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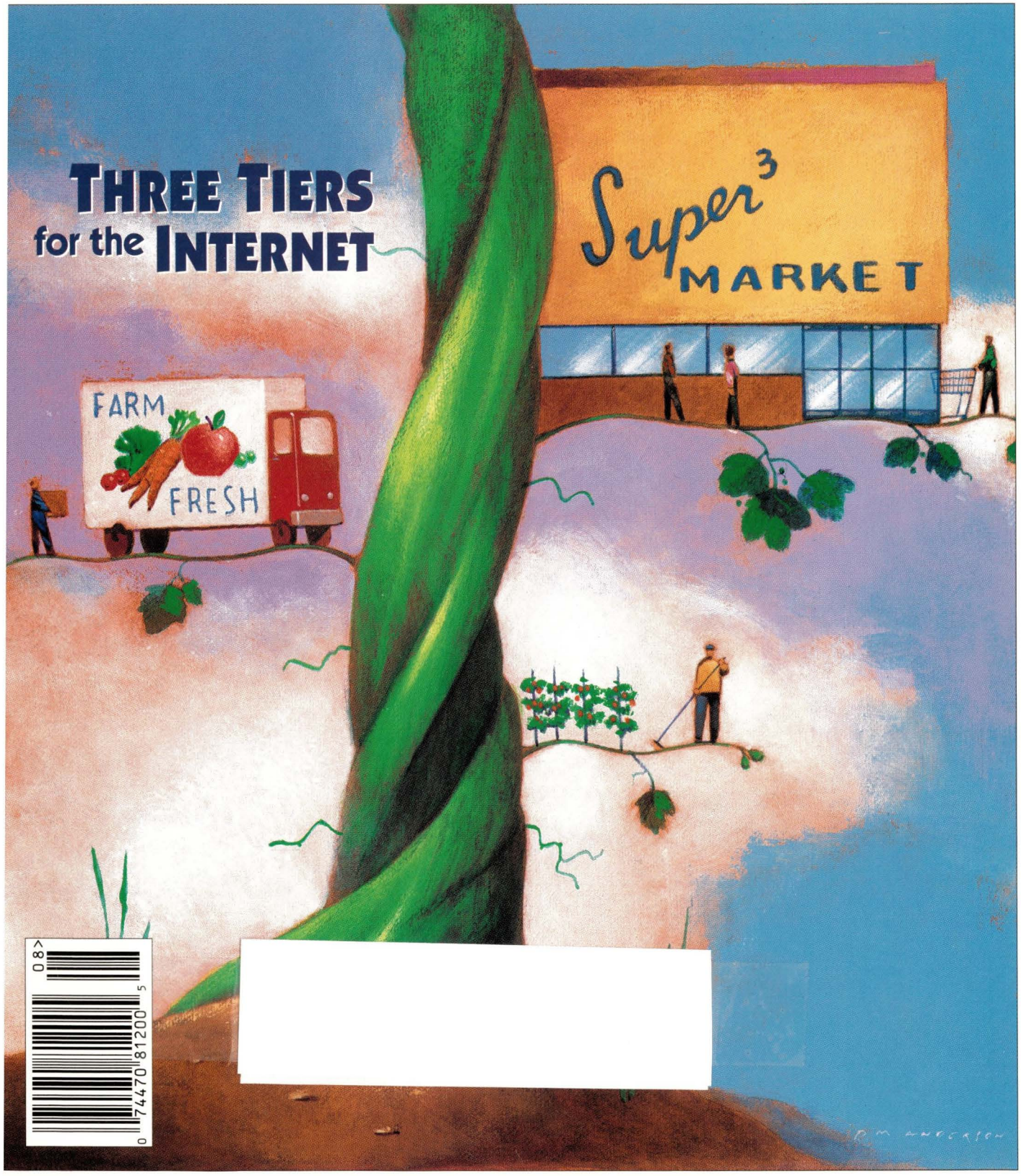

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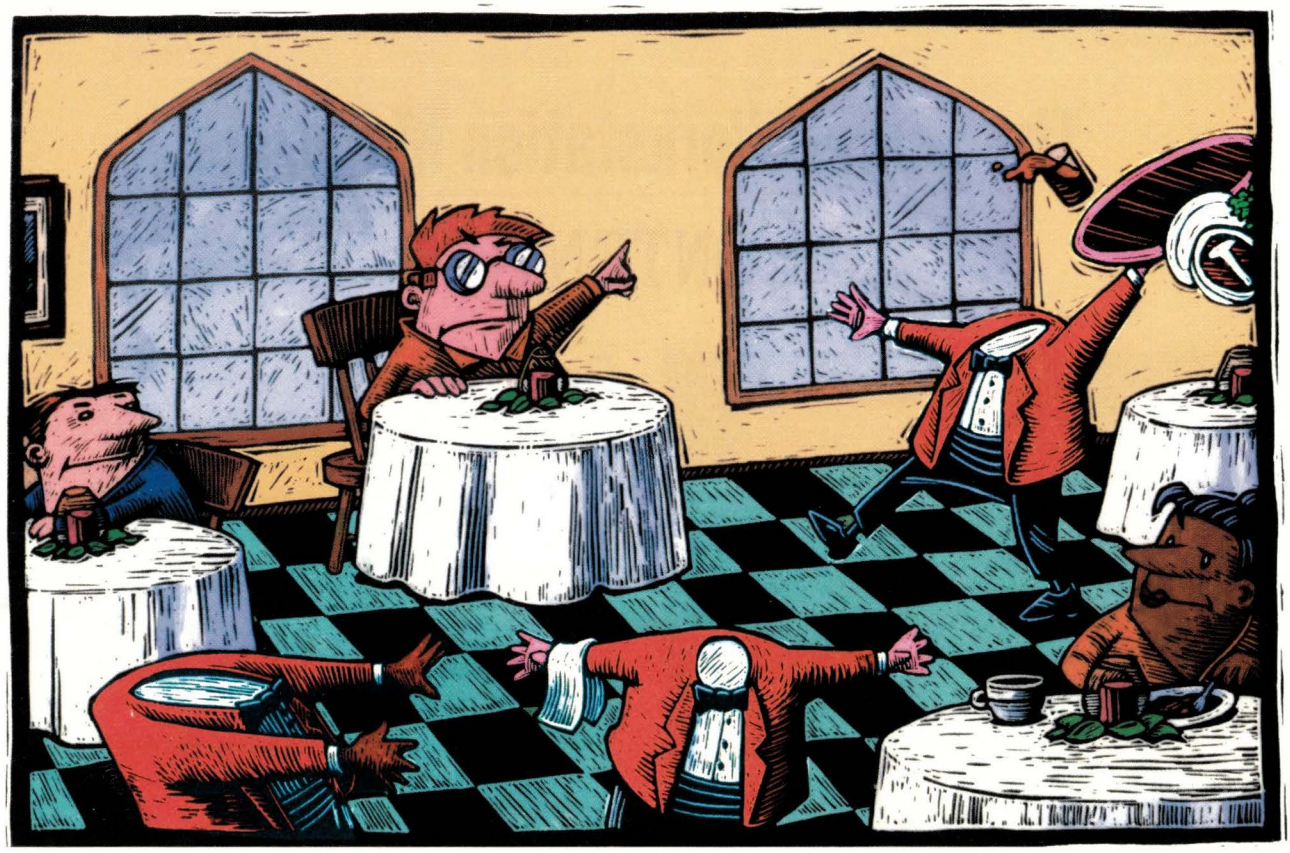

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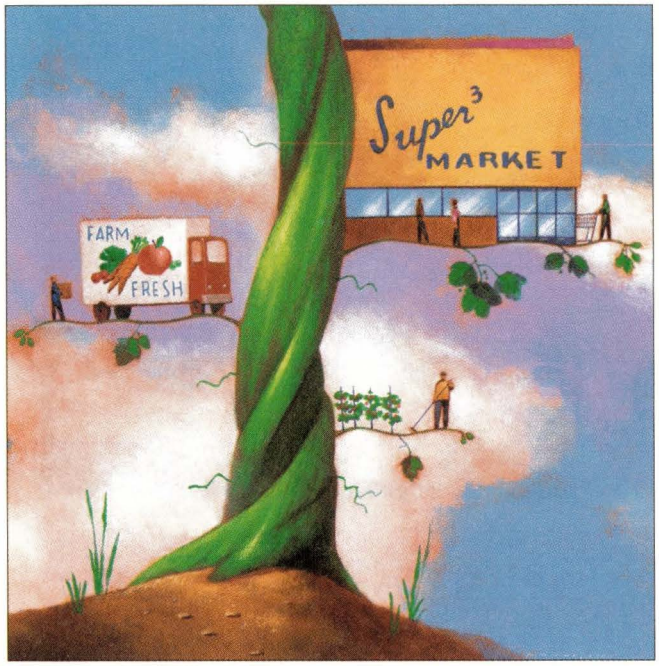

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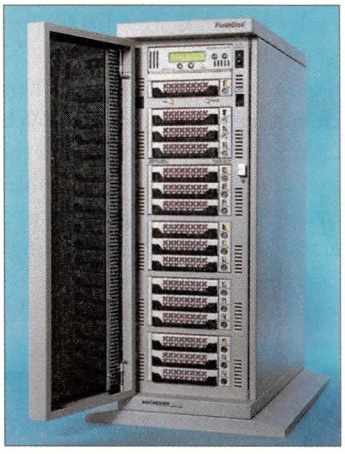

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EDITORIAL

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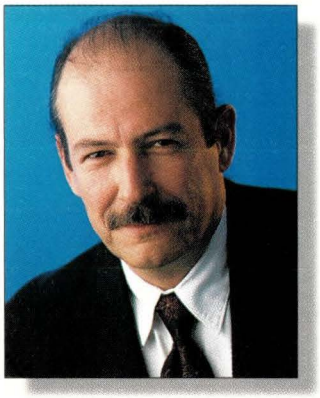

The Magical Data Diet

Clients seem to be getting thinner and thinner as their data diet gets richer and richer. What is this magical diet?

Some call it a three-tier architecture. For me, the appearance of three-tier systems is not much of a surprise. It seems the separation of data, application logic and presentation (GUI) has been overdue. If we were all installing brand-new systems without the weight of old apps and network infrastructure, we would be working with a three-tier model from the start. The real surprise is the speed with which large companies are bringing this paradigm from lab and early adoption projects to live production systems.

Why the haste? It seems the Web has given three-tier computing a big boost. The Web is like a vast research and development arm for everyone. In this month's cover story, "Three Tiers for the Internet," Page 60, Staff Editor Alexandra Barrett says, "Users have long hungered for a better variety of data, but in pre-Internet days, had no practical means of getting to it. The growth of the Internet supplied end users with an ideal data distribution method, paving roads across which data could travel from one end of the globe to the other, and back again."

The widespread use of the Web has trained users to expect more, and at the same time offered IT a way to share the database jewels with the masses that it didn't have before. "Mainframe guys had been looking for a way to give end users a GUI client into the database for years, but it was just too hard," says Tom Herring, vice president of sales and marketing for Computer Systems Development Inc., a systems integrator based in Albuquerque, NM. With the browser/Web server/database threesome and a little security hardware and software, building database-driven applications by way of a Web server turned out to be remarkably simple. An archetypal example of a three-tier application–presentation layer, logic layer and data layer–Web-enabled database applications are leading the way to thousands and thousands of three-tier applications that serve users a much richer and more rewarding data diet. And the client continues to lose weight.

Doug Pryor

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The Stampede to IA-64

And they're off! Just as there can only be one horse in the winner's circle at the end of a race, key players in the UNIX market feel there can be only one predominant choice as the supplier for UNIX on the IA-64 architecture. It appears there's a consolidation about to happen in the market and only a few vendors in the pack will be able to finish the race. These vendors are also racing to line up OEM and independent software vendor (ISV) support for their platforms on the IA-64 architecture.

More than six years ago, Hewlett-Packard Co., Palo Alto, CA, partnered with Intel Corp., Santa Clara, CA, to form a technical research group and co-develop the IA-64 chip, code-named Merced. HP has since realized the significance of the chip and has contracted Hitachi Data Systems Corp., Santa Clara, CA, NEC Computer Systems, Boxborough, MA, and Stratus Computer Inc., Marlborough, MA, to license its 64-bit version of HP-UX.

Before it ports its own UNIX platform to the new chip, however, HP says it will first offer Windows NT running on Merced. The reasoning, HP says, is many customers want to see the new chip prove itself before moving mission-critical data to it, which in most cases runs in a UNIX environment. In May, HP became the first PC server vendor to unveil upgrade programs to Merced, offering customers who buy the HP NetServer significant discounts on future purchases of IA-64-based four- and eight-way servers.

Meanwhile, in April, Intel announced an interim chip called the Pentium II Xeon processor, which is designed to meet the needs of the mid-range to high-end server and workstation markets. The chip runs at 400 MHz and offers 512-KB or 1-MB level 2 cache also running at 400 MHz, and a 100-MHz system bus is standard. By year-end, the processor is expected to run at 450 MHz and offer 2 MB of cache.

ERIN TERRY

Pricing for quantities of 100 or more is $4,000 per 512-KB workstation and $6,000 per 512-KB server that comes with one processor installed but is four-processor capable. "For $500 or $1,000 more, users can buy a four-way capable system instead of a two-way server," says Larry Michel, product marketing manager at Intel's Enterprise Server Group.

In April, Sun Microsystems Inc., Mountain View, CA, announced its partnership with Siemens AG of Germany, the third largest supplier of UNIX mid-range systems in Europe. NCR Corp., Dayton, OH, has also joined the Sun camp and says it will begin selling Solaris on its Intel-based WorldMark servers with a focus on Merced by 1999. Fujitsu Ltd., Santa Clara, CA, followed NCR and became the second licensee of Solaris for Merced. It plans to sell and support Solaris software as a strategic solution for cost-effective, reliable, ready-to-go networking systems on Intel-based servers. But Fujitsu has also said it will continue to offer Windows NT on its Amdahl Corp. servers in addition to Solaris when Merced ships. Amdahl is a subsidiary of Fujitsu Ltd. and a major reseller of the company's servers.

"You can't stay in the market long-term if you don't have volume. Most companies are realizing that and offering NT solutions. Sun is the only company stressing the point that they *don't* offer an NT solution. They're losing business there and will not grow as fast as competitors who do offer NT solutions," says Jay Bretzmann, analyst with International Data Corp. (IDC), Framingham, MA.

Sun's release of Solaris 2.7, scheduled for September, will mark the debut of its 64-bit operating system. Sun says the product, now in beta, will allow for full-forward compatibility as customers move from the 32-bit operating system. Sun says the release of the 64-bit operating system is important because it will allow software vendors to get a jump on the development of products for Merced

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Circle No. 3

before it's on the market.

In March, Sun released a developer's kit to help software companies write 32-bit programs that could easily be transferred to Merced-powered machines when the processor starts showing up in systems in mid-2000.

The move to a 64-bit architecture has required that Sun and Intel work closely with ISVs. Sun currently offers more than 3,000 applications for Solaris on Intel and that number is increasing rapidly. Sun hopes to be able to offer identical applications on Solaris running on Intel when Merced becomes available.

The largest player in the UNIX server market, Santa Cruz, CA-based The Santa Cruz Operation Inc. (SCO), is reportedly leading the way in the race to be the primary player in the IA-64 market. It has signed agreements with Compaq Computer Corp., Houston, TX, Data General Corp., Westborough, MA, ICL Inc., Reston, VA, and Unisys Corp., Blue Bell, PA, to offer SCO's UnixWare as the preferred operating system on Merced. Compaq's deal with SCO makes some industry watchers wonder what its plans are for Digital UNIX, which Compaq now owns after acquiring Digital Equipment Corp. (DEC), Maynard, MA, in January.

"Now that they [Compaq] have Digital UNIX, they're trying to figure our what to do with it," says Andrew Allison, an independent analyst based in Carmel, CA, who specializes in the RISC and UNIX markets. "My guess is, at minimum, the APIs will go into alignment so that the code that runs on SCO will run on Digital UNIX."

DEC, itself, has signed a deal with Sequent Computer Systems Inc., Beaverton, OR, to develop a version of Digital UNIX for Merced and has announced a development and porting program for the IA-64 architecture. Entitled "Destination 64-bit UNIX," the plan is designed to assist ISVs and application value-added resellers in the development of, and migration to, a 64-bit UNIX computing environment. DEC says the program offers a seamless and risk-free path to IA-64 built on Digital Alpha technology and the Digital UNIX 64-bit operating system.

Will Big Blue be getting into the game? IBM Corp., Armonk, NY, has not officially announced a marketing plan for Merced, but rumors that IBM has secretly begun work on an AIX version of the Merced chip have surfaced. "There have been comments about plans [to support Merced]," says IDC's Bretzmann, "I don't see them giving up on PowerPC right now, but I'm sure they realize that they must give customers what they want."

IBM does plan to continue support for its UNIX on PowerPC platform, but it would seem that it also wants to have a stake in Merced technology if and when it takes off. "Right now, we have AIX and PowerPC and we see a good life in front of the PowerPC products," says Glenn Rossman, manager of public relations at IBM's server group. "We have tuned AIX and the PowerPC together and we feel it can carry that performance forward to the year 2000."

In April, Rick Belluzzo, chairman and chief executive officer of Silicon Graphics Inc., Mountain View, CA, rolled out the corporate strategy for SGI's product lines and strategic relationship with Intel. "They didn't say specifically, but I think they'll port IRIX over to Merced and then try to build a server line there," Bretzmann says. SGI's announcement included plans to incorporate Intel's IA-32 technology into SGI's workstation product lines, expected sometime in the second half of 1998. Also announced were plans to port its established 64-bit IRIX operating system to Intel's Merced/IA-64 platform.

According to IDC, last year, Microsoft Corp., Redmond, WA, shipped more than 1 million units of Windows NT compared with 693,000 units of all other flavors of UNIX servers combined. Sun is pushing hard to make its presence felt in the Merced race. It is possible that Sun is looking at IA-64 as a way to take business away from Microsoft's Windows NT platform, which currently dominates the Intel server platform. Some industry analysts feel Sun also seems to be looking to compete more effectively with SCO by joining with partners like NCR.–*mm*

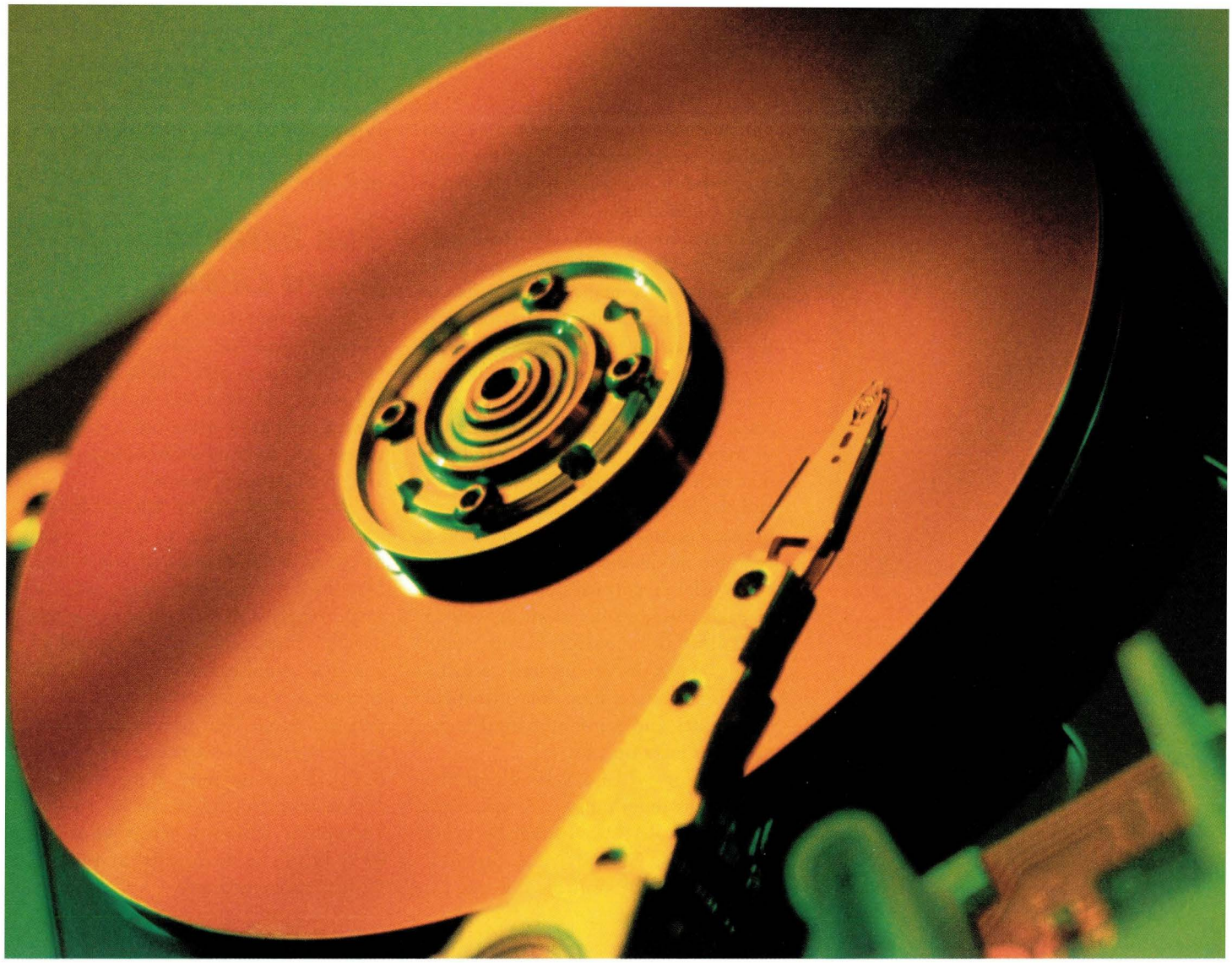
The Roundup:
Companies Offering Support for IA-64

Amdahl Corp.	IA-64 on Solaris
Fujitsu Ltd.	IA-64 on Solaris
Hitatchi Data Systems Corp.	IA-64 on HP-UX
NCR Corp.	IA-64 on Solaris
NEC Computer Systems	IA-64 on HP-UX
Siemens AG	IA-64 on Solaris
Stratus Computer Inc.	IA-64 on HP-UX
Tandem Computers Inc.	IA-64 on Digital/Compaq UNIX
Unisys Corp.	IA-64 on Solaris

Seascape Expands

A shared disk system designed to support mixed-server environments has been added to IBM Corp.'s Seascape Storage Enterprise Architecture. The IBM Versatile Storage Server (VSS) is one of several new products being offered for Big Blue's storage system and it is designed to consolidate, share and centrally manage storage across multiple and dissimilar servers, the company says.

Introduced in 1997, Seascape employs a building-block approach to developing and upgrading storage systems. These building blocks are hardware and software pieces designed to work both independently or together. The first three pieces offered were the IBM 7133 Serial Disk, a high-performance disk system for UNIX and Windows NT server platforms; the Magstar line of high-performance tape products; and the ADSTAR Distributed Storage Manager (ADSM) software for storage management.



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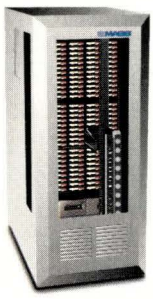

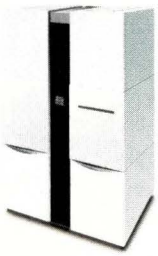

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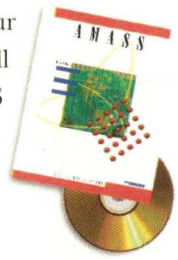

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IBM says its Versatile Storage Server (VSS) for the Seascape architecture provides 'true data' sharing among like servers.

With VSS, companies can integrate currently installed 7133 disks into open systems servers from companies such as Sun Microsystems Inc., Hewlett-Packard Co., Digital Equipment Corp. and Silicon Graphics Inc., as well as IBM. It provides "true data" sharing among like servers, the company says.

"IBM has had the ability to attach to Sun servers in the past with the 7133s," says John McArthur, program director at International Data Corp., a research firm based in Framingham, MA. "Now [with VSS] they have the ability to really go after the heterogeneous opportunities."

In addition to being able to attach to a variety of server platforms, VSS addresses the demands required of a company planning to implement a server consolidation approach. Users who currently attach 7133s to servers can redeploy them under the controls of a VSS if they choose to move to a server consolidation system where more functions are placed on fewer, but larger, servers.

"[VSS] is a storage disk subsystem designed for server consolidation for a centralized shared disk of multiple UNIX, Windows NT and AS/400 servers," says Bill Pinkerton, director of worldwide marketing for open systems storage at IBM in San Jose, CA. "It's specifically designed for server consolidation, not only from the time you actually consolidate but from the time a company would begin to think about consolidation."

In addition to VSS, IBM has introduced StorWatch, a family of enterprise storage resource management software products. Specifically, IBM is offering the StorWatch Versatile Storage Specialist, a software tool for managing and configuring the VSS; the StorWatch Serial Storage Expert, which is designed to manage multiple storage products that each have a single enterprise view; and the StorWatch Report, which uses software agents residing on servers and Seascape products scattered throughout a network to report back on the capacity of each storage subsystem as well as to collect information about usage trends. "Most of our customers actually do this with a combination of manual techniques and semiautomated techniques," Pinkerton says.

The VSS will be available at the end of this month and will scale from 230 GB of RAID 5 storage to more than 2.1 TB. The StorWatch products will also be made available this month. Pricing for the new Seascape components had not been announced at press time.–*ptc*

Sun Extends Board Lineup

A new four-way board from Sun Microsystems Inc., Mountain View, CA, looks set to give OEMs and large corporate shops more flexibility in configuring rack-mounted industrial servers for their telecommunications and networking applications.

The SPARCengine Ultra AXmp, announced in July, is a four-way board with four embedded Ultra SPARC-II S-series processors. With a small footprint that can fit into a standard 19-inch rack, the new board is aimed at applications such as telecom adjunct servers, airport security scanners and large Web servers like those used by Internet service providers (ISPs). The dimensions of the SPARCengine Ultra AXmp (6.75- by 13- by 16-inches) allows as many as eight to 10 boards to be installed in a single 19-inch rack enclosure.

Quantum Acquires ATL Products

Milpitas, CA-based Quantum Corp., a powerhouse in the disk and tape drive markets, announced in May that it plans to acquire automatic tape library vendor ATL Products Inc, Irvine, CA, in an all-stock transaction valued at approximately $300 million. The acquisition will allow the company to expand its existing library business into the mid- and upper-range markets, Quantum officials say.

As a wholly-owned Quantum subsidiary, ATL will continue to set its sights on the mid- to high-end automated tape library markets. ATL will also assume responsibility for Quantum's entry-level line of tape library products. "ATL's and Quantum's tape library lines are really quite complementary," says Scott Harlin, public relations manager for ATL. "What this will translate into is the most comprehensive line of autoloaders in the industry."

As the premier vendor of digital linear tape (DLT) drives, it would seem that Quantum's acquisition of ATL would give the library vendor an unfair advantage over its competitors. However, ATL's Harlin argues just the opposite is true. "Strangely enough, this acquisition has put us at arm's length from Quantum." Quantum will continue to sell drives to ATL's competitors, and ATL will continue to manufacture libraries based on technologies other than DLT.

Quantum customers and ATL competitors include companies such as Storage Technology Corp. (StorageTek), Louisville, CO, and Overland Data, Inc., San Diego, CA.

For Sun Microsystems Inc. customers, Quantum's acquisition of ATL should ultimately mean more choice. Sun is a major OEM vendor of ATL products, which it resells under the Sun brand.–*ab*

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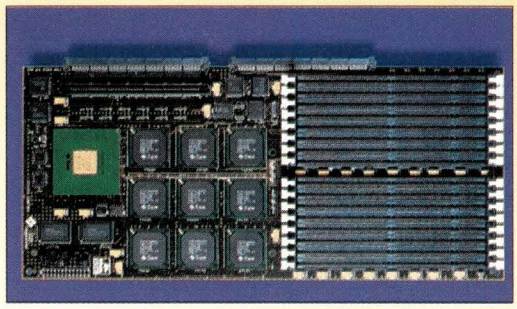
Circle No. 5

The idea, says Jeff Veis, group marketing manager for the platform products group at Sun's microelectronics division, is to give customers the ability to mix and match components, such as I/O or power supplies, more freely. "With this, for instance, you can use an off-the-shelf power supply. It gives people more flexibility," Veis says.



Sun's new SPARCengine Ultra AXmp is a four-way board with four embedded Ultra SPARC-II S-series processors in a 19-inch rack.

Paul Zorfass, embedded systems analyst for International Data Corp. (IDC) in Framingham, MA, says the board is a nice addition to Sun's lineup for its telecommunications customers. "The telecom market has been a critical target for Sun in terms of their boards group. They already have a PCI motherboard [the SPARCengine Ultra AX] and a CompactPCI board [SPARCengine CP], and this product further fills out the line," Zorfass says.

The Ultra AXmp comes with six 64-bit PCI slots–four at 33 MHz and two at 66 MHz. Sun's Ultra Port Architecture (UPA) system design enables aggregate bandwidth to be increased to 3.2 GB/s via a custom cross-bar switch. It's this bandwidth capacity that allows the system to scale to up to four UltraSPARC-II S-series processors (available in 250-, 300- and 360-MHz versions).

The board sells for $7,500 when purchased in volume.–*sjh*

Ross Ceases to Clone

Ross Technology Inc., an Austin, TX-based subsidiary of Fujitsu Ltd., Santa Clara, CA, has announced it will cease operations after 10 years in the SPARC clone market. Although it was one of the original clone vendors, sales of the company's 32-bit products have been declining for some time and the company has been actively seeking various strategic alternatives for its business–including an acquisition of the entire company by a third party. To date, however, Ross has been unable to find an interested party and says it plans to continue operations, at a reduced level, only through the end of the year.

Approximately 46% of Ross's employees will be laid off over the next eight months, not including employees at the Ross Design Center in Tel Aviv, Israel. Those employees are currently working on what is being called the Viper processor. It remains to be seen if this 64-bit RISC processor will ever make it to market.

Meanwhile, Tatung Science and Technology Inc., Milpitas, CA, seems to be doing quite well with its SPARC clone business, although Tatung admits it's not an easy market to compete in. The company has had to come up with ways to be more competitive and says it helps to be backed by a large parent company, especially one that produces monitors and other computer products that it can acquire cheaply and pass on at a discount to its customers.

When Scott McNealy, chief executive officer of Sun Microsystems Inc., Mountain View, CA, traveled to Taiwan in the late 1980's to look for possible adopters of the SPARC technology, Tatung was one of the first companies to commit. Tatung still works closely with Sun, often bringing new products to market just months after Sun has released the original. When asked why he thinks Ross Technology folded, Kam Chan, president of Tatung says, "You have to be focused and dedicated to SPARC. But you also have to go one step further and provide a better value than Sun."

Tatung feels the secret of its success includes offering better service and more flexible configurations to its customers than Sun. "We do something different than Sun–we offer choice to our customers," Chan says.

Ted Atlee, chief executive officer of SPARC International Inc., Santa Clara, CA, a member-funded group founded in 1988 to promote the SPARC architecture, feels that, based on the number of shipments, the SPARC market is stronger than it's ever been. Sun, of course, is shipping the most and Atlee attributes this to the success of the Internet. "The Internet made such a requirement for having high-speed and scalar type installations." He adds, "Not to throw stones, but the boys at Intel [Corp.] are not being able to do what they said they would, while Sun keeps pumping out the products."

But the SPARC clone market itself is a different matter. "When the [Sun] Darwins came out with their low prices, clone makers realized, hey, we'd better produce at really high volumes or it's going to be very difficult to recoup our engineering costs," Atlee says.

Atlee feels Tatung is the only real clone vendor left. He defines "real clone vendor" as a company that engineers and manufactures their own boards. Most clone vendors today simply buy Sun boards and put their own cabinets around them, he says.

Many clone vendors have diversified their offerings in hopes of expanding their customer base. Tatung recently announced plans to focus more on communications and industrial markets and will do this with its new PCI workstations. Axil Computer Inc., Santa Clara, CA, which had been building SPARC-compatible workstations and servers since 1991, revealed last September its plans to build an eight-way symmetrical multiprocessing server mainly for the Microsoft Corp. Windows NT market. But Axil, like Ross, announced in June it will cease operations after its parent company, Hyundai Electronics America, San Jose, CA, decided to stop funding it.–*mm*

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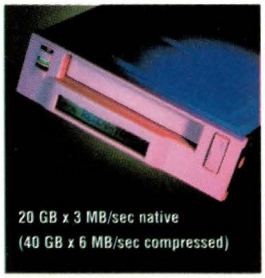

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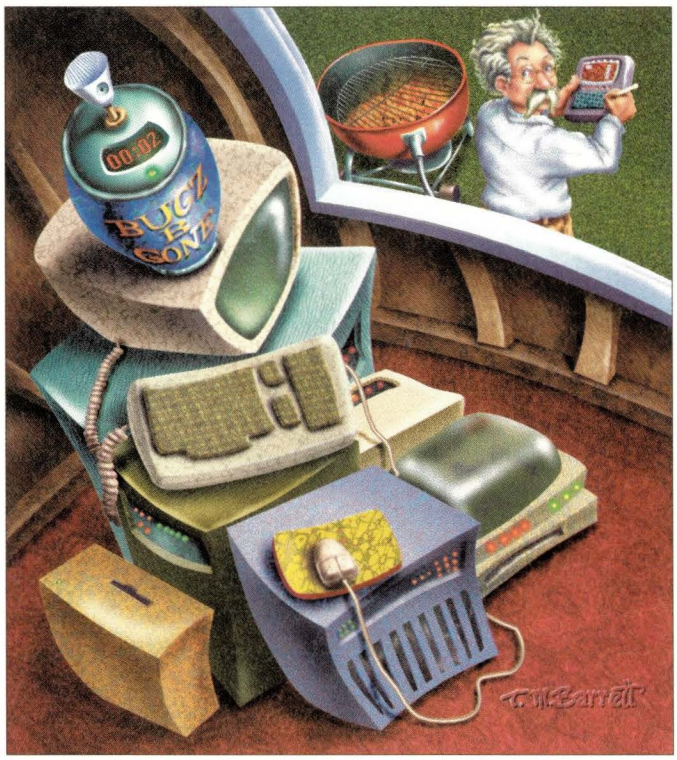
by Michael O'Brien



"Leading the Web to its full potential, the World Wide Web Consortium (W3C) has today released the CSS2 (Cascading Style Sheets, level 2) specification as a W3C Recommendation."
– World Wide Web Consortium

"To further the momentum behind the Flash technology, Macromedia has made the decision to make the Flash format publicly available (free!) to developers interested in creating content and tools based on the format.."
– Macromedia Inc.

"The FrobozzWave Streamer, with at least three installed sites, is the leading pizza-delivery streaming application on the Internet."
– More of same

Mr. P. and the Eighty Percent Solution

Q: *Where's Mr. Protocol? All I see is about six tons of computer equipment piled in the middle of the floor with a bug bomb sitting on top. Come to think of it, why doesn't this house have any interior walls?*

A: You'll find Mr. Protocol in the backyard, and we sould be joining him right away because that bug bomb is about to let go.

There. Put another couple of prawns on the barbie like a good fellow, would you? We'll just let Mr. P. get on with reading his email on his Newton via the 10baseT connection in the lawn sprinkler, while we sack out in these deck chairs and wait for the toxicity level inside to come back down. This is a regular occurrence here at Chez Protocol, as you can tell from that atmospheric test strip hanging in the kitchen window. Let me know when it goes from magenta to fuchsia. At that point, I can hold my breath and make a dash inside for more sodas.

No doubt you had a question of major import. I'm sorry to report that all our resources for answering such questions are inside, in the middle of the pile of stuff under the bug bomb. This exercise in cartoon household arrangements is brought to you by Mr. Protocol's latest indiscretion in testing yet another snazzy new network service that was insufficiently thought out before deployment. The Internet has had many growing pains, and it'll have more–just wait until IPv6 starts being seriously deployed! But as growing pains go, this one's more than a two-Naproxin headache. It's a corker, and it looks like it'll get worse before it gets better.

The problem comes from the way Internet standards are generated these days. No, we're not rehashing the recent column about the standards process. I'm talking about how standards are really generated.

Back in the good old premammalian days of the ARPANET, most new standards were generated via a process of trial and error. The initial services were fielded by the initial implementers, but once the basics of the net were up, with Telnet, FTP and mail services running, new services were developed by a sort of free-wheeling cooperative consensus.

First, someone would come up with a new idea for a service. Next, they'd design the protocol for it and write an implementation. If no one else particularly cared for the service, this is as far as it would go. Sometimes, many people at the same site would be converted to using the service, usually by watching over other people's shoulders. There's nothing like a live demo. But, again, sometimes the service would stall out, and would only ever be really popular at that one site.

Mr. Protocol has mentioned the Massachusetts Institute of Technology's SUPDUP protocol in the past, which was `termcap/terminfo` done right, as a prime example of such a protocol. Several SUPDUP clients were actually written at the Stanford AI Lab, Rand, and elsewhere, but the only SUPDUP servers were the ones at MIT, which ran

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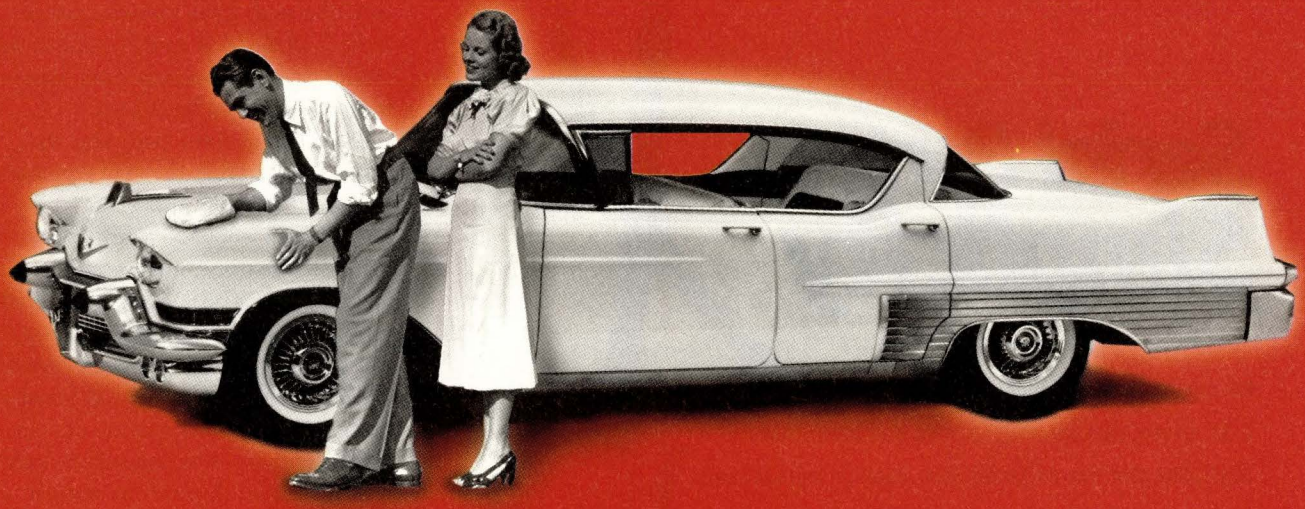

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Circle No. 6

on the MIT ITS machines. ITS was a big favorite in the early hacker community, mainly because it was the only really libertarian operating system ever written. The operating system started life as an octal debugger on a stand-alone machine, and wound up as a time-sharing system, which provided no protection on any files (including system files), supported all users as what we today would call superusers, provided the most extensive online help system in history, the world's most powerful editor (emacs) and the most outrageously baroque and abbreviated command structure in computer history. It made UNIX look verbose and overobvious.

It naturally followed that when it came up with the world's cleverest method of handling full-screen displays over the network, all of the topflight hacker centers around the country started noodling up SUPDUP clients on their own time. However, no SUPDUP servers were ever deployed except the ones at MIT, and with the demise of ITS, SUPDUP's days also came to an end.

The usual method of refining a service, however, was to have several groups each write an implementation of the server and the client, and to ensure that all the servers and all the clients interoperated. Then someone would write it all down in an RFC, and as the service gained popularity, more implementations would be written.

SMTP came into being this way. Email started off as the mail command within FTP. Often, half of an FTP server's code would be given over to handling electronic mail receipt and local delivery. The cutover to TCP/IP provided a golden opportunity to revisit some of the old protocols, email among them. A separate Mail Transfer Protocol (MTP) was written, and an implementation was done. The result was so baroque that no one wanted anything further to do with it, so most of it was chopped away and the rest was reworked into the Simple Mail Transfer Protocol, and SMTP is with us to this day, in a multitude of implementations. The Telnet protocol was reworked at the same time, which is why Telnet connects on port 23 instead of port 1, which is where it used to reside. Mr. Protocol wonders if there are any classicists running Old Telnet servers on port 1. He also wonders if there are any surviving Old Telnet clients in existence to talk to them.

This schema, of writing several interoperable implementations before creating a standard, has historically been one of the Internet's strong points. It tends to promote lean, straightforward implementations, basically through the design-a-little, test-a-little process that now goes by fancy names such as "spiral design" and others, which net consultants $5,000 per day. The happy chance of bringing a lean, robust implementation into widespread operation years before the protocol suite being promoted by most of the world's post, telephone and telegraph organizations is one reason that

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Circle No. 8

you're probably more familiar with TCP than with TP4. Blood poured in the streets from the arguments over which suite was "better," but TCP/IP won out because it was deployed, and worked.

So isn't that how things are still done?

Mr. Protocol is glad you asked.

Formally, yes. The Internet Engineering Task Force (IETF), having codified its standards-making process more than a little since the SUPDUP days, wants two independent, interoperable implementations before allowing a standard to progress.

The problem is that in the rigorously noncommercial days of the ARPANET, no one gave a hoot if they were the first one out there with a snappy new protocol, aside from matters of ego. In that world there was no stronger drive than ego, not even money. However, the urge was to get other people to follow along behind you and do new implementations, so that the proposed protocol would operate on more than just a few of the machines in the ARPANET's highly pluralistic domain. There were ITS machines, there were PDP-11s running UNIX, there were IBM Corp. mainframes, there were Lisp machines, there were TENEX boxes, TWENEX boxes, home-brew boxes, you name it. To get your protocol adopted into the mainstream, you had to get others to join in and write implementations.

This model began to break down somewhat with the advent of the World Wide Web. This was the first Internet service that began to look as if it might make a number of people very seriously rich because of a new protocol. Service operators like UUNET had already made a number of people seriously rich, but not through the widespread adoption of a new standard. UUNET got rich pushing bits the same old way it always had, but more reliably.

There had also been a minor bit of dust raised around the low-level eXternal Data Representation (XDR) protocols defined by Sun Microsystems Inc. as an underpinning to its network Remote Procedure Call (RPC) service strategy. Sun had, and has, several proprietary RPC services, but it wanted XDR adopted as an industrywide standard in order to provide a common playing field for competition where there hadn't been any playing field at all before. This resulted in the IETF having to take on, for the first time, the question of how to standardize a protocol that was the intellectual property of a corporation. The IETF did eventually evolve a policy and a mechanism for this, and it has been used several times since.

But the World Wide Web was a different matter. Here, we did not have an old-line company playing new games with standards. Instead, we had a whole new company more or less defining the protocol on-the-fly by successive refinement. A standards movement for HTML did get going soon after the Web became popular and, in fact, resulted in the formation of a separate standards consortium for HTML, but this body has had an uneven history of dealing with the big players in the Web browser business.

When the Web first became popular, the Internet was still largely noncommercial except for the Internet service provider business, and the only Web browser in existence was the free browser, Mosaic, from the University of Illinois. Netscape Communications Corp. became one of the first runaway market successes with its Netscape browser, which is still the dominant browser despite severe competition from Microsoft Corp. At first, Netscape defined its own "extensions" to the HTML protocol without consulting anybody, just announcing them as supported by the Netscape browser. The standards body played catch-up for a while, but it always seemed to run about two or three "extensions" behind. Besides, it was essentially powerless: Netscape had left its Mosaic roots far behind and had become the only game in town. Whatever Netscape decided to put into its server and browser technology became the de facto definition of HTML. This was a rip-roaring demonstration that the histories of Microsoft and IBM were not flukes caused by corporate megalomania. Netscape was barely a few months old and was already displaying alarming signs of metamorphosing from Pinky into The Brain.

After Microsoft placed its 600-pound gorilla in the marketplace, Netscape began to see the wisdom of standards, and the HTML standards organization known as the World Wide Web Consortium (W3C) gained more ground and credibility. Much of its effort is concentrated on fundamental changes to the way HTML does business.

For example, Tim Bernars-Lee originally designed each hypertext link as opening a new TCP connection because he was thinking in terms of linked documents, not the multimedia explosions that most Web pages now represent. Newer versions of the HTML standard advocate persistent TCP connections to handle each of the links on a page that refer to the same host. It's hard to overestimate the beneficial effect this would have on the Internet as a whole, which has always been tuned for persistent TCP connections.

Netscape and Microsoft have each been pushing the envelope of HTML protocol extension, in different and often incompatible directions, regardless of the standards effort, maintaining just enough compatibility to fend off claims of "standards-busting." The real threat to a standards-based Internet, though, seems not to come from these larger players, who have a vested interest in compatibility (at some level at least), but from the innumerable small-fry who are trying to become big-fry by adding services to the Web.

Big Threat from Small-Fry

Almost all of these fry are multimedia vendors of some sort or another, such as RealNetworks Inc., Vosaic Corp., Macromedia Inc., VXtreme Inc. and a bajillion others. The way they typically operate is to figure out some clever way of cramming more information than is realistically plausible over a 28.8 Kb/s dial-up connection, writing a Netscape extension for Windows, and getting as many Web sites as possible to pick up on their technology to snazz up the site. If they get picked up, they'll write an extension for Microsoft Internet Explorer, too. It's very rare they'll go beyond this. They then concentrate their efforts on extending their player and becoming a tantalizing enough company that Microsoft will buy them and make all of the founders rich.

By no stretch of the imagination will they go to the effort of writing an extension for any other platform. Diminishing returns make it uneconomical to do so. Just by handling Net-

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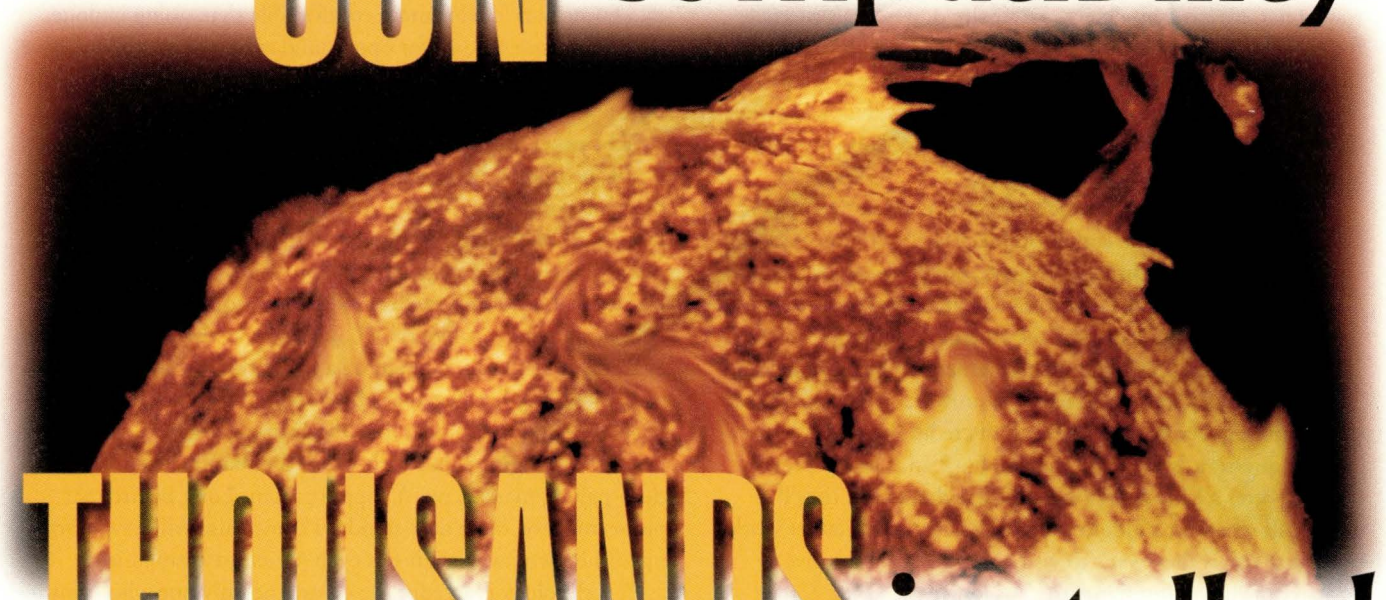

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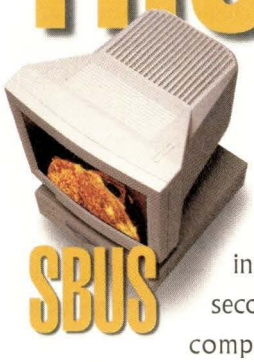

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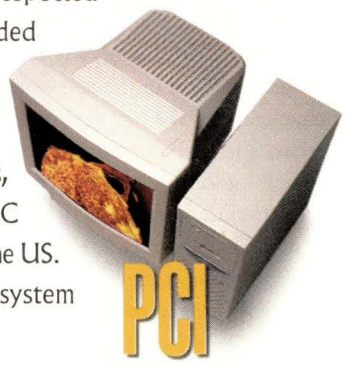

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scape and Explorer for Windows, they've covered 70% to 80% of the market. The 80% solution is good enough for them to get rich from, and who gives a hoot about the other 20% anyway? That 20% is completely marginalized. The real Internet is that 80% market share–80% drives the market. If told that the Internet Engineering Task Force does all of its development on such systems as FreeBSD and NetBSD, they'll look at you blankly and say, "Internet Engineering what? C'mon, everyone knows Microsoft invented the Internet."

There is no salvation for such people this side of Humboldt County. It illustrates the largest problem facing Internet standards today, and that problem is hype. Every pip-squeak streaming multimedia company immediately announces its proprietary software and stream format as "the emerging standard" or the "de facto standard." Variants such as "emergent technology" and "supreme ultimate standard in all the universe, so there!" are also to be found, at about the same level of credibility.

One question is, who are they fooling? In some cases, that's obvious, after a little thought. End users don't care; they'll download whatever random plug-in makes their browser work right at the sites they want to visit, and they couldn't give a hoot about "emerging standards," as long as the Blue Screen of Death doesn't pop up too often. Web site administrators will use whatever's cheap, works and has a plug-in readily available, which, given the Internet, just about any conceivable plug-in has to be.

No, the people who really need convincing are the trade press and the cash cows they feed, the venture capitalists. Man does not live by bread alone, but the company grows by it and it buys just about everything else man lives by. These men, anyway.

All is not hopeless here. Certain corrective factors are at work. In the first place, the success of many of these companies is similar to the success in the early 1900s of steel construction firms in Pennsylvania, when anyone who could weld steel could form a successful company erecting oil derricks. The Internet is currently still in the stage of balloon-like hyperinflation that characterized the first few microseconds of the universe's existence, and just about any old thing that delivers something snazzy-looking is going to be successful, if, and only if, it can attract enough initial capital to get started. Capital, and not market share, is the determining factor in the success of Internet companies today. Market share is like Doritos: "Eat all you want–we'll make more!"

That being the case, some of the companies that have come to the top of the current dogpile have noticed that other companies are in the multimedia business too, and that being part of a framework is a lot more comfortable than going it alone. Such companies are all for open standards, mostly when they've got five or six major hardware and software companies lined up to support their brand new, open standard.

The other corrective factor is the real marketplace. Many, if not most, of these companies are only in existence because of the hyperinflation of the Internet. Hyperinflationary systems tend to undergo a phase change and the Internet will undergo one in the next, oh, three to five years, Mr. Protocol thinks. It'll become a medium like television, a utility like the telephone, a service like the U.S. Mail. Mostly, it'll lose degrees of freedom. Television could be a lot of things, but it isn't, it's only one thing because that's how the market shook out. Mr. Protocol hates to admit it, but the Internet will probably never be all the things it could be because the market, the real, final, dues-paying market, won't support them. Long before that point, most of these non-standard companies will have dried up and blown away, with not even a memory remaining.

A technology is an edge, if you are the only one who owns it. A standard is not an edge, even if you are the one who developed it. It is a playing field. But, if you can turn a technology into a playing field, you have a much better chance of creating a large, long-lasting market for your products. That's the dangerous game the really smart players are in for.

I'm sorry, we seem to have run out of time. You wanted to know why Mr. Protocol's house has no interior walls. I'm afraid that'll have to wait for another time. ⊸

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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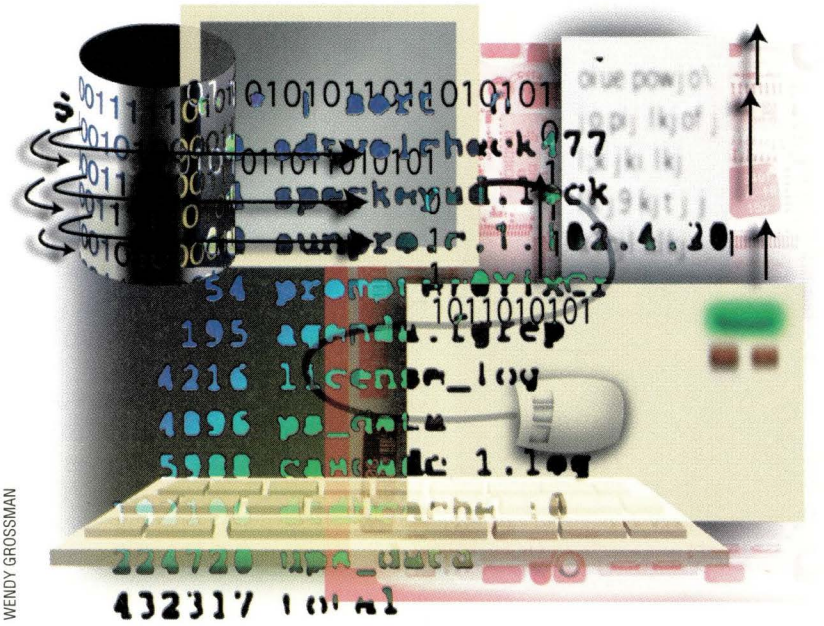
by Peter Collinson, **Hillside Systems**



WENDY GROSSMAN

Tool Talk

Last month, I talked about the notions of device independence and UNIX. We saw that most programs read and write streams of bytes. Programs are generally written so they read a stream from somewhere, or write a stream of bytes to somewhere, with no compiled-in knowledge of exactly where that "somewhere" is. The system provides mechanisms for setting up a source or a destination of the appropriate byte stream outside the running program. So a program can write to a disk file, a terminal screen or a printer where the destination is chosen by the user at run time.

Strictly, a byte stream is a sequence of characters processed by program. However, on UNIX, many programs impose structure onto the stream. These programs deal in text, where the byte stream is split into lines, several groups of characters each separated by a new line. Of course, this is convenient and maps directly onto human activity. Humans generate lines of text from their keyboard and expect to see lines of text scrolling up their screen.

Many utility programs on UNIX process text in some way or other and expect to receive or transmit new line-separated, variable length chunks of information. Actually, many programs that read data also have a secret limit to the length of the text line that they are able to process. The limit was set by a programmer back in the mists of time. When the program was written, the programmer wanted to store a complete line of text for processing by the program, and usually chose an internal buffer size that seemed infinite at the time. On 80-column terminals, no one would create lines longer than 256, 512, or 1,024 bytes, would they?

These hidden limits have proved a fruitful source of ways to hack into UNIX. All the hacker needs to do is provide a long text line, causing the program to overflow that previously infinite buffer. Then, perhaps, the program can be made to do unexpected things. It's true to say that most of these bugs have been fixed in recent system releases. The fix that was applied, generally, did not make the buffer infinite but ensured there is sufficient range checking so that the buffer overflow cannot happen.

To my mind, this is fixing the wrong bug. I want my UNIX tools to deal with lines of any length. There's a good reason for this. I'm beginning to find that some of these limits are more than inconvenient when dealing with HTML files created by some of the WYSIWYG HTML editors. These programs usually come from the heritage of word processing, where lines are very long because the new line character only appears at the end of a paragraph. When such files are transplanted onto a UNIX system, they appear to contain text but the lines are too long to be handled successfully by many of the tools, including many UNIX text editors.

If we ignore these infrequent line length problems, it's true to say that UNIX provides many tools that are designed to handle text. The tools fit casually together to process text byte streams and, with the shell, create an

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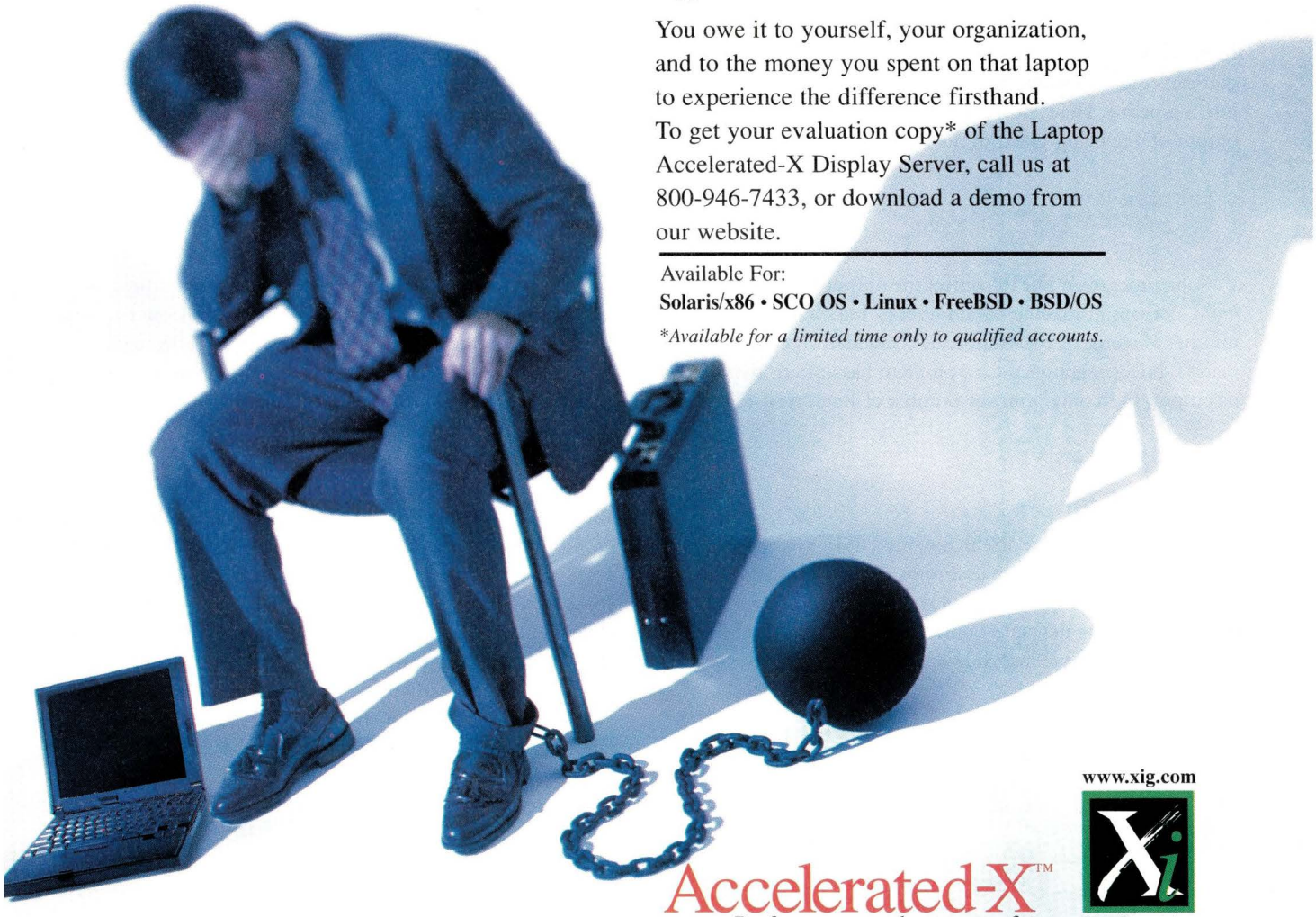

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extensible language to make new tools. To illustrate the language and its use, let's start with the wc program. Unlike some UNIX commands, wc is actually mnemonic and stands for "word count." It prints the number of lines, words and characters in a file. So, we'll get something like this:

```
$ wc file
     204      482     4674     file
```

This file has 204 lines, 482 words and 4,674 bytes. The command is intrinsically useful by itself, we can use it to find out information about the file. We can give the command several files. When we do this, we are also told the total number of lines, words and characters for all files:

```
$ wc file.*
     204      482     4674     file.1
     123     1678     7892     file.2
     327     2160    12567     total
```

The wc command will also read from its standard input and give us a similar result to the first example:

```
$ wc < file
     204      482     4674
```

It doesn't know the file name, so cannot print it. Any command that can read data from its standard input can also be placed into a pipeline. Here, two commands run in parallel, with the output of one being glued to the input of another:

```
$ cat file | wc
     204      482     4674
```

Sometimes, we'd like to control the output from the wc program, perhaps just seeing the number of lines in the file, or the number of words or the number of characters. In common with many UNIX programs, the wc program has options that modify its output, so to only print the number of lines, we'll add -l:

```
$ cat file | wc -l
     204
```

The next step is to realize that many UNIX system programs generate lines of text as a byte streams. We mostly display those lines on the screen, but we can pipe them into other programs, trivially answering new questions. For example, we might ask: How many people are logged in at present?

```
$ who | wc -l
       3
```

How many processes are running on this system? (Use ps ax on SunOS.)

```
$ ps -ef | wc -l
      92
```

Now, the astute reader will have noticed that perhaps I'm not telling the whole truth about this example. If you look at the output from the ps command, you'll see that it prints a title line, so the total number of lines outputted by the command is the number of processes running on the machine plus one. Subtracting one isn't that difficult, but if you're using the sequence in a script, you might want to remove the first line automatically. For example, by inserting a call to the sed command to delete the first line of the output from ps:

```
$ ps -ef | sed 1d | wc -l
```

The ps command has always printed a title line, showing that the ideas of tools and making commands fit together postdate the early development of UNIX.

Let's have another question: How many files are there in the current directory?

```
$ ls | wc -l
      16
```

There's something odd going on here, too. When you type ls, then you will see its output in columns:

```
$ cd /bin
$ ls
acctcom    filesync   mc68040    setuname
adb        find       mconnect   sh
addbib     finger     mesg       showrev
admintool  fmli       mkdir      sleep
alias      fmt        mkfifo     soelim
and so on
```

Output from ls wasn't always presented like this. The default output from the original command, as supplied in UNIX V6 and V7, only printed the names of the files, one per line. Of course, when the directory contains loads of files, then the file that you're trying to find will inevitably scroll off the screen. You would probably think this is bad. Well, in some ways, single-column output may be a good thing. Eons ago, whenever I saw names scrolling away in someone's home directory, I would use it as an excuse to tell them about how wonderful directories were, and how they could use the hierarchical file structure to organize their files. Single-column output provided them with a focus to put some order into their file collections. Rather than placing all their files in one directory, they were encouraged to collect them together in meaningful groups.

Anyway, at an early point in the development of the Berkeley System Distribution (BSD), the ls command was given columnar output by default. However, the ls command was already embedded in loads of shell scripts that could not be easily altered. The command was made backwards compatible by inserting a test to make it check where its output is going and alter its behavior depending on the result of that test. If its output device is a terminal, then it displays multicolumn output; if not, it prints a single column.

The folks at Bell Labs, the home of UNIX, didn't like this change to the `ls` command much, they regarded it as typical Berkeley hackery. They considered it unethical for programs that are intended to be general-purpose tools to ask specific questions about the devices with which they are communicating. A second, and perhaps more important, reason was they felt that programs should not change their behavior unless told to do so by the user.

A new version of the `ls` command (called `lc`) was created that always printed multicolumn output. The `lc` command found its way onto many versions of the "official" AT&T UNIX releases, but didn't really catch on. Berkeley `ls` prevailed. However, the result is a still an idiosyncratic hack. It can be confusing that:

```
$ ls
```

and

```
$ ls | cat
```

will give different results.

Filter Programs

Once we have the idea of passing the output from one program into the input of another, then it's a short step to begin to think about filters. These are programs designed to suck in data, usually one line at a time, do some processing and write an answer. We've had one of these already. The `sed` stream editor is a general-purpose tool often used to clean up data passing down a pipeline so that the sequence of commands you're using will give a correct answer. Of course, there is often no clear distinction between a stand-alone program and a filter. You can often employ a stand-alone program as a filter, and vice versa.

It's very common to want to look for some text in a file, a collection of files or a byte stream. The main filter program that is employed for searching is the `grep` command. By default, the command scans its input sources for the string that you give it and prints the lines it finds. For example, I might wish to find all the occurrences of `grep` in the articles I have written:

```
$ grep grep */*.ms
lines of output
```

When I pipe the output from this command into `wc`, I see that I have 135 lines containing `grep` in the text files that contain these articles. The format of the `grep` command is simple, the command name is followed by a single string (which is actually a regular expression allowing variable character matches), followed by a list of files to be searched. If there are no files, then the command assumes it should read its standard input.

For example, is my friend `aws` logged on?

```
$ who | grep aws
```

The command prints nothing, so `aws` is not logged on. We can use `grep` to find out what's happening on the system. For example, is `sendmail` running? (Use `ps -ef` on Solaris.)

```
$ ps ax | grep sendmail
 2369 ?     S 0:07 /usr/lib/sendmail -bd -q1h
19191 pts/4 S 0:00 grep sendmail
```

This shows that `sendmail` is running and also `grep`.

The `grep` command has three switches that are useful. First, the `-i` option performs a case-independent search for the string to be matched. This is useful when looking through general text and you have no clear idea about the case of the target. Second, the `-v` option prints the lines that don't contain the string to be matched. You can often use this to reduce output from a search to manageable proportions. If we wanted to list all the files in a directory that start with `a`, but don't contain `.doc`, we might say

```
$ ls a* | grep -v .doc
```

This pipeline results in a list of file names. We can use this list to move the selected files somewhere else:

```
$ mv `ls a*|grep -v .doc` fred
```

Here, we use the backquote operator to take the output from a command or command pipeline and insert it into the command line. On recent shells, like `ksh` or `bash`, you can use the POSIX syntax for this operation:

```
$ mv $(ls a*|grep -v .doc) fred
```

If the result of the `ls...grep` sequence is

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```
a67.ms
auto.txt
```

then the mv command becomes

```
$ mv a67.ms auto.txt fred
```

moving the named files into the fred directory.

Third, you can give grep a switch making it print a list of file names that contain the lookup string rather than the lines in the files it matches. At least once a week, I'll say something like

```
$ vi $(grep -l somestring */*.ms)
```

starting the vi editor on a list of files that contain the word somestring. The ability to accurately pick up a list of files and edit them saves so much time.

Incidentally, there are traditionally three versions of grep. The standard, general-purpose grep takes regular expressions and searches for matching lines. The simpler fgrep is given strings with no regular expression metacharacters and uses a different match algorithm because it's looking for a complete match against a fixed string. The command can be given a list of search strings. The more complex egrep takes *extended regular expressions* and permits more complex matching, including alternates (look for *fred* or *jim*).

Personally, I use grep unless I need one of the features that is supported by one of the other commands. Actually, some of the publicly available versions of grep map the three variants to a single binary that takes different actions depending on how it is called.

Sorting Data

Sorting data into order is another way of seeing what is interesting without being force-fed screenfuls of meaningless information that you are required to scan. By default, the sort command sorts its input by lines into ASCII order, or actually these days, the order that is defined by the locale on your machine. I'll guess this means ASCII for most readers.

The sort command has a very useful option (-n) that makes it look for a numeric value at the start of each input line and then sorts the lines into numeric order depending on the value. We can use this to list files with wc and sort them into size order:

```
$ wc -c * | sort -n
       0 sdtvolcheck477
       4 speckeysd.lock
      48 sunpro.c.1.102.4.20
      54 prompter0YixCr
     195 agenda.fgrep
    4216 license_log
    4896 ps_data
    5988 cascade_1.log
  192196 dtdbcache_:0
  224720 ups_data
  432317 total
```

(This is my current /tmp directory.) The -c option to the wc command tells it to print the number of characters in a file. Here, the wc command is generating a number and a name on each line, and there are plenty of programs in UNIX that print their output like this.

One way of compressing lots of data into more meaningful output is to examine the frequency at which a text string appears in the data. Let's look at something concrete to illustrate this. The last command chugs through the login history on the machine (stored in /usr/adm/wtmp) telling you when someone last logged in and how long they stayed logged in. On a busy machine, the information can be voluminous, but let's say we were trying to find the actual user population on the machine, who has logged in and how often.

Well, the first column of the output from the last command is the login name of the user, so if we can pick that up and eliminate all the other information we don't need, something like

```
$ last | awk '{print $1}'
```

will give us the necessary data. The awk command is another general tool, we are telling it to print column 1 of every line that it receives. By default, columns for the awk command are defined as white space-separated chunks of text on a line. This pipeline will print a line for each user that has logged into the machine.

We can impose some order by sorting the data. We can then pass the sorted data into the uniq program. This program examines its input and collapses multiple copies of the same line into just one copy. Again, the uniq program is intrinsically useful. I've often used it to reduce sets of repeated blank lines in a file to just one blank line per source set. In our current context, we can use it to reduce output to only show those users who have logged in:

```
$ last | awk '{print $1}' | sort | uniq
```

The output is a sorted list of people who have logged into the machine. Beware that you'll get an apparently extraneous wtmp login, because the last command finishes its output by saying:

```
wtmp begins Sat May  1 21:28
```

wtmp is the file that is being examined by the last command. On a busy machine, this list may be useful, but it may be more helpful to know how many times a particular user has logged in. If we use the -c (count) option to the uniq command, it will print the line preceded by the number of repeats that it has seen of that line. Notice that this format is eminently suitable for passing into sort -n. So my full pipeline that tells me who has logged in and how frequently is

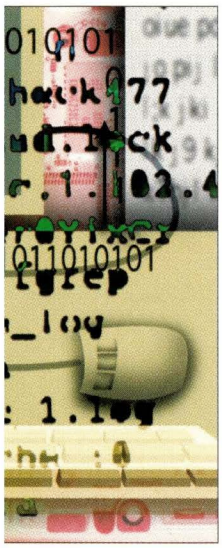
```
$ last | awk '{print $1}' |
         sort | uniq -c | sort -nr
```

which will give me output like the following:

```
146 mmi1
103 cj9
 99 jmb
 93 dpm
 88 cghd1
 73 eeb
 72 mcp
 69 ldc
```

and so on...

The `sort|uniq -c|sort -n` sequence is a common way of processing statistical data. The key idea is to create a format where the data that interests us is shown on separate text lines. Once we've done that, we can sort it, mostly to ensure that identical lines follow each other. We pass that data into `uniq` to count the repeats and then pass the data to `sort -n` to place the results in order. I use this technique for processing many log files where the most and least frequent events are often the most interesting.



Further Reading

There's lots of related material in *UNIX Power Tools* by Jerry Peek, Tim O'Reilly, Mike Loukides and others (now in its second edition, published by O'Reilly & Associates Inc., ISBN 1-56592-260-3). Also, get hold of *The UNIX Programming Environment* by Brian Kernighan and Rob Pike (published by Prentice-Hall Inc., ISBN 0-13-937681-X). This book is perhaps a little old now, it dates to 1984, but is one of those seminal UNIX books that all UNIX users should read.

***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**

KEN CONDON

Ways To Do It

The Perl community delights in the fact that "There's More Than One Way To Do It," but the UNIX community got there years earlier. This month's column explores a simple file administration problem, offering a variety of "Ways To Do It."

Finding Duplicate Files

Let's say you have some largish collections of files from disparate sources. You know there's a lot of duplication, but you have no easy way to ferret it out. You can't compare names, for instance, because the sources of the files have used different naming conventions. So, what to do?

Here's a simple script, written in the Bourne shell (`sh`), that will find all of the duplicate files. It prepares a sorted list of file names, then uses the list to drive a pair of nested loops, doing an N-by-N comparison:

```
:
# dup1 - find dups
#
# Usage: dup1 [dir ...]

list="$@"
T=/tmp/dup1.$$
find $list -type f -print |
sort > $T

while read f1; do
  while read f2; do
    if [ $f1 = $f2 ]; then
      break
    fi
    cmp -s $f1 $f2
    if [ $? -eq 0 ]; then
      echo ''; echo $f1
               echo $f2
    fi
  done < $T
done < $T
rm $T
```

Unfortunately, this script is a bit too simplistic; it has fundamental efficiency problems. The files are compared byte-for-byte, which is rather expensive. Worse, as the number of files increases, the number of file comparisons goes up geometrically.

If every file were compared against every other file, there would be N^2 comparisons. This "optimized" script is more than twice that efficient (:-), making a mere $(N^2 - N)/2$ comparisons:

N	N^2	$(N^2 - N)/2$
10	100	45
100	10000	4950
1000	1000000	499500
10000	100000000	49995000

In any event, this kind of performance is not likely to be acceptable, so let's look at some ways to improve it.

By using "signatures" (representative values) for each file, we can speed up the comparisons dramatically. While we're at it, we'll reduce the number of comparisons–from $(N^2 - N)/2$ to N. Finally, we'll clean up the output format. Lists of matching files are easier to use than multiple pairs of matching files.

The following version creates a list of

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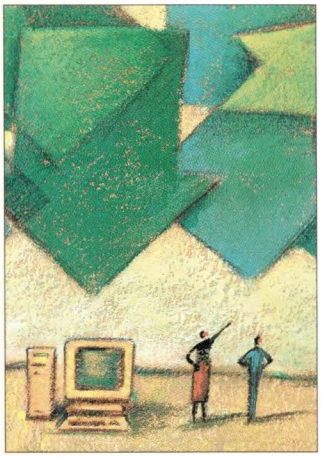
The checksum code uses a handy feature of Perl's unpack function. It tells unpack to do a 32-bit wide checksum, treating $data as a string of unsigned characters.



signatures from the files' checksums and sizes, sorts the list, then looks for matches:

```
:
# dup2 - find dups, using signatures
#
# Usage: dup2 [dir ...]

list="$@"
T=/tmp/dup2.$$
find $list -type f -print |
while read file; do
  sum=`sum    $file | awk '{print $1}'`
  siz=`ls -al $file | awk '{print $4}'`
  echo "$sum,$siz  $file"
done | sort |
awk '
  {
    if ($1 == lkey) {
      printf("%-15s  %s\n",    lkey, lnam)
      printf("%-15s  %s\n\n", $1,   $2)
    }
    lkey = $1; lnam = $2
  }
```

Because some files may match in signatures, but not in reality, this version may produce some "false positive" results. We can clean this up, however, as discussed below.

At this point, for both speed and programming convenience, we should switch programming languages. The following version, in Perl, uses a pair of hashes (associative arrays) to collect information on matches, then prints out a sorted list of the matches it has found. Because all of the work is done within a single program, the Perl version is quite a bit faster than the shell version:

```
#!/usr/local/bin/perl
#
# dup3 - find dups, using signatures

use File::Find;

# walk file trees, calling &wanted

@bases = ('/tmp');
foreach $base (@bases) {
  find(\&wanted, $base);
}

# print results

foreach $key (sort(keys(%tag))) {
  @got = split(/\t/, $got{$key});
  foreach $name (@got) {
    printf("%s (%s)\n", $name, $key);
  }
  printf("\n");
}

# called for each file/directory

sub wanted {
  my($name) = $File::Find::name;

  if (-f $name) {
    open(FILE, $name);
    read(FILE, $data, 1024);
    $sum = unpack("%32C*", $data);
    close(FILE);

    $siz = -s $name;
    $key = "$siz,$sum";
    $tag{$key}++ if ($got{$key} ne '') ;

    $got{$key} .= "$name\t";
  }
}
```

If you're not (yet :-) a Perl hacker, some of the code in this version may have gotten past you. So, here are a few hints. The `find` function acts somewhat like the UNIX `find(1)` command. It walks down a file hierarchy, calling a specified routine, for example, `wanted`, at each node (directory or file). `$File::Find::name` is set to the full path name of the current node.

The checksum code uses a handy feature of Perl's `unpack` function. It tells `unpack` to do a 32-bit wide checksum, treating `$data` as a string of unsigned characters. Page 237 of *Programming Perl,* Second Edition, by Larry Wall, Tom Christiansen and Randal L. Schwartz (published by O'Reilly & Associates Inc., 1996, ISBN 1-56592-149-6), covers this aspect of `unpack`.

Performance and Tweaks

I ran these scripts against the `/etc` directory on `cfc1`, a Sun SPARCstation 2, running SunOS 4.1.3. As I expected, the brute-force version, `dup1`, took quite a while, 420.30 seconds

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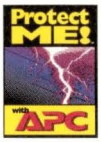

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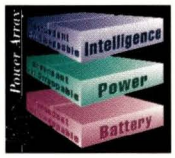

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to be exact; the second and third versions got faster and faster:

Seconds	Script
420.30	dup1
36.09	dup2
2.32	dup3

It is quite possible, although unlikely in practice, that files could have the same byte counts and 32-bit checksums, yet still be different. You could create such a situation, for instance, by copying a large file and reversing the order of the last pair of bytes. If this possibility is unacceptable in your situation, you'll need to perform a final "sanity check."

Because we already have lists of putatively-matching files, this process will not take very long. We just need to perform full comparisons on supposedly matching files to see if they match in reality. For example,

```
# print results

  $/ = '';
  foreach $key (sort(keys(%tag))) {
    undef @chk;
    @got = split(/\t/, $got{$key});
    $name = shift(@got);
    open(TMP, $name) or die("1: <$name>");
    $last = <TMP>;
    close(TMP);
    push(@chk, $name);
    foreach $name (@got) {
      open(TMP, $name) or die("2: <$name>");
      $this = <TMP>;
      close(TMP);
      push(@chk, $name) if ($this eq $last);
    }
    foreach $name (@chk) {
      printf("%s (%s)\n", $name, $key);
    }
    printf("\n");
  }
```

Ironically, this checking routine introduces a small bug. If all but the first file in a set match, the code will decide that none match. Taking a classic "out," I'll leave this as an exercise for the reader.

If you would like to know more about these sorts of design issues, I suggest that you take a look at Jon Bentley's columns in *Dr. Dobb's Journal* (`http://www.ddj.com/`) and his two excellent books, *Programming Pearls* and *More Programming Pearls* (both published by Addison-Wesley Publishing Co., ISBN 0-201-10331-1 and ISBN 0-201-101889-0, respectively). ➸

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

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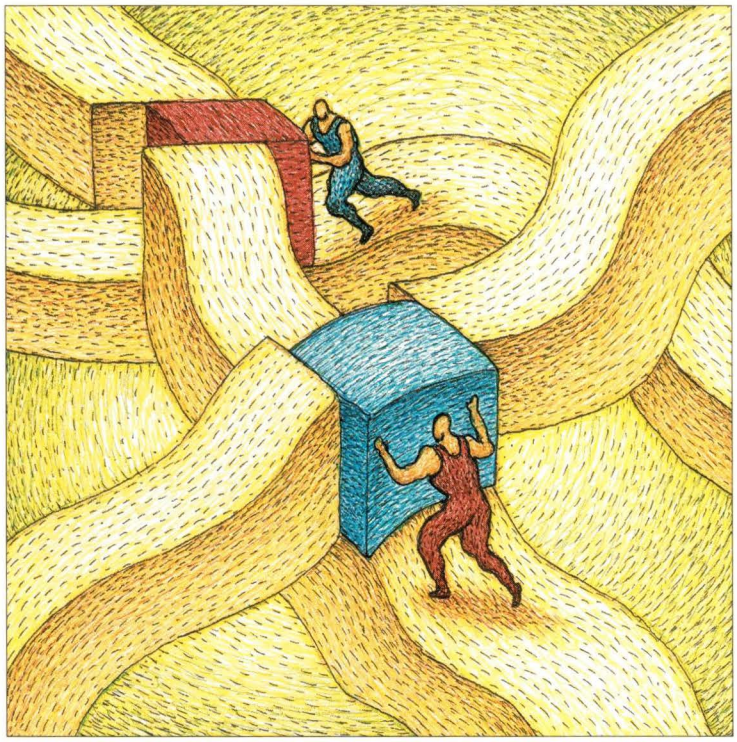
by S. Lee Henry



DAVE RIDLEY

Pitching Patches

Patches, oh what can I do?
I swear I'll always need you
You may not be right, but I'll install you tonight
Patches, what else can I do?

Patching our Solaris systems to ensure that they're both secure and running properly is one of the many routine tasks performed by systems administrators. Determining what patches need to be applied and what patches have already been applied to each of our systems can seem like a daunting task. Though it's possible to install, back out, report on and be informed about patches just by knowing a few commands, keeping ourselves informed about newly discovered security holes or updated patches, and then patching our systems wisely and consistently, takes a dedicated effort and time that always seems in short supply.

What is a Patch?

Patches are fixes to software problems (generally) discovered after distribution and (generally) made available via the Web or an FTP site. Most patches are simply replacement executables; in other words, a new binary file might replace a system process like `ftpd`, the file transfer protocol daemon, when a flaw (often a security "hole") is discovered in the corresponding binary in the previously released operating system. Occasionally, but rarely, patches are distributed as file insertions used to update existing files rather than replace them.

If the particular flaw being addressed by a patch were of little consequence, the corresponding fix might have waited for the next release of the software. For serious problems, waiting is rarely an option and a patch is released as soon as the bug can be dissected and the code repaired and rebuilt.

The need for patches is no reason to panic or to think really bad thoughts about Sun Microsystems Inc. or any other software vendor–unless maybe you're swimming in them. As someone who's had the experience of developing seriously difficult software, I can bear witness to the near impossibility of perfect code. Because of their magnificent complexity and wonderfully versatile nature, all operating systems have bugs and all operating systems require patches in between releases.

Different Types of Patches

You'll hear a number of descriptors prepended to the word "patch": jumbo patch, mega patch, mandatory patch, recommended patch and security patch, come to mind. The words "jumbo" and "mega" indicate that a number of binaries are being replaced or modified in the same patch file. The term "mandatory" implies that the referenced patch must be installed if you want your system to work properly. This is as close to a you're-in-deep-(kimchi?)-without-the-patch warning as ever you'll hear. "Recommended," which is the term Sun prefers to use today, means that Sun considers the patches to be universally applicable. In other words, they are fixes to problems that all users are likely to

encounter. Patches labelled as either mandatory or recommended should *not* be installed unless you're having serious problems without them. Let's quickly examine why this is so.

Recall that we said patches are quick fixes for flawed code. Any particular patch is run through a series of tests, no matter how much some of us might like to mutter to the contrary. It will not, however, be tested in concert with all other patches, be exhaustively tested in concert with all other patches, or be exhaustively tested with all previously released and in-progress patches! Get the picture? If patches could be tested this well, they'd probably be packaged up as the next release. But because a patch cannot be tested alongside every other patch, there may be side effects to installing incompatible patches–the risk of new and different bugs! Limiting the application of patches to only those that you know will address problems you're having will make this risk negligible.

Another term you will see (and likely appreciate) is "patch cluster," a packaging of recommended and security patches created to facilitate download and installation.

When Should Patches Be Applied?

You should always install the patches that come with a new release of Solaris. Consider these just part of the release that didn't quite make it in time to be incorporated into the files used in the primary install. These patches will have been tested together with the release and will bring you up to the proper and expected operating level.

Other than these patches, security patches are the only patches that you should install *regardless* of whether you are aware that you are having problems. Discovered security holes present enough risks to warrant immediate application of the appropriate patches without regard for possible side effects. Security patches (always classified as recommended patches, just to add to the confusion) should be installed as soon as possible. Discovered security holes present enough risk to warrant immediate application of the appropriate patches without regard for possible side effects. There is no reason to assume that hackers will fail to read all the latest reports on security holes. We might as well try to keep up with them.

Recommended patches should be installed periodically. Researching and installing them on a weekly, biweekly or even monthly basis is probably a good idea. Depending on your workload, you might even apply patches as you learn about them. One of the little life rules that has helped me over the years says that any task takes less time and mental resources if you take care of it right away. If you manage a lot of systems, the hardest part of applying these patches will probably be keeping all of your systems at the same patch level. On the other hand, it's not difficult to determine which patches have been installed on what systems.

Other patches should be installed only if you encounter the problem that they fix or suspect that you will run into it based on the description of the patch.

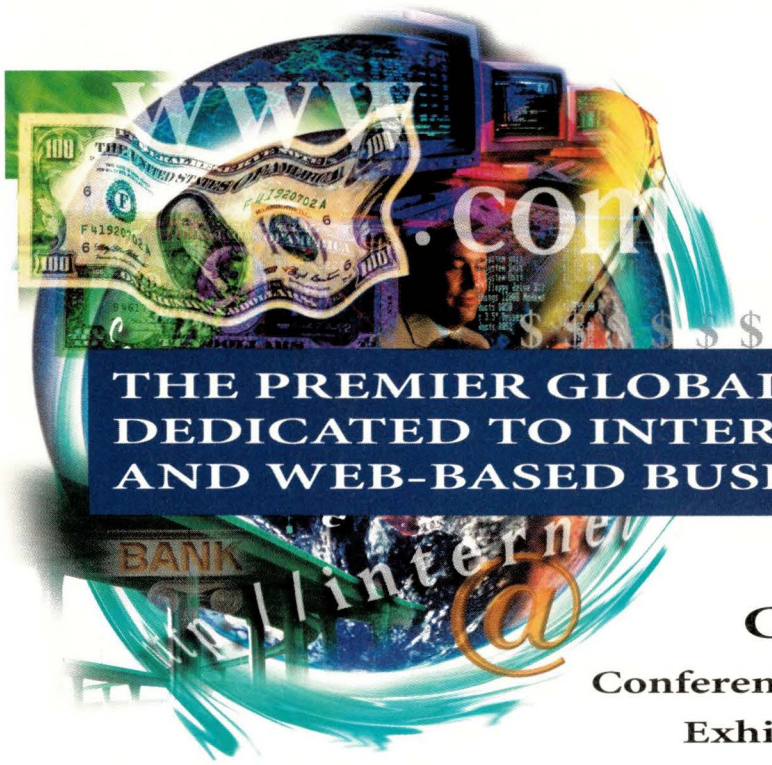
Table 1. Where to Find Patches

- **SunSolve Online**
  `http://sunsolve1.sun.com/`
- **SunSITE USA Exchange**
  `http://sunsite.unc.edu:/pub/sun-info/sun-patches/`
- **SunSITE Japan**
  `http://sunsite.sut.ac.jp:/pub/sun-info/sun-us/sun-patches/`
- **SunSITE UK**
  `http://sunsite.doc.ic.ac.uk:/sun/sunsite-sun-info/sun-patches/`

Do Patches Interact with Each Other?

Clearly, they could. The likelihood of different patches replacing or otherwise affecting the same executables is not high, however, unless one of the patches supersedes the other. Patches will change over time. This can be frustrating if you have to determine not only whether you've applied a certain patch, but applied the latest version. You should be careful to apply patches in the proper order. Patches have names like 123456-08, where 123456 is the patch number and the 08 is the version. If you've installed 123456-08, you don't want to reapply 123456-07. You could replace an executable with an older one if you're not careful.

If you obtain patches from SunSolve, or a site that properly maintains current patches, you shouldn't run into any problems. If you maintain a collection of patches for updating your internal systems, make sure you keep the collection as up-to-date as possible, especially if individual users might be getting patches both from this collection and from outside. The order in which patches are installed can make a difference. If you use SunSolve's Online service (see Table 1), you can set yourself up to be notified when patches are revised. This works well for those of us



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Circle No. 19

Figure 1. Checking for Installed Patches

```
# showrev -p | head -4
Patch: 105642-01 Obsoletes:  Requires:  Incompatibles:  Packages: SUNWkvm
Patch: 105210-01 Obsoletes:  Requires:  Incompatibles:  Packages: SUNWcsu, SUNWa
rc
Patch: 105216-01 Obsoletes:  Requires:  Incompatibles:  Packages: SUNWcsu
Patch: 105393-01 Obsoletes:  Requires:  Incompatibles:  Packages: SUNWcsu
```

who are often preoccupied with half a dozen emergencies.

Patches are generally distributed as compressed `tar` files and include the generic Korn shell scripts, `installpatch` and `backoutpatch`, for doing the obvious, and a readme file describing the patch and the problems it fixes. The readme file includes a list of files replaced (that is, included) with the patch, the bug IDs and descriptions and any special installation instructions that may be required. Some patches are large and you might have to check your disk space before trying to install them.

Can I Back Out a Patch?

Sure you can. The `backoutpatch` script manages this by retrieving files saved in `/var/sadm` when the patch was installed. This, by the way, is a good reason to build extra space into this file system when you partition your disks during a Solaris installation.

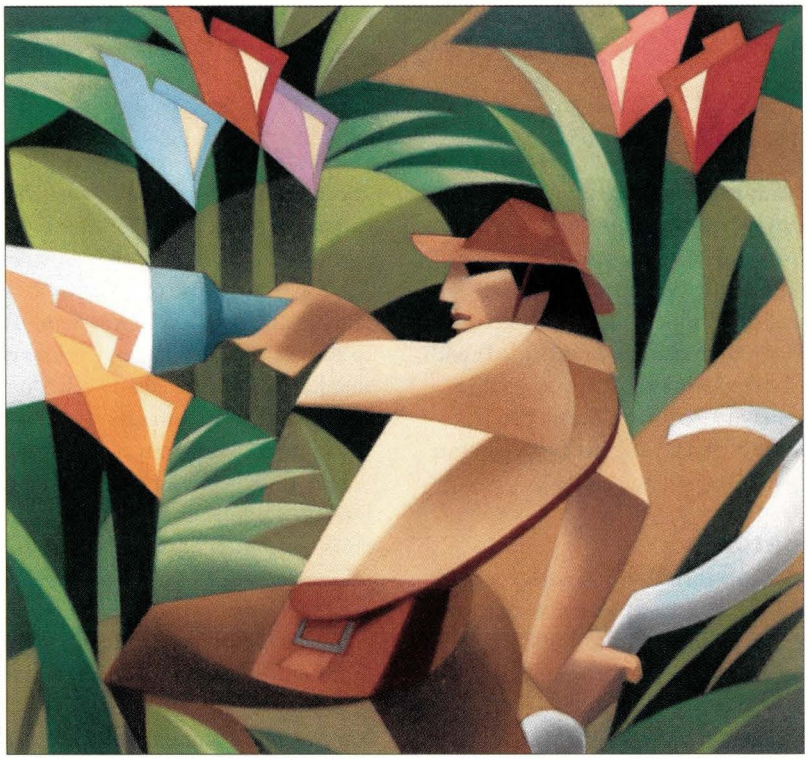
You don't need to back out an older version of a patch before installing a new one unless the associated readme file specifically asks that you do so. The new patch should do the job whether or not the previous version was ever installed.

How do you know what patches have already been installed? You can use the command `showrev -p` to find out what patches are installed on a system. The output will look similar to the example in Figure 1. It lists each patch and version that has been installed and tells you when a particular patch becomes obsolete or requires another.

There are numerous places where you can go to get patches. Some of the better known (and known to be reliable) sites are listed in Table 1. To receive information from, or subscribe to, Sun's Customer Warning System (CWS) mailing list, send email to `security-alert@sun.com`.

S. Lee Henry *manages systems and development at InCap Corp., Marin County, CA. She hopes that some of her readers will recognize the "Patches" lyrics at the beginning of the article liberally mutilated from a song popular in the early sixties. Her email address is* `slee@cpg.com`.

by Æleen Frisch



LYNNE CANNOY

Windows NT Q&A

This month, let's take time out to answer a few questions from the NTegration mailbag.

How do I set the search path in Windows NT?

This is set via the Environment tab of the System Properties menu (right click on My Computer). There are actually two search paths: a system search path that applies to everyone and an individual search path definable by each user. The actual path used is the concatenation of the two, system path first.

Figure 1 shows a dialog box ready to modify the system search path. The Value field at the bottom of the dialog may be used to modify or add to it. Note that environment variables used within the search path, `%SystemRoot%`, in our example, are expanded when the value is displayed in the upper list box, but they are stored unexpanded in the actual `PATH` environment variable.

When you update the search path via this dialog box, changes are stored immediately, but they apply only to subsequently-initiated processes.

You can also use the Resource Kit's `pathman` command to perform the same task from the command line. For example, the following command will add `D:\Bin` to the end of the system search path and remove `C:\Bin` if it's present:

```
C:\> pathman /as D:\Bin /rs C:\Bin
```

You can also modify the search path using the standard DOS method of defining the `PATH` environment variable, `PATH=1`, but changes made in this way apply only to the command window in which they are entered.

Is it possible to append standard error to standard input using I/O redirection?

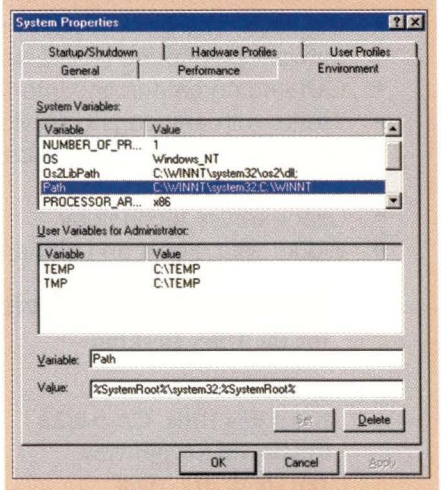
I thought this wasn't possible for a long time, but I was wrong. My problem was my test case was a command like the following:

```
C:\> some-command 2>&1 > output.txt
```

This command does not work. However, this one does:

```
C:\> some-command > output.txt 2>&1
```

Figure 1. Specifying the Search Path



Changes to the search path via this dialog box are stored immediately.

In other words, order is everything. If the construct to append standard error follows the standard output I/O redirection specification, it works fine. Live and learn.

I want to telnet *into my Windows NT machine. How do I set this up?*

You need to get a Telnet server for Windows NT. An easy way to get hold of one is to use the beta Telnet server included with the Resource Kit. Installing it is quite simple:

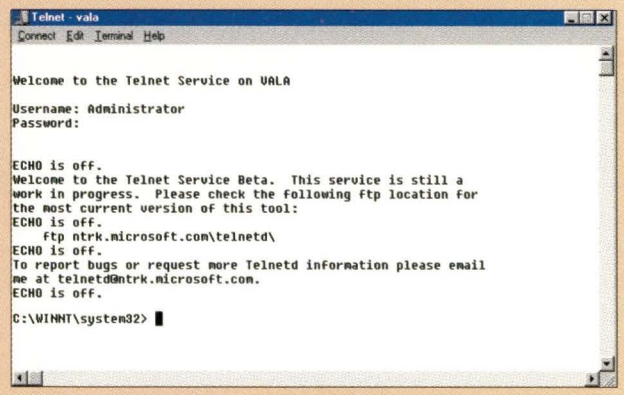
1. Install the Resource Kit on a Windows NT file system. The files you need are in the Telnet subdirectory of the Resource Kit directory, `NTResKit`.

2. Open the Network Properties (one way is Network Neighborhood=>Properties) and select the Services tab. Determine if the Remote Session Manager service is installed or not. If it is, click Update. If not, click Add and then Have Disk. Enter the path to the Telnet subdirectory into the resulting dialog box. If you are updating, continue on to step 3. If you're adding, select the Remote Session Manager from the list. Do not reboot if you're prompted as to whether you want to do so.

3. When you are back at the Services tab, click Add and then Have Disk, enter the path to the Telnet subdirectory and select Telnetd Service Beta (Inbound Telnet).

4. Exit from the Network Properties applet. When prompted, reboot the system. When it returns, the Telnet service should be running and you can attempt to `telnet` to the system from another computer (see Figure 2).

Figure 2. Using the NT Telnet Server



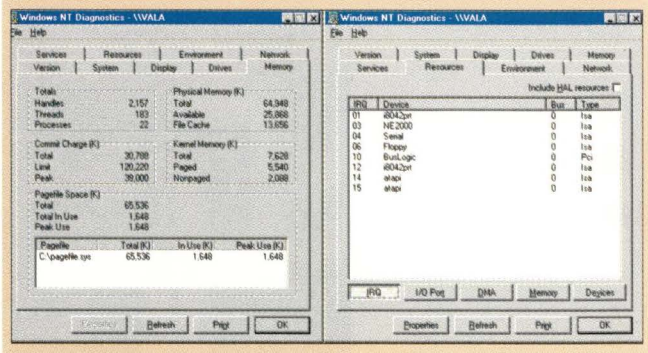
You can check that your Telnet service is running by trying to telnet *to the system from another computer.*

Is there any way to view system-related information, such as the amount of memory, on the system?

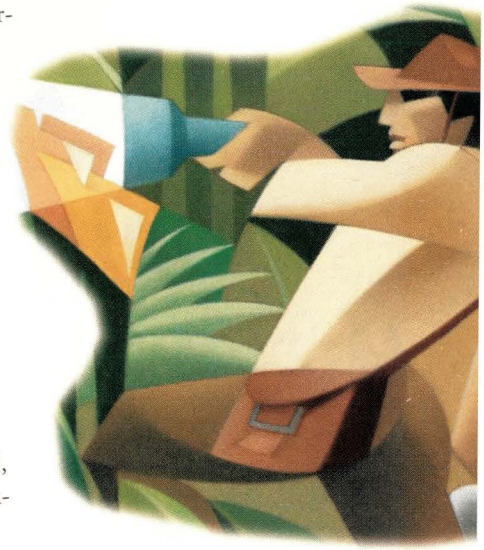
One way is to use the `winmsd` utility via Start=>Programs=>Administrative Tools (Common)=>Windows NT Diagnostics. The tool has nine tabs displaying various data about the local system and its configuration. The Memory tab displays a variety of information about system memory and paging space (see the left illustration in Figure 3).

Another useful tab is Resources, which can be used to list the settings of the various hardware devices on the system (see right illustration in Figure 3). In this case, we are viewing the IRQ settings, but the buttons at the bottom of the panel can be used to display I/O port assignments, DMA channels, memory regions and a list of installed devices. The buttons at the bottom of the main window are also useful. The Properties button is active whenever there is additional information available about the selected item. The Print button may be used to generate a textual report of the information displayed by this tool, which may be printed and/or saved to a file.

Figure 3. System Information Display



The winmsd *utility has nine tabs displaying various data about the local system and its configuration.*



The Windows NT Diagnostics tools includes a Drives panel, which displays information about the disks and file systems on the system. Another quick way to determine information about the various file systems is to open My Computer and select View=>Details. The resulting window will display the total size of, and free space within, each file system on the computer.

What's Your Question?

If you have an NT question you'd like addressed in a future column, feel free to send it to me at `aefrisch@lorentzian.com`.

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

by Jim Fox

A *wizard's apprentice*

AA *super user*

AAA *wizard*

JANE MARINSKY

Unity Among Web Pages

Q: I want to gain some control over the consistency of my Web pages by using Secure Hypertext Markup Language (SHTML), but my systems administrator won't allow it. He says it's too much work for the server. Is it? What else can I do? AA

Julie Singer
Eastlake Marketing

A: Having the Web server parse documents (as with SHTML) seems to me to be unnecessary overhead. Most Web pages, except those built by CGI programs, tend to be "write once/read often" kind of documents.

There are two uses of parsed HTML: one tailors pages to particular browsers or client sites; the other gives your site a consistent look by copying common page parts from `include` files. The former is a job better handled by CGI programs. The latter can be done in another way, one that won't bother your administrator at all.

We want to construct Web pages from common components and we'd like an automatic system that rebuilds the pages whenever a given component changes. A couple of UNIX utilities come to mind: `cpp` and `make`.

`cpp`, the C preprocessor, is a readily available, standard UNIX tool that will gather component sources to build a complete file. `make` is a handy tool that recognizes dependencies and builds targets from sources. The fit seems perfect (if unexpected).

The C Preprocessor

Granted not everyone immediately thinks of `cpp` for building Web pages, but what other choices are there? The M4 macro language would work, but that's even farther out in left field. And, personally, I've done all the M4 writing I ever care to do. There's also the SHTML parser that comes with some Web servers, which would work if it could be split off from the server. The idea has merit, but it involves writing and maintaining a new program. `cpp` is already on your system, so let's use it for now and maybe consider the SHTML approach next month.

A typical Web page looks like this:

```
<!DOCTYPE HTML PUBLIC
"-//W3C//DTD HTML 3.2 Final//EN">

<html>
<head>
<title>
The page's title
</title>
Other common header stuff
</head>

<body>

Some common page parts

Specific text of this page

</body>
</html>
```

There may be several occasions where all the pages on your Web site have very

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similar text. Let's see how cpp can help organize these pages. If you want your HTML pages to be rendered correctly on the screen, then they must all start with the standard <!DOCTYPE ...> language. Let's write a starter include file, "webtop.ht", that has this text. Each of our documents will start with #include "webtop.ht".

We can use cpp a couple of ways. One way is to define some macros and invoke them later. In the webtop file, we might define a HEADER macro, as follows:

```
#define HEADER(t)   \
  <html><head>   \
  <title>t</title>   \
  </head><body>
```

and start each page with

```
#include "webtop.ht"
HEADER(The page title)
```

This is neat but limited: We can't use commas and quotes with abandon in macro arguments because they have special meaning to cpp. However, this turns out to be a huge restriction with Web pages. A better way is to define the arguments as symbols before including the common material. The above example now looks like this:

```
#include "webtop.ht"
#define TITLE The page title
#include "header.ht"
```

where the header.ht file contains

```
/* Header stuff */
<html>
<head>
<title>TITLE</title>
</head>
<body>
```

This way, the title can contain any text. Notice how we use standard C-style comments, however, we must make sure we use the -P option so those comments won't get passed to the real Web page, where they would show up as text.

We might format the bottom of each page the same way. Include the following definitions in your page's source:

```
#define SIGNATURE Julie Singer,<br>\
   Chief Technical Writer
#define UPDATED June 2, 1998
#include "trailer.ht"
```

where the trailer.ht file contains the following:

```
/* Trailer stuff */
#if defined (SIGNATURE)
<address>SIGNATURE</address>
#endif
#if defined (UPDATED)
<i>Page updated: UPDATED</i>
#endif
```

You see how easy it is to include conditional text.

Using make

Now that we know it's both possible and practical to build a Web page from component parts using cpp, let's see how we can use make to automate the installation of a Web site.

make infers a file's purpose from the file name suffix, so we have to choose suffixes for our sources files. Our Web page source files will end in .w and the include files will end in .ht. We'll put all the common components, the *.ht, in one directory (include). The following makefile entry tells make how to convert source code (.w) into a Web page (.html):

```
INCL=-Iinclude
CPP=/usr/ccs/lib/cpp -P

.SUFFIXES:  .w .html
.w.html:  $(@@:.html=.w)
   @ echo making $@
   @ rm -f $@
   @ $(CPP) $(INCL) $< $@
```

You'll recall from your experience with makefiles that $< means the dependency, $@ means the target, $(@@:.html=.w) means the target with .w substituted for .html and @ means to not echo that line. This definition of cpp is for AIX.

With that entry in a makefile you can type

make *pagename*.html

Figure 1. Common Rules for Makefiles

```
# Common makefile rules for web pages
# WEBROOT is the root of the web site
WEBROOT=/home/fox/public_html
INCL=$(LOCAL_ROOT)/include
DEST=$(WEBROOT)/$(LOCAL_PATH)
CFLAGS= -I$(INCL)
CPP=/usr/ccs/lib/cpp -P
MAKE=  make
HTML=  $(DOCS:=.html)
# preliminary targets
.SUFFIXES:       .w .html
.w.html:  $(@@:.html=.w)
   @ echo making $@
   @ rm -f $@
   @ $(CPP) $(CFLAGS) $< $@


all:   $(HTML) subdirs
html:  $(HTML)
```

and `make` will build the page from the *pagename*`.w` source. That builds a single page, but what we really want is to automate an entire site, or at least part of the site. Let's improve the makefiles. First, build a source tree that mirrors the Web site. This will keep things clean and separates the source files from the finished product. It shouldn't be a burden on disk space. Remember the page sources will generally be a lot smaller than the actual pages. Images and other non-buildable items should probably be left out of this system, so put them in some library directory on the server.

Generally, every directory will have its own makefile, identifying specific pages to build in that directory. We can use some common tricks to automatically do `make`s in each subdirectory. If, for example, `HTML` is a list of HTML documents and `SUBD` is a list of subdirectories, then the makefile entry

```
all: $(HTML) subdirs

subdirs:
  @ if [ ! -z "$(SUBD)" ]; then  \
    for f in ""$(SUBD); do  \
       (cd $$f;  \
       echo $$f/;  \
       make all );  \
    done;  \
fi
```

will build the Web pages in the current directory and in all the subdirectories. It may seem like the makefiles are getting large and complicated, but in practice they can be made very simple. All the common elements can be moved to separate files and "included" in each directory's makefile. The local makefile will only have to identify the pages to build and install.

Let's look at an example. Figure 1 shows `Web Makefile.rules`, the common rules to be used by all makefiles. Figure 2 shows `Web Makefile.targets`, the common targets for all makefiles.

Suppose we have a directory, `projects`, with two pages (`index.w` and `details.w`) and one subdirectory (`history`). Here's what its makefile would look like:

```
# Makefile for directory 'projects'

# Web pages and cgi programs to make

LOCAL_ROOT=   ..
LOCAL_PATH=  projects
DOCS=           index details
SUBDIRS=         history

# Common rules

include $(LOCAL_ROOT)/Makefile.rules

# Installation targets

INSTALL_PROD=  $(DEST)/index.html  \
      $(DEST)/details.html

# Common targets

include $(LOCAL_ROOT)/Makefile.targets
```

Figure 2. Common Targets for Makefiles

```
# Common makefile targets web pages
install:  $(INSTALL_PROD) install_subdirs
$(INSTALL_PROD):  $$(@F)
  @ echo installing $@
  @ cp $(@F) $@
subdirs:
  @ if [ ! -z "$(SUBDIRS)" ]; then  \
    for f in ""$(SUBDIRS); do  \
       (cd $$f;  \
       echo $$f/;  \
       $(MAKE) all );  \
    done;  \
fi
install_subdirs:
  @ if [ ! -z "$(SUBDIRS)" ]; then  \
    for f in ""$(SUBDIRS); do  \
       (cd $$f;  \
       echo $$f/;  \
       $(MAKE) install );  \
    done;  \
fi
clean:  subdirs
  @ echo cleaning `pwd`
  @  rm -f $(HTML) $(CGI)
  @ if [ ! -z "$(SUBDIRS)" ]; then  \
    for f in ""$(SUBDIRS); do  \
       (cd $$f;  \
       echo $$f/;  \
       $(MAKE) clean );  \
    done;  \
fi
# Common dependencies
$(HTML):  $(INCL)/webtop.ht  \
  $(INCL)/header.ht  \
  $(INCL)/trailer.ht
```

And that's it! In the top directory, type `make install` and all your pages are automatically assembled and installed.

With these cpp-built Web pages you have an easy-to-maintain, consistent Web site. I tried it. Check it out at `http://staff.washington.edu/fox/`. It may not be the cutting edge, but you will definitely be near some edge of the Web programming world. ⊸

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by John S. Quarterman

HARRY BARTLETT

The U.S. White Paper on DNS

On June 5, the U.S. government issued a white paper on the Internet Domain Name System (DNS). Specifically, the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce issued docket number: 980212036-8146-02, entitled "Management of Internet Names and Addresses" (see `http://www.ntia.doc.gov/ntiahome/domainname/6_5_98dns.htm`).

This white paper is the U.S. government's solution to the expansion of the organizational mechanisms supporting the Internet DNS. It follows a Department of Commerce green paper that was issued January 30, 1998, which in turn followed a Request for Comments (RFC) filed July 2, 1997, also by the Department of Commerce, which followed a presidential directive issued July 1, 1997 to "privatize the Domain Name System (DNS) in a manner that increases competition and facilitates international participation in its management."

There's an implicit problem lurking in this whole process. The U.S. government never owned the Internet DNS in the first place, so it has no authority to privatize it. It's true that the U.S. government has been partly funding the administration of the `.gov`, `.edu`, `.org`, `.net` and `.com` domains through a series of grant agreements–most recently through InterNIC (`http://www.internic.net/`), which is run by Network Solutions Inc. (`http://www.netsol.com`). The U.S. government can privatize the administration of those domains (now known as generic top-level domains, or gTLDs) insofar as it funds their administration.

But the U.S. government has never owned, for example, the FR domain for France, the PE domain for Peru or the HT domain for Haiti. And whole regions of DNS and IP network number assignment authority have been delegated to organizations such as RIPE (`http://www.ripe.net/`) in Europe and APNIC (`http://www.apnic.net/`) in the Asia Pacific region (see Table 1).

So why has the U.S. government now issued a white paper spelling out who is supposed to run the DNS? Because everyone else has made such a mess of it.

Just as no one predicted the extended rapid growth of the Internet or the social effects resulting from it, no one adequately anticipated the organizational changes that would be necessary to handle such growth. The DNS itself was one of several factors that combined around 1988 to make the rapid growth of the Internet possible. Now that growth has made some kind of reform of the DNS necessary.

Unfortunately, the preexisting organization took too long to arrange for a change. This permitted various other organizations to move in. They failed to produce a solution that the Internet at large would agree to. The continuing lack of adequate DNS organization led the U.S. government to step in.

Is this intervention in the DNS by the U.S. government a good thing? Mostly, but only in the same sense that the United States' and NATO's intervention in

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Table 1. Common Internet Acronyms

APNIC	–	Asia Pacific Network Information Center
ARIN	–	American Registry for Internet Numbers
ARPA	–	Advanced Research Projects Agency (United States)
ATCPIP	–	Association for the Creation and Propagation of Internet Policies
DNRC	–	Domain Names Rights Coalition
CORE	–	Council of Registrars
FNC	–	Federal Networking Council (United States)
IAB	–	Internet Architecture Board
IAHC	–	International Ad Hoc Committee
IANA	–	Internet Assigned Numbers Authority
ISOC	–	Internet Society
ITU	–	International Telecommunications Union
NTIA	–	National Telecommunications and Information Administration (United States)
POC	–	Policy Oversight Committee
RIPE	–	Réseaux IP Européens
SLD	–	Second-level domain
TLD	–	Top-level domain
WIPO	–	World Intellectual Property Organization

Bosnia is a good thing: no one else seemed willing, or able, to solve the problem. In this case, the white paper may be preferable to the Internet civil war that preceded and accompanied the ISOC-IAHC-CORE gTLD MoU that involved the WIPO, ITU and FNC (see Table 1). The failure of that Memorandum of Understanding (MoU) plan to gain consensus led to increased U.S. government involvement. Of course, there's no guarantee that the U.S. government will succeed in solving the problems of either Bosnia or the DNS.

There is perhaps a moral here: Consensus of the Internet community, not governments, is the real basis of Internet authority.

Some DNS History

One interesting aspect of the white paper is that it includes the closest thing to a history that I've ever seen for the origins of the organizational structure of the DNS.

Basically, it states that Jon Postel, now of IANA, undertook the maintenance of a list of host names and addresses back in ARPANET days, when he was a graduate student at the University of California at Los Angeles (UCLA). He also undertook publishing RFCs, which were the working documents of the ARPANET research community. (The white paper doesn't note that the RFCs were the publication method for the lists of assigned numbers and names Postel maintained.) This is the way the ARPANET and the Internet used to work–when a job needed doing, somebody did it. This sort of anarchistic initiative has served the Internet well for many years.

The predecessor of the current InterNIC came about when Postel chose to delegate some of the administrative work of maintaining the assigned numbers and names to SRI International (`http://www.sri.com`).

The most telling historical sentence in the document is "Eventually, these functions collectively became known as the Internet Assigned Numbers Authority (IANA)." It's not entirely clear whether the functions of IANA included only what Postel was doing or also what SRI was doing, or where the line between the two was drawn. In those days, there was no need for fine lines of that sort. As long as there was someone as responsible and capable as Postel in charge of IANA, it all worked.

How did Postel end up in charge of IANA? Basically, the researchers and the funding agencies all agreed that he was the best man for the job. Collegiate consensus.

But the catch, as far as what the white paper is doing, is the researchers were always international, and there is no evidence that the U.S. government originated the authority for IANA, because it didn't: the Internet community did. The U.S. government has always played a strong role in that community, but it has never controlled it. Even the white paper merely says, "the U.S. government has played a pivotal role in creating the Internet as we know it today." No one denies that. But the only way the U.S. government is going to succeed in getting its white paper implemented is by getting consensus in the Internet community.

To its credit, the White House has been working hard toward that end for the past six months or more. For example, Ira Magaziner, senior advisor to the president on policy development, has been meeting Internet players in places as far-flung as Manila.

The white paper nonetheless glosses over a few inconvenient historical points. It says "IANA has functioned as a government contractor, albeit with considerable latitude, for some time now." This omits the point that ARPA stopped funding IANA in April 1997 and much of the time since, IANA has been funded by RIPE and APNIC, both non-U.S. bodies.

What It Says

But what does the white paper say? It spells out many of the problems with the way the DNS is being run, including lack of competition in domain name registration, confusion of trademarks and domains and so on. It's interesting how much interpretation is silently encoded in the wording. It says many commercial interests are "calling for" a more formal and robust management structure. Even that wording is loaded, because it omits any mention of historical evidence to support the notion that too much formality may not be good for the Internet; but not nearly as loaded as this next point: "Conflicts between trademark holders and domain name holders are becoming more common. Mechanisms for resolving these conflicts are expensive and cumbersome." This implicitly accepts that trademarks are closely related to domains, which is a point that has not yet been resolved. The white paper essentially delegates such resolution to WIPO, which indicates de facto acceptance of an equation of trademarks and domain names–that is a point that will require its own column. For now, for one viewpoint, see `http://www.domain-name.org/980526meet.txt`.

One point in the white paper is rather misleading: "An

increasing percentage of Internet users reside outside of the U.S., and those stakeholders want to participate in Internet coordination." Actually, the change in percentage is very slow. The Internet has for many years consisted of 40% or more non-U.S. users, and Internet coordination for non-U.S. regions such as Europe and Asia Pacific has long been done by agencies outside the United States. What is actually happening is that commercial interests and international governmental bodies scent money and power in the Internet, and want a slice of the pie.

There is a real problem of coordinating the DNS as the Internet has become so large and continues to grow; this problem includes making IANA more flexible in order to accomodate input from many sources.

The white paper does get around to emphasizing the word "commercial" in its last two motivating points.

There is a real problem of coordinating the DNS as the Internet has become so large and continues to grow; this problem includes making IANA more flexible (not more formal) in order to accommodate input from many sources. There is evidence that the historical IANA has not been up to handling current Internet DNS politics as, for example, in the Haiti debacle (see `http://www.mids.org/mn/712/reht.html` and my columns "Haiti and Internet Governance, Parts 1 and 2," July and August 1997, Pages 78 and 69, respectively). More bureaucracy and formality is not the solution to that class of problem.

The reason so many organizations are trying to get into the game has little to do with the actual coordination issues and a lot to do with money and power. Personally, I think there are plenty of opportunities for organizations to make money on the Internet without tearing apart the structure of the DNS in their feeding frenzy.

The New IANA

The white paper wishes to expand IANA into a new private not-for-profit corporation with a board of directors drawn from the Internet community. This is not a new idea; I, among others, tried to get Postel to accept such a solution more than a year ago. Evidently, he has now accepted it. (Maybe it helped that I stayed out of it. :-) However, some of the most basic issues related to such a corporation have not been resolved, such as the source of its funding. All the white paper says about this is: "Once established, the new corporation could be funded by domain name registries, regional IP registries, or other entities identified by the board." There is also the question of whether a not-for-profit corporation is the appropriate type of corporation, because a for-profit corporation would have to be more accountable; this isn't even mentioned in the white paper.

One of the most positive statements in the white paper reads: "While international organizations may provide specific expertise or act as advisors to the new corporation, the U.S. continues to believe, as do most commenters, that neither national governments acting as sovereigns, nor intergovernmental organizations acting as representatives of governments, should participate in management of Internet names and addresses." This is a far better position than handing the DNS over to the United Nations or any other governmental body.

Unfortunately, it is followed by this statement: "Of course, national governments now have, and will continue to have, authority to manage or establish policy for their own ccTLDs." That is a U.S. government rubber stamp of Postel's stated position, a position that was not publicly known before the Haiti situation. Note that no prior precedents are cited, just "of course."

Note also that it's assumed Postel will continue to be the primary person in the revamped IANA. I don't necessarily object to that. I, like many people, think Jon Postel has for the most part done a fine job–probably better than most people would have done. Nonetheless, it's interesting that he's just automatically grandfathered in. However, considering that he, personally, represents the only real authority in this whole mess, except for the consensus of the Internet community, which has proven very difficult to divine, an expanded IANA without Postel would have questionable authority unless he signed off on it.

Many TLDs or Many Registries?

I find it rather amusing that after multiple gTLDs were equated with multiple registries a couple years ago in the frenzy to produce new slices of the DNS pie for people to run in competition to Network Solutions, that now the white paper steps back from that and recognizes what was technically obvious all along–new gTLDs are not necessary to have new registries. This change appears to have been motivated by complaints from commercial entities that did *not* want to be registries and that adding more gTLDs would confuse Internet users.

Coda

The stock of Network Solutions went up immediately with the announcement of the U.S. government white paper. Presumably, the ex-spooks who founded the company could either see the future or they invested wisely. ⊸

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by Jim DeRoest

DANIEL C. O'CONNOR

Island-Hopping with VPNs

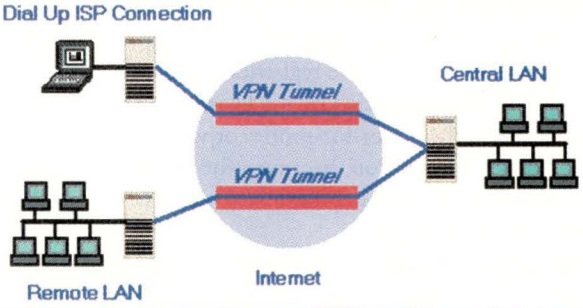
In the beginning, there were only islands of corporate interconnectivity in the vast and turbulent network sea called the Internet. Oh, how these isolated communities longed to link one unto another. To reap deeply and well from the sharing of information and the promises of low-cost intercompany communications. But few ventured forth to cross the fabled trade routes of the Internet. It was rumored that there be marauding data pirates and notorious network hackers waiting to prey upon those bold enough to send business communications across the network sea.

Using the Internet as a carrier for secure communications has vastly improved since these days of old. This is primarily the result of developments in data encryption, hashing, encapsulation and authentication algorithms. By programmatically combining these algorithms at one or more layers of the network protocol stack, it is possible to build a secure channel or "tunnel" between end points in an untrusted network. Packet encapsulation techniques, combined with tunneling, provide a means for including non-IP protocols within this framework. The result is the creation of logical networks, which are independent of the physical network infrastructure. These logical networks are called virtual private networks, or VPNs (see Figure 1).

Virtual Private Networks

VPN technology provides a means for exploiting the commodity Internet as a conduit for interconnecting remote local-area networks (LANs) and mobile computer users. Although communication is conducted over unsecure wires, the integrated authentication and encryption algorithms that comprise a VPN offer the same security and data integrity found in private intranets. This means remote LANs can be incorporated into a logical wide-area network (WAN). As such they can be easily integrated into central systems management and administration procedures. In many cases, a VPN infrastructure is more cost-effective than alter-

Figure 1. Virtual Private Network



native physical network topologies based on leased lines, value added networks (VANs) or other long-distance services.

Along with providing secure communications channels, VPNs also provide a means for applying access controls at the network, service or end-user level. The granularity of control is dependent on which network protocol layers the VPN techniques are applied. Tunneling at the lower data link and network layers secure all point-to-point traffic and provide full access between participating machines and LANs. Microsoft Corp.'s Point-to-Point Tunneling Protocol (PPTP) is an example of a lower level VPN. VPN algorithms applied at the session and application levels allow access controls to be enforced on a transaction-by-transaction basis. Examples include protocols like Secure Sockets Layer (SSL), Secure Shell (SSH), network proxies and firewall products. Access controls can be policy driven by incorporating authorization information from a directory service such as Lightweight Directory Access Protocol (LDAP).

Applying VPN methods at multiple network layers can secure all communications, yet allow access controls to be applied at any level. Each LAN and dial-up connection can have a unique view of the network infrastructure.

When considering a VPN system, it is prudent to consider all the security exposures related to traversing an untrusted network. Communications paths over the Internet will include a number of machines, routers and Internet service providers (ISPs) that aren't under your control. This means traffic may be monitored, rerouted or replayed as it traverses between sites. You may also be exposed to a wide range of denial-of-service attacks.

Review your internal system and network infrastructure. You never know whether a pirate or two has infiltrated your own staff. The mission-critical nature of the data and the physical network structure to be traversed will dictate the authentication and encryption requirements for the VPN. Audit all aspects of your security environment. For example, recently exposed vulnerabilities in Microsoft's Windows 95 and NT authentication structure were found to compromise the data integrity of PPTP services even when encrypted channels were employed between end points.

VPN Layers

As mentioned earlier, VPN methodologies can be applied at one or more layers of the network protocol stack to create custom tunnels and access control profiles. Lower level VPN solutions provide a means for securing all transmissions between the end points of a tunnel. This is especially useful for tunneling LAN protocols between remote sites and for dial-up connections. Microsoft is likely the biggest player in this environment with the inclusion of PPTP service in its Windows products.

Table 1. Useful Resources

- Ascend Communications Inc.'s Virtual Private Networks Resource Guide
  http://www.ascend.com/2174.html
- Cisco Systems Inc.'s Solutions for Virtual Private Dial-Up Networks
  http://www.cisco.com/warp/public/728/General/vpdn_wp.htm
- IBM Corp.'s A Comprehensive Guide to Virtual Private Networks, Vol. 1
  http://www.redbooks.ibm.com/SG245201/sg245201.html
- IETF's Layer 2 Tunneling Protocol (L2TP)
  http://search.ietf.org/internet-drafts/draft-ietf-pppext-l2tp-11.txt
- IETF's Securing L2TP Using IPsec
  http://search.ietf.org/internet-drafts/draft-ietf-pppext-l2tp-security-02.txt
- IETF's Security Architecture for the Internet Protocol
  http://search.ietf.org/internet-drafts/draft-ietf-ipsec-arch-sec-06.txt
- IETF's Internet Security Association and Key Management Protocol (ISAKMP)
  http://search.ietf.org/internet-drafts/draft-ietf-ipsec-isakmp-09.txt
- Microsoft Corp.'s Point-to-Point Tunneling Protocol
  http://www.microsoft.com/ntserver/support/pptpfaq.asp
- 3Com Corp./US Robotics' Enterprise Remote Access
  http://www.3com.com/solutions/enterprise/wan/remote.html

PPTP has been submitted as a Internet Engineering Task Force (IETF) draft specification for secure point-to-point connections (see below). Although PPTP tends to be associated with Microsoft, a great deal of PPTP development has been done by companies like US Robotics and Ascend Communications Inc. The popularity of PPTP stems from its ability to extend Microsoft LAN services through the Point-to-Point Protocol (PPP) connections provided by most ISPs. PPTP supports both PPP Challenge-Handshake Authentication Protocol (CHAP) and Password Authentication Protocol (PAP) for authenticating users. Data encryption is based on the proprietary Microsoft Point-to-Point Encryption (MPPE) algorithm. Although it isn't likely PPTP will end up as a tunneling standard, the ubiquitous availability of the technology in Windows will make it a big player in the VPN world.

Another tunneling solution more likely to surface as the IETF-blessed standard for point-to-point tunnels is the Layer 2 Tunneling Protocol (L2TP). L2TP is based on PPTP and Cisco Systems Inc.'s Layer 2 Filter (L2F) product. It addresses many of the problems found in PPTP and L2F. L2TP will use the proposed IP security (IPsec) standard as its default authentication and encryption technology. In the event that IPsec is not available, L2TP will fall back to CHAP/PAP authentication behavior. L2TP is also a leaner VPN protocol than PPTP. It uses UDP rather than TCP and it combines data and control information into one stream.

At the middle layers of the IP protocol stack, packet filters, proxies and firewalls have been the traditional solution for architecting IP-based VPNs. These systems work well for securing IP-based communications but they can be difficult to implement and manage. Filter rules for large enterprise networks can be complex and require synchronization between a large number of routers and gateway systems. They also require access to clear text packet information to apply address and socket level rules. On the plus side, firewalls and proxies can also be applied at the application layer to filter application-specific protocols like streaming multimedia.

The upper layers of the IP stack provide the greatest opportunity for applying granular access controls. This is because authentication and encryption rules are directly under application control. They also tend to be friendly with packet filters, firewalls and Layer 2 tunneling. Protocols such as SSL and SSH can be applied as needed on a transaction-by-transaction basis to provide individual access to network services.

VPN Standards

There is still work to be done regarding the adoption of VPN standards. I've already pointed out that although PPTP has been submitted as a draft for point-to-point tunneling, it is being replaced by the L2TP specification. Most of the attention of the various VPN working groups centers on integrating and refining the authentication, privacy, integrity, nonrepudiation and access control mechanisms defined in the IPsec specification (see Table 1).

The IPsec framework consists of three basic services: an IP Authentication Header (AH) protocol, which is responsible for authentication; an IP Encapsulation Security Payload (ESP) protocol for ensuring data confidentiality and integrity; and the Internet Security Association and Key Management Protocol (ISAKMP) for managing keys, certificates and associations. The basic IPsec handshake involves an exchange of certificates, which are then used to negotiate and set up the secure communications channel. Like all public-key systems, IPsec relies heavily on management functions to define, refresh and revoke certificates and keys. Thus, the IPsec specification mandates the use of ISAKMP/Oakley for key administration and management. IPsec is integrated into the IPv6 specification. Current IPv4 environments can be upgraded to include IPsec functionality.

AIX and VPNs

IBM Corp. currently provides IPsec functionality in its eNetwork product line. eNetwork Firewall for AIX can be used to create AIX-based VPNs, which incorporate IPsec

services to secure tunnels. This product includes other VPN functions such as packet filtering, access auditing and logging. AIX Version 4.3.1 will replace the firewall product with native IPsec services in the operating system. It will also offer triple Data Encryption Standard (DES)-based encapsulation and DES performance improvements for PowerPC-based systems. Cryptographic extensions can also be dynamically loaded and unloaded in a running system. For more information on eNetwork Firewall for AIX and IPsec in AIX 4.3.1, take a look at the IBM redbook, "A Comprehensive Guide to Virtual Private Networks," Vol. 1, SG245201 (see Table 1).

VPNs: Ready or Not?

Although VPN standards are still settling out, vendors haven't wasted any time making products available. The main concern is ensuring interoperability between different products, which claim to follow standards that are still in the draft process. This should become less of an issue when IPv6 becomes the default Internet protocol for popular operating systems and network peripherals. VPN scaling might be of concern in large enterprises with high-speed interconnects. The encryption and hashing algorithms inherent in VPN technologies don't come without some additional processing overhead. For low-speed dial-up connections it shouldn't be a problem to keep the available bandwidth between modems saturated with traffic. At higher speeds, cryptographic computation overhead may become a bottleneck, reducing the ability to make full use of bandwidth in large network pipes.

The reality is many of us are already moving mission-critical data between sites over the Internet. Market demand and cost savings persistently nag us to do something now rather than wait for the best-of-all-worlds secure networking solution. Because VPN products are currently available, it's a good idea to consider using them to secure existing clear text communications.

The trick is to plan an infrastructure that will allow you to upgrade to standards-based solutions, ensuring your ability to interoperate in the future. Just make sure you keep a sharp network lookout in the crows nest and lock down the data cargo hold before setting sail on the unpredictable seas of the Internet.

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by Jeffreys Copeland and Haemer

PAUL STODDARD

Virtual Threaded News Reader

When last we left our plucky heroes, they had started to organize a list of Usenet news articles into useful order. The task was to take a random list of articles and output that list in the order in which a threaded reader like `trn` might present them. We had finished the input processing when we ran out of time, leaving us with a large blank space on our blackboard, onto which was scrawled "and then a miracle occurs."

This month, we'll show you how to drop articles into the data structure we invented last time, and present a quick recursive routine to print the list of articles in threaded order. As we mentioned last month, we're writing this column using Donald Knuth and Silvio Levy's `CWEB` literate programming tool, so the column doesn't contain the source code; the original text of the column *is* the source code (for details, see our Web site).

For review, the two important data structures are for the article itself and for the references to its predecessors. We'll present them here so you don't have to flip back to last month's column. (We're cheating: We're producing this code as a separate source module and we *should* define these structures in an `include` file. Instead, we've just copied the lines from last month.)

```
<data structures>=
typedef struct _article {
  struct _article *sibling;
  struct _article *child;
  char *message_file;
  char *message_id;
  char *subject;
  struct _reference *refs;
  struct _reference *end_refs;
  time_t date;
} ART;

typedef struct _reference  {
  struct _reference *next, *prev;
  char *reftext;
} REF;
```

There are some bits of nomenclature we need to get out of the way first. An article's siblings are articles with the same number of references. In a diagram, we list them vertically down the page. An article's children are articles that refer to it, and we list them horizontally, growing to the right.

News articles have ID strings of the form `<31415926@opennt.com>`. These strings appear in both the `Message-id` and `References` headers of the articles. For convenience, we'll refer to these symbolically in our examples (`Message-id`s with italic letters, and we'll use a colon to separate the ID from the references) so an article with ID *j* may have references, or *j:adf*, which point to articles *a*, *d* and *f*. So, when we enter `place_article ()`, we may have an existing tree of articles:

```
a:-    d:a   y:adx
       e:a   g:ae
b:-    q:b
       r:b   w:br   z:brw
             h:br
c:-
```

Given an article *x:ad,* for example, we would insert it in the top row of this diagram between *d:a* and *y:adx*. (You may find it easier to envision this as a directory tree. In this analogy, the root directory of the file system contains the articles with no references. When we find an article with references, its "path name" consists of the references in some order.)

We also know what the overall structure of this module will be:

```
#define _ALL_SOURCE
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
<data structures>
<service routines>
<place the articles>
<print the tree>
```

We also need the head of the data tree:

```
<data structures>=
ART *root;
```

Insertion Sorts

As Beth, our local Lisp hacker put it, after listening to a long-winded explanation of the problem, "It's just an insertion sort. Check for a null `cdr` and recurse."

So we break our insertion into the tree of each new article into two basic cases. In the base case, where the existing root is `null`, we insert this article as the root. In the "normal" case, we insert it somewhere into the tree, as in our diagram above.

With that in mind, we can begin to lay out the top level of `place_article ()`:

```
<place the articles>=
void
place_article( ART *art )
{
  <null root case>
  <normal case>
}
```

Let's begin with the simplest case:

```
<null root case>=
if( root == NULL )
{
  root = art;
  return;
}
```

Because the normal case is recursive, we front it with a function call, as follows:

```
<normal case>=
normal_case(root, art);
```

The body of the normal case breaks down into some simple cases. We want to loop through the siblings of the root, examining each in turn. If the sibling we're examining is referred to by `art`, we recurse with the root set to the child of the sibling. In effect, `art` has asked the sibling, "are you my mother?" (In the special case, where the sibling has no child, we insert the new article as its child.)

If, on the other hand, `art` appears in the list of references for the sibling we are examining, then `art` is actually the parent of the sibling. (In effect, the sibling is asking `art`, "are you *my* mother?") In this case, we insert `art` as the parent of the sibling. If we fall through the list of siblings without finding a hit, we insert `art` as a new sibling.

(Returning to the directory analogy, we check the files [articles] in each directory to see if the new file we're trying to insert has this file in its path name. If it does, we change into the subdirectory and repeat the process. If the new file has no files from this directory in its path name, then we park the file here for the time being.)

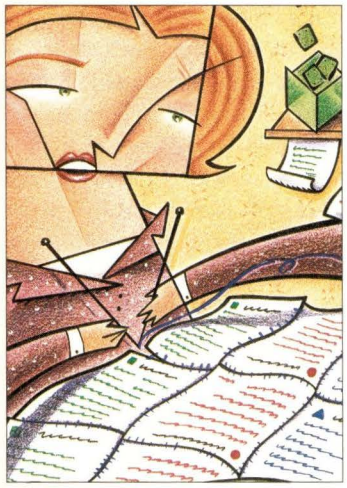
```
<service routines>=
void
normal_case( ART *root, ART *art )
{
  ART *p, *s;

  s = NULL;
  p = root;
  while( p != NULL )
  {
    if( refs_in_list(p->message_id, art->refs) )
    {
      if( p->child )
      {
        normal_case(p->child, art);
        return;
      } else {
        append_child(p, art);
        return;
      }
    }
    if( refs_in_list(art->message_id, p->refs) )
    {
      insert_parent(p, art);
      return;
      }
      s = p;
      p = p->sibling;
    }
    append_sibling(s,art);
}
```

Service Routines

We've postulated some routines that we now need to write: a routine to cross-check references and a flock of insertion routines. (Exercise for the reader: What's the collective noun for software? Would this be a Dilbert of insertion routines?)

Notice that we've chosen to use singly-linked lists for our data structures, which means we need to go to a little more trouble to keep track of the structure links in our insertion routines. With the complications caused by children and parents and siblings and single-links, this could turn out to be as difficult a job as being the booking agent for the Jackson Five.

We've chosen to use singly-linked lists for our data structures, which means we need to go to a little more trouble to keep track of the structure links in our insertion routines.



(Of course, as much fun as we have with this writing gig, we too have suffered at the hands of booking agents. Haemer, for example, once was booked to speak at a Usenix conference immediately *after* Penn Gillette. We keep thinking that if only we had really good agents, one of us would be attempting to hit home runs off Robin Roberts of the Phillies and the other would be wearing a bowler and tooling around England with Uma Thurman. But we digress.)

We'll begin by checking references. If the `Message-id` appears in the specified `References` list, then we return true:

```
<service routines>=
int
refs_in_list( char *id, REF *ref )
{
  REF *p;

  for( p = ref;  p != NULL;  p = p->next )
    if( strcmp(id, p->reftext) == 0 )
      return 1;
  return 0;
}
```

Now we can begin the insertion routines. The first hangs the given article off the current one as its child, thus:

```
<service routines>=
append_child( ART *current, ART *newart )
{
#ifdef DEBUG
  printf("@@@ insert %s/%s as child of %s/%s\n",
    newart->message_file, newart->message_id,
    current->message_file, current->message_id);
#endif
  current->child = newart;
}
```

The next insertion routine hangs the new article off the current one as a sibling:

```
<service routines>=
append_sibling( ART *current, ART *newart )
{
#ifdef DEBUG
  printf("@@@ insert %s as sibling of %s/%s\n",
    newart->message_file, newart->message_id,
    current->message_file, current->message_id);
#endif
  current->sibling = newart;
}
```

The last one of these is the most complicated. We need to exchange the new article and the current article, making the current one the child of the new one. That is, we're inserting *q:krs* in front of *w:krsq*. (Using the directory analogy, we've got a file that doesn't belong in this directory, but rather in a subdirectory, and we've found the parent of that path name. We put the new file in this directory and put the other file in the subdirectory.) This one is complicated because of the singly-linked lists we're using–we don't necessarily know the parent or older sibling of the current article, so we exchange the data, leaving the links to the current article intact. We'll do this in a few steps, to keep our sanity:

```
<service routines>=
insert_parent( ART *current, ART *newart )
{
  ART *temp;

#ifdef DEBUG
  printf("@@@ insert %s as parent of %s/%s\n",
    newart->message_file, newart->message_id,
    current->message_file, current->message_id);
#endif
  temp = malloc(sizeof(ART));
  <copy current to temp>
  <copy newart into current>
  <link temp as current's child>
  <clean up after parent insert>
}
```

First, we copy the current article to the temporary one, ensuring that we don't have dangling pointers to siblings or children:

```
<copy current to temp>=
temp->message_file   = current->message_file;
temp->message_id     = current->message_id;
temp->subject        = current->subject;
temp->refs           = current->refs;
```

```
temp->end_refs      = current->end_refs;
temp->date          = current->date;
temp->sibling       = NULL;
temp->child         = current->child;
```

Then, we copy the data from the new article into the current structure:

```
<copy newart into current>=
current->message_file   = newart->message_file;
current->message_id     = newart->message_id;
current->subject        = newart->subject;
current->refs           = newart->refs;
current->end_refs       = newart->end_refs;
current->date           = newart->date;
```

To complete the links we need to hang the temporary structure as a child of `current`:

```
<link temp as current's child>=
current->child = temp;
```

Finally, we need to clean up by freeing some allocated memory. We only need to free a structure because we've copied its contents. But which structure? Almost paradoxically, it's the new article, `newart`, whose data is now stored in `current`:

```
<clean up after parent insert>=
free(newart) ;
```

Showing the Results

Printing the results is the next step. This, too, is a recursive process. We'll begin with the function declaration and our interface from last month's article.

If we're debugging, we want to separate the trace output as we read and constructed the tree from the display of the tree itself:

```
<print the tree>=
display_tree()
{
#ifdef DEBUG
  printf("\n\n==========\n");
#endif
  display_subtree(root);
}
```

We want to show each subtree in chronological order. This is made easier because we've already stored the article time stamps from the UNIX epoch in a variable of type `time_t`, correcting for time zone differences. This means that (barring a posting host with its clock set incorrectly) the subtrees should be in chronological order if we run through the siblings in the order of the time stamps. We reset the time to zero after we've processed each sibling's subtree. Thus, we look through the list of siblings repeatedly, picking out the oldest, printing it and processing its children, until we have no more siblings with non-zero time stamps:

```
<print the tree>=
display_subtree( ART *root )
{
  ART *p, *earliest;

#ifdef DEBUG
  printf("displaying subtree from %s\n",
    root->message_id);
#endif
  do  {
    earliest = NULL;
    for( p = root;  p != NULL;  p = p->sibling )
    {
      if( p->date == (time_t) 0 )
        continue;
      if( !earliest  ||
          earliest->date > p->date )
        earliest = p;
    }
    if( earliest ) {
      <show this article>
      if( earliest->child )
        display_subtree(earliest->child);
      earliest->date = (time_t) 0;
    }
  } while( earliest != NULL );
}
```

Showing the results of the article in question is very easy. For our purposes, we just print the article file name. We also optionally provide some debugging output showing the sibling and parent of this article. However, we can envision applications where we'd want to do something more complicated, such as to provide a graphic representation of the tree structure:

```
<show this article>=
printf("%s", earliest->message_file);
#ifdef DEBUG
if( earliest->sibling )
  printf(" v%s",
        earliest->sibling->message_file);
if( earliest->child )
  printf(" >%s",
        earliest->child->message_file);
#endif
printf("\n");
```

Wrapping Up

That's more or less it. Like the other software we've written for this series, this represents a real problem that we've run across and solved. The problem provides an interesting technique or lesson: In this case, the problem is

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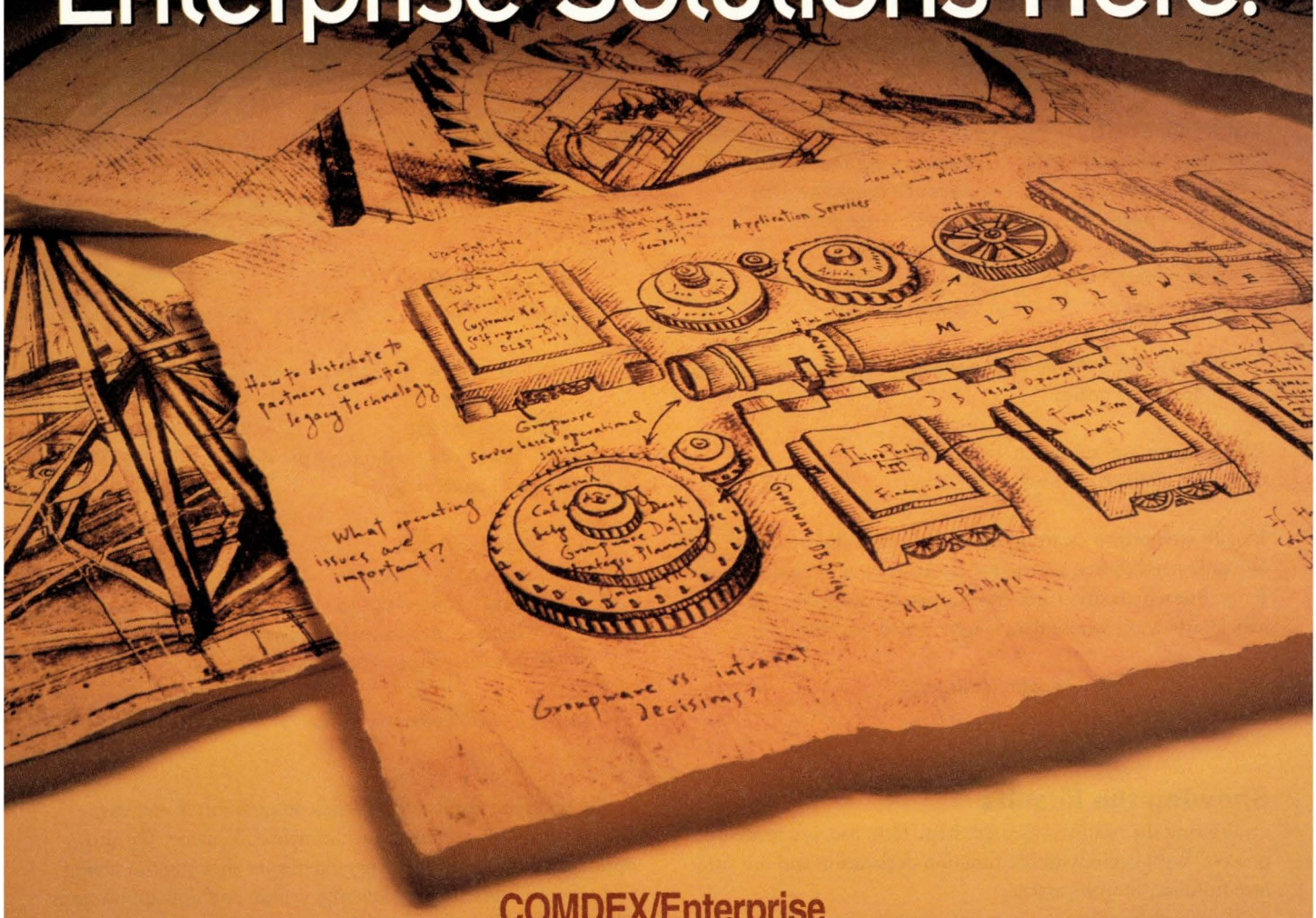

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solved by a good data structure. Programming around the data structure gives us some interesting utilities. You probably won't run into the same problem, but if you do, you've now got software to solve it. More likely, you'll run into a problem–it may be sitting on your desk right now–where data structures like these, or other tricks we have shown you, will be useful.

Meanwhile, we took a few minutes to visit Chez Protocol earlier in the month and talk to Mike O'Brien about cathedrals and bazaars, our launching point for last month's column. In April ("The Cathedral, the Bazaar and Mr. P.," *SunExpert*, Page 24), he noted that Mr. Protocol has "this picture–I think it's the only one he owns–which has a single vertical black bar on it, and underneath, in script, the words, 'Ceci n'est pas une pipe.' I don't want to think about it."

We were amused to discover that's not exactly the whole story. In fact, in Mr. P.'s wing of Chez Protocol, one wall is entirely covered with the following text:

```
%!
% The Betrayal of Special Characters


/center {
  dup 8.5 72 mul 2 div exch stringwidth
  pop 2 div sub 3 2 roll moveto show
} def
/Helvetica 512 selectfont
11 72 mul 500 sub (\174) center

/KuenstlerScript-Black 50 selectfont
11 72 mul 600 sub
    (Ceci n'est pas une pipe) center

showpage
```

This, of course, means that Mr. Protocol's mutterings aren't the only thing Mike interprets.

What next? We may explore data compression. Or we may discuss some database problems and how UNIX is better than single-purpose tools for solving them. Or we may talk about entertaining off-by-one bugs we've encountered. Or we may spend the month brewing beer. Until then, happy trails. ⊸

Jeffrey Copeland *(copeland@alumni.caltech.edu) lives in Boulder, CO, and works at Softway Systems Inc. on UNIX internationalization. He spends his spare time rearing children, raising cats and being a thorn in the side of his local school board.*

Jeffrey S. Haemer *(jsh@usenix.org) works at QMS Inc. in Boulder, CO, building laser printer firmware. Before he worked for QMS, he operated his own consulting firm, and did a lot of other things, like everyone else in the software industry.*

Note: The software from this and past Work columns is available at `http://alumni.caltech.edu/~copeland/work.html`.

Three Tiers for the Internet

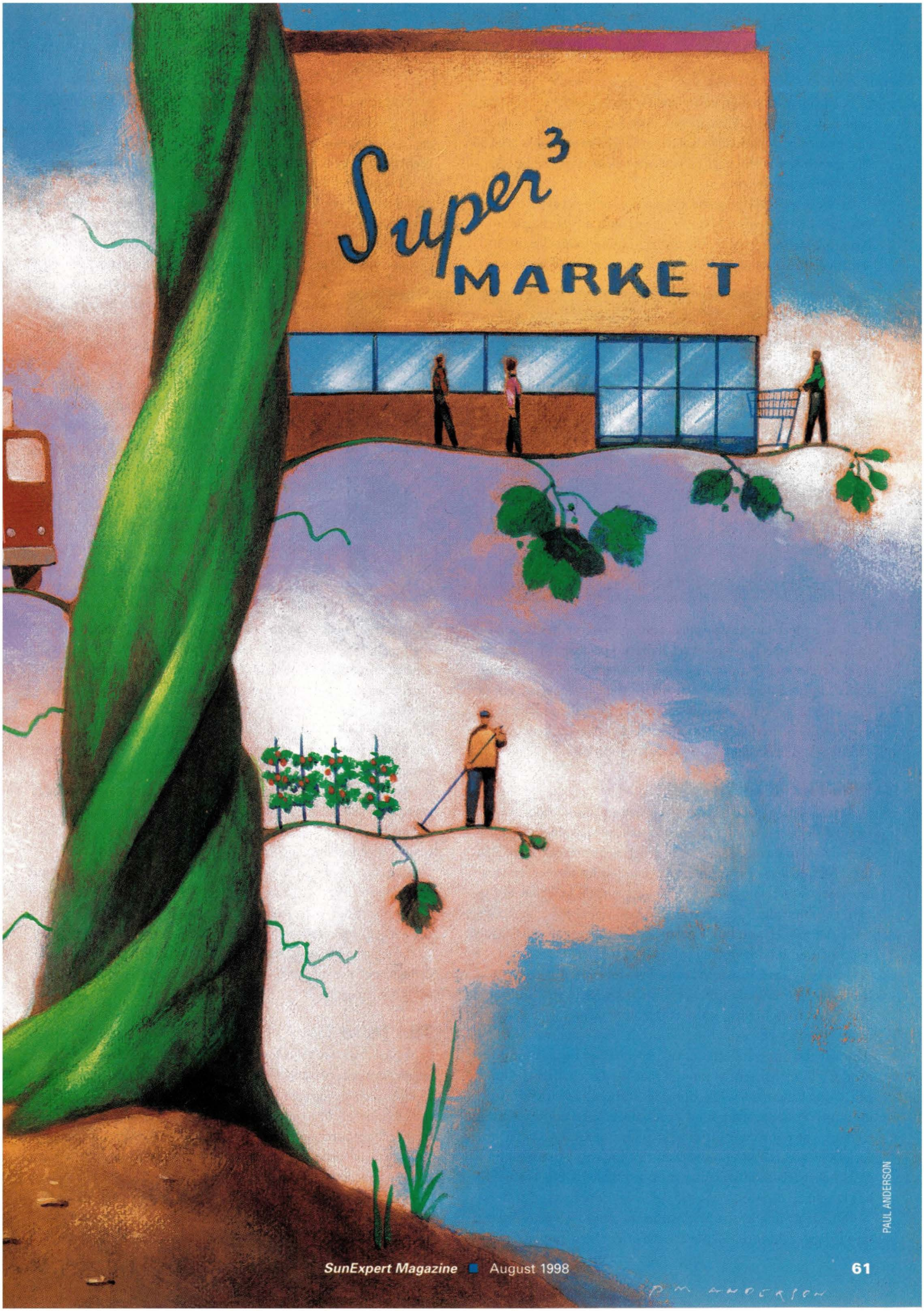
In the years before browsers were installed on people's desktops, end users consumed a bland and monotonous diet of data picked from local servers. These days, with the world just a URL away, the data on our plates is just as likely to come from a database in Paris or Peoria as it is from the server down the hall.

End users have long hungered for a better variety of data, but in pre-Internet days, had no practical means of getting to it. The growth of the Internet supplied end users with an ideal data distribution method, paving roads across which data could travel from one end of the globe to the other, and back again. But despite these improvements in infrastructure, IT shops were still reluctant to open their databases to the masses.

It would be a few years before IT happened upon a way to share their databases in a manner with which they felt comfortable. "Mainframe guys had been looking for a way to give end users a GUI client into the database for years, but it was just too hard," says Tom Herring, vice president of sales and marketing for Computer Systems Development Inc., a systems integrator based in Albuquerque, NM. Questions of security topped their list of concerns, followed by doubts about how feasible it would be to build these systems in the first place.

The answer to IT's fears came in the form of the browser/Web server/database threesome. Wedged in between the client and the server, and in front of the corporate firewall, the Web server did an adequate job of keeping unwanted intruders away from private data. But more to the point, building database-driven applications by way of a Web server turned out to be remarkably simple. The browser, preinstalled on the end user's desktop, freed developers of having to write an elaborate GUI for the application. If the application proved

by Alexandra Barrett, Staff Editor

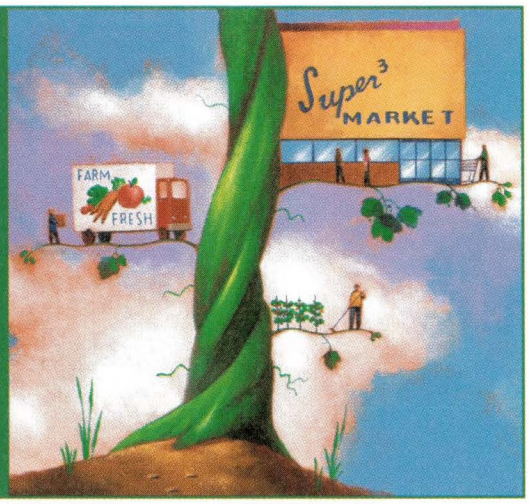


PAUL ANDERSON

to be popular, IT could easily scale it up, distributing the workload across multiple Web servers. And because the browser automatically downloaded whatever GUI the end user needed along with the Web page, IT was also relieved of the burden of software distribution.

A Web-enabled database application is the consummate example of a three-tiered application, with a presentation layer, a logic layer and a data layer. Judging from the thousands of three-tiered applications that litter the Web, this three-tier model is very popular among Internet developers. In fact, the three-tier model is becoming popular with the software development community as a whole, which is becoming increasingly hip to its virtues. To hear the experts speak about it, it's just a matter of time before the three-tier model has successfully overtaken traditional two-tier client/server as the architectural mainstay of software development.

In a one-tier system, you gather your food yourself. In a two-tier system, you buy your food directly from a local farmer. Under the three-tier model, you buy your food from a supermarket.



Why Not Two Tiers?

If you want a good analogy for the one-, two- and three-tier architectures, think in terms of food production, suggests Dennis Moore, vice president of Progress Software Corp., Bedford, MA, maker of the Apptivity Java application server. In a one-tier system, you gather your food yourself. In a two-tier system, you buy your food directly from a local farmer. Under the three-tier model, you buy your food from a supermarket, which has procured food from any number of farmers.

At first glance, it would seem that shipping in a tomato from the Netherlands would be much less efficient–and more expensive–than buying it directly from a farmer down the road, or better yet, growing it yourself. However, we all know that just the opposite is true. Big, specialized farms tend to produce food efficiently enough that they can offset the additional costs incurred with shipping, storage and distributor markups. By delegating food production to several specialized farmers, the consumer ultimately saves money, receives a wider variety of goods and ensures that–barring some catastrophic, global disaster–food will always be available. If big business has taught us anything, it's the value of economies of scale.

Similar principles are at work in the world of client/server, says Progress' Moore. While the two-tier client/server model is an evolutionary step-up from one-tier PC-based applications, the model is still flawed. "Client/server made a lot of promises," says Computer Systems Development's Herring, "but the technology never really lived up to them."

One of the promises that client/server made to end users was it would give them widespread access to data. Prior to client/server, end users had only limited experience with the vast stores of data residing in the world's databases; the mainframes that housed that data were locked up tighter than Fort Knox. As to the few applications that did offer glimpses into these warehouses–usually 3270 green screen applications–they were clunky and dull enough to turn end users off the whole concept.

Equally absent from end users' experiences was the notion that you could interact with data, that you could perform transactions on it. Data was a sacred entity, which only qualified professionals trained in the appropriate tools were allowed to manipulate.

The problem with client/server was, of course, that for each and every user that you wanted to have application access, you had to go and install software on their machines. This model is troublesome on many fronts. First of all, installing software on a machine-by-machine basis is a time-consuming process, to say nothing of the cost. Second, in the world of personal computers, every machine is different, which can make for a real maintenance nightmare. For example, suggests Frank Vafier, president of Prolifics, a Jyacc Inc. company, New York, NY, and maker of component-based application development tools, "sometimes the DLLs [dynamic link libraries] that you had to install competed with DLLs that you needed for other programs."

And third, says Herring, because under the two-tier model presentation and logic are cemented together into one tier, clients tended to be rather large, or at the very least, "chubby," consuming local storage space and system resources.

In other words, says Vafier, "it really wasn't worth installing these things unless you were going to be a high-volume user of the application. For casual users, it just didn't work." Among the early failures of two-tier client/server applications targeted to the mass market, Vafier cites original home-banking applications and the non Web-based Federal Express Corp. package tracking program.

The Third Tier

These days, we take for granted all sorts of online database applications–applications that were, for all intents and purposes, impossible even just a few years ago. Whether we're making our own travel arrangements, ordering books or CDs online, or accessing our employee 401K records, the ability to perform "transactions at the source," to use Vafier's term, is a must-have for any new application.

With very few exceptions, what's made these sorts of applications possible has been the introduction of an extra layer between the client and the databases–the so-called "middle

tier." Says Progress' Moore: "What the middle tier does for computing is parcel out the conversations, the communication load, as well as the work itself, into manageable chunks that can be specialized and handled efficiently."

Alternately referred to as the logic layer, the application server or the information broker, the middle tier performs many functions. Some of this functionality used to be performed by the client or the database, but a lot of the functionality the middle tier offers is entirely new.

In the context of a Web-enabled database application, perhaps the most fundamental job of the middle tier is to provide security, says Stu Stern, general manager of Sun Microsystems Inc.'s North American Java Centers. Residing on the corporate network, yet placed outside the firewall, the middle tier in the form of a Web server acts as a formidable gate between the barrage of clients and the database fortress.

In a pure three-tier system, the job of the middle tier is to provide the application logic, the guts of the program. Placing the application logic in either the client or data layers is asking for trouble, says Stern, because "front- and back-end systems tend to change a lot." By building application logic into the mediating middle tier, you can ensure that a large portion of your code base will remain stable when either the front or the back ends change.

Finally, the middle tier is also relied upon to make sure the application is available to end users. In large implementations, this may involve functionality such as load balancing between servers, managing client connections and brokering information back and forth between the client and the database. The ability to plug additional computing horsepower into an application by distributing the application logic over multiple servers is especially crucial on the Web, says Prolifics' Vafier. "If a two-tier client/server application is successful, the rule is that the number of users wanting to use it will be an order of magnitude more than you planned on. On the Web it could be two or three orders of magnitude [higher]."

Why Now? Why Not Earlier?

If everyone thinks that three-tier is so wonderful, why is it just catching on now?

In truth, the idea of a three-tier architecture is nothing new. "Three-tier has been possible for a long time," says Progress' Moore, using middleware such as IBM Corp.'s Customer Information Control System (CICS) and BEA Systems Inc.'s Tuxedo transaction processing (TP) monitor. In fact, you can find examples of three-tiered applications in production all over the place, if you know where to look.

The classic example of a three-tier application has always been the airline reservation system. "You've heard the joke about the check-in clerk really being a frustrated writer, typing away at his life story? Well, what's really going on is that a little computer is running a specially-built client, talking to a very specialized application server somewhere else, maybe CICS from IBM, or one of the TP monitors from the UNIX world, which are themselves talking to data sources in the back," says Moore. This application certainly has the characteristics of a three-tier system: client, application server and database all physically partitioned

OTMs Take Over

One of the things making developers' jobs difficult these days is the amazing array of different clients and data sources that need to be integrated into a common application framework. "Instead of moving toward greater homogeneity," says Rob Veitch, director of business development at Sybase Inc., Emeryville, CA, "we're moving toward a world that's even more profoundly heterogeneous."

Faced with the task of linking Web, Windows and Java clients into legacy UNIX and MVS systems, developers are increasingly looking to middle-tier Common Object Request Broker Architecture (CORBA) solutions for some sort of application glue. "In the beginning, people wrote these sorts of applications using sockets," says Stu Stern, general manager of Sun Microsystems Inc. North American Java Centers, "but in the past year or so, CORBA has become totally mainstream."

CORBA's growing popularity is in keeping with predictions from International Data Corp. (IDC), an industry research firm based in Framingham, MA. According to IDC, the object middleware market is growing at a 50% annual growth rate, and is expected to exceed $700 million by 2001.

However, CORBA's traditional lack of support for transactions has precluded it from use as the integration engine for so-called business-critical systems.

This is changing rapidly, though. With the ratification of the Object Transaction Services (OTS) specification by the Object Management Group (OMG), CORBA solutions are making homes in places where before they weren't even invited in.

Transaction-capable CORBA solutions comprise a new category of middleware–the Object Transaction Monitor, or OTM. An OTM, as it is implemented today, is typically a hybrid between an Object Request Broker (ORB) and a traditional transaction processing (TP) monitor. "With an OTM, the resources managed by the TP are themselves objects," says J. P. Morgenthal, president of NC.Focus, a research firm based in Hewitt, NY. "It tells you whether the method calls you are making on an object have succeeded or failed."

Vendors from both camps–the CORBA camp and the TP monitor camp–both play heavily in the OTM market. Topping the list are Iona Technologies Inc. with its OrbixOTM product; IBM Corp.'s Component Broker; Hitachi America Ltd.'s TP-Broker; and newcomer M3, which was announced by BEA Systems Inc. in June.

While OTM is a relatively new phenomenon, vendors expect the market to get more and more crowded. Put simply, Sybase's Veitch says, "There just isn't a market for just ORBs or just transaction processing anymore."–*ab*

onto different system components.

Building and maintaining three-tier applications, however, used to be fraught with enough difficulties to scare away all but the most dedicated–or desperate–development teams. "We had our best programmers look into these sorts of projects before," says Computer Systems Development's Herring, "but they always came back saying that it was too hard." Without the peace of mind of a Web browser on every desktop, developers were still constrained to build, and install, clients on end-users' machines. There was only a limited number of development tools available for building these sorts of applications, most notably, PowerBuilder from Sybase Inc. And in order to achieve the sorts of transactional capabilities required for most database applications–guaranteed delivery, two-phase commit and so on–you needed to employ developers well-versed in the complexities of middleware.

"Partitioning the three tiers logically and physically has always been a good idea," says Sun's Stern. "But don't get me wrong, in the short run, you're definitely giving yourself more work." The temptation, therefore, for the vast majority of client/server developers, was to skip the step of developing a middle tier and go ahead and build the application logic directly in with the GUI client.

Three-tier application development was therefore reserved for those systems that truly needed it, for example, Automatic Teller Machine (ATM) banking applications or the above-mentioned airline reservation system. In general, applications that would be considered for a three-tier approach had the following characteristics: they required the guaranteed delivery of messages and they needed to support a large number of potential users–that is, they required good scalability and performance.

But perhaps the main reason developers have embraced the three-tier model is not because it's the right way to architect applications, but because, in many cases, it's easier than two-tier. For this, three-tier has the downloadable thin client to thank. "Three-tier has become simple enough to bring us back to a one-tier level of simplicity," Progress' Moore says.

Java, too, has made substantial contributions to the popularization of the three-tier architecture. Developers agree that Java is the language to use if you're creating networked applications.

"Java was designed as a network computing architecture from the get go," says Moore, delivering several key elements behind the successful emergence of three-tier systems–the ability to download thin clients, but also built-in network security and other neat features of the language, like the fact that Java makes it easy to call functionality from one computer over to the next.

Now What?

Now that three-tier is firmly fixed in the minds of developers as a valid model for application development, what are some of the areas that still need work if three-tier is to become a really workable system?

For one thing, says Sun's Stern, the middle tier is going to have to evolve to support more than just Web and Windows clients. "It's a real zoo of client devices out there," says Stern, alluding to the next generation of palmtops, telephones, televisions, beepers and so on.

Middleware vendors, in particular, are already hard at work adding support for different component architectures. "Today, there [is] a set of three dominating technologies," says Ian Hunter, marketing manager for Reston, VA-based ICL Inc.'s DAIS Common Object Request Broker Architecture (CORBA) object request broker (ORB) offering. These are the Component Object Model (COM) and Distributed COM, from Microsoft Corp., CORBA and the ORB solutions (see "OTMs Take Over", Page 63) and Java. "Any solution that an organization develops for the middle-

Companies Mentioned in this Article

Active Software Inc.
3255-1 Scott Blvd., Ste. 201
Santa Clara, CA 95054
http://www.activesw.com
Circle 120

BEA Systems Inc.
385 Moffett Park Drive
Sunnyvale, CA 94089
http://www.beasys.com
Circle 121

Computer Systems Development Inc.
P.O. Box 13796
Albuquerque, NM 87192
http://www.csdinc.com
Circle 122

Hitachi America Ltd.
437 Madison Ave.
New York, NY 10022
http://www.hitachisoft.com
Circle 123

IBM Corp.
Contact local sales office.
http://www.ibm.com
Circle 124

ICL Inc.
11490 Commerce Park Drive
Reston, VA 22091
http://www.icl.com
Circle 125

Iona Technologies Inc.
60 Aberdeen Ave.
Cambridge, MA 02138
http://www.iona.com
Circle 126

NobleNet Inc.
337 Turnpike Road
Southboro, MA 01772
http://www.noblenet.com
Circle 127

Progress Software Corp.
14 Oak Park
Bedford, MA 01730
http://www.progress.com
Circle 128

Prolifics
(a Jyacc Inc. company)
116 John St., 20th Floor
New York, NY 10038
http://www.prolifics.com
Circle 129

Sun Microsystems Inc.
2550 Garcia Ave.
Mountain View, CA 94043
http://www.sun.com
Circle 130

Sybase Inc.
6475 Christie Ave.
Emeryville, CA 94608
http://www.sybase.com
Circle 131

ware arena has to embrace those three areas," Hunter says.

To this effect, ICL recently added two new products to the DAIS family: COM2CORBA, a development kit for linking Windows applications to CORBA-based enterprise applications, and J^2, a Java version of DAIS ORB. Other middleware vendors are following suit. NobleNet Inc., Southboro, MA, for example, known for its Remote Procedure Call (RPC) offerings, recently announced Nouveau, an application development tool that supports interoperability across no less than four middleware environments: COM, CORBA, Java and RPC.

To *n*-Tier and Beyond

So if computer systems have successfully evolved from one to two, and now three tiers, what's next?

"The next logical step for computer architectures," says Progress' Moore, "is this concept called fully distributed computing. Under this model, there really aren't clients; there really aren't servers–everybody can client and everybody can serve." However, Moore points out, under the fully distributed computing model, you lose the benefits of specialization that are so prevalent under three-tier. Managing fully distributed applications would also be very difficult. "Three-tier is the most sophisticated application architecture available that is still manageable," Moore says.

Which is not to say that there is no room for improvement. Rafael Bracho, chief technical officer of Active Software Inc., Santa Clara, CA, maker of the ActiveWeb application integration system, envisions a world not of two-tier or three-tier, but *n*-tier. This model calls for a lot more flexibility in what constitutes the middle tier, while maintaining the general presentation, logic and data layers of three-tier.

For example, Bracho describes a new customer tracking application. "Information about your customers could be scattered all over the organization, handled by different applications," says Bracho. "If you're going to build the application that you want, the applications in the middle tier are going to need to talk to one another." ⊸

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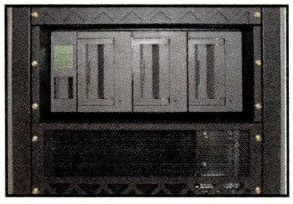
SharkRack E3000

SharkRack E4000



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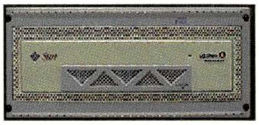

SharkRack Unimount Ultra1

SharkRack Unimount Ultra2

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Sun microsystems VALUE ADDED RESELLER

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SharkRack, Inc. 573 Maude Court Sunnyvale California 94086 Telephone 408 523-1816 Fax 408 735-9111 www.sharkrack.com

Circle No. 30

by PAUL A. TRUNFIO

Paul A. Trunfio is a research associate at the Center for Polymer Studies at Boston University.

The Multimedia Train Slowly Chugs Along

For more than a decade, the ability to display and integrate multiple forms of media using computers has shaped our modern digital world. Multimedia, that buzz-word, which integrates graphics, animation, audio, video and virtual reality into a single interactive environment, is where it's at. With the advent of the World Wide Web, this multimedia train can now travel anywhere.

Illustrations by STEPHEN SCHILDBACH

In 1844, Samuel Morse transmitted the message "What hath God wrought!" from Washington D.C. to Baltimore and, thus, opened the first electronic network. The modern-day Web is merely an extension of what Morse began 154 years ago. Our new digital era is still about sending signals over networks, only they're more complex, faster and provide opportunities for increasingly rich multimedia experiences.

Most everyone has heard the oft-quoted statistic that computer processor speed has doubled roughly every two years. While scientists drool waiting for a faster processor to simulate the interactions of more molecules, render more realistic three-dimensional structures, or obtain results faster, the average home computer user is doing little more than running the next version of his word processor. You hardly need a 500,000-instructions per second machine to dictate a letter.

The computer vendors, however, are betting that if they build faster machines, engineers and Web designers will find a way to take advantage of the blazing speed. We are only just beginning to see whether or not this is a good bet. The nascent fields of digital streaming audio and video, 3D virtual reality and other forms of multimedia served to us over the Web are evolving slowly.

Despite the wondrous interactive potential brought forth by the Web and its ability to share multimedia, it has a major limiting feature: the problem of bandwidth. It is nearly impossible to talk about multimedia on the Web without bringing up the bandwidth issue in the same sentence.

Multimedia on the Web is, at its heart, all about tackling this issue. But despite the limitations of current bandwidth speeds, Web-based multimedia is still moving forward.

Encoding Digital Media

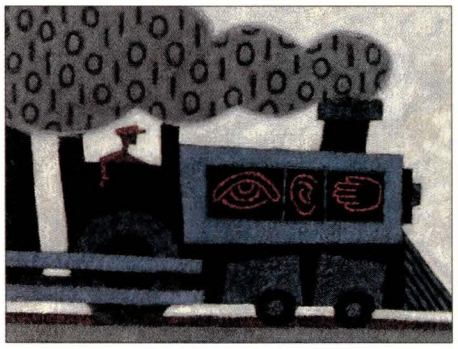
As with most tasks, there are many ways to skin a cat. The task of encoding digital media is no exception. Now, with the advent of the Apple Computer Inc.-developed FireWire specification (aka IEEE 1394), there is yet another way. In case you don't know, FireWire is an all-in-one digital interface designed for consumer-grade products. Professional video editing and shooting is being revolutionized due to the ability to stay all-digital. Even fields outside of video are capitalizing on FireWire. Yamaha Corp., for example, is adopting the FireWire spec to produce the successor to the venerable MIDI standard (a format for rendering simple instructions to music synthesizers on which notes to play) by adding 32 channels of digital audio to MIDI's simple note on/note off controller data.

Despite the limitations of current bandwidth speeds, Web-based multimedia is still moving forward.

There are now more than a dozen FireWire-equipped digital camcorders on the market that shoot, store and edit purely

digital audio and video as opposed to, say, shooting analog with Hi8 format tape and then converting the incoming signal to your computer to digital. Although Apple plans to have a FireWired-based computer system available in a few months–and Intel Corp. maybe in a couple of years–users that want to go all-digital must now rely on the less elegant, but viable, solution of using a capture board. These new FireWire-based digital capture cards basically put a wrapper around the incoming video, encoding the video in either Apple's QuickTime or audio/video interleaved (AVI) formats that can be used in standard software editing packages.

One advantage of all-digital technology is the potential for higher quality video over the Web. We all know that Web-based video must be compressed significantly, to put it mildly, so that it can be sent over a low bit-rate connection. One way to yield better compressed video is to have a higher quality video to begin with–and all-digital video is decidedly better than analog-to-digital video.



Another advantage is that the transfer of digital video from the camcorder to the computer does not have the limitations of its analog counterpart. Namely, analog video can be captured only in real time, or 1x speeds. Digital video, on the other hand, can be transferred as fast as a computer's bus can take it–in other words, at speeds faster than 1x. The digital camera itself compresses the video, and keeps it compressed during transfer, from a data transfer rate of 30 MB/s to 3.6 MB/s for 1x transfers. Given FireWire's ceiling of about 50 MB/s, we are left with a lot of headroom for an increase in transfer speed. In addition, 4x speeds at a bandwidth requirement of 14.4 MB/s (four times 3.6 MB/s) are already available in camcorders from Panasonic Communications and Systems Co. and Sony Electronics Inc. A quick calculation tells us that the available bandwidth of FireWire will allow more than 12x speed (50 MB/s divided by 3.6 MB/s). Digital video transfers will probably soon see an explosion in transfer speeds similar to that of CD-ROM players.

In contrast to digital video, which is relatively new, digital audio has been around for a number of years. Capturing digital audio can be done in any number of ways, from digitizing an analog audio input with an audio card, to transferring digital audio recorded on DAT, to even interfacing with Palo Alto, CA-based Opcode Systems Inc.'s Open Music System to converse in MIDI with music synthesizers.

For Web-based applications, audio has exploded whereas video has not. There are many more opportunities to embed audio into a site to meet lower bandwidth requirements. For example, a Seattle-based RealNetworks Inc. RealAudio file can easily be served at a bandwidth of 1.8 KB/s (28.8 Kb/s).

MIDI music files offer an excellent low-bandwidth opportunity for embedding multimedia. Headspace Inc., San Mateo, CA, the Web-music trailblazer with its Beatnik Editor and Rich Music Format (RMF), is adding dramatic flair to sites with these tiny files. For further information about MIDI, see "A Guide to Sonifying your Web Site," *WebServer Online*, September, 1997 (`http://www.webserver.cpg.com/wt/2.8`).

Compression and Decompression

Compression and decompression of video (and audio) is, pardon the expression, the name of the digital game. Digital video camcorders compress broadcast-quality video from a required bandwidth of roughly 30 MB/s to 3.6 MB/s. We all know that for Web delivery we have to crunch the video down much further to fit the Web's limited bandwidth of 192 KB/s, 7 KB/s or 3.6 KB/s (corresponding to a T1, 56 kilobaud or 28.8 kilobaud line, respectively). To give you an idea of how small that is and why Web video is so focused on bandwidth, we have to go back to the ancient days of the 1x CD-ROM that had a throughput of 150 KB/s!

Compression and decompression tools–otherwise known as codecs–are important for Web delivery because video must be compressed to small file sizes, sent to the client and uncompressed on the other side, while retaining a decent level of picture quality. Obviously, something must be sacrificed in order to achieve this seemingly impossible feat. The codec challenge of deciding what special tricks to employ to keep file sizes down and quality high is indeed a very tough game to play.

A few years ago, there was basically just one guy on the codec block: Cinepak from Compression Technologies Inc., Oakland, CA, Cinepak was so popular that it was preinstalled on nearly all personal computers during the last few years and was the staple of the old QuickTime 1.5. Simple codec schemes involving tricks such as discarding pixel information that doesn't change from frame to frame and ignoring a fraction of frames. Nowadays, there are lots of guys on the codec block. Each adds its own set of special tricks, which are giving Cinepak a clear run for its money. For example, Apple's release of QuickTime 3.0 features the Sorenson Video codec from Sorenson Vision Inc., Logan, UT. It is a physiological fact that the brain is more sensitive to brightness than it is to color information, so Sorenson's special trick is to emphasize brightness data over color data by a ratio of four to one.

Of course, the game is not nearly as difficult in the land of the corporate intranet, where Fast Ethernet bandwidth equivalent to 100 Mb/s is not uncommon. Video compressed as video recorder-quality MPEG-1 requires only 1.2 Mb/s, and broadcast-quality MPEG-2 only 6 Mb/s (150 KB/s and 750 KB/s, respectively).

In the land of audio, compression is also a necessity. Audio compression has evolved because stereo requires twice as much information as mono. Vancouver, Canada-based QDesign Corp.'s QDesign Music codec in QuickTime 3.0, for example, compares information in each of the two channels of stereo, taking out the duplicate information. Such techniques pro-

duce smaller audio streams (around 1 KB/s) that sound astonishingly good.

Transmitting video and audio over the Internet, despite several commercial options, is accomplished basically one way. A request is made to a server to send digital audio or video data and the compressed content is streamed to the client (in contrast to the old days of download first, then play) and decompressed with the aid of a player, typically a Netscape Communications Corp. plug-in or a Microsoft Corp. Internet Explorer ActiveX control.

For best results, most commercial streaming options require a media server. Another solution, though not as good as a commercial streaming server, is to stream the media with the Web server itself using HTTP. The main drawback of the serverless (HTTP) streaming solution is the inability to control the amount of data streaming from your site. This won't be a problem if you have a small site with few visitors, but if your visitor count rises, your network can choke. In contrast, media server solutions limit the amount of data leaving your site by reducing the stream count (number of consecutive streams) or dedicating a maximum bandwidth for video (which is less than the overall bandwidth available) that cannot be exceeded.

RealVideo from RealNetworks has clearly been the most visible player in the streaming and nonstreaming video markets. It has an advantage over its main competitor, Microsoft's NetShow, because its servers can run on a variety of platforms (from Windows to UNIX). In addition to supporting stream count and bandwidth limits, RealVideo and NetShow both support real-time broadcasting and multicasting, which feeds video to many users on the same stream.

3D and Other Virtual Worlds

The latest multimedia advances on the Web are not just about audio and video (although these are the major players), ask any teenager what they like best about computers and they will most likely start talking about virtual reality.

Cosmo Software Inc., Mountain View, CA, a Silicon Graphics Inc. subsidiary, is moving the Web into the third dimension. Its new PageFX design tool could potentially breath new life into the Virtual Reality Markup Language (VRML). By adding small VRML enhancements to a site, PageFX can allow designers to add 3D elements to a previously 2D page.

Although by no means new, the ability to create immersive photographs to give the illusion of a virtual space has evolved somewhat since Apple's QuickTime VR created a virtual *Star Trek* bridge. Panorama software takes separate images, stitches them together and pastes them inside a cylinder or sphere. Interactivity is added through the creation of object movies in such worlds that, when clicked and dragged, display the object at different viewing angles.

For the ultimate in creating 3D worlds, however, there is VRML. In VRML worlds, everything can be explored. The most impressive applications are online games, where a player can compete with other players in real time, while navigating in the same 3D world. Even though VRML hasn't made a huge splash on the Web, despite NASA's use of it for the Path-Finder mission to Mars, its day will come. Its limitation lies in the fact that truly realistic models require high-end graphics. However, it's only a matter of time before such graphics cards find their way into consumer-grade computers.

Multimedia on the Horizon

Apart from bandwidth, another problem hindering the implementation of multimedia over the Web is that there is no single way to implement different multimedia objects. The World Wide Web Consortium (W3C) released a proposed specification in late April for the Synchronized Multimedia Integration Language (SMIL), based on the eXtensible Markup Language (XML). In a nutshell, SMIL allows developers to write Web-based multimedia presentations that allow for synchronization of elements such as sound, video and images over time.

However, even this will probably not transform the "multimedia locomotive" into a "bullet train." The main issue is to increase bandwidth, which will pave the way for the much talked about convergence of the computing, communications and entertainment industries. Right now, there is anything but convergence. Telephone companies and cable companies are exploring a wide range of technologies capable of video-on-demand, Web access and a host of other unforeseen applications.

The telephone companies have put forth three solutions. Asymmetric Digital Subscriber Line (ADSL), their Band-Aid solution, is based on the use of already existing twisted-pair copper wire used for plain old telephone service. ADSL offers a T1 (1.536-Mb/s) connection plus an analog telephone channel. But, as we saw above, this basically supports, at most, MPEG-1. There are other implementations that support MPEG-2, though only over small local loops. Fiber to the Curb (FTTC) is another solution that can support full-duplex T1 or T2 (allowing for applications such as symmetrical videoconferencing). The third solution offered by the telephone companies is Fiber to the Home (FTTH), which can support a whopping OC-3 bandwidth of 150 Mb/s (or 100 T1 lines).

The cable companies are offering a different solution: Hybrid Fiber Coax (HFC). Basically, HFC replaces the 450-MHz coaxial cables with 750-MHz cables, resulting in 125 6-MHz channels, 75 of which are reserved for television. The other 50 channels each provide 40 Mb/s, thereby bringing an additional bandwidth of 2 Gb/s into each home.

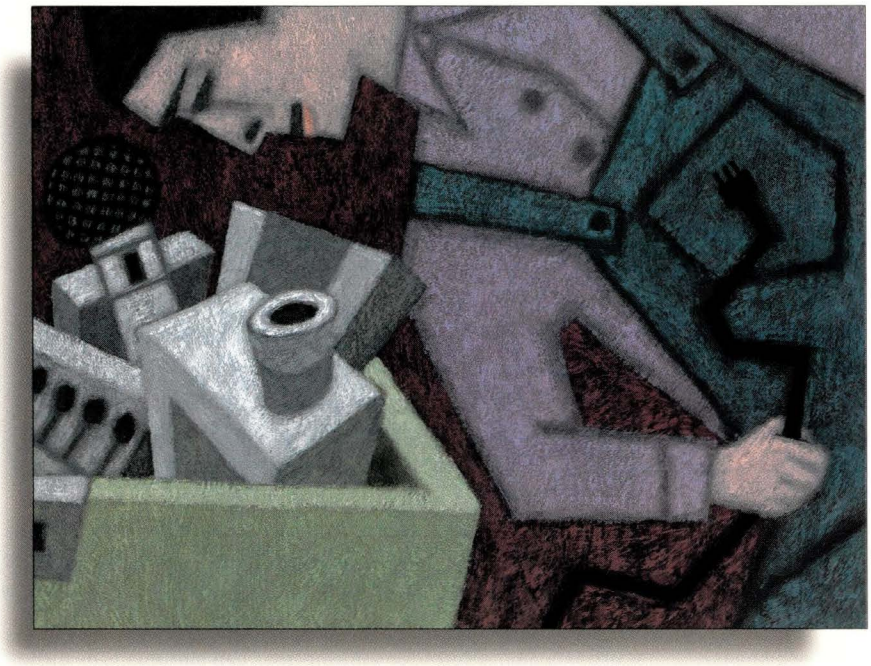
Where all of this will ultimately go no one knows at the moment. Perhaps the only way to talk about where multimedia is really going is to have a science fiction-style discussion. *Star Trek* fans have already seen worlds that incorporate digital video and audio as part of everyday life. Even holosuites that can simulate "real" worlds down to the smallest detail or people that have the ability to think, are possibilities. For better or worse, one thing is certain: The world is changing and multimedia will be a part of it. Now that the train has started, there will be no stopping it (see "Choosing the Right Multimedia Tools," Page 70, for more information about the products mentioned in this article. ⊸

by PAUL A. TRUNFIO

Paul A. Trunfio is a research associate at the Center for Polymer Studies at Boston University.

Choosing the Right Multimedia Tools

In this month's WebServer Magazine Supplement feature, "The Multimedia Train Slowly Chugs Along," Page 67, I take a look at the state of multimedia on the Web and some issues surrounding its future. This article is meant to serve as its companion.



In this article, I will point out many of the currently available Web multimedia tools. This list is *not* meant as a comprehensive buyers guide for all multimedia products for the Web–for it would be huge and probably not all that helpful. Instead, this list features products across a wide range of categories and prices, and, in some cases, offers helpful hints.

The choice of products is admittedly subjective. In some cases, I chose products because I feel they are outstanding (that is, I have personal experience with them or have read nothing but good reviews). In other cases, I chose products that are representative of the major companies involved (for example, I chose only one Sony Electronics Inc. digital video camcorder instead of the whole product line). In still other cases, I chose from different price categories. With that said, please do not chastise me too much if I forgot company X or product Y. The point is to take a snapshot of what is currently available and point you in the right direction.

In addition to multimedia products, I've also provided a list of top-notch–and some less than top-notch–multimedia Web sites that can give you a feeling for what to do, or what not to do, as the case may be. I did not go into any discussion in the feature about what to do with the multimedia you can create, how to embed it in your Web pages, or what not to do. This was purposely done because I felt it was wiser to give a snapshot of the whole field rather than go into everything there is to know about a particular aspect of multimedia. My philosophy on Web development, as well as in life, is that you learn by doing. So check out what others have done. Think about what aspects you would like to modify for your own development efforts and what you would like to completely avoid.

Finally, you may notice in "The Multimedia Train Slowly Chugs Along," that I spent a lot of time discussing bandwidth. Bandwidth is a huger than huge issue when it comes to multimedia on the Web. I believe every Web developer should have a basic understanding of bandwidth and networking in general, so I have provided a list of several sites that will help you build up that knowledge base. On to the list...

Digital Media Recorders

The following digital video camcorders all offer Apple Computer Inc.-developed FireWire (IEEE 1394) ports and two channels of digital audio. Basically, the more charged coupled devices (CCDs), the better the video quality. Here's a smattering of the more than two dozen products currently available:

Product	Company	CCDs	($) Price
ZR	Canon USA Inc.	single	1,999
DCR-VX1000	Sony Electronics Inc.	triple	4,100
AG-EZ30U	Panasonic Communications and Systems Co.	triple	2,900

Although the rage these days is digital video, digital-still cameras can provide excellent graphics for your site. PhotoDisc Inc.'s Stock Photography, for example, is another option whereby you select images from a library:

Product	Company	($) Price
D-600L	Olympus America Inc.	1,300
Stock Photography	PhotoDisc Inc.	150-300

Digital Media Editing Systems

We will have to wait until the end of the year for a FireWire-equipped computer, but there are already a number of dedicated FireWire-based cards on the market. Because the video coming into the machine from the digital video camcorder is already compressed, many systems come with software codecs to decompress the video, while the more expensive ones come with a hardware codec. Many come with editing software. Check out the following:

Product	Company	Platform	($) Price
DVRex-M1	Canopus Corp.	Windows	3,495
DV Master	Fast Multimedia U.S. Inc.	Windows	3,295
HotConnect Ultra	Adaptec Inc.	Win/Mac	699
FireMax-C	ProMax Technology Inc.	Macintosh	395
EditDV	Radius Inc.	Macintosh	999

An inventory of audio hardware needed to create quality multimedia music could include music synthesizers, microphones (analog) or DAT (digital) for recording, a 16-bit audio card and a MIDI studio using Opcode Systems Inc.'s Open Music System. Because of my personal interest in this area and because there are just so many aspects to consider, I will reserve discussion on digital audio for a future column. But, here's a quick list of some audio/music products to get you started:

Product	What Is it?	Company	Platform	($) Price
1212-I/O	Sound card	Korg USA Inc.	Mac/Win	999
Sound Blaster-64	Sound card	Creative Labs Inc.	Windows	79
Open Music System	MIDI	Opcode Systems Inc.	Mac/Win	Free
Shure SM-58	Microphone	Shure Brothers Inc.	–	159
ADAT-XT	Digital tape	Alesis Corp.	–	3,499
Beatnik	MIDI plug-in	Headspace Inc.	Mac/Win	Free

Audio and Video Codecs

Compression and decompression of audio and video is a necessity because of bandwidth problems due to large images. There are many players in this arena, and many issues surrounding which codec to choose in a given situation. Most of the Web-based codecs are built into products that stream the media (for example, Sorenson Vision Inc.'s Sorenson Video and QDesign Corp.'s QDesign Music are built into Apple's QuickTime, and Real Encoder and RealAudio are part of RealNetworks Inc.'s RealSystem 5.0):

Product	Company	Type
Sorenson Video	Sorenson Vision Inc.	Video
Real Encoder	RealNetworks Inc.	Video
Cinepak Pro	Compression Technologies Inc.	Video
RealAudio	RealNetworks Inc.	Audio
QDesign Music	QDesign Corp.	Audio
PureVoice	Qualcomm Inc.	Audio

Digital Media Editing Software

Whether you are editing digital video or audio files, or creating multimedia presentations, there are plenty of tools to make your project come alive. Here's a few of them:

Product	Company	Type	($) Price
Premiere 4.2	Adobe Systems Inc.	Video/audio editing	488
Director 6.0	Macromedia Inc.	Multimedia presentation	898
Studio Vision	Opcode Systems Inc.	MIDI/audio editing	999
Pro Tools 4.1	Digidesign Inc.	Audio editing Mac	795
Sound Forge 4.0	Sonic Foundry Inc.	Audio editing Win	495

Serving Streaming Digital Media

There are many streaming video servers, though most are clustured around the high-bandwidth intranet market. Real-time videoconferencing for corporate meetings or distributed-learning applications is a daily reality with these tools and I will reserve discussion of them for a future column. On the Web-based front, there are basically three major players that offer low-end free solutions that can handle hundreds of streams without an overly expensive server ($30,000 range):

Product	Company	Platform
NetShow	Microsoft Corp.	Windows
RealMedia	RealNetworks Inc.	Mac/Win/UNIX
QuickTime	Apple Computer Inc.	Mac/Win

Virtual Reality Tools

These products let you create 3D virtual worlds. The first three tools allow users to stitch together photographs to create a feeling of navigating through 3D space, the last two in the list are full Virtual Reality Markup Language (VRML) tools that create fully navigable virtual worlds:

Product	Company	Platform	($) Price
QuickTime VR 1.0	Apple Computer Inc.	Macintosh	395
Reality Studio 1.0	Live Picture Inc.	Windows	399
PhotoVista	Live Picture Inc.	Mac/Win	49
Cosmo Worlds	Cosmo Software Inc.	Windows	999
VRCreator	Platinum Technology Inc.	Windows	129

Challenges of Multimedia on the Web

Merely learning how to do something technical does not make a good Web site. All these technologies require an artistic sense to really make them shine. Throwing video up on your site for the sake of throwing it up, isn't the right way to go. Learning how to integrate the video and audio into the site is the real trick.

Of course, I can't teach anyone how to be an artist, for I'm the first to admit I'm not very artistic. The best way to hone your artistic skills when it comes to introducing multimedia onto your site is to look at some shining examples of what others have done. You will undoubtedly find examples of things you can do better, things you have never thought of and things you absolutely hate and would never do. But the important thing is to take a look.

One of the best ways, and certainly one of the easiest, is to check out the "Showcase Sites" highlighted on the home pages of many of the above-mentioned product vendors. Many of them have some excellent sites that can help get your artistic juices flowing.

What limits multimedia on the Web can be summarized in one word: bandwidth. There are several excellent Web sites that provide general knowledge of current networking issues as well as a look at emerging future Web technologies. I recommend the following:

- World Wide Web Consortium (W3C)–`http://www.w3c.org`
- Web TV–`http://www.webtv.net`
- Lynn Larrow's Networking Links–`http://www.webcom.com/~llarrow/comfaqs.html`
- High Bandwidth Web Page–`http://www.specialty.com/hiband/`
- MCI/NSF Very High Speed Backbone–`http://www.vbns.net` ➥

Companies Mentioned in this Article

Adaptec Inc.
691 S. Milpitas Blvd.
Milpitas, CA 95035
http://www.adaptec.com
Circle 132

Adobe Systems Inc.
345 Park Ave.
San Jose, CA 95110
http://www.adobe.com
Circle 133

Alesis Corp.
1633 26th St.
Santa Monica, CA 90404
http://www.alesis.com
Circle 134

Apple Computer Inc.
1 Infinite Loop
Cupertino, CA 95014
http://www.apple.com
Circle 135

Canon USA Inc.
One Canon Plaza
Lake Success, NY 11042
http://www.canondv.com
Circle 136

Canopus Corp.
2010 N. First St., Ste. 510
San Jose, CA 95131
http://www.canopuscorp.com
Circle 137

Compression Technologies Inc.
5756 Ayala Ave.
Oakland, CA 94609
http://www.cinepak.com
Circle 138

Cosmo Software Inc.
2011 N. Shoreline Blvd.
Mountain View, CA 94043
http://www.cosmosoftware.com
Circle 139

Creative Labs Inc.
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2 Panasonic Way
Seacaucus, NJ 07094
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1011 W. 400 N.
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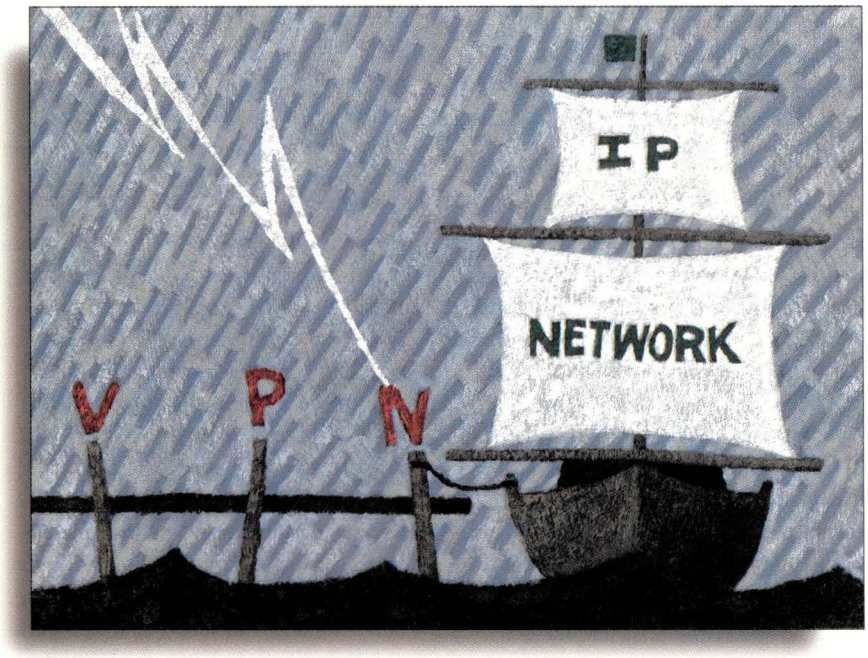
VPNs - A Port for Any Storm

Virtual Private Networks, it seems, are causing quite a stir among security experts, networking analysts and potential users.



How much do you really know about VPNs? Here's a quick quiz to find out.

A Virtual Private Network (VPN) is:

a. A private communications link over an IP network.
b. A way to expand access to the corporate network while reducing costs.
c. A potential security headache.
d. A potential performance bottleneck.
e. All of the above.

If you answered e, you'd be correct–and probably somewhat uncertain about whether or not you should consider implementing a VPN. Rightly so. VPNs are one of the newest networking schemes to arrive on the scene, and they're causing quite a stir among security experts, networking analysts and, of course, potential users.

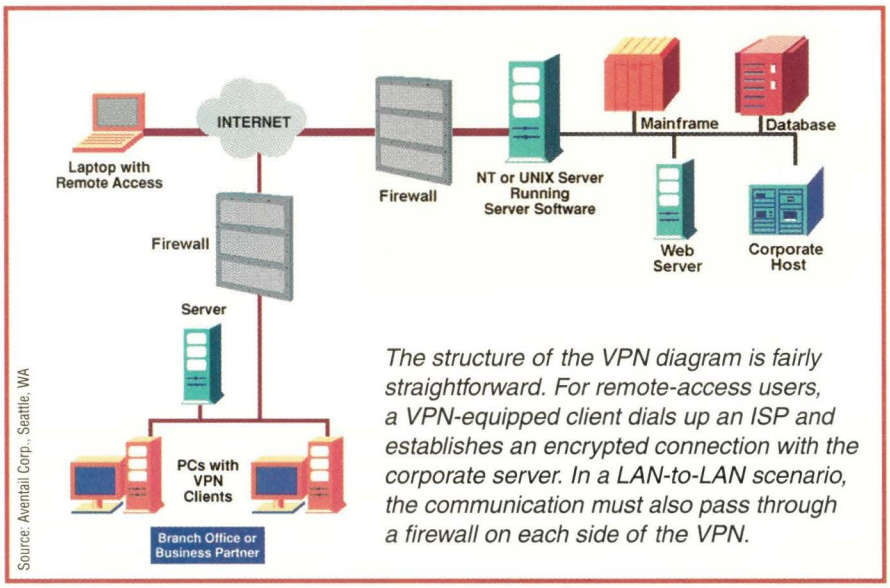
First, what is a Virtual Private Network? While a VPN can take a number of forms, it is generally defined as a temporary, secure connection over an IP network between branch offices, remote users and the head office; or between business partners seeking to communicate sales, order processing or customer service information.

"A lot of our customers are companies looking to ease the pain of connecting remote offices or branch offices, or connecting remote users such as telecommuters or road warriors who need remote access to internal applications," says Rob Spence, director of product marketing for Aventail Corp., a Seattle, WA-based maker of Aventail VPN, a client/server VPN application.

"They're also business partners–suppliers, vendors and consultants–who need to collaborate on production schedules, inventories or other kinds of business-to-business information," Spence says.

How such a network is implemented can vary quite a bit. A VPN can be an entirely software-based implementation, such as a firewall or client/server application, or it can be a hardware implementation, such as remote-acces router or stand-alone box. Ascend Communications Inc., Alameda, CA, for example, has a number of VPN products for corporations and Internet service providers (ISPs), including VPN-capable switches and routers. A VPN can also be a combination of the two. For instance, Check Point Software Technologies Ltd., Redwood City, CA, sells a VPN module for $2,995 as an add-on to its Firewall-1 firewall product. While, Richard Kagen, vice president of marketing for VPNet Technologies Inc., San Jose, CA, says his company's fastest selling product is VPNywhere, a family of turnkey solutions that include hardware, software and global roaming services–a network of ISPs for mobile workers to access–in a single package. Pricing for VPNywhere ranges from $4,000 for one site with 25 remote users to $39,000 for four sites with up to 2,400 remote users.

However, regardless of the hardware or software used, the structure of the network diagram is fairly straightforward. For remote-access users, a VPN-equipped client–a laptop or PC with VPN software installed–dials up a local ISP and attempts to connect to the IP address of the corporate server. Before letting the client in, the VPN server authenticates the identity of the client and establishes an encrypted connection between the client and the internal corporate network. In a LAN-to-



The structure of the VPN diagram is fairly straightforward. For remote-access users, a VPN-equipped client dials up an ISP and establishes an encrypted connection with the corporate server. In a LAN-to-LAN scenario, the communication must also pass through a firewall on each side of the VPN.

LAN scenario, the communication must also pass through a firewall on each side of the VPN, which is why many firewall vendors are now embedding VPN features in their products.

IP – Cheap and Convenient

The benefits of a VPN include convenience and low cost. The advantage of a VPN stems from the fact that it runs over an IP network–be it a private network, commercial network or the Internet. "That is what makes VPNs fundamentally different from leased-line or frame-relay networks. If your company is on one frame-relay network and mine's on the other, there's no reason at all to think that we're going to be able to get from one network to the other. But if we're both on an IP network, I can get to you, as long as I know your IP address," explains VPNet's Kagen.

It's the ubiquitous nature of IP networks that makes VPNs not only attractive for corporate LAN-to-LAN and remote worker connectivity, but for connecting with business partners. By year-end 2003, 25% to 30% of electronic commerce transactions will be conducted over VPNs, according to figures by research firm Gartner Group Inc., Stamford, CT.

And you don't have to look far to see this prediction being borne out. One of the largest–perhaps *the* largest–example of a VPN extranet is currently being developed by the Automotive Industry Action Group (AIAG), a nonprofit trade association based in Southfield, MI. The AIAG, made up of more than 1,300 North American auto manufacturers, is in the process of establishing a VPN for its members, called the Automotive Network eXchange (ANX) service. The concept originated in 1995, when the Big Three auto makers–Chrysler, Ford and General Motors–endorsed TCP/IP for enterprise access to data and applications, and formed the Telecommunications Project Team at the AIAG to develop a common TCP/IP data network service for all automotive trading partners. The resulting ANX service, which is expected to be in the pilot stage through the third quarter of 1998, will eventually support electronic data interchange (EDI), email, CAD exchange and shared use of groupware and other applications among 40,000 automotive manufacturers and associated suppliers in North America and Europe.

Cost often plays the biggest role in a company's decision to implement a VPN. Typically, a VPN used to connect branch offices can cost anywhere from 20% to 40% less than a traditional leased-line connection, according to Infonetics Research Inc., San Jose, CA, while companies may see savings of 60% to 80% for telecommuters and remote mobile workers (savings for remote access come from reduced long-distance telephone charges and the cost of modems and ports to handle dial-up connections).

Expense was a major factor behind Mount Holly, NJ-based Memorial Hospital's decision to install a VPN to connect affiliated physicians and traveling executives to its network. The 369-bed hospital had been using Cupertino, CA-based Symantec Corp.'s pcAnywhere communications software to dial into the network from mostly 486 PCs. However, as part of an overall upgrade last summer, the hospital brought in some 32-bit applications, including Microsoft Corp.'s Office 97 and Novell Inc.'s Groupwise messaging software, that couldn't be accessed via the old setup. The cost of upgrading the hospital's remote-access server and pcAnywhere software would have run to $68,000, says Bob Haines, lead network administrator for the hospital.

Instead, the hospital opted to try a VPN, spending about $12,000 for server and client software from Aventail.

"We basically wanted to enable client/server access between the end user's house or office and our network. We decided that a VPN would work perfectly and cost a lot less money," says Haines, noting that the hospital is also saving on networking costs by not having to pay $2,000 per month for leased ISDN lines and associated support costs. Instead, the hospital is relying more heavily on its existing T1 line to the Internet and on physicians paying for their own Internet access through an ISP of their choosing.

So far, approximately 25 employees and physicians are using the VPN, with plans for a total of 100 offices and laptops to be equipped over the next several months. The only real obstacle to the program, says Haines, is the hardware upgrade the VPN requires. Some of the physicians are reluctant to upgrade from their 486 and 386 PCs to Pentium-based desktops, says Haines, so the hospital is considering a bulk purchasing program in which it will resell sub-$1,000 PCs, equipped with the VPN access software, to the physicians.

Infonetics Research recently conducted a market study on VPNs and found that 21% of U.S. organizations with networks plan to use at least one type of VPN by the year 2000. By 2001, Infonetics predicts there will be 17.6 million remote-access VPN users, 1.4 million sites connected via VPNs and 1.3 million extranet partners using VPNs worldwide.

Needless to say, ISPs see potential profits in the VPN market. Many are includ-

ing VPNs in their corporate access packages or are reselling VPN products to customers. In 1997, 92% of U.S.-based ISPs providing national or international Internet access reported that they intended to offer some sort of VPN service or product to their customers by mid-1998, according to Infonetics Research. Jeff Wilson, director of access programs for Infonetics, says 92% isn't far from the actual number of ISPs that are, today, either reselling VPN products or offering a VPN service as part of a corporate Internet access package.

"ISPs can offer VPNs in a thousand different ways. They can offer them as an integration/CPE [Customer Premises Equipment] type of solution, where they just install some equipment at the customer site, or they could offer a VPN solution tied to their network," says Wilson. It's the ISPs who can provide integrated VPN solutions that are likely to be most attractive to corporate IS managers, however. Outsourcing of VPNs to national ISPs is becoming big business. International Data Corp. (IDC), Framingham, MA, predicts that revenue from IP-based VPN services will reach $1.98 billion in 2002, compared with a projected $317.3 million in 1998. UUNET Technologies USA, Fairfax, VA; WorldCom Inc., Washington, D.C.; and PSINet Inc., Herndon, VA, all offer VPN services.

Performance, Security: Weaknesses of the Net

One reason why a company might want to outsource its VPN to a national ISP is to get a better level of performance. The Internet may be ubiquitous and cheap, but it's not always the fastest or most reliable network for running the corporate WAN. And simply installing a VPN product on either end of a vanilla Internet connection won't provide consistent, or stellar, performance either. There is, after all, no way to control how fast corporate data is transported over the Internet from within the corporate IS department. Only an ISP has the ability to manage the performance of the Internet–or, at least, manage the part of it that runs over the ISP's own pipes–which is one reason many companies are handing over the reins of their VPNs to national ISPs.

But a firm needs more than an ISP with a VPN package to ensure good performance. It also needs guarantees. The only way to ensure a minimum level of quality for a corporate LAN-to-LAN type of VPN connection, says Mark Winthers, group vice president of worldwide telecommunications for IDC in New York City, is to contract with a national or international ISP that has a solid network and can give a written service-level guarantee. But, that's not always easy to find. "The kind of guarantees today are nowhere near the level that a traditional network manager is used to," says Winthers. "The only way you can be guaranteed a service-level at all is by going to a provider, such as UUNET, which is always tweaking its network–adding

bandwidth, bigger switches, more modem banks."

Of course, if all you want is dial-up access for a few remote users, then a standard Internet connection is certainly adequate, Winthers says.

Security is another sticky issue. Any time a company sends sensitive information over the Internet, it must worry about it being intercepted; which is why security is a particularly sensitive issue with VPNs. There are a number of protocols available for packaging data for transport across the Internet, for encrypting data and for authenticating clients attempting to access a VPN. One of the more well-known protocols for transporting VPN data, Microsoft's version of the Point-to-Point Tunneling Protocol (PPTP),was recently criticized for having inadequate security.

In June, Bruce Schneier, head of security for consulting firm Counterpane Systems, Minneapolis, MN, released a cryptographic analysis of the PPTP implementation in Microsoft's Remote Access Services (RAS) server, which is built into Windows NT. Schneier ran an analysis of the Microsoft PPTP implementation and found several significant flaws.

According to Schneier, who claims to have broken Microsoft's encryption algorithms, Microsoft's PPTP implementation suffers from inadequate authentication and encryption. For instance, Schneier says Microsoft's LAN Manager (LM) hash system for encoding passwords is so simple that a hacker could break it by simply generating a reverse dictionary of the hashed passwords. (Microsoft has responded to Schneier's criticisms by saying, essentially, that many of the flaws have already been fixed with updates or patches, and that others will be addressed in the near future. Microsoft recommends all its customers update to the latest Service Pack 3 for Windows NT and install the PPTP fixes, see `ftp://ftp.microsoft.com/bussys/winnt/winnt-public/fixes/usa/NT40/hotfixes-postSP3`.)

PPTP is used for packaging both IP and nonIP traffic, such as IPX or Appletalk, over an IP-based VPN. While it doesn't handle encryption by itself, it does have to be implemented with other, industry standard or proprietary encryption and authentication algorithms. Microsoft has implemented PPTP with its own encryption approach, called the Microsoft Point-to-Point Encryption, which is based on the RSA Data Security Inc. RC4 algorithm, and its own authentication scheme, called MS-CHAP, which is based on the Challenge Handshake Authentication Protocol. Schneier's security criticisms are specific only to Microsoft's PPTP implementation.

Although PPTP is an Internet Engineering Task Force (IETF)-proposed protocol jointly developed by a handful of vendors, its most common implementation is Microsoft's PPTP–simply by virtue of its being included in Windows NT. That means UNIX shops can't actually use PPTP because it requires an NT server at one end. Another standard, however, which is used in many other VPN products is IPSec. IPSec is an open standard supported by many vendors as well as the IETF. Developed to ensure interoperability of VPN products from different vendors, it includes support protocols for authentication, privacy and data integrity, and supports a number of different encryption algorithms, such as Data Encryption Standard (DES) and Triple DES. It doesn't use PPTP's encapsulation approach for packaging data, but has its own packaging schemes, namely Authentication Header (AH) and Encapsulating Security Payload (ESP). One drawback of IPSec, however, is the client needs to have a fixed IP address–something a traveling employee or a telecommuter using an ISP to access the company VPN wouldn't possess. Also, IPSec only supports IP traffic.

Schneier recommends customers looking for a secure VPN product consider only those that conform to the IPSec standard. Because open standards are supported by many vendors and organizations, more people have had a chance to look for, and fix, flaws in the standard–theoretically, at least. "A product that's designed as proprietary is far less likely to be secure then a product that's designed in the open," Schneier says.

One organization attempting to test and certify IPSec-based VPN products is the International Computer Security Association (ICSA) based in Carlisle, PA. Earlier this year, the ICSA announced the first group of products to be certified under the ICSA IPSec certification criteria (Check Point's FireWall-1 and VPNet's VSU-1010 are among the first products to receive ICSA certification). The criteria was originally developed by the ICSA for the AIAG, which has been actively testing IPSec-based products for interoperability with its ANX service. The AIAG also requires ISPs who want to participate in the ANX service to complete its certification test for interoperability, performance, disaster recovery and security standards (criteria are on the ANX Web site at `http://www.anxo.com/whatis.htm#csp`).

User Concerns

Could security concerns, such as those posed by the report concerning Microsoft PPTP flaws, have a chilling effect on the VPN market?

Infonetics' Wilson doesn't think so. "We just completed a big marketing study on VPNs and found that while security is a big concern, it's not their only concern, and PPTP technology is not the only technology they plan to use. Actually, right now, IPSec looks to be the way that VPNs are going. That's the standard that all the vendors are gelling around."

Haines of the Mount Holly Memorial Hospital says he's always felt fairly secure with the Aventail product and the supported Remote Access Dial-In User Service (RADIUS)-based server that he uses to administer user access and security. And Haines echoes the sentiment that open security standards are more secure than proprietary ones. "The technology that Aventail uses, such as its RC4 ciphers, is also available from other vendors. It's not like they came up with their own proprietary algorithms." Aventail VPN actually supports a number of industry cryptographic algorithms, including DES, Triple DES, Message Digest 5 (MD5), Secure Hash Algorithm-1 (SHA-1) and RC4, a cipher developed by RSA Data Security.

However, IDC's Winthers says businesses tend to become security conscious mainly after reading reports in the media of hacking or other security breaches. So the mere report of a security flaw could have some impact–more so if any actual incidences of a Microsoft-based VPN being hacked are reported (something Microsoft is quick to note has not occurred).

"Security is a funny thing. People don't need it and can't cost-justify it until they've had a problem, after which any amount of money is worth it," Winthers says. ⊸

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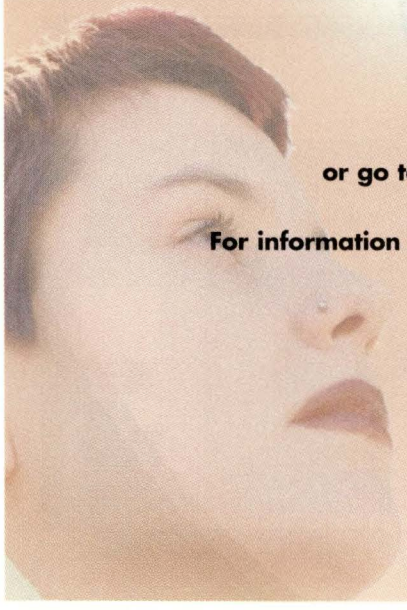

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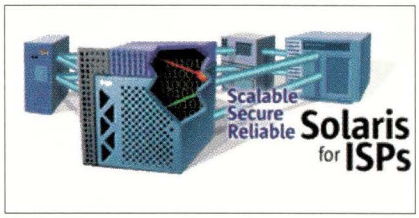
URL/New Products

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.

Sun Debuts Products for ISPs

Sun Microsystems has announced a number of new products aimed at large corporate intranets and Internet service providers (ISPs). Solaris for ISPs server software is designed to provide enhanced



system-level security, scalability and performance. It reportedly features a browser-based administration and monitoring interface that allows ISPs to administer services from anywhere on the network and provides full support for Java servlets and integrated ISP services, including Sun WebServer 2.0, Sun Internet News Server and Sun Internet FTP Server.

Security features include intrusion detection, administrator authentication and access control, central auditing and privacy and integrity protection for all network traffic. Solaris for ISPs includes Sun's IPSec product, SunScreen SKIP, to enable users to secure any IP transmission between servers, as well as Directory Services, a Lightweight Directory Access Protocol (LDAP) v3 implementation that provides a shared repository for administrator and user access information. Solaris for ISPs runs on Solaris 2.6 for SPARC or Intel Corp. systems and pricing starts at $5,995.

Also for ISPs and enterprise service providers, Sun has unveiled an updated version of the Internet Mail Server and the first release of its Internet Calendar Server. Sun Internet Mail Server is designed for 24x7 systems that require maximum uptime. It features a new high-availability option to provide automatic failover in the event of a system failure or during routine maintenance. It operates with all popular email clients, including Lotus Development Corp. cc:Mail and Microsoft Corp. Mail, and supports both Secure Sockets Layer (SSL) for message encryption between client and server and X.509 certification. Sun Internet Mail Server 3.5 will be available in September at a cost of $1,496 for the Departmental Version and $3,495 for the Enterprise Version. The Internet Calendar Server provides group calendaring and scheduling capabilities, and easy access from any Web- or Java-based browser. Sun Internet Calendar Server 1.0 will be available sometime this fall. Pricing is not yet available.

Sun Microsystems Inc.
2550 Garcia Ave.
Mountain View, CA 94043
http://www.sun.com
Circle 163

Software to Ensure Secure Communications

Anyware Technology has announced its EverLink Suite of software tools, designed for private and secure email and file transfers over wide-area networks (WANs) or the Internet. EverLink Suite comprises three fully integrated software components: EverLink Client, Locator-One Server and EntryGuard Server. All three work together to provide a low-

Toolkits Bring Web Pages to Life

Intel has announced it is expanding its Web development tool offerings with the introduction of Intel Web Design Effects and Intel Indeo Media Kit.

Web Design Effects allows developers to create low-bandwidth, realistic, animated effects such as fire, rain, smoke and other customized effects using a single bitmap, Intel says. Indeo Media Kit provides developers with progressive download technology and audio and video tools to produce high-quality multimedia content, the company says. Intel Web Design Effects and Intel Indeo Media Kit cost $149 each and require a Pentium processor running at 90 MHz or greater, 16 MB of RAM and Windows 95/NT.

Intel Corp.
2200 Mission College Blvd.
P.O. Box 58119
Santa Clara, CA 95052
http://www.intel.com
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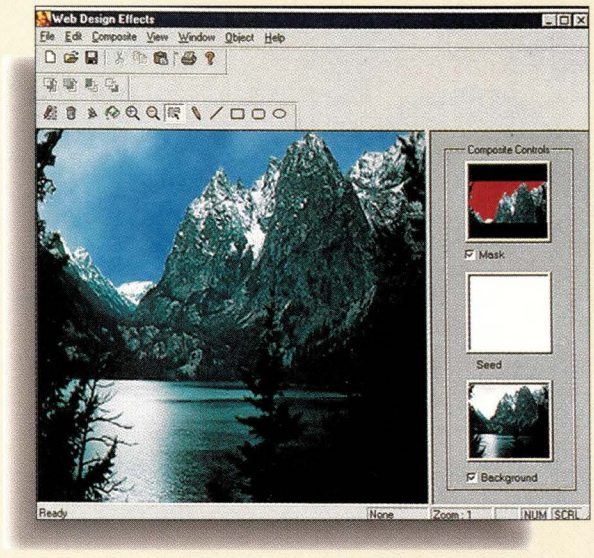

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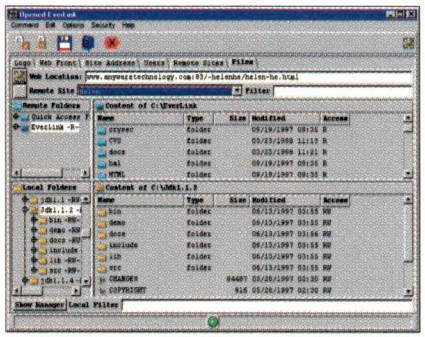


cost, secure, cross-platform solution for communications and network access, Anyware says.

EverLink Client reportedly allows users to access personalized Web pages, so-called "virtual offices," on the corporate intranet. LocatorOne Server lists IP addresses for EverLink users' virtual office home pages and allows an address to be listed after authenticating the client's EverLink Owner's Certificate, Anyware says. The EntryGuard Server module protects internal networks from unauthorized access, while allowing authorized users to communicate securely and privately with specific sites inside the firewall. To guard against interception by an outside party, all access is peer-to-peer through Secure Sockets Layer (SSL) channels. Pricing for the Java-based EverLink Suite starts at $495 for a 25-user system.

Anyware Technology Inc.
17837 Rowland St.
City of Industry, CA 91748
http://www.anywaretechnology.com
Circle 164

Data Presentation for the Web

Metaphoria Data Transformation Server (DTS) 1.1 from Pencom Web Works reportedly culls and integrates database data, spreadsheets, email, text, graphics and other digital information for display in a Web browser. Designed for business users who want quick and easy access to data from multiple sources, including legacy applications, Metaphoria DTS is a Java servlet that can access data via HTTP, FTP and Gopher protocols, as well as through its JDBC and ODBC interfaces and filters for more than 200 file formats, Pencom says. Because it separates content from presentation, Metaphoria DTS reportedly allows users to present the culled data in HTML, VRML, XML or as a Java applet. Metaphoria DTS 1.1 Development Server costs $25,000 per server.

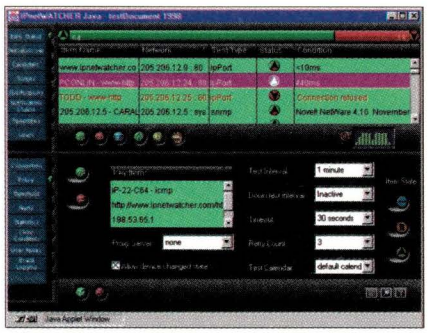
Pencom Web Works
40 Fulton St., 6th Floor
New York, NY 10038
http://www.pww.pencom.com
Circle 165

Java Application Guards Corporate Networks

IPnetWatcher 1.1 Java Edition from Avesta Technologies is said to deliver real-time fault and performance monitoring for devices, servers, services and applications to managers of IP and Microsoft Corp. Windows NT networks. IPnetWatcher reportedly finds and concurrently tests on-site and remote IP, SNMP and NT devices, services and applications without the need for additional software or agents. When impending problems or real-time failures are identified, IPnetWatcher immediately notifies the designated people via email, pager, individual desktop alerts and/or real-time network status reports, which are delivered to any Java-enabled browser, Avesta says.

Written in Java as a server-side application, IPnetWatcher 1.1 Java Edition uses the Web to provide secure console access and control through any Java-enabled browser, 24 hours per day. For mission-critical networks, this allows a network manager to be notified of, and respond to, problems at work and at home, the company says.

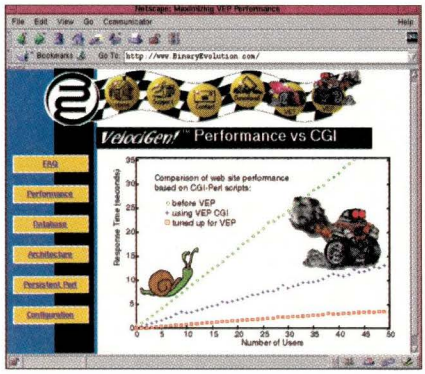
IPnetWatcher can also manage Web servers and applications in detail–monitoring Web site performance, checking for broken links and testing databases and applications. Pricing for IPnetWatcher starts at $4,995. Pricing per node ranges from $100 to $500, depending on the number purchased.



Avesta Technologies Inc.
Two Rector St.
New York, NY 10006
http://www.avesta.com
Circle 166

Plug-In to Speed Web Site Response Time

Busy Web sites can get a performance boost from VelociGen, according to Binary Evolution. VelociGen is an HTTP server plug-in, which speeds the response time of online applications used in electronic commerce and dynamic content publishing. The product allows large, sophisticated Web sites to respond more quickly to Web browsers' requests–as much as 25 times faster, in some cases, the company says.



VelociGen uses a group of interpreter engines to store and execute precompiled scripts. The ability to establish a persistent connection to the database eliminates the delay of reestablishing a new connection for each individual request, the company says. The software installs on UNIX and Windows NT servers and interacts with database engines via industry-standard protocols, such as ODBC and SQL. A developer's license for VelociGen costs $4,995. Run-time license fees cost $799 for the Linux version, $1,299 for the Windows NT version and $2,499 for the Solaris, IRIX and HP-UX versions.

Binary Evolution Inc.
P.O. Box 3258
Rancho Sante Fe, CA 92067
http://wwwbinevolve.com
Circle 167

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.

Software-Based License Manager Out

Rainbow Technologies has released SentinelLM Version 6.0, a software-based license manager designed to protect against the unauthorized use of applications. SentinelLM 6.0 is a 100% Pure Java-certified software solution that allows developers to add a license enforcement capability to Microsoft Corp. Windows and UNIX applications, either on a stand-alone or networkwide basis, the company says. Users can reportedly license applications with a simple point and click operation.

SentinelLM 6.0 also offers a two-call API for implementing license management on UNIX platforms. This latest release offers enhancements in the Windows dynamic link library (DLL), which enables developers working in languages other than C/C++, including Visual Basic, PowerBuilder and Delphi, to incorporate SentinelLM license management.

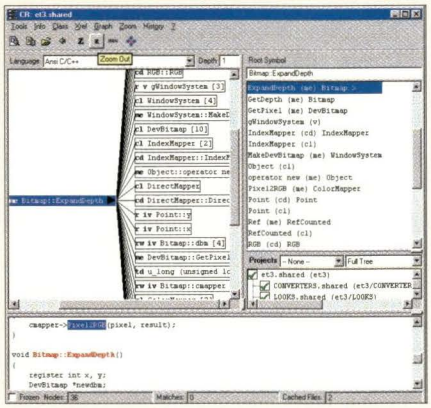
With SentinelLM 6.0 developers can enforce the licensing of applications running on SunOS, Solaris, AIX, Digtial UNIX, HP-UX, IRIX, Linux, SCO UNIX and Windows NT/95/3.x. Pricing starts at $49.94 for the developer's kit with an additional $5 to $12.50 fee per license, depending on the number.

Rainbow Technologies Inc.
50 Technology Drive
Irvine, CA 92618
http://www.rainbow.com
Circle 101

Cross-Platform Development Tools Debut

Developers of large-scale Solaris and Windows NT software projects may want to take advantage of the advanced filtering capabilities of SNiFF+ Version 3.0 and SNiFF+ Cross source code development tools from TakeFive Software.

The SNiFF+ products feature pattern-based search and replace capabilities, built-in predefined filters to automate



common change requests–as well as customizable filters–and an improved GUI, which includes tool bars, hierarchical views and wizards, the company says.

SNiFF+ 3.0, a Windows-based product, supports development in multiple language environments, including C, C++ and Java. SNiFF+ Cross is intended for UNIX developers who want to do their development and debugging on an NT host.

SNiFF+ 3.0 costs $1,750 for a single-

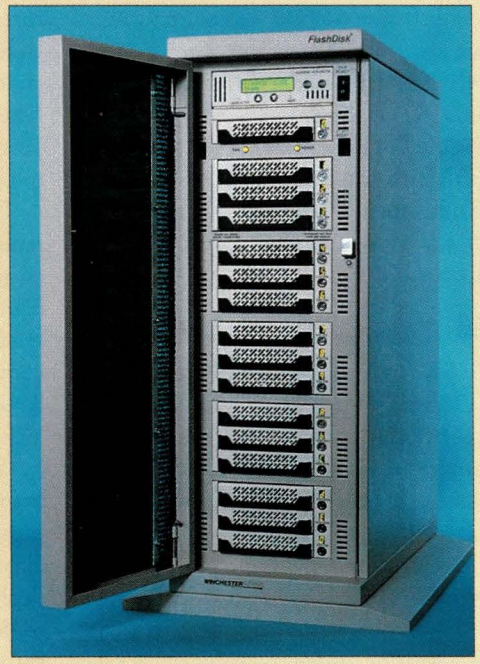
Winchester Beefs Up RAID Capacity

Winchester Systems' FlashDisk RAID Departmental and Enterprise disk arrays feature low-profile, small footprint 4.55- and 9.1-GB disk drives in pedestal and rack-mount enclosures, which can hold up to 16 low-profile disk drives for a storage capacity of 145.6 GB in a single unit, the company says.

Low-profile disk technology is said to increase storage capacity by 45%, from 100.1 GB using 11 standard 3.5-inch disk drives to 145.6 GB using 16 low-profile disk drives. The new disk arrays measure 3.5 inches in diameter, but only 1 inch in height; compared with standard 1.6-inch full-height drives. The RAID disk arrays continue to support Ultra SCSI host interfaces and Ultra SCSI disk drives, with a data transfer rate of 40 MB/s. FlashDisk also supports up to 9.779 disk I/O operations per second for random access applications such as database inquiries, sorts and reports, the company says.

Available for all mid-range servers, including Sun Microsystems Inc. SPARC, Intel Corp. Pentium and Pentium Pro for either Windows or Solaris, and IBM Corp. RS/6000 servers, a FlashDisk RAID disk array pedestal enclosure costs $28,739 with 16 4.55-GB drives or $45,592 with 16 9.1-GB drives.

Winchester Systems Inc.
400 West Cummings Park
Woburn, MA 01801
http://www.winsys.com
Circle 100



user, node-locked license or $2,795 for a multiuser license. A multiuser license for SNiFF+ Cross costs $3,295.

TakeFive Software Inc.
20813 Stevens Creek Blvd., Ste. 200
Cupertino, CA 95014
http://www.takefive.com
Circle 102

Distributed Application Development Tool Out

Until now, developers working in both CORBA and Java could largely only communicate through "bridge" translation layers, object mapping specifications or opt for multivendor solutions in order to connect different applications across multiple environments.

Now, NobleNet, a developer of enterprisewide middleware technology, has announced Nouveau, a distributed application development tool designed to automate the generation and integration of diverse CORBA-, COM-, Java- and RPC-based applications. By supporting C/C++, Java, ActiveX and 4GLs, Nouveau enables IT departments to experience greater functionality, increased productivity and improved performance without retraining existing staff members, NobleNet says.

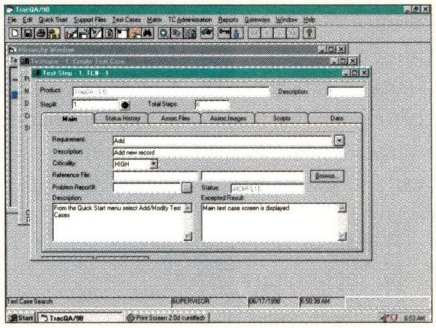
Nouveau runs on Solaris, HP-UX, AIX, SCO UNIX and Windows NT/95. It's priced at $5,000 for a single-user license, with each additional license costing $1,500. Concurrent user licenses are charged per application server and are based on the number of simultaneous users.

NobleNet Inc.
337 Turnpike Road
Southboro, MA 01772
http://www.noblenet.com
Circle 103

Testing Software to Track Y2K Compliance

Optima Software is now shipping TracQA cross-platform test information management software for SunOS, Solaris, Windows NT, AS/400 and other major platforms.

TracQA is test methodology software designed to improve software quality by standardizing the test measurement and reporting phases of software development, Optima says. The software reportedly stores, tracks and manages all documents, images and data associated with the testing and quality assurance process and makes that data available to Year 2000 team members through a central decision-support database.



The product provides testing logs, audit trails and software development tracking and reporting to provide increased legal and regulatory protection for companies concerned about the Year 2000 compliance of their software products, the company says.

TracQA is sold on a per-seat basis, with individual licenses starting at $795.

Optima Software Inc.
100 Howe Ave., Ste. 120 S
Sacramento, CA 95825
http://www.optimasoft.com
Circle 104

Compact, Portable Object Database Unveiled

ObjectStore PSE Pro 2.0 is a full-featured Java-based database management system in a compact 450-KB footprint that can be easily deployed over the Internet and run on any client with a Java Virtual Machine (JVM), according to Object Design.

Designed for use in embedded systems, thin-client applications and mobile computing, PSE Pro 2.0 reportedly allows multiple users to simultaneously read data in the database while preventing them from updating the same data at the same time through special locking features.

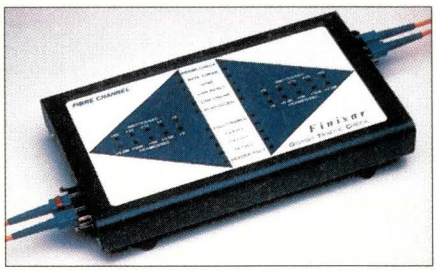
ObjectStore PSE Pro 2.0, capable of managing a database of several hundred megabytes, is composed of portable Java class libraries that are automatically deployed with a Java component's classes. It works by retrieving related objects through navigating relationships stored in the database. This provides significant performance gains compared with traditional database management systems, which require added code to translate between Java objects and relational tables, Object Design says. PSE Pro 2.0 runs on Solaris and Windows NT and costs $245 per developer license and $95 per end-user license.

Object Design Inc.
25 Mall Road
Burlington, MA 01803
http://www.odi.com
Circle 105

Link Status, Performance Monitor

Having problems with a Fibre Channel or Gigabit Ethernet link? Then Gigabit Traffic Check (GT-C) from Finisar might be just what you're looking for.

According to Finisar, GT-C continuously monitors a user's communications link and displays a wide range of status parameters, error conditions and performance measures via a multicolor LED display. It measures hardware parameters, such as power and synchronization, and monitors links for various protocol-level conditions, such as link online and link in a reset condition, plus data and frame errors. The LED display is updated 30 times per second with concurrent information from the counters.

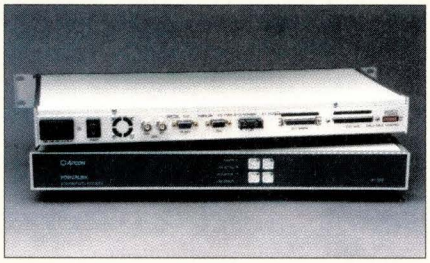


GT-C can be connected to either copper or optical links using industry standard GigaBit Interface Converter modules (GBIC). For Fibre Channel, a GT-C-01 with copper GBIC interfaces costs $1,500; and for Gigabit Ethernet, a GT-C-21 with copper GBIC interfaces costs $1,600.

Finisar Corp.
274 Ferguson Drive
Mountain View, CA 94043
http://www.finisar.com
Circle 106

SCSI Bus Extender Out

The PowerLink Ultra Wide SCSI Bus Extender from Apcon is said to enable users to locate remote RAID arrays, tape libraries, optical jukeboxes and CD-ROM towers up to 10km from the host computer. Apcon says PowerLink is often used in disaster recovery applications requiring remote access of high-speed tape libraries and server-clustering solutions where the servers are located in different MIS centers.



The product supports Ultra Wide, Single-Ended or Differential SCSI devices and supports data rates of up to 40 MB/s. PowerLink is available in 500m, 2km and 10km versions, each supporting 62.5-, 50- and 8-micron fiber-optic cable, respectively. PowerLink also includes a Fibre Channel-compatible coaxial cable interface for extensions up to 30m and a high-performance coaxial cable interface for distances up to 200m.

The PowerLink Model ACI-2030-CSW, single-ended version costs $3,995, and the Model ACI-2030-CDW, differential version, costs $4,495.

Apcon Inc.
17938 S.W. Boones Ferry Road
Portland, OR 97224
http://www.apcon.com
Circle 107

Upgrades, Enhancements, Additions...

■ Backup Express 2.0 from SyncSort runs in UNIX, Windows NT and NetWare environments. This latest version includes an easy-to-use, drag-and-drop GUI, which is said to allow users to distribute backup devices across the network while retaining centralized administrative control–users can now monitor backup jobs via network management tools such as Hewlett-Packard Co.'s OpenView. Other features include an enhanced import/export capability, which allows users to import or export either one tape at a time or multiple tapes simultaneously via a simple drag-and-drop operation, and an updated Operator Console, which provides real-time backup and restore job information, the company says. Backup Express 2.0 has been certified as a Database Backup Solution for the SAP America Inc. Complementary Software Program (CSP), ensuring seamless integration with SAP's R/3 Enterprise Resource Planning Solutions. In addition, users can now perform online backups of Microsoft Corp. Exchange Servers for Windows NT through the Microsoft Exchange API. Pricing is based on the number and type of servers, clients and backup devices. **SyncSort Inc.**, 50 Tice Blvd., Woodcliff Lake, NJ 07675, *http://www.syncsort.com*. **Circle 108**

■ Digital Equipment has announced AltaVista Firewall 98, the latest version of its Internet security software for UNIX and Windows NT platforms. Firewall 98 supports isolated local-area networks (LANs) where companies can place servers for applications such as customer support or business-to-business commerce. Its GUI reportedly enables systems administrators to easily set security policies with separate rules for the isolated LAN and the corporate intranet. It can also integrate third-party products into a company's overall security environment through the addition of Content Vectoring Protocol (CVP) support. Firewall 98 provides a combination of Domain Name System (DNS) servers and a DNS proxy on the firewall server so administrators can create DNS proxy rules and avoid having queries pass through the firewall, DEC says. AltaVista Firewall 98 is priced at $2,495, $3,995, $7,995 and $14,995 for 25, 50, 200 and an unlimited number of nodes, respectively. It runs on Windows NT (Intel and Alpha) or Digital UNIX (Alpha). **Digital Equipment Corp.**, 146 Main St., Maynard, MA 01754, *http://www.dec.com*. **Circle 109**

■ Version 3.0 of OmniEnterprise is now available from Praxis International. This latest version of the data movement software offers several new capabilities focused on exchanging information within heterogeneous database environments. Specifically, it includes features for table mapping design to facilitate data movement among different databases and schema, such as add column concatenation, column splitting, primary key enhancement and the ability to derive new columns on the target database. Praxis has also announced enhanced process monitoring functionality, which allows active polling of all nodes for up-to-the-minute process status. In addition, visual status indication and automatic alert notification via email for remote administration is available, the company says. Pricing for OmniEnterprise 3.0 starts at $2,500. It supports several databases running on Solaris and SunOS, as well as AIX, HP-UX, MVS on mainframes and Windows NT. **Praxis International Inc.**, 245 Winter St., Waltham, MA 02154, *http://www.praxisint.com*. **Circle 110**

■ WRQ's Reflection X Version 7 comprises several new features, most notably Reflection Hands-Free Administration toolkit, a set of tools to aid IS managers in the deployment and configuration of NT/UNIX systems. The Hands-Free Administration toolkit features Reflection Deploy, a new standard for deploying and launching applications from a Web page via the company intranet, and Reflection X Profiler, a tool for centralized, remote configuration of user access to information on UNIX systems. This latest version supports Broadway, the X11R6.3 protocol, which enables integration of X applications with the Web. Reflection X 7 includes a PC X server, integrated VT emulator, an FTP client and diagnostic tools. It costs $400 for a single-user license. **WRQ Inc.**, 1500 Dexter Ave. N., Seattle, WA 98109, *http://www.wrq.com*. **Circle 111**

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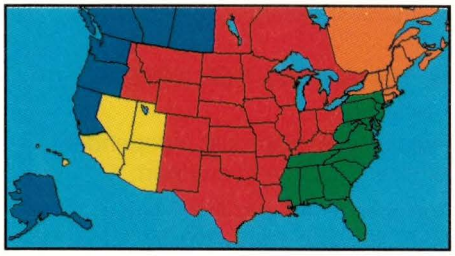

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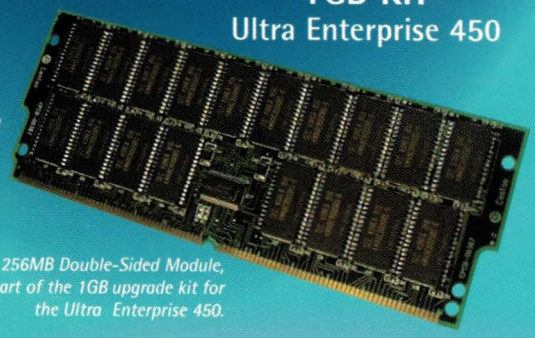
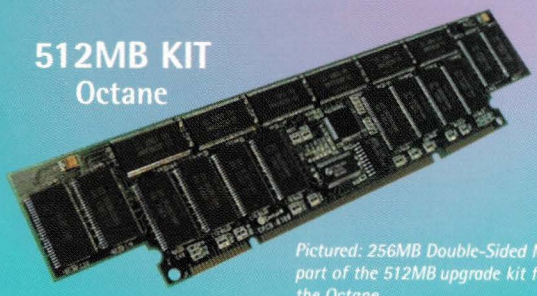


Pictured: 256MB Double-Sided Module, part of the 1GB upgrade kit for the Ultra Enterprise 450.

512MB KIT
Octane



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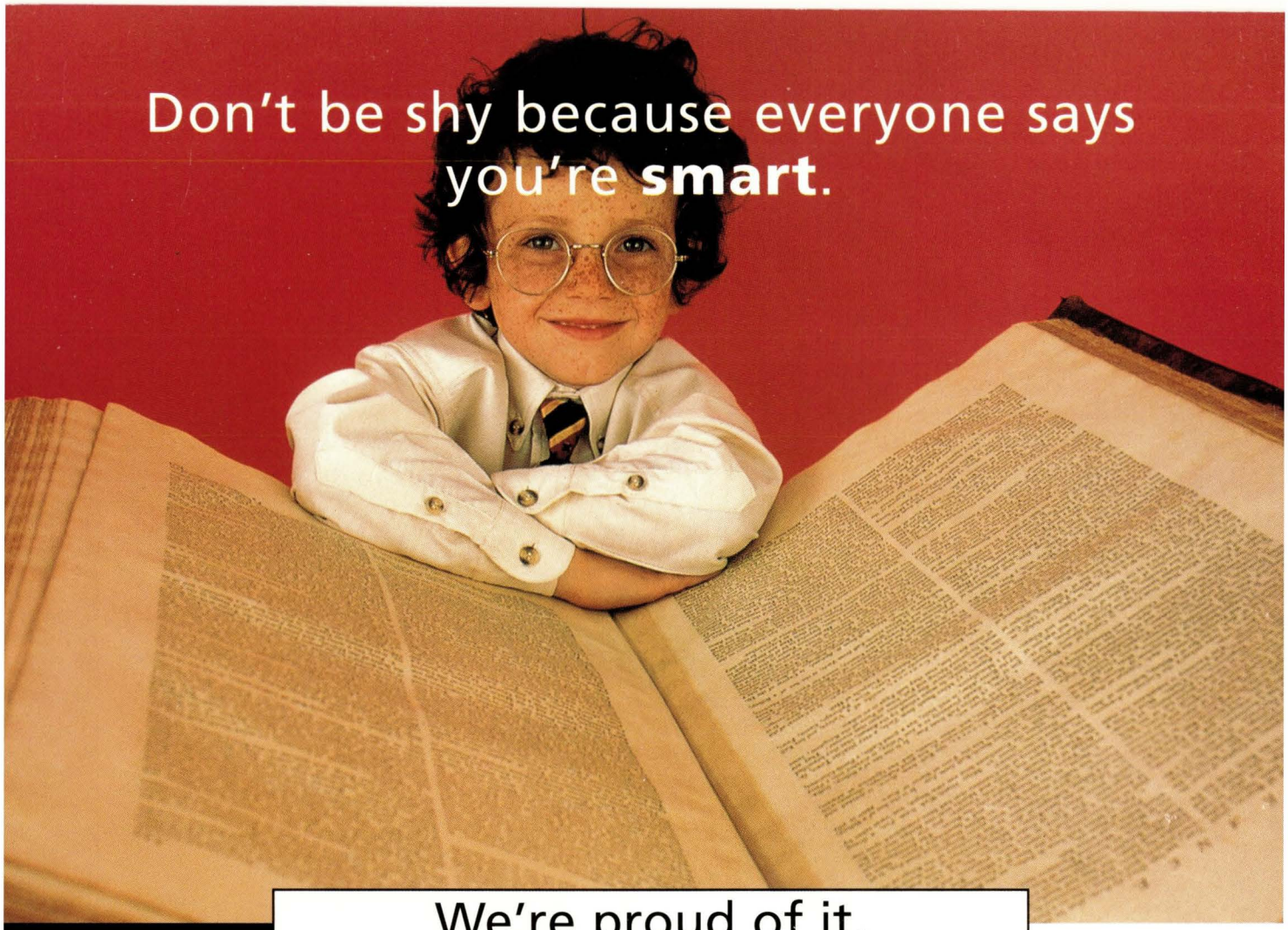

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