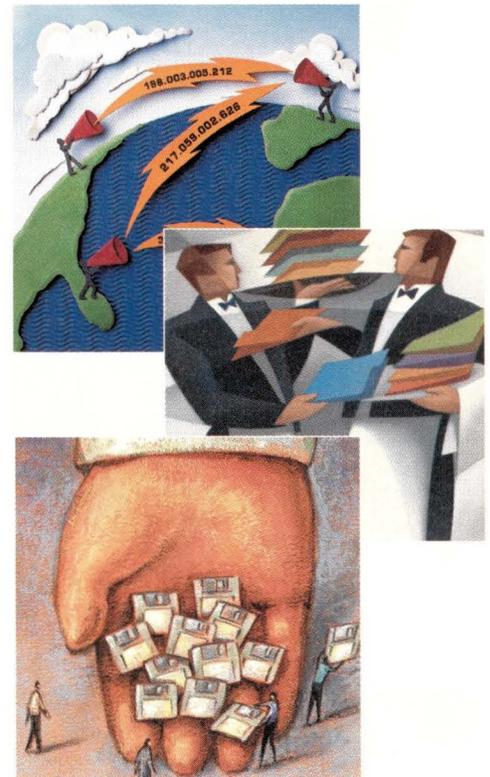
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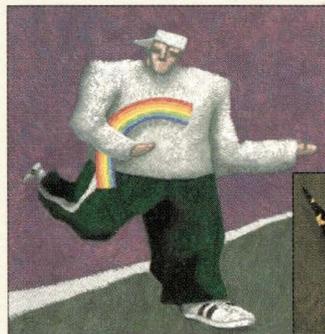
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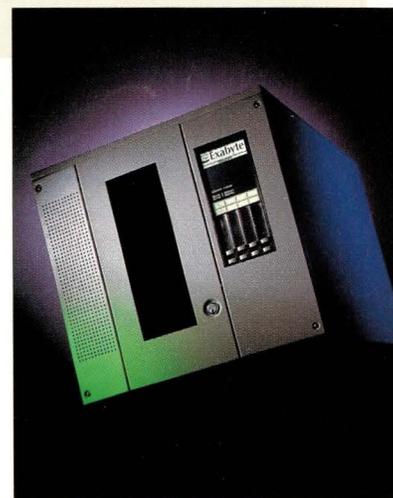
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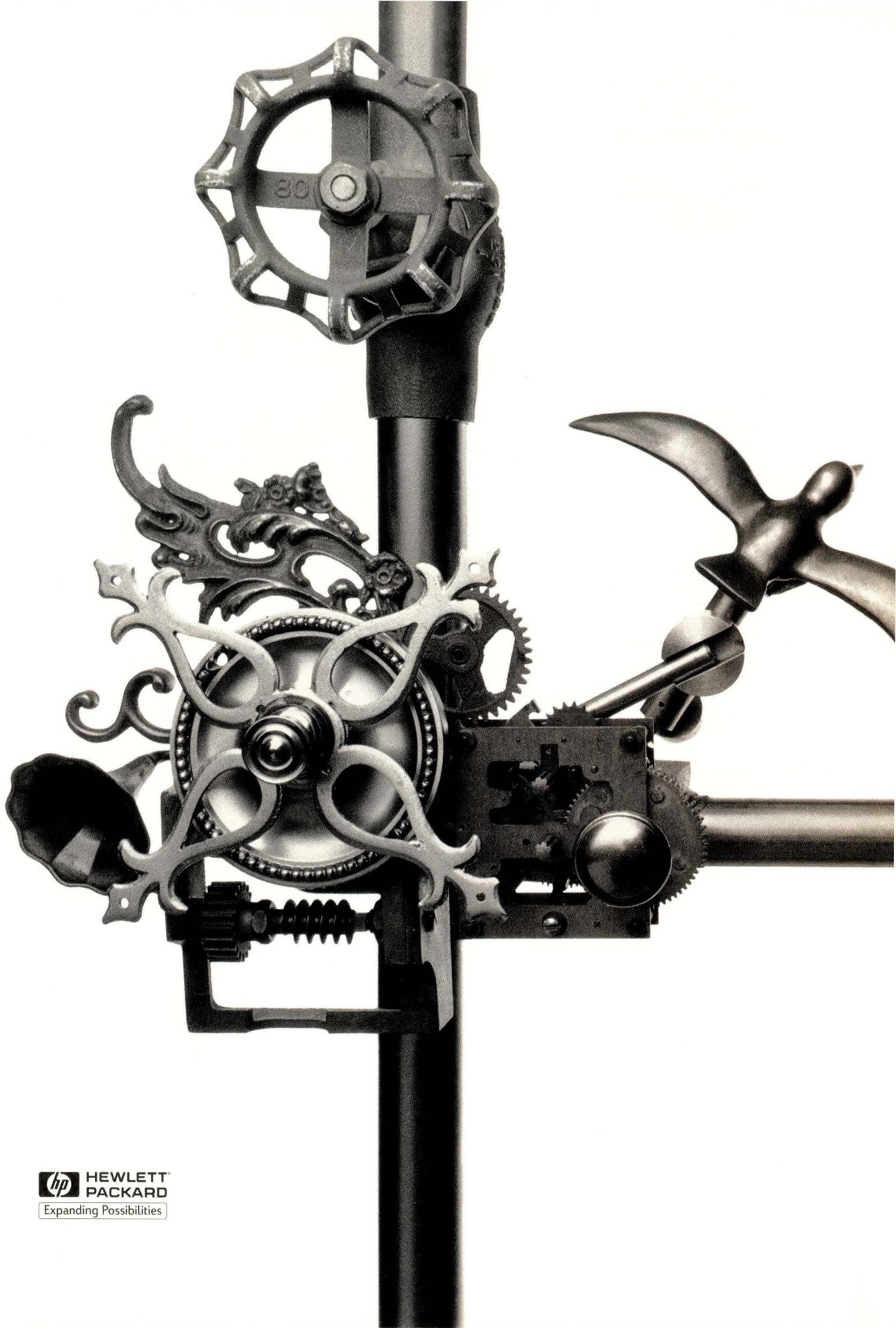
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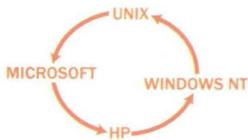
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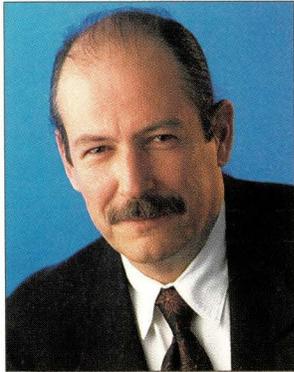
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# EDITORIAL

dpryor@cpg.com



## Toys and More Toys

First there were Cabbage Patch kids, then Tickle-Me Elmo, then Beanie Babies and now there's RAID. All these products seem to have come out of

nowhere to become overnight manias. "It doesn't seem that long ago that researchers David A. Patterson, Garth Gibson and Randy H. Katz of the University of California at Berkeley published a seminal paper entitled 'A Case for Redundant Arrays of Inexpensive Disks,'" says Gode Davis in this month's cover story, "Is Our Data Safe Yet," Page 50. The paper appeared in 1988. This year, according to Disk/Trend Inc., Mountain View, CA, users are gobbling up fault-tolerant disk storage to use with network file servers, mainframes and specialized file servers. That's fueling phenomenal growth in sales of disk drive arrays. Disk/Trend estimates that 775,000 arrays shipped in 1996 and 986,000 disk drive arrays in 1997. The research company projects a shipment total of some 1.5 million arrays by the new millennium. Revenues are also soaring. Disk/Trend reports a \$15.9 billion sales total for last year and projects a robust \$17.1 billion by the year 2000.

Fortunately for users, this largess and potential profit—sometimes capitalism works—has attracted some 150 or so vendors. As a result of the competition, new products with innovative feature sets appear almost daily and prices will continue to fall. Disk/Trend's Jim Porter estimates the current price of array storage at 35 to 40 cents per megabyte. Farid Neema, president of the Santa Barbara, CA-based consulting company Peripherals Concepts Inc., expects the cost per megabyte to fall to 25 cents by the year 2000. Of course, the downside is that users have to scrutinize claims carefully. Unfortunately, a frequent side effect of fierce competition is hype, and who likes to be toyed with?

*Doug Pryor*

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## No Free Y2K Fix for Solaris Customers

If you have an older version of Solaris or SunOS and you're not on a service contract, don't expect much help from Sun Microsystems Inc. in achieving Year 2000 compliance.

That's because Sun restricts access to its Year 2000 patch site to those under a SunSpectrum service contract. Customers with bronze or higher SunSpectrum support contracts can download patches from Sun's Year 2000 site via the SunSolve Web page (<http://sunsolve.sun.com>).

One exception to this rule is customers with SunOS 4.1.3u1 Version B or 4.1.4. These users can buy a Year 2000 Pack for Desktop Systems from SunExpress for \$695. Another exception is Solaris 2.6. It's supposed to be completely Year 2000-compliant, although Sun says a couple of "enhancements" to its Year 2000 compliance are available via the online patch site. Those patches are #105686 and #106033 for Solaris 2.6 on SPARC and #105687 and #106034 for Solaris 2.6 on Intel.

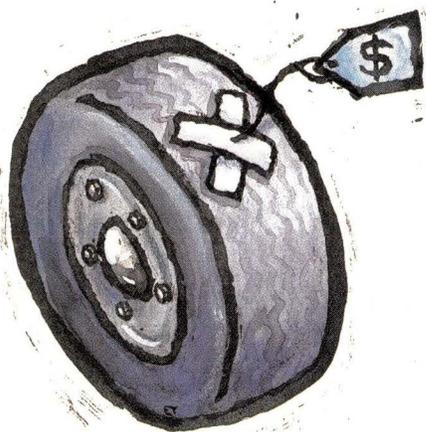
Naturally, not all Solaris customers are pleased with the lack of free Year 2000 support. "[Sun] seems to be cashing in on other companies' need to prove their own Year 2000 compliance," complains Peter Miller, a scientist at a British research institute that uses Solaris products.

Sun maintains, however, that it's definitely not out to generate extra revenue from Year 2000 problems in its products and feels that it's enough of a service to provide free patches to customers on support contracts, considering that many of them have operating systems dating back to the early 1990s.

"We're talking about some very old versions of Solaris, some going back

to 1990," says Tony Hampel, acting director of Sun's Year 2000 project. "We're not trying to make a profit on the Year 2000."

That's certainly true for many versions of Solaris and SunOS. Solaris 2 was first released in 1991, for instance. However, Solaris 2.5, which is not guaranteed to be Y2K-compliant, was the latest version shipping until June 1997,



ERIN TERRY

when Solaris 2.6 was released. So there are plenty of Sun customers with a year-old version of Solaris that is not guaranteed to be Y2K-compliant.

Sun's Year 2000 policy is that all products that shipped after May 1997 are guaranteed to be compliant. "If a product shipped after May 1997, we will issue enhancements at no cost to the end user," Hampel says. (To find out what products are, and aren't,

Y2K-compliant, go to <http://www.sun.com/y2000/cpl.html>.)

The issue of Year 2000 compliance in software products and platforms is a hot one, and getting hotter every month closer to the end of the century. Symantec Corp., Cupertino, CA, was recently sued over its Year 2000 upgrade policy, which required customers with versions of Norton Antivirus that were older than 4.0 (released in September 1997) to pay for their upgrades. Another software company, Software Business Technologies of San Rafael, CA, was sued last year for not providing free upgrades to fix a Year 2000 problem in its accounting product.

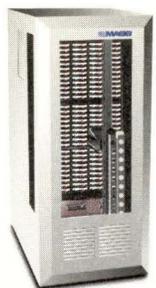
Some software companies do provide free patches to fix older versions of their products. The Santa Cruz Operation Inc., Santa Cruz, CA, for example, provides free patches to all its customers, whether on a support contract or not, for products dating as far back as the early 1990s, including SCO UNIX 3.2 (see <http://www.sco.com/technology/y2k>). On the other hand, the Year 2000 Web page for customers of Silicon Graphics Inc., Mountain View, CA, offers only this advice: "Even though it is unlikely that you will experience Year 2000 problems with prior IRIX releases, if your organization is concerned with Year 2000 compliance, you should plan to upgrade to IRIX 6.5 by the end of 1999." Unfortunately, IRIX 6.5 isn't slated for release until next summer.

Do Sun and other OS vendors have an obligation to provide complete Year 2000 compliance for their products? While most agree that no company should be shipping a noncompliant software product today, the issue of when products ought to have been compliant—and how much responsibility vendors should bear to retroactively make them compliant—is the subject of considerable debate.

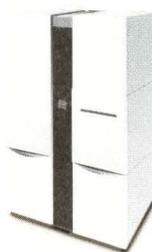


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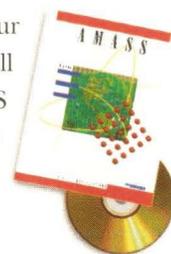


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**Circle No. 4**

## IBM Pushes Business Intelligence Initiative

IBM Corp. has announced a companywide initiative directed at the business intelligence market that includes more bundling news than new software or hardware products. The major theme behind this business intelligence push is to provide companies with the tools and services to make business decisions regarding marketing, products and customer relationships based on its data. "That's the hot application," says Mitch Kramer, senior consultant with Patricia Seybold Group, Boston, MA. "It's something that a lot of companies are doing."

The goal of business intelligence is to enable companies to make the right decisions on which markets to enter, how to select and manage customer relationships and how to promote products, in an effort to increase profitability and market share. "The next major use of the computer will be in this thing called business intelligence," says Ben Barnes, general manager for IBM global business intelligence solutions. "[That is] the gathering, the organization, the management, the analysis of data and turning that into a strategic advantage."

At the heart of IBM's initiative is its DB2 Universal Database. The company says it will tune DB2 across RS/6000,

AS/400 and S/390 servers. With DB2 and its applications, a company can perform mining and interpreting of structured data, text and Web site content. Also, Big Blue intends to offer data warehouse tools, including the Intelligent Miner line for analyzing, categorizing and locating information and the Visual Warehouse line for quickly building, managing and analyzing data warehouses and data marts.

Industry-specific, data mining software applications have also been introduced, including DecisionEdge for Finance, DecisionEdge for Insurance, IBM Discovery Series for Banking and IBM Discovery Series for Telecommunications. Furthermore, IBM will have more than 2,500 internal specialists at its disposal for consulting services and will bundle products from more than 150 partners, including Arbor Software Corp., Business Objects, Cognos Corp. and Vality Technology Inc.

"What I found interesting about what they have done here, is where their products have holes, instead of signing up many partners to address it, IBM picked one and signed it up as a partner," says Kramer. "As a result, they have a pretty good offering."—*ptc*

Jim Geisman, president of MarketShare Inc., a Wayland, MA-based consulting firm specializing in software licensing, says that many software companies do offer free Year 2000 patches to customers on maintenance contracts, but it is less common for them to provide patches to all customers.

Dave Johnson, an attorney with Fenwick and West's IP property and litigation group in Palo Alto, CA, says that, because a lack of Year 2000 compliance isn't technically a bug—it doesn't affect the operation of a software product when it is first shipped—there is less obligation on the part of vendors to fix the problem in older versions of their products.

"There's not something you could yet call an industry standard, but, generally speaking, an OS ought to be more robust than a shrink-wrapped consumer application," says Johnson. "However, most consumers know that OS platforms upgrade continuously, so it might be seen as unreasonable for a customer to expect an OS released in 1992 to be the same one they're using in the Year 2000."

Most experts agree that the question of who's to blame for the problem will, unfortunately, have to be settled in

court—a process likely to extend well past the beginning of the next millennium.

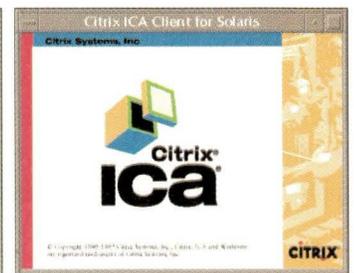
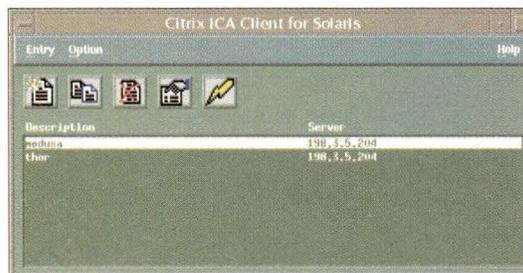
For now, however, customers running Solaris 2.5 or older who are worried about Year 2000 compliancy have limited options, and none that are free. They can either purchase a Sun-Spectrum service contract or upgrade to Solaris 2.6.—*sjb*

## Citrix Offers UNIX ICA Clients

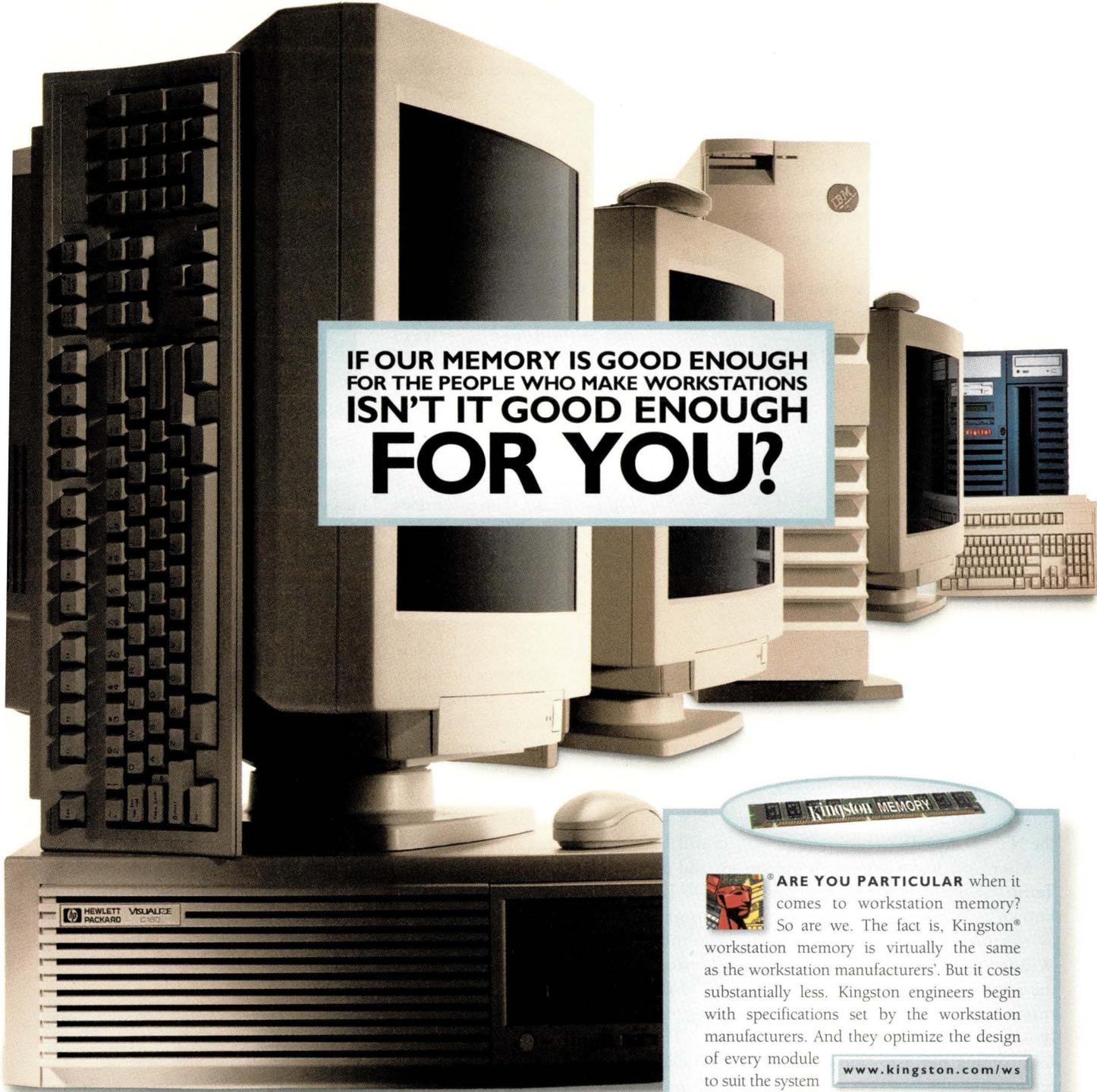
Citrix Systems Inc., Fort Lauderdale, FL, recently released new UNIX and Macintosh clients that work with its WinFrame software. These new clients, based on the company's Independent

Computing Architecture (ICA) technology, make Windows applications, such as email, word processing and spreadsheets, accessible from a variety of desktops in heterogeneous networking environments.

Citrix WinFrame adds multiuser functionality to Windows NT 3.51. The ICA client opens up a remote session on the server and displays either individual applications in separate windows or an actual Windows desktop inside a window on a X11 desktop. The ICA protocol communicates directly with the Windows NT operating system. ICA then displays the output of the application much the way X terminals do. "What we're doing is bringing to the world of Windows



*Citrix ICA Client for Solaris is one of the new ICA clients for UNIX workstations that works with Citrix's WinFrame software to make Windows applications accessible from a number of desktops.*



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multiuser capabilities,” says Mike Richtberg, senior product manager at Citrix Systems. “We provide to a customer a way of connecting additional heterogeneous clients that will allow people to maintain an investment they have in a desktop by allowing them to use existing hardware to connect to a WinFrame server.”

The new clients are based on Insignia Solutions Inc.’s NTrigue technology, which Citrix acquired in February. The Citrix clients are basically the same as the ones provided by Insignia and support Solaris, AIX, HP-UX, Digital UNIX, IRIX and PowerPC- and 680x0-based Macs running System 7 or higher. Prior to the release of the UNIX and Mac clients, Citrix offered support for 16- and 32-bit Windows environments such as Windows 3.x, 95, NT and DOS. Also, the company made available a version that would be usable in either a Microsoft Corp. or Netscape Communications Corp. browser in the form of an ActiveX control or a Netscape plugin. A Java-based client is also available.

Where do these developments leave the NT 4.0 crowd?

Microsoft is developing Windows Terminal Server (WTS), previously known as Hydra, to replace Citrix WinFrame—WinFrame only supports Windows NT 3.51. WTS will offer the same multiuser extensions offered through WinFrame but on NT 4.0. It will be necessary to use Citrix’s forthcoming pICasso, the code name for its thin-client/server system software for WTS. The reason is WTS runs on Microsoft’s Remote Desktop Protocol, formerly known as T.Share. WTS and pICasso will work together to deliver a thin-client, multiuser version of NT 4.0. In addition, Citrix and Microsoft are working together to develop a multiuser product for NT 5.0 platforms.

All these changes have a few WinFrame users concerned about the future. “Everybody experiences confusion when Microsoft gets involved,” says Bill Gardner, president of UltraServ Inc.,

San Jose, CA, a Citrix products reseller. According to Gardner, his customers have a few concerns. “Mostly what [my customers] are looking for is reassurance that if they do deploy Citrix products, there is a valid migration path.”

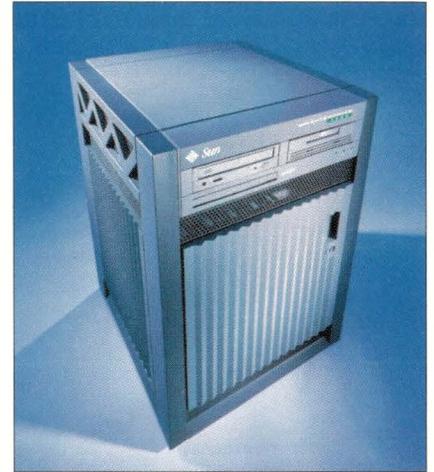
The migration path today looks like this. WinFrame users can purchase pICasso for \$1,495 when it becomes available (at press time, Citrix had not announced a release date). The new product will migrate a single WinFrame server and use all existing server-side options such as User License Packs, Load Balancing and Secure ICA Option Packs. The price does not include WTS software, which is required and must be purchased separately from Microsoft.

At Payne Weber Inc., a brokerage firm based in New York, NY, Citrix WinFrame and ICA clients are used to give 250 employees access to Microsoft Outlook, Word and Excel applications. The company has several projects planned that will require the deployment of Windows NT 4.0. To achieve this, Payne Weber will have to make the switch to WTS and pICasso. “They’re claiming Hydra [WTS] and pICasso will be direct upgrades from the current Citrix WinFrame,” says Kent Cinquegrana, systems architect for Payne Weber. “That remains to be seen. But we will aggressively pursue these upgrades.”

The UNIX and Mac ICA clients are available now and can be downloaded from the Citrix Web site at <http://www.citrix.com>.—ptc

## Power Boost for Enterprise Servers

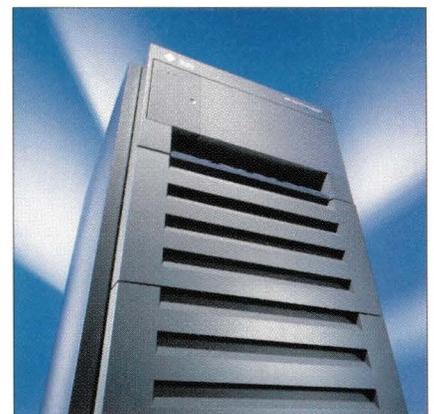
For the second time in less than a year, Sun Microsystems Inc. is offering enhancements to its midrange and high-end server family. Sun’s Enterprise Server and Storage Group has announced a new 336-MHz UltraSPARC-II processor module with a 4-MB external cache. According to



Sun is giving its Enterprise server line, including the midrange Enterprise 3000 (above), a boost in processing power with the release of the new 336-MHz UltraSPARC-II processor module.

Sun, Enterprise 3000-6000 servers equipped with the new processor and Sun’s latest compiler can deliver up to 43% higher computer performance than servers equipped with 250-MHz processors.

Sun touts this latest announcement as a show of commitment to scalability and part of an ongoing investment in SPARC and an ongoing commitment to Sun’s installed base. Sun says the new, faster CPU module can provide more performance “headroom” in existing servers, enabling information systems departments to accommodate more users as business grows. Alternatively, by increasing individual



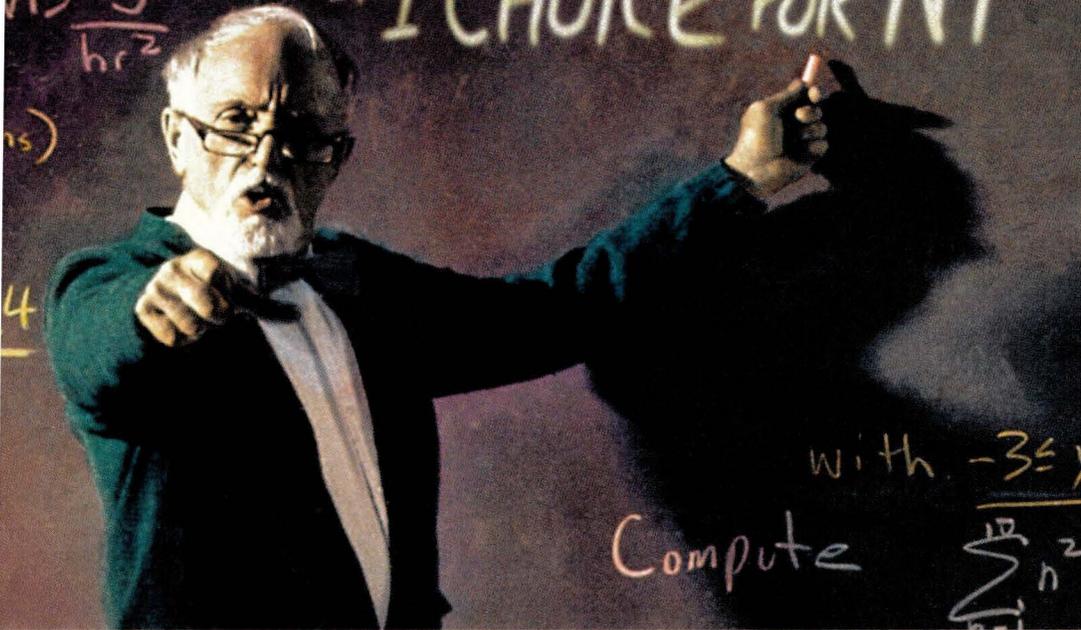
Equipped with a \$19,000, 336-MHz CPU module and Sun’s latest compiler, the Enterprise 6000 can achieve up to a 43% increase in system performance and faster response times.

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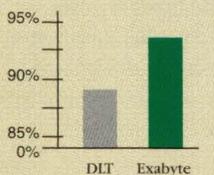
## Exabyte Mammoth technology adds up to better backup.

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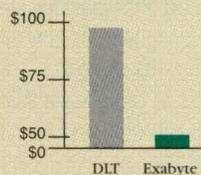
Mammoth wins on reliability, too. While a Mammoth drive writes to a tape in a single, gentle pass, a DLT drive demands 64 high-tension passes to do the same job. Small wonder that Mammoth 8mm tape drives are rated significantly more reliable than comparable DLT products. And with Mammoth's availability, it all adds up.

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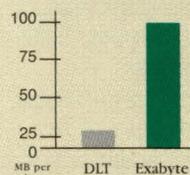
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processor speeds, immediate boosts in overall system performance and faster user response times can be seen by those whose current systems are reaching maximum performance levels.

"Another key feature is that these modules will be added in a way that's code compatible," says Andy Ingram, director of marketing for Enterprise server products at Sun. He adds, "The key to our product line is that no code changes are required as we move forward with the UltraSPARC chip sets."

The 336-MHz UltraSPARC-II processor module costs \$19,000. Sun has created the 336-MHz UltraSPARC CPU Module Upgrade Program to ensure investment protection. This program provides aggressively priced trade-in values of up to 50% for those customers who wish to migrate from earlier Sun UltraSPARC 250-MHz CPU modules. In addition, Sun offers trade-in values of up to 34% for customers who wish to migrate from the UltraSPARC 167-MHz CPU modules. There is also special upgrade/trade-in pricing for customers with Sun non-UltraSPARC processors or qualified competitive processors.—*mm*

## Sun Releases 3D Java Tool

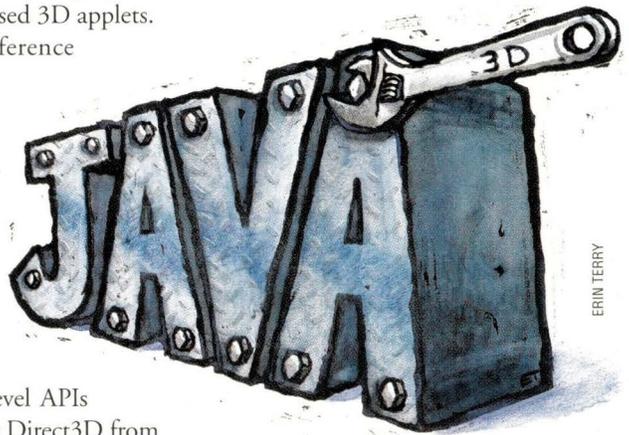
Developers of 3D graphics will now be able to try out Sun Microsystems Inc.'s new Java 3D API, an application programming interface used for writing stand-alone three-dimensional graphics applications and Web-based 3D applets.

At the JavaOne conference in San Francisco, CA, in March, the company released a beta version of the API designed to simplify 3D graphics programming by providing a high-level, object-oriented model that can still take advantage of native, low-level APIs on other systems, such as Direct3D from Microsoft Corp., OpenGL from Silicon Graphics Inc. and QuickDraw 3D from Apple Computer Inc.

The Java 3D API, which was first announced in August, is part of the Java Media suite of APIs, which includes a 2D API, as well as sound, speech and telephony APIs. All of the multimedia

APIs can be found at <http://java.sun.com:80/products/java-media/index.html>.

This new API, available for Sun's JavaOS, Apple's Mac OS, UNIX and Windows systems, will be of chief interest to developers working in areas such



as data visualization, 3D Web page development, animation, CAD/CAM and high-end business graphics, says Kenneth Tallman, senior product marketing manager for Sun.

The API features 10-to-1 geometric compression to facilitate faster down-

## Cost-Effective Developer Suite

**S**un Microsystems Inc. has announced a bundling of software development tools. Called the Professional Developer Suite, the tools are meant to complement Sun's recently announced, low-cost Ultra 5 and Ultra 10 workstations, enabling developers to create complex, business-critical Solaris applications quickly and easily, according to Sun.

Peter Jeffcock, senior product manager at Sun, says the key idea behind this tool suite emerged from the fact that large organizations had found good tools to build substantial mission-critical applications, and for large development teams, floating licenses worked well. But for small teams, floating licenses were less effective. "Usually, in a small organization, engineers need to use the compilers and such at the same time, which doesn't work out," says Jeffcock. "Sun wanted to find a solution for small groups, typically five or fewer engineers, for whom floating licenses didn't make sense, and came up with the Professional Developer Suite and teamed it with low-cost Ultra workstations."

The suite includes single-user versions of the Sun Visual Workshop C++ Personal Edition, Java WorkShop and Java Studio development tools. By offering both C++ and Java tools,

developers can easily extend the reach of their existing applications by adding Java technology as an interface for users on any platform, Sun says. "We've found that 50% of the people using C++ are using Java as well," says Jeffcock. "We're finding that that's how they're getting started with Java."

The Java WorkShop software included with the suite offers what Sun claims is one of the most advanced software IDEs available for building customer components. It also supports the latest Java Developer's Kit (JDK) standards and the new JavaBeans component model. The Java Studio software included is an intuitive, graphical environment that lets users create dynamic Inter/intranet Java applets and applications without programming. In addition, Java Studio enables developers to leverage the growing list of JavaBeans components available, Sun says. Java Studio features more than 50 JavaBeans components, including animation, sound and drawing.

The Sun Professional Developer Suite costs \$1,155 with the purchase of any Sun workstation; when purchased separately, the suite costs \$2,219. According to Sun, users don't have to register as a Sun Developer in order to purchase the suite. Support is not included but can be purchased separately.—*mm*

## New Products



### Sun compatible workstations from Tatung

Tatung now offers Ultra-10 and Ultra-60 Sun compatible workstations featuring PCI I/O buses. Also available are the Ultra-1 and Ultra-2 Sun Compatible systems. The workstations all run on Sun Solaris 2.x and utilize Sun Processors. These units are the cost-effective solution that every Systems Administrator should seriously consider.

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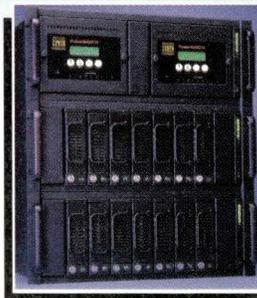
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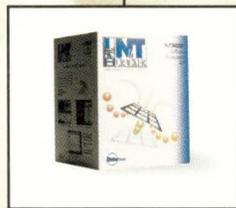
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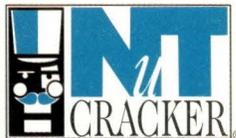
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loading of graphics files and applets, as well as advanced culling capabilities to speed performance by animating only the portion of the graphic that is being viewed. It's also intended to make collaboration among developers on different systems easier, because the only requirement to view a file created with the 3D API is a Java Virtual Machine (JVM) equipped with the 3D API. Tallman says that it's designed to work on top of, not replace, lower-level 3D rendering APIs such as Direct3D, OpenGL, QuickDraw 3D and Sun's XGL.

Evan Quinn, analyst for Framingham, MA-based International Data Corp., says the announcement is good news, although it's likely to appeal only to a select group of customers. "It's not an announcement that's going to drive adoption of Java," says Quinn, noting that a recent IDC study of corporate IS departments using Java showed that less than 5% were using, or planned to use, Virtual Reality Modeling Language (VRML) and other Web- and Java-based 3D technologies.

Nevertheless, it's a market that Sun clearly has strong interest in pursuing. In February, Sun acquired the patent portfolio of former VPL Research Inc., a virtual reality firm that gained notoriety in the late 1980s with virtual reality products such as the DataGlove and DataSuit. VPL, which went bankrupt in the early 1990s, had more than a dozen patents in its portfolio, according to Sun, some granted as recently as last year. The inventions include things such as networked 3D graphics, virtual reality peripherals such as the DataGlove, and image rendering and manipulation.

Michael Deering, a Sun distinguished engineer working on 3D technology, says that Sun may license out some of the technology to other companies and keep others in-house. Sun plans to incorporate some of the technology into future versions of its Java 3D API, for example. However, Deering says that he is only just now finishing up its inventory of the various technologies, so it's too early to say for sure what Sun will do with them all. "It's like buying a house with a lot of stuff in the attic—it takes time to figure out what you have."—*sjh*

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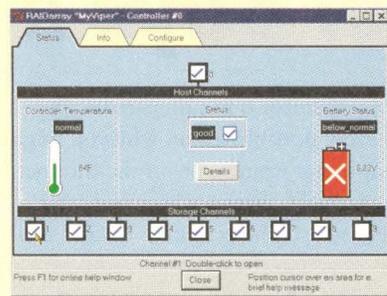
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*CMD StorageView makes it easy to setup, control and monitor all CMD controllers either locally or remotely.*

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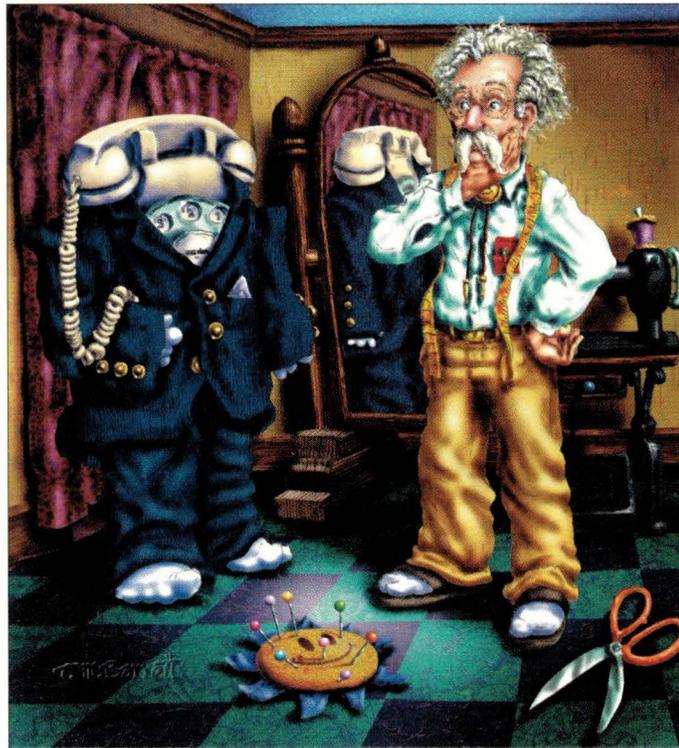
ORD-5330



ORD-5640

# Ask Mr. Protocol

by Michael O'Brien



TOM BARRETT

*"We don't do 'networking.'"*  
– One clueless front-line support person at an Internet service provider

*"We don't support shell accounts."*  
– Another front-line support person, at 3 a.m., when informed that attempts to test a failed PPP account by logging into it manually in a terminal window result in a phone hang-up instead of an initial burst of PPP packets

*"Generic PPP setup: Configure your PPP client software to use this for an account name, that for a password, and use these options for DNS and gateway services. Your client software must support PAP."*  
– A wise provider

## Mr. Protocol Buys a Driveway

**Q:** *Let me check. No wild animals in the house. That's OK. No electronics exploded all over everywhere. That's OK. Mr. Protocol is humming to himself in the corner. That's OK, I think. Can I ask a question? What do I want to look for in an Internet service provider?*

**A:** Item three is far from OK. Mr. Protocol is humming to himself in the corner because he's recently become a devotee of "found" music, and he heard a catchy tune from a modem that was having trouble synching up the other day. Now he's trying to rearrange the filter poles on the complex plane, in his head, to come up with harmonies. I try not to go near him at times like this. It wouldn't be so bad if he hadn't gotten three phone calls from alternative music labels just this morning.

As to your question, I feel I can safely commit to an answer. And that answer is: It all depends. Mostly, what you want in an Internet service provider (ISP) depends on what you want from the Internet.

Mr. Protocol is not prepared to go into every possible reason why you might or might not want to be on the Internet. Well, actually, that's a whopping great lie. Not only is he prepared, it's all I can do to stop him. Believe me, you don't want that. The world is not ready for an 850-page monthly column. Let's try to cut things down a bit.

There are two big reasons why you might want to be on the Internet. The first is to get information from other people for yourself and your business. The second is to provide information about yourself and your business to other people. You already know how to do that for most things. It's disingenuous to say that the Internet is a rapidly moving target, though. It's a skeet shoot with hypersonic skeet.

Let's take the first type of connection. You want to connect to the Internet because you want to mine it for information. How you do this is going to depend on how much information you want to move, and how fast.

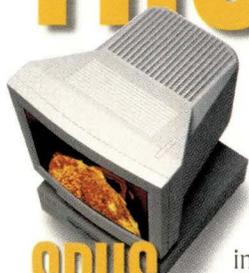
If you're a loner, a standard dial-up connection will do the trick. The going rate is pretty much \$20 per month for all the bits you can eat. Some providers are putting on a cap of 100 or 150 hours per month, after which surcharges kick in. For most single-machine operations, though, this kind of deal is hard to beat.

It used to be important to check the width of the ISP's own connection to the Internet because, in the early days, three guys would buy a machine, put it in an office, order up a 64-Kb/s frame relay connection to the Internet, and sell far, far too many subscriptions to their new ISP business. The network, as seen through one of these providers, was impossibly slow, because about five users with 14.4-Kb/s dial-up modems would saturate such a provider. The only thing that kept this sort of setup from being slow beyond belief was that these yo-yos generally didn't buy enough modems either, so they were mostly known for providing busy signals. Most of these operations have

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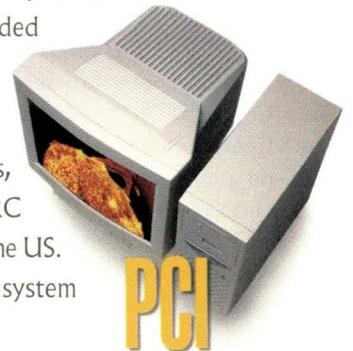
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# Ask Mr. Protocol

sunk without a trace, and even America Online took a considerable public relations hit when it oversubscribed itself. Many providers now advertise a “no busy signal” policy, and a few even come close to making good on it.

Small-office operations, with several machines to be put on the Net, need a different kind of connection. Typically, this will be an ISDN connection. ISDN, which stands for Integrated Services Digital Network, provides an end-to-end digital connection from your site to the service provider. On the customer end, the line looks like a regular phone line, except that special equipment has to be plugged into it. It's not as simple as just plugging in a telephone. And, just as regular phone lines can be set up with call waiting, call forwarding, busy-number redial and a host of other features, ISDN lines also have several dozen possible options that can be ordered. The problem is that unless you order exactly the right set—and the set varies from provider to provider—your Net connection won't work.

The upside of ISDN is that you get either 64 Kb/s or 128 Kb/s of data transfer, and you can plug in a box that will act as a router, allowing several machines at your site to be on the network at the same time. These ISDN minirouters don't cost much money and hook right onto a local Ethernet.

ISDN can also result in busy signals, but it's easier for providers to service large numbers of lines because of ISDN's all-digital nature. They'll bring in a single high-speed digital line. This line will support a large number of individual ISDN dial-in lines, which themselves have only a virtual existence as a multiplexed fraction of the high-speed line. The high-speed line plugs into a single box, which decodes the incoming call requests and handles the business of validating logins and serving PPP packets over the individual ISDN connections.

One little secret about ISDN is that some telephone companies have a tariff for “Centrex ISDN.” Centrex is a telephone service ordered by many large companies where the telephone company's own central office switch acts as a local PBX for the company. Calls internal to the company aren't billed individually. Centrex ISDN is the same notion. Your ISDN line acts like a Centrex extension, allowing you to place all the ISDN calls you want for a fixed monthly fee, *if* the ISDN line you're calling is in the same telephone company central office as your own line. Calls placed entirely within a switch consume so few resources that this sort of pricing is practical. What this means is that you can call your provider all you want for a fixed price. Providers who know about such things will also offer you a fixed price on Internet access to go along with this.

## Not So Cable Ready

One other service that's being brought to market now is broadband service, provided by local cable companies. This is slow in reaching the market because cable companies are now reaping the harvest they sowed back when the cable television infrastructure was first being installed. The original designers of cable TV standards knew that as long as they were paying out good money for all this coax, they might as well write the standards to allow two-way communication with the home. Even though no one knew what it would be

good for, the designers figured it would be really handy some day. Therefore, they wrote standards that called for two-way cable amplifiers, receivers at the cable head ends, and two-way repeaters.

Being a bunch of cheapo weasels, the people who were actually forking over the money for all of this rammed

**Many providers now advertise a 'no busy signal' policy, and a few even come close to making good on it.**

through an appendix after the fact that said that if you really wanted to, you could install one-way equipment and still be in compliance with the standards. Absolutely everyone then proceeded to build systems that worked in one direction only and also proceeded to use really cheeseball coax that had high losses, which provided a television picture that was “good enough,” though on a spectrum analyzer it looked terrible. They got away with this because enough customers who knew what a good picture looked like were still willing to fork over for a bad one, because most customers didn't know what coax cable looks

like, let alone what good coax looks like compared with bad coax, and because not very many customers knew how to use a spectrum analyzer.

Then came the day when it looked like you could make a boodle selling Internet service to the home. Cable could carry a signal at around 1.5 Mb/s to the home, as opposed to 28.8 or 56 Kb/s, about a 50-fold better deal. Ha ha ha ha, you can't really do that, because the coax is way too cheeseball to carry digital data, and all the amplifiers only work in one direction, and they're all cheeseball anyway, as well. You've got to reinstall your entire cable plant from the ground up if you want to do this.

Most cable companies would rather sell out than do this. Hence, broadband service is very slow in coming.

If it does come, the box the company puts in your home is good for only one computer. If you want to run a business and get a bunch of addresses, talk to them, they'll charge you business rates, which is MBA-speak for “out the wazoo.” Nevertheless, there are a few people who have managed to sneak a small network through one of these boxes, using a very clever trick.

The Internet Assigned Numbers Authority, back before it had to spend most of its time in court or giving depositions in lawsuits brought by rabid weasels who think that it's worth risking the Internet if they get rich in the process, set aside several ranges of addresses for assignment to networks that were not going to be connected to the Internet. The sneaky trick is to assign these IP addresses to the machines on your little private net, and then connect one computer to the cable modem. This computer has an interface on the nonroutable net in addition to its connection to the cable modem, and it acts as a router. A host on the private net that wants to make a connection to the big wide world sends out a TCP connection request packet to an outside Internet host. The router notes what port number is being connected to and rewrites the source address to be the address of its interface to the

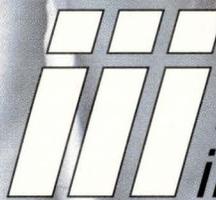
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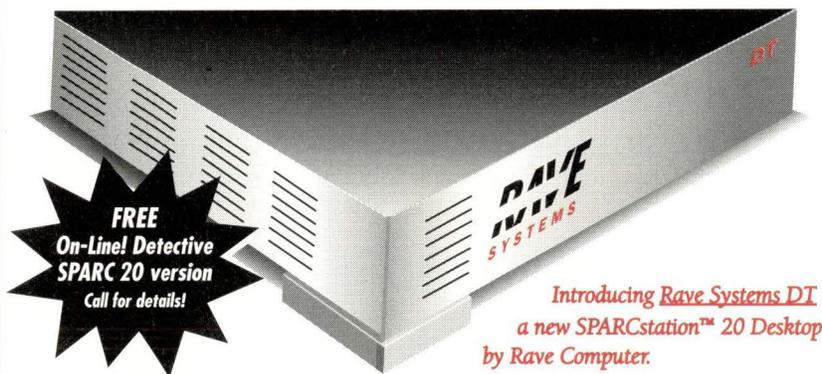
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## Ask Mr. Protocol

cable modem. When a response comes back from that host, the response has its destination address rewritten to be the nonroutable IP address of the host that originally sent out the connection request. The nonroutable host gets its packets routed and doesn't notice anything funny. The cable company sees a single host with a lot of connections. Everyone's happily ignorant.

Of course, this trick only works with TCP, because there's enough state information in TCP to allow the router to keep things straight. For most purposes, though, that's fine.

Larger companies need fatter pipelines. Unfortunately, the price rises steeply here, and the language gets esoteric. The advent of high-speed Internet connections has taken a number of terms that ordinarily were only spoken by telephone companies and by that special breed of human hired by companies to speak to telephone companies. T1 lines at 1.5 Mb/s, T3 lines at 45 Mb/s, exotica up to OC48 at unbelievable megabits per second, are all available for enough money. Fractional amounts are available too, so that you can tune the size of your Internet pipeline to meet your aggregate needs. This works best in large corporations where it is possible to speak about a statistical aggregate of traffic, although there is some initial research that seems to show that Internet traffic is uneven at a fractal level, that is, there is burstiness on all time-scales, from a few seconds to a few months.

A company this large is going to hire people who know about the special equipment that a T1 line plugs into, so we won't cover it here. Suffice it to say that it's got to be some species of router, unless you're running a really, *really* big server. Walnut Creek CD-ROM claims to operate the largest FTP server on the Internet; it's an overclocked Pentium running FreeBSD, it has three T3 lines dedicated to serving it, and supports around 3,000 simultaneous FTP users.

This machine brings us to our second type of user, the user who wants to pump information out of the company, as opposed to importing information. The simplest example of this is the personal



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## Ask Mr. Protocol

Web site. Here, the user is sharing a Web server machine with many other users with whom he has no other connection. The machine itself is located at the ISP's site, where it can share a large pipeline to the backbone.

This collocation scheme satisfies a broad range of customers. Those who only want a small or medium-size Web site can just pay for their slice of a big Web server run by the provider in the provider's own machine room. Larger offerings, or services other than Web service, can be handled by collocating the customer's own machine at the provider's site, where it will sit at the end of the provider's high-speed backbone connection. Maintenance is done by the customer over the Net, leaving only the thorny matter of systems administration to be worked out with the provider.

All of this is well and good, you may say, but what happens when something goes wrong? How am I supposed to deal with problems?

Mr. Protocol is glad you asked.

### It's a Mystery

One of the many ways in which the Internet is unique is that it provides a service whose technical details can be understood by almost none of its customers. This transition is a thorny one, because when the Internet first came into existence, it provided services whose nature was understood in considerable detail by a large fraction of its users. It did not begin as a mystery. It began as something whose work-

ings were obvious to just about everybody, and only became mysterious when its customer base changed.

As a single user, or as a small company whose expertise lies somewhere other than in networking, you have a problem.

**One of the many ways in which the Internet is unique is that it provides a service whose technical details can be understood by almost none of its customers.**

The Internet is not yet a public utility. A public utility can still be awfully mysterious. One look at the pilot light interlock on a hot water heater will convince even the hardiest soul of this fact. But technology turnover in the power generation business, the water and natural gas industries, and even in the cable TV market is so low that these services can be installed by experts, and then just left there. When it breaks, you

call someone, and they fix it with no further intervention on your part aside from opening the back gate.

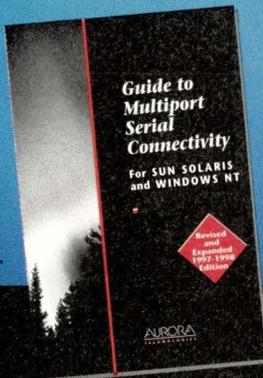
The Internet isn't at that stage. Hypersonic skeet, remember? An Internet connection is something that undergoes continual change, either at your end, your provider's end, or both. One of the few real advantages to Microsoft's monopoly on the small-computer market is that providers can train people to teach end users how to connect to their network without having to turn their front-line phone support staff into high-level Internet experts. Of course, this is the downside for anybody running

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Circle No. 14

## Ask Mr. Protocol

any other kind of operating system, sometimes even including Macintosh. Providers are clueless about off-brand systems and profoundly uninterested in hearing problems. Some go so far as to insist that you be running Windows before you try to connect to them. Mr. Protocol thinks that it's vital to resist this, and give these people as much grief as is humanly possible, to prevent the decline of the Internet into a single-species ecosystem on the brink of death. Of course, you're going to have to play your own expert. If you can't do that, run Windows.

Solaris and other such high-end UNIX variants flourish in environments where there is network expertise available to the customer. Sun and other vendors will train your staff to any degree that makes you comfortable to run your network. It'll cost you, is all. However, one principle applies at any level, from the at-home dial-up machine to the multicampus corporate intranet: If you can reduce the question of what you're getting from your provider down to

something that matches up with published standards, you stand a lot better chance of figuring out how to get your network connection to work. This takes homework, but it's worth it. What flavor of PPP do they support? Do they use PAP or CHAP for authentication? And so forth. It's not important that you know the details of what PAP or CHAP are, or how they work, it's enough to know that the network software you've got supports them (or not), and that your provider requires one or the other (or neither). First, get some rough idea of the territory, then see if you can find out what positions you and your provider both occupy. Most providers are willing to work with you if you know even halfway what you're talking about. Be prepared to learn.

One thing to remember is that they know a lot more about what they have at their end than you do. Sometimes you can make educated guesses, but calling up and coming off as the Internet super-expert is useful only at 3 a.m. when you're having trouble convincing the

guy who pulled night shift that, yes, it is possible to connect your OS to their network, because up until 10 minutes ago, you'd been doing it every day for the last two and a half years.

If you're a network sort in a large corporation, you already know the answer. You talk to your provider so often that you probably have your favorite lunch place picked out. If you don't have this sort of relationship with your provider, think about a change.

Finally, there's the question of the second provider. Often, it is desirable to open an account with a completely separate provider. Your first provider may give excellent service, but perhaps only in your local region. You'll want an account at a national or global provider for use on the road. Or you may have a provider whose backbone connection goes right through one of the flakier national hubs, such as MAE-East. You might want to get a slower line to a second provider who uses a different exchange point, for use in those sorts of emergencies where MAE-East is having route amnesia, or a bad headache, or an unfortunate encounter with some Night Train, or whatever it is that seems to keep happening to it. It might be a good insurance policy, as well as giving you the opportunity to do load-balancing on your own network.

Someday you'll plug the computer into the wall, and the Internet will just work. Thank heavens those days aren't here yet. There's still time to try to get it right first. ⇐

*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](mailto:amp@cpg.com).*

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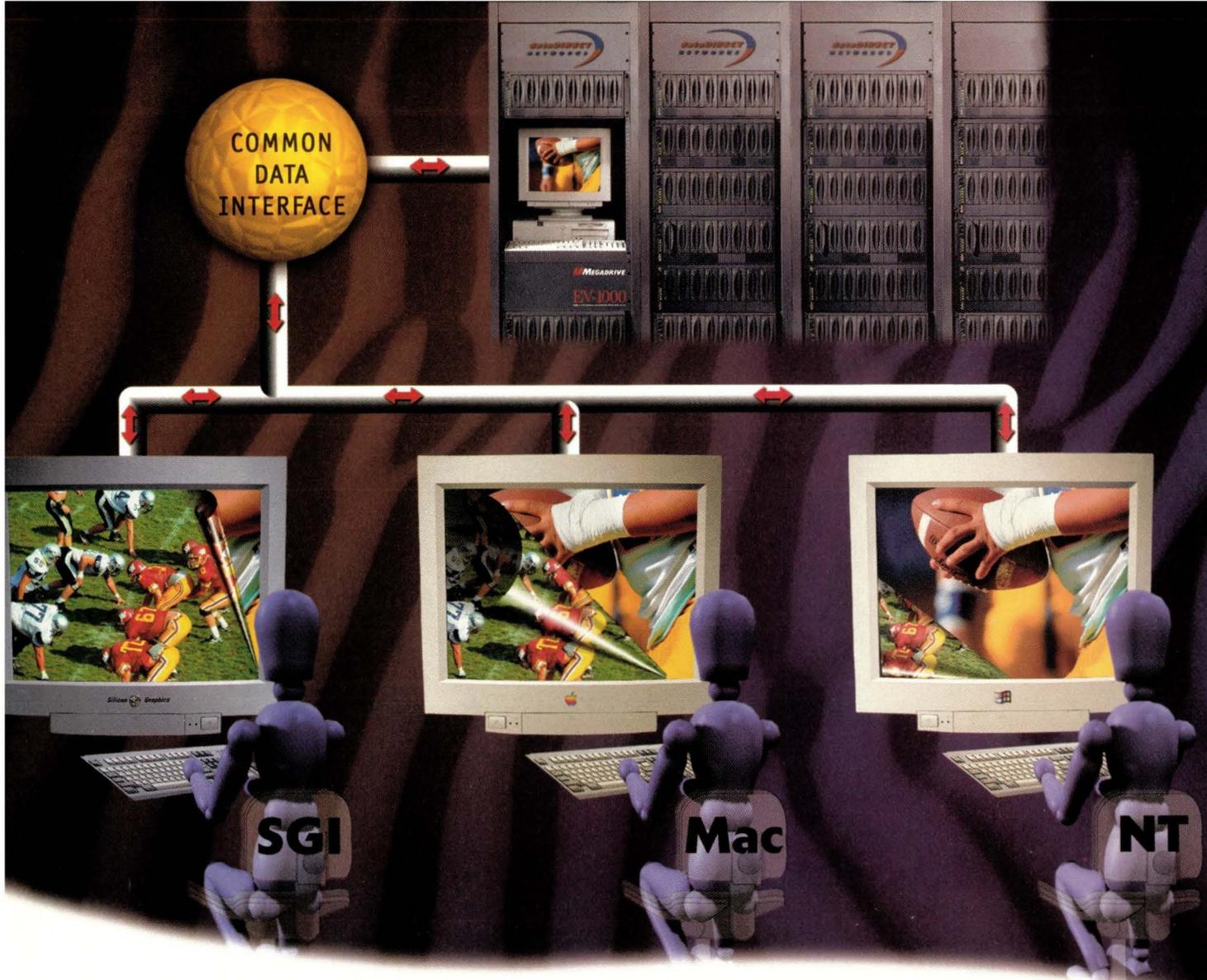
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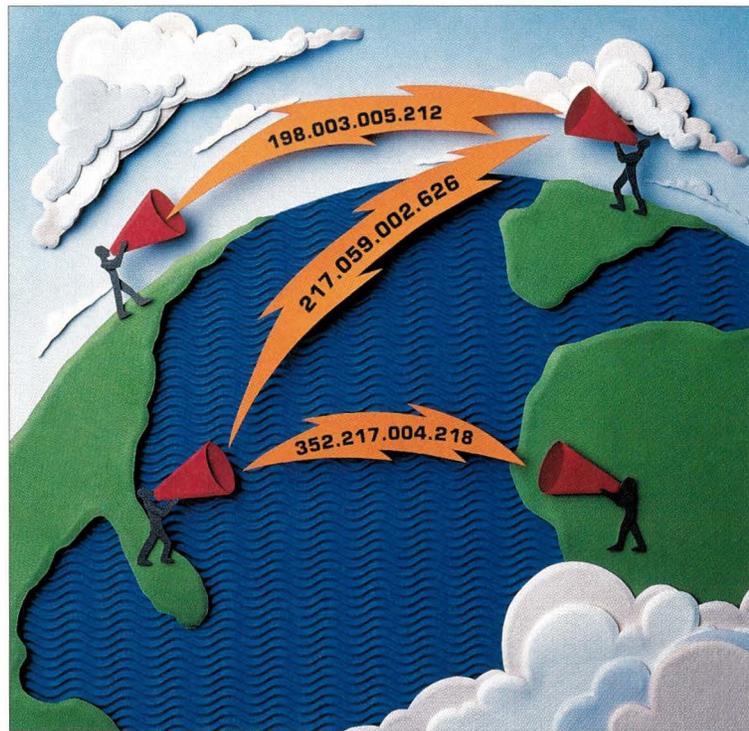
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# UNIX Basics

by Peter Collinson, Hillside Systems



## The Domain Name Service

One of the many reasons for the success of the Internet has been the Domain Name Service, or DNS. (Incidentally, the “S” in DNS can also stand for “Server.”) The primary task of DNS is to translate machine or service names into IP numbers. By using a clever ruse, which I’ll get to later, it will also translate IP numbers back into names.

However, how the DNS works is poorly understood. When I hear someone say, “Oh, I couldn’t get to your Web site. It said something like ‘Site Unknown,’” I always ask if they tried again, because I know that what’s happened is the DNS lookup for the machine name has failed. This usually happens because the information request was taking too long and, when they try again, the necessary information has probably arrived and can be accessed.

In the beginning, on the ARPANET, name-to-address translation was done using a file known as `HOSTS.TXT`. The single file was maintained by the Stanford Research Institute (SRI) Network Infor-

mation Center, known as “The NIC,” and distributed from a single machine, SRI-NIC. Administrators would periodically grab copies of the file using FTP. The file was the basis for the UNIX `/etc/hosts` file, which lists numbers and machine names.

The scheme did not scale. Not only did the size of the file increase as the network expanded but also the traffic from hosts accessing SRI-NIC grew. At the time, all the machines were called by a single-word name, and coordinating the name space became increasingly difficult. Anyway, using a unique single word as a name for each machine was obviously not going to work forever. Paul Mockapetris was responsible for designing the architecture of a system that would replace the `HOSTS.TXT` file. He came up with the Domain Name Scheme (yet another translation for the “S”).

DNS has two principal good ideas. First, it provides a way of expressing machine names in a hierarchy—a tree of names where each word in the name only

needs to be unique at one particular level. The tree means that you, like trillions of other people, could call your machine “zaphod,” but your zaphod would be distinguished from my zaphod because the remainder of its fully qualified domain name would be different. Douglas Adams has a lot to answer for. As you know, the hierarchy is written “bottom up,” starting with the name of the machine, and as we move from left to right we move up through the separate domains to the top, each level is separated by a “dot.”

Second, DNS was envisaged as a distributed database, consisting of many small local databases scattered over the planet, each managed by a program called “a name server.” The name server is usually called `named`, although on a Sun machine it’s called `in.named`. The job of the name server is to answer queries from local programs and to communicate with other name servers, answering their queries about the local domain.

The key operational idea that makes



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this distributed database work is “delegation.” At any level in the hierarchy, a name server is able to say, “Well, I don’t know about that name. Ask the name server that you will find here.” Delegation allows a server higher up the domain tree to pass lookup requests onto a name server further down the tree. For example, if you are looking up `strange.cpg.com`, your application will send the information request to your local name server. Assuming that your local name server doesn’t know the answer already, it must traverse all the name servers from the top domain down to find one that contains the information you need. Thus, your local server will start work at the right-most part of the address looking for information on the `.com` domain.

Your name server will already know where to find top-level domain information. When `named` starts, it is given a file that contains the names and addresses of a set of top-level servers. It uses this information to ask one of those top-level servers to send its “zone,” a copy of the information that a name server can access from its own disks. A zone contains all the information from a particular level in the domain hierarchy and is logically a single file on the name server. Most `named` implementations allow “include” directives so this logical file can be split over several physical files, should that be desirable. Because the name server is pulling the information from its own disks, it is certain that the information is correct and is said to be “authoritative” about the zone.

The zone data from a top-level server tells your `named` where it can find name servers for all the top-level domains that are recognized in the world. So when you make your request for `strange.cpg.com`, your name server already knows where to find a server that can give it relevant information about the `.com` domain and will move to the next part of the domain name, looking up `cpg.com`.

The `.com` name server will know where to find two name servers for the `cpg.com` domain because this information was supplied when the `cpg.com` domain was registered. Your name server will contact one of these servers to find the address of Computer Publishing Group’s name server. Finally, your name server is able to look up the full address `strange.cpg.com`, getting information from a machine located in CPG’s offices.

The ability to locally administer your own name space is a great strength of DNS. When you want to make changes, you don’t have to tell some poor overworked person in a central administrative office to change the contents of a file, you can do this yourself and have those changes reflected around the world very quickly.

Of course, it would be desperately slow to have to go through the rigmarole of asking several servers for information for every address that you need to look up, so name servers cache all the information they get. Caching means that a second lookup on the same name will use the information that has just been laboriously obtained. Also, it means that a second lookup on a domain in `.com` can use the information that was obtained before. When a name server has cached information about a zone, it’s said to be “nonauthoritative” about that zone.

When you cache information, you have to accept that the data will become incorrect at some random point in time,

depending on the whim of disorganized humans. DNS places the control of behavior of the remote caches in the hands of the information owner by allowing them to place a “time to live” (TTL) on the zone data. When that time expires, remote DNS servers know that they must flush the information from their cache.

If you are supporting a zone with DNS, then you will need to choose a TTL for your data. The decision is a trade-off between the load that external sites will present to your system and the accuracy of the picture that you are presenting to the outside world. A short TTL means that remote sites will be accessing your server more frequently, increasing the load on your system. A long TTL means that remote sites will take time to recognize any changes in your information. My name servers set a TTL of one day, which seems a common choice. It means that I only have to wait 24 hours before I know that local changes are reflected in the outside world.

## Name Server Types

So you sit in front of your screen typing away, generating DNS requests that may be satisfied by the cache in your local `named`, or more often by reaching out to some remote name server to obtain the necessary information. It all works well in a reliable world, but networking is not reliable. Machines may be down being rebooted, or worse, they’ve crashed. Perhaps the route to them is temporarily unavailable while the routers across the world struggle to make the network operational because a train derailment in New Jersey has done serious damage to the fiber infrastructure that normally carries the packets.

Well, if we are thinking about reliability, a name server is obviously a single point of failure. If there is only one, and it’s down when someone needs information from it, then they are stuck. DNS helps with this problem by allowing you to define a secondary master name server for a particular zone. The basic idea is that the secondary name server mirrors the master, getting its information by pulling data from a master server that is authoritative about the zone and storing it locally.

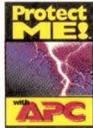
Of course, you can mix and match the definitions for a particular name server; an invocation of `named` can be primary for one zone and secondary for another. It can just support primary information, just secondary information, or both, or actually neither. It’s often desirable to set up a name server that supplies no information but simply acts as a cache to speed up local name searches.

A name server that’s acting as a secondary for a particular zone will pull the data from the zone master on startup and will then obey some directives in that information, ensuring that this new cache of information remains current. First, each zone file will contain a serial number that’s advanced whenever the file is changed. I use the common convention of placing a reversed date in this field: `yyyymmddSS`, where `yyyy`, `mm`, `dd` are the current year, month and day numeric values, and `SS` is an advancing number, allowing me to make more than one change per day. Forgetting to advance the serial number is a common mistake made by DNS administrators. When a secondary server contacts a master, it first asks for the serial

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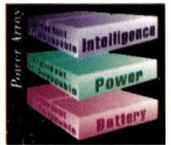
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number and will only pull the data if the serial on the master is greater than the value that it holds.

Second, each zone file contains a *refresh* interval that tells the secondary how often to wake up and ask the master for the zone data. Again, there's a performance and consistency choice to be made here. If the refresh interval is too short, then you may be transferring zones much too often and gobbling bandwidth; if it's too long, then users will get restive because the address of their new workstation hasn't appeared in the copy of `named` that they need to access. The screaming users can be pacified by restarting the appropriate `named`, forcing a reload of its secondary files. However, a restart may not be an option if the machine is remote. On my small network, where my machines are within reach, I set a 12-hour refresh period.

Third, there is a *retry* value. If the secondary server cannot get to the master, it will delay for this period before trying again. Finally, there's an *expire* value, used to completely expire all the data if the name server cannot be reached. I set this to seven days, and I'm considering increasing it to 15.

So there is excellent support for secondary name servers, and this support is endorsed by the name registration bodies that insist that a new domain should exist in two distinct name servers before they will register it. Duplicating name servers makes great sense. The secondary for my domain is run by my Internet service provider (ISP), so that if I have some disaster that persists for a significant period (like the five-day power outage that happened as a result of the great southern English hurricane in 1987), my names and addresses won't disappear from the Net, and mail will not be bounced. The notice of my Net death will not be premature.

Sensible placement of your secondary is a must, and the need to get this right is often neglected. I've recently started to host someone's domain on my server because they had had reports that there were often lookup errors for their machines. Their ISP has two name servers, but they are on the same network, and I suspect that when their network becomes congested, DNS access suffers and fails. If their secondary was placed on another network, with different access characteristics, then I suspect these problems would disappear.

## What's in a Zone?

For any zone, the file contains several different types of record. Each record has a key, which is a domain name, a class (which is always IN for Internet), a type and some associated value(s). The number of values will depend on the record type. It's worth knowing a little about the record types because it helps to understand the results of name server access tools like `nslookup`.

Each zone file will begin with a Start of Authority (SOA) record that has a bunch of arguments. First, it has the name of the name server that supplied the data. Second, it has a "fake" machine name that supplies the email address of the person who controls the data. The SOA record for `hillside.co.uk` has `pc.hillside.co.uk` as its second argument; you can replace the first dot with `@` and derive my mail address. This information is not used by name servers but is intended

for use by humans, providing them with a contact address at the site. The remaining SOA arguments are the TTL and the values used by secondary name servers to time out their copies of the data.

The basic record used to map a domain name to an IP address is the "A" or address record. An IP address defines an interface, and it's often the case that a machine will have several interfaces, so it's perfectly possible to have several A records mapping the same name to different IP addresses.

If a machine has aliases, for example, my machine `wooded.hillside.co.uk` is also known as `ftp.hillside.co.uk` and `www.hillside.co.uk`, then the alias is included as a canonical name (CNAME) record. A CNAME maps one name to its canonical form. Canonical forms are defined by A records and give an IP address for their key. When the name server is given a name to look up and finds a CNAME, it replaces the name it is looking up with the canonical name and does another lookup to find the IP address.

It would be possible for me to define these aliases using A records to map `www.hillside.co.uk` directly to an IP address. However, some applications, notably `sendmail`, need to know that a particular name is an alias so they can change any mail name to its canonical form. It's better to mark an alias as such by using a CNAME record.

DNS also provides routing information for the email by using a mail exchanger (MX) record. When processing mail, the handling program will process a destination address such as `pc@cpg.com` by looking up the name that appears after the `@` symbol as an MX query. MX records have priority value and a canonical name. It's usual to have several MX records for any given mail address, and the sending machine will try each starting with the lowest priority value until it manages to deliver the mail. Mailbox addresses can be names of machines but are often domain names forcing the delivery of mail to one mail gateway machine on a local network.

Reverse lookups, translating an IP address into a machine name, are handled by a cunning use of the DNS mechanism with a special pointer record (PTR). The IP address is reversed and used to construct a name in the `in-addr.arpa` domain. For example, my machine `craggy.hillside.co.uk` has an IP address of `194.205.42.1`, but a site wishing to perform a lookup on the address will look up `1.42.205.194.in-addr.arpa`.

The reason for the reversal of the IP address is simple. IP addresses are hierarchical, being split into *classes*. However, the number reads from left to right with the left-most bits used to denote the class and the right-most bits used for machine numbering or further subnetting on a site. I have a Class C address, and my network number is `194.205.42`. My local addresses use the last value of the dotted quad.

To allow me to control my reverse name space, the registration authority needs to delegate my network number to my name server in the form `42.205.194.in-addr.arpa` so that I can associate the correct machine name with the correct number. I create a special zone file for this delegated domain and make PTR record entries that map my IP numbers onto machine (or service) names.

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# UNIX Basics

## Applications and DNS

Any application on your machine that needs to access the DNS will send a message to its local `named` using routines that are compiled into the program binary. The program will use a set of routines known as the *resolver library* to format the query and interpret the response from the local `named`. The cache that `named` supports plays an important role in making DNS lookup operate quickly.

When the lookup fails, it's actually your `named` that gives up and times out. I'm sure you've experienced a Web browser "getting stuck" after you type a URL; you sit there waiting for something to happen, get bored, but then nothing happens when you hit the Stop button. The browser is hanging because it has looked the name up in the DNS, and very probably a name server somewhere is not reachable. The lookup mechanism tends to take time to realize that something isn't working but will time out, eventually.

Because the lookup routines are

compiled into applications, there has to be some mechanism to configure how lookups are to be done if there is no `named` running, or you want to use a `named` on another machine. There are extra complications on SunOS and Solaris machines because of the interaction with the name service formerly known as Yellow Pages, now known as NIS and NIS+.

In the traditional implementation, the resolver routines consult `/etc/hosts` if there is no `named` running on the machine. This means that machines on island networks that are not connected to the Internet can quite happily talk to each other using IP addresses taken from a static file. NIS provides a way to transport this file around an island network, so larger sets of machines can share one master copy of the file.

Once the network is connected to the Internet, then there's a need to run a regular name server to support access to external Internet addresses and also to provide the world with local address mappings. It's still not necessary to run

a `named` on every machine on the network. It's possible to establish a file called `/etc/resolv.conf`, which tells the resolver routines where on the local network a name service can be found. However, it's probably better to run a simple cache-only name server in these circumstances; users will get a faster response for name lookups.

Sun has struggled with the interaction between NIS and DNS for several years, meaning that its version of `named` has often lagged considerably behind the current public release. When I was running SunOS on a single machine that was connected to the Internet, I was forced to run YP to ensure that I had a working `named` on the machine. The alternative was to install a version of the Berkeley Internet Name Daemon (BIND), but this meant editing some shared libraries, which I was always queasy about doing.

With recent releases of Solaris, Sun has sorted out many of the name service problems that occurred in earlier systems. The resolver routines inspect `/etc/nsswitch.conf` to find out which sources of name information are available in a particular machine.

## Finally

I haven't managed to say that most versions of `named` derive from BIND, which is freely distributable and has been maintained in recent years by Paul Vixie of Vixie Enterprises (<http://www.vix.com>). The System Administrator's Guild (SAGE) awarded Paul its SAGE Outstanding Achievement Award in 1997 for this work.

The bible for DNS and its associated lookup routines is *DNS and Bind* by Paul Albitz and Cricket Liu (ISBN 1-56592-236-0). It's published by O'Reilly & Associates Inc. and is now in its second edition. ➔

*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@cpj.com](mailto:pc@cpj.com).*



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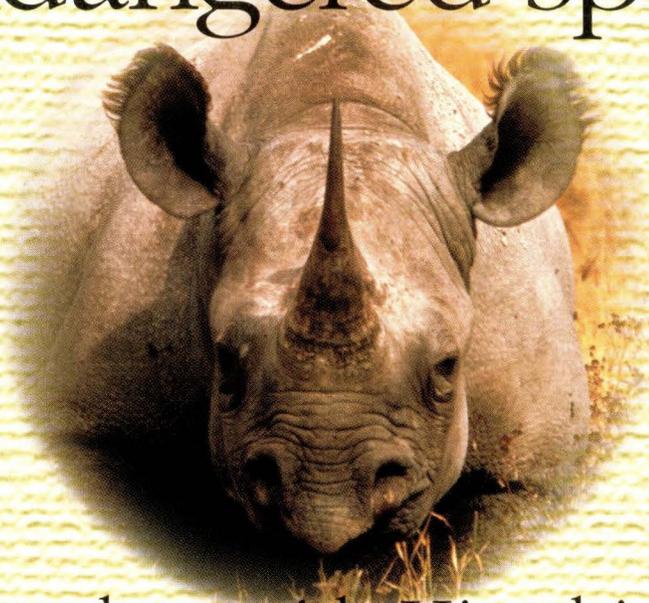
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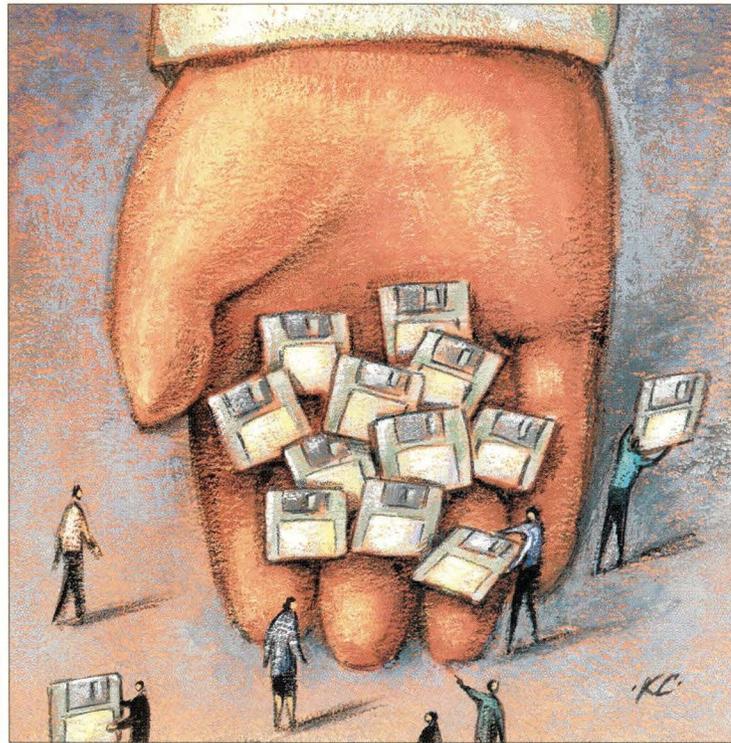
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# I/Opener

by Richard Morin, Technical Editor



KEN CONDON

## MkLinux: A Status Report

*Note: This month's column was originally written at the request of HyperLib Magazine, a Japanese computer-related periodical. It seemed like a good time to bring my SunExpert readers up-to-date on MkLinux, however, so I requested permission for dual publication. Fortunately, all parties were amenable to this "recycling."*

**M**kLinux, Apple Computer Inc.'s hybridization of Linux 2 and Mach 3, was created several years ago as a pilot project in operating systems portability. Brett Halle, an Apple manager, convinced his superiors to fund a small number of engineers from Apple and the Open Software Foundation (OSF), now part of The Open Group, in an effort to do the following:

1. Adapt the Linux kernel to run as a Mach "server."
2. Adapt the Mach microkernel to run on Apple (PowerPC) hardware.
3. Write low-level (for example, bootstrap and driver) code.

The effort was very successful, clearly demonstrating Mach's portability benefits. To reduce the number of complications, MkLinux was first made to run on Intel Corp. hardware (Linux itself was running on Intel, keeping the CPU architecture constant). Then, within a few weeks, it was moved to Macintosh hardware. Both Intel and PowerPC hardware are still supported by MkLinux, as well as Hewlett-Packard Co.'s PA-RISC.

In May 1996 at the World Wide Developer's Conference in San Jose, CA, Apple unveiled MkLinux Developer Release 1 (DR1). A packed auditorium of developers watched demonstrations of DR1, then received (hitherto unexpected) copies of the DR1 CD-ROM. MkLinux had "gone public," and there was no turning back; thousands of copies of DR1 were sold and/or given away during the summer of 1996.

In September 1996, MkLinux DR2 was released. DR2 offered greatly enhanced stability, more features, applications and so on. DR3 was promised "real soon

now," but circumstances—in the form of Apple's purchase of NeXT Software Inc., formerly of Redwood City, CA—intervened.

The MkLinux engineers had valuable knowledge of Mach technology, knowledge that Apple needed very badly to demonstrate the portability of the NeXT software. Consequently, most of the MkLinux engineers were pulled into the Rhapsody (a BSD/Mach/Mac OS/OpenStep merger currently under development by Apple) effort. The MkLinux team, never large, got dramatically smaller.

Even so, Apple managed to produce another release. It wasn't the promised (and much-desired) DR3, but it did offer a number of stability and performance enhancements. It also ran on PCI-based Power Macintosh systems, greatly increasing the number of usable machines.

The DR2.1 release, issued in early 1997, has been the basis for all MkLinux use and development during the past year. New MkLinux users have started with it,

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FTP updates have been referenced to it, and Apple's MkLinux Reference Release was based on it.

The Reference Release, *MkLinux: Microkernel Linux for the Power Macintosh*, is a mixture of original and archival material from Apple, NeXT and the OSF. It consists of a reference volume and two Hierarchical File System (HFS)-format CD-ROMs. One of the disks is

an installable copy of MkLinux DR2.1; the other contains 600 MB of Apple, NeXT and OSF documentation.

With the advent of MkLinux DR3 (described below), the Reference Release continues to be a valuable resource. The book and documentation disk are still current; an installable DR3 disk is now included in place of DR2.1.

MkLinux continues to be a leading-

edge technology, playing an important role in the development of Rhapsody. With the advent of Apple's new, fast G3 (third-generation PowerPC) machines, MkLinux is also beginning to be a serious contender in the Linux price/performance competition.

Although MkLinux is unlikely to displace "native" Linux on Intel machines, I do expect to see more MkLinux-based Web servers. The new Apple G3 machines are very competitive, having reasonable price tags and excellent performance; a G3-based MkLinux system is more than a match for any Pentium-based Linux system. And, in terms of price/performance, a G3-based MkLinux system crushes any conventional UNIX workstation.

## Who Uses MkLinux?

It is difficult to know how many MkLinux users there are. The English-language email lists, administered by Apple, currently have about 14,000 subscriptions altogether, representing about 7,000 unique addresses. Japanese MkLinux users have their own lists, however, and other overseas users may have their own lists, as well.

It is also likely that many MkLinux users do not bother to join the email lists. People who simply have accounts on an MkLinux system, for instance, might have little reason to participate. In any case, although I have heard estimates of up to 100,000 users, my own estimate is about 25,000 to 50,000 users worldwide.

MkLinux has never been advertised as a "commercial" system. Neither Apple nor Prime Time Freeware offers any technical support. Consequently, you might expect that MkLinux use is restricted to experimental purposes and study. Although many MkLinux systems are used in this manner, many others are not.

We have received customer reports of MkLinux systems being used for Web browsing, software development, serving Web pages, running database management systems, acting as gateways for local-area networks and more. In short, people are using MkLinux just as if it were a "real" operating system.

MkLinux runs on standard Macintosh hardware, allowing Mac-oriented organiz-

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ations to avoid having to support Intel-based PCs or UNIX workstations. In addition, because of MkLinux's efficiency, old (and thus less desirable) hardware can be "rejuvenated."

A Power Mac 6100 is not a very powerful system these days—a G3 is about eight times faster—on the other hand, a 6100 runs MkLinux very nicely indeed. It can sit in a corner and provide UNIX-style logins to a whole network of Mac OS systems.

We are also hearing from developers who like the fact that MkLinux is a free, Mach-based, UNIX-like system. True, MkLinux isn't Rhapsody, but it runs on more hardware and is open to inspection, experimentation and modification.

This has been useful for developers of other operating systems, such as Be Inc.'s BeOS, PowerPC Linux and, of course, Rhapsody. It is also useful to prospective Rhapsody developers. Peeking inside MkLinux is a good way to understand the underlying structure of Mach and Rhapsody.

If and when Rhapsody converts to a Mach 3 (microkernel) foundation, MkLinux may be able to run as a second "personality" on the same machine. This would let kernel hackers play with experimental MkLinux kernels on a running Rhapsody system!

## MkLinux in Japan

When *HyperLib Magazine* asked me to write this MkLinux status report, I was happy to oblige. The Japanese MkLinux community is substantial; it has an active email list, a Web site and a large body of users and developers. With upcoming events, it should grow even larger. ASCII Corp.'s Japanese translation of the Reference Release is now in progress. Even if ASCII doesn't invite me over for a book-signing tour (:-), the translation should make MkLinux far more accessible to the Japanese audience than it has been to date.

Unfortunately, I do not read Japanese, so I won't be able to critique the translations of either this article or the book. I am planning, however, to post the English version of this article on my Web site, <http://www.ptf.com>. So stop by and take a look.

While you're at it, be sure to visit Apple's MkLinux Web pages, <http://www.mklinux.apple.com>, they contain pointers to Web-based resources, forms for joining the MkLinux email lists and more. These Web pages are the hub of the MkLinux community and are definitely worth exploring.

My favorite MkLinux email lists are `mklinux-announce` (announcements),

`mklinux-misc-d` (miscellany) and `mklinux-setup-d` (setup issues). The `-d` suffix on the latter two lists indicates that they have been collected into digests. The digests are issued about once a day and contain summary headers that tell the reader the topics being discussed. Using the digests, I can scan a week's worth of messages in just a few minutes!

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## Development and Testing

MkLinux development has been active over the past year, putting out “updates” every month or so and “work in progress” releases even more frequently. These releases give the MkLinux community new software to try out, but they also provide valuable feedback to the MkLinux development team.

In fact, the MkLinux community acts as a worldwide distributed “testing laboratory.” As soon as a release is made available, the MkLinux users go to work; they find processor incompatibilities, compiler bugs and even more obscure problems. Then, when the developers offer a proposed fix, the users are more than willing to test it.

The MkLinux development group has never been large—given Apple’s current austerity measures, it’s a mark of the company’s interest in MkLinux that any engineers are still paid to work on MkLinux at all. Consequently, having a large body of volunteer testers has been absolutely essential to the project’s success. The DR3 development process, in particular, has relied strongly on the MkLinux email lists and related volunteer efforts. It is not an overstatement to say that DR3 would not have had anything like its capabilities and robustness without the aid of the worldwide MkLinux community.

## Project Status

Despite the size of the development group, MkLinux has hundreds of ported applications. Most of these were simply recompiled from Intel-based RedHat versions (<http://www.redhat.com>). Because MkLinux really is Linux, applications “build” (compile and link) with few problems. The remaining applications seldom pose any real difficulty to prospective porters.

In addition, the PowerPC Linux developers have standardized on the UNIX System V Release 4 Application Binary Interface (ABI). The result is that each application needs to be ported only once to PowerPC Linux, saving a lot of (otherwise duplicated) effort.

With the efficiency gained by this standardization (and a lot of volunteer porting effort!), the PowerPC Linux community now has a very respectable set of ported applications, with more on the way. For instance, Netscape Communications Corp. Communicator 4 is available, as well as a full Java Developer’s Kit (JDK) 1.1.5 environment, including a Just In Time (JIT) Java compiler.

With the applications largely under control, the MkLinux developers have been able to work on kernel-related issues. Here are some of their accomplishments, as of DR3:

- Applications use dynamic shared libraries, greatly reducing disk and memory requirements.

- I/O support is available for audio output and Integrated Drive Electronics (IDE) disk drives.
- Networking support includes file access, network access and printer sharing for Mac OS, Microsoft Corp. Windows and UNIX systems.
- MkLinux file systems use Intel, little-endian, byte ordering. (Individual files, of course, may still use PowerPC-specific byte ordering.)
- Mac OS HFS partitions are directly mountable.
- Many new machine types, for example, [2346]400, [56]500 and Tanzania-based models, along with the new G3-based systems, are supported.
- Multiprocessor systems are supported.

In addition, the Installer has been totally redesigned, based on the RedHat 5.0 installer and utility base. It now boots up an MkLinux system in RAM disk, allowing the user to select and partition disk drives, select desired “packages” and so on. More than 400 RedHat Package Manager (RPM) archives are included with the distribution, in both binary and source versions. MkLinux relies heavily on RPM; many source RPM archives actually build on MkLinux with no changes whatsoever.

The new installation technique is much more flexible and powerful than the one used in DR2.1, and it is easy to use. And, of course, the use of intelligent Macintosh hardware removes any need to set jumpers, adjust display scan rates and so on.

The MkLinux DR3 feature set draws upon work done in several disparate communities. The GNU tools, of course, are the work of the GNU Project (<http://www.gnu.org>). The Linux components are the work of Linux developers around the world.

The Open Group continues to work on Mach, both independently and as part of its work for Apple. And, as a nice bit of payback, some of the Rhapsody engineers have contributed to the MkLinux project, accounting for I/O and other improvements. In short, MkLinux continues to promote, and benefit from, the spirit of cooperation in the free software community. ➔

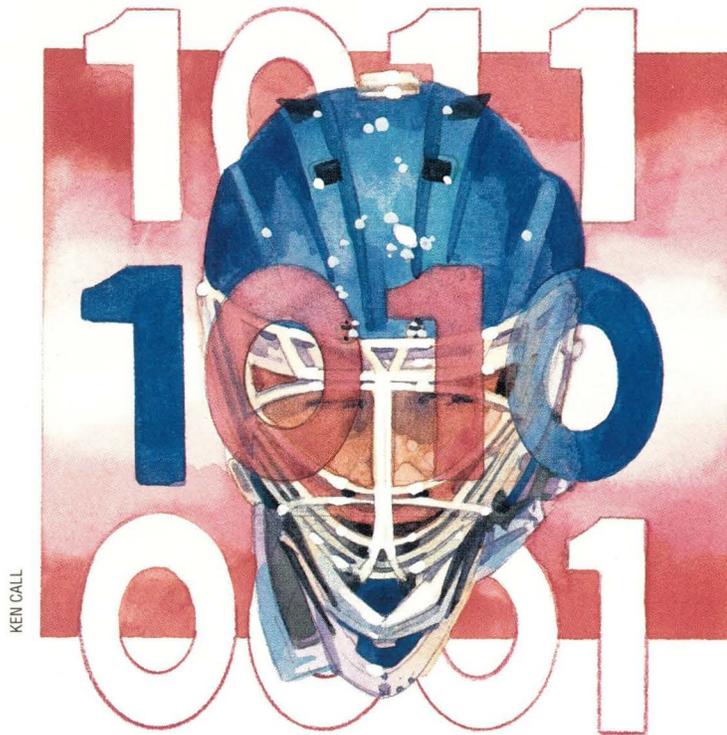
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**Richard Morin** operates *Prime Time Freeware* ([info@ptf.com](mailto:info@ptf.com)), which publishes mixed-media (book/CD-ROM) freeware collections. He also consults and writes on UNIX-related topics. He may be reached at *Canta Forda Computer Laboratory*,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

## COMING NEXT MONTH

### WEBSERVER MAGAZINE SUPPLEMENT

Taken from our *WebServer OnLine Magazine*, the monthly editorial section will be directed to those readers who are involved with evaluating hardware/software products for corporate Web sites and Internet applications.



## Demystifying Netmasks

**A**re you confused about netmasks? Don't let images of pranksters on Halloween give you the wrong idea. Netmasks are actually quite easy to understand and even easier to calculate.

With only a handful of concepts, you can work through the simple calculations and sling the lingo with the best. If you understand how IP addressing works, then the finer granularity imposed by netmasks to form subnets is a logical extension of the same idea.

To begin with, it is important to understand that netmasks are masks. And what is a mask, you ask? According to the ANSI/IEEE Standard Dictionary of Electrical and Electronics Terms (4th Edition), a mask is "a pattern of characters that is used to control the retention or elimination of portions of another pattern of characters," or alternatively, "a filter."

Looking at a mask of four binary digits, 1010, and applying it to a value of four binary digits, 1011, for example, we get the results shown here:

```
1011  value
1010  mask
-----
0001  result
```

Each bit that is set on the mask hides the value of the number it's masking. Each bit that is not set (that is, equal to 0) allows the value of the number to show through. Thus, the result of applying the 1010 mask to the 1011 value is 0001.

Masks do not have to be expressed in binary, by the way. Consider a character mask where every other character is masked, as shown here:

```
help
x-x-
-----
 e p
```

The mask in this case would have a value of 255.0.255.0. Two of the 8-bit characters would be blocked completely and two not at all. Now, let's consider a mask that blocks one byte of the value impartially.

The mask 255.0.255.032 masks our string as shown here:

```
help
x-x-
-----
 e P
```

Notice how the mask turned a lowercase p into an uppercase P. In fact, a mask of 032 will always change a lowercase letter to its uppercase counterpart, simply by masking—eliminating—the single bit that is different in the two sets of characters.

Netmasks are applied to network addresses in much the same way we have applied them in these examples. The most common netmask, 255.255.255.0, masks the left three bytes (octets) of a network address and leaves the rightmost single byte. This mask, therefore, separates the host portion of a network address from the rest of the address in a class C network. The mask 255.255.0.0 does this for a class B network, and 255.0.0.0 does this for a class A network.

Netmasks are most challenging when they are used to divide a network (almost always a class C network) into a series of sub-networks. If, for example, you don't have 255 hosts, but only 12, reserving a class C address would be wasteful. So what do you do? You use a subnet mask that affects a smaller-than-class-C network. A common subnet mask is 255.255.255.240. Let's look at how this works:

255	255	255	240	decimal
11111111	11111111	11111111	11110000	binary

Converting this mask to binary makes it easy to see that it masks everything in an address but the last four bits. In four bits, you can express any of 16 values—0 to 15. Thus, this netmask will create a subnet with 16 hosts. Let's not lose sight of the fact that we're talking about a mask, not your network address. Let's say your network address is 192.9.200.0. With this address and this netmask, you might be using 16 host IP addresses in the range 192.9.200.128 through 192.9.200.143. The last byte would have the following values in binary:

```
10000000
10000001
10000010
10000011
10000100
10000101
10000110
10000111
10001000
10001001
10001010
10001011
10001100
10001101
10001110
10001111
```

Subnet masks are not defined in an arbitrary way, of course. Anyone wanting to use them needs a sequence of IP addresses that they can use to isolate a small subnet. What you want, therefore, is to have your subnet mask leave unmasked a sequence of bits large enough to accommodate your subnet. In our example, the last octet of our mask was 11110000, giving us

**Table 1. Example Subnet Sizes**

Number of IP Addresses	Netmask	Number of Subnets
2	255.255.255.254	128
4	255.255.255.252	64
8	255.255.255.248	32
16	255.255.255.240	16
32	255.255.255.224	8
64	255.255.255.192	4
128	255.255.255.128	2

a 16-host subnet. We could have chosen 11111000 for an 8-host subnet or 11000000 for a 64-host subnet, and so on. In fact, using a 255.255.255.240 netmask, you can divide a class C network into 16 16-host subnets, the first starting on 0 and the rest starting on a multiple of 16: 16-31, 32-47, 48-63, 64-79, 80-95, 96-111, 112-127, 128-143, 144-159, 160-175, 176-191, 192-207, 208-223, 224-239 and 240-255. Alternately, netmasks could be used to divide a class C network into eight 32-host subnets or even 128 2-host subnets. The size of a subnet depends on the mask that is used, as shown in Table 1. Netmasks are established in the sample `/etc/netmasks` file, as shown below:

```
#
# The netmasks file associates Internet Protocol (IP)
# address masks with IP network numbers.
#
#      network-number netmask
#
# The term network-number refers to a number obtained
# from the Internet Network Information Center.
# Currently this number is restricted to being a class
# A, B, or C network number. In the future we should be
# able to support arbitrary network numbers per the
# Classless Internet Domain Routing guidelines.
#
# Both the network-number and the netmasks are
# specified in "decimal dot" notation, e.g:
#
#           128.32.0.0 255.255.255.0
#
# 192.9.200.0 255.255.255.240
```

## WebServer Magazine Back In Print!

Starting with the June 1998 issue of *SunExpert*, editorial from our online magazine will form the basis for a WebServer supplement. Editorial will include expert discussions on Web security, Web tools, new Internet products and Web-related feature articles.

# Systems Administration

Calculating the correct subnet mask to use is easy. Subtract the size of the subnet you want to define from the number 256. You can always use the command `expr 256 - $$SZ`, if you want to do this in a script, where `$$SZ` is set to the size you want. This is not some lucky coincidence, of course, but the logical result of the mask and the subnet sharing the octet as depicted here:

```
Subnet = -
128 X-----
192 XX-----
224 XXX-----
240 XXXX----
248 XXXXX---
252 XXXXXX--
254 XXXXXXX-
Mask = x
```

In a routing table, the netmask defines the portion of a network address that must match a particular route to be used. Each set (1) bit in the mask must match, but each unset (0) bit doesn't have to match. If we used a mask of 255.255.255.255, an IP address would have to match exactly before the particular route would be used.

If we used the mask defined above, 255.255.255.240, for example, all but the last four bits would have to match before a route would be selected. In the example below, to



use the network address 192.9.200.128, we need to match all but the last four bits:

Network Address	Netmask	Gateway	Interface
192.9.200.128	255.255.255.240	192.9.200.137	192.9.200.137

Network traffic sent from this system to any of the other hosts in the subnet 192.9.200.128 through 192.9.200.143 would, therefore, be directed to 192.9.200.137. ➔

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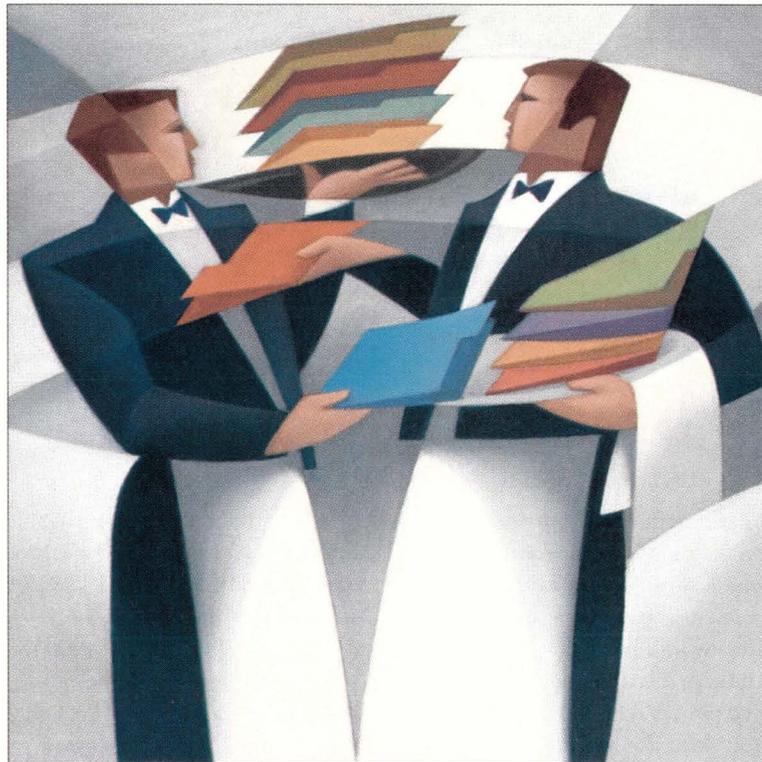
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SunExpert Magazine ■ May 1998



LYNNE CANDY

## Sharing File Systems, Part 1

This month, we continue our look at disks and file systems under Windows NT. We have already considered using the Disk Administrator tool to manage disks and disk partitions, and last time we discussed the NTFS file system in some detail. In both cases, we focused on disks and file systems in the context of a single system. This time, we consider how Windows NT makes local file systems available to users on a networkwide basis. Next month, we'll conclude our discussion of file systems with a look at sharing file systems between Windows NT and UNIX systems.

Windows NT refers to making a file system available for network access as *sharing* it, and file systems exported in this way are called *shares*. Any directory may be shared—from a single folder to an entire file system—and sharing a directory automatically shares the entire subdirectory tree rooted at that point. It is also perfectly legal to share a directory that is part of an already-shared directory tree, that is, one of its ancestors is already

shared. You might want to do this to provide convenient, one-step access to a frequently used location that happens to be part of another share.

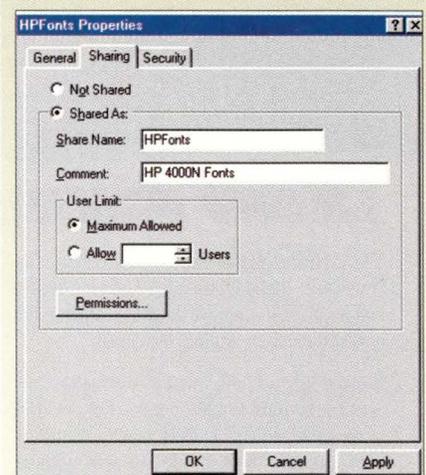
Sharing a directory is a simple process, and there are several ways to accomplish it. The easiest is to use the Sharing... option on its shortcut menu (right-click on its icon to access it). This option brings up the dialog box shown in Figure 1.

In this example, we define a share named HPFonts, which happens to consist of the top-level subdirectory of the same name on drive C:. We have provided descriptive comments about the share, which will be made available to users when browsing. We have chosen not to limit the number of users who can access the share simultaneously, although we could have done so under User Limit. The same operation can be accomplished with the following one-line net share command:

```
net share HPFonts=C:\HPFonts
/users:unlimited
/remark:"HP 4000N Fonts"
```

The /users option is not really necessary because this value is the default, but it is included for illustration purposes. The option takes the maximum

Figure 1. Sharing a Directory



Sharing a directory is made easy with the Sharing option. Here you can provide users with comments about each share and control user access.

number of simultaneous users as its parameter (or the key word `unlimited`, as in our example).

Sharing CD-ROM drives is no different than sharing any other file system resource. When a CD-ROM drive is shared, any CD that happens to be inserted there is available for network access. You can remove a defined share by selecting the Not Shared radio button in the Sharing dialog box or by using the `net share` command's `/delete` option. For example, the following command removes (undefines) the `HPFonts` share:

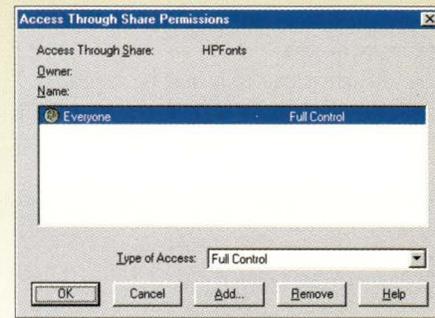
```
net share HPFonts /delete
```

Users can access a share in many ways. For example, they can open the corresponding folder by entering the server and share name into the Start=>Run dialog box as a Universal Naming Convention (UNC) path: `\\vala\HPFonts`, in this case, where `vala` is the name of the server. In general, shares may be specified in any context where a UNC path may be used. In addition, items within the share's subtree may be specified by appending the subpath and item name to the share specification:

```
\\vala\hpfonts\obsolete\marigold.ttf
```

It is often more convenient to define a drive letter to point to a frequently accessed share; for one thing, it cuts down considerably on the typing. This can be accomplished with the Map Network Drive item on My Computer's shortcut menu or by using the `net use` command. For example, the following command defines the drive letter `X:` to point

**Figure 2. Default Share Permissions**



You can specify access to a share on a per-group or per-user basis. The default is Full Control.

to the `HPFonts` share:

```
net use X: \\vala\hpfonts /persistent:yes
```

The `/persistent:yes` option says that this drive mapping should persist across user login sessions. By default, drive mappings are not persistent, but the `/persistent` option is sticky. Once it is specified, the given setting remains in effect until it is explicitly changed on a subsequent command. In other words, any use of this option also sets the default for all future commands that do not specify it explicitly. Removing a drive mapping is similar to undefining a share. For example, the following command will remove the definition of drive `X:` that we set up previously:

```
net use X: /delete
```

The `net use` command has other options for mapping drives to shares in special circumstances. Table 1 summarizes these options as well as other useful commands for manipulating shares and drive mappings. It includes two commands from the Resource Kit that may be used to inspect and manipulate shares on a remote server.

**Table 1. Commands for Manipulating Shares**

- ◆ Add a share  
`net share sharename=path [/users:n] [/remark:description]`
- ◆ Remove a share  
`net share sharename /delete`
- ◆ Map a share to a drive letter  
`net use X: path [/user:username *] [/persistent:yesno]`
- ◆ Remove a drive mapping  
`net use X: /delete`
- ◆ Define a share on a remote system  
`rmtshare \\server\sharename=path [/users:n] [/remark:description]`
- ◆ Change share permissions for a remote share  
`rmtshare \\server\sharename [/grant user:perm] [/remove user]`  
*Note: perm is one of F, C, R or N (none).*
- ◆ Remove a remote share  
`rmtshare \\server\sharename /delete`
- ◆ Display defined shares  
`net share`
- ◆ Display mapped shares  
`net use`
- ◆ Display remote shares and permissions  
`srvcheck \\server`  
*Note: The rmtshare and srvcheck commands are found in the Resource Kit.*

## Share Permissions

The Permissions... button in the Sharing dialog box allows you to specify access to the share on a per-group or per-user basis. Figure 2 illustrates the default permissions applied to new shares.

As you can see, all users have unlimited access to a share by default (Full Control). However, this does not mean that they necessarily have such access to all items within the share. Share permissions function as a screening filter: They define the *maximum* level of access that the user will be granted for any item within the share. For NTFS file systems, access levels are defined via each item's access control list (ACL). Think of share permissions as an initial barrier: If a user gets over it, he still

must be granted access to any specific item by the item itself. In addition, a user's level of access will never exceed that allowed via the share permissions, even if a specific item happens to grant him more access.

There are four levels of share access that may be assigned:

- Full Control—Unlimited access in accordance with item ACLs

- Change—Read-write access
- Read—Read-only permission
- No Access—The user is prevented from using anything within the share

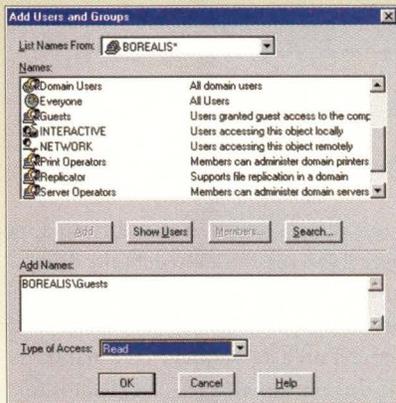
These four levels may be assigned to users and groups by clicking the Add button in the Access Through Share Permissions dialog box, which results in the dialog box shown in Figure 3.

Share permissions for a specific user or group are set by selecting one or more users and/or groups from the upper list box (click on Show Users to include user names in the list) and then clicking the Add button (or by double-clicking on the desired item). The Type of Access pop-up menu at the bottom of the dialog box may then be used to specify the level of access for the names in the lower list box under Add Names.

Figure 4 illustrates a set of share permissions containing two entries. Members of the Domain Users group, which normally contains all users in the local domain, have full access to the share, but members of the Guests group have only Read access. You can use the Type of Access menu to change the access level for an existing entry.

If more than one entry in the share permissions specification applies to a user requesting access to the share, conflicts

**Figure 3. Specifying Share Permissions**



*One of four levels of share access may be assigned to users selected from the upper list of names by clicking the Add button.*

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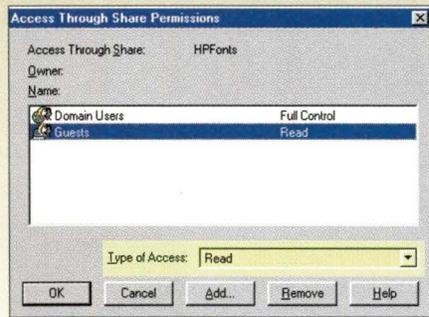
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**Figure 4. Restricting Share Access**



The Type of Access menu controls the access level for an existing entry.

are resolved in the following manner. First, if *any* entry—user or group—denies the user access, then she is denied access to the share. Otherwise, the least restrictive access level in any of the entries applying to the user is used as her access level. For example, if a user got Change access from one entry and Full Control from another, then her access level would be Full Control.

Windows 95 includes a similar sharing mechanism, but share permissions are handled differently. You may grant full or read-only access to the share only on a sharewide basis, using the buttons in the Access Type area. In addition, you may require a password for either type of access by entering it into the corresponding field in the Password area.

## Hidden Shares Aren't

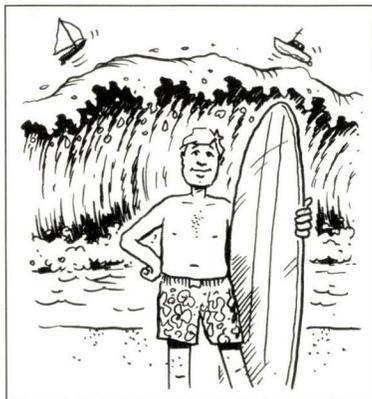
A share name with a dollar sign as its final character is known as a *hidden share*. These shares are not displayed when users browse the network and so are theoretically “invisible” to them. However, this behavior should never be mistaken for share security. In particular, if a user knows the name of the share, then it will still be accessible to him, even if it is “hidden.” Hidden shares are no substitute for appropriate share access permissions.

Administrative hidden shares are also created automatically for each file system, named after the corresponding drive letter. For example, the administrative share for C:\ is C\$. These shares may be accessed only by members of the Administrators group, and so they do not give rise to the same issues as hidden shares. They may be renamed, removed or ignored, as appropriate for your system.

Next month, we'll look at sharing file systems between Windows NT and UNIX systems. ➔

*Aleen 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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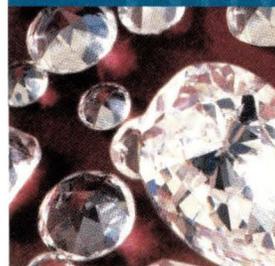
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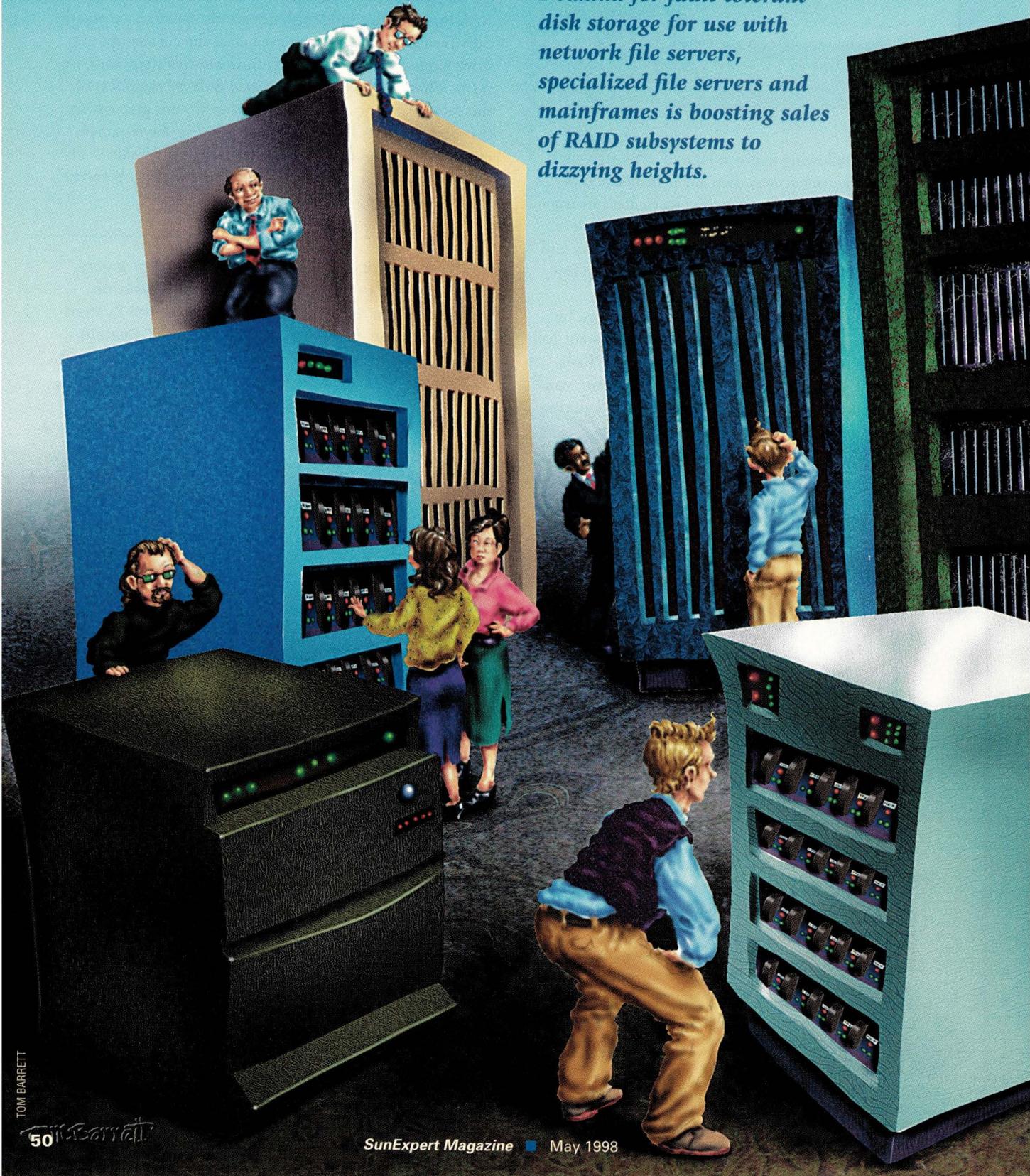
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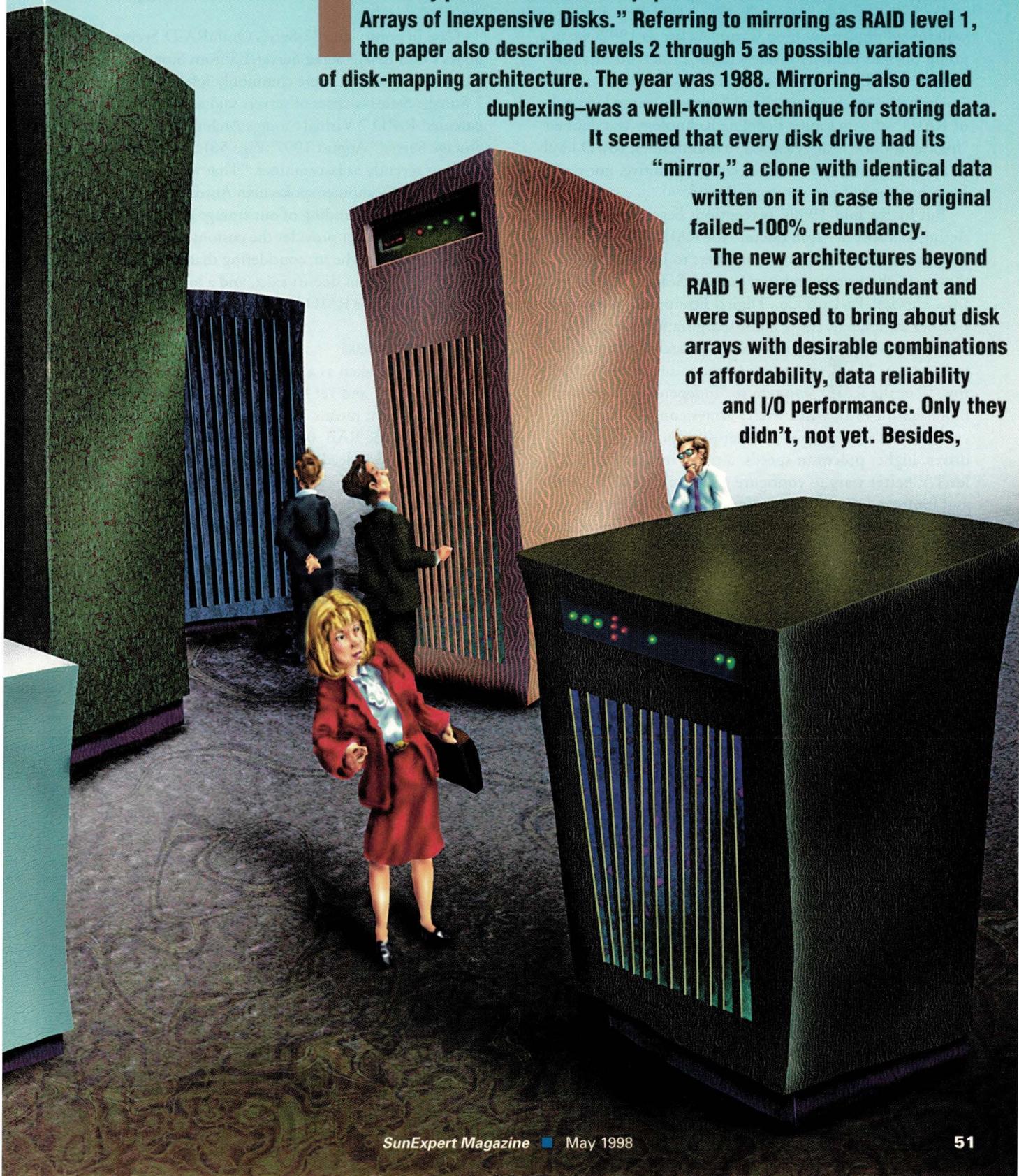
# RAID

by GODE DAVIS

It doesn't seem that long ago that researchers David A. Patterson, Garth Gibson and Randy H. Katz of the University of California at Berkeley published a seminal paper entitled "A Case for Redundant Arrays of Inexpensive Disks." Referring to mirroring as RAID level 1, the paper also described levels 2 through 5 as possible variations of disk-mapping architecture. The year was 1988. Mirroring—also called duplexing—was a well-known technique for storing data.

It seemed that every disk drive had its "mirror," a clone with identical data written on it in case the original failed—100% redundancy.

The new architectures beyond RAID 1 were less redundant and were supposed to bring about disk arrays with desirable combinations of affordability, data reliability and I/O performance. Only they didn't, not yet. Besides,



mirroring had already been built in as a popular feature of Novell Inc. NetWare (which was free to many users). While network administrators realized that mirrored disks required twice as much data storage capacity, they also knew that early RAID configurations (notably levels 3 and 5) needed to generate and write parity during write operations and were all too prone to I/O bottlenecks. While innovations such as caching and write-assist disks were well along by the new decade, their widespread implementation wasn't. As late as 1992—when a group of eight industry insiders formed the Raid Advisory Board, or RAB (<http://www.raid-advisory.com>), “to create storage standards” and “promote an understanding of RAID”—the no longer fledgling technology was dubbed “high-end-only.” Still relegated to mainframes, RAID levels other than level 1 were deemed cost-prohibitive, not ready for prime time or just too complicated.

But by the mid-1990s, perceptions began to change. Acting as a sort of “spin doctor” for RAID, the RAB had blossomed from eight to 55 members to include power players in the storage industry such as Seagate Technology Inc., Hewlett-Packard Co., Digital Equipment Corp. and Conner Peripherals (now nStor Corporation Inc.); test equipment manufacturers; market research firms; and universities. The RAB had urged the industry to change the “I” in the RAID acronym to “independent.” Perhaps more significantly, while RAID arrays could no longer be construed as “inexpensive,” lower price points for disk drives, higher processor speeds, a rising interest in RAID level 5, better ways to configure and optimize RAID levels and improved overall I/O performance had given rise to extravagant claims that some 40% of mass-storage usage would incorporate RAID technology by 1998.

Well, it's 1998, and while such claims have been pushed back a wee bit, an unprecedented demand for RAID-based solutions is being fed by a new wave of centralized mass storage, Fibre Channel momentum and a pervasive anxiety among network administrators—is my data safe yet, is it really safe?

Maybe not, but it's more likely to be stored on a disk drive array. Disk/Trend Inc., perhaps the definitive source for RAID statistics, points to an increasing demand for fault-tolerant disk storage for use with network file servers, mainframes and specialized file servers that's boosting sales of disk drive arrays—popularly known as RAID subsystems. In fact, the Mountain View, CA-based consultancy reported shipments of an estimated 986,000 disk drive arrays in 1997 (up from 775,000 in 1996) and projects a shipment total of some 1.5 million arrays by the year 2000. Revenues are up too: Disk/Trend reported a \$15.9 billion sales total for last year and projects a robust \$17.1 billion by the year 2000.

Who's divvying up this bona fide windfall? It's a free-for-all among storage vendors (almost exclusively U.S.-based), according to Disk/Trend, with industry giants such as IBM Corp., EMC Corp., DEC, Compaq Computer Corp. and Sun Microsystems Inc. leading a pack of 149 companies in the RAID business as of 1997—down from a peak count of 179 companies that offered disk drive arrays under their own name in 1995. Most of this volume is garnered by the few

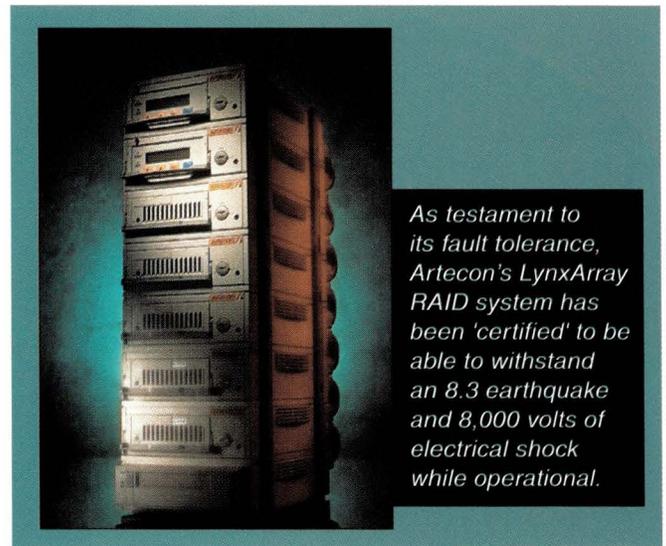
billion-dollar vendors at the RAID heap's summit, leaving a multitude of vendors to scrap for the last billion or two—fierce competition that fosters a continuing shakeout of manufacturers with marginal market shares. One paradox is that some of the best RAID solutions can be purchased from smaller companies—even if some of these players, like their larger counterparts, will use just about any marketing ploy to differentiate themselves.

Case in point: The 72-Series OmniRAID Server and 74-Series OmniRAID Super Server/ES from Storage Computer Corp., Nashua, NH, were commonly referred to as the RAID 7 Storage Series—a series of servers said to be derived from a patented RAID 7 Virtual Storage Architecture (see “RAID 7 Storage Server,” August 1997, Page 58). Such allusions were made as recently as last summer. “That was a historical usage,” says Storage Computer spokesman Anton Murphy. “I think the more recent branding of our storage exclusively under the OmniRAID banner provides the customer with a lot more clarification.” Maybe so, considering that the RAID level “7” implied by the firm doesn't exist, and a lot of other confusing nomenclatures for RAID levels already do.

## RAID Defined

The levels, taken as a whole, have traditionally defined RAID's essence and yet hampered its acceptance. According to Berkeley, that means 1 through 5 and, more recently, according to the RAB, 0 through 6. So enter immediate confusion, and indeed, a contradiction.

Level 0, because it contains no redundancy, doesn't fit the strict criteria for a Berkeley level, and perhaps shouldn't be called one. Nonetheless, RAB Chairman Joe Molina can glibly define the levels. “Level 0 is striping. Level 1 is mirroring. Level 2 doesn't exist for all practical purposes because it requires a modified disk drive that makes it too expensive to implement. Level 3 offers parallel access for high read and write rates. Level 4, forget it; the write penalty is too high. Level 5 is striping across the disks along with the parity data. Level 6 is double parity, or if you prefer, Level 5 with data duplication to provide for extra redundancy. That's all the levels are.”



*As testament to its fault tolerance, Artecon's LynxArray RAID system has been 'certified' to be able to withstand an 8.3 earthquake and 8,000 volts of electrical shock while operational.*

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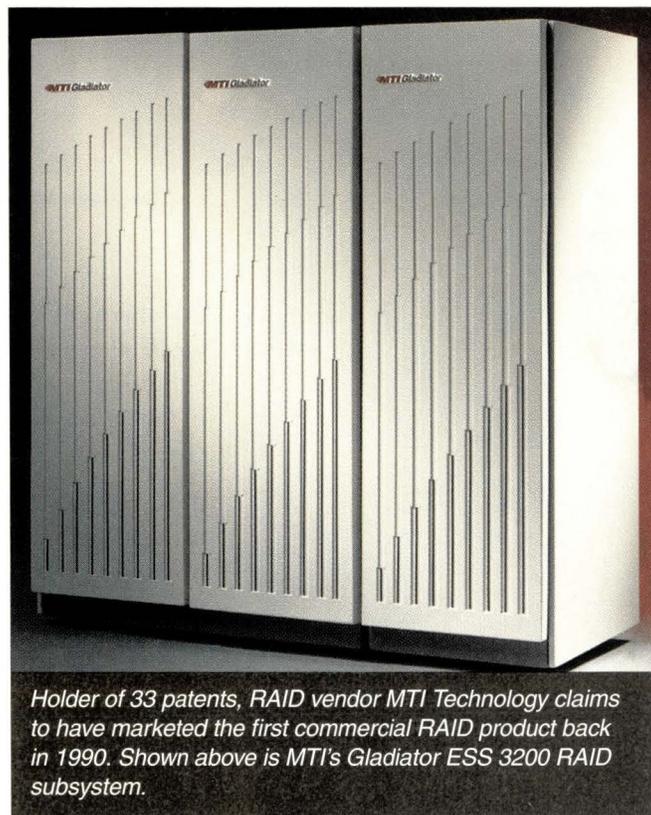
Well, not exactly. RAID levels are full of nuances. For instance, what's parity? "It's a calculation based upon data where good existing data is used to recover lost data," says Mark Kincaid, vice president for strategic programs at Andataco Corp., San Diego, CA. Kincaid uses a numeric example to delineate further. "If  $1+2+3+4+5=15$ , then 15 is the parity value. But if you only have  $1+2+3+?+5=15$ , then you can use parity to reconstruct the lost data (4) from the parity that exists on the other drive."

Past parity and a morass of similar theoretical terminology, and wading past the RAB's post-Berkeley contribution, there are the hybrids to consider—RAID levels combined in order to enhance disk array performance. For instance, 0 and 1, often targeted to video mass-storage environments, is variously referred to as level 10, level 0 & 1, or level 0 + 1, according to how the vendor using the hybrid chooses to express it. Another popular trend in the RAID arena is so-called "adaptive" RAID—when subsystems automatically switch levels as required, depending on the type of data being stored (HP's AutoRAID was a pioneer in this regard). The widespread adoption of adaptive RAID, according to many experts, serves to undermine any significance that RAID levels might once have had. Still, the RAB likes to say that the only RAID levels commonly used singly for mass storage are 1, 3 and 5.

Ah, but what of RAID 6? In fact, when the unique example of Storage Technology Corp.'s onetime RAID offering is put forth, RAB Chairman Molina tends to downplay it. "Need we go into that messy chronology?" he asks. In 1991, Storage Technology (aka StorageTek), based in Louisville, CO, announced what was to be the greatest breakthrough ever in disk storage history. The one and only RAID subsystem designed to exploit level 6 architecture, its code name was Iceberg. But an extensive microcode development process delayed the touted product's arrival until 1993. While no company has released a RAID 6 product since, the original provided a unique protection. "Double parity. You can have two disk drives fail concurrently (or the second drive can fail during the reconstruction period of the previously failed drive), and still have access to reliable data online in a timely fashion," Molina says. But, he says in the same breath, "disk drives have gotten so reliable that the likelihood of two disk drives failing at the same time is extremely remote." Au contraire, says Andataco's Kincaid: "It could easily happen. A disk drive is the most failed device in a RAID subsystem outside of software."

At any rate, StorageTek's Iceberg survives in the RAID marketplace—albeit with a new look and name (IBM RAMAC Virtual Array)—and appears to be selling well in the high end since the inception of an OEM marketing agreement with IBM in June 1996. Half the size of the former Iceberg and boasting vastly improved performance, the reinvigorated product has managed to snare a mainframe market share in the high 20s (when IBM began OEMing, Iceberg's market share was 8%), according to StorageTek's marketing spokesman David W. Reid.

Yet, except for its disk drives, Iceberg isn't designed to be



*Holder of 33 patents, RAID vendor MTI Technology claims to have marketed the first commercial RAID product back in 1990. Shown above is MTI's Gladiator ESS 3200 RAID subsystem.*

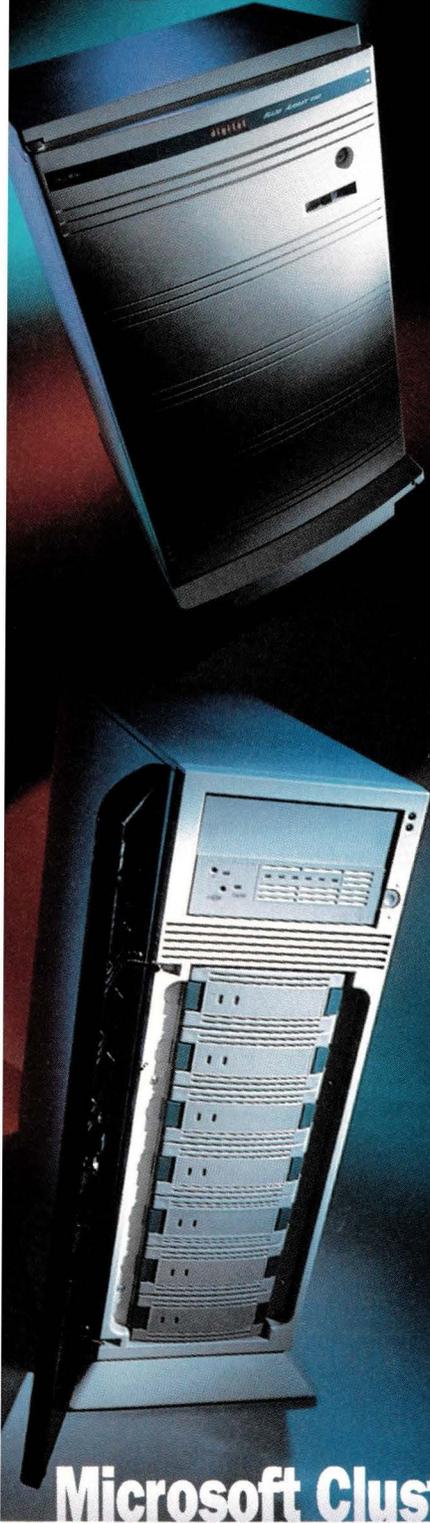
especially fault tolerant. And despite a pervasive desire among network administrators in the RAID arena to obtain ever-increasing amounts of fault tolerance to safeguard sensitive data, according to the RAB, RAID in any form, in and of itself, incorporates the lowest "level" of fault tolerance. Worse, "RAID levels tell you nothing about the degree to which the storage system is fault tolerant," Molina says.

To really know how fault tolerant your RAID subsystem is, according to Molina, you need to understand a new paradigm—22 RAB-selected criteria for providing extended data availability and protection, or EDAP. "EDAP criteria can nail down just how fault tolerant a RAID array system is," he says. Ultimately, measures taken in the name of EDAP take into account not only component and power failures but can allow access to protected data in the event of a hurricane storm surge, terrorist bombing or even an earthquake. Speaking of earthquakes, while attempting to differentiate their products, some RAID vendors are taking the RAB's new criteria quite to heart. For instance, the LynxArray RAID system offered by Artecon Inc., Carlsbad, CA, has been "certified" to be able to withstand an earthquake measuring 8.3 on the Richter scale and 8,000 volts of direct electrical shock while operational. It also comes with failover and hot-swap components and can supposedly extinguish itself in the event of fire—even at entry-level configurations. While it might be nice to "minimize the vulnerable period" as the RAB puts it, measures so "prudent" can amount to sheer overkill (not to mention big bucks).

What's more misleading, some vendors tout RAID subsystem features that might be obscure but are probably not all that special. For instance, the literature of several vendors selling traditional host-attached systems screams out terms like

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DS-RZIDB-VW	9.1-GB UW Disk Drive	2,599	1,999	<b>23%</b>

## StorageWorks RAID Array 450

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QB-5JCAE-SA	Windows NT Platform Kit	750	750	
SWXA3-BC	PCI-to-FWD Adapter	549	549	
DS-RZICB-VW	4.3-GB UW Disk Drive	1,499	1,329	<b>11%</b>
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“parity shedding algorithms” and praises extraordinary flare sniffers that “read all data on a periodic basis and correct soft errors before a compounding failure on another disk occurs.” Yet a sniffer is merely a diagnostic tool used to monitor wires as they interface with practically any mass-storage subsystem.

## Take the Bus

That said, is it time to take the bus or the loop? Almost since Berkeley, the only choice has been the bus leading to Small Computer Systems Interface (SCSI) interfaces. Or at least it was. Alongside the “revolutionary” Fibre Channel serial interfaces, even the “evolutionary” if once wondrous Ultra SCSI and Ultra2 SCSI devices can seem, well, scuzzier.

Employed via disk drive or host connection, Fibre Channel is a serial interface, meaning that information flows through it one bit at a time. It's also an arbitrated loop, instead of a bus. What makes Fibre Channel so special, however, is its high bandwidth, a practical data transfer speed of between 92 and 106 MB/s. Employing two loops in full-duplex mode (sending and receiving on two ports, simultaneously) can theoretically double the data transfer rate for a RAID subsystem array. And Fibre Channel has a lot more going for it than mere speed: It facilitates storage networks and storage area networks (SAN)



*With the release of its new StorageWorks Fibre Channel RAID Array 7000 in February, DEC extends its StorageWorks family to offer Fibre Channel connectivity.*

because, according to Robin Harris, storage network marketing manager at Sun in Menlo Park, CA, “it’s an interconnect that has network-style technology built into it.”

All this isn’t being lost on the more opportunistic RAID vendors. Even marginal firms are already shipping Fibre Channel-equipped RAID subsystems, and most vendors can offer low-voltage differential Ultra SCSI (bandwidth: 40 MB/s) and transitional Ultra2 SCSI (bandwidth: 80 MB/s) devices as a way for their customers to eventually merge with the newest communications technology.

Fibre Channel isn’t that nouveau under the Sun banner. “Sun has been shipping Fibre Channel storage since 1994,” Harris says. In fact, this RAID vending giant (especially for UNIX and high-end operating systems) doesn’t put all its eggs, so to speak, beneath one bus or loop—or for that matter, isn’t restricted to controller-based RAID or host-based RAID. Sun’s Intelligent Storage enterprise solutions include its StorEdge A5000 and A3000 arrays—and both can be configured much to the customer’s preference.

EMC, based in Hopkinton, MA, competes directly with Sun for UNIX and Windows NT platform business but takes a somewhat different approach. Specializing in RAID 1 and RAID 5 applications, EMC offers Fast Wide (regular SCSI interconnects at 20 MB/s), Ultra, Ultra2 and Fibre Channel devices—all connecting to a host-based, network-attached range of similar Symmetrix Storage Platform servers via a proprietary architecture through fiber-optic cable. “Symmetric [multi-processing] systems are less vulnerable to single points of failure,” says Doug Fierro, EMC’s director of product marketing. EMC’s RAID subsystems can store and “protect” from 36 GB to 3 TB of data in a single such system using 9-, 18- and 23-GB capacity devices.

By contrast, the StorageWorks division of DEC, Marlboro, MA, is now keying almost exclusively on Fibre Channel innovations. In 1997, it earned about \$2.5 billion (primarily RAID revenue).

Players positioned beneath the top tier of RAID vendors employ variations of these oft-discussed marketing strategies and more. Some have plied their trade in RAID almost since the technology’s inception. For instance, MTI Technology Corp., Anaheim, CA, claims to have introduced the first commercial RAID product, code-named Failsafe, in 1990. With 33 patents

## Smart Shopping

**C**hoosing a RAID solution can be intimidating, even for seasoned storage shoppers. Buzzwords like flexibility, scalability and Fibre Channel mean little unless the vendor can validate such terms with service. “Ask the right questions,” says Tom Lahive, a senior analyst specializing in server storage and RAID issues for Dataquest Inc., a San Jose, CA-based consultancy.

Asks Lahive: “What is the service offering that the vendor is providing? Is it on site? Is it 24-7 [24 hours a day, 7 days a week]?” Full on-site service bundled in for two years is standard industry practice, but the level of service offered by disk array manufacturers can vary greatly.

As for performance—what the manufacturer or vendor is going to guarantee for performance on your particular server or application—“Get it in writing. You don’t want to be getting SCSI performance when you’re paying for Fibre Channel,” Lahive says.

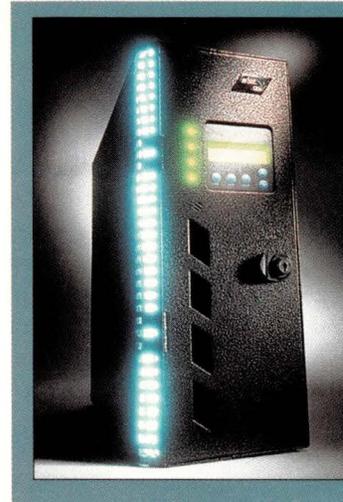
Another tip: Pay only for usable capacity. “A lot of RAID customers end up buying raw capacity (capacity that includes mirrored disk drives) or paying more to vendors for (rapidly depreciating) future add-on capacity,” he adds. But what might prove most costly are those little oversights undertaken in the name of prudence—like when RAID customers purchase more fault tolerance than is necessary, or in pursuit of redundancy, buy components that will remain idle except when a primary component fails. For instance, “If you have two controllers, you might just as well use the spare controller to help out with I/O,” says RAID Advisory Board Chairman Joe Molina, “Otherwise, it’s silly to have the darn thing just sitting there.”—gd

# RAID

granted as of this writing in the litigious areas of RAID and fault tolerance, MTI also has the distinction of leading the industry in that regard. But soon names and logos begin appearing like a litany of counterpunchers, each with "bells and whistles" to call at least somewhat their own. The 5700 Intelligent Storage product line from Hitachi Data Systems Corp., Santa Clara, CA, offers "excellent granularity" in that users can scale from 4.1 GB to multiple terabytes. Box Hill Systems Corp., New York, NY, offers similar scaling potential with its RAID box 5300 Turbo+ (2 GB to 2 TB) and promises super Fibre Channel speed with its embedded X/OR FibreBox subsystem.

Clariion Corp., Southborough, MA, has released a server interface kit for its FC5000 Fibre Channel disk array that lets value-added resellers attach the disk array to servers from Sun—a development of some significance because "combining RAID subsystems from varying manufacturers is (usually) difficult at best," says Steven Paulhus, director of marketing for nStor, Lake Mary, FL. The upshot of not being able to combine disk array products from different vendors can have expensive consequences when buyers are forced to reinvest in new hardware or integrate somewhat noncompatible systems in a precarious "round peg vs. square hole" fashion.

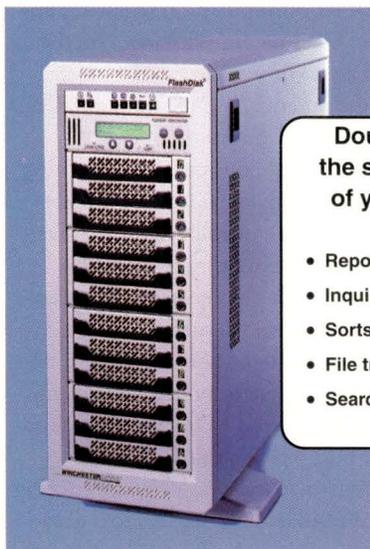
While DEC keys on Fibre Channel, nStor's CR8e Ultra Wide RAID subsystem for the PC and midrange UNIX marketplace achieves transfer rates of 40 MB/s with eight bays, eight devices and is the company's leading RAID offering. Adds Paulhus, "The CR8e was designed to take



According to nStor, its CR8e RAID subsystem was specifically designed to take advantage of today's SCSI technology as well as future technologies.

advantage of today's SCSI technology, as well as future technologies when they are released." Although it began shipping two "new" Fibre Channel products in mid-March and April and plans to jump on the bandwagon whenever Boulder, CO-based Borg Adaptive Technologies' proprietary FibreChannel-2 product (180 MB/s, tentatively) is released, the gestures seem like hedging. Having acquired Borg in February, and assisted by its new subsidiary's research and development group, nStor happens to be moving in a rather promising direction—file-driven disk arrays. "You need to do

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# RAID

RAID at the file level if you want to play in the SAN—the storage area networking environment,” Paulhus says.

But another RAID vendor, Plymouth, MN-based Tricord Systems Inc., certainly did file arrays first. Actually, Tricord is all the more remarkable because of its recent corporate chronology—having pulled off a real switcheroo. Giving new meaning to the phrase “company in transition,” Tricord reinvented itself by moving from the manufacture of client/servers

and announcing a strategic shift to sell and develop file-driven, data-sharing storage devices. Now that’s imagination!

## RAID Has Potential

So where is RAID headed? More intelligent storage arrays are a no-brainer, multiplatform and more interchangeable platforms between RAID vendors and manufacturers would be a smart move, but whether it will ever happen is problematic.



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Writes Farid Neema, president of Peripheral Concepts Inc., a consultancy based in Santa Barbara, CA, in his October 1997 executive summary, “By the year 2000, it will be practically impossible to differentiate RAID from JBOD [Just a Bunch Of Disks], as RAID controllers will be integrated in several motherboards and in many operating systems.” Mere wishful thinking? Neema also predicts that RAID prices will continue to drop—reaching 25 cents per MB. (Disk/Trend President Jim Porter estimates that the current cost of RAID usage is about 35 to 40 cents per MB.) Video and multimedia applications—not just 0 + 1 mapping combinations—constitute a “very large market potential” for RAID storage systems, Neema says.

But technology changes will continue to affect RAID fast and furiously; that’s a given, especially as RAID requirements grow in sophistication. Basic RAID controllers are already implemented with a smaller number of ASICs (what a molecule is to an atom, an ASIC is to a chip), increasing potential motherboard-related options, and will soon shrink to a single chip. Controllers are evolving in several directions with added functionality and reduced costs. But Neema writes somewhat ominously, “Integrated array controllers and controllers on a motherboard are to be watched closely, as they have the potential of putting some RAID vendors out of business.”

With RAID controllers approaching the size of a single chip, an important question faces controller suppliers: How do they maintain or increase their revenue? Ah, but a musing deeper than any of Jack Handy’s surfaces. I have a doomsday thought, sort of. What if all that fault tolerance and an infinite and ultimately realized EDAP come back to haunt future generations? What if a corporate management team comprising extraterrestrial aliens returns to a desolate scene only to find reams and reams of well-protected data? ➡

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

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"I suspect that UNIX magazines' interest in NT has less to do with the desires of their readers, and more to do with hedging their bets, so that if NT gets big, they can say We're the magazine of multi-OS technology and systems administration, blah blah..." OK – I got that off my chest. Listen, this NT stuff bugs me, **but I still think *SunExpert* is one of the best computer industry magazines around – perhaps the best.**"



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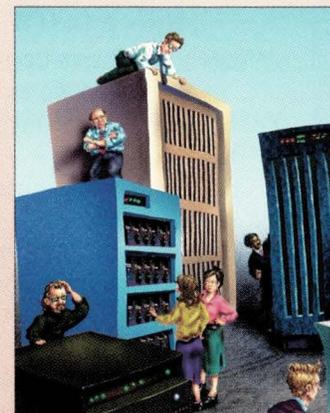
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## FrameMaker Upgrade

by SIMSON L. GARFINKEL, Contributing Editor

*This month, frequent contributor Simson L. Garfinkel delves into the world of desktop publishing with FrameMaker 5.5.3 and questions the relevance of this latest release number.*

### FrameMaker 5.5.3: Flexible Desktop Publishing

Without question, Adobe Systems Inc.'s FrameMaker 5.5.3 is one of the best desktop publishing systems for creating large structured documents like technical books and computer manuals. FrameMaker's powerful style sheets, its flexible autonumbering features and its "master page" document templates assure publishers of a flexible yet consistent look for their documents. In addition, FrameMaker has numerous features for working with very long documents, including the ability to import images and text into a document by reference, as well as the ability to combine multiple files into a single "book."

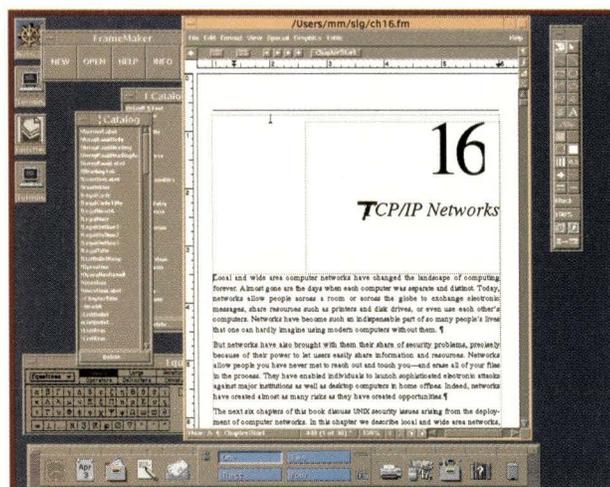
Despite its power, the program has been relatively stagnant since Adobe purchased Frame Inc. in 1994. Adobe says that it has made significant changes to Frame's document layout engine, the guts of any desktop publishing system. But from the user's perspective, there have been few

visible changes—despite the fact that many are needed.

FrameMaker 5.5.3 continues Adobe's tradition of combining incremental improvement to Frame's code base with incompatible changes to Frame's file format. The small improvements all but ensure that there will be some individuals within an organization who want to upgrade. The new file format all but

mandates that the entire organization will have to follow in order to preserve file compatibility. That's because, as with previous Frame upgrades, FrameMaker 5.5.3 can read files created by earlier versions of Frame, but earlier versions of Frame can only read 5.5.3's files if the documents are first saved in Frame's "MIF" format—a hassle for day-to-day operations.

FrameMaker 5.5.3 is actually a maintenance release of FrameMaker 5.5, a product that had so many bugs that Adobe was forced to cut new CD-ROMs and send them out to registered customers for free.

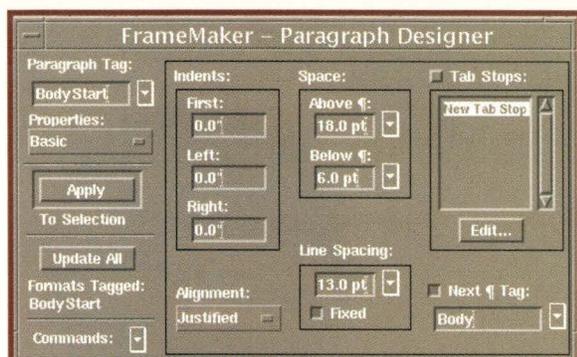


*FrameMaker 5.5.3's screen layout includes a main window for the document and floating windows for the paragraph catalog, the font catalog, drawing tools and so on. This layout is indistinguishable from previous versions of the product.*

### Minimal Enhancement

Although FrameMaker 5.5.3 adds some handy new features, the list is short. FrameMaker can now sort information in tables. FrameMaker now includes direct support for Japanese fonts, which means that Japanese users won't have to wait for Adobe to ship the internationalized version of its application. And for people publishing information on the Internet, FrameMaker can now save files directly in HTML or PDF, without using a helper application such as Adobe's Acrobat Distiller.

HTML exporting is pretty straightforward. You simply specify which paragraph types should be interpreted as breaks between files and then FrameMaker does



*The paragraph style catalog has been essentially unchanged since Version 4.0. FrameMaker's style sheet system lacks many features found in Microsoft Word, such as the ability to have hierarchical styles.*

its thing, automatically creating both the HTML files as well as the GIFs for the included graphics. When saving as PDF, you can specify which paragraph types should be bookmarked in the resulting file.

If your job is taking corporate publications and putting them on Web servers, these new features will save you a lot of time. Nevertheless, it's disappointing to see Adobe devoting precious engineering resources to these check-box features while neglecting the product's overall usability and positioning.

Probably the most important area in FrameMaker that needs Adobe's attention is the program's handling of search and replace. There is still no way to search and replace across multiple files. This is FrameMaker's single largest failing, says Mike Sierra, software tools specialist at O'Reilly & Associates Inc., which uses FrameMaker to produce many of its books.

There are other problems with Frame's search and replace as well. Although you can use wildcards in your search strings, you can't use them in the replace strings—wildcards can't match spaces. You can search for a specific piece of text or for a specific paragraph tag or font, but there is no easy way to search for a piece of text that appears in a given kind of paragraph or in a given font. There is no way to search and replace for text that is in Frame's markers, which are used for building indexes and tables of contents. Likewise, there is no easy way to replace all of the occurrences of one icon with another.

Another fundamental problem with

Frame's current architecture is the complete disconnect between the text on a page and its format. For example, FrameMaker allows you to designate some pages in a document as being in landscape mode and other pages as being in portrait mode. You change a page's format by changing its master page. What happens if you make Page 5 of your document landscape, and then insert three pages at the beginning? You've

got to manually change Page 5 back to portrait, then go to Page 8 and change its format from portrait to landscape. This sort of thing should happen automatically. One solution, suggests Sierra, would be to allow some paragraph types to set the master page format of the pages on which they land.

These failings are puzzling, because they make it harder to use FrameMaker for its primary mission—assembling large documents. But with no real competitor in this product space, Adobe is under little pressure to correct such problems.

## Far Behind Word

For editing text, Frame continues to fall farther and farther behind Microsoft Corp. Word. Many of Word's editing features are simply missing from FrameMaker, including the ability to split windows, drag-and-drop text, automatic correction of commonly misspelled words, and an "undo" button for the spell checker. Speaking of undo, Frame still only has simple undo/redo, rather than the multilevel undo that's present in a growing number of PC-based products. And Frame has many features that don't even support single-level undo, such as global search and replace.

Unfortunately, it's getting harder to use Microsoft Word to edit documents and then use FrameMaker to paste them up because FrameMaker 5.5.3 can't read files that are saved in Microsoft's Word 97 format (although it can read files saved in Word 6.0 and Word '95).

Complicating the life of both writers and production managers is a laundry list of other problems with this product.

Frame *still* doesn't support hierarchical style sheets. Frame allows you to align paragraph text to the left or right margins, but not to the *inside* or *outside* margins. And while Frame allows you to automatically put a rule above or below a paragraph, the rule must extend to the margins. It would be nice to have the rule extend to the edge of the paragraph's text, and no further.

I had a chance to review FrameMaker 5.5.3 on UNIX, Windows and Macintosh. All versions of the program perform well, although the UNIX version is still hobbled by Frame's nonstandard license manager. However, it's unfortunate that each version defaults to its own set of command-key equivalents, rather than allowing this to be a user-settable option.

Overall, FrameMaker 5.5.3 remains the industry's best program for producing book-length manuscripts, but that's not because of any Herculean effort on Adobe's part. Rather, Frame's position results from a failure on the part of the rest of the software industry to come up with anything better. If there were any justice in the assigning of version numbers, FrameMaker 5.5.3 would rightfully be called FrameMaker 4.2. →

## FrameMaker 5.5.3

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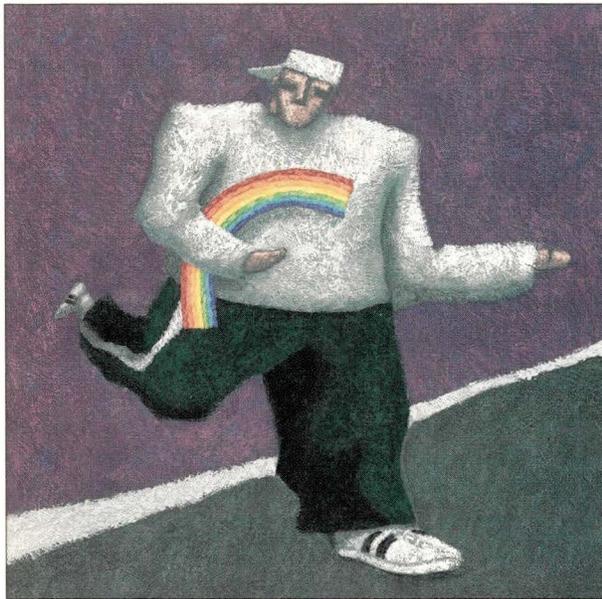
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Circle 166

# RS/Magazine Supplement

## Q&AIX

by Jim Fox



# Colorizing File Listings

*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.*

**Q:** Is it possible to get color file listings on AIX? I have seen this on other UNIX systems. I think Linux was one of them. ▲▲

Melody Rumford  
Kelly Consulting

**A:** Yes, it's possible. You need a couple of items: an `ls` program that prints color codes and a terminal emulator that displays color.

One of the conveniences of the standard `ls` suffix approach, what you get with the `-F` option, is that it looks the same everywhere. One gets so used to the suffixes. It's true that file names ending in a star or an equal sign can be misinterpreted. However, colors are not a perfect solution either. Some terminal emulators support them; some do not. Colors that look good on a black background don't look so good on a white one.

Let's take a look at how color listings are accomplished; you can decide for yourself if they're worthwhile.

### How Color Is Coded

Color text is specified through a series of standardized codes (ISO 6429). The common ones are shown in Figure 1.

These codes can be combined using semicolons. For example, the code `0;44;1;33`, specifies bright yellow text on a blue background.

Color codes are sent to a terminal encapsulated in an escape sequence, which consists of: escape, left bracket, the color code and the letter "m." Enter an escape on a UNIX shell command line by typing control-V followed by the escape key. It appears as *hat left-bracket*. For example, to set your prompt to a bright

Figure 1. ISO 6429 Color Codes

Foreground Colors	Background Colors	Other Codes
30 Black	40 Black	0 Restore default
31 Red	41 Red	1 Brighter color
32 Green	42 Green	4 Underline
33 Yellow	43 Yellow	5 Blink
34 Blue	44 Blue	
35 Purple	45 Purple	
36 Cyan	46 Cyan	
37 White	47 White	

- ▲ wizard's apprentice
- ▲▲ super user
- ▲▲▲ wizard

yellow dollar sign, you would set

```
export PS1="^[[1;33m$ ^[[0m"
```

where `^[]` represents an escape character. Notice that you must reset the text color after printing the prompt; otherwise, all subsequent text would show up in yellow as well.

## Color ls

Standard `ls` won't do color. You want the GNU version. Fortunately, there's a prebuilt one for AIX. Anonymous FTP to `aixpdslib.seas.ucla.edu` and get the compressed tar file from `/pub/fileutils/RISC/4.1/exec`. Untarring the file creates several utility programs in a `./usr/local/bin` directory; one of these is `ls`. Move it to your `/usr/local/bin`. Make sure this new `ls` is the first one in your path. Now you can either use `ls's --color` option or create an alias like

```
alias cls="ls --color"
```

Install the new man page as well.

I've found the default colors to be difficult to read; you might want to change them. This is done using an environment variable that specifies the color codes you want to use for each file type. Set the variable `LS_COLORS` to a colon-separated list with elements of the form: `xx=code`, where `xx` is one of the following file-type descriptors:

no	Normal text	bd	Block device
fi	Regular file	cd	Character device
di	Directory	ex	Executable
ln	Symbolic link	mi	Missing file
pi	Named pipe	or	Orphaned link
so	Socket		

and `code` is one or more of the color codes listed in Figure 1. For example, to list directories in bright green and executables in bright red, set

```
export LS_COLORS="di=1;32:ex=1;31"
```

I'm not pretending this is a good choice of colors.

Your new `ls` can colorize by file extension as well. Add the specification `*ext=code` to your `LS_COLORS` environment variable. For example, `*.c=0;34` will list C source files in blue.

## Color xterms

There are several terminal emulators that will display color. They are not all readily available on all systems, but you can find at least one for almost any system you are running—even Windows 95 or NT! Here, in no particular order, are some common terminal emulators that support color.

- **aixterm** – `aixterm` is, I believe, available only on AIX. I like it because it also has a handy status line you can write to. `aixterm` doesn't automatically revert to the default foreground color as do other terminal emulators, so you have to specify the regular file code, `fi=0`. This emulator also has a frustrating habit of holding onto the last color used in the file list. This color then becomes the color used for all prompts, commands and other text. That's probably not what you want. To ensure the default color gets restored, you should set it in your prompt. To restore the prompt to a dollar sign in the normal foreground color, for example, you would set

```
export PS1="^[[0m$ "
```

where `^[]` is an escape character.

- **nxterm** – This is the color version of `xterm` that comes with Linux. So, if you use Linux, use `nxterm`. If you use another brand of UNIX but have access to Linux, you might try `nxterm`. I haven't tried to do that on AIX; it doesn't look easy.

- **rxvt** – This is another derivative of `xterm` that is commonly found on Linux systems. Fortunately, a prebuilt one is available for AIX (go to `aixpdslib.seas.ucla.edu` and look in `/pub/rxvt/RISC/4.1/exec`). `rxvt` is like `xterm`, but has dropped the Tektronix screen and some of the dynamic configuration features in favor of a smaller memory footprint. The scrollbar is different and takes some getting used to.

- **vt320** – Some Windows 95/NT terminal emulation programs will emulate a `vt320`, which has color capability. Check out the telnet programs at `http://www.windows95.com/`, looking for programs that can emulate a `vt320`.

You can use color in any text you print, whether from a program or script, just by inserting the proper escape sequences. I think there might be some utility here. Maybe you have some programs that would benefit from colorization. ➡

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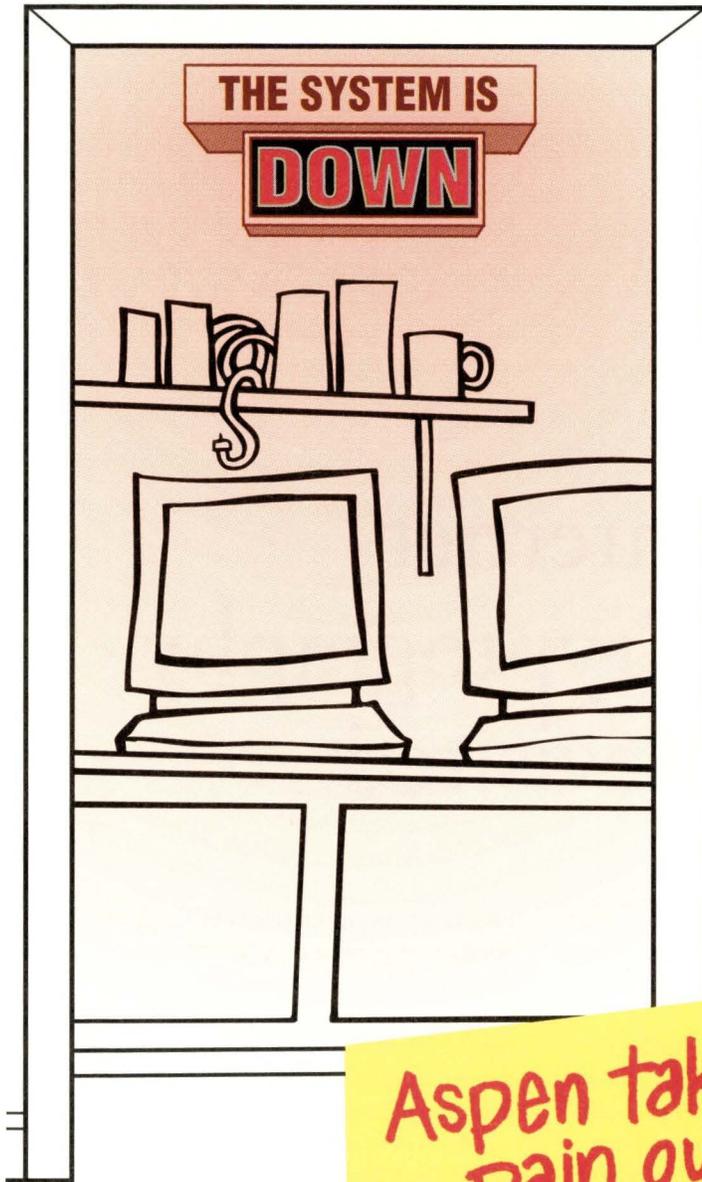
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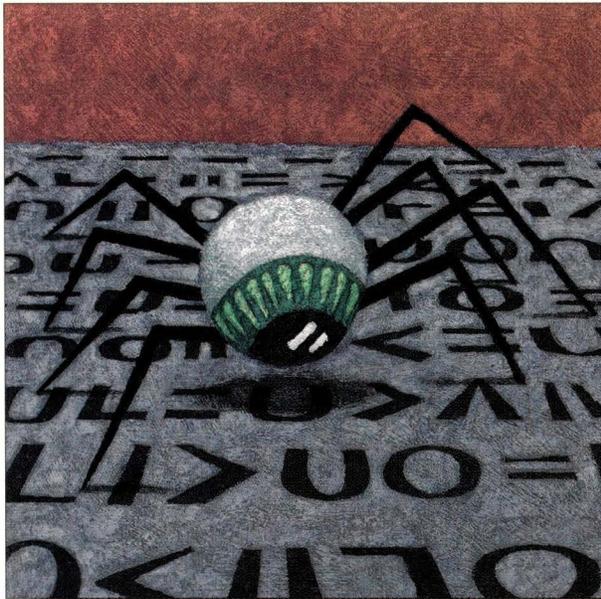


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# Datagrams

by John S. Quarterman



## Internet Cryptography Revisited

*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 co-authored 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](mailto:jsq@mids.org), by voice at (512) 451-7602 or by fax at (512) 452-0127.*

**C**ryptography must be an interesting subject; the U.S. government keeps bringing it up. Here's a brief history and some recent developments.

The Clinton administration has been particularly prolific with regard to cryptography. First there was the Clipper proposal in 1994, which would have put a Clipper chip in every telephone, permitting public key encryption between telephones. The catch is that the Clipper chip would have a back door. The private key used in each Clipper chip would be deposited with a "key escrow" organization. Federal law enforcement agencies could then use the escrowed key to decrypt messages. When could they use it? Any time they chose.

### The Untouchables

Why do the law enforcement agencies want to use it? Ever since Eliot Ness put away Al Capone, if not before, the U.S. government has used wiretaps to gather information about criminals. Today's Federal Bureau of Investigation (and National Security Agency and Central Intelligence Agency) worries that drug lords, spies and terrorists will be able to hatch their schemes undetected due to the spread of cryptogra-

phy. Government schemes like Clipper are attempts to enforce a single cryptography method with government access to it for wiretapping. That way, if government can't tap the criminals' communications, it can at least charge them for use of an illegal cryptographic method.

Many of us—for example, the Institute of Electrical and Electronics Engineers, American Civil Liberties Union, Computer Professionals for Social Responsibility, Center for Democracy and Technology, Electronic Frontier Foundation and others—object to that argument, saying that wiretapping is not a constitutional right of law enforcement agencies, strong cryptography is an important engine of industry and criminals already have it, anyway. There is also the problem of leaving use of escrowed keys to the discretion of the government. The key escrow proposals would give law enforcement agencies far more discretion in using escrowed keys than they have now in wiretapping. Current wiretaps require a judge's approval. However, the various key escrow proposals would permit the FBI and other law enforcement agencies to acquire a key without judicial approval.

The original Clipper proposal was

dropped because of a barrage of criticism, not only from civil libertarians, but more so from industry, both the computing industry and industry at large. The idea has not gone away, however. It has been repropounded several times. Key escrow, in particular, keeps recurring. One of its main proponents is FBI Director Louis Freeh. As I have remarked elsewhere, it's his job to propose measures that would help his agency, but it is the job of Congress, the executive branch, the courts and the people to decide whether to accept and implement such measures.

Incidentally, Congress already passed the Digital Telephony Act of 1994 (see [http://www.cdt.org/digi\\_tele/](http://www.cdt.org/digi_tele/)), which attempts to extend previous wiretap procedures into the modern age of computer networks.

## The Unexportable

Then there was the case of Phil Zimmermann, who was accused by the government of illegally exporting cryptography. This was because he wrote a popular public key cryptography package, Pretty Good Privacy (PGP). He didn't personally export it, but someone else did, by posting the source on USENET. Zimmermann was never formally charged with anything and was eventually let off the hook, after years of governmental suspicion. Why is exporting cryptography illegal, anyway? Actually, only certain strengths of cryptography are illegal. The U.S. government doesn't want the stronger varieties being used by unfriendly governments or foreign nationals.

The catch in that position (other than the harassment of U.S. nationals) is that anybody who wants strong cryptography already has it. Sources to not only PGP, but to almost any cryptography algorithm you can think of, including Defense Encryption Standard (DES), have long been available outside the United States.

The practical effect of U.S. government cryptography export restrictions has historically been to force U.S. companies to produce two versions of each of product that uses cryptography: one for U.S. domestic use, and one for export. This is unnecessary extra work

and a drain on productivity. Thus, the U.S. government is hindering U.S. companies in areas such as the Internet, where the U.S. has a global lead.

The U.S. government isn't alone in worrying about cryptography. France, for example, bans all use of cryptography outright, classing it as munitions. But that may be one reason why France is not generally known as a leader in Internet commerce.

The latest reincarnation of the key escrow idea, now called "key recovery," is in Senate Bill 909 (S.909), the Secure Public Networks Act. This bill would also continue export controls. The original version of this bill was introduced in June 1997. This revision attempts to address criticisms but leaves the main problems intact. For example, S.909 would permit the FBI to use a subpoena to acquire an escrowed key, without judicial approval, and without notifying the owner of the key.

## Dueling Bills

This bill was introduced by Sens. John McCain (R-AZ), John Kerry (D-MA) and Ernest Hollings (D-SC). Note the bipartisan and broad geographical backing. It is clear that government attempts to impose cryptographic back doors and other restrictions are not going to go away. S.909 is closely based on a draft bill produced by the Clinton administration. This is not surprising. Remember, the infamous Communications Decency Act (CDA) had broad bipartisan support and was passed by an overwhelming majority of both houses of Congress and signed by the president before it was finally declared unconstitutional by the Supreme Court (see "CDA Buried," September 1997, Page 80, or <http://www.mids.org/mn/707/cda.html>).

An indication of the degree of support in the Senate for S.909 can be seen in its approval over the objections of Sen. Conrad Burns (R-MT), who had sponsored only months before (February 1997) the Promotion of Commerce Online in the Digital Era Act (Pro-CODE), S.377, previously introduced in 1996 as S.1726. Sen. Burns was joined by eight other senators in objecting to S.909.

The Pro-CODE bill was an attempt "to promote electronic commerce through the use of strong encryption..." It would relax export restrictions, and it would not implement key escrow. While it was technologically a bit bumbling ("INTERNET—The term 'internet' means the international computer network of both Federal and non-Federal interconnected packet-switched data networks."), it had a very useful purpose and was a reasonable attempt to achieve it. The Pro-CODE bill certainly showed more understanding of Internet technology than does S.909. The surprising part is that Pro-CODE made it as far as it did in a legislative body whose members overwhelmingly do not use the Internet.

Sen. Burns is an Internet user, and in February 1997 he posted an open letter to the Internet community asking for continued support. Evidently, he didn't get enough support. But it's not too late.

## Encrypted Hotcakes

Since Phil Zimmermann was cleared, his company, PGP Associates, has been selling PGP like hotcakes. Recently, that company merged with several others, including Trusted Information Systems, a well-known maker of Internet firewall gateway products, to form a company called Network Associates Inc.

Another player in the commercial cryptography arena is C2Net Software Inc. (<http://www.c2.net/>). This company claims to be dedicated to strong cryptography worldwide. How can it do this, given current U.S. government cryptography export rules? Easy, it manufactures its software abroad. This approach seems to have led to booming business and has gotten one of its founders on the cover of *Forbes*.

Then there is RSA Data Security Inc. (<http://www.rsa.com/>), which sells products based on the popular RSA public key cryptography technique.

A major cryptographic conference, Financial Cryptography '98 (<http://www.fc98.ai/>) has recently taken the offshore approach, holding its meetings in Anguilla in the West Indies. This venue and the February 1998 timing permitted the observation of solar cryptography (a solar eclipse,

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Circle No. 34



## Datagrams

<http://umbra.nascom.nasa.gov/eclipse/980226/text/toc.html>).

This brief list of cryptographic companies is merely illustrative, not comprehensive. My apologies to anyone I have omitted. The point is that the communications cryptography industry is booming, and the main effect so far of U.S. government restrictions has been to force segments of the industry offshore.

### Further Information and Action

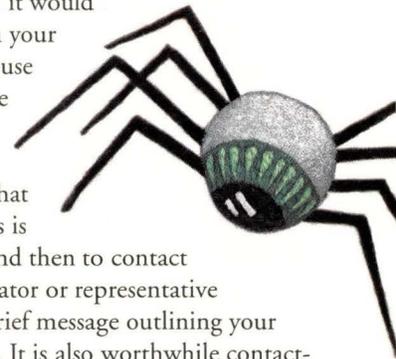
A column such as this only permits hitting the highlights of a policy debate as long-standing and complicated as the one about cryptography. A reasonably reliable source of updates and commentary on U.S. government cryptography proposals is the Center for Democracy and Technology (<http://www.cdt.org/>).

For direct access to the texts of U.S. government bills and laws, plus directories of every U.S. Senate and House member, take a look at the Thomas service of the Library of Congress (<http://thomas.loc.gov/>).

If you are interested in cryptographic policy, it would be worth your while to use the above sources to read up on what Congress is doing, and then to contact your senator or representative with a brief message outlining your position. It is also worthwhile contacting the sponsor of a bill, stating your position.

The U.S. Congress clearly intends to pass some kind of cryptographic legislation. It's a lot easier to affect the outcome when a bill is still in committee, as S.909 is now, than when it gets closer to being enacted into law. It is to no one's advantage to let this issue end up in the Supreme Court, as the CDA did. And there is no guarantee that the Supreme Court will agree with your point of view any more than Congress will.

Speak now or have Congress decide for you how you can speak. →



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San Francisco, CA



## ODM Incantations

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**F**irst rule of systems administration: No matter how many graphical system management tools you have at your disposal, you will occasionally have to put on your wizard's hat and dig into a system configuration problem from the command line. Don't get me wrong. I'm a devout user of administration tools like the AIX System Management Interface Tool (SMIT), which greatly simplify cumbersome configuration tasks. These tools ensure that everything is done in the proper order and that required information isn't lost during the configuration process.

SMIT and other AIX features, such as dynamically linked kernels, Logical Volume Manager and Journaled File Systems, assist in improving system availability. However, the added functionality and availability provided by these features comes with added complexity within the operating system. In rare instances where kernel configuration data has been corrupted by an unforeseen system fault, tools like SMIT may operate at too high and general a level to correct the problem.

When this happens, your only alternatives may be to reinstall the operating system or try to invoke the low-level system commands and functions used

by SMIT to remedy the situation. If it looks like you're going to have to reinstall, then why not roll up your sleeves, delve into the inner sanctum of the operating system and do that AIX sorcery thing you do so well.

### Object Data Manager

AIX maintains much of its device configuration information under a simple object data management subsystem affectionately known as the Object Data Manager (ODM). Operating system devices and drivers are stored as objects within ODM class databases according to type characteristics and operational behavior. Each object class database is implemented as a standard UNIX file. Objects within each class database are defined and manipulated using SQL-like semantics from a set of callable library routines and commands supplied with the ODM. AIX Version 4 uses two default directories to store object class databases (see Table 1). A special shell environment variable, `ODMDIR`, identifies the directory paths used

**Table 1. Default AIX ODM Database Paths**

<code>/etc/objrepos</code>	Default object class directory
<code>/usr/lib/objrepos</code>	Additional AIX V4 directory

by the ODM in locating object databases. This environment variable can also be used from nonprivileged accounts to develop ODM-managed data sets for other applications.

Before delving too far into how the ODM manages devices and subsystems, let me take a moment to describe what is meant by an object. Think of an "object" as a self-contained system of code and data that can interact with other objects. Like real-world systems, an object is defined by its set of properties, which include state, behavior and identity. An object's properties might include things like color, location, size and actions taken for specific stimuli. Messages used to communicate and invoke responses from an object operate on the properties that make up the interface to the object. This provides a means for altering the internal state and attributes of an object while leaving the interface properties intact for backward compatibility with other existing objects.

At a higher structure level, objects are defined or classified by an object "class." The object class indicates the generalized structure and behavior of an object. Each object may be thought of as an instance of its class definition. As such, it inherits all the prop-

erties associated with its parent class. This brings me to "subclasses" and "inheritance." As you might guess, subclasses inherit a subset of the properties of higher level classes. For example, a class called "automobile" defines a set of properties that are exhibited by subclasses "car" and "truck." Lower level subclasses might represent makes of automobile such as "Ford" or "Volvo." An object instance of these classes might be "1996 Red Ford Mustang Convertible."

Object behavior is defined by "functions" and "methods." A function is a code section that performs a task. Methods are functions associated with an object and define the object's behavior. A method is invoked on receipt of a message. The message may carry values and parameters that will be operated on by functions that make up the method. "Event handlers" are special-purpose functions that are executed when an event occurs, for example, a request to read a block of data from a disk drive.

Object attributes are mapped into a language-specific structure to represent the object class definition for application programs. The object class definition describes the set of *descriptor = value* pairs that make up the properties of an object. Object classes may also be relationally joined to other object classes using special link descriptors.

## Example 1. Inventory Object Class Definition

```
1) inventory.cre                                Object Class Definition

class Inventory {
    char item[20];
    char description[80];
    char color[20];
    short unit_number;
    char manufacturer[20];
    long quantity;
    long unit_price;
    method order_more;
}

2) odmcreate inventory.cre                       Create an object class called inventory.

3) Inventory Object Instance

Inventory:
item           = "Drum Sticks"
description    = "Rudimental drum sticks, plastic tip."
color          = "black"
unit_number    = 293
manufacturer   = "Prehistoric Logs"
quantity       = 20
unit_price     = 2050
order_more     = /usr/local/bin/check_inventory
```

## Creating ODM Classes, Objects

Initially, ODM object class definitions are constructed from ASCII text files identified with a .cre file name extension. This description file is read by the odmcreate command to create the object class. The result is an empty object class and a .h header file that may then be used by application programs to populate and manipulate members in the object class. Example 1 describes the generic attributes of an inventory object class for a music store.

The inventory object class definition in Example 1 specifies a method descriptor variable order\_more. A method descriptor defines a function that is to be invoked by the odm\_run\_method routine. The method updates the state of the object. In Example 1, the method order\_more could check product inventory and change state when the inventory was exhausted. Each object in the object class may specify a unique method program. Methods are represented as null-terminated, 255-character strings. The special character "&" may be appended to the method for asynchronous execution.

As an exercise, set the ODMDIR environment variable to point to a subdirectory in your own \$HOME directory. Use an editor to create an object class definition and invoke odmcreate to build the new object class. Use the commands listed in Table 2 to manipulate data in the test object class. A much richer set of callable routines is available for application programs (see AIX InfoExplorer for more information).

## Table 2. ODM Commands

ODMDIR	Set ODM database location path
odmadd	Add an object to an object class
odmchange	Modify object attributes
odmcreate	Create empty object and C descriptor
odmdelete	Delete object from an object class
odmdrop	Remove an object class
odmget	Retrieve an object in odmadd format
odmshow	Display object class definition

## AIX Device Configuration

As I mentioned earlier, AIX stores device interface definitions and configuration attributes as objects in ODM class databases. Each time the system is booted, the ODM `cfgmgr` routine walks the I/O bus and identifies all devices present on the system. Device location and type information is stored in the ODM and the associated configuration rules and initialization methods are run to make the devices available for use.

`cfgmgr` can also be invoked on a running system from the SMIT devices menus or by executing `cfgmgr`, `mkdev`, `chdev` or `rmdev` from the command line (see Example 2). The same dynamic device configuration activities performed at boot time can be invoked while the system is up and available for use. This feature allows you to make new devices available without requiring a system reboot.

AIX separates device configuration information into predefined and customized object classes (see Table 3). Predefined object class information represents default configuration information for all device types supported by AIX. Customized object classes represent the devices actually present on the system.

Device object classes are linked hierarchically into subclasses. For example, 7207 and 3490E tape devices represent subclasses under the tape object class. The tape object class is in turn a subclass of the SCSI object class. This hierarchy enforces configuration relationships. Parent object class information must be configured before child subclass configuration. Parent object class information may not be modified if child subclasses exist. Parent object classes may not be removed if child subclasses exist. A special object class, Predefined Connections (`PdCn`), defines the hierarchy of device classes and subclasses. Device attributes are maintained as separate attribute object classes.

When `cfgmgr` updates custom device information, it invokes the method specified for each device and updates device state information. When the method is invoked, the device is set to one of three states, `DEFINED`, `STOPPED` or `AVAILABLE`. Devices marked as `DEFINED` are known to the system but are not available for use. Devices in the `STOPPED` state are config-

### Example 2. Configuring ODM Device Definitions

```
# smit devices
# mkdev -l tty0           Add a tty device
# lsdev -C -s scsi -H     List existing SCSI devices
# chdev -l rmt0 -a block_size=0 Change tape block size
# lsattr -D -l rmt0      List tape attributes
# rmdev -l rmt0 -d       Remove a tape device
# cfgmgr                 Update ODM and kernel
```

ured but also not available. Devices marked as `AVAILABLE` are configured and available for use by the system.

A small ODM database representing device configuration information is maintained as part of the AIX boot image. This information can be updated from the master ODM database using the `savebase` command. Likewise, ODM information from a boot image can be restored to the master ODM database by invoking the `restbase` command (see Table 4).

To coexist with traditional UNIX administration techniques, some ODM information is mirrored in human-readable UNIX configuration tables. Care must be taken to be certain that ODM information is kept synchronized with configuration table contents. This is especially true in older versions of AIX. ODM and table synchronization is performed automatically if updates are introduced using SMIT.

### Warning, There Be Dragons Here

The ODM is one of the most difficult AIX subsystems to manage without a good front-end tool like SMIT. The combination of SMIT and the ODM do an excellent job of configuring the operating system, but they're not perfect. When objects and their associated attributes and methods become corrupt, you may have to go after the problem from the command line. IBM used to offer an ODM editing tool in AIX Version 3 called `odme` that did a good job of filling the gap between SMIT and the command line. Alas, `odme` is no more.

To those who are willing to invoke the arcane spells of the ODM, I offer a word of warning. You must first fully understand ODM object attributes, relationships and hierarchies as they apply to the operating system and its devices. I repeat, *do not try this unless you are very familiar with system object class relationships!* Sounds like I'm warning you away from a motorcycle jump across Hell's Canyon? Yep kids, don't try this one at home.

Before undertaking any modifications to live system definitions, experiment with ODM commands and routines using an account without write permission to the production ODM files and directories. Begin by selecting the object class of interest. Then display and manipulate objects within the selected class. When you think you're ready for the production run, try it out on a test system instead. The ODM command and library routine sets are powerful spells, so you'll want to make certain you come through a configuration change with all your operating system fingers and toes intact. Seriously, these tools provide a means for correcting serious system problems that might otherwise only be remedied by a complete overwrite install of the operating system. Do your homework first and everything will work out fine. You'll be adding more stars to your wizard's hat in no time at all. ➡

**Table 3. Predefined and Customized Device Classes**

<code>PdDv</code>	Predefined devices supported by AIX
<code>PdAt</code>	Predefined device attributes
<code>PdCn</code>	Predefined device subclass connections
<code>CuDv</code>	Customized devices attached to the system
<code>CuDvDr</code>	Customized device drivers
<code>CuAt</code>	Customized device attributes
<code>CuDep</code>	Customized device dependencies
<code>CuVPD</code>	Customized Vital Product Data
<code>Config_Rules</code>	Configuration rule sets

**Table 4. ODM Boot Image Configuration Commands**

<code>savebase</code>	Save master ODM data to AIX boot image
<code>restbase</code>	Restore custom ODM data from the boot image

# Work

by Jeffreys Copeland and Haemer



## Not Looking Through Our Mail

### 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.html>.

Letters,  
We get letters,  
We get stacks and stacks of letters ...

— Perry Como

What? Again? You guys just used this quote.

— Our readers

Dad. You're not funny. I mean it.

— Our children

Look on the bright side. At least you're not seeing the same Perry Como quote over and over again in your email. After you read this column, you'll be able to arrange not to see some other things in your email, too.

Do you get unsolicited junk email? Do you find it tiresome to see people rewrite their email addresses in news postings to avoid spam? (“To get my real email address, remove NOSPAM from my address, <jNOSPAMsh@useNOSPAMnix.org>”) Is there a subset of your mail that you always either delete, or perhaps refile into a separate folder? Are there sites or people that you'd prefer not to hear from, ever? Answers to all these questions come under the header of “mail filtering.”

This month, we'll walk you through the basic idea of mail filtering, to give you an idea of how filters work and what's possible.

### How's It Work?

Mail is delivered to your mailbox, typically a file named with your login name in a well-known directory, where it has been deposited by a Mail Transfer Agent (MTA), typically Eric Allman's `sendmail`. Jeff Haemer's mailbox, for example, is usually in `/var/spool/mail/jsh` or `/usr/spool/mail/jsh`. After delivery, the mail sits there, waiting for you to look at the mailbox with one of several user agents—such as `elm`, `Mail`, `pico` or even Netscape—that are used to compose and read mail.

If you run a filter over your mailbox before you read it, that filter can file, auto-reply to, discard or redirect mail messages without your ever having to see them. This takes some of the burden off of you and puts it onto the software, where it belongs.

Seems pretty obvious, and it is. The two most common forms of mail filtering, `.forward` files and the vacation program, are nearly ubiquitous. We'll review them both briefly.

## Filtering with .forward Files

If you create a file in your home directory named `.forward`, which contains another email address, all your mail will get forwarded to that address. (If you have never tried this, try it now. Be sure to warn the person to whom you're forwarding the mail first, if you care what they think of you.)

Understand, this does not produce a carbon copy. Suppose, for example, that we have the following:

```
$ cat ~jsh/.forward
jeff@softway.com
```

Upon discovering that a piece of mail has `jsh` as its intended recipient, `sendmail` looks for `~jsh/.forward`, reads it and ships the mail to `jeff@softway.com` instead of depositing it into `/var/spool/mail/jsh`.

At this point, if you're already trying to change your boss' `.forward` file so that all his mail will be sent to you instead, the reason it's not working is that contemporary versions of `sendmail` won't use a `.forward` file that is writable by anyone but the owner.

Nevertheless, `.forward` files are the simplest tool for handling changes of address. (You can also redirect mail with changes to your system `/etc/aliases` file with the help of your systems administrator. For more complicated changes, such as redirecting all the mail for your site, modifying the MX records for your site may be called for, but that's a story for another day.) One of our colleagues, Henry Stiles, told us last week that he's still getting mail forwarded from his QMS address, even though he's been at another company, Artifex, for about a year. Similarly, Jeff Haemer routinely gets email forwarded to him at QMS, from the address `jsh@usenix.org`.

It's a good bet that most of the folks who run ads on the Net offering permanent email addresses ("*Now, a way to let you never have to change your email address, EVER!!!!*") just have a PC with a lot of home directories, each with a single `.forward` file and nothing more. A single Linux box with a couple of large disks could, in theory, provide this kind of service for the entire world's population, although its `sendmail` process would be very weary at the end of the day.

This is not the only useful trick available with `.forward` files. If an address in a `.forward` file begins with the pipe symbol, `|`, what follows is a program that will act as a filter. Instead of merely forwarding the mail, it is piped as standard input to that filter, which in turn can do all sorts of arbitrary and interesting things to the incoming mail.

## Filters on Vacation

The `vacation` program is a commonly used program that makes use of pipes in `.forward` files. When you send someone email, and you get a rapid reply that says something like this:

```
To: jeff@softway.com
From: jsh@boulder.qms.com
Subject: Out of town
Delivered-BY-The-Graces-Of: the vacation program
```

Precedence: junk

Status: RO

I am in Romania for the last week of October, for the Romanian Open Systems Exposition.

If you get this and live in Boulder, don't even think of breaking in. I've filled my house completely with water and stocked it with piranhas.

Your message has been saved, and will be delivered to me on my return, after I finish draining the children's bedrooms.

the reply has probably been automatically generated by the vacation program.

The process of generating it goes like this:

1. Jeff Copeland's mail arrives, addressed to Haemer (`jsh`).
2. Our MTA, `sendmail`, reads `~jsh/.forward`, finds something like the following:

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

and feeds the mail to `vacation` instead of putting it into Haemer's mailbox.

3. The `vacation` program checks to make sure the mail isn't from a mailing list, and that the sender doesn't already know Haemer is on vacation—that is, he hasn't already gotten an "on vacation" message. It also checks to make sure the message isn't "ringing" (see below).

4. If none of these is the case, `vacation` replies to Copeland's mail with the contents of `~jsh/.vacation.msg` and stores his address in a database, generated using the Berkeley DBM library (kept in the files `~jsh/.vacation.pag` and `~jsh/.vacation.dir`), so that he only gets told once that Haemer's out of town.

5. Finally, `vacation` stores the message in `/var/spool/mail/jsh`, so Haemer can read it on his return.

In other words, `vacation` is just a program that handles individual messages in a stereotyped but useful way. And if `vacation` can do that, why stop there? What's to stop us from writing our own code to parse mail messages, and turning it into a back end for `sendmail`?

(The real answer is, "your systems administrator." As you can guess, this sort of thing could be used to create interesting security holes, and some sites configure `sendmail` to prohibit using filters in `.forward` files. We'll talk about that later, too.)

## Not Writing a Mail Filter

OK, so the general principle seems easy enough: We write a filter that parses incoming mail messages, figures out what to do based on the contents and the headers, and then does it.

This is a straightforward text-processing application that doesn't require things like GUIs or complex algorithms, so we could probably do the job using a Perl or shell script. Perl even has a suite of mail-manipulating modules, available on

the Comprehensive Perl Archive Network (<http://www.perl.com/CPAN/>). In the March issue ("Looking Through Our Mail," Page 80), we used these modules for a different job, but they can make jobs like this one relatively easy, too.

The problem with this approach is that we risk having to write and maintain an endless string of `sendmail` back ends, each for a slightly different job: filing, discarding spam and so forth.

But what's our alternative? `procmail`.

When we need software, instead of writing our own from scratch, we start by looking to see what's already out there. A quick look around reveals no shortage of general-purpose mail-filtering programs. In all cases, these programs generalize the capability of `vacation`. Through some launching mechanism—typically, `sendmail`'s ability to execute commands in users' `.forward` files—the programs examine mail messages and take actions based on what they find. Nearly all of these programs give users a little language to configure the filter, which pairs search keys with actions—much like `make`'s target/rule pairs or `lex`'s regular-expression/code-block pairs. A short example by Jamie Hoglund, together with a brief analysis, can be found at <http://www.skypoint.com/members/jhoglund/perl/filter.html>.

At the other end of the spectrum, the most mature mail filter is Stephen van den Berg's `procmail`. (Maturity is important: You don't want bugs in programs that mess with your email.) The syntax for `procmail` is a little painful, but the capabilities are complete. We know of systems administrators for large installations who first arranged to have critical processes notify them of problems by email, then configured `.procmail` to page them whenever things go amiss, or even send them a display message telling them exactly what's gone wrong.

What does the syntax look like? Here's an example rule—one of many in Haemer's `.procmailrc`:

```
1 :0 B
2 * Content-Type:.*name=".*\doc"
3 {
4     :0 h
5     * !^X-Loop: jsh@woodcock.boulder.qms.com
6     | (formail -r -A"Precedence: junk"\
7     -A"X-Loop: jsh@woodcock.boulder.qms.com" ;\
```



```
8     $HOME/Mail/procmail/microsoft ) \
9     | $SENDMAIL -t
10 }
```

In line 1, `:0` begins a rule, and `B` says to examine the body of the message. In line 2, `*` signals a regular expression. This rule is triggered whenever `procmail` sees a message that contains a MIME-encoded Microsoft Corp. `.doc` file.

Lines 3 through 10, enclosed in braces, are an action to take. In this case, we look at the header (lines 4 and 5) to guard against "ringing" (see below), and then auto-generate a reply. The header of the reply is created by a stand-alone utility called `formail` (lines 6 and 7), which comes as part of the `procmail` distribution. We generate the body, in line 8, with a shell script, but we could have just hard-wired the text into the action itself. Finally, in line 9, we pipe the entire message back to `sendmail`, which ships the reply to the original sender, explaining what's happened:

The email you sent to Jeff appears to be a Microsoft `.doc` file. Jeff cannot read Microsoft `.doc` files, and your message has been automatically discarded.

This reply was automatically generated, so Jeff is unaware that you sent anything.

If you want to communicate with him, you can do so by resending your email as flat, ASCII text.

## Your Email's Ringing

OK, imagine that Haemer has a `.procmailrc` that says "Auto-reply to all mail from Copeland,"

```
:0 c
* ^From.*Copeland# Anything from Copeland
| (formail -r -A"Precedence: junk";\
    echo "Got your mail!") | $SENDMAIL -t
```

and Copeland has a `.procmailrc` that says "Auto-reply to all mail from Haemer,"

```
:0 c
* ^From.*Haemer# Anything from Haemer
| (formail -r -A"Precedence: junk";\
    echo "Got your mail!") | $SENDMAIL -t
```

Any message from Copeland to Haemer will generate a reply from Haemer to Copeland, which will generate a reply from Copeland to Haemer, which will generate a.... If people were doing this, someone would suggest that the participants get a life, but the perpetrators are programs, and can't get a life, no matter what William Gibson and Bruce Sterling tell you. What they can do is create a flurry of email traffic that quickly swamps all other mail processing.

By analogy with circuits, this behavior is called "ringing." To prevent this, a mail filter should insert a sentinel into its

reply that will let it detect whether it comes back around.

For procmail, an easy solution looks like this:

```
1 :0 c
2 * ^From.*Copeland# Anything from Copeland
3 * !^X-Loop: jsh@boulder.qms.com
4 | (formail -r -A"Precedence: junk" \
5 -A"X-Loop: jsh@boulder.qms.com" ; \
6 echo "Got your mail!") | $SENDMAIL -t
```

The new argument to `formail`, in line 5, inserts a user-defined field into the header. When the message comes back around, the regular expression in line 3 detects that header and doesn't auto-reply to it.

### Filters: Just Say No

Security-conscious installations may prohibit the use of filters in `.forward` files. For example, in the incomprehensible configuration file for `sendmail`, `/etc/sendmail.cf`, the variable `Mprog` dictates what program parses the filter command. A line like this:

```
Mprog, P=/bin/sh, F=lsDFMeuP,
S=10, R=20, A=sh -c $u
```

means "hand all filter lines to the shell." In contrast,

```
Mprog, P=/bin/true, F=lsDFMeuP,
S=10, R=20, A=true -c $u
```

will make `sendmail` ignore filters; `true` will return immediately and successfully without doing anything at all.

If this is your situation, what's to be done? One possibility is to coax your systems administrator into installing `procmail` as your local mail delivery program, by replacing the line that looks like this:

```
Mlocal, P=/bin/mail, F=r1sDFMmnP,
S=10, R=20, A=mail -d $u
```

with one like this:

```
Mlocal, P=/usr/local/bin/procmail,
F=lsSDFMhPfn, S=10, R=20,
A=procmail -Y -a $h -d $u
```

This option is discussed in some detail in the documentation that comes with the `procmail` distribution, but it requires getting on your systems administrator's good side. That's a worthwhile goal in and of itself, so we encourage this approach.

If that's impossible, all is not lost. First, you have read and write permission for your own mailbox. One possibility is to run a `cron` job through a filter nightly, or even more frequently. This will at least cut down on your work. However,

you need to take precautions to keep User Agents and Mail Transfer Agents from modifying your mailbox at the same time your filter is—if two programs are writing to your mailbox at the same time, you're likely to scramble its contents.

A second approach would be to filter on demand. One interesting way to do this is to build a front end for your User Agent. To read your mail, for example, you could invoke a front end that would filter your mail, then invoke your mail reader. This wouldn't work well for an application like Netscape, which typically gets invoked only once, but would work for programs like `pico` or `elm` that get a separate invocation for each mail-reading session. (Another reason we avoid those monolithic what-you-

see-is-what-you-get programs: As nice a user interface as Netscape mail provides for some, filtering your mailboxes gets to be a little tricky.)

Now that we've got the tools to automatically defend our battlements against spammers, we need a good heuristic for detecting mail from them. We tried just bouncing back mail we got from anyone at AOL but realized that we were losing correspondence with people we needed to talk to, not to mention Dogbert's father, Scott Adams.

If you'd like to learn more about mail filtering, a fine place to start is the mail-filtering FAQ, which can be found scattered around the Web at places like <http://www.ii.com/internet/faqs/launchers/mail/filtering-faq/>.

Next month, we'll either talk about that, or about how we shot ourselves in the foot by being too careful when we had a flaky disk, or whatever other interesting problem we trip over in the meantime.

Until next time, happy trails. ☞

***One possibility is to coax your systems administrator into installing procmail as your local mail delivery program... it requires getting on your systems administrator's good side. That's a worthwhile goal in and of itself.***

## COMING NEXT MONTH

### WEBSERVER MAGAZINE SUPPLEMENT

Taken from our *WebServer OnLine Magazine*, the monthly editorial section will be directed to those readers who are involved with evaluating hardware/software products for corporate Web sites and Internet applications.

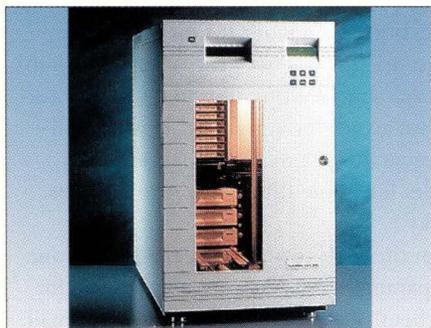
# NEW PRODUCTS

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.

## MLR Tape Family Grows

Tandberg Data has introduced three additions to its MLR Library Systems product line: the TDS 1210-1 MLR3, TDS 1420-1 MLR3 and TDS 1440-1 MLR3. All three library systems use Multi-channel Linear Recording (MLR) technology and range in capacity from 250 GB (native) to 2 TB (compressed). According to Tandberg, its MLR technology provides complete backward read and write compatibility. Two-channel recording is standard on all models.

All three models are reportedly designed for storage management applications, including on-site or remote backup, disaster recovery, near-line storage, hier-



archical storage management (HSM) and archival storage of mission-critical data.

The 1210-1 MLR3 costs \$11,638, the 1420-1 MLR3 costs \$21,485, and the 1440-1 MLR3 costs \$29,107.

### Tandberg Data Inc.

2685-A Park Center Drive  
Simi Valley, CA 93065

<http://www.tandberg.com>

Circle 101

## Telco Service Software Unveiled

Internet Administration Framework (IAF) 2.5, a customer care and billing software package from Solect Technology Group, is targeted at the telecommunications industry and Internet service providers. IAF is reportedly designed to help companies provide more sophisticated services to their customers as well as improve the overall billing process.

With IAF, a company can customize the applications and services it offers to customers. IAF allows the automation of processes such as integrated provisioning, data collection and registration, Solect says.

In addition, IAF offers new options and features for billing. It is designed to interface with existing billing systems, while offering new report analysis tools and hierarchical account management and billing. In addition, it is said that IAF can offer companies a means to improve their rate pricing plans. Also, IAF supports promotions, discounts and prepaid billing and gives customers online access to their billing information.

Solect is only available on Sun Solaris systems. Pricing varies depending on configuration, but a company with 25,000 to 50,000 service subscribers can expect to pay around \$125,000 for the software.

### Solect Technology Group

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Toronto, Ontario  
Canada M5J 2H7

<http://www.solect.com>

Circle 102

## Messaging Server Supports Solaris

Isocor has made N-PLEX Global Version 2.0 available for Solaris. N-PLEX is a scalable messaging and directory ser-

## Monitors Offer Bigger View

**K**DS has released two new 19-inch color monitors, the Visual Sensations VS-195 and VS-19sn. Both monitors can be used with Sun Microsystems Inc. workstations as well as Apple Computer Inc. Macintoshes and PCs, and are targeted at graphic designers, desktop publishers and CAD/CAM users, KDS says.

In particular, KDS touts the monitors' ability to offer a large viewing area in a small desktop space. The VS-19sn uses a short-neck tube that gives the monitor a depth of 17.2 inches, while the VS-195 features a depth of 18.9 inches, which is 10% smaller than the existing KDS VS-19 19-inch monitor. Both the VS-19sn and VS-195 offer 18 inches of antistatic, nonglare viewable space on a flat screen, KDS says. Also, the monitors offer a 95-KHz horizontal scanning frequency, providing a resolution of



1,600-by-1,200 pixels at a 79-Hz refresh rate. KDS uses a super-fine crystal pigment cathode ray tube (CRT) from Matsushita Electric Industrial Co. to produce a .26 mm dot pitch.

Both monitors come with a three-year warranty on parts, labor and CRT, and the KDS Advanced Replacement Express Service (KARES) program, which entitles the user to a replacement monitor if servicing is required. The VS-195 costs \$899, and the VS-19sn costs \$949.

### KDS USA

12300 Edison Way  
Garden Grove, CA 92841  
<http://www.kdsusa.com>

Circle 100

## New Products

ver designed for Internet service providers and large organizations with high-end messaging requirements. Isocor's server software is said to offer a distributed architecture for multiple server environments, remote management capabilities, anti-spamming features and APIs for value-added applications.

N-PLEX Global 2.0 for Solaris offers a centralized administration interface and supports POP3 and IMAP4 message store. The message store allows for load balancing, distributed message processing and storage among multiple servers with single-domain addressing, the company says. LDAP and SMTP message delivery are supported. N-PLEX uses address verification via reverse DNS lookup in SMTP to prevent SMTP spoofing.

Centralized administration and Web-based management features are also available in the form of Java applets. These features include message store management facilities, performance monitoring, built-in security and remote administration of user accounts, Isocor says.

Previously, N-PLEX Global was only available on Windows NT. Pricing starts at \$35,000.

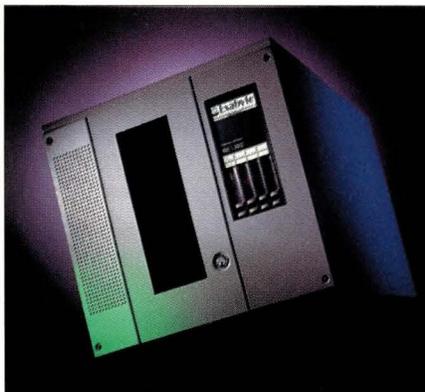
### Isocor

3420 Ocean Park Blvd.  
Santa Monica, CA 90405  
<http://www.isocor.com>

Circle 103

## Arrowhead Automated Tape Library Out

Arrowhead, Exabyte's new family of automated tape libraries, is reportedly designed to deliver reliable and economic storage solutions to a range of computer environments, from departmental workgroups to large application servers. The Exabyte 230D is the first to be released



and is designed for multiple tape technologies, including 8mm and DLT.

The 230D is a two-drive, 30-cartridge DLT tape library that can accommodate either two Quantum DLT4000 tape drives (Model 230D 4000) or two DLT7000 tape drives (Model 230D 7000). Also, it supports network backup/restore, remote storage and automated archiving operations.

The 230D 4000 offers a compressed capacity of 1.2 TB, with data transfer rates of approximately 21.6 GB per hour, and the 230D 7000 offers up to 2.1 TB, with data transfer rates of 72 GB per hour, Exabyte says. Aggregate throughput, with two drives, is 6 MB/s (compressed) for the DLT4000 and 20 MB/s (compressed) for the DLT7000.

The 230D 4000 and 230D 7000 cost \$15,000 and \$20,000, respectively. The tape libraries are available in either rack-mount or tower configurations.

### Exabyte Corp.

1685 38th St.  
Boulder, CO 80301  
<http://www.exabyte.com>

Circle 104

## High-Capacity, AIT Tape Array

Storage Dimensions says its new SuperFlex AIT TapeArray offers performance, capacity and reliability comparable to DLT but in a smaller, lower cost unit. The system combines Sony Corp.'s new Advanced Intelligent Tape (AIT) technology with Storage Dimensions' fault-tolerant SuperFlex TapeArray enclosure in a seven-drive, 350-GB tape backup solution for Solaris, HP-UX, AIX, NetWare and Windows NT. The drives are also available in a two-bay MiniFlex storage enclosure for a compact 100-GB backup solution.

According to Storage Dimensions, Sony's AIT technology has redefined helical-scan recording technology, resulting in a number of benefits, including a 3.5-inch form factor, as opposed to traditional 5.25-inch helical-scan devices. Features such as an integrated fan, automatic head cleaning and gentler handling of tape media are said to prevent tape "shedding," increasing the reliability of AIT systems while reducing maintenance costs. Capacity and performance have been



refined to provide 25 GB of native capacity per drive with a native data transfer rate of 3 MB/s.

The SuperFlex AIT TapeArray is designed to address the distributed backup requirements of multiple server environments as well as the high-performance backup requirements of large consolidated servers, Storage Dimensions says.

The SuperFlex AIT TapeArray with seven drives costs \$31,898, and the MiniFlex with two drives costs \$8,650.

### Storage Dimensions

1656 McCarthy Blvd.  
Milpitas, CA 95035  
<http://www.storagedimensions.com>  
Circle 105

## Storage Replicator for Solaris File Systems

Veritas Software has announced data replication software that it says will provide Solaris customers with extended high-availability capabilities over local or wide-area networks. Veritas says its Storage Replicator for File Systems (SRFS) software delivers disaster recovery at a fraction of the cost of hardware-based solutions.

The synchronous replication capabilities of SRFS are said to guarantee that all servers sharing a file system have exactly the same view of the file system at all times. Any changes to replicated file systems across multiple servers are immediately reflected and available for use at all participation sites. Recovery across multiple consecutive failure modes can either be fully automated or set to require some manual intervention, depending on user needs, Veritas says.

Although Storage Replicator is volume manager- and file system-independent, its use with companion products such as Veritas Volume Manager and Veritas File System offer additional advantages in the areas of performance, availability and manageability, Veritas

## New Products

says. Volume Manager supports online manageability, allowing administrators to optimize data layouts online without affecting client access to data. Host-based RAID levels 0, 1, 0+1 and 5 are supported, and replicated file systems can be mirrored for better availability and more robust recovery.

Veritas says SRFS offers consistently better performance than Sun Microsystems Inc.'s UNIX File System. File system journaling is supported to promote extremely rapid recovery in the event of a failure.

Pricing for Veritas Storage Replicator for File Systems starts at \$10,000 per node and is available only on Solaris. Support for HP-UX and Windows NT will follow, Veritas says.

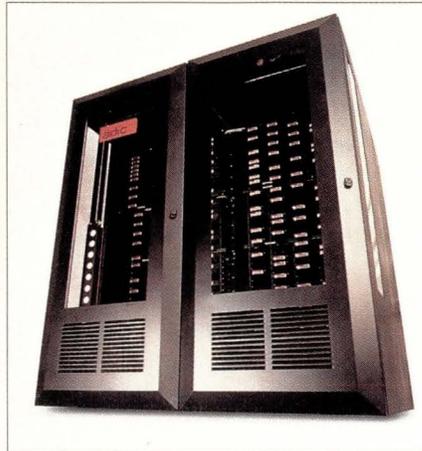
**Veritas Software Corp.**  
1600 Plymouth St.  
Mountain View, CA 94043  
<http://www.veritas.com>  
**Circle 106**

### Scalable DLT Library Unveiled

Advanced Digital Information Corp. (ADIC) has extended its Scalar product family to include a mid- to high-end UNIX and Windows NT solution, the Scalar 1000. ADIC calls it a high-capacity, high-reliability DLT-based automated tape library system that offers a flexible, cost-effective growth path from one to 48 DLT tape drives and from 118 to 788 tape cartridges.

The Scalar 1000 scales by expanding the size of its modular cabinet and by extending its robotics along one axis. This modular expansion means that even with four modules used (the maximum), the Scalar 1000 operates as one integrated library with one robotic system, ADIC says. This design is said to be faster because the library is not required to pass cartridges through multiple robotics and pass-through ports as with other expanded libraries. Also, ADIC says the Scalar 1000 is a cost-effective solution because it requires only one robotic system.

Even in its largest configuration, the Scalar 1000 can reportedly move any cartridge to any drive in less than six seconds, for up to 500 cartridge swaps per hour. It has a 1,000,000 cartridge swaps between failure rate. The Scalar uses



Quantum DLT7000 drives. Users may configure each Scalar 1000 module separately, installing from one to 48 drives. This translates into more than 55 TB (compressed) of online storage with throughput speeds ranging up to 864 GB/hour (native), ADIC says.

Pricing for the Scalar 1000 starts at \$54,290, depending on configuration.

**Advanced Digital Information Corp.**  
10201 Willows Road N.E.  
Redmond, WA 98052  
<http://www.adic.com>  
**Circle 107**

### Ultra 10 Clone Debuts

The first clones of Sun Microsystems Inc.'s Ultra 10 workstations have hit the market. Tatung Science & Technology's COMPstation U10-300 desktop workstation features a 300-MHz UltraSPARCIII PCI processor and supports five 32-bit PCI devices.



Designed for high-end applications in the engineering, medical research, animation, geophysics and finance industries, the COMPstation U10-300 has 512 KB of external cache, 64 MB of memory (expandable to 1 GB), one 4.3-GB hard drive, one 1.44-MB floppy drive and one PCI graphics card. In addition, it supports

Creator Graphics 3D technology via a 64-bit slot for Creator graphics cards and comes with on-chip Visual Instruction Set (VIS) for multimedia, graphics and imaging applications.

Other features include extended IDE built into the motherboard, two serial ports, one parallel port, 100BaseT Ethernet interface and 16-bit audio capabilities. While incorporating the PCI I/O bus, the workstation also maintains full binary compatibility with existing Solaris applications, Tatung says.

The COMPstation U10-300 workstation measures 18.7 by 7.1 by 16.9 inches and is priced at \$4,995, not including the monitor. (By comparison, Sun's Ultra 10 is priced at \$5,595 and up.)

**Tatung Science & Technology Inc.**  
1840 McCarthy Blvd.  
Milpitas, CA 95035  
<http://www.tsti.com>  
**Circle 108**

### UNIX/NT Automated Backup

Quick Restore, Workstation Solutions' backup and recovery system, now supports heterogeneous UNIX and Windows NT networks. From a central management console, Quick Restore Version 2.2 automates the backup of clients to a variety of storage devices. A GUI-based "Restore Browser" reportedly displays an integrated view of UNIX and Windows NT files to help users quickly find what they're looking for.

Quick Restore 2.2 adds support for Intel Corp. 386, 486 and Pentium processors running Windows NT, and Digital Equipment Corp.'s Alpha processors running Digital UNIX, complementing previous support for most of the major UNIX workstations and servers. Also, this version adds support for devices such as the Breece Hill Quad 7, Quad 47 and Q2-15 tape libraries.

Server software packages are priced at \$5,400, which includes an unlimited number of clients of the same architecture in the same administrative domain. Client software for UNIX is priced at \$1,800 per type of client architecture with an unlimited number of clients of the same architecture/domain. For Windows NT, client software is priced per client. Clients can be distributed across multiple media

## New Products

servers as long as they are in the same administrative domain. Pricing for NT ranges from \$2,250 for five clients to \$15,000 for 200 clients.

### **Workstation Solutions Inc.**

Five Overlook Drive  
Amherst, NH 03031  
<http://www.worksta.com>  
**Circle 109**

## IP Services Management Solution

Quadritek Systems, a provider of IP name and address services management systems, has released QIP Enterprise 5.0. The company describes the product as a suite of management tools and integrated IP services for managing mid- to large-scale enterprise networks.

New features are said to include Dynamic Host Configuration Protocol (DHCP) failover services; support for Domain Name Service (DNS) and DHCP services from Microsoft Corp., IBM Corp. and Novell Inc.; Lightweight Directory Access Protocol (LDAP); integrated RADIUS authentication services; database replication; support for Microsoft SQL Server, Secure Dynamic DNS updates and zone transfers; audit manager and billing capabilities; and enhanced import/export utilities.

QIP Enterprise 5.0 runs on Solaris, HP-UX, AIX and Windows NT, and base pricing starts at \$5 per address (quantity discounts are available). Optional services and management tools are sold separately.

### **Quadritek Systems Inc.**

10 Valley Stream Pkwy., Ste. 240  
Malvern, PA 19355  
<http://www.quadritek.com>  
**Circle 110**

## CORBA/Java Development Tool Out

Ikonodyne has announced a component-based approach to developing CORBA applications in the form of its Morphous Object Technology (MOT). MOT provides programmers with an integrated development environment to create, deploy and manage CORBA objects written in Java, the company says.

MOT's Wizard features reportedly allow users to build CORBA objects automatically. With just a few mouse clicks, CORBA objects can be built, converted

into JavaBeans and registered to services such as CORBA Naming, Trader and Event services. MOT also provides an administrative and monitoring tool.

MOT supports both commercial and customized Object Request Brokers, including Visigenic Software Inc.'s Visibroker 3.0, under Solaris 2.5 and Windows NT 4.0. Pricing starts at \$1,450 per seat; price includes one half-day on-site training.

### **Ikonodyne**

2680 Bayshore Pkwy., Ste. 106  
Mountain View, CA 94043  
<http://www.ikonodyne.com>  
**Circle 111**

## Affordable Desktop DLT

LoaderXpress from Overland Data is an automated Digital Linear Tape (DLT) storage system that permits Solaris, AIX, HP-UX and Windows NT servers to be backed up for up to two months without any operator intervention, the company says. LoaderXpress uses the cartridge magazine design of the LibraryXpress tape library, which reportedly allows users to perform bulk cartridge installation and removal instead of installing cartridges individually. In addition, magazine-based media management minimizes the risk of losing individual DLT cartridges.



All LoaderXpress functions can be managed via front-panel controls that provide direct access to magazine, cartridge and drive status information. For extra security, the loader can be locked, preventing unauthorized access to critical company data, Overland says.

LoaderXpress comes in three versions: the Model 405 (\$4,995), which features a DLT4000 drive with a five-cartridge magazine providing a native capacity of 100 GB with a throughput of 5.4 GB/hour; the Model 410 (\$5,595), which uses a DLT4000 drive and a 10-cartridge magazine to double native capacity to 200 GB;

and the Model 710 (\$10,995), which uses a DLT7000 drive and has a 10-cartridge magazine with native capacity of 350 GB and maximum throughput of 18 GB/hour. All capacities and data rates can be doubled with the use of on-board hardware data compression, Overland says.

### **Overland Data Inc.**

8975 Balboa Ave.  
San Diego, CA 92123  
<http://www.overlanddata.com>  
**Circle 112**

## Software for Forms Enhancement

A new electronic forms software product for UNIX is designed to make it easy to enhance forms, reports and documents containing images, logos and other graphics without modifying existing code. UnForm Page Enhancer, from Synergetic Data Systems, reportedly lets users modify existing forms and documents or create new ones with boxes, shading and special font styles.

In addition, UnForm allows developers to build cost-effective processing logic into the documents. For example, the tool lets developers print and fax identical copies of forms within the same batch. Forms can also be structured to perform specific tasks, such as calculations or data retrieval, within the document before printing, the company says. UnForm's content-based enhancement feature is said to make it possible to specify the appearance of certain words or phrases. For instance, the company name could appear in bold throughout a document.

Aimed at small- to medium-size companies that require state-of-the-art forms functionality but can't afford the high cost of most traditional forms tools, UnForm allows business to print forms as needed on any PCL5 device, such as a Hewlett-Packard Co. laser printer, as well as some ink-jet printers and fax machines. UnForm runs on all UNIX platforms, including Solaris and Windows NT, and is priced at \$695 per license.

### **Synergetic Data Systems Inc.**

907 Embarcadero Drive, Ste. 4  
El Dorado Hills, CA 95762  
<http://i99.com/sdsi>  
**Circle 113**

## New Products

### Graphics Card for Ultra 5 and Ultra 10

Tech-Source's Raptor GFX 24-bit true color video graphics adapter is a PCI-based graphics accelerator for windowing applications that require 24-bit color or higher resolutions than Sun Microsystems Inc.'s PGX PCI card.

According to Tech-Source, the GFX adapter boosts the Ultra 5 and Ultra 10 workstations' standard 256-color capability to 16.7 million colors. Tested for use in all current PCI-capable Sun systems running Solaris 2.5.1 or 2.6, the Raptor GFX card can reportedly handle more than 50 resolutions and support 8- and 16-bit-per-pixel applications.

Tech-Source's card runs X Window System applications and offers extremely fast 2D performance. Applications requiring 3D, however, will function properly but will not be accelerated in the hardware, the company says.

Designed for applications in software development, 2D design, modeling and visualization, digital content creation and server consoles, the Raptor GFX comes with 4 or 8 MB of video RAM and offers advanced features such as optimizing for Sun's Visual Instruction Set (VIS).

Pricing for the Raptor GFX graphics adapter starts at \$550 for the 4-MB version and \$850 for the 8-MB version.

#### Tech-Source Inc.

442 S. North Lake Blvd.  
Altamonte Springs, FL 32701  
<http://www.techsource.com>

Circle 114

### Correction

In "OpenNT – More Than Just UNIX and NT," Page 65, March 1998, the total cost for configuration should have been \$3,023, not \$4,002. The correct contact information for Softway Systems Inc. is 185 Berry St., Ste. 5514, San Francisco, CA 94107 (<http://www.opennt.com>); Tel: (415) 896-0708; Fax: (415) 896-0709.

## Upgrades, Enhancements, Additions...

▶ Legato has released Version 1.1 of its Global Enterprise Management of Storage (G.E.M.S.). The G.E.M.S. initiative is Legato's approach for centrally managing distributed storage by allowing IT personnel to administer and control disparate storage management resources across an entire organization while ensuring that the data is still protected. Release 1.1 allows the GEMStation to now run on Windows NT in addition to Solaris. It supports the Oracle 7.3 database for both Windows NT and UNIX as well as Sybase on UNIX. Pricing for Version 1.1 starts at \$3,000 for the GEMStation, G.E.M.S. console and two managed nodes. Additional managed nodes are available in multiples of one, five and 25, starting at \$4,000 for a single managed node for UNIX and \$2,000 for a single NT node. Legato has also announced NetWorker 5.1 for Windows NT and UNIX. Support for "Storage Nodes" has been extended to the NT environment—a Storage Node is any system on the network that has a locally attached storage device. With NetWorker 5.1, administrators can deploy failover services across multiple Storage Nodes distributed across multiple operating systems. **Legato Systems Inc.**, 3210 Porter Drive, Palo Alto, CA 94304, <http://www.legato.com>. **Circle 115**

▶ SpatialWare, software from MapInfo that integrates with database management systems to store geographic data in relational databases, is now in Release 2.1. This version features 130 verbs, operators and functions. It is available for Oracle 7.3 databases on major UNIX platforms, including Solaris, HP-UX and Digital UNIX, as well as Windows NT. A SpatialWare Datablade module for the Informix Software Inc. Universal Data Option is also available. Pricing starts at \$11,995 per seat, with a minimum of five concurrent users. **MapInfo Corp.**, One Global View, Troy, NY 12180, <http://www.mapinfo.com>. **Circle 116**

▶ Computer Associates International, maker of the Unicenter TNG management platform, has announced enhanced sup-

port for Sun Microsystems Inc.'s Sun Enterprise 10000 platform, aka Starfire. Chief among the integration features are new class definitions for Starfire servers, for use in topology maps; menu-level integration; automatic discovery of Starfire management agents; and comprehensive event-action policies. Pricing for Unicenter TNG starts at \$2,300. **Computer Associates International Inc.**, One Computer Associates Plaza, Islandia, NY 11788, <http://www.cai.com>. **Circle 117**

▶ Sybase's PowerBuilder Enterprise 6.0 is now available on AIX. PowerBuilder is a 4GL development tool for building enterprise business applications for client/server, multitier and Internet architectures. PowerBuilder 6.0 has several new features, including an improved capability for developing standard application components; accessibility to PowerBuilder logic components from a range of thin Web clients; open technology, supporting development and deployment of applications in a heterogeneous enterprise; and rapid development of enterprise class business applications. It costs \$4,995. **Sybase Inc.**, 6475 Christie Ave., Emeryville, CA 94608, <http://www.sybase.com>. **Circle 118**

▶ Programmed Logic has announced StackOS 2.0, the latest version of its storage-optimized, processor-independent embedded operating system. Originally called ESME, StackOS is designed to enable mission-critical storage management software to run in an embedded environment. This latest release offers features such as a fast SCSI framework, a fast TCP/IP stack and optional features to export files simultaneously to Windows and UNIX clients using integrated NFS and SMB protocol servers, the company says. Other features include support of real-time operating systems from Accelerated Technologies Inc. and Wind River Systems Inc. Also, StackOS supports Ultra SCSI and Ultra Wide SCSI. Contact company for pricing. **Programmed Logic Corp.**, 200 Cottontail Lane, Somerset, NJ 08873, <http://www.plc.com>. **Circle 119**

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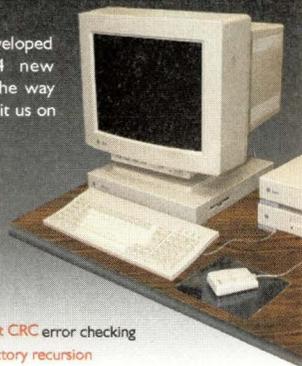
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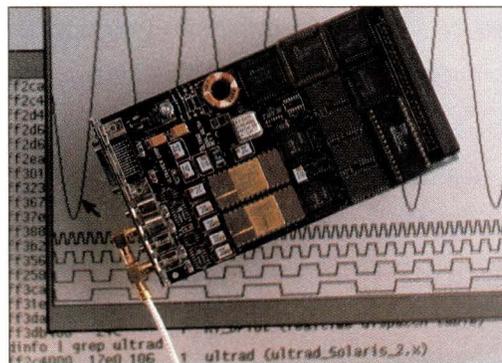
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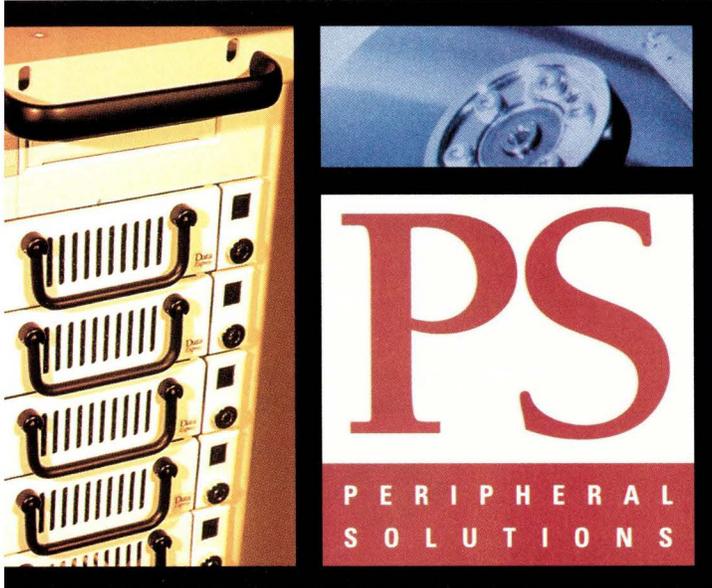
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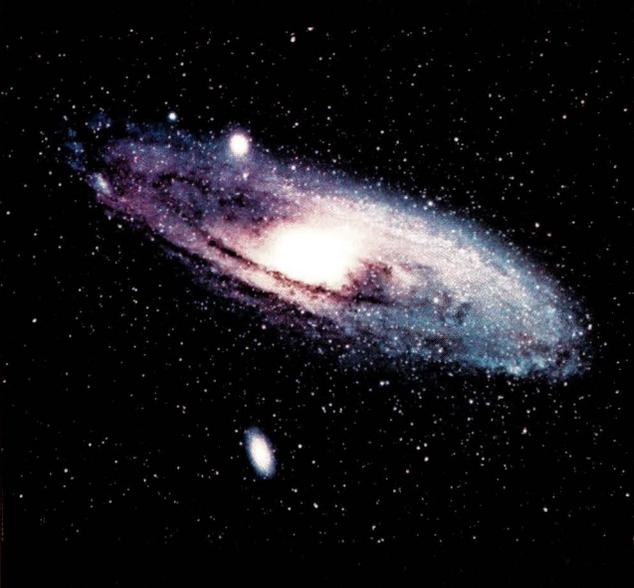
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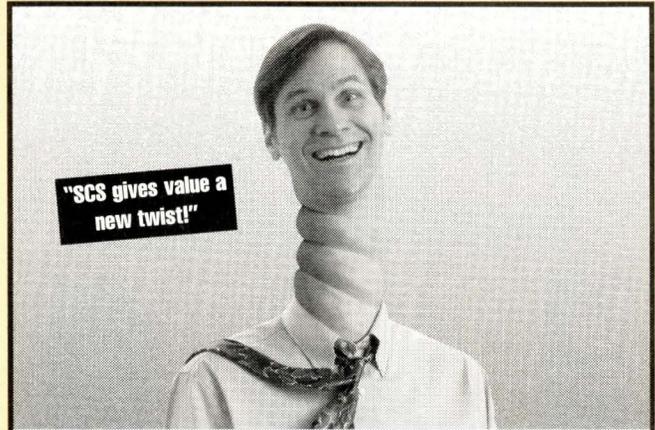


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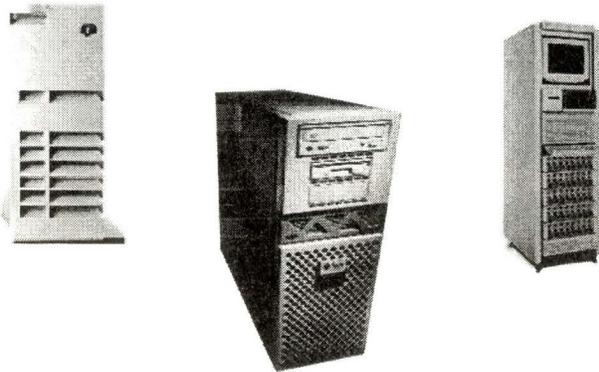
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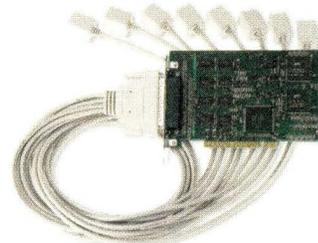
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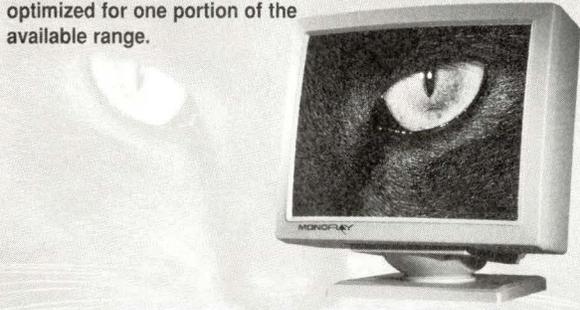
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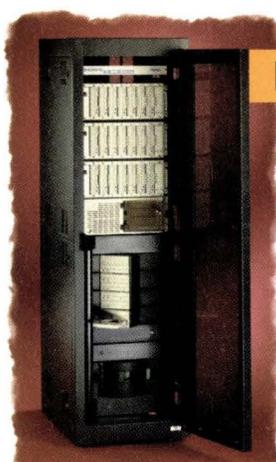
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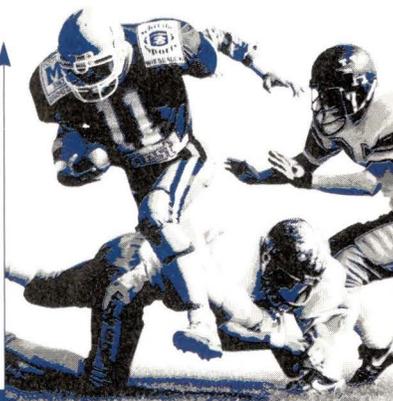
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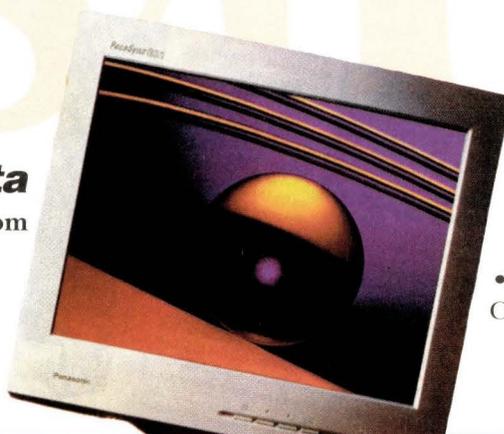
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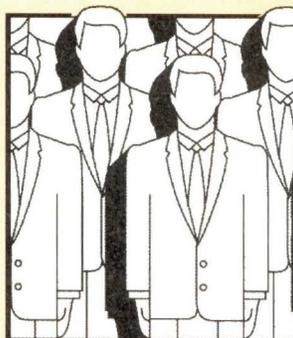
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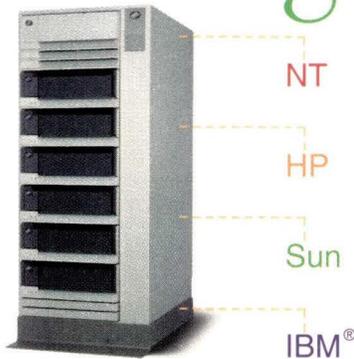
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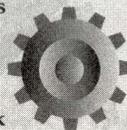
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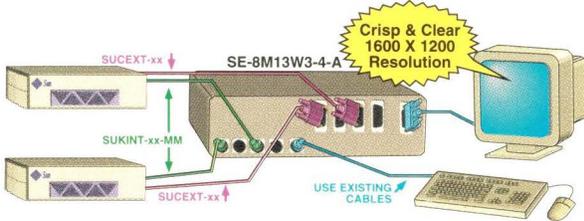
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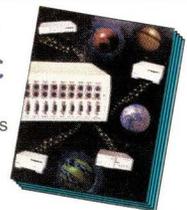


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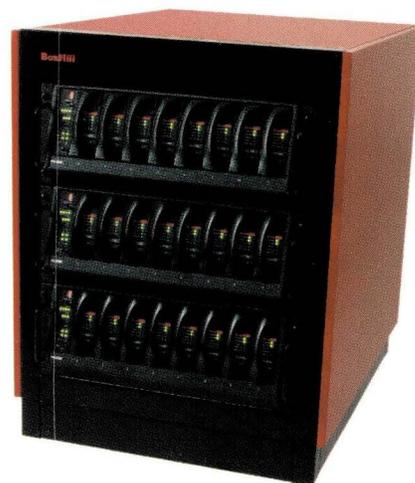
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