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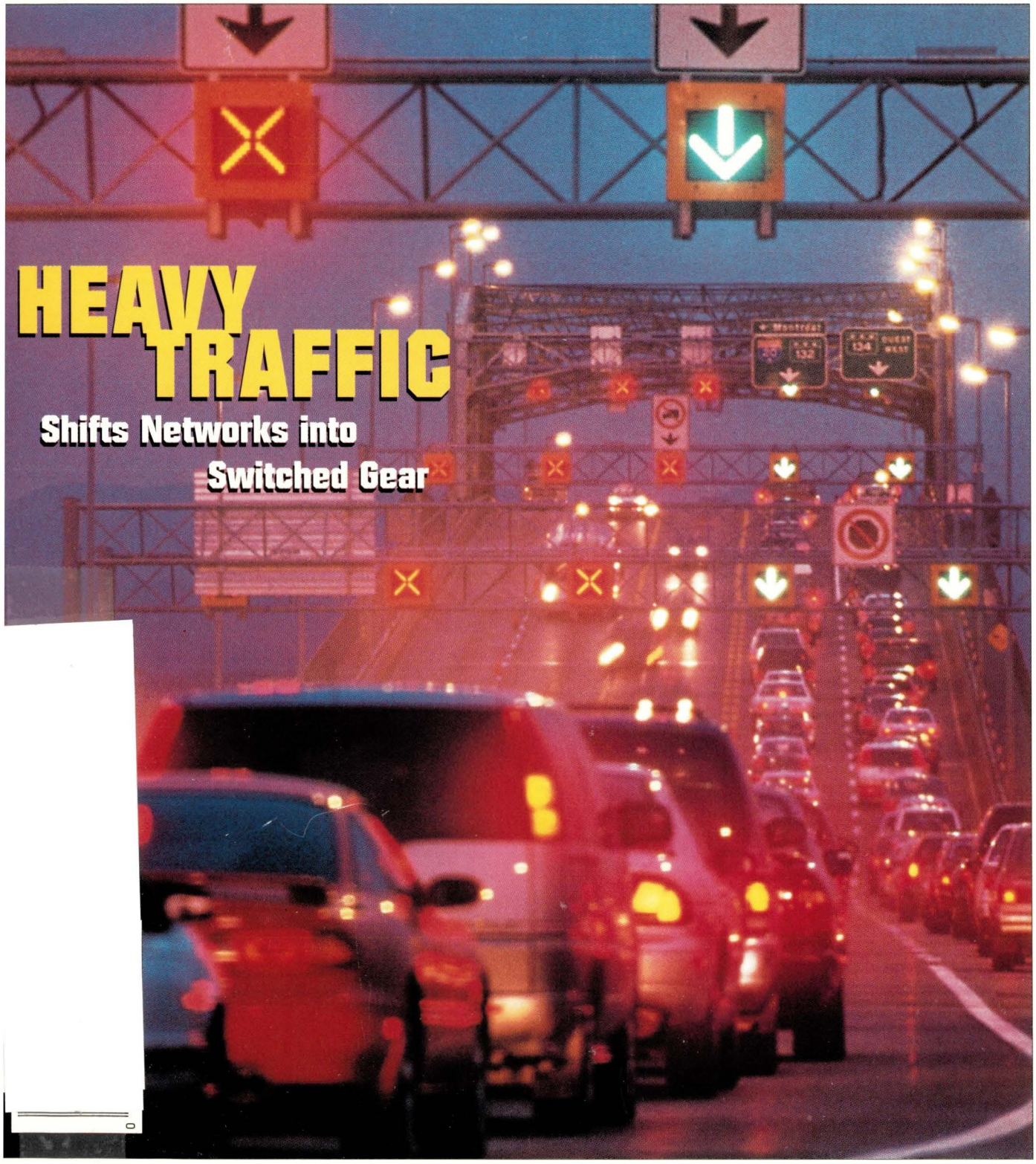
September 1997 Vol. 8 No. 9 $5.50

SUNEXPERT

The Server/Workstation Magazine for UNIX/NT IS Managers



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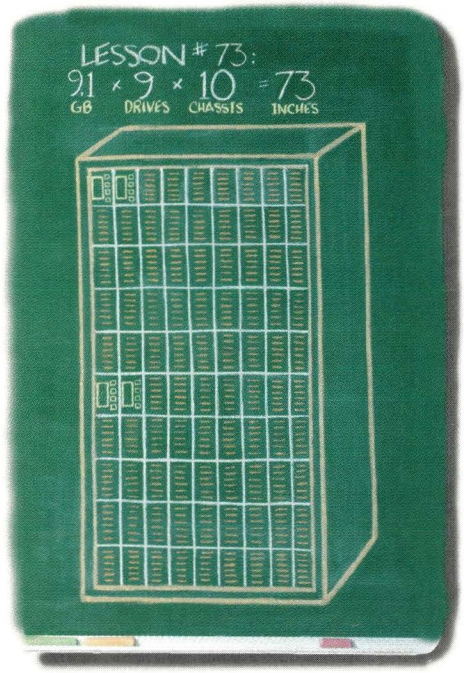
Shifts Networks into Switched Gear

Survey: Remote Access Servers

Artecon's New RAID Math



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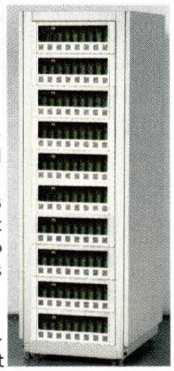

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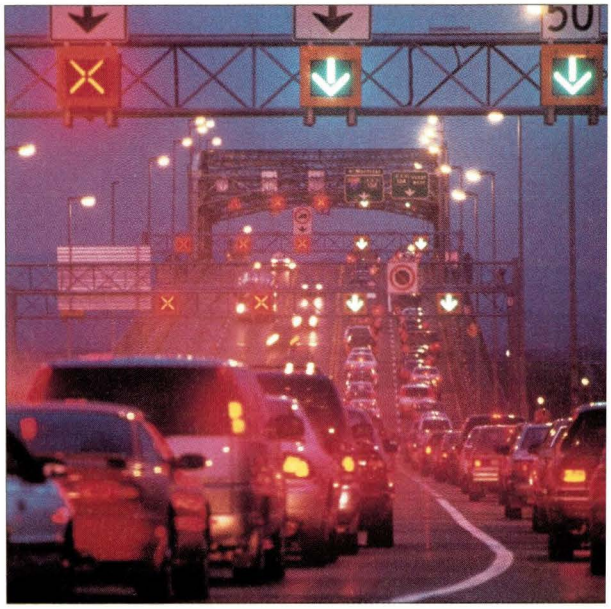

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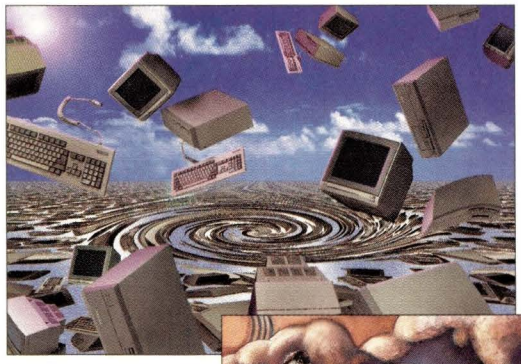

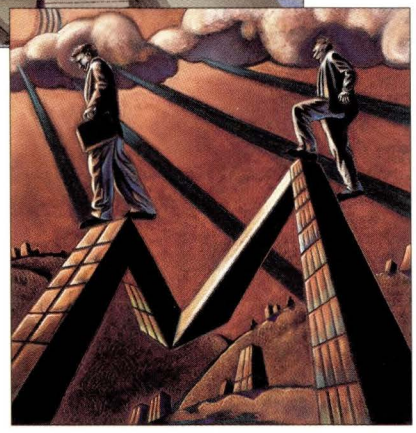

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Survey

61 Remote Access Servers

compiled by Maureen McKeon

The salient features of scores of stand-alone servers from 27 vendors.

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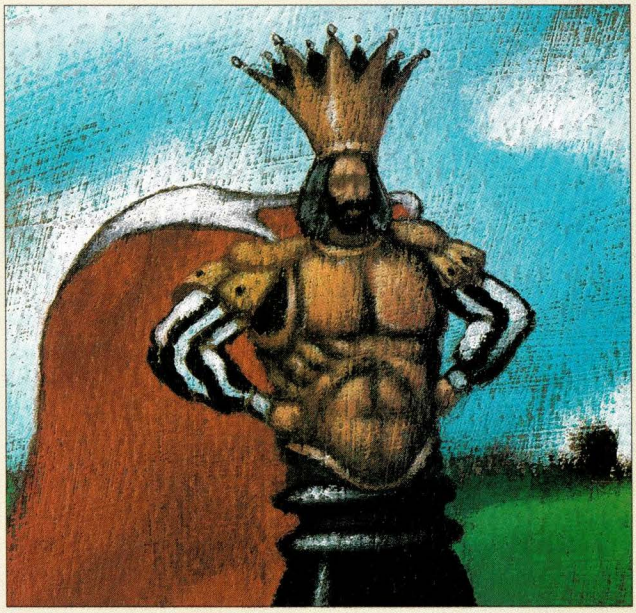
Feature

92 Master Moves

Patrick T. Coleman, Staff Editor

IBM's Scalable POWERparallel system has much more than chess moves to offer those looking for powerful parallel processing in a modular, scalable package.



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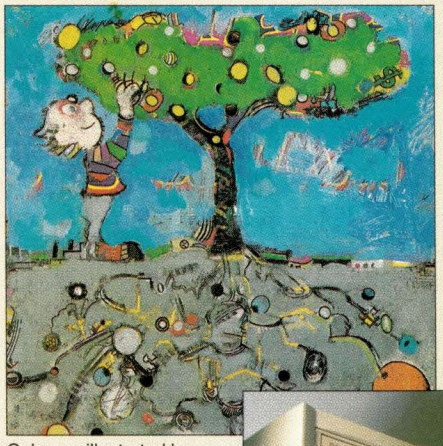
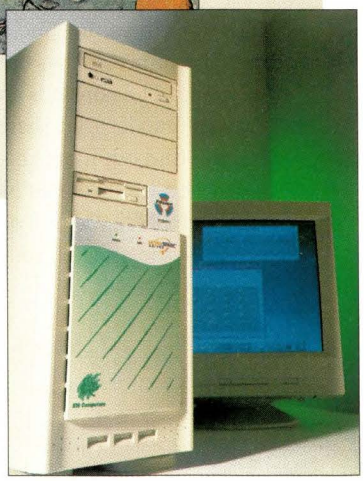


Columns illustrated by DANIEL C. O'CONNOR



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EDITORIAL

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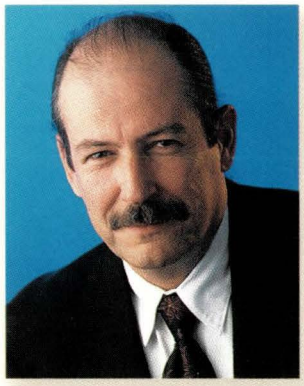

The Switch Is on

It seems that Ethernet users today would rather switch than fight. That's the conclusion in this month's cover story by frequent contributor Paul Korzeniowski. Although the press is full of talk about gigabit networking and ATM switching, it seems the bread-and-butter network is still 10 Mb/s–not even 100 Mb/s. Network managers are choosing to wring as much performance as possible for as long as possible out of current wiring plants by installing switched hubs. "The big change in customer buying patterns occurred with the delivery of Ethernet switches during the past few years," notes Martin DeBeer, a product line manager for switching at Cisco Systems Inc., San Jose, CA. "Prices for a managed switched connection have dropped quickly. Two years ago, they were in the $800 to $1,000 range, but now they sell for about $300, and I expect them to drop under $200 by the end of the year." For more details and numerous first-hand experiences of the decision-making process, check out "Heavy Traffic Shifts Networks into Switched Gear," Page 52.

As the competition heats up between high-end Ultra-based servers and IBM's SP line, Staff Editor Pat Coleman thought it would be a good idea to explore the latest SP developments. His feature "Master Moves," Page 92, appears in the RS Supplement this month. These parallel processing behemoths are being used for much more than chess exhibitions. Pat also gives you a sneak peek at the forthcoming SP system code-named Wildcat.

As many of you know, I've spent a lot of space pooh-poohing NT as a UNIX replacement. But while we're on the subject of switching rather than fighting, I thought you'd be interested in a new offering from SunService, the training, consulting and service division of Sun Microsystems. The group is offering a four-day class entitled "Solaris and Windows NT Network Integration." The course is aimed at sysadmins and includes topics such as file sharing, email, print sharing and name services.

You can find out more about the course from `http://www.sun.com/sunservice/suned`. I think the course would be perfectly complemented by Æleen Frisch's NTegration column, which appears every month in *SunExpert*. This month, she offers us some insight into "The Windows NT World View." It begins on Page 42.

Doug Pryor

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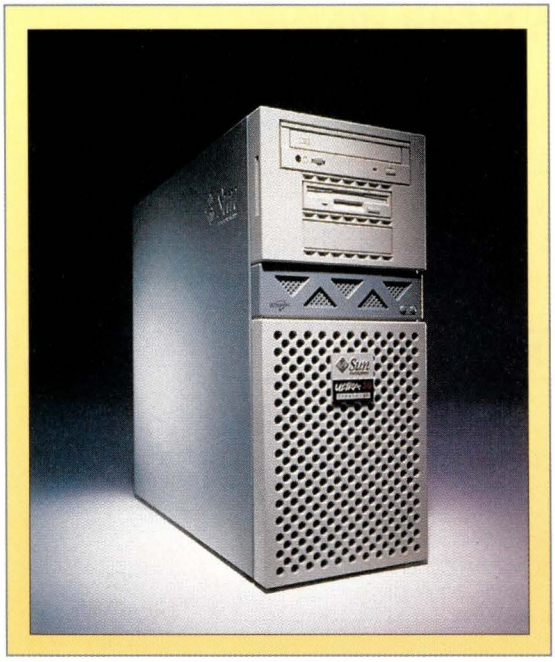
Sun Introduces PCI Power Workstations

After months of speculation, rumors about a Sun Microsystems Inc. Peripheral Component Interface (PCI) product line can finally be confirmed. The first systems in a line of PCI-based workstations have been announced: the Ultra 30 Model 250 with a 250-MHz UltraSPARC-II processor, and Ultra 30 Model 300 with a 300-MHz UltraSPARC-II processor. These uniprocessor workstations are the first to feature Sun's new multiple-channel 33- and 66-MHz PCI I/O buses.



The Ultra 30 Model 250 and Ultra 30 Model 300 (pictured at left) are the first uniprocessor workstations to feature Sun's new multiple-channel 33- and 66-MHz PCI I/O buses.

Sun, known for its SBus architecture, has committed to add a full product portfolio supporting the widely accepted, industry-standard PCI bus. Sun had been accused by some in the industry of taking its time in announcing support for PCI. "DEC has been shipping it [PCI] for three years, and Hewlett-Packard and SGI are there already, so yes, it's a bit late, but this move increases Sun's price/performance value of their products and that can only help them now," says Jim Garden, analyst and director of technical services at Technology Business Research Inc., Hampton, NH.

Sun's Robert E. Novak, group manager for power desktop workstations, says Sun adopted the SBus architecture when it was first introduced in 1989 because the company needed a technology that could keep up with its fast processing speeds. "PCI, which was introduced in 1994, could not keep up with the performance levels that the UltraSPARC required," Novak says. However, now that PCI can support 66-MHz speeds, Sun is willing to support the technology.

Novak says adoption of the popular PCI architecture will make it easier for third-party hardware and software vendors to develop compatible products quickly and cost-effectively which, in turn, will enable Sun to swiftly provide its customers with more products at improved price/performance levels. Nevertheless, Sun says it will continue to support the SBus architecture and will continue to introduce new SBus options.

According to Sun, the Ultra 30 Model 250 with a 1-MB external cache delivers a SPECint95 of 10 and a SPECfp95 of 14.9, and the Ultra 30 Model 300 with a 2-MB external cache delivers a SPECint95 of 12.1 and a SPECfp95 of 18.3. Sun says the floating-point performance results, crucial for graphics-intensive applications, far surpass those for 266-MHz Pentium II-based machines.

These latest Ultra workstations include a new generation of Creator Graphics technology to meet the highly sophisticated graphics needs of today's MCAD, EDA, oil exploration, high-end financial services and software development markets, while providing the standardized graphics capabilities needed by a growing number of less specialized users, Sun says. The new Creator Graphics reportedly offers 100% compatibility with current products in the Ultra Creator line, while running significantly faster, supporting higher resolution monitors and offering enhancements in video playback performance. These improvements will give users an average performance increase of as much as 50%, according to Sun, plus high-resolution support for Sun's new 24-inch wide-screen monitors (up to 1,920 by 1,200).

The 250-MHz and 300-MHz UltraSPARC II processors also support the Solaris operating system, which features high-functionality graphics and imaging APIs, including XIL, Sun's imaging API for delivering powerful Visual Instruction Set (VIS) accelerated imaging and video functionality to applications. In addition, Sun says it is committed to providing high-performance implementations of OpenGL. OpenGL 1.1 is standard on

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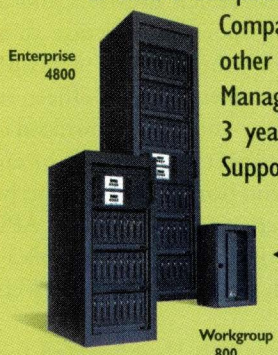

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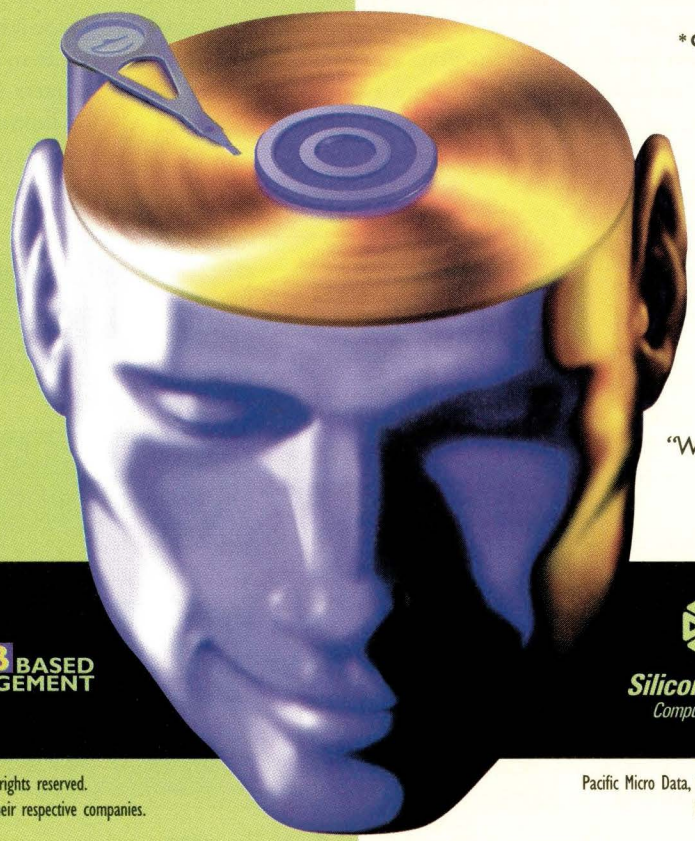

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Solaris beginning with Version 2.5.1 and is based on the OpenGL 1.1 specifications put forth by the OpenGL Architecture Review Board. Sun's Solaris OpenGL 1.1 runtime environment is available for download at `http://www.sun.com/solaris/opengl/`.

The Ultra 30 family offers significant expansion potential with two UPA slots, which allow dual-headed (two-monitor) accelerated Creator Graphics operation to give customers significantly more display area plus the acceleration needed to work with multiple complex models simultaneously. A new 24-inch monitor features an enhanced High Definition Television (HDTV) aspect ratio (16:10), which enables users to view at least two $8^1/_2$-by-11-inch pages at a resolution of 1,920-by-1,200 pixels. The Ultra 30 workstations support up to two 24-inch monitors.

How fast are these things? Using Ultra Port Architecture (UPA), the Ultra 30s transfer data to the processors three times faster than PC workstations and support up to 2 GB of DIMM memory, according to Sun. The UPA architecture is said to enable data transfer to the graphics accelerator at up to 800 MB/s. In addition, the modular design reportedly lets users upgrade to faster processors with a simple module swap. Another industry first, Sun says, is that the Ultra 30s support Gigabit Ethernet via its new PCI Gigabit Ethernet network interface card.

Also shipping with the Ultra 30 workstations is the latest version of Sun's Ultra Pack. Like the original Ultra Pack, Ultra Pack 2 includes software demos and applications that take advantage of Sun's technologies–Ultra Pack enables customers to sample software. Ultra Pack 2, with its Hot Java Web Browser interface, includes six CDs running demos, games and applications offered by Sun and third-party vendors.

As well as recommending them for their graphics capabilities, Sun is touting the Ultra 30s as a platform for Internet and Java developers. Sun points to the Ultra's built-in high-bandwidth networking, high throughput, scalable architecture, Java performance and the availability of development tools. These tools include Sun Workshop, a family of tightly integrated development environments that support Java, C, C++ and FORTRAN.

According to Sun, the entire Ultra line maintains full binary compatibility with application software, meaning customers can continue to use existing applications on the new machines with no configuration changes required. The Ultra 30 Model 250 and the Model 300 have quantity one starting prices of $16,495 and $21,495, respectively.–*mm*

Start-Up Offers Hope of Middleware Alternative

Anyone who has ever used middleware to integrate several different applications knows what a difficult, thankless task that can be. "Using middleware is fine if all you have is a couple of applications," says John Mann, research director of Internet Computing Strategies at The Yankee Group, Boston, MA. "The minute you get to four or five applications, well, forget it."

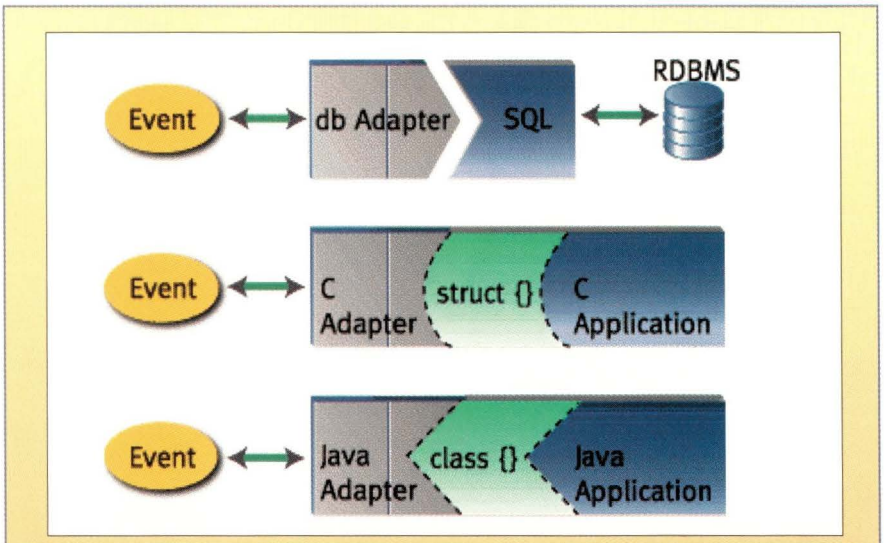
Active Software, a Santa Clara, CA-based start-up founded by two former Sun Microsystems Inc. employees, knows these difficulties all too well. Its answer to the problem is the ActiveWeb Integration System, described by Active Software as an elegant, scalable and flexible way to approach application integration.

Active Software depicts its software's architecture as a hub-and-spoke wheel, where the hub is the "Information Broker," a server application that performs duties such as mediating requests to and from networked clients, queuing, filtering, routing events and guaranteeing delivery of information. The spokes represent the "Adapters," which translate information from its native form into Information Broker events.

Adapters come in all shapes and sizes: Java Adapters, CGI Adapters, Database Adapters, Application Adapters and Mainframe Adapters.

The word "Web" in its name implies that ActiveWeb can be used to "Web-enable" your applications. In its first release, which was in July 1996, ActiveWeb provided limited connectivity between Java-enabled browsers and a database. "To open a connection to a database from your browser," explains Rafael Bracha, chief technical officer at Active Software, "you would download a 100K Java applet that would open up the Information Broker." Shortly thereafter, Active introduced a C API Adapter, adding custom C/C++ applications to the list of resources ActiveWeb supported.

With ActiveWeb II, scheduled for release last month, the software is emerging as more than an intranet tool. New adapters include a generic Java Adapter, for linking to server-side Java applications; an ActiveX Adapter, enabling



ActiveWeb supports Adapters for databases, C and Java, among others.

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Visual Basic clients; an ODBC Adapter; and an HTML Adapter, which takes information from CGI forms.

In addition, Active Software will begin beta testing Adapters for commercial applications such as SAP America Inc.'s R/3 and Clarify Inc.'s customer support system, as well as Adapters for IBM's DB/2 and 3270 on MVS/ESA and AS/400 mainframe environments. Now, ActiveWeb can not only let Web-based applications interoperate with legacy systems, says Jeanine Fourier, senior analyst at The Aberdeen Group, Boston, MA, but it can also enable legacy applications to interoperate with each other.

Analysts cite ActiveWeb's use of publish and subscribe technology, a middleware architecture first popularized by Tibco Inc. (formerly Teknekron Software Systems) on Wall Street in the late '80s. "The more common approach–polling–introduces a lot of network overhead," says Mitch Kramer, senior consultant with the Patricia Seybold Group, Boston, MA. "With publish and subscribe, network traffic goes way down."

Publish and subscribe, however, is by no means unique. What is unique is ActiveWeb's approach to application integration. "What they did," says Mann, "is take the translation facility (the Adapter) outside of the applications." This translates into less programming, because a major portion of the connectivity is already in place.

How much less programming? "With ActiveWeb, you still need smart people, but you need less of them," says P.K. Pande, president of Technology House, an IT consulting firm based in New York, NY. The firm has built several systems based on ActiveWeb, including a real-time trading application for a major Wall Street firm, and several computer telephone integration (CTI) projects for which it wrote its own Adapters. "Active has great technology. Overall, they've allowed us to deploy applications faster, and probably for a lesser up-front dollar amount."

ActiveWeb's Information Broker runs on Sun Solaris and Microsoft Windows NT and, as of Release II, on SGI IRIX. Pricing for a five-developer license starts at $75,000.–*as*

The Air Force Transitions to NT

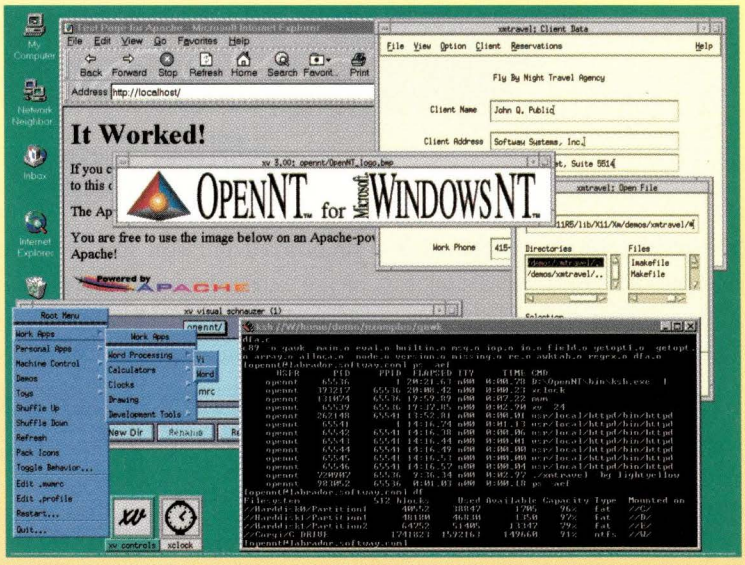
In July, the U.S. Air Force signed a contract with Hughes Data Systems, Irvine, CA, a prime contractor on the Air Force workstations contract, that will introduce a new UNIX variety into our armed forces. The UNIX flavor? OpenNT, a native UNIX system built on Microsoft Corp.'s Windows NT kernel, from Softway Systems Inc., San Francisco, CA. The precedent-setting contract calls for Hughes to sell up to $960 million of NT hardware, peripherals, software, services and support to the U.S. Air Force over the next five years. The contract has also been opened to other segments of the government.

In the past, selling NT to the Department of Defense would have been impossible, explains Gary Ziegler, Air Force workstations program manager at Hughes, because of a requirement that systems meet POSIX compliance levels 1 and 2. POSIX (which stands for Portable Operating System Interface) is an IEEE standard. Clearly, it's always been easy for commercial UNIX systems vendors to meet these requirements, but "these specifications made it impossible for Microsoft to participate," says Jack Hersey, federal marketing manager for Microsoft Federal, Washington, D.C.

To date, Windows NT is still not POSIX-compliant, but Softway's OpenNT 2.0 is. The product, first released in March 1996, offers most of what you would expect from a modern UNIX operating system, including standard shells and utilities, multiuser shell login, sockets-based networking, the X11 Windowing System and OSF/Motif. OpenNT can run concurrently with Windows NT, enabling users to launch an OpenNT application side by side with a Win32 application.

It might not be immediately obvious to UNIX purists why anyone would want to run OpenNT, but, says Ziegler, OpenNT fits into the government's plans. "The Department of Defense has been public about its desire to migrate their applications off UNIX onto NT for two years now," says Ziegler, "mainly for economic reasons." OpenNT provides a bridge between those two worlds, he says, allowing for coexistence between the two operating systems.

The other main market for OpenNT is application development, especially when it comes to porting UNIX applications to NT. An option with the OpenNT 2.0 environment is the OpenNT Software Development Kit (SDK) for



One option offered with Softway Systems' OpenNT 2.0 is the OpenNT Software Development Kit for porting applications from OpenNT to Windows NT.

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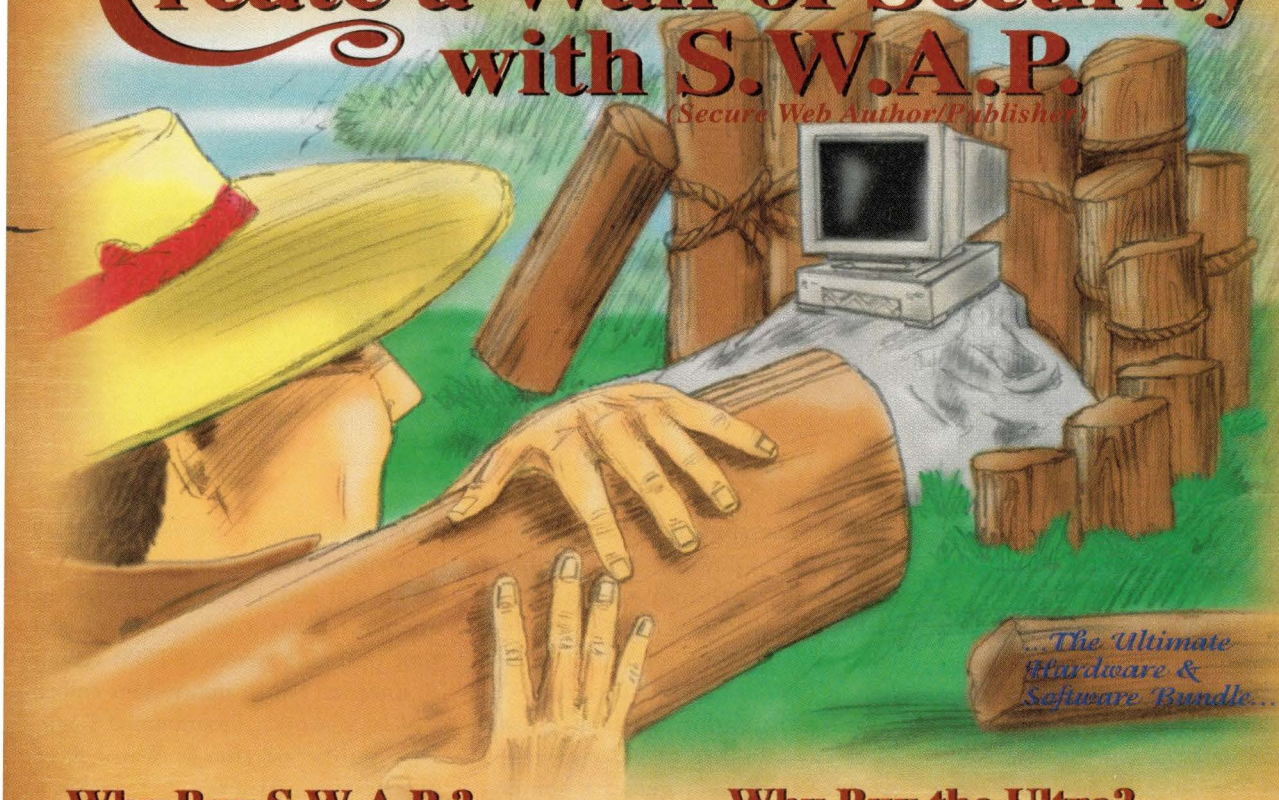

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porting applications from OpenNT to Windows NT. With it, developers can port character, network or graphical applications. The applications built with the OpenNT SDK run as native, 32-bit Windows NT binaries, which do not require emulation or runtime interpretation (but do require OpenNT).

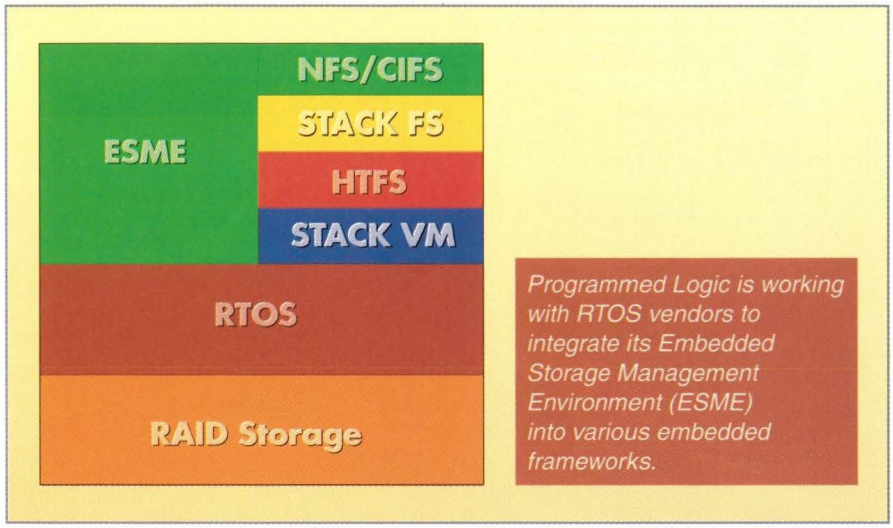
Products like Softway's OpenNT 2.0, and NuTCRACKER (a UNIX-to-Windows porting environment) from DataFocus Inc., Fairfax, VA, spell trouble for the UNIX technical workstation market, says Joe Clabby, director of transitional technologies at The Aberdeen Group, Boston, MA. "Imagine being able to run a POSIX environment on significantly less expensive hardware," says Clabby. "That'll eat the heart out of the mid-range, at least, and ultimately out of the high end."

Mary Hubley, principal analyst with Datapro Information Services Group, Delran, NJ, isn't sure that OpenNT is the product that will see NT overtake the UNIX desktop, but she admits it's a sign of the times. Today, there's no such thing as a "pure UNIX shop." Everyone is at least trying out NT somewhere in their organization. "It makes you wonder: What's the future of UNIX? Does UNIX even have a future?"–*as*

Doors Open to Network-Attached Storage

Over the past couple of years, the network-attached storage market has grown tremendously, spearheaded by the likes of Auspex Systems Inc., Santa Clara, CA, and Network Appliance Inc., Mountain View, CA. Compared with traditional server-attached storage–UNIX file servers such as Sun Microsystems Inc.'s Netra NFS product–network-attached storage devices are single-function, dedicated devices. Because they are specialized, they often boast better performance and a lower price tag than comparable systems.

There's no doubt that these network-attached storage devices, sometimes referred to as storage "appliances," have struck a chord in IT circles. "The appliance metaphor feels intuitively good," says Robert Hamilton, product manager at NetApp, a sentiment reflected in the company's growing revenues: $2 million in 1994 and $93 million in 1997.



Programmed Logic is working with RTOS vendors to integrate its Embedded Storage Management Environment (ESME) into various embedded frameworks.

With the enthusiasm and growth rates surrounding network-attached storage, more companies are jumping on the bandwagon. For example, in February, Mylex Corp., Fremont, CA, announced a new division, Network Power and Light, dedicated to making a network server based on an embedded real-time operating system. EMC Corp., Hopkinton, MA, unveiled its network-attached storage technology, Symmetrix Network File Storage (SNFS) for joint mainframe/open systems file serving, last fall.

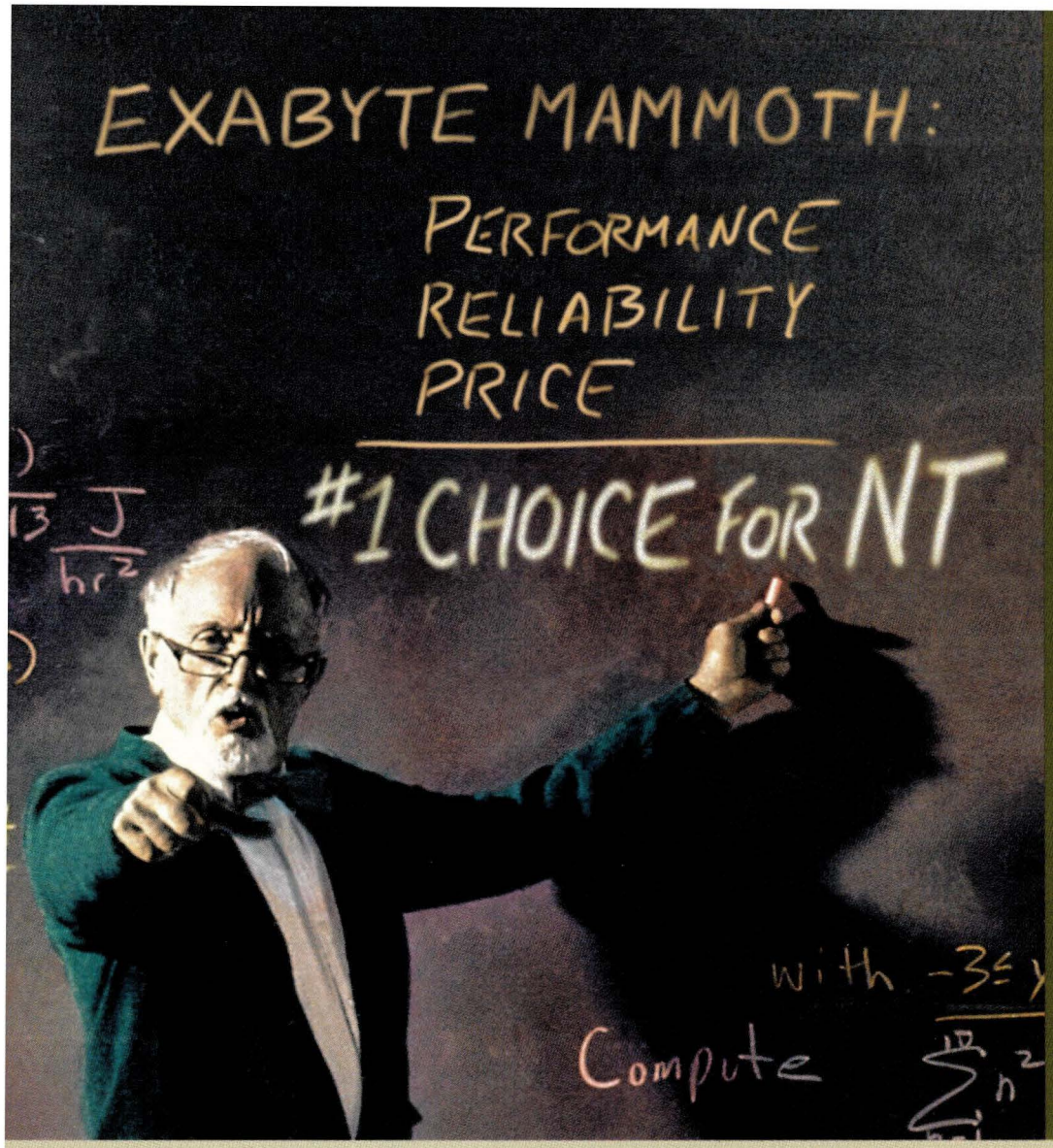
According to Tim Williams, president at Programmed Logic Corp., the Somerset, NJ-based company responsible for High Throughput File System (HTFS), a journaling file system found on The Santa Cruz Operation Inc.'s OpenServer platform, the next wave of participants in the network-attached storage market will be smaller storage and RAID vendors. And Programmed Logic, with a product offering called the Embedded Storage Management Environment (ESME), wants to be propelling this wave.

"The network-attached storage market is ripe for the picking, and there's a good fit between it and storage vendors," Williams says. But the prohibitive costs associated with developing a file system from scratch have prevented most smaller companies from even trying.

To that end, Programmed Logic has announced that it will work with real-time operating system (RTOS) vendors to integrate ESME into various embedded frameworks. Programmed Logic's first public partner is Wind River Systems Inc., Alameda, CA, maker of the VxWorks embedded RTOS and the Tornado development environment. RTOS vendors can in turn offer clients the ESME module with their development environments. ESME includes the above-mentioned HTFS, as well as StackFS, a stackable, modular file system that can be enhanced for backup and data compression.

Caroline Yao, product marketing manager at Wind River, says that a RTOS can bring several benefits to a file server, namely high availability and performance. "People go with real time when they can't afford to wait around for a couple of seconds for the system to respond." She adds that the VxWorks kernel can be made extremely small, as little as 5 KB (although a file server kernel would obviously be much bigger), which is attractive to hardware manufacturers.

"[ESME] simplifies the problem of developing a file system, making it easier for smaller companies to enter the market," says Farid Neema, president at Peripheral Concepts Inc., Santa Barbara, CA, a storage and storage management consulting firm. Neema agrees with Programmed Logic's esti-



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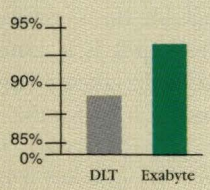
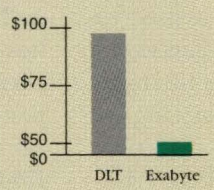
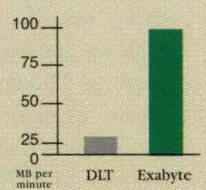


Annual Reliability Rate



Cost per Megabyte



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mation that most storage vendors are looking for ways to add value to their product lineup, and that a storage management offering may well be the solution. "It's still too early to tell whether or not it will take off, but we'll certainly be keeping an eye on them," Neema says.–*as*

IBM Builds New Storage Landscape

The wait is over. IBM Corp. has finally unveiled its much-anticipated Seascape architecture, which employs a building-block approach to developing and upgrading storage systems while consolidating data storage on a common UNIX-based platform.

Short for Storage Enterprise Architecture scape, Seascape combines hardware and software components, RISC processors, and builds a modular storage system that also utilizes a PCI-based symmetrical multiprocessing (SMP) board. "The modularity allows us to move much faster," says Bill Pinkerton, director of worldwide marketing for IBM's open systems storage division. "It gives us the ability to keep pace with all the technology that is going on."

The main philosophy behind Seascape is to offer an open industry-standard storage server that can scale according to an organization's needs. It uses snap-in "building blocks" and software upgrades designed to enable companies to more easily deploy new or improved applications. These building blocks are capable of working either as stand-alone products or together in a full storage system. According to IBM, the modularity allows for the smooth interchange of products, such as the replacement of an old serial drive with a new one.

The building blocks consist of five types: the actual storage components (which include things such as tape and optical drives); intelligent adapters for connecting to the storage server; RISC processors; network platform attachments (these include adapters that connect to Fibre Channel, SCSI, Ethernet and token-ring networks); and software. "All those building blocks are really open components," says Pinkerton. "As different pieces show up on the market, it allows the customers to take that new piece and integrate it into their solution."

One of the new "pieces" that IBM now offers is the Network Storage Manager (NSM) Version 2.0. NSM 2.0 is designed for small to medium-size companies that require a scalable combination of full storage management with backup, disaster recovery and archive functions. Also being offered is ADSTAR Distributed Storage Manager (ADSM) 3.0, IBM 7133 SSA Disk Subsystem, Magstar 3590 tape drive and 3494 tape drive library. In addition, there are plans to release a product described as an open versatile storage server, which is supposed to support mixed multivendor host servers concurrently, some time before the end of the year.

An example of what IBM is calling the snapped-together approach is its Virtual Tape Server. IBM takes ADSM, IBM 7133 SSA Disk Subsystem, Magstar 3590 tape drive and 3494 tape drive library, and builds what it calls a Virtual Tape Server that offers volume stacking (50 volumes per cartridge), up to 32 virtual tape drives, a maximum of 50,000 tape volumes, 8 TB of compressed capacity, storage management, RAID-5 serial disk cache and S/390 ESCON attachment. Each building block can also operate as a stand-alone product. "As we build some of these large configurations, we use exactly the same tape unit and disk unit that you can buy stand-alone," Pinkerton says.

Susan Marino, software engineer specialist for Northrop Grumman, a maker of military electronic systems and machinery, Long Island, NY, is planning to upgrade to ADSM 3.0 from Version 2.0. At Northrop Grumman, ADSM runs two RS/6000s and a mainframe, which is used to back up and archive servers and workstations. The company has a heterogeneous environment consisting of machines running many different flavors of UNIX, including AIX, SunOS, Solaris, IRIX and HP-UX, as well as Windows NT and 95. "We choose ADSM because it supports every flavor that we have in the corporation," says Marino. "It's wonderful. We're very successful. Whenever we have a failure, we can always get back everything very quickly."

Marino says the modularity offered by the Seascape architecture will move a lot of the functionality to the servers and provide for easier maintenance.

IBM is not the only company offering a modular storage architecture. Last June, Clariion, a unit of Data General Corp., Southborough, MA, for example, announced its Multidimensional Storage Architecture, which is also built with modular components. "I think the modular architecture is significant for end users," says Anders Lofgren, industry analyst with Cambridge, MA-based research firm Giga Information Group. "A lot of times when we talk about modularity, we're just talking about adding disk drives. I think one of the things IBM is making a point of saying is that is only one aspect of modularity."

In addition to the modularity, Lofgren says that the intelligence of the products IBM is offering for the architecture, such as the proposed Virtual Storage Server as well as the Network Storage Manager, is an important aspect of the announcement. "These products are all basically fronted by a scaled-down server that includes the RISC processor and an AIX kernel. A little stripped down, but what you are doing is infusing the potential for intelligence," says Lofgren. "Those components are core to the architecture across the board as we know it today."

That's exactly what IBM hoped people would think. With the addition of this intelligence, there is the potential for more functionality compared with what was available through microcode traditionally available on a connected host. "This [Seascape] is a concept where we have actually taken a written processor and pushed it under the covers of the storage subsystem," says IBM's Pinkerton. "We just hid it from everybody."–*ptc*

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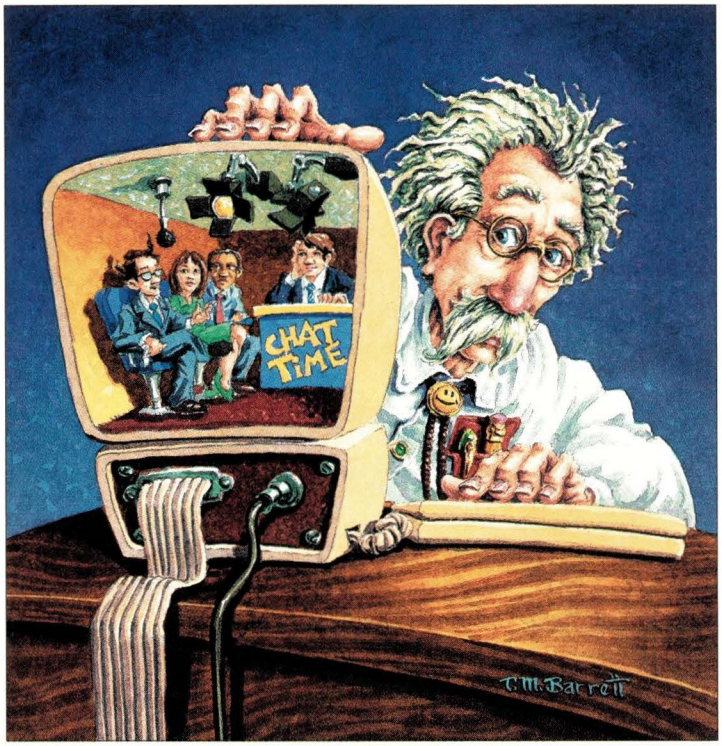

TOM BARRETT

"I spy with my little eye..."
– An Internet cameraman

"Take one and pass it along."
– A first grade teacher, instructing the kiddies on the nature of multicast

"Everyone needs to be running up-to-date versions of mrouted."
– Someone who's been there

Mr. Protocol Puts on a Show

Q: *I hear they're broadcasting some of the computer conferences on the Internet, but I don't see it on the VXtreme schedule, or over at RealAudio, either. Are they fibbing?*

A: Not a bit of it. There are other ways to skin a cat than by taking a scalpel and making an initial incision just below the... Oh, excuse me. I just got out of a symposium on mummification and it's left me a bit distracted. You absolutely do not want the job of being Mr. Protocol's research assistant. What he studies himself is so completely weird that the stuff he leaves for me to research is downright scary. Do the words "Apis bull" mean anything to you? No? You're happier that way.

Um. Where were we? Oh, right, conferences on the Internet. Those are about the closest thing to television that Mr. Protocol ever watches. He can't bear to wait for the proceedings, and a bad case of irreality makes travel difficult. He's become quite a critic. Claims they need better writers, and says the actors are as wooden as a cigar store Indian. This seems to me to be a fairly bold statement, considering that to my certain knowledge he's never even seen a cigar store, let alone an emblem that's so politically incorrect that most antique dealers lack the courage to get rich from selling fake ones. He keeps looking at the Nielsen ratings in the newspapers and wonders why the IETF conferences never appear.

It would be difficult to discover how many viewers such a conference has, though. Unlike RealAudio or VXtreme, viewers do not make a connection to the site from which the conference is being broadcast. The technology used by the IETF is completely different. Mr. P. has talked about it before. It's called *multicast*.

The Internet is being used to carry an increasing load of multimedia events. The commercial operations, which are all pioneering competing technologies, are attempting to cram video and/or audio over a 28.8-Kb/s line. Sometimes the magic works, and sometimes it doesn't. One excellent test of the commercial technology has been the recent Mars Pathfinder coverage. About 10 mirror sites have been set up to cover the Pathfinder mission. Each one of these sites is set up primarily as a Web server and is prepared to serve 10 million to 15 million Web hits per day. Mr. P., of course, dived in with both mouse buttons clicking. (Well, all three actually, because he's a longtime Smalltalk speaker, but the middle button just doesn't do a whole lot these days. It's sad.) The static pictures were served up very rapidly indeed. The video feed worked less well. Mr. Protocol wasn't able to get a connection to a site that was feeding video, except for the VXtreme feed of NASA Select that was offered from the CNN site. The Jet Propulsion Laboratory mirror sites were, apparently, overwhelmed by the requests for video.

This points to two of the main problems with the current commercial approach. The first problem is that specific mirrors have to be set up, each one capable of handling enormous amounts of

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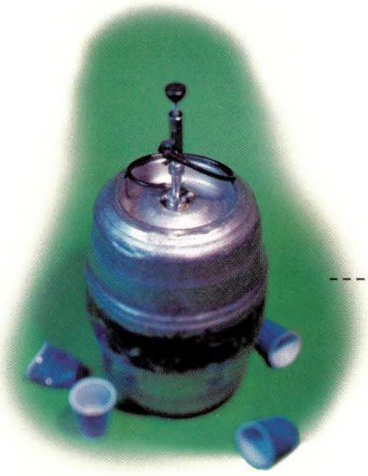

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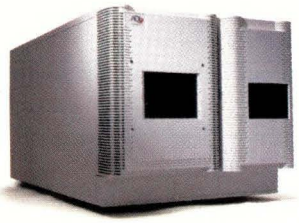

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traffic. Further, these mirrors must be advertised and made known to the end user explicitly, who must in turn choose a specific mirror site and try to get the feed from there. Load sharing is more or less random.

The second problem is that the current commercial services look terrible. Audio works well so long as it gets to take over the entire modem connection, and so long as there are no significant network delays, but video looks muddy and awful, when it gets through at all. All of the services are gearing their offerings to the current speed of modem technology.

Multicast technology, on the other hand, offers a fundamentally different alternative. In the first place, it is based on an end-user speed model that is ahead of the curve of current offerings. In most cases, a full audio and video multicast session occupies between 150 and 250 Kb/s of bandwidth. Not even ISDN can carry this, so most multicast viewers are sitting at the end of a corporate connection running at T1 speeds or better. However, newer technology such as cable modems can carry even higher rates. The trick is being able to make decent use of such bandwidth. Services requiring high bandwidths don't tend to spread very widely when high bandwidth is a scarce and expensive technology. It benefits everyone, however, to develop services for bandwidths like this so that when they do become generally available, there will already be applications in place that can make use of the added bandwidth to provide fundamentally new services.

Multicast avoids the overload problems experienced by current services that use a centralized service by avoiding having anyone talk to the central site. In fact, they avoid having a central site, period.

Multicast works by the "take one and pass it along" principle. An entire section of the IP address space has been reserved solely for the use of multicast operations. This development, while years old, is nevertheless new enough that many routers currently in service know nothing about it. A type of protocol jujitsu has to be carried out to allow the "pass it along" part to work.

Each IP address in the multicast range represents not a single machine, but a group of machines. Furthermore, the membership of this group is a constantly changing quantity. A multicast address and the machines that are paying attention to packets sent to that address constitute a session. A given machine, after having determined that it is interested in the information being sent to a particular multicast address, joins the session at that address by notifying its nearest router. Unfortunately, if that router is not multicast-aware, the show stops there. Otherwise, the router passes the request upstream, until it hits a router that does know about the session. This router then begins to forward all future multicast packets addressed to that particular multicast IP address out the interface from which the "join" request was received. That's all it knows. It neither needs nor cares to know where the packets go from there. Each router along the way will look at its record of where the request came in, and forward multicast packets sent to the same magical multicast IP address out that interface as required.

This "bucket brigade" of packets assumes an Internet backbone that has routers smart enough to handle multicast. One wishes this were the case. Unfortunately, it isn't, so the current Internet multicast topology is...well, "complex" is a good word. So is "spaghetti." The real-life Internet consists of a large number of "multicast-aware islands" connected by "tunnels" through the parts of the Internet that don't use and don't understand multicast. These tunnels are set up manually on a semipermanent basis, in a configuration known as the MBONE: the multicast backbone. Be it noted that this is regarded by all and sundry in the multicast community as a temporary measure, until the backbone is made fully multicast-aware. Be it also noted that this is almost certainly going to happen, because multicast is taken very seriously indeed by the Internet implementors.

Why should this be? Mr. Protocol is glad you asked.

The reason may be summed up in one word: scaling. The Mars Pathfinder effort could be taken in either of two ways. In one way, it's a masterpiece of advance planning and legwork, and brilliantly shows off the capabilities of the Internet. It gives millions of people immediate access to information, on request. It proves that major parties can work together for the common good. But it also shows the limitations of any form of information dissemination that requires users to communicate directly with a central server to get access to information. There has to be a way to shovel lots of information across the Internet in such a way that the one or few central servers with the information don't melt down trying to satisfy end-user requests. Multicast is that method. Because your local network "tunes in" a multicast session on request, your request goes no higher in the hierarchy of routers than it needs to, to find a router that is already carrying the session.

So fundamental is this notion that the next version of IP, IPv6, is being designed primarily from the point of view of multicast. "Unicast," which is what you call the ordinary sort of single-user TCP connection we're used to when you're primarily discussing multicast, is regarded as a simple subclass of multicast. The implementors expect large amounts of multimedia "flows" to be carried on the next version of the Internet.

Current multicast sessions are routed through the multicast-aware "islands" using a routing protocol called Distance-Vector Multicast Routing Protocol, or DVMRP. This routing protocol is somewhat heavyweight in that it transmits the entire routing table to its neighbors, covering the entire topology of the MBONE. A new protocol, called Protocol-Independent Multicast, uses both a "sparse" mode and a "dense" mode. The dense mode is used in areas of the Internet that are multicast-aware, in which case it works pretty much like DVMRP. The sparse mode is used in areas that know nothing about multicast, and passes sufficient information to allow multicast tunnels to be established.

Planning for the Future

The chicken-and-egg problem is, how do you find out what sessions are out there to join and what their multicast addresses are? The answer is that there is a well-known session, amounting to a well-known IP multicast address, that carries information in a peculiar format. This is the "session director session," which carries information about all the other sessions. A special program, called `sdr`, is used to view the contents of this session. `sdr` is a calendar scheduling facility, listing not only the cur-

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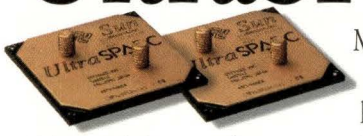

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rent sessions, but sessions that are planned for weeks or even months in advance.

Advance planning is a key element of a successful multicast event. The backbone capacity of the Internet is a finite resource, particularly today, and not very many simultaneous high-bandwidth multicast sessions can be carried. At any given time, `sdr` will show a fair number of sessions, but these are not generally video sessions, or if they are, they are carrying a very low frame rate. Most of them are either audio or whiteboard sessions, occupying a fairly small amount of bandwidth compared with a full video feed.

So, how do you do it? What's the real nitty-gritty involved in placing a video and audio feed onto the multicast backbone? To answer that, let's take a look at how a technical conference might be held.

The first thing to do is to get hold of the tools. It turns out that broadcasts are originated and received with the same set of tools: There is only one set of multicast software tools. These exist for Sun Solaris systems, FreeBSD and other BSD-derived systems, and some new commercial offerings support Windows 95 and NT. Information on where to find these tools, including the session director `sdr`, the video and audio tools and the whiteboard tool, can be found at `http://www.mbone.com` or at `http://www.netlab.indiana.edu/iunet/mbone.html`

Broadcasts are originated and received with the same set of tools: There is only one set of multicast software tools. These exist for Sun Solaris systems, FreeBSD and other BSD-derived systems, and some new commercial offerings support Windows 95 and NT.

The next thing to do is to nail down the bandwidth. Using the session director, announce the session and the expected bandwidth. For a major event, it would not be out of line to reserve this at least four months in advance. Also, send email to `rem-conf@mash.berkeley.edu`, announcing your plans and requesting people to notify you of conflicts. This mailing list used to be the mandatory place for working out reservations, but ever since the current version of `sdr` was released with its calendar-management capabilities, this has become less necessary. It's still a good gesture, though. Gentlemen's agreements are important in this area, because the current backbone has no bandwidth-limiting abilities. Too many simultaneous high-bandwidth multicast sessions will just melt the backbone. Another good idea is to check the Web site at `http://www.precept.com`.

Now the fun starts. You have a conference venue, but you must now arrange for a high-speed network connection, probably a T1 line, to be run to the conference site. Nothing takes the place of a really heads-up Internet service provider serving the conference area. These boys are going to be your back end, and they will have to get that T1 working. Establishing a good rapport with the ISP is critical to your success.

Don't forget to line up your workstations, the ones you'll use to originate the multicast packets. You'll need one station per simultaneous video feed at a minimum. Solaris 2.5 and 2.5.1, as well as SunOS, need additional multicast patches installed in the kernel, but for what it's worth, all versions of Windows above 3.1 are multicast-aware out of the box.

Physical problems at the conference site come next. Not only must the T1 be installed and tested by the ISP, you will probably be called upon to share the wealth, as it were, with a show floor. Actually, getting the T1 into the conference site can be a real problem. Some hotels just don't have the wiring or the will. In that case, desperate measures may be called for. One hotel with no wiring to speak of dating after the Renaissance nevertheless managed to mount quite an adequate show net by using a 900-MHz point-to-point radio link. The link sat near a window facing several other nearby buildings, one of which actually possessed a T1 or better link, as well as a similar radio. Exotica such as this can be rented.

On with the Show

Be sure to get everyone's roles straight. Are you just there to run a multicast session, or are you going to wind up laying and running the show net too? You will need a technical crew big enough to do all the jobs. The multicast session will take a minimum of two. And that doesn't count the theater company.

The what?

The theater company. You are not, primarily, cramming bits down a wire, you are producing a television program that runs over seven days. The fact that you're then cramming the video and audio down a T1 wire is immaterial. If it looks like poo-poo in the first place, it's only going to look worse later when it comes out on the computer screen. The best thing you could possibly do for yourself is to hire a professional staging company to come in with a full audio setup, including an audio mixer, and a full video setup, including professional cameras, dollys, and a video switcher and effects station. You have a show to produce, and these people know how to make it look good. Let them do their job.

You have two jobs already. Not only do you have to run the multicast broadcast, you have to direct the show. That's why you need a partner. One of you directs, while the other one handles the multicast feed. As the director, you interact with the sound person, the camera person (or camera people), the lighting person and so forth. By the time you get this job figured out, you may actually know what words such as "key grip" and "best boy" mean in movie credits.

On the technical side of things, you've got a balanced, equalized audio feed coming out of the mixer board. That typically plugs straight into the microphone jack of a Sun SPARCstation, where it's digitized. The packets are picked up by the audio tool, turned into a multicast stream and sent on down the T1 line to be dispersed by a cloud of routers. Likewise, the output of the video switcher is typically plugged into a Sun RCVT video capture board, for multicasting by the video tool. One possibility is to carry a single video feed at about 10 frames per second. A second possibility is to cut the video covering the speaker down to about five frames per second, figuring that most talking heads make profoundly uninteresting video (so long as the heads are

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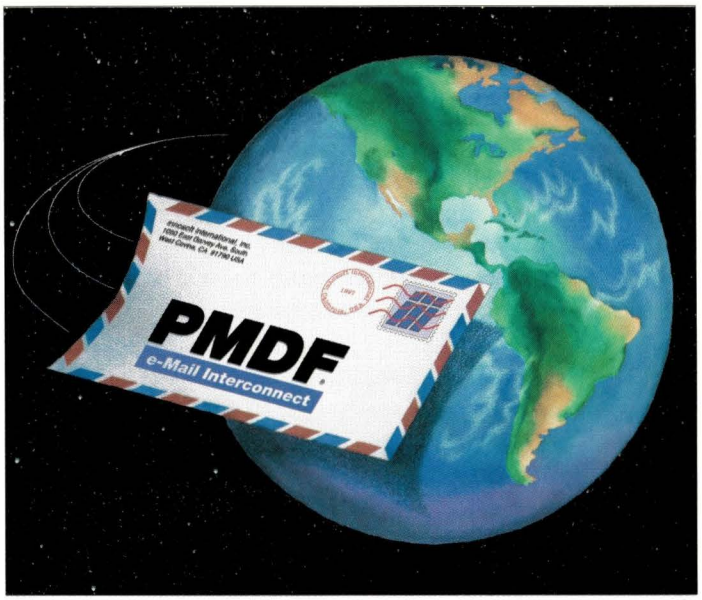

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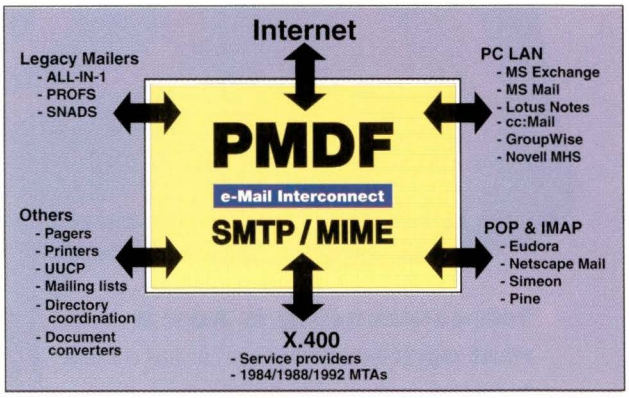

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firmly attached to a further expanse of anatomy, which is typically the case at the duller conferences). Use the extra bandwidth to carry the speaker's viewgraphs. One way to do this is to use a light table, which is like an open-air overhead projector with a video camera instead of a projection system. The audience sees the viewgraphs on one or several giant back-projection screens, driven from the video feed (you rented that video switcher for a reason).

Using the video channel to carry something static such as viewgraphs is probably a waste of net bandwidth, though. What's needed is to convert the overhead to a form where it can be placed on another MBONE tool, the whiteboard. This looks like a shared chalkboard, used alternately for sketching and typing. The whiteboard's bandwidth overhead is much lower than video.

At this point you're ready to roll. You might want to play music over the audio channel for about a half hour before the conference opens each day, to let people know that the conference is up and running, and so they can check for glitches in their reception of the multicast feed.

Because multicast users don't connect to you as a server, you have no way of knowing who, if anyone, is hearing you. This is when having a friend at the local ISP is invaluable. If you can have someone there subscribe to your broadcast and look in occasionally, you'll see whether or not you're actually making it out of the conference site.

You may hear from people during the course of the broadcast. Some will have used a tool such as `mtrace` and discovered just which router has gone spiritual and is preventing them from getting the broadcast. Others may call you saying that they have a one-hour class scheduled for the MBONE and can you please cut back on your frame rate for an hour or so? Bring up your own copy of the whiteboard tool, and people will use it in the course of the broadcast to give you signal quality reports from the different corners of the Internet.

That's why you have a guy running the technical stuff *and* a guy directing the show. You'll need 'em both. If you can mount an effort of this size, though, you'll be in good hands with the pros. Relax and let them make you look good.

Special thanks to Michael Gorlick and B. Scott Michel, who have been through it all, for invaluable information on "multicasting as she is did." ⊸

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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Network File Systems

I keep smashing the stupid connector that 3Com Corp. supplies to attach its very thin PCMCIA Ethernet card that slides into my laptop to the very thick BNC plug that connects the card into my Ethernet. The box in which the card came trumpets that 3Com has a new design for the connector; I presume people have complained about the facility to easily perform connector crunching. Well, 3Com in Ireland, the connector is still trivially smashable, and it really shouldn't be.

When I crunch the connector, I realize how dependent I have become on my LAN. Without the Ethernet connection, my laptop is useless. I cannot get any significant data into or out of it without the huge pain of using floppies. My son is pleased; it means that he can get on with the massively more important task of designing his new add-on level for the Dark Forces computer game to which he is addicted.

The main use of my LAN is file sharing. I use the network to carry the information that allows various systems to manage files stored on the disks of other computers. Of course, we think of the systems delivering the files as "servers" and those that access the files over the network as "clients." However, the distinction between the machines that are servers and those that are clients is blurred somewhat on my site, and I suspect the same is true at many sites.

I must confess I still have great feelings of delight when I access files on a remote system as if the files were sitting on a disk connected to the local machine. I like the whole notion. I enjoy the ease of use that mechanism permits. As time has gone on, I find that people to whom I explain the geography of my system are less surprised by the idea. Network file systems have become a fact of daily life for many people.

I'm using two different types of network protocols to provide remote file access on my network. My UNIX machines use NFS, the Network File System from Sun. My Windows NT and 95 systems want to talk LAN Manager protocols, and I use the excellent freeware Samba system from Andrew Tridgell and his team to support file access on the UNIX machines from my PC-based systems.

The NFS Protocol

If you use a UNIX workstation on a LAN with other UNIX workstations, it's a fair bet you will be using NFS to connect file systems together. The Solaris 2.5 system that I am running supports two versions of the NFS protocol. NFS Version 2 was implemented in 1984 and was first released with SunOS 2.0. It formed the basis of RFC 1094, dated March 1989. Version 3 was created in 1992, when a group of people from several companies got together to firm up the draft. After some pondering and discussion, the results were published for the world in June 1994 at the USENIX Conference in Boston. If you are wondering about Version 1 of NFS, well, that was internal to Sun and didn't escape.

Version 3, then, is the upstart newcomer, and is used between consenting machines. The choice of version is trans-

```
corp:/acctg >ls general.ledger
UX:ls: ERROR: Cannot access general.ledger:
No such file or directory

corp:/acctg >ls payroll.1qtr
UX:ls: ERROR: Cannot access payroll.1qtr:
No such file or directory

corp:/mfg >ls inventory.cont
UX:ls: ERROR: Cannot access inventory.cont:
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corp:/mfg >ls order.entry
UX:ls: ERROR: Cannot access order.entry:
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parent to the user of the system; if a machine cannot connect using Version 3, it will default back to Version 2.

The basic idea of NFS is simple. When you add a disk to the system on UNIX, you join it to the existing file system tree by the *mount* system call. The new disk forms a new branch of the tree structure. You can move into it using the `cd` command and access its files. With NFS, you do the same thing. You, as the client, issue a *mount* command that is sent to a remote server, and part of the file system tree on the server is joined to your local file store. The server will have a list of machines that are permitted to access its file store and will validate your request before passing back a "file handle."

On SunOS, the list is stored in a file called `/etc/exports`. On Solaris, the list is controlled by a call to the `share` command, and you'll find a set of these commands in `/etc/dfs/dfstab`. The file handle returned by the mount call is used in all further requests from the client to the server. Now, when a process on the client accesses a remote file with a read system call, for example, that system call is turned into a network request using the NFS protocol. The server checks the validity of the request, performs the desired operation and returns the result.

Once you have mounted the remote file system at some point in your file tree, whenever you attempt to open a file that is below the mount point, the system call that you emit will be translated into an NFS request and sent over the network to the server. The server will execute the request and will return a result to your kernel. In turn, your kernel will pass a system call result into your process as if the request was serviced by a local disk.

The NFS protocol assumes that the server does not retain any state about the client. For example, a normal UNIX read system call remembers how far a particular process has got in reading or writing a file. A sequence of read calls can be used to scan a file from beginning to end; there is no need to reposition file pointers before every read. NFS will store the "where we are now" state in the client, and when scanning a file, it's the job of the client to send appropriate read primitives, each containing position and size information.

So the server is not clever. It knows nothing about what the client is doing. Clients do tend to be clever, for efficiency reasons. They remember file positioning information so that they may present UNIX file semantics to the user process. They will also cache information so that it doesn't have to travel the network again.

It was an early aim of the NFS design that the remote file system should not be tied to UNIX, and that it would not be constrained to offer full UNIX file system semantics. So, for example, you cannot access a special device file on a remote system and expect that it will access the I/O device to which the special device interfaces. The NFS model was an "ideal" file system, with some UNIX overtones that I'll come to later. The aim of generating a system that would support different types of file system access paid off, I think. Sun must have sold a considerable number of PC-NFS licenses allowing PC systems to access shared file stores on UNIX servers.

An icon for the design was the notion of "statelessness" in the server. As we've seen, UNIX expects the kernel to retain state about the file that is open, the "where we are now" state. It was a great heresy to suggest that the server should maintain the state. At the time of the NFS design and early implementation, its competitor was the Remote File System (RFS) from AT&T, which aimed to provide a complete remote UNIX semantics, and did this by maintaining server state. Many loud debates, approaching the level of religious argument, ensued in public forums about the validity of the two approaches. For UNIX, RFS was probably the better approach, however, NFS won the contest by being an open standard and also because the world is not full of UNIX systems.

The NFS server is stateless. It's simply sent a transaction request and performs the operation. Each request is an independent event and, theoretically, file updates can occur in any order. Statelessness was really an original design criterion in NFS to avoid the need for crash recovery. When a server crashes, a client can just wait for it to come back and continue with operations as if nothing had happened. There is no state to be recovered and reloaded into the server. Cynics would say that it was a criterion because the early Sun systems were not exactly resilient: Because they tended to crash often, it was better to design something that avoided the recovery problem.

Stateless operation has a downside. File locking implies that state is retained on a file. This state needs to be kept close to the file–on the server–because several clients may be accessing the same file and need to see the locks. Getting file-locking operational on NFS took some time to implement. There is a separate lock manager to handle it.

UNIX Overtones

The NFS client/server has UNIX overtones because it adopted the UNIX file system tree model, an inevitable conclusion of its development. As a result, it doesn't easily supply file system features that UNIX doesn't support. For example, it doesn't provide support for file versioning, which might be needed to provide full remote support for a VMS file system. In general, people get by with this restriction. So far, no one has generated a widely used operating system whose file system differs wildly from the UNIX hierarchical structure.

POSIX and ANSI C have helped to sanctify the various values that a programmer might be expected to know about a file. These two standards rely heavily on UNIX, and so NFS has been able to interwork with several operating system clients that comply with the standards.

The details that are stored for each file in NFS map onto the traditional UNIX set of values. Each file has a set of file permissions that happen to be the same as the UNIX file permissions. NFS Version 2 doesn't support access control lists provided by other operating systems. The file permissions are applied to a user ID, group ID pair (UID, GID) that are also stored with the file. This pair of numbers needs to be the same for each user on your network. There's no translation mechanism to map local users on one machine to local users on another.

The need for (UID, GID) harmonization is one of the NFS features that I like the least. It is possible to provide a mapping scheme for the (UID, GID) pair, and non-UNIX servers sometimes do so. I well remember the nastiness of the renumbering operation that I had to perform on several machines to generate a single (UID, GID) space when the prospect of NFS loomed into view. The need to maintain a single local database of (UID, GID) pairs has given rise to systems that distribute databases around a site, known these days as NIS or NIS+.

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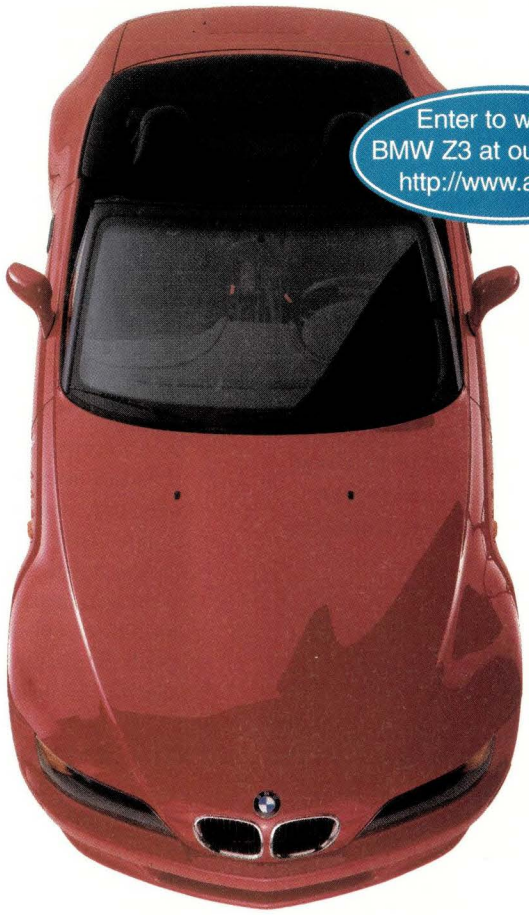

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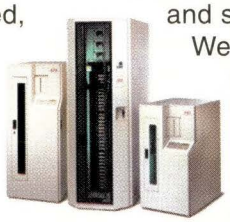

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These systems are really Band-Aids that don't solve the underlying problem. For one thing, the systems don't easily scale out from your local network to the wider real world. NFS really needs to provide for users to be local to a machine, but have shared access to files on other machines, and that access should be independent from the actual (UID, GID) values used on any particular machine.

You'll perhaps realize that something has to be done about superuser permissions, and this is one area where UID mapping does take place. Someone is superuser because the UID in the process that they are running is zero, which is what happens when they log in as root. When their process accesses a remote machine, it will tell the server that it is running with UID zero, which should allow them to have superuser privilege. However, the zero UID value is usually changed to the UID of the nobody user on the remote machine, meaning that they probably have less right to the files than a normal user.

Controls exist to map the UID to any value that seems sensible, and so it can be mapped back to the zero value. The conversion is controlled locally on the server, so the administration on a particular machine can decide which superusers on which external machines are permitted to have root access to their files.

NFS Version 3

So what does Version 3 give us? The Sun Answerbook doesn't help a lot. What follows is derived from the Boston USENIX paper (see below for details on the paper).

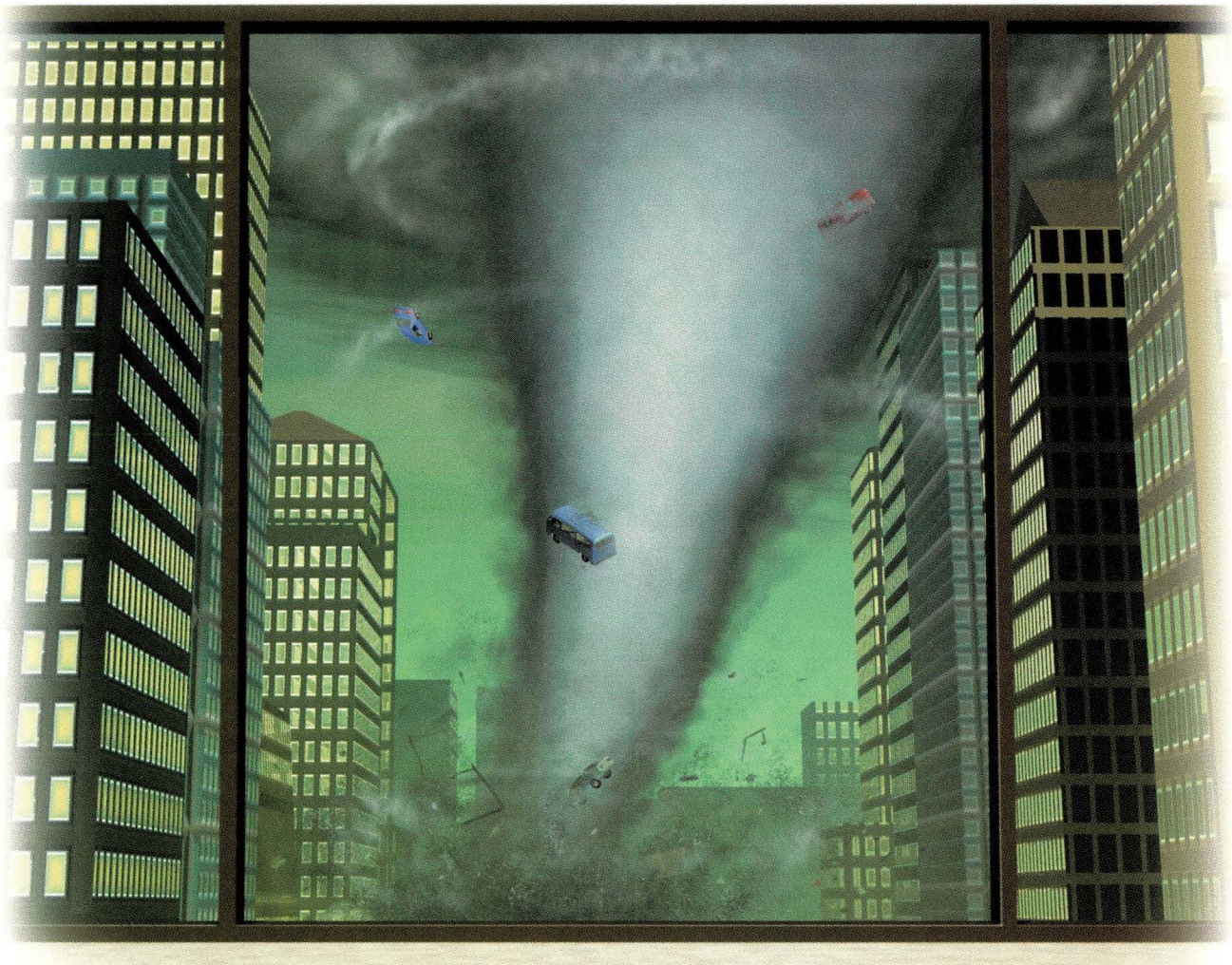
One of the big problems in Version 2 is the need for an NFS server to perform synchronous writes. When a client issues a write request, it sends an RPC call saying "write this data at such and such a position in the file." The server cannot reply to this RPC request saying "done" until the data is safely stored on magnetic media. If it says "OK" when it has it in memory but crashes before it manages to write it to disk, then the file will be in an inconsistent state because the client thinks that it has written some data that is not actually present on the disk. The server must do a "synchronous" write and not return any result until the data is safely stored on disk. The client has to wait until the write operation has completed, so runs in step with the speed of the network and the remote disk.

This has proved a huge bottleneck for NFS implementations. Some systems have provided an "unsafe" write mode where the data is retained in the memory of the server and the users hope that crashes are infrequent. To date, the most common solution for NFS servers to provide asynchronous writes has been the Prestoserve system, originally from Legato Systems Inc. Prestoserve is a kernel driver that uses an NVRAM disk cache sitting between the kernel and the disk. When the kernel initiates a write, the data is loaded into the cache and the kernel is told that the disk write has succeeded. The kernel tells the NFS server, and the server tells the client.

In time, the data finds its way onto the disk. If the system crashes, Prestoserve will write any unwritten data onto the disk before allowing the system to bootstrap, so the file system is consistent. The Prestoserve system also helps with normal local file system operations that require synchronous writes, for example, creating files.

Version 3 improves the write performance by allowing a client to choose to use asynchronous write transactions and later send a command that says "commit and write the data that you have to the disk." The operation is coupled with a "write verifier" value, an 8-bit number that is changed every time a server crashes. The idea is that the client can now determine whether a server has died and lost data that has been sent aimed at being written asynchronously.

Version 3 now allows NFS to operate using a TCP/IP connection to a remote machine rather than the previous UDP-based datagram system. The use of UDP goes back to the early obsession with transaction speed. The thinking was that TCP/IP imposed too much protocol overhead, and this would slow down NFS operation. The NFS designers then found that there was a need to supply many of the features of TCP/IP, such as reliability, error recovery, congestion control, timeouts and so on. The UDP code became a reimplementation of certain TCP/IP aspects, so why not just use TCP/IP in the first place? To be fair, the vast increase in processor speed since the original NFS design had made the TCP protocol overhead much less of a cycle stealer.



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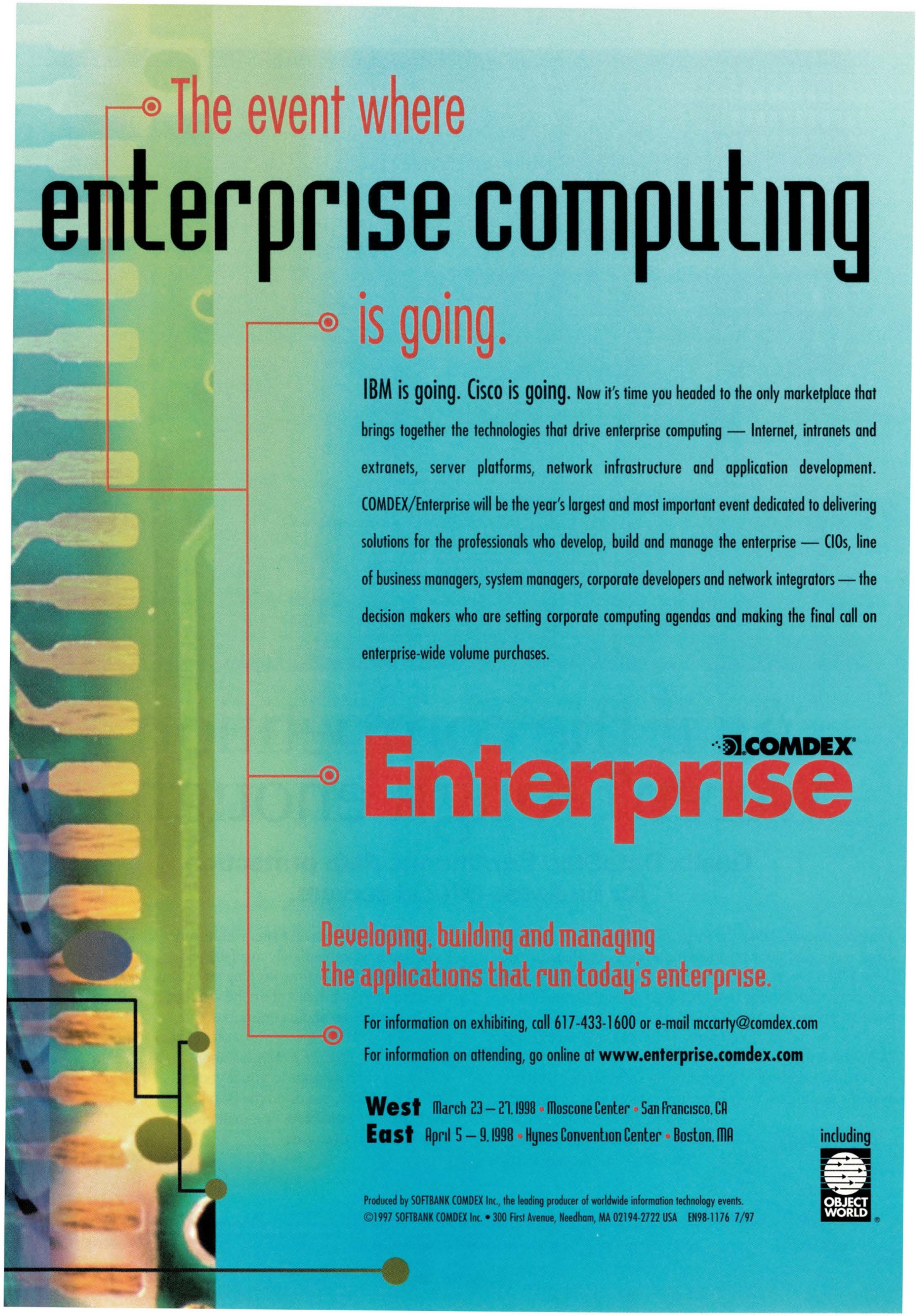
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Version 3 provides some performance improvements by reducing the protocol overhead when returning directory information. There's a new primitive operation that returns a directory and the attributes of all the files it contains. The aim is to support the very common situation where a client will open a directory and then cycle through all the files that it contains looking for a file with a specific attribute. In NFS Version 2, this common operation sequence results in a flurry of network activity as the information for each individual file is retrieved one file at a time.

Version 3 provides some help for clients to maintain caches of information that is stored on the server. It's obviously a win if a file can be retained locally and supplied to the user processes without recourse to the network. Every reply for an operation that modifies data contains two sets of file attributes: a version taken before the operation was done and one taken after the operation. If the modification time in the preoperation attributes matches the client's copy, then the client knows that the local cache is consistent. Only the client has modified the file. The clients replace their local copy of the attributes with ones that existed after the operation and continue merrily along. If the preoperation times are different, then the client knows that its cached data is incorrect and can take steps to flush and reload it. This is a great improvement on the situation in Version 2 where a client was unsure who had altered a file with which it was dealing.

Finally, Version 3 supports 64-bit file pointers reflecting the change in our general expectation of the size of a large file. I can't say that I have a file on any of my systems that is bigger than 4,294,967,296 bytes, but undoubtedly some people are creating them.

As I said at the beginning, your Solaris 2.5+ system will use NFS Version 3 when it can, so most of these changes are invisible to users. Of course, the ability to interwork with older implementations was a design aim for Version 3.

Finally

This is another article where I intended writing about one thing and ended up talking about some subset of the topic. Never mind, another time. If you are interested in the NFS Version 3 paper, then you can find it in the *Proceedings of the USENIX Summer 1994 Technical Conference, Boston, MA,* ISBN 1-880446-62-6. I had hoped to say that you would find the paper online at the USENIX Web site (`http://www.usenix.org`) accessible only to members of the association, but sadly it's not there.

You'll find Samba at `http://samba.canberra.edu.au/pub/samba`. Another thing you will find on the Web are my son's Dark Forces Web pages: `http://www.hillside.co.uk/glyn/dark/dark.html`. ⊸

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`.

by Richard Morin, **Technical Editor**

JUDE MACEREN

The Role of Standards

> "Representatives and direct taxes shall be apportioned among the several States which may be included within this Union, according to their respective numbers, which shall be determined by adding to the whole number of free persons, including those bound to service for a term of years, and excluding Indians not taxed, three-fifths of all other persons. The actual enumeration shall be made within three years after the first meeting of the Congress of the United States, and within every subsequent term of ten years, in such manner as they shall by law direct...."
>
> THE CONSTITUTION OF THE UNITED STATES OF AMERICA: ARTICLE I, SECTION 2, PARAGRAPH 3

Although some details have changed, the actual enumeration specified above is still carried out every decade. The country has grown a bit, however, requiring rather more effort than the framers may have envisaged. By 1890, it had become clear that strictly manual methods were not going to be sufficient. So, Herman Hollerith designed a new ("punched card") format for the primary data records, along with machines to punch and read the cards.

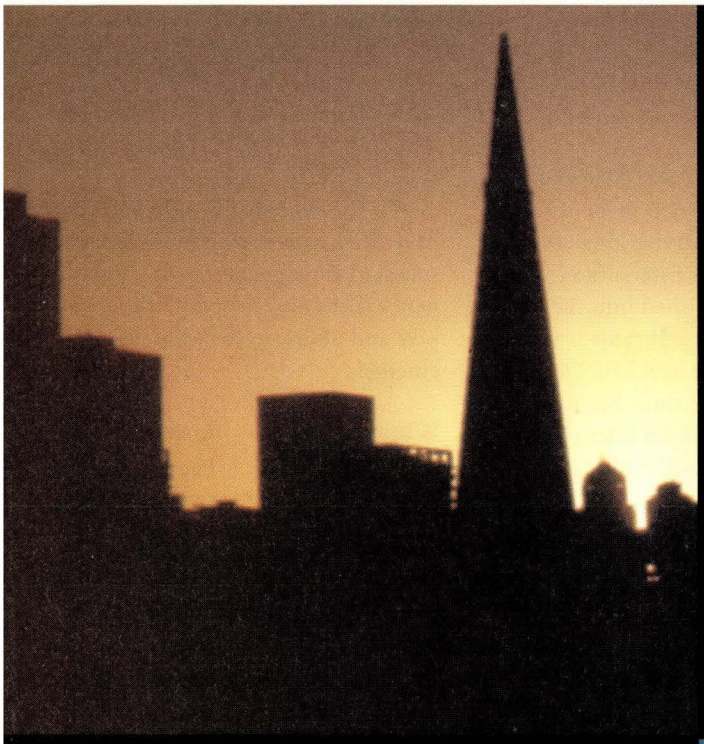
By making the cards in the same size (3.25 by 7.375 inches) as the currency of the day, the Census Bureau was able to take advantage of existing currency-handling apparatus. The precision of the available tabulating equipment limited the cards to 80 columns of 12 holes each. The bottom 10 holes in each column were used for the digits zero through nine. The top two holes were used for out-of-band ("zone") punches.

As time passed, the interpretation of the punches became more and more complex. Alphabetic and some special characters were added in the BCDIC (Binary Coded Decimal Interchange Code) format. Lowercase alphabetics and still more special characters were added in the Extended BCDIC (EBCDIC) format. The vagaries of the EBCDIC coding scheme became quite comprehensible (and quite interesting, as a design problem) when seen from this historic perspective.

Over time, the idea of punching physical cards became less attractive. Electronic terminals were developed, finding use in key entry and time-sharing systems. To retain compatibility with punched cards, however, most of these terminals used 80-column lines.

Today's bit-mapped screens are far more flexible than these early terminals, but the 80-column line is still a strong cultural standard. Email and Netnews postings, for instance, are typically formatted to fit within 80-column lines. Most text editors and terminal emulation programs also use 80 columns as the default line length.

In a related development, most cur-



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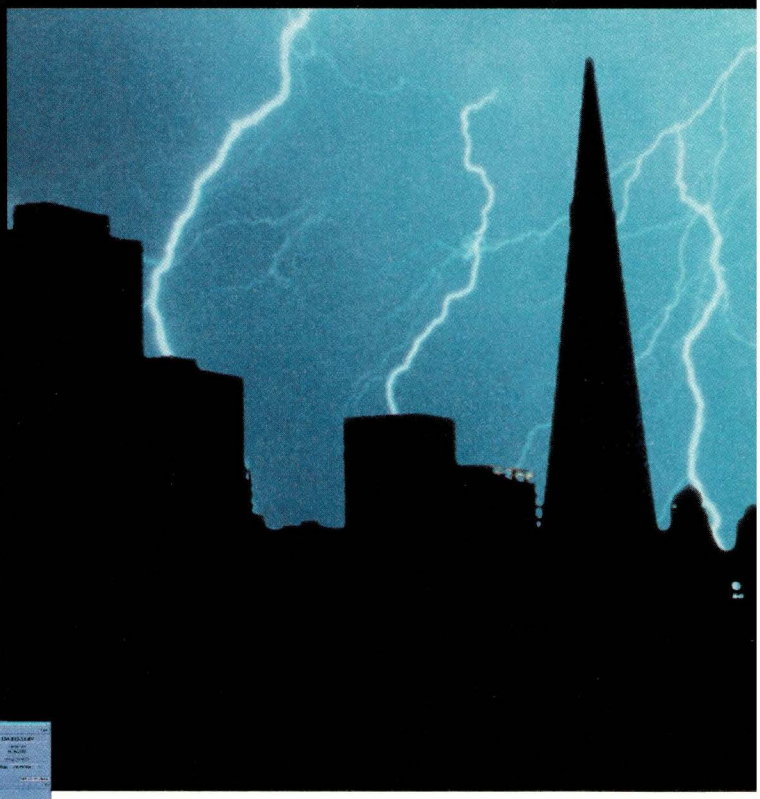

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rent terminal emulation and cursor-control programs, including `xterm` and `curses`, still support `vt100` mode, based on Digital Equipment Corp.'s VT100 terminal. I find it somewhat amusing to contemplate millions of computers busily generating and/or emulating the cursor-control sequences of a long-discontinued computer terminal. But I digress.

Some Standards Survive

The important lesson in all of this is that standards can survive long after their original design criteria (and designers!) have vanished into the mist. Paper tape and punched cards have vanished, but ASCII and EBCDIC will be around for a long time. Similarly, I would expect 80-column lines to be the default format for fixed-width applications for the foreseeable future.

On the other hand, many standards have disappeared, thus, adoption of a standard is no guarantee of permanence. Let's look at some of the winners and losers, to see what patterns emerge:

Winners	Losers
ASCII, EBCDIC	Paper tape, punched cards
C, etc.	Pascal, etc.
Ethernet	3BNet, Localtalk
Java, X Window	NeWS
NFS	RFS
RS-232	Current loop
SCSI	ST-506
TCP/IP	AppleTalk, XNS
Twisted-pair cable	Coaxial cable
UNIX	Apollo Domain, VMS
Windows	UNIX

In the cases of ASCII and EBCDIC, the encoding schemes were found to be useful long after the physical manifestations had been dropped. I expect the SCSI protocols to show similar resiliency. Similarly, the UNIX sets of commands, library functions and system calls have been adopted in circles extending far beyond licensed UNIX.

Some of the winners are technically superior to the losers. Coaxial cable can be more difficult (and expensive) than twisted pair to install, extend and debug. And once twisted-pair cable started to get installed, bright engineers could begin adding improvements such as switching hubs and cheap IP routers.

The design of some interfaces may be so closely tied to a given environment as to make them unsuitable for use in others. RFS, for example, offered features that were not available with NFS (for example, remote use of devices), but it did not work as well with other operating systems. Apollo Domain, which many users believed to be superior to UNIX, has disappeared due to a lack of portability.

Despite its technical superiority over X Window, NeWS got trounced in the UNIX window system wars.

Although some complaints can be made about NeWS' CPU-intensive nature, I submit that the primary reason for its demise was an overall industry disinterest in paying license fees (and giving up control) to Sun.

On the other hand, aversion to RPN-style programming languages and reluctance to let Sun "win" another standards coup may have been significant factors. (I find it both amusing and gratifying that James Gosling has been able to recast many of NeWS' attributes into today's wildly successful Java system.)

UNIX is a conundrum. It has prospered while some proprietary systems were dying, but it has never achieved mass-market stature. As Sun's Scott McNealy notes, UNIX has been dying at a sustained growth rate of 20% per year for the last 15 years. So it would appear that the technical merits of UNIX have given it a place in certain markets, but its complexity (and the Microsoft gorilla) have kept it from wide-scale use.

How to Choose

Aye, there's the rub... We are besieged by proposed standards, covering every aspect of computer hardware and software. As some wag noted: "The nice thing about standards is that there are so many to choose from." Sometimes a wrong decision doesn't matter at all; other times it can be devastating. Choosing the wrong bus on a PC is a small matter to most users, but it could sink a manufacturer. Choosing the wrong type of cabling for a LAN could cause a great deal of pain in 10 years' time.

My own advice would be to opt in favor of generality and openness. Standards that can't grow with improving performance cannot last long. Standards that force the industry to pay tribute to a single vendor are ripe for replacement, if the industry can muster a viable replacement. Thus, although Microsoft now seems too big to stop, you should remember that some other industry leaders have been deposed.

Finally, keep an eye out for standards that can outlive their original design goals. I use Category-5 twisted-pair cable for all my Ethernet wiring. Originally, this was my way of preparing for 100BaseT. Now, I realize that it will allow me to go quite a bit further than that, as smart engineers find ways to cram bits into it. If a standard is reasonably well-designed and becomes popular, the industry is quite likely to find ways of extending its lifetime. ⊸

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

by S. Lee Henry

IP Routing Demystified

Have you ever dreamed about managing your routing tables while they are accessed as often as hundreds of times per second? Have you spent sleepless nights thinking about the differences between static and dynamic routes and wondering if inaccurate routes might be creeping into your network? Have you worried that you might suddenly be asked to stand up and explain how `netmasks` work? No? Me neither. Just the same, I know of few sysadmins who haven't run up against a challenging routing problem at one time or another. One of the primary functions of IP, routing is something all sysadmins need to understand.

Building Routing Tables

One of the first things a sysadmin interested in routing might want to know is how and when routing tables are built. Given the increasing extent to which hosts are automagically configured, modern sysadmins can go a long time before ever having to probe the details of IP routing. The basic data used to initialize routing tables comes from files set up during system installation, namely the host name and IP address. From this data, the class and address of the network, the appropriate `netmask` and the network interface can be derived. When the system boots, several of the start-up scripts invoked through `/etc/init.d` access these files and configure initial routing.

The `/etc/rcS.d/S30rootusr.sh` and `/etc/rc2.d/S69inetinit` scripts set up `netmasks` for networks defined in the `/etc/netmasks` file, if it exists, derive a list of interfaces by looking for `/etc/hostname.*` files (`/etc/hostname.le0`, for example) and run `ifconfig` commands for each interface. If an `/etc/defaultrouter` file exists, a default route through the specified router is added to the routing table. The `/etc/rc2.d/S69inetinit` script also assigns the `domainname` from the `/etc/defaultdomain` file.

All hostnames used during this process must be included in the `/etc/hosts` file because naming services won't yet have started. If there are more than two interfaces (besides the loopback), the

Example 1. Sample Routing Table

```
Routing Table:
Destination      Gateway     Flags    Ref   Use   Interface
---------------- ----------  -------- ----- ----- ----------
localhost        localhost     UH       0     9      lo0
192.133.72.0     myhost        U        6    23      le0
224.0.0.0        myhost        U        6     0      le0
default          router1       UG       0    12
```

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host will be configured as a router and `ip_forwarding` will be turned on. The daemon `in.rdisc` will be used to discover routes if the `/etc/defaultrouter` file is empty or doesn't exist. The `/etc/rc2.d/S72inetsvc` script completes the routing setup by adding the route for multicast and starts the `inetd` in "stand-alone" mode.

By the time the system is in run state 2 or 3 (the multiuser modes), the routing table should include several entries, as shown in Example 1.

If you take a look at the routing table on your system by issuing the `netstat -r` command, you'll see a display similar to that shown in Example 1. Note: You may have many more entries, depending on the complexity of your network. IP routing was designed to be efficient, adding new routes as well as replacing existing routes with shorter or fresher routes derived from routers sharing (advertising) their routes.

The "Flags" column indicates that a route is up (`U`), is a route to a gateway (`G`), is a route to a host (`H`), was created by a redirect (`D`) or was modified by a redirect (`M`).

Example 2. A Sample of Advertised Routes Captured by snoop

```
ETHER: ----- Ether Header -----
ETHER:
ETHER: Packet 1 arrived at 20:54:34.86
ETHER: Packet size   = 546 bytes
ETHER: Destination   = ff:ff:ff:ff:ff:ff, (broadcast)
ETHER: Source        = 0:60:5c:99:ee:11,
ETHER: Ethertype     = 0800 (IP)
ETHER:
IP: ----- IP Header -----
IP:
IP:  Version = 4
IP:  Header length   = 20 bytes
IP:  Type of service = 0x00
IP:        xxx. ....  = 0 (precedence)
IP:        ...0 ....  = normal delay
IP:        .... 0...  = normal throughput
IP:        .... .0..  = normal reliability
IP:  Total length    = 532 bytes
IP:  Identification  = 0
IP:  Flags = 0x0
IP:        .0.. ....  = may fragment
IP:        ..0. ....  = last fragment
IP:  Fragment offset = 0 bytes
IP:  Time to live = 2 seconds/hops
IP:  Protocol = 17 (UDP)
IP:  Header checksum = a94f
IP:  Source address  = 198.133.71.1, router1
IP:  Destination address = 255.255.255.255, BROADCAST
IP:  No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 520
UDP: Destination port = 520 (RIP)
UDP: Length = 512
UDP: Checksum = 0000 (no checksum)
UDP:
RIP: ----- Routing Information Protocol -----
RIP:
RIP: Opcode = 2 (route response)
RIP: Version = 1
RIP:
RIP: Address                                Port  Metric
RIP: 0.0.0.0              (default)          0      5
RIP: 198.133.76.0     198.133.76.0           0      5
RIP: 201.244.58.0     201.244.58.0           0      5
RIP: 198.133.75.0     198.133.75.0           0      5
RIP: 198.133.74.0     198.133.74.0           0      1
```

The route Command

Routes can also be added to and removed from your routing tables with the `route` command. For example, if your host only "knows" about the network to which it is attached, you might want to add a route to your table so that you can communicate with hosts on attached networks. The one-line command to add a route will look something like this:

```
/usr/etc/route add
 192.133.77.0 192.133.72.1 1
```

where the IP address ending in zero is a network address. The next IP address is that of the router through which the network is reachable and a `hop` count, indicating that packets will need to go through another host before reaching their destination. (All the `route` command does with this metric is install the route with a `G` flag if the number is greater than 1.)

Another source of updates to routing tables comes from ICMP, the Internet Control Message Protocol, which provides `ping` and other network management commands. When a datagram is sent to the wrong router (one with no route to the intended system), it sends an ICMP Redirect Message error back to the sender of the datagram so the routing table can be updated.

Dynamic Routing

The routes established during the bootup process as well as those added with the `route` command are referred to as static routing. In large networks, routers often exchange routing information with one another, most often with a dynamic routing protocol known as RIP, the Routing Information Protocol. Routers sharing this information usually "advertise" it every 30 seconds, resulting in fairly large and frequently changing routing tables. Newer routing protocols, OSPF and BGP, exist but won't be covered in this column, we'll take a look at these protocols in later issue.

Example 2 shows a sample of advertised routes captured by `snoop`. To view a single RIP packet, use the command `snoop -v -c 1 port 520`. This command selects a packet for UDP port 520. The route addresses in this packet are network addresses and indicate that each of the networks included in this list can be reached through the gateway `198.133.71.1` (`router1`), which advertised its routes.

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Example 3. Sample snoop Capture File

```
ETHER: Destination = 0:60:5c:93:ef:13,
IP:    Destination address = 192.92.11.1, 192.92.11.1
UDP:   Destination port = 53 (DNS)

ETHER: Destination = 0:60:77:ee:49:ef,
IP:    Destination address = 198.133.72.65, 198.133.72.65
ICMP:  Type = 3 (Destination unreachable)
ICMP:IP:  Destination address = 192.92.21.1, 192.92.11.1
ICMP:UDP: Destination port = 53 (DNS)

ETHER: Destination = 0:60:55:93:af:13,
IP:    Destination address = 192.92.78.247, ducky

ETHER: Destination = 8:0:20:77:aa:15, Sun
IP:    Destination address = 198.133.72.95, possum

ETHER: Destination = ff:ff:ff:ff:ff:ff, (broadcast)
```

Protocols and Addresses

Before we go any further, let's take a quick look at the levels of addressing that may be included in each packet (or, more correctly, *frame*). The four address levels are as follows:

Layer	Uses
link	ARP, RARP, hardware interface
network	IP, ICMP, IGMP
transport	TCP, UDP
application	User processes

Whenever packets are going out over the wire, we are said to be operating at the "link layer." The addresses that are important are associated with the hardware and are what the network interfaces respond to. The information shown in Example 3 was extracted from a `snoop` capture file.

By looking at the addressing within packets in Example 3, we can see that a number of address levels exist. In the first example, the hardware address at the outermost or link layer is actually that of a router. The host we were trying to reach (`192.92.21.1`) is on the other side of this particular router. Once the router receives this packet, it replaces its hardware address with the address of the host (or another router if the host is not on the local network) and passes on the packet.

The second address is the network layer address–the IP address of the intended host (*not* the router). This lets the router know where it is to send the packet. From the third level of addressing, the transport layer, we can see that port address 53 (corresponding to the DNS, as the label and excerpt taken from the `/etc/services` file shown below indicates). This packet represents a DNS request, the reply to which follows:

```
domain      53/udp
domain      53/tcp
```

Using Routing Tables

Routing tables are used frequently on busy networks with connections to a lot of systems and, of course, on routers. There is an order of precedence in which routes are used. If there is a route for the specific host being addressed (for example, `192.92.92.92 router1 UH 6 139`), it is used. We can tell that this is a route to a host both by the IP address (which doesn't end in `.0`) and the `H` in the Flags field. If there is no route for the specific host, a route to the host's network (for example, `192.92.92.0 router1 UGH 6 4091`) is used. If neither a host nor a network route is found, the default route is used.

Of course, routing tables are not always used when a connection to a host is being established. The hardware (interface) address of the host may be stored in your `arp` cache. If this hardware-to-IP-address mapping information is available, network traffic can be addressed to the host using the hardware address of the Ethernet interface.

You can display the `arp` cache on your system using the `arp -a` command (see Net-to-Media Table below).

If the host is on the other side of a router, the cached hardware address will be that of the router that forwards packets to the host in question. A cached hardware address might be wrong if changes to your network have not yet propagated. If a host is moved in front of a router from beyond it and your host cannot "reach" it, it may be that you have a stale address in your `arp` cache. Until it times out or you delete it, your packets may never reach their destination. They will contain the wrong address at the hardware (link) level.

If you're unsure of which address is being used when you unsuccessfully try to reach a host, capture a packet with `snoop` and look at the hardware address in the frame line (`ETHER: Destination = 0:60:5c:93:ef:13`) or check your `arp` cache. If you have a stale address in your `arp` cache, you can remove it with the `arp -d desthost` command. If you then `ping` the system, a new entry should appear. ⊷

Net-to-Media Table

```
Device  IP Address      Mask             Flags   Physical Address
------  ------------    ---------------  -----   ----------------
le0     ducky           255.255.255.255          08:00:20:dd:1a:12
le0     possum          255.255.255.255          00:60:4c:63:ef:13
le0     198.133.72.11   255.255.255.255          00:80:2f:ee:05:01
le0     myself          255.255.255.255  SP      08:00:20:1f:44:a8
le0     224.0.0.0       240.0.0.0        SM      01:00:5e:00:00:00
```

S. Lee Henry *leads a blissful life in LA LA Land (i.e., Los Angeles) and works as a security engineer at Infonet, where no one else necessarily shares any of her opinions. If you'd like to share your opinions, write to her using the address* `slee@cpg.com`.

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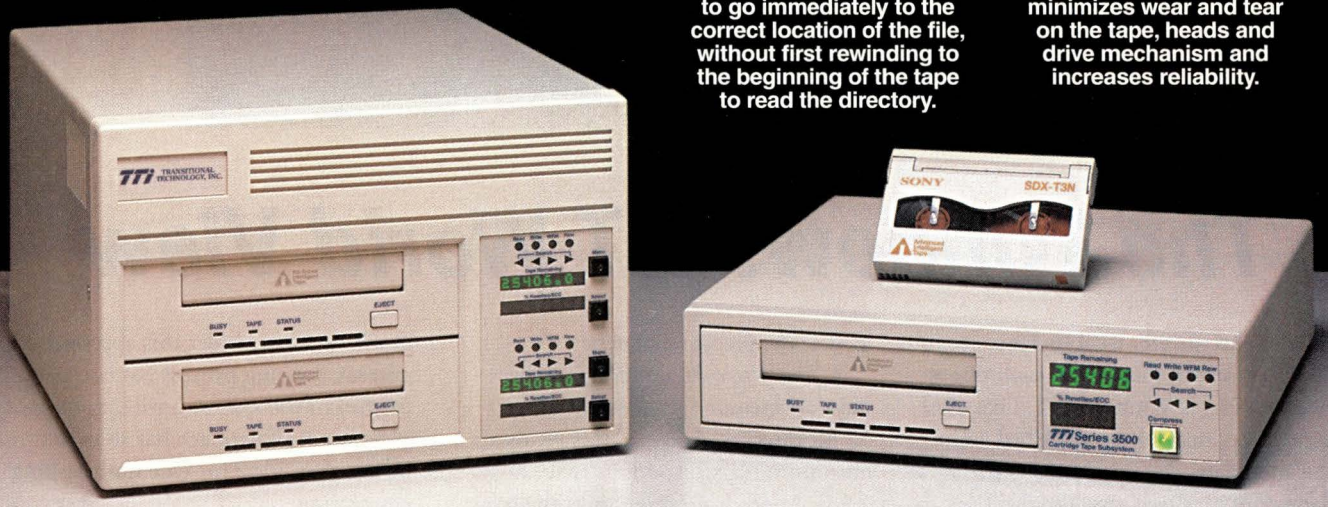

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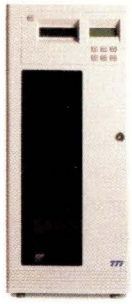

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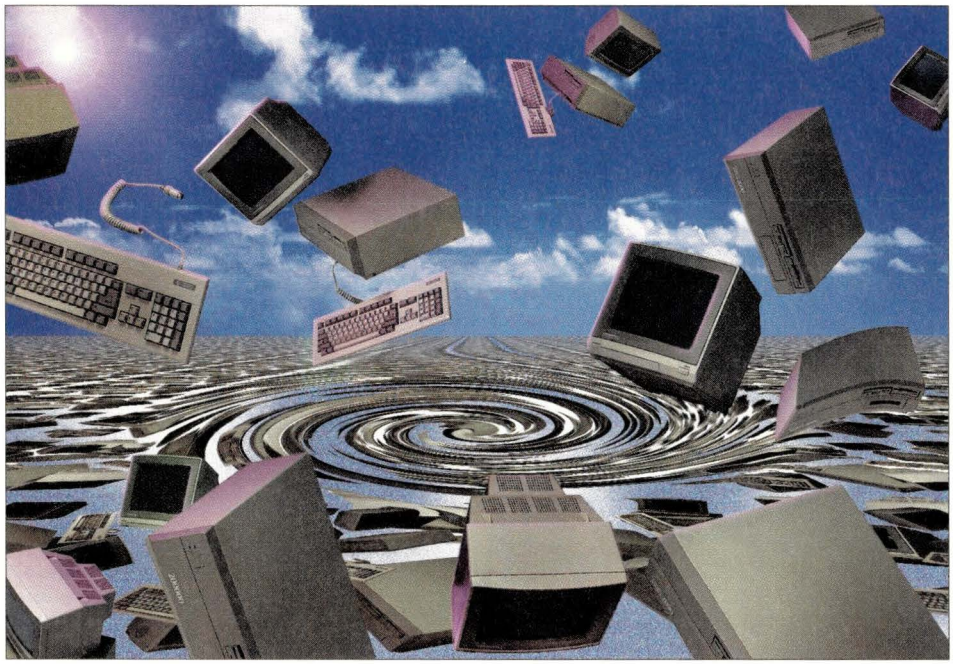
by Æleen Frisch



JOSEPH COLUCCI

The Windows NT World View

This month, we'll stick our toes a little farther into the whirlpool that is Windows NT. Like most experiences that can be described with this metaphor, this one is not nearly as dangerous as it feels, and the thrill can be exhilarating as well as overwhelming. We'll be considering some fundamental concepts and design features of Windows NT as well as finding our way around a typical system. It will also be our first attempt to identify and understand the Windows NT perspective on things.

What Is Windows NT?

Recently, I defined Windows NT as follows:

Windows NT is a 32-bit, microkernel-centered, preemptive multitasking operating system providing privileged and unprivileged execution modes and compatibility with some legacy programs designed for DOS/Windows 3.1 systems and, to a lesser extent, OS/2 systems and POSIX-compliant systems.

Let's take that sentence apart and look at the pieces separately:

- *Thirty-two-bit operating system:* Physical memory is addressed using 32-bit integers. As usual, this yields a maximum physical address space of 4 GB. Application programs can access 2 GB of it under the out-of-the-box version of the operating system.
- *Microkernel-centered:* The core of the Windows NT OS is a small compact program that handles the most fundamental and important operating system functions. Other operating system services are provided by a series of secondary subsystems under its control (as we'll see). The microkernel and the various subsystem modules make up the operating system kernel.
- *Preemptive multitasking:* The kernel includes a scheduler facility that is used for running processes and switching among them. In Windows NT, this function is part of the microkernel. Cooperative multitasking is the opposite of preemptive multitasking, and this is the scheme used by traditional PC environments. Under this approach, the current running process has complete control of the system until it voluntarily gives it up. Experience has shown it to be less than ideal for true multitasking computing.
- *Privileged and unprivileged execution modes:* Windows NT distinguishes between processes that execute in user mode and those that execute in kernel mode. Only kernel mode processes have complete access to all system resources (including all of the memory); user mode processes gain access only via operating system requests. Only the operating system itself runs in kernel mode, so system memory is protected from the sorts of random corruption by application programs that result in General Protection Faults under Windows and System Bomb dialog boxes on Macintosh computers.
- *Compatibility with some legacy DOS/Windows 3.1, OS/2 and POSIX programs:* The operating system includes (user mode) subsystems for running

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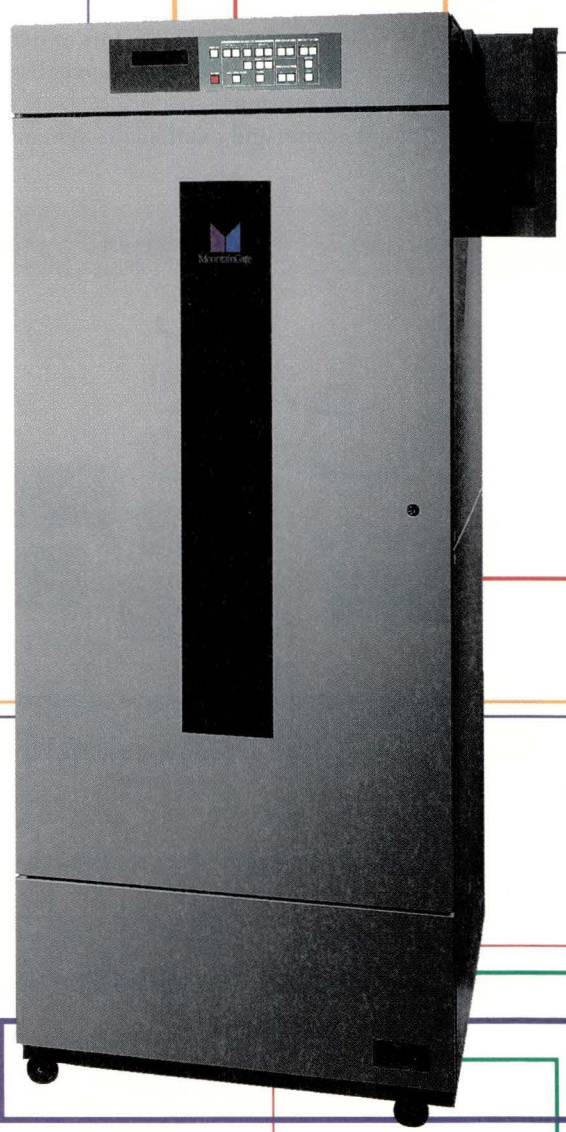

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many 16-bit DOS and Windows programs and OS/2 programs. Windows NT also supports the POSIX 1 standard–the POSIX application program interface–therefore, POSIX programs can be ported to Windows NT more easily. A few POSIX-compatible commands are also included in the Resource Kit.

Figure 1 depicts the overall architecture of the Windows NT operating system. The upper section of the diagram illustrates user mode processes, and the lower section depicts the kernel (which runs in kernel mode). We'll consider the various components individually, beginning at the bottom of the figure and working our way up.

The Hardware Abstraction Layer (HAL) handles most hardware operations, serving as an interface between the microkernel and other kernel modules. As Figure 1 indicates, a few device drivers also directly access the hardware. The microkernel also handles communications among the other secondary kernel components:

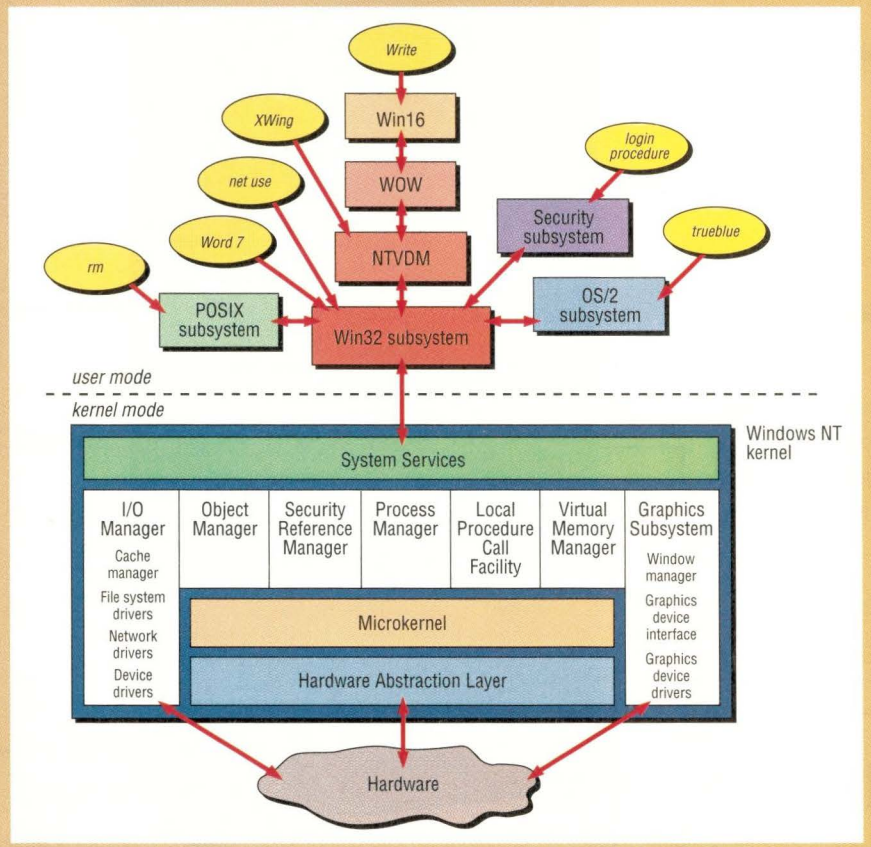
- The I/O Manager handles most system I/O.
- The Object Manager controls system objects, which are the data structures corresponding to files, ports, processes and other system entities (under Windows NT, everything is an object).
- The Security Reference Manager (SRM) grants or denies processes access to system objects and system resources based upon their ownership and permissions.
- The Process Manager creates and manipulates system processes.
- The Local Procedure Call Facility handles interprocess communication, that is, communication between distinct local processes.
- The Virtual Memory Manager allocates and manages system memory.
- What I'm calling the "Graphics Subsystem" is responsible for interfacing to graphical displays. I have chosen to depict it separately in the architecture diagram to emphasize its presence within the kernel in Windows NT Version 4. Previously, this functionality was performed in the Win32 subsystem in user mode.

All of these kernel modules provide system services to ordinary processes to enable them to get work done.

The items at the top of Figure 1 are all running in user mode. As such, they are able to access system resources and memory only via the system services provided by the kernel. The most important item here is the Win32 subsystem. It provides a standard application programming interface (API) to user processes (an API is a set of standard library subroutines used to perform operations, access resources and otherwise request system services). Under the idealized view of the Windows NT design, all application programs, which are depicted in Figure 1 as ovals, must ultimately go through the Win32 subsystem to interact with the kernel:

- Native Windows NT programs, that is, 32-bit applications designed specifically for the Windows NT environment–Word is the canonical example–communicate directly with the Win32 subsystem.
- Compatibility with other computing environments is provided by the secondary API subsystems. For example, the few provided POSIX commands communicate first with the POSIX subsystem, and this facility itself then interfaces with the Win32 subsystem (OS/2 commands are handled in a similar way by the OS/2 subsystem). In the idealized view, all compatibility features will be provided in this way, and everything will eventually wind up in the Win32 subsystem. In practice, however, such subsystems do make some direct kernel calls.
- Sixteen-bit DOS and Windows applications run via several nested subsystems culminating with Win32. The NT Virtual DOS Machine (NTVDM) creates a DOS-compatible environment for applications that need it, including DOS programs. Sixteen-bit Windows 3.x applications, like the Write word processor, are handled by a component that converts their 16-bit system calls into the 32-bit calls used by Windows NT; this subsystem is known as Windows on Win32 (WOW). Because they are still dependent on DOS services, such programs also require NTVDM.

Figure 1. Windows NT Architecture (Simplified and Idealized)



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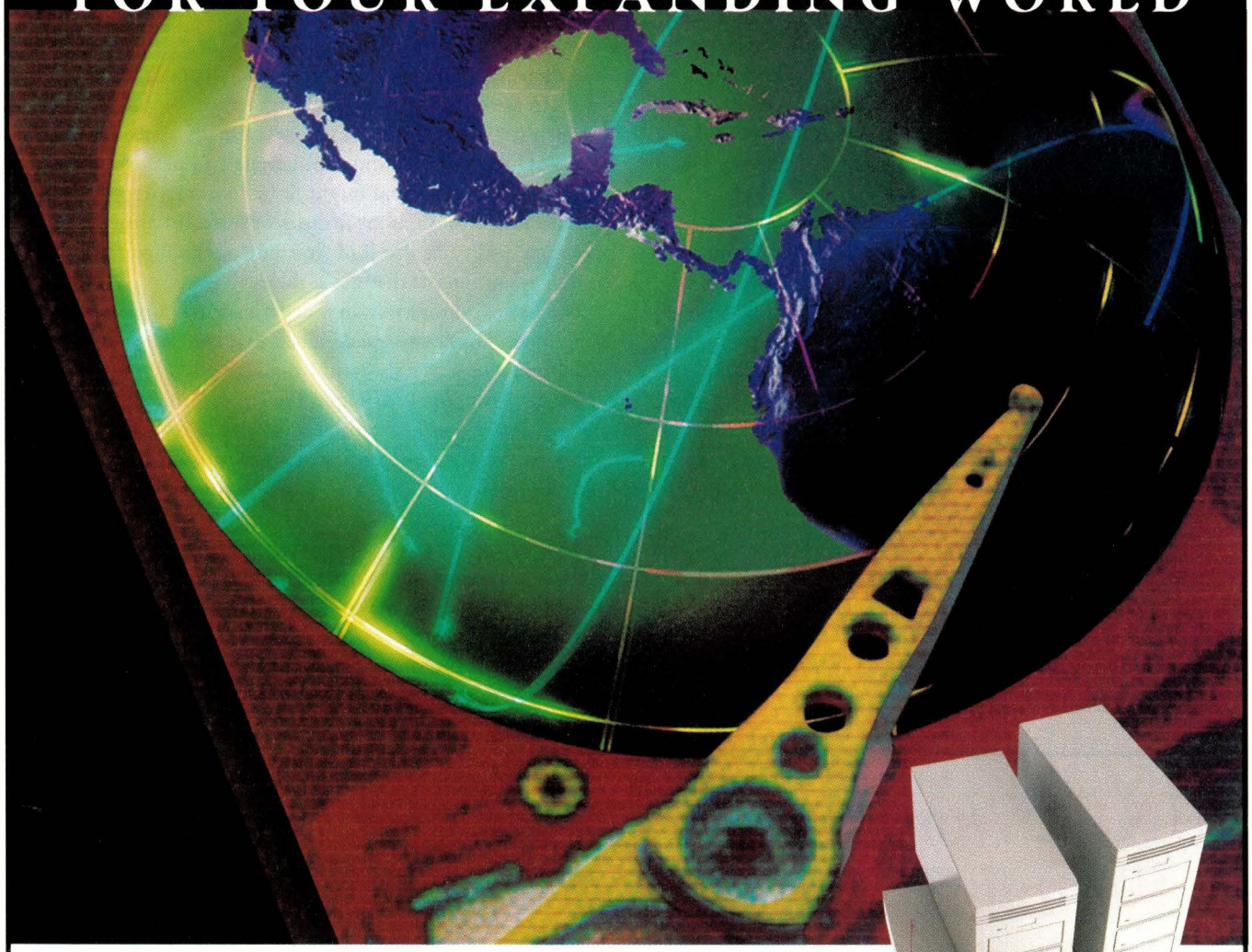

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• A security subsystem controls the Windows NT login process and is used for user authentication.

Why does any of this matter to you? A superficial understanding of the Windows NT design is helpful because the assumptions driving it and the philosophy behind it pervade all of Windows NT, from the most basic utility to the OS itself. While they are neither good nor bad in themselves, they do have a number of implications and consequences, and being aware of them will make working with Windows NT systems easier. These are the most important of them:

• Windows NT has a very different view of a multiuser computer system than that found on any of the systems with which you are familiar. Windows NT sees separate computers as single-user systems. Only one user may be logged into a system at any one time, although multiple users may access system resources and communicate with processes running on a single Windows NT system. In fact, the network is the only means by which this operating system allows more than one user to share computer resources at all. You will find that many Windows NT commands and utilities have been created with these same assumptions.

There are third-party products that will allow a Windows NT system to support multiple simultaneous users, and Microsoft has announced a collaboration with one of these vendors to create a multiuser support add-on product for Windows NT (the project is named Hydra). We will consider these facilities in a future column.

• The modularization and compartmentalization that characterizes the OS design continues in the other facilities provided by Windows NT, including its systems administration tools and user commands. There are lots of tools, each with a narrowly defined scope of action. Again, this is neither good nor bad in and of itself (UNIX tools could be characterized in the same way). In fact, this approach succeeds most of the time. It only occasionally leads to inconvenience and some counterintuitiveness in performing some actions when items that ought to be together are arbitrarily partitioned into different utilities or different areas within the same utility. It also leads to some minor inconsistencies in the operations of distinct utilities.

• Systems administration is deemphasized or overlooked. Windows NT systems are designed to require very little administrating (at least that's what the marketing folks will tell you). Once properly installed, applications and Windows NT itself are assumed to work as expected. As long as reality matches what the designers expected it to be, there is no problem. But once the unexpected happens, and it inevitably does, there are often relatively few or no means to alter the operating system's normal functioning. In other words, if your particular situation deviates in some important way from the underlying view of normal activity, there may not be any way to change the system's current behavior to correspond.

• The GUI interface is given much more emphasis than command-line tools. There are many system functions that

cannot be performed from the command line at all. This makes automating systems administration considerably more of a challenge.

Windows NT Flavors

At the present time, Windows NT is packaged and sold in three flavors:

- **Windows NT Workstation**, designed for a system whose resources are used almost exclusively by a single user.
- **Windows NT Server**, designed for server systems of various types: file servers, database servers, print servers, network name servers and so on.
- **Windows NT Server Enterprise Edition**, a special version of Windows NT Server that also includes built-in clustering support and facilities for running distributed applications.

We won't worry about the exact distinctions between the two types of server operating system at this point. The two product types are clearly intended for systems with different purposes within a network or site. An identical kernel is used for both of them, although it is configured to operate differently depending on whether it is a workstation or server system (some performance-related parameter settings are different). The rest of the Windows NT system differs more substantially between the two product types. These are the most important differences:

- Maximum number of processors in a multiprocessor system (two for workstation and 32 for server).
- Maximum number of simultaneous network client connections (limited to 10 for workstation and only by practicality for server).
- Additional server software: administrative tools for managing domains, the Internet Information Server, various networking name service facilities and others.
- Additional features in server subsystems: fault-tolerant file systems and remote booting capabilities for diskless workstations, for example.
- Price: The workstation version costs about $700 less than the server (for a 10-user license).

The differences in the two products have been the subject of some controversy. For more details, read the article by Andrew Schulman entitled "Differences Between NT Server and Workstation are Minimal," which is available on the Internet at `ftp://ftp.ora.com/pub/examples/windows/win95.update/ntnodiff.html`.

Service Packs and Hot Fixes

The current version of Windows NT, in all of its flavors, is 4.0. Microsoft also makes available no-cost minor update releases called service packs. These service packs are numbered sequentially, and each service pack includes all changes from the earlier ones. Thus, any service pack may be installed to a vanilla Windows NT installation, and a system at a given service pack level can install any higher numbered service pack.

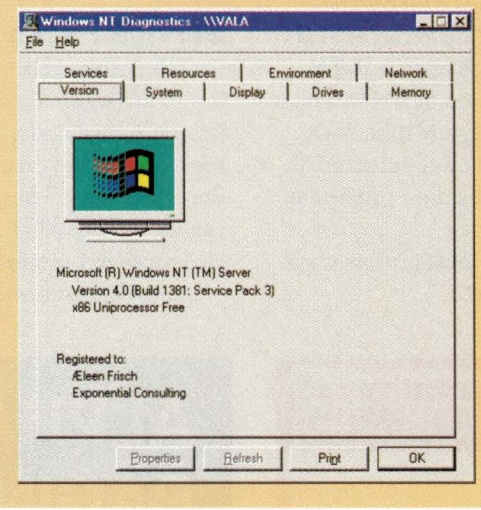
As with most operating system updates, I seldom install ser-

vice packs as soon as they are released. Instead, I watch the Windows NT-related newsgroups for other people's experiences and install the update only after it has been demonstrated to be an unambiguous improvement (or has had the most egregious of its bugs shaken out by others).

You can download service packs from the Microsoft FTP site: `ftp.microsoft.com/bussys/winnt/winnt-public/fixes/country/nt40`, where country is the subdirectory corresponding to your version of the OS (`usa` is the country code for the United States). The actual service pack files are found in a subdirectory of `nt40` whose name varies a bit (for example, the U.S. service pack 3 files are in the subdirectory `ussp3`). This location will itself contain subdirectories named for the various computer architectures supported by Windows NT, usually alpha and i386, which hold the actual files. Service packs may also be obtained on CD-ROM from Microsoft (call 800-370-8758 or fax 716-873-0906 within the United States).

Service packs are delivered as self-extracting archives: executable (`.EXE`) files that unpack themselves when they are run, either from the command line via the desktop's Start menu, or by double-clicking on an icon. They usually run the enclosed `Update.EXE` program automatically, which performs the actual installation. Alternatively, you can run the executable from the command line using the `/X` option to unpack it without installing it and later run `Update.EXE` manually.

Figure 2. Windows NT Version Information



The current Windows NT version and service pack level is displayed in the Version tab of the Windows NT Diagnostics administrative tool (open it with Start > Programs > Administrative Tools [Common] > Windows NT Diagnostics). A sample display is shown in Figure 2.

Beyond service packs are hot fixes: minor patches to the operating system to correct specific problems issued between service packs. They are also available for downloading at the Microsoft FTP site. For example, hot fixes to service pack 3 are located in subdirectories of `ftp.microsoft.com/bussys/winnt/winnt-public/fixes/country/nt40/hotfixes-postSP3`. Currently, hot fixes are delivered as self-installing executables that you activate by double-clicking on their icon or running them from the command line. Hot fixes do not affect the Windows NT version information displayed.

The Windows NT File System

Windows NT uses far fewer system directories than UNIX systems. These are the most important directories found on the Windows NT system disk (usually `C:`):

`\Program Files` holds some Windows NT executables. Application programs often install files here.

`\Temp` is a scratch directory used for temporary files.

`\WinNT` is the top-level directory for the Windows NT system files. The built-in environment variable `%SystemRoot%` points here (thus, its usual value is `C:\WinNT`).

The following are the most important subdirectories of `%SystemRoot%`:

`Profiles`: User account profiles subdirectories are located here (user profiles specify a user's default desktop environment).

`System32`: Holds command executables, dynamic link library (DLLs) files and some configuration files.

`System32\Config`: Contains the system registry files (holds configuration settings), the system event logs and the user accounts database.

`System32\Drivers`: Holds device driver files.

`System32\Spool`: Contains spooling subsystem files.

`Fonts`: Stores TrueType font files.

`Repair`: Holds the files needed to create an emergency repair disk.

`Help`: Contains the Windows NT help files.

What's in a Name?

Officially, the "NT" in Windows NT is an acronym that stands for "New Technology." However, there are other stories about the origin of the name "Windows NT" (as well as other translations for the NT acronym). My personal favorite notes that head of the Windows NT development project is David N. Cutler, who formerly worked for Digital Equipment Corp., and that VMS++ = WNT (increment each letter), just as IBM-- = HAL (2001). Coincidentally (?), Windows NT does have many design features in common with VMS.

In fact, almost nothing in Windows NT represents a brand-new operating system feature, but Windows NT is the first operating system to combine them with the familiar look and feel of Windows that many people are comfortable with. It is also the first operating system that Microsoft has created and marketed that truly is a modern OS. I'll conclude this column by once again quoting Shakespeare (*The Tempest* V.i.183-84):

Miranda: "O brave new world that has such people in it!"
Prospero: "'tis new to thee." ➸

Æleen Frisch *is systems administrator for a very heterogeneous network of UNIX and NT systems. She is also the author of the book* Essential System Administration *(O'Reilly & Associates Inc., now in its second edition) and is currently finishing up another on Windows NT systems administration. In her (almost nonexistent) spare time, she enjoys painting and lounging around with her cats, Daphne and Sarah. Email:* `aefrisch@lorentzian.com`.

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by Alex Newman

KRISTINA WEISS

Hellos and Good-Byes

Apparently, there is some cosmic connection between the name "John M." and the Sun User Group. All of the current changes at SUG involve someone named John M. It's a coincidence that borders on the eerie, worthy of Mulder and Scully, or enough to make you think that there might be some higher power guiding the fate of the Sun User Group–a higher power with a weird sense of humor and an obsession for guys named John M., but a higher power nonetheless.

Take a look at the facts.

John McLaughlin concluded his term as president of the board of directors at this year's SUG East Coast Conference in June. John was an active and effective president, although not as active as he would liked to have been, and he felt it was time to hand the reins over to someone else. John will continue as a director and is currently secretary of the board of directors.

So who's stepping up to the plate for a one-year term as president? It is John Mangrich, of the University of California, Irvine, where he manages the Response Center of the Office of Academic Computing. The center operates the HelpDesk and provides consulting and support services to campus computer users. He has been a member of the Sun User Group (as well as a Sun user and systems administrator) for more than seven years and has attended many of SUG's annual conferences. Previously, he was involved with the San Diego Sun Local User Group and is now on the steering committee of the Orange County Sun User Group (OCSUG).

John is very excited about becoming president. Besides getting use of the SUG autogyro and a complimentary fruit-flavored beverage, he also has a lot to say about upcoming SUG activities, such as the annual *Computers & The Law Conference* and our new books (published in conjunction with Wiley Computing), and getting to know more about what our membership wants and doesn't want through surveys and feedback forms.

Also, after seven years, I'm moving on to another position. But, as you've guessed by now, we had to fill the executive director slot with someone named John M. Longtime SUG staffer John Mickevich will be sitting in the big chair come October 10. John, like John Mangrich, has some exciting ideas about the future of the Sun User Group, and I'm really looking forward to seeing in which direction he takes SUG.

Do all these changes mean that SUG as we know it is gone forever? Don't you believe it. *Plus ça change, plus c'est la même chose*, as Talleyrand put it.

Our newsletter, *Readme*, also has a new production manager, Mike Ciano, and we are always looking for articles. Want to write one? Contact the SUG office. Also, if you're a SUG member and you're not getting your copy of *Readme* every two months, please contact the office. If you're not a member, but you'd like a sample issue, drop us a line to `office@sug.org`, and we'll

send you one.

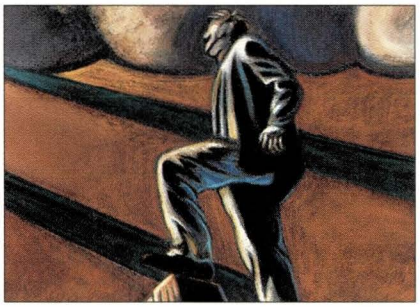
The big news is our annual *Computers & The Law Conference*. For the past four years, the Sun User Group has organized and sponsored this important conference. *Computers & The Law* brings together attorneys, legislators, security professionals, law enforcement officials (from both the state and federal levels) and key decision makers to discuss the intersection of legality and technology.

The event will consist of one day of intensive workshops followed by three days of presentations and town meeting-style discussions. This year's conference will be held October 6 through 9 at the John Hancock Conference Center in the hometown of *SunExpert*, SUG and baked beans–Boston, MA. Up-to-the-minute information about the event is available via the Sun User Group Web site, `http://www.sug.org/CL4` (see also "The Fourth Annual Computers & The Law Conference").

So...good-bye. Over the past few years there has been more than one occasion when people, sometimes even me, thought the Sun User Group would go out of business. Despite an almost hostile indifference from Sun Microsystems, we have survived. Sun is, in theory, our "mother" organization, but if a mother ever treated a child with the neglect and scorn that Sun has heaped on its users and user group over the past few years, the woman would be in jail, and the child taken away. I've gotten a lot of satisfaction out of running the user group and had the pleasure of meeting many of you at conferences and local user group meetings.

Running the Sun User Group is not something one person can do alone, and I've been fortunate over the years to have an excellent staff, and the support of SUG's board of directors. I will never remember everyone I need to thank, but I'm going to try here: Kristine Gabb, Anil Gadre, Sandy Belknap, Peter Galvin, Jeanne Prisbylla, Stan Hanks, Dinah McNutt, John C. Smith, Ed Cavazos, Bob Elliott, Ritu Gorczyca, Rick Otten, Jay Cross, Jay Pedersen, all of the Local User Group leaders around the country, and the good folks at *SunExpert* magazine who decided it would be a good idea for me to write this column–and put up with my chronic lateness.

I especially want to thank John Mickevich, who has been my right-hand man, and "the other guy," at the Sun User Group for almost five years now,



and my good friend for longer than that. I hope he gets the kind of reward out of running the user group that I have.

Finally, if you've made it this far, I want to thank you, the reader. You're probably not a SUG member–why not? It's the question I've asked most frequently over the years. If you read *SunExpert*, you clearly want to keep up on Sun news, and if you want to be involved with the Sun industry, what better way than to join the user group? Sun, as a whole, doesn't listen to individuals (although individuals within Sun do). If you want to be heard by this company you spend thousands of dollars on, you need to band together–under the banner of the Sun User Group. As Benjamin Franklin said, "Gentlemen, if we do not hang together...we will surely hang separately," and while technology isn't war, your voice is certainly worth fighting for. Especially when most of the fight consists of dropping a membership application in the mail.

You've been meaning to do it for awhile. Do it today! ➸

Alex Newman (`troll@sug.org`) *is the executive director of the Sun User Group and Java-SIG. He is also the author of* Special Edition: Using Java *published by Que Publishing and an upcoming book on the history of computer crime.*

Shifting into

As network traffic gets heavier and the 'packages' get larger, network managers have some critical decisions to make about how to divvy up the load.

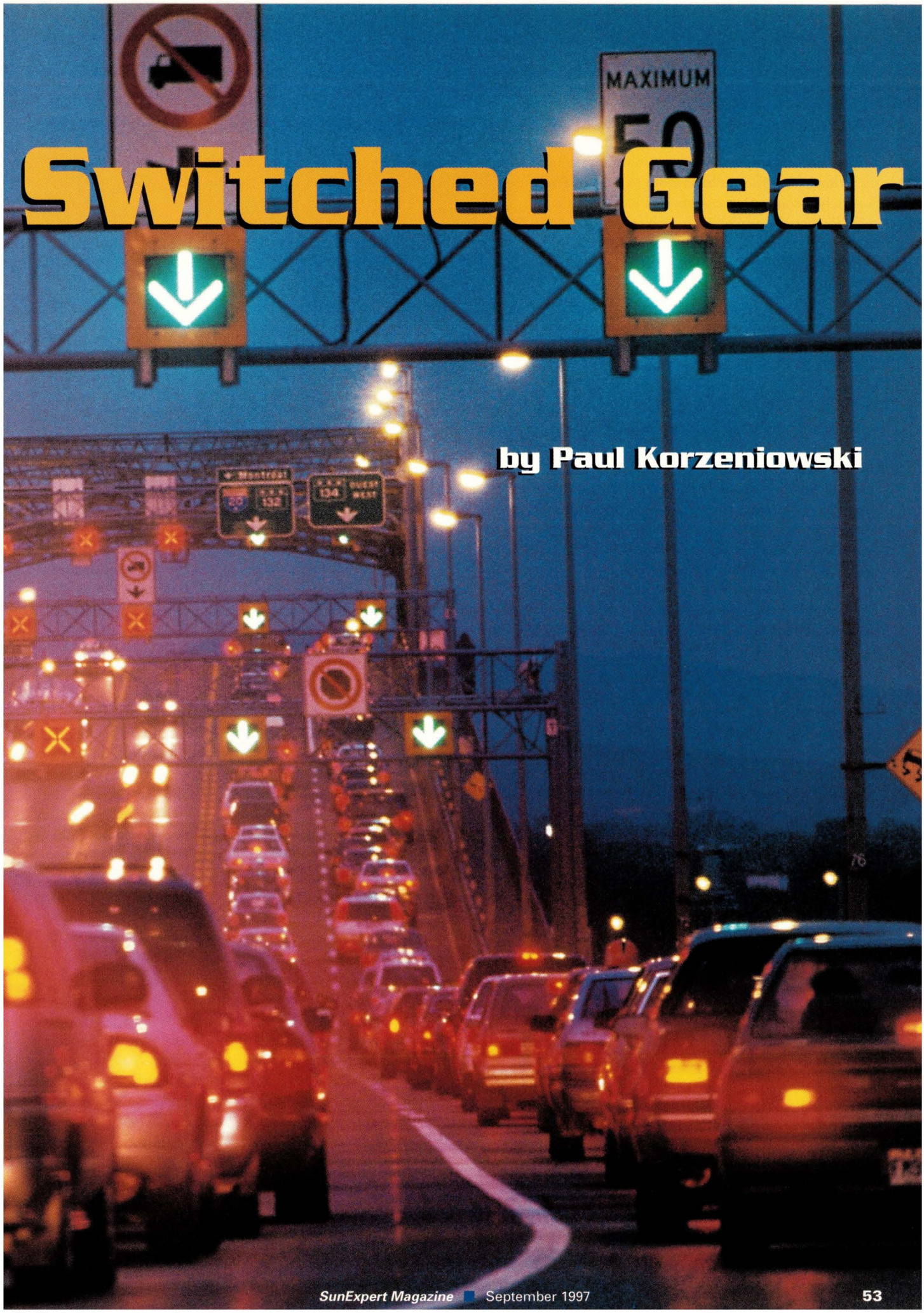
Each day, the load on corporate networks grows. As employees become more comfortable with network applications such as electronic mail, they send and receive more and more messages. As departments install new multimedia applications, larger and larger files travel from department to department.

Network managers have to determine how to manage bandwidth so their corporate networks won't collapse under the weight of growing network traffic. Fundamental to making network decisions is the choice of methods for adding bandwidth. Typically, managers can select from two approaches: bandwidth can be given to a group of systems, a feature called a shared LAN; or allocated to individual machines, a technique called a switched network.

The decision can be difficult because each approach has strong and weak points. A shared connection is less expensive than a switched one; the difference can be as little as $50 or as much as $500 per connection, depending on the network type and transmission

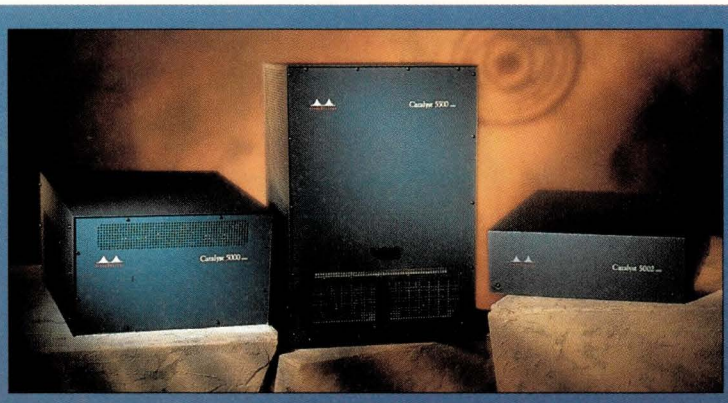
Switched Gear

by Paul Korzeniowski



speed. But relying on shared network connections means groups of users must contend for network bandwidth, and important transactions can get held up waiting for sufficient bandwidth to become free. A switched connection ensures that bandwidth is more likely to be available for such transactions because it is assigned to specific machines.

Network managers can place shared or switched connections in three places: the desktop, the backbone or the server. Traditionally, desktop connections, the most common network connection, have relied on shared connections. On a shared LAN, as the number of users rises so does the amount of network traffic. Companies have solved this problem by dividing one LAN into multiple LANs, a process called segmentation. For instance, one 200-user LAN could be broken into two 100-user LANs or even four 50-user networks.



Cisco's Catalyst 5000 family enables users to construct high-performance, cost-effective switched networks with a modular, flexible chassis system.

LAN wiring hubs support shared network connections, which have represented the bulk of customer purchases. Dataquest Inc., a San Jose, CA-based market research firm, found that shared networks accounted for 86% of the total LAN connections shipped in 1996.

The most common shared desktop choice is 10-Mb/s Ethernet, which accounts for as many as three out of every four sales. According to the Dell'Oro Group, a Portolla Valley, CA-based market research firm, vendors sold $6.953 billion worth of Ethernet products compared with $1.112 billion of token-ring wares, and $458 million of Asynchronous Transfer Mode (ATM) products in 1996 (see Table 1).

Fannie Mae, a Washington, D.C.-based agency that deals with home mortgages, represents a typical Ethernet customer. The company has 3,300 users who work on PCs connected to 80 Sun Microsystems Inc. (UltraSPARC 2000 and 5000) servers. Marty Colburn, vice president of technology at Fannie Mae, says, "Right now, we don't have any application that requires a dedicated 10-Mb/s connection, so all of our LANs are shared."

According to Don Miller, an industry analyst at Dataquest, price is one attraction of shared networks. "If a company looks a little bit, it can find an unmanaged shared Ethernet connection for as little as $20," says Joseph Skorupa, senior director of marketing, architecture and solutions at Fore Systems Inc., a network equipment supplier in Warrendale, PA.

One reason for the low price is that computer vendors, such as Sun, include an integrated 10-Mb/s Ethernet adapter with each of their computer systems. So, a company only has to pay for the Ethernet connection on the wiring hub.

Shared networks enable companies to add bandwidth gradually by increasing the number of network segments. A switched connection represents the ultimate segmentation because it provides each user with a dedicated 10-Mb/s (or 100-Mb/s in the case of Fast Ethernet) connection.

Table 1. Rising Network Revenue

(Worldwide revenue in millions of dollars)

	1995	1996	1997
Ethernet	4,633	6,953	9,164
Token Ring	977	1,112	1,021
ATM	150	458	736
Total	5,760	8,523	10,921

Source: Dell'Oro Group, Portolla Valley, CA

Rather Switch than Fight

Switching emerged first in the Ethernet space and has moved quickly into the corporate mainstream. "The big change in customer buying patterns occurred with the delivery of Ethernet switches during the past few years," says Martin DeBeer, product line manager for switching at Cisco Systems Inc., San Jose, CA. "Prices for a managed switched connection have dropped quickly. Two years ago, they were in the $800 to $1,000 range, but now they sell for about $300, and I expect them to drop under $200 by the end of the year."

Low-priced Ethernet options have been attracting customers who had relied on other networking techniques. Kerr-McGee Corp., an oil and chemical company based in Oklahoma City, OK, had been using token-ring connections for its 2,500 employees, who work with PCs, a few UNIX workstations and IBM Corp. mainframe computers.

Last year, Kerr-McGee encountered network problems. "Traffic was getting bogged down as users sent electronic mail messages with our WordPerfect Office system," says Sam Payne, a LAN/workstation specialist at Kerr-McGee.

Token-ring technology was losing its appeal. "Technological developments came out first on Ethernet and much later on token ring," says Payne. Pricing was also an issue. A switched Ethernet connection costs from $100 to $300, which was the same range as a shared token-ring link.

So the company has been gradually moving its users from shared token-ring connections to switched Ethernet. Kerr-McGee relied on the Centillion switch from Bay Networks Inc., Billerica, MA, to support its network, and the device can

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Exabyte 218 Library	ADIC VLS 8mm Library
Intel Storage Express DAT Autochanger	Lago LS/380L DataWheel
ADIC VLS 4mm Library	
ADIC 1200 DAT Autochanger	

Systems listed are examples, many others qualify. Call for program details and to see if your library qualifies.

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Circle No. 1

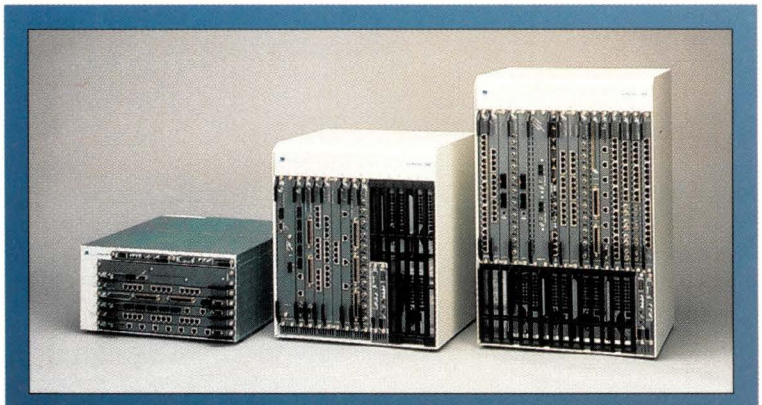
simultaneously support both Ethernet and token-ring networks.

Kerr-McGee is not the only company moving away from token ring at the desktop. "Price differences between Ethernet and token ring widened with the advent of switching, so a growing number of companies are opting for lower cost Ethernet solutions," says Cisco's DeBeer. A switched 16-Mb/s token-ring link costs about $1,000, compared with a few hundred dollars for a 10-Mb/s Ethernet connection.

Customers also see that Ethernet offers a long-term growth path. Migrating from a 10-Mb/s to a 100-Mb/s connection is a simple process because Fast Ethernet, which supports transmission rates up to 100 Mb/s, was designed as a follow-on to 10-Mb/s Ethernet. Vendors sell adapter cards that support both transmission speeds and are now outfitting their switches with autosensing features, which will automatically set a port to the appropriate speed. Also, existing network management software can often control the upgraded connections so network technicians do not need training to work with a new package.

While companies are moving to switched 10-Mb/s desktop connections, they are not yet interested in switched 100 Mb/s at the desktop. Pricing is one reason. Neil Glazebrook, product manager for the CoreBuilder 5000 at 3Com Corp.'s Southborough, MA-based office, pegged a switched 100-Mb/s price at between $700 an $1,000, compared with $300 to $400 for a shared 100-Mb/s Ethernet connection.

Also, few desktop applications require that much bandwidth. In fact, many desktop computers do not have sufficient processing power to fill up a 10-Mb/s connection, let alone a 100-Mb/s link.



3Com's CoreBuilder 5000 provides a migration path for shared media to LAN switching to ATM and Gigabit Ethernet.

But shared 100-Mb/s Ethernet is carving out a niche at the desktop because it can offer a dramatic performance boost. Moving a 100-MB file takes two minutes on a 10-Mb/s switched Ethernet connection, which may be too much time for a top executive. Increasing the speed to 100 Mb/s cuts the transmission time to 10 seconds.

A few organizations with high-bandwidth applications are adopting 100-Mb/s shared connections. Richard Goon is the Macintosh manager at Harman Consumer Group, a design and production company in Woodbury, NY. The company's 25 employees, who work with Apple Computer Inc. Macintoshes and IBM PCs, move large graphics and image files from their desktops to various servers.

The company started out using a Bay Networks wiring hub for a shared Ethernet network. Goon says employees were moving larger and larger files–some as big as 600 MB–so Harman needed faster network connections. Last year, the company purchased Ethernet switches from Asante Technologies Inc., a San Jose, CA-based supplier of wiring hubs and switches.

Most of the company's users work with 10-Mb/s connections, but small workgroups are connected to 100-Mb/s shared LANs. The performance boost has eased the network problems springing up when Harman neared its shipment deadlines.

Coulda Been a Contenda

The push to switched 10-Mb/s and Fast Ethernet has had a negative impact on a second switched desktop contender: Asynchronous Transfer Mode (ATM) technology. Unlike Ethernet, ATM was designed from the ground up as a switching technology and features sophisticated capabilities, such as integrated data, voice and video transmissions, and seamless connections to wide-area networks.

Despite those attributes, the technology has struggled to make any headway at the desktop for a variety of reasons. Cost has been a major barrier. Suppliers started out selling 155-Mb/s desktop connections with a price tag of around $2,000, which was much too high for most organizations.

Recently, vendors have brought pricing down to around $500 per connection, but it still tends to be a bit higher than comparable Ethernet options. ATM reportedly costs more than Ethernet because it is a more sophisticated technology and requires more complex microprocessors and software. Another issue is that 155-Mb/s ATM connections require companies to install fiber-optic cabling. Most organizations now run twisted-pair wiring to their desktops.

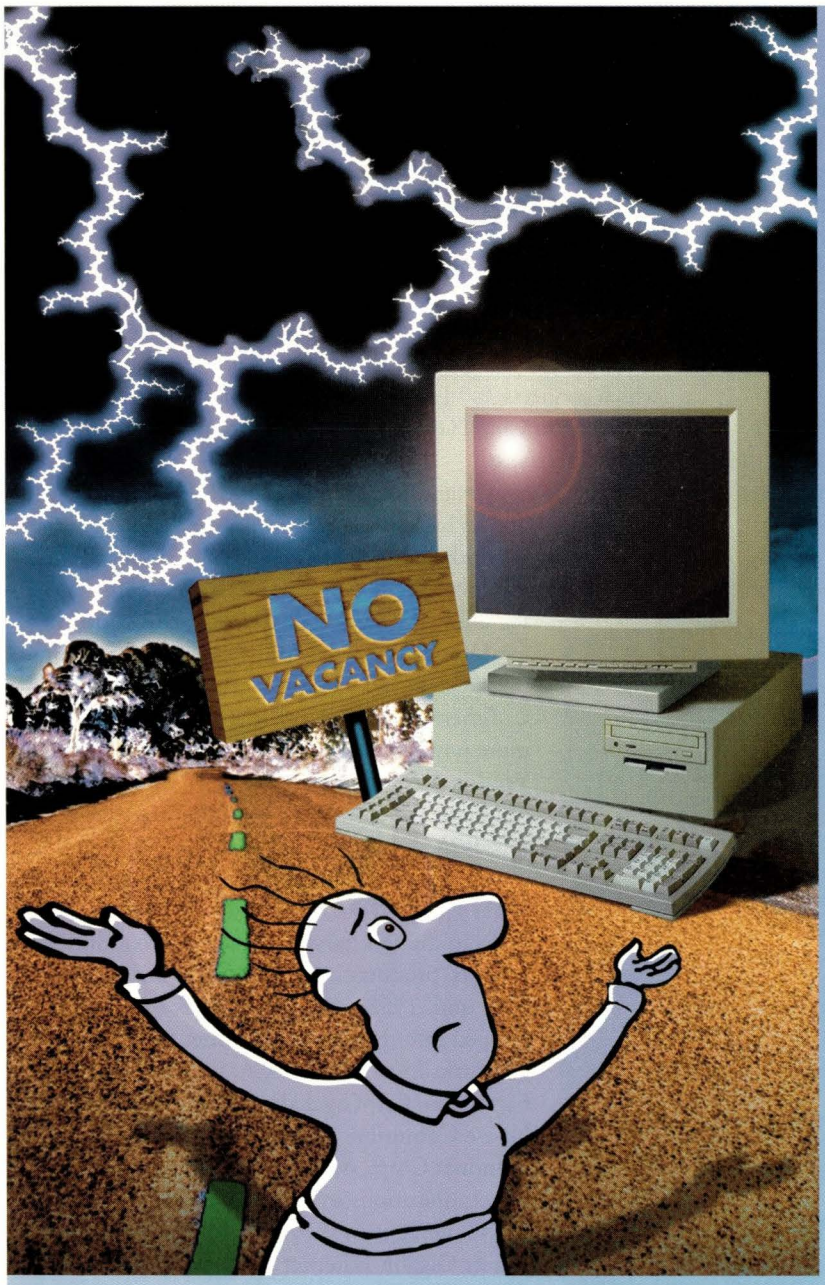
Vendors have tried to address these problems with a 25-Mb/s version of ATM, which runs on copper wiring and costs $500 to $750. "There has been a lot of interest in 25 Mb/s in Europe, but not as much here in the United States," says Fore's Skorupa.

U.S. companies have been resistant because moving to ATM requires that companies swap out adapter cards and install new LAN switches. At the low end, all the work results in only a modest bandwidth increase: from 10 or 16 to 25 Mb/s.

Fore's Skorupa remains optimistic that ATM will gain a foothold at the desktop. "Companies will install new applications that will require the features that only ATM can deliver," he says.

But a growing number of people think that Ethernet has already won the battle at the desktop. "We just haven't seen much customer interest in desktop ATM, and I don't see any reason why that may change," says Cisco's DeBeer.

ATM is faring well in other segments, such as backbone networks that connect a series of departmental LANs. For instance, a backbone LAN enables engineers to ship documents to the marketing department. Usually, a company dumps all of its



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department traffic onto one backbone network. Because hundreds, or thousands, of users rely on these networks, backbones typically require faster transmission speeds than departmental LANs. ATM, which operates at up to 155 Mb/s, offers faster transmission speeds than Fast Ethernet on the backbone.

Ethernet has its limitations as a backbone option. Throughput is one issue. Ethernet parcels out bandwidth on a first-come, first-served basis. So, while Fast Ethernet theoretically offers companies 100 Mb/s of bandwidth, actual throughput tends to be 20% to 50% less.

Redundancy is another important issue with backbone networks. If a problem occurs on one network segment, then the entire network could go down, and no department could send information. ATM includes redundant capabilities; Ethernet lacks them.

Consequently, a growing number of organizations are looking to ATM for their backbone connections. Fannie Mae plans to upgrade its backbone, which is based on Fiber Distributed Data Interface (FDDI) technology. Fannie Mae's Colburn says the organization, which could select a new backbone by the fall, is now leaning toward ATM because of its ability to carry data, video and voice on one communications line.

Yet there are organizations installing Fast Ethernet on their backbones, despite its limitations. Stanford University, Stanford, CA, has been using shared FDDI connections as its backbone, which connects 300 LANs stationed in various departments, according to Chip Haven, acting director of network systems at the university.

The university plans to use Cisco 100-Mb/s Ethernet switches to build its backbone. Stanford's Haven says the move will simplify network management because most backbone, desktop and server connections will be based on Ethernet. Also, the university has installed twisted-pair wiring in a few locations, and they can more easily be tied into the backbone via Ethernet than with ATM.

Ethernet has the potential to become an even more popular backbone option in the future. Vendors have been developing 1-Gb/s Ethernet products, which would offer faster transmission speeds than ATM.

Early Adopters

Even though standards to ensure that different vendors' products interoperate will not be complete until 1998, start-up suppliers have already jumped into the Gigabit Ethernet arena. Alteon Networks Inc., San Jose, CA; Extreme Networks, Cupertino, CA; GigaLabs Inc., Sunnyvale, CA; NBase Communications Corp., Chatsworth, CA; Prominet Corp., Marlborough, MA; Rapid-City Communications Inc., Mountain View, CA; and XLNT Designs Inc., San Diego, CA, all plan to deliver Gigabit Ethernet products by the fall. 3Com also plans to enter the fray at that time. The first wave of products will support shared Gigabit connections, but switched connections are in the vendors' product development plans.

Fast Ethernet is gaining a foothold with the third type of network connection: server connections. With the move to distributed computing, companies have built applications that divide processing chores among a series of networked systems. In this case, computers handle specific functions: one system may run a database management system and support every application accessing customer records.

As the number of computers accessing one server increases, bottlenecks arise. A company can alleviate this problem by providing a high-speed connection from a server to department LANs.

Fast Ethernet is gaining ground here because many Ethernet switches were built to support 10-Mb/s switched Ethernet connections to the

Companies Mentioned in this Article

3Com Corp.
5400 Bayfront Plaza
P.O. Box 58145
Santa Clara, CA 95052
http://www.3com.com
Circle 150

Alteon Networks Inc.
6351 San Ignacio Ave.
San Jose, CA 95119
http://www.alteon.com
Circle 151

Asante Technologies Inc.
821 Fox Lane
San Jose, CA 95131
http://www.asante.com
Circle 152

Bay Networks Inc.
4401 Great America Pkwy.
P.O. Box 58185
Santa Clara, CA 95052
http://www.baynetworks.com
Circle 153

Cisco Systems Inc.
170 W. Tasman Drive
San Jose, CA 95134
http://www.cisco.com
Circle 154

Extreme Networks
10460 Bandley Drive
Cupertino, CA 95014
http://www.extremenetworks.com
Circle 155

Fore Systems Inc.
174 Thorn Hill Road
Warrendale, PA 15086
http://www.fore.com
Circle 156

GigaLabs Inc.
290 Santa Ana Court
Sunnyvale, CA 94086
http://www.gigalabs.com
Circle 157

NBase Communications Corp.
8943 Fullbright Ave.
Chatsworth, CA 91311
http://www.nbase.com
Circle 158

Prominet Corp.
100 Nickerson Road
Windsor Corporate Center
Marlborough, MA 01752
http://www.prominet.com
Circle 159

Rapid-City Communications Inc.
1215 Terra Bella Ave.
Mountain View, CA 94043
http://www.rapid-city.com
Circle 160

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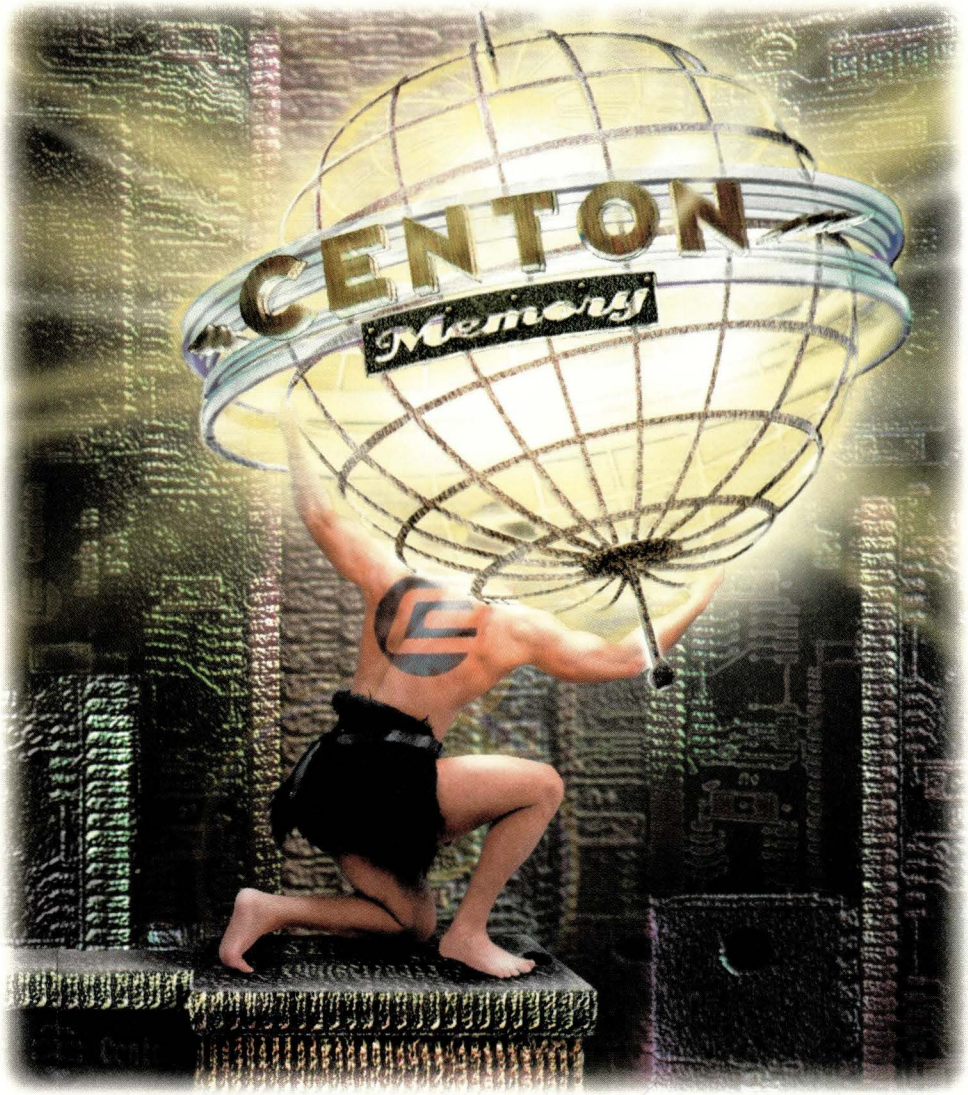

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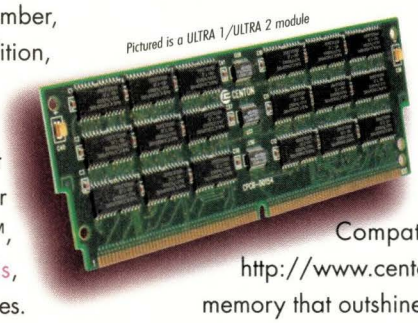

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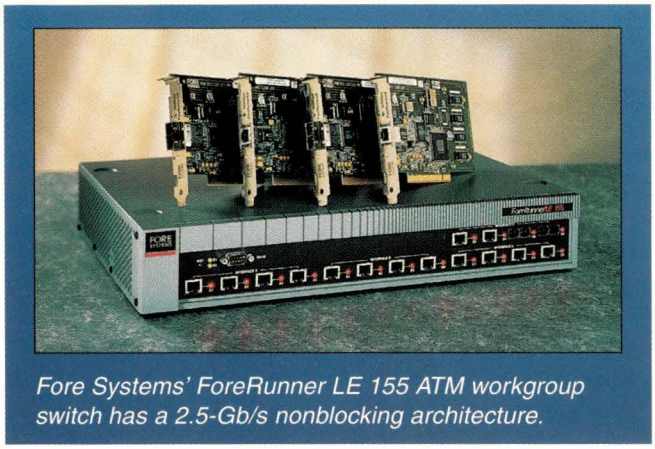


Fore Systems' ForeRunner LE 155 ATM workgroup switch has a 2.5-Gb/s nonblocking architecture.

desktop and 100-Mb/s connections for special requirements, such as easing server congestion. Vendors such as Sun have begun including integrated Fast Ethernet adapters in their high-end servers.

The growing Ethernet momentum is making switching a more popular option on corporate networks. "Revenue from our switched connections has been gaining on our shared products during the past 18 months, and we see no reason why that will change," says 3Com's Glazebrook. "In fact, this [second] quarter, we expect to ship as many switched connections as shared connections."

The Dell'Oro Group expects sales of switched Ethernet ports to increase by 12% to 27% each quarter during 1997; in comparison, it expects shared Ethernet port shipments to decrease by 4% to 9% per quarter.

So the scales seem to be tipping toward switched connections. Cisco's DeBeer says many large corporations have mapped out strategic long-term plans to move from shared to switched LANs during the next 12 to 18 months.

3Com's Glazebrook says companies are now dabbling with sophisticated applications that will require dedicated bandwidth. "Companies are moving to more real applications, such as multicast and desktop video systems," he says. "To keep these transmissions from jarring, a desktop will need dedicated bandwidth, and switching is one way to offer that capability."

Users also see a shift in buying patterns. At Stanford, Havens expects the percentage of switched connections on the university's network to rise from the current level of less than 5% of the network connections to more than 50% in two to three years. "The pricing for switched products has dropped so significantly that it's now comparable to a shared connection," Havens says. "Switching helps to solve bandwidth contention issues, so I expect more and more users will take advantage of it."

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

Remote Access Servers

KEY

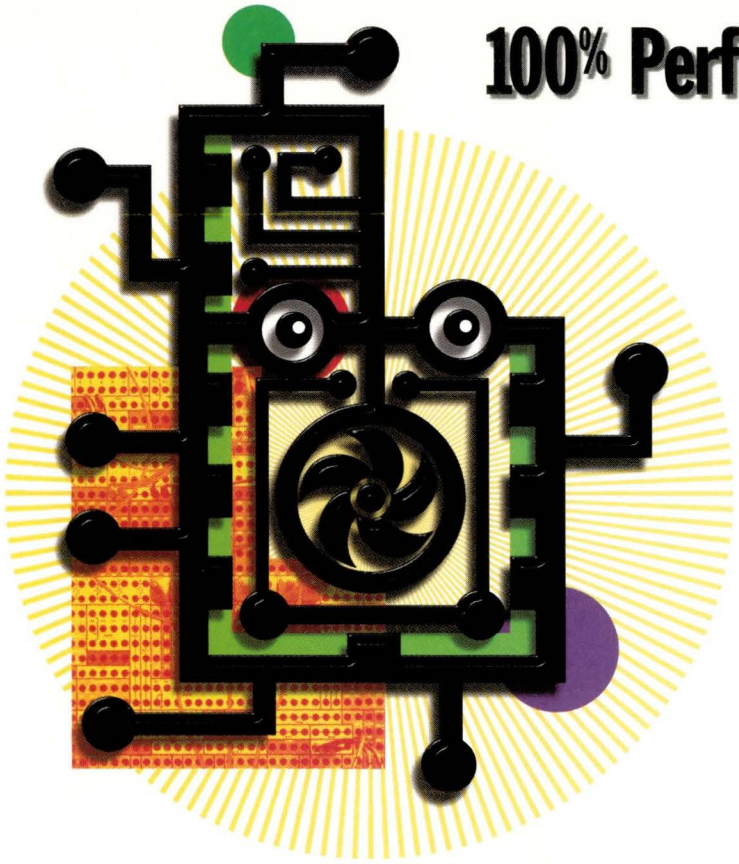
BRI	=	Basic Rate Interface
CLID	=	Calling Line Identification
DES	=	Data Encryption Standard
E1	=	European wide-area digital transmission
NA	=	Not applicable
PRI	=	Primary Rate Interface
TACACS	=	Terminal Access Controller Access Control System

compiled by MAUREEN MCKEON

	3Com NetServer 8/16 I-Modem	Advanced Computer Communications Mississippi	Advanced Computer Communications Tigris	Ascend Communications MAX 200+	Ascend Communications MAX 1800
Number of ports supported	8 or 16	10	28 T1 lines	8	16
Fast Ethernet network connection	No	No	Yes	No	No
RJ45 port	Yes	Yes	Yes	Yes	Yes
10-MB/s functionality	Yes	Yes	Yes	Yes	Yes
100-MB/s functionality	No	No	Yes	No	No
Mixed 10- or 100-MB/s functionality	No	No	Yes	No	No
Maximum data transfer rate supported	1,024 Kb/s (uncompressed)	512 Kb/s	8.19 Mb/s (LAN 100 Mb/s)	230 Kb/s	230 Kb/s
Modem speeds supported	56 Kb/s	56 Kb/s	56 Kb/s	v.34, ISDN BRI	56 Kb/s, ISDN BRI
Interfaces	1 BNC, 1 10BaseT	1 AUI or 1 BNC	None	1 AUI or 10BaseT	1 AUI or 10BaseT
ROUTING SUPPORT:					
TCP/IP	Yes	Yes	Yes	Yes	Yes
IPX	Yes	Yes	Yes	Yes	Yes
AppleTalk	Yes	No	Yes	Yes	Yes
Remote user	Yes	Yes	Yes	Yes	Yes
LAN to LAN	Yes	No	Yes	Yes	Yes
Internet access	Yes	Yes	Yes	Yes	Yes
Modem sharing	Yes	Yes	Yes	Yes	Yes
Windows 95	Yes	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	Yes	No	No	Yes	Yes
Multilink PPP (MP)	Yes	Yes	Yes	Yes	Yes
Compressed SLIP	Yes	No	No	Yes	Yes
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	None	Static or roaming dial-back, encrypted passwords, more	CLID, call back	Proprietary (TACACS, TACACS+, Token Card, more)	Proprietary (TACACS, TACACS+, Token Card, more)
Authentication Method Support					
RADIUS	Yes	Yes	Yes	Yes	Yes
Kerberos	No	No	No	No	No
SecurID	No	Yes	No	Yes	Yes
Server login required of all users to gain network access	Yes	Yes	If desired	Yes	Yes
Dial-back authentication	Yes	If desired	If desired	Yes	Yes
Scheduled dial-back support	No	Yes	No	Yes	Yes
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	Yes	Yes	Yes	Yes	Yes
Bandwidth on demand	Yes	Yes	Yes	Yes	Yes
Protocol filtering	Yes	Yes	Yes	Yes	Yes
IPX spoofing	Yes	No	Yes	Yes	Yes
Connection-time parameter setup	No	No	No	Yes	Yes
MANAGEMENT:					
GUI for configuration/management	Yes	Yes	Yes	Yes	Yes
Web browser-based utility	No	No	Yes	No	No
SNMP agent	Yes	Yes	Yes	Yes	Yes
Telnet capabilities	Yes	Yes	Yes	Yes	Yes
Pricing	$6,495 (8-port model), $9,995 (16-port model)	$2,495+ (hardware & software)	$14,990+	Chassis with MAXLink Pro & MAXDial $2,400; with 4 ISDN PCMCIA BRI cards $4,200	Chassis $6,400, MAXDial $500, Secure Access Firewall $2,000

Remote Access Servers

	Ascend Communications MAX 2000	Ascend Communications MAX 2012	Ascend Communications MAX 4004	Ascend Communications MAX 4048	Ascend Communications MAX TNT
Number of ports supported	24	12	96	96	672
Fast Ethernet network connection	No	Yes	No	No	Yes
RJ45 port	Yes	Yes	Yes	Yes	Yes
10-MB/s functionality	Yes	Yes	Yes	Yes	Yes
100-MB/s functionality	No	No	No	No	Yes
Mixed 10- or 100-MB/s functionality	No	No	No	No	Yes
Maximum data transfer rate supported	230 Kb/s	230 Kb/s	230 Kb/s	230 Kb/s	100 Mb/s
Modem speeds supported	56 Kb/s, ISDN BRI	56 Kb/s	56 Kb/s, ISDN BRI/PRI, v.34	56 Kb/s, ISDN BRI/PRI, v.34	56 Kb/s, v.34
Interfaces	1 AUI or 10BaseT	1 AUI or 10BaseT	1 AUI or 10BaseT	1 AUI or 10BaseT	1 AUI or 10BaseT
ROUTING SUPPORT:					
TCP/IP	Yes	Yes	Yes	Yes	Yes
IPX	Yes	Yes	Yes	Yes	Yes
AppleTalk	Yes	Yes	Yes	Yes	Yes
Remote user	Yes	Yes	Yes	Yes	Yes
LAN to LAN	Yes	Yes	Yes	Yes	Yes
Internet access	Yes	Yes	Yes	Yes	Yes
Modem sharing	Yes	Yes	Yes	Yes	Yes
Windows 95	Yes	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	Yes	Yes	Yes	Yes	Yes
Multilink PPP (MP)	Yes	Yes	Yes	Yes	Yes
Compressed SLIP	Yes	Yes	Yes	Yes	Yes
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	Proprietary (TACACS, TACACS+, Token Card, more)	Proprietary (TACACS, TACACS+, Token Card, more)	Proprietary (TACACS, TACACS+, Token Card, more)	Proprietary (TACACS, TACACS+, Token Card, more)	Proprietary (TACACS, TACACS+, Token Card, more)
Authentication Method Support					
RADIUS	Yes	Yes	Yes	Yes	Yes
Kerberos	No	No	No	No	Yes
SecurID	Yes	Yes	Yes	Yes	Yes
Server login required of all users to gain network access	Yes	Yes	Yes	Yes	If desired
Dial-back authentication	Yes	Yes	Yes	Yes	Yes
Scheduled dial-back support	Yes	Yes	Yes	Yes	Yes
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	Yes	Yes	Yes	Yes	Yes
Bandwidth on demand	Yes	Yes	Yes	Yes	Yes
Protocol filtering	Yes	Yes	Yes	Yes	Yes
IPX spoofing	Yes	Yes	Yes	Yes	Yes
Connection-time parameter setup	Yes	Yes	Yes	Yes	Yes
MANAGEMENT:					
GUI for configuration/management	Yes	Yes	Yes	Yes	Yes
Web browser-based utility	No	No	No	No	Yes
SNMP agent	Yes	Yes	Yes	Yes	Yes
Telnet capabilities	Yes	Yes	Yes	Yes	Yes
Pricing	Chassis $6,500, MAXDial $500, Secure Access Firewall $2,000	Chassis $8,400, Hybrid Access Software $1,500, Secure Access Firewall $2,000	Chassis $15,500, Hybrid Access Software $1,500, MAXLink Pro $2,500, MAXDial $2,500	$26,400 (hardware & software)	$18,750-$120,000



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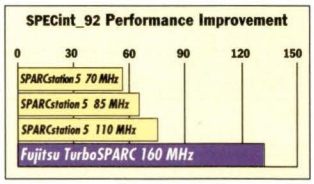

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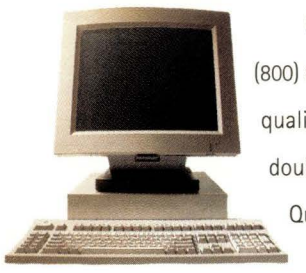

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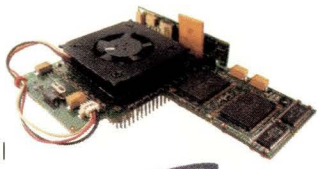

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Remote Access Servers

	Aurora Technologies LANMultiServer 2000*	Bay Networks 5399 Concentrator Module	Cabletron Systems CSX400	Cabletron Systems CSX5500	Cabletron Systems CSX6000
Number of ports supported	16-64	48-576 (T1), 60-720 (E1)	2 WAN	16 WAN, 2 LAN	24 WAN, 2 LAN
Fast Ethernet network connection	NA	Yes	No	No	No
RJ45 port	NA	Yes	Yes	Yes	Yes
10-MB/s functionality	NA	Yes	Yes	Yes	Yes
100-MB/s functionality	NA	Yes	No	No	No
Mixed 10- or 100-MB/s functionality	NA	Yes	No	No	No
Maximum data transfer rate supported	115.2 Kb/s async., 256 Kb/s sync.	230 Kb/s	2.048 Mb/s	2.048 Mb/s	2.048 Mb/s
Modem speeds supported	115.2 Kb/s	33.6 Kb/s	512 Kb/s	56 Kb/s	56 Kb/s
Interfaces	NA	4 AUI, 24 10BaseT	2 AUI	2 AUI	2 AUI
ROUTING SUPPORT:					
TCP/IP	NA	Yes	Yes	Yes	Yes
IPX	NA	Yes	Yes	Yes	Yes
AppleTalk	NA	Yes	No	Yes	Yes
Remote user	Software-determined	Yes	Yes	Yes	Yes
LAN to LAN	Software-determined	Yes	Yes	Yes	Yes
Internet access	Software-determined	Yes	Yes	Yes	Yes
Modem sharing	Software-determined	Yes	No	No	No
Windows 95	No	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	Yes	Yes	Yes	No	No
Multilink PPP (MP)	Yes	Yes	Yes	Yes	Yes
Compressed SLIP	Yes	Yes	Yes	No	No
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	NA	Access Control Panel (proprietary), more	None	TACACS, SecureID, CLID, more	TACACS, SecureID, CLID, more
Authentication Method Support					
RADIUS	Software-determined	Yes	No	Yes	Yes
Kerberos	Software-determined	Yes	No	No	No
SecurID	Software-determined	Yes	No	Yes	Yes
Server login required of all users to gain network access	Yes	Yes	No	Yes, if user-level authentication is activated	Yes, if user-level authentication is activated
Dial-back authentication	If desired	Yes, via Fast Link software	Yes	Yes	Yes
Scheduled dial-back support	No	No	Yes	No	No
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	Software-determined	Yes	Yes	Yes	Yes
Bandwidth on demand	No	No	Yes	Yes	Yes
Protocol filtering	Software-determined	Yes	Yes	Yes	Yes
IPX spoofing	No	No	Yes	Yes	Yes
Connection-time parameter setup	Software-determined	Yes	Yes	Yes	Yes
MANAGEMENT:					
GUI for configuration/management	No	Yes	Yes	Yes	Yes
Web browser-based utility	No	Yes	No	No	No
SNMP agent	No	Yes	Yes	Yes	Yes
Telnet capabilities	Yes	Yes	Yes	Yes	Yes
Pricing	$2,500 for 16 ports	$19,995 (48 dual-WAN ports), $25,995 (60 dual-WAN ports)	$3,063 (hardware & software)	$9,500+ (hardware & software)	$14,500+ (hardware & software)

*SBus-compatible terminal server that attaches directly to the serial port.

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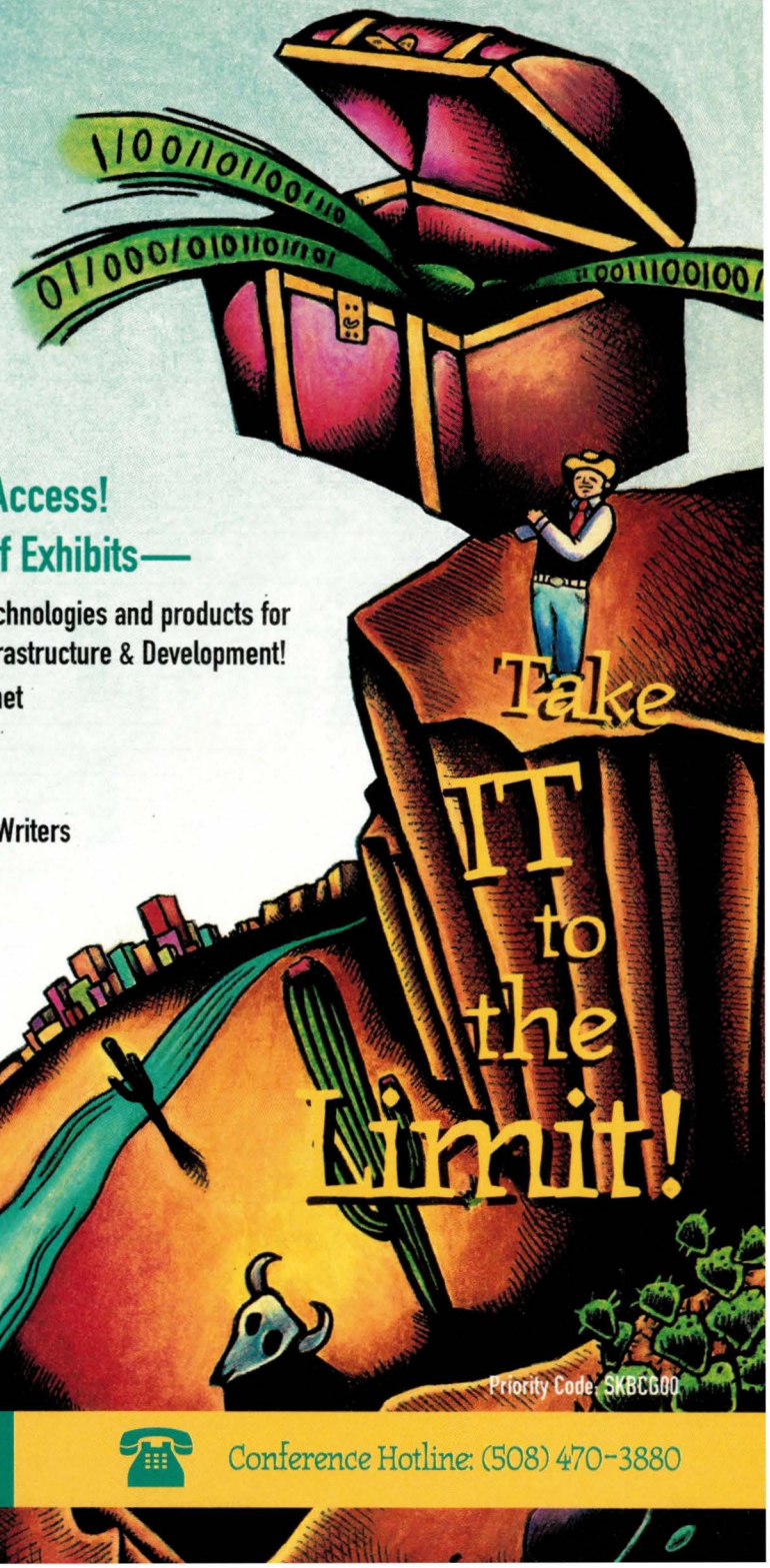

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Remote Access Servers

	Cabletron Systems CSX7000	Cayman Systems Marina 130	Cisco Systems AS5200	Cyclades PathRAS	Digital Equipment DECserver 90M
Number of ports supported	48 WAN, 4 LAN	3 WAN	48 (2 PRI), 48 (T1), 60 (E1)	8-16	8
Fast Ethernet network connection	No	No	No	No	No
RJ45 port	Yes	Yes	No	Yes	Yes
10-MB/s functionality	Yes	Yes	Yes	Yes	Yes
100-MB/s functionality	No	No	No	No	No
Mixed 10- or 100-MB/s functionality	No	No	No	No	No
Maximum data transfer rate supported	2,048 Mb/s	115.2 Kb/s	1,544 Mb/s (T1) 2,048 Mb/s (E1)	115.2 Kb/s	57.6 Kb/s
Modem speeds supported	56 Kb/s	56 Kb/s, ISDN	56 Kb/s	Any DTE speed up to 115.2 Kb/s	v.34 at 33.6 Kb/s
Interfaces	2 AUI	1 AUI, 1 BNC or 1 10BaseT	None	1 AUI, 1 10BaseT	1 BNC, 1 10BaseT, 1 DEChub90
ROUTING SUPPORT:					
TCP/IP	Yes	Yes	Yes	Yes	No
IPX	Yes	No	Yes	No	No
AppleTalk	Yes	Yes	Yes	No	No
Remote user	Yes	Yes	Yes	Yes	Yes
LAN to LAN	Yes	Yes	Yes	Yes	Yes, via static routing tables
Internet access	Yes	Yes	Yes	Yes	No
Modem sharing	No	No	Yes	No	Yes, via Telnet listeners
Windows 95	Yes	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	No	No	Yes	No	Yes
Multilink PPP (MP)	Yes	No	Yes	No	No
Compressed SLIP	No	No	Yes	No	Yes
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	TACACS, SecureID, CLID, more	None	None	TACACS	Proprietary keycards (Watchword, Defender)
Authentication Method Support					
RADIUS	Yes	No	Yes	Yes	Yes
Kerberos	No	No	Yes	No	Yes
SecurID	Yes	No	Yes	No	Yes
Server login required of all users to gain network access	Yes, if user-level authentication is activated	If desired	Yes	If desired	Yes
Dial-back authentication	Yes	No	Yes	No	Yes (fixed & roaming)
Scheduled dial-back support	No	No	Yes	No	Yes
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	Yes	Yes	Yes	Yes	Yes
Bandwidth on demand	Yes	No	Yes	Yes	No
Protocol filtering	Yes	No	Yes	No	No
IPX spoofing	Yes	No	Yes	No	No
Connection-time parameter setup	Yes	No	Yes	No	Yes
MANAGEMENT:					
GUI for configuration/management	Yes	Yes	Yes	No	Yes
Web browser-based utility	No	No	Yes, with Cisco's AccessPath	No	No
SNMP agent	Yes	No	Yes	Yes	Yes
Telnet capabilities	Yes	Yes	Yes	Yes	Yes
Pricing	$24,800+ (hardware & software)	$995 (hardware & software)	$28,100 (48 modems, IP only)	$1,332 (8 ports, hardware & software), $1,499 (16 ports, hardware & software)	$1,527 (hardware & software)

Remote Access Servers

	Digital Equipment DECserver 700-16	Digital Equipment DECserver 900TM	Emulex Network Systems ConnectPlus LT	Emulex Network Systems ConnectPlus Pro	Hayes Microcomputer Products Century 9200
Number of ports supported	16	32	2	8 PC card, 2 serial WAN	8-24
Fast Ethernet network connection	No	No	No	No	No
RJ45 port	Yes	Yes	Yes	Yes	Yes
10-MB/s functionality	Yes	Yes	Yes	Yes	Yes
100-MB/s functionality	No	No	No	No	No
Mixed 10- or 100-MB/s functionality	No	No	No	No	No
Maximum data transfer rate supported	115.2 Kb/s	115.2 Kb/s	115.2 Kb/s	115.2 Kb/s	115.2 Kb/s
Modem speeds supported	v.34 at 33.6 Kb/s	v.34 at 33.6 Kb/s	56 Kb/s	56 Kb/s	33.6 Kb/s
Interfaces	1 AUI, 1 10BaseT	1 AUI, 1 DEChub 900	1 BNC	1 AUI, 1 BNC	1 AUI, 1 10BaseT
ROUTING SUPPORT:					
TCP/IP	No	No	Yes	Yes	Yes
IPX	No	No	Yes	Yes	Yes
AppleTalk	No	No	Yes	No	No
Remote user	Yes	Yes	Yes	Yes	Yes
LAN to LAN	Yes, via static routing tables	Yes, via static routing tables	No	Yes	No
Internet access	No	No	Yes	Yes	No
Modem sharing	Yes, via Telnet listeners	Yes, via Telnet listeners	Yes	Yes	No
Windows 95	Yes	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	Yes	Yes	Yes	Yes	Yes
Multilink PPP (MP)	No	No	No	No	No
Compressed SLIP	Yes	Yes	No	No	Yes
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	Proprietary keycards (Watchword, Defender)	Proprietary keycards (Watchword, Defender)	Password encryption	Password encryption	None
Authentication Method Support					
RADIUS	Yes	Yes	No	Yes	Yes
Kerberos	Yes	Yes	No	No	No
SecurID	Yes	Yes	No	Yes	No
Server login required of all users to gain network access	Yes	Yes	If desired	If desired	If desired
Dial-back authentication	Yes (fixed & roaming)	Yes (fixed & roaming)	Yes	Yes	If desired
Scheduled dial-back support	Yes	Yes	Yes	Yes	No
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	Yes	Yes	Yes	Yes	Yes
Bandwidth on demand	No	No	No	No	No
Protocol filtering	No	No	Yes	Yes	Yes
IPX spoofing	No	No	Yes	Yes	No
Connection-time parameter setup	Yes	Yes	Yes	Yes	No
MANAGEMENT:					
GUI for configuration/management	Yes	Yes	Yes	Yes	Yes
Web browser-based utility	No	No	No	No	No
SNMP agent	Yes	Yes	Yes	Yes	Yes
Telnet capabilities	Yes	Yes	No	No	Yes
Pricing	$3,377 (hardware & software)	$4,915 (hardware & software)	$699 (hardware & software)	$2,695 (hardware & software)	$8,995 (with dual T1 & 48-port digital modems)

Remote Access Servers

	Hayes Microcomputer Products Century 9400	IBM 8235 DIALs (Dial-in Access to LANs) Server	ITK International NetBlazer LS Family	ITK International NetBlazer PN Family	ITK International NetBlazer STi
Number of ports supported	8-48	2-72	2	4	32
Fast Ethernet network connection	No	No	No	No	No
RJ45 port	Yes	Yes	Yes	Yes	Yes
10-MB/s functionality	Yes	Yes	Yes	Yes	Yes
100-MB/s functionality	No	No	No	No	No
Mixed 10- or 100-MB/s functionality	No	No	No	No	No
Maximum data transfer rate supported	115.2 Kb/s	115.2 Kb/s single port, 512 Kb/s LAN-to-LAN	384 Kb/s	128 Kb/s	1.544 Mb/s (T1), 2.048 Mb/s (E1)
Modem speeds supported	33.6 Kb/s	33.6 Kb/s	115.2 Kb/s	115.2 Kb/s	115.2 Kb/s
Interfaces	1 AUI, 1 10BaseT	1 AUI or 1 BNC	1 AUI, 1 BNC	1 AUI, 1 BNC	1 AUI, 1 BNC
ROUTING SUPPORT:					
TCP/IP	Yes	Yes	Yes	Yes	Yes
IPX	Yes	Yes	Yes	Yes	Yes
AppleTalk	No	Yes	Yes	Yes	Yes
Remote user	Yes	Yes	Yes	Yes	Yes
LAN to LAN	No	Yes	Yes	Yes	Yes
Internet access	No	Yes	Yes	Yes	Yes
Modem sharing	Yes	Yes	Yes	Yes	Yes
Windows 95	Yes	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	Yes	Yes	Yes	Yes	Yes
Multilink PPP (MP)	No	Yes	Yes	Yes	Yes
Compressed SLIP	Yes	Yes	Yes	Yes	Yes
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	None	TACACS, TACACS+, more	None	None	None
Authentication Method Support					
RADIUS	Yes	Yes	Yes	Yes	Yes
Kerberos	No	Yes	Yes	Yes	Yes
SecurID	No	Yes	Yes	Yes	Yes
Server login required of all users to gain network access	If desired	Yes	Yes	Yes	Yes
Dial-back authentication	If desired	Yes	Yes	Yes	Yes
Scheduled dial-back support	No	Yes	No	No	No
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	Yes	Yes	No	No	No
Bandwidth on demand	No	No	Yes	Yes	Yes
Protocol filtering	Yes	Yes	Yes	Yes	Yes
IPX spoofing	No	Yes	Yes	Yes	Yes
Connection-time parameter setup	No	Yes	No	No	No
MANAGEMENT:					
GUI for configuration/management	Yes	Yes	Yes	Yes	Yes
Web browser-based utility	No	No	Yes	Yes	Yes
SNMP agent	Yes	Yes	Yes	Yes	Yes
Telnet capabilities	Yes	Yes	Yes	Yes	Yes
Pricing	$16,995 (with dual T1 & 48-port digital modems)	$1,500-$50,000 (hardware & software)	$899-$1,399 (depending on model & functionality)	$1,849-$2,149 (depending on model & number of connections)	$3,199+ (hardware & software)

Remote Access Servers

	ITK International NetBlazer 40i	ITK International MicaBlazer	ITK International Suprimo	Kasten Chase Applied Research Secure+	Kasten Chase Applied Research Optiva 8.2.1
Number of ports supported	64	60	120	8	10
Fast Ethernet network connection	No	No	No	No	No
RJ45 port	Yes	Yes	Yes	Yes	Yes
10-MB/s functionality	Yes	Yes	Yes	Yes	Yes
100-MB/s functionality	No	No	No	No	No
Mixed 10- or 100-MB/s functionality	No	No	No	No	No
Maximum data transfer rate supported	1.544 Mb/s (T1), 2.048 Mb/s (E1)	1.544 Mb/s (T1), 2.048 Mb/s (E1)	2.048 Mb/s (E1)	115.2 Kb/s on all ports simultaneously	115.2 Kb/s on all ports simultaneously
Modem speeds supported	115.2 Kb/s	115.2 Kb/s	115.2 Kb/s	33.6 Kb/s v.34, ISDN	33.6 Kb/s v.34, ISDN
Interfaces	1 AUI, 1 BNC	1 AUI, 1 BNC	1 AUI, 1 BNC	1 AUI, 1 BNC	1 AUI, 1 BNC
ROUTING SUPPORT:					
TCP/IP	Yes	Yes	Yes	Yes	Yes
IPX	Yes	Yes	No	Yes	Yes
AppleTalk	Yes	Yes	No	No	No
Remote user	Yes	Yes	Yes	Yes	Yes
LAN to LAN	Yes	Yes	Yes	Yes	Yes
Internet access	Yes	Yes	Yes	Yes	Yes
Modem sharing	Yes	Yes	Yes	Yes	Yes
Windows 95	Yes	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	Yes	Yes	Yes	No	No
Multilink PPP (MP)	Yes	Yes	Yes	No	No
Compressed SLIP	Yes	Yes	Yes	No	No
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	None	None	None	Real-time, data-stream encryption	None
Authentication Method Support					
RADIUS	Yes	Yes	Yes	Yes	Yes
Kerberos	Yes	Yes	No	No	No
SecurID	Yes	Yes	No	Yes	Yes
Server login required of all users to gain network access	Yes	Yes	If desired	If desired	If desired
Dial-back authentication	Yes	Yes	Yes	If desired (static & roaming)	If desired (static & roaming)
Scheduled dial-back support	No	No	No	Yes	Yes
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	No	No	No	Yes	Yes
Bandwidth on demand	Yes	Yes	Yes	No	No
Protocol filtering	Yes	Yes	No	No	No
IPX spoofing	Yes	Yes	No	Yes	Yes
Connection-time parameter setup	No	No	No	Yes	Yes
MANAGEMENT:					
GUI for configuration/management	Yes	Yes	Yes	Yes	Yes
Web browser-based utility	Yes	Yes	Yes	No	No
SNMP agent	Yes	Yes	Yes	Yes	Yes
Telnet capabilities	Yes	Yes	Yes	Yes	Yes
Pricing	$5,199 (hardware & software)	$15,299 [T1 Model] (24-port digital modem board, a dual T1 PRI or E1 PRI board, 8-MB RAM & software)	$19,998-$52,498 (models scaling from 30 ISDN-only connections to 60 ISDN analog modem connections)	$3,495 (dial-in, dial-out)	$3,495 (dial-in, dial-out)

Remote Access Servers

	Lantronix LRS1-T	Lantronix LRS2	Lantronix LRS16	Lantronix LRS32F	LeeMah DataCom BandWagon
Number of ports supported	1	2	16	32	66-72
Fast Ethernet network connection	No	No	No	Yes	Yes, 2 100BaseT
RJ45 port	Yes	Yes	Yes	Yes	Yes
10-MB/s functionality	Yes	Yes	Yes	Yes	Yes
100-MB/s functionality	No	No	No	Yes	Yes
Mixed 10- or 100-MB/s functionality	No	No	No	Yes	Yes
Maximum data transfer rate supported	115 Kb/s	115 Kb/s	115 Kb/s	230 Kb/s	115.2 Kb/s
Modem speeds supported	No internal modems	No internal modems	No internal modems	No internal modems	33.6 Kb/s
Interfaces	None	1 AUI, 1 BNC	1 AUI, 1 BNC	1 AUI, 1 BNC	1 AUI, 1 BNC, 1 10BaseT
ROUTING SUPPORT:					
TCP/IP	Yes	Yes	Yes	Yes	Yes
IPX	Yes	Yes	Yes	Yes	Yes
AppleTalk	Yes	Yes	Yes	Yes	No
Remote user	Yes	Yes	Yes	Yes	Yes
LAN to LAN	Yes	Yes	Yes	Yes	Yes
Internet access	Yes	Yes	Yes	Yes	Yes
Modem sharing	Yes	Yes	Yes	Yes	Yes
Windows 95	Yes	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	Yes	Yes	Yes	Yes	Yes
Multilink PPP (MP)	No	Yes	Yes	Yes	Yes
Compressed SLIP	Yes	Yes	Yes	Yes	No
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	None	None	None	None	DES-based user authentication, Challenge/Response, more
Authentication Method Support					
RADIUS	Yes	Yes	Yes	Yes	Yes
Kerberos	Yes	Yes	Yes	Yes	No
SecurID	Yes	Yes	Yes	Yes	Yes
Server login required of all users to gain network access	If desired	If desired	If desired	If desired	If desired
Dial-back authentication	If desired	If desired	If desired	If desired	Yes
Scheduled dial-back support	No	No	No	No	No
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	Yes	Yes	Yes	Yes	Yes
Bandwidth on demand	No	Yes	Yes	Yes	Yes
Protocol filtering	Yes	Yes	Yes	Yes	Yes
IPX spoofing	Yes	Yes	Yes	Yes	No
Connection-time parameter setup	Yes	Yes	Yes	Yes	Yes
MANAGEMENT:					
GUI for configuration/management	Yes	Yes	Yes	Yes	Yes
Web browser-based utility	No	No	No	No	No
SNMP agent	Yes	Yes	Yes	Yes	Yes
Telnet capabilities	Yes	Yes	Yes	Yes	No
Pricing	$545 (hardware & software)	$995 (hardware & software)	$2,495 (hardware & software)	$3,995 (hardware & software)	$5,800 (hardware & software)

Remote Access Servers

	Livingston Enterprises PortMaster2 Communications Server	Livingston Enterprises PortMaster3 Integrated Access Server	Multi-Tech Systems MiniArrayIII	Osicom Technologies IQX-200	Perle Systems 833
Number of ports supported	30	60	32	168	2, 4 or 8
Fast Ethernet network connection	No	No	No	Yes	No
RJ45 port	Yes	Yes	Yes	Yes	No
10-MB/s functionality	Yes	Yes	Yes	Yes	Yes
100-MB/s functionality	No	No	No	Yes	No
Mixed 10- or 100-MB/s functionality	No	No	No	Yes	No
Maximum data transfer rate supported	115.2 Kb/s	1.544 Mb/s (T1), 2.048 Mb/s (E1)	115.2 Kb/s	1.3 GB (PCI backplane)	115 Kb/s
Modem speeds supported	56 Kb/s	56 Kb/s	33.6 Kb/s	56 Kb/s	56 Kb/s
Interfaces	1 AUI, 1 BNC	1 AUI, 1 BNC	1 BNC	None	1 AUI, 1 BNC
ROUTING SUPPORT:					
TCP/IP	Yes	Yes	Yes	Yes	Yes
IPX	Yes	Yes	Yes	Yes	Yes
AppleTalk	No	No	No	No	Yes
Remote user	Yes	Yes	Yes	Yes	Yes
LAN to LAN	Yes	Yes	Yes	Yes	No
Internet access	Yes	Yes	Yes	Yes	Yes
Modem sharing	Yes	Yes	Yes	Yes	Yes
Windows 95	Yes	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	Yes	Yes	Yes	No	No
Multilink PPP (MP)	Yes	Yes	No	Yes	No
Compressed SLIP	Yes	Yes	No	No	No
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	None	None	None	Access Shift (allows time of day access per employee)	Password aging
Authentication Method Support					
RADIUS	Yes	Yes	Yes	Yes	Yes
Kerberos	Yes	Yes	No	No	No
SecurID	Yes	Yes	Yes	No	Yes
Server login required of all users to gain network access	If desired	If desired	No	If desired	Yes
Dial-back authentication	If desired	If desired	No	If desired	Yes
Scheduled dial-back support	Yes	Yes	No	Yes	No
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	Yes	Yes	Yes	Yes	Yes
Bandwidth on demand	Yes	Yes	No	Yes	No
Protocol filtering	Yes	Yes	Yes	Yes	No
IPX spoofing	Yes	Yes	No	Yes	Yes
Connection-time parameter setup	Yes, via RADIUS	Yes, via RADIUS	No	Yes	No
MANAGEMENT:					
GUI for configuration/management	Yes	Yes	Yes	No	Yes
Web browser-based utility	No	No	Yes	No	No
SNMP agent	Yes	Yes	No	Yes	Yes
Telnet capabilities	Yes	Yes	Yes	Yes	No
Pricing	$2,495+	$6,950+	$4,299 (rack & 8 serial ports), $4,599 (rack & 8 modems)	$3,945 (hardware & software)	$1,795+

Remote Access Servers

	SBE netXpand Central Version 3.0	Shiva LanRover E/Plus	Shiva LanRover Access Switch	Sonic Systems QuickStream Pro	VersaNET Communications ISP-Accelerator
Number of ports supported	10	4-8	12-72	3	48
Fast Ethernet network connection	No	No	No	No	Yes
RJ45 port	Yes	Yes	Yes	Yes	Yes
10-MB/s functionality	Yes	Yes	Yes	Yes	Yes
100-MB/s functionality	No	No	Yes	No	Yes
Mixed 10- or 100-MB/s functionality	No	No	Yes	No	Yes
Maximum data transfer rate supported	2.0 Mb/s (E1)	128 Kb/s	128 Kb/s	115.2 Kb/s	100 Mb/s
Modem speeds supported	14.4-33.6 Kb/s, ISDN BRI	33.6 Kb/s	56 Kb/s	56 Kb/s	33.6 Kb/s, 56 Kb/s
Interfaces	1 AUI	1 AUI, 1 BNC, 1 10BaseT	1 AUI, 1 10BaseT	1 BNC	1 10BaseT
ROUTING SUPPORT:					
TCP/IP	Yes	Yes	Yes	No	Yes
IPX	Yes	Yes	Yes	No	No
AppleTalk	No (bridged)	Yes	Yes	No	No
Remote user	Yes	Yes	Yes	Yes	Yes
LAN to LAN	No	Yes	Yes	No	Yes
Internet access	Yes	Yes	Yes	Yes	Yes
Modem sharing	Yes	Yes	Yes	Yes	Yes
Windows 95	Yes	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:					
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	No	Yes	Yes	No	Yes
Multilink PPP (MP)	Yes	Yes	Yes	No	Yes
Compressed SLIP	No	No	No	No	Yes
SECURITY:					
Dial-in Security Support					
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes	Yes
Other	IP filtering	Shiva Password Authentication Program	Shiva Password Authentication Program	None	None
Authentication Method Support					
RADIUS	No	Yes	Yes	No	Yes
Kerberos	No	Yes	Yes	No	No
SecurID	No	Yes	Yes	No	No
Server login required of all users to gain network access	If desired	Yes	Yes	Yes	Yes
Dial-back authentication	If desired	Yes	Yes	No	No
Scheduled dial-back support	No	No	No	No	No
LINK MANAGEMENT SUPPORT:					
Inactivity time-out	Yes	Yes	Yes	No	Yes
Bandwidth on demand	No	Yes	Yes	No	Yes
Protocol filtering	Yes	Yes	Yes	No	Yes
IPX spoofing	Yes	Yes	Yes	No	No
Connection-time parameter setup	Yes	No	No	No	Yes
MANAGEMENT:					
GUI for configuration/management	Yes	Yes	Yes	Yes	Yes
Web browser-based utility	No	No	No	Yes	Yes
SNMP agent	Yes	Yes	Yes	No	Yes
Telnet capabilities	No	Yes	Yes	Yes	Yes
Pricing	$2,499 (hardware & software)	Contact vendor	Contact vendor	$999 (hardware & software)	$258/port or $9,300 fully configured (33.6 Kb/s) product; $351/port or $16,860 fully configured digital (56 Kb/s) product


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Remote Access Servers

	Xyplex Networks MAXserver 1600 Family	Xyplex Networks Network 3000 Edge Router	Zoom Telephonics Access 2 (Model 7402)	Zoom Telephonics Access 8 (Model 7401)
Number of ports supported	4, 8, 20 or 40	4 WAN, 1 LAN	2	8
Fast Ethernet network connection	No	No	No	No
RJ45 port	Yes	Yes	Yes	Yes
10-MB/s functionality	No	Yes	Yes	Yes
100-MB/s functionality	No	No	No	No
Mixed 10- or 100-MB/s functionality	No	No	No	No
Maximum data transfer rate supported	115.2 Kb/s	115.2 Kb/s async.	115 Kb/s	115 Kb/s
Modem speeds supported	115.2 Kb/s	115.2 Kb/s	33.6 Kb/s	33.6 Kb/s
Interfaces	1 AUI	1 AUI	1 AUI	1 AUI
ROUTING SUPPORT:				
TCP/IP	Yes, static only	Yes	Yes	Yes
IPX	No	Yes	No	No
AppleTalk	No	Yes	No	No
Remote user	Yes	Yes	Yes	Yes
LAN to LAN	Yes	Yes	Yes	Yes
Internet access	Yes	Yes	Yes	Yes
Modem sharing	Yes	No	Yes	Yes
Windows 95	Yes	Yes	Yes	Yes
PROTOCOLS SUPPORTED:				
Point-to-Point Protocol (PPP)	Yes	Yes	Yes	Yes
Serial Line Internet Protocol (SLIP)	Yes	Yes	No	No
Multilink PPP (MP)	Yes	Yes	Yes	Yes
Compressed SLIP	Yes	No	No	No
SECURITY:				
Dial-in Security Support				
Password Authentication Protocol (PAP)	Yes	Yes	Yes	Yes
Challenge Handshake Authentication Protocol (CHAP)	Yes	Yes	Yes	Yes
Other	None	DES, administrative password, packet filtering	None	None
Authentication Method Support				
RADIUS	Yes	Yes	Yes	Yes
Kerberos	Yes	Yes	No	No
SecurID	Yes	Yes	No	No
Server login required of all users to gain network access	If desired	If desired	Yes	Yes
Dial-back authentication	If desired	No	Yes	Yes
Scheduled dial-back support	Yes	No	No	No
LINK MANAGEMENT SUPPORT:				
Inactivity time-out	Yes	Yes	Yes	Yes
Bandwidth on demand	Yes	Yes	No	No
Protocol filtering	Yes	Yes	Yes	Yes
IPX spoofing	No	Yes	No	No
Connection-time parameter setup	Yes	Yes	Yes	Yes
MANAGEMENT:				
GUI for configuration/management	Yes	Yes	Yes	Yes
Web browser-based utility	No	No	Yes	Yes
SNMP agent	Yes	Yes	No	No
Telnet capabilities	Yes	Yes	No	No
Pricing	$1,195-$4,995	$2,490+	$895	$1,795

Remote Access Servers

Companies Mentioned in this Survey

3Com Corp.
8100 McCormick Blvd.
Skokie, IL 60078
Circle 200

Advanced Computer Communications Inc.
340 Storke Road
Santa Barbara, CA 93117
Circle 201

Ascend Communications Inc.
1701 Harbor Bay Pkwy.
Alameda, CA 94502
Circle 202

Aurora Technologies Inc.
176 Second Ave.
Waltham, MA 02154
Circle 203

Bay Networks Inc.
4401 Great America Pkwy.
Santa Clara, CA 95054
Circle 204

Cabletron Systems Inc.
35 Industrial Pkwy.
Rochester, NH 03867
Circle 205

Cayman Systems Inc.
100 Maple St.
Stoneham, MA 02180
Circle 206

Cisco Systems Inc.
170 W. Tasman Drive
San Jose, CA 95134
Circle 207

Cyclades Corp.
41934 Christy St.
Fremont, CA 94538
Circle 208

Digital Equipment Corp.
550 King St.
Littleton, MA 01460
Circle 209

Emulex Network Systems Corp.
3535 Harbor Blvd.
Costa Mesa, CA 92626
Circle 210

Hayes Microcomputer Products Inc.
P.O. Box 105203
Atlanta, GA 30348
Circle 211

IBM Corp.
3039 Cornwallis Road
Research Triangle Park, NC 27709
Circle 212

ITK International Inc.
(formerly Telebit Corp.)
One Executive Drive
Chelmsford, MA 01824
Circle 213

Kasten Chase Applied Research
5100 Orbitor Drive
Mississauga, Ontario
Canada L4W 4Z4
Circle 214

Lantronix
15353 Barranca Pkwy.
Irvine, CA 92618
Circle 215

LeeMah DataCom
6200 Paseo Padre Pkwy.
Fremont, CA 94555
Circle 216

Livingston Enterprises Inc.
4464 Willow Road
Pleasanton, CA 94588
Circle 217

Multi-Tech Systems Inc.
2205 Woodale Drive
Mounds View, MN 55112
Circle 218

Osicom Technologies Inc.
7402 Hollister Ave.
Santa Barbara, CA 93117
Circle 219

Perle Systems Inc.
630 Oakmont Lane
Westmont, IL 60559
Circle 220

SBE Inc.
4550 Norris Canyon Road
San Ramon, CA 94583
Circle 221

Shiva Corp.
28 Crosby Drive
Bedford, MA 01730
Circle 222

Sonic Systems Inc.
575 N. Pastoria Ave.
Sunnyvale, CA 94086
Circle 223

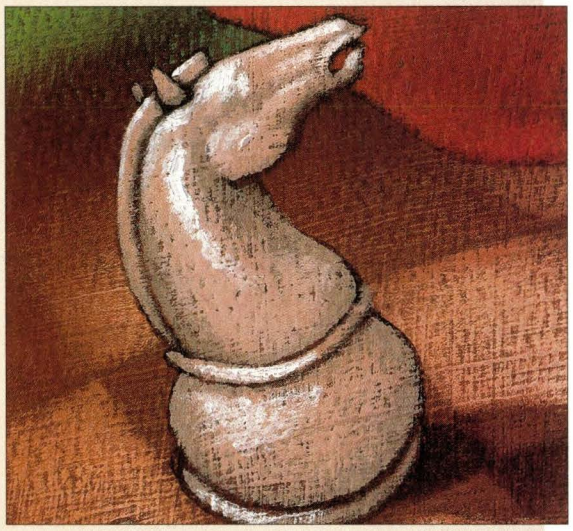
VersaNET Communications Inc.
6 N. Diamond Bar Blvd.
Diamond Bar, CA 91765
Circle 224

Xyplex Networks
295 Foster St.
Littleton, MA 01460
Circle 225

Zoom Telephonics Inc.
207 South St.
Boston, MA 02111
Circle 226

RS/Magazine

Feature



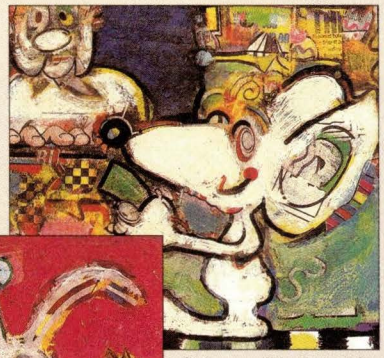
92 Master Moves

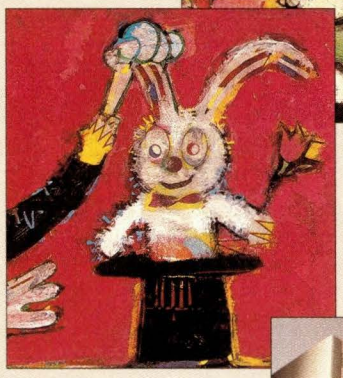
by Patrick T. Coleman, Staff Editor

IBM's Scalable POWERparallel system has much more than chess moves to offer those looking for powerful parallel processing in a modular, scalable package.

Columns

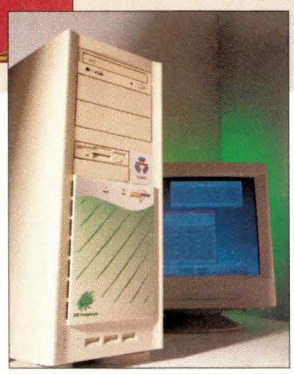
Read our Web site ***http://www.cpg.com***





Columns illustrated by DANIEL C. O'CONNOR

Departments



Bonus Distribution of the October Issue:
NetWorld/Interop — *Atlanta, GA*

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Fed UNIX 97 — *Washington, DC*

Daily Times

Special Edition • August, 1997

TODAY'S NEWS...

IBM®AIX® 3.2.x Users Need to Upgrade to 4.x

By Bill Stevens

After December 31, 1997, IBM will no longer support older AIX versions 3.2.x. According to Stephan Moen, Vice-President of Information Technology, Aspen is ready to upgrade all AIX 3.2.x users to the latest version of AIX 4.x. "This is just one of the many system integration services that Aspen offers," commented Moen.

As the system integrator to the AIX user community, Aspen Consulting is a full service firm handling all aspects of the RS/6000 and AIX. Aspen consultants are experts working with IBM RS/6000™SP™, Storage Systems, HACMP, Tivoli®,

SEE UPGRADE, PAGE 5

Martian Pathfinder Mission A Success

IBM® RS/6000™ Capabilities Make It All Possible

By Linda Smith
DAILY TIMES NEWS SERVICE

This month's proper soft landing on develop- captured th and testing. It would nc rol, AIX the comput municate the IBM RS ace-dust technology ess beam on board th hnology Pathfinder. metime

The new ,000 IBM budget, usi 00's are in off the shelf in over businesses h 00 com- Developed f l and tech- in less than customers the vehicle v AIX, the to carry cam UNIX the Sojourne operating meteorologic environ- communicate computer back to earth er. The withstand tak mission landing on un ne up to deploy its scie 0 IBM direct the expe commer- the mission to stomers using AIX, the closest in comp IX based operating system. The computer

The flight c is based on a vers IBM's RS/6000 technology and the first commercially based processor to travel into deep space. Since software development was critical to the success of the mission, using known and successful technology was key to saving money and time to allow

SEE PATHFINDER, BACK PAGE

by Jim Fox

Root with Restrictions

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

A *wizard's apprentice*

AA *super user*

AAA *wizard*

Q: I've a question regarding the Q&AIX article that appeared in *SunExpert,* May 1997 ("setuid Dangers," Page 66), where Bud Ding Hacker finds a way to be root. Do you know of a way to set up a user with some root privileges such as executing commands and scripts so that a computer operator can run a system backup, for instance, or execute some commands that require one to be root? But, I don't want them to have complete root access, to overwrite or delete files, for example. AA

Raju Shah
TTI Inc.

A: A limited root capability is such a good idea one wonders why vendors haven't implemented it. Fortunately, someone else did, so you're saved a lot of work. But before we get to the program, let's consider the problem.

There's a reason some commands and files are restricted to root access. They have the capability to compromise the system. Allowing someone to run backup, for example, gives that person access to all files on the system, including `/etc/security/passwd` and the company president's email. Only give partial root access to people you already trust.

What you're really gaining is convenience. Restricted access prevents conscientious operators from accidentally causing damage, and it makes browsing of private files sufficiently difficult that it will not be done casually or whimsically. But don't be misled: Don't give this capability to anyone you don't know and trust.

The sudo Program

The program I have in mind is `sudo`. It was written by several generous people, most recently, Todd Miller of Courtesan Consulting, and is found at `http://www.courtesan.com/courtesan/products/sudo/`.

Get the distribution from one of the mirror sites shown on that Web page. You get source in a compressed `tar` file. Uncompress and untar it. Before building the program, there's some customization you will have to do. All of these are found in the include file `options.h` and are described more fully in the `OPTIONS` text file. Make the following changes to the defaults:

1. Define **`NO_MESSAGE`.** `sudo` has a kind of chummy, informal approach that is incompatible with its serious utility.

2. Define **`SECURE_PATH`.** By default, `sudo` allows a user to have any path at all.

That's intolerable. Check the path you assign to SECURE_PATH to make sure it contains only the necessary directories. An example of a good path might be /bin:/usr/sbin:/etc.

3. **Define NO_ROOT_SUDO.** This prevents root from running sudo. There's no reason for root to be running this program, and it invites chicanery to allow it.

4. **Define LOGGING and LOGFAC.** These tell sudo how to log usage. The defaults are OK, but you can't watch things without knowing what these values are.

Apart from these, the defaults won't hurt you. Even if this program is just for you, you really should avoid the funny error messages triggered by the USE_INSULTS definition. It may have been funny to hear HAL say, "I'm sorry Dave, I can't do that," in the movie *2001: A Space Odyssey*, but you won't like it when the hour is late, the raptors are chewing at the door, and your only hope of salvation keeps responding, "Whoa buddy, my horse types better'n that!" Computer humor has to be very innocent and subtle, or it doesn't work at all.

After setting and checking the options, run configure. This will build a Makefile. I always enjoy watching configure run. It gives a kind of bird's-eye view of the system.

sudo has some capability to use many common authentication protocols in addition to the standard password file. These include one-time passwords, SecurID cards, Kerberos and DCE. Activate one of these with the appropriate configure command-line option. See the INSTALL notes for details, if you want to use one of these methods.

Finally, type make install to install the files. The sudo program will be installed into /usr/local/bin with the setuid bit set.

Authorizing Users

Now you're ready to authorize some users. Do that by editing the authorization file /etc/sudoers. It contains a list of all users who have access to sudo and specifies what commands each user can run. A sample file is shown in Figure 1.

You have quite a bit of flexibility. The host specifications allow a single file to serve several machines for convenience. The sample permits the regular operators, joe and bob, to run all of the specified commands. The apprentice operator, pete, is allowed to do backups on all systems, but restores and shutdowns only on the server systems.

Obviously, I could not think of any really useful commands. The configuration is largely dependent on your local practices. You can get the idea though.

The sudoers file is actually a little more capable than I have shown–too capable, I think. Be conservative here. Look at the sudoers man page to see a more complete description of the authorization file.

sudo comes with an editor wrapper, visudo, which locks the file before running vi and verifies the contents afterward. This seems like overkill to me, but there's certainly no harm in using it.

Once sudo and the configuration file are in place, you're done. Any authorized user can run one of the allowed commands as root by typing

```
$ sudo command args
```

There are some optional parameters to sudo, but the plain way is probably how you'll be using it. You might want to keep an eye on the logs for your own peace of mind.

Well, now you can give limited permission to your operators to do backups. Be careful though. That limited permission can be hard to control. ⊸

Figure 1. Sample sudo Authorization File

```
# Hosts
Host_Alias   SERVERS=alpha,beta,gamma
Host_Alias   ADMIN=delta,chi

# Users
User_Alias   OPS=joe,bob
User_Alias   PRENTICE=pete

# Commands
Cmnd_Alias   LS=ls,cat
Cmnd_Alias   DOWN=shutdown,reboot,halt
Cmnd_Alias   BKP=backup.restore

# Who and what
OPS          LS,DOWN,BKP
PRENTICE     SERVERS=LS,BKP: ALL=backup

%wheels      DOWN
```

by John S. Quarterman

CDA Buried

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

At about 10 a.m. (CDT), Thursday, June 26, 1997, the U.S. Supreme Court, by a vote of seven to two, upheld the preliminary injunction of last year by the U.S. District Court for the Eastern District of Pennsylvania and declared the so-called Communications Decency Act (CDA) unconstitutional (for more information, see `http://www.ciec.org/SC_appeal/decision.html`). By doing so, it buried the CDA, and did so in no uncertain fashion:

"The CDA's 'indecent transmission' and 'patently offensive display' provisions abridge the 'freedom of speech' protected by the First Amendment."

Furthermore:

"In Sable, 492 U.S., at 127, we remarked that the speech restriction there amounted to 'burn[ing] the house to roast the pig.' The CDA, casting a far darker shadow over free speech, threatens to torch a large segment of the Internet community."

Problems with the CDA

As problems with the CDA, the court cited (among other things):

- The lack of definition of "indecent."
- The restrictions on parental consent to their children's use of restricted materials.
- Its broad categorical prohibitions.

The Court turned the arguments of the defendants (including the government) against them, saying that review of Ginsberg v. New York and FCC v. Pacifica "raises, rather than relieves, doubts about the CDA's constitutionality."

The Court clearly stated that the Internet is "a medium that, unlike radio, receives full First Amendment protection." So that there would be no mistake about it, the Court enumerated specific differences, such as that traditional broadcast media have, or had, scarce available frequencies and could be invasive. The Court thus headed off any further attempts to censor the Internet based on analogies with media such as the telephone (which as you may recall was one of Sen. James Exon's [R-Nebraska] favorite analogies), radio and television.

The Court dealt with the distributed nature of the Internet in its example of

"a parent who sent his 17-year-old college freshman information on birth control via email could be incarcerated even though neither he, his child, nor anyone in their home community, found the material 'indecent' or 'patently offensive,' if the college town's community thought otherwise."

Such examples permitted the Court to note that the CDA did not attempt to define the time, place or manner of its prohibitions. They also permitted the Court to avoid dealing directly with the international extent of the Internet and to stick to U.S. issues.

And the Court specifically noted that the CDA was tacked onto the Telecommunications Act of 1996 in a manner unlike any of the other provisions of that law, and that its content was different from that of the rest of the Act, which was intended to reduce regulation and promote competition among providers of other media, such as telephone, cable and traditional broadcasting. The Court even quoted Sen. Patrick Leahy (D-Vermont), from a speech he made in the Senate noting the unusual path the CDA had taken to get into the Act.

Implications for Spam

This decision by the U.S. Supreme Court doesn't seem to say anything explicitly about spam. However, it does have an implication for spam. The decision is very clear that content censorship was the primary problem with the CDA. Those of us who are fighting spam should therefore be very careful not to define spam in terms of content. To do so would be to violate the very freedom of speech First Amendment protection of the Internet many of us have fought all the way to the Supreme Court to have affirmed.

We should, instead, define spam in terms of the real problems of spam, which are that it is unsolicited by the recipients, distributed in bulk, often uses other parties' (especially Internet service providers') resources without permission, and usually contains forged return address information. Those are plenty of reasons and sufficient characteristics for fighting spam. The content of most spam would not be a problem anyway, if it appeared on a Web page or an FTP server. The few exceptions are just that: exceptions. They should not be used to define the whole category of spam.

The Press

It is interesting to see how the press reports on this decision. Local television news stations here in Austin, TX, had been playing this story as the "Internet regulation" or "Internet pornography" case. Reuters played it as a slap in the face for the Clinton administration. Both of those interpretations are a bit off the mark. This case was more about the legal definition of an entire class of new media carried on the Internet and about the application of the First Amendment to it. It's true that President Clinton signed the law and was half-hearted in his criticism of the CDA, but he did at least say that he did so expecting it to be challenged in the courts for a final decision.

Some news reports have stated that the Court ruled the Internet has the same protections as print media. I don't see anywhere in the decision where it says that. Rather, the decision says that the Internet is "a unique and wholly new medium." In other words, the Internet may actually have *more* protections than print media. Since the Court's decision, even President Clinton has come around to a position of hands off the Internet.

This case was also about whether the system of government enshrined in the U.S. Constitution would act to protect one of the most basic features of the Constitution: the First Amendment. It did. The entire apparatus of legislative, executive and judicial branches got involved before it did, but it did.

The Supreme Court declined, however, to deal with the Fifth Amendment issues that the Philadelphia District Court had raised.

And in a more general sense, this case was about whether the United States would be a good Internet citizen and avoid imposing problems that the rest of the world would have to route around, or setting precedents that could be used by repressive regimes in other parts of the world. The Supreme Court did avoid these pitfalls.

From time to time, people ask me what their governments should do regarding the Internet. My recommendation is very simple: "Stay out of the way." The U.S. Supreme Court provides in this decision reasoning for that position:

"In the absence of evidence to the contrary, we presume that governmental regulation of the content of speech is more likely to interfere with the free exchange of ideas than to encourage it. The interest in encouraging freedom of expression in a democratic society outweighs any theoretical but unproven benefit of censorship."

To the Proponents of CDA...

This decision is good for you, too. You still have ways of regulating what your children see over the Internet. These include the numerous products that block connections from a local machine to specific Internet servers; many of these were listed by the Philadelphia District Court in its decision. (For our take on the Philadelphia District Court decision, see `http://www.mids.org/mn/607/phila.html`.) Other means include subscribing to ISPs that provide tailored content. None of these are perfect. They all, however, offer more than the CDA. And because the CDA has been struck down, you retain the choice of means.

To the Opponents of CDA...

Let this be evidence that sometimes it does pay to stand by your position and not capitulate or compromise it away. For example, various people in Texas have attempted to make a deal with the state legislature to require ISPs to provide certain content, such as a list of end-user filtering products like those mentioned above. This introduces problems such as who will decide which products to list? The answer proposed in Texas was to have the state Internet Service Provider's Association, TISPA, decide (`http://www.tispa.org/`). But such a function gives a nongovernmental body a quasigovernmental role, which is a can of the same worms we've seen in the domain name registration arena.

I see no problem with ISPs listing content-filtering products; I encourage it. But I see great problems with letting the state camel's nose under the tent of ISP content provision. Once a precedent is set, the rest of the camel will follow, and ISPs will be dealing with more content regulations than they ever imagined. Fortunately, the Supreme Court CDA decision can now be used like a rolled up newspaper to encourage the camel to stay out of the tent.

The primary reason I heard for why ISPs should make this strange deal with the state government was that the proponents of censorship were going to pass some law, and this was the best law they would bend to. But we're not talking about compromising on amounts of money to fix potholes. State-mandated content regulation is state-mandated content regulation. When your opponent is standing firm on basic issues is often the best time for you to do the same. Appeasement is seldom the answer. The CDA was not struck down because those of us who opposed it offered 10% here and 5% there. It was struck down because it was opposed openly, consistently, for a long time, in many arenas and on basic issues.

A Unique and Wholly New Medium

The basic issue of the nature of the Internet has been around for a long time. I remember when we the USENIX Board of Directors were providing the first funding for UUNET in 1987, one of the most consistently recurring issues was whether networks such as USENET, the Internet and carriers like UUNET (and later AlterNet, which with PSINet was one of the first two commercial Internet providers in 1991) were broadcasters like radio and television stations and, thus, subject to content regulation, or common carriers like telephone companies and, thus, not subject. The interim solution was to assert that they were something in between. The basic question was whether the Internet was protected by the First Amendment.

The First Amendment to the U.S. Constitution:

"Congress shall make no law respecting the establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the Government for a redress of grievances."

The Supreme Court has finally clarified this issue by accepting all of the Philadelphia District Court's findings of fact as just that, fact ("the Internet is 'a unique and wholly new medium of worldwide human communication'") and in elaborating in its own words that the Internet is something different from previous media, not subject to many of the commonly cited precedents concerning those media, and clearly protected by the free speech provisions of the First Amendment. Ten years is a relatively short time for such a far-reaching legal precedent to be so clearly established. Finally, it has been done.

For ongoing updates on this and related issues, see the following: Citizens Internet Empowerment Coalition (`http://www.ciec.org/`), which was first with news of the Supreme Court decision; Voters Telecommunications Watch (`http://www.vtw.org/`), which has been very informative on this topic; and Electronic Privacy Information Center (`http://www.epic.org/`), which has stuck with the issue all the way.

by Jim DeRoest

Multimedia Plumbing

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

Some time ago, I received an email message from one of my editors after submitting a column on Web-based multimedia architectures. The message said that some well-known computer visionary had declared that "multimedia" was passé. Please, somebody announce this bit of wisdom to the millions of Web users. My Web servers and network pipes are already swamped by demand for more audio and video Web candy. I still wonder who this visionary was and whether they live on the same planet that I do.

Every news site and webzine I visit these days is announcing yet another Gates-esque power play to take over a business-critical piece of the broadcast and entertainment industry. We've got arguments in progress between computer and television vendors trying to decide whether every household will have a PC/TV or a TV/PC? Universities are scrambling to reach ever wider marketplaces through network-based distance education. No need to get out of bed to make it to class. Just pick up today's lecture from the department's Web page. Computer gaming has moved onto the Internet. Grandma has put away her knitting and is going head-to-head in network aerial combat with fighter pilots from all over the world. How about all the Web soap operas being produced in garages and dormitories? Then there's the computer sex industry. I'll leave it to your imaginations as to the multimedia possibilities in this genre.

So what are we as systems and network integrators supposed to do to keep Grandma from being prematurely knocked out of the virtual sky by traffic overload? These end users are not interested in whether or not we're ready for the service demand. Network video and audio is being marketed to them in a big way, and they expect us to deliver it.

Multimedia Infrastructure

We all know the core of the delivery quality of service problem is bandwidth. We need to squeeze more data down network pipes that are already full. This doesn't necessarily mean that the only solution is to add more and bigger pipes. Before calling the network plumber, we need to carefully review what it is we are trying to deliver, who the intended audience is, and how best to deliver it. Just because the Internet is there doesn't mean we should abandon traditional broadcast systems. I still prefer listening to FM on my $20 radio vs. the network broadcasts I get on my

$3,000 workstation. When network delivery is the target, then one place to start is reevaluating server infrastructure.

First, is the data format compatible with available network bandwidth? Multiple copies of a file formatted in different compression encodings can be mapped to interfaces that are best suited for transmission. Highly compressed, lower quality instances can be used for low bit-rate connections like modems. Higher quality, larger, content-rich files are for faster LAN connections. Note that you will want to do the actual data encoding and compression on systems other than your production delivery servers. Compression is numerically intensive and will consume a large amount of computational resources, in some cases for many days.

Next, rather than relying on a download-and-play service, consider installing streaming server and client software. Clients can begin playback of the information stream as soon as it arrives at the desktop. Server implementations that support stream splitting and IP multicast technologies can be used to conserve bandwidth by setting up distribution hierarchies for delivering data streams to individual clients. Some of the newer multimedia servers support multiple network protocols so as to work behind firewalls that may limit available protocols. Other protocol-based features include MTU discovery to reduce packet fragmentation when traversing multiple routers and gateways.

There are also a number of options to consider at the operating system and hardware levels. The hosting computers might be clustered to facilitate incremental growth and support load sharing. Clustering can be done by using hybrid domain name systems (DNSs) that respond to domain name queries by returning one of a set of server IP addresses based on a round-robin or server-busy algorithm. Access to file system data can be speeded up by increasing transfer block sizes and using striped disk media. This could be done using RAID disks or parallel file systems. Multimedia-friendly disks are also available that optimize track access to sequential data streams and limit or eliminate the time spent on error correction and retries. Less frequently accessed data could be moved to near-line storage, freeing high-speed devices for high-profile data. Near-line storage devices would include high transfer rate tapes and CD-ROMs managed by robotic systems.

Most of these technologies have been around for some time; others are newer or have recently been improved. The bottom line is that we've got a number of options we can use to buy us time until the next leap in multimedia server and network technology.

Compression vs. Quality

Even when you think you've got plenty of network bandwidth, compression can be desirable. For example, by using compression you can squeeze a larger number of simultaneous transmissions into the same network bandwidth. Trade-offs must be made between the quality of the signal on playback and the amount of bandwidth saved. Reception quality is a function of resolution, frames per second, connection bit rate and compression format. The trick is to pick the right combination of these parameters to optimize your use of network bandwidth. It is worth remembering, when making these choices, that the human perception of an audio signal will suffer more than with video signals when data is lost or delayed.

Any of a growing number of compression techniques may be employed to compress audio and video signals. The signals are transformed using coder/decoder software called "codecs." Commonly used compression methods for multimedia data are the MPEG-1 and MPEG-2 algorithms (see Table 1). The specification for MPEG officially titled the "Generic Coding of Moving Pictures and Associated Audio" was published in 1994 by the Moving Pictures Experts Group. MPEG compression reduces both spatial and temporal redundancy in a sequence of video frames and, thus, categorized as transform methods. The compressed data stream is made up of the compressed audio and video information, and timing information used to synchronize the audio and video during decompression on playback. Compression algorithms based on fractal and wavelet theory are achieving even higher compression rates with minimal transform interference.

The International Telecommunications Union/Telecommunications Standardization Sector (ITU-T) is also defining compression standards to support various bit rates, resolutions and application interfaces (see Table 2).

Table 1. MPEG Compression Formats

MPEG-1	Low bit-rate applications (352 by 240 by 30 Hz).
MPEG-2	Higher bit-rate applications up to 9 Mb/s.
MPEG-3	Originally directed at HDTV. Replaced by modified MPEG-2 syntax.
MPEG-4	Very low bit rates and frame rates (176 by 144 by 10 Hz). Downloadable (Java).

Table 2. ITU-T Compression Formats

G.723	Audio dual rate codec 5.3 and 6.3 Kb/s.
H.261	Video codec for fps X 64 Kb/s (fps=1 to 30). Discrete Cosine Transform (DCT).
H.263	Low bit-rate video codec. Supports higher resolution streams.
H.223, H.245	Control information.

Streaming Formats

Along with the compression method used, the data format may also indicate how the information is to be played back on reception. Older codec formats were meant to be played locally. This means when the files are served over the network, they will have to be downloaded completely before playback can commence. Common local data formats include Sun Microsystems Inc.'s Audio Sound format (AU), Microsoft Corp.'s Audio/Video Interleaved format (AVI), Apple Computer Inc.'s Audio Interchange File format (AIF, IIF) and QuickTime format (MOV).

Most people quickly grow impatient waiting for large local format files to transfer over slow connections. Stream protocols were introduced to reduce the download wait time along with the related end-user high blood pressure. As mentioned earlier, stream protocols allow files to be played as soon as the

Table 3. Multimedia Server Software

NetShow
Vendor: Microsoft Corp.
Platform: Windows NT
Features: Synchronizes audio, video, graphics and URLs.

RealServer
Vendor: Progressive Networks Inc.
Platforms: NT, Solaris, AIX, Linux, FreeBSD, SGI IRIX and HP/UX.
Features: UNIX Fork and NT Thread support Stream Thinning–dynamically adjust frame rates.

VideoCharger
Vendor: IBM Corp.
Platform: AIX
Features: MTU discovery to reduce fragmentation, 64-bit multimedia file system, real-time disk scheduling/calibration.

WebTheater
Vendor: VXtreme Inc.
Platforms: NT, Solaris and SGI IRIX.
Features: ActiveX compliant, Adaptive bandwidth adjustment.

data enters the receive buffer on the desktop client. Low-level stream protocol is defined by RFCs 1889 and 1890 "Real Time Transport Protocol (RTP)." A recently submitted IETF draft, "Real Time Streaming Protocol (RTSP)," adds higher level functions to RTP-like session negotiation and licensing checks to RTP.

RTSP is used in Progressive Networks Inc.'s RealAudio and RealVideo products and is backed by a large number of vendors, including Netscape Communications Corp., Sun, IBM Corp., Digital Equipment Corp., Hewlett-Packard Co. and Apple. Microsoft has developed its own streaming format called Active Streaming Format (ASF). ASF is an object-based system that supports selectable transfer bit rates up to 6 Mb/s. ASF objects are identified and versioned using the Open Software Foundation's Universal Unique Identifier (UUID) system (UUID). This provides a means for authenticating ASF objects and managing access controls.

What do you need in the way of server software to take advantage of these new compression and streaming capabilities? There are a growing number of vendor products to choose from. Most of them provide a common set of base features. These include support for prerecorded and live video feeds, broadcast scheduling, streaming and multicast transmission, multiprotocol transports, multiple data rates and load balancing across multiple servers. Table 3 lists some of the available vendor offerings. Visit the URLs listed in Table 4 for information regarding the complete set of features provided by the applications.

Table 4. Multimedia References

ITU-T
`http://www.itu.ch/`

MPEG
`http://drogo.cselt.stet.it/mpeg/`
`http://www.mpeg.org/`

Players and Servers
`http://www.microsoft.com/netshow/asf-wp.htm`
`http://www.real.com/`
`http://www.vxtreme.com/`
`http://quicktime.apple.com/`
`http://www.quicktimefaq.org/`
`http://www.rs6000.ibm.com/resource/technology/videoservers/`
`http://www.rs6000.ibm.com/solutions/videoservers/`
`http://www.interactive.ibm.com/`
`http://www.alphaworks.ibm.com/`

IEEE MultiMedia, April-June 1997, IEEE Computer Society

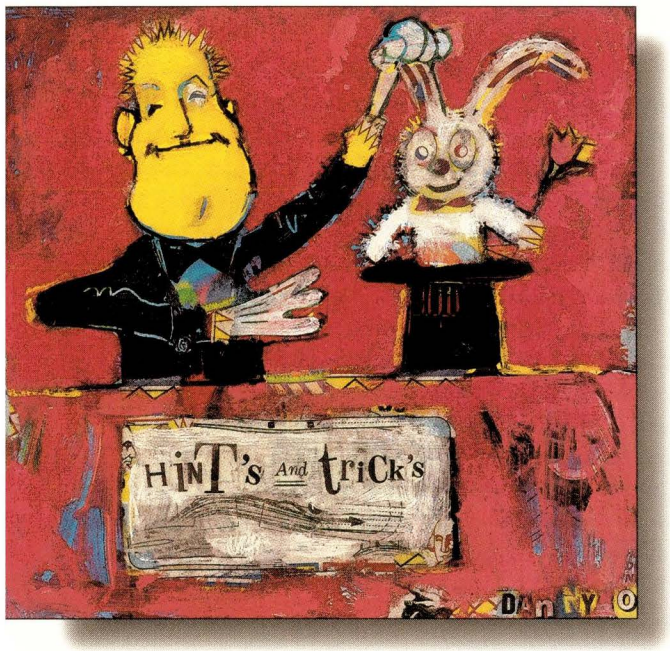
What you Need on the Desktop

Now that you have streaming servers in place, you're going to need desktop client codecs that can understand their lingo. Traditional local data format codecs such as Apple's QuickTime player and Microsoft's Video for Windows (VFW) are not compatible with the newer compression and streaming technologies. Can you upgrade? Bridge the gap from the old to new by using Swiss army knife codecs like Microsoft's ActiveMovie.

ActiveMovie understands a large number of legacy local data formats such as AVI and QuickTime as well as the newer streaming format used in ASF. ActiveMovie is object-based, using Microsoft's Component Object Module (COM) architecture. This allows it to be integrated with other object-based systems such as DirectX, and facilitates easy incorporation of other codecs into the ActiveX environment. You can also install additional client codecs on the desktop to provide interfaces to other streaming servers. Examples include Progressive Networks' RealPlayer for RealAudio and RealVideo playback, VXtreme's WebTheater client and IBM's Bamba codec. Most of these are supplied as plug-ins when users access Web servers using the particular architecture.

Again, most of these technologies have been around for awhile. Unfortunately, many of us have gathered a large number of download-and-play skeletons in our Web closets and just haven't kept up with the housekeeping. This means a conversion effort to achieve the benefits offered by compression and streaming. However, you'll find the end result well worth the effort. You can always offer both formats and migrate legacy files over time. Those of you lucky enough to be just getting started with network multimedia won't have this headache. But don't get to feeling too good about yourself, because the day's coming when your network pipes will be clogged and you'll be hollering for more Draino with the rest of us. ➸

by Jeffreys Copeland and Haemer



Practical CVS, Part 2

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For several articles, we have been developing a theme. Three months ago, we discussed how to back up individual files with `cp`. (If you didn't read the article, you're probably thinking, "How you write an entire article about `cp`?" Utilities from the Free Software Foundation, like love, are many-splendor'd things.) Next, we progressed to Revision Control System (RCS), which lets you maintain a detailed revision history of a file. Last month, we discussed the basics of Concurrent Versions System (CVS), which extends RCS to let you manage the full complexity of entire product releases.

Significantly, all of these are free and available from the Net: CVS is available at `http://www.loria.fr/~molli/cvs-index.html`; and the current version of RCS can be found in your favorite GNU tools directory, `ftp://prep.ai.mit.edu/pub/gnu/rcs-5.7.tar.gz`, for example.

This month, we'll sketch some of the more sophisticated features CVS offers to multideveloper, multisite, multirelease products.

Keeping Tags on Releases

Students and professors sometimes ask us how professional programming differs from programming for courses. One unique feature of professional programming is that because products evolve as time goes on, so much of it deals with multiple releases: preparing releases, documenting releases, freezing releases, fixing bugs in releases, upgrading releases, merging features from one release into another and so on. Academic software engineering, in contrast, often focuses on development toward a defined goal. When the "final version" of the software is finished, so is the project.

One thing that CVS provides to help manage product releases is *tags*.

Like RCS, on which it's built, CVS lets developers check out particular file revisions:

```
cvs co -r 30.2 main.c
```

The convenience of symbolic names was not lost on the authors of CVS, and so

```
cvs co -r prometheus main.c
```

will check out the revision named "prometheus." Not only is this easier to remember, but you can use a single name to check out an entire release. Assuming we have a module named "ll," instead of saying this:

```
cd ll
cvs co -r 100.43 README
cvs co -r 30.2 main.c
cvs co -r 12.1.9.6 abracadabra.pl
...
```

we can say

```
cvs co -r prometheus ll
```

assuming you've already attached the tag "prometheus" to release 100.43 of `README`, release 30.2 of `main.c` and so on.

And how do you attach tags to versions?

```
cvs tag prometheus ll
```

Like most other CVS commands, `cvs tag` understands trees and will traverse the entire hierarchy that you name, tagging every file in it. As an aside, you can block this file-tree walk by invoking it as `cvs tag -l`.

CVS uses the same flag in the same way for different commands wherever it's sensible, and the `-l` (local) flag also prevents subdirectory traversal for `checkout`, `commit`, `diff`, `export`, `remove`, `rdiff`, `rtag`, `status` and `update`.

This brings us to an interesting distinction: tags versus sticky tags.

Implementing Sticky Tags

There are two reasons to name a release: (a) because you want to work on it and (b) because you don't. For example, if I'm running a project and announce a code freeze, I probably want a label for all the file versions that make up that frozen release. This label provides a snapshot of the code at the point of the freeze.

Tags are the tool of choice here, and `cvs freeze` is a synonym for `cvs tag`. (Actually, many CVS commands have mnemonic synonyms. Try `cvs --help-synonyms` for a list.)

On the other hand, when I release products to the field, doing maintenance on those products means being able to check out old versions of files, revise them, and check those revised versions back into the repository without interfering with main-line development.

RCS permits this kind of work on individual files with "branch deltas." If the main-line development version of `foo.c` is revision 20.17, then checking out that version and checking it back in produces revision 20.18. If, however, you also need to fix a bug in an older version, say, revision 16.35, you can check out that revision with the command `co -r 16.35 foo.c`. Modifying the file and checking it back in produces a branch, with revision 16.35.1.1, and further work on that branch can produce 16.35.1.2, 16.35.1.3 and so on. The branch this creates is 16.35.1, and you can request the most recent revision of that branch by just typing `co -r 16.35.1 foo.c`

This sort of maintenance work is frequent for real software releases, so CVS lets you tag an entire collection of particular files for future checkout and maintenance. If you have a particular suite of file versions checked out, the command `cvs tag -b prometheus_maintenance` puts a "sticky tag" on all the modules in the current directory hierarchy. Not only will this let you check out the tagged version in the future–say with `cvs co -r prometheus_maintenance ll`–but when you check any changes back in, they will go in as a branch off of the appropriate revision of each of the changed files. Future checkouts of this same tagged version will get the most recent file revisions associated with that label. The tag "sticks to" the tip of the branch and grows with it.

There is a second sense in which the tag is sticky: If you check out a version with a sticky tag, chances are you're doing maintenance, so CVS remembers that you're working with this product release. Thus, a typical cycle looks like this:

```
# begin by checking out the
# "prometheus_maintenance" version
# of module "ll".
cvs co -r prometheus_maintenance ll
cd ll
   # work to upgrade some of the files,
...
   # save the changes in the branch
cvs ci
   # work to upgrade more files
   # in the same branch
...
   # pick up everyone else's
   # changes to this branch
cvs update
...   # and so on
```

To return to working on the main-line, you can reset the sticky tags with

```
cvs update -A
```

or you can simply discard the `prometheus_maintenance` tree and start from scratch with a new `cvs co`.

Administrative Files

Try this:

```
cvs co CVSROOT
ls CVSROOT
```

As we discussed last time, when you create a tree with `cvs init`, CVS automatically creates a suite of administrative files

in the directory $CVSROOT/CVSROOT. (If we were designing CVS, we'd pick a better name. If we were designing CVS, we'd have to implement it and maintain it. Actually, the name's not all that bad.)

Because the files are kept in the repository itself, we can check them out, modify them and check them back in. Figure 1 shows us the files in $CVSROOT/CVSROOT. Notice that $CVSROOT/CVSROOT contains both an RCS version *and* a checked-out master version of each file. The checked-out master is the administrative file that governs CVS' behavior. The RCS version is the repository version that contains that file's entire history. Whenever you check in a new revision of one of these files, CVS automatically updates the checked-out master with your changes.

One file, history, has no RCS version. This isn't a file that you can edit. It's just a record CVS keeps of what's been done. Each of the other files lets you configure how CVS behaves in interesting ways. Here are some highlights:

• commitinfo lets you specify what sorts of sanity checks should be made on files at check-in time. On our system, we run all files through a program that does a suite of fairly simple, but still useful, checks. For example, we require that all files have a "Header" or "Id" line (see the man page for the RCS co command). If they fail the check, CVS warns us of the problem, and the check-in fails until we fix it.

• editinfo lets you specify sanity checks on the log comments. Ours makes you say something. Anything. No more empty log comments in our tree, but we still get comments like "Fixed a bug."

• modules is a key file because it helps CVS users manipulate collections of files as entities. Some of this is well-documented, but some isn't. For example, if you have three top-level modules, called "curly," "larry" and "moe," each of which you can check out individually, you can make a sort of compound module with an entry like this in the modules file:

```
stooges    stooges & curly & larry & moe
```

This will check out the stooges module, but then also check out curly, larry and moe, making each of them a subdirectory under stooges.

• rcsinfo lets you specify log entry templates. If you have a form–or 40 forms, a different one for every module–that you want developers to use when they change files, this is the place to specify them.

These files, and the other administrative files, are well-documented internally. We encourage you to check out a copy and read through them.

Figure 1. The $CVSROOT/CVSROOT Directory

```
$ ls -C $CVSROOT/CVSROOT
checkoutlist     cvswrappers,v  loginfo,v   rcsinfo     verifymsg,v
checkoutlist,v   editinfo       modules     rcsinfo,v
commitinfo       editinfo,v     modules,v   taginfo
commitinfo,v     history        notify      taginfo,v
cvswrappers      loginfo        notify,v    verifymsg
```

Miscellaneous Tricks

The title of this column is "Practical CVS," and we want to leave you with a few useful tricks that we couldn't figure out where to fit in earlier:

• **CVS understands dates.** The flag -D, which lets you specify a date, is often a useful alternative to -r, which makes you specify a revision. The variety of acceptable date formats is surprising. For example, if you broke your product sometime in the last two weeks, but you don't know how or when, you can get back a working version like this:

```
cvs update -D 'a fortnight ago'
```

and work your way forward. Or, you can just see the changes:

```
cvs diff -D 'a fortnight ago'
```

• **CVS understands the Internet.** If you have networked development machines, CVS will work across the Net. We do not just mean that you can remote mount $CVSROOT. We have a CVS repository in Mobile, AL. Working on machines in Boulder, CO, we routinely work with modules from the Mobile, AL, repository like this:

```
CVSROOT=jsh@moe.qms.com:/proj_storage/cvsroot
export CVSROOT
cvs co mvp
```

The first line says the CVS repository is on the Mobile machine moe.qms.com in directory /proj_storage/cvsroot, and we want to work with this repository as user jsh. The second line uses the local CVS program as a client and the remote CVS program as a server, and checks out a copy across the Net. All subsequent CVS commands within our checked-out copy know that the repository is remote, and just work. (Note: Your .rhosts file must be set up correctly on the remote machine.)

If performance is a problem, we use the -z flag, which automatically gzips commands and data at one end, and gunzips them at the other. You also need to give it a degree of compression, like this:

```
cvs -z 5 update
```

• **CVS understands the idea of merging changes into the main-line.** We often want to merge our changes from branches into the main-line development tree. Sometimes, these are bug-fixes to field releases that we want to fold into the main-line. Other times, we create branches to do experimental development. If the experiment is a success, we add it to our product.

A traditional, and tedious, way to approach problems like this is with diff. CVS provides a labor-saving -j flag that does much of the work for us. A single -j flag joins changes from the named revision into the current version. For example, using the command below, we join changes from the prometheus_maintenance revision

to the tree we're currently working on:

```
's update -j prometheus_maintenance
```

To merge changes from the top-of-the-tree into the version you have checked out use

```
cvs update -j HEAD
```

The manual will also show you how to use a pair of `-j` flags to merge a specific pair of revisions, and even to remove all changes between a pair of revisions.

• **CVS understands changes in the hierarchy.** If you remove a file, you expect to stop seeing it. Well, at least up to the point that you need to reproduce last week's build. The command

```
cvs rm foo.c
```

schedules a file for removal, and the next check-in "removes" it. Under the covers, CVS actually moves the underlying RCS file into a subdirectory within the CVS repository, called the "Attic." When you ask for old versions, CVS will go into the Attic and find them, where they're stored with their entire revision history intact.

On the other side of the coin, if we want to add a new file,

```
cvs add
```

does the trick. A subsequent `cvs co` of a version before the file existed will omit that file from the check-out.

Directories are more complicated. When we've removed all the files in a directory with `cvs rm`, we're left with a bunch of empty directories. We can prune those dead branches with

```
cvs update -P
```

When someone else has created new directories that we want to bring in, we can fall back on `cvs co`, but we can also use

```
cvs update -d
```

• **Using diffs.** When we're checking things in, we find it useful to have the `diffs` around to help us write our log comments:

```
cvs diff > /tmp/DIFFS 2>&1
cvs ci
```

By now, you should have an overview of how CVS works, and some tricks to make your use of it more productive. Next time, we'll begin discussing the problem of printing over the Net, and how our old UNIX standby `lpr` and its daemon `lpd` are insufficient to the task. Until then, happy trails. ⊸

ART VALERO

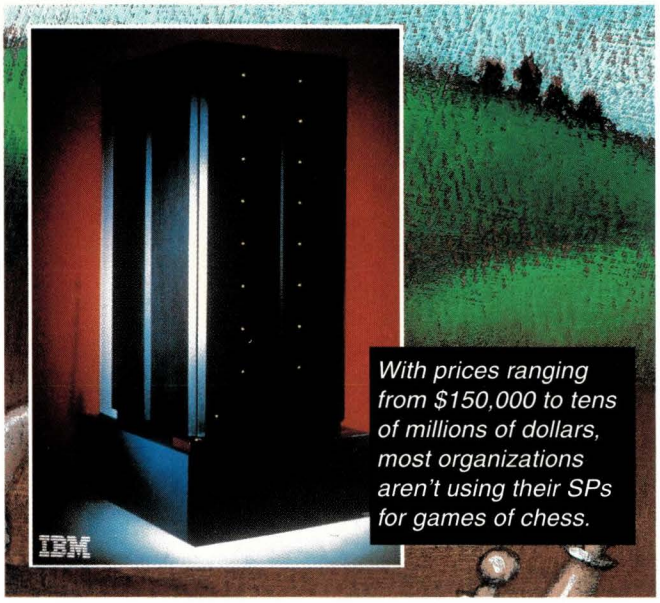
Master Moves

by Patrick T. Coleman, Staff Editor

Ever since the unprecedented outcome of IBM's media-friendly, man-versus-machine chess competition last May, there's been a din of industry noise. What's all the fuss about? Well, it's centered around IBM's Deep Blue becoming the first machine to defeat a champion chess player in a tournament-like setting.

IBM's Scalable POWER-parallel has much more than chess moves to offer those looking for powerful parallel processing in a modular, scalable package.

Gary Kasparov, the world's leading grand master, was surprisingly defeated in this rematch to a similar contest staged in February 1996 when Kasparov was victorious. The result of his defeat this year: plenty of ink debating the significance of a computer beating a person in game that relies on mental skill and strategy. The technology behind Deep Blue, the muscle responsible for all the hubbub, is the IBM RS/6000 Scalable



POWERparallel (SP) system. While winning at chess is certainly a major accomplishment for the IBM supercomputer, especially since the same basic technology lost to Kasparov back in 1996, the question Big Blue hoped people would ask as a result of the publicity stunt was, what can the machine do besides play a killer game of chess and spark interesting conversations around the water cooler?

As the name suggests, the RS/6000 SP is part of the RS/6000 family–in fact, the high end of the product line. The SP runs the AIX operating system and applications designed for that UNIX environment. The computer itself consists of a frame that houses any combination of the three nodes offered by IBM. The node types are thin, wide and, the latest offering, high (see "A Look Under the Hood"). The interconnect can be Ethernet LAN or a high-performance SP switch that provides a point-to-point connection for all nodes throughout the frame.

The lure of the SP is parallel processing, the ability to simultaneously bring any number of RISC processor nodes to work on a computing problem. The SP can be as small as two nodes or scale up to 512. Another attraction is that systems can be built as needed, block by block. This ability to scale is a compelling feature to many organizations that do not need the power of a supercomputer today but might five years from now.

Originally, IBM marketed the SP into the scientific research community. Back in February 1993, it was introduced as the RS/6000 SP1. The computer's ability to provide parallel processing, as well as its strong floating-point performance, meant it became typecast as a technical computing engine. Then, in September 1993, IBM shifted gears and began to push the SP into commercial markets. This time it was called the RS/6000 SP2 and sported some applications for the corporate environment with its database management and decision support demands. "At the very beginning, even before we released SP1, our plan was to bring it to the commercial marketplace," says David V. Gelardi, program director of decision support solutions for IBM's RS/6000 division. Before that could happen, improvements were needed. "We knew we had some enhancements to make."

Late in 1994, the decision was made to drop the numeric designator. The reason points to IBM's basic philosophy with the machine. The SP is designed to expand with the addition of new node types, software enhancements or improved performance for the interconnect technology. It's not the SP that changes but the pieces within it. In fact, any new feature available in 1997 could be incorporated into a SP1 bought in 1993. "It can be added to the machine so that all our customers can migrate forward," says Gelardi. "We don't have hard boundaries."

The SP in 1997

Some of the more high-profile implementations of the computer are still in the technical market. Among them is the $93 million grant awarded to IBM from the U.S. Department of Energy's (DOE) Lawrence Livermore Labs to build a supercomputer. The grant calls for the delivery of a computer based on the SP by mid-1998 that can perform 3 trillion operations per second and have 2.5 trillion characters of memory. The supercomputer will work on problems relating to DOE cleanup projects and nuclear safety programs.

In the world of academia, the SP is found at many universities around the globe. The SP at the Cornell Theory Center consists of 472 thin nodes and 52 wide nodes, for example. The computer is used for a wide range of projects from various scientific disciplines, including engineering, physics, biology, chemistry and astrophysics. Scientists use the Cornell Theory Center SP for projects that model the universe, simulate plasma turbulence and study the molecular structure of the enzyme acetylcholinesterase. The SP is also used to look at the behavior of black holes, to predict the fine structure constant in physics, to study the evolution of X-Ray galaxies, the formation of quantum vortices, the structure of protein or optimal remediation strategies for relieving ground water pollution. Through a simple Internet connection, many scientists from remote sites can conduct their research. "Part of the beauty of the SP is its effects are seen by all science," says Malvin Kalos, director, Cornell Theory Center.

Although the SP may be a useful tool for scientific studies, the commercial market is where IBM is generating the most revenue, according to International Data Corp. (IDC), a market research firm in Framingham, MA. IDC estimates the SP generated $1 billion in revenue worldwide for 1996. IDC reported the SP servicing four markets: technical high end, technical midrange, commercial high end and commercial midrange. The commercial midrange generated the most revenue at roughly 42%, while the second highest grouping was the commercial high end at 24%. The technical midrange and high-end markets reportedly brought in approximately 18% each.

With prices ranging from $150,000 to tens of millions of dollars, it would be safe to say that most organizations deploying the SP are not looking for a challenging game of chess. In fact, IDC suggests that in the commercial midrange, organizations are using the SP primarily for LAN consolidation; while at the

high end, they are used for strategic business analysis that includes data warehouse-based applications, data mining and decision support.

LAN in a Can

LAN consolidation, at times affectionately known as "LAN in a Can," is a strategy to replace a geographically distributed collection of servers with one centralized system. This would allow for easier administration and make way for a situation that requires fewer external systems such as consoles, tape and CD drives, as well as other redundant peripheral devices. More important, LAN consolidation with the SP offers an organized Lego-like block style of expansion. "The most compelling reason why people buy SPs is the LAN in a can environment," says Jon Ostsik, senior analyst at Forrester Research Inc., Cambridge, MA. "Faster communications, tighter management, single system; you can manage one of four virtual partitions as one physical system."

This strategy intrigued the city of Seattle's ESD/Technology division, a centralized supplier of database services to different departments of the city of Seattle, two years ago. The division was looking for the right server to run a human resources application as well as future applications for other departments. The decision was already made that it was going to run in a RS/6000 environment, but the question was what size server? The data center was concerned that there would be a proliferation of servers throughout the department. One of the alternatives offered to them by IBM was LAN consolidation.

Initially, the center decided to install two nodes and has now expanded to four. "For just a two-processor environment, it was more expensive to go into this environment than to go and buy two separate processors," says Randy Johnson, SP project manager, city of Seattle ESD/Technology. "But it seemed like there could be long-term savings."

To date, the actual return on investment has not been calculated, but the system does provide many of the advantages Johnson was hoping for. With the addition of processors, there has not been the need to increase staff at the center, and

also there has not been the need to buy any redundant peripheral devices. "Definitely, the scalability and modularity is there," says Johnson. "I do think you can add additional processors with less additional labor. The SP is a complicated environment compared to other individual stand-alone boxes, but I do think there are some long-term benefits."

Currently, the four nodes in the city of Seattle's SP are functioning with an Oracle Corp. database server for client/server-based applications. These applications include the citywide human resources and payroll system, a conservation tracking system for the electric utility, two executive management information systems based on data from the city's financial accounting system, and access to a mainframe (ES9000) DB2 database of electric meter information and a labor collections system.

The different departments are able to connect to the SP through a fiber-based data communications backbone. All communications run TCP/IP through the backbone to the data center where the hardware is housed. Each node is connected via token ring to the backbone, and a block multiplexer connection runs from one node directly to the ES9000 mainframe. The data center runs a partitioned system with two nodes in AIX 4.1.4 and two nodes in AIX 3.2.5.

Many SP deployments involve a single large application that is divided into multiple tiers. One high node can act as the database engine, and half a dozen thin nodes can act as the application engine.

"What the network consolidation does is it allows you to take all of these products and all of these applications and put them in one box," says Christopher Willard, research director of high-performance technologies at IDC. "It reduces your floor space and maintenance contracts into one, and your operating system costs into one, provides a unified file system and cuts down on administration costs."

The city of Seattle's Johnson adds, "From our experience, if you know your application well, and you know that you are not going to grow, maybe you only need a couple of processors. You might be just as well off with individual processors. But if you are in an environment where those applications are growing, the modularity, the scalability and the consolidation aspect [of LAN consolidation with SP] should certainly be looked at."

IDC's Willard adds that while the machine is very powerful, it certainly is not a cure for all problems. "I caution you not to make the assumption that it is a panacea."

Data Management

The LAN consolidation approach has grown in popularity over the past couple of years, but one of the initial commercial applications of the SP, data management, is still being used. In some situations, LAN consolidation doesn't leverage the SP's parallel processing capabilities and has less focus on the interconnection of the nodes. Database management, at times, does use the parallel processing strength of the computer. According to IBM, many SP deployments involve a single large application that is divided into multiple tiers. For example, one high node can act as the database engine, and a half dozen thin nodes can act as the application engine. The nodes do not talk to each other but rather request services of the database through the application engine. The database itself is a collection of nodes running in parallel.

In addition to the parallel processing, scalability of the system is another important aspect of SP installations. MCI Communications Corp. made full use of the SP's scalability when it installed a 16-node system in September 1994, then upgraded it to 52 nodes at the end of 1994, and finally added another 52 nodes in the first quarter of 1995. The SP, located in a MCI technical center in Colorado Springs, CO, manages a data warehousing environment that supports the sales and marketing efforts of the company. Customer information is analyzed for potential new products and lead generation. The 104-node SP acts as the computing warehouse for data integration, using Informix Software Inc.'s 8.1 RDMS Illustra database and Prism Solutions Inc.'s Warehouse Manager. The data is brought in from operational systems within MCI, as well as some external sources. Data marts are also used, which run on Sun Microsystems Computer Co.'s SPARCcenter 2000 and SPARC 20 servers and extract information from the warehouse down to the data marts.

The major benefit MCI has seen from employing the SP has come down to scalability. "SMP couldn't have grown to the size we're talking about," says Chip Grim, director of sales system development at MCI. "We've seen 100% linear scalability, which at some point is going to drop, but right now we see 100%. It is very predictable, if you need more horsepower, you know what it's going to cost and exactly what you're going to get out of it as well."

From MCI's experience, the use of the system has been smooth. Grim feels an important reason for that has been the emphasis on training. "We've invested a lot of dollars to send our administrators to classes."

At Colorado Compensation Insurance, Denver, CO, the company went through a different data management situation. Instead of creating a system for data warehousing, the insurance company had to move its existing data off the mainframe and into the SP environment to be used with an Oracle database. The company uses its database to manage insurance policy information and claims processing. Again, the number one reason for turning to the SP, according to Bernie Williams, technical service manager at Colorado Compensation Insurance, was scalability. When asked to state one of SP's strengths, Williams says, "[To have] the ability to just add another node or two, as your needs grow."

The management at Colorado Compensation Insurance felt the SP technology would also help get product to market quicker by cutting down the development backlog. It projected that by using a client/server environment with a relational database, the development time would be shorter. "That was the primary business reason for moving off the mainframe," Williams says.

The project took two years to complete the transition to the machine, convert data and increase the SP from its initial two nodes to the present seven (four thin and three wide) as needed during the conversion. The flexibility of the computer also allowed the running of an accounting package as a pilot project on one node while maintaining a separate production environment on the other nodes. The conversion required the mapping of the existing data off the mainframe and converting it to the new field, columns and table in the Oracle database. "We had 60 million records on the mainframe that needed to be converted and moved over to the SP environment," Williams says.

With the conversion complete, the insurance company is in full production without incident.

Down the Road

Although IBM sees the SP continuing in the commercial areas of LAN consolidation and data management, the company has begun to emphasize its use as a Web server. The Deep Blue chess match was chronicled on a SP acting as a Web server, as were the results and news updates at the 1996 Summer Olympics in Atlanta. During the first Deep Blue chess match, the site received more hits than anticipated, resulting in a poor response from the server, which generated some negative publicity, but the company has since added nodes to handle the load. "That is one of the terrific things about the SP, you just add more nodes," says IBM's Eric Rosencrans, manager of marketing operations for RS/6000.

Several analysts feel that we're going to see more of the same from IBM for the SP, that is, improvements to the nodes and the interconnection technology. In fact, IBM is hoping to make the latest node type for the RS/6000 SP available in the first quarter of 1998. Code-named Wildcat, it's based on the latest RS/6000 server, the F50. Because the RS/6000 SP is so closely related to the servers from the RS/6000 product line, this latest server technology could be an indication of future node technology for the SP. "You can sort of look ahead with our basic servers as to what to expect in future nodes of the SP," Rosencrans says.

According to IBM, work is being done to improve the way new nodes are connected to the SP Switch. The Wildcat equipment is described as fitting into the machine in Lego block fashion, which for some users might be more beneficial than the other three nodes already on the market. "[It could be] a more attractive building block and, depending on the application, could be a more useful piece," says IBM's Gelardi. "The price/performance characteristics of the F50 server are very good, and we want to have that same benefit for our SP users."

One user, MCI's Grim, looks forward to seeing the new equipment. MCI plans to upgrade its SP equipment and has been evaluating the new high nodes. It has decided to wait and evaluate the Wildcat equipment before a final decision is made. "The 120 nodes that we have can all be replaced with 30 Wildcat nodes," says Grim. "We'd have four times the horsepower we currently have."

It appears that the future of the SP will be more improvements to the pieces making up the system. And it's a safe bet there will be more events designed to ride the wave of success of Deep Blue's performance against Kasparov. ⊸

A Look Under the Hood

The hardware of the RS/6000 SP consists of a frame, housing a collection of processing nodes, and a switch providing a means for interconnection. These nodes come in three types: thin, wide and, the latest, high. There are also plans for a new type of node to be released in the first quarter of 1998. Code-named Wildcat, it will be based in some way on the technology in the new RS/6000 F50, a one- to four-way SMP server using a PCI architecture with 166-MHz PowerPC 604e microprocessors. The F50 also offers nine I/O expansion slots (seven PCI, two PCI/ISA).

The thin node is a 120-MHz POWER2 Super Chip (P2SC) processor with four Micro Channel expansion slots. In addition, there is 64 MB of RAM memory and two disk/media bays. "The thin node is the smallest, least expensive node that is uniprocessor," says David V. Gelardi, program director of decision support solutions for IBM's RS/6000 division.

The wide node, also a uniprocessor node type, is powered by a 135-MHz P2SC processor and can support more memory. The wide node comes with 64 MB of RAM and can expand to 2 GB of RAM, compared with the thin node's 1-GB limit. Internal storage ranges from 4.5 GB to 36.4 GB. This doubles the internal storage expansion capability of the thin node. Also, the wide node has seven Micro Channel expansion slots.

The third type is the high node, a 112-MHz, two-, four-, six-, eight-way PowerPC 604 processor. This node comes with 14 Micro Channel expansion slots and 64 MB of RAM expandable to 2 GB. Also, the high node comes with internal storage capacity of 2.2 GB, expandable to 6.6 GB. The 604 high node has three disk/media bays, one less than the 135 wide node. "[The high node] offers more flexibility," says Howard Richmond, vice president, Gartner Group Inc., a Stamford, CT-based research company. "More configuration flexibility and more application flexibility."

The nodes are interconnected through a high-performance SP Switch. The switch is designed to offer consistent bandwidth and latency between nodes, regardless of their location within the system. The frame housing the nodes can also provide interconnection between the nodes over an Ethernet LAN. From a systems management standpoint, the nodes are managed with software called Parallel Systems Support Programs (PSSP) for AIX. This allows the SP to be managed as a single system even though it is a collection of nodes.

The SP comes in two frame sizes, a tall frame that reaches 79 inches, and the short frame topping out at 49 inches.–*ptc*

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.

IP Management Tool Out

Quadritek Systems has announced its QIP*xpress* IP management software, designed to run on IP switching or routing equipment. With QIP*xpress,* Quadritek says, users can deploy Dynamic Host Configuration Protocol (DHCP) and Dynamic/Domain Name Service (DDNS/DNS) on their networks.

QIP*xpress* can manage up to 1,000 IP addresses and allows users to define security, permission and configuration policies that can be enforced and distributed throughout their networks via a single point of control, the company says. It can also create a central database, called the QIP KnowledgeBase, which catalogs all network resources.

In addition, QIP*xpress* reportedly enables true unattended network management by automatically downloading key data, such as moves, adds, changes and IP address lease updates; delivers automatic updates for primary and secondary DDNS/DNS servers; integrates third-party network management systems into the global environment; and delivers easy access to management functions from standard clients.

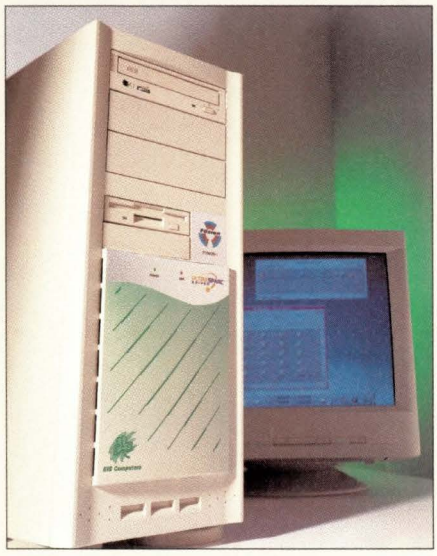
QIP*xpress* costs $1,995 per switch and operates across Windows NT and most major UNIX platforms.

Quadritek Systems Inc.
10 Valley Stream Pkwy., Ste. 240
Malvern, PA 19355
http://www.quadritek.com
Circle 101

UltraSPARC with PCI Form Factor

The upshot of Sun Microsystems Inc.'s July move to a PCI bus architecture is that it enables SPARC clone manufacturers to offer competitive machines below premium pricing. Case in point, the new Fusion-1 system from EIS Computers. Fusion-1 is a fully configured workstation based on a Sun Microelectronics Inc. motherboard, priced at just $7,899. The price also includes onsite support and software maintenance.

Specifically, Fusion-1 comes in a desktop, tower or rack-mounted chassis. It includes a 170-MHz UltraSPARC CPU with 512 KB of Level 2 cache on a Sun Ultra AX system board. It also



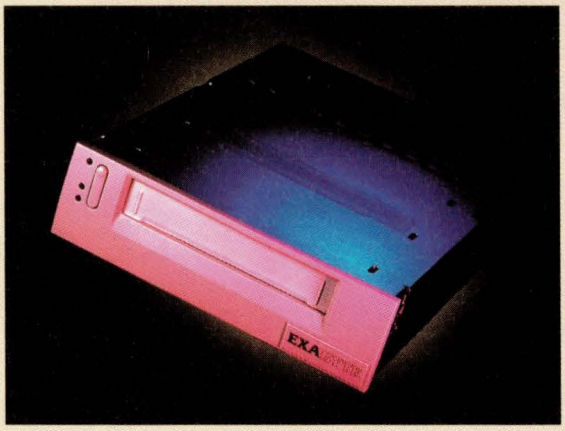
features 64 MB of RAM (expandable to 512 MB), built-in 10/100 Ethernet, serial and parallel ports, a 2.5-GB hard drive, 12X CD-ROM, 1.44-MB floppy drive and the choice of either a SunType 5 or PC-style keyboard.

Fusion-1 comes preinstalled with Solaris 2.5.1. A companion CD-ROM contains 250 public-domain Solaris applications. And, unlike Solaris on x86,

Strict Backup on a Budget

Exabyte has announced the release of its latest Eliant 820 14-GB 8mm tape drive. Available as a stand-alone drive or as part of Exabyte's automated tape libraries, the new Eliant drive is being targeted at organizations with strict backup requirements but that are on a tight budget. Priced 20% lower than its predecessor, the Eliant 820 lists for $1,795 and features a 120-MB/min. data transfer rate, Exabyte says.

Sun Microsystems Inc. has announced that it will integrate the Eliant 820 into its UniPack enclosures for use with Ultra Enterprise and Netra servers. Exabyte also expects software support from leading backup software providers, including Cheyenne Software Inc., Legato Systems Inc. and Seagate Software Inc., into UNIX, Microsoft Corp. Windows NT and Novell Inc. NetWare environments.



For sites requiring storage automation and unattended backup, the Eliant 820 is also available for Exabyte's automated tape libraries, the Exabyte 210 and Exabyte 10h. In these configurations, Exabyte says, users can expect data transfer rates of 14.4 GB/hr and 7.2 GB/hr, respectively.

Exabyte Corp.
1685 38th St.
Boulder, CO 80301
http://www.exabyte.com
Circle 100

the entire range of SPARC/Solaris applications are available to the Fusion line, EIS says.

EIS Computers Inc.
207 W. Los Angeles Ave., Ste. 303
Moorpark, CA 93021
http://www.eis.com
Circle 102

Ethernet Switches Are ATM-Compatible

A Fast Ethernet switch, Formula 8200, and an Ethernet workgroup switch, CentreCom 3718, both from Allied Telesyn, together can provide an affordable migration path from Ethernet to Fast Ethernet, or to an ATM backbone, Allied Telesyn says.

Formula 8200 can be used in workgroups using bandwidth-intensive CAD and multimedia applications, while CentreCom 3718, with its high-speed uplinks, can further extend Fast Ethernet speeds to the workgroup.

Formula 8200 is a 16-port Fast Ethernet switch that supports SNMP, MIB II and RMON standards. Virtual LAN (VLAN) capabilities support logical user grouping regardless of physical location, and Layer 3 switching through integrated IP routing allows users to route through VLANs without the need for an external routing device. Equipped with the optional OC-3 ATM uplink, the ATM-enabled switch will work with any other standard ATM equipment.

The CentreCom 3718 Ethernet switch comes in two models: the 3718-TR, which includes 16 switched 10BaseT ports and two switched 100BaseTX Fast Ethernet ports (one with MII); and the 3718FT, which includes 16 switched 10BaseT ports, one switched 100BaseT Fast Ethernet port and one switched 100BaseFX/SC port. Both models include two Fast Ethernet uplink ports with auto negotiation for full or half duplex, which provides greater throughput, according to the company.

Pricing starts at $9,995 for Allied Telesyn's Formula 8200 and at $2,595 for CentreCom 3718.

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

More SPARC Portables from Tadpole

Tadpole Technology, already known for its portable workstations, has added to its SPARCbook 3000 product line by introducing two new workstations: the SPARCbook 3000XT and SPARCbook 3000ST. The 3000 series was designed around Fujitsu Microelectronics Inc.'s 170-MHz TurboSPARC processor and features enhanced graphics capabilities, up to 256 MB of DRAM–double that of current products on the market–and a 3-GB removable hard disk, Tadpole says.

The SPARCbook 3000XT offers 12.1-inch active matrix 1,024-by-768 resolution and the SPARCbook 3000ST offers 10.4-inch active matrix

800-by-600 resolution. Both systems can be used with an external Sun Microsystems Inc. keyboard, mouse and display, and support external display resolutions of up to 1,280-by-1,024.

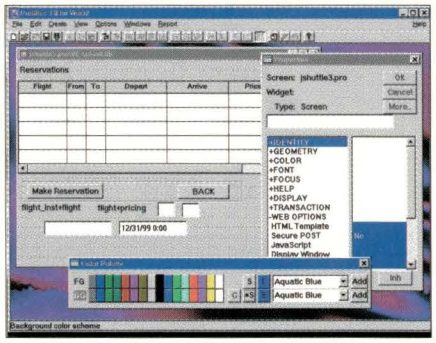
The new series features a 3.5 SPECint95 rating and a 3.0 SPECfp95 rating. Tadpole says the SPARCbook 3000 series delivers twice the integer performance and 50% better floating-point performance of the 100-MHz MicroSPARC-2 processor used in its SPARCbook 3GX. Other SPARCbook 3000 features include DRAM options of 32, 64, 128 and 256 MB; a 3-GB removable hard disk; card and socket services-compliant PCMCIA slots, supporting two Type I/II devices or one Type III device; built-in ISDN; on-board Ethernet; SCSI-2; one parallel and two serial ports; a Lexmark International Inc. keyboard with integrated pointing stick; and an internal 12V NiMH battery.

The SPARCbook 3000 workstations come loaded with Solaris 2.5.1 and Tadpole's Notebook Computing Environment. Suggested list prices for 32-MB and 256-MB SPARCbook 3000XT configurations with 3-GB removable hard drives are $21,350 and $26,700, respectively. List prices for 32-MB and 256-MB SPARCbook 3000ST configurations with 3-GB removable hard drives are $18,650 and $24,000, respectively.

Tadpole Technology Inc.
12012 Technology Blvd.
Austin, TX 78727
http://www.tadpole.com
Circle 104

Java Rapid Application Building Tool

Prolifics, a division of Jyacc Inc., has introduced Prolifics 3, a server-based rapid application development (RAD) tool designed to produce business-critical applications to be deployed in Java.



Prolifics 3 reportedly provides automatic failover Java deployment where HTML is normally substituted when Java execution fails, such as with nonsupporting browsers or firewalls that prevent the execution of Java. Also featured is the Distributed Transactional Object Model (D/TOM). With this, Java applications are integrated into a distributed database and transactional environment. Prolifics says there are no requirements for hand-coded SQL or the use of Java database connectivity (JDBC).

Prolifics 3 is available this month, supporting SunOS 4.x, Solaris and Windows NT. Support for AIX, HP-UX, OpenServer, IRIX, Digital UNIX

and Macintosh operating systems will be available in October. Pricing for a five-user development license starts at $35,000.

Prolifics
116 John St., 20th Floor
New York, NY 10038
http://www.prolifics.com
Circle 105

Secure Telecommuting via the Internet

Pilot Network Services has come up with a cheap, easy and secure way for telecommuters to connect their laptops to the internal corporate network. Its new service, Secure Road Warrior, supports any TCP/IP-based application and offers access to the corporate network via a dial-up or a direct Internet connection, the company says.

Instead of dialing an in-house modem directly, Secure Road Warrior enables traveling employees to connect to their corporate network through the Internet and via a Pilot Secure Network Service Center. Pilot provides a secure dedicated link to the corporate network that establishes a defense against dangerous "back-door" security problems. Pilot says that by telecommuting over the Internet, rather than via a direct link, companies can achieve estimated savings of 70% on long-distance costs and 50% on modem/remote access support costs.

On the road, telecommuters dial the most convenient local access provider. Strong, IPSec-compliant encryption software that resides on Windows 95 or NT Pentium-based laptops reportedly creates a seamless "encrypted tunnel" from the laptop through the Internet to the Pilot Secure Network Service Center. The traffic is monitored, authenticated and decrypted in the Service Center's so-called "virtual safe room," which is configured with a Pilot Dynamic Firewall technology. Traffic free of anomalies continues via a secure dedicated connection to the corporate network. Pricing starts at $5,000 per month.

Pilot Network Services Inc.
1080 Marina Village Pkwy.
Alameda, CA 94501
http://www.pilot.net
Circle 106

Upgrades, Enhancements, Additions...

■ Thanks to a new C/C++ language option, it takes less time to create transaction processing (TP) applications with the latest version of Magna Software's Magna X 3.0 rapid application development tool, the company says. Magna X, which generates TP applications for UNIX servers, Java, PowerBuilder and Visual Basic clients, provides developers with a suite of software utilities that lets them diagram the components in their N-tier application (for example, servers, messages and clients). From there, Magna X generates template programs for second-tier business logic or third-tier data services, optionally as C or C++ code. Magna X pricing starts at $60,000 for a five-seat developer's license. **Magna Software Corp.**, 275 Seventh Ave., New York, NY 10001, *http://www.magna.com.* **Circle 107**

■ Vibe DE, an integrated development environment for building Java applications, is now available for AIX and Linux platforms, in addition to Solaris and Windows 95/NT. The GUI-based Vibe IDE includes a Java Virtual Machine, compiler, debugger, editing tools, interface construction tools and extensive runtime classes. A single developer's license costs $49.95. **Visix Software Inc.**, 11440 Commerce Park Drive, Reston, VA 20191, *http://www.visix.com.* **Circle 108**

■ Discover Y2K 5.0, from Software Emancipation Technology, has been updated to make it easier for users to track down date problems in their C/C++ code. Enhancements include standard filters based on simple menus; customizable filters; the ability to track, classify and prioritize problems they've discovered; and the ability to generate reports for each of the project's stages (asset identification, impact assessment, change implementation and testing). Discover Y2K supports any C/C++ application, and runs on Solaris, HP-UX and IRIX platforms. Pricing starts at $200,000. **Software Emancipation Technology Inc.**, 20 Maguire Road, Lexington, MA 02173, *http://www.setech.com.* **Circle 109**

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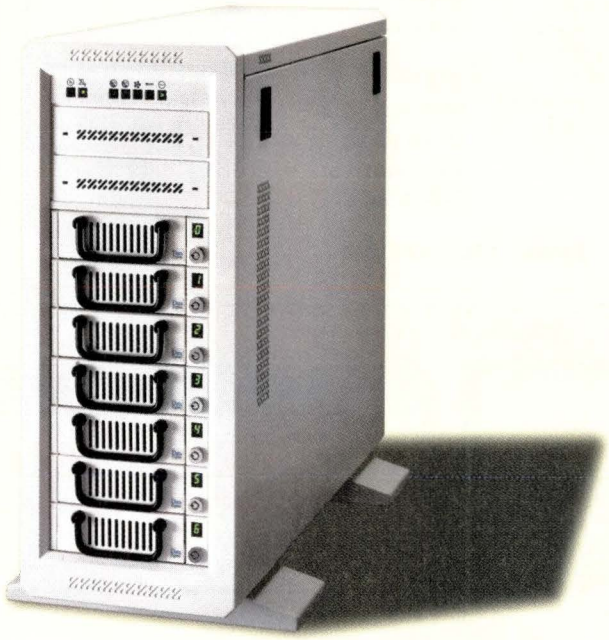

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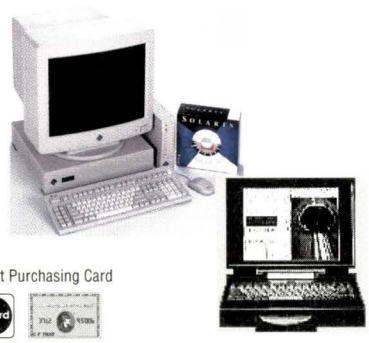

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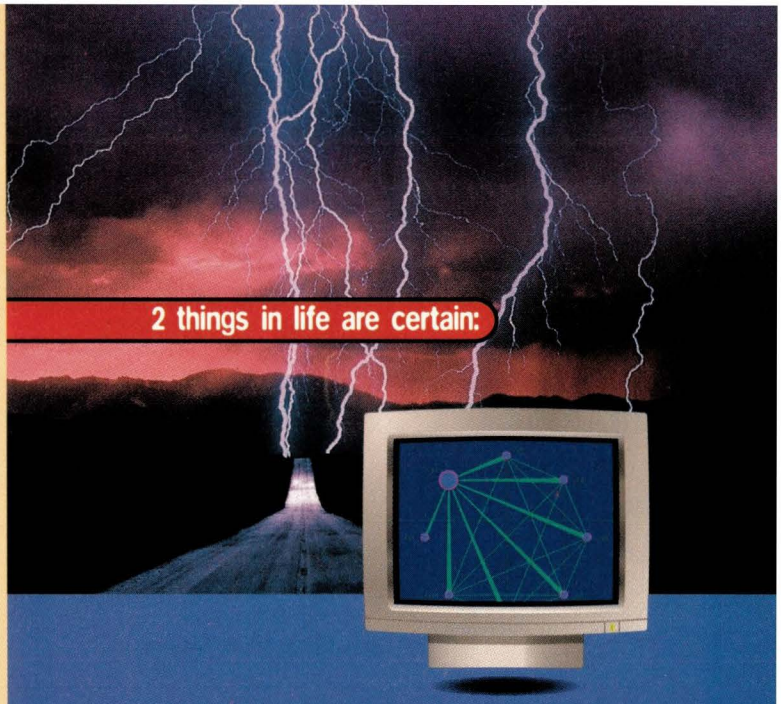

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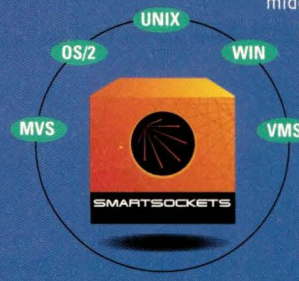

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