Incorporating RS/Magazine

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The Server/Workstation Magazine for UNIX IS Managers

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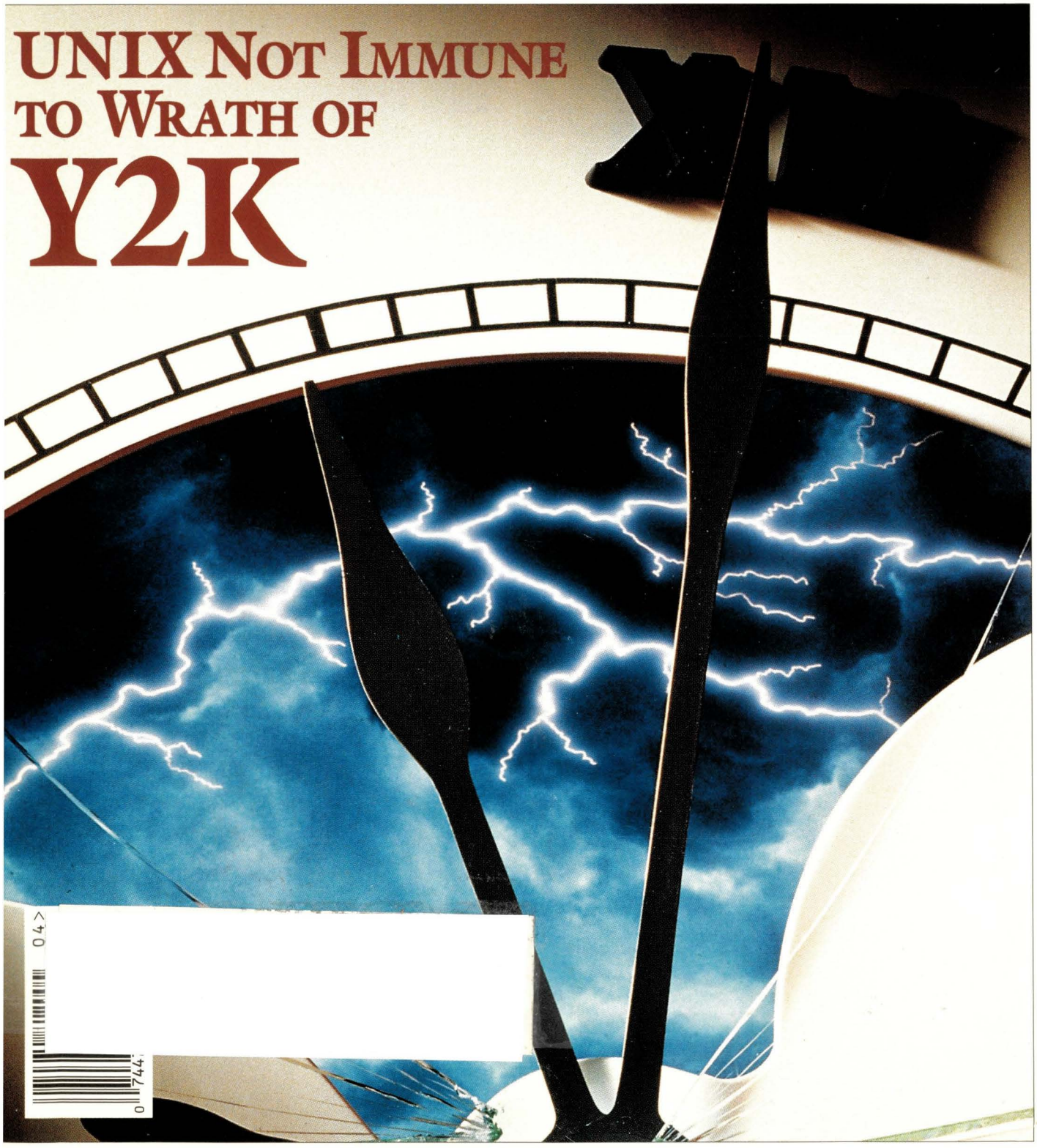

Reviews: RAID Disk Array and Ultra Clone

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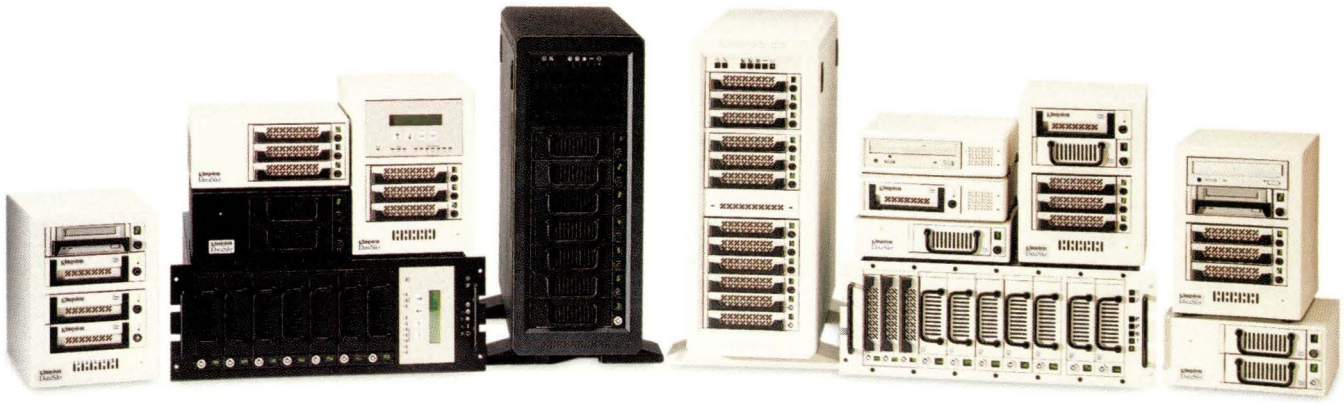

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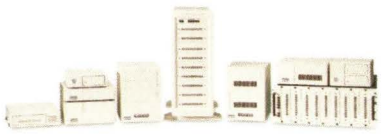

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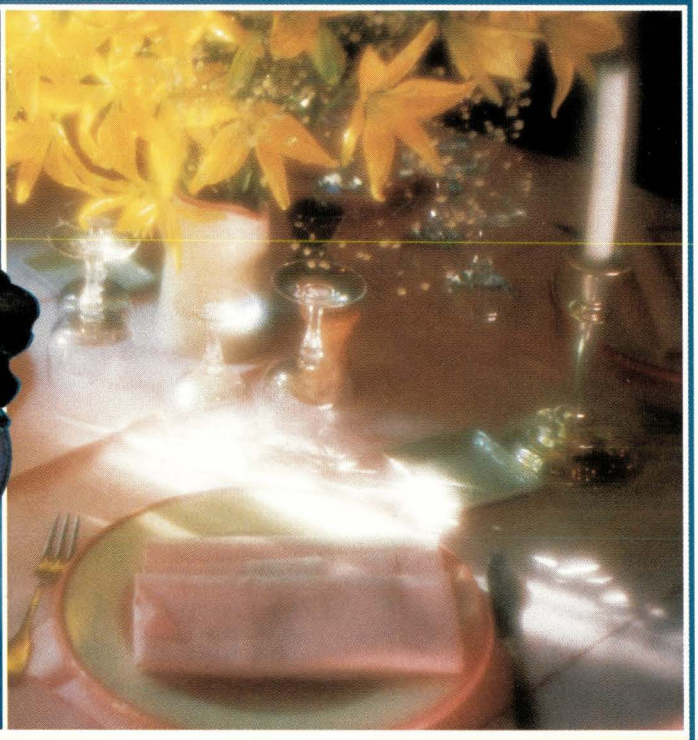

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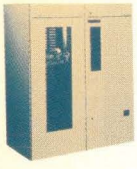

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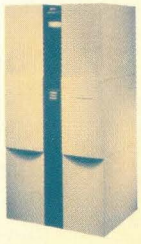

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Alex Simeonides

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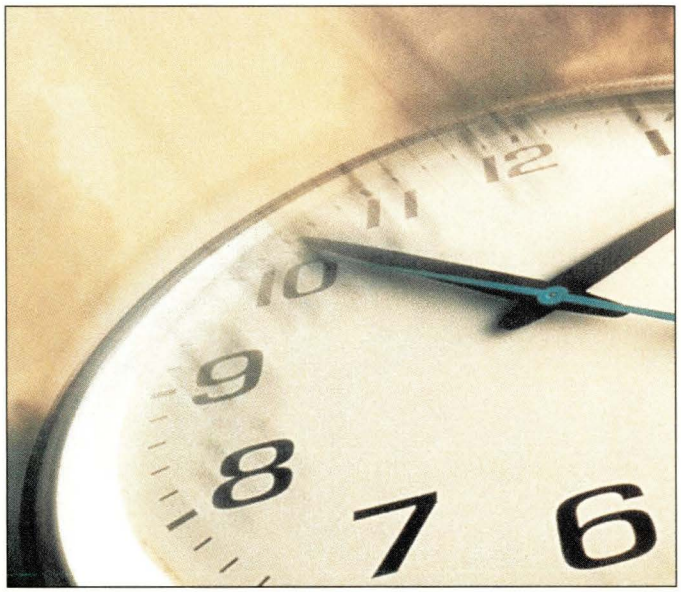

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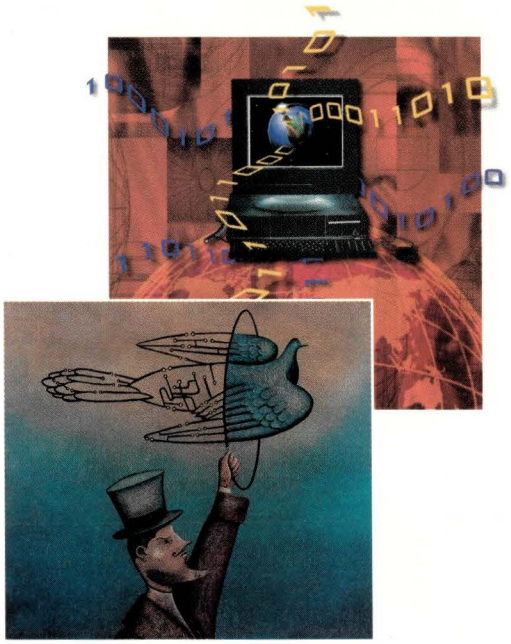

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RAID Disk Array and Ultra 2 Clone

Ian Westmacott

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RS/Magazine

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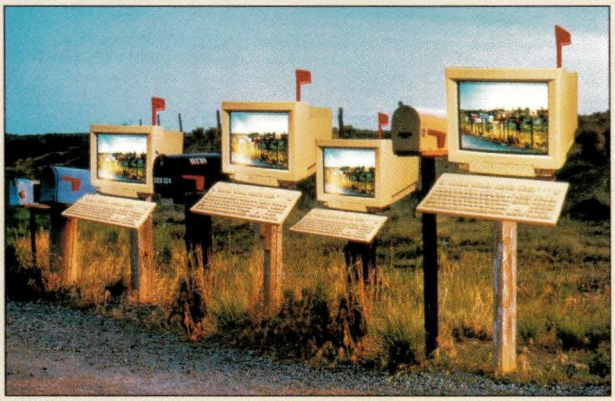
94 DCE Begins to Deliver on Promise

George Lawton

Whether you're looking for a complete distributed computing infrastructure or merely secure data distribution via the Web, DCE can be the solution.



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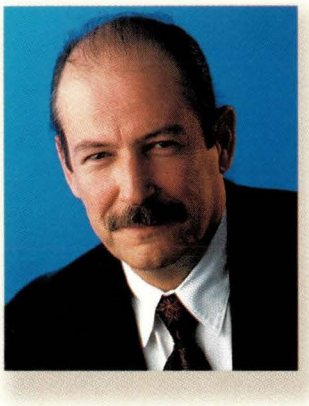

UNIX and You

Rumors abound about the future of UNIX. I have heard more than a few pundits suggest that one way to save UNIX is to brand NT as a UNIX-compliant system–based on some POSIX APIs. Some even suggest that Apple will become the largest UNIX vendor in terms of licenses after the MacOS is integrated with NeXT. To me this sort of rhapsody sounds a little discordant. I for one am not worried about the future of UNIX. Speculation of this ilk represents a lot of UNIX envy. If Microsoft sees a UNIX brand as proof that its OS is robust, scalable and manageable, doesn't that tell all of you committed to UNIX that you made the right choice? Sure, I would have been happy if UNIX had won a larger share of the client market. I don't especially like paying boutique prices for ordinary productivity tools like spreadsheets and word processors.

All of these issues will unfold in the fullness of time.

Meanwhile, you'll see something new beginning in *SunExpert* this month. Take a look at the table of contents on Pages 2 and 3. You'll see a section called Supplement: RS/Magazine. Despite the fact that AIX and Solaris have different UNIX roots, Computer Publishing Group feels there's a vast common ground. For some time, CPG has been watching the demographics of *SunExpert*'s readership change. As of this issue, which will reach more than 93,000 UNIX professionals, some 80,000 of you have Sun servers and workstations, more than 42,000 use RS/6000 machines, about 31,000 use HP-UX, approximately 21,000 use IRIX (SGI) and about the same number use a UNIX from DEC. What these figures make clear is that the network has become heterogeneous.

Any UNIX jockey will find a wealth of new ideas in the RS section. Written by UNIX pros with decades of experience, the columns in particular provide practical advice for living with UNIX.

I am eager to hear what you think of the expanded content. You can even make suggestions about the new look and feel of the magazine if you want to. Drop me a note at dpryor@cpg.com.

Doug Pryor

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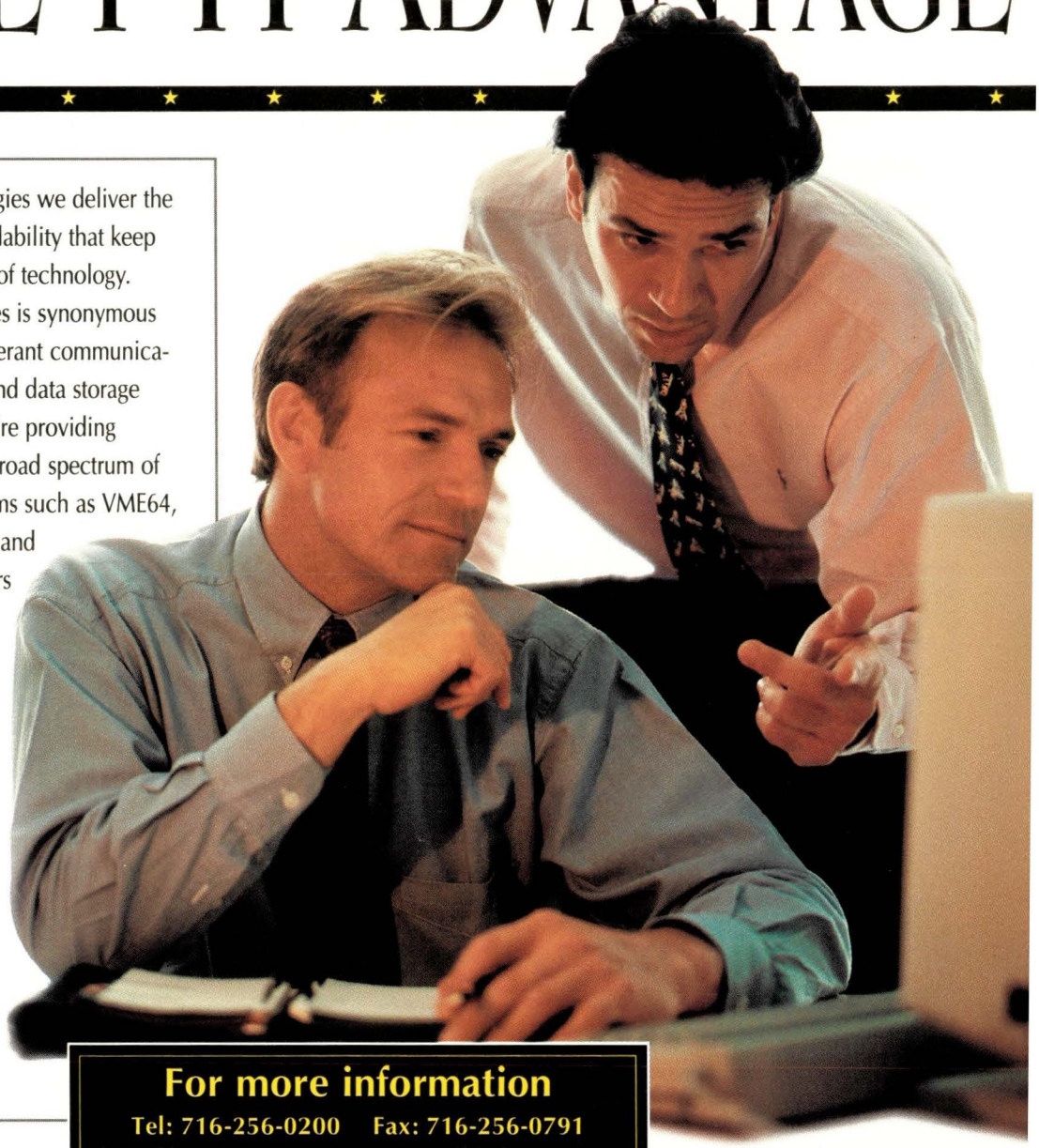

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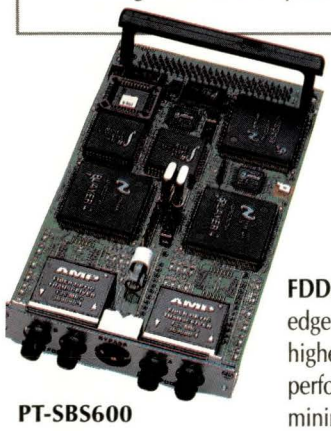

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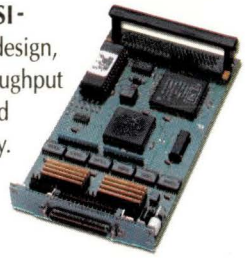

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SunExpert NEWS

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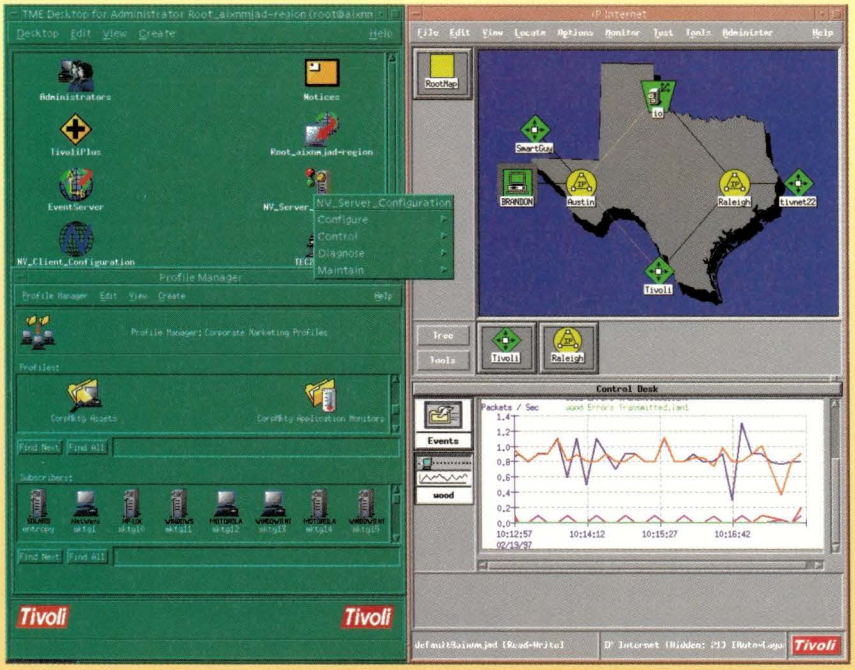
NetView Supports Solaris...Again

Tivoli Systems Inc., a subsidiary of IBM, has brought Solaris support back to NetView. In February, the company shipped test versions of its TME 10 NetView 5.0 for Solaris, the first NetView release to support Sun's operating system since Version 2. The reason for the change has to do with the January 1996 merger between IBM and Tivoli.



The January 1996 merger between IBM and Tivoli has brought forth the first NetView release to support Solaris since Version 2.

While NetView was managed by IBM, the product was developed largely from a hardware perspective; instead of being handled and marketed as a separate software package, the network management product was used to facilitate IBM's hardware sales.

"The focus of NetView under IBM was very hardware-oriented," says Leo Cole, director of TME 10 NetView development at Tivoli. "It was geared toward selling IBM networking equipment and RS/6000s."

The move away from the hardware-centric strategy began in January 1996, when it was announced that IBM would spend $743 million to merge with the Austin, TX-based systems management company. IBM then began to hand over management responsibilities of its SystemView product line, including NetView, to Tivoli. Also, IBM reassigned 700 employees from its Raleigh, NC-based research facility to Tivoli.

One of the first results of the merger was the introduction of the TME 10 product line. A combination of the Tivoli Management Environment (TME) and IBM's SystemView products centered around the Tivoli Management Framework (TMF), TME 10 provides cross-platform software for managing different parts of a computing environment.

With this new management philosophy behind NetView, the development of multiple platform versions was no longer hindered. The latest version is TME 10 NetView 5.0 and was scheduled to ship by the end of March. It now supports Solaris 2.5 and 2.5.1, Microsoft Corp. Windows NT 4.0, as well as AIX 3.2.5, 4.1 and 4.2, Windows NT 3.5 and 3.5.1, Digital UNIX 3.2 and 4.0, and OS/2 2.1.

The TME 10 NetView product is designed to identify and solve problems with network resources and includes features such as integrated rules-based event correlation, operator security and manager-to-manager backup capability.

In addition, TME 10 NetView offers Web accessibility that provides the status display of objects in a collection or in a map. Managers can use a Web browser to run diagnostic applications. In addition, SNMP traps and other network events can be viewed with the Web feature.

Also being offered is TME 10 NetView Mid-Level Manager, which addresses scalability issues. The Mid-Level Manager is designed to reduce the traffic that a management system creates on the network. It allows users to distribute network availability management close to the source, handling tasks such as status polling, thresholds and event automation, and automatic detection of newly added or deleted devices.

There have been changes to the NetView product resulting from the integration with the TMF. NetView for AIX uses the AIX-specific SMIT (systems management interface tool) for the installation process, and that is being replaced with Tivoli desktop. "SMIT is an AIX-unique way to install, administer and configure your system," says Cole. "So what we've done for 5.0 is remove our AIX-unique system calls, and we are now using the TME framework services."

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install as a TME application from the Tivoli desktop and have a common installation process across all operating systems. The services available in the framework of Release 5.0 are installation, configuration, administration, security and database. Users running NetView 4.1 can upgrade to TME 10 NetView 5.0 by first installing the TME framework and then installing NetView on top of the framework.

More than a year after the merger, Tivoli and IBM appear to be maintaining their course.

Cole believes the combination of the two companies' technology will benefit customers in the long run. People will be able to take advantage of Tivoli's strengths in systems management while benefiting from the network management abilities of a product like NetView.

"In the past, TMF wasn't necessarily an option for me," says Rod Bowman, manager of network operations for Foundation Health Systems in Rancho Cordova, CA, who runs NetView for AIX 4.1. "I was doing all that integration already on NetView. As TMF becomes part of NetView or as NetView becomes part of TMF, then maybe I can take advantage of some of the other added functionality in the systems management arena."

One of the problems facing NetView users in the first few months after the merger was not knowing exactly what was going on with the product. "Up until a year ago they didn't know what would happen," says Jim Hurley, director of operation environments with Boston-based The Aberdeen Group. "In general, they feel that they have a future now."

Bowman felt the confusion but says Tivoli's efforts to clear up any questions have been helpful. "In the past couple of months it has started to get a little bit clearer," he says.

Tivoli published a road map back in April 1996 to outline the integration path of the SystemView products and TME. "We came out with a product road map within 30 days of the merger. The document listed all of IBM's products and all of Tivoli's products and what was going to happen to them," Cole says.

More than a year after the merger, Tivoli and IBM appear to be maintaining their course. According to Aberdeen's Hurley, they have been able to meet the goals stated in the road map, and their customers have been happy with the treatment they've received.

In addition, Tivoli is using its strength as a software vendor and bringing a better product to market faster than IBM was able to in the past. "[Tivoli's] lead time is shorter, and they're rolling out product quicker than IBM ever did," Hurley says. "[NetView] has big improvements. It brings them into the 20th century."

Future plans include furthering the integration of IBM's SystemView technology and Tivoli's TME technology.–*pc*

Veritas, OpenVision Pool Talents

Touted as a giant step toward "end-to-end" storage management software, two big players in the Sun Microsystems Inc. storage arena have joined forces in a merger that combines their complementary product lines and gives users a comprehensive suite of backup tools.

In January, Veritas Software Corp., Mountain View, CA, and OpenVision Technologies Inc., Pleasanton, CA, agreed to merge. Called a "tax-free, pooling-of-interests stock transaction," the agreement bestows all OpenVision products, services and technology research upon the resulting entity, which keeps the Veritas name, in exchange for about $400 million worth of Veritas stock. The new, 400-person company will be headquartered in Mountain View, CA.

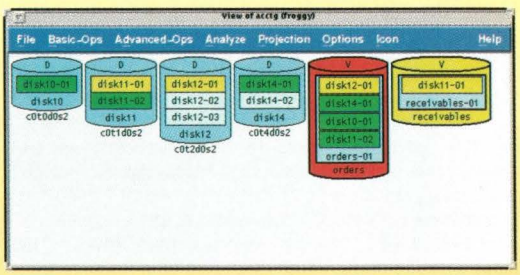
The merger came shortly after Veritas expanded its relationship with Sun. The Veritas Volume Manager will be bundled with Future versions of Solaris. Previously, the companies merely had a "price-listing" agreement, which continues with the Veritas File System online management software and other Veritas products. In August 1996, Microsoft Corp. announced that it would embed the Volume Manager into its Windows NT operating system.

Those agreements tie Veritas software to a lot of servers, and OpenVision's product line can only benefit from the merger. This includes OpenVision's Axxion-NetBackup package, for backup, archiving and recovery of data across the enterprise. Sun also resells the OpenVision package under the name Sun Enterprise Backup.

Officials from both companies view their respective product offerings as complementary, and the synergy between the Veritas Volume Manager and OpenVision Axxion-Net Backup, for example, allows the new entity to build a class of storage automation and configuration products that will drastically improve overall manageability of the backup process.

The scope of the company's offerings will encompass online (server-based magnetic disk storage), near-line (storage on tape and optical drives) and off-line (backup of files to optical or tape media) software products.

The main thrust of the merger is to provide an all-in-one storage management system, eliminating configuration hassles that customers can encounter when they implement a complete file management and backup system. Storage industry analysts predict a warm welcome for such a broad line of



The Veritas Volume Manager GUI lets systems administrators configure a server environment by choosing an optimum layout to meet I/O demands of applications.

IBM Offers Free Management Software

IBM has introduced a Java application called Network Printer Manager (NPM) that enables users to manage their network printers with a Web browser.

NPM is reportedly designed to help determine printer availability and evaluate which printers are best suited to handle specific jobs. According to IBM, this will reduce the number of jobs sent to the wrong printer or a printer with low toner or with the wrong type of paper.

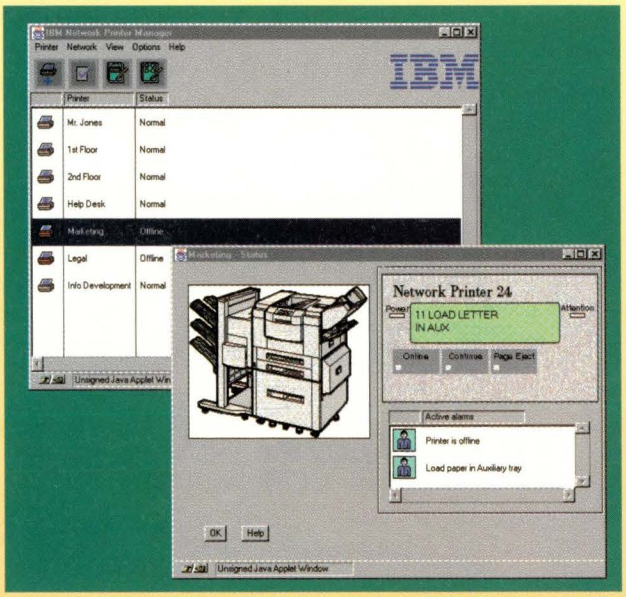
Installed directly into a Web server, NPM requires no additional client software. Once the Java-based application is launched, it runs outside of the browser, freeing up the browser for other uses, IBM says.

In addition to offering the remote installation and configuration of a printer, NPM has a directory service that lists available printers on the network. Also, the new software can indicate each printer's capabilities and features, such as PostScript support, paper handling, finishing options and statistical information about usage.

IBM also says NPM can integrate with network management applications such as IBM's NetView and Hewlett-Packard Co.'s OpenView. Administrators can configure printers to send SNMP traps and alerts to these network management applications.

NPM is initially available for Windows NT only. Additional versions for AIX, OS/2, HP-UX and Solaris are scheduled for the second half of 1997. Supported browsers include the Netscape Communications Corp. Navigator and Microsoft Corp. Internet Explorer.

NPM can be downloaded free of charge from the IBM home page: `http://www.ibm.com`.–*pc*



IBM's Network Printer Manager helps determine printer availability.

management software.

"OpenVision has a number of technologies. In addition to Net Backup, they offer security and encryption, a console environment and the Event Manager. What they plan to do is pull them together into a storage management suite. Before, these other products were available separately. We believe that by offering the console, for example, along with the Veritas Volume Manager, the new company will have the best-of-breed in storage management," says Donna Scott, research director of systems and network management at consulting firm Gartner Group Inc., Stamford, CT.

This all-encompassing approach to storage management will greatly simplify the task of configuring and administering network backup and related functions.

"The problem for users has been implementing end-to-end storage management," says Mark Nicolett, a storage management analyst also with Gartner Group. "People spend a lot of time automating their backup, which requires a lot of shell script writing and interaction with other hardware components. With this merger, a new level of automation is possible. No one else is doing this right now, and, for the Sun and NT environments, this will be very useful. We're very positive about the technical potential for the merger."

This all-encompassing approach to storage management will greatly simplify the task of configuring and administering network backup.

For their part, Veritas officials, too, espouse the benefits of providing a range of storage management functionality. Peter Levine, vice president of marketing at Veritas, says: "Together with OpenVision, we can deliver a new concept in defining storage management. The merger lets the new Veritas set a whole new bar for enterprise storage management. The definition of storage management goes beyond back-up–that's only one piece. OpenVision brings the online piece together with the near-line and off-line pieces, which come with the Veritas Volume Manager."

Until now, OpenVision has seen sales of its security products, including Axxion-SecureMax and Axxion-Authenticate, lag behind its backup products. The recent merger will allow them to market the lagging product lines as accompanying packages to the storage products, and to emphasize the need to focus not just on managing files and performing backups, but on ensuring data is also secure.

"We want to apply all our security products to our storage products. We

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will offer an event-driven, secure line of storage products, which we will still sell as separate components. We plan to apply all our nonstorage products to our storage products to get pull-through. Then, one year from now, we'll have built a revenue stream with our security products," says Steve Foote, director of product marketing at OpenVision (and holding the same position now with Veritas).

In terms of improving storage management, Foote says that some of OpenVision's larger customers, such as Chrysler Corp. and MCI Communications Corp., are backing up enormous files into 800-GB data repositories, using NetBackup. With the addition of the Veritas Volume Manager, users will be able to replace the raw partitions they've been creating with the Veritas file system, allowing them to do "block-level backup," for on-, near- and off-line storage.

"We can now provide an event-driven storage solution. With the addition of Veritas products, it's low-hanging fruit. We have customers that were looking for us to offer this capability, and now we do," Foote says.–*jsw*

Gigabit Ethernet Firming Up

According to the Gigabit Ethernet Alliance, an industry forum dedicated to the promotion of 1,000-Mb/s Ethernet, the Institute of Electrical and Electronics Engineers' (IEEE) proposed 802.3z Gigabit Ethernet proposal is on track.

The IEEE 802.3z Task Force met in February to review a first draft of the Gigabit Ethernet standard and, according to Bob Grow, vice president of Industry Relations for XLNT Designs Inc., San Diego, CA, and spokesman for the alliance, found few significant flaws with the original proposal.

"One clear reading of what went on during the week is the strong desire of committee members to keep on schedule and not to be distracted into working on issues that broaden the scope of work beyond specification of Ethernet for 1,000-Mb/s operation," said Grow, in a prepared statement. The 802.3 working group is expected to vote on the 1000BaseT standard in November; final standard approval is expected in July 1998.

"I've been to this movie before," says Don Miller, chief analyst with Dataquest Inc.'s networking services group in San Jose, CA. "The [IEEE] working group eventually says that there are no more technology proposals on the table and, from that point on, it's just a matter of time until they can hammer out the details."

Miller adds that this is particularly true of the IEEE 802.3z working group, which is composed of people who have worked together through several iterations of the Ethernet standard.

Analysts expect the 802.3z working group to adopt 1000BaseT, or 100m unshielded twisted-pair (UTP) cable, for extending Gigabit Ethernet out to the desktop. As it stands, the Gigabit Ethernet proposal encompasses 1000-

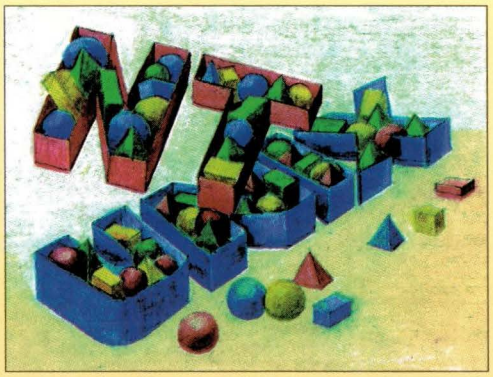
NT Closing in on UNIX in Data Warehousing

If you have a data warehouse, chances are it's a UNIX-based data warehouse, at least for now. Of sites surveyed recently by the Data Warehousing Institute, 85% store their data on a UNIX platform, while 30% use Windows NT, and 11% of respondents say they use mainframes. (Obviously, some respondents use multiple platforms.)

While UNIX continues to dominate as the data warehouse platform of choice, the survey shows that NT is gaining ground.

The institute, based in Baltimore, MD, conducted its survey at Oracle Corp.'s Open World trade show in November 1996. The survey encompasses all "information servers" (a term the organization applies to data warehouses, data marts, online analytical processing and related technologies) in production, in development or planned for development, including Web servers.

Questions included platform used, number of users, amount of data stored and Web server links. The results were tallied from 387 respondents, most of whom were from development or systems administration backgrounds, with some project leaders and management personnel as well as users and consultants in the mix.



JOHN W. KELLEY JR.

According to the institute, "the results showed a significant growth trend for NT, in contrast to UNIX, which showed a flat to small increase in selection as a data warehouse platform."

UNIX still has a strong grip on this market at the time of the survey, in terms of data marts in production, with 12 times the number of NT data marts in production. But respondents plan to develop five times the existing number of NT data marts.

Specifically, the survey revealed the following numbers: among UNIX data warehouses, 381 are in production, 311 are in development and 380 are planned; as for NT, 65 data warehouses are in production, 114 are in development and 258 are planned.

Clearly, NT is making inroads in the data warehouse arena.–*jsw*

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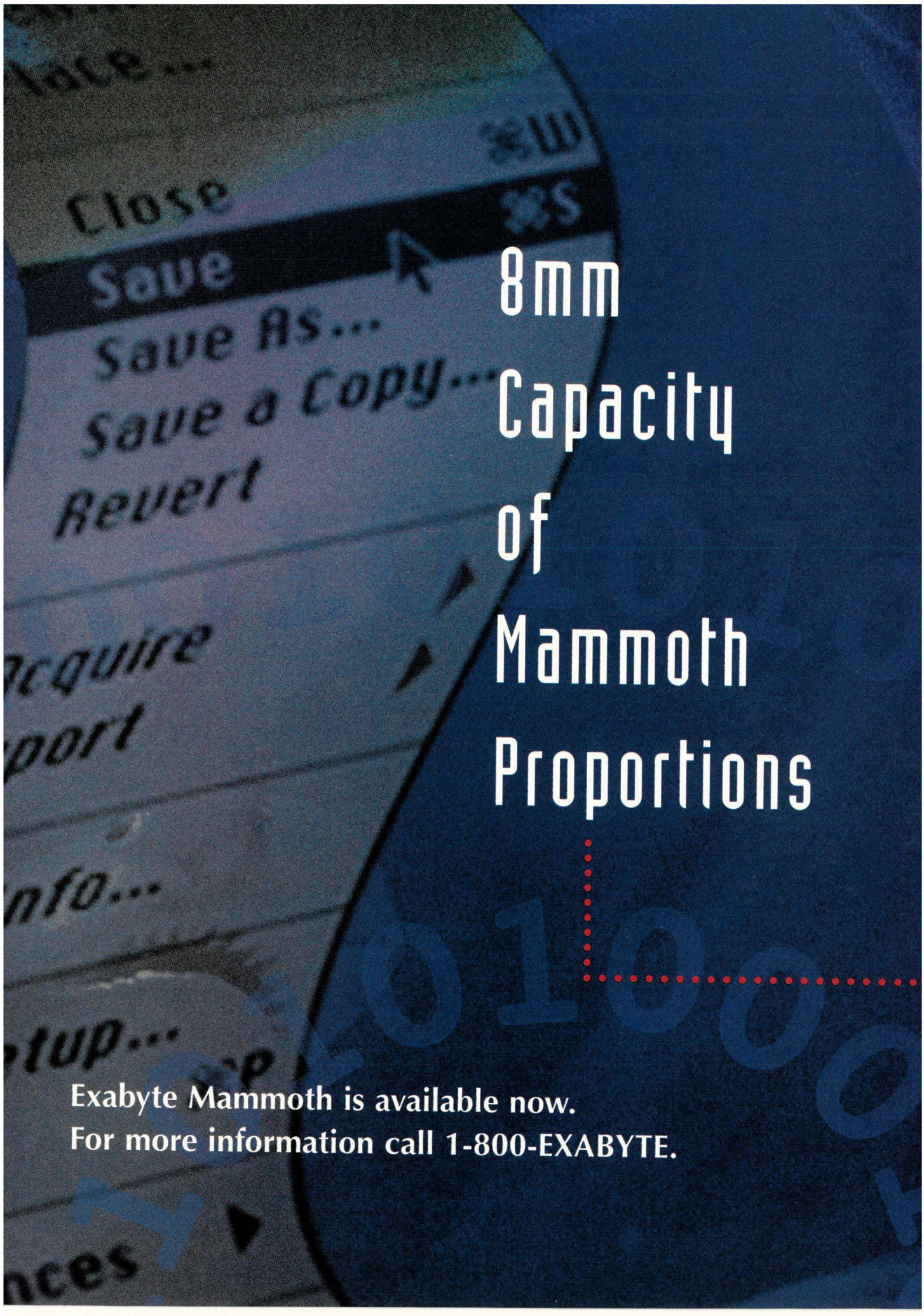
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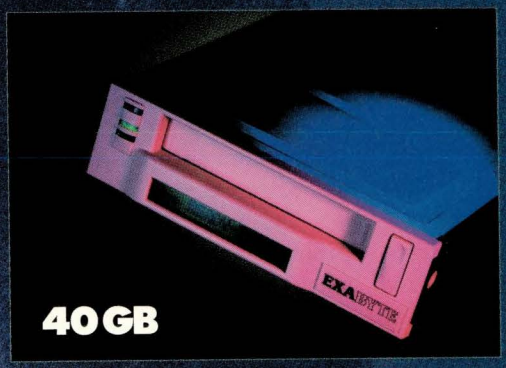

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BaseSX (short wavelengths on fiber) and 1000BaseCX (25m copper link). The 1000BaseCX and SX implementations stand to be ratified early in 1998, whereas 1000BaseT will be ratified in July 1998.

That said, the market will quickly begin to produce prestandard Gigabit Ethernet products, Grow says. Most will come in the form of LAN "uplink" switches, Grow predicts, for moving a network backbone from Fast to Gigabit Ethernet. Another kind of Gigabit Ethernet application will address replacing traditional FDDI and ATM server-to-server networks, offering both switches and network interface cards (NICs).

Despite Alteon's nonstandard approach to a niche market, analysts seem to think that the start-up has a fighting chance.

One company focusing its energies on the server-to-server market is Alteon Networks Inc. This San Jose, CA, start-up released its flagship AceNIC (Network Interface Card) and AceSwitch 110 products for PCI architectures in March, and in May plans to announce AceNICs optimized for both IBM AIX and SBus-based Sun Solaris. A PCI-based NIC for Solaris is also in the works.

Alteon's approach is unique in several ways. First, few vendors offer both switch and NIC solutions, but rather, offer "bandwidth aggregating" switches. Second, Alteon reportedly "tweaks" its products for different hardware platforms. This represents a change from the prevailing philosophy of generic networking products. One notable exception to this rule is networking giant Cisco Systems Inc., Coral Springs, FL, which last February announced an alliance with Hewlett-Packard Co. to deliver its networking software Cisco IOS on HP's UNIX and NT server families.

Third, Alteon switches support "Jumbo Frames," a nonstandard technique designed to minimize the performance hits servers suffer when confronted with 1,000-Mb/s streams of data. Jumbo Frames is an optional feature that allows users to send Ethernet frames in 9-Kb chunks, as opposed to 1.5 Kb, the Ethernet standard. Thus, an Alteon Gigabit Ethernet network can transfer an 8-Kb NFS frame in a single pass. A traditional Ethernet network would require six passes to send that same NFS frame, thereby increasing the number of CPU cycles needed to process the data, the company says.

Despite Alteon's nonstandard approach to a niche market, analysts seem to think that the start-up has a fighting chance. "Alteon seems to have a defensible market position by concentrating on servers," says David Passmore, president of Decisys Inc., a networking consulting firm based in Sterling, VA. "Everyone else has an enterprise networking focus, and no NIC," he says, adding that product differentiation is key in this crowded market.

Frank Dzubek, president of Communications Network Architects, Washington, D.C., points to another feature of Alteon's NICs: They are standards-based. Jumbo Frames, while proprietary, is optional, so you could conceivably connect Alteon's NICs to Gigabit Ethernet switches from other vendors.

"Other vendors offer server-to-server gigabit products that compete with Alteon's line," Dzubek says, "but you have to read between the lines; a lot of them are simply repackaged Fibre Channel or HIPPI" that rely on matched pairs of switches and NICs. "If all you want to do is connect your servers, what do you care? But if you eventually want to connect back to the LAN, then you've got trouble," Dzubek says.–*as*

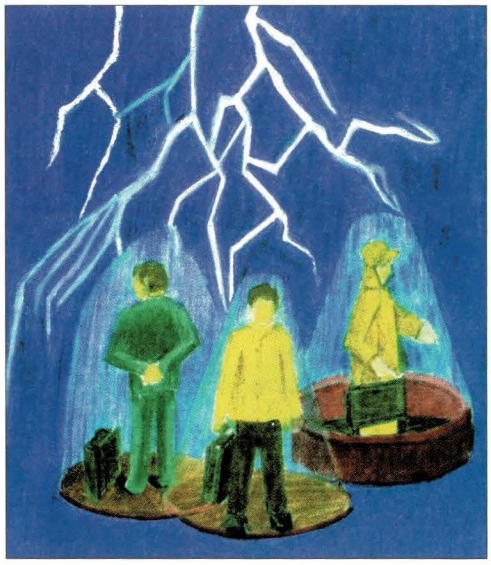
New RAID Classifications

The RAID Advisory Board (RAB) has reworked its RAID classification system and has put together what it claims is a simplified method of naming the functionality of RAID devices.

These new classifications replace the existing RAID Levels 0 through 5 established in 1993. Consumers can now choose from these options: failure resistant, failure tolerant and disaster tolerant.

Failure resistant describes systems that protect data in the event of a single component failure but do not offer immediate access to data during a failure. This type of RAID would be appropriate for users whose online data requires protection but is not sufficiently critical to justify the cost of continuous availability.

Failure tolerant RAID systems protect data and offer continuous data availability in the event of any single system component failure. Disaster tolerant RAID offers the most protection by dividing the storage across two zones, which cooperate to protect against data loss in the event that one system suffers complete failure. Zones should be at least 1 kilometer apart. These systems offer protection against environmental disasters such as floods or fires but still allow users immediate access to their data.



JOHN W. KELLEY JR.

John Hartjen, senior product marketing manager at EMC Corp., Hopkinton, MA, chaired the committee that put together the new RAID classifications. "The RAB Disk Classification Program is the culmination of many months' work by the RAB subcommittee to further educate customers and eliminate confusion surrounding data protection capabilities of various RAID

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implementations," Hartjen says.

"The old RAID classifications did us a great service and, at the same time, a great disservice. Many customers believed that the higher the RAID level, the better the product, and that wasn't necessarily true," he says.

The current RAID level classifications depend on the needs of the consumer, but many consumers do not take the time to fully understand what each RAID level stands for. For example, RAID 0 (disk striping) offers the best overall cost and performance without fault tolerance. RAID 0, although cost-effective, would not be appropriate for most applications in the finance industries.

RAID 1 (disk mirroring) offers super fault tolerance and availability of data but at a higher cost. RAID 1 offers more assurance than most small "mom and pop" operations would require when its high cost is considered.

The old-style numbering system for RAID classification is now being phased out.

Many consumers do not take the time to fully understand what each RAID level stands for.

If a vendor has been awarded the logos for existing products, it may continue to use them, but new products must use the new classification system. If vendors want to use the new system on existing products, they must submit the product for inspection. Then, the product will be awarded the appropriate logo based on the inspector's findings. Only one logo is allowed on product packaging, so there will be no possibility of old and new logos appearing on the same package.

"At present, certification is based on an inspection of the product's documentation. The RAB currently has a functional test subcommittee working on practical tests that equipment will have to go through in the future before being awarded a logo," Hartjen says.

The new classification is supported by industry players such as Adaptec Inc., Amdahl Corp., Digital Equipment Corp., IBM Corp., Fujitsu Computer Products of America Inc. and Hewlett-Packard Co.–*mm*

Microsoft Shakes Up Windows-NC Connectivity

In the Network Computer (NC) world, most users get their Windows applications using technology developed by Citrix Systems Inc., Coral Springs, FL. Citrix's WinFrame software is a multiuser application server that lets users run 16- and 32-bit Windows applications remotely on a thin client, such as an NC. Through a close technology-sharing relationship with Microsoft Corp., Citrix's WinFrame has enjoyed widespread licensing from NC vendors, including Network Computing Devices Inc., Wyse Technology Inc., HDS Networked Systems Inc. and Sun Microsystems Inc.

But, according to market research firm Zona Research Inc., Redwood City, CA, it looks as if Microsoft wants to be the primary supplier of Windows-to-NC connectivity. Microsoft has informed Citrix that it intends to offer capabilities allowing concurrent, multiuser and remote access in the Windows NT operating system. This is essentially what Citrix offers with its WinFrame product.

The big question is whether Microsoft will supply that technology by licensing WinFrame, or whether it will develop it in-house, leaving Citrix to its own (NC) devices, so to speak.

"The reason for the big hoo-hah is that Microsoft notified us of their intention to support multiuser functionality in NT," says David Weiss, director of product development at Citrix. "The discussion was centered around cross-licensing WinFrame and Windows NT, and Microsoft hasn't stated where their technology will come from. Our licensing agreement with Microsoft will continue, and we will continue to sell WinFrame."

The controversy began at the end of February, when Citrix warned its investors that Microsoft may develop WinFrame-like technology internally or "may cross-license such technology from alternative sources." Despite this proactive statement, Microsoft's indication that it will include multiuser and remote access capabilities with the next release of Windows NT does not mean that technology will not be supplied by Citrix, says Stephen Auditore, president of Zona Research.

"But," Auditore says, "Microsoft is highly unlikely to pay royalties to another company using components of their operating system. They will prob-

ICA Products and Vendors

Citrix Systems has client software licensing agreements with a number of vendors whose client devices and software use the Citrix Intelligent Console Architecture (ICA) to work with its WinFrame multiuser Windows application servers.

Company	ICA-Enabled Product
Boundless Technologies Inc.	Boundless NC
Cruise Technologies	Cruisepad
HDS Network Systems Inc.	@workStation
Insignia Solutions Inc.	NTrigue
Microsoft Corp.	Internet Explorer 3.0 Windows NT Windows 95
Motorola Inc.	PowerPC chip
Network Computing Devices Inc.	WinCenter Pro
Plexcom Inc.	QUE
Sun Microsystems Inc.	Java Virtual Machine
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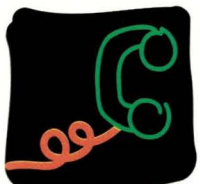

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ably figure out how to supply the technology on their own, but Citrix will support it."

If Microsoft terminates its current agreement with Citrix, the latter will have a more difficult time supporting upgrades to the operating system. Indeed, WinFrame currently supports a dated release of Windows NT, Version 3.5.1, while Microsoft ships Version 4.0 of the operating system.

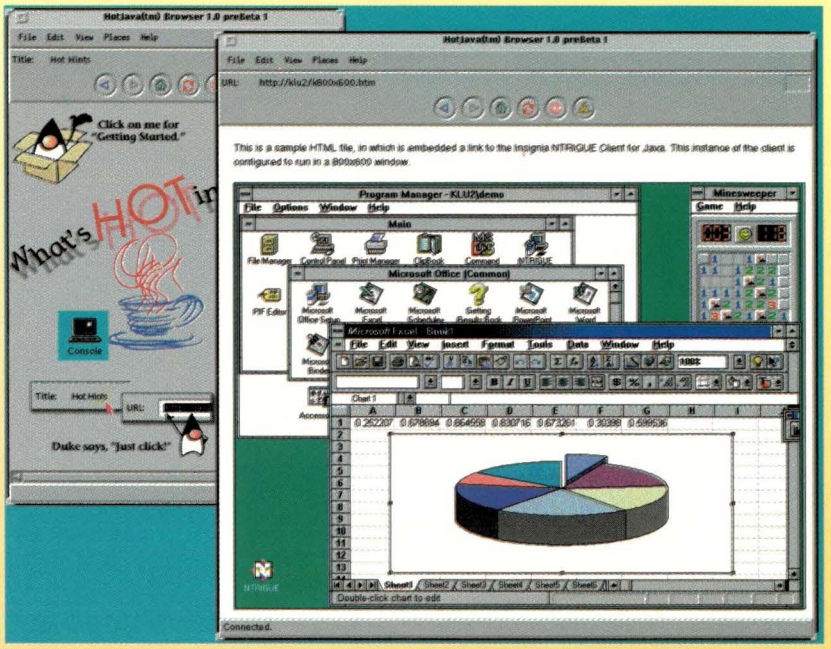
The controversy began at the end of February, when Citrix warned its investors that Microsoft may develop WinFrame-like technology.

NC vendors, including Sun, will have to consider what this means to customers, who will surely desire support for the latest features in Windows NT. Part of the impetus for Microsoft's desire to give NCs access to Windows is the thought of the "Anyone But Microsoft" crowd, of which Sun is a charter member, providing Windows access using WinFrame, says Zona Research.

"This could have very significant ramifications for NC vendors, most of which are banking on WinFrame, and this would cause a cosmic disruption as the market is going forward," Auditore says.–*jsw*

Insignia Delivers Windows to Java Desktops

Sun Microsystems Inc. promises its JavaStation, and other devices that can support a Java Virtual Machine (JVM), will be utilitarian network devices, but by themselves, they're not very useful if you want to access Windows applications residing on the network. Java alone can't do that, but Insignia Solutions Inc.'s NTrigue Client for Java, which began shipping in volume in February, can. It does this by taking the form of a thin client application that downloads to the desktop when a user logs onto the network. Windows applications can subsequently be launched from an NTrigue server by clicking on an icon.



Insignia's NTrigue Client for Java brings Windows apps to Java desktops.

Source: Citrix Systems Inc.

The NTrigue Client for Java actually made its first appearance in October, when Sun announced that it would be bundled with its JavaStation, allowing users to access Windows applications from a Windows NT server. Now, the NTrigue Client for Java is available directly from Insignia Solutions, Santa Clara, CA. By delivering standard Windows applications to Java-supported platforms and browsers, the Java applet lets corporate sites fully implement Java technology while preserving their investment in Windows applications, the company says.

Specifically, the new software is a Java applet that is transparently downloaded from an Intel Corp. microprocessor-based server running NTrigue to any Java desktop. It works with Java-enabled desktops and Web browsers such as the Microsoft Corp. Internet Explorer and Netscape Communications Corp. Navigator.

"The philosophy behind NTrigue is to bring Windows to the desktop throughout the enterprise, and the Java client is one more step in that direction," says Peter Crosby, product line manager for the NTrigue server at Insignia.

Crosby adds that while Java is touted as a platform for developing mission-critical applications, "right now it is not powerful enough to deliver those, and Sun isn't even going to ship the JavaStation until late summer. The NTrigue Client for Java will let JVM users continue to use Windows applications while they're developing Java-based applications. It's an undisputed fact that Windows is the dominant OS on the corporate desktop right now."

Based on the company's portable Keoke technology, the NTrigue Client for Java ships as part of the NTrigue Product Enhancement Pack (PEP) 1.0. The PEP program is made up of a proactive release of bug fixes and service packs, as well as early access to new technology. It can be downloaded from the Insignia Web site: `http://www.insignia.com/`.

"Sun's argument, which is valid, is that a big part of Java is still on the development side, so there are not a lot of shrink-wrapped applications out there. This comes down to how many users know Java, and how many know Windows, which is already installed as the front end at most corporate sites.

This client will be the solution while development people get up to speed, but also, in the long term, it's a way to bring Windows to Java desktops," Crosby says.

Insignia, with the help of Citrix Systems Inc., Coral Springs, FL, has been providing Windows access to a variety of platforms, including a number of UNIX desktops, and Network Computers. Citrix licenses its Intelligent Console Architecture (ICA) protocol, also found in its WinFrame multiuser Windows NT server, to various UNIX-to-Windows connectivity software developers and systems vendors, including Microsoft Corp., Boundless Technologies Inc., Tektronix Inc., Network Computing Devices Inc. and Zenith Data Systems. For its part, Insignia uses the protocol in parts of its NTrigue software line.

"The technology for accessing Windows from a variety of platforms has been in use for some time, but the piece of software that allows products to run Windows from Java has not been a part of that picture, and that's why this was developed," says Greg Blatnik, vice president of Zona Research Inc., Redwood City, CA, an Inter/intranet market research firm.

The Java client is based on Keoke, a "thin" version of the X Window System graphics protocol. By employing a subset of the X protocol, it is designed to distribute graphics over a LAN or company intranet to Java desktops. Its inclusion of X allows Keoke, and hence the NTrigue Client for Java, to run on any JVM, and ensures that users can run Windows applications on their Java desktops.

"Keoke is written in the Java language as a thin, light version of X. Because Java and X share some of the same graphics commands, we stripped out the duplicate commands in the X protocol. Keoke is completely open and portable, and it connects to the NTrigue server. We plan to base future products on it as well," Crosby says.

The NTrigue server is priced at $7,495 for 15 concurrent users. The NTrigue Client for Java is included with PEP 1.0.–*jsw*

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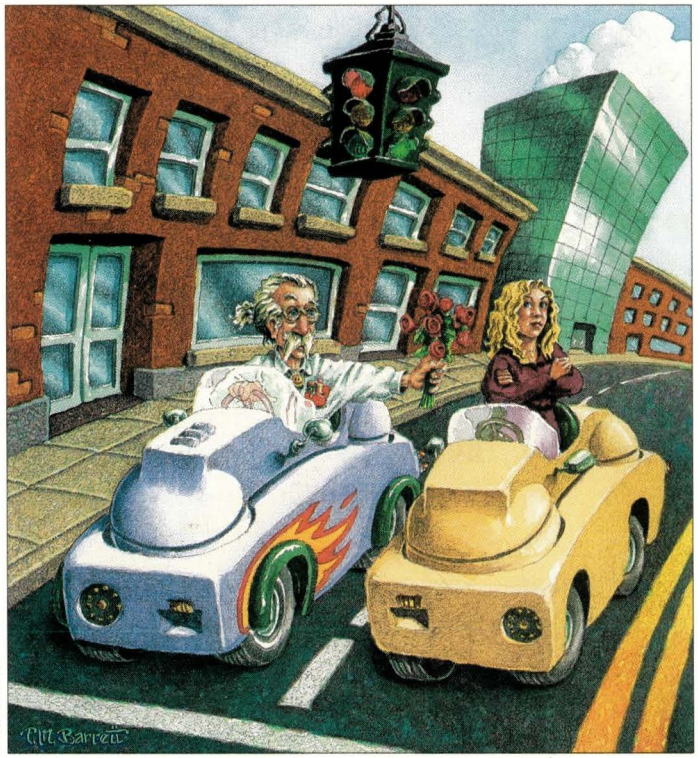

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Q: *How can Mr. Protocol be such an amazing expert? All I ever see him do is sit around with a dreamy look on his face. I'm not even sure he knows how to type. How does a guy like that talk to the Net?*

A: Wrong question. What you should be asking is, how does someone like that communicate with anyone who's *not* on the Net? The answer is, mostly he doesn't. That's why I earn the big bucks.

Here's an example. You've got to figure this place has to be well connected to the Net, right? Well, the last time I decided to speed things up, Mr. P. threw a fit and a half. He had decided that he was tired of all this constant change in the maximum rate, and he wanted something that would last a while. He was holding out for a network speed of OC48. Now, some people have heard of rates like T1 and T3, but not many people have heard of rates that start with OC. OC3 is generally regarded as so blindingly fast that you don't even want to think about it, let alone think about paying for it. When I asked the phone guy for documentation on OC48, he handed me a copy of the Book of Revelation.

Now, I'm a guy who makes his living by following this nearly incomprehensible apparition around through his haze of irreality, transcribing what he says, getting it wrong occasionally, and making a monthly column out of it. Nowhere in any of this does it say that I get to rip the walls out of my house and rewire the whole place for OC48. As best I can figure out, the hardware at this speed consists of cables the diameter of a human hair, branching out into connectors the size of garbage-can lids. The strain relief arrangements must be phenomenal. The cable is shielded in neutronium, and its cost alone is measured in GNPs per foot. I don't even want to think about the interface box. And Mr. Protocol expects it to be bought, installed and passing packets by dinnertime, or I can consider my meal ticket revoked.

I did what any right-thinking administrator would do in a case like this. I wandered on down to the local comic book emporium, bought a bunch of lightly electrified fake prop equipment based on those great old *Commando Cody* serials of the '30s and '40s, stuck a regular old 28.8-Kb/s modem inside the model junk, glued the lot together, and told Mr. P. this terrible story I'd read about how the backbone was so overloaded you were lucky to get 20 Kb/s during the day, and only somewhat better at night.

Little did I know the Pandora's box I'd opened with all that junk. It wasn't that Mr. Protocol was having such a bad time. He's actually pretty time-insensitive, so unless you give him a specific time to look for something or be somewhere, you can forget it, nada, goose egg, next question please. I'm still convinced I was on the right track. The problem is that my "solution" was subject to problems of its own. I knew little about the ins and outs of getting two modems to

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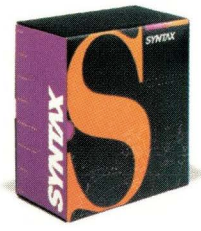

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agree. I was stuck. I had a protocol problem, and the one guy in the world best qualified to solve the problem was the one guy I didn't dare tell. My only hope was to talk to him in broad generalities and hope that the specific problem and its solution would drop into my lap.

Consider what we're trying to do with modems. Generally, we don't think much about them, except when they don't work, and then, we generally limit ourselves to thoughts of ill will. What's actually going on inside them we don't think about. This is a good thing, too, because for most of us, really understanding what goes on inside a modem would involve cluttering our harried minds with enough material on complex differential equations, filter theory and digital signal processing, not to mention a whole bunch of stuff by guys named Nyquist and Shannon, that we wouldn't want to get up in the morning.

What we need to remember is that modern modems are computer systems all on their own. They're controlled by a microprocessor and have enough settable variables to keep us busy from now to next Tuesday. Of course, all these little-bitty variables have to be set only once, which means that when we discover after weeks or months that this is a lie, and we have to set them again, we've not only forgotten everything we ever knew about those variables, we've lost the manual.

But for all that, modems are designed to talk to one another with a minimum of muss, fuss and bother. What could go wrong that isn't fixable with all these variables?

Mr. Protocol is glad you asked.

A Bit of Binary Background

Mr. Protocol, being an unbelievably sticky old so-and-so, naturally sympathizes with those who continue to make unhappy noises about the confusion of the terms *kilobit* and *kilobaud*. These people are fighting a battle that was lost sometime around the time that *data* became a singular word. *Baud*, of course, is a contraction of *binary audio*, and refers to the actual bits that move over the wire. Thanks to data compression techniques, the number of bits of information actually transferred can be far higher. This means, however, that the modems at each end have to agree on several levels in order to transfer data successfully.

Early modems were fairly direct. Teletype machines used this sort of modulation, called AFSK (for audio frequency shift keying) to transmit binary information. One tone meant one, a second tone meant zero, and that was pretty much that. This was good for a rousing 110 bits per second, limited mostly by the fact that Teletype machines were almost entirely mechanical. Mr. Protocol notes that there was a certain amount of ego-building involved in using a machine where it was possible to type characters faster than the machine could accept them. Fast typists noted that, at high typing speeds, the Teletype machine keyboard became notably "stiff," almost like a manual typewriter, due to the inertia of the mechanical linkage.

Higher speeds meant fancier methods, mostly involving the use of more than two tones. Modern modems sound like white noise. What's going on here is that the modems, at start-up, go through an elaborate negotiation to test the connection and determine how many tones can be distinguished. This determines the actual speed of the connection.

Obviously this song and dance must obey a choreography that's known to each end at the start. The notations V.32bis and V.34 refer to the standards that define this behavior. Because the tones used by the modem extend over the entire range of frequencies that the phone line can carry, and because the tones are so close together that they can barely be distinguished, the result sounds like white noise.

Above this we have the compression techniques. These tend to be more proprietary and less standardized, or at least, they have been in the past. Market forces and the inconvenience of not having universal compression have recently pushed modem manufacturers into agreeing on common ground here too, so that most modems are able to negotiate some sort of common compression scheme.

There's a problem here, though. A modem that is compressing data in order to transmit it to the far end has to get that data from somewhere. It may come from computer software, sending, for instance, PPP packets wrapped around IP packets wrapped around TCP packets. Or it may be transferring ZMODEM packets during a file transfer to a BBS. Or it may be something as simple as handling a dial-up connection to a shell, in which case, it's transmitting single key presses. The point is that the modem literally doesn't know where its next byte is coming from, or when.

Compression techniques by definition compress a sequence of bytes into a shorter sequence of bytes. These two facts, taken together, spell headaches. The modem has to wait for the "right" number of bytes to pile up locally before applying compression to the entire sequence. If the modem is transmitting raw key presses instead of PPP packets, this means that it must actually notice that fact and transmit each character as it comes in. This, in turn, means that it has to time the arrival of packets to notice when they are coming in at a rate less than the negotiated connection speed, in which case, it can send them immediately, without compression, and when they're piling up at a respectable rate. This means that compression will actually move the data somewhat faster.

And sometimes this whole house of cards falls down.

Consider the headache of U.S. Robotics Corp. (recently acquired by 3Com Corp.). To find out who they are, let's look at the marketplace.

Modem Marketplace

Generally speaking, there are two types of modem buyers: those who buy one modem, and those who buy several hundred. It's a real bimodal distribution. There just aren't that many people who buy five modems, compared with those who buy 500. If you have 500 modems, you tend to buy modems that come plugged into racks, with status consoles and centralized power supplies and maybe even fancy hardware for talking directly to a telephone switch. In fact, the rack looks suspiciously like a telephone switch all by itself. If you buy one

modem, you get a modem in a box. End of story.

It makes sense that modem manufacturers target one or the other of these markets. The software that goes into the modem proper is really just about the same, but the overall construction and packaging couldn't be more different. Hayes Microcomputer Products Inc., for example, makes some very nice rack-mount stuff. The company also happens to make a line of consumer modems. U.S. Robotics, on the other hand, concentrates on the consumer end of things. Its Sportster line is almost ubiquitous, because it has a reputation for coming out quickly with the highest speed technology at an affordable price.

Modem software being pretty much the same, it should come as no surprise that many modem manufacturers end up using a common chipset. One of the most common chipsets is made by Rockwell. Many Hayes models use Rockwell chipsets. The difference between modems comes in areas such as the analog part of the modem (the part that actually handles listening to and making noises, and in getting the noises to and from the phone line), custom firmware and writing a manual that's at least got English words in it, even if they're strung together in the usual impenetrable fashion.

U.S. Robotics bucks this trend. It designs and fabricates its own chips. This saves the firm boodles in royalties but leaves it open to other problems.

Consider protocols in general. Usually, we wind up in one of two camps. In the first camp are the denizens of the world at large, such as TCP/IP, which have dozens of implementations. Do these implementations interoperate, just because they were each written to the standards? Hah. Each new implementation has to be hooked up to a fair fraction of the older ones to make sure that it interoperates. The Interop conference actually started out as a nonmarketing, technical-types-only get-together to do exactly this sort of interoperability testing. Gradually, the marketing droids took over and the meeting lost its utility except as a sales venue, and people started holding "Connectathons" to do the same thing Interop was originally supposed to do: provide a forum and a laboratory for TCP/IP implementors to get together, point their protocol stacks at one another and hash out the differences, many of which aren't covered by the standards in their present form.

So U.S. Robotics goes its own way, but there's a problem (see "Sportster's Tendency to Freeze"). Suddenly a whole bunch of individual cases of oddball behavior wind up being linked to one big firmware problem. It's a problem that only shows up in applications involving people typing into dial-up connections, with no packet software in between to trigger possible compression. If you're running packet software, as in a PPP connection, you may never see the problem. If you're typing to a BBS, you'll get frozen out.

What to do? Well, U.S. Robotics did the only thing it could do. It announced that it would fix the bug in existing modems. All you have to do is change the chips, if they were socketed, or otherwise return the modem to U.S. Robotics for upgrading.

Sounds like a manufacturing glitch, eh? Except there are other things going on. For example, Hayes modems have the reputation of hanging onto a line like grim death. Even if the line quality is so crappy that other modems drop the line regularly, Hayes modems keep the line going without even blinking the "retrain" light. Mr. Protocol's columns written in Yellowstone National Park, for instance, were accompanied by trouble-free 14.4-Kb/s connections back to his place of employ, via a Hayes modem, while his companion's Sportster continually flashed the "retrain" light. On the other hand, the Sportster is built like, and weighs like, a Celica, while the Hayes resembles a HumVee.

The point of all this is that modem interconnection is not the wonderful, trouble-free world we'd all like. There are rumors that the rate of successful connection attempts between modems of dissimilar ancestry hover around 95%, while between modems of identical manufacture it's closer to 100%. Imagine the stink if this were true of TCP/IP implementations. Things might not be so bad if it were as simple as that, but Mr. Protocol also knows that far from being the bad guy, U.S. Robotics is the winner in reliability for huge installations of dial-in modems. Mr. P. has seen the modem rooms of two respectable Internet service providers (ISPs), and these amount to some hundreds of individual little U.S. Robotics Sportsters sitting in a wire frame cage. Nothing beats them, and they still don't work exactly right.

And things will only get worse. In the bad old days, each jump in modem speed was a proprietary jump. The mad fools who wanted to spend $2,000 for a modem that would go 9,600 baud had to spend their money all in one place, because the encoding scheme used by the first 9,600-baud modems was proprietary. It was only when all that Vee-dot stuff started

Sportster's Tendency to Freeze

The U.S. Robotics Sportster external modems with serial numbers beginning 00083900, 00083901 or 00083902, and internal modems beginning with 84001 or 84002, having ROM software dates between 10/18/95 and 3/4/96, have a tendency to freeze during interactive use with BBSs, that is, when sending single keystrokes. Freezes can last up to three minutes. To check the ROM date, type *ati7* to the modem using a terminal program. If your modem has the problem, call U.S. Robotics at (847) 982-5151.–*mob*

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to attract widespread recognition in the marketplace that we had the interoperability we have now, where you can go down to the local candy store and buy anybody's 28.8 modem with the confidence that you can connect to your ISP with it, no matter what they've got stacked up. Those days may be coming to an end.

Rockwell and U.S. Robotics have both discovered that, in one very special case, it's possible to jack the line speed up to 56 Kb/s. They use several tricks. The primary trick is to limit the usage of such modems to one case only: dialing in from home to an ISP. In this particular case, it is often true that the circuit is entirely digital, except for the copper loop connecting the subscriber's home to his central office. ISPs are hanging digital modems off of T1 or T3 multiplexers, without ever converting the signal back to an analog form.

It turns out that in this particular case, the characteristics of that copper subscriber loop can be discovered and controlled so completely that Shannon's law no longer quite applies. The noise sources on the copper are not random. The Web site `http://www.nb.rockwell.com` has an excellent white paper on the technical details behind this, and it is worth looking over as a very clever piece of engineering of which the company is rightly proud.

The trouble is that Rockwell and U.S. Robotics have both had the idea, and are pursuing it with incompatible technologies. Each is rushing to establish both a de facto and a de jure standard. It's Beta vs. VHS all over again. If you want 56 Kb/s to your house, you'd better ask your ISP which flavor of modem he's buying.

It used to be that ISDN was an underrepresented technology. Thanks to this stupid little market war, ISDN is looking better all the time, not to mention ADSL, cable modems, DirectPC, telepathy and banging out Morse code on a light pole with an angle iron.

Mr. Protocol counsels you to track these technologies, and don't be afraid to get irritated. ⊸

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

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

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

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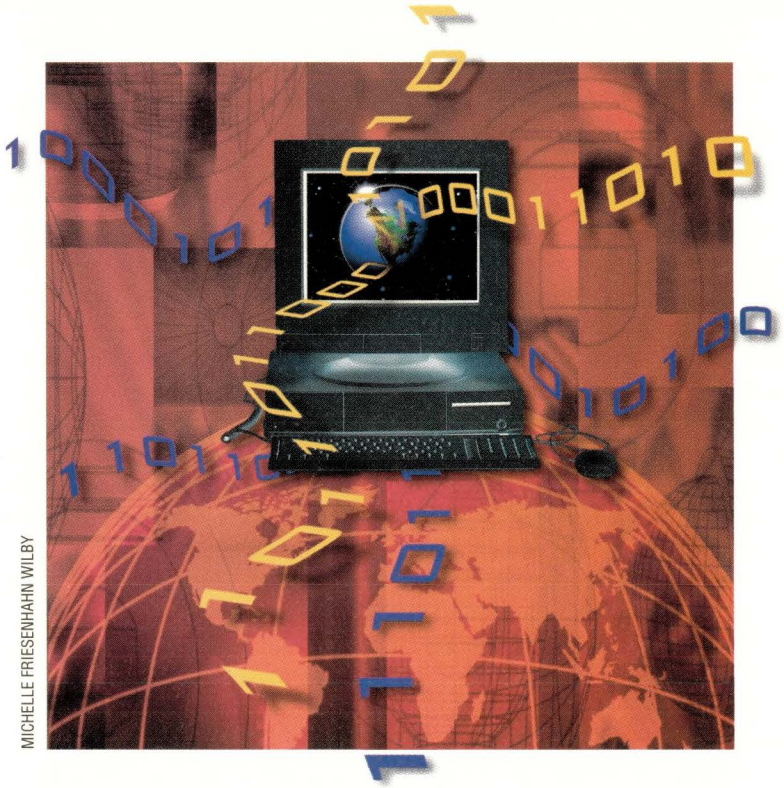

MICHELLE FRIESENHAHN WILBY

Talking to the World

Most processes on UNIX acquire or emit data as byte streams. They open a file, read a stream of data until the source is exhausted, or write data until they have nothing more to say. Finally, they close the file. The open, close, read and write actions are system calls used by the process to affect the outside world. Essentially, a system call allows the process to run a piece of kernel code that undertakes some task. When the task is over, the kernel will return a result to the calling process. The result may be a value saying, "Yup I did that, and things went OK" or an error return saying, "Tough luck, there were problems." If the kernel is moving data into the address space of the process, then the return value can be the number of bytes that were moved.

System calls access routines in the kernel that do the work. These routines also mask the nasty truth about the real world by providing the process with an ideal model of how the outside world operates. For example, a process can write a 1K file by making 1,024 system calls that each send a single byte, or by creating a buffer in the process address space and making a single system call that tells the kernel to write 1,024 bytes. The UNIX model says that these two very different sets of actions should be equivalent because the process is writing a stream of bytes. In general, and there are exceptions, the act of making a read or write system call implies nothing about the data.

So when a process writes information, the data traveling between the process and the kernel is a stream of bytes. The order is significant, but the number of write system calls is irrelevant. The same thinking is true when a process is reading data: The read system call tells the kernel how much data the process is expecting. If the kernel has the correct number of bytes available, then it will move the data into the process address space. The kernel may have more data available and is expected to hang onto it until the process requests more. Alternatively, the kernel may not have the correct amount of data and can wait for more to come in, or can simply return what it holds. Notice that the model implies that the kernel buffers data for the process. In fact, managing the memory resources to provide data buffering is one of the most important jobs of the kernel.

If the process is dealing with a disk file, then the UNIX model is able to select the position in the file where the reading or writing is to start. Setting the position in the file is done with the seek system call, known as `lseek` because its argument changed from a 16-bit pointer to a 32-bit "long" integer when UNIX Version 7 was released on the PDP-11. The system call in Solaris is now called `llseek` because it deals with a 64-bit file pointer. The existence of the seek call doesn't break the byte stream model. The data is still a stream, but the programmer can affect the positioning of the read or write pointer in the stream.

Record-Oriented Behavior

I suppose the fact that I am discussing the byte stream model may not be surprising to you, because you are convinced that it's the only way the world works. Well, there are other schools of thought. Many systems use record-oriented I/O, where the act of writing creates a record that is a complete single unit of data. For example, a record could be a card image, 80 bytes of data stored in chunks. The act of reading will return a record, and if the process has not asked for all the bytes in the record, then some information will be discarded.

We see record-oriented behavior when UNIX deals with magnetic tapes, where the normal rules about byte streams have been pragmatically ignored. The original 9-track reel-to-reel tape storage systems used variable-length records written on the tape. The end of the record was marked by a special data block that the hardware recognized. Several modern tape-based systems still operate using variable-length records. UNIX needed to have a way of creating a record of a known size on the tape, and a pragmatic solution was provided by setting the size of the record equal to the number of bytes in the write system call. Later in this article, I'll discuss some other reasons for providing record-oriented I/O for tapes.

Each file on the tape should have records of the same size; otherwise there can be problems when the data is read back. If the program that is reading asks for too little data in one read, then some of the tape block will be thrown away. Each program dealing with the tape device needs to know how the tape interface behaves to ensure the integrity of the data.

Most of the programs that deal with tapes are actually special utilities written specifically for tape manipulation; for example, `tar`, or the original `dump/restore` programs. So the person writing the code knows that tape devices needed special handling. Every write to the output device means a new record on the tape, and when the tape is read back, the programmer can provide a memory buffer that is the maximum blocking factor on the tape.

Problems can arise when general-purpose programs are used with tapes. For example, you can use `cat` with a tape device, but you cannot guarantee what block sizes will be used. The `cpio` program has an option to set the blocking factor, and the option is designed to be used when `cpio` is dealing with tapes. However, it's up to the programmer to remember, or record, the blocking factor that is used by a particular data set.

UNIX treats its hardware devices as part of the file system. Each device is accessed through a "special" file, providing a name in the file system tree. The special file behaves like any other file on the system. It can be opened by quoting its name, data can be read or written, and the file can be closed. The special device is implemented by a kernel device driver, which provides device-specific routines that are called in place of the

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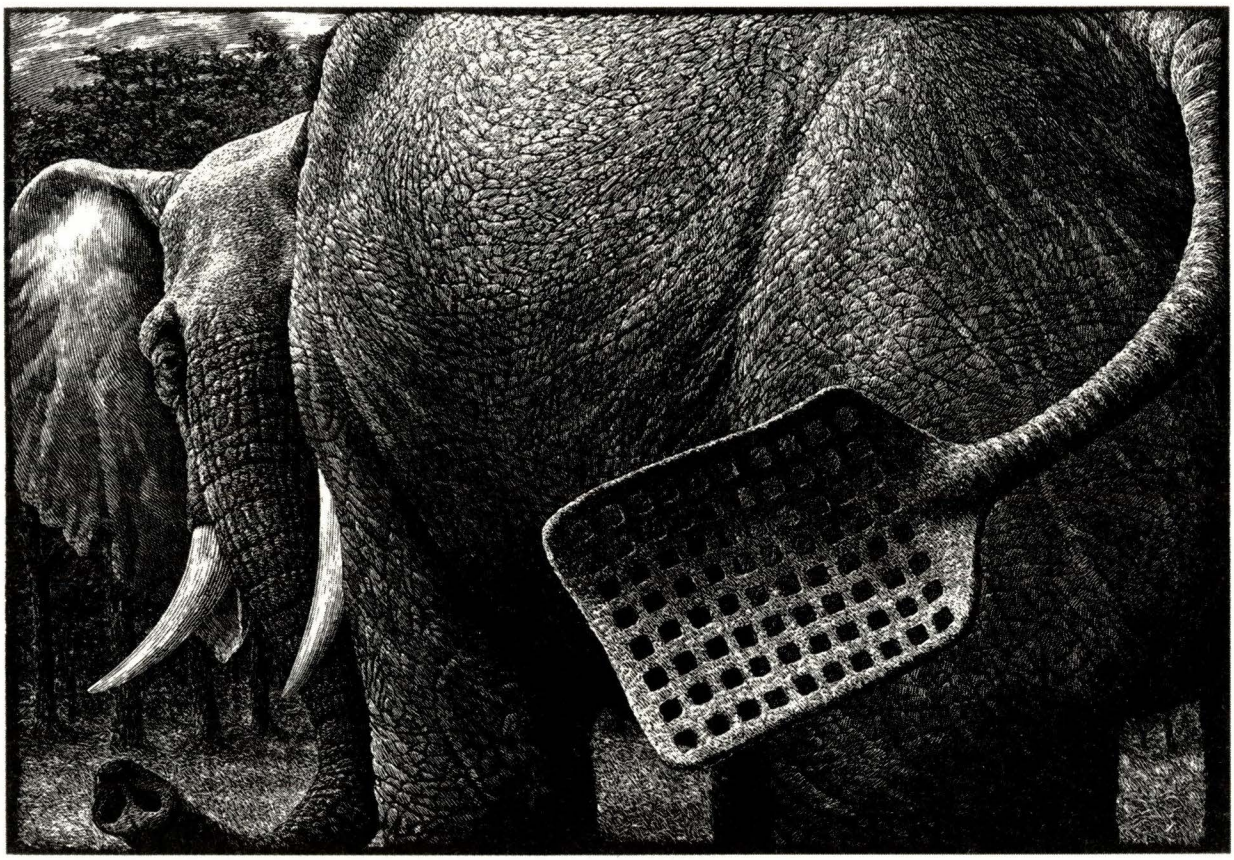

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Circle No. 34

regular file-based I/O routines.

There are two types of special files: *block* and *character*. The block special files are used for any device that is intended to be used as part of the file system. Block special files are usually disk partitions that can be mounted to make the single tree-structured file system that UNIX supports. The device drivers deal with the hardware and manage the blocks of data that form part of the file system.

It's usual for the hardware of disks to operate using direct memory access (DMA). A disk controller is given a command to move data between a point on its surface and the memory of the machine. The disk controller performs the command, reading or writing the memory with no intervention from the CPU of the computer to which it is attached. The CPU is notified with an interrupt when the transfer has taken place.

The hardware of the disk is a shared resource, and so is the file system that is written on its surfaces. It makes sense for all the processes on the system to share the pool of data buffers used to communicate with the disk. When several processes update the same file, perhaps a directory, they are really updating a single block or set of blocks held in the kernel memory. The data block in memory will eventually be copied out to the disk surface.

The pool of buffers managed by the disk drivers acts as a cache, storing data in the memory of the machine. The cache is a win for small temporary files that are written and immediately read. The files need never exist on the surface of the disk, they can remain in memory for their entire lifetime. The cache is also a win for files that have been read and whose contents are currently in memory when the same files are reread. There are many files, mostly directories, that are frequently read by processes.

UNIX also implements "read ahead" of blocks into the cache. Most processes read files sequentially, and the kernel will queue a read of the next block of a file before it is requested by the process. In most circumstances, read ahead is a win, improving processing speed because, while the process is munching on the data that it has just read, the system is getting on with loading the next block.

Block device drivers are generally called by the file system management code on behalf of processes that are accessing files in the file system. When a process writes data to a file, it will travel from the address space of the process into a kernel buffer before being written to the disk. Data that is read will also move from the disk into the kernel and from there to the process that originated the request. The cost of this copy is outweighed by the sharing of data that occurs in the cache, and the ability of the disk driver to control access to the disk surface.

Character Special Files

Character special files primarily support all the other devices on the system, for example, terminals or printers. The kernel imposes the byte stream model on the devices, so a stream of data is sent from a process to a printer; and streams of data are traveling in both directions between a process and the terminal line. Generally, apart from terminals, only one process deals with a particular character device at any one time.

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

Character special devices are also used to provide "raw" access to disks and other DMA devices. Raw devices allow data to be moved directly between the address space of the process and the peripheral, avoiding the kernel copy that is demanded by the block special devices. This allows faster data copying for the raw devices and the DMA of large arbitrarily sized data blocks. Tape handling programs need both features.

There are often restrictions on the size of the data that is moved. The data request must fit in with the hardware, typically moving data in units of 512-byte blocks to and from disks. A read DMA request for tape devices with variable-length records must fit the block of data that is to be read; a write request will cause one record to be written by DMA directly to the tape, creating a tape block of the size of the write call. Thus, there are good hardware reasons for the model of tape activity that I outlined earlier.

Raw devices allow programs to deal with a whole disk or partitions within the disk as sequences of blocks, permitting programs like `df` or `dump` to operate outside the constraints of the normal file system. Most programs that deal with the file system as an entity operate with raw devices. One example is `fsck`, which checks and repairs the file system. Some people run this program on a live system overnight to "see if the file system is OK." Panic can set in when errors are reported. The errors are illusory, and go away when the machine is taken down to single-user mode and `fsck` is run again. The false errors occur because data on the disk which `fsck` is reading via the character device is not synchronized with the live file system, part of which is stored in the buffer cache and is accessed independently via the usual block device driver. Running `fsck` on a live system is a waste of time and nervous energy.

Character Peripherals

As I said earlier, character special devices were designed to deal with peripherals like terminals and printers. Printers are generally attached to the machine by a Centronics parallel interface. The device driver for such an interface is simple. Its job is to take characters from the process and throw them down the line to the printer one by one. The character special device implements a byte stream interface for the processes that call it, so you can use a simple program like the `cat` command to send data to be printed. These days, we wrap the printing command with a complex line printer spooling program, but the central routine of this spooler will simply open the file to be printed, read the data in chunks and write the output to the printer.

The device driver for terminal lines was always considerably

more complex than a printer driver. Terminal device drivers are complicated pieces of software that are configurable from user processes. The hardware is generally simple to drive, but we expect the line to function in many different ways: We can attach a hard-wired terminal, a modem for dial-in, a modem for dial-out, a printer, a mouse–the list of uses goes on and on.

A terminal line is controlled by a small block of data that the kernel interrogates to select different processing options when characters are received from the outside world or sent by a process to output half of the line. In the early UNIX systems, there was a need to set values in this control block, and this was done by the `stty` system call. The values in the block were returned to a process using the `gtty` call. (Of course, the name `stty` is preserved in the command used today to set up and print values from the terminal interface.) Later, it was realized that the `stty`/`gtty` system calls were too specific. The `ioctl` call was born, providing a general-purpose kernel interface to set device characteristics for all character special devices.

The `ioctl` call is used to establish many aspects of the terminal interface. The stream of text flowing to the terminal can be processed by the code in several ways. For example, UNIX stores the end of a line as a single character (the newline character; actually, the ASCII line feed character), and the interface provides automatic conversion to the carriage return and line feed that most devices need to move down to the next line.

The text flowing into the system from the user can also be processed. For example, it's possible to stop the interface from echoing characters, used to suppress your password being displayed when you log in. Also, in the default state, the interface will store all the text that is typed and will only pass it to a process waiting in the read system call when the user hits return. The interface processes the stored data, applying the control characters that delete a character and delete a line, ensuring clean data is sent to the process. The interface will also look for control characters that mean interrupt (often control-C), end of file (control-D), suspend (control-Z), and will cause the appropriate signal to be sent to processes attached to the terminal.

It's common for a process to wish to change the default action of the interface. For example, the `vi` program wants to see any character the user types immediately after the key is pressed and will disable much of the input character processing. If the process gets things wrong, or dies unexpectedly, then the terminal can be left in an unusable state.

In today's Solaris systems, terminal functionality is provided by a Streams module called `ldterm`. The Streams-based device drivers were originally designed by Dennis Ritchie, who saw a need for a clean way to glue parts of the kernel together. Streams modules are pieces of code that have well-defined input and output interfaces. Messages containing information flow in both

directions through the module. A Streams module can be arbitrarily connected to any other module, forming a processing stack. Each module will perform its own characteristic processing on the messages passing through. Data from a user process is translated into a message, which is then passed down into the kernel via various modules and out the hardware driver. Inbound data is also translated into a message and passed up through the set of modules on its way to the user process. Streams modules can be used with any appropriate Streams hardware driver, but I will concentrate on terminal lines.

If we look at one of the serial lines on a Sun, the hardware driver is a Streams driver called `zs`. If we connect to this, we can send raw character data in both directions. If we want to give the interface the standard terminal functionality, we push the `ldterm` module onto the line. We probably also want to maintain `ioctl` compatibility with older programs, and can push the `ttcompat` module to handle conversions from the old format to the new. This loading of modules happens automatically, usually before we open the line.

Streams allows us to change the use of a terminal line. For example, if we wanted to run the IP Point-to-Point (PPP) protocol over the line, we would replace the modules that handle regular terminal I/O with the stack that handles the PPP protocol. The `strconf` command can be used to find out what Streams are being used on your terminal line. For example, on my terminal emulator running under X, I get output like this:

```
ttcompat
ldterm
ptem
pts
```

showing four Streams modules in use. `ttcompat` and `ldterm` provide the standard terminal functionality. `ptem` and `pts` handle the client side of the pseudoterminal. When you use X, or log in from `telnet` or `rlogin`, there has to be a way of presenting the programs you run with a system interface that is identical to the terminal interface. However, the data from these programs that is written to the terminal has to be turned into a TCP/IP data stream that perhaps connects internally to the X server, or may be sent over the network to a client handling the `telnet` or `rlogin` protocols.

The pseudoterminal driver provides the necessary functionality. It consists of two special devices in the file system. The devices are connected, so if you push data in one end it pops up at the other. The client end, discussed above, emulates a terminal. It passes data down into the kernel using the `pts` device driver. The data pops up again on the master end of the connection translated into a series of messages. These messages are translated into the necessary protocol and sent on their way to the server. Data from the server travels the reverse route, ending up in the processes that are being run on the machine.

Further Information

The book *The Magic Garden Explained*, by Berny Goodheart and James Cox, published by Prentice Hall, ISBN 013-098138-9, describes the internals of UNIX System V, Release 4. I suspect that the Sun Solaris kernel has diverged from the basic release in several ways, but this book provides enough clues about where things started for you to work out what is going on in your own system.

Streams have made device drivers into complicated beasts. For simpler explanations, take a look at *The Design and Implementation of the 4.4 Operating System* by Marshall Kirk McKusick, Keith Bostic, Michael Karels and John Quarterman, published by Addison-Wesley, ISBN 0-201-54979-4. This is a revised edition of the 4.3BSD book.

To return to UNIX roots and see the complete operating system code with a clear explanation of how device drivers work, read *Lion's Commentary on UNIX, 6th Edition* by John Lions, recently republished by Peer-to-Peer Communications, ISBN 1-57396-013-7. This is a reprint of the seminal book that inspired many of us who started with UNIX all those years ago.

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

I/Opener

by Richard Morin, **Technical Editor**

JACQUES COURNOYER

"The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man."

– George Bernard Shaw

The Unreasonable Man

The existence of free UNIX-like systems today is largely due to the idealism of Richard M. Stallman (rms), who in the 1980s worked persistently towards this goal, even though most of us thought it was an impossible dream. By doing a large part of the job himself, he showed us it wasn't too far to aim for, and then we could do the rest.

The free software community owes a tremendous debt to this pioneering work. rms has made fundamental contributions to the technical, organizational and legal aspects of free software. It is unlikely that the free software community would have developed in anything like its current form, to say nothing of its current size and robust state of health, without him.

rms has written (and overseen the development of) immense amounts of free software, including substantial and innovative software systems. GNU Emacs and the GNU C Compiler (GCC) are just two examples of his work. The utility and overall quality of this software is so high that it is often used by commercial developers in preference to proprietary software.

rms founded the Free Software Foundation and the GNU Project, creating an organizational framework for collecting, developing and distributing free software. The mission of the project was the creation of the GNU system: a freely redistributable, UNIX-like operating system. To this end, the project has created many dozens of commands, ranging from trivial to very complex, and is now working on an advanced Mach-based kernel, known as the Hurd.

By instigating and promoting the use of the GNU General Public License (GPL), rms has changed the legal foundations of free software. The GPL allows individuals and organizations to examine, use and modify the free software it covers. It even allows companies such as Prime Time Freeware to sell collections of free software.

The GPL does not, however, allow anyone (save, in general, the original author) to distribute binaries without source code, modify the licensing terms or in any other way convert free software into proprietary products.

Last month's column ("World Domination," March 1997, Page 40) alluded to the GNU Project's role in the inspiration and development of Linux. More needed to be said on the subject, however, prompting this follow-on column.

It is important to realize that the Linux operating system, more commonly known as Linux, is really a Linux-flavored version of the GNU system, with historical roots going back more than a decade. GNU utilities form a large fraction of the code of every Linux system; without these, it is unlikely Linux would exist.

It is also important to understand why rms and his compatriots did all the hard work of writing compilers, assemblers and libraries. After all, much of this work is not glamorous computer science!

Although each of the GNU developers has his or her own motivation, rms is motivated by the belief that proprietary software is inimical to good will in society; that the presence of software on his system that he is forbidden to share with his neighbors prevents him from living ethically.

By writing software, founding organizations and establishing a legal basis for protecting free software, rms has changed the landscape of the computer community. We all owe rms (and all the other GNU contributors) a debt of gratitude.

How can we pay this debt? rms says, "The best way to thank us for writing GNU is to write more of it. Write a new free application that does a substantial job which no free software exists for–and then we can thank you too."

The remainder of this column is reprinted, with permission, from a short article of the same name. It summarizes the GNU (and to a large degree, my) perspective on Linux. I think it is well worth reading.

Linux and The GNU Project

Richard M. Stallman
The GNU Project

Many computer users run a GNU system every day, without realizing it. Through a peculiar turn of events, the version of GNU that is widely used today is more often known as "Linux," and many users are not aware of the extent of its connection with the GNU Project.

There really is a Linux; it is a kernel, and these people are using it. But you can't use a kernel by itself; a kernel is useful only as part of a whole system. The system in which Linux is typically used is a modified variant of the GNU system–a Linux-based GNU system.

Many users are not fully aware of the distinction between the kernel, which is Linux, and the whole system, which they also call "Linux." The ambiguous use of the name doesn't contribute to understanding.

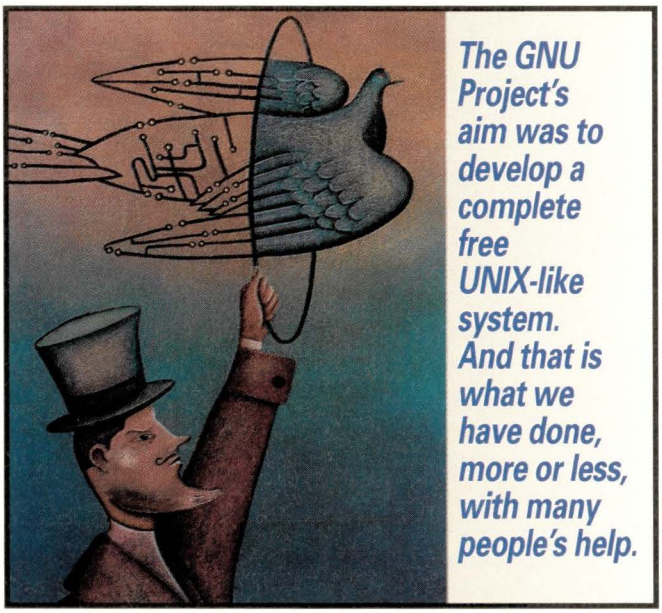
Programmers generally know that Linux is a kernel. But since they have generally heard the whole system called "Linux" as well, they often assume that there must be a good reason for this. For example, some believe that once Linus Torvalds finished writing the kernel, his friends looked around for other available free software and just happened to find everything necessary to make a UNIX-like system.

What they found was no accident–it was the GNU system. The available free software added up to a complete system because the GNU Project had been working since 1984 to make one. The GNU Manifesto set forth the goal of developing a free UNIX-like system, and after more than a decade of work, we have one.

Most free software projects have the goal of developing a particular program for a particular job. For example, Linus Torvalds set out to write a UNIX-like kernel (Linux); Donald Knuth set out to write a text formatter (T_EX); Rob Scheiffler set out to develop a window system (X). It's natural to measure the contribution of this kind of project by specific programs that came from the project.

If the GNU Project were a project of this kind, and its contribution were measured in this way, what conclusions would follow? One CD-ROM vendor counted how much of their "Linux distribution" was GNU software. They found that GNU software was the largest single contingent, around 28% of the total source code, and this included some of the essential major components without which there could be no system. Linux itself was about 3%. So if you wanted to pick a name for the system based on credit for the programs in the system, that name would be "GNU."

But choosing the name in this way would overlook a fundamental distinction. The GNU Project was not a project to develop specific software. It was not a project to develop a C compiler, although we developed one. It was not a project to develop a text editor, although we did so. The GNU Project's aim was to develop a complete free UNIX-like system. And that is what we have done, more or less, with many people's help.



Many people have made major contributions to the free software in the system, and they all deserve credit. But the reason it is a system–and not just a collection of useful programs–is because the GNU Project set out to make it one. We chose what programs to write based on what was needed to get a complete free system. We wrote essential but unexciting major components, such as the assembler and the C library, because you can't have a complete free system without them.

By the early '90s, when Linux was ready, we had put together the whole system, aside from the kernel (and we were working on a kernel, the GNU Hurd, which runs on Mach). So it was possible to put Linux, a free kernel, together with the GNU system, which had everything but the kernel, to make a complete free system.

Putting them together sounds simple, but it was not a trivial

job. The GNU C library had to be changed substantially. And integrating a complete system as a distribution that would work "out of the box" was a big job, too. It required addressing the issue of how to install and boot the system–a problem we had not tackled, because we hadn't yet reached that point. The people who developed the various system distributions made a substantial contribution. Seen in perspective, their contribution was to combine Linux and the GNU system to produce a Linux-based modified GNU system.

Aside from GNU, one other project has independently produced a free UNIX-like operating system. This system is known as BSD, and it was developed at UC Berkeley. The BSD developers were inspired by the example of the GNU Project, and occasionally encouraged by GNU activists, but their actual work had little overlap with GNU. BSD systems today use some GNU software, just as GNU systems use some BSD software; but taken as wholes, they are two different systems which evolved separately. A free operating system that exists today is most likely either a GNU or a BSD system.

We use Linux-based GNU systems in the GNU Project today, and we encourage you to use them too. But please don't confuse people by using the name "Linux" ambiguously. Linux is the kernel, one of the essential major components of a system. The system is GNU.

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

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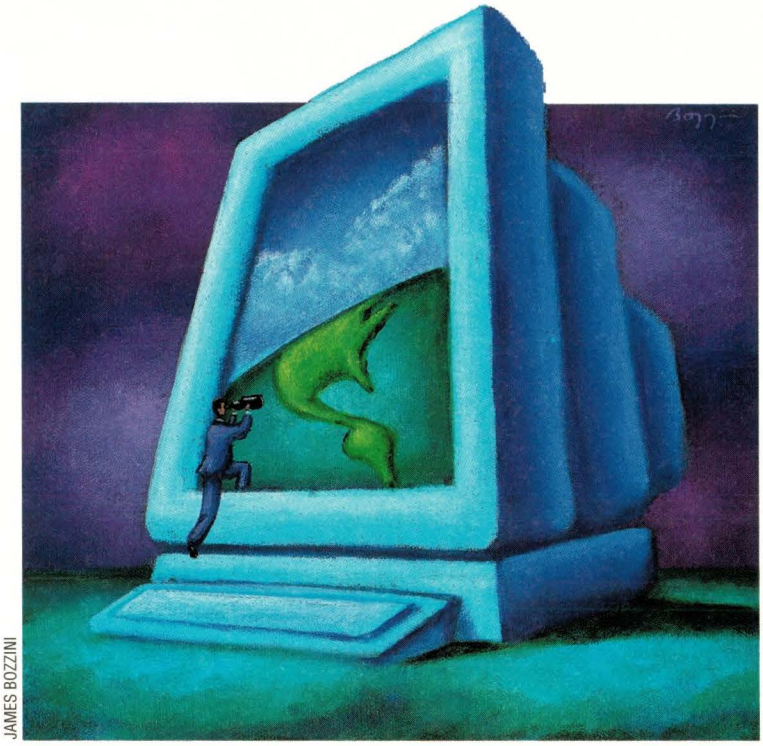

JAMES BOZZINI

The Lay of the LAN

Imagine yourself sitting in front of a Sun workstation. It's situated inside a bland cubicle with absolutely nothing to make you think a human has ever worked in this spot. No one else is around, but someone is logged in and an open terminal window is tempting you to investigate the system and network, which appear to be at your beck and call.

It reminds you of all those times you went to customer sites expecting to get some work done, but there was no one around who could explain to you even the simplest things about how the systems were connected, how large a network it was connected to, or even what services were provided by other systems or by the workstation on which you were supposed to be working.

With no one else around and no idea what you're expected to do, you decide it's time to "let your fingers do the exploring" and see what you can figure out while you wait for someone to show up and tell you what you're supposed to be doing.

Twenty Questions

There are a lot of questions you'd be asking if someone were around to answer. You start making a list of some of the things you might want to know. Let's see:

1. What operating system is running?
2. What is the system's name?
3. What naming service is running?
4. If NIS or NIS+ is running, what is the name of the master server?
5. If DNS is running, what name servers is it binding to?
6. What printers are available?
7. Are there user accounts on this system?
8. When was the system last backed up?
9. Who's logged in? Who logged in last? Who uses this system most often?
10. How much disk capacity is there? How much swap? How much memory?
11. What file systems are being made available for other systems?
12. What file systems are being mounted from other systems on the network?
13. What type of network cabling is in use?
14. How heavy is network traffic?
15. Is email received directly on this system or is there a mail exchanger?
16. What applications are installed? Do they start up when the system boots?
17. Are disk quotas in use?
18. Who knows the root password?
19. Is the system heavily loaded?
20. What SCSI addresses are in use?

OK, let's start sniffing around on this system and see what we can learn.

1. What operating system is running?

From the look of the screen, it seems CDE (Common Desktop Environment) is running. That suggests we're running Solaris 2.5 or better. We can quickly `cat` the `/etc/motd` file or, if this has been replaced by announcements about the company's chili contest, look at the bottom of a `man` page. But the easiest thing to do is to use the `uname -r` command,

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which will tell us the OS release:

```
boson% uname -r
5.5.1
```

2. What is the system's name?

Duh! Because we're obviously logged in with a `/bin/csh` shell, the name is part of the prompt (by default). If we'd been logged in with the Bourne or Korn shells, we could have used the `uname -a` command and listed more information about the system:

```
boson% uname -a
SunOS boson 5.5.1 Generic sun4u sparc SUNW,Ultra-1
```

This tells us the system is running Solaris 2.5.1, is called `boson`, and is a SPARC system of the `sun4u` class; an `Ultra-1`, in fact.

3. What naming service is running?

This is a little more interesting. You could, after all, send a note back to the office if the system can resolve host names from the "real world." Checking whether it's running NIS or NIS+ would help us figure out most of the information we'd like to know. If it's running NIS, it should be able to handle this:

```
boson% ypwhich
ypwhich: can't communicate with ypbind
```

OK, so much for that. Let's try NIS+ by seeing if we can use the `nisls` command:

```
boson% nisls
PARTICLE.PHYSICS.:
org_dir
groups_dir
```

Particle physics, huh? No wonder there's no one here. They're probably out chasing quarks. No, they're probably just taking a very long lunch. We can look at the `/etc/nsswitch.conf` file to see whether we're using local files or NIS+ tables to resolve host names. Or DNS! We might be running DNS as well.

```
boson% grep hosts /etc/nsswitch.conf
# "hosts:" and "services:" in this file are used only if the
#hosts: nisplus [NOTFOUND=return] files
hosts: nisplus files dns [NOTFOUND=return] files
```

Aha, it seems we are running DNS. That's good. We can probably log into the server back at the office to check email and send a message to the boss. Maybe *he* knows why we're here.

```
boson% cat /etc/resolv.conf
domain particle.physics.sci.org
nameserver 123.123.2.1
nameserver 123.123.3.1
```

Hmm, there are two name servers, but no one bothered to include the names in the `/etc/resolv.conf` file. That's odd. Anyway, we should have no problem telneting to the office if this place is on the Internet. Maybe we should run an `nslookup`:

```
boson% nslookup world.std.com
xxx
xxx
```

4. If NIS or NIS+ is running, what is the name of the master server?

If we had gotten an answer to our `ypwhich`, we'd already know this. Let's try the `nisstat` command:

```
boson% nisstat
Statistics for domain PARTICLE.PHYSICS.:

Statistics from server : TOPQUARK.PARTICLE.PHYSICS.
Stat root server' = ON'
Stat NIS compat mode' = ON'
Stat DNS forwarding in NIS mode' = ON'
Stat security level' = 2'
```

5. If DNS is running, what name servers is it binding to?

See question three.

6. What printers are available?

Because we're running Solaris, the best way to list printers is to use the `lpstat -a` command. However, that still won't tell us whether we can actually print to all of the printers listed. We could be listed in a file for denying printer access. After all, who'd trust someone who goes off for a long lunch and leaves themself logged in? Anyway, let's go ahead and take a look at the printer list:

```
boson% lpstat -a
scribe accepting requests since Fri Jan 3 17:00:32 EDT 1997
ps accepting requests since Mon Oct 7 11:11:11 EDT 1996
```

7. Are there user accounts on this system?

There are a number of ways to check this. First, check to see if there's a mounted `/export/home` and if it's local. Otherwise, we can see if there's a `/home` and if there are any file systems automounted from somewhere else. We could also check `/etc/passwd` to see where locally defined users have their accounts, or we could list the contents of the NIS+ table `passwd.org_dir` to see where users defined in NIS+ have their home accounts.

```
boson% ls /export/home
danielle  eric   mallory  onowa  slee  vail
```

```
boson% niscat passwd.orgdir | awk -F: {print $6}'
/home/boson/danielle
/home/boson/eric
/home/boson/mallory
/home/boson/onowa
/home/boson/slee
/home/boson/vail
```

Perhaps this is a much smaller organization than we thought. It looks as if the accounts are all local to this machine.

8. When was the system last backed up?

We won't know the answer to that question unless the `/etc/dumpdates` file is updated when backups are done with `ufsdump`. It might be the case that some other software is used that may or may not update this file. Let's check anyway. If we're going to end up doing any work on this system, it would be nice to know if it was backed up recently.

```
cat /etc/dumpdates
/dev/rdsk/c0t2d0s7    0 Fri Apr 11 23:34:09 1997
/dev/rdsk/c0t2d0s7    5 Tue Apr  8 22:06:00 1997
```

With entries like these, it looks like full and incremental backups are done fairly regularly.

9. Who's logged in? Who logged in last? Who uses the system most often?

If we say `who`, we're going to see who is logged in now and who left their session unattended. Let's run `who` against the `/var/adm/wtmp` file to get an idea of recent logins along with the current one:

```
boson%
who /var/adm/wtmp | tail -3
peterpan  pts/3     Apr 10 09:17   (neverneverland)
suzyq     pts/0     Apr 11 10:05   (nextdoor)
eric      console   Apr 11 13:13
```

So, someone named Eric is logged in now, and some other users we didn't see in the NIS+ table have logged in from other systems. Let's see if this Eric guy is the one who normally works here:

```
boson%
who /var/adm/wtmp | tail -1000 | awk {print $1}' | sort \
    awk -f count_same | sort -t: -n +1 | tail -3
root:13
suziq:51
eric:794
```

Oh, by the way, I forgot to tell you that I was writing that little `count_same` script while you were nodding off on the last page. It counts consecutive lines that are the same. It looks like Eric is the primary user.

10. How much disk capacity is there? How much swap? How much memory?

I don't know about you, but I'm getting a little tired of adding columns of numbers that are some number of 512-byte blocks, or some number of kilobytes if I remember to use the `-k` option with my `df` command. Let's toss an `awk` script together to add any arbitrary column of numbers for us.

```
#
{
TOT = TOT + $COL
}
END { print TOT }
```

That was easy. Now let's count up our disk space:

```
df -k | grep /dev | awk -f add COL=2
1826834
```

OK, sliding the decimal point into the right place, I'd say that's just about 2 GB. I could use that much space myself. I'm glad I don't have to share with Eric, Mallory, Vail and the others.

To Be Continued...

Oh, sorry, looks like someone's trying to tell me this column is long enough already. Guess we'll have to answer the rest of the questions next month. ➸

S. Lee "slee" Henry *is on the board of directors of the Sun User Group and is temporarily living a bi-coastal life with one foot just outside the nation's capital and the other in California. Anyone with nothing better to do and room in their trunk should write to* `slee@cpg.com`.

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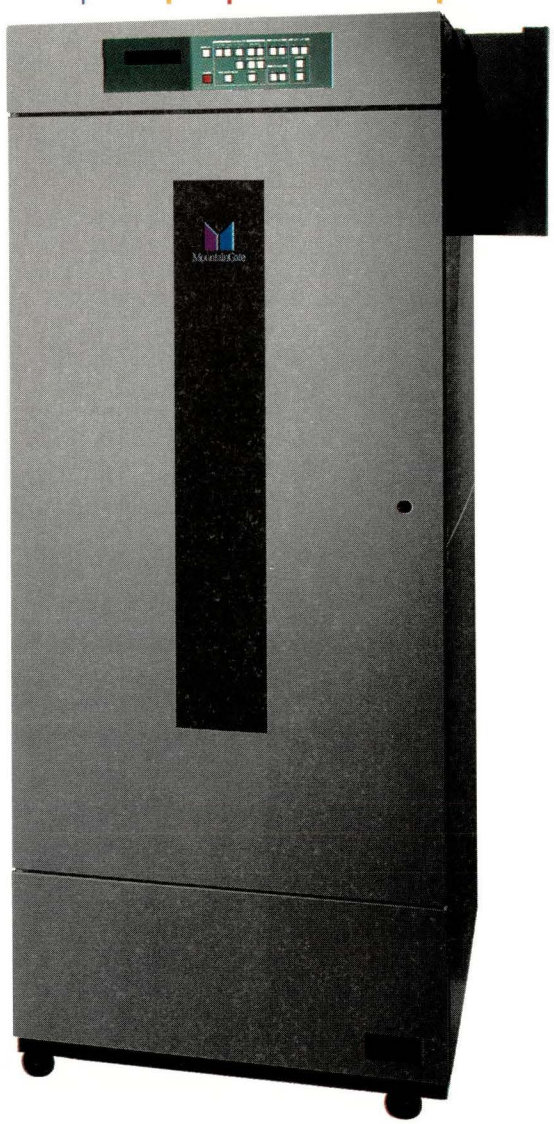

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UNIX Not Immune

by ALEX SIMEONIDES, Staff Editor

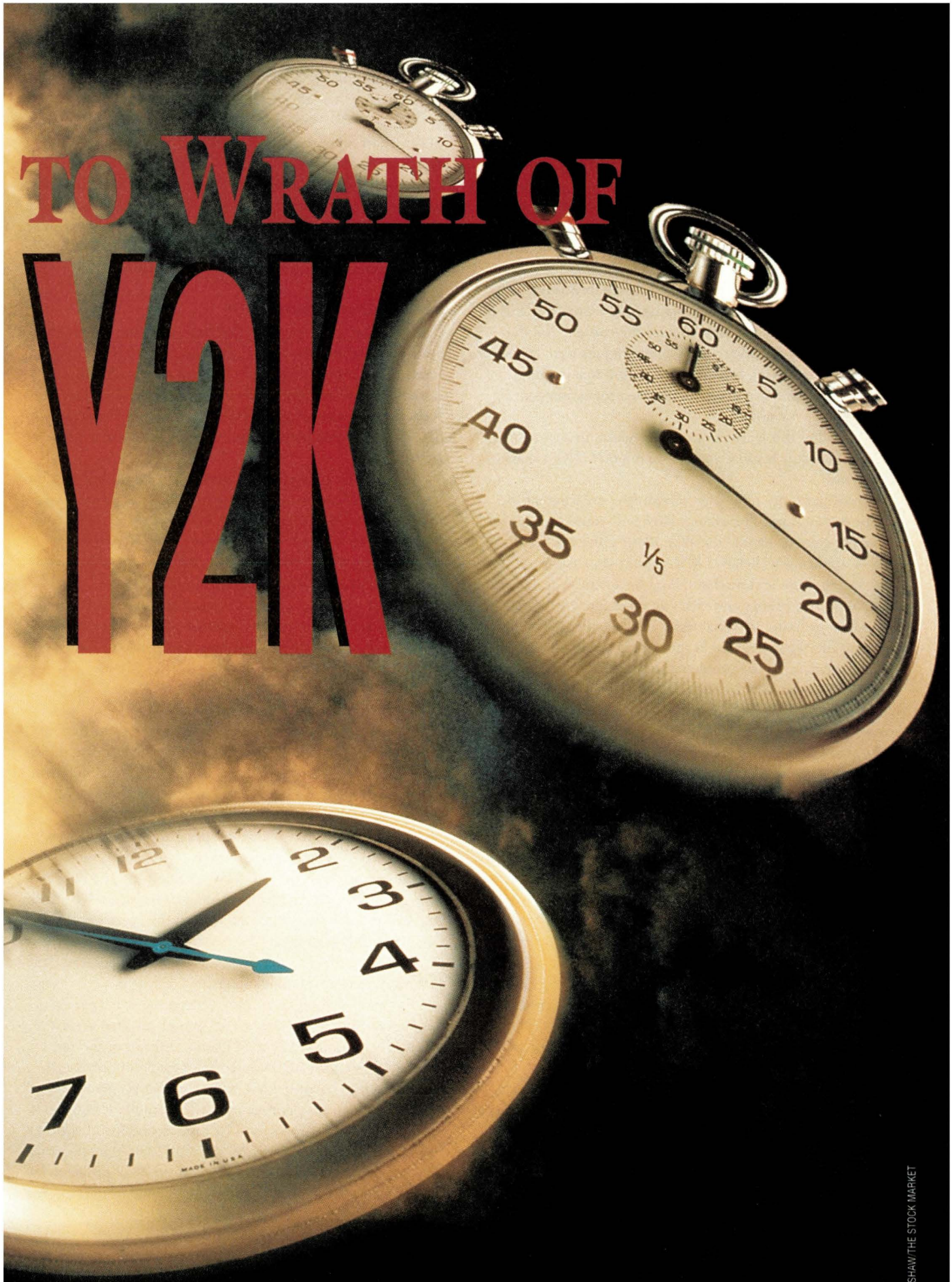
The Year 2000 is coming, and Millenarians and IT departments alike are busying themselves for the Judgment Day.

In fact, some organizations have already begun to feel the wrath of the Year 2000 date change. Computer systems at a Department of Motor Vehicles in a southern state, for example, failed last year when a new system was put in place that issued licenses for five years instead of three. The first customer to request a license under this system was denied.

What happened, you ask? It's quite simple, really: When the DMV program added five years to the current date, it came up with a date in the year 2001 as its expiration date. Unfortunately, dates are commonly coded so that the "19" in "1900" is implicit. That is, when the DMV program tallied up "01," it tacked a "19" on to the front; "1901," clearly,

UNIX OPERATING SYSTEMS MAY BE GOOD FOR ANOTHER 41 YEARS, BUT ARE YOUR APPLICATIONS AND UTILITIES READY FOR THE NEXT MILLENNIUM?

TO WRATH OF Y2K



BOB SHAW/THE STOCK MARKET

is not a valid expiration date. This particular DMV was unable to issue licenses for two months, while programmers labored to fix Year 2000-related glitches.

Oddly enough, members of the UNIX community seem to think themselves innocent of any date coding transgressions. "This might be because most UNIX applications were coded later on in the game," offers Brian Keane, vice president of Keane Inc., a systems integration firm based in Boston, MA, that offers Y2K services. "Programmers were more aware of the Y2K issue because it was right around the corner." Another line of reasoning goes that UNIX programmers were not faced with the same capacity limitations as mainframe programmers–limitations that caused mainframe programmers to skimp on date notations.

While all of this is true to a certain extent, to assume that you're in the clear because you're running on UNIX is naive, experts say.

Before any more time gets wasted, here are some of the questions you should be asking: How will your hardware and operating systems handle the Year 2000? How will your C/C++ applications behave? What about your database: In what format does it store dates? And once you've determined that you have a problem–which you most likely will–how do you go about fixing it? What tools are available? Who are the vendors, and what services do they offer?

And speaking of the problems your UNIX environments could have in the Year 2000, what kinds of problems can UNIX-based systems fix? As the Y2K deadline looms, beleaguered mainframe and PC administrators are increasingly turning to UNIX-based solutions as the potential fix for their date change problems.

How UNIX Keeps Time

First of all, if you're worried about how UNIX operating systems will fare on January 1, 2000, don't be. From Sun Solaris' perspective, the Year 2000 will register as a "nonevent," according to Steve MacKay, vice president and general manager for the Sun Solaris products group.

UNIX operating systems in general, and Solaris in particular, count time as the number of seconds since 00:00:00, January 1, 1970. This precise moment is usually referred to as the Epoch. Standard UNIX systems store the date variable as a signed 32-bit integer, for a total of 214,748,364 possible seconds. Thus, 214,748,364 seconds from January 1, 1970, will be January 19, 2038, 3:14:07, 41 years from today.

But because the UNIX kernel handles the Year 2000 correctly, don't assume that UNIX utilities do. The people who programmed the Solaris operating system are no more perfect than the rest of the programming world.

The Sun community has uncovered several improperly coded utilities, regarding which SunSoft Inc. has officially promised that all Sun software released on or after May 1, 1997, will be fully Year 2000-compliant. Sun will also issue patches to previous releases of Solaris and SunOS. Further details of Sun Microsystems Inc.'s Year 2000 position, as well as the list of supported Solaris versions, can be found at the Sun Year 2000 Web site: `http://www.sun.com/y2000`.

According to Jan Testamarta, director of SunSoft's Year 2000 strategies, Sun developers will be able to check their Solaris code for calls to faulty system utilities with the help of several Application Binary Interface tools, tools that check to see whether the utilities you reference use two- or four-digit dates.

The 2038 Conundrum

If this Year 2000 mess has taught us anything, it's that 40 years go by faster than you might think. "In 1970, a mainframe programmer would have laughed if you told him that the code he was writing would still be in use today," says Tim Nelson, chief scientist with MCI Systemhouse, Houston, TX, MCI's systems integration division. "But just look at where we are today."

For Sun, the solution to the 2038 conundrum lies with the next 64-bit Solaris operating system, to be released sometime in calendar 1998. "That's Phase 2 of our strategy," jokes Sun's MacKay. "We anticipate having most of our user base on Solaris 2.x by 1998," MacKay says. "At that rate, we'll have another 40 years to move them up to 64-bit Solaris." And according to MacKay, current 32-bit applications will not need to be recoded to support the increased address space afforded by the 64-bit system; Solaris will reportedly handle that behind the scenes.

Where the Real Problems Begin

The problems facing most UNIX systems administrators are fundamentally the same as those facing any other administrator. It doesn't matter whether you're in a PC, mainframe or UNIX environment, the question you must ask yourself is: Do all my applications process dates correctly?

You may be positive that your applications are OK, but experts say you should check anyway. "Remember," says Gary Ross, vice president of the systems development and integration group for Comtex Information Systems Inc., a New York-based consulting firm, "application software is custom developed, and if the developers did not specifically state that they paid attention to Y2K compliance, then, at the very least, [the program] needs to be reexamined."

On a more cynical note, some experts warn that even if developers claim a program is Y2K-compliant, that doesn't necessarily mean it is. Glenn Williams, director of the Year 2000 Task Force for RSG Global Business Solutions Inc., a consulting firm based in New York, says that programmers will sometimes claim that a program is Y2K-compliant in order to move it into production status. "It's much easier to check off a box that says, 'Yes, we're OK for the Year 2000' than to actually fix the code." And, he adds, "in all my years of programming, I've never ever seen anyone apply a suite of tests for Year 2000 compliance."

Another common assumption is that because there aren't many Y2K tools or services that cater specifically to UNIX environments, it must not be much of a problem. If any-

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thing, the lack of tools and services for UNIX belies the gravity of the situation.

"We don't offer Year 2000 services for UNIX," says Comtex's Ross, point blank, "not because there aren't problems, there are, but because working with UNIX systems opens up a lot of cans of worms." In distributed environments such as UNIX, date problems are harder to track down than on the mainframe. "Your date problem could reside in the database software, it could be in the middleware, or maybe it's in the desktop client. Your problem could be just about anywhere," Ross says.

"I asked an Italian colleague of mine how they were addressing the Year 2000 on UNIX," RSG's Williams recalls. "He suggested that they were taking the ostrich approach."

C and C++ code, too, is harder to debug for date field errors than COBOL and other mainframe languages. One of the reasons for this, Williams says, is that C is a much more abbreviated language than COBOL. "In COBOL, you'd probably call your date variable something obvious like ExpirationDate, but in C, it's just as likely that you'd call it A." This makes C code very hard to analyze using straight text string searches.

On a deeper level, the structure of C makes it hard to analyze for date problems. "Pointer abuse," says Ted Swoyer, director of marketing for Peritus Software Services Inc., a consulting firm based in Billerica, MA, is largely responsible for the difficulties associated with debugging C code. Values are inherited, and variables get renamed, which makes tracing date-dependent variables tricky.

So while there are a lot of companies that will fix your mainframe code, very few will delve into your C applications. "Peritus is considering adding C language support in the future," says Swoyer, but in the meantime, "COBOL is where the money is."

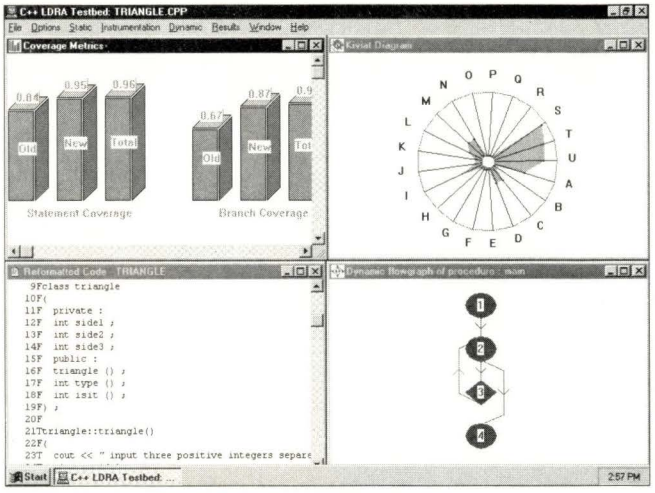
What's Out There for UNIX?

"You can't throw a cat without hitting a tool for analyzing COBOL code," says Nelson of MCI Systemhouse. Unfortunately, the same is not true for C or C++, the languages in which most UNIX applications are developed.

Of the available tools for C/C++ code analysis, most fall into two basic categories: tools that perform searches on text strings, and tools that trace data flow. In general, the former is the preferred tool for small-scale projects (50,000 lines of code or less) but is not deemed very reliable. "Using `grep` or one of its derivatives, you're lucky if you find 60% of date-related strings," Nelson says.

Data flow analysis tools, on the other hand, tend to be expensive and require a large infrastructure investment. However, once you've found your initial date-related variables, you can be fairly certain that you'll find many others that depend on them.

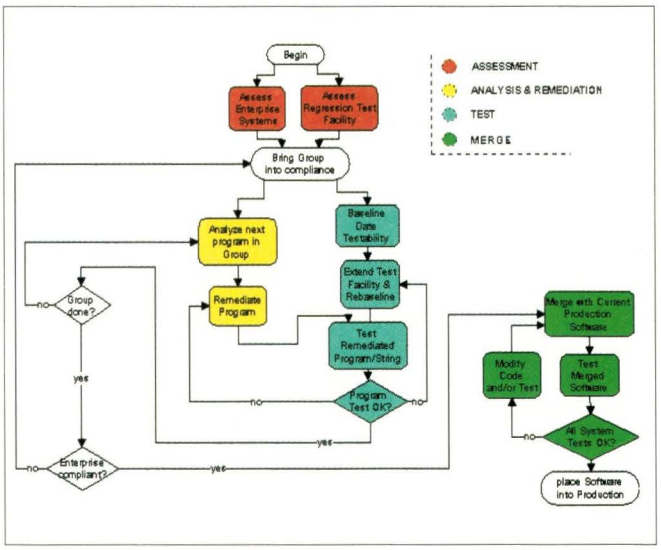
For most programmers, special Year 2000 text-based search tools don't offer much over basic UNIX utilities. Rajeev Arora, director of business development for Software Emancipation Technology Inc., Lexington, MA, calls these tools "sophisticated `greps`." But as all UNIX practitioners will tell you, `grep` and



LDRA's Testbed is a testing tool that has been remodeled for Year 2000 purposes.

`sed` can be the building blocks to powerful shell scripts. Chris Anderson, of the Y2K Cinderella Project, a group based in New Zealand dedicated to tracking down Y2K problems under DOS, uses the UNIX utilities that come with Linux to seek out his date problems. "The purists will scoff. But the pragmatists probably do it that way already," he says.

For larger scale projects, professional consultants usually turn to data flow analysis tools. Data flow analysis tools are typically testing tools that have been enhanced to check for Year 2000 date inconsistencies. For example, McCabe and Associates Inc., Columbia, MD, known for developing the McCabe Cyclomatic Complexity Metric, offers a Year 2000 product called the Visual 2000 Environment (V2000E). Testbed, developed by LDRA UK Ltd., and remarketed in the United States by Eastern Systems Inc., Westboro, MA, is another example of a testing tool that has been remodeled for Year 2000 purposes. Both of these packages run on major



McCabe and Associates' V2000E runs on UNIX platforms and checks for Year 2000 date inconsistencies.

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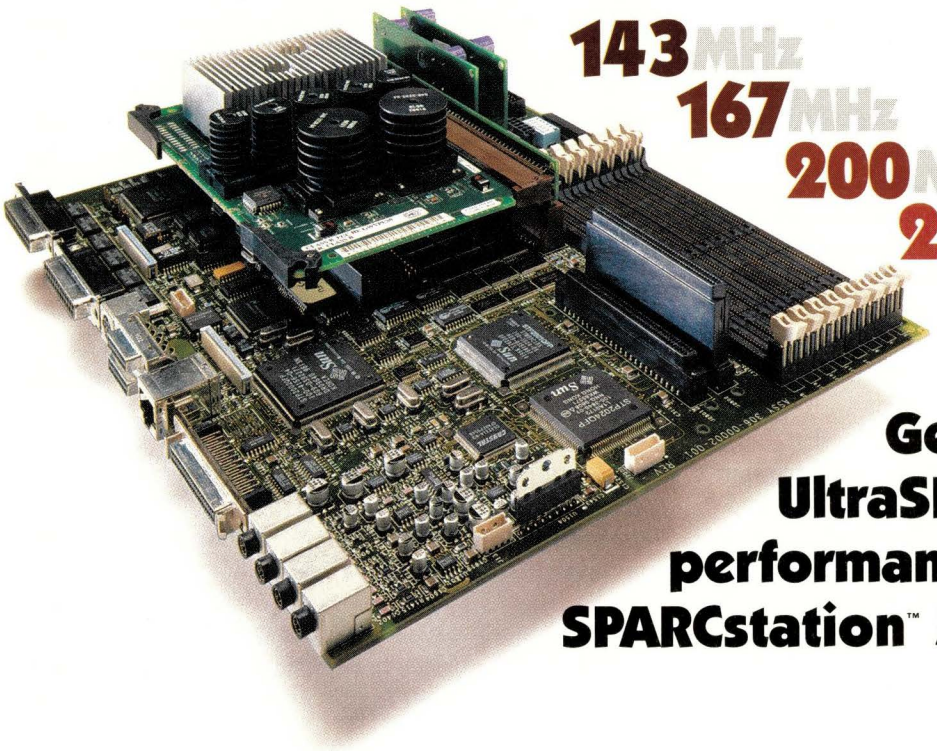

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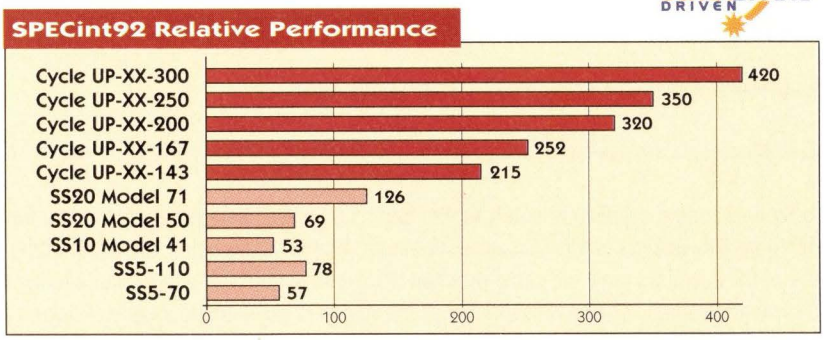

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UNIX platforms and can process several programming languages, including Ada, C/C++, FORTRAN and several COBOL dialects.

Another tool that has been getting a lot of attention from the Y2K community is Discover Y2K, from Software Emancipation. Unlike LDRA's Testbed and McCabe's V2000E, however, Discover Y2K is not a testing package at heart. Rather, Discover Y2K is an integrated C/C++ development environment that places a special focus on code-level process control. As such, it includes a compiler, debugger and a whole host of visualization tools.

What makes Discover Y2K valuable to Year 2000 professionals in particular is how it displays its elements in the project, and how they relate to one another. Once Discover Y2K has identified the date-related items in the code, it can automatically recognize which variables are related to them. "For C code, Discover is the only game in town," says Ian Hayes, principal with Clarity Consulting Inc., Marblehead, MA, and a frequent speaker at Year 2000 events.

Software Emancipation officials warn, however, that Discover Y2K should not be used as merely a quick fix to your Year 2000 problems. "Companies would be losing out on a huge opportunity if they only used Discover in a Year 2000 context," says Arora. "We often tell our customers that if they had implemented Discover from the beginning, they wouldn't be in such a panic today," he adds, "because their Information Model would already be in place." A tool such as Discover Y2K is useful in any fire-fighting situation, Arora argues. "People in the software industry face crises all the time; the only reason why everyone is making such a fuss around the Year 2000 problem is because we're all facing it at the same time."

Moving to UNIX

Despite the fact that UNIX systems are just as susceptible to poor coding practices as any other environment, some companies are turning to UNIX-based solutions to fix their Year 2000 ills.

For example, when Snelling and Snelling Inc., a large employment placement service based in Dallas, TX, realized in 1993 that it was not Year 2000-compliant, the company opted to switch from its homegrown PC-based application to a commercial solution running on UNIX hardware.

"We knew that our software was noncompliant, and that there was no way that it was ever going to be compliant," says Buck Buchanan, senior vice president of information systems for Snelling. "We wanted a one-vendor solution, and I was pushing to get the company on industrial-strength hardware, and away from the mom-and-pop stuff."

Snelling eventually opted for a Y2K-compliant payroll package from Pleasanton, CA-based PeopleSoft Inc., PeopleSoft Payroll. The company runs the software on Sun hardware, against an Oracle Corp. relational database. Snelling processes 14,000 paychecks a week, in 43 states. Last year, Snelling issued 63,000 W2 forms. And Buchanan is confident that Snelling will survive the Year 2000 without a hitch.

But while the Snelling and Snelling story may paint a pretty picture of migrating to UNIX as a solution to Year 2000 prob-

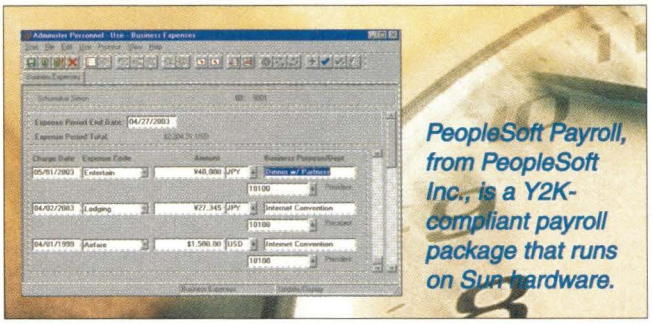
Editing Shell Scripts the UNIX Brute Force Way

flong@sgi73.wwb.noaa.gov (Fred Scoresby Long) wrote:

>OK. What tools are available to scan the scripts written for the various UNIX shells? Also, for PERL.

Yo Fred, I thought I replied privately to you on this one. Well here we go again, just for the record.
My immediate answer is that you are not going to find anything better than grep in the UNIX arena.
ALL of the scanners have the same problem. Provided you KNOW what you are looking for, they will find it. But you first have to know the variable names. Essentially, all the scanners do is create a table of search entries and then scan. I use a slightly different technique. This specific way is for DOS because I simulate UNIX under DOS, and don't have a problem in Linux (yet).
1. First, I create a list of potential file names (a find or ls would do the same in UNIX). I exclude all the obviously nonapplicable stuff such as .gif .lib, etc., etc.
2. I then define a set of keywords, e.g., "time(" etc., etc.).
3. Then for each keyword, I grep the file list and spool the output to a file named for the keyword, e.g., time.hit.
4. I put all these grep searches into a single .bat file and let her rip.
It's fast and simple, and you can do it cheaply and modify it to fit your environment. For example, you might want to find all occurrences of printf- and date-related variables. First, I search for the variable name, pop the result in a file, and then scan the result file for printf.
Crude. But the old 80/20 principle still applies.

Chris Anderson	email: slug@fast.co.za
Y2K Cinderella Project	webmaster@cinderella.co.za
www.cinderella.co.za –	Striving to Achieve Year 2000 Compliance



PeopleSoft Payroll, from PeopleSoft Inc., is a Y2K-compliant payroll package that runs on Sun hardware.

lems, Snelling's success rests on two very important factors. Snelling started researching a solution back in 1993 and had the luxury of being able to throw away its old solution. Organizations that are eligible for this sort of solution are extremely rare.

Companies that run their business on a mainframe are especially reluctant to migrate to UNIX, despite the emergence of "mainframe class" UNIX hardware, like the 64-processor Sun Ultra Enterprise 10000, announced in January.

"Belts-and-suspenders conservatives–the kinds of people running their businesses on mainframes–have traditionally shied away from UNIX, its freaks and hackers," says Richard Partridge, research analyst with D. H. Brown, an industry analysis firm based in Port Chester, NY. True, mainframe applications that adapt well to UNIX-style parallelization, for example, data mining and decision support applications, are slowly being moved over to UNIX. But the bulk of the number-crunching applications are still running on mainframes, and Partridge does not see that changing any time soon.

"The days of being embarrassed to be running your business on a mainframe are over," says Partridge. "The companies that wanted to move from the mainframe to UNIX–mainly for economic reasons–already did so five years ago," he adds.

The Year 2000 Changes Things

On the other hand, in the face of the Year 2000, IT departments are being forced to come up with creative solutions to their two-digit century noncompliance. "The Year 2000 is one of those 'compelling events' that is forcing organizations to rethink their technology strategies," says Doug Wetzel, chief executive officer of International Software Finance Corp., a consulting firm based in Wilton, CT, that helps software vendors and their clients devise creative financing plans for software acquisitions.

David Matthews, vice president of marketing for UniKix Technologies, Phoenix, AZ, says, "We were already experiencing a slow migration off mainframe onto open systems. But the Year 2000 is the great accelerator."

UniKix is servicing mainframe environments with a stopgap software solution that runs on UNIX servers. Called Open 2000, the software emulates MVS or DOS/VSE and runs COBOL programs under batch or CICS. This allows COBOL programmers to identify, change and test code away from the already taxed mainframes, and load the corrected code back onto the mainframe only after it has been fully tested.

Matthews anticipates that some organizations will continue to run corrected COBOL code under Open 2000, even after the new millennium. The reason for this, Matthews explains, is that most mainframes today are already running close to capacity. Depending on the programming logic you use to fix Year 2000 problems, the corrected application may require up to 20% more processing power. This is especially true of applying date window logic to two-digit centuries, for example, if the date reads between 70 and 99, assume "19" as the century, but if it reads between 00 and 69, assume "20". While this programming solution is faster and easier than recoding dates to think of years as four digits, it adds a loop to all of your date

Companies Mentioned in this Article

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Circle 159

routines, which can mean bigger executables.

Another step to ensuring Y2K compliance is making sure that dates in your database are stored using the four-digit date field. For example, TeleService Resources Inc. (TSR), a hotel reservation and inventory company based in Fort Worth, TX, embarked on a project to deploy a new central reservation system. In the process, Jack Clark, lead developer for the project, realized that years were stored as two digits. "Our system lets guests book one year in advance. If we had kept data in the form it was in, the booking system would have stopped working on January 1, 1999," Clark says.

Fixing the data involved adding the "19" prefix to all the dates in the database. To do so, TSR turned to a data migration tool, DCLE (Data Conversion Language Engine, pronounced "diesel"), from Reliant Data Systems Inc., Austin, TX. DCLE, which Clark describes as a "way advanced `awk`," allows you to define multiple sources and targets, and through a modified SQL, define the logic transformations to apply to the data. TSR's project, which migrated data from a proprietary database running on a Sequent Computer Systems Inc. box to an Informix database running on an IBM RS/6000, took four weeks–half the time it would have taken without DCLE, Clark says. "What it really saves you on is development time," he says.

As the Year 2000 deadline approaches, it's becoming increasingly clear that there's no alternative to good old hard work. "It's hard watching people sit around, waiting for magic to happen," MCI's Nelson says. "People need to realize that they can't wait around for Sun to release the Java Year 2000 applet, or Microsoft to announce Windows '00."

"It's true, there's not a whole lot of happiness in this line of work," Nelson says, in reference to Year 2000 experts' glum demeanors. "But look at it this way: We're just out there trying to save the world. Because if our customers go out of business in the Year 2000, who will be our customers?" ⊸

The Year 2000 is a Leap Year

By the way, the Year 2000 is a leap year. When updating your system for Year 2000 problems, make sure your applications have been properly coded to reflect this fact.

Basically, as most people know, every fourth year is a leap year. Many people assume that the Year 2000 is *not* a leap year because of the exception for hundredth years, which, according to a 1751 British Act of Parliament, are "to be common Years of 365 days," see http://206.86.55.127:80/legal/calendar_act.html. However, if you read on, there's an exception to the hundredth year-exception, such that hundredth years divisible by four are leap years.–*as*

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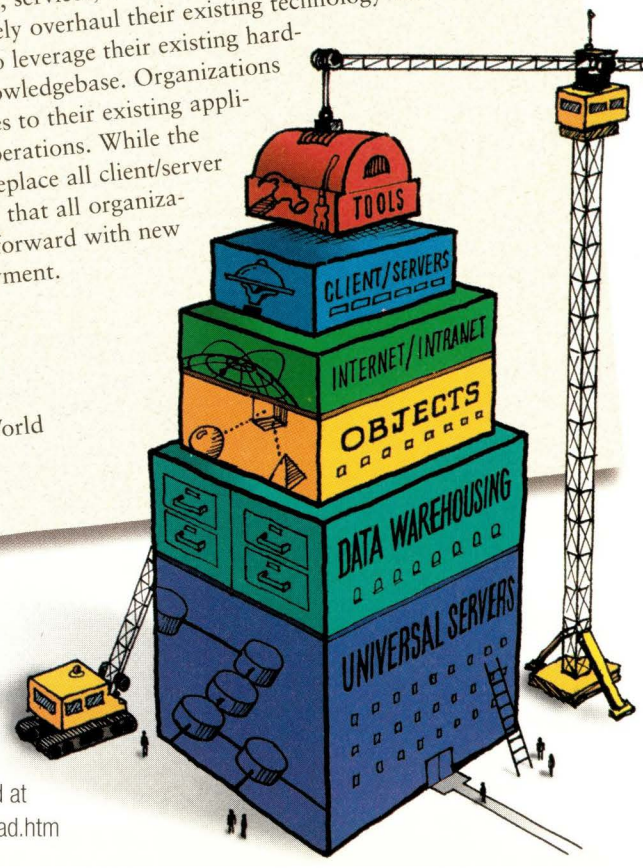

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RAID Disk Array and Ultra 2 Clone

by **IAN WESTMACOTT, Technical Editor**

This month, we report on a speedy RAID solution for moderate amounts of data and an Ultra 2 clone that comes with a range of hardware and software options to fit most desktop needs.

Western Scientific CycloneRAID Disk Array

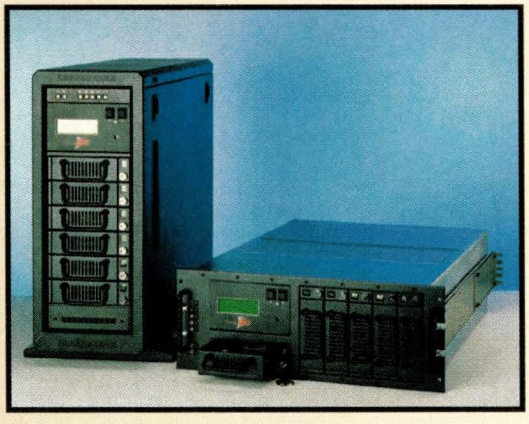
The CycloneRAID disk array storage system from Western Scientific Inc. is a deskside RAID system supporting RAID levels 0, 3 and 5. The controller is based on a 25-MHz Intel Corp. 80960-CA RISC processor. The five-array SCSI channels and one hot spare SCSI channel support both $5^1/_4$-inch and $3^1/_2$-inch back-end disks of 1, 2, 4 or 9 GB, as well as SCSI-2 Command Tag Queuing.

The Cyclone supports up to seven ranks of heterogeneous or homogeneous drives, for a total of 49 drives (including hot spares). Internal SCSI buses are single-ended Fast SCSI (10 MB/s), while the host connection is single-ended or differential Fast/Wide SCSI (20 MB/s). All disks are hot-swappable, and the unit includes redundant power supplies and fans. Up to 128 MB of RAM cache can be installed, and (field-upgradable) flash EPROM is used.

The unit we looked at included six 9-GB Seagate Technology Inc. ST19171N disks and 36 MB of RAM cache. The box itself is about the size of a larger deskside tower CPU enclosure (approximately 21 by 11 by 24 inches), and is matte black in color. A rack-mount version is also available.

The SCSI controller, comprising motherboard and two daughtercards, fits into a $5^1/_4$-inch form factor space. Its face includes a backlit, 4-by-20-character LCD panel for diagnostics and two pushbuttons for alarm defeat and background reconstruction. This is accessible at the top of the front panel, just below seven alarm and diagnostic LEDs. Beneath this, the remainder of the front panel is taken up with six disk bays. Each bay houses a disk tray whose front is numbered and includes a handle. Each tray can be locked into its bay (all using the same key), and each bay includes a single-digit LED.

The sides of the tower are removable, providing access to internal connections. The rear of the tower includes two power supplies and two cooling fans (all of which operate full time), two Wide SCSI ports and a 9-pin serial port. A 9-pin-to-9-pin serial cable is provided, as is a SCSI cable and terminator, two power cables and keys to the drive bays. Internal SCSI termination is provided, and SCSI ID can be set by jumpers or via the controller software interface. Configuration of the unit is accomplished through the controller software–only accessible through the serial port. There is no host configuration or management software for the Cyclone.



Both tower and rack-mount versions of the CycloneRAID disk array storage system provide solid construction and easy accessibility.

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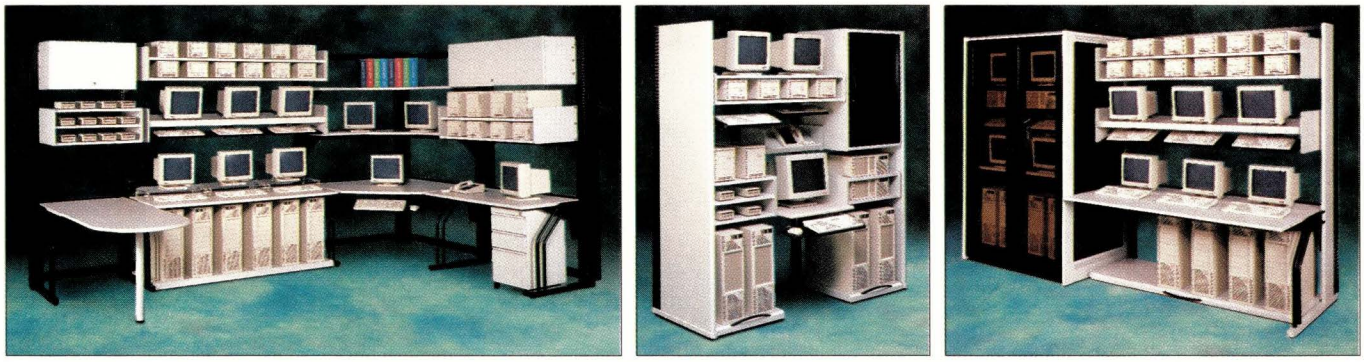

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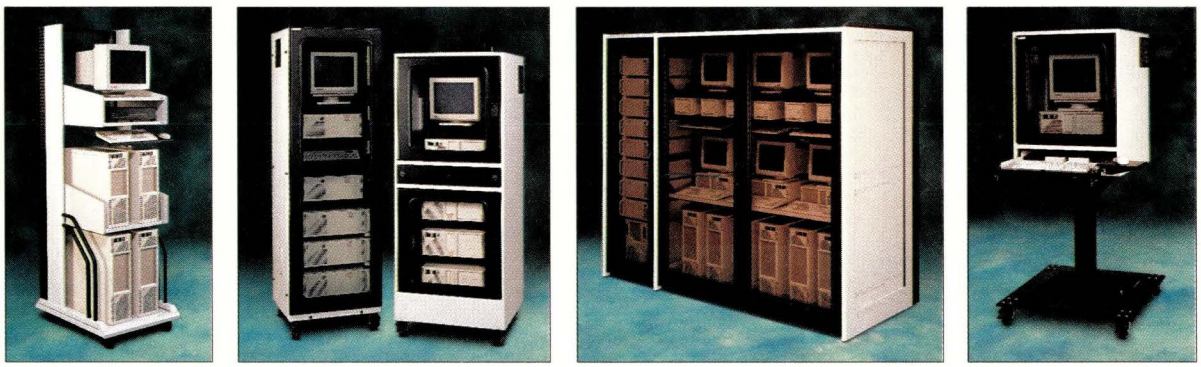

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The 100-page installation and user manual leaves a lot to be desired. While it does include enough information to get a moderately experienced administrator up and running, it is little more than a description of the command interface, with almost no troubleshooting tips, the most basic OS-specific notes and RAID level descriptions.

For technical support, the manual provides an 800 number, an FTP site and a Web site. However, the Web pages specified did not exist when we tried to access them, and the entire support section of the Western Scientific server requires registration. It took us two tries to get through via telephone, but, when we did, the support personnel were both courteous and efficient. We are told by Western Scientific that the manual has been rewritten.

Performance

We connected the Cyclone to a Sun Microsystems Computer Co. Ultra 1/170E and configured it for RAID level 3, with four data drives, one parity drive and one hot spare drive. In level 3, data is striped across the data drives and parity information is stored on the parity drive, so that if any one of the drives fails, its data can be reconstructed from the other drives. Configured with a spare drive, the Cyclone will automatically reconstruct a failed drive on the spare drive without operator intervention. Level 3 is not the fastest RAID level but offers good performance and modest data protection, fault tolerance and availability.

In this configuration, we first tested out-of-box, application-level data transfer speeds of the Cyclone–that is, without any tuning beyond what is suggested in the manual for our system. We simply sent application reads and writes to and from memory via the file system. When writing out 50-MB files in level 3, the Cyclone averaged 7.0 seconds, or 7.14 MB/s. Compare this with 5.96 MB/s for the host's internal Seagate Barracuda drive. When concurrently writing out 10 10-MB files, the Cyclone averaged 15.3 seconds, or 6.54 MB/s. Compare this with 5.39 MB/s for the Sun host.

Using an instrumented `dd`-like tool for measuring I/O performance, Western Scientific has obtained transfer rates in level 3 of up to 17 MB/s. However, these results were obtained on Silicon Graphics Inc. computers running the IRIX OS and were a measure of raw disk reads and writes. Using a similar process, Western Scientific was able to obtain 14-MB/s transfers on a Sun Ultra 170E, and we were able to confirm these numbers. You are unlikely to see these kinds of numbers in production, however.

From a technical point of view, we were pleased with the unit. The documentation, however, needs work.

We then tested RAID functionality by simulating single and multiple drive failures. On the failure of a single drive, the Cyclone emits a piercing 90-decibel audio alarm, and the front-panel LCD display instructs you to replace/fix the particular failed drive. Meanwhile, background reconstruction of the failed drive commences on the hot spare drive. The LCD display also instructs you to press one of the front-panel buttons to eliminate the alarm. Once you have replaced the failed drive, the LCD display instructs you to press another front-panel button to begin reconstruction on the new drive. Why this is not automatic is a mystery, but the front-panel instructions are a nice touch.

When faced with an unrecoverable situation, for example, two simultaneous drive failures, the Cyclone sounds the alarm and attempts to provide instructions for recovery but essentially becomes confused. However, the unit remains coherent enough that you can dismount the array for repair without bringing the host down, at least in our lightly loaded configuration.

Summary

We found the Cyclone system to be a speedy RAID solution for moderate amounts of data, which can scale to large amounts of data. Our pedestal unit was well constructed, and the controller was also designed well. The command interface language could use some abbreviations for various commands but is otherwise well done. From a technical point of view, we were pleased with the unit. The documentation, however, needs work, and the inclusion of software management and monitoring tools would be a welcome addition.

We are told by Western Scientific that a new generation of the Cyclone, which will include Ultrawide SCSI both internally and externally, should be available by the time you read this. Preliminary testing has shown as much as twice the performance of the current model.

CycloneRAID Disk Array

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Western Scientific Inc.
9445 Farnham St.
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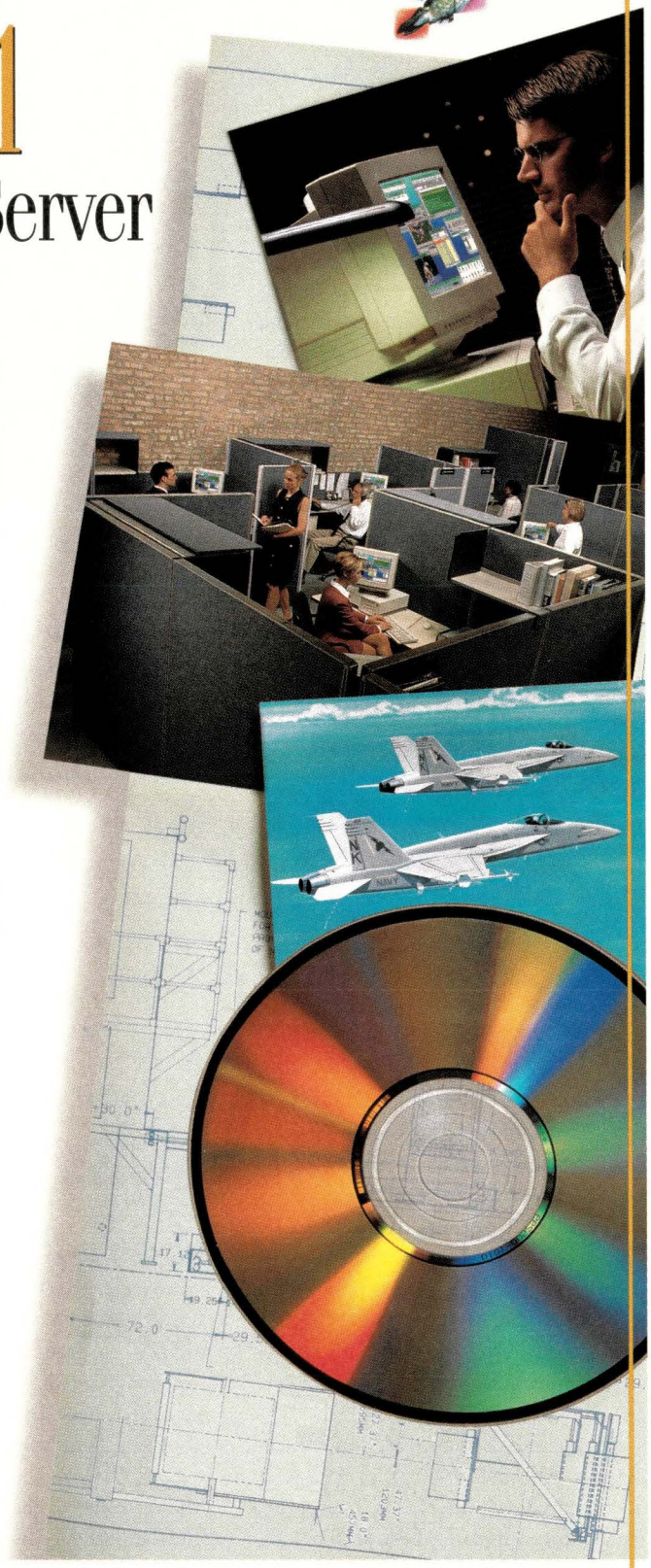

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Tatung COMPstation U2-2200 SMP SPARC Workstation

In December 1996, Tatung Science and Technology Inc. introduced four models of its Sun Ultra 2-compatible systems. The U2-1170 and U2-2170 are single- and dual-processor models based on the 167-MHz UltraSPARC, while the U2-1200 and U2-2200 are single- and dual-processor models based on the 200-MHz version of the chip. To distinguish these systems from their clonees, all models are packaged in a larger chassis (the same used for the entire U line), which gives the systems more storage capacity than the Sun models, for a total of 18 GB.

With its COMPstation U2-2200 SMP SPARC workstation, Tatung has designed a competent system with solid construction and impressive performance.

We looked at a U2-2200 equipped with 256 MB of RAM, a Quantum Corp. Atlas II 4-GB hard disk, an optional Turbo GX framebuffer and an optional Southland Media Systems Inc. MGX framebuffer, a Plextor Corp. PX-43CE quad-speed CD-ROM and a $3^1/_2$-inch floppy disk drive. Our configuration included a Sony Electronics Inc. GDM 20-inch monitor, a no-name mouse, and a Forward Electronics Co. Sun type 5-compatible keyboard.

The two processors are each equipped with 16 KB of data, 16-KB instruction on-chip caches and 1-MB external secondary caches, and the system supports up to 1 GB of main memory. The Ultra Port Architecture crossbar interconnect provides a 100-MHz system bus supporting a maximum transfer rate of 1.6 GB/s. The optional Creator Graphics framebuffer attaches directly to the UPA bus, providing up to 660-MB/s CPU-to-framebuffer peak throughput.

As mentioned, the COMPstation U systems are packaged in a slightly larger system chassis than their Sun counterparts. At 5.36 by 17.72 by 19 inches, this larger chassis allows Tatung to install more internal physical devices, most notably hard disks. The chassis itself is that familiar putty color so prevalent in the computer industry, with removable media accessed on the front panel and heavily vented side panels for heat dissipation. The rear panel is typical, with ports for SCSI-2, twisted-pair 10/100-MB/s Ethernet, two serial ports, four 16-bit audio jacks and all the usual peripheral connections.

The engineering and manufacture of the chassis was very good; everything fit, cable management was good and component access was easy.

Inside the chassis, internal storage devices are located at the front in four drive bays (only two of these can be used for removable media) with hinged and interlocking supports. The motherboard includes four (stacked) 32/64-bit SBus expansion slots (two of them were occupied by the two framebuffers in our configuration), two 128-bit UPA slots (each occupied with an UltraSPARC daughtercard in our configuration), and a 64-bit UPA slot, which can be used for the optional Creator Graphics framebuffer. The engineering and manufacture of the chassis was very good; everything fit, cable management was good and component access was easy. Overall, it had good, solid construction.

Installation is easy. Once you unpack it, all you have to do is connect the peripherals and boot. The systems come with Solaris 2.5.1 preinstalled, including OpenWindows and CDE. A number of software options are available, including the C compiler, Sun's Internet Gateway for Solaris and HTTP server, and Netscape Communications Corp.'s FastTrack server. Our 4-GB disk was partitioned into 1.47-GB swap, 100-MB `/`, 435-MB `/usr`, 150-MB `/var`, 2.03-GB `/export/home`, 320-MB `/opt` and 50-MB `/tmp`. A generic but fairly complete hardware user manual is provided as well.

Performance

The dual-processor U2 COMPstation systems are symmetric multiprocessors (SMP), meaning the operating system and applications can be distributed across multiple processors for faster execution, if so written. Multithreaded applications (applications that contain multiple executable processes) may be scheduled such that several threads execute on different processors at the same time. Thus, an SMP with *n* processors can potentially run applications *n* times faster than a uniprocessor.

However, there is system overhead to be paid and synchronization issues to resolve, which often result in much less than linear speedup. Tatung reports SPEC results of 7.88 SPECint95 and 14.7 SPECfp95 for the U2-2200, compared with 7.72 SPECint95 and 11.4 SPECfp95 for the uniprocessor U2-1200. You will notice the U2-2200 numbers are much less than twice the U2-1200 numbers, and that the second processor seems to give very little boost to the system. However, this is because the SPEC suite is not suited to measure SMP performance–adding more processors will not allow you to perform calculations faster, but perform more calculations simultaneously.

Applications must be specifically written to take advantage of SMP in order to obtain per-application performance benefits of multiple processors.

Applications must be specifically written to take advantage of SMP in order to obtain per-application performance benefits of multiple processors, and the list of Solaris applications of this type is not long. All the major database vendors are there, of course, and a number of design and analysis packages as well as development libraries and the complete line of Netscape Server products. Solaris itself contains multithreaded components, which gives the operating system a boost on SMP machines, including the Sun HTTP server. The combination of 200-MHz UltraSPARC processors and the multithreaded components of Solaris alone make the U2-2200 a speedy machine.

For SMP applications, we tested Adobe Systems Inc.'s Photoshop 3.0.1 with the MPCharged plug-in, which provides performance enhancements on multiprocessors, and ID Software Inc.'s Doom adventure game, with multithreaded image rendering. For comparison, we also ran these applications on a Sun Ultra 1/170 Creator3D, which is based on a 167-MHz UltraSPARC processor. Both applications saw a dramatic increase in performance on the U2-2200, partially due to the higher clock rate of its processors, but mostly due to the SMP architecture. For example, applying a twirl deformation to a 50-MB EPS file in Photoshop took 5 minutes 56 seconds on the Ultra 1, but only 1 minute 26 seconds on the U2-2200, a four-fold improvement.

Summary

In the COMPstation U series, Tatung has designed very competent systems in a range of configurations. We found the U2-2200 to be no exception, with solid construction and a range of hardware and software options to fit most desktop needs. Whether a symmetric multiprocessor is the right solution depends primarily on your applications, but if SMP is what you're after, then Solaris running on UltraSPARC CPUs and the Ultra Port Architecture provides impressive performance. The provided documentation was fairly good but slightly generic and light on troubleshooting tips. Technical support is not extensive, but is generally responsive. In addition, Tatung has partnered with Computervision Corp. to offer Tatung systems support. ⊸

COMPstation U2-2200

Company
Tatung Science and Technology Inc.
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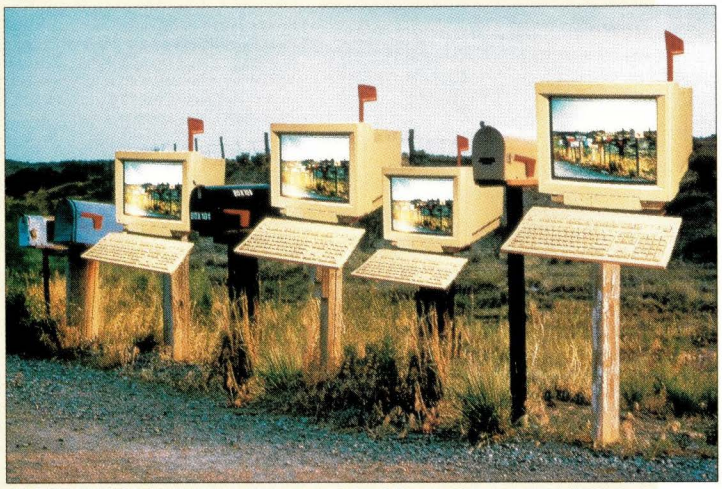

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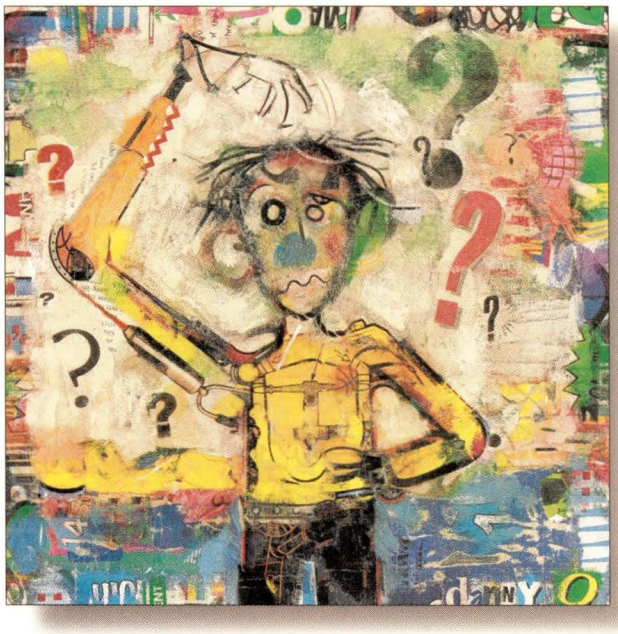


Keeping an Eye on Those Daemons

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: I am responsible for administering a growing assortment of AIX systems. It is becoming increasingly difficult to keep a careful eye on them all. Most of them have email service. Some of them have World Wide Web servers. One has a homegrown database server. Is there any automatic way to keep track of all the systems and services?

John Sebastian
City Networks Inc.

A: Those daemons can be hard to keep track of all right. Here at the University of Washington we have the same problem. If your situation is similar to ours, you might be interested in what we've done.

Our group has responsibility for a couple of hundred UNIX systems (and some non-UNIX ones), each with a bunch of daemons, data servers and other processes that must be constantly running. In addition, there are more general network services that have to be monitored. Is `sendmail` delivering mail on your system? Are the Web servers serving Web pages?

You didn't say whether or not your site has any operations staff, or if you have to monitor the systems during lights-out operations. In our computer room, there is always at least one operator keeping an eye on things around the clock. That sometimes lonely operator needs help watching all the daemons. That's where Argus comes in.

Argus, a set of programs, watches all the daemons on all the machines and alerts the operator when something is amiss. Help text accompanying the alert messages explains how to fix any problem that occurs. The efficacy of the help text is of course dependent upon the competence of its author–that would be you.

A sample Argus window, an X11 client, appears in Figure 1. Each monitored service

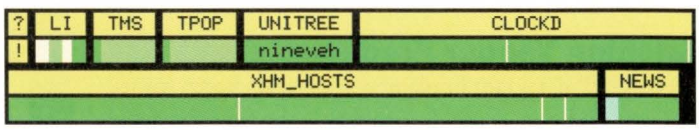
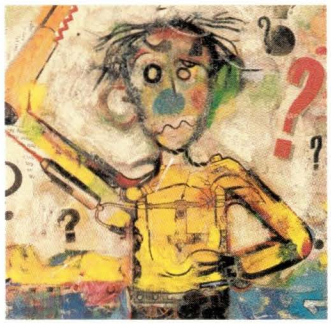


Figure 1. This is an example of an Argus display showing all servers running normally.

appears as a label, below which are color indicators that show the status of that service on many different hosts.

The display appears simple and takes up little real estate on the screen, but there are actually 410 indicators on that little window in Figure 1!

I like my indicators and monitors to be as small as possible, especially when everything is OK. I mean, I have other things to do, other uses for my precious window space. The indicator windows used by Argus can be reduced to one pixel wide by a few tall. And, yes, you can still see them. This way, I get those 410 windows into a $^1/_2$- by 6-inch area on my monitor. It's very convenient.



Argus takes a strictly active approach to daemon monitoring. It sends a UDP datagram asking, in essence, "How are you?" It expects to get back a UDP datagram indicating, on a scale of zero to nine, how well the daemon is functioning. Zero indicates very well; nine very poorly; and one through eight somewhere in between. There are actually a couple of other states: no response and out of service. The reply datagram also contains a human-readable ASCII message that provides more detail.

Argus uses this "feel good" value to color the background of the corresponding window. In cases where the status represents an urgent condition, a status popup message will appear that shows what's wrong with the daemon. Figure 2 shows an example status message.

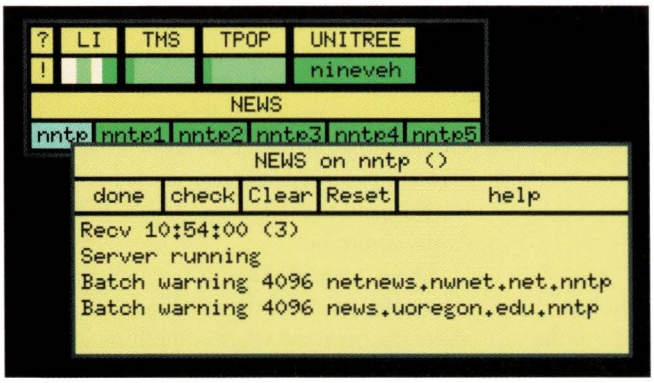


Figure 2. This is an example of an Argus display showing the detailed status of a server.

The net effect of all this is that you normally have a small, solid green panel indicating all is well. When something bad happens, you see an obvious popup that shows the problem and explains what might be wrong and how you can fix it.

Watching Vendor Products

The UDP datagram implementation was chosen for its simplicity and ease of use. It is probably the simplest network interface and fits easily into the operation of most servers.

However, there is a class of services that don't readily adapt to this scheme: those servers that you buy from a vendor and don't have source code; or maybe you have the source but don't want to hack it up. A separate tool (Argmon) works with Argus to monitor those services. Argmon contains the necessary code to respond to Argus' queries but gets all its information from server-dependent scripts or programs, running as child processes. Our Web server watcher is illustrative.

We have a cluster of similar machines that serve the Web host `http://weber.u.washington.edu/`. Each request for a page from `weber.u.washington.edu` connects to one of these "webers" at random. If one of these machines is out to lunch (technically speaking), the Web browser gets an error message, the user attempts to reconnect, gets a different machine, and continues working. As a result, we tend not to hear about problems in a timely manner.

Our Web servers are from Apache, and they respond to a request for the page `http://`*hostname*`/status?auto` with a canned message indicating the server's status. It looks like this:

```
Total Accesses: 407126
Total Bytes: 3891958780
CPULoad: 0.058009
Uptime: 82516
ReqPerSec: 4.9339
BytesPerSec: 47166.1
BytesPerReq: 9559.59
Scoreboard:

KKKW_W_RKKW_KK_K_W_K.__KWW_W
.............................
.............................

BusyServers: 23
IdleServers: 17
```

It's a succinct bit of information that can be processed by a script quite easily. Such a script is shown in Figure 3.

You can see how the "how are you" status level is coded into the message (second byte). The Argmon program will relay this message to Argus. As long as the servers are responding, Argus will see a status of "`0`," and I will see a cool green band on my X terminal. A more sophisticated script might interpret the rate information and return a status ranging from zero through nine. Then you could tell, just by noticing the color of the indicator window, the activity of the server.

The script contains a couple of instructive tricks. You can connect to any Web server and retrieve a page by telneting to the server's host, specifying the appropriate port, usually port 80 for Web servers. Case is important.

Also, `telnet` will read input from a pipe and can therefore

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be used in scripts, but you must be aware of a couple of restrictions. First, it closes the connection on an end-of-file in the input stream. That `sleep` keeps the connection open long enough for the other end to do its work and reply. Second, `telnet` needs a `TERM` defined. If your script is started by `cron`, there is no default `TERM`.

Check It Out

If Argus looks like it might solve your problem, you are welcome to check it out. See the Web page at `http://weber.u.washington.edu/~fox/Argus/`.

Argus was named for the many-eyed creature from Greek mythology, sent by Zeus to watch over Io. Be like Zeus. ⊸

Figure 3. Example Script

```
#!/bin/ksh
# Test apache web server
# Return status in Argus syntax
server=$1
now="`date '+%H:%M:%S'`"
mode=0
export TERM=dumb
(echo "GET /status/?auto"; sleep 5) | \
    telnet $server 80 | \
    while read i
    do
       case $i in
          "Total Access"*) # start of good stuff
                mode=1;
                print "x0Web server OK"
                print " "
                print "Time: $now"
                ;;
          Score*) # end of the good stuff
                mode=2;
                ;;
          esac
          case $mode in
             1) print $i;
                ;;
          esac
    done
    case $mode in
     0) print "x9Web server not responding."
        ;;
    esac
exit 0
```

by Æleen Frisch

Keeping the Herd Up-to-Date

Æleen Frisch *is Systems Wrangler for a very heterogeneous network of computers and workstations. She is also the author of the book* Essential System Administration *(O'Reilly & Associates Inc., now in its second edition). In her spare time, she enjoys painting and lounging around with her cats, Daphne and Sarah. Email:* aefrisch@lorentzian.com.

When you have more than just a few systems to take care of, even simple, routine systems administration tasks can become very time-consuming and overwhelming. Adding a new user to one system is easy, adding him to 10 systems is boring and repetitive but manageable, but if you have to add him to 50 systems, you'll spend a lot of time wishing for a better way. Similarly, adding a new host to the hosts files on a small network is not a big deal, but keeping the hosts files synchronized on even a medium-size network can be a substantial task.

The Network Information Service (NIS, also known colloquially as the Yellow Pages) is one solution for such dilemmas. It is designed to allow a single set of system configuration files to be used by a group of systems, thereby centralizing their administration and control. However, NIS has two important limitations that make it unsuitable for many sites:

- NIS has significant security problems.
- It is difficult or impossible to manage other, site-specific shared files beyond traditional UNIX system configuration files.

The `rdist` facility offers another way to keep system configuration and other files up-to-date across a set of systems. AIX provides a version of `rdist`, and there is also a freely available version.

How rdist Works

`rdist` is designed to automatically update one or more specified sets of files to a group of networked computers. `rdist`'s actions are controlled via a configuration file, conventionally named `distfile` or `Distfile`, whose syntax is similar to that used in `makefiles`. A `Distfile` contains two kinds of entries: variable definitions (primarily designed to make the file easier to read) and file update specifications. The latter have the following general syntax:

```
label:
        files  -> destinations
        subcommand;
        ...
```

The *label* is optional and serves to assign a name to the entry, which may be used by a subsequent `rdist` command to execute the operations for that entry. The second line specifies the files to be copied from the current host and the desired destination systems. One or more optional sub-

commands may follow the file update specification. All subcommands are terminated by a semicolon.

For example, the following entry would direct rdist to distribute the hosts and hosts.equiv files to systems dalton and hamlet:

```
FILES = (/etc/hosts /etc/hosts.equiv)
HOSTS = (dalton hamlet)
hosts:
        ${FILES} -> ${HOSTS}
        notify netadm;
```

The first two lines of this entry define the variables FILES and HOSTS by equating them to parenthesized lists of items, in this case, file names and host names, respectively.

The hosts: label introduces the entry, which says to update the specified files on the specified hosts. Note that variables are dereferenced (expanded) by placing them in curly braces preceded by a dollar sign. The final line of the entry illustrates the use of rdist's notify subcommand, which tells the facility to send mail to the specified user whenever the entry is executed.

The following rdist command would perform the updates corresponding to the entry we just examined (asssume that the distfile is in the current directory):

```
# rdist hosts
```

The rdist command has several useful options:

-n	Displays actions that would be taken without actually performing them (useful for testing and debugging purposes).
-y	Only updates files that are older than the new ones.
-v	Verifies that files on remote systems are up-to-date.
-f *file*	Specifies an alternate distfile.

Listing 1 illustrates a more complex distfile containing multiple entries. The file begins with several variable definitions for lists of files and hosts. As these examples illustrate, shell wildcards are allowed in file lists (see the RS_FILES and DB_FILES variables), and lists themselves may be included in subsequent lists (see the ALL_HOSTS variable).

The hosts entry in Listing 1 is equivalent to our previous example. The aliases entry updates the systemwide mail aliases file. The special subcommand that concludes the entry causes the newaliases command to run on each destination system after the file /etc/aliases is updated. Note that the full path name for the command is given–an essential security practice–and that the command is enclosed within quotation marks.

The next three entries are used to update the password files in a heterogeneous network of systems. Some of the systems use only the standard password and group files in /etc; others use a standard shadow password file, /etc/shadow, for example; and still others are AIX systems using the standard files as well as those in the /etc/security subdirectory.

The PASSWD_FILES, SHADOW_FILES and RS_FILES variables specify the user account files by these three types of systems, and the PWD_HOSTS, SHADOW_HOSTS and RS6K_HOSTS variables create lists of systems of each type.

The passwd entry simply updates the password and group files on the designated hosts, and the rs_passwd entry similarly updates these files and the user-account related files in /etc/security. The shadow entry updates the password file, shadow password file and group file for systems using the standard UNIX shadow password file.

The special form of the /etc/passwd file needed with a shadow password file is stored on the local system as /etc/

Listing 1. A Complex distfile

```
HOST_FILES = (/etc/hosts /etc/hosts.equiv)
ALIAS_FILES = (/etc/aliases /etc/mailrc)
PASSWD_FILES = (/etc/passwd /etc/group)
SHADOW_FILES = (/etc/passwd.shadow /etc/group /etc/shadow)
RS_FILES = (${PASSWD_FILES} /etc/security/{passwd,group,user})
DB_FILES = (/usr/chem/data/*)

PWD_HOSTS = (hamlet ophelia laertes puck hermia iago)
RS6K_HOSTS = (dalton mendel newton dirac)
SHADOW_HOSTS = (vorlon zahadun)
ALL_HOSTS = (${PWD_HOSTS} ${SHADOW_HOSTS} ${RS6K_HOSTS})

hosts:
    ${HOST_FILES} -> ${ALL_HOSTS}

aliases:
    ${ALIAS_FILES} -> ${ALL_HOSTS}
    special /etc/aliases "/usr/bin/newaliases";

passwd:
    ${PASSWD_FILES} -> ${OTHER_HOSTS}

rs_passwd:
    ${RS_SHADOW_FILES} -> ${RS6K_HOSTS}

shadow:
    ${SHADOW_FILES} -> ${SHADOW_HOSTS}
    special /etc/passwd.shadow "/bin/mv /etc/passwd.shadow /etc/passwd";

db:
    ${DB_FILES} -> ${ALL_HOSTS}
    except /usr/chem/data/db.old;
    except_pat ( /dev /scratch \\.junk\$ );
    notify dbmgr;
```

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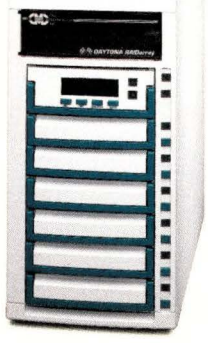

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passwd.shadow, and the special subcommand in this entry renames the target file on each destination system. Note that once again full path names are used in the command to be executed.

The final entry in Listing 1 updates some files that are specific to this site. This entry updates the files in the /usr/chem/data subdirectory (including any component subdirectories) specified by the DB_FILES variable–except the file db.old (via the except subcommand)–files in the directory's dev and scratch subdirectories, and any files with the extension .junk.

The except_pat subcommand excludes all files matching any of the regular expression patterns included in its parenthesized list. Note that special characters must be escaped. The final subcommand causes mail to be sent to the user dbmgr on each destination system when the entry is executed.

More recent versions of rdist use two distinct executables for the server and client sides of the operation.

Flavors of rdist

The version of rdist distributed with AIX is the same as the one that was part of the 4.3BSD operating system. It consists of a single executable, rdist (usually located in /usr/bin or /usr/ucb), which is SETUID to root. This scheme has significant security problems. Thus, more recent versions of rdist use two distinct executables for the server and client sides of the operation, and rely on the /.rhosts mechanism rather than SETUID root–which is somewhat less problematic. It also adds the cmdspecial subcommand, which executes a specified command on the remote host when all of the files in an entry have been updated, an oft-requested enhancement.

The latest version of rdist is 6.1.3 and may be obtained by anonymous ftp to usc.edu, retrieving the file /pub/rdist/rdist.tar.gz. It can be built via the following steps:

- Uncompress the file (you may need to get gzip from any GNU archive source) and untar the source directory in some convenient location. Read the README file for the latest information about the package.
- Save the current version of rdist by renaming /usr/bin/rdist to usr/bin/rdist.old, or some other name.
- Edit the Makefile.local file, setting the value of the BIN_DIR variable to /usr/bin.
- Edit config/config.h, setting any desired options.
- Edit config/mf.aix3, changing the value of the INSTALL variable to /usr/bin/install, if necessary.
- Edit include/paths.h, changing the value for _PATH_REMSH to /usr/bin/rsh (not /usr/ucb/rsh).
- If your system is running AIX Version 4, execute the following commands:

```
# cp config/os-aix{34}.h
# cp config/mf.aix{34}
```

(If you are not running the C shell, you'll have to expand the curly braces wildcarding yourself.)

- If your system is running AIX Version 4, edit the file src/comon.c, changing one line in the mysetlinebuf(fp) routine (occurring at around line 977):

```
return(setlinebuf(fp));
```

becomes

```
setlinebuf(fp);
```

- Run the make command (from the top-level rdist directory) and then run make install to install the new software. You can safely ignore compiler warning messages that appear under AIX 4. Note that the rdist executable is owned by user root, the rdistd executable is owned by user bin, and both are protected 555–neither is SETUID.
- Repeat the process on each host where you want to use rdist, and set up an /.rhosts file on each destination host containing the true (first) host name of the system containing the master files.

Once these steps have been completed and you have set up your distfile, rdist is ready to use.

by John S. Quarterman

USENIX Conferences

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`, *by voice at (512) 451-7602 or by fax at (512) 452-0127.*

What does the color purple have to do with UNIX and the Internet? Well, for thousands of years, purple was only made by an expensive process starting with a scarce natural resource, which was why it was the color of royalty; only kings and princes could afford it. Then, a chemist was experimenting for an unrelated purpose and happened to spill the latest mixture on his sleeve, which promptly turned royal purple.

Serendipity, facilitated by the leisure to experiment. The UNIX community used to be known for that sort of thing, back in the early academic and government research days, and even in the early Internet days. Network File System, the X Window System, Perl and any number of other favorite hacks and facilities came about because somebody had the time to play around with ideas and resources and come up with something new.

There's Bill Joy and Berkeley sockets, for example, which became the de facto standard programming interface for TCP/IP and other protocols. To a significant degree, there's the Internet itself, for that matter. Without Berkeley UNIX, the Internet would not have arrived the way it did, and without UNIX, it surely wouldn't have spread the way it has.

So it is somewhat ironic to note, as James Gosling did in his keynote speech at the 1997 USENIX Annual Technical Conference and USELINUX, held January 6-10 in Anaheim, CA, that the Internet is the strongest factor currently reducing the leisure to experiment. He said he had a couple of years to play around with Java before anybody knew about it and, thus, he had time to go through several iterations of design and implementation. But with the Internet accelerating product cycles, few vendors have such luxury anymore. Three years from conception to product is almost unheard of now. A few years ago, 18 months was considered fast. Now, it can be eight months or less.

In the old days (maybe five years ago), products commonly went through a cycle of alpha testing (a few people who could be counted on for major feedback), beta testing (a larger group, many of them outside the producing organization, for fine-tuning) and final product release. These days an alpha release is often made available over the Internet to all comers, many of whom immediately start using it in production. Anything called a beta release is probably what most people use daily; who really waits for a final release of a Web browser like Netscape?

This speedup reduces room for maneuver.

Large numbers of alpha users mean many people who will not take kindly to modifications of existing facilities in the next release. It also means dank caverns of overworked programmers trying to outcompete the next start-up by staying up all night at the office.

So what do you do? Work smarter, if you can. That was one of the incentives for Java. Porting software to multiple platforms takes time and effort that could be devoted to producing new software or improving the old. Compilation similarly adds time and introduces complications. So a programming language that is interpreted on multiple platforms should be a big win. Particularly if you're trying to promote speed and changeability as weapons against the monolith with a quick-thinking absolute dictator in Redmond, WA.

Is this a vicious circle? Trying to win at the speed game by producing a facility that permits even more speed? Perhaps; perhaps not. I can say it was interesting to hear such thoughts from one of the people at the center of the whirlwind.

Gosling had some amusing comments on other subjects as well. He argued that Emacs is still the best program editor. There are lots of GUI programming environments, but when it comes to actually modifying code, Emacs is still the winner. (If you prefer `vi`, substitute it for Emacs and the argument is still the same.) Why? Programs are procedural; pictures are not.

The Conference

This was the 15th year or so of USENIX conferences. The USENIX Association is the oldest of all UNIX user groups. It is so old that there were more former board members milling around than current ones, by a sizable factor. You could spot them (well, I could, being one) by a certain shake of the head or raised eyebrow when certain topics came up. Serving time on the board of any volunteer organization leads to a modicum of disillusionment, but the amazing thing is that so many have survived their sentence and still appear at the conferences. There really is such a thing as the UNIX community, and this is the center of it.

The next conference is summer 1998 in New Orleans. Why a year and a half between? Are they petering out? No, merely switching from a winter to a summer schedule. Yes, there used to be two per year, but that was before LISA (Large Installation Systems Administration) grew from a workshop to a conference, not to mention security and all the smaller ones. USENIX is in some sense a victim of its own success. It has so many successful venues that it has to balance them all. Even so, the main conference reliably draws some 1,500 people year after year, as does LISA. Nor is the association hurting for money, either. The number of attendees may not be going up, but their affluence is.

So is this, as some attendees opined, merely a computing ghetto, or a sideshow

beside the Microsoft big top? Maybe, but I prefer these clowns to those. And no doubt you're aware that the majority of Internet servers run some form of UNIX.

UNIX Books

"Is there a bookstore nearby?" I asked the hotel gift shop clerk. "Sure, four blocks that way there's a Target," she replied.

I used that little exchange for a joke all week. To be fair, the hotel had a shuttle that went to several shopping centers, one of which has a Barnes and Noble bookstore, but Orange County is more noted for Disneyland (right down the street) than for books.

So it was amusing for me and Peter Salus and Mike Padlipsky (author of *The Elements of Networking Style*–for a bibliography of Mike's work, see `http://world.std.com/~wdr/map-bib.html`) to sit in the lobby bar and discuss the writing of network history. Padlipsky is quite the primary source himself. It seems he may have had as much to do with inventing networked electronic mail back around 1972 as Ray Tomlinson did, not to mention that Padlipsky invented anonymous FTP.

Salus has written the pair of basic UNIX and Internet history books, (*A Quarter Century of Unix*, Addison-Wesley, 1994, ISBN 0-201-54777-5, and *Casting the Net*, Addison-Wesley, 1995, ISBN 0-201-87674-4) and is now working on something similar for programming languages. I'm working on the second edition of *The Matrix* (`http://www.mids.org/matrix/second/`), so that I can augment some of the history that Salus expanded in his book from the sketches I had in the first edition.

This is one of the advantages of a conference of this type. It's small enough that you can find people, and people like Mike Padlipsky will show up if requested. Yet it's large enough that quite a few interesting people are present, such as Dennis Ritchie, Linus Torvalds, Sam Leffler and Rick Adams. It's a veritable *Who's Who* of the last 25 years of UNIX. Penniless students mingle in similar dress (suits are not popular) and on equal terms with captains of industry. The rankest newbie can talk to the eldest old-timer and expect to get a response.

All four authors (me, Keith Bostic, Michael J. Karels and Marshall Kirk McKusick) of *The Design and Implementation of the 4.4BSD Operating System,* Addison-Wesley, 1996, ISBN 0-201-54979-4 (`http://www.mids.org/44book/`) were there as well, and our hordes of book-signing fans (both of them :-) chased us down for autographs.

The Program

You've probably noticed that I haven't said much about the program. That's what proceedings are for! Order yours from `http://www.usenix.org` or write to USENIX Association, 2560 Ninth St., Ste. 215, Berkeley, CA 94710, or to `office@usenix.org`.

It was a refereed technical conference,

with an academic-style program committee and chair. Topics of discussion include file systems, compilers, debuggers, environments, performance, standards, tools and caching.

In addition, there was an entire track of invited talks by experts such as Charles Perkins of IBM Watson on "Mobile IP," Margo Seltzer of Harvard on "Performance Measurement," and Rob Pike of Bell Labs on "Inferno," his latest distributed operating system, which was distributed on CD-ROM to all attendees. This track solves the problem of many interesting topics not being amenable to the technical paper format of a well-defined problem and its solution, not to mention drawing in people who might not have taken the time to submit a regular paper.

Linux was heavily represented at this year's conference, perhaps in a bid for the various Linux user groups to merge, or at least coordinate, with USENIX.

It's Not a Bug, It's a Feature

Slightly idiosyncratic features included:

- The Guru-Is-In sessions, in which the elders hand down pithy wisdom.
- The Works in Progress sessions, in which anyone can stand up and talk for 10 minutes about anything, finished or not.
- Evening informal birds of a feather (BOF) meetings.
- The terminal room, which had half a dozen Suns and a couple dozen PCs running Linux–this was apparently the first all-UNIX USENIX terminal room.
- There was a vendor exhibit that was small but had technically astute booth staff.
- Instead of one evening reception there was food every evening, in honor of the stellar Anaheim nightlife. Judy DesHarnais, the ever-competent meeting planner, even brought in papier-mâché animals one evening for decoration.

Many attendees go to these conferences to pick up new information, skills or software in the technical sessions or at the vendor exhibits, and that's a very good reason. I go to hear more contextual talks such as Gosling's, and to ask people directly about specific technical problems. And to shmooze; after all, where else can you find more than one person who actually used the original Emacs written in TECO, or a third of the key people who started EUnet in Europe, or where can you hear Mr. Protocol talk about the steam bubble as big as a school bus?

The quickest technical tip I got was in the terminal room: How to make Java work under Linux, see `http://www.blackdown.org/Howto/Howto.html` for the details.

It's a Matter of Taste

If you want to be part of a big crowd, go to Comdex. If you want networking suits, go to Interop or Internet World. If you want an intense schedule and a small group of knowledgeable people from half the world, go to ROSE in Romania or APRICOT in Hong Kong. It's all a matter of taste. But for the UNIX community's annual get-together, go to USENIX. ⊸

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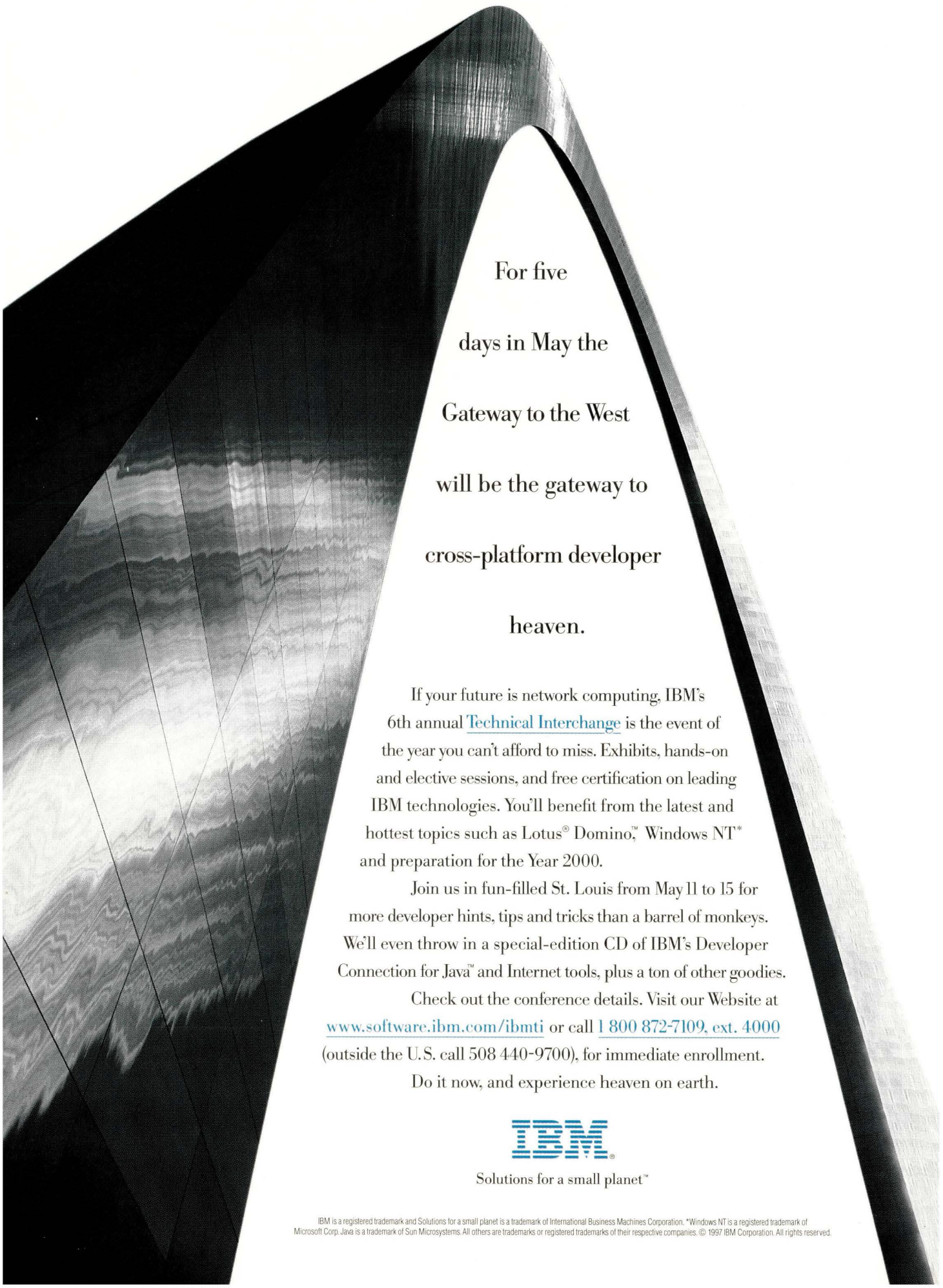

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by Jim DeRoest

Distributed File System

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

"The network is the computer," or is it "The computer is the network"? Either way it means relying heavily on network-based file systems to facilitate pervasive access to data. Increased demand for network file system services are posing a number of interesting scaling and security problems to systems administrators:

- How will you manage mount permissions?
- How will you enforce common views of file system directory structures?
- How will you authenticate and authorize access to sensitive data?
- Will file and/or record locking be required?
- How well will your server and authentication infrastructure scale?
- What are the security implications of your chosen architecture?

Most current UNIX network file system implementations are based on Sun Network File System Version 2. NFS 2 is ubiquitous across most operating systems and is easy to deploy and administer. On the downside, its stateless nature introduces scaling limitations when it comes to locking and file system metadata updates. NFS can also be difficult to manage when attempting to maintain consistent file system views in networks where administration is distributed. In addition, NFS can impose limitations on advanced access controls available in newer file system architectures.

DFS Technology

In the late 1980s, the Open Software Foundation (OSF) went looking for a network-based file system architecture to address some of the limitations inherent in NFS. The file system had to be statefull to better support access control and locking in a distributed environment. Improvements in caching, replication and cloning were desired to improve performance and availability. A centrally managed directory structure was needed to enforce a common file system view between participating systems, without restricting flexibility and access.

These are features exhibited by the Andrew File System (AFS) architecture. The OSF selected AFS Version 4 from Transarc Corp. as the basis for its Distributed Computing Environment (DCE) Distributed File System (DFS) technology. Whew, too many acronyms this early in the column.

Conceptually, DFS is enhanced AFS. DFS takes the features offered by AFS and

marries them to the other OSF DCE services that make up a tightly integrated client/server computing environment. DFS relies on other DCE services to coordinate communication, access control and synchronization. These services include the DCE Remote Procedure Call (RPC), DCE Security Service, DCE Global and Cell Directory Service and DCE Distributed Time Service. These DCE servers must be configured and started before you can begin working with DFS.

DFS File System Structure

DFS shared file system trees are similar to AFS in that a common root is identified with the next lower level delimited by cell name. The DFS shared root is named `/...` and cell subdirectories follow as `/.../cellname/` (the shorthand strings to indicate the local cell are `/.:` and `/:`). Clients only need mount the root `/...`-level DFS space to access all filesets exported by DFS file servers in the cell space (see Table 1).

Table 1. Path Name Comparison

AIX	DFS
/u/deroest/.kshrc	/.:/u/deroest/.kshrc
	/.../[CellName]/u/deroest/.kshrc

A DFS file system mount point is similar in concept to an NFS or UNIX file system mount point. Instead of using a directory as the mount point, DFS uses an object as the mount interface. As an end user, you won't be able to tell the difference between a mount point directory and an object.

DFS is a cached file system. Frequently accessed files and directories are cached on the client either in memory or on disk. Client cache consistency is maintained via a token-passing mechanism complete with callback for synchronizing shared access to file metadata. DFS servers control the right to file access tokens, which must be acquired by a client before modifying data. DFS also supports both scheduled and release (manual) file system replication.

Under AIX 4 and DCE 2.1, you can also export an AIX CD-ROM file system from a DFS file server. The exported CD-ROM file system can be mounted into the DFS file space and accessed from DFS client machines. In addition, DFS supports file system sizes greater than 2 GB.

Access Control Lists

Access control is delegated by administrative domains called DCE cells. DFS users (principals) are identified uniquely and globally by cell so that problems with UID and GID collisions are eliminated. Principals in a cell authenticate themselves via the DCE Security Service based on the Massachusetts Institute of Technology Kerberos Version 5.

Access control lists (ACLs) are used in DFS to manage access permissions to directories and files. DCE ACLs work a bit differently than what you may expect from dealing with standard UNIX permissions. ACLs are applied to containers and objects. DFS containers are directories that contain objects (files) or other containers. By default, directories and files inherit the container ACL of the directory under which they reside. You can set specific ACLs for users, groups and others using the `acl_edit` command (see Tables 2 and 3).

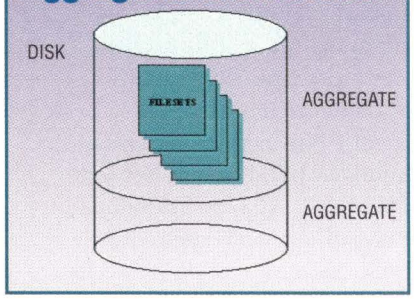
Table 2. ACL Permissions

r	Read
w	Write
x	Execute
c	Control ACL
i	Insert (meaningless for files)
d	Delete (meaningless for files)

Table 3. ACL Types

user_obj	The user who owns the object.
user	The user username from the local cell.
foreign_user	The user username from the foreign cell cell_name.
group_obj	Members of the group that own the object.
group	The group group_name from the local cell.
foreign_group	The group group_name from the foreign cell cell_name.
other_obj	Users from the local cell who do not match any preceding entries.
foreign_other	Users from the foreign cell cell_name who do not match any preceding entries.
any_other	Users from any foreign cell who do not match any preceding entries.
mask_obj	Mask for maximum permissions that can be set. Except for group_obj and other_obj.

Figure 1. DFS Aggregates and Filesets



ACLs are very nice in that they can be set up by the owning user. A systems administrator only has to worry about system default ACLs that are required to ensure general security. Remember that ACLs only apply to DCE LFS filesets.

In order to gain the full benefit of DFS services and take advantage of ACLs, you must use the DCE Local File System (LFS) as the underlying physical file system for DFS. The LFS architecture comprises aggregates–which are analogous to UNIX disk partitions and filesets–that are collections of related files and directories (see Figure 1).

LFS is a log-based file system similar to the AIX Journaled File System. All file system metadata updates are grouped and logged as atomic transactions. Groups of transactions against a

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single object are also grouped into an equivalence class to facilitate recovery. The transaction equivalence class ensures that either all or none of the updates will be applied during system recovery.

DFS filesets may be moved between LFS aggregates while maintaining online access via a procedure called fileset cloning. Space must be available in the partition to build a copy of the fileset. The cloned fileset is marked read-only and kept up-to-date via copy-on-write procedures until the move is complete.

Filesets may also be replicated. Think of this as somewhat like cloning between computers over a network. Cloning and replication along with logging and dynamic aggregate sizing provide a highly available file system architecture that is easy to administer.

VFS and NFS Compatibility

Any Virtual File System (VFS) that has been enhanced to support DCE VFS+ can be exported by DFS file servers. DFS also provides an NFS protocol exporter to provide DFS file system access to NFS clients. An NFS client may have difficulty working with DFS ACLs in the exported file system because it does not have a way to get a DCE context. What you have to do is set default ACLs that cause a slight security exposure. Everyone's friendly on the Internet so who worries about security?

The solution is to use the AIX NFS/DFS Authenticating Gateway, which maintains DCE credentials on behalf of NFS clients to satisfy ACL permission restrictions. To use the authenticating gateway, install the `dce.dfsnfs.rte` fileset. Note that I'm talking AIX installation fileset vs. DFS fileset. DFS, AFS and NFS may also be used independently on a DFS file server. Given these capabilities, you should be able to easily integrate DCE DFS into existing NFS and AFS environments.

DFS requires a number of servers for coordinating file system activities in a cell. These servers can be distributed and, in some cases, replicated across a number of machines or they can be run on a single computer. I'd avoid doing the latter unless you are running a very small cell. The gaggle of DFS components include the following:

- **System control machine** (SCM) is responsible for housing and distributing the administration lists. These lists determine which principals (users and machines) can issue requests to the DFS servers.
- **Binary distribution machine** distributes `/usr/lpp/dce/bin` executables to other server machines in the cell of the same architecture (CPU/OS).
- **DFS fileset database machine** (FLDB) runs the `flserver` process, which is responsible for maintaining information on all filesets available in a cell. All DFS file servers must register their filesets with the FLDB. The FLDB maps path names to the associated file server and make this information available to DFS clients.
- **File server machine** runs the fileset exporter, which makes filesets available to DFS clients.
- **Fileset replicator machine** manages fileset replication in a domain. It is primarily responsible for handling scheduled replication. Replicas improve availability of critical filesets in a domain.
- **Backup database machine** (BDM) manages the dump schedules of all the fileset families requiring backup services.
- **Tape coordinator machine** controls physically-attached dump devices and makes them available for use by the BDM.
- **DFS clients** access filesets exported by the DFS file servers. A client contacts the FLDB to find the DFS file server which is exporting the desired fileset.

DFS Installation

One of the first things you will want to do when installing DCE and DFS is to create a separate file system for `/var/dce`. Nearly everything that DCE services create is stored in the `/var/dce` directory. For DFS, the big hitter will be on-disk cache. Creating a separate `/var/dce` will cut down on grumbling later on when you start running out of space in the root partition. This should preferably be done before you install DCE or any components. You will need to regularly clean out expired credentials and audit files from this file system, so consider adding these tasks to `cron`.

After installing the required DCE and DFS filesets, use SMIT to configure DFS components (see Table 4). Command-line tools are available for administering DFS. However, I would recommend using SMIT until you are comfortable with the environment. Most of the AIX on-line documentation is directed at using SMIT to manage the DFS environment.

Table 4. AIX DCE/DFS Packages, Filesets

`dce.client`	DCE client
`dce.dfs_server`	DFS server
`dce.dfsnfs`	DFS/NFS authenticating exporter
`dce.doc`	On-line documentation
`dce.edfs`	Enhanced DFS services

First, configure one or more SCMs. Each SCM will control an individual domain in the cell. Second, configure one or more FLDB systems for your cell. Multiple FLDBs will improve availability and share the workload of client requests. One or more DFS file servers will be required to export DFS aggregates and filesets. To perform periodic DFS backups, create one or more DFS BDM(s).

After completing DFS installation and configuration, verify that all the DCE and DFS services to be run on each machine are listed in `/etc/mkdce.data`. Check `dfstab`, and use `dfsexport` to verify aggregates and fileset exports. Invoke `fts_lsfldb` to display fileset and server information recorded in the FLDB. If you make a mistake, it'll be easier to delete all client and server information using `rmdfs` and `rmdce` than to correct a particular entry.

Creating Aggregates and Filesets

With DCE and DFS servers in place, you can begin creating aggregate logical volumes to hold the LFS filesets. It's probably easiest to use SMIT to do the whole process. If you decide you want to use the `newaggr` command-line option, remember that you will need to create a logical volume device

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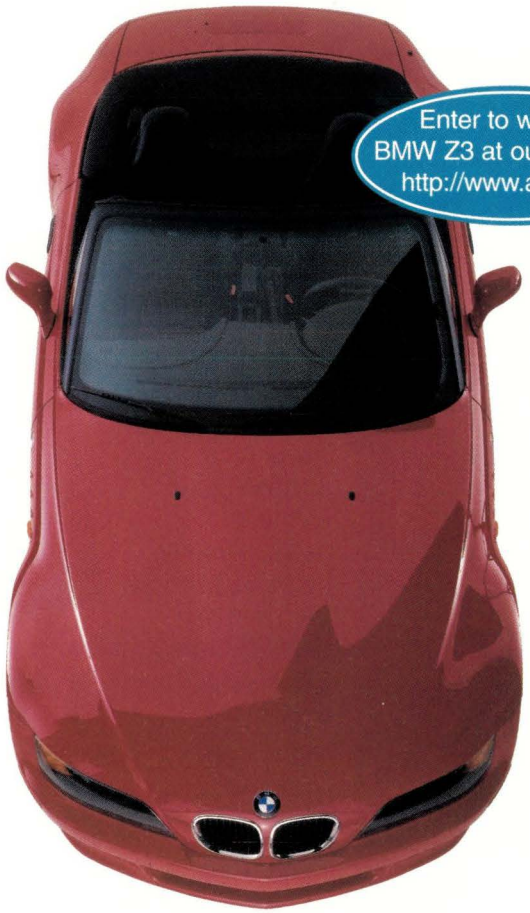

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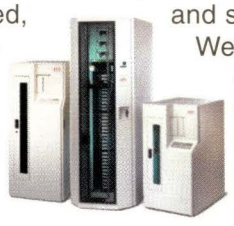

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first to map to the aggregate. If you set the logical volume type to `lfs` within SMIT, then the aggregate creation will be handled for you. You might also want to tune the aggregate block size to match the intended use of the file system. For example, use a small block size for file systems that will hold many small files.

Now create filesets in the aggregate. The first fileset that must be created is the root fileset named `root.dfs`. The fileset name is entered in the `FILESET` field on the SMIT menu and can be any text string with the exception of the root fileset. You will also need to specify a mount point for the fileset. In the case of the root fileset, this is automatically set to `/.:/fs`. Once the fileset is created, an entry is placed in `/opt/dcelocal/var/dfs/dfstab`.

Export newly created aggregates and filesets either via SMIT or by using the `dfsexport` command. Along with making the aggregate and/or fileset available to clients, these commands will also register the exporter in the FLDB. Note that exporting an aggregate makes all the filesets it contains available to clients. Once a fileset has been exported, it can be mounted using `fts crmount`. You may wish to modify default fileset permissions and quotas before permitting it to be mounted.

DFS Backup

DFS has its own backup system that keeps track of tapes, dump dates, backup sets and other types of fileset recovery information. You can't perform dumps using standard UNIX dump commands because of DFS-specific metadata such as ACLs. The DFS dump process begins by taking a snapshot of an active file system called a clone. The clone is not a copy of the data, but rather a set of pointers to the data blocks that made up the file system at the time the clone was made.

Users may continue to actively use the file system while the clone is traversed for backup purposes. This eliminates the problem of backing up an active file system where an inode may be invalid due to updates in progress. DFS backup supports both full and incremental dumps.

Further Information

An excellent article, "Performance Characteristics of the DCE Distributed File Service," in the May/June 1995 issue of *AIXtra* magazine compares performance characteristics of DFS and NFS. The article is a bit dated in that it references AIX DCE 1.3 rather than AIX DCE 2.1, but it does point out some of the plusses and minuses of each technology.

You might also want to look at Sun's NFS Version 3, which offers many new features that address performance and scalability. NFS 3 is interoperable with NFS 2 clients, thus it provides a migration path for existing NFS 2 sites. ➸

Work

by Jeffreys Copeland and Haemer

Drawing on the Net

Jeffrey Copeland (copeland@alumni.caltech.edu) *is a member of the technical staff at QMS' R&D group in Boulder, CO. He's been a software consultant to the Hugo award administrators for several years. He spends his spare time raising children and cats.*

Jeffrey S. Haemer (jsh@canary.com) *now works for QMS, too, and is having a great time. Before he worked for QMS, he operated his own consultancy firm, and did a lot of other things, like everyone else in the software industry.*

Allow us to give you a bit of background before we begin, for those of you who didn't read our column in *RS/Magazine* and don't know us yet. Jeffreys Copeland and Haemer have known each other for more than a dozen years. We met when we were both working for the now defunct, original UNIX vendor Interactive Systems Corp., Copeland in Santa Monica, Haemer in Estes Park. We were building opposite ends of a very early object-oriented word processing and database package. It took us about 20 minutes to discover that we had lived in the same house at Caltech, separated by eight years.

Since then, Copeland worked for SHL Systemhouse after it absorbed part of Interactive Systems but before it became a subsidiary of MCI Communications Corp. Haemer spent several years consulting on issues of internationalization, standardization and software portability. Now we're both working at QMS Inc., building the innards of laser printers.

This column was originally written as our 56th column for *RS/Magazine.* We began with a 12-part series on internationalization, moved onto a 17-part series on POSIX, did a quick three-part filler on literate programming, and now you're reading our 24th "Work" column. In "Work," we have been exploring problems we trip over in our daily work. Oddly enough, because we're software nerds, many of these problems have solutions that require writing some software. If you are interested in the software we have developed to date for these columns, take a look at `http://www.alumni.caltech.edu/~copeland/work.html` for a quick review. Unfortunately, now that *RS/Magazine* has suspended publication, we have been left in the middle of a multipart discussion of maps and HTML. With that, you're up-to-date, and we can proceed with our regularly scheduled column.

Every Vote Counts

Last time, we developed a CGI form to help us count the results of the recent U.S. presidential election. It wasn't until after the column went to press that we realized we had left out some important details for our non-U.S (and our U.S.-based, but high school civics course-deficient) readers.

U.S. presidential elections are not as simple as those in some other countries. (The good news is they aren't as complicated as Israeli parliamentary elections; but then

again, nothing is.) Each state is allocated a number of electoral votes based on its members of congress, which is, in turn, based on its population. There are 538 electoral votes. The winner of the plurality of the popular vote in any given state is awarded all the electoral votes for that state. Thus, when Bob Dole won 46% of the vote in Colorado (to Clinton's 44% and Perot's 7%) he got all eight of Colorado's electoral votes.

Not only did we ignore the mechanics of the election, but we completely ignored the issue of how to display the results–We both voted for Mickey Mouse, but who *won* the election? This month, we'll address that issue.

As you may recall, this all started when our eldest daughter needed to learn the names of the states, and we wrote a quick Web page containing a clickable map of the United States–you click on a state, and it tells you the name. ("I think that one's Montana!" (click!) "Oops! It's North Dakota!") The map was static, so we didn't need to worry about the computing power required to redraw it.

However, when we were updating the election map, we needed to be able to redraw it quickly, with states colored in red for Bill Clinton, the Democrat, blue for Bob Dole, the Republican, and green for the Ferengi, Ross Perot.

For quick drawing, we will turn to the GD package in Perl. But where do we get the map that we're going to color?

Space, the Final Frontier

We began with map data from the Massachusetts Institute of Technology. (We don't have the exact ftp reference. We've had the data for years and have converted it from line segments into PostScript, but we think the MIT folks derived the original data from the CIA geographic database. We'll be happy to pass the maps to you on request.) These are the outlines of the 48 continental states in longitude-latitude coordinates. So we have a bunch of files named things like CA that contain lines like the following:

```
% Begin: CA California
newpath
-120.0109 42.0125 M
-120.0090 41.2002 L
-120.0121 39.7082 L
-120.0020 39.4411 L
-120.0086 39.3135 L
-120.0033 39.1623 L
-120.0092 39.1152 L
```

The data in that form leaves us with two problems. First, how do we render the PostScript into a GIF or JPEG image suitable for display on a Web page? Second, how do we extract the map data so that we can handle the HTML inline MAP telling us what position on the screen corresponds to what state on the ground?

Our original solution to the first problem was the complicated and time-consuming pipeline we used to draw the map in the first case:

- PostScript data piped through a script to color the map.
- Output of the script read into GhostScript to convert it to Jef Poskanzer's portable pixel map (PPM) format. (Yes, we could have converted it directly to GIF, *if* our version of GhostScript had had the GIF driver installed.)
- Rotate the PPM file 90 degrees so north points up.
- Convert the PPM to a GIF.

Whew! This took about 45 seconds on the SPARC 5s we normally use on our desktops and for our Web server at the office, which is not nearly quick enough.

We solve the problem by producing several files for each state, naming them MA_1, MA_2 and so on, and sticking the set in a subdirectory named MA.

Next, we investigated the Perl package GD, which leads us to the solution to both problems we posed earlier. GD is a graphics package for Perl (versions also exist for C and Tcl) that allows us to render our output directly into GIF. If we convert the original map data from longitude-latitude space to the appropriate coordinates for GIF space, we can use the same map data to both draw the map and to give us the outlines of the clickable regions displayed on the map.

The program to do the conversion is pretty simple and is shown in Figure 1. Basically, we read each line in the PostScript map data, and each time we encounter a line with an M (move and begin a new polygon), we stop and produce output. We convert the coordinates as we read them in, preserving our original Mercator projection at 12.6-GIF pixels per degree, appropriately offset so that Kansas is in the center of our picture.

That's not the whole story, however. We need to do some small adjustments in the output. We want to eliminate points that are identical in GIF space, as well as points that we don't need because they're on the same horizontal or vertical line as points surrounding them. This serves to compress the data to a shorter list of points for each state outline.

This compression takes place in the print_stuff routine, which is called each time we need to output a self-contained polygon of the state. We could improve the compression yet again by eliminating all points that lie in the middle of a line segment of any orientation, but it's not worth the computational hassle.

But that's not the whole story, either. Some states, such as Massachusetts and Michigan, are made up of more than one polygon. We solve the problem by producing several files for each state, naming them MA_1, MA_2 and so on, and sticking the set in a subdirectory named MA. Making the subdirectory and splitting up the output file is left as an exercise for the reader. An alternate exercise for the reader: Modify our conversion to preserve the notion of one state, one file. Warning: You'll need to modify the drawmap pro-

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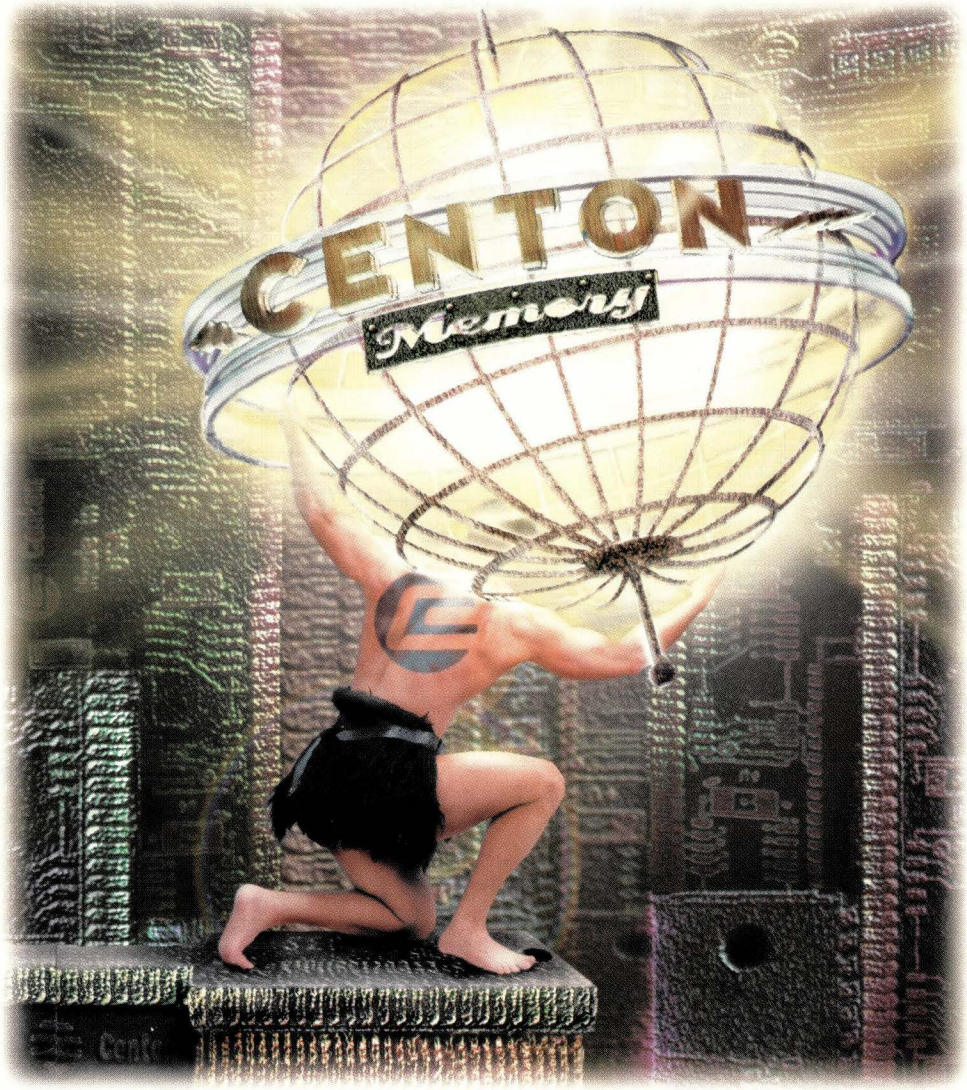

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gram, which we'll look at next.

And *that's* not all, either. We've produced the data to draw the maps but still haven't produced the data for the MAP production in the HTML file. You'll notice some lines commented out in gifmap with double ##. Those are the lines that provide the HTML wrapper for the in-line map.

That's the whole story. Next, we have to figure out how to redraw the map from the data.

A Map, a Map, My Kingdom for a Map

Take a look at Figure 2. It contains the code for drawmap, our program to redraw and color the map. There are several interesting features that we need to note.

First, usage. We use the program by giving the directory containing the map data, and a results file. The file contains something like:

```
CA      Clinton   red
CO      Dole      blue
```

Notice that we've added the -T flag. 'T' is for 'taint' and checks for possible security breaches.

Strictly speaking, the names of the candidates are redundant: drawmap needs only the state names and colors.

Second, we can explore some of the innards of drawmap. (For space reasons, we're going to do this quickly.) We begin the program with our usual "shebang" line specifying the path of the Perl executable. Notice, however, that we've added the -T flag. "T" is for "taint" and checks for possible security breaches. For example, the PATH is set explicitly because the taint checking feature is turned on–without the explicit set, the program won't run.

We turn on taint checking because we're going to use this routine as part of a CGI script, and we want code used by folks outside our local net to have a higher level of suspicion about its environment.

Given that, we can begin talking about the GD package, which is available from the CPAN archive at http://www.perl.com/cpan/. It has an excellent man page as part of the installation set.

In general, when using GD, we define an image object using a line like this:

Figure 1. Converting to GIF Space

```
#! /usr/local/bin/perl
# generate the cgi outline map
# from the PS outlines

$n = 0;

while( <> ) {
 if( /^% Begin: ([A-Z][A-Z]) (.*)/ ) {
    $state = $1;
    $full = $2;
    $full =~ s/ /_/g;
    print "# $1 $2  \
\$Id: gifmap,v 1.3 1997/01/06 23:38:01 jeff Exp $\n";
 }

 if( /([\d.-]*) ([\d.-]*) ([LM])/ ) {
    print_stuff() if( $3 eq 'M' && $n );
    $x[$n] = int(12.6 * $1 + 1610.7);
    $y[$n] = int((-12.6) * $2 + 762.7);
    $n++;
 }
}
&print_stuff();

sub print_stuff
{
    ## print "  <AREA SHAPE=poly \
    ## HREF=/cgi-bin/state.cgi?state=$state";
    ## print " ALT=\ "$state\" COORDS=\"";
    print "$x[0] $y[0]\n";
    # now we go through the points in sequence,
    # eliminating those we can::
    #  begin with identical ones
    for( $i = 1; $i < $n-1; $i++ ) {
      $x[$i] = 0 if( $x[$i] == $x[$i-1]
         && $y[$i] == $y[$i-1] );
    }
    #  skip one of vertically co-linear pairs
    for( $i = 1; $i < $n-1; $i++ ) {
      $y[$i] = 0 if( $x[$i] == $x[$i-1]
         && $x[$i] == $x[$i+1] );

    }
    #  skip one of horizontal co-linear pairs
    for( $i = 1; $i < $n-1; $i++ ) {
      $y[$i] = 0 if( $y[$i] > 0 &&
         $y[$i] == $y[$i-1] &&
         $y[$i] == $y[$i+1] );
    }
    # now print those not eliminated
    for( $i = 1; $i < $n-1; $i++ ) {
      print "$x[$i] $y[$i]\n"
         if( $x[$i] > 0 && $y[$i] > 0 );
    }
    print "$x[$n-1] $y[$n-1]\n";
    # assume the last point and the first
    # are the same to close the polygon
    ## print "\">\n";
    $n = 0;
}
```

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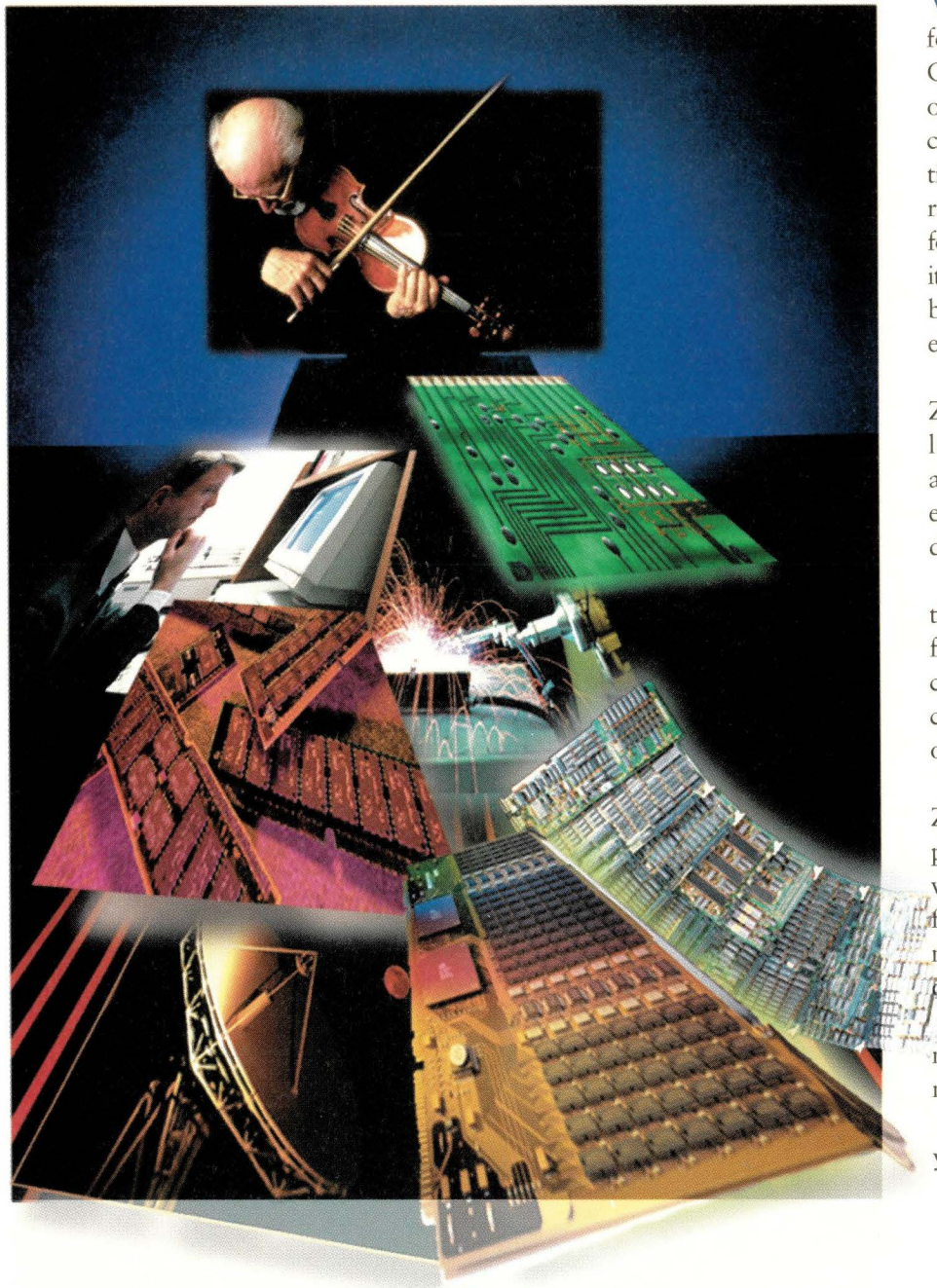

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Figure 2. The Code for drawmap

```
#!/usr/local/bin/perl -Tw
# $Id: drawmap,v 1.7 1997/01/06 23:29:52 jeff Exp $

use GD;
use FileHandle;
use DirHandle;
use Getopt::Std;

use strict;         # Perl's lint
use subs qw(draw_state draw_chunk);
use vars qw($opt_h $opt_d $opt_c %color);
$ENV{PATH} = '/usr/bin';

my $usage = "$0 [-h] [-c color_file] \
 [-d states_directory] [state ...]";
getopt("cd");
die $usage if $opt_h;

# Create an image object
my $im = new GD::Image(800,500);

# Give the image's colors symbolic names
my $white= $im->colorAllocate(255,255,255);
my $black = $im->colorAllocate(0,0,0);
my $red = $im->colorAllocate(255,0,0);
my $green = $im->colorAllocate(0,255,0);
my $blue = $im->colorAllocate(0,0,255);

# Make the background transparent and interlaced
$im->transparent($white);
$im->interlaced('true');

# Frame the picture
$im->rectangle(0,0,1000,1000,$black);

# Read state colors
my %c;
if ($opt_c) {
   my $fh = new FileHandle $opt_c
        or die "Can't read $opt_c: $!";
   while (<$fh>) {
        # next if /^\s*\#?.*$/; # skip comment lines
        # Color file has format
        #  "state_name candidate color"
        my($state, $c);
        ($state, undef, $c) = split;
        $c{$state} = $c;
   }
   close ($fh);
}

# Get a list of the states
my @states;
$opt_d ||= ".";    # the directory of state outlines
unless (@ARGV) {  # individually named states
   # get all the states from the named directory
   my $dh = new DirHandle $opt_d
        or die "Can't read directory $opt_d: $!";
    @states = grep /^[A-Z][A-Z]$/, $dh->read;
   $dh->close;
}
@states = map {"$opt_d/$_"} @states;

 # Draw each of them
 foreach (@states) {
   my $state = $_;
   s|$opt_d/||; # strip directory and suffixes
   my $cname = $c{$_};
   draw_state $state, $cname;
 }

# Convert the image to GIF and print
print $im->gif;

# Draw a state
sub draw_state {
  my($state, $cname) = @_;

   # Most states are single files.
   # If the state needs to be drawn in chunks
   # we make the state a subdirectory,
   # and the chunks individual files

   # draw the whole state at once
   unless (-d $state) {
        draw_chunk(@_);
        return;
   }

   my $dh = new DirHandle $state
        or die "Can't read directory $state: $!";
   my @chunks = grep /\w/, $dh->read;
   $dh->close;
   foreach (@chunks) {      # draw it in chunks
   draw_chunk("$state/$_", $cname);
   }
 }

# Draw a chunk (and maybe color it)
sub draw_chunk {
   my($chunk, $cname) = @_;
   my (@x, @y);
   my $i = 0;

   my %color = (              # for convenience
        'white'   => $white,
        'black'   => $black,
        'red'     => $red,
        'green'   => $green,
        'blue'    => $blue,
   );

   # A "chunk" contains X,Y coordinates of the
   # vertices. It can also contain comment lines,
   # which have a '#' as the first non-whitespace
   # character. We like to allow comments.

   # Read coordinates of vertices
   my $fh = new FileHandle $chunk
        or die "Can't read $chunk: $!";
   while (<$fh>) {
        next if /^\s*\#/;    # skip comment lines
        ($x[$i], $y[$i]) = split;
        $i++;
   }
   close $fh;

   # Now draw the polygon
   my $poly = new GD::Polygon;
   for ($i = 0; $i < @x; $i++) {
        $poly->addPt($x[$i], $y[$i]);
   }
   if ($cname) {
        $im->filledPolygon($poly, $color{$cname});
   } else {
        $im->polygon($poly,$black);
   }
}
```

```
my $im = new GD::Image(800,500);
```

for an image 800 pixels wide by 500 high. We can allocate colors and add items to the image with lines like the following:

```
my $red = $im->colorAllocate(255,0,0);
$im->rectangle(150,150,250,250,$red);
```

which draws a 100-pixel red square outline with its lower left corner at (150,150). We finish up and render the picture to standard output with the line

```
print $im->gif;
```

Caveat emptor: There's a bug in the Perl version of `GD` that leaves blank stripes in flood fills of complicated polygons like the state of California. We don't know what the fix is yet, but if we find it, we'll pass it on.

One final thing to notice is that we've used Perl's `FileHandle` and `DirHandle` packages. The former is used to safely read the map components, and the latter is employed to open the directories for states consisting of multiple polygons. Note that the `Handle` package, which obsoletes both `FileHandle` and `DirHandle`, has been announced, but is not yet available–though it may be by the time you read this.

In Summary

Here's where we've done: Earlier, we showed you a CGI script to allow the input of candidate/state pairs for the electoral college, and now we've just finished another CGI Perl program to turn the data we generated into a colorful map. We'll leave you with one last exercise: Combine the two programs into a single CGI script that allows you to click on the candidate and state, and then redraws the whole map, which, in turn, you can click on.

Next month, we'll return to a topic of long ago, building things, with implications for Web page development.

Until then, happy trails. ➸

DCE Begins to Deliver on Promise

by George Lawton

Whether you're looking for a complete distributed computing infrastructure or merely secure data distribution via the Web, DCE can be the solution.

When organizations begin to look at moving legacy applications to high-end servers, they realize they need an infrastructure that provides the same functionality as the mainframe computers they use. Although vendors do have some offerings in areas such as security, distributed file systems and naming services, they are not well integrated and do not work across all platforms.

Enter the Distributed Computing Environment (DCE). Born when the major high-end systems vendors came together–including heavyweights

such as IBM Corp., Sun Microsystems Inc., Hewlett-Packard Co. and Digital Equipment Corp.–DCE is an attempt to integrate the best of their technologies to provide a single environment that would work across all of their platforms and provide the same level of security and reliability customers have been used to with mainframes. Initially, the organization that coordinated this effort was called the Open Software Foundation, but it merged with X/Open to form The Open Group last year.

Today, DCE comes bundled on all major server platforms, including the RS/6000. It is available for the major client operating systems such as Windows and Macintosh, as an external product that must be bought separately. There are also a number of options for using DCE to securely distribute information via the Web. This has helped to win acceptance in a number of organizations for real-world deployments.

However, the deployment of DCE has been slowed down by weak support from the software industry for development tools and applications that run on top of DCE. John Millburn, brand manager for DCE products at IBM in Austin, TX, who has been working on DCE since the beginning, says, "If I had the last five years to do over, we would have focused much more on application

DENNIS NOVAK/IMAGE BANK

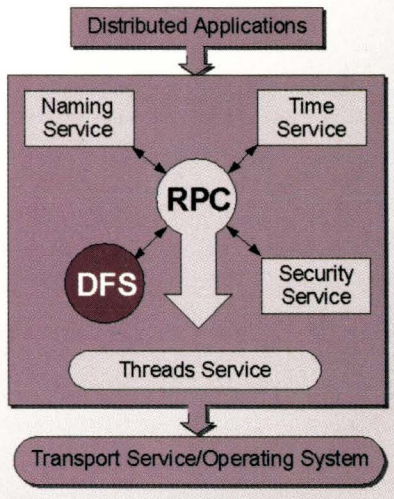
development tools and key [independent software vendors]. Many felt that those would come automatically, but I don't think we did a good enough job back then encouraging those applications to move."

Expanding the File System

For companies that want to build a complete distributed computing infrastructure, the DCE environment is an ideal solution. But others that only need to solve a problem in security or a distributed file system are also finding that DCE meets their needs. The Distributed File System (DFS), perfected by Transarc Corp. (a subsidiary of IBM), is a key element of DCE for the IBM server environment. It allows a network administrator to serve files from a collection of servers in the same room, or even across the country.

Fundamental DCE services such as RPC (remote procedure call), naming, security and time, provide the tools for writing distributed applications. DFS extends these services to support file sharing and data management activities. Together, DCE services and DFS are said to deliver a highly portable computing solution across the enterprise and beyond.

Source: Transarc Corp.



For example, the U.S. Forest Service was looking for a way to create a distributed file system that would work across several different geographical locations in each management area. It put out a technology-neutral bid for such a system, and IBM responded with a solution based on DFS, which was accepted.

Jim Reid, director of information systems of the Northern Region for the Forest Service, says the other solution people bid on used the Network File System (NFS) as a way to share files between systems. "I had used NFS to do that in environments a lot less complex than this, and it was more difficult to manage. Now with DCE integrated into AIX on the RS/6000, you can just log in. With AIX 3, you had to log into it and then log into DCE. IBM integrated DCE and AIX logins so now things like FTP and Telnet work within the DCE environment."

For companies that want to build a complete distributed computing infrastructure, the DCE environment is an ideal solution. But others that only need to solve a problem in security are also finding that DCE meets their needs.

Reid manages the computer systems for 83 of the Forest Service's 800 or so offices. The country is broken into regions that are managed by two to six separate offices within a hundred miles of one another. Reid has deployed 14 DCE cells for 85 offices so far. The cells allow people in separate offices to share and manage information together.

Reid explains, "I can sit down at one desktop or another, but I always have access to the whole data set. Our users don't know that there is more than one server; they just see it as one big machine."

IBM has been using DCE internally to scale the size of its file servers at its Austin, TX, site for its AIX programming and chip design operations. The site has about 2 TB of data in Transarc's Andrew File System (AFS) and 400 GB in DFS. Eventually, all of the data will be moved to DFS. John Nials, the systems analyst involved in the Austin DCE deployment, says the site has around 70 servers at the moment, about 15 of which support DCE.

"The biggest selling point from the end user's point of view is that DFS gives much better performance and has a more robust access control list model," Nials says. "We can give secure access to just the files an end user needs. It is also more tightly integrated with AIX, so a lot of the UNIX things like changing file permissions and copying files around work better."

Another benefit is that DFS is more scaleable and reliable than AFS. For example, if one developer had saved something to a shared directory, it could take up to half an hour for AFS to move that file from the user's individual cache to the network directory. There were many cases of people working on the wrong file because the new one did not make it to the server in time to replace the old one.

Nials says, "In AFS, if you write a file on the client, it will stay in the client's cache until it feels like writing to the server. In DFS, when you close a file it does not return anything other than an error message until it has been transferred to the server. We had to do a lot of work on our utilities with AFS to make sure we did not lose any data. With a positive file system like DFS, data will not be lost silently. You will get an error message if it fails. Just about every user ran into a problem with AFS at least once or twice."

Securing the Internet

Last August, The Open Group Research Institute announced the availability of the OSF DCE Web technology. This was intended to provide the core technology for companies to implement secure Web policies and manage users, documents and system access across an enterprise. The technology is being incorporated into commercial Web server products from companies such as IBM and Gradient Technologies Inc.

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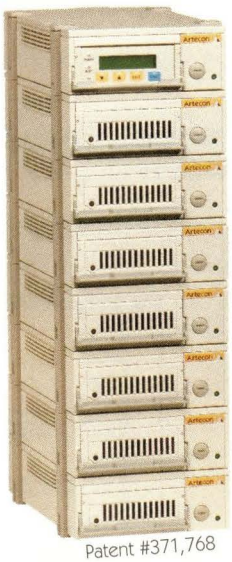

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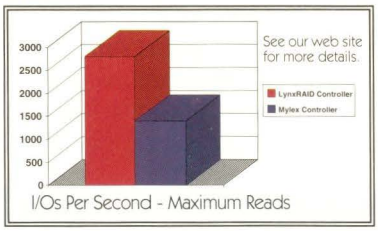

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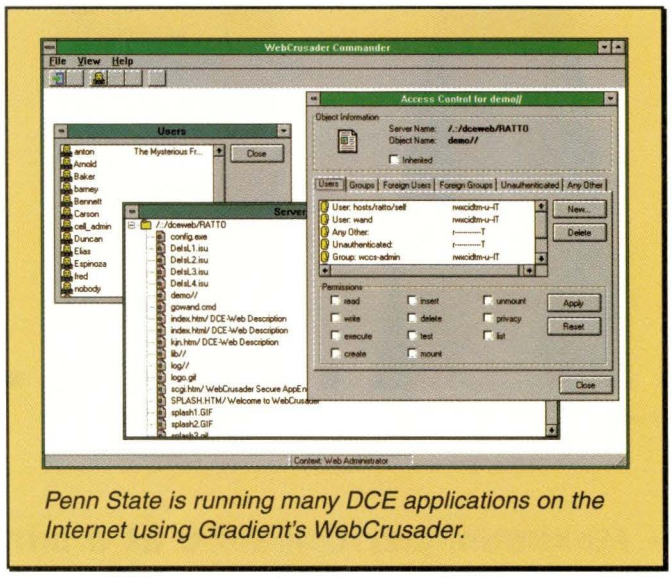
Circle No. 5

Gradient has already released WebCrusader, which is based on this technology.

Brian Bretton, vice president of marketing at Gradient in Marlborough, MA, says, "One of the things the Internet lacks is an infrastructure. You can provide a server, but what else can you do? Netscape Secure Sockets provide some security but do not give you a complete range. We are providing a common infrastructure so you are not managing Web stuff in one room and client/server in another."

Penn State University, State College, PA, began looking for an open computing architecture that would scale across its numerous campuses throughout Pennsylvania about five years ago. Ken Blythe, director of the Office of Administrative Systems at Penn State, says, "We looked at all of the solutions at the time, and there was only one that seemed to fulfill all of our needs, with openness being one of the most important of those needs."



Penn State is running many DCE applications on the Internet using Gradient's WebCrusader.

In the university environment, security is key. Not because we are guarding top-secret information, says Blythe, but because every want-to-be hacker at the university would probably try to crack the security at least once to see if there are any holes. "Because we are a university, we were looking for a bulletproof mechanism for security. It is a hostile environment. We have every kind of intellectual that wants to prove their ability to hack," he says.

Blythe was looking for something that would work well across all the different university computing environments. "DCE's directory services, distributed file system and remote procedure call fit into our university environment. DCE works well with academic, administrative and research computing," Blythe explains.

Altogether, Penn State has 70,000 students linked across several campuses. There are about 30,000 computers on the network, including 500 RS/6000 servers and workstations. Since the university began building its DCE environment, it has had a TCP/IP backbone network, which, Blythe says, "was an excellent solution because the Internet is IP-based."

Penn State is starting to run many of its DCE applications on the Internet using Gradient's WebCrusader. This makes it easy to distribute information via the Web and maintain the high level of security possible with DCE.

The university is also running a lot of Telnet applications

Secure Single Sign-On

One of the original visions of DCE was to enable single sign-on, so that users would only have to log in once to do all of their work. Over time, it became apparent that was not going to be difficult to do over a pure DCE environment, but companies ran into problems when trying to implement single sign-on for database and LAN access that was not tied to DCE.

In the second quarter of 1997, IBM plans to release a single sign-on product that will extend DCE security into other enterprise systems. John Millburn, brand manager for DCE at IBM, says, "Capturing keystrokes in the field is not hard to do, but it is not very secure. We have accomplished the same look and feel, but by using DCE secure authentication environment for enhanced security."

The three target areas of this capability will be to support RACF (Resource Access Control Facility) mainframe connections, network operating systems like Novell Inc.'s NetWare and IBM's LAN Server, and database applications. Eventually, password management will be incorporated into IBM's Tivoli Management Environment, which will make it easier for network administrators to manage passwords across the enterprise.

Millburn says, "I don't know if it was too much hype and overoptimism, but single sign-on and a common system and directory infrastructure were doable, assuming all of the applications being written were using DCE services, when we had our vision five years ago. The challenge was overoptimism on the level of investment in private systems like Novell that was not going to be replaced by DCE.

"The database companies were our early supporters, but they found that going to DCE's standards would slow down their performance. Basically, the application world did not move to DCE. We did not see any secure interface that was portable to other platforms, so we built some code on the back end so you could log into NetWare or RACF after you made it past the secure gatekeeper," Millburn says.–*gl*

DCE Over ActiveX

Although Microsoft Corp. has no plans to implement DCE directly atop its operating systems, an effort is under way to make DCE compatible with the ActiveX component technology that runs on Windows desktops. This should make it easier to develop Windows applications with widely available tools, such as Visual Basic, that can take advantage of DCE features like security.

Last October, The Active Group was formed under The Open Group umbrella. It will provide a forum for discussions on the future of ActiveX. Microsoft will provide the source code, reference implementations and validation tests for ActiveX for use by Active Group members.

The key goals of the group are to promote ActiveX for use on different systems and architectures, enhance ActiveX interoperability with DCE, and accelerate the evolution of ActiveX through collaborative development. However, it will probably be at least a year before commercial products that take advantage of ActiveX and DCE emerge from this group.–*gl*

across the network, but because its version of AIX lacks DCE support for Telnet, these applications are run without DCE security. However, AIX Version 4.3 for the RS/6000 platform, targeted for fourth-quarter 1997 availability, will come bundled with a number of standard UNIX applications, such as Telnet, that can take advantage of DCE.

Blythe says the biggest limitation the university has found with DCE has been the scalability of its security. DCE uses "cells" to break down a distributed file system into different areas based on security needs. Blythe had wanted to create a single cell for the entire university that could handle the 140,000 users that log in. However, by the time it was scaled to just 80,000 users, the login time slowed to three minutes. Consequently, Penn State has limited its implementation of security to putting only 1,000 to 2,000 users in each cell.

Roger Lawson, associate director of computing and information technology at the University of Vermont, based in Burlington, says the university had some serious performance problems when it first installed DCE. He says, "Performance was the biggest problem, and it was caused by memory leaks. It took a while to shake that out."

With the help of IBM consultants, the University of Vermont was able to solve the problem. "We did have some pretty disappointing performance in the beginning, but we have had pretty good performance since March [1996]."

Lawson says the university decided to implement DCE so it could scale its file system to accommodate more space efficiently and cheaply. "We looked at the RS/6000 SP2, but it was more than we could afford to grow. Last fall, we implemented DCE on an R24 and two J30s."

The university finished the conversion at the beginning of this year, so now all 17,000 host accounts are accessed via DCE. Lawson says that one of the things he misses from the old file system is quotas for limiting how much each user stores on the system. "There are things that work better in a non-DCE environment, like quotas, but our end users like not having them," he says.

One of the things DCE opens up is secure business communications with numerous separate organizations over the Internet, often referred to as "extranets." For example, a number of leading universities, including Michigan, Wisconsin, Illinois, Indiana, Ohio State, Penn State and Purdue, are deploying a large-scale DCE environment that will allow them to share their electronic resources.

Bob Riddle, assistant director at the Center for Information Technology Integration at the University of Michigan, says the university began deploying distributed computing technologies several years ago, but the problem was that they were sepa-

rate technologies and there was no clear place of intersection. "When the Open Software Foundation came out, many of the components they picked for integration into DCE were technologies we had a warm feeling for," Riddle says.

Riddle's current project is to help build an interauthentication and authorization service over the Internet using DCE. An example of its use might be to allow people from other universities to access materials that have been licensed to one university without giving access to everyone on the Internet. Riddle explains, "We are thinking about creating interinstitutional gateways so that you could map your DCE credentials to the Web server environment. This is a solution that does not imply that all of the schools use DCE for local authentication."

Riddle says one of the greatest roadblocks to deploying DCE in his environment has been the cost. As an educational institution, it does not have a large enough budget to put DCE on every desktop. The Open Group has made the source code freely available to universities but not the actual software. Riddle says, "If The Open Group is successful in distributing a freely distributed client free of license, we would deploy a lot more DCE. That has been a real inhibitor for us. We are talking about tens of thousands of licenses. We have a site license with Gradient, but the university extends beyond that."

Riddle has been working with WebCrusader from Gradient to experiment with distributing Web content using DCE security. At the moment, WebCrusader requires a plug-in on the client side that enables it to access DCE. Riddle's team is working on an extension to the server that will allow Netscape Communications Corp. browsers to access DCE services without requiring a DCE client.

The Future of DCE

Not everyone is convinced of DCE's inevitability. Roy Schulte, vice president of systems software technology at consulting firm Gartner Group, Stamford, CT, says, "Most enterprises are doing distributed computing without DCE today, so if DCE is really essential, no one could be doing distributed computing today. The way they do it is using a patchwork combination of various technologies. It is true there is not one in widespread use, but the fact is you do not need a single common infrastructure for applications, and that is proved by enterprises today."

Gradient's Bretton counters, "The Gartner Group has been claiming that DCE is dead for the life of DCE, yet anytime I ask them what else is out there that can provide the infrastructure needed for corporate environments, they say there is nothing else. But DCE is growing. As the desktop provider of the industry, we have seen sales [for 1996] surge over 1,000% over the last year [1995]. We attribute this to the fact that people are ready to deploy mission-critical applications on a large scale. If DCE was dead, our business would be shrinking."

Despite the growth of DCE desktop sales, Schulte does not see a bright future for DCE. "DCE has a lot of latent good will in the industry, but when push comes to shove, actual project leaders building applications do not find it a good choice for most situations. They are picking development tools like Visual Basic, Power Builder or Texas Instrument's Composer. Those products don't use DCE in most cases, so it ends up being irrelevant most of the time. If there had been a consensus, if all of the vendors of development tools and middleware applications had agreed, then the lives of all of us would have been simpler. But they did not, so DCE cannot fulfill its promise by itself."

Schulte sees a future in which the best parts of DCE are picked off for use in different products targeted at specific enterprise applications. "What will really come out of DCE is that IBM's future, or some fairly large proportion of it, will be based on middleware technology that is a derivative of DCE. DCE itself came about as gluing technology from different companies. It is now going back to its origins. It is not being adopted as a package, it is ending as pieces."

Mitchell Kramer, an analyst with the Patricia Seybold Group based in Boston, is a bit more optimistic about the future of DCE, although he sees room for better integration with other technologies. "I find that I am among the few people that are fans of DCE. I understand where Gartner is coming from, but I cannot find a good alternative technology. If you want to do big-time security and directories, what else do you do? I would be more than willing to change my attitude if I saw something that could provide an alternative. What DCE needs is updating, integration with Java, object orientation and good administrative tools," Kramer says. ⊸

Companies Mentioned in this Article

Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
Circle 162

Gradient Technologies Inc.
2 Mount Royal Ave.
Marlborough, MA 01752
Circle 163

Hewlett-Packard Co.
3000 Hanover St.
Palo Alto, CA 94304
Circle 164

IBM Corp.
Contact local sales office

Microsoft Corp.
One Microsoft Way
Redmond, WA 98052
Circle 165

The Open Group
11 Cambridge Center
Cambridge, MA 02142
Circle 166

Sun Microsystems Inc.
2550 Garcia Ave.
Mountain View, CA 94043
Circle 167

Transarc Corp.
707 Grant St.
Gulf Tower, 20th Floor
Pittsburgh, PA 15219
Circle 168

George Lawton is a freelance writer based in Brisbane, CA, who has been covering the computer and telecommunications industries for the past five years. He is currently working on a book, *Anatomy of a Network Computer*, that is scheduled to be published this spring.

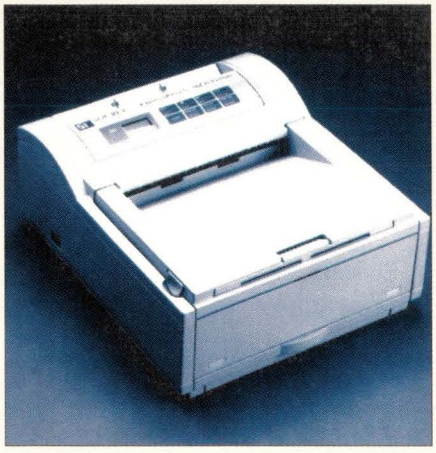
NEW PRODUCTS

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.

Low-Cost MICR Printers

Two new magnetic ink character recognition (MICR) printers have been introduced by Source Technologies. The ExpressPrint 6 is positioned as a low-cost MICR printer for users with low volume needs, while the ExpressPrint 8 is designed for higher work demands, the company says.

Priced at $1,495, the ExpressPrint 6 features multiple paper handling capacity, 600-dpi print quality, and can produce first page printout in just 14 seconds, Source Technologies says. The ExpressPrint 8 is priced at $1,995 and comes with a larger paper capacity than the ExpressPrint 6 as well as a print speed of 8 ppm.



According to the company, both models are capable of supporting parallel and serial interfaces and optional twinax and coaxial cable connections when used with Source Technologies' proprietary interface. In addition, both printers support Ethernet and token-ring networks.

Source Technologies Inc.
628 Griffith Road
Charlotte, NC 28217
Circle 101

Tool to Duplicate CDs

Companies that need to produce exact copies of CDs now have a new duplicator to consider. Microboards Technology's CD Blaster II replaces Version I and offers a tool that meets the needs of both the occasional and the heavy-duty industrial user, the company says.

CD Blaster II provides the option of recording with either track-at-once or disk-at-once modes. The latter produces recorded copies equivalent to glass master-ready CD-Recorders, the company says.

To eliminate degradation of quality, CD Blaster II uses a SCSI pipeline architecture to establish the high-speed CD-ROM-to-CD-R data transfer. The duplicator also features a SCSI-MUX II controller, which enables recording on the fly, parallel data confirmation and bit-by-bit track validation with the data coming from an outside CD-ROM drive or an internal SCSI hard drive, the company says.

Also included is a SCAN-CD program. This feature is used to scan every track on the CD and automatically strip all undesired post gaps while preserving the length of the track, the company says. This information can be used to build a track list that controls subsequent CD recording. The system architecture is said to be able to support recording speeds of up to 32X for sustained device-to-device transfer rates.

A single 4X drive version costs $2,995. This version complies with the Red, Yellow, Green, Blue and White book specifications and can drive up to

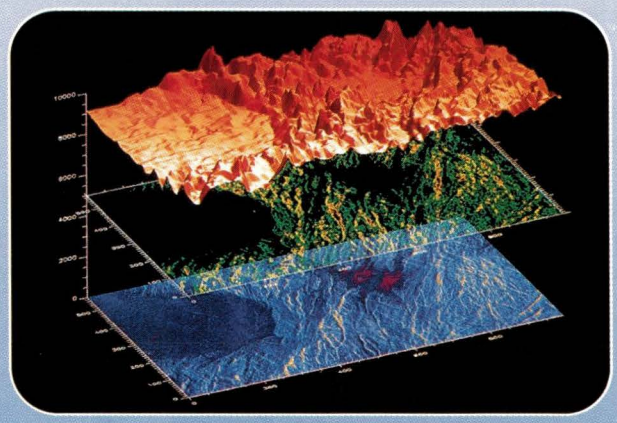
IDL with Prebuilt GUI

Research Systems has announced the availability of IDL Version 5.0. IDL (Interactive Data Language) is a programming language used to create data analysis and visualization applications.

IDL offers a suite of mathematics, statistics, graphics, image processing, mapping and data manipulation features in a single integrated package. This latest version of IDL includes a prebuilt GUI, called IDL Insight, that provides access to more commonly used IDL functions. Other enhancements include support for OpenGL, interactive graphics capabilities and a new object-oriented graphics architecture.

Version 5.0 also includes the IDL Object System, an object-oriented implementation of IDL that supports encapsulation, polymorphism, multiple inheritance and persistence.

IDL 5.0 is available on a variety of UNIX platforms, including those from Sun, IBM, Hewlett-Packard, Silicon Graphics and Digital Equipment. Pricing starts at $3,495. Windows 3.1, 95 and NT, Power Macintosh



and Linux versions are also available at a starting price of $1,500.

Research Systems Inc.
2995 Wilderness Place
Boulder, CO 80301
Circle 100

four 4X CD-Rs simultaneously. A four-drive version with SCSI-MUX II is available for $7,995. An optional 1-GB SCSI hard drive is also available.

Microboards Technology Inc.
1480 Park Road, Ste. B
P.O. Box 846
Chanhassen, MN 55317
Circle 102

UltraSPARC Offered in Rack-Mount Chassis

Integrix is now offering a 167-MHz UltraSPARC-compatible server in a 19-inch, rack-mount chassis. Unlike traditional SPARC "pizza boxes," the RS1-170 fits into standard server banks and offers front-panel accessibility for easy upgrade and service, the company says.

The RS1-170 comes with the DM100 diagnostic LCD monitor, which displays the status of motherboard, cooling fans, power supply and system temperature. If a failure is detected, the DM100's LCD displays the system's status and issues an audible alarm.

The RS1-170 can accommodate two front-accessible 1.6- by 5.25-inch (CD-ROM or DAT) drives, as well as two internal 1.6- by 3.5-inch hard drives. In this case, two additional fans are also supplied, with a cooling capacity of 70 cubic feet per minute, for increased thermal dissipation.

The RS1-170 comes with two 32-MB SIMM modules, a 1.05-MB hard disk and an 180W power supply; Solaris is preinstalled. Options for the RS1-170 include tape, floppy and CD-ROM drives. Pricing starts at $10,500.

Integrix Inc.
2001 Corporate Center Drive
Newbury Park, CA 91320
Circle 103

RAID Storage Series Out

A new series of space-efficient desktop RAID storage products has been introduced by Procom Technology. Called the DTR2300 series, it includes four units that provide storage capacity ranging from 6 to 27 GB, Procom says.

According to Procom, the four RAID 5 units use four half-height hard drives housed in a 15- by 6.75- by 9-inch enclosure. The units use a single Fast/Wide SCSI host channel, which enables them to sustain throughput of 18 MB/s.

Also, these RAID subsystems can support RAID levels 0, 0+1 and 4. Data-access speed is enhanced by 8 MB of cache memory (16- and 32-MB cache are optionally available). The DTR2300 series contains redundant power supplies and hot-swappable hard disk drives to further ensure fault-tolerant operation, Procom says.

Each unit is sold separately. The DTR2300-6 costs $7,295. It provides 6 GB of storage capacity and uses 2-GB drives. The DTR2300-8T costs $9,450 and features 8 GB of storage. This RAID box uses three 4-GB drives and one 8-GB DAT drive to provide data storage and tape backup in a single desktop enclosure.

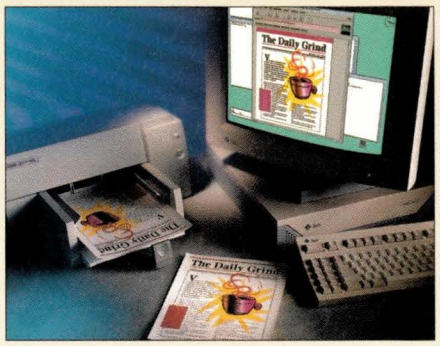
Also being offered is the DTR2300-12, which offers 12 GB of storage and uses 4-GB drives. It costs $9,795. The DTR2300-27 costs $16,295 and provides up to 27 GB of storage using 9-GB drives.

Procom Technology Inc.
2181 Dupont Drive
Irvine, CA 92715
Circle 104

Software Prints PostScript to any Color Printer

PostShop, new printing software from Vividata, is said to allow UNIX workstation users to print PostScript 1 and 2 to inexpensive ink-jet and laser printers from vendors such as Hewlett-Packard Co., Epson America Inc. and Canon Computer Systems Inc.

PostShop works by integrating itself with the standard UNIX print utilities, `lpd` and `lpq`, allowing for network printing. The software also allows users



to send file formats such as JPEG and GIF directly to the PostScript printer, a feature that most PostScript printers do not support, the company says. In addition, PostShop includes features for controlling brightness, contrast, positioning, scaling and orientation.

PostShop supports TIFF, CCITT Group 3 & 4, LZW, PBM, GIF, JPEG, EPSI, PostScript 1 and 2, Sun Raster and X11 Bitmaps. It runs on SunOS, Solaris, HP-UX, Digital UNIX, SGI IRIX and IBM AIX. PostShop costs $495.

Vividata Inc.
1250 Addison St., Ste. 213A
Berkeley, CA 94702
Circle 105

Navigation Tools Unveiled

Prism Solutions has introduced two new products, one for navigating and accessing data warehouse information, and one for organizing and displaying information in a relational database.

The Web Access module reportedly helps users locate desired metadata stored in a Prism Warehouse Directory, sends a request for that data and then downloads it to a desktop. The company says the software works with the Prism Warehouse Directory's MetaLink capability to create Java or HTML interpretations of the metadata. This allows the user to view data with a Web browser and download it to a desktop application for analysis.

The Prism Personal Mart Toolkit is said to build a navigation model that uses a point-and-click interface to identify data for analysis, without the user needing to know the structure of the database. The navigation model can be stored on a server for future viewing and provides a means for centrally updating requirements for information change. Also, ses-

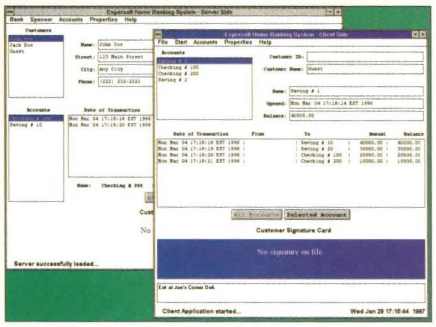
sion history will be recorded for later use to quickly select previously viewed forms and queries.

The Web Access module comes with a license for five concurrent seats and costs $2,500. It runs with Prism Warehouse Directory Version 3.1, the Prism Web Access Java applet on the client workstation and the Microsoft Corp. Windows NT Version 4.0 Intel-based Web Navigation Server. The Prism Personal Mart Toolkit can be licensed for $2,995 with five concurrent users.

Prism Solutions Inc.
1000 Hamlin Court
Sunnyvale, CA 94089
Circle 106

CORBAplus Supports Java ORB

Expersoft has announced an addition to its PowerBroker CORBAplus ORB, the Java Edition. Thus Java becomes a first-class language in Expersoft's CORBA 2.0 object request broker (ORB) environment, like C++ or Smalltalk, according to the company.



By extending CORBAplus to support Java-based ORBs, Expersoft says developers can create large-scale distributed applications over the Internet. CORBA supplies a standard interface, the Interface Definition Language (IDL) to distributed components, using the Internet Inter-ORB Protocol (IIOP) as the underlying network protocol. Several key Internet vendors have adopted the CORBA standard for precisely this purpose, Expersoft says, including SunSoft Inc. with JOE, Netscape Communications Corp. with NetscapeOne and Oracle Corp. with NCA.

This first release of CORBAplus, Java Edition, provides core CORBA-compliant services. Future versions will include a messaging infrastructure, object transaction processing services, networked security and adoption of the Publish/Subscribe paradigm, the company says.

CORBAplus, Java Edition, runs on Sun Solaris and Windows NT/95 platforms. Pricing is set at $2,995.

Expersoft Corp.
5825 Oberlin Drive
San Diego, CA 92121
Circle 107

HAL Offers Supercomputer Performance

Powered by the SPARC64-II processor, the new HALstations 375 and 385 are said to bring true supercomputer-class performance to the engineering and scientific research desktop. According to HAL Computer Systems, a Fujitsu company, the HALstation 300 series offers large memory, high throughput and 64-bit address space.

The HALstations are designed with the mechanical computer-aided engineering (MCAE) user in mind, the company says. The new series is said to offer faster job turnaround and improved floating-point performance and memory throughput. The HALstation 385 is said to achieve 13.6 SPECfp95 and 8.40 SPECint95 performance. In addition, the company boasts of a competitive price/performance ratio on both linear and nonlinear finite-element analysis using large models.

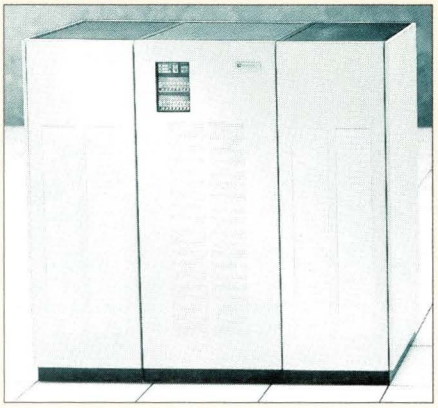
The 300 series also includes a complement of RAS features supported by a diagnostic service processor. The service processor monitors the condition of the entire system in order to prevent the corruption of data, the company says.

The HALstation 300 series comes with the base unit, 64 MB of RAM, 2-GB hard drive, Fujitsu AG-10E graphics option, keyboard and 20-inch color monitor. The HALstation 375 performs at 141 MHz and costs $15,995. Priced at $19,495, the HALstation 385 performs at 161 MHz.

HAL Computer Systems
1315 Dell Ave.
Campbell, CA 95008
Circle 108

Hitachi Enters Shared Storage Market

Hitachi Data Systems has entered the shared storage market with the introduction of its HDS 7700 Scalable Array for heterogeneous environments. Previously, HDS 7700 was only available for mainframe environments.



HDS 7700 reportedly offers the industry's largest usable capacity in a single subsystem of 1.63 TB. In addition, it can be configured to intermix RAID 1 and RAID 5 in the same subsystem.

In order to store data for both open system and mainframe environments, the HDS 7700 relies on the Hitachi Multiplatform Resource Sharing (HMRS) architecture. Features of this architecture include the Hitachi Multiplatform Data Exchange (HMDE) function, which allows the 7700 to quickly transfer data from MVS-based OLTP systems to UNIX-based data warehousing systems; a Backup and Restore function (the HMBR), for backing up 7700 UNIX data onto the mainframe using standard MVS software; Extended Remote Copy (HXRC), which provides asynchronous remote copy; Online Data Migration (HODM), for outboard data migration between other DASD subsystems and the 7700; and HDS Graph-Track Version 2.0, for reporting at the logical device level.

HDS 7700 is built upon HDS' high-density packing high-performance 3.5-inch, 9.2-GB disk drive. The drive incorporates magnetoresistive head technology, the company says.

HDS 7700 now supports Sun Solaris, IBM AIX and HP-UX systems, as well as

MVS environments. A low-end configuration (181 GB) starts at $500,000.

Hitachi Data Systems Corp.
750 Central Expressway
P.O. Box 54996
Santa Clara, CA 95056
Circle 109

RAID Storage with ESP

The GigaRAID line of intelligent RAID and non-RAID storage systems has been introduced by Andataco. It features Enterprise Storage Packaging (ESP) to help minimize unplanned system downtime, the company says.

ESP is said to use an intelligent onboard microprocessor to monitor a system's weakest components, such as fans, power supplies and drives. Systems administrators are notified of any abnormalities in the system via visual and audible alarms. Alerts can also be sent via their alphanumeric pagers and email with the addition of Andataco's Web Storage Manager software. According to the company, these early warnings enable a problem to be fixed before it causes system downtime or data loss.

The GigaRAID line supports a variety of standard disks (2, 4 and 9 GB) and tape drives (4mm, 8mm and DLT). These drives are housed in removable storage elements, which can be placed in single-, three- or eight-bay enclosures. The eight-bay units can also be daisy-chained in a GigaRAID data center cabinet, providing up to 1 TB of storage capacity.

The new line also features hot-swappable drives, power supplies and fans; a cableless chassis for increased SCSI integrity; the ability to support UltraSCSI data transfer rates; and the capability to cool 10,000-RPM disk drives, the company says.

Pricing starts at $3,000 and varies throughout the product line.

Andataco
10140 Mesa Rim Road
San Diego, CA 92121
Circle 110

Online Data Storage Tool

Operators of data networks can maintain an online version of critical data right on the network for access and recovery thanks to the latest software package from Hiarc, called the Hiarc Gemini.

With the tool, systems administrators can ensure that all stipulated partitions, directories and files have duplicates maintained on a local server, the company says.

By working from their client on a NFS network, systems administrators can select which data and operational information is to be automatically maintained by Hiarc Gemini. Data is held in a designated repository and is said to remain as current as the software's last access of the client's disk.

According to Hiarc, backups can be made as frequently as every five minutes to minimize the amount of potential lost data. Also, it has its own built-in backup, so that even data held by Hiarc Gemini can be recovered in the event of a failure, the company says.

As an additional layer of protection, Hiarc Gemini writes all data and backups in a nonproprietary format so that the data can be accessed even if the package is not present.

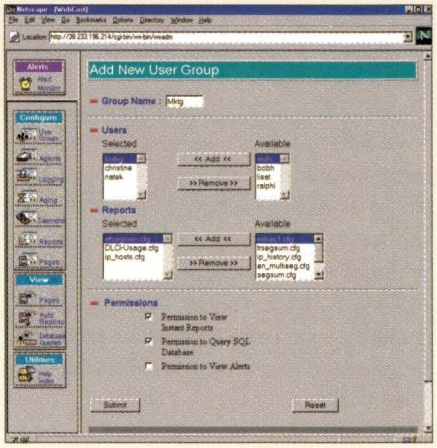
The product operates on Sun Microsystems Inc. servers and is available at a starting price of $12,000.

Hiarc
305 Second St., SE
Ste. 500
Cedar Rapids, IA 52401
Circle 111

Window to your Network

Frontier Software Development, maker of NETscout Manager, recently announced WebCast, which provides a browser-based front end to the network monitoring, reporting and troubleshooting package. The program quickly converts NETscout data into Web-readable form, making the data available across the enterprise at a low cost, the company says.

WebCast rests upon EnterpriseRMON, a superset of RMON1 and RMON2. EnterpriseRMON reportedly extends remote monitoring by adding client/server traffic reports and improved enterprise traffic and system-level troubleshooting. It can monitor several network topologies, including Ethernet, Fast Ethernet, token ring, Switched LAN,



VLAN (virtual LAN), WAN, Frame Relay, FDDI and CDDI.

WebCast's components, Frontier says, include the embedded security framework; automatic polling at user-defined intervals and automatic report generation; customized SQL queries via a Web-based form; and the NETscout Server, supporting the end-to-end network monitoring of RMON-based probes and MIB2 devices.

One benefit of WebCast, Frontier says, is that network administrators are not tied to any particular location. Administrators can configure network agents and probes and four levels of security controls from anywhere on the Internet.

WebCast is available to users of Frontier's NETscout Manager console and NETscout Server and costs $2,495.

Frontier Software Development Inc.
321 Billerica Road
Chelmsford, MA 01824
Circle 112

Communications Servers for LAN-to-WAN

Uconx has announced two highly scalable LAN-to-WAN communications servers, the MPS 300 and 600.

Both servers are based on a portable Streams-based, real-time operating system and support most communications protocols, including X.25, Frame Relay, HDLC/SDLC, asynchronous data transfer, financial market feeds and radar receivers. Client software accesses the communications server through an API. According to Uconx, other communications servers first encapsulate messages

going from one WAN port to another in a wrapper, which must then be stripped at the other end.

The MPS 300 and 600 are based on a MC68360 QUICC integrated communications controller and are equipped with up to 8 MB of RAM. The MPS 600 includes 2 MB of Flash EPROM for optional storage of runtime software and PCMCIA. Both servers include support for either one or two Ethernet ports, one to six serial ports and various electrical line interfaces.

If you wish to develop your own communications protocol, Uconx offers ProtoKit. ProtoKit provides the foundations for developing protocols based on async, bisync, HDLC or serial bit communications, Uconx says.

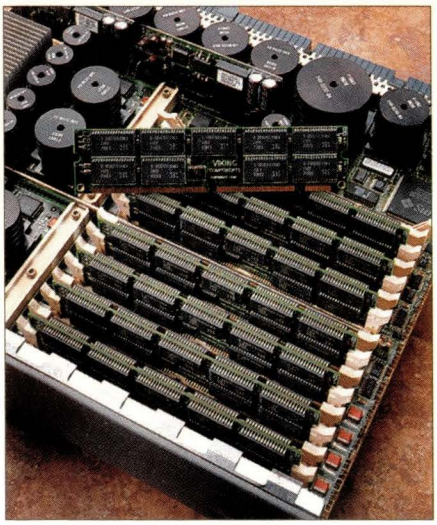
The MPS 300 with three serial ports is priced at $4,295, and the MPS 600 with six serial ports is priced at $4,995.

Uconx Corp.
4669 Murphy Canyon Road
San Diego, CA 92123
Circle 113

Ultra Upgrade Kit

The Sun Ultra Enterprise Servers in the 3000, 4000, 5000 and 6000 series can now receive a 1-GB upgrade with Viking Components' upgrade kit. The kit comes with eight 128-MB dual-in-line memory modules (DIMMs) designed to give 64-Mb/s data transfer capacity, Viking says.

According to Viking, the modules are buffered, enabling the memory and the system to share the same address line and use less power. Also, the modules are reportedly small enough to fit in available motherboard space.



The upgrade kit, part number S7023A, is said to be 100% compatible with Sun hardware, software and diagnostics. In addition, the product carries a lifetime warranty from Viking. The 1-GB upgrade kit costs $14,300.

Viking Components
11 Columbia
Laguna Hills, CA 92656
Circle 114

RAD Web Tool Unveiled

Blyth Software has introduced its Omnis Web RAD (Rapid Application Development) tool to help users create sophisticated Internet applications. Developers already working in the Omnis client/server environment can use the Omnis Web-Enabled SDK to achieve the same results, Blyth says.

Omnis Web RAD provides more than straight HTML and Java development support; it also provides support for building transaction-based applications incorporating messages and other system services, Blyth says.

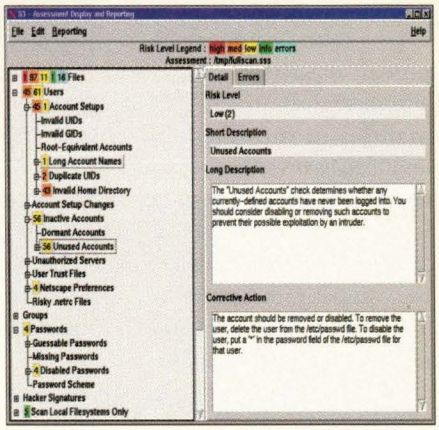
Features include the Universal Scripting Language, for consistent access to Web services, client desktops and databases; socket-level network interfaces, for building applications that communicate directly with other socket-based programs on a TCP/IP network; Direct Database Access, enabling native connections to Oracle, Sybase, Informix and EDA/SQL middleware, for access to other databases; Multiple Client Architectures, for building either client/server, peer-to-peer or mobile architectures; and binary compatibility of Omnis applications across all Windows, Macintosh and OS/2 platforms.

Omnis Web RAD is available in two configurations. Omnis Workgroup Web RAD, which includes Omnis and Omnis Web Enabler SDK, is priced at $990 per developer's license. Omnis Enterprise, which also incorporates version control and change management, is priced at $3,490 per developer's license. Evaluation copies are available from the company's Web site: `http://www.blyth.com/`.

Blyth Software Inc.
989 E. Hillsdale Blvd., Ste. 400
Foster City, CA 94404
Circle 115

Tool to Assess Security Practices

Internet Security Systems, maker of Internet security assessment tools, has released a product devoted to assessing the security of UNIX-based environments. Called the System Security Scanner (S3), the product enables administrators to seek out internal vulnerabilities, ISS says.



S3 systematically searches the UNIX environment for typical security holes such as file permissions and ownership, network service configuration, account setups, program authenticity and "guessable passwords." It also searches systems for signs of hacker intrusion.

The S3 program includes the configuration and scanning of multiple machines; an intuitive GUI; a comprehensive list of security holes, updated regularly and made available at the company's Web site; report generation; corrective action recommendations; and prioritization of vulnerabilities.

S3 is available in single- or 10-server license packages, priced at $495 and $3,500, respectively. S3 is available for most major UNIX systems, including SunOS, Solaris, Linux, IBM AIX and HP-UX.

Internet Security Systems Inc.
41 Perimeter Center East, Ste. 660
Atlanta, GA 30305
Circle 116

Data Management Engine Clusters Data

Search Software America has announced the availability of Data Clustering Engine Version 2.0. According to the company, names, addresses and other data can be processed despite spelling errors or variations in data.

The Data Clustering Engine groups diverse data records into clusters of related records. This is said to enable duplicate records to be eliminated or relationships between records to be identified.

In addition, the Data Clustering Engine can be used for data mining purposes, for customer information, marketing or fraud investigation systems. The software can also be used to combine multiple files into a data warehouse.

Groupings of data can be made based on user-defined rules. The Data Clustering Engine uses its own high-performance database, which can accept data from other databases, according to the company. The Data Clustering Engine is used in conjunction with SSA-NAME, which is a name-search and matching tool.

A license for SSA-NAME and Data Clustering Engine 2.0 ranges from $64,000 to $152,500. The product is available on various UNIX platforms, including Sun, IBM and HP. It is also available for MVS, Windows NT and 95, PC-DOS and OS/2.

Search Software America
1445 E. Putnam Ave.
Old Greenwich, CT 06870
Circle 117

Upgrades, Enhancements, Additions...

◆ Invincible Technologies has announced that the Lifeline SFT (Symmetric Fault Tolerant) NFS server is now available with dual 366-MHz Digital Equipment Corp. Alpha CPUs. Invincible also announced built-in support for the Microsoft Corp. SMB file system protocol and the availability of 9-MB drives. A 366-MHz system equipped with approximately 200 GB of storage is priced at $158,410.
Invincible Technologies Corp.
4 Marc Road
Medway, MA 02053
Circle 118

◆ Raima, maker of the Raima Database Manager++ (RDM++), has released a version of the product for the Solaris operating system. In particular, RDM++ 4.5 includes the Raima Object Manager, a class library that encapsulates object storage and database navigation into C++ class definitions, for an object-oriented interface to RDM++. Also, developers of UNIX-based applications will benefit from improved thread safety, a new RDM.ini file, and the UNIX Lock Manager program, for controlling access to the database in multiuser applications. RDM++ 4.5 also runs on Windows NT and 95, and on most major UNIX platforms. RDM++ 4.5 starts at $6,195 for a multiuser, single developer's license.
Raima Corp.
1605 NW Sammamish Road, Ste. 200
Issaquah, WA 98027
Circle 119

◆ Red Hat Software has released Linux Version 4.1 for Intel Corp., Digital Equipment Corp. Alpha and Sun Microsystems Inc. SPARC architectures. The new version is said to be much easier to install and configure, making use of fill-in-the blank forms. It also includes Sun's Java Developer's Kit (JDK) 1.0.2, Metro-X 3.2 X server and the Red Baron secure Web browser. Linux Version 4.1 can be downloaded for $49.95 from the company's Web site at `http://www.redhat.com`.
Red Hat Software Inc.
3203 Yorktown Ave., Ste. 123
Durham, NC 27713
Circle 120

◆ PMDF e-Mail Interconnect, an SMTP/MIME messaging backbone from Innosoft International, is now available for Solaris on Intel. PMDF is a commercially supported messaging backbone that exclusively uses the Internet's Multipurpose Internet Mail Extensions (MIME) as its standard mail format. As such, PMDF is used to connect disparate (legacy and mainframe) email systems. PMDF is offered for Sun Solaris (SPARC and Intel), Digital UNIX and OpenVMS (VAX and Alpha AXP). Software licensing fees range from $6,000 to $15,000.
Innosoft International Inc.
1050 E. Garvey Ave. SW
Corvina, CA 91790
Circle 121

◆ NCD's PC-Xware X server software has been upgraded to Version 5.0. This latest release is said to be more tightly integrated with the Windows 95 and NT 4.0 environments. For example, PC-Xware 5.0 features a connection wizard for creating the initial network connection; PC-Xware is represented as an icon in Windows' Task Manager; and configuring options are done through Property Sheets, the company says. The latest release also includes NCD's WinCenter Acceleration extension, for improved performance. Pricing for PC-Xware starts at $395.
Network Computing Devices Inc.
350 N. Bernardo Ave.
Mountain View, CA 94043
Circle 122

◆ Integrix's SEC160 SBus expansion unit now supports both the UltraSPARC and SPARC desktop lines. The SEC160 provides six additional SBus slots to all Ultra 1- and 2-compatible systems, allowing administrators to add additional I/O capabilities to limited systems. The SEC160 for UltraSPARCs costs $1,995. A free firmware upgrade is available to current users of Version 1.0.8.
Integrix Inc.
2001 Corporate Center Drive
Newbury Park, CA 91320
Circle 123

Golden Gate Family Unveiled

A new family of tape backup and recovery systems has been introduced by Mosaic Technology. The system, called the Golden Gate family, offers a variety of tape technologies such as Quantum Digital Linear Tape (DLT), Exabyte 8mm, 4mm DAT and 3490 $^1/_2$-inch 36-track tape technology. The backup and recovery solution works with Sun Microsystems Inc., IBM RS/6000 and AS/400, Hewlett-Packard Co., Digital Equipment Corp., Silicon Graphics Inc., Novell Inc. and Microsoft Corp. Windows NT environments.

The Golden Gate line reportedly offers a controller architecture with high-speed data matching cache buffer that allows for optimization of data transfer between a host system and tape transport. In addition, the Golden Gate line is designed to offer simultaneous dual host operation with its Autoswitch capability. Also, Golden Gate features multiple emulation support, the company says.

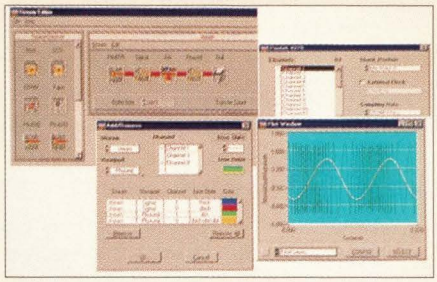
Pricing for Model MT-4000-D, with direct-attach single drive, starts at $2,500 and ranges up to $19,500. The single-port single-drive model MT-4000-11 costs from $3,500 to $18,500. The single-port dual-drive model MT-4000-12 has price range of $4,850 to $23,500. Model-4000-21, which is available with a dual-port single drive, has a starting price of $4,500, ranging up to $22,500. And the MT-4000-22 costs between $6,500 and $25,500 and comes with a dual-port dual drive. Pricing varies based on tape technology and attachment type.

Mosaic Technology Corp.
8A Industrial Way, Unit 3
Salem, NH 03079
Circle 124

View Real-Time Data Acquisition

Pentek's new File Transfer Language (FTL) lets users view data acquisition for VMEbus-based digital signal processing in real time.

Pentek says FTL includes a collection of software libraries for initializing, organizing, sorting and retrieving data, as well as support for single- or multichannel A/D and D/A converters, SCSI disk



and tape drives, local RAM disks, digital I/O, TMS320C40 communications ports, host workstation file systems and all VME devices. FTL runs on any Texas Instruments Inc.-based C40 DSP board that Pentek supports.

FTL also offers a GUI interface to a data streaming engine that automates the setup and control of the I/O interface. GUI interfaces are already available for National Instruments Corp.'s LAB-Windows/CVI, Entropic Research Laboratory Inc. Waves (for Sun and HP), The Math Works Inc.'s Matlab and DSP Development Corp.'s DaDisp.

The FTL interface can be programmed in either C or SPOX, a language that provides a compact, real-time, multitasking kernel with support for preemptive, event-driven scheduling, dynamically prioritized tasks, synchronization and communication facilities, and device interrupt handling, the company says.

FTL supports SunOS, HP-UX and Windows NT/95. UNIX versions of Pentek FTL (Model 4958) cost $7,000.

Pentek Inc.
One Park Way
Upper Saddle River, NJ 07458
Circle 125

Customer Service App Uses 'Push' Technology

ImpaQ from Quintus is a Web-based customer service application that provides information about clients in real time, through a push technology paradigm.

Current customer information gets pushed down to an ImpaQ client running in the browser. The information is then hypertexted, so that the user can access further information, if necessary. This way, Quintus says, organizational data can be consolidated and distributed appropriately across the enterprise.

ImpaQ is based on Java, Web and publish and subscribe technologies. Types of data that can be retrieved include call center data, company news, specific details on customer accounts and product information, Quintus says.

ImpaQ integrates with Quintus' WebQ, which delivers search, review and updating capabilities for call center and customer data. ImpaQ can also drill down to legacy data and display it in the user's browser, the company says.

The product runs on Sun Solaris, Windows NT, HP-UX and IBM AIX server platforms. It supports access to Microsoft SQL Server, Oracle, Sybase and Informix databases. Pricing for ImpaQ is set at $25,000 per server, and $250 per client.

Quintus Corp.
47212 Mission Falls Court
Fremont, CA 94539
Circle 126

Distribute Java Objects Across the Net

Black & White Software has introduced Web/Enable, a product that uses standard Java and the CORBA Internet Inter-ORB Protocol (IIOP) to provide an infrastructure for building and migrating applications that function across the Internet and corporate intranets.

Web/Enable can be used to create and register servers with the CORBA Object Request Broker (ORB). These servers can then be accessed from within Web/Enable to create client applications or applets in Java or C++.

The product includes a graphical palette of Java components and tools for constructing clients and servers, and automatically integrates the GUI and three-tier distribution-based code. Web/Enable also includes IDL development and CORBA 2.0-conformant features, and facilitates the administration of deployed applications across a network, Black & White says.

Web/Enable fully supports development in Java and features CORBA for object distribution and IIOP for object communication. Web/Enable runs on Solaris and is priced at $3,500.

Black & White Software Inc.
1901 S. Bascom Ave., Ste. 700
Campbell, CA 95008
Circle 127

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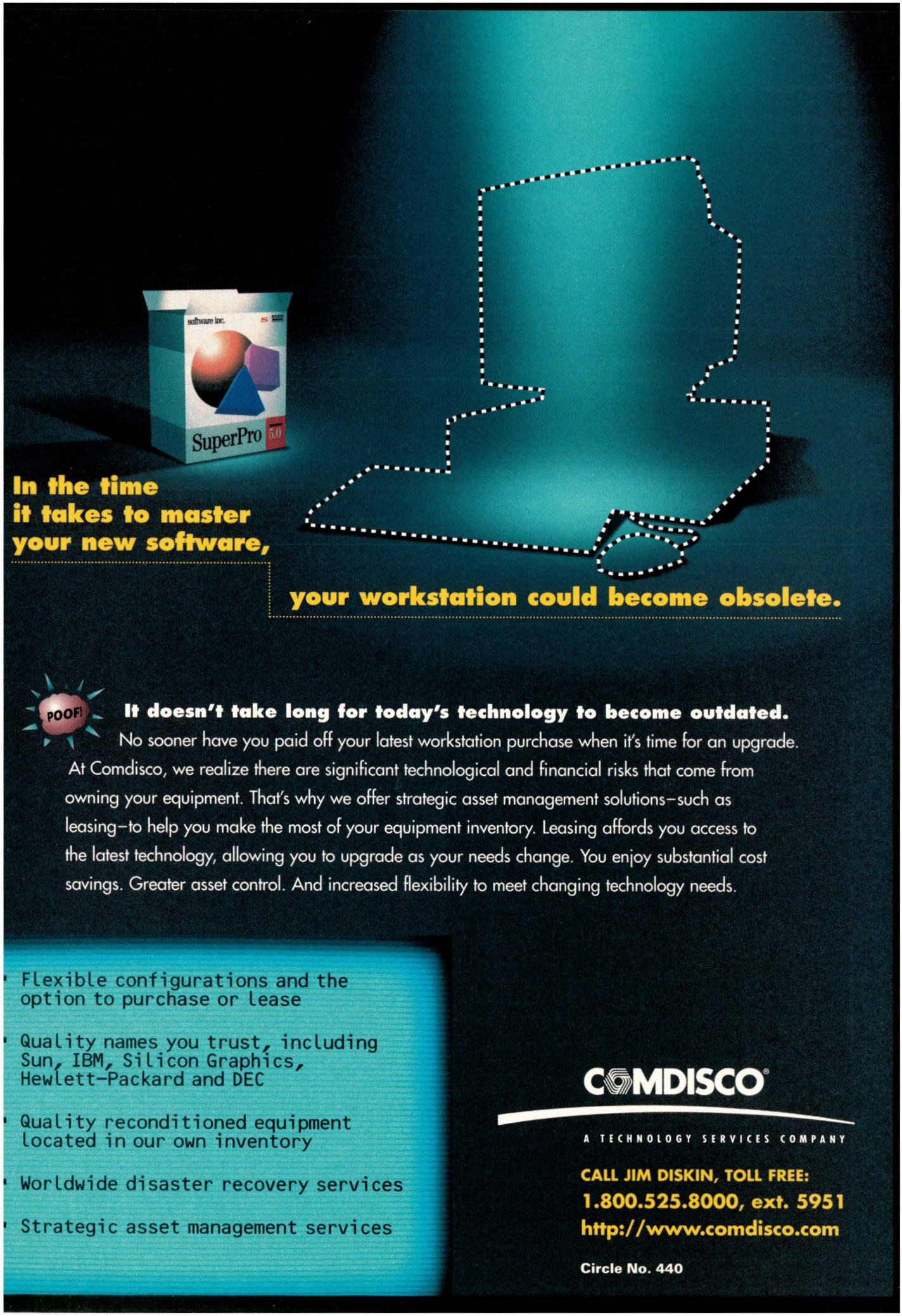
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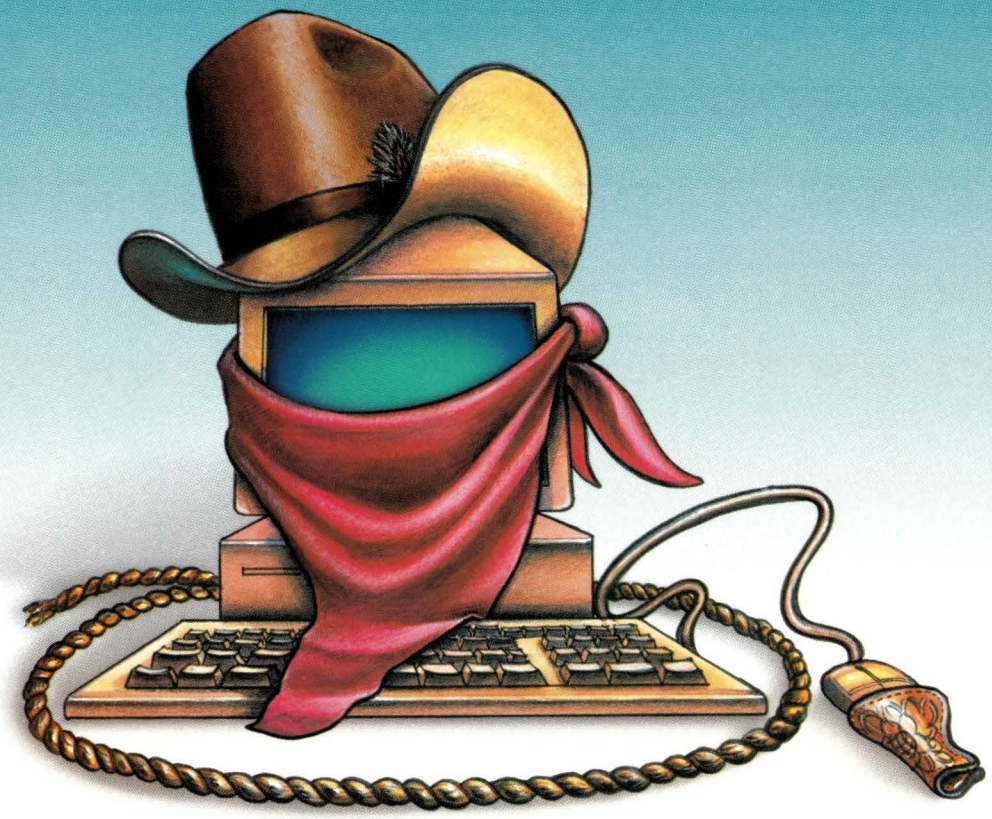

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