Server/Workstation EXPERT

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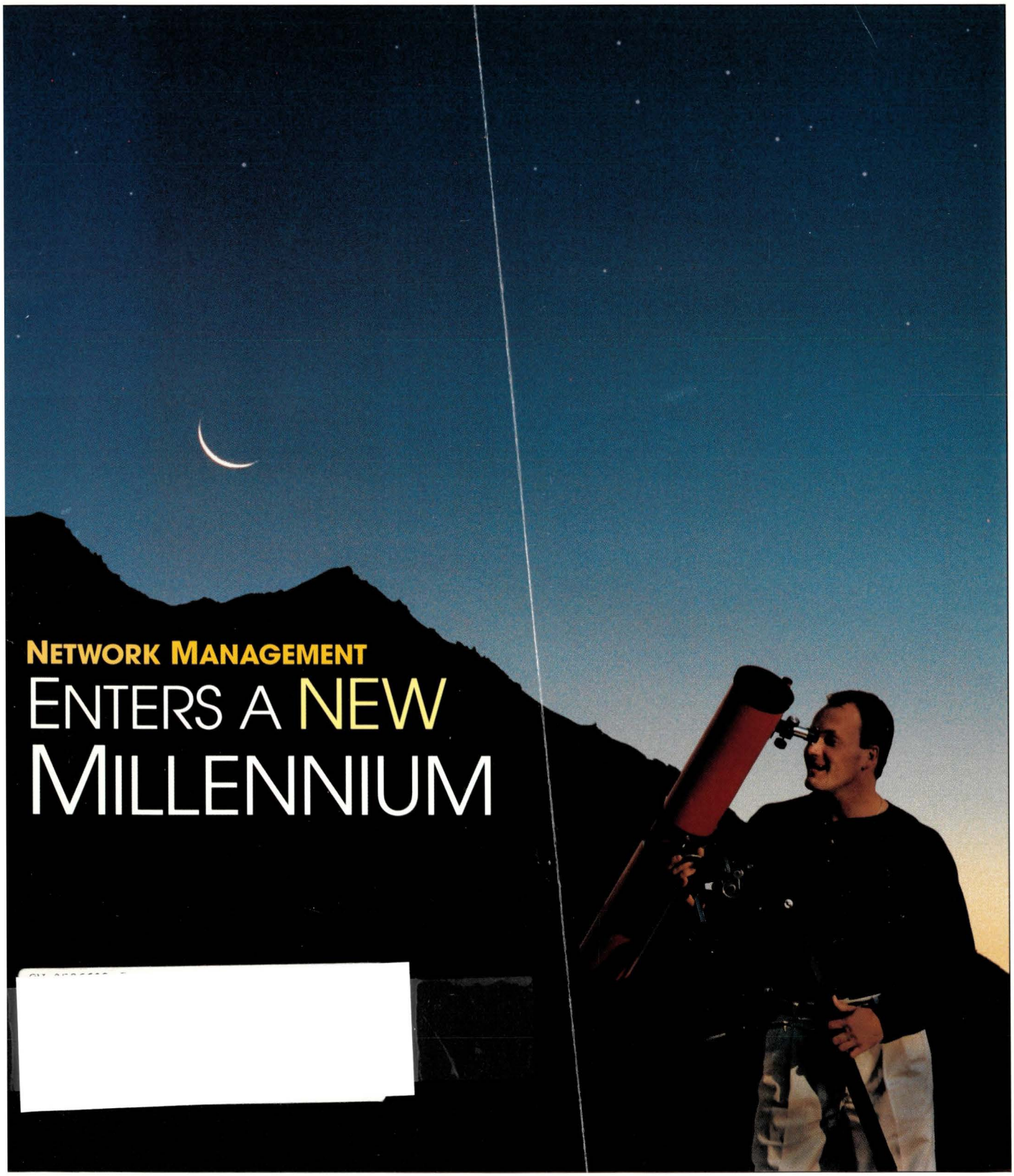

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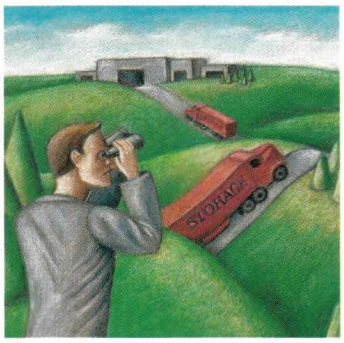

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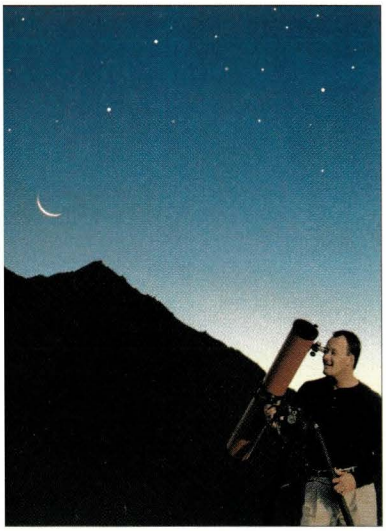

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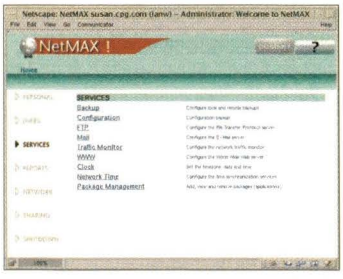

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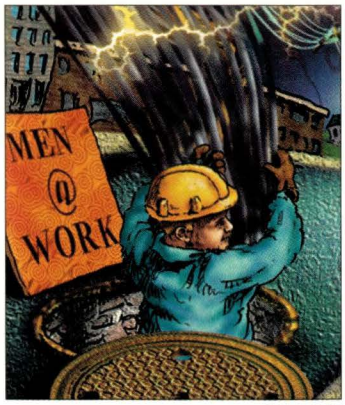

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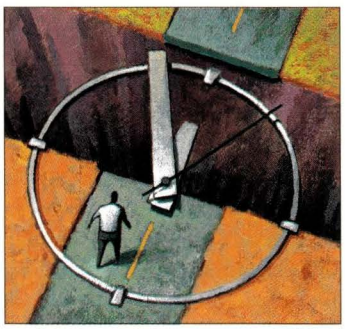

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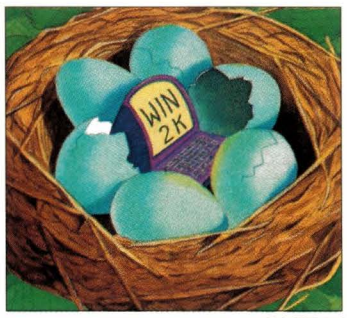

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Storage Technologies

EDITORIAL

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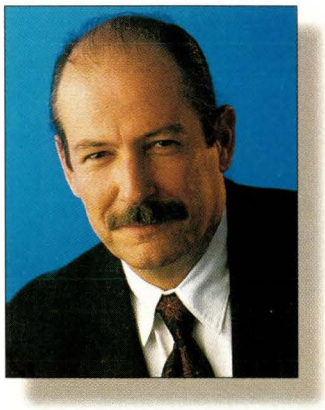

'And Indeed There Will Be Time'

By now, most of you should be emerging from the yellow fog of millennium celebrations and, like sysadmins etherized upon a table, waking from the anesthesia of Y2K. (Regular readers of *SW Expert* may recognize that these phrases are borrowed from T.S. Eliot and appear in his poem "The Love Song of J. Alfred Prufrock." I have alluded to them before. Some might say stolen.) So everyone is breathing a sigh of relief over the chronometers turning 2000. You think to yourself, as Prufrock does, "There will be time, there will be time."

Not so fast UNIX fans. You should take a look at Peter Collinson's UNIX Basics column this month. "Once the dust has settled," he says, "let's all start worrying seriously about 2038, specifically Tuesday, January 19, 2038 at 03:14:07 GMT. At this point, there will have been exactly 2,147,483,647 seconds since midnight on January 1, 1970, which is the time that Ken Thompson decided to set as the epoch for UNIX internal time measurement." Here we go again, you say. Well, Peter explains some options. Don't wait until you're a Prufrock "pinned and wriggling on the wall." But, if you like to procrastinate, one of Peter's solutions postpones the date-processing problem until the year 292471210647. Is that enough time?

Also in this issue, Paul Korzeniowski takes on a timely topic: network management. "For more than a decade, customers have yearned for tools that would provide them with a cohesive view of all of their network and system elements," says Paul. Well it seems the time is coming when the network is the computer and the computer is the business. Hence, network management will play a linchpin role in the new millennium–whether it starts in 00 or 01. In the fall of 1996, many industry heavyweights, among them Cisco Systems Inc. and Microsoft Corp., outlined plans for a Web-Based Enterprise Management (WBEM) scheme. Since then, some progress has been made. In fact, a key component is the Common Information Model. This object-oriented model provides a conceptual framework for managing data and allows information to be exchanged among management systems and applications. This model wedded to XML as an intermediary, should eventually provide a way for applications to trade CIM data. Network management systems then would be able to sing "each to each," not unlike Prufrock's singing mermaids. It's just a matter of time.

Doug Pryor

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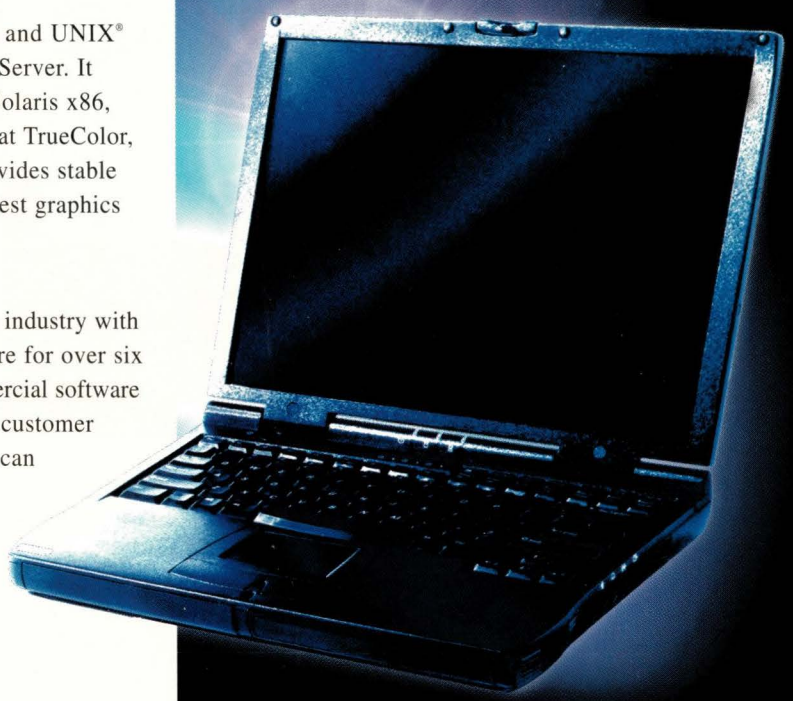

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Sun Finishes Strong

As 1999 drew to a close and final-quarter consumer marketing forecasts grew darker, many hardware and software manufacturers began devoting their resources to toughening up existing products until the Y2K storm blew over and consumer wariness began to fade.

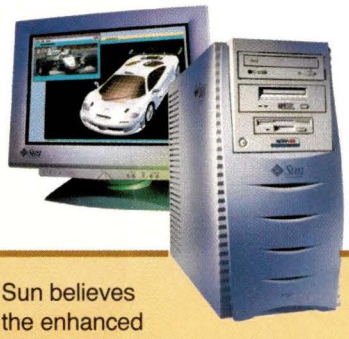
Yet Palo Alto, CA-based Sun Microsystems Inc. preferred to finish the year dropping prices and pushing several new products to market. Beginning in October, Sun dropped the price of its Ultra 5 and Ultra 60 workstations, which was followed in November by several major new product announcements and existing product enhancements–among them, the introduction of the Ultra 80 workstation, the Enterprise 220R and 420R workgroup servers, and the availability of a new 18.1-inch flat-panel display.

Needless to say, the final quarter of 1999 was a busy one for Sun, says Chris Scheufele, product line manager for the workstation family at Sun.

But although the Ultra 80 announcement kept Sun's public relations representatives busy, research analysts like David Witzel of D.H. Brown & Associates Inc., Port Chester, NY, say its release will simply allow Sun to compete, rather than jump ahead, in the high-end workstation market. "I think they've done a good job thinking this one out, rather than just repackaging something," says Witzel, noting that Sun's Ultra 450 four-way system was also designed for this space but never really caught on. "It was an enormous system. I guess it was too big," he says. "[The Ultra 80] is geared more toward the workstation user, which is good."

Kara Yokley, a research analyst at International Data Corp. (IDC), Framingham, MA, agrees that Sun is directly targeting the workstation market with the Ultra 80, but doesn't feel that it's breaking any new ground. "Sun already had a presence in this space with the 450 server. The Ultra 80 is more of a replacement for the 450 than a revolutionary new system," she says.

The Ultra 80, which costs $15,635 for a single-processor system with no monitor and runs up to $38,365 for a four-processor model with a 19-inch monitor, is the focal point of the company's autumn announcements. Aimed at what Sun calls the "sweet spot of the high-end workstation market," it's the company's most powerful multiprocessor graphics workstation to date.



Sun believes the enhanced graphics processing capabilities of the new Ultra 80 is the first major step in the company's drive to make graphics technology and development a priority.

Designed for both graphics and compute-intensive applications, the Ultra 80 is ideal for the earth science, gas and satellite imagery markets, says Sun's Scheufele. And with the ability to be configured with four 450-MHz UltraSPARC II processors, 4 GB of memory, two Elite3D graphics accelerators and enhanced storage capacity and I/O performance via support for two 18.2-GB/10,000-rpm UltraSCSI internal drives, the Ultra 80 offers twice the processing and memory capacity of the Ultra 60. "It is a premier product," says Scheufele. "We expect to sell a lot of these units to our customers who have been pushing us for more memory capacity. It serves several different requirements: memory, processing or both."

One major concern for Sun, says Scheufele, was that along with memory and processing demands, many of the company's high-end users were asking for better graphics processing capabilities. Both SGI, Mountain View, CA, and Hewlett-Packard Co., Palo Alto, CA, have four-way processing workstations on the market–the Octane from SGI and the J7000 from HP–and according to some analysts, their graphics capabilities are leading the space. "Sun is throwing this one toward the SGI market," says D.H. Brown's Witzel. "Their graphics capabilities are second to SGI and HP. The early part of 2000 will show if [Sun] will be able to compete."

To that end, Scheufele feels the Ultra 80 is a big step in the right direction. "[The Ultra 80] shows how Sun is looking at graphics technology going forward," he says. "[We're] dedicated to driving up the performance."

To further emphasize that dedication, Sun also released an 18.1-inch flat-panel monitor, featuring 24-bit true color, a thin-film transistor LCD with 16.7 million colors, 1,280-by-1,024 resolution and a depth of only 2.7 inches. The new monitor also has dual video inputs, allowing users to simultaneously connect the monitor to two separate workstations or PCs, Sun says.

"I think they are trying to address parts of the market they haven't embraced," Witzel says. "They're keeping the UPA architecture, which is good. Certainly, this will help them."

And even for potential workstation buyers that may not be looking at the Ultra 80, its release is good news. The introduction of the Ultra 80 triggered an 18% price reduction on the Ultra 60, dropping the price of an entry-level model to $8,995. Sun has also doubled the Ultra 60's internal disk capacity. All of this, coupled with the price reduction

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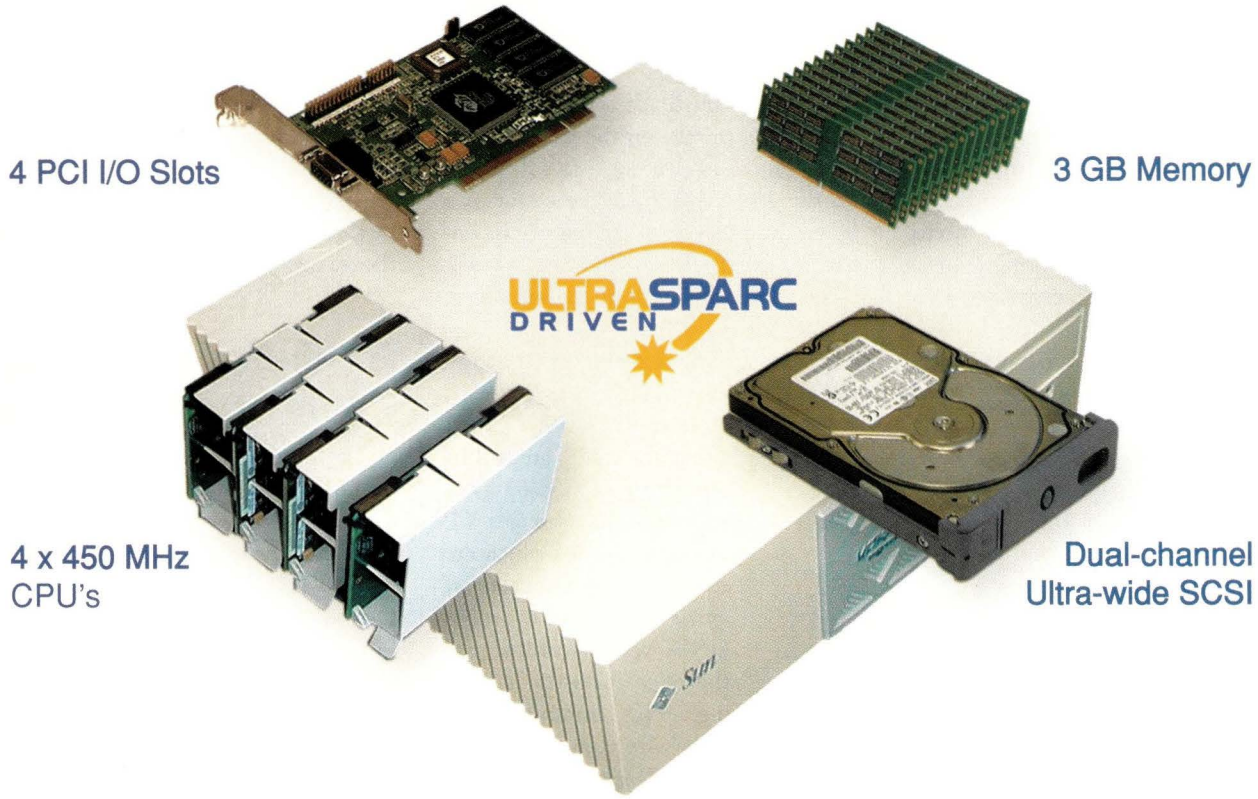

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With front-accessible hot-swap disks and power supplies, and the ability to mount 10 servers in a 72-inch rack, Sun's Enterprise 420R server is ideal for companies with limited space.

of the Ultra 5 workstation in October (to $1,945), and the Ultra workstation family is tough to beat in terms of price/performance, Witzel says. "Sun is way on top in terms of UNIX workstations," he says. "They're good price performers."

IDC's Yokley agrees. "This is pretty much business as usual for Sun. This is in keeping with their aggressive price reductions."

Sun also released two new workgroup servers in November, the Enterprise 220R and Enterprise 420R, designed specifically for the telecommunications industry, Internet service providers (ISPs) and other compute-intensive environments.

The 220R and 420R can be configured with two or four 450-MHz UltraSPARC II CPUs and 2 or 4 GB of memory, and both come with Ultra Port Architecture (UPA) crossbar-switch interconnect, PCI local bus and 40-MB/s UltraSCSI disk for maximum throughput. Although the technology is nothing new, it's the servers' practicality and attention to detail–notably the ability to stack the servers (up to 10 per 72-inch rack) and their front-accessible hot-swap disks and power supplies–that make them a substantial step for Sun in the telco and ISP space, where floor space is precious, says Joyce Becknell, director of enterprise platforms and IT architecture at Aberdeen Group Inc., a Boston, MA-based market research firm.

"What Sun did is they said, 'OK, we're going to take on the issues [of the workgroup server space],'" says Becknell. So this isn't a huge new processor or a large advance as far as technology is concerned, says Becknell, "but Sun has met those additional needs at the infrastructure level."

More important than their practical focus and design, says Jean Bozman, research director at IDC in Mountain View, CA, is that the 220R and 420R servers are specifically geared toward the telco and ISP markets, both of which are experiencing substantial growth. "Sun and the other UNIX vendors realize that the telco industry is buying UNIX computers like there's no tomorrow," she says. "These guys can't buy computers fast enough." And based on Sun's reputation as a solid performer in the workgroup space, and the attention Sun has paid in optimizing the 220R and 420R for this market, Bozman says Sun will most likely be among the top choices for consumers.

The servers are specifically geared toward the telco and ISP markets, both of which are experiencing substantial growth.

Aberdeen Group's Becknell agrees that Sun is targeting a specific niche with the release of the new servers. "This is one of the most lucrative areas for Sun," says Becknell. "They have whole business units dedicated to handling those areas."

Both the 220R and 420R are binary compatible with Sun's entire server line, run the latest Solaris operating environment and support Solaris PC NetLink software, which delivers Windows NT services to Sun servers. The 220R and 420R cost $11,995 and $16,995, respectively, for a base configuration. And although Sun isn't the only hardware manufacturer targeting this exploding market, Becknell says the competition must now play catch-up.

"They're still ahead," says Becknell, referring to Sun's position in the workgroup server space. "Where Sun is ahead is in the conceptual understanding of the market and the commitment level they have in this market." While Becknell acknowledges that competitors such as HP and IBM Corp., Armonk, NY, may have a leg up in the e-commerce arena, Sun is fueling the ISP and telco boom, she says.

"Sun has a lead in this telco space," says Becknell. "This is the space where they're strongest."–*ml*

Intel, Red Hat Bring Linux to ISP Market

Currently the ISP market is the bastion of the UNIX operating system, but Santa Clara, CA-based Intel Corp. is aggressively moving into the space with its ISP Program, and it's bringing Durham, NC-based Red Hat Inc.'s Linux with it. Intel has announced plans to bundle the Red Hat Linux operating system on the servers it supplies to ISPs.

Many analysts believe Linux has the potential to be an extremely important operating environment for the ISP market. Industry watchers say it performs well as a Web server, runs on inexpensive hardware and it's free. For ISPs that need to maximize the return on their investments, that makes Linux very appealing. "ISP are conscious of margins," says Tony Iams, senior analyst with technology research firm, D.H. Brown & Associates Inc., Port Chester, NY.

But from a technology stand point it also meets the ISP's needs as well. A popular configuration among ISPs includes small rack mounted servers that are dedicated to one function, like act-

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ing as an email or Web server. "Typically the model configurations we are seeing are single function servers," says Paul McNamara, general manager of Red Hat's enterprise business unit. "That way if a server goes down, the ISP only loses one function."

This is precisely the type of setup that Iams sees Linux being a part of. Of course, he believes it doesn't have to be limited to just a small ISP. If a large ISP uses a farm of small servers to run single functions, Linux is ideal. "Linux works very well for any ISP that sets up small boxes that have unique IP addresses," says Iams.

However, it's the cost factor that seems to really score points for Linux over other operating systems, like Palo Alto, CA-based Sun Microsystems Inc.'s Solaris. At Norfolk County Internet Inc., a small ISP located in Franklin, MA, Linux and Microsoft Corp.'s Windows NT are the company's two operating environments. "We use Linux probably half and half with Windows NT," says Travis Morse, network administrator.

An operating system like Solaris was just too expensive for his company, Morse says. "We're too small for that. We don't have the big bucks," he says. "To really get into a Solaris environment, you really have to be a big roller."

Red Hat and Intel will offer combined support and services to their customers using the Red Hat version of the open source operating environment. In November, Red Hat also added new features to its Linux 6.1 release. These features include the first distributed English version of Sun Microsystems' office suite Star Office 5.1, and full LDAP integration.–*ptc*

IBM Woos the Would-be ASP Market

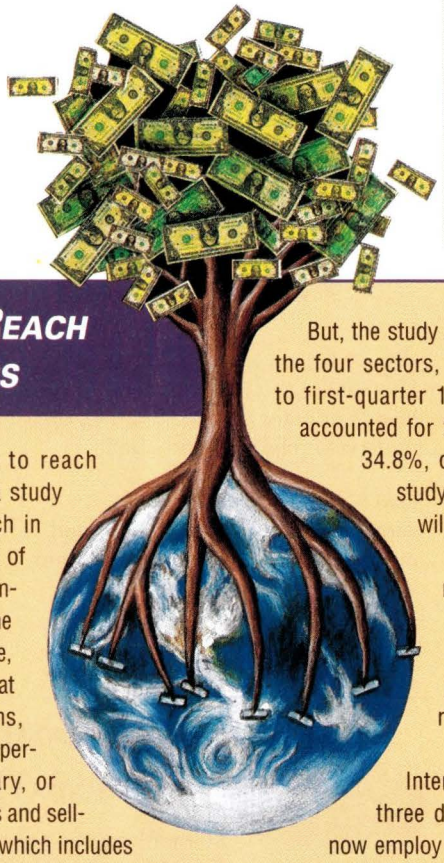
A series of announcements in November by IBM Corp., Armonk, NY, surrounding the nascent application service provider (ASP) market suggests that the company firmly believes in the potential of the ASP model.

Doing its part to get the ASP market off the ground, IBM has announced that it will work with independent software vendors (ISVs) interested in offering their applications through the ASP channel in order to help them determine whether their products are a good fit for a hosting scenario. Called ASP Prime, the program has three goals, says Ann Reiter, service provider marketing executive, IBM Server Group: "educate" ISVs surrounding the ASP model; "assess" individual applications for suitability; and, of course, "enable," the applications themselves.

"Our ISVs have expressed a strong interest in the ASP model," says Reiter, who notes that renting applications on a monthly basis could turn out to be a lucrative and steady source of revenue for ISVs. In particular, ISVs hope to target resource-strapped small- to medium-sized businesses, that otherwise might not be able to afford large capital expenditures on software.

The ASP way of doing things states that a customer pay for access to software monthly, usually on a per-user basis. Software is hosted at a remote location and delivered to the end user via the Internet, a VPN or a private leased data line. Applications that have proved themselves ASP-worthy so far include e-commerce applications, collaboration suites, and to a limited extent, enterprise resource planning (ERP) packages.

Apparently, some of IBM's own applications have benefited from the ASP Prime program because several



JANE MARINSKY

Internet Economy to Reach Half a Trillion Dollars

The Internet economy is projected to reach $507 billion this year, according to a study conducted by the Center for Research in Electronic Commerce at the Graduate School of Business, University of Texas. The study examines the economic impact of four layers of the economy relating to the Internet: Infrastructure, or companies with products and services that help create IP-based networks; applications, products or services that make it possible to perform business activities online; intermediary, or companies that facilitate the meeting of buyers and sellers over the Internet; and Internet commerce, which includes companies involved in the sales of products and services to consumers and businesses via the Internet. In total, the four segments will generate half a trillion dollars in revenues, the study finds.

But, the study says, Internet commerce was the hottest of the four sectors, increasing 127% from first-quarter 1998 to first-quarter 1999. In first-quarter 1998, e-commerce accounted for 25.8% of Internet revenue and jumped to 34.8%, or $37.5 billion, in first-quarter 1999. The study also predicts that total revenues for 1999 will reach $170 billion.

Another finding of note was that Internet-related jobs increased from 1.6 million in first-quarter 1998 to 2.3 million in first quarter 1999. "Nearly 400,000 e-commerce jobs alone were added in [September]," the report states.

The report also finds that of the 3,400 Internet economy companies surveyed, one in three didn't exist before 1996. These companies now employ 305,000 employees. In addition, 2,000 new secure Web sites are created each month. This activity reflects the number of businesses flocking to the Internet or expanding their online presence, according to the study.–*ptc*

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Circle No. 6

Lotus applications are now available to ASPs. These include online awareness and instant messaging, meeting services, team collaboration services and group calendaring. They come with an integrated "portal" which allows the customer to self-manage the application, the company says.

IBM is also hoping that members of its PartnerWorld program will catch ASP fever. Through the newly launched Hosting Advantage initiative, IBM is offering service providers the ability to test their equipment's reliability in a hosting environment. This can be done at IBM's testing center in Beaverton, OR, which houses diverse IBM hardware, including Intel Corp.-based Netfinity servers, RS/6000s and NUMA-Q servers, which IBM added to its hardware roster when it acquired Sequent Computer Systems Inc. in September.

Ultimately, IBM will benefit from these efforts by "launching [our] partners on an IBM infrastructure," says Reiter. And unlike Internet service providers (ISPs) or Web hosting businesses, ASPs require a greater variety of hardware platforms on which to run their applications. "We're seeing all platforms coming into play–AS/400, NUMA Center–not just UNIX and NT," she says.

Analysts, for their part, see IBM's ASP initiatives as a shrewd move. "This effort to help make ASPs successful is very wise," says Claire Gillan, analyst at industry research firm International Data Corp., Framingham, MA. "As an ASP, it's definitely better to partner than to go it alone."

How initiatives of this ilk will benefit real-life ASP customers remains to be seen, however. That's because, for all intents and purposes, the ASP market is still in a larval stage. According to Gillan, the current ASP market is "tiny, less than 200 million [dollars] a year." But that stands to change dramatically over the next couple of years, insiders say. IDC predicts the ASP market will reach $5 billion by 2003. "It's true, there's been more buzz in the press and among vendors than there has been in the user community, but that doesn't change the fact that this is definitely an important trend," says Gillan.–*alexandra barrett, contributing editor*

Sun Continues to Eye Storage Market

Ten months after Sun Microsystems Inc. set its sites on the storage market beyond its own installed base, the Palo Alto, CA-based company has maintained its course with the release of new storage array configurations, software and a storage management specification called Jiro.

In January of 1999, Sun introduced its Intelligent Storage Network architecture featuring the StorEdge A7000 Intelligent Storage Server system that would connect to servers running Solaris, IBM Corp. S/390 and AIX, HP-UX and Microsoft Corp. Windows NT using SCSI. Then in October of last year, Sun took the wraps off new modular Sun StorEdge disk array configurations to continue to position itself as a multivendor storage provider.

JANE MARINSKY

"Sun is changing the rules in network storage by delivering software and hardware written to an open network architecture," says Jeff Allen, vice president of marketing for Sun Network Storage.

Sun has doubled the storage capacity by integrating 36-GB disk drives into the Sun StorEdge A1000, D1000 and 3500 UltraSCSI arrays, as well as the Fibre Channel Sun StorEdge A5100 array. Sun has also introduced 18-GB low-profile disk drives for the Sun StorEdge A5200 array which was previously available with only 9-GB drives. In addition, the entire StorEdge array product line comes with 10,000-rpm disk drives.

So far, Sun's efforts have been well received. "Sun has an excellent vision on where it wants to go," says David Hill, research director at Aberdeen Group Inc., a research firm based in Boston, MA. "It has a ways to get there of course, but it's on the right track and going in the right direction."

One of the challenges Sun faces is proving to users that its storage offerings will work better with other platforms. It's one thing to convince a customer of Sun servers that Sun storage is a good choice, it's another to court IBM Corp. and Hewlett-Packard Co. users.

"The [server] vendors have always been providing their own storage, but what's new is that they are trying to capture the storage capacity of other server suppliers," says John McArthur, vice president of storage research, International Data Corp., a market research firm based in Framingham, MA. "It's tough for Sun to convince an HP user that they have better storage for an HP server than HP would have. It's tough, but it doesn't mean it's not doable."

While Sun is attempting to meet the server storage needs of its competition's users, the company is still servicing its own customers. Along with the new

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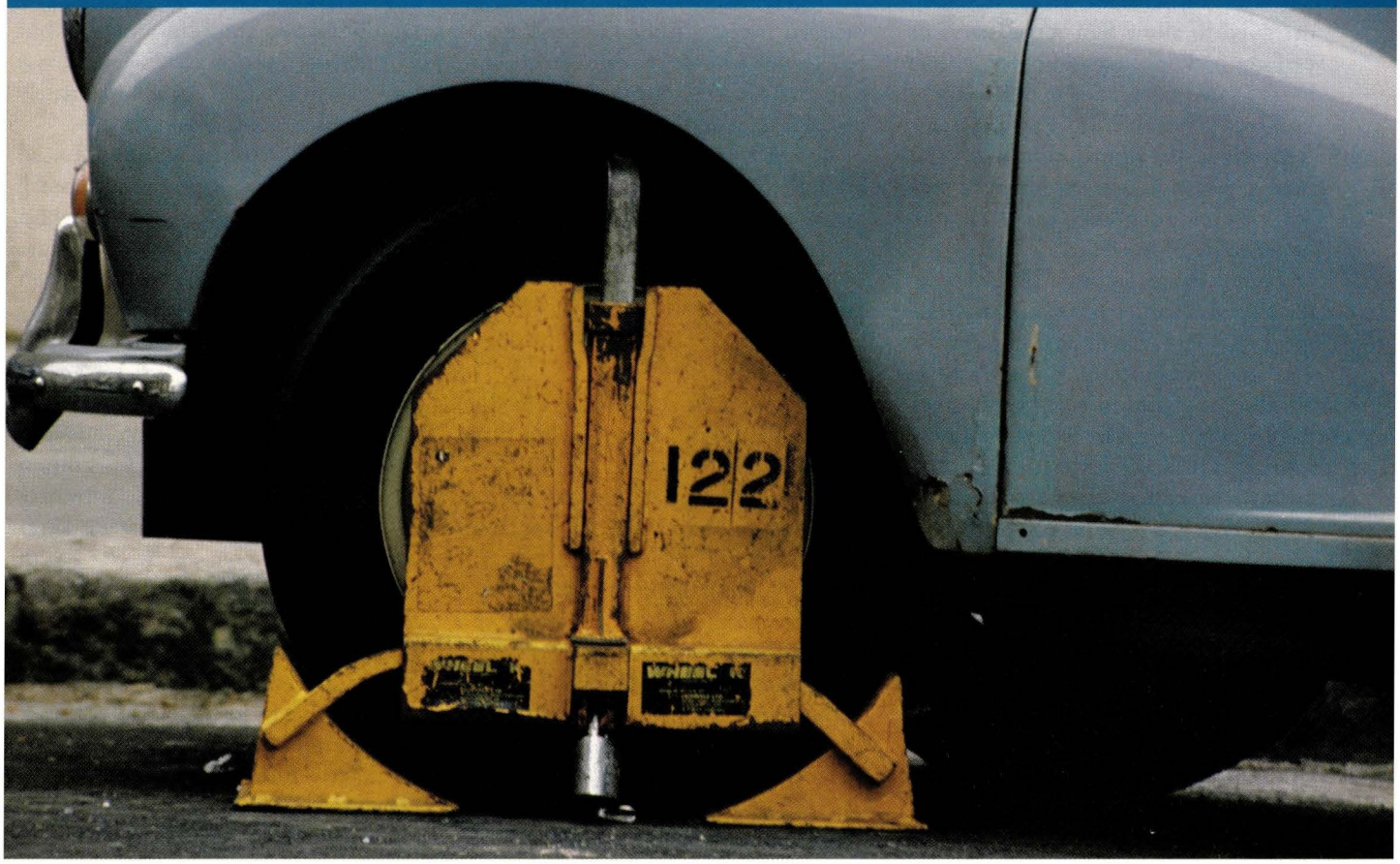

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array configuration, Sun introduced Sun StorEdge Instant Image software, designed to allow Sun server users to perform backups, test and development, instant data recovery and data warehouse loading. "[This] software is an important technology because it eliminates the need to take your business offline to perform time consuming tasks such as backups," Sun's Allen says.

Instant Image Software also supports the Jiro platform, a Java-based development and deployment environment for management solutions. On November 15, the Jiro platform core specification was released for public review. Jiro, now formally called the Federated Management Architecture, defines a standard set of Java APIs for multivendor device and application interoperability. The development of Jiro is led by Sun but includes more than 30 storage vendors to date. It is designed to enable interopability and automation of management devices and applications on a network.

When you add the new storage arrays, software and Jiro, most analysts believe Sun is working toward success. But the company isn't there yet. "I think that their offering in Jiro has to mature," says Aberdeen Group's Hill "It will be very powerful storage management software and, with their storage products and with Jiro, they will have a much better opportunity in the marketplace."

Related Storage News

While Sun was attempting to promote itself as a multi-vendor storage company, Veritas Software Corp., Mountain View, CA, pushed into the storage area network (SAN) space. The company unveiled Veritas V³ SAN initiative, new virtualization technologies that will allow server applications and storage management software to access SAN device functionality across multiple platforms.

The initiative, which also supports Jiro, consists of three standards-based components. The V³ SAN Access Layer is a host based technology layer that extends Veritas Software products to take advantage of new SAN hardware. The V³ Storage Appliance software suite allows hardware OEM partners and integrators to embed storage virtualization services into SAN equipment. V³ SAN Management Tools is a collection of modular management agents and applications that provide centralized visualization, monitoring and automation of logical SAN resources.

Veritas V³ SAN technology will be available in future releases of Veritas software.–*ptc*

Sun Harps on Java IDEs

As the creator and shepherd of the Java programming language and platform, Sun Microsystems Inc., Palo Alto, CA, has kept a relatively low profile when it comes to Java development tools. Until now.

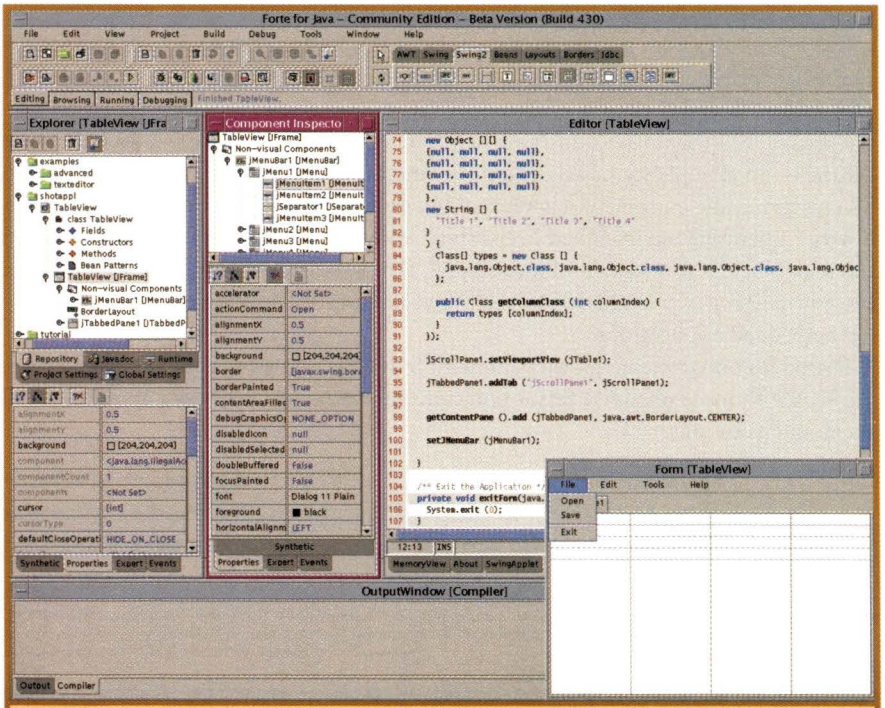
During the past several months, Sun has spent upwards of $1 billion to acquire competitive Java integrated development environment (IDE) products.

Sun's first big expenditure came in August, when the company announced that it would acquire Forté Software Inc., Oakland, CA, developer of Forté 4GL, a programming language often used in enterprise application integration (EAI) projects, as well as Java and eXtensible Markup Language (XML) development environments. Forté will operate as a wholly owned subsidiary of Sun but will remain independent. The deal was finalized in October for approximately $700 million worth of Sun stock.

Then in October, Sun announced that it would buy NetBeans Inc., a small company based in the Czech Republic. Its NetBeans IDE is especially popular among smaller-scale Linux and Microsoft Corp. Windows NT developers creating JavaBeans components. Terms of the deal were not disclosed, but NetBeans reportedly employs 40 engineers.

At the same time, Sun also announced the formation of a $200 million investment fund aimed at "minority investment opportunities" that are working on Java technologies. Working with venture capitalists, Sun will offer financial assistance, as well as contacts and advice, to companies "aligned with Sun's vision," according to Jonathan Schwartz vice president for the Sun Equity Investment Portfolio.

Exactly how Sun's acquisition of Forté and NetBeans will play out is unclear, although analysts see the two product lines breaking down along "high-end" and "low-end" lines.



Creating an application containing a table with Forté for Java Community Edition Beta 1.0.

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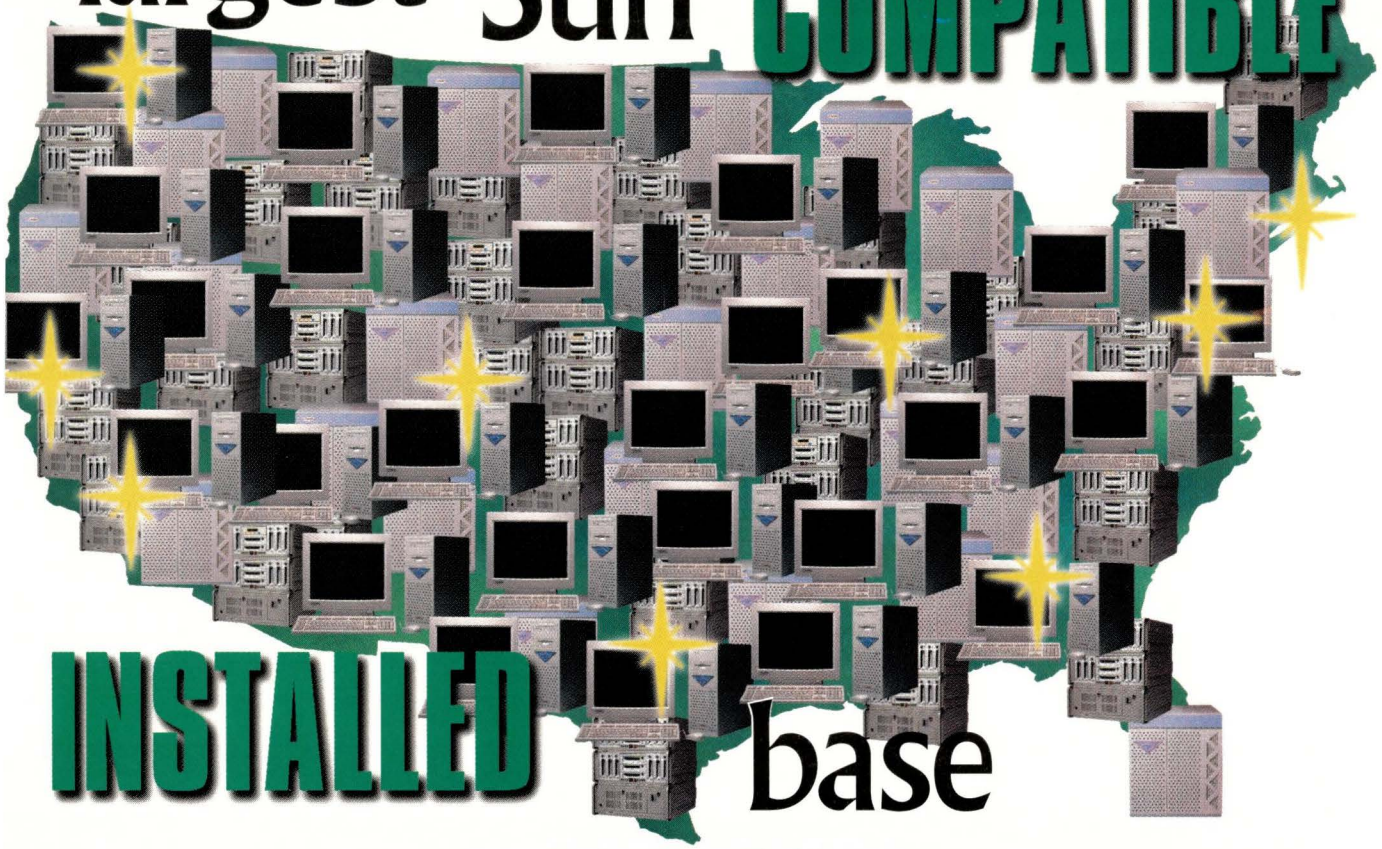

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"You'll find Forté being used in large enterprise development projects," predicts Deborah Hess, senior analyst at industry research firm Gartner Group Inc., Stamford, CT, complete with "application servers and connectivity to different databases."

NetBeans, meanwhile, has operated largely under the open-source model, and therefore tends to attract more modest developers running Linux. For the time being, Sun is perpetuating NetBeans' free software approach and is giving NetBeans Developer 2.x away for both commercial and noncommercial use. Eventually, however, Hess sees the NetBeans product line having a $100 to $200 price tag.

The purchase of Forté and NetBeans highlights one of Sun's well-known weaknesses: development tools.

In November, Sun announced that it had chosen NetBeans Developer 3.0 as the base IDE for its Java tools suite. It will be combined with Forté's SynerJ, which will be renamed Forté for Java. The next release of NetBeans Developer 3.0 Entry will be called Forté for Java Community Edition Beta 1.0. It will be free when released in first-quarter 2000. Developer 3.0 Pro and Enterprise will be combined into Forté for Java Internet Edition, which will be commercially available in June 2000. The modules that will make up this release are now available in preview build through the NetBeans Early Access Program (`http://www.netbeans.com`).

The purchase of the Forté and NetBeans product lines highlights one of Sun's well-known weaknesses, Hess says. "Sun's core competency has never been development tools," but rather, networking, operating systems and hardware, she says. It's not surprising, therefore, that "Java WorkShop and Java Studio never really took off. From the get-go, they were plagued with problems."

Fortunately for Sun, the unpopularity of the Java WorkShop and Java Studio products hasn't stopped developers from adopting Java. According to a recent report conducted by the Santa Cruz, CA-based research firm Evans Marketing Services, developers are adopting Java at a steady rate. Of 500 developers surveyed in North America, 44% reported using Java in some capacity as part of their development efforts. By next year, 57% of respondents say they will be using Java. Interviews conducted with international respondents yielded similar results: 43% are currently using it, and 61% plan to over the course of this year.–*alexandra barrett, contributing editor*

INFINIBAND DEFINES FUTURE I/O

The future of I/O technology is in the hands of the newly formed InfiniBand Trade Association, a standards group based in Portland, OR. InfiniBand is the result of two separate efforts, Next Generation I/O (NGIO) and Future I/O (FIO), which merged in August after a summer of intense negotiations. The group was first called System I/O, but that name was changed in October to InfiniBand.

InfiniBand has seven promoting companies: Compaq Computer Corp., Houston, TX; Dell Computer Corp., Round Rock, TX; Hewlett-Packard Co., Palo Alto, CA; IBM Corp., Armonk, NY; Intel Corp., Santa Clara, CA; Microsoft Corp., Redmond, WA; and Sun Microsystems Inc., Palo Alto, CA. Several working groups are focusing on various aspects of the definition. At press time, the group was scheduled to deliver a specification by the end of December 1999 with actual products hitting the market in 2001.

InfiniBand technology is being positioned as a channel-based, switch fabric architecture offering point to point links rather than another shared bus environment. The point to point links would look similar to PCI slots with some systems having Inifiniband slots instead. Other systems will bring InfiniBand out of the box over an electric cable, conventional fibre cable or fibre optics. There are three link widths, defined as 1x, 4x, and 12x. A 4x implementation would be 4 wires running from point A to point B, with four more wires running back from point B to point A.

"If you look at the 1x, the 4x and the 12x, you'll find that the aggregate bandwidth you get with those three options is 500 MB/s, 2 GB/s and 6 GB/s," says Martin Whittaker, R&D manager at Hewlett-Packard's Enterprise Systems & Software Group. And it offers 2.5 Gb/s, or what is sometimes called 2.5 Gb/s wire signaling rate. "We can deliver the bandwidth of the fastest PCI bus today and it is capable of providing the bandwidth for emerging links like 10-GB Ethernet or PC 192 Internet backplane."

Whittaker adds, "One of our goals here is to provide a single interconnect, [but] not only for I/O or cluster communication. It can be used to talk to storage or to talk to the network."

The different levels of performance are being offered to meet the different needs of different market segments. "The whole overall objective is to get the broadest possible market applicability that we can," says Kris Meier, product marketing manager of the enterprise system group at Dell. "You're starting with the lower performance rates and scaling greatly to satisfy as many customers as possible and run the cost of the implementation down to the lowest point possible."

The union of the two I/O groups appears to have unified vendors on the development of a future generation of servers using one I/O technology. Previously, NGIO was favored by Sun, Dell, and Intel, while FIO was supported by Compaq, HP and IBM. Now these seven system vendors, plus Microsoft, are endorsing and developing InfiniBand. "[With the two groups] the biggest issue was vendors had to bet on one camp or split their resources and try to bet on both sides and see if they could actually execute them both," says Tom MacDonald, steering committee co-chair and general manager of the fabric component division, enterprise server group at Intel. "What we've done is actually taken away the risk that they've had, so they could concentrate all their activities on a common standard."

InfiniBand Trade Association also has eight corporate members which joined in August, including Adaptec Inc., Milpitas, CA; 3Com Corp., Santa Clara, CA; Cisco Systems Inc., San Jose, CA; and Lucent Technologies Inc., Murray Hill, NJ. "If you look at the breadth of the sponsoring members, as well as the steering committee members, there is no reason to believe that you wouldn't have a very broad and complete offering in 2001," says Meier.–*ptc*

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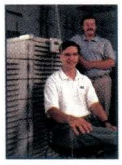

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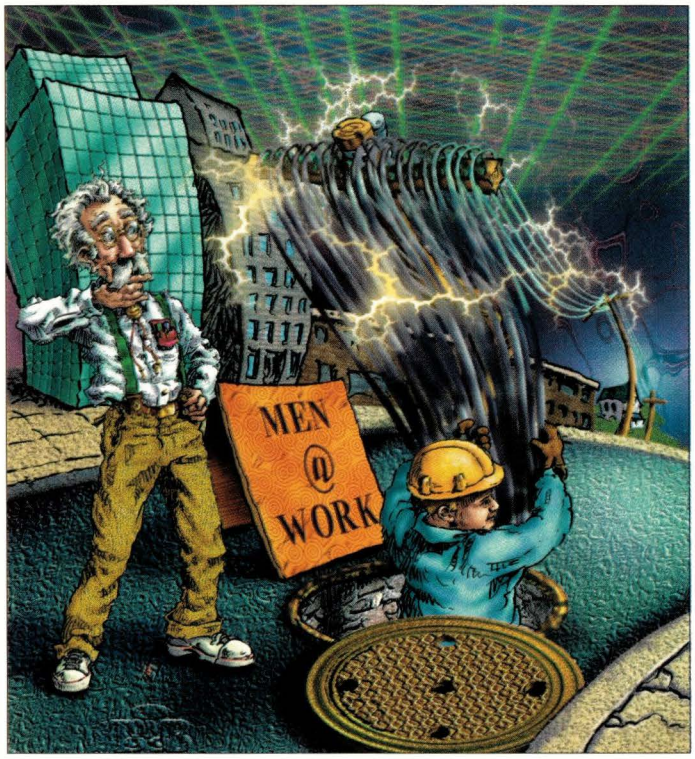
by Michael O'Brien



TOM BARRETT

"The world has a market for about five computers."
– T. J. Watson

"What would I ever do with a PC?"
– T. J. Consumer

"You strike the rabid missionary for 18 points of damage. You have gotten rid of a rabid missionary. You gain experience!"
– Nintendo Doorbell 8.6

Mr. P. and the Wired World

Q: *We have one too many computers at my house. How can I get my kids off the PlayStation and onto the Internet?*

A: Not to worry! Soon they'll be surfing the Internet via the PlayStation and your problems will be solved.

Let's look at this more closely. At the moment, Mr. Protocol is holding a Nintendo game controller and staring intently at the toaster. The fact that the game controller is not connected to anything does not appear to bother him. He is, as always, thoroughly connected. The fact that we perceive him as generally disconnected is our problem. Mr. P.'s current task is less interesting than his approach. Currently, he is trying to toast a Big Stuf Ding-Dong. He likes toast, he loves Big Stuff Ding-Dongs, and his logical system, which believes in the transitive properties of absolutely everything, therefore believes that a toasted Big Stuf Ding-Dong would be yummy. So much for this episode of Julia Child meets Alfred North Whitehead. It will end as so many others do, in fire extinguishers and regret.

So why the game controller? Mr. Protocol is glad you asked.

For openers, consider the phrase, "The Wired Society." Here's a phrase rich in both denotation and connotation, which manages to imply everything while conveying nothing.

In just about any seaside town in the United States, the water table is too close to the surface to permit extensive use of underground conduits, except at considerable expense. This leaves the older streets in these areas strewn with phone poles, power poles, high-tension towers and a rat's nest of wires straggling across the skyline. The scene is reminiscent of the sepia-toned photographs of big city life in the first three decades of this century when underground conduits were either unknown, or considered too much of an extravagance in an age where pollution concerns, visual or chemical, took a definite second place to capitalistic expansion. The seaside buildings almost invariably have an often retrograde charm inherited from the odd nature of those who choose to dwell beside an ocean, which only increases the resemblance to the urban cityscape of yore.

To this, add a little magic. It is a power possessed by Mr. Protocol, and is one of the chief reasons why he is both so fearsomely capable in network matters and, at the same time, so blindingly incomprehensible. It is his ability to focus on a single aspect of a thing from an uncommon point of view to the exclusion of all else. This is responsible for many of his savant-like qualities and not a few of his idiotic ones as well.

View this seaside cityscape of wires from above or from below, but view only the web of wires. Ignore the buildings and the people for now. And slow down the perception of time so that the city hums, vibrates and flickers around you, days passing so quickly that, like

the flicker of a fluorescent lamp, you cannot even see them.

In the resulting gray half-light, see how the network changes over time. It changes very slowly. Wires vibrate in the breeze. The coronal discharge of the high-tension lines across their insulated supports forms a faint purple haze, which grows and shrinks with the weather. As years pass, you begin to be able to tell the difference between the networks. The heavy cabling of the power network changes hardly at all. Insulators flicker from clean to dirty to clean again, as rain and the power company fight the battle against the grime that allows power to jump to ground. The lines do not move. The poles do not move. The meters at their terminations spin with blinding speed, but do not themselves change. They are replaced with identical units when they fail.

Things are slightly more interesting on the telephone front. Lines go up, lines come down. The fat, 18-inch-long bumps in the line that amplify voices come and go. The basic fabric of the network remains the same, but the web shifts, slowly over time, becoming first more dense as more lines are installed, and then more sparse as long-haul trunks are collapsed down into fiber lines. Looking into a telephone central office where the local switch is located, we see a boil of activity across the years. First, a bulky electromechanical switch, which almost fills the building, blinks out of existence too fast to see, obsolete and destined for some other country to which it has been resold. It is replaced by a comparatively tiny installation, which occupies a fraction of the space, but which is connected to the same enormous wire frame that supplies it with a pair of wires for every phone line in the area, coming in through gigantic conduits at the roofline and spreading like a spiderweb across the thin metal supports of the two-story frame. The switch itself, dense and black, is a blur of motion to us, as cards are pulled and replaced, and as upgrades sweep across it like a snake shedding its skin.

Back out on the street, something interesting is happening. Swarming in on existing power and telephone poles, a new set of wires flashes through the neighborhood: cable television service. The cables, which run along the poles, don't stay there. They go up and come down again several times, as succeeding generations of cable television franchise owners discover what terrible jobs the previous owners did. Finally a new, fatter web spins along the poles, and seems to stay there for a while.

Meanwhile, other lines appear, branching from the poles to the houses, looking like newer versions of the telephone cables. There is a difference, though: phone cables run to every house, and don't move. Cable lines run to only some of the houses, and many of them come and go. In fact, at some houses, they flicker in and out of existence more or less continually. Whatever they carry, it doesn't seem to be as vital as what the telephone cables carry.

Looking inside the homes, we see changes over the years. One phone turns into two phones, and they all look alike. Then they begin to multiply and diversify. Some look like phones, some look like seashells, some look like Mickey Mouse, some look like bananas. Then a new thing appears at the end of a phone line.

It's a modem.

The modem is connected to a computer. This configuration remains stable over the years, though both the modem and the computer metamorphose often. Then things begin to switch around. The cable television cable comes in and hooks up to the TV set. Then it grows a branch over to the computer and the telephone modem goes away. Then the cable disappears and the phone line comes back, only it's not connected to a modem. It's connected to a weird box that says "DSL" or "ISDN" on it. Then the modem comes back, and the computer suddenly sprouts a cable that runs up to the roof to a satellite antenna.

Things don't quit switching around. That's a Wired Society.

People Power

As we relax and allow our perceptions to return to normal, we realize that we've probably hurt ourselves. A craving for a Big Stuf Ding-Dong, possibly toasted, nearly overwhelms us, and we realize we'd better think twice before we try that one again. Better leave it to the experts, like Mr. Protocol. Anyway, he has consumed every Ding-Dong in the place, Big Stuf or otherwise, while we were entranced. He lives like this all the time.

If we were to apply the same sort of skewed perception to the use people make of the wires running into their home, we'd see a situation that resembles the one outside. In fact, the inside situation drives the outside situation.

People make varied and continual use of the power that flows into the home. By and large, there are no wild swings in the amount of power used. People's use of power is stable, and the stability of the distribution network reflects that. Weather is the biggest driver: in very hot or very cold weather, more power is used for cooling and heating. Temperate weather means temperate power use.

The phone lines see an increase in use as the years go by. Long distance charges were high enough that long distance calls in most homes were special occasions–and short. Charges fell only slightly in dollar terms, but the rate of inflation over the years has made long distance charges much more attractive, which has led to greater use of phones. By the same token, telephone extensions and multiple telephone lines, which used to be rarities, have gradually become fixtures common to most homes.

Not all the telephone lines go to telephones anymore. Some go to modems. Modems used to share lines with telephones, but increasingly, modems have lines of their own. Phone lines, in fact, are connected to an increasing variety of things. In addition to answering machines, they are now connected to set-top boxes, where they are used to provide a back-channel for interactive services. In New York, they're even connected to apartment building front-door buzzers, but there's no accounting for New Yorkers.

The modems connect home computers to the Internet via the phone lines. Below the visible level, what's moving on those phone lines is changing drastically. For most of the history of the phone system, they carried analog signals: first voice, then modem tones. Now, they can carry digital signals. Integrated Services Digital Network (ISDN) was the first offering, but it

is being superseded by various flavors of Digital Subscriber Line (DSL) service, which moves more bits faster for less money than ISDN. Of course, the modems aren't really modems then because they don't modulate or demodulate, they just convert one flavor of bit-streaming to another.

Originally, the modems didn't connect the computer to the Internet, of course. Originally, the computer connected to a Bulletin Board System (BBS) in some other guy's front room. A whole culture sprang up, now gone the way of the dodo. Online services were next, like CompuServe, Genie and a host of others. Some made the transition to an Internet environment, others did not. Many people still use an online service to mediate between them and the Internet. Others prefer to join the Internet directly as an equal partner, and contract with an Internet service provider (ISP) to pass their packets indiscriminately. Of course, ISPs are becoming more and more stroppy about what sorts of packets they'll pass. People who once would have put up a four-line BBS in the front parlor are now finding it difficult to dig up an ISP that will let them run servers of their own, as opposed to whatever Web server the ISP wants to run on their behalf.

Meanwhile, over by the TV set, more stuff is happening. If we go back a couple of generations in TV sets, we'll find sets that had to be replaced because they had images permanently burned into the face of the picture tube: generally, an image of two paddles and a ball. Atari's Pong video game was, obviously, popular. That dichotomy remains today. There are two sources of computer games: those that run on a PC or Mac, and those that run on funny boxes that connect to the TV set. If we look at the technology involved, a shock is on the way: while PCs were becoming so speedy that it seemed as if they could run supercomputer applications, the real supercomputers have been bouncing Super Mario et frères all around the TV screen.

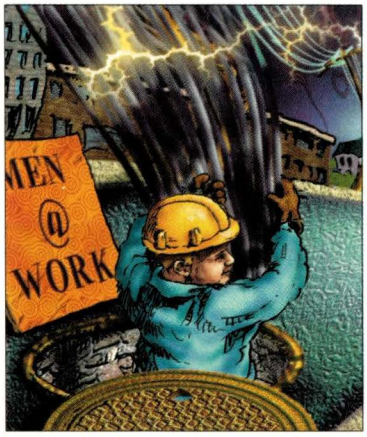
PCs are currently built not as a single computer with peripherals, but as a federation of processing units of approximately equal power. The Pentium or PowerPC chip gets most of the attention because it is the orchestra conductor, the general-purpose chip that runs software off the disk. However, the sound card runs Digital Signal Processing (DSP) chips of incredible speed and power, and the video adapter runs similarly powerful frame buffer and video systems right on the board. For the more advanced computer games, the speed of the processor is only one of several factors that determine the overall speed of the game. The speed and capabilities of the video processor are becoming even more important. Some applications, for example, require that the video adapter hardware be able to render 3D video scenes, work that used to be done by the CPU.

The boxes being connected to television sets these days have video processing systems that are just as powerful as the most advanced PC video adapters and, in some cases, even more powerful. The Sony PlayStation 2, for example, is able to render scenes in real time which, only a few years ago, required supercomputer capability to render slowly on a frame-by-frame basis.

These special-purpose video systems do have CPUs. But they are missing several major pieces that a regular PC would

have, such as long-term read-write storage (that is, a disk), a keyboard and several others. What is less obvious is that they slowly seem to be acquiring them, or things like them…including an operating system. Some are already moving to Windows CE, and while many might not regard this as an actual operating system, others are looking at Linux. Why go to such a powerful, general-purpose system for a Nintendo game? One good reason is as true today as it was when UNIX got big: it's easier to borrow something that's functional and mature than to go out and (re-)invent your own.

Another reason is that the functionality of these game units is expanding. Some are being given the ability to connect directly to the Internet to support distributed, multiplayer gaming. And once you're on the Internet, something equivalent to WebTV is only a few steps away. And once you've got a real Internet machine, why, you want some more local storage for caches, bank statements, letters to Mom…



There's a funny thing about these video games, though. They only cost about as much as a PC's video adapter. And they don't take any time to boot up. Turn 'em on and they're instant-on, ready to go. And they're connected to the TV, where you already have a nice seating arrangement. And, and, and…

A PC sits off in a corner and does whatever a PC does. It doesn't do much with the rest of the house. In fact, at home or in the office, a PC pretty much looks and acts the same. A game controller is an integral part of the home setup and does not appear in an office at all, except shortly before its owner is fired. And a game controller, with its dedicated applications, is far, far easier to learn to use than a PC.

Therefore, one begins to wonder: is the home PC really the natural gateway between the home and the Internet? Oh, to be sure, really sophisticated Web surfing and suchlike belong on a PC, but most of the things one does around the house are simple. So when the day dawns that the refrigerator and the stereo and the oven and the TV and the doorbell all have network addresses, maybe they won't be speaking today's TCP/IP. Maybe they'll be speaking IPv6, or X-10 on steroids, or some new home gadget protocol we haven't invented yet. And maybe, just maybe, they won't be speaking it to the home PC. It's at least a strong possibility that the home data console will grow up out of game controllers and not a PC.

If conquering by accretion is the way to go, and it surely seems reasonable that it is, then game controllers are, fittingly enough, already ahead of the game. ⊸

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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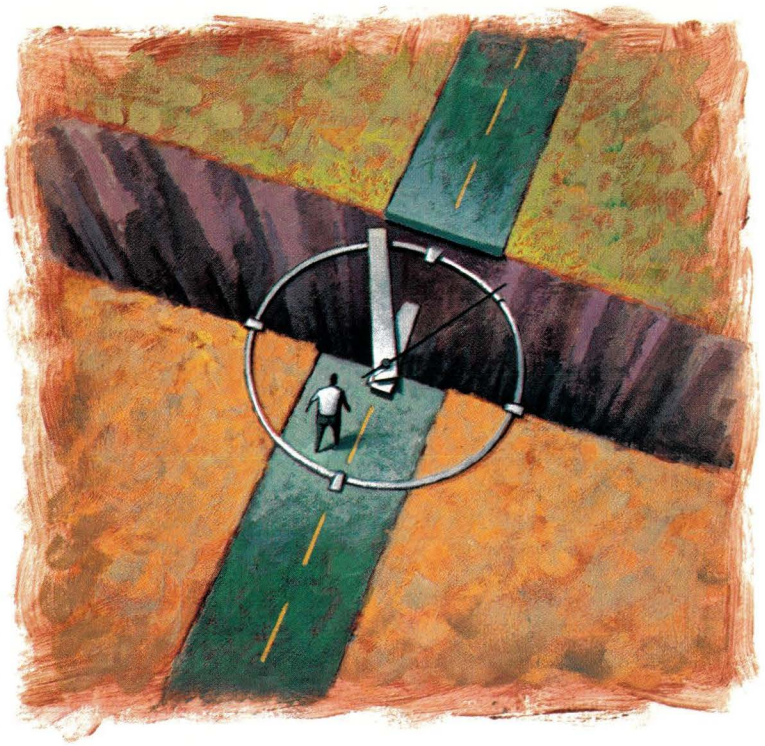

PAUL SCHULENBURG

The Time

Happy New Year. As I write this, I have more than the usual feeling of posting an article into the future. I am on one side of a great divide, you on the other. I am pre, you are post January 1, 2000. I'm finding it really hard to get excited about the new millennium, I'm afraid. I am sure that it will just be like a birthday. When you wake up on the morning of a birthday, you always expect to feel different somehow. Sadly you don't, and you always feel cheated because you don't. For the millennium, there is a faint worry that the computing systems that I run will break in some way. You are able to read this knowing one way (or the other) what happened to you. I actually expect to feel cheated that things worked out fine.

What now? You should probably make sure your systems know that 2000 is a leap year, if you haven't already done so. My fax machine thinks "00" is 1900, so it will supply the correct day and date until March. Then there's a bunch of other fun questions to consider. We have a year to worry about what to call 2001–are we allowed to use 1 or 01, or will we be forced to write four digits? There seems to be some date standard now that forces the use of four-digit dates. I think that suddenly Roman numerals seem attractive again. After all, MM is a short string. We also have a year to complain that any mention of "being in the 21st century" is bogus. There was no year zero and 2000 is the last year of the 20th century.

Once the dust has settled, let's all start worrying seriously about 2038; specifically Tuesday, January 19, 2038 at 03:14:07 GMT. At this point, there will have been exactly 2,147,483,647 seconds since midnight on January 1, 1970, which is the time that Ken Thompson decided to set as the epoch for UNIX internal time measurement. The next clock tick after that makes the 32-bit integer that holds the time a negative number.

Number Theory

Incrementing a value and obtaining a negative number may seem odd, but it's a fact of life on a computer. The effect is due to the way that integer numbers are represented. Numbers are stored in computer "words" that contain a fixed number of binary digits, or "bits." We want to perform arithmetic on the numbers, so there has to be a way of expressing positive and negative numbers. For most users, computers use signed integers where the "top" bit, or leftmost bit, is a sign bit. When the top bit is "0" we have a positive number and when it's "1" we have a negative number. If we look at a computer with a three-bit word, then:

0 is binary 000
1 is binary 001
2 is binary 010
3 is binary 011

If, for example, we add 1 to 2, we are adding binary 001 to binary 010, which

is 011 and that equals 3. Negative numbers have the top bit set:

-1 is binary 111
-2 is binary 110
-3 is binary 101
-4 is binary 100

If we add 1 to -2, we are adding binary 001 to binary 110, deriving 111, which is -1. The coding means that we don't have to make the computer subtract, we just make it add negative values.

I've picked some easy examples above, ones that don't create any "carry." When you add any numbers together, you start with the right-most pair of digits and add them together to derive the sum for that digit position. Of course, there's always the possibility of a carry value that needs to be added into the pair of digits to the left of the first pair. When adding binary digits, a carry is generated when we add 1 to 1. The result is 0 and a carry of 1 is added into the computation of the next digit position. Bearing this in mind, and returning to our three-bit word computer, try adding 1 to -1, or binary 001 to binary 111. The carry that's generated by the addition of the right-most bits ripples up the three-bit word and drops off the top, and the final result is 000, which is decimal 0.

When the result of addition is "in range," the mechanism works well. However, what happens when we add a 1 to 3? We are creating a number that is larger than the three-bit word computer can handle; we have no coding for 4. But we get a valid result, the binary value 100, which in our coding system is -4. What's happened is that we've incremented a positive number and ended up with a negative one. This effect is exactly what will happen on January 19, 2038 at 03:14:07 GMT.

Looking After the Time

The way that UNIX maintains the time is simple. The hardware has a clock that's usually ticking at 1,000 times per second. On each of these ticks, the processor is interrupted and runs code in the kernel that increments a central location. Programs interrogate the kernel to obtain this value. When the system is bootstrapped, the central value is set to a starting value that we interpret as the time by using the `date` program.

We normally run UNIX systems with this central value set to GMT, and layers in the system libraries perform the computation to adjust for the local time zone, or daylight savings time. It's not "part of UNIX" to run the clock on GMT, you can run the system with the local time loaded into the kernel's clock. However, when you put the clocks back at the start of winter, you'll need to change the kernel's value. You'll subtract 3,600 seconds, and time stamps that are derived from the clock will be incorrect because that hour will happen again. It's more convenient to let the system do the work of displaying the correct time based on a continuously advancing kernel value.

However, as we've seen, this continuously advancing value will eventually "go negative," creating an out-of-range time.

Why has UNIX picked a 32-bit signed integer to represent time and not a 32-bit unsigned integer? UNIX practice goes back to the days of PDP-11, which operated with 16-bit integers, but `time` was always returned as a 32-bit value. It's just simple expediency. A 16-bit clock, even unsigned, doesn't last very long (about 18 hours) and the next step is a 32-bit value.

When UNIX migrated to 32-bit machines in the 1980s, this 32-bit value was preserved, but became the same size as the standard integer on the machine. There are loads of programs out there in userland that expect to be able to perform computations on time, and for these purposes, an integer is an ideal representation. For example, when evaluating elapsed time, we can just subtract one time value from another. When comparing two times, we can use the normal comparison instructions that the hardware uses to compare integers.

The ANSI C standard carefully avoided placing any limits on the number of bits that are used to represent time. It defined that the `time` system call should return a value with a special `time_t` type that implied nothing about how many bits should be used to represent time. The POSIX standard extended this definition to state that the system call should return time in seconds from 00:00 on January 1, 1970. Neither standard said anything about how many bits should be used to represent time.

As we approach 2038, and get closer to the point where our time representation goes out of range, we have two options. First, we could make the `time` routine return an unsigned 32-bit integer. Doing this gives us approximately until 2106 before we run out of bits again. The second alternative is to go to a 64-bit signed internal time representation. The number of years that this value supplies is mind-boggling geologically: we run out of bits around the year 292,471,210,647 (I am not worrying about leap years in that computation).

Actually, Sun Microsystems has perhaps preempted the use of a 32-bit unsigned number. If you are running a current Solaris 2.6 system in January 2038 when the clock's time value turns negative, your `date` command will show `Fri, Dec 13 21:45:52 1901`. The effect on other systems is undefined. When I ran my little test program to obtain the December date on Windows NT 4.0, the `time` routine returned (`null`).

Times and Files

The choice between going to a 32-bit unsigned value or moving to a 64-bit value is important because kernel times are central to the system's operation. They are not simply maintained by the kernel to be displayed by the `date` command. A time stamp is placed with every file on your file system. In fact, on UNIX each file has three stored times. You've got time values expressed as signed 32-bit integers sprinkled liberally all over your system.

The times that UNIX stores for each file are returned to a calling program by the `stat` system call and so the usual names are prefaced by `st`. The first time stamp, `st_atime`, contains the time of last access to the file, basically the time the file was last read. The second, `st_mtime`, is the time the file was last modified. Usually, this means the time the file was last written.

The final time, `st_ctime`, tells you the time the `inode` information for the file was last changed. Remember that an `inode` is the small block of information that the system stores on a disk to refer to each file. It's a common mistake to think that `ctime` means *Creation* time. The `st_ctime` is set when the file is created, but it's altered whenever the `inode` is updated. The `inode` is changed when we write to a file, because usually the size of the file changes. The `inode` is also updated when we change permission bits or ownership.

To investigate these times on a file or set of files, you can use the `ls` command. Here's a shell script that can be given a list of files and will print three lines for each file:

```
#!/bin/sh
for f in "$@"
do
    echo "atime: \c"; ls -dlu $f
    echo "mtime: \c"; ls -dl $f
    echo "ctime: \c"; ls -dlc $f
done
```

The script should work in all Bourne shell variants. I've put the guts of the solution in a loop so you can use it to look at a bunch of files easily. The `\c` at the end of each `echo` command inhibits the command from printing a newline at the end of its output. Some shells may prefer to use

```
echo -n "atime: "
```

to achieve the same effect.

Each `ls` command in the script is given the `d` option so that when it's applied with a directory argument, it deals with the directory itself and not its contents. I am sure you are familiar with the `l` (*ell*) option that makes `ls` print a long listing. The final letters in the options list tell `ls` to print the appropriate time for the nominated file. Of course, you could pass the output of the `ls` command into `sed` or `awk` to reduce what it prints to just the times in which you are interested, but I didn't want to get into that here.

Seeing the times on files may be illuminating, but the time stamps can also be used in the `find` command to tell you things about your file system. The `find` command searches a file tree applying a set of tests to each of the files it locates. Here's an example I've adapted from the `find` manual page:

```
find $HOME \( -name a.out -o -name '*.o' \) \
          -atime +7 -print
```

The command searches the tree starting at your home directory (`$HOME`) for files named `a.out`, or anything ending in `.o` that was accessed more than seven days ago. When it finds a matching file, it prints its name. Notice that the `find` command uses `+` before the number to mean more than the specified number of days. We have two other options: We can just use the number by itself to mean exactly seven days ago, or we can prefix the number with a `-` (*minus sign*), which means less than seven days ago. Of course, this example is aimed at programmers who will be creating `.o` and `a.out` files. You can replace the name selection by any set of temporary files that you use.

You can get `find` to execute a command whenever it finds a matching file. In the `find` manual page, the `-print` in the example above is replaced by

```
-exec rm {} \;
```

The `-exec` option is followed by a command that possibly has a set of options. Here we have one `{}` that is replaced by the name of the file that's been matched. The revised `find` command will delete any matched file. The backslash before the semicolon at the end of the line ensures that the semicolon is passed into the `find` command and is used to announce the end of the command you have typed.

This type of `find` statement is often used to clear out entire file systems, deleting common temporary files. I realize that I may be using the system when the clean-up command runs and will always insert something like

```
-atime +1
```

into the command so that it leaves today's files alone. This means that I am not suddenly surprised when a file disappears from under my feet.

As you might expect, the `find` command also has `-mtime` and `-ctime` predicates, both of which have their uses. For example, my mail system places my mail in a `Sent` folder after I have composed it and pressed the appropriate transmit button. Because I use `exmh`, each piece of mail is stored as a separate file and I run a script every night that eliminates any file older than three days. This keeps my `Sent` folder down to manageable proportions.

Size Choice

I started with some worry about what is going to happen to dates in about 38 years, and now it's time to come clean. I think this issue will be resolved, just like the millennium bug has been (I hope). It will be interesting to see what will happen. If we go to a 64-bit time stamp in `inodes`, then we will reduce the total amount of usable disk space that exists on each disk. We increase the amount of information that we need to pull off the disk to process a single file. Perhaps three years ago, loss of space might have been a worry, but disk technology has advanced in leaps and bounds. We may have disk space to spare for this. Worrying about pulling more data from a disk may also not be relevant for the same reason.

All operating systems now have the ability to deal with different file system formats, and many of these formats use different time stamp formulae. At the moment, the presence of different formats means systems have to translate the dates on file systems into something the local system understands. It would be pretty easy to create a system that has an internal 64-bit date format, but could deal with 32-bit dates in files. Of course, the old file systems would expire when we reach 2038 or 2106, because there just aren't enough bits.

What? Me Worry?

Worrying about these issues may seem somewhat academic. I am unconvinced that I will get to 2038, I certainly won't be around in 2106, and the human race as we know it may not be around at all in 292,471,210,647.

However, I think the writing is on the wall, and that writing is digital. I believe that in the next few years we're all going to start owning huge digital file systems. You may already, but at the moment most people don't. My personal set of electronic baggage is growing because I've acquired a digital camera. My son's disks are groaning with MP3s and he's managed to fill some significant portion of his system with music. We haven't started to see much digital video retained on rewritable media yet, but we will. I've spotted digital video cameras in electronics stores already.

We are all going to start collecting digital file systems that hold things that we really want to keep. Quite a lot of what I have on disk is of no interest to anyone else at all. I have a lot of source code of things that I am running, an immense amount of email, odd letters and general personally relevant information. I can live without this and so can everyone else.

However, official documents, sound recordings of family members, family photos and video are all going to be on digital media in a very short time, and these will be things that people will want to pass down the generations. To support this need, the computing world will need to think seriously, and soon, about generating and supporting an extensible file system that's vendor-independent and guaranteed to be around and usable over a considerable time period.

For example, I have an audio cassette somewhere that's a recording of my grandmother talking about her grandmother who was born in 1815. My grandmother's life spanned from having horses on the streets to seeing men on the moon. I'm not sure that changes in my lifetime will be so visibly dramatic. I recorded her originally on a reel-to-reel recorder and had the presence of mind to put it onto a C90 at some point. Of course, the copying process lost quality and the C90's magnetic tape has probably print through by now.

The story is relevant to this discussion. We need file systems that can be replicated from media to media without worrying about individual file contents so the data can be preserved for long periods.

The file system may be an archival system, not designed for speed of access, but designed to be portable. We've been learning about portability for a long time. A key change in the `tar` file format in the early days of UNIX altered the meta-information held about each file on the archive into text format. Originally, the information was binary, but consequently it wasn't portable across systems. The dates and sizes moved from binary integers to text to allow receiving systems to read and understand them.

However, I am not sure I want an archive-only file system for my persistent files. I suspect that we will want to write and read randomly accessible data that is organized hierarchically from our live systems in this portable format. The problem with archiving and dumping is that you have to take specific action to archive the file or files, and you have to work out how to retrieve those files. I like to keep all my "stuff" online so I can get to it at any time.

Networking has proved that having a ubiquitous transport format from your desktop to mine is a win. I suspect the same will be true of file systems. The worry is that such a system will be developed to support one vendor's products. We will end up with the mess that occurred with CD-ROM file system formats, where the people sitting on the standards body were more concerned with promoting their own needs and didn't seem to even consider other people's requirements. ⊸

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

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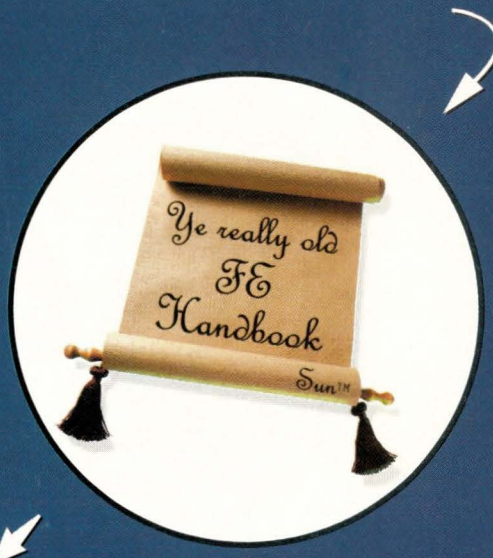

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Circle No. 16

by Alan Benway

DANNY O'CONNOR

The Storage Wilderness

Welcome to *SW Expert*'s new monthly Storage column. The purpose of this endeavor is to help the reader, the truth seeker, construct a solid base of knowledge regarding the fundamental elements of storage, and then progress onto more complex concepts. The reader will learn how to apply both the immutable laws of science and the cool breeze of logic to many of today's storage problems.

We will try to stay off the beaten trail covered by so many other guides and cut a more rigorous and fruitful path through the dense underbrush and dark woods of Storageland. Why? Because the easy trail will neither hone the truth seeker's skills nor prepare them for encounters with the truth twisters of storage sales and marketing. On this trek, we will tackle the hazards and obstacles found in the great storage wilderness head-on, and we will discover how to avoid self-inflicted blows from the staff of ignorance.

We will begin by considering the basic topics. This foundation will ensure that each reader develops sufficient background (including the very important one of skepticism!) to tackle the larger complexities of storage solutions. It will also ensure that we have the observational skills and understanding of terminology necessary to successfully hack through the creepers and vines of marketing hype and folklore that can sometimes obscure the truth.

The following examples illustrate how the truth can become twisted when we don't use (or aren't paying attention to) our common sense.

An ad proclaims that you too can access your data at 80 MB/s (note the uppercase B) once you install the company's newest Ultra2 Wide LVD SCSI disk in your system. Alternately, perhaps a company shows a 100-MB/s Fibre Channel disk, or a 33/66-MB/s ATA-3/4 EIDE disk. We'll work the science and the logic to see how no disk currently exists that can sustain transfer rates anywhere near those speeds. It takes several such drives in a RAID stripe to achieve such performance and even then only with nonfragmented, large file, large record sequential I/O requests.

An e-commerce ad beseeches you to trade credit from your valuable embossed plastic for an "ORB, a fast, 8-MB/s, USB bus, 2.2-GB removable disk!" Ah, sounds good, yes? Nope. The new Universal Serial Bus is but a 12-Mb/s (note the lowercase b) shared serial bus, incapable of even 1.5-MB/s. It would be a true statement with a decimal point, as in .8 MB/s. Perhaps the dot was lost during the typesetting.

A sysadmin decides to use a wide-to-narrow ribbon reducer to add an 8-bit (narrow) SCSI device to a group of internal 16-bit (wide) devices. What to do? Or how about a sysadmin who uses a simple wide-to-narrow reducing cable for daisy chaining narrow external devices onto existing wide devices? These are common problems today with so many wide devices coming into

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use. However, one must use special cables or reducers with built-in active termination for the eight dangling, unused data lines. A simple passive reducer that merely chops off the eight unwanted data wires, leaving them with no termination, leads to severe bus errors or crashes for the wide devices.

Suppose a VAR comes to you pushing its "blazing fast RAID 3/5 box" (with six disks and a single SCSI channel) that it proclaims can deliver more than 6,000 I/O operations per second (IOPS). We will discover that this little entry-level RAID box with six 7,200-rpm disks will never see 800 IOPS, let alone 6,000. It's also the case that RAID 3 is nearly always RAID 4 and, oftentimes, the vendor won't know the difference. The same is true of the confusion over RAID 0+1 and 10–not the same thing.

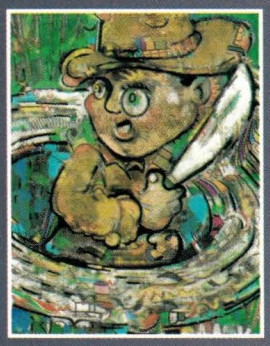
An enterprise storage vendor with RAID 1/Just a Bunch Of Disks (JBOD) systems proclaims that its magic cache will somehow allow its old, mainframe-based technology to perform as well as any current hardware RAID 5/10/50 solution. The vendor defends its lack of RAID 5 ability by claiming that RAID 1 is required for databases. We will see how neither of these claims is true, and why.

I recently encountered an online ad that claimed an internal, three-channel Ultra2 Wide SCSI PCI controller could outperform an external RAID unit. The controller was described as being able to deliver "240 MB/s throughput to the host," compared to "only 40 MB/s for the external RAID unit." How can this be so, you ask, when the standard PCI bus can only sustain traffic of up to 90 MB/s under ideal conditions?

The Basics

In order to reach the state of awareness where all of the above mistakes are obvious, we must discuss the basics:

- What are the fundamentals of disk drive science? We'll tackle the big drive vs. little drive performance argument, and consider the following questions: Why is it that an EIDE disk usually outperforms a SCSI disk? What are the meaningful features to look for in a disk drive? What are they doing on the inside?
- What are the various storage connection technologies, and how do they differ?
- We will investigate both the theoretical and real-world aspects of disk performance–IOPS and throughput, opposing conditions.
- What are some of the disk benchmark tests for UNIX and Wintel, and what are their uses and shortcomings? Do they tell you anything useful?
- We will take a deep look at the disk storage classes of JBOD, enhanced JBOD (my term) and RAID. What are the very distinct differences between RAID 3 and RAID 4, or RAID 0+1 and RAID10? Is RAID 50 the best solution available today? What are the many shortfalls of host-based (software) RAID? (Hint: pity the poor sysadmin managing 480 required partitions on one vendor's caching JBOD unit with 96 23-GB disks.)



We must discuss the basics. Why is it that an EIDE disk usually outperforms a SCSI disk? What are the meaningful features to look for in a disk drive?

- We'll explore host (internal) RAID controllers vs. external RAID disk systems. When should you choose one of these solutions over the other, what costs are involved and what performance levels can be expected?

Upon completion of the basics, we will move on to more complex topics:

- We'll investigate case studies of the architectures of various vendors' disk solutions to learn how to dissect and understand what they can really do. These will most likely include hardware RAID solutions from Clariion, Compaq Computer Corp., Hitachi Data Systems, MTI Technology Corp. and Sun Microsystems Inc./Maxstrat Corp., as well as EMC Corp.'s current storage units.
- We'll discuss some real-world RAID configuration issues and file system tuning concepts.
- We'll answer the questions surrounding the combined caching effects within the disks, controllers and file system. We'll compare the performance and limitations of some commonly deployed file systems, such as Veritas, UFS and NTFS.
- What are some network or local backup solutions, and what are their limitations? For example, how can you make

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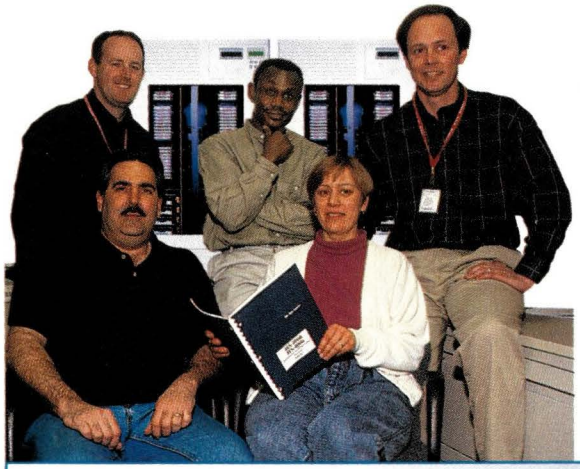

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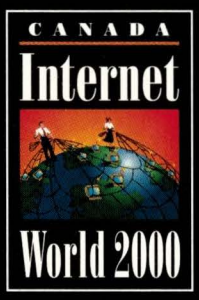

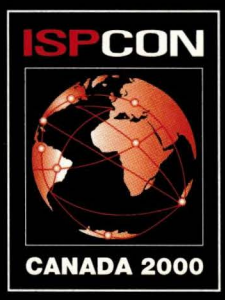

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use of the Veritas file system Snapshot feature to help solve the backup problem?

• Several of our discussions will focus on the emerging concepts–and fictions–of storage area networking (SAN). How is SAN's missing link (the required external file system with a token management server) going to be better than its current equivalent, NFS 3? How many vendors are developing these new external file systems and how long before they can be safely used in your production environment?

• For additional fuel for the ongoing operating system wars, we'll compare and contrast the I/O performance of operating systems such as Solaris, Linux and Windows NT on the same hardware and disks. What are some observations on how they compare as low-end server hosts? What are the hardware RAID controllers that will work with each for budget systems? What are the volume manager and software RAID issues for JBOD disks with such a server?

For Your Information

SW Expert plans to set up a new storage reference section at `http://sw.expert.com`. It will contain references and links to worthwhile books, technical articles, performance tests and vendor white papers. Discussions that are too big for the column may end up here as well. There will be tables and charts posted here, including a SCSI cabling limits table and comparative disk drive data, a file system's limitations guide and other such handy references. We may also assemble FAQ sheets based on reader questions/comments. Stay tuned.

Ours will be a long journey, with many surprising twists and turns for explorers of all skill levels. We hope you'll find it interesting. Down the road, you should become a trained truth seeker who can sort out the meaningful facts and associations from the tangles of claims in the expanding wilderness of Storageland.

By the way, I am a 20-year veteran of the computer industry, with considerable background experience in both large-scale, high-performance real-time control systems (Lawrence Livermore National Laboratory and US Windpower) and supercomputers (Fujitsu America). I am presently employed by a large database company located near Silicon Valley, where I deal with production infrastructure architectures and performance issues. I have a degree in computer science (operating systems and hardware) and have been a computer hobbyist for 10 years. I have written internal white papers on SCSI technology and large-scale disk solutions, as well as exchanged volumes of storage-related email with users and storage engineers alike. In addition, I have observed (or participated in) many memorable bouts with the Staff of Ignorance, and experienced many jousts with industry truth twisters along the way. ➸

***Alan Benway**, a 20-year veteran of the computer industry, is presently employed by a large database company located near Silicon Valley. He can be reached at* `abenway@cpg.com`.

by Æleen Frisch

LOUISE GOLDENBERG

What's New in Windows 2000?

This month, as we begin a new millennium, we will be taking our first look at the upcoming release of the next version of Windows NT: Windows 2000 (I'll abbreviate its name to Win2K for the purposes of this column). As I write this, the first release candidate for this product has been available for about a month and the scheduled first shipping date is still about a month away, so it seems the time to take Win2K seriously as a product has come.

This column will outline the new features in Win2K in an attempt to get a broad overview of what it's like and the changes that it will bring. We will also look at a couple of facilities in more detail when we consider the modifications to user accounts and groups and the new NTFS file system.

Win2K is sold in four versions: Windows 2000 Professional, Windows 2000 Server, Windows 2000 Advanced Server and Windows 2000 Datacenter Server. Windows 2000 Professional corresponds to what is currently called Windows NT Workstation, and is accordingly designed as the operating system used on standard user workstations within a site. Windows 2000 Server corresponds to the current Windows NT Server and, like the latter product, it's designed to fulfill a server role, providing resources, facilities and system services to network users. Systems running Windows 2000 Server can function as Domain Name System (DNS) servers, Dynamic Host Configuration Protocol (DHCP) servers, Web site hosts running Internet Information Server (IIS) and so on.

Windows 2000 Advanced Server, again roughly corresponding to the current Windows NT Advanced Server, contains all the functions of Windows 2000 Server. It supports symmetric multiprocessing (SMP) on up to four processors and clustering support. Finally, Windows 2000 Datacenter Server, which will be released later than the other three versions, will support SMP multiprocessing on up to 16 processors and up to 64 GB of main memory on Intel systems.

Win2K also has significantly larger system resource requirements than Windows NT 4.0. For example, while the stated memory requirements for Windows 2000 Server indicate that it can run on 64 MB of memory, it performs extremely poorly in such an environment. My experience indicates that 128 MB is the minimum amount of memory that will produce acceptable performance for Windows 2000 Server; in the same way, 96 MB seems to be the minimum realistic amount of memory required for Windows 2000 Professional. Disk space requirements are also greatly increased: Windows 2000 Server requires close to 1 GB of disk space by the time the operating system is installed, services are configured and activated, and the Active Directory has been set up and deployed.

A New Look and Feel

Win2K introduces a tremendous number of new features, many of them designed for traditional, large-scale corporate environments. This focus is evi-

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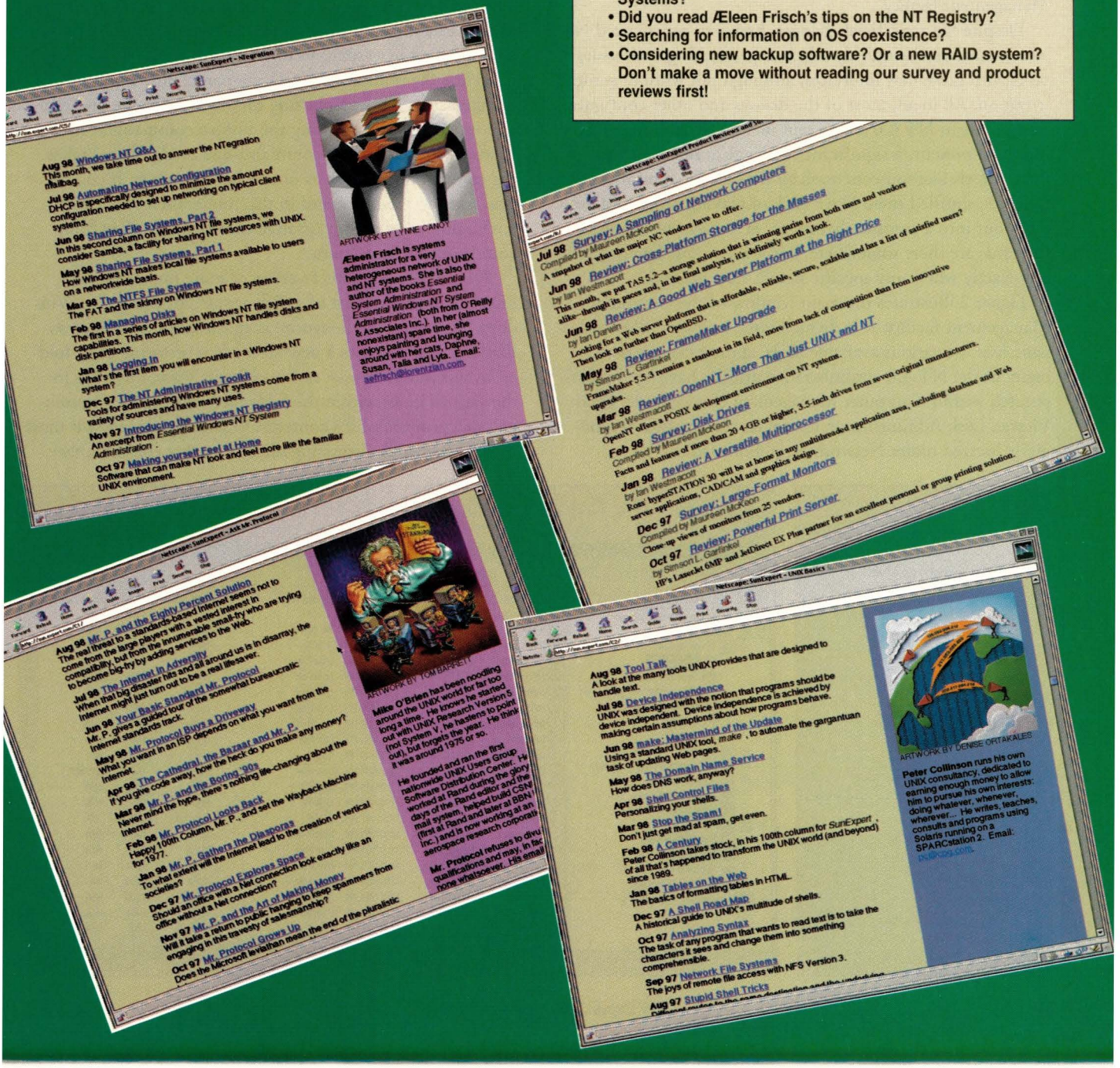


dent throughout the product, even in features that are not specifically oriented for large sites. The basic design and organization of Win2K is relentlessly hierarchical, and we will see many examples of this as we examine it more closely.

Initially, Win2K may seem very different from NT 4.0. For example, if you examine the Programs menu, you'll find the systems administration tools are now stored in a group called Administrative Tools (the Common has been removed), and when you examine its contents, you'll find them significantly altered. The new submenu is illustrated in Figure 1.

Some of the items are familiar–for example, those that correspond to network server facilities such as DNS and WINS–but some items are no longer present, for example, Disk Administrator. In addition, several new items have been added. In fact, the majority of systems administration tasks can be performed from four of these new tools: the three Active Directory administration utilities and the Computer Management facility.

Despite the superficial changes, however, experienced NT administrators will quickly adapt to performing their usual tasks with these new interfaces, although not without some irritation. All in all, most of the dialogs and other configuration points in NT 4.0 are present in Win2K, although finding them presents a significant challenge at first. On bad days, it feels like someone took all the current administrative facilities, shuffled them like a deck of playing cards, and dealt them out into a completely new set of hands–you know all the cards are there somewhere, but it isn't immediately obvious exactly where any specific item is now located.

Figure 2 illustrates the main window of the Computer Management facility. It is divided into two parts. The left pane lists the various available tools, and we can see that many of the NT 4.0 administrative utilities have been incorporated within Computer Management (for example, Event Viewer, Disk Administrator, the folder sharing features formerly located under Network Neighborhood and so on).

The right pane is used for display purposes by the currently active tool. In our example, Event Viewer is in use, and we are performing the summary display of events within the Application log. From this illustration, we can note some changes in the Event Viewer facility, including a new class of events (warnings, indicated by an icon consisting of an exclamation point within a yellow triangle) and three new event log recording events for the DNS facility, the Active Directory facility and the File Replication Service.

The Computer Management tool is based on the Microsoft Management Console (MMC) administrative interface. We examined this briefly a few months ago when we looked at some of the new features in Windows NT 4.0 Service Pack 5 (see "What's New in SP5," October 1999, Page 32, `http://sw.expert.com/C5/SE.C5.OCT.99.pdf`).

Win2K also adds the Runas facility, which allows a user to execute a command or run programs as a different user. The most obvious application of this feature is for a normal user to be able to do something as an administrator without having to log in as such. In this way, the Runas facility functions like the traditional UNIX `su` command. You can invoke Runas by right-clicking on the icon for the program you want to run or by using the `runas` command at the **Start=>Run** prompt. In command-line mode, Runas takes the command to be run as one of its arguments. If you use `cmd.exe` as the command in this mode, then you can initiate a privileged, administrative command window from your normal user account.

Win2K also contains a variety of more mundane user interface changes, most of which are already present in Windows 98. My personal favorite is an extension to Windows Explorer that provides a new view when browsing a file folder. In this mode, known as Thumbnails View, the icons for the various items within the folder are replaced by a thumbnail image of each file's contents. Obviously, this view is most useful when you're browsing directories that contain image

Figure 1. Win2K Administrative Tools

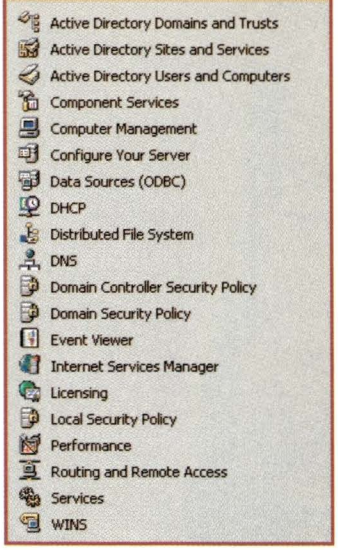
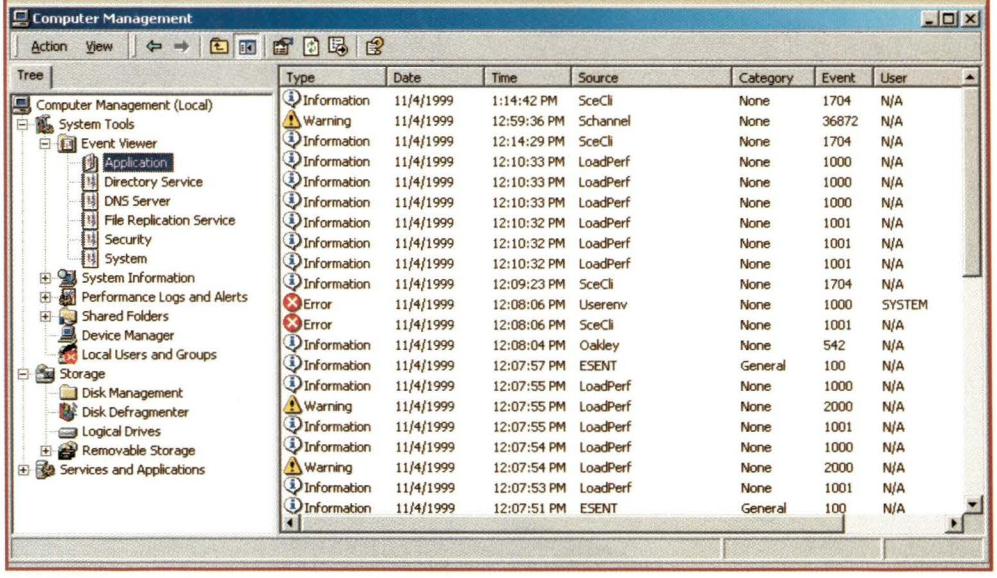


Figure 2. The Computer Management Facility



Share Your Experience

For those of you unfamiliar with it, the annual LISA NT conference–which will be held this year from July 30 through August 2 in Seattle, WA–is a great place to meet other Windows NT systems administrators and share ideas and frustrations about taking care of these systems. The deadline for paper proposals for this year's conference is fast approaching (February 16). If you have an interesting NT administration experience or have devised a solution to a common problem, consider submitting a proposal for the conference.

Not sure if your idea is appropriate? If you think you have something to share, but are unsure whether it is interesting, complicated or unique enough, chances are it is. Everyone tends to think their own ideas are less original or helpful than they actually are! All you have to do to submit a proposal is send in an outline of the potential paper and a brief, one to two paragraph summary (abstract) of it. The LISA NT program committee provides as much (or as little) assistance as needed to the authors of accepted proposals. Authors give 20-minute presentations about their work at the conference and their papers are published in the official proceedings.

For additional details, consult the LISA NT Web site, *http://www.usenix.org/events/lisa-nt2000/cfp*. If you have any questions or you're wondering if your idea is a good one, feel free to send me an email at *aefrisch@lorentzian.com.–æf*

files so you can quickly locate the particular image you are looking for. There were tricks that would provide similar functionality under previous versions of Explorer, but it's nice to have this facility built in.

A Plethora of Features

At this point, it is probably appropriate to present the enormous list of new features in Win2K before looking at a couple of them in more detail. To me, it makes sense to divide them into categories: ones related to various hardware devices and options, and major new Win2K facilities.

Win2K introduces Windows NT-based support for the following hardware items and facilities:

- A general plug-and-play facility
- Asynchronous Transfer Mode (ATM)
- DVD drives
- Infrared devices
- Laptop power management
- Universal Serial Bus (USB) devices

This list brings Win2K more or less up to date with the most important hardware features in widespread use.

In addition to incorporating all of the administrative facilities in NT 4.0, Win2K also includes quite a few new ones. We will briefly consider several of the most important, and then go on to look at Win2K users and groups and file permissions in more detail.

Several of the new facilities were prereleased and were available under NT 4.0 via the Microsoft Corp. Web site. These include IndexServer, the multiprotocol routing facility, and the Terminal Server optional add-on feature. With Win2K, IndexServer now operates in two modes. Terminal Server still serves as a method for making CPU resources on a server system available to users throughout the network by allowing them to initiate processes on the server so that interactive input and display remain on the user's local system.

In addition, Terminal Server can function in another mode in which a user can monitor and/or take control of a session on a remote computer. This functionality is very similar to that offered by commercial products such as pcAnywhere from PCAnywhere Group LLC, and is designed to make remote systems administration easier and more convenient. It is available by default and without additional cost in Win2K (clients wishing to connect to the Terminal Server facility functioning as an application server will still need an additional license to do so, which comes at additional cost above the price for the base operating system).

Let's also briefly discuss three more new facilities:

- Win2K contains a facility known as Active Scripting, which allows a system to function as a Windows Scripting Host. This feature provides the ability to run scripts within the Win2K visual environment, such as scripts used in Visual Basic, and allows a systems administrator to create ones to automate many tasks.
- Win2K provides related facilities to support automation of operating system and application software installations. Remote Installation Services allows new systems to be installed/upgraded without explicit systems administrator intervention. The IntelliMirror facility includes features for automating and standardizing software distribution and maintenance, as well as managing and replicating user data and propagating administrator-specified user profile and system policy-like settings to the appropriate users.
- Win2K also includes a Services for UNIX facility designed to allow transparent access to resources in UNIX environments for Windows users. This facility is similar to the Services for Mac OS and NetWare interoperability features in NT 4.0. For example, a server system running Services for UNIX can function as a gateway to NFS-based file systems residing on UNIX systems, and it can also enable UNIX host-based resources to appear within the normal network browsing facilities.

In addition, the package incorporates many items designed to ease migration away from a UNIX environment, including network information services (NIS) Migration Wizard and an Active Perl scripting engine for use by a scripting host, which I doubt will be of much interest to most sites. An optional UNIX Add-On Pack (at additional cost) provides a UNIX-like user environment under Win2K (it is based on the Interix product from Softway Systems Inc.).

As you can see, there's no shortage of new buzzwords in Win2K either.

Win2K Users and Groups

By far, the most important and far-reaching new feature of Win2K is the Active Directory. We will look at Active Directory in more detail next month. For now, suffice it to say that Active Directory is the underpinning of all of Win2K's domain structure and that it incorporates many network services such as DNS.

Active Directory brings a variety of changes to domain users and groups. User accounts retain all of the attributes they had under NT 4.0 and gain quite a few new ones. In addition, the user interface for modifying user accounts has changed considerably. There are many more panels than there were previously and familiar settings are parceled out among them. Figure 3 illustrates the Win2K user account configuration tool.

The illustration displays the Account panel of the User Properties dialog. This panel includes specifications for the user account name and mapping to the NT 4.0 user name for compatibility purposes, password change settings, account expiration settings and buttons leading to dialogs for valid login hours and login workstation locations. As we can see, this dialog brings together settings found on three different panels of the current User Properties facility (as well as providing access to two others).

We can also see the names of the other 11 panels that comprise this facility. They are described briefly below:

- **General**: Basic account information.
- **Address**: Work or home address data.
- **Telephones**: Telephone numbers for this user.
- **Organization**: Data related to the user's position within the company, potentially including both his manager and subordinates.
- **Member Of**: Group memberships.
- **Profile**: User profile and home directory specifications.
- **Environment**: Login and logout scripts and their execution parameters.
- **Remote control**: Settings related to remote access out of the user's session.
- **Terminal Services Profile**: Settings related to the Terminal Server facility.
- **Sessions**: Session time-out parameters for the Terminal Server facility.
- **Dial-in**: Settings related to the user's dial-in access.

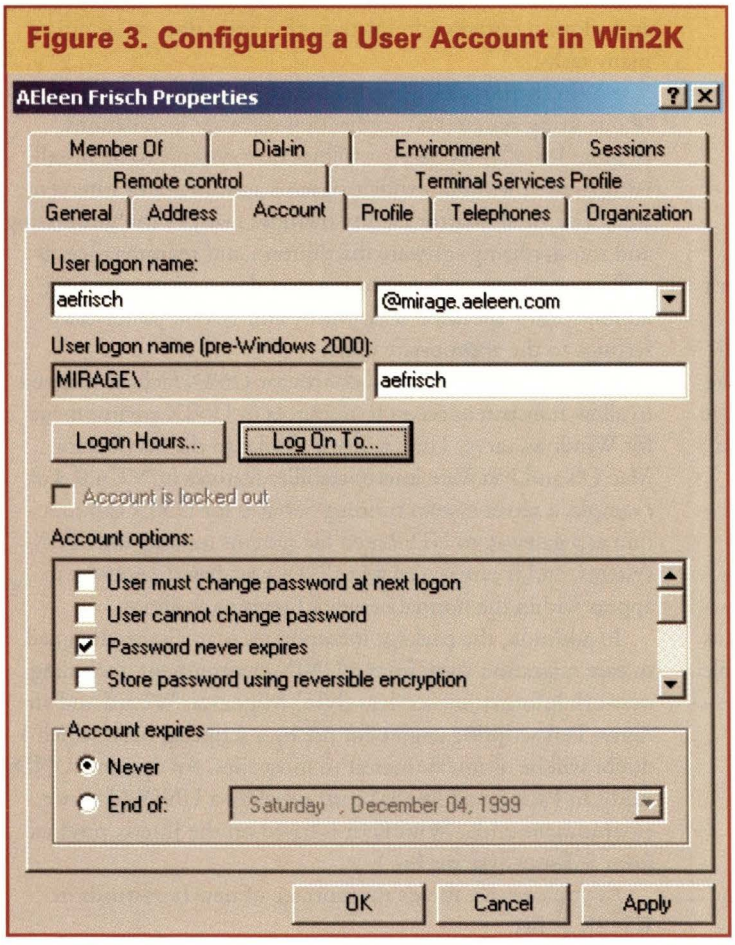
One of the major changes to domain organization that has been brought about by Active Directory is a shift from a flat domain structure to a hierarchical one. In NT 4.0, any relationships between domains were defined and enforced by systems administrators. In contrast, domains are always organized into domain trees under Win2K. This change has major ramifications for domain-level groups.

Domain-wide groups now can have one of three scopes (the official term). A domain local group includes members only from within the local domain, and it may be used to assign permissions (for example, in access control lists, or ACLs) only within the local domain. A global group also draws members only from within the local domain, but it may be assigned access rights anywhere within the domain tree. Finally, a universal group can include members from anywhere within the domain tree and may be assigned access rights throughout it as well.

Under Win2K, there are two types of groups: security and distribution. Security groups correspond to the groups used under NT 4.0, while distribution groups are designed to function merely as lists of users (for example, as an email distribution list). As such, a distribution group may not be used for assigning access rights. In addition, universal security groups may not be defined until a Win2K domain is functioning in what is known as "native mode," meaning that all of the NT 4.0 backward compatibility features have been turned off and the entire domain has been upgraded to Win2K (the opposite of native mode is known as mixed mode).

We will consider Win2K groups and their properties in more detail next month when we focus on Active Directory.

Figure 3. Configuring a User Account in Win2K



A New NTFS File System

We will conclude our overview of the new features in Win2K by considering the enhancements that have been made to the NTFS file system (Win2K also includes support for the FAT 32 file system used by Windows 98). To begin with, NTFS 5 is incompatible with the version of NTFS found in NT 4.0. However, both Win2K in mixed mode and NT 4.0 running with

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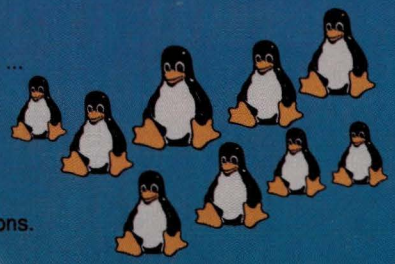

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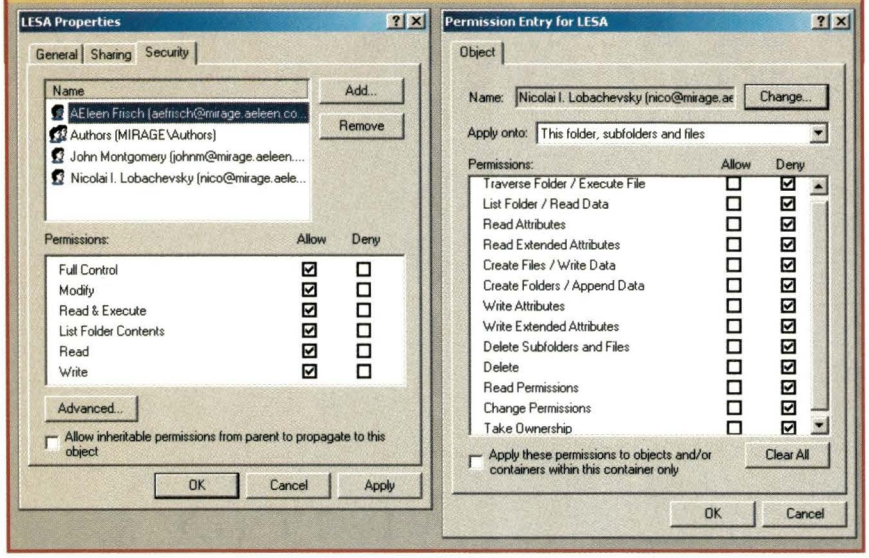
Figure 4. Win2K Access Control Lists



SP5 (or later) contain bridging facilities enabling both NTFS types to be used in a mixed environment. Here, we will concentrate on a high-level administrative view of NTFS 5 (space limitations require that a detailed look at its internal structure must wait for a future column).

NTFS 5 contains several important new capabilities. The most important of these is built-in encryption. This facility functions in a similar way to the built-in compression found in NTFS 4. On an encrypted file system, all data is encrypted and the operating system is responsible for the dynamic decryption of files as they are accessed and for reencrypting them when they are written to disk.

NTFS 5 contains several important new capabilities. The most important of these is built-in encryption.

NTFS 5 also provides the underlying facilities needed for Win2K's enhanced Volume Manager. The Volume Set facility present in NT 4.0 is still supported, but a more sophisticated facility is also available. Under the new scheme (which is conceptually similar to the logical volume facilities present in many UNIX operating systems), disks or disk partitions can become part of dynamic volumes, which can accordingly span multiple physical desks. Dynamic volumes may also be mounted in an empty folder anywhere within the file system. The new facility also supports striped volumes and fault-tolerant volumes (RAID 5), which are composed of dynamic volumes.

NTFS 5 includes enhanced ACLs. Two of the dialogs related to these new features are illustrated in Figure 4.

The left dialog displays the Security panel of a file or folder's properties. The upper list shows the names of users and groups for which access control entries (ACEs) exist, and the lower list displays the settings in the ACE for the selected user/group. Clearly, the layout has changed from the NT 4.0 version of this dialog. However, there are couple of more substantive changes as well.

First, each of the permissions sets listed in the Permissions area of the dialog has two settings associated with it: Allow and Deny. Previously, denying access to a user or group was an all-or-nothing proposition; you could deny all access to a file/folder, or you could grant specific access types, but there was no way to deny anything at a more fine-grained level.

As a specific example, consider if user Rachel is a member of the Authors group. Under NT 4.0, if the Authors group had read-write access to a file, there was no way to allow Rachel to have read-only access to it (although you could deny her all access whatsoever). This was true because all of the granted access for users who were not denied access to a file were combined together (unioned). Under Win2K you can deny as well as grant any access set or individual access permissions. In order for user to gain access to an item, the necessary permissions must be both explicitly granted and not denied. In our example, we simply grant Rachel read access and deny her write access to the file. Then, even if the Authors group has write access, it will not be granted to Rachel because it has been specifically denied.

The dialog on the right of Figure 4 illustrates the expanded set of basic permissions present under NTFS 5. In this example, we choose to deny all of them to the selected user.

As with NTFS 4, new files inherit their initial permissions from the directory in which they are created by default. However, the administrator now has control over how and when permissions propagate from parents to children via check boxes like the one located at the bottom of the left dialog in the illustration.

Stay Tuned!

As this brief overview illustrates very clearly, Win2K brings with it a number of changes to any existing Windows NT environment, and it offers a lot of challenges to systems administrators. Next month, we will continue our exploration of this brave new world. ➸

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

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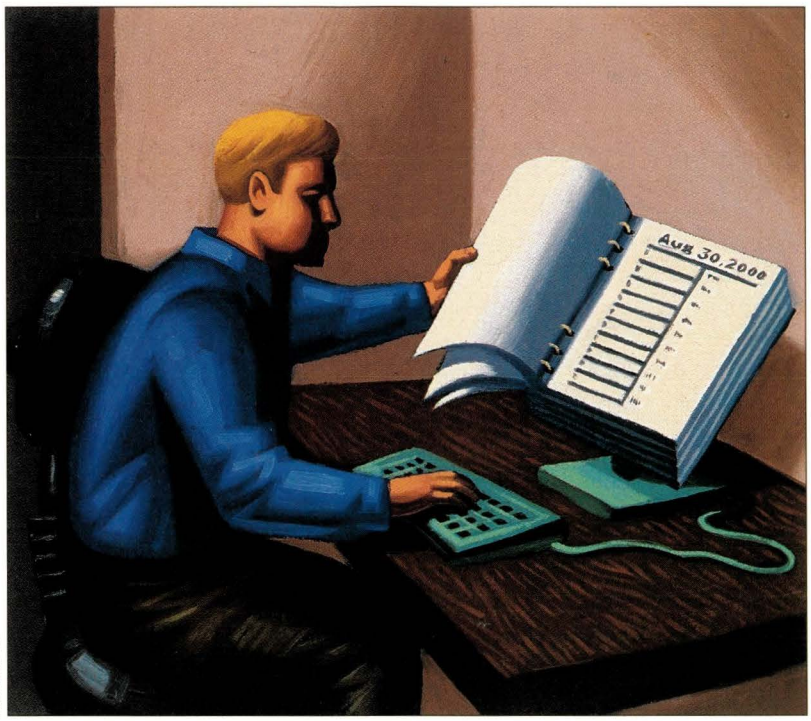

ALEX GROSS

"Teach us to number our days, that we may attain a wise heart."
–Psalms 90:12, Revised Standard

"A calendar, a calendar! Look in the almanac; find out moonshine, find out moonshine."
– William Shakespeare's *A Midsummer Night's Dream*, Act III, Scene 1

Calendar Pages

There's a whole aisle of them at your local Staples or OfficeMax. There's a counter at the boutique stationary store–and in Boulder, even at the kitchen gadget store–devoted to them, complete with a helpful twenty-something employee. We get catalogs from the mail-order fetish fountain pen store that's mostly taken up with them: calendars. Last month we showed you some interesting `troff` tricks, and because the beginning of the year is a very natural time to talk about calendars, we thought we would continue with a special macro package we've built and added to over the years to produce page inserts for those ubiquitous daily planners.

We started down this road to perdition nearly 20 years ago when Copeland's wife took a time-management course at work. Soon thereafter she started saying things like, "Gosh, it would be really nice if I had a form to go in this notebook for keeping track of projects around the house." And, "Y'know, I'd like to have a form for keeping a list of books I'm missing from various mystery series." Laser printers were just starting to become available but were priced around $15,000, so one-offs were difficult. However, we had a fabulous high-resolution phototypesetter sitting in the office, and we occasionally managed to turn out a few feet of film from it for purposes of testing the `troff` back end. This meant that we could very easily do multiple copies of a form from a single, very nice, master copy.

(Once again, we missed a business opportunity: At about the same time, as we were knocking off a few dozen copies of useful forms for Copeland's wife, Day Runner Inc. started up as a garage operation in Torrance, CA, about 15 miles south of Copeland's house at the time. Day Runner was producing many of the same things–forms for household organization, expenses and so forth–but in the thousands. Today, it's one of the major players in this market.)

The Page Macros

Let's begin by talking about the page macros themselves. The stock pages are 6.75-inches tall by 3.75-inches wide. For each page, we assume the left page edge corresponds to the `troff` page offset, contained in the `.o` number register. Within the page, the text is indented by the `troff` indent in the `.i` register. Setting up our code with as many parameters as we can, we'll store the full page width in the `W` register, its length in the `L` register and the usable page width–which allows for left and right margins–in the `w` register. Given those variables as our starting point, we need a macro to provide the cut marks at the corners of the page:

```
.\" cut mark: horiz-pos
.\" [orientation: {u|d}]
.de CM
.sp |\\$1
.nr t \\n(cmu
.nr u 2u*\\n(cmu/3u
.nr v \\n(cmu/3u
```

```
.nr x \\n(.o
.nr y \\n(.i
.nr z \\n(.s
.ps
.po
.in
.ps 5
.po \\nxu-\\ntu
.in 0
.lt \\nWu+\\ntu+\\ntu
.ie "\\$2"u" .tl @\l'\\nuu'\h'\\nvu\
  '\v'-\\ntu'\L'\\nuu'\v'\\nvu'@\
  @\v'-\\ntu'\L'\\nuu'\v'\\nvu\
  '\h'\\nvu'\l'\\nuu'@
.el .ie "\\$2"d" .tl @\l'\\nuu'\h'\\nvu'\
  \v'\\ntu'\L'-\\nuu'\v'-\\nvu'@\
  @\v'\\ntu'\L'-\\nuu'\v'-\\nvu'\
  \h'\\nvu'\l'\\nuu'@
.el .tl @\l'\\nuu'@@\l'\\nuu'@
.ps
.ps \\nz
.po
.po \\nxu
.in
.in \\nyu
.lt
..
```

We provide the width of the cut mark as a parameter in the `cm` register, which is only used by this macro. We do a great deal of hand-waving to carefully save and restore the page offset and indent. We'll need to put the left cut mark not only to the left of the current indent, but to the left of the logical page boundary as well. Notice that we try to honor `troff`'s one-deep stack of indents and page offsets by saving and then restoring the previous values. The guts are in the `if-else` sequence. This sets the cut mark as a title line. In general, we'll use this macro by providing an upward-pointing cut mark at the top of the page and then a downward-pointing one `\nLu` further down:

```
.CM 1i u
.CM 1i+\nLu d
```

If you look ahead to Figure 3 on Page 47, you'll see cut marks in all four corners of the sample page.

Next, we want to show where the holes should be punched.

```
\"  six holes at page offset: top-of-page-y
.de HO
.sp |\\$1
.nr x \\n(.iu
.in
.in 0
.sp .875i
\h'.4c'\D'c .4c'
.sp .75i-1v
\h'.4c'\D'c .4c'
.sp .75i-1v
\h'.4c'\D'c .4c'
.sp .75i-1v
\h'.4c'\D'c .4c'
.sp 2i-1v
\h'.4c'\D'c .4c'
.sp .75i-1v
\h'.4c'\D'c .4c'
.sp .75i-1v
\h'.4c'\D'c .4c'
.in
.in \\nxu
.sp |\\$1
..
```

Given the top-of-page position as an argument, and having the page offset at the left edge of the sheet, positioning the circles for the holes is a simple business. Again, the only complication is saving and restoring the current and previous page indent.

In addition, because we began this project before duplex printers were common, we have a macro to generate registration marks on the page to ensure that we aren't sloppy when reinserting the paper into the printer.

```
.\" registration mark: xpos ypos [dia]
.de RG
.nr u \\$1
.nr v \\$2
.nr x \\n(.o
.nr y \\n(.i
.po
.in
.po \\nOu
.in 0
.br
.ie \w"\\$3" .nr z \\$3/2u
.el .nr z .1i
.sp |\\nvu
\h'\\nuu'\h'-\\nzu'\D'c 2u*\\nzu\
  '\h'-3u*\\nzu'\D'l 4u*\\nzu 0\
  '\h'-2u*\\nzu'\v'-2u*\\nzu\
  '\D'l 0 4u*\\nzu'
.sp -1v
.if "\\*S"f" \h'\\nuu'\v'-\\nzu'\h'-\\nzu\
  '\h'-\w'\s6FRONT'u'\s6FRONT\s0
.if "\\*S"b" \h'\\nuu'\v'-\\nzu'\h'-\\nzu\
  '\h'-\w'\s6BACK'u'\s6BACK\s0
.in
.in \\nyu
.po
.po \\nxu
..
```

We invoke this macro with the horizontal and vertical positions of the registration mark's center. It's positioned horizontally with respect to the base page offset in the `O` register. It simply draws a circle of the specified diameter, with crosshairs overlaid. If we have defined the string register `S`, it allows us to specify whether we're drawing a mark on the front or back of the page so that we

Figure 1. Registration Marks

label the cut mark. Figure 1 shows examples of the registration marks. Normally, we'd use the registration mark on each side of a physical page, but we need to be careful to position it in the same relative horizontal place on both sides of the paper.

Given that setup, we can provide a macro for generating the setup for a logical page on the front or back of one sheet of physical paper:

```
.de NP
.\" new sheet: xpos ypos {f|b} indent linelength
.po \\$1+\\nOu
.CM \\$2 u
.CM \\$2+\\nLu d
.ie "\\$3"b" .ds S b
.el .ie "\\$3"v" .ds S b
.el .ds S f
.nr I \\$4
.in \\$4
.nr w \\$5
.nr X \\$1
.nr Y \\$2
.sp |\\$2
..
```

This macro allows us to specify the upper left corner of the logical page, setting the page offset to the left edge. It also saves information on whether we're producing a recto or verso image, defaulting to the front side.

Last, it would be nice to have a macro that allows us to mount fonts in the first three positions. This will allow us (in good `troff` style) to refer to fonts by position, rather than name. The following macro is overkill for doing this:

```
.\" ----- font positions
.ds i R \" last mounted
.ds j I
.ds k B
.ds f R \" currently mounted
.ds g I
.ds h B
.de FP
.ie !"\\$1\\$2\\$3"" \{\
.\" we had args: mount \\$1 in pos 1, etc.
.ds i \\*f\" save current
.ds j \\*g
.ds k \\*h
.if !"\\$1"" \{ .fp 1 \\$1
.ds f \\$1 \}
.if !"\\$2"" \{ .fp 2 \\$2
.ds g \\$2 \}
.if !"\\$3"" \{ .fp 3 \\$3
.ds h \\$3 \}
.\}
.el \{\
.\" no args: flip (f,g,h) and (i,j,k)
.ds x \\*i \" pos 1
.ds i \\*f
.ds f \\*x
.ds x \\*j \" pos 2
.ds j \\*g
.ds g \\*x
.ds x \\*k \" pos 3
.ds k \\*h
.ds h \\*x
.\}
..
```

This maintains a one-deep stack of fonts so that we can flip back and forth between two font families, which is probably not necessary.

Providing Content

At this point, we have the infrastructure we need to begin putting together pages, but we need some macros to help us put information on those pages:

```
.de LI\" line: mark
.ie "\\*S"b" \
\h'-\\nBu'\kx\\$1\h'|\\nxu'\v'.25m\
  '\D'l \\nwu+\\nIu-\\n(.iu+\\nBu 0\
  '\v'-.25m'
.el \kx\\$1\h'|\\nxu'\v'.25m'\D'l \
  \\nwu+\\nIu-\\n(.iu+\\nBu 0'\v'-.25m'
.br
..
.de ML\" multiple lines: count mark
.LI \\$2
.nr x \\$1-1
.if \\nx .ML \\nx \\$2
..
.de DL\" double lines
.LI
.sp -1v
.sp .2v
.LI
..
```

The first gives us a label with a line under it so that we can do something like: `.LI 8am`. The second produces multiple lines with the same label, such as a set of lines with little boxes at the left side: `.ML 10 \(sq`. The third will generate a double line as a separator. We've used all three of these macros in the example shown in Figure 3 on Page 47.

Given all that, we can build arbitrary tables for our forms:

```
.nf
.na
```

```
.di TB
.ll \nwu
\!.ll \nwu
.ps -1
.TS
box tab(~);
c s s s
l | c | c | c .
Daily Exercise
=
weights~lbs~sets~reps
_
\0\0curl~
_
\0\0press~
_
\0\0legs~
=
running~
.TE
.ps +1
.di
```

This actually builds a diversion containing the table. Notice that we've specified the line length twice: once when we read the diversion and the second time is protected by the `\!` to be read when we replay the diversion. In effect, we now have a macro to display an exercise chart, which we can use anywhere, for example, in the code we used to generate Figure 2.

What are we missing? We only have the tools to build forms in portrait orientation; we don't have hooks in our macros to build landscape forms. A book list, for example, would be more natural laid out horizontally, rather than vertically. A check register form also comes to mind as one that's more convenient in landscape orientation. We'll leave this as our first exercise for the reader.

While we can build data sheets–we could show you a chart of aerobic points vs. time and distance on the treadmill–we don't have the bottom-of-page processing to allow us to generate arbitrary text as successive pages. We'll leave that as an exercise, too.

Last, two of our logical pages fit with room to spare on a single letter-size page, or even a slightly narrower European A4 page. We have a few macros to handle this, but as a third exercise, can you come up with a version of your own? Even better–and we don't have a solution to this one–can you combine the previous two exercises by building the diversion hooks so that we can prepare running text input linearly, and then have logical pages one and three printed on the front of the physical sheet and logical pages two and four on the rear?

Figure 2. Exercise Chart

Daily Exercise			
weights	lbs	sets	reps
curl			
press			
legs			
running			

The Daily Pages

As desktop and workgroup laser printers became affordable, it became clear that the next step was to provide custom daily calendar pages. The critical question was: "How come nobody does a day planner with the phases of the moon?"

Let's approach this sideways and start with a (relatively) simple page layout:

```
.de PG\" basic daily calendar page
.FP H HO HB
.HO \\nYu
.sp |\\nYu
.sp .325i
.lt \\nwu
.tl """\\$1"
.sp -.75v
.DL
.sp -1v
.mk *x
\h'2.25i+3p'\v'.25m'\D'l 0 \
  |\\nYu+\\nLu'\v'-.25m'
.sp |\\n(*xu+1v
.nr *y \\nwu
.nr w 2.25i
\|\(sq\|\|To Do\(emWork:
.sp -1v
.LI
.ML 19 \h'1m'\(sq
.sp -1v
.sp 2p
.LI
\|\(sq\|\|To Do\(emHome:
.sp -1v
.LI
.ML 16 \h'1m'\(sq
.in +2.25i+1n
.sp |\\n(*xu-1v
.vs .5i
\08:00
\09:00
10:00
11:00
12:00
\01:00
\02:00
\03:00
\04:00
\05:00
evening
.nr w \\n(*yu
.in
```

```
.vs
..
```

This presupposes that we've already invoked the .NP macro we developed earlier and have the page cut marks and positioning set. We do some initial setup for the page, including putting the macro's argument in the upper right corner. Then it's simply a matter of drawing some lines with check boxes (using the .ML macro from earlier) for our "at work" and "at home" to-do lists. To the right of those lists, we provide a place to write appointments. Given that, we now have a page on which to hang the moon. And if you look at Figure 3, you'll see that's just what we've done. But how did the moon get there?

Calculating the phase of the moon is just a matter of crunching numbers, and we'll share a routine we've found for doing just that on our Web site. More interesting is how we produce a picture of that partial moon.

The moon is new–that is, completely dark–when its angle is zero relative to the line from Earth to sun. It is full when it is on the opposite side of the Earth from the sun and its angle is 180 degrees. If we have the phase as an angle, phi, we can use the troff arc-drawing functions to generate a picture. That picture will generally be two arcs, the regular outer edge of the moon and the curve made by the Earth's shadow. The radius of the outer edge arc is the radius of the full moon; let's call it R. Then, the radius of the other arc is R *tan(phi). Because the troff arc drawing function draws an arc from the current position *(x,y)* to *(x+dh1+dh2,y+dv1+dv2)* with a center at *(x+dh1,y+dh2)*, and with the knowledge that the endpoints of the two arcs must meet, it is merely a matter of algebra to figure out what the arc-drawing directives for the moon are. Further, because the quadrants of the moon are similar, once we have the proper calculation for the first quadrant, generating the arcs for the other three is merely a matter of flipping signs (see Listing 1, Page 48).

This subroutine draws the outer arc of a waxing or waning moon, and then, within those branches of the if, it handles either a concave or convex arc for the shadowed side. Full and new moons are handled as special cases, though our display of the new moon depends on a PostScript printer and, in particular, the relative size of the bullet from the PostScript special character font. For example, for a moon phase of 248 degrees, the routine above produces

```
\v'-20p'\D'a 0 10p 0 10p'\D'a \
   -16.00p -10p 16.00p -10p'
```

which generates Figure 4.

We now have (in outline at least) all the tools we need to build arbitrary pages for our daily planners. Of course, if you want to use the phase of the moon code, you'll need to build a scaffold around it to generate the moon pictures interspersed with calls to a macro that

Figure 3. Planner with Phases of the Moon

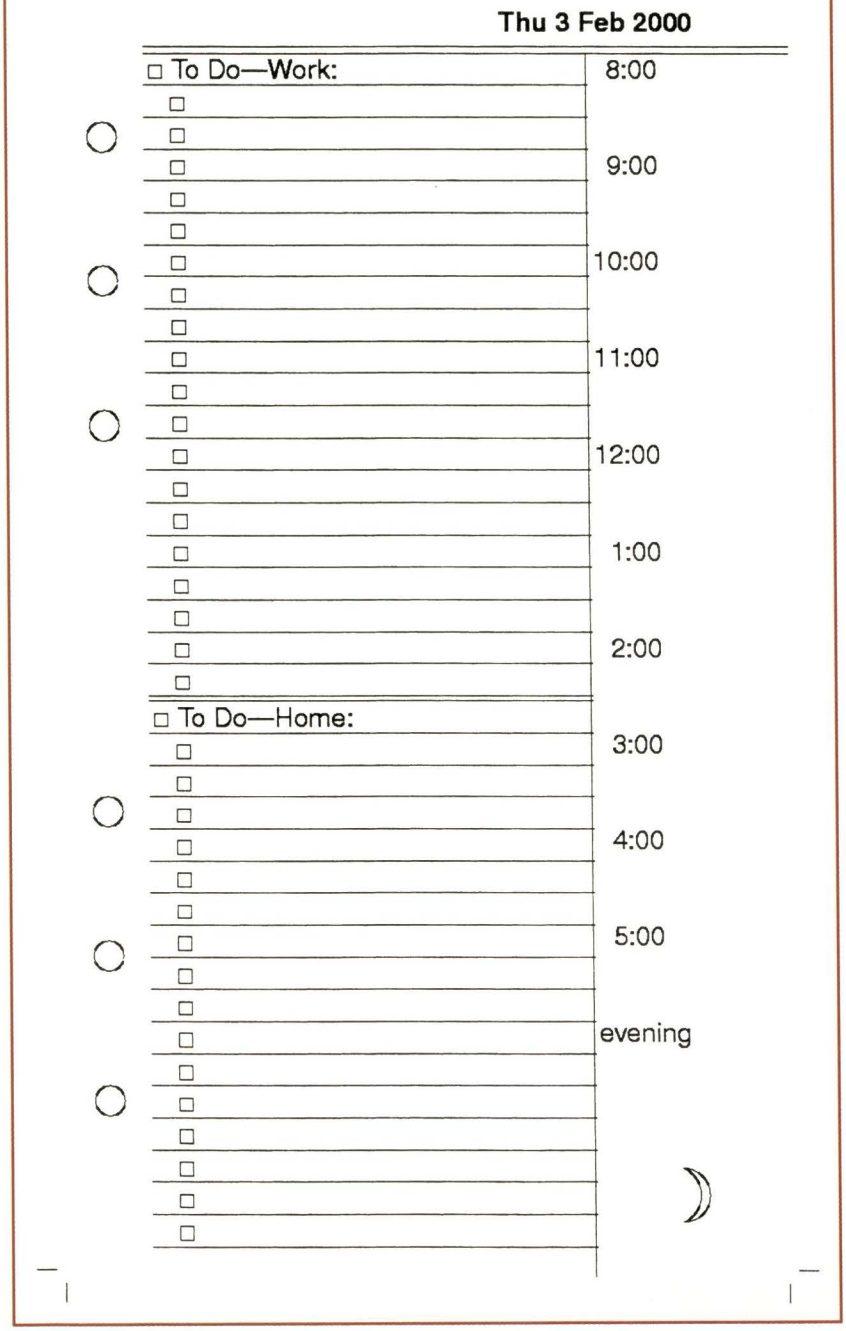

Figure 4. The Moon

Listing 1. Drawing the Phase of the Moon

```
/* this draws a picture of the phase of the moon */
static char *id = "$Id: ...";
#include <math.h>
#ifndef M_PI
#define M_PI 3.14159295358979323846264433
#endif

moon_pic ( phase )
int phase;
{
 int radius = 10;  /* moon radius in points */
 float phi;

 /* We print only the troff commands to
 produce the moon picture.  We assume
 the caller produces newlines before and
 after, as appropriate, and ensures we
 are in the correct position. */

 /* new moon is a special case */
 /* we use the bullet on the PostScript
 special font;  if we aren't printing
 on a PS printer, this code must change */
 if( phase == 0 )
 {
  printf( "\\s(%02d\\v'.05m'\\h'-\\w'",
     radius * 5 );
  printf( "\\(bu'u/2u'\\(bu\\s0");
  return;
 }

 /* handle anything but a new moon */
 phi = tan(phase*2.*M_PI/360.) * radius;

 if( phase < 180 )
 {
  /* the semi-circle on the right */
  printf( "\\D'a 0 %dp 0 %dp'",
    -radius, -radius );
  /* the other part of the crescent */
  if( phase < 90 )
   printf( "\\v'%dp'", 2*radius );
   printf( "\\D'a %.2fp %dp %.2fp %dp'",
    -phi, -radius, phi, -radius );
  else if( phase > 90 )
   printf( "\\D'a %.2fp %dp %.2fp %dp'",
      -phi, radius, phi, radius );
  else /* exactly 90, so we get a half-circle */
   printf( "\\D'l 0 %dp'", 2*radius );
 } else if( phase > 180 )
 {
  /* a semi-circle on the left */
  printf( "\\v'-%dp\\D'a 0 %dp 0 %dp'",
    2*radius, radius, radius );
  /* the other part of the crescent */
  if( phase < 270 )
   printf( "\\D'a %.2fp %dp %.2fp %dp'",
    -phi, -radius, phi, -radius );
  else if( phase > 270 )
   printf( "\\v'%dp'\\D'a %.2fp %dp %.2fp %dp'",
    -2*radius, -phi, radius, phi, radius );
  else /* exactly 270: we get a half-circle */
   printf( "\\D'l 0 %dp'", -2*radius );
 } else
  /* phase is 180 --> full moon */
  printf( "\\v'%dp'\\h'%dp'\\D'c %dp'",
      -radius, -radius, 2*radius );
}
```

generates the daily page. The full macros and code we've discussed are available in the usual place, `http://alumni.caltech.edu/~copeland/work/`, and we encourage you to add to them and share your additions. But now let's return to an item we discussed a while back.

Electronic Books Revisited

A year ago, we issued a challenge (see "Reader, Part 2," January 1999, Page 40, `http://sw.expert.com/C9/SE.C9.JAN.99.pdf`). Electronic book hardware had just become available from NuvoMedia Inc. and SoftBook Press, and we suggested that these companies should provide reader software so their electronic books could be read on general-purpose computers. In particular, we noted, "We already carry a lot of hardware when we travel–our normal mode of operation is to clear an airport with more weight in our briefcase than in our suitcase. Just thinking about adding an extra two pounds for the specialized hardware makes our shoulders hurt."

NuvoMedia is now giving away a software package called eRocket, which provides the look-and-feel of its custom e-book hardware on your screen. (Pick up your own copy at `http://www.rocket-ebook.com`.) Unfortunately, the company provides a binary-only distribution and only provides executables for Windows systems. Also, because the software-only package doesn't have the ability to interact with a separate piece of hardware at your end of the download, you can only read the free editions. That is, because there is no secure way of emulating the security hardware built into the Rocket hardware and its cradle, you can't yet buy and download the latest (encrypted) Thomas Harris blockbuster from `barnesandnoble.com`.

After spending an evening reacquainting ourselves with *Alice's Adventures in Wonderland* using eRocket, we can certainly understand the advantages of having a custom piece of hardware for leisure reading, particularly one that's smaller, lighter and easier to use in bed than our laptop.

The next interesting step would be for NuvoMedia to provide a version of the eRocket software for the Palm Pilot or other generic portable hardware.

Enough of this speculation. We hope that the last year of the millennium started nicely for you. We will return with another interesting problem next month. In the meantime, go forth and make interesting calendar pages.

Until then, happy trails.

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Note: The software from this and past Work columns is available at `http://alumni.caltech.edu/~copeland/work` or alternately at `ftp://ftp.expert.com/pub/Work`.

by Jim Frost

LISA VAN DUSEN

Postal: Getting Framed

Last month, we began our long-term project to build an email client by taking a look at the JavaMail class library. This month, we approach the task from the other side: building the GUI using the Java Foundation Classes (JFC) Swing library.

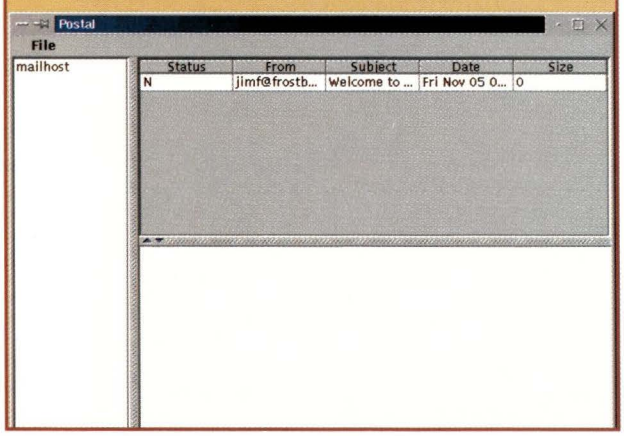
The Swing library extends the very basic, but functional, Abstract Windowing Toolkit (AWT) classes that were provided in Java 1.1 with a number of useful widgets. These widgets include more advanced windows, transparent panels, slider panels, flexible menus, and tree, list and table displays. We will eventually use all of these in the construction of Postal.

While most of the code discussed this month is presented here, space limitations prevent complete listings. You can pick up a complete working version from `ftp://ftp.expert.com/pub/JavaClass/01.2000/postal-frame.tar`.

One of the nicest aspects of Swing is that most of the components can be filled with dummy information and they'll look and behave as if there was something there. This is useful for constructing prototypes and mock-ups, but it's also useful for getting the basic framework of an application built before you have many functioning components.

We'll make use of this feature in this first phase of the construction of our email client, Postal, by creating the main application frame and populating it with a few dummied-up components. This will allow us to get something up and running quickly while we investigate the basics of a few Swing components. Figure 1 illustrates our dummied-up main application window for Postal.

Figure 1. The Postal Application Window



The outermost component of a Swing application window is the `JFrame`. This provides a GUI window that interacts with the native window system and a container into which you can place other Swing components. The `Postal` class, shown in Listing 1 (Page 50), is a subclass of `JFrame`. This class does triple duty: it not only provides the application window implementation, but provides the `main()` method for the Postal application, in

Listing 1. The Postal Class

```
package postal;

import java.awt.*;
import java.awt.event.*;
import javax.swing.*;

public class Postal
  extends JFrame
  implements WindowListener
{
  private JSplitPane mainSplitter;
  private ServerSelector serverSelector;
  private FolderPanel folderPanel;

  /** Constructor for the Postal application. */
  public Postal()
  {
          super("Postal");

          // size and position window.  this will do for now.
          setLocation(100, 100);
          setSize(600, 600);

          // listen to our own window events
          addWindowListener(this);

          // build application menu bar
          JMenuBar menuBar = new JMenuBar();
          menuBar.add(new FileMenu());
          setJMenuBar(menuBar);

          // build major sub-panes
          serverSelector = new ServerSelector();
          folderPanel = new FolderPanel();
          mainSplitter = new JSplitPane(JSplitPane.HORIZONTAL_SPLIT);
          mainSplitter.setLeftComponent(serverSelector);
          mainSplitter.setRightComponent(folderPanel);
          setContentPane(mainSplitter);
  }

  // WindowListener interface implementation

  public void windowActivated(WindowEvent e) {}

  public void windowClosed(WindowEvent e) { System.exit(0); }

  public void windowClosing(WindowEvent e) { dispose(); }

  public void windowDeactivated(WindowEvent e) {}

  public void windowDeiconified(WindowEvent e) {}

  public void windowIconified(WindowEvent e) {}

  public void windowOpened(WindowEvent e)
  {
          // set the splitter sizes when the window opens
          folderPanel.setDividerLocation(0.33);
          mainSplitter.setDividerLocation(0.20);
  }

  /** Application interface */
  public static void main(String[] args)
  {
          Postal postal = new Postal();
          postal.show();
  }

  // Inner classes
```

addition to listening for window control events sent to the application window by the operating system. We'll look at each of these functions in turn.

Postal is launched by invoking the Java Virtual Machine (JVM) on the `Postal` class. This calls its `main()` method, which performs two functions: it instantiates an instance of the `Postal` class and then makes it visible to the user by calling its `show()` method (a standard method for all AWT and Swing components). Once the Postal application is visible, the job of `main()` is done; all other program functionality will be driven through the GUI.

During instantiation, the `Postal` class sets its size and location using the AWT `setSize()` and `setLocation()` methods, respectively, so that it appears appropriately when it is made visible. Setting its size manually is a quick-and-dirty way of doing things. It would be better to have the window calculate its size from the size of its internal components, but until we have more of the application running, that isn't possible. The window system should place the window appropriately without us having to explicitly tell it where to do so, but in practice most do a poor job of it. Therefore, we merely pick some reasonable numbers.

After configuration, Postal adds itself as a listener to its own window control events, which are provided via the `WindowListener` interface (more on these later).

At this point, we have a fully functioning window for our application; now it's time to fill it up.

Five to One, Baby, One in Five

Perhaps the most important feature of any application, particularly during its construction, is its `exit` command. To that end, the first thing we add to our application window is a menu bar with the standard "File" menu and "Exit" menu.

Swing components that perform operations, such as menu items, are called *actions* and must implement the `Action` interface. The most important

```
  class FileMenu extends JMenu
  {
          FileMenu()
          {
             super("File");
             add(new ExitAction());
          }
  }

  class ExitAction extends AbstractAction
  {
          ExitAction() { super("Exit"); }

          public void actionPerformed(ActionEvent e) { dispose(); }
  }
}
```

Listing 2. The FolderPanel Class

```
public class FolderPanel extends JSplitPane

{
  /** Smallest that we allow ourselves to become. */
  static private final Dimension minimumSize = new Dimension();

  public FolderPanel()
  {
          super(VERTICAL_SPLIT);
          setOneTouchExpandable(true);
          setTopComponent(new MessageSelector());
          setBottomComponent(new MessageViewer());
  }

  public Dimension getMinimumSize() { return minimumSize; }
}
```

method in this interface is `actionPerformed()`, which is called whenever the user selects the `Action` object in the application, for example, by selecting a menu entry. Our exit menu item class, `ExitAction`, derives from `AbstractAction`, a class that implements most of the basic functionality of the `Action` interface other than `actionPerformed()`. By implementing `ExitAction` as an inner class to `Postal`, we make available to it all of the methods of the outer class's instance, including the standard AWT `dispose()` method used to destroy the application window. This is what is called by `ExitAction.actionPerformed()`.

The action item needs a `JMenu` to live in so we also supply a `FileMenu` class to provide it, and populate the menu with an instance of `ExitAction` in its constructor. After configuring itself, the `Postal()` constructor creates a `JMenuBar` (which is needed to hang menus on a `JFrame`), populates it with an instance of `FileMenu` and makes the menu bar active by placing it in the application window with `setMenuBar()`. This provides us with our much-needed way out of the application.

Floor Plan

The main display area of a `JFrame` is called the *Content pane*. Often this is just a `JPanel`, but in our case we want to divide the window up into resizable sections, so we use a `JSplitPane` instead. This component provides two resizable areas separated by a splitter bar that can be dragged to set the sizes of the other panels. The `Postal()` constructor creates a horizontally split (meaning vertically oriented splitter bar) `JSplitPane`, and populates the left half with a server selector panel (implemented by the dummy `ServerSelector` class, a derivative of `JList`) and the right half with one that can be used to select messages within a folder for display (a `FolderPanel`, see Listing 2).

The `FolderPanel` class is itself a `JSplitPane`, this time vertically split, composed of the `MessageSelector` and `MessageViewer` objects (just dummy instances of a `JTable` and `JEditorPane`, respectively). Normally, we would instantiate another `JSplitPane` rather than create a new subclass, but there is a limitation to `JSplitPane`'s behavior: it will not resize its child components to be smaller than the sizes they specify as their minimums via the `getMinimumSize()` method. Ordinarily this is good behavior, but in our case, the `MessageSelector` table is too large to allow the splitter much freedom at all, so our subclass overrides `getMinimumSize()` to allow itself to be shrunk as desired by the user.

Automatic Windows

Most window environments provide a number of basic window controls, such as minimize, maximize and close. AWT exposes these features to the application by sending events to any `WindowListener` objects that have registered themselves with the window. Usually, the window object is interested in these events itself so it can control its own destiny. It is therefore typical for a window to register itself as a listener for its own events and the `Postal` class does exactly this.

The `WindowListener` class provides seven callbacks:

- `windowActivated()` – This is called when the window is given focus by the window system.
- `windowClosed()` – This is called after the window is destroyed by the window system or by a call to its `dispose()` method.
- `windowClosing()` – This is called when the user selects "close window" using one of the standard window widgets or menus. This event is only a request; if the application ignores it, the window stays open.
- `windowDeactivated()` – This is called when the window loses focus, usually because some other window was given focus.
- `windowDeiconified()` – This is called whenever a minimized window is restored.
- `windowIconified()` – This is called whenever a window is minimized.

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• `windowOpened()` – This is called when a window is made visible to the user, usually immediately after the `show()` method is called.

Often, the main application frame is interested in at least `windowClosing()` and `windowClosed()`; the former so that it can ask the user if they want to save any changes to whatever they were doing, `dispose()`ing the window afterward, and the latter to actually shut down the application. Postal provides minimal implementations of both methods.

Postal does one other useful thing with the window event notifications. Because most of the application components are still dummy components, they do not yet do a good job of recommending their preferred sizes for layout management. As a result, the `JSplitPane` components tend to do a poor job at setting their initial sizes. Luckily, `JSplitPane` provides a couple of ways of adjusting the position of the splitter bar with two versions of the `setDividerLocation()` method: one to set its absolute location within the pane, the other to set its location to a fraction of the size of the pane. Unfortunately, you can't merely set the splitter bar location inside a constructor and be done with it. The panel must be resized by the layout manager before it can be properly placed. As a quick-and-dirty fix to this problem, we use the `windowOpened()` method to set the splitter locations appropriately.

One Step Forward

Next month, we'll hook up the JavaMail functionality we discussed last month to the various dummy components we have set up in our application frame. This will drag us kicking and screaming into the Model/View/Controller design pattern favored by Swing, and allow us to begin to see the power of some of the more interesting Swing components, such as `JTable`. Stay tuned.

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

NETWORK MANAGEMENT

Will XML bring new methods to the data

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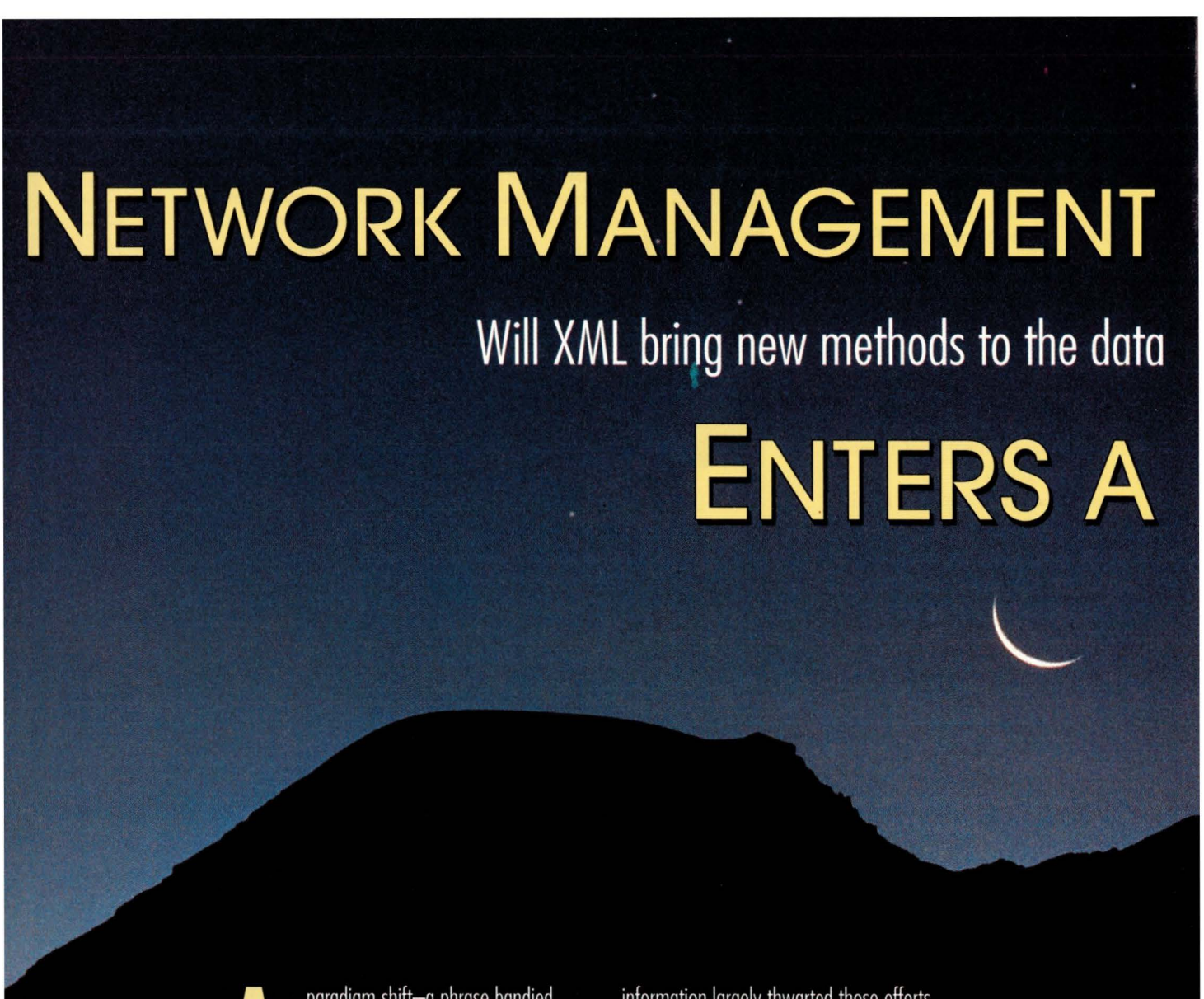

A paradigm shift—a phrase bandied about by suppliers to illustrate a dramatic change in product design and capabilities—appears to be on the horizon in the network and systems management space. For more than a decade, customers have yearned for tools that would provide them with a cohesive view of all of their network and system elements. Suppliers have tried to fulfill such desires, but the ever-expanding reach of enterprise management and the various ways equipment vendors have used to identify management information largely thwarted those efforts.

Standards were needed, and after several failed attempts to deliver them, there is reason to hope standardization will arrive. A new alternative—one based on World Wide Web technology—is emerging. Just as the Web has dramatically altered the way companies build daily business applications, it has the potential to change the way equipment vendors design their management applications. Rather than be locked into proprietary interfaces that hinder interoperability and increase development costs, suppliers are moving toward

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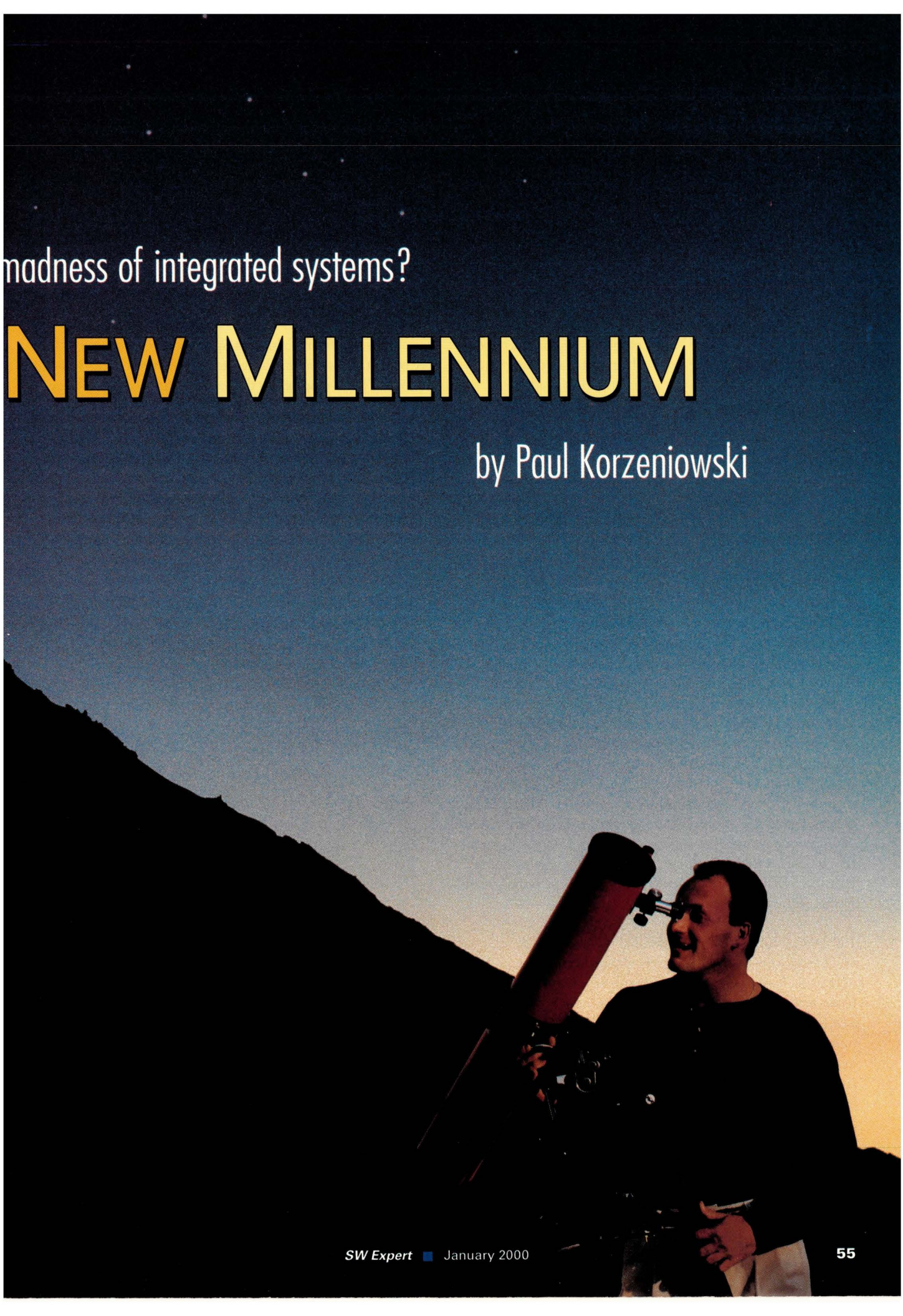
madness of integrated systems?

NEW MILLENNIUM

by Paul Korzeniowski



Web-based systems that ease integration.

Integrated network and systems management has been an ongoing issue for enterprises. "As networks have become more integral to business operations they have also become larger and more difficult to manage," says Allan Anderson, product manager with Computer Associates International Inc., Islandia, NY. As corporations expanded their network reach beyond branch offices to telecommuters and traveling executives, the number of possible trouble spots doubled and even tripled. Movement away from centralized to distributed processing has increased the number of places where information resides.

Ideally, network managers want their management tools to sift through all of the potential problem spots for them, and not only identify defective equipment, but begin the process of fixing it.

When a problem does occur, a network manager needs to quickly sift through a vast array of potential causes and pinpoint the malfunctioning device. The possibilities are endless, including computers that have stopped working, network bandwidth that has overflowed, servers that have fallen behind the number of transactions they need to process, a wireless connection that has dropped transmissions, a database that has been overrun with complex queries, or a desktop workstation that has been overloaded with too many applications.

Ideally, network managers want their management tools to sift through all of the potential problem spots for them, and not only identify the defective equipment, but begin the process of fixing it. Instead, suppliers have addressed management issues in a piecemeal fashion. For example, one management tool may outline how a desktop computer is functioning, a second gauges how quickly a router processes packets, a third determines if a server has sufficient memory to process graphics files quickly, a fourth examines the health of a wireless connection and a fifth outlines which queries a database management system (DBMS) processes.

The Search for Integrated Solutions

Underscoring the cost to companies owing to the vast range of management tools available, Dataquest Inc., a San Jose, CA-based market research firm, estimates companies will spend $14.6 billion on management packages this year and that number will grow to $28.8 billion in 2003. Systems management–examining what is happening with desktop computers and servers–represents the largest slice of this space, and Patrol from BMC Software Inc., Houston, TX, OpenView from Hewlett-Packard Co., Palo Alto, CA, Tivoli Management Environment (TME) from Tivoli Systems Inc., Austin, TX, and Unicenter TNG from Computer Associates, are the leading tools (see "Leading System Management Suppliers," Page 59).

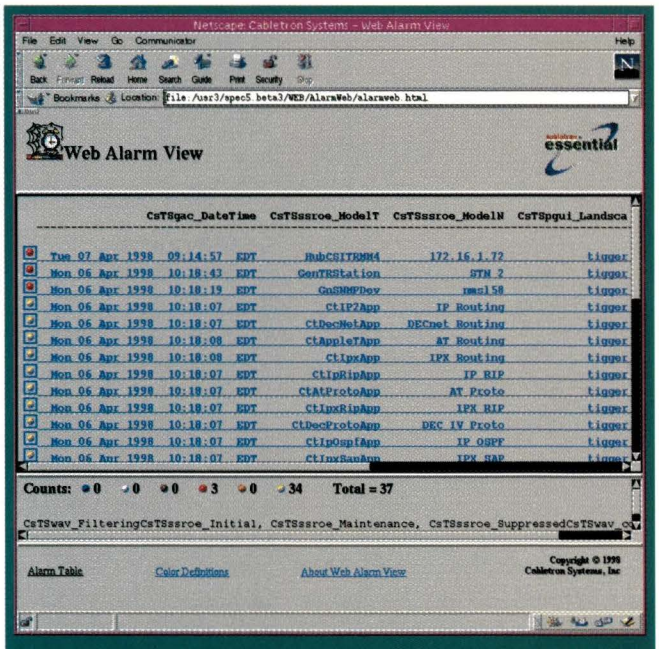
Because there are so many tools, pinpointing problems has meant bouncing from application to application, testing each individual component until, eventually, uncovering the problem. This process is inefficient and increases the workload in network control centers, where highly skilled, expensive technicians must wade through potential problem spots.

Aware of the desire among users for integrated management systems, vendors have delivered framework packages. These systems provide open APIs that third parties can use to send management data from their devices to a central location for processing. For instance, within a management framework, a router supplier can transmit information about the health of its devices to a central console to be viewed by a network manager.

Spectrum from Cabletron Systems Inc., Rochester, NH, Computer Associates' Unicenter TNG, HP's OpenView and Tivoli's TME emerged as the leading framework packages, and some companies have used them to integrate both their network management and system data.

For instance, Teranet Land Information Services Ltd., Toronto, Ontario, has 750 employees that provide property information to various federal, municipal and provincial agencies throughout Canada. The company operates an asynchronous transfer mode (ATM) network that ties together 13 locations, a frame relay network that relies on IBM Corp.'s System Network Architecture to link 24 sites and another frame relay network running TCP/IP that connects 49 sites. Users rely on variations of Windows (95/98/NT) to access information stored on IBM mainframes and HP-UX and Windows NT servers.

In 1996, Teranet Land Information Services searched for a management framework and selected Cabletron's Spectrum. "We felt the Cabletron package offered a higher level of inte-

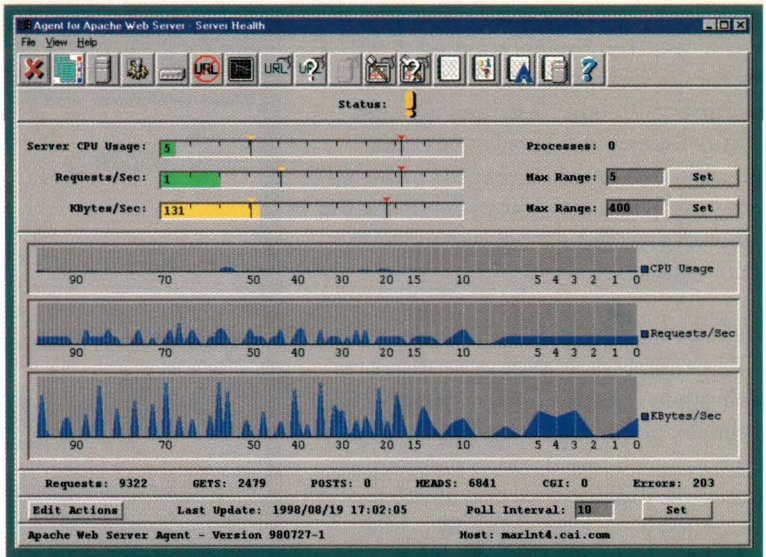


Web Alarm View is a browser-based advanced application for the Spectrum Management framework. Using Cabletron's Inductive Modeling Technology, it centralizes the results of fault-isolation data from anywhere in a network.

gration and more flexibility than any other package available," says Michael Smith, director of the company's data center.

Since purchasing the package, Teranet Land Information Services has connected eight standalone packages to Spectrum, a process Smith terms as "relatively" easy. "It does take a little bit of effort to get the various tools calibrated," Smith admits.

The integration has enabled the company to automate certain management functions. For instance, the management system will automatically open up a trouble ticket (a file noting when a problem occurred and what steps have been taken to resolve it) whenever a malfunction on the network occurs. Because of the automation benefits, the company is now moving to tie another eight packages into Spectrum. "We are now focusing on improving the integration of our desktop application [remote control, software distribution, software metering and so on]," Smith says.



Computer Associates' Unicenter TNG Web Management Option monitors and reports on numerous system parameters to ensure Web servers and sites are functioning properly.

A Role for Service Providers

Merrill Lynch Inc., Somerset, NJ, relies on Computer Associates' Unicenter TNG to integrate its management applications. "We examined the alternatives and felt the Computer Associates system would be easier and faster to install than other packages," says Frank McCarthy, assistant vice president at the financial services company.

Merrill Lynch has used Unicenter TNG to integrate management tools that oversee its servers, monitor its pagers and support its help desk. "Our training costs are less since our technicians are working with a consistent user interface," McCarthy says.

With network and systems management chores becoming more complex, corporations have been looking to outsource such functions rather than continue to fix problems in-house. Consequently, a growing number of telecommunications carriers have been developing network management services for their customers. "The service provider market will be the single-most important dynamic shaping the network and service management market over the next five years," says Elisabeth Rainge, research manager for International Data Corp. (IDC), Framingham, MA. IDC found that service providers accounted for 51% of network management spending in 1998, and expects that number to reach 71% in 2003.

Intira Corp., Pleasanton, CA, represents one of a new breed of companies developing such services. The service provider generally takes over the IT and network infrastructure needed to operate a firm's electronic commerce business. To support its customers, the company operates data centers in Pleasanton, New York City and St. Louis, where technicians oversee HP, IBM and Sun Microsystems Inc. servers running UNIX or Windows NT operating systems.

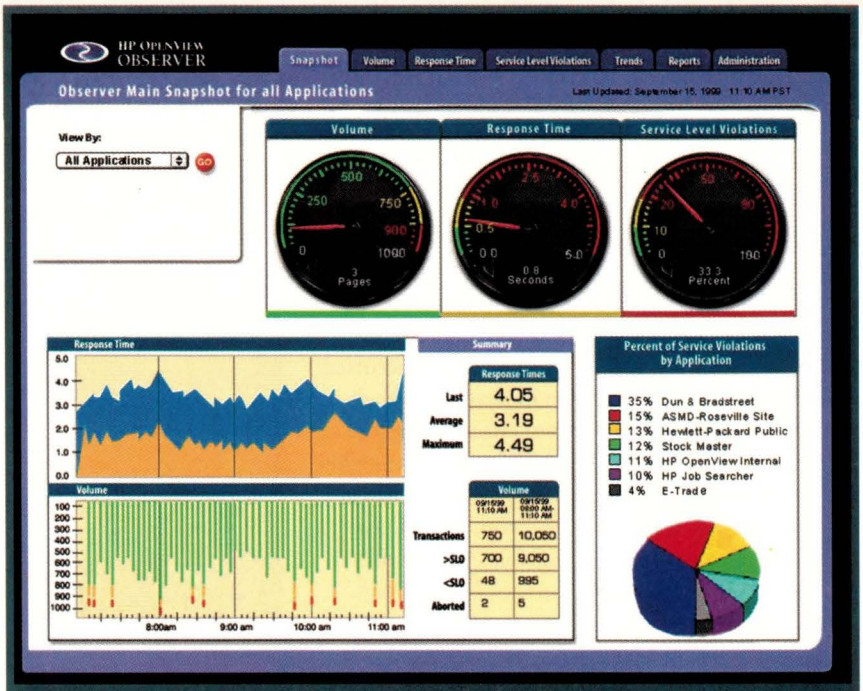
Intira needed a management platform that would consolidate a number of management applications and selected HP's OpenView. As opposed to a framework approach to network management, HP OpenView provides a building-block, or modular, approach. By doing so, customers are able to deploy solutions as their needs grow. "We felt the HP system offered us the most visibility into our network and systems," says Steve Sidore, vice president of operations and engineering at the e-business service provider. The company has used OpenView to link half a dozen packages, and its technicians try to improve the level of integration every day.

Although Teranet Land Information Services, Merrill Lynch and Intira have been satisfied with the level of integration their chosen platforms offer, that's not the case with all corporations. "Firms have found that management integration work is complex and time-consuming," says Stephen Elliot, industry analyst with Dataquest. In fact, many companies started down the path to integration and stopped because the work proved so difficult.

Web and Internet technologies are now emerging to ease the integration process. "Browsers have already emerged as inexpensive, easy-to-use alternatives to the proprietary user interfaces found in management packages," says Maureen Mellon, general manager at HP. Customers often find the proprietary command-line interfaces difficult to understand and their navigation hard to complete, and have been demanding–and receiving–devices that can be accessed, monitored and controlled by Web browsers. Browsers provide the flexibility of enabling users to access information from a wide range of places. So rather than having to drive into the office, a technician can view the corporate network if, for example, a problem arises in the middle of the night.

But the use of browsers has not been a panacea. "We're concerned about the security issues that browsers raise," says Intira's Sidore. "Just about anyone with a browser may be able

to access and change management data." In certain cases, companies permit users with browsers to view, but not change, corporate information. In other instances, they add security features such as encryption and authentication to the browser to be sure only authorized persons are using it; although the additions generally increase cost and lower performance.



HP's OpenView Observer illustrates transaction volume, end-user response time and percentage of service level agreement failures.

What the Browser Sees

The first set of Web-based management applications offered a browser-based view of simple, proprietary, static pages. While this was a good initial step, it did not fully address the problems associated with the integration of management information.

The work began in the fall of 1996, when industry heavyweights Cisco Systems Inc., San Jose, CA, Compaq Computer Corp., Houston, TX, and Microsoft Corp., Redmond, WA, outlined plans for the Web-Based Enterprise Management (WBEM) specifications that would leverage Internet standards and technology to solve enterprise management issues. After outlining its goal and a working architecture, the group decided to hand the development work over to an independent consortium and selected Distributed Management Task Force (DMTF) Inc., San Jose, CA (`http://www.dmtf.org/wbem/index.html`). Founded in 1992, DMTF was developing specifications for the collection of management information from desktop PCs, and was concluding that process when industry leaders approached.

A key component of the WBEM initiative is the Common Information Model (CIM), an object-oriented information model that provides a conceptual framework within which management data may be modeled. The model is not bound to a particular product, and allows for the interchange of management information between management systems and applications, which can be either element manager-to-framework or framework-to-framework. In a CIM-compliant world, one can build applications using management data from a variety of sources. The specification enables management data to be collected, stored and analyzed using a common format, while allowing vendors to add proprietary extensions for value-added functions.

> While CIM is a strong foundation for solving common management data interchange problems, other amenities are still needed.

CIM comprises two parts: the CIM Specification and the CIM Schema. The CIM Specification outlines how to describe management data and map CIM to other management models such as Simple Network Management Protocol (SNMP) Management Information Bases (MIBs). The Schema defines how to store management information in a database.

While CIM is a strong foundation for solving common management data interchange problems, other amenities are still needed. Although vendors could use CIM as a data model, they can still retain their own proprietary encoding and transport mechanisms for exchanging data between applications. This would limit interoperability and force users to standardize on a single vendor's management software, according to DMTF.

DMTF had a couple of options for tackling data exchange problems. One possibility was to create a new application development standard. However, this approach would have continued to wedge network management issues into a narrow niche and drive up personnel and programming costs.

Finding the Right Language

Instead, the consortium decided to adopt eXtensible Markup Language (XML) as the glue for linking applications together. XML is a meta language that describes information and outlines how data is formatted and exchanged between servers and clients over a network. XML provides a way of identifying structured management information exchanges so applications can trade CIM data. With XML, a programmer can specify details about elements through document type definitions (DTDs) that provide a way to pass information between different vendors' products or send it directly to a Web browser. XML provides an application with access to diverse data sources and the ability to manipulate them many times without a trip back to a database.

The combination of CIM and XML should help companies identify network problems faster and more easily, according to industry watchers. "Rather than bouncing from one

lement management application to another to pinpoint a rouble spot, network managers will be able to systematically est all potential trouble spots and identify the faulty devices," ays Bob Quillin, vice president of marketing at Manage.com nc., a Santa Clara, CA-based management vendor.

For instance, say the executive vice president of marketing, who works out of one of the firm's remote offices, calls the elp desk and says he has been having problems accessing an ntranet application that allows employees to place orders for omputer equipment. The help desk echnician needs to quickly examine ach component along the link (the ser's browser, his PC, his network onnection, the local switch, the local outer, the central remote access concentrator, the data center switch, the Web server's network connection, the erver and the application), pinpoint he malfunction and take the necesary steps to improve response time.

With CIM, an enterprise management application will start at the lowest layer of the networking model and work its way up until the problem is dentified, a process called root cause nalysis. First, it checks the physical network connection (the ocal switch, the local router, the central office remote access concentrator, the data center switch) by sending a packet over he line. Next, it examines the network layer (the user's network connection, the Web server's connection) to determine whether or not there is a protocol problem. Then, the management tool looks at the server to determine how quickly it s processing information. Last, it examines the application ayer (the browser, the intranet application) to determine if hey are hung up.

Root cause analysis offers companies two main benefits. First, training requirements drop because technicians only need to know how to operate a browser rather than a series of proprietary user interfaces. Second, suppliers can build more sophisticated management applications, ones that examine problems and recommend solutions on an end-to-end basis rather than in a piecemeal fashion.

Root cause analysis is the ultimate goal for network management customers, but vendors still have to put a few pieces in place before firms can set up their management systems in this way. The DMTF needs to define data schemes (basically, outlines of how devices, such as routers or switches, function), a task the group is now in the process of wrapping up.

Leading System Management Suppliers

Company	Market %
Computer Associates	28.6
Tivoli	19.2
BMC	11.1
Platinum	9.5
HP	3.7
Candle	3.7
Other	24.2

Source: Dataquest Inc., San Jose, CA

Also, vendors have to incorporate CIM and XML support into their products. A growing number, including Cisco, Computer Associates, HP, Microsoft and Tivoli, are moving in that direction. "In early 2000, the first wave of CIM-compliant products will start to arrive," says Jim Turner, director of marketing at Cisco.

Next, these devices have to be certified so they will work with one another. "We are struggling now to determine exactly what compliance means and how to test for it," says Winston Bumpus, DMTF Chairman.

Despite that issue, there is optimism about the impact CIM and XML will have on network and system management tools. "The integration of management information has been a long-standing problem for customers," says Dataquest's Elliot. "CIM and XML hold a lot of promise as a potential solution to it." ⊸

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Companies Mentioned in This Article

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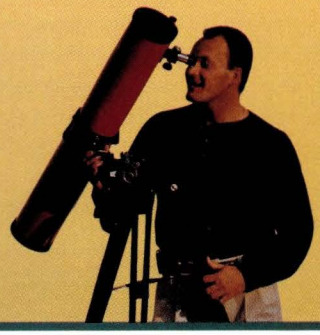


Making the Power of UNIX Affordable and Manageable

by **IAN WESTMACOTT**, Technical Editor

Looking for UNIX server functionality without the aggravation of installing, configuring and maintaining a UNIX server? Then Cybernet Systems' NetMax servers may be just what the doctor ordered.

I don't have to tell you about the power of UNIX as a server operating system. And I don't have to tell you about the relative difficulty of installing, configuring and maintaining a UNIX server. But if you have clients, customers or workgroups within your organization that need or desire UNIX server functionality but don't themselves have the knowledge or experience to run it, Cybernet Systems' NetMax servers may be a solution.

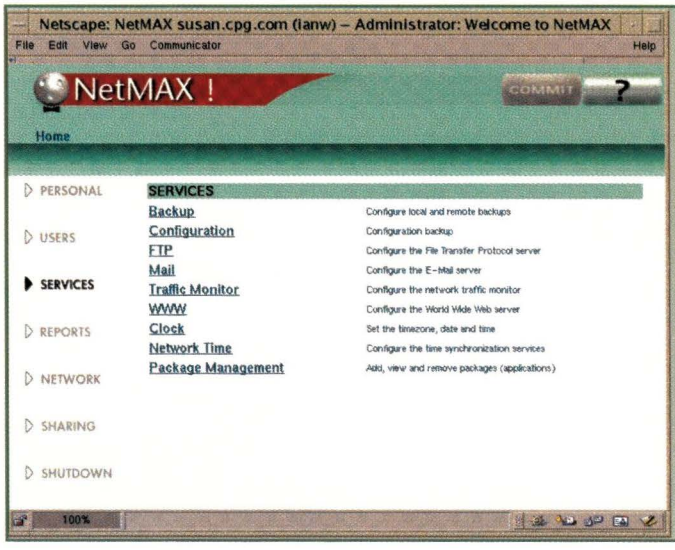
The NetMax servers come in four flavors: NetMax WebServer with Email and FTP, NetMax FireWall with Router, NetMax FileServer with Print Sharing and NetMax Professional. Cybernet Systems calls these products "thin" servers, although they don't really fit into any definition of this overloaded term that I've come across. Each product includes a full version of Red Hat Linux or FreeBSD and may be installed in any combination (NetMax Professional includes WebServer, FireWall and FileServer, as well as additional features).

Essentially, what the NetMax servers provide is point-and-click installation, configuration and management of server functionality already available in Linux or FreeBSD. Though it may not sound like much, NetMax servers can significantly reduce the time required to set up and maintain these services, which in turn reduces total cost of ownership. In fact, NetMax servers make it possible to install UNIX servers in places previously impractical owing to cost or lack of knowledge. All of the NetMax servers can be set up and managed without ever using the UNIX command line, although the services may be managed from the command line if desired.

We obtained Linux versions of NetMax WebServer, Firewall and FileServer for review. Hardware requirements are modest: Intel Pentium-class computer with 32 MB of RAM (64 MB recommended) and 1 GB of available storage. Of course, overall performance will be affected by the underlying hardware, but Linux allows even this minimal hardware configuration to function ably.

WebServer

NetMax WebServer with Email and FTP provides Web- or console-based installation of Red Hat Linux and Web-based or command-line set up and administration of Web, email and FTP



NetMax servers feature centralized Web-based administration, which makes configuration and management easier and faster.

ervices. Web services are implemented ısing the Apache Web server included vith Red Hat Linux, but without hav- ng to deal with Apache configuration ïles, UNIX pathnames, access permis- ions or processes. The NetMax Ad- ninistrator Web interface allows the ıser to set up and manage multiple Web servers using a Web browser.

Email services are implemented ısing `sendmail` as the mail transport, ınd IMAP4 and POP 3 and 4 servers ˙or client access. Masquerade, blocked ınd relayed domains may be specified :hrough the Administrator interface. Aliases and forwards for individual ısers may also be specified.

As for FTP services, the Adminis- :rator interface allows you to enable or lisable either authenticated or anony- mous access for both the local domain (intranet) and for any domain (Inter- net). You can also set up a writable "incoming" directory, with periodic deletion of old files.

NetMax WebServer also includes common user and systems administra- tion functions in addition to system monitoring and reports. Surprisingly, user disk quotas are not supported in this server, although they are in File- Server. With user Web pages, home directories, email and FTP directories, I would expect to see disk quotas here.

FileServer

NetMax FileServer with Print Sharing provides Web- or console- based installation of Red Hat Linux and Web-based or command-line set up and administration of file shar- ing, printer sharing, backup and FTP services (same as in WebServer). File sharing is implemented using NFS for UNIX clients, SMB/CIFS for Windows clients (using `Samba`) and Appletalk for Macintosh clients (using Netatalk). Quotas, volumes and soft- ware RAID are supported, as is sharing of removable media. The sharing of both local and remote printers (UNIX, Windows or Macintosh) can be con- figured through the Administrator interface as well.

NetMax FileServer can also act as a backup server for both local and remote client backup and restore. Full and differential backups are supported, as well as software compression. In addition, backups and restores, as well as scheduled backups, may all be per- formed in the Administrator interface.

Like WebServer, FileServer includes common user and systems administra- tion functions and system monitoring and reports.

FireWall

NetMax FireWall with Router pro- vides Web- or console-based installa- tion of Red Hat Linux and Web-based or command-line set up and adminis- tration of firewall, routing, interface, Domain Name System (DNS) and Dynamic Host Configuration Protocol (DHCP) services. The packet filter firewall supports network address translation (NAT) and comes with preconfigured common rules and exceptions. Customized firewalls may also be specified.

Routing and interface services allow the server to act as an Internet router, supporting multiple interfaces. On- demand dial-out connections are also supported. The DNS and DHCP ser- vices allow the server to act as a client or server and both services can be com- pletely configured with the Adminis- trator interface.

As with the other servers, FireWall includes common systems administra- tion functions and system monitoring and reports. It does not include user- management features.

Summary

You can download Linux, install and configure it, download the neces- sary tools, install and configure those, and wind up with a server supporting the same services as any one, or all, of the NetMax servers–and all for the price of the hardware alone. But this would take considerable time and knowledge. The value of the NetMax servers is the Web-based management interface they provide, which makes configuration and management of the server much easier and quicker.

You do not lose any power with NetMax servers, however. The com- mand line (and X desktop) are always available if needed. But the Adminis- trator interface is comprehensive enough that fairly customized and detailed configurations can be accom- plished with it alone. And it may be used by anyone who can use a browser. No knowledge of UNIX shells, text editors, free-form configuration files, `crontabs` and the like are needed. Of course, some server and network knowledge is needed, such as creating well-formed IP addresses, but online tutorials and help files are available.

I was impressed with how compre- hensive and easy the Administrator interface was, and as HTML adminis- tration interfaces go, Cybernet Systems' is pretty good. This product is not for UNIX veterans though, who will still

NetMax WebServer with Email and FTP

NetMax FileServer with Print Sharing

NetMax FireWall with Router

Company
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WWW
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Circle 160

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.

RAID Controller for Entry-Level Networks

Mylex has announced SANArray FFx, an external RAID controller that brings Fibre Channel and storage area network (SAN) capabilities to entry-level networks.

SANArray FFx's external features include a 233-MHz processor and dual 64-bit PCI bus design, one Fibre Channel-to-host channel, two Fibre Channel-to-disk drive channels and a 3.5-inch form factor. Mylex has also developed three new technologies that are said to improve the performance, fault tolerance and flexibility of the controller: SANmapping for heterogeneous host configurations; cache coherency to protect the most current data during a failure; and pinging, which allows the controllers to be installed on different subsystems while still maintaining controller-to-controller messaging.

With SANmapping, the RAID controllers create mapping tables to enable UNIX and Windows NT servers to share disk drives, Mylex says. Its cache coherency technology ensures that users access the most recent data, even if the server chooses an alternate path to access that data. If a server uses an alternate path to access the data, the controller that services the I/O will deliver the current state of the data, the company says. Mylex's new pinging technology reportedly provides extra redundancy and flexibility for SANs by enabling controllers to communicate across back-end loops and to be installed in different storage subsystems.

Other features include mirrored cache for data integrity, automatic detection of failed drives, automatic and transparent rebuild of replacement drives, clustering, online RAID expansion and support for hot drive swapping. In addition, the controller provides full support for RAID levels 0, 1, 0+1, 3, 5, 10, 30, 50 and Just a Bunch Of Disks (JBOD) configuration capabilities.

Mylex says the SANArray FFx controller delivers sustainable RAID 5 read and write rates of more than 95 MB/s in simplex mode and burst cache transfer rates of more than 190 MB/s in duplex mode. Data rate performance is further enhanced with dual-ported Fibre Channel disk drive support, the company says. Each controller can support up to 250 drives for a total of 18 TB of storage. SANArray FFx costs $2,999.

Mylex Corp.
34551 Ardenwood Blvd.
Fremont, CA 94555
http://www.mylex.com
Circle 101

Remote Backup Software Enhanced

Veritas has released TeleBackup 2.05, the latest version of the company's remote backup and recovery software. TeleBackup is a single software solution, which manages all of the remote and

New Storage Software from Sun

Sun Microsystems has announced StorEdge Instant Image software, which allows Sun Enterprise server customers to perform backups, instant data recovery, data warehouse loading, and test and development processes without impacting 24x7 operations.

Sun says Instant Image enables nonstop availability of enterprise applications such as OLTP, data warehousing, the Internet, enterprise resource planning (ERP) and customer relations management (CRM) by allowing backups and other business-critical processing activities to be performed without disruption to the online application.

With Instant Image point-in-time snapshots of online data, data can be restored in minutes as opposed to hours, significantly reducing recovery time for 24x7 business operations, Sun says. StorEdge Instant Image software can also be used in application development and testing. By testing against a snapshot of the entire production system, the integrity of any change can be fully verified, and the time to market for new products and upgrades can be greatly reduced, the company says.

In addition, Instant Image will be one of the first intelligent storage management services to be compatible with Sun's new Jiro platform, a Java-based development environment for interoperable and automated network management services, the company says.

StorEdge Instant Image software supports Solaris 2.6/7 running on a wide range of Sun Enterprise servers and StorEdge storage systems, including Enterprise 250, 450 and 10000 and StorEdge A1000 and D1000. Pricing for the StorEdge Instant Image software license, which includes CD-ROM and documentation, ranges from $3,000 for Enterprise 250 and 450 servers to $50,000 for the Enterprise 10000 server platform.

Sun Microsystems Inc.
901 San Antonio Road
Palo Alto, CA 94303
http://www.sun.com
Circle 100

desktop users in a heterogeneous server environment, including Solaris, HP-UX and Windows NT, the company says. It can support more than 4,000 users on a UNIX server and more than 2,000 users on an NT server, and works with LAN, WAN and Internet service provider (ISP) connections, Veritas says.

TeleBackup 2.05 has several levels of security, including password restore, authentication codes for session validation and binary identifiers. Using TeleBackup, the server takes a daily, full-image snapshot with each backup. This allows for a one-step restore process, the company says. In addition, a user's data is kept online, limiting downtime, minimizing IT intervention and enabling a user to simply enter a password to begin restoring selected data, Veritas says.

TeleBackup is reportedly the only remote recovery software package that allows users to recover key files or use the restore CD to bring back a complete system. Veritas offers TeleBackup as either a corporate solution, which includes server and client software, or as an electronic data vaulting (EDV) solution for ISPs and application service providers (ASPs) to sell as a service. The EDV version delivers backup and recovery via the Internet. The online service includes the ability to upload data to a remote server managed by the ISP or ASP and retrieve data or a complete system via the Internet, the company says.

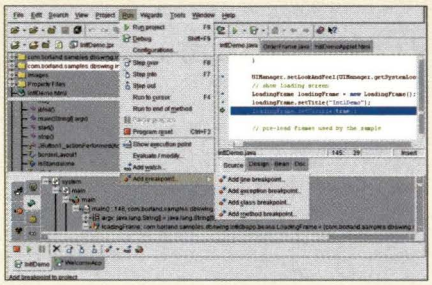
TeleBackup 2.05 costs $16,000 for a single-server UNIX license and $10,000 for a single-server Windows NT license.

Veritas Software Corp.
1600 Plymouth St.
Mountain View, CA 94043
http://www.veritas.com
Circle 102

Java Development Tool for Solaris

Inprise has made JBuilder 3 Enterprise available for the Solaris operating system. The visual development tool is designed to build business, database and distributed Java-based applications, applets, JavaServer Pages (JSP)/servlets, JavaBeans, Enterprise JavaBeans and distributed CORBA applications for the Java2 platform.

JBuilder 3 provides visual tools and reusable components for creating platform-independent applications, including support for networked database connectivity, the company says. The development tool comes with JBuilder Application Browser, which is said to combine the features of a project manager, compiler, debugger, class browser, visual designer and source code editor.



JBuilder 3 incorporates Inprise BeansExpress technology to create JavaBeans in a point-and-click environment. It offers JDBC connectivity for Oracle, Sybase, Informix and DB2 databases. In addition, it comes with JDataStore, a storage system for mobile computing applications that provides persistent storage of data, objects and files.

JBuilder 3 Enterprise Solaris Edition costs $2,495.

Inprise Corp.
100 Enterprise Way
Scotts Valley, CA 95066
http://www.inprise.com
Circle 103

Routed WAN Management Solution

Cisco Systems has introduced CiscoWorks 2000 Routed WAN Management, a suite of six applications designed to help run a wide area network (WAN), including Access Control List (ACL) Manager 1.1, Internetwork Performance Monitor (IMP) 2.0, TrafficDirector 5.7.2, Resource Manager Essentials 3.0, CiscoView 5.0 and CiscoWorks 2000 Management Server.

ACL Manager 1.1 provides simplified management and administration of ACLs for improved traffic filtering and device access control, the company says.

IMP 2.0, which is said to be a proactive troubleshooting application used to identify network bottlenecks, provides analysis in response time trends to determine device availability.

TrafficDirector 5.7.2 monitors and troubleshoots network traffic, looking for issues that pose a threat to the WAN's service. Resource Manager Essentials 3.0 is reportedly a suite of Web-based network management applications that can be used in building a management intranet. It can provide information relating to network inventory and device management, network configuration, software image management, network availability and system log analysis, the company says.

Cisco has also included CiscoView 5.0, a Web-based version of the company's graphical device management application that enables network managers to access real-time device status, operational and configuration functions.

CiscoWorks 2000 Management Server reportedly consolidates key management services and provides a Web-based desktop that simplifies the secure integration of third-party and other Cisco management tools.

The CiscoWorks 2000 Routed WAN Management suite costs $14,995, and runs on Solaris and Windows NT.

Cisco Systems Inc.
170 W. Tasman Drive
San Jose, CA 95134
http://www.cisco.com
Circle 104

Ultra 10-Compatible Rack-Mount System

Tatung Science & Technology has unveiled a new rack-mount system in 2U form factor for Internet and commercial applications. The Sun Microsystems Inc. Ultra 10-compatible COMPstation U10-440R2U features the 64-bit 440-MHz UltraSPARC-IIi chip housed in a compact 2U enclosure, the company says.

The U10-440R2U is designed for users that need a system that can meet tight space requirements without sacrificing performance or speed, Tatung

says. With a small footprint–3.5 by 17.25 by 20 inches–the system's space-saving design allows for easy vertical stacking. Front panel access to CD-ROM and floppy drives facilitates upgrades and routine administration tasks, the company says.

The U10-440R2U supports four drive bays suitable for two 3.5-inch hard drives, one 5.25-inch CD-ROM drive and one 3.5-inch floppy drive. Standard features include 128 MB of RAM, 9-GB hard drive, built-in dual-channel Ultra Wide SCSI, two serial ports, one parallel port and a 10/100BaseT Ethernet interface. In addition, the COMPstation U10-440R2U comes with Solaris 7 preinstalled and supports the open-source Linux operating system and Apache Web Server. Optional features include up to 1 GB of memory, 36 GB of hard disk, 24-bit PCI graphics and an add-on disk array storage subsystem that is said to increase hard disk capacity to more than 250 GB.

Pricing for the COMPstation U10-440R2U starts at $4,390.

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

Embedded, Ultra SCSI NAS Systems

Unicore Technologies has developed a series of high-performance, multifunction network-attached storage (NAS) systems that are ideal for departmental and office use, the comany says. According to Unicore, the NAServer 5/10 series is the industry's first embedded, Ultra SCSI NAS departmental data storage solution.

NAServer is said to include next-generation thin server technology that dynamically increases the efficiency of network traffic. In large environments, it allows the main servers to be free of heavy data access for search and retrieval processes. In small environments, it can be used as the main shared storage device available to all users, the company says. NAServer's key advantage is said to be its direct heterogeneous network access via UNIX, NetWare, Windows and MAC clients.

The product's design reportedly leverages the latest hardware and software technologies to deliver plug-and-play simplicity and reliability. With NAServer, adding or removing network resources is easy, Unicore Technologies says. In addition, NAServer attaches to any 10BaseT/100BaseTX Ethernet LAN and supports multiple high-speed

Upgrades, Enhancements, Additions...

■ Brio Technology has announced Brio.Report 5.2, the latest release of its enterprise reporting product that offers expanded support for UNIX platforms (including Solaris, AIX and HP-UX), as well as Windows NT. Brio.Report is used to transform data from disparate sources throughout an enterprise into distributable reports. Brio.Report 5.2 is designed so users can access non-SQL data sources, including SAP R/3, BAPIs, Essbase, COM, CORBA and XML, as well as SQL data sources. Brio.Report 5.2 includes SQR Server 5.2, which offers compile, run and print/render functionality deployed as a single executable that provides both single-byte and double-byte character sets, Brio says. In addition, it comes with a Windows-based graphical development tool that supports the generation of SQR code that can be deployed on any SQR Server and Personal SQR for local execution of programs during development. Contact vendor for pricing. **Brio Technology Inc.**, 3460 W. Bayshore Road, Palo Alto, CA 94303, *http://www.brio.com*. **Circle 106**

■ Sterling Commerce has added capabilities to its CONNECT: Remote remote systems management tool. The new capabilities are offered in so-called "Feature Packs." One feature pack, for example, is said to provide administrators with the ability to remotely manage Open VMS, Alpha-Async, Open VMS-Async, HP-UX and AIX clients via the CONNECT:Remote server or workstation. Another feature pack now allows CONNECT: Remote to run on Spanish versions of Windows 3.x/95/98/NT, Sterling says. Sterling is also offering client-side APIs for the CONNECT:Remote client. This is said to enable administrators and developers to build custom applications to interface with and use the additional CONNECT:Remote functionality on remote systems. The client-side APIs are available for Windows 32 bit, OS/2 and DOS operating systems. Contact vendor for pricing. **Sterling Commerce Inc.**, 4600 Lakehurst Court, Dublin, OH 43016, *http://www.sterlingcommerce.com*. **Circle 107**

■ JSB has announced Version 5.0 of its PC-to-UNIX connectivity solution, MultiView 2000. The new version enhances limited network bandwidth with host support on UNIX servers, and provides Windows look-and-feel terminal emulation, mouse support and Web-enabling functionality to existing UNIX applications without reprogramming, JSB says. MultiView 2000 Version 5.0 offers users access to multiple server applications over a single UNIX login (up to six applications can be opened concurrently), and extends printer sharing and file transfer capabilities to users with limited bandwidth, such as remote users. In addition, it includes a set of "face-lifting" tools that provide users with a completely mouse-driven GUI, including task automation, Web-enabled connectivity, active URL links that automatically launch Web applications and data sharing between systems. MultiView 2000 Version 5.0 runs on Windows 95/98/NT and costs $199 for a single-user license. A free 30-day trial version is available for download from the JSB Web site. **JSB Corp.**, 100 Enterprise Way, Mod. A-1, Scotts Valley, CA 95066, *http://www.jsb.com*. **Circle 108**

■ Tangram Enterprise Solutions has added support for SGI IRIX and Compaq Tru64 UNIX to Asset Insight 3.0, its asset tracking solution. Asset Insight already supports SunOS, Solaris, AIX, HP-UX, Linux and Windows 95/98/NT. Asset Insight is said to be a robust and automated asset tracking software solution that provides an electronic image of every asset in the enterprise, including hardware, software, operating systems, configuration files and infrastructure devices. Once installed, Tangram says, users can use the software to track things such as software upgrades and licenses, help desk support and Y2K risks. Asset Insight 3.0 for UNIX costs $30 to $50 per node, depending on configuration. **Tangram Enterprise Solutions Inc.**, 11000 Regency Pkwy., Ste. 401, Cary, NC 27511, *http://www.tangram.com*. **Circle 109**

CSI storage devices.

Available in five- or 10-bay desktop nd rack-mount configurations, NASer- er is ideal for businesses that require dditional data storage space–up to 00 GB–Unicore says.

Key features of this platform- and perating system-independent solution nclude industry standard open hard- vare, real-time operating system, built-in ape backup support, browser-based con- iguration and management, RAID 5 upport via a built-in SCSI-to-SCSI con- roller and redundant power supplies. Pricing starts at $2,995.

Unicore Technologies Corp.
55 Middlesex St.
North Chelmsford, MA 01863
http://www.unicoretech.com
Circle 110

SAN-Ready Automated Tape Library

Exabyte has announced the Exabyte X80 MammothTape technology library, which is designed for large application servers and storage networks. This high rack density tape library integrates into storage area network (SAN) and Fibre Channel architectures, the company says. The X80 will begin shipping with Mammoth and Mammoth 2 drives this month.

With eight Mammoth drives and 80 slots, the X80 will have a capacity of 1.6 TB and transfer data at 86.4 GB/ hour, the company says. With eight Mammoth 2 drives, capacity will be 4.8 TB at 345.6 GB/hour uncompressed. According to Exabyte, the X80, based on Mammoth's 5.25-inch half-high form factor, offers the highest rack storage density in the industry. The X80 can accommodate from two to eight MammothTape drives and from 40 to 80 AME SmartClean media cartridges.

The library can be managed and operated remotely via a Java-based Web browser, allowing for an out-of-band Ethernet connection for management and control. In addition, the X80 supports applications such as lights-out data center operations, unattended network backup/restore, remote storage, automated archiving, imaging and hierarchical storage management, the company says.

The X80 is priced starting at $30,445 for a library with 40 slots and two drives, and ranges up to $65,410 for a library with 80 slots and eight drives. The library comes with a three-year warranty and one-year of on site maintenance.

Exabyte Corp.
1685 38th St.
Boulder, CO 80301
http://www.exabyte.com
Circle 111

Covert Security Software

Recourse Technologies has released ManTrap, a network security application for businesses that rely on enterprisewide networks and the Internet. ManTrap enables organizations to contain, control and track network intruders, Recourse Technologies says.

When an attack is made on a corporate firewall, it is immediately redirected to ManTrap, which runs off its own Solaris-based server and responds to the intruder's commands by offering information that is preprogrammed by the company, Recourse says. This means the intruder thinks they are accessing a secure server when in fact they are accessing ManTrap. ManTrap will alert the systems administrator when an unauthorized action has taken place and will track each move an intruder makes, maintaining an audit trail, saving log files and recording keystrokes. ManTrap will also present this information as evidence designed for criminal prosecution, the company says. In addition, ManTrap features configurable alerting that can be customized for specific security needs.

ManTrap comes with its own Solaris 7-based server, which presents itself as the system server when an intruder attacks a corporate firewall. The interface runs on Solaris and Windows 95/98/NT. It costs $3,495 per server.

Recourse Technologies Inc.
2450 El Camino Real, Ste. 100
Palo Alto, CA 94306
http://www.recourse.net
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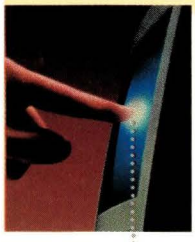

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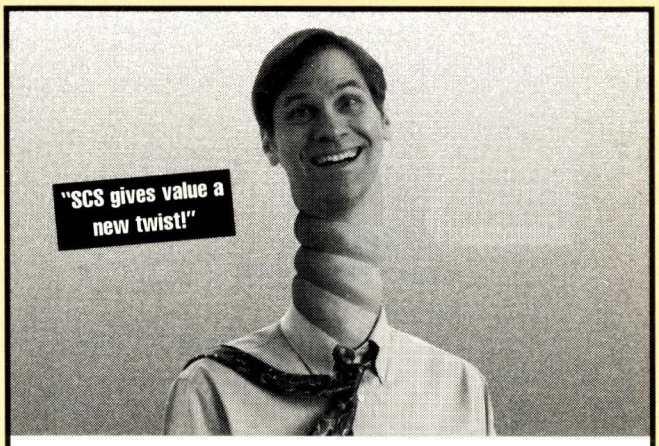

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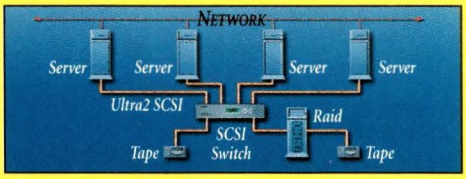

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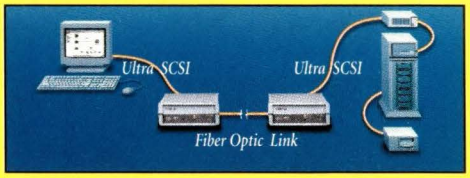

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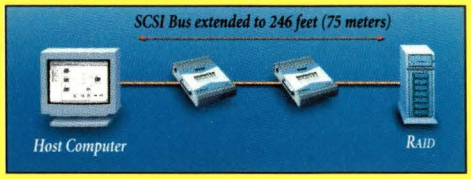

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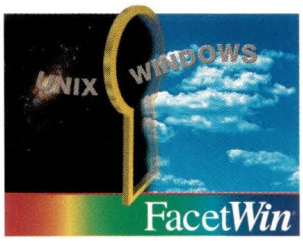

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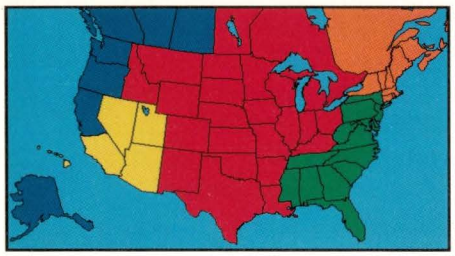

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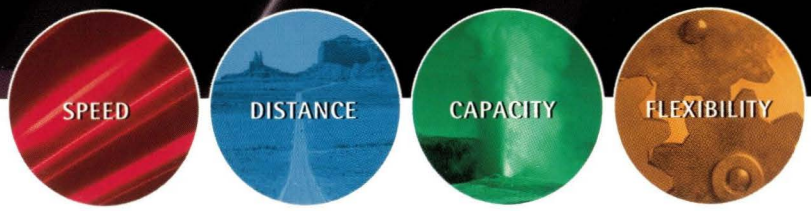

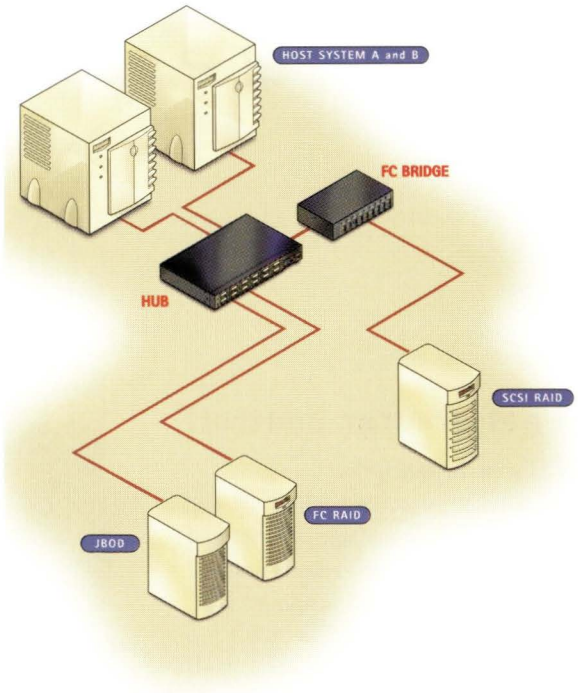

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