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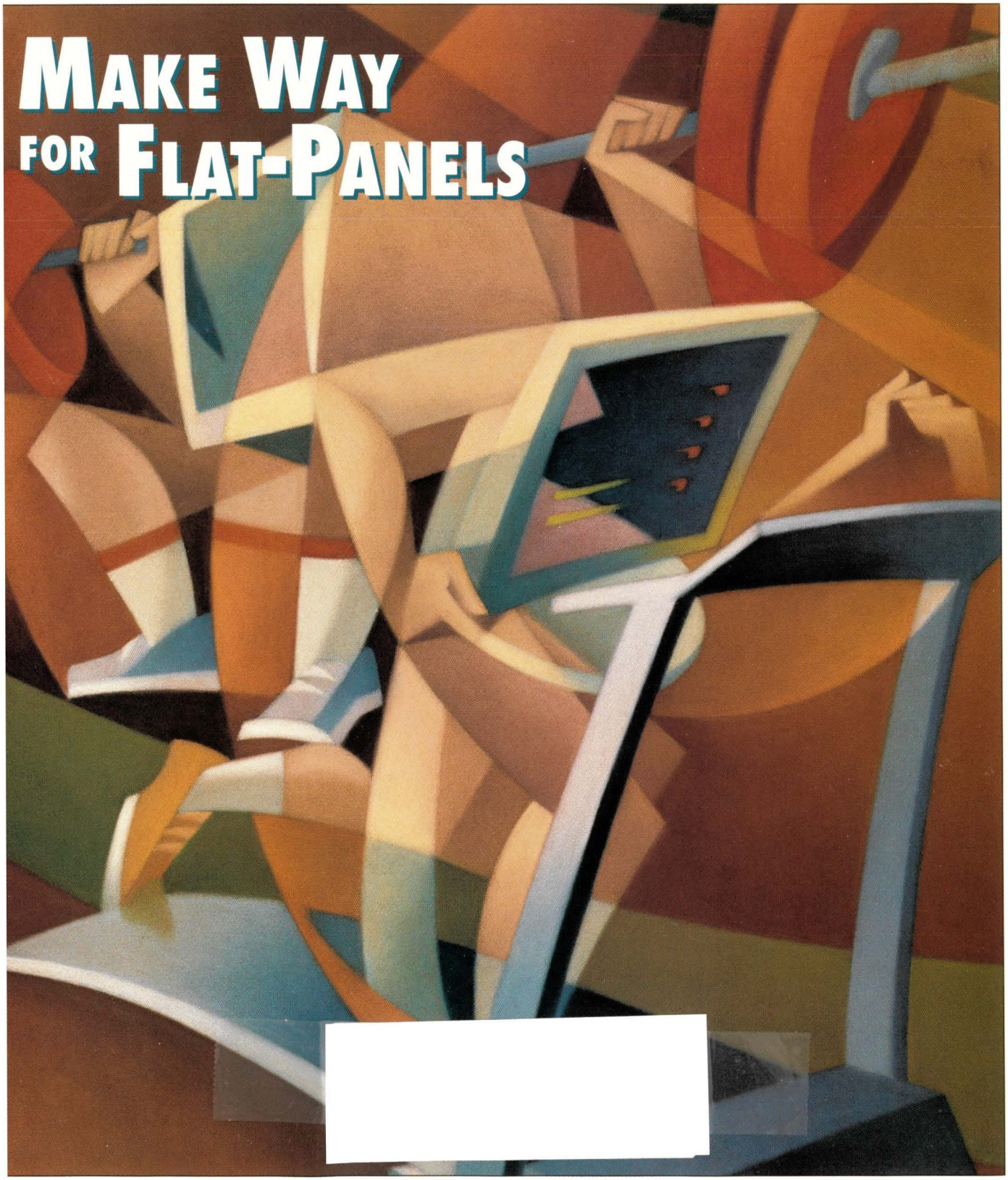

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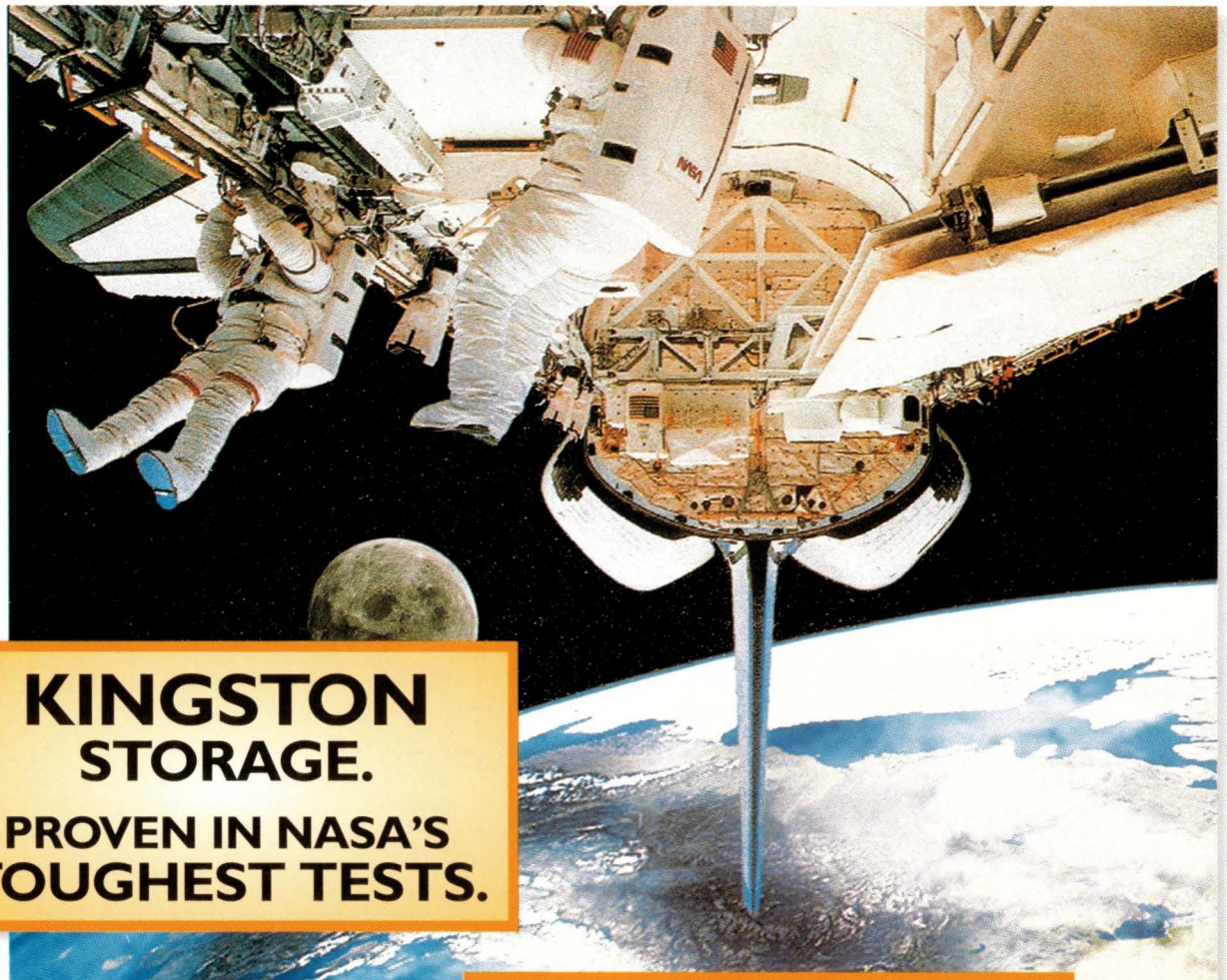

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by Mark Petrie, Staff Editor

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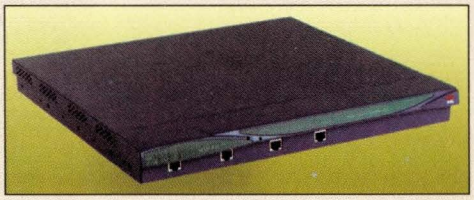
67 VPNs: Build or Buy?

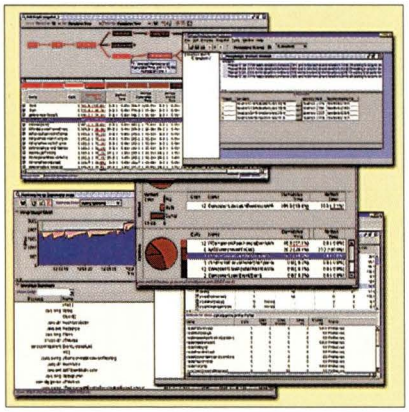
by Suzanne Hildreth, Staff Editor

A virtual private network (VPN) can be an effective way to reduce your company's remote access and LAN-to-LAN connection costs. But assembling your own VPN takes time and, usually, a substantial investment in equipment. With Y2K projects demanding priority, should you spend precious time and money building and maintaining your own VPN, or risk outsourcing the project to a VPN service provider?



72 URL/New Products

New products, services and resources for the World Wide Web market.



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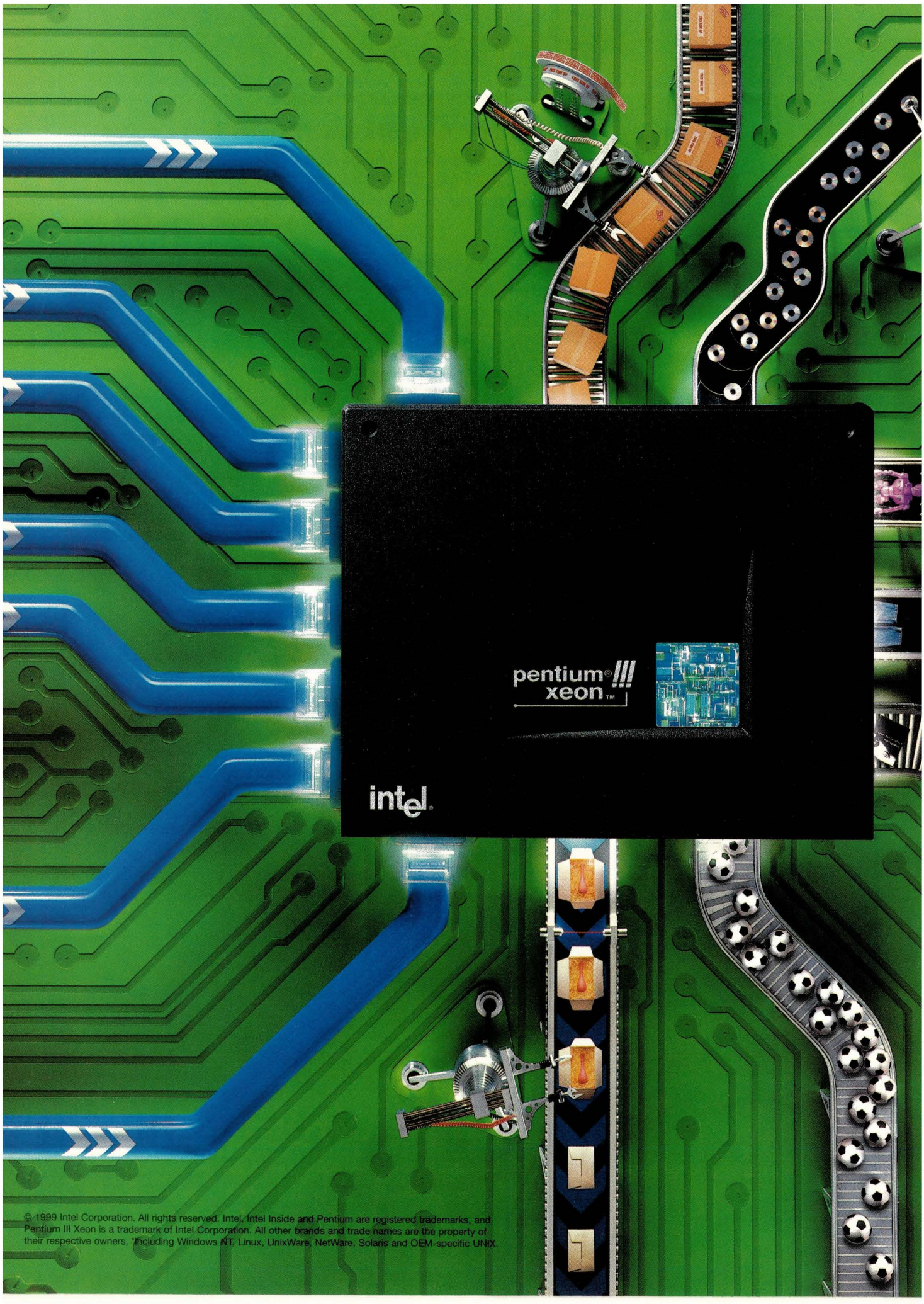

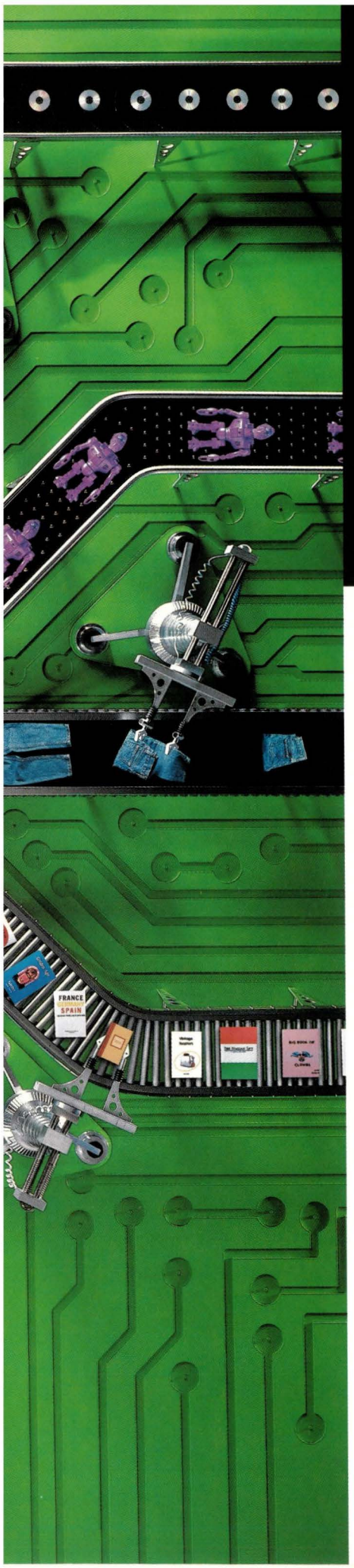

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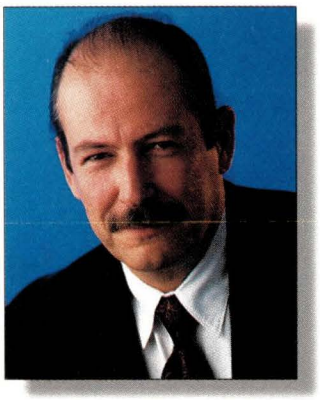

Y2K, W2K and Displays

I don't know about you, but there have been three things nagging me recently about my computer systems. Two I have no control over–the Y2K problem throughout the world and the W2K problem to come for many of us before 2005 perhaps. The W2K–that is, the Windows 2000 bug–may have even broader implications than keeping track of dates in billions of lines of code. But these two are out of my hands. As they say, "Grant me the wisdom...."

The other problem I can do something about, but it'll cost me; but not as much as it would have just one year ago. As my eyes weaken with age–and overwork, but that's another issue–I find myself looking for either bigger or better displays. Fortunately for me, frequent contributor Alexandra Barrett explores this very subject in this month's cover story, "Make Way for Flat-Panel Monitors," Page 50. Surely, most of us can use more desk space. That's a no-brainer benefit of these sleek, thin windows into our systems. According to Stanford Resources Inc., San Jose, CA, a market research firm specializing in displays, in 1998, LCD flat-panel monitors glowed in only 1% of the total desktop monitor market. Stanford expects that number to reach 2.1% this year. Monitor manufacturers are gearing up for a rapid expansion in the LCD market. "Flat-panels are the future of monitors," says Jeff Geis, marketing manager at Samsung Information Systems America Inc., San Jose, CA. Currently, only 5% of Samsung's total monitor sales can be attributed to flat-panel LCDs, but according to Geis, he wouldn't be surprised to find 25% to 30% of monitor sales to come from LCDs in the next five to six years.

It seems the traditional barriers to flats are coming down, but one that's been a high hurdle is image quality. There too, manufacturers are making great strides. Alex finds that the latest generation of flat-panel displays boast competitive resolutions. For example, the 20.1-inch MultiSync LCD2010 from NEC Technologies Inc. has a maximum resolution of 1,280 by 1,024, while the 17.3-inch 1600SW flat-panel monitor from SGI features a whopping 1,600-by-1,024 resolution. If you're looking for a space saver with muscle, you'll want to take a look at Alex's article.

Many of these displays will be showing off the W2K problem. Be prepared.

Doug Pryor

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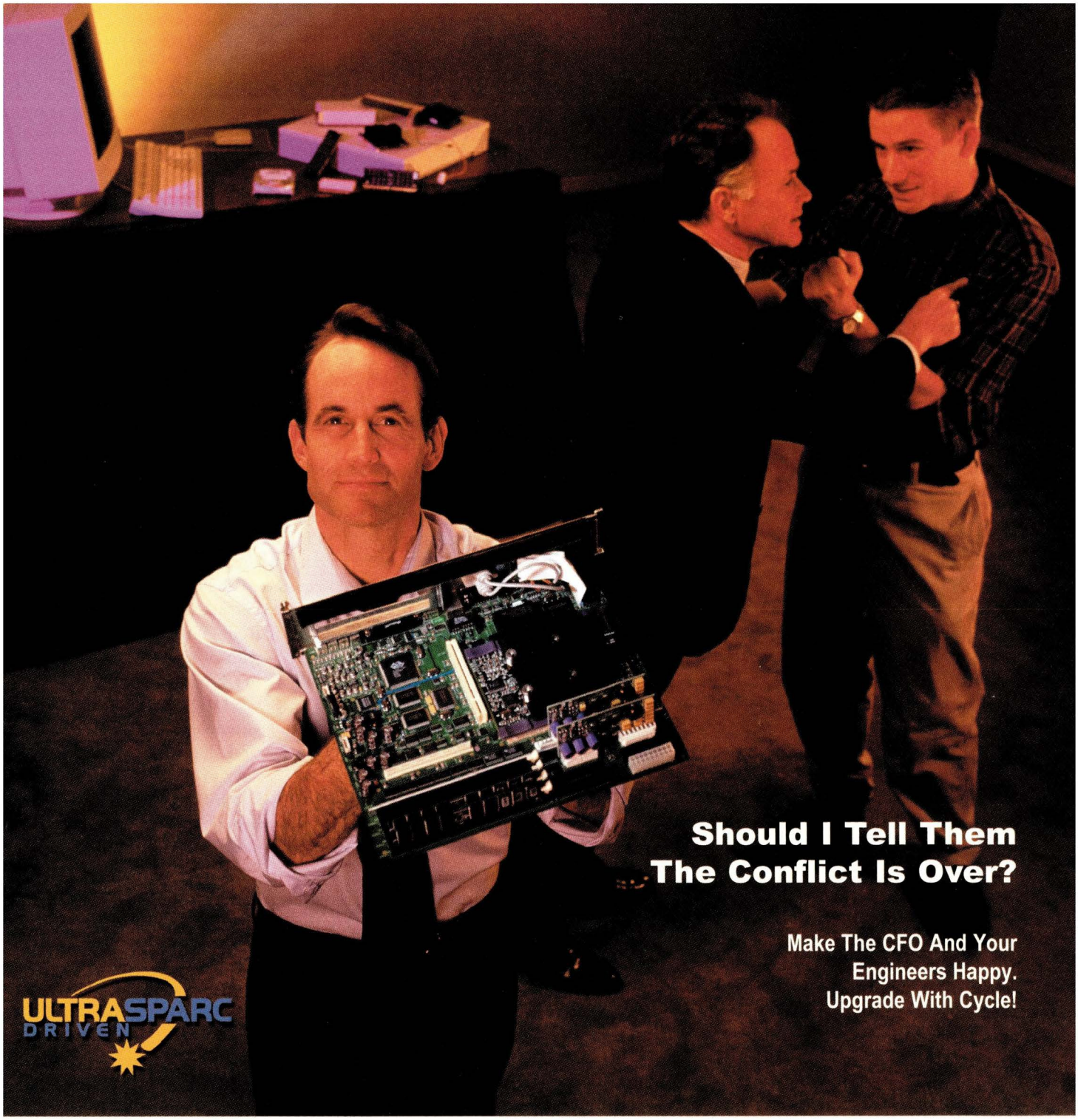

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Circle No. 3

Linux Systems Flourish

The two leading vendors of commercial Linux packages have both released new versions of the increasingly popular open-source operating system. Red Hat Software Inc., Durham, NC, has released Official Red Hat Linux 6.0, while Caldera Systems Inc., Orem, UT, has begun shipping OpenLinux 2.2.

These latest versions of Linux were released in April, less than three weeks after International Data Corp. (IDC), a Framingham, MA-based market research firm, predicted commercial Linux shipments would flourish over the next four years. In a March bulletin entitled, "Linux Operating System Market Overview," IDC estimated commercial shipments of Linux server operating environments will increase at a compound annual growth rate of 25% from 1999 to 2003. Furthermore, IDC predicts this growth will be significantly more than all other operating environments combined. "That's the server side," says Dan Kusnetzky, program director of operating environments and serverware research programs at IDC. "We don't think the client side is going to grow that rapidly."

IDC says there are a number of factors driving Linux growth as a server operating system. Kusnetzky cites low price tags for commercial Linux packages–Official Red Hat Linux 6.0, for example, can be purchased for as little as $39–and the operating system's free availability off the Web. Also, the skills required to manage Linux are similar to those required by UNIX, which allows organizations to leverage employee skills already in place.

Moreover, Linux hardware is inexpensive. Linux can run on old 386, 486 and other dated Intel Corp. Pentium systems. In fact, Linux can revitalize old, unused hardware. "Linux is a very small operating system that runs fairly effectively on those machines," Kusnetzky says.

The main limitation on client-side Linux growth comes down to the availability of applications. "Unless the most popular applications, which, of course, are all Windows-based, are available [on Linux], the growth of the platform is constrained to those developing their own software," Kusnetzky says, adding that a minority of Linux users are either satisfied with what little packaged software is currently available, or plan to run transactional environments that don't require the most popular applications.


ROBERT BURGER

Both Red Hat Linux 6.0 and OpenLinux 2.2 feature the Linux 2.2 kernel, support for GNU C Library 2.1 and come with StarOffice 5.0, a collection of word processing and spreadsheet applications from German firm Star Division GmbH. OpenLinux also comes with the Caldera Open Administration System (COAS), which provides a graphical administration interface for the existing Linux administration architecture.

In addition, OpenLinux offers a point-and-click graphical installation process. "We've made using Linux much easier, in both the install and documentation," says Ransom Love, president and chief executive officer at Caldera.

Red Had Linux 6.0 adds symmetrical multiprocessing (SMP) support for up to four processors. With its open-source code, the Red Hat version allows users to customize the system to meet individual needs. Like OpenLinux, Red Hat Linux 6.0 comes with two new GUIs, K Desktop Environment (KDE) and GNU Object Modeling Environment (Gnome). In addition, Red Hat is offering 30 days of unlimited telephone support for customers who install Version 6.0. Linux is available for Intel, Alpha and SPARC platforms.

An indication of the strength of interest in Linux is the long list of Red Hat Software investors. Currently, Compaq Computer Corp., Dell Computer Corp., IBM Corp., Intel, Novell Inc. and Oracle Corp. have a financial investment in the company. Red Hat says this helps promote the operating system. "The support of such a stellar group of leaders creates even more momentum for the open-source software movement and for Linux as a powerful, reliable, cost-effective and safe choice for any computer environment," said Robert Young, Red Hat Chief Executive Officer, in a statement released on March 9 announcing the addition of IBM, Novell and Oracle to the list of equity investors.

However, IDC's Kusnetzky sees it a little differently. "I think their investments are really more of an attempt to

control essentially an uncontrollable environment," he says. "It is a community developing this software and they can't invest everywhere. The one thing they can do is pick one member of the community and fund them to make sure that the software runs well on their platform."–*ptc*

Ubiquitous UNIX

Could software for UNIX-based Intel Corp. machines soon become as ubiquitous as software for Windows-based PCs?

That's one of the goals of a project led by IBM Corp. and supported by a number of UNIX operating system and software vendors, including Compaq Computer Corp., Hewlett-Packard Co., Intel, Oracle Corp., PeopleSoft Inc., The Santa Cruz Operation Inc. (SCO) and Sequent Computer Systems Inc. The goal is to create a set of guidelines for UNIX development on Intel. The guidelines will include a comprehensive set of APIs and services, as well as a single application binary interface (ABI) to ensure that a program compiled for one version of UNIX on Intel will run on another.

The creation of a uniform ABI, in particular, will help guarantee portability of UNIX applications from one UNIX operating environment to another. "When I go into CompUSA [a retail computer chain], I see a hundred different applications for Windows and Windows NT. The reason that's possible is because there's an application binary interface for Windows. An ABI for UNIX on Merced [Intel's long-awaited 64-bit chip] will enable that kind of volume market for that chip set," says Mike Lambert, chief technical officer for The Open Group, Menlo Park, CA, which has worked with IBM to coordinate the project and will review and publish the guidelines when completed.

The guidelines will include a single application binary interface (ABI) to ensure that a program compiled for one version of UNIX on Intel will run on another.

"If you really want to create a high-volume shrink-wrapped UNIX platform for Intel, you need to reduce the cost and complexity for ISVs [independent software vendors]," adds Rajiv Samant, general manager of UNIX for IBM's server group. "To do that, you need standardization of the application programming interface, as well as the application binary interface, which is tied to the Intel instruction set," he says.

The guidelines would go beyond the existing Single UNIX Specification maintained by The Open Group and supported by most UNIX vendors. "The Single UNIX Specification is a platform-neutral definition of operating system interfaces," says Lambert. "It was always intended to cover not just one chip, but any chip in the industry. This builds on that from two directions. First, it adds guidance for implementing UNIX on a specific chip with a specific

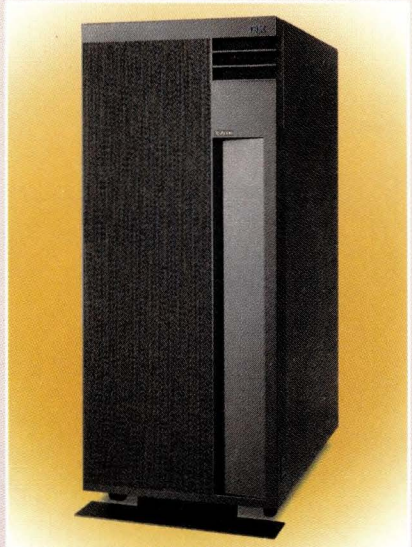
Compaq, IBM Offer Cluster Servers

Compaq Computer Corp. and IBM Corp. both announced new clustering products in April. Compaq announced TruCluster Server Version 5.0, which it intends to release by the end of the summer, while IBM unveiled HA-H70 Cluster Server, which features Big Blue's latest RS/6000.

Compaq's TruCluster Server 5.0 software is designed to provide a uniform shared root file system. Through a single system view of the entire cluster, TruCluster Server is said to simplify tasks such as application installation and the execution of file-based management operations, as well as ease the process of adding disks. Pricing for TruCluster Server 5.0 will start at around $5,000.

IBM's HA-H70 Cluster Server is a hardware/software bundle. It features the recently introduced RS/6000 Model H70, which is a 64-bit one- to four-way symmetrical multiprocessing (SMP) enterprise server. The HA-H70 comes with two H70 Enterprise Servers, the 7133 Serial Disk System and IBM's High-Availability Cluster Multiprocessor (HACMP) software for AIX.

Prior to the release of the HA-H70, IBM offered the HA50, a similar bundle based on the RS/6000 Model H50–the predecessor to the H70. "We changed the naming convention a little bit," says Mike Maas, manager of enterprise products for the IBM RS/6000. "The H50 to H70 is a 70% improvement in transaction processing power."



IBM's new HA-H70 Cluster Server features the newly released 64-bit RS/6000 Model H70 (above).

The H70 Enterprise Server can run 32- and 64-bit applications concurrently or independently, without rebooting the system, IBM says. The H70 offers a faster input/output subsystem, plus integrated 10/100BaseT Ethernet, Ultra SCSI and up to 8 GB of SDRAM memory. It costs $26,900 (the price of the H50 will be reduced from $26,900 to $22,000). The HA-H70 Cluster Server is offered at a starting price of $56,900.

In addition to the new clustering software, Compaq announced the AlphaServer ES40, which is powered by up to four 500-MHz Alpha 21264 chips. The new box can run either Tru64 (formerly Digital UNIX), Open VMS, Windows NT or Linux. It scales up to 1 TB of internal storage, has input/output expansion for up to 10 64-bit PCI bus slots and costs $23,900.–*ptc*

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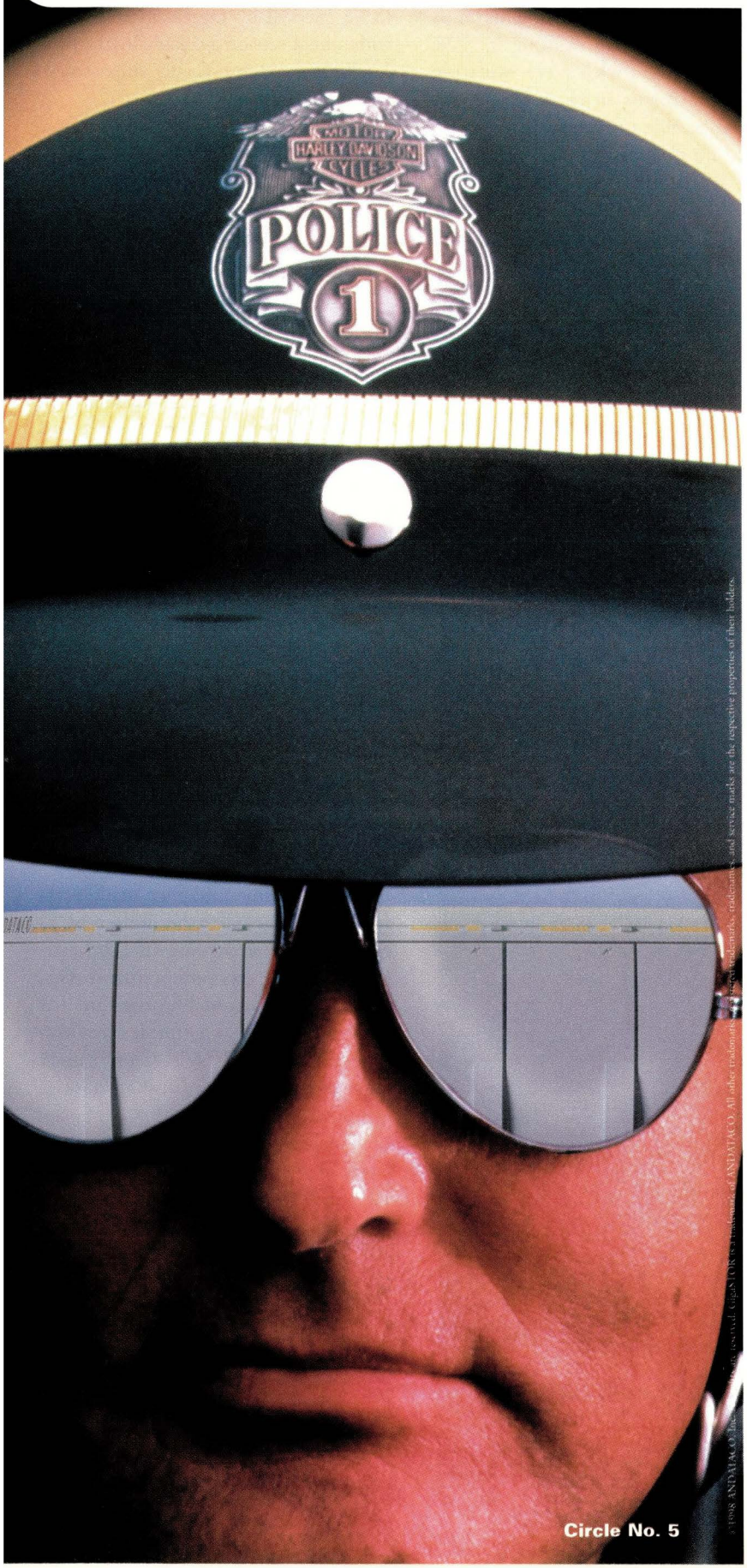

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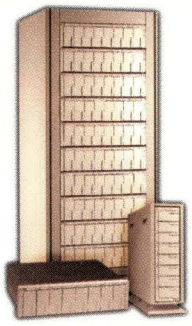

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architecture and a specific set of data structures. And it also builds on UNIX to define a much more complete environment." Lambert says the guidelines will not only include operating system interfaces but also APIs for things such as network management, security, communications and directory services.

Tim Yeaton, vice president and general manager of Compaq's UNIX software division, says the impetus for UNIX operating system vendors to support a set of standard guidelines is the heterogeneous environments most UNIX customers are working in. "We have customers who have multiple UNIX platforms in their shops and want to be able to run the same applications on our platform, as well as the others. Portability is just generally good for customers and for the vendors that want to satisfy those customers."

Version 0.9 of the guidelines is slated to be released by fourth-quarter 1999, with a final version available by the time Intel's Merced chip finally ships–sometime mid-2000.–*sjh*

Surf's Up in the Midrange Market

The market for midrange servers is making headway thanks to several new trends in corporate server purchasing. The move toward server consolidation–in which small department servers are consolidated into larger ones–and an increase in demand for Internet and electronic commerce-related servers are both helping to boost sales of midrange servers, according to a new report published by International Data Corp. (IDC), Framingham, MA.

The report, "1998 Midrange Server Year in Review," found that growth in sales revenue for midrange servers–those priced between $100,000 and $1 million–was a healthy 4.4% in 1998. That's better than the 2% growth rate midrange server vendors experienced in 1997, and considerably better than the performance of the entry-level and high-end server markets, both of which saw a decline in revenue last year.

Growth in the midrange market was actually predicted to be higher–by as much as 8%, according to IDC estimates–but the economic crisis in Asia, and an unexpected low turnout for small players like SGI (formerly Silicon Graphics Inc.) and NCR Corp. caused the market's growth to fall short of original predictions.

"Smaller players lost substantially in terms of market share, and the leaders are running away with the market," says Lloyd Cohen, research director for IDC's commercial systems and servers group. Those leaders include IBM Corp., which has a 26% share of midrange server revenue, Hewlett-Packard Co., which holds 23% of the market, and Sun Microsystems Inc. with 13%–a 28% increase over Sun's midrange server revenue in 1997.

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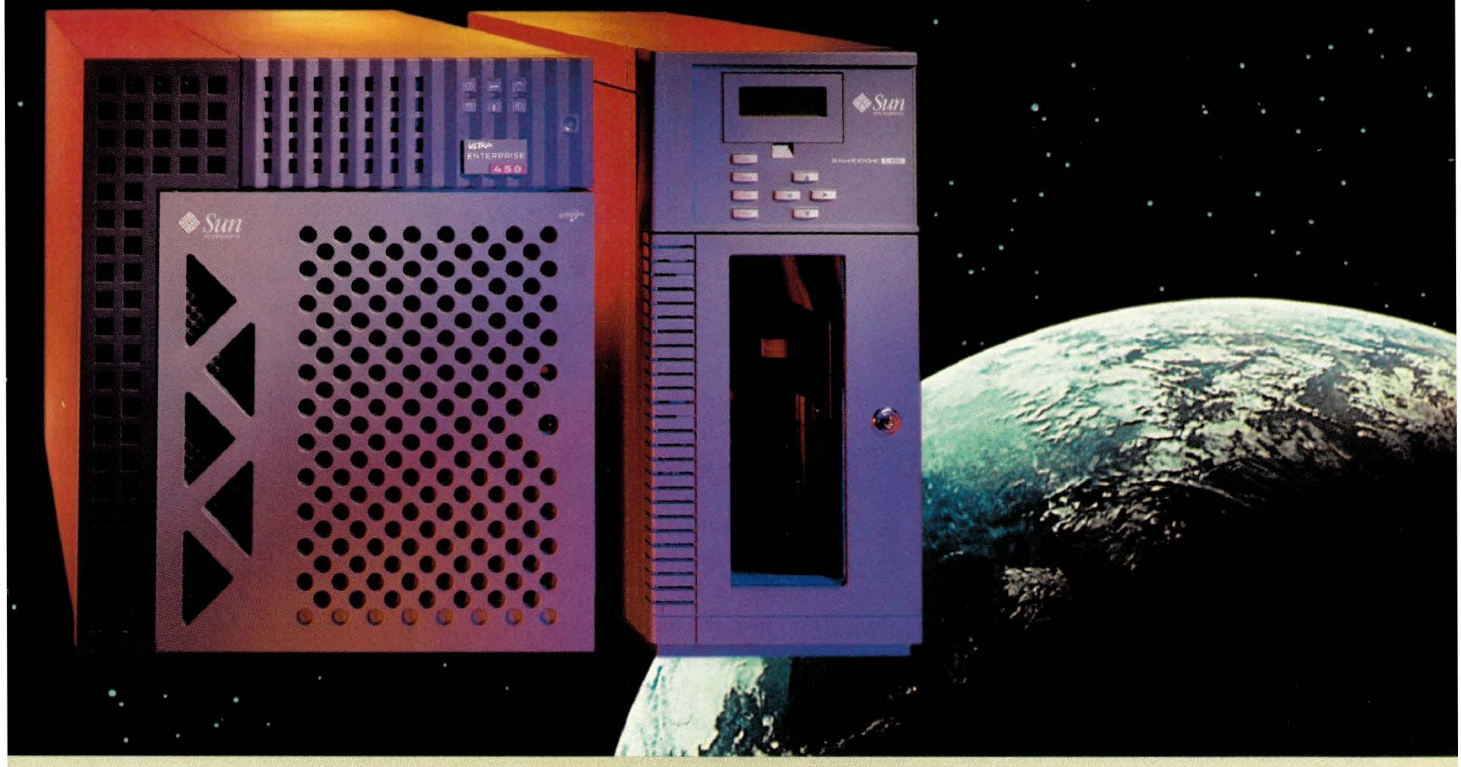

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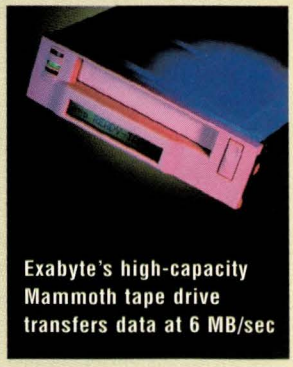

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having a positive impact on the midrange market. According to IDC Senior Analyst Michelle Bailey, the proliferation of servers for Internet and e-commerce services is boosting sales of both entry-level and midrange servers, and is expected to continue to do so. The effect on the midrange market will be greater, Bailey says, as Internet service providers (ISPs) and companies look to upgrade and consolidate servers to handle larger loads.

ROBERT BURGER

This will particularly benefit Sun, which has been targeting ISPs and other Internet markets for the past several years. "Sun is very, very strong with the ISP community. They have a lot of mindshare and market share there. So they have a hold on a very influential piece of the server market," Bailey says.

Another key phenomenon helping to bolster demand for the midrange server, says Bailey, is the move by many IT departments to consolidate their many smaller servers into larger, more centrally managed ones. "We've had the trend toward distributed computing, where servers were installed in every line of business or department. Now, we've reached a kind of critical mass, where the management of all these servers has become astronomical," says Bailey. "A lot of organizations want to put the breaks on that kind of spending and pull it all into a more centralized organization."

Server consolidation tends to favor larger vendors, such as HP and IBM, which can provide services to assist customers in their consolidation efforts. For instance, HP announced a new server consolidation program in March. Dubbed HP 9000 HyperPlex, the hardware/software/services package combines HP 9000 HP-UX servers with server consolidation consulting services, a free total-cost-of-ownership (TCO) analysis and new HP 9000 system-management products.

"HP is very good at pulling together a complete solution for the client, from soup to nuts, and this is another example of that," says Bill Moran, research director with D.H. Brown & Associates Inc., Port Chester, NY.

An all-in-one approach to server sales, such as the one promoted by HP, is likely to be very popular among busy IT managers, says Jonathan Eunice, analyst with Illuminata Inc., an IT consulting firm based in Nashua, NH. "It's a very appealing theme because people don't want to be their own systems engineers anymore. People are so pressed to get the latest ERP [enterprise resource planning] application, the latest business app, or whatever, up and running.... Customers want to find someone who will just do the driving for them," Eunice says.

Although IDC expects trends such as server consolidation and e-commerce to continue to drive the midrange market, overall server sales are expected to ebb somewhat in the second half of 1999 as companies shift even more of their budgets toward finishing up Y2K software projects. "There'll be a real rush to try to fix that," IDC's Bailey says. "As a whole, we expect to see a slight downturn at the end of the year."–*sjh*

Sun-Netscape Alliance Explained

Details of the deal between industry heavyweights Sun Microsystems Inc. and America Online Inc. (AOL) were finally released on March 30. Sun and the newly merged AOL/Netscape Communications Corp. will form an alliance that focuses on delivering electronic commerce products. The collective effort will be called the Sun-Netscape Alliance and will report to a board made up of AOL and Sun executives.

The Sun-Netscape Alliance will be headed by president and general manager Mark Tolliver, and will operate as an independent software company with approximately 2,000 employees drawn equally from Sun and Netscape. It will be responsible for merging existing technologies from all three companies.

News of the deal was first reported in November, when AOL declared its intention to acquire Netscape, but specific details of how the three companies would operate were kept quiet until the merger was finalized in March.

Sun President and Chief Operating Officer Ed Zander says the goals of the alliance are to become the world's leading e-commerce software and infrastructure company, to develop products for multiple platforms and vendors, and to establish itself as the preeminent software company for the Internet economy. "I think versus IBM, the kinds of product [and] breadth of products that we have, can establish [us] as a leading player," Zander says. He also believes Sun's attention to scalability and robust products will make Sun-Netscape Alliance a formidable challenger to Microsoft Corp.

Industry analysts say the alliance has the potential to accomplish these goals. "This is going to be a successful effort for them," says Martin Marshall, director of Internet server/application development services at Zona Research Inc., a research firm based in Redwood City, CA. "They certainly have a number of energetic components and have a very good tale to tell. And it is a tale that goes down very well with people already using Sun hardware to run their Internet stuff. Would I want to bet against Sun in this environment? No."

In terms of actual products, the alliance will offer new versions of Netscape Messaging Server 4.1 and Sun Internet Mail Server 4.0 in the form of a melded product. There are also plans to merge the calendaring servers from Sun and Netscape into a single program. Both of these "combined" prod-

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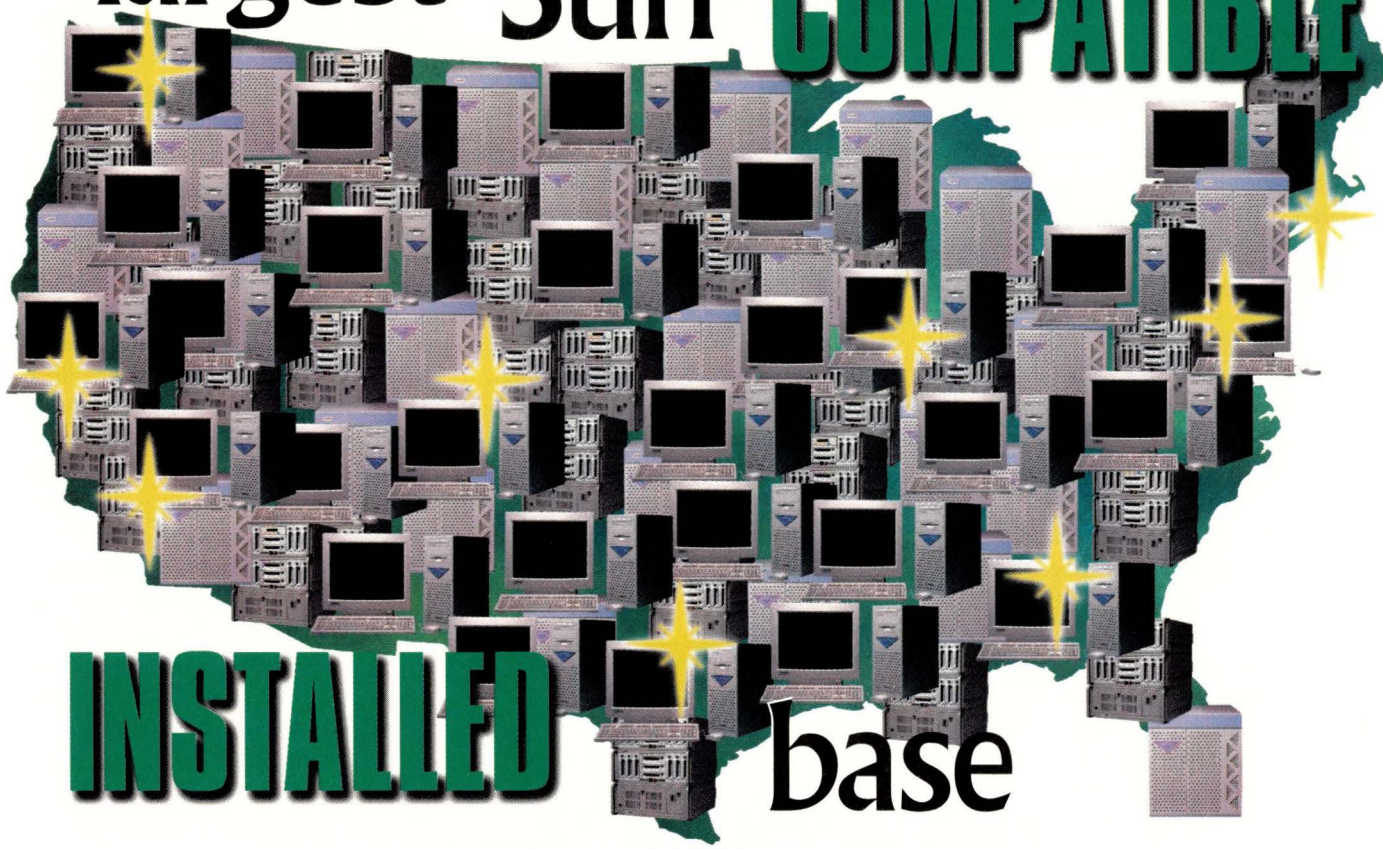

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ucts are scheduled to be available first-quarter 2000.

In addition, a new version of Netscape Application Server will be released later this year. This is a competing product to Sun's NetDynamics 5 application server, which was released in March. The alliance plans to deliver a jointly developed application server by early next year based on preferred technology from each. A directory, security and management server will also be offered through the alliance based on Netscape's Lightweight Directory Access Protocol (LDAP) directory server, which will be strengthened by Sun's Network Information Server (NIS) and NIS+ technology. And Netscape Communicator will continue to be based on Mozilla, the browser's open-source development.

AOL has nearly 17 million members and currently supports more than one million concurrent users during "prime-time" hours. Netscape brings a broad range of enterprise middleware and Internet products, as well as Netcenter, the company's popular portal. And Sun brings Java and its systems infrastructure to the alliance. Together, Sun and AOL/Netscape hope to provide the necessary parts for developing e-commerce systems, as well as drive potential customers to merchant sites. "We have to bring these three companies together to tackle the problem of bringing [e-commerce] to the next level," says Barry Ariko, senior vice president for AOL.

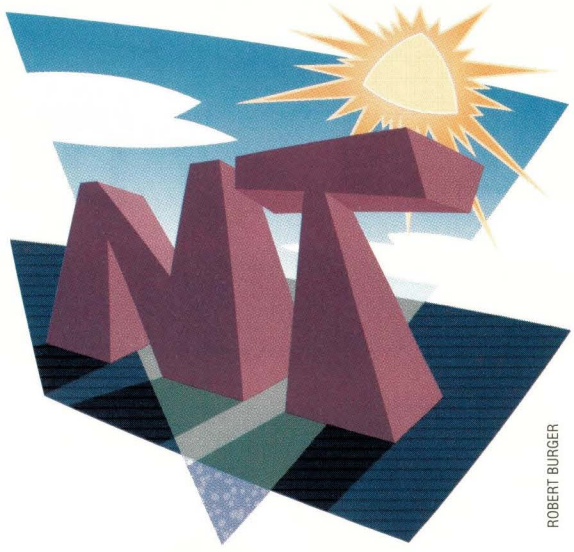
In order to bring it to this next level, the alliance will offer a "silicon-to-eyeballs solution," Ariko says. Collectively, the companies will provide applications and tools to build e-commerce sites, the infrastructure to reliably handle Internet business and a very large consumer base. "The final part of the equation is really the audience," he says. "The entire equation is being driven by the fact that people are going online to do e-commerce to buy products."

To further articulate their plans, Sun and AOL representatives went on the road starting last month and continuing through June, for a series of briefings called "Get the .Com Advantage." To register to attend a briefing, go to `http://sun.com/advantage`.–*ptc*

Sun Shines on NT

In a twist of Microsoft Corp.'s "embrace and extend" strategy of dealing with competing technologies, Sun Microsystems Inc. is opting to embrace some aspects of the Windows NT operating system and extend support for the competing operating system to its Solaris platform.

In April, Sun made several NT-related announcements, including additional NT certification for its storage products, support for NT on its SunPCi card for running Windows applications on Sun workstations and the official release of PC NetLink, formerly known as Project Cascade, for putting some NT services on Solaris servers.



ROBERT BURGER

PC NetLink, to be included for free on all Sun Enterprise Servers with one to eight CPUs–namely Sun Enterprise 5 through Sun Enterprise 3500–will enable Solaris servers to act as NT domain controllers in a network and to authenticate logons by Windows clients. The product, which is based on AT&T Corp.'s Advanced Server for UNIX and uses actual NT 4.0 source code licensed from Microsoft, will include Windows NT Directory Services (NTDS) and NT File System (NTFS), as well as the NT model for authenticating Windows clients.

"It demonstrates that Sun is not going to say 'no' to NT, but will accommodate it [the NT operating system and NT applications] on a network," says Greg Weiss, analyst with D.H. Brown & Associates Inc., Port Chester, NY.

With Sun servers able to handle many NT administrative tasks, customers will have less incentive to add more NT servers to their networks, says John Shoemaker, vice president of the enterprise desktop server systems group at Sun. "Customers will continue to have issues with the stability and reliability of NT. Our expertise lies in scalability, reliability and remote management," Shoemaker said at a press conference announcing PC NetLink's availability in April. "We're now extending those advantages to NT network services."

However, Microsoft's upcoming Windows 2000 operating system may prove to be a rather large fly in Sun's NT integration formula. That's because AT&T will not have the right to license NT 5.0, aka Windows 2000, from Microsoft. That will make it more difficult for Sun to support Windows 2000 when it's finally released, sometime toward the end of 1999 or early 2000.

Sun says that won't be a problem. Mark Canepa, vice president for workgroup servers at Sun, says most customers will be initially purchasing licenses to Windows 2000 to serve up new applications, but won't be ready to migrate authentication and directory services to Windows 2000 and its new Active Directory service until much later. "Even when Windows 2000 starts to ship, the primary application environment for that product will be as an application server," says Canepa. Also, he says, Active Directory's support for open standards such as Kerberos (an authentication system) and Lightweight Directory Access Protocol (LDAP) will make it easier for Sun to circumvent the Microsoft code by simply relying on open standards to handle many tasks.

But relying on open standards is more of a handicap than an advantage, according to Rob Enderle, analyst with Giga Information Group, Cambridge, MA. "The open standard will always be something less than what Microsoft will

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be deploying and compatibility will suffer as a result–you won't get full compatibility, but some subset of it."

D.H. Brown's Weiss agrees. "The fact that Sun has access to technologies such as Kerberos and LDAP will help them, but I don't think it's going to be a slam dunk," Weiss says. "Microsoft typically takes these technologies and modifies them. So there might be interoperability over the wire, but there'll probably be a different set of APIs to write to."

Weiss speculates that Sun might be able to take advantage of open source efforts involving Samba, a PC NetLink work-alike for UNIX operating systems, including Linux and Solaris. Samba will have the same trouble supporting Windows 2000 as will PC NetLink. "If [the Samba group] decides to try to reverse-engineer some of the Windows 2000 stuff, Sun could potentially take a draft off of that," Weiss says.

In addition to PC NetLink, Sun announced two other NT integration efforts. Sun's StorEdge A1000, A3500 and A5000 disk array storage products are now NT-certified, and customers can use them to store both NT and Solaris files. The certification means that Sun has passed Microsoft's test suites and appears on Microsoft's hardware compatibility lists. Previously, only the StorEdge A7000 storage server bore the Microsoft seal of approval. With this added NT support, Sun hopes to increase its revenue opportunities in the storage market, says Sun's Shoemaker. "The $20 billion storage market is projected to double in the next three to five years, and a good portion of that will go to support NT systems. Offering Microsoft-approved storage opens up a huge new market opportunity."

For workstation customers, Sun has also added NT support to its SunPCi card for running Windows applications on Ultra 5, 10, 30, 45 and 60 workstations. The card, which has been shipping with Windows 95 support since February, is essentially a motherboard with 64 to 256 MB of RAM and a 300-MHz Advanced Micro Devices K6-2 processor. It also boasts 24-bit graphics and a USB port. The $495 card makes it possible to not only run Windows applications, but also cut and paste between Windows and Solaris files and perform file sharing. "This gives customers 12,000+ applications on Solaris, as well as all of the PC productivity applications for Windows 95 and NT," says Craig Miller, senior product manager for PC interoperability at Sun.

Adding NT support to its SunPCI card will give users a cheap and space-saving alternative to installing a Windows PC alongside their Sun Ultra.

While the SunPCi card gives UNIX technical workstation users a convenient method for accessing everyday Windows office tools, it's not likely to tempt customers who want to run NT-based technical and graphics software, says Alexander Lloyd, marketing manager for SGI's workstation division. "You're not going to want to run those kinds of applications on an NT card," he says.

True enough. But it will give users of Sun's technical workstations a cheap and space-saving alternative to installing a Windows PC alongside their Sun Ultra. "These days, you really only need a $500 PC to run most of your business software, and there's not as much need to have the latest and greatest CPU. So it's less of a downside to having the PC stuck inside your workstation," says D.H. Brown's Weiss. "This $500 price is attractive, and now is exactly the right time for Sun to do this."–*sjh*

Sun's Spring Sale

Sun Microsystems Inc. has instituted a fresh round of price cuts and performance boosts for its Ultra workstations and graphics products. The additional discounts–following on the heels of similar price cuts and performance increases in November and January–are intended to encourage more workstation purchases by existing Sun customers, says Bob Mitton, product line manager for Sun's desktop systems group.

"Because of the aggressive pricing we have going now, we're seeing a lot more of our current customer base buying more [workstations] and spreading them out within the enterprise," Mitton says.

In May, Sun announced that its entry-level workstation, the Ultra 5, would ship with a faster, 360-MHz UltraSPARC-IIi chip and twice as much hard disk storage–8 GB instead of 4 GB. A base configuration with 64 MB of RAM now sells for $2,495. That compares favorably to the two previous versions of the Ultra 5: the Model 333, which had a base price of $3,695, and the Model 270, which started at $2,495.

The Ultra 10 workstation now has two new versions, Model 440, which ships with a 440-MHz UltraSPARC-IIi chip, Elite3D m3 graphics card and a base price of $6,195; and Model 333, which starts at $4,295 and sports a 333-MHz chip and 24-bit onboard graphics. The Model 333 used to sell for $4,995, and a previous version of the Ultra 10, the Model 360, was priced at $7,995. Also, for the first time, Ultra 10 customers can now add on Sun's Elite3D m6 graphics accelerator.

The Ultra 2 and Ultra 60 workstations are getting performance boosts as well. The dual-processor Ultra 2 will now be available with 400-MHz UltraSPARC II processors–a 33% speed boost over the old 300-MHz processor–and will be priced starting at $13,275 for a single-CPU system. The dual-processor Ultra 60 system will now feature a 450-MHz chip. It will start at $12,995 for a one-processor system. The base price for the 360-MHz Ultra 60 ($9,995) has not changed.

Sun has also dropped the prices on graphics boards. Sun's Creator3D graphics subsystem, which was originally priced at $1,195, will now sell for $795; the Elite3D m3 now sells for $1,995, down 41% from its former price of $3,395; and the Elite3D m6 now sells for $2,995, down 40% from its original $4,995 price tag.–*sjh*

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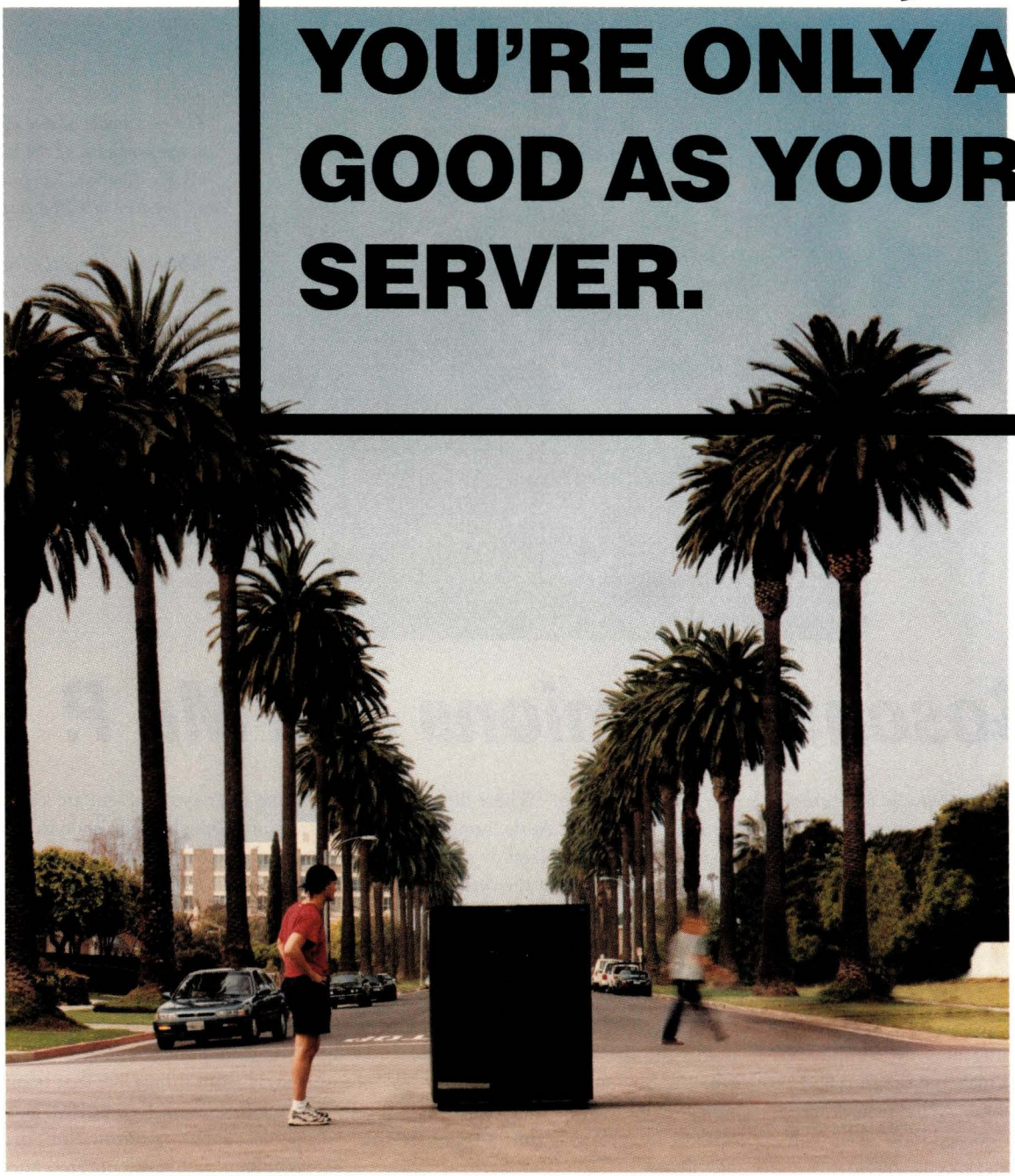

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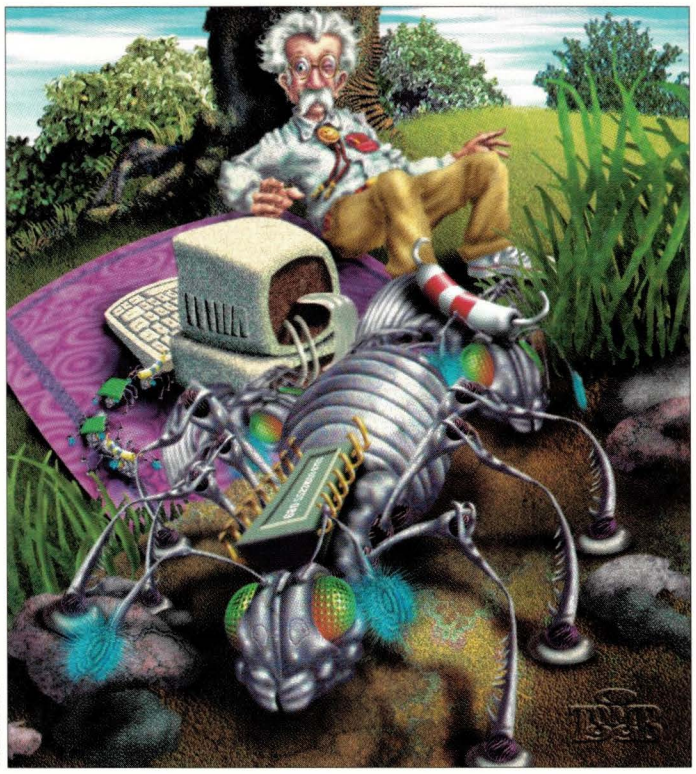
Ask Mr. Protocol

by Michael O'Brien



TOM BARRETT

"*The certainties of one age are the problems of the next.*"
– R.H. Tawney, *Religion and the Rise of Capitalism*

"*When you choose the lesser of two evils, always remember that it is still an evil.*"
– Max Lerner, *Actions and Passions*

"*It's about as clear as a Bose-Einstein condensate.*"
– Reader of Windows documentation

Bosons, Fermions and Mr. P.

Q: *I heard that Dell and some other manufacturers are starting to ship some systems with Linux preinstalled. Does this threaten Microsoft's de facto ownership of the Internet?*

A: Not at all. As you know, 99.983% of all computers on Earth run Microsoft software and only Microsoft software, including all of the computers and routers that make up the so-called Internet "backbone." What little is left of the so-called "competition" is in such disarray that even flaky academic software like Linux is…

WHAP!

That's better. I was hoping I could distract him until we could get the drop on him, before he got violent. We'll be giving him some de facto therapy with Thorazine and teaching him to play the piano–take his mind off computers. I used to have trouble with people like that, who'd been overexposed to people who name one-person consultancies after themselves, like "Joe Blow, President of the Joe Blow Group." Where do reporters meet these guys? At the same corn dog wagon on Wall Street or something? It's pretty obvious that the "group" consists of the guy's eight cats.

As I say, these people used to cause me grief, until I learned that the best thing to do was to speak a language they felt comfortable with, full of quotation marks and the adjective "so-called," which is obviously a shorthand for "so called by idiots who are too dim to pay $3,500 a year for my four-page quarterly newsletter."

It's a racket I'd try myself if I didn't believe, deep down, that the bunco squad would find me.

There is an interesting symbiotic relationship between the small set of science fiction authors who pioneered the cyberpunk movement, and the cyberpunk movement itself. And there is a cyberpunk movement, a real one, even if its members are much too clean-cut to really succeed at the "punk" part. Absent are the surgically implanted sunglasses covering their eyes. Present are a whole bunch of people hacking code in a movement with a very near-term focus, trying to free the world from corporate domination.

Corporations, of course, don't dominate the world, at least, not individual corporations. That's because real, live world domination necessitates the dropping of a few bombs, and corporations stay away from things like that because such confrontations can be lost, and if they lost such a confrontation, their stockholders would ask pointed questions. Corporations don't engage in world domination not because of innate nobility or cowardice, but because they are risk-averse. What they dominate, or try to, are markets.

The cyberpunk movement in literature produced works where the forces of darkness arose from corporations and computers, produced by writers who understood neither. This is where art triumphs over life, because despite these handicaps, or perhaps because

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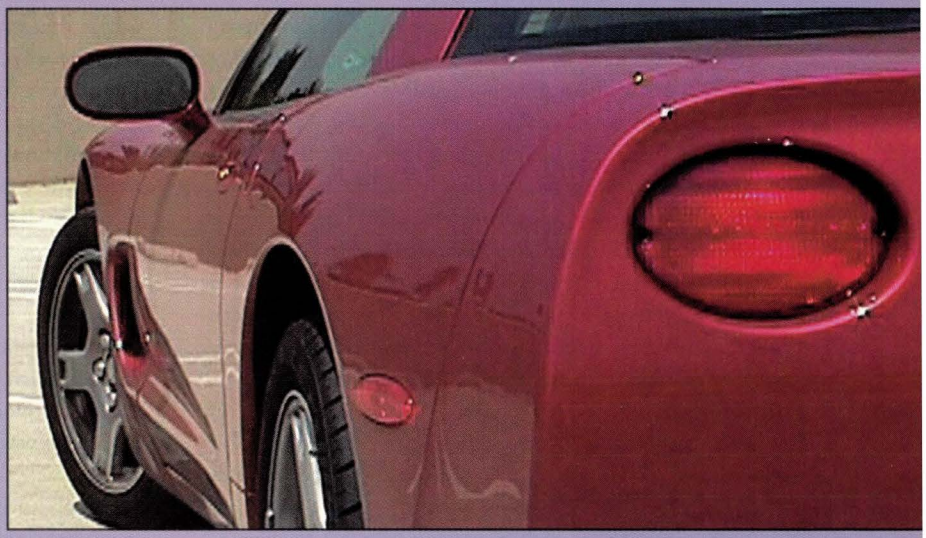

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of them, works like William Gibson's *Neuromancer* produced depictions of both corporations and computers which were unforgettable. Actually, almost all corporate types, and nearly all hacker types, lack the extreme sense of style that permeates cyberpunk literature.

This hasn't stopped either the corporate types or the hacker types from following their own agendas.

Hackers–by which I mean extreme coders, and not system crackers–actually do have an extreme sense of style, if they're any good at all, but this stylistic ability is usually limited to the code they write. Mr. Protocol has come across some very cute hackers, but none of them look like Angelina Jolie. And few indeed are social creatures, outside of a rousing game of Quake.

But while the early cyberpunk writers, including Gibson, were computer-illiterate, that's no longer true. Vernor Vinge's *Fire Upon the Deep* made hysterical reading for anyone familiar with Usenet, for example. His portrayal of interstellar communication as an extremely confused Usenet was a dead-on parody of the reality of an extremely confused Usenet.

And then there's Neal Stephenson.

His book, *Snow Crash,* portrayed a sort of communal cyberbar that created a lifetime longing inside all sorts of cyber types who in real life don't feel like going anywhere near a bar. If all it takes to be respected is a really snappy virtual-reality avatar, these people are ready. They're ready with oak leaf clusters.

UNIX became widespread in the face of strong opposition from IBM Corp. and Digital Equipment Corp. because it was innately better than the offerings of these two companies.

This gave Mr. Stephenson major street cred in the cyberverse. So it was a matter of some interest when he came out with a new novel, *Cryptonomicon*. Which doesn't concern us here. Except to say that his publisher, Avon Books, put up a Web site, `http://www.cryptonomicon.com`, which for a short period gave unrestricted access to a very interesting essay by Stephenson, entitled "In the Beginning Was the Command Line." It is an essay on the history of operating systems and it makes clear that unlike Gibson, Stephenson has had considerable experience with a variety of operating systems.

Which is not to say that he has wide experience, because wide experience in operating systems is almost an oxymoron in these ecologically sparse days. Stephenson makes the observation operating systems that only have GUI interfaces are for end users only; real hackers put command-line interfaces on their systems as quickly as they can. This may be so. What Stephenson does not make clear, despite his description of his own batch-oriented days in high school, is that early operating systems all had command-line interfaces, even the nonbatch-oriented interactive variety. These interfaces would give acute heartburn to modern hackers. Even TENEX. And certainly TSO (which one early UNIX implementor likened to "kicking a dead whale down the beach").

Mr. Protocol, ever the idealist, preaches that UNIX became widespread in the face of strong opposition from IBM Corp. and Digital Equipment Corp. because it was innately better than the offerings of these two companies. This is debatable. It is true that early UNIX was the most cleanly designed operating system ever produced up to that date. It was so cleanly designed that it took at least 10 years, and more like 20, for this cleanliness of design to be eroded by the hacker ethic. This ethic states that anything can be improved into unrecognizability if enough hands and eyes are given enough time. With UNIX, they had plenty of all three.

Mr. Protocol's amanuensis (me), if plied with Guinness and pressed hard, will opine at the drop of a hat that UNIX succeeded mostly because it ran on everything and had better networking code than anything else. If absolutely necessary the Guinness and pressing can be omitted, though appetite and ego prefer them.

UNIX was met with strong resistance by certain elements of the hacker community, partly because they didn't like some things about it, partly because they preferred what they knew and partly because hackers are fermions: no two of them like to be in the same state. They like to stake out territory nobody else knows and become a world expert in that area by inventing it from whole bits. They do cluster to a certain extent around some operating systems in preference to others, around the more common hardware. But you will always find a champion of obscure hardware, old hardware, obscure operating systems, new operating systems, you name it.

Users, on the other hand, are bosons. Preferentially, they're all in the same state. Like corporate officers, they hate being alone. The more of them there are using exactly the same applications and exactly the same software, the happier they are, because they don't want to have to be bothered by differences and incompatibilities. If users were in charge, there'd be one operating system and one set of application software to fit everybody.

Sound familiar? They almost pulled it off. Microsoft Corp. succeeded because it sold people not what they needed but what they wanted to buy, even if it didn't work very well. And that really rankles. You can call the users terminally stupid. Won't matter. They don't care. They know they're not. They're just not interested. They don't want to do interesting things. They want to do boring things and then forget about it all as much as possible.

There's this whole transgender thing going on. Almost anyone who's computer-literate has had the experience of being asked by a MOTAS (Member Of The Appropriate Sex) to show them how to do something. Great! Lecture time. Each keypress is preceded by an explanation of what it does, how it does it and why. This lasts about 10 minutes, then the whole interpersonal channel of communication breaks down in some (usually highly annoying) way because this is NOT what the person wanted to know. They just wanted to know what buttons to click and what to type, in a brainless, scripted way. Often the computer-literate person is humiliated by the inci-

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dental sight, later, of some better-educated user showing the MOTAS in about five minutes just how to accomplish the task, in just such a rote fashion.

Computer-literate people have highly complex mental models of how computers and operating systems do what they do, and geekly conversation is made up mostly of an exchange and comparison of these models.

Users do not want a complex mental model of their dishwasher and fiercely resent attempts to instill one. It makes them feel put-down for not having one and yet, at the same time, they know they neither want nor need one. All they want to know is what to set the knob to. They are appliance users and they want the computer to act like an appliance. More experienced users, more successful users, are those who have developed a mental model of how things really work out of necessity. The model may sound lunatic, if it were ever explicated, to someone who has learned what's really going on. But the mental model allows the user to view the computer as a sort of complex appliance, and supplies a sufficiently appliance-like view of the computer to allow the sophisticated user to explain operations to the naive users in acceptably appliance-like terms.

As Tim Hunkin points out in his TV series, "The Secret Life of Machines," an appliance interface is the most difficult and sophisticated interface that can be constructed. To allow people to accomplish a complex task without possessing a mental model of the process is extremely difficult. Except for highly vertical computer tasks with few options, generally involving the repackaging of the entire computer into some space alien-looking handheld device, we haven't figured out how to do it yet. GUIs are our best shot, and anyone familiar with the cherry bomb or the Blue Screen of Death knows that the wallpaper's still a bit thin. Mr. Protocol is extremely appreciative of the occasional Macintosh error that can lead to a screen full of numbers and a command-line prompt down in some low-level ROM debugger to whose very existence Apple Computer's big bright user-friendly manuals contain no slightest clue. Meanwhile, the Blue Screen of Death is so annoying on so many levels that if you think about it too long, the words on this page turn dark red on a light red background. Then you stroke out.

But users are largely oblivious to this. They've learned from experience that PCs and Macs (the only two computers left in the world, or at least, in their world) have to be rebooted from time to time. They learn to live with this. But they've also learned that these machines can generally be successfully configured to do a few different things (mostly) reliably, as long as they always perform these tasks the same way every time and avoid certain things that "don't work." This approach is anathema to hackers. It had better work, or they'll make it work. When they're done, it may bear no resemblance to what they started with.

People want to get their work done, and they'll put up with a lot. But only if they have to. This is one big reason for the rise of Linux. Microsoft software simply hasn't been performing, and the hacker ethic has finally produced an operating system that works well enough and has a user base big enough that companies can make money supporting it. This creates a snowball effect: more users, more support, more users. Presto! Microsoft has competition again. Good. Microsoft thrives on competition, so maybe it'll write better software. Maybe it won't. It doesn't matter. Somebody will. The market is lurching toward open standards again.

Users are professed to love this. Actually, they hate it. All the moaning and complaining about monopolies and their evils generally comes from columnists, not users. Users like variety in neckties, not operating environments. If open standards really did allow different applications and operating systems to exchange information as readily as under a corporatewide mandatory single-source regime, it would be different. They don't. They can't. Products by their nature must differentiate themselves to compete.

Linux and the other *NIX operating systems won't make users happy. But they'll do them some good whether they like it or not.

What does all this have to do with the Internet? Mr. Protocol is glad you asked.

Don't Bypass the Middleman

The Internet "browser wars" are mostly a fiction. Mr. P. was highly amused to learn that Intel Corp. had put up a set of Web pages that can only be viewed by computers running Pentium III chips. Some folks believe this is the end of the world, a sort of Balkanization of the Web without the bombs. Similarly with the advent of sites that can only be viewed with Netscape, or Internet Explorer, and throw up a "Thou shalt not pass" page when confronted with any other browser.

This is actually hysterically funny and indicates the need for more browsers, not less. These sites can only restrict access to browsers that tell the truth. Entirely too many browsers tell entirely too much of the truth. This may seem like a shocking stance for Mr. Protocol to take, given his history as a bastion in the world of protocols telling the truth and agreeing with one another. However, when people are involved, involuntary truth-telling is generally a bad idea except under certain carefully defined circumstances.

Consider that dead platform, the Apple Newton. This platform has a remarkably healthy software market given its status as a corpse. One well-supported package, Steve Weyer's Newt's Cape, is a document producer that can do duty as a Web browser. It reads HTML from a site and converts it to a book form that the Newton can display, complete with images. This makes it a Web browser. As such, certain additions have been made to it to make life easier. In particular, because nobody in the Web site construction business has ever heard of it, it has had to make certain mammalian adaptations. Some sites have gone so far as to interrogate all browsers upon connection as to their identity. If they don't come back as Netscape or Internet Explorer, they get bounced. Therefore, Newt's Cape has had to learn how lie like billy blue blazes. It claims to be whatever browser the user tells it to be.

After all, the Web is supposed to be based on HTML, an abstract document description language. What and how the browser renders what it hears is up to the browser, and Web sites that push the envelope by including specific code for specific browsers have already gone so far beyond a standards-

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Ask Mr. Protocol

based solution that they deserve whatever lies they're told in the course of business.

Web site constructors who pull this nonsense aren't hackers. They're users, business-oriented users, who will violate any standard in sight if it gets the job done. They should not be surprised if they are summarily dealt with appropriately.

And this is the beginning of a trend: the creation of intermediary software, a sort of "middleware," which acts on behalf of users to make the Internet a more palatable place.

Consider a recent front-page story in *The Los Angeles Times*, describing an emerging Internet business, the "infomediary," a company which holds a user's personal information in a highly protected information "vault," releasing it to commercial entities such as merchants only at the user's direction. Users would use infomediaries to band together to negotiate more favorable terms, and merchants would use infomediaries to provide targeted audiences.

This is one possible application of the idea of Internet middleware. Today, such tasks are carried out by Web browsers. The Web is extremely unstructured. The only organizational tools for personal and Web information lie in the browsers themselves, which keep bookmark, history and mail information, as well as cached pages. Independent entities acting as much more powerful intermediaries for transactions of all sorts are beginning to appear, such as TradeSafe and I-Escrow, which act as intermediaries for online purchases between private parties.

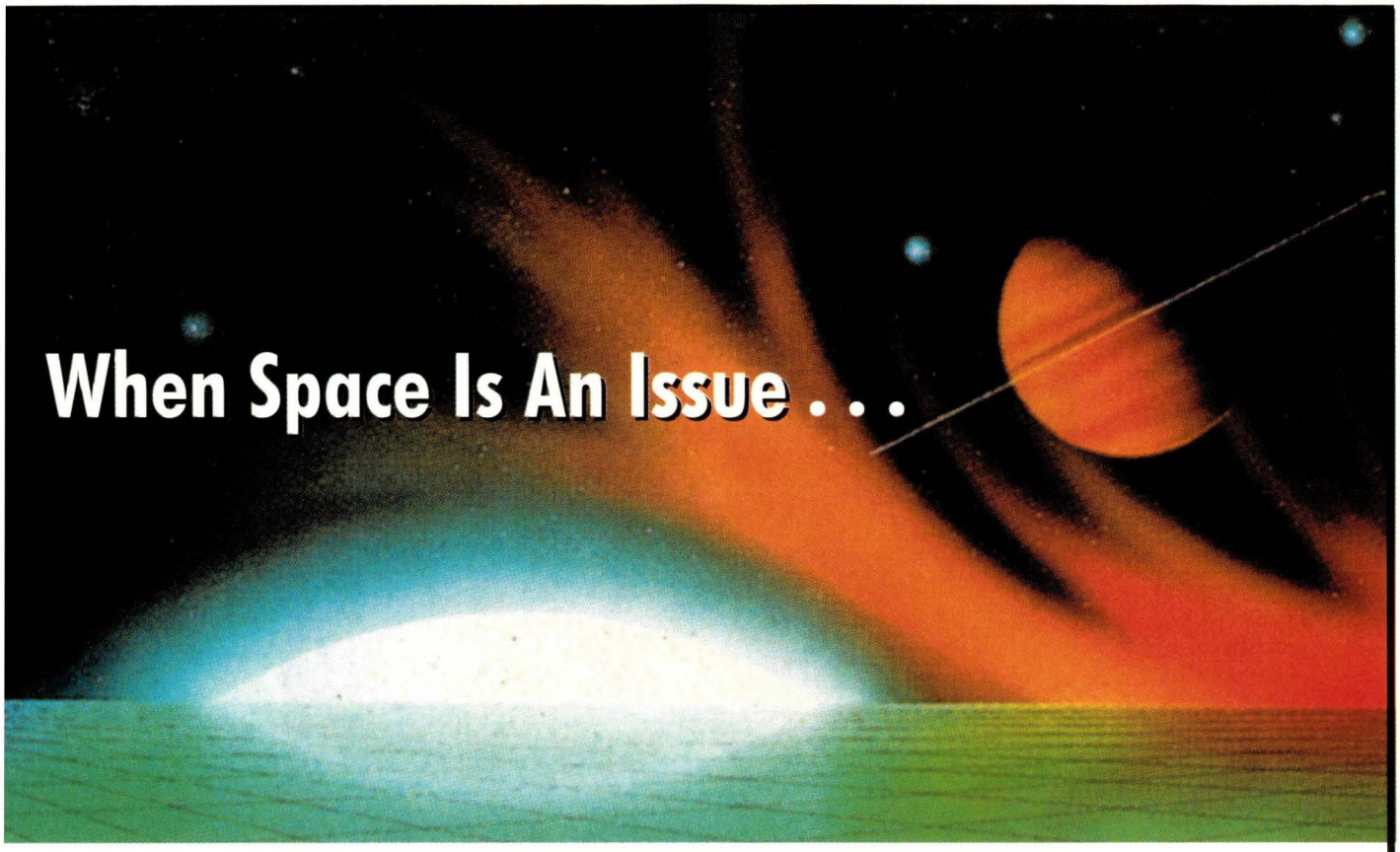
Such entities only work if they attract the majority of users to their model of doing business because, paradoxically, one of their great advantages is that they eliminate the necessity for users to form a mental model of how the Internet actually works. Consumers can make use of these services without thinking about it any further. The commercial version of the hacker is the entrepreneur, searching for a niche. Entrepreneurs create new services and new markets, which may or may not succeed. Success is measured by the degree to which the markets expand to include a significant number of customers who prize uniformity and ease of use in their transactions.

The fly in the ointment is the dishonest user, out to earn every buck he can steal or win by fraud. These guys aren't fermions or bosons: they're bogons, emitters of bogosity. They confute and convolute markets by their very presence. In an Internet marketplace that's only beginning to define itself, the coming of the cybercrooks will be fascinating to see. ⊸

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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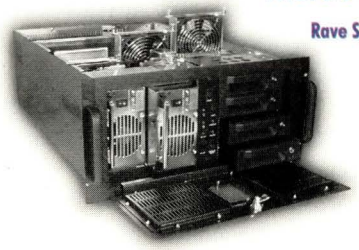

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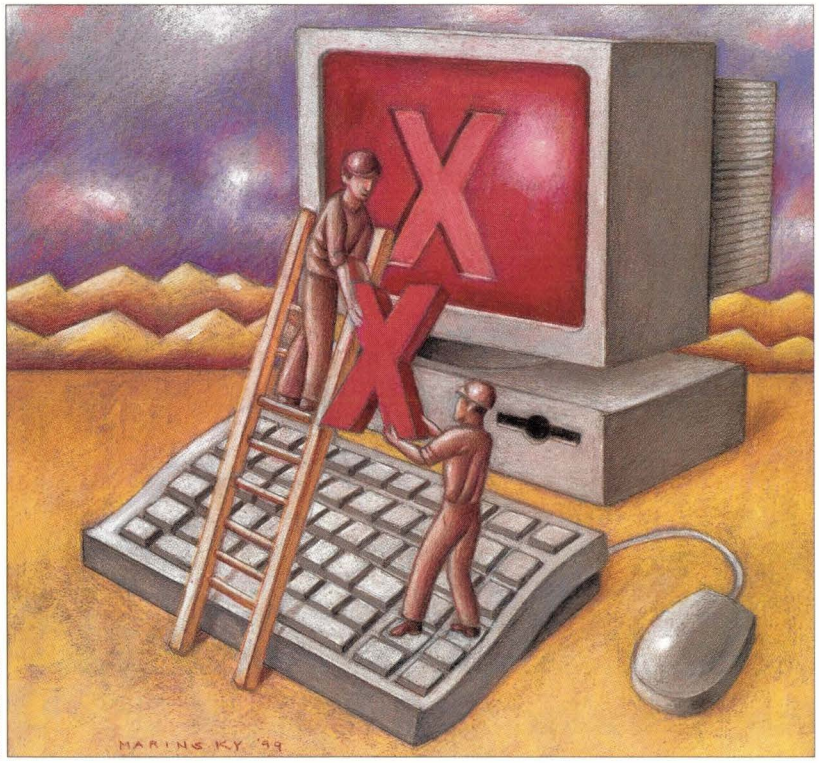

JANE MARINSKY

Using X

Last month, I discussed the use of the `xterm` program. Several parts of the story were left dangling and I hope to fill in those holes with this month's column. As you probably know, `xterm` is a client for the X Window System, which has become the dominant method of providing GUIs on UNIX workstations.

The X Window System is an example of a "client/server" application; although many people were using X before the marketeers decided to use client/server as a buzzword. The hardware in your workstation–the bitmapped screen, keyboard and mouse–is controlled by an *X server. X clients* on your machine use the low-level X protocol to communicate with the X server, placing images on the screen. Input from your keyboard and mouse is captured by the X server, which directs data to the appropriate client.

To understand what's happening, let's start by thinking about a traditional UNIX application like a visual editor, `vi` or `emacs`, running on a nonwindowed system. Programs like `vi` and `emacs` execute commands directly by reading text from the keyboard: The text is interpreted and the stored file is changed. The editor reflects the changes in the file on the screen by sending the necessary hardware command sequences to the terminal, changing the image that the user sees. The programs are monolithic; they are large pieces of code that do the complete job of editing a file.

There is no reason why a program like `vi` should not be split into two sections: one that handles the interaction with the user and one that deals with editing the file. After all, these can be well-defined sections in the code. If we make the split and provide some communication between the two halves, then we've invented a new client that handles the user interface and a new server that handles the commands the user sends from the interface. The server takes in information from the client, edits the file and sends screen change commands back to the client.

Why would we want to do this? Well, Rob Pike (of Bell Laboratories) created his `Sam` editor in this fashion so that he could have a lightweight GUI running in an intelligent terminal. The GUI talks over a network to a more powerful system that runs the editor on the files stored on the remote machine. Rob was looking to make a clean split between the user interface and the main actions of the editor. Rob had other reasons too. Splitting the code into well-defined sections, which each take some input, perform an action and create some output, means the programmer is able to think more clearly about how each section of the program should be coded. The result is cleaner, more precise code.

Client/server working means we split the application into well-defined chunks, each undertaking some portion of the application. The chunks communicate using messages. At some point in the code of one chunk, the program will want to do something that uses a service provided by another chunk and

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will create a message asking for the necessary action to be taken. The job of each chunk is to read a message, perform some action and send out a new message indicating that the action has been completed.

Once we have placed the requests for services into messages, there is no reason why we cannot pass those messages over a network, so that parts of the application can run on different machines. It all boils down to delivering the message to the appropriate server and making sure the result ends up at the correct place.

So I have created a picture where a single application is created from several constituent parts, all working together to achieve some work for the user. Often there are several applications where we want to provide multiplexed access to some shared resource. Coding such an application as a server accessed by a set of clients is a win because it's easier to control a single resource using a single program. Clients wishing to access the resource can do so by sending messages to the server, which can arbitrate between client demands in a controlled way. The server can take messages from several clients, each of whom are unaware of the others' existence. Messages from the clients can be sent in any order to be dealt with by the server, and a response is sent to the appropriate client.

There are two main ways to code such a server to cope with multiplexing. In the case of X, we are happy for the server to retain information about its clients and, in fact, we use the server to store data that is used by its clients.

Other applications have chosen to retain no state for their clients and simply act on the incoming messages in order of receipt. A Network File System (NFS) server is one example of this type of server. When NFS was designed, much was made of its "stateless" operation. Statelessness was designed in to ensure that when a client or server crashed and was rebooted, there was no need for complex recovery operations to resynchronize the client's view of its remote file system with the physical copy that was present on the server's machine. Both NFS and X servers handle requests from several clients controlling access to a shared set of resources, files for the NFS server and screen real estate for the X server.

The X Server

The X server is intended to be small and portable to many platforms. The aim is to provide a core server that supports only the functions that are needed to act as the glue for the windowing system. The X server handles the low-level output functions of creating and destroying windows, handling fonts and drawing text, lines, arcs, areas and bitmapped images. By the way, "windows" are more than just the area of screen real estate occupied by one client application. Each client may have several windows. For example, in the `xterm` program I used to create this document, there's a main text window and a scrollbar. In addition, `xterm` can create pop-up windows for menu dialogs and the like.

As I've mentioned before, the server accepts and processes keyboard and mouse events, sending them to the appropriate client. However, most of the work relating to input processing is done in the client, which allows it to have complete control.

The server manages several output resources for clients. It stores cursors and off-screen images called *pixmaps*. It looks after colormaps that control the mapping of colors onto the display. Many early display systems could only display 256 colors at any one time, but each one of these colors could be a full 24-bit color value. So an 8-bit color value is looked up in the color map to obtain the actual color that is to be displayed for any specific pixel on the screen.

The server also manages *graphical contexts*. There are many aspects of line and area drawing that can be configured and it's not efficient to send all the information each time a line is to be drawn. The client will set up a graphical context in the server and use it to dictate how several subsequent drawing actions are to be executed, thereby minimizing the amount of information that is sent from the client to the server for a particular set of drawing operations.

The server also manages a considerable amount of data for the clients, known as the *property database*. Some of this data is used for inter-client communication (such as cut and paste); and some is used to establish aspects of the look and feel and can be loaded from your `.Xresources` file.

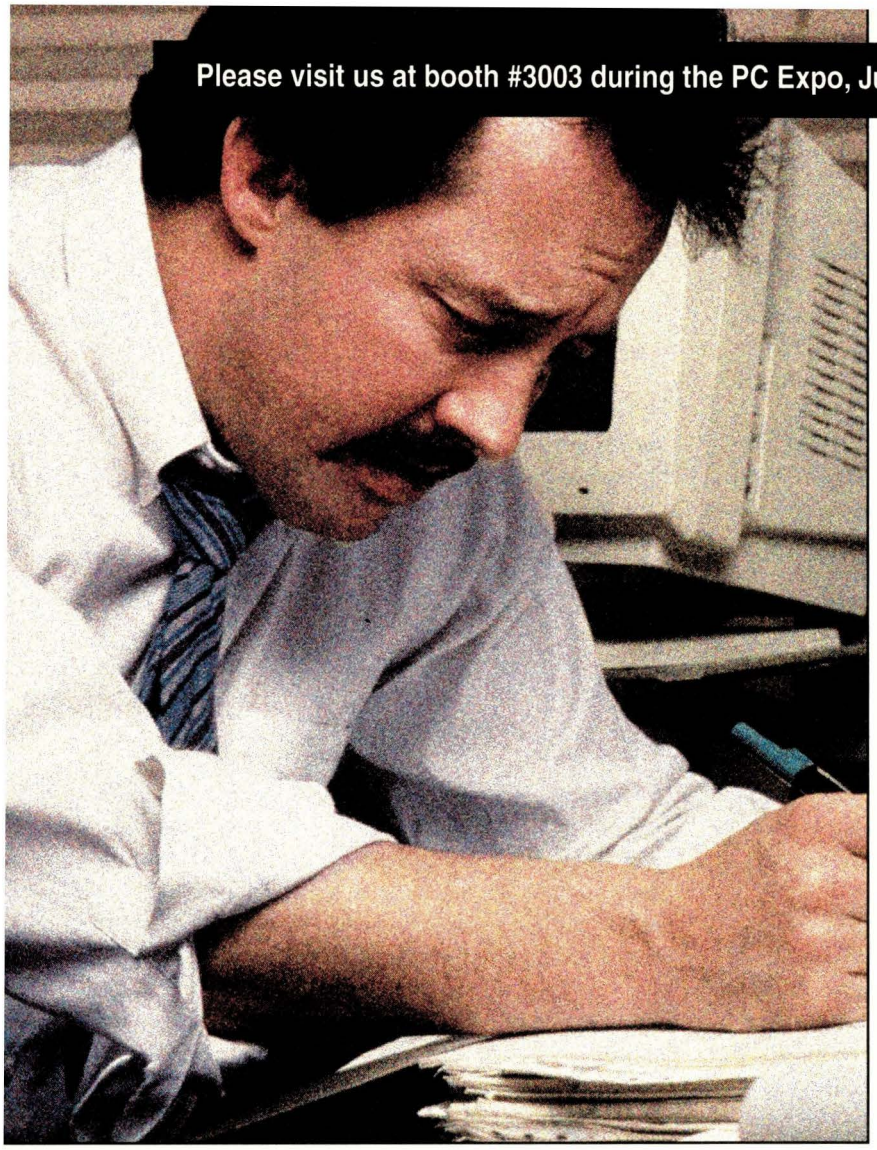
Finally, the server manages the various network connections that are used to convey messages between itself and its clients. Most UNIX-based servers have several different methods that can be used to communicate with them. The server will either accept TCP connections from the network, establish a UNIX domain socket somewhere in the file system or use some form of shared memory connection.

There are several aspects of managing windows that you might expect to find in the server, but are off-loaded into clients. First, the server does not store the contents of the windows it manages. We might expect this because windows are dynamic objects that are covered by other windows, sometimes partially. When the user flips an obscured window on the screen from the back to the front, it's because the user wishes to see its contents. If the server stores the contents, it can redraw the window's contents and fulfil the user's request. However, X doesn't do this. Instead it's up to the client to redraw its windows (or some section of its windows) on the server's request. I'll guess this was done to save memory in the server.

Second, the server has no facilities for resizing windows. Resizing has to be done in the client, which then makes a request for screen real estate to accomodate its new window size and redraws the image.

Third, there is no support for any standard look and feel in the server. How each application should look is left completely up to the client. The client programmer can construct a look and feel that is thought to be desirable. This allows the programmer to create any look and feel they fancy, and permits a single platform to support a range of looks. Placing this utility into the client also makes development considerably easier, you don't need to take the X server up and down to create a new look.

Fourth, the server has no provision to handle "window manager" functions. A large part of the look and feel is provided by the window manager that supports the graphical infrastructure, allowing the user to manage their applications. Each display is



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managed by a single window manager that intercedes between the clients and the server. The task of the window manager is to provide basic functions like virtual screens, resizing and movement of application windows, start/stop functions and swapping between large windows and icons.

Over the years, we've seen the rise and fall of many window managers–at present, I'm using two main ones. I use CDE on my Sun system and `fvwm` on my BSD/OS system. It's possible to switch trivially between window managers; you just kill one and start another. I notice that my newly booted Red Hat Linux system has a menu option that allows the user to switch between several managers, resulting in radical changes to the look and feel.

Using X Remotely

If you log in to a Sun workstation these days, then you will be using X, but you won't really notice the presence of the X server or any window manager. The server and the window manager will simply be there running for you. You only need to delve below the hood when you want to run X applications on other machines on your network. X allows you to run remote applications where their output appears on your screen and you can divert input from your keyboard and mouse into them.

I mentioned last month that I run `xterm` programs on various machines on my network, with their terminal emulator window sitting on my display taking input from my keyboard. My screen can be filled with several windows, each connected to a separate machine and each providing a command-line shell, allowing me to run commands on that machine. How do I do that?

Well, let's start at the beginning. One way is to start a local terminal window and use `rlogin` to access the remote machine. This works fine for terminal access, but isn't exactly what I want to achieve. I'd like to run the `xterm` program on the remote machine, but have its X events sent to the X server running on my workstation. Incidentally, we expect programs that have more graphical interfaces to run like this, and I certainly use `xterm` to test a new X setup, proving that the configuration is correct.

What happens if I log in to a remote machine and start the `xterm` program?

```
$ rlogin wooded
loads of login messages
I am now on wooded
$ xterm
Xterm Xt error: Can't open display:
$
```

I am greeted with an error message that hints something is missing. In fact, each X application looks in its environment for a variable called `DISPLAY`, which gives the name of the machine where the X server resides. Let's try again

```
$ rlogin wooded
loads of login messages
I am now on wooded
$ DISPLAY=craggy:0
$ export DISPLAY
$ xterm
```

Incidentally, if I was a `csh` user (or I was using one of its derivatives), I'd have said

```
% rlogin wooded
loads of login messages
I am now on wooded
% setenv DISPLAY craggy:0
% xterm
```

This time, I'm given another error message:

```
Xlib: connection to "craggy:0.0" refused by server
Xlib: Client is not authorized to connect to Server
xterm Xt error: Can't open display: craggy:0
```

However, something different is happening. The `xterm` program is actually trying to connect to my workstation, but my workstation is refusing the connection. Before pursuing this, let me explain a little more about the `DISPLAY` environment variable. The content of `DISPLAY` has the following general syntax: *machinename:displaynumber.screennumber*. The *machinename* entry is somewhat self-evident, it should contain the name of the machine that is your workstation. My network is arranged so that I can just use machine names without having to supply the fully qualified domain name. This may not be the case on your network.

The number that follows the colon (*displaynumber*) identifies a particular "display," where a display is a set of screens that share a common keyboard and pointing device. Most workstations only have one set, so the number is usually zero. However, the mechanism is there to provide support for large machines that have several distinct displays directly attached to them being used by several people.

The final number, the *screennumber*, is used to identify a specific screen in a multiple screen cluster. X can arrange to support more than one screen displaying applications for one user. Again, in most workstations that only have one keyboard, one mouse and one screen, this number is zero. When this value is zero, it can be omitted from the display specification, which I've done above.

Access Control

Well, back to the error message. Why is the connection being refused? In general, you don't want to permit just anyone to connect to the X server supporting your display. X doesn't provide any per-window access control; your window manager uses this lack of access control to manage the windows on the screen. In general, if someone can connect to your server, then they can access any of your windows and grab their contents. So it's important to be able to maintain control over who can and cannot access your X server.

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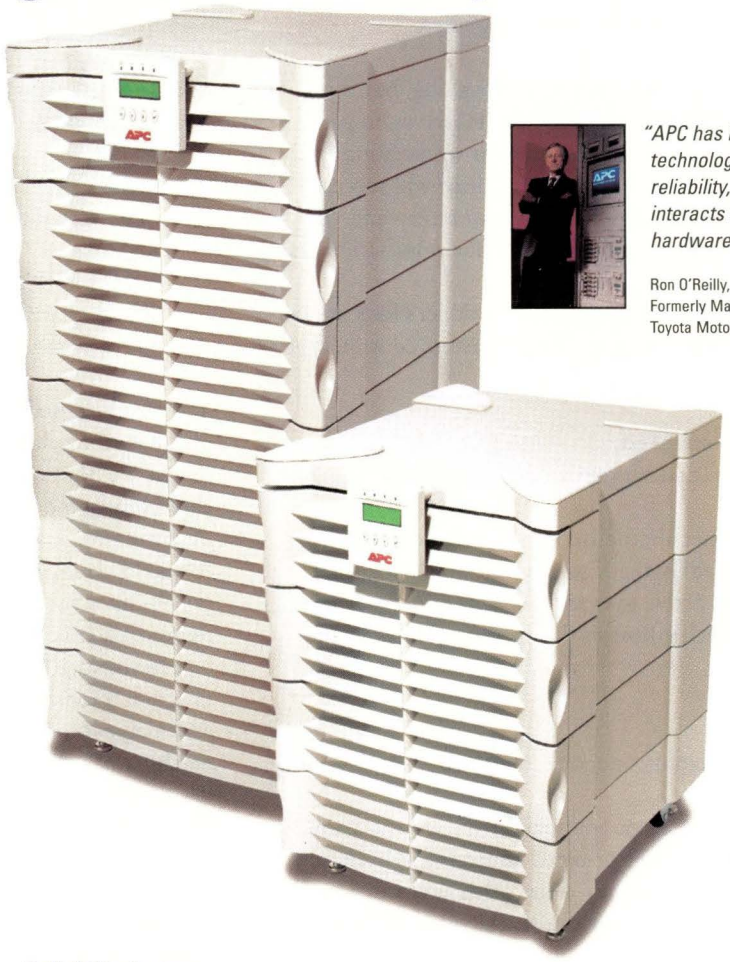

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server to allow all connects from anywhere by using the xhost command:

```
$ xhost +
access control disabled,
     clients can connect from any host
```

This is useful when you are getting things going, but is not recommended practice for everyday use. However, to prove that things work, you can use this on your workstation and the xterm command on the remote machine will succeed. An xterm window should pop up on your screen and you will be able to type commands in from your workstation and have them run on a remote machine.

Having proved the connection will work, let's look at alternatives that offer better security. To reset access control, type

```
$ xhost -
access control enabled,
    only authorized clients can connect
```

One slightly better alternative is to use the access control list feature supported by the X server. With the default setting established to deny access to every other machine, we can use xhost to add a specific host to the list of machines that are permitted access:

```
$ xhost +wooded
wooded being added to access control list
```

We can now run the xterm command from wooded and only from that machine. Host-based controls might be sufficient in your environment, but if any other user can access the remote machine, then they can access your server, which might not be desirable.

The standard X system comes with a standard per-user authorization method. The idea is that the system stores a magic number (a magic cookie) in a secure file in your home directory (.Xauthority). When connecting to the server, the client reads the file and sends the cookie to the server. The server then permits access. The magic cookie is reset when you start the X server.

You may wonder exactly what help is provided by having a file that is local to the machine on which the X server is running. Well, if you share your home directory across all the machines in your environment, then things will work nicely. When you use rlogin to access the remote machine and start the xterm, then that xterm will find your .Xauthority file and send the cookie that will allow you access into the X server.

I am not able to do this on my network because I don't share my home directory across my machines. However, I usually leave my X server running for long periods and I have an authorization script that disseminates the cookie to the machines from which I plan to run remote terminals. The script uses the xauth program to manipulate the contents of the .Xauthority file on the remote machines.

Another alternative is to combine setting up the authorization with the actual setup of the xterm, creating a script that merges the necessary authorization information on the remote .Xauthority file and then calls a remote xterm. This would be something like

```
#!/bin/sh
local=`hostname`
# call this by xtc machinename
remote=$1
xauth nextract - "$local:0" |
     rsh $remote xauth nmerge -
rsh $remote \
     DISPLAY=$local:0.0 \
     exec xterm -sb -sl 1000\
     -T $remote -name $remote
```

The first line establishes a local variable that contains the name of the local machine using the backquote feature of the shell to run the hostname command and capture its result. Line 3 could bear some improvement; currently, it takes the name of the remote machine from the first argument to the script. It should check for the presence of an argument. Another possibility is to use the file name of the script to refer to the remote machine.

Having established these two constants, we use the xauth program to obtain the magic cookie from the local machine and merge it into the .Xauthority file on the remote machine. We do this by running xauth locally to extract the cookie in a numeric form (nextract), but writing it to the standard output. We run xauth remotely using rsh and merge the numeric value it finds by reading its standard input (nmerge) with the current contents of the .Xauthority file. Note the use of the common UNIX convention, where a hyphen on the command line means "use the standard input or output channels" instead of an explicit file name.

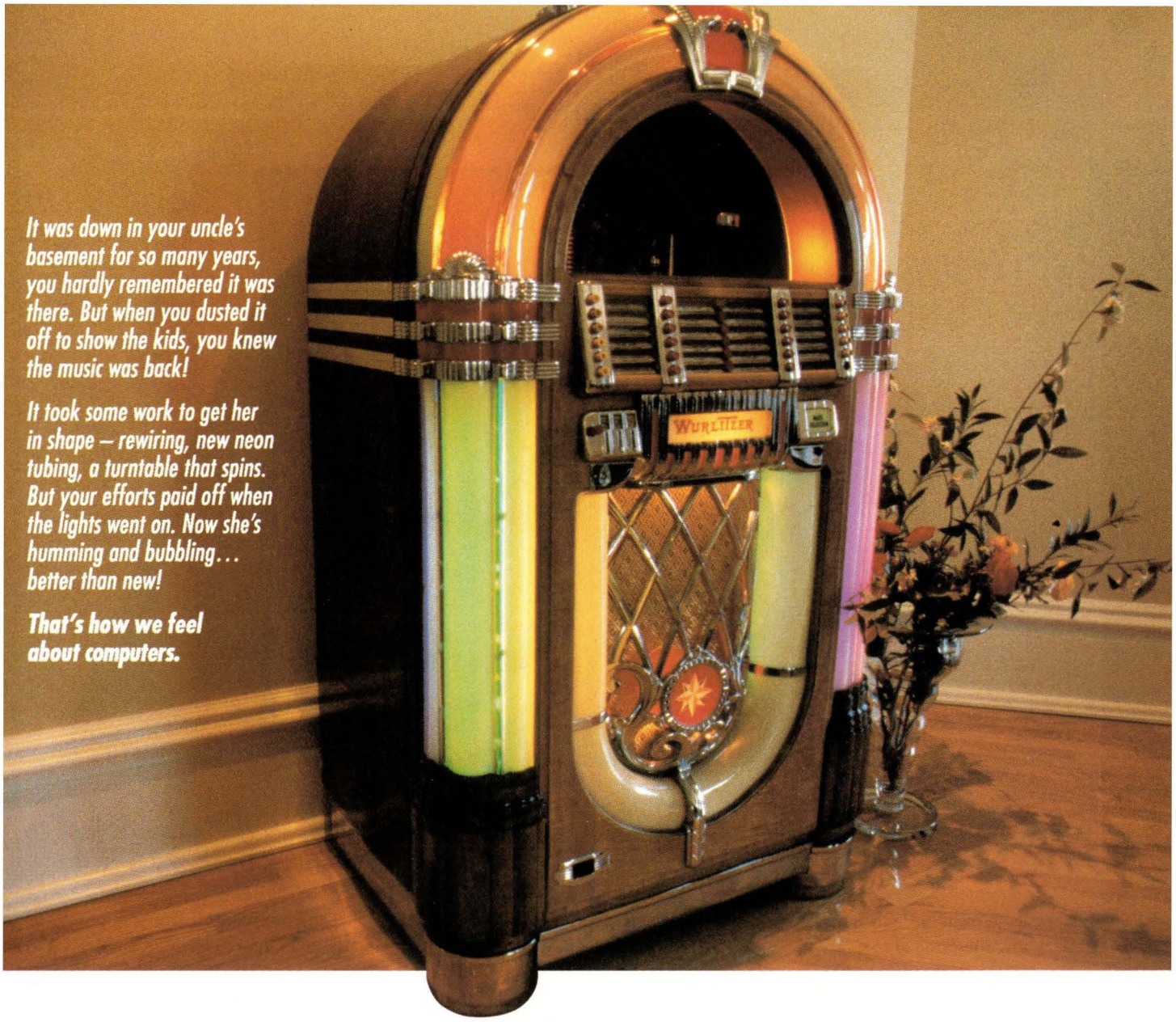
Having established the magic cookie in the remote .Xauthority file, we now use rsh to start the remote xterm. We ensure that the environment for the remote command contains the correct DISPLAY value and then use exec to replace the shell that rsh starts with the xterm. The arguments to xterm were discussed at length last month, so I'll say no more about them here.

As a final thought, it may be that you are running Kerberos on your site. This system can be used to establish rights for your clients to access your X server.

Further Reading

My personal touchstone when looking for a broad introduction to all things X is *The Joy of X, An overview of the X Window System* by Niall Mansfield (published by Addison-Wesley Publishing Co., 1993, ISBN 0-201-56512-9). ⊸

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



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Circle No. 30

by Æleen Frisch

LYNNE CANNOY

Lessons from a System Crash

This month, I'm writing about how I responded to a recent system crash on one of my Windows NT servers. The floundering around I did in response will hopefully prove instructive, as well as entertaining.

My problems began during tests of a client/server transaction processing application I was developing. A new report I was working on initiated a large and complex query–too large and complex for the server's capabilities as it turned out (the system is rather underconfigured at 32 MB of main memory). As a result of this query, the system ground to a halt.

Killing the application from which the query was initiated did nothing to alleviate the process, because the query continued to (attempt to) execute. Eventually, it became clear the system was in serious trouble, so I decided to kill the database server process itself, despite the fact that the database in question was serving live data. However, at this point, the system had hung and wasn't even responding to Control-Alt-Delete. So I pressed the machine's Reset button.

When the system rebooted, it automatically checked the file system for errors, and the process found none. The command to check the integrity of a file system under Windows NT is `chkdsk`, which verifies the file system's drive letter is specified as its argument, listing any problems or errors it finds. You can add the `/F` option to have `chkdsk` fix errors, as well as report on them (this is the mode run automatically on reboot after a system crash). You can also run `chkdsk` from the Disk Administrator facility.

At this point, confident that I had successfully dodged a bullet, I resumed working on my application. Sometime later, I ran into a printing problem while I was testing a new functionality. The error message I received read something like this:

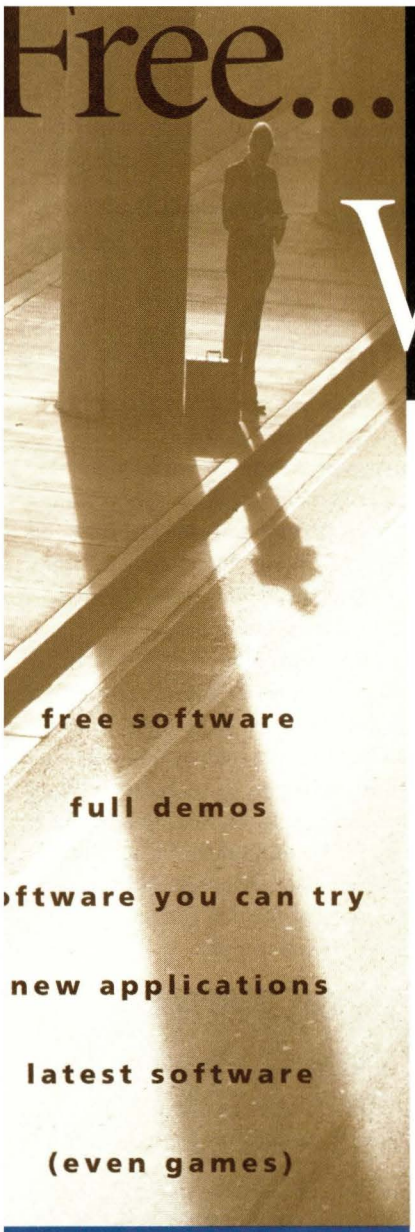
```
Problem printing file 'db_addr.doc'
on address on COM1: File not found.
```

At this point, my troubleshooting left something to be desired. First, I spent quite a lot of time looking for a bug in my program that could cause the problem. I assumed that some recent change I made broke the printing facilities within my application, which had been working perfectly for several months. I was convinced that something I did wasn't allowing the application to find the file I wanted to print.

Only after convincing myself there was no such bug did it occur to me to try printing from another application. Only after that too failed did I begin to get anywhere near the right track for solving the problem. I tried printing a test page from the printer's Properties dialog, but that failed with the same error message.

Next, I deleted and recreated the Windows NT printer (in the Printers folder). When that did nothing, I reinstalled the printer driver for the printer. Still no change.

At this point, I finally did what



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Circle No. 17

I should have done first: I read the error message carefully. When I did, it became clear that the file being referred to as not being found was not the file to be printed, but `COM1:`, the printer port. I could have saved myself a lot of time had I noticed this earlier.

I tried to look at the settings for `COM1:` and found I could not. So I removed the serial port from the system configuration and rebooted. When the system returned, the port had been recreated and the settings were correct when I checked them. At this point, printing was also restored to the formerly nonworking printer.

So what's the moral of the story? Read messages the system gives you very carefully if you want to have any chance of correcting the underlying problem.

Pay Attention

On a related note, another system message you should read carefully is the one below, which appears just before the system goes down during a normal system shutdown:

```
Please wait while the system writes unsaved data to disk.
```

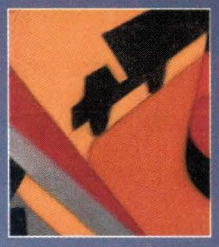
What's happening here is the system is flushing unsaved disk buffers from memory out to the physical disks. Why is this important? You need to be aware of the significance of this message because NT's standard buffering strategy can result in data loss if you ignore it. It can also result in data loss in some relatively rare circumstances when a system crash occurs (for example, in the event of a power failure).

Windows NT employs a lazy-write strategy; disk buffers are stored in memory and are only written out to disk periodically–for example, when buffers become full, when there is idle time and so on. This strategy, used by many modern operating systems, results in lowered I/O overhead and correspondingly improved I/O performance for the operating system.

As a result of this strategy, however, unsaved data is likely to be present in memory at any given moment and an unexpected system crash can prevent them from being written out to the physical disk. I have personally witnessed such minor data loss. One time a user made very minor changes to a Microsoft Corp. Word document, saved the document and exited from Word. However, a power failure more than an hour later resulted in the previous file version being present on the system when it rebooted. In this case, the contents of the disk buffers were presumably too small to trigger a write to disk.

A Note on mkdir

Many readers wrote to me pointing out that the UNIX `mkdir` command can work in the DOS/NT mode by including the `-p` option. I did know this, but I want it to be the default. For some reason, it never occurred to me to create an alias to make this happen. Thanks to everyone who wrote in.



Read the messages the system gives you very carefully if you want to have any chance of correcting the underlying problem.

A logical question to ask at this point is whether Windows NT provides a utility for forcing disk buffers to be written out. Windows NT itself does not, but there is a utility named `sync` (named after the similar UNIX utility) written by Mark Russinovich and Bryce Cogswell, and made freely available at `http://www.sysinternals.com`. By default, `sync` flushes all disk buffers corresponding to large hard disk partitions from memory, but you can limit its scope by specifying drive letters as its arguments. It also has a `-r` option to include removable media (for example, floppy disks and Zip disks) in its operation. You'll also find a lot of other useful free software at the above Web site. ➵

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

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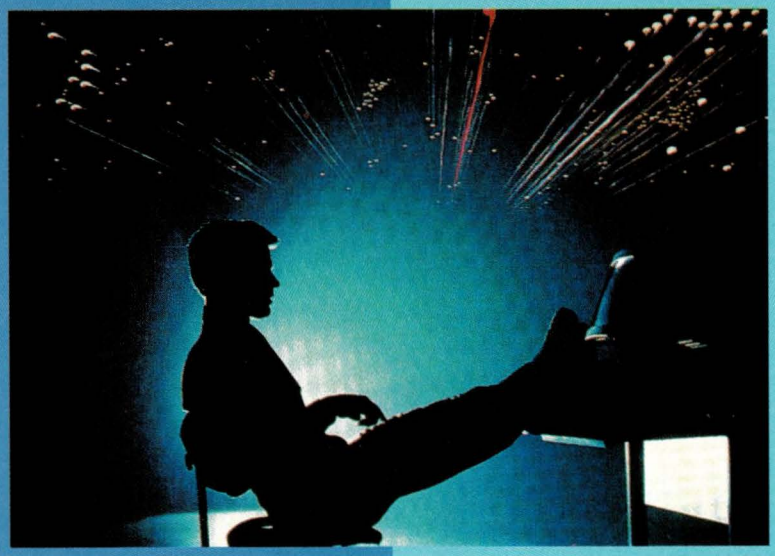

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Circle No. 19

by Jeffreys Copeland and Haemer

MICHAEL AVETO

"hello, world"
– Everyone

"bonjour, monde"
– Tout le monde français

"konichiwa, sekai"
– Nihonjin

I18N, Part 1

Most of the software we've written is flawed: it assumes an anglophone environment in an ASCII codeset. While it might be OK for the program we wrote to index our music CDs, it doesn't help our pen pal in Japan organize his music collection–unless all of his CDs are by English-speaking artists. And it doesn't help our college roommate from Paris either, because his recordings will have titles with odd accent marks. In fact, our software probably won't even sort the titles correctly for our French friend, because the numeric sequence of the Latin-1 codeset is not the same as the lexical sequence. Indeed, if you look above at the linguistic variations of "hello, world," you'll see that the non-English ones require characters we don't even have in ASCII. What to do?

I18N is the accepted abbreviation for internationalization–"I," followed by 18 characters, followed by "N," which neatly solves the Anglo-American dispute over the use of "Z" versus "S." The interfaces we need when we internationalize software are dictated by a few standards, principally ANSI C, the POSIX family and The Open Group's System Headers and Interfaces Guide. Some time ago, in *S/W Expert*'s now defunct sibling *RS/Magazine*, we wrote a series of articles on this topic. Recently, Copeland has found himself up to his hips in I18N development as Softway Systems prepares to have its Interix system UNIX-branded, so we thought it was time for a quick refresher.

Software in 75 Languages

It should be obvious, even in places as homogenous as Boulder, CO, that English is not the only language in the world. The process of writing software to operate in different countries involves not just different languages, but different character sets and collation orders, as well as some extensions to things like regular expressions. How do we represent this information?

First, let's recognize that there are two roughly orthogonal sets of information: There are the text strings in the program that need to be translated ("file not found") and there is culture-specific information about our current environment (use comma instead of period for a radix point and use day-month-year as the date format). The text strings are stored in *message catalogs*, and the language and region in which we want to operate are represented by something called a *locale*. We'll come back to message catalogs later, but locales actually have six separate categories of data:

- `LC_CTYPE`, containing the data used by `ctype` functions.
- `LC_COLLATE`, containing data about the lexical order of the characters, as opposed to the numeric order of their character codes.
- `LC_NUMERIC`, providing data about how to format numeric quantities.
- `LC_MONETARY`, providing rules on formatting currency.
- `LC_TIME`, containing culture-specific details about the clock.
- `LC_MESSAGES`, not directly related

to message catalogs, but telling us how to recognize yes/no responses from the user.

In general, we declare what linguistic environment we're operating in with the LANG environment variable. Generally, LANG takes the form of the language followed by the country in two-letter abbreviations, often with the codeset appended. For example, fr_CA for Canadian French or en_US.Latin1 for American English.

To make our programs locale-aware, we call setlocale() early in the program, with the locale category and locale name. Almost always, the call will be setlocale(LC_ALL,"")–that is, for all locale categories, set the current environment to the value specified by LANG.

A Matter of Character

For European languages, getting enough characters in an 8-bit byte is fairly easy: 256 characters give us plenty of room for the likes of "n with tilde," "capital a with grave accent" and so on. This is even the case for languages like Russian and Ukrainian, which aren't based on the Latin alphabet. Many languages are handled by the ISO family of 8859 codeset standards. Most Western European languages use a character set called ISO8859-1, or Latin-1. Russian can be handled by 8859-5, which contains Cyrillic characters.

Unfortunately, there are some languages for which this doesn't work. Japanese, for example, has about 6,400 ideographs. Usually, these characters are represented externally to the program–on disk, for example–as multibyte sequences. Thus, "hello, world" in Japanese might be encoded (at two bytes per character) as the hexadecimal codes 82 B1 82 F1 82 C9 82 BF 82 F1 99 A2 8D 45.

But we're still stuck with the problem of characters not fitting in a char. Fortunately, ANSI C provides a data type just for this purpose, wchar_t, the wide character. A wchar_t is at least a 16-bit quantity. Solaris defines it with a typedef unsigned long wchar_t, while Interix uses unsigned short; UNIX successor Plan 9 substitutes a 16-bit Rune data type, which contains a Unicode character; your mileage may vary. When internationalizing programs, you'll find most of the changes you make center around manipulating wchar_ts. You'll also discover that wchar_ts will figure prominently in many of the bugs you find. You'll need to include <stlib.h> in your programs to use wide characters and related interfaces.

If the data are stored externally with the characters represented as multibyte strings, how do we convert them into wide characters to deal with them internally? Well, you may not have to. If you are only processing bytes and don't need to worry about the characters themselves–think cat–it's sufficient to be 8-bit clean. What's 8-bit clean? It means your code doesn't assume a 7-bit ASCII-only environment. An example of incorrect code we've tripped over in the past involves storing strings in an array of char, but assuming the characters are only seven bits, so that the program can store a single-status bit in the high-order bit of each char in the buffer. This code won't even work in the Latin-1 character set!

In the normal case, where we have a multibyte character to convert to a wide character, we'll avail ourselves of the mbtowc() interface. This useful function takes a pointer to a multibyte character string, a pointer to the destination wide character and the maximum number of bytes that comprise a character in the multibyte string; mbtowc returns the number of bytes actually converted, which allows you to increment the string pointer for the next pass. How many chars constitute a character? For all interesting implementations of the standards, it's a minimum of one byte and a maximum of MB_CUR_MAX. While MB_CUR_MAX may look like a defined constant value, it actually returns the size of the maximum character from the current locale.

On the other hand, if you have a string to convert, you can use the mbstowcs() interface, which takes pointers to the multibyte source string and the wchar_t target string, plus a count of the maximum number of bytes to convert.

In general, when you are operating on strings–think of a filter program–the steps you want to take for an I18N program are as follows:

- Read the string of multibyte characters.
- Convert it to a string of wchar_ts.
- Process the wchar_ts using an algorithm similar to the original char-based one ("similar" is important, more about that in a moment).
- Convert the wchar_t string back to multibyte characters.
- Output the multibyte string.

There are a handful of things we need to look out for when processing wide characters. To begin with, we want to compare against characters, not bytes, in our loops. For example, to step through a string, the classic loop

```
char *s, buf[128];
for( s = buf;  *s;  s++ )
```

needs to be transformed into

```
wchar_t *s, buf[128];
for( s = buf;  *s != L'\0';  s++ )
```

where L'\0' represents the wide-character null byte. Likewise, L'a' represents the wide-character version of lowercase a. By analogy to our normal single-byte methods, when doing input we need to read wide characters into wint_ts rather than wchar_ts, so we can recognize the wide character end-of-file marker (more about this when we discuss input and output).

A major source of bugs is the fact that sizeof(char) != sizeof(wchar_t). For example, even though memset (buf,0,BUFSIZ) worked on your character array, it won't work on your wchar_t array. Instead you need to say

```
memset(buf,0,BUFSIZ*sizeof(wchar_t))
```

An important consequence of this size difference is that problems may arise in using the same algorithm for single-byte characters and wide characters. For example, it means your bitmap for each character, short bitmaps[256], may suddenly become short bitmaps[65536] (assuming your wide character is an unsigned short), which may take far

more memory than you intended. Worse, a two-dimensional array of character data that previously took 64 KB of memory will now take 4 GB. Sometimes, the larger character size means we have to rethink our algorithms.

What else won't work quite the way we expect?

Strings are one of our most common data structures because so much of what we do is text processing. As you might expect, there are many helpful routines in the standard libraries for handling wide-character strings. The most important of these is comparison.

If all you need is to test the equality of two wide-character strings, you can substitute `wcscmp()` for `strcmp()`. This will also work if all you care about is the relative numeric values of a pair of strings. However, if you are trying to compare the lexical values of "ça" and "done," you suddenly have a more complicated problem.

In the normal course of events, we'd expect the string "ça" to be less than "done." But (assuming we're operating in Latin-1) the character code for ç is 0xE7, which is much higher than the code for d, 0x64. Fortunately, there's an interface to solve the problem. To compare two wide-character strings lexically, we use `wcscoll()`, which does a magic transformation on the strings based on their lexical values.

If we're going to be doing a lot of comparisons among the same set of strings–think `sort`–we don't want to perform the lexical transformation for every single comparison. We'd like to separate that step from `wcscoll()`, so that for the comparison step we could just use the relatively cheaper `wcscmp()`. For that, we want the `wscxfrm()` interface, which takes a wide-character string and returns, in another wide-character string, the lexically transformed value used by `wcscoll()`. In other words, `wcscoll()` is just two calls to `wcsxfrm()`, followed by a call to `wcscmp()`.

Finishing Up

This gets us about halfway through our discussion of I18N techniques. We've discussed locales and wide characters, and how changing from `chars` to `wchar_ts` can make a mess of your algorithms. We also began a discussion of wide-character strings. Next time, we'll finish up talking about strings and discuss input, output, time, dates and money. We'll also discuss message catalogs once over lightly.

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.*

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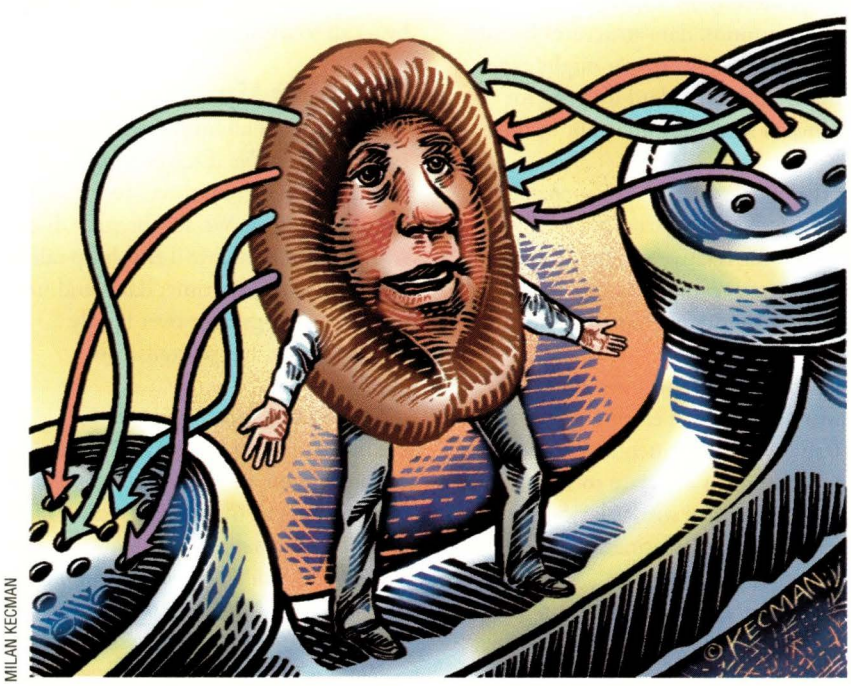
Note: The software from this and past Work columns is available at `http://alumni.caltech.edu/~copeland/work`.

by Jim Frost



At Your Service

Last month (see "Building a Bean Pot," Page 54, `http://sw.expert.com/CA/SE.C10.MAY.99.pdf`), we implemented a framework for creating JavaBeans applications. This month, we're going to use that same framework to create a simple Internet server bean, exploring the Java sockets API and creating a thread pool to manage connections efficiently.

If you've ever built socket-based applications in C or C++, you're going to be pleasantly surprised at how much easier it is to do with Java (see `http://world.std.com/~jimf/papers/sockets/sockets.html` for some examples in C). Better yet, Java makes it quite easy to build efficient socket-based server applications–an arduous task in C/C++.

Basic Concepts

In Java there are only a handful of classes that you must be familiar with in order to build a TCP client or server application. They are:

```
Socket
ServerSocket
InputStream
OutputStream
DataInputStream
DataOutputStream
Thread
```

A *socket* is a communications endpoint. Think of it as a telephone handset. Like a telephone handset, which has a mouthpiece for input and an earpiece for output, a Java `Socket` object can be used to obtain an `InputStream` and an `OutputStream`. These are used to receive data from the TCP connection or send data over it, respectively.

A socket has an associated *port number*, which is very similar to a telephone extension number. It provides a way to allow multiple sockets to coexist on a machine that has a single Internet address, much like an extension number allows multiple telephones to use a single incoming telephone number.

To create a TCP-based server, the first thing you have to do is instantiate a `ServerSocket` object, supplying its constructor with the port number you wish your server to use (or zero if you'd like a random port). You then wait for a client connection by calling the `accept()` method. For example,

```
ServerSocket ss = new
   ServerSocket(port_number);
Socket clientSock = ss.accept();
```

A client that would like to connect to a server does so in a similar manner:

```
Socket s = new Socket
   ("domain.com", port_number);
```

Once a client has connected to the server, each side may retrieve data streams by calling the methods `getInputStream()` and `getOutputStream()` on the `Socket` object and use them as appropriate for the application.

Because most applications will be

sending complex data types over the TCP connection, it is often useful to wrap the `InputStream` and `OutputStream` returned by a `Socket` object with `DataInputStream` and `DataOutputStream` objects, respectively. These objects provide reliable communication of many basic Java types, including `Strings`.

Thread Pools

One of the most severe limitations in the Java I/O system design is there is no concept of nonblocking I/O, nor any way to have one thread wait on multiple I/O streams simultaneously. This effectively forces all Java servers to be multithreaded.

There is a lot to like about multithreaded servers; in particular, they are easier to write than single-threaded servers and their performance is usually much better. In fact, typical UNIX servers emulate the threaded server design using the `fork()` system call to create new execution contexts by cloning the server process. Because this duplicates many process resources it is an expensive technique, but one for which UNIX has been optimized over the years.

In Java, the typical technique is to spawn a new thread to handle the task. A typical `ConnectionHandlerThread` object might look like this:

```
public class HandlerThread
  extends Thread
{
  private sock;

  public HandlerThread(Socket sock)
  {
    this.sock = sock;
    start();
  }

  public void run()
  {
    // … do something with the socket …
  }
}
```

A server can then loop on the `ServerSocket.accept()` method, spawning new threads to handle each connection:

```
for (;;) {
  new HandlerThread(ss.accept());
}
```

This design is simple, but has a big drawback. As much as Sun Microsystems Inc. would like you to believe threads are cheap enough to create and destroy on-the-fly, it's not true. On most systems, thread creation is fairly expensive, and a high-volume server will waste a lot of time creating new ones. Furthermore, there are often limits as to how many threads an application can spawn simultaneously. On some operating systems, that limit may be as low as a few hundred threads. If you create threads willy-nilly according to the whim of clients–as the above code example does–your system may become overloaded.

The typical approach for dealing with both of these problems is a *thread pool.* In such a design, you preallocate a set of threads that will continually process requests throughout the life of the server. This has two benefits. First, the number of threads you allocate becomes the maximum concurrency of your server. No matter how many clients try to connect, your server will not be overloaded; clients may have to wait longer or try again, but the server will keep running and will process as many as it can. Second, all of the thread creation costs are taken care of up-front, allowing the server to spend more time working and less time on overhead.

Listing 1 illustrates the change necessary to the `HandlerThread` object to work as a pooled thread. The server simply creates a number of these threads after creating the `ServerSocket` object:

```
ServerSocket ss = new ServerSocket(port_number);
for (int i = 0; i < 10; i++) {
  new PooledHandlerThread(ss);
}
```

Listing 1. The PooledHandlerThread Class

```
/**
 * A thread in a socket connection handler thread pool.
 */
public class PooledHandlerThread extends Thread
{
  private ServerSocket ss;

  public PooledHandlerThread(ServerSocket ss)
  {
    this.sock = sock;
    start(); // start up the thread now
  }

  public void run()
  {
    for (;;) {
      Socket sock = null;
      try {
        sock = ss.accept();
      }
      catch (IOException e) {
        e.printStackTrace(System.err);
        return;
      }
      finally {
        if (sock != null) {
          try {
            sock.close();
          }
          catch (IOException e) {}
        }
      }
    }
  }
}
```

Unfortunately, the upper limit on the number of threads a Java application can create effectively limits how many concurrent clients a Java server can have. As of Java Development Kit 1.2 (now called Java 2), the only workaround for this limitation, outside of native code, is to run multiple servers.

A Generic TCP Server Bean

Now that we've taken a look at the basic concepts and objects behind a Java-based TCP server, let's look at a complete one. Our example uses the standard "abstract factory" design pattern (see *Design Patterns*, by Erich Gamma et al, published by Addison-Wesley Publishing Co., 1994, ISBN 0-201-63361-2, pp. 87-95) to allow the substitution of factories that implement different server functionality without the modification of the server framework. The basic server and class factory are both implemented as JavaBeans that run within the Bean Manager framework we built last month. Our example is a simple file server that sends the contents of a file (for example, `/etc/motd`) to any client that makes a connection.

Listing 2 shows the `GenericTcpServer` bean. Here, the `beanInstantiated()` method, which is called by the Bean

Listing 2. The GenericTcpServer Bean

```
public class GenericTcpServer implements BeanInstantiationListener
{
    /** The port number to be used by the server. */
    private int port;

    /** The server socket created by the server. */
    private ServerSocket serverSocket;

    /** The number of threads to be used by the server to handle clients. */
    private int threadPoolSize;

    /** The object factory that creates new connection handler threads */
    private ConnectionHandlerThreadFactory handlerFactory;

    // Property accessors

    public ConnectionHandlerThreadFactory getConnectionHandlerFactory()
    { return handlerFactory; }

    public void setConnectionHandlerFactory(ConnectionHandlerThreadFactory newHandlerFactory)
    { handlerFactory = newHandlerFactory; }

    public int getPort()
    { return port; }

    public void setPort(int newPort)
    { port = newPort; }

    public int getThreadPoolSize()
    { return threadPoolSize; }

    public void setThreadPoolSize(int newSize)
    { threadPoolSize = newSize; }

    // BeanInstantiationListener interface implementation

    /** Method called when the bean is fully initialized.  This creates the server-side socket
      * and a pool of threads to service it. */
    public void beanInstantiated(BeanHandle handle)
    {
        try {
            serverSocket = new ServerSocket(port);
        }
        catch (IOException e) {
            System.err.println("Cannot start server on port " + port);
            e.printStackTrace();
            System.exit(1);
        }
        System.err.println("Server started on port " + port);
        for (int i = 0; i < threadPoolSize; i++) {
            // create connection handler thread pool
            handlerFactory.createHandlerThread(serverSocket);
        }
    }
}
```

Manager after the bean is instantiated and configured, creates the `ServerSocket` object and launches a set of threads created by the `ThreadHandlerFactory` bean that is supplied as a bean configuration option. The server is up and running as soon as the first thread is created.

Listing 3 shows the abstract base class, `ConnectionHandlerThread`, which is the base class for all threads in our server's thread pool. This implementation is very similar to the previous example.

Meanwhile, Listing 4 shows the `ConnectionHandlerThreadFactory` interface, which must be implemented by the factory bean that creates threads to handle client connections. Its only method is `createHandlerThread()`, whose job it is to instantiate a new pooled thread using the supplied `ServerSocket`.

Finally, Listing 5 on Page 48 is the implementation of the `FileConnectionHandlerThreadFactory` bean, a concrete instance of a connection handler thread factory. An inner class, called `FileConnectionHandlerThread`, provides the actual server functionality for a single client connection. This inner class subclasses `ConnectionHandlerThread`. Then, its `handleClient()` method

Listing 3. The ConnectionHandlerThread Base Class

```
/** A thread that handles client connections.  This must be subclassed to implement
  * specific server functions. */
public abstract class ConnectionHandlerThread extends Thread
{
    private ServerSocket serverSocket;

    /** Creates a new connection handler thread. */
    public ConnectionHandlerThread(ServerSocket serverSocket)
    {
        super("connection-handler");
        this.serverSocket = serverSocket;
        start();
    }

    /** Thread body; this waits for threads to connect to the server socket and passes them
      * off to a handler method. */
    public void run()
    {
        for (;;) {
            Socket sock = null;
            try {
                sock = serverSocket.accept();
            }
            catch (IOException e) {
               e.printStackTrace();
            }
            if (sock == null) // terminate thread on error
               return;

            try {
               // handle the client connection
               handleClient(sock);
            }
            catch (Throwable t) { // catch-all error handler
               t.printStackTrace();
            }
            try {
               sock.close();
            }
            catch (IOException e) {}
        }
    }

    /** Method called when a client has connected. */
    protected abstract void handleClient(Socket sock) throws Exception;
}
```

Listing 4. The ConnectionHandlerThreadFactory Base Class

```
/** An object factory that creates connection handler threads. */
public interface ConnectionHandlerThreadFactory
{
    /** Creates a new connection handler thread object. */
    public ConnectionHandlerThread createHandlerThread(ServerSocket serverSocket);
}
```

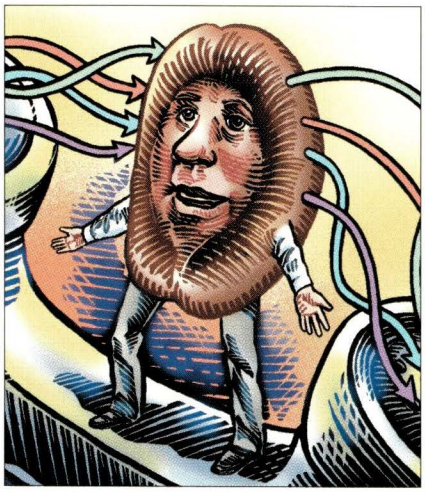
Listing 5. The FileConnectionHandlerThreadFactory Bean

```
/** An object factory that creates connection handler threads. */
public class FileConnectionHandlerThreadFactory
    implements ConnectionHandlerThreadFactory
{
    /** The name of the file that our connection handlers will send to the client. */
    private String filename;

    // Property accessors

    public String getFilename()
    { return filename; }

    public void setFilename(String newFilename)
    { filename = newFilename; }

    // Abstract method implementations

    /** Creates a new connection handler thread object. */
    public ConnectionHandlerThread createHandlerThread(ServerSocket serverSocket)
    { return new FileConnectionHandlerThread(serverSocket); }

    // Inner classes

    /** A connection handler thread that dumps the contents of a file to the client. */
    class FileConnectionHandlerThread extends ConnectionHandlerThread
    {
        FileConnectionHandlerThread(ServerSocket serverSocket)
        { super(serverSocket); }

        // Abstract method implementations

        /** Called by our superclass whenever a client connects to us. */
        protected void handleClient(Socket sock) throws IOException
        {
            FileInputStream fileIn = null;
            OutputStream sockOut = sock.getOutputStream();
            try {
                // open the file
                try {
                    fileIn = new FileInputStream(filename);
                }
                catch (IOException e) { // oops; configuration error
                    System.err.println(e);
                    sockOut.write(e.toString().getBytes());
                    sockOut.write('\n');
                    return;
                }

                // copy file to the socket
                byte[] buffer = new byte[1024];
                for (;;) {
                    int bytesRead = fileIn.read(buffer);
                    if (bytesRead <= 0)
                        return;
                    sockOut.write(buffer, 0, bytesRead);
                }
            }
            finally { // clean up
                try {
                    if (fileIn != null)
                        fileIn.close();
                }
                catch (IOException e) {}
                sockOut.flush();
            }
        }
    }
}
```

opens the file specified in the factory bean configuration and copies it to the socket `OutputStream`.

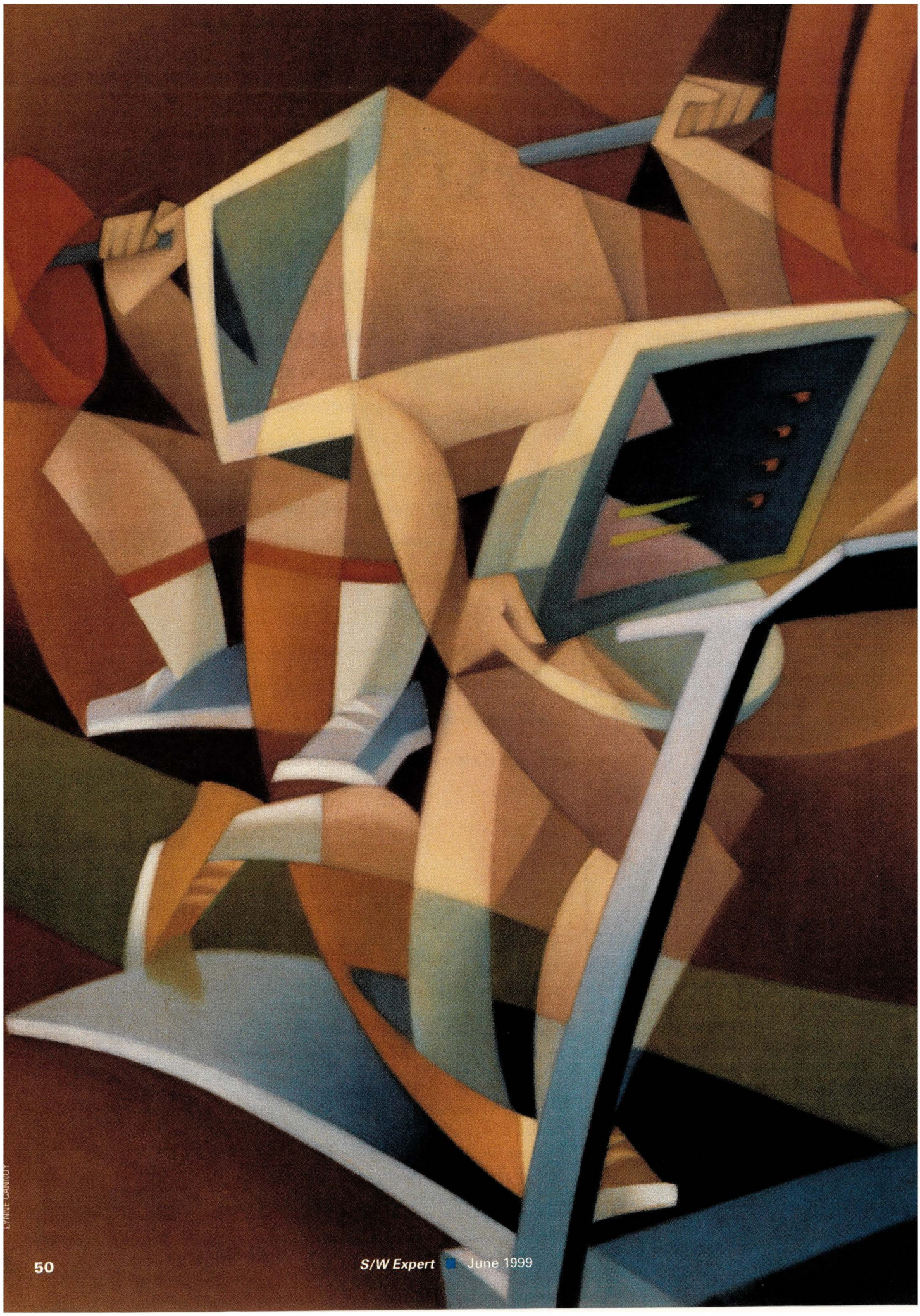
The code for this example, the associated bean configuration files and the Bean Manager from last month can be downloaded via anonymous FTP from `ftp://ftp.expert.com/pub/JavaClass/06.1999/`. To start the server, simply run the `runserver` script. The server will start up and tell you the port number on which it is waiting for connections (10000 by default). The normal `telnet` application makes a handy client:

```
[jimf@snowplow]$ telnet
   localhost 10000
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
        Welcome to Snowplow
 Development Server To The Stars
Connection closed by foreign host.
```



This month, we built a framework that could be the basis for almost any TCP-based Internet application; a very useful thing indeed in this day and age. In the process, we touched on the use of threads in servers as a way to handle concurrent clients efficiently. Next month, we'll delve more deeply into their use, including some design patterns and useful synchronization objects.

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



LYNNE GARNOT

Make Way for Flat-Panel Monitors

Get ready folks, thin is in! Well, maybe not quite 'in' yet, but certainly on its way. Get set to clear those heavy CRTs off burdened desktops and make room for fit and trim flat-panel LCDs.

by Alexandra Barrett

Over the years, we've become so accustomed to having cathode ray tube (CRT) monitors perched on our desks that it's hard to imagine things any other way. Sure, CRTs are ungodly heavy and they do take up the better part of an average-size desk, but where would we be without them?

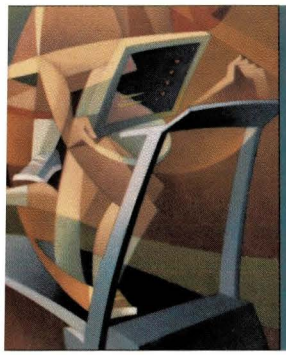
As it turns out, CRTs are no longer your only option when it comes to monitors. More and more, flat-panel displays based on thin film transistor liquid crystal display (TFT-LCD) technology are posturing themselves as attractive alternatives to the ubiquitous CRT.

And while the day when flat-panel LCDs outnumber desktop CRTs is still distant, industry observers say the CRT's days are definitely numbered. Better hold onto your hats, boys and girls, CRTs are a thing of the past. Or at least, they will be in another 10 years or so.

Already, if you look hard enough, it's possible to see cracks in the CRT's stronghold of the desktop monitor market. In 1998, LCD flat-panel monitors made up only 1% of the total desktop monitor market, according to

Stanford Resources Inc., San Jose, CA, a market research firm specializing in computer displays. But this year, it's predicted the technology will capture 2.1% of the market.

When taken out of the context of CRTs, of which the United States alone houses 80 million to 90 million units, LCD flat-panels have exhibited staggering growth. Last year, flat-panel sales grew by 600%. And as the technology improves and prices drop, demand is only expected to increase.



Especially when it comes to the mainstream desktop monitor market, the size and weight of flat-panel LCDs are by far their most attractive features.

Of course, "600% growth is easy to attain when you're starting from zero," cautions Rhoda Alexander, senior market analyst with Stanford Resources. "It's important to keep that in perspective."

But statistics or no, "flat-panels are the future of monitors," says Jeff Geis, marketing manager for Samsung Information Systems America Inc., San Jose, CA. Whereas only 5% of Samsung's total monitor sales can be attributed to flat-panel LCDs, Geis says he wouldn't be surprised to find 25% to 30% of monitor sales coming from LCDs within the next five to six years.

Why Go Flat?

Indeed, besides their sleek appearance, flat-panel LCDs have many virtues. First among them is their, well, flatness. Especially when it comes to the mainstream desktop monitor market, the size and weight of flat-panel LCDs are by far their most attractive features. Whereas a typical CRT is usually about as deep as it is wide, an average LCD flat-panel is only about three inches deep. Given a 15-inch monitor, this represents a space saving of roughly 70%.

Furthermore, because flat-panels are relatively light (a 15-inch flat-panel LCD typically weighs well under 20 lbs), you can usually mount them directly on a wall, taking up no desk space whatsoever. Mounting the panels, however, comes with a few provisions: Before mounting, the user should feel comfortable that the monitor is positioned exactly where they want it, because it's hard to adjust once the monitor has been installed.

The market's great appreciation for LCD's reduced footprint is evident in the industry in which LCD flat-panels have really taken off–the financial market. "This is a market with severe space constraints," says Lorene Salcido, product line manager for peripherals and I/O strategy at Sun Microsystems Inc., Palo Alto, CA. "If you're a broker with two 21-inch CRTs on your desk, it can get kind of difficult to do anything else," Salcido says, painting pictures of Wall Street trading floors teeming with brokers.

Other space-constrained industries that have latched onto flat-panel displays include the military, which reportedly uses flat-panels in space-limited mobile units such as tanks and submarines; the health care industry, where flat-panel displays are sometimes seen on rolling nurses' stations; and factory floors, where the displays can be mounted directly onto walls or equipment.

The space savings you get from a flat-panel LCD over a CRT can be significant no matter what industry you work in. After all, who couldn't use a little more desk space?

But space isn't the only reason to go with a flat-panel LCD. Power consumption is a big reason too, says Emanuel Soucek, president of Advanced Video Technologies Inc., a Marlborough, MA-based monitor VAR. Whereas, for example, the 15-inch DJ530 CRT from MAG Innovision, Irvine, CA, consumes up to 80 watts, the 15.1-inch LC-150M2U LCD Video Monitor from Sharp Electronics Corp., Mahwah, NJ, uses a maximum of 40 watts. "If you have a floor full of CRTs, replacing them with flat-panel displays can make a big difference power-wise," says Sun's Salcido.

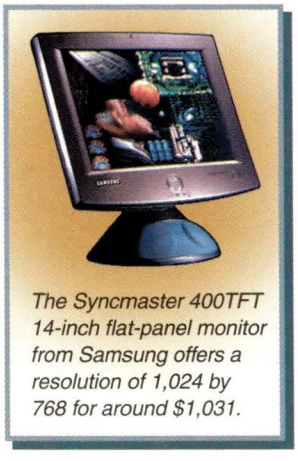
Plus, flat-panel LCDs emit hardly any radiation and, unlike CRTs, are not susceptible to magnetic fields. These features make LCDs naturals for both industrial and medical markets, which in the past have had to custom-order CRTs with heavy shielding so that they won't interfere with sensitive equipment.

A few manufacturers have begun offering flat-panel LCDs that can be turned from landscape to portrait orientation. Examples of these include the 1600SW from SGI (formerly Silicon Graphics Inc.), Mountain View, CA, and the LS500C and LT500C from MAG Innovision. This functionality is reportedly of interest to the CAD/CAM and desktop publishing industries, because it enables users to work with larger views of certain images.

Finally, LCDs are sometimes said to last longer than CRTs. That's because the electron gun used in a CRT generates intense heat, which will eventually cause parts to fail. Also, because LCDs are not subject to magnetic fields, images rarely get distorted and the monitors never need to be degaussed.

Why Not Flat?

Despite their advantages, flat-panel monitors have so far remained largely niche market products. And for good reason: Flat-panels are more expensive than CRTs and, overall, don't offer the same image quality. But increasingly, flat-panel manufacturers are introducing products that are silencing the critics.



The Syncmaster 400TFT 14-inch flat-panel monitor from Samsung offers a resolution of 1,024 by 768 for around $1,031.

In short, flat-panel LCD manufacturers have not been sitting still the past few years. "There's a lot going on in flat," says Bob Steinberg, president of Iicon Corp., Morgan Hill, CA, a monitor reseller, "because ultimately, everyone wants to have a flat-screen display on their desktop."

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with a CRT over a flat-panel LCD has been cost. A few years ago, when a 17-inch monitor cost $500, a flat-panel LCD cost between four and 20 times as much.

In 1998, however, flat-panel pricing dropped dramatically. "[Last year] saw as much as 50% price erosion," says Stanford Research's Alexander. However, CRT prices also fell. Today, the basic rule of thumb is a flat-panel LCD costs about twice as much as a comparable CRT monitor. Although these prices keep flat-panels off most desks, "a flat-panel monitor is no longer out of the question," says Samsung's Geis.

The LT500C 15-inch flat-panel from MAG Innovision can be turned from lanscape to portrait orientation.

But, if you're waiting for prices to drop further, you might end up waiting a while. In fact, some industry observers actually foresee prices rising slightly this year, especially for larger displays. "Prices went down and down and down," says Sun's Salcido. "It's possible that they went down too far."

It doesn't take a Ph.D. in economics to understand why flat-panels are so expensive, and why prices aren't dropping faster. The fault lies mainly with the manufacturing process, which is complex and imperfect. In particular, when it comes to newer 18-inch-plus-sized panels, "yields have been significantly less than what you could hope for," says Alexander. In fact, for every 1,000 motherglass panels (the initial glass panel manufacturers work with to get the final display), you only get between 100 and 200 actual displays, Salcido says.

Manufacturers are also recouping large investments in flat-panel research and development. For example, Samsung invested more than $2 billion into TFT-LCD research between 1995 and 1996, Geis says. Investments this large make it difficult for vendors to offer flat-panel products at more competitive price points.

The law of supply and demand also figures into the flat-panel's elevated price. Because the manufacturing process is so imprecise, demand for flat-panels far outpaces supply, meaning only organizations that truly need flat-panel displays will buy them, with very little regard for what they cost. "The industry is engaged in a waltz of sorts between capacity and demand," Alexander says.

In order for flat-panels to go truly mainstream, Alexander estimates they will need to retail at $500 or less. "That appears to be the price point consumers are comfortable with," she says. It's feasible that will happen in about five to six years, but more realistically, Alexander says, the $500 mark will be attained in seven or eight.

Quality: No Longer a Bugbear

Image quality is another factor that has traditionally hindered the acceptance of flat-panel LCDs, but that concern is rapidly falling by the wayside, according to some industry observers.

For one, the latest generation of flat-panel monitors boast resolutions competitive with most mid-range CRTs, and a few with resolutions that are better. For example, the 20.1-inch MultiSync LCD2010 from NEC Technologies Inc., Itasca, IL, has a maximum resolution of 1,280 by 1,024, while the 17.3-inch 1600SW from SGI features a whopping 1,600-by-1,024 resolution.

Also, although flat-panel LCDs are

Moving to a Digital Interface?

When it comes to digital flat-panel monitors, "the biggest problem is there are no cards for them," says Dave Nelson, chief engineer at Software Integrators Inc., Bozeman, MT, a fixed-frequency video card manufacturer. Or at least, not many. But what is also hindering controller manufacturers is the lack of consensus on a digital interface standard.

To date, there are four basic contenders vying for the digital interface crown, each with their own proponents:

- Plug & Display (P&D), developed by the Video Electronics Standards Association, or VESA (http://www.vesa.org), uses Transition Minimized Differential Signaling (TMDS) technology from Silicon Image Inc., Cupertino, CA, which defines a single connector for analog and digital video data.
- Digital Flat Panel (DFP), also from VESA, specifies a single connector for digital video, and is also based on TMDS. DFP was ratified in March.
- Digital Video Interface (DVI) is a single-connector digital video interface, which uses TMDS technology developed by the Digital Display Working Group (http://www.ddwg.org), an open industry group lead by Intel Corp. A final draft of DVI was announced in February.
- LVDS Digital Interface (LDI) is a digital video interface that uses a single connector based on Low-Voltage Differential Signaling (LVDS) technology developed by National Semiconductor Corp., Santa Clara, CA, and Texas Instruments Inc., Dallas, TX.

Which one of these standards will take hold is still anyone's guess, however. Software Integrators' Nelson likens the digital interface standard controversy to the early days of CD-ROMs, when there were three or four different flavors, and none were mutually compatible. Whatever the case, Nelson says, "It's whoever has the most clout in the monitor world–not the card business–who will win."–*ab*

all technically fixed-matrix displays (that is, if the panel's native resolution is 1,024 by 768, there are exactly 1,024-by-768, or 786,432, pixels on the screen) and, therefore, limited to displaying images at a single resolution, some manufacturers have recently begun to equip flat-panel LCDs with the ability to display images at less than native resolutions as well. This is typically done using an expansion technique known as interpolated algorithm, which calculates how to show images in nonnative resolutions. For example, Panasonic Computer Peripherals Co., Secaucus, NJ, has unveiled a new super-thin monitor, the PanaFlat LC90S 19-inch digital multiscan LCD, which features a TFT active-matrix screen, ultrafine 0.294mm dot pitch, a spectrum of 16.77 million colors and a contrast ratio of 200:1.

Being able to work with multiple resolutions is very important for some users, says Iicon's Steinberg. "Our industrial customers, for example, could not use LCDs as long as they were single resolution."

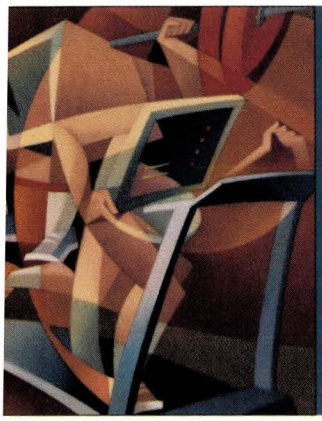
Screen response time–a traditional LCD bugaboo–has improved as well. Trails and image burn-in have been significantly diminished, says Sun's Salcido. Certainly, SGI is marketing its 1600SW toward graphics-oriented professionals, who previously wouldn't have considered an LCD panel over a CRT.

And manufacturers are working hard on what is perhaps the number one annoyance associated with flat-panel monitors: the viewing angle. Anyone who's ever worked with a laptop is familiar with this problem. The minute you sit anywhere but directly in front of the LCD display, you can't see it. The images appear washed out or negative from any angled viewpoint.

Several companies have introduced workarounds to this technological shortcoming. NEC, for example, offers flat-panel MutliSync LCDs with so-called "XtraView," which delivers a viewing angle of 160 degrees. This means you can sit 80 degrees in any direction (up, down, left or right) from the center of the monitor and still see the image clearly. Samsung too, offers a 160-degree viewing angle, says Geis, as do the SuperScan LC150 and LC140 displays

from Westwood, MA-based Hitachi-NSA Monitor Division.

And it can be argued that when it comes to desktop monitors, viewing angle is not as important as it might be on a laptop, because people who work with desktop-bound monitors don't typically vary their seating positions. Laptop users, on the other hand, work in a variety of locations and in a variety of positions, frequently taking their laptops on the road to give business presentations–a scenario where viewing angles become all-important.



LCD flat-panel manufacturers have made so many technological improvements over the past few years that some analysts feel certain LCDs are actually better buys than CRTs.

Another technological breakthrough that promises to help improve image clarity is the eventual digital interface, says Dave Nelson, chief engineer at Software Integrators Inc., Bozeman, MT, a manufacturer of fixed-frequency video cards and proprietor of the MonitorWorld.com reference site. Currently, most flat-panel LCDs have analog interfaces, which, Nelson says, can translate into poor image quality. "When you have an analog signal going to a digital device, you first have to decide where the start of each pixel is and then decode that information into digital data. If there's any uncertainty over where the start of the sync occurs, you get noise and jitter." So, for the consumer, a digital interface could mean fewer layers of noise and interference, Nelson explains, and ultimately, a clearer picture.

However, flat-panel LCDs equipped with digital interfaces are still few and far between, with products from Princeton Graphic Systems Inc., Santa Ana, CA, ViewSonic Corp., Walnut, CA, SGI and MAG Innovision being the notable exceptions. Nor is there much agreement over digital interface standards (see "Moving to a Digital Interface?" Page 54). As a result, not only are digital flat-panel monitors hard to come by, but so are the controller cards to run them.

In the end, though, LCD flat-panel manufacturers have made so many technological improvements over the past few years that some analysts feel certain LCDs are actually better buys than CRTs. For example, speaking of SGI's 1600SW, Martin Reynolds, vice president of technology for market research firm Dataquest Inc., San Jose, CA, says, "This high-resolution flat-panel monitor is a prime example of the benefits of LCD display devices: higher resolution, higher quality and a more convenient form factor than a CRT. Coupled with a much longer useful life and lower use of desk space, the overall cost of an LCD can come out below that of a CRT display despite the price premium."

Still, "There are certain industries for which I certainly wouldn't recommend flat-panels; for example, medical imaging. In these cases, you can't afford to have any clouding, the images absolutely can't be distorted," says Sun's Salcido. "Consumers definitely need to be educated before they buy a flat-panel monitor."

Who Sells Them?

LCD flat-panel monitors may have come a long way, but they're not commodity items yet. You can't pick one up at your local computer superstore; nor do most major equipment vendors offer flat-panels as part of their standard repertoire. To date, if you want to go flat, you'll probably have to apply to an OEM or VAR; or go directly to the manufacturer.

The SuperScan LC140 flat-panel display from Hitachi-NSA offers a 160-degree viewing angle.

However, high-end workstation and server vendors do have plans to start carrying LCD flat-panels in the near future, as soon as a few issues are resolved. For Sun, the issue is cost. "We've been waiting for the cost of a flat-panel display to be more in line with the technical and commercial markets," says Salcido. She estimates that Sun could begin directly offering flat-panel monitors by the end of the year. Although she could not divulge who would supply the Sun-branded panels, she could say that they would initially offer monitors with analog interfaces. "We'll go with an analog over digital interface because it's important to us that whatever monitor we offer be compatible with current systems," Salcido says.

Alexandra Barrett is a Massachusetts-based freelance writer specializing in computer industry topics.

Companies Mentioned in this Article

Advanced Video Technologies Inc.
34 Simarano Drive
Marlborough, MA 01752
http://www.avt.com
Circle 120

Hitachi-NSA Monitor Division
200 Lowder Brook Drive, Ste. 2200
Westwood, MA 02092
http://www.hitachidisplays.com
Circle 121

MAG Innovision
20 Goodyear
Irvine, CA 92618
http://www.maginnovision.com
Circle 122

NEC Technologies Inc.
1250 N. Arlington Heights Road
Itasca, IL 60143
http://www.nectech.com
Circle 123

Panasonic Computer Peripherals Co.
2 Panasonic Way
Secaucus, NJ 07094
http://www.panasonic.com
Circle 124

Princeton Graphic Systems Inc.
2801 S. Yale St.
Santa Ana, CA 92704
http://www.prgr.com
Circle 125

SGI
1600 Amphitheatre Pkwy.
Mountain View, CA 94043
http://www.sgi.com
Circle 126

Samsung Information Systems America Inc.
99 W. Tasman Drive
San Jose, CA 95134
http://www.samsungelectronics.com
Circle 127

Sharp Electronics Corp.
Sharp Plaza
Mahwah, NJ 07430
http://www.sharpelectronics.com
Circle 128

Sun Microsystems Inc.
901 San Antonio Road
Palo Alto, CA 94303
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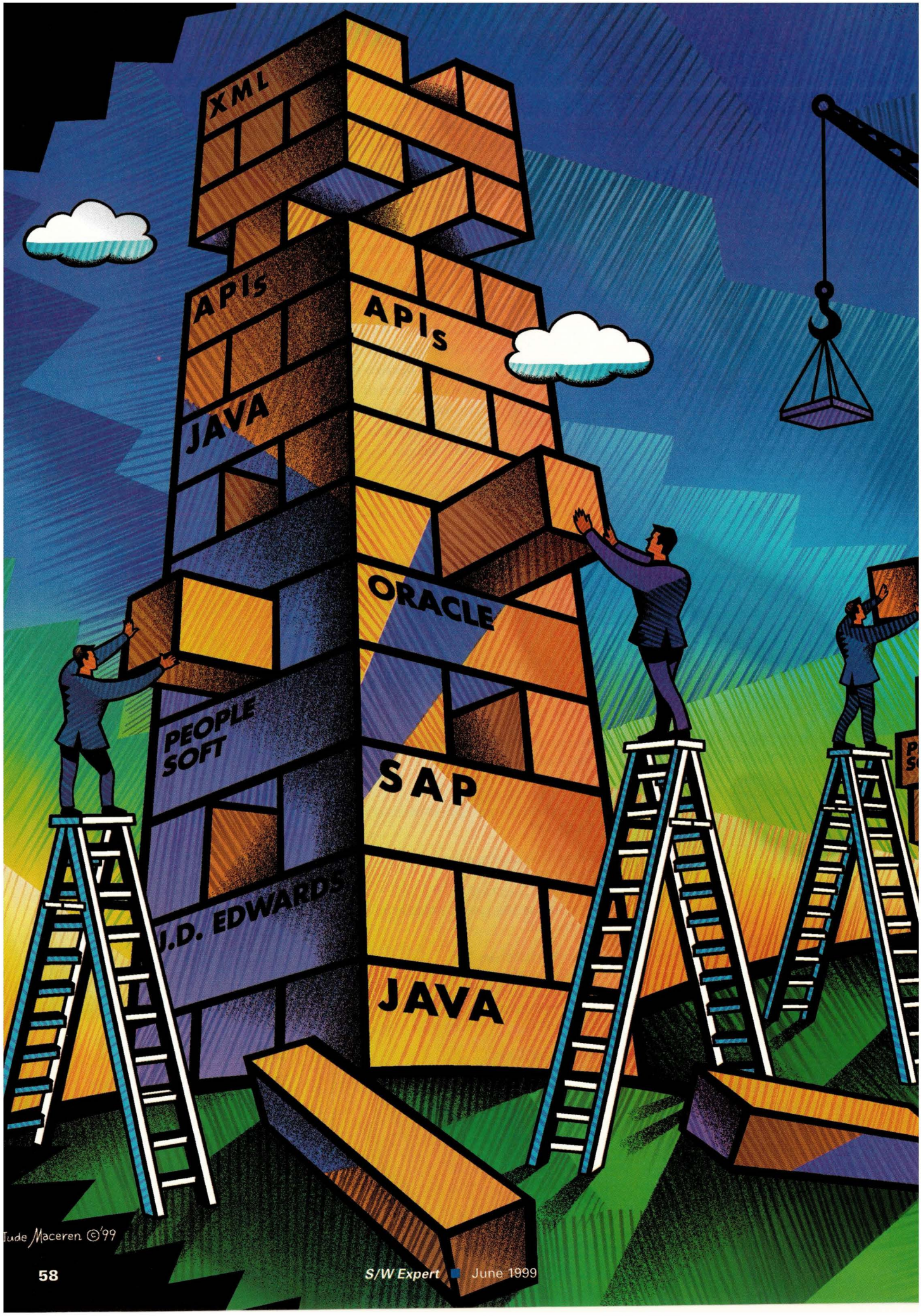
Circle 129

ViewSonic Corp.
381 Brea Canyon Road
Walnut, CA 91789
http://www.viewsonic.com
Circle 130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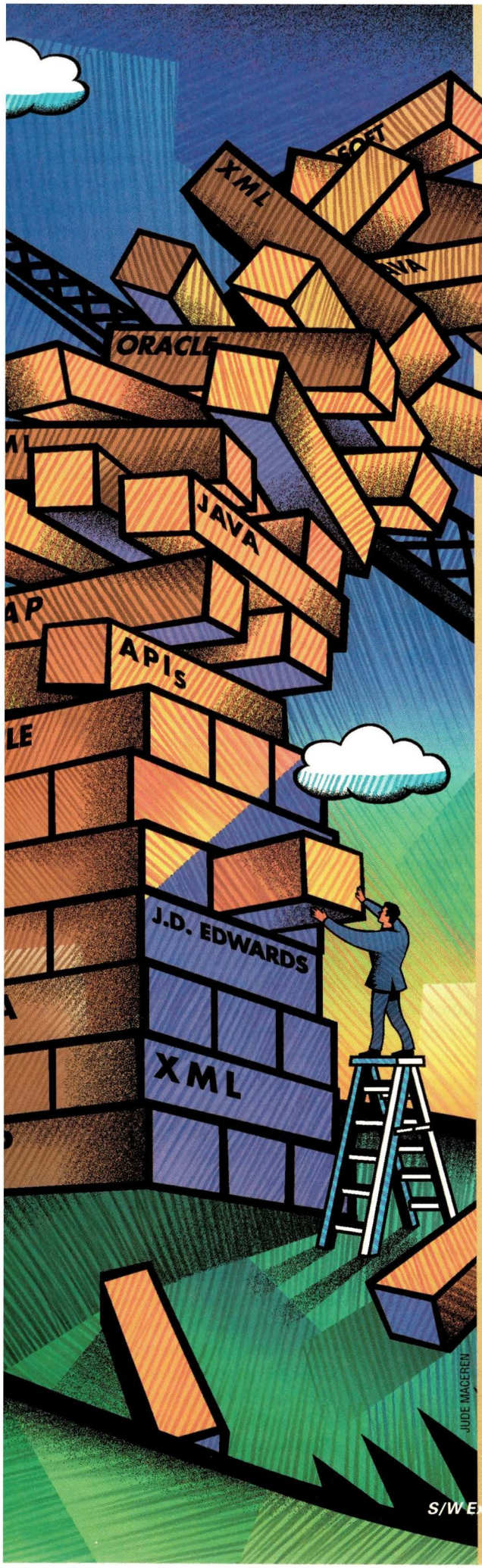


ERP Woes

by Suzanne Hildreth, Staff Editor

Where once a single, tightly integrated suite of enterprise applications seemed like the perfect solution, some companies are now finding that the tight integration is creating its own difficulties.

When enterprise resource planning (ERP) software first hit the market in the early 1990s, it was supposed to be a panacea for the agony of corporate software integration. ERP would provide companies with a tightly integrated, proprietary application framework for all finance, human resources and inventory functions. IT managers would finally be spared the misery of trying to get disparate pieces of business-critical software to communicate.

Well, that isn't quite how ERP has worked out for Bruce Ambler, manager of component technology and strategic planning for Lucent Technologies, maker of networking and communications hardware and software based in Murray Hill, NJ. ERP systems, as Ambler has discovered, sometimes bring their own integration woes.

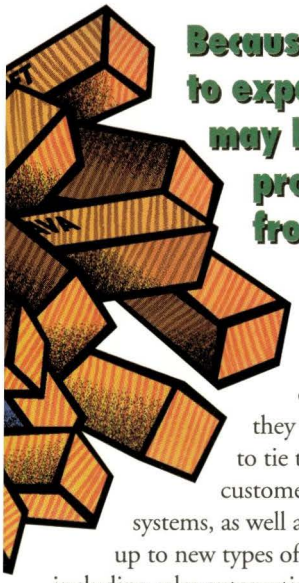
The problem is Lucent, an international company with a dozen different business units and 130,000 employees, regularly acquires other companies. With each new acquisition usually comes a new ERP system and a set of unique integration requirements.

"We can't just take all that infrastructure and throw it out," says Ambler. "So we knew integration was going to be necessary. That wasn't a surprise. But what has been a surprise is how much effort and resources it has consumed."

And it's not just the company's internal divisions that require integration. Increasingly, outside organizations, such as business

partners and suppliers, need to communicate with Lucent's systems as well. For example, one of Lucent's key suppliers wants the company to begin submitting its purchase orders electronically. However, that will require the construction of a special interface between the supplier's system and Lucent's–an added chore.

Lucent is a prime example of how some companies are hitting a glass ceiling on their ERP systems. Where once a single, tightly integrated suite of enterprise applications seemed like the perfect solution, now that tight integration is creating its own difficulties. Not only do companies need their various ERP systems to be able to communicate with one another, but they need to be able to tie them in with customer and supplier systems, as well as hook them up to new types of applications, including sales automation, customer relationship management (CRM) and electronic commerce systems.



Because more ERP vendors are trying to expand their systems, many customers may be able to avoid a major integration project by simply choosing a package from their existing ERP vendor.

"The interoperability issue has been with us since the packaged application industry began, but it's become a bigger issue now," says David Connolly, president of Open Applications Group Inc. (`http://www.openapplications.org`), a Chicago, IL-based, not-for-profit consortium of ERP vendors, customers and integrators, working on a data-sharing mechanism for ERP systems.

The rise of consumer and business-to-business e-commerce is one cause. Another is the emergence of new and different types of applications that must somehow be tied into the ERP framework. Such new applications include horizontal packages like CRM and e-commerce. They also include vertical, industry-specific applications, such as plant optimization software for the logging industry or applications that keep track of project bids and proposals for government defense contractors.

Eric Anderson, president of ERP-Link, a consulting and systems integration firm based in Portland, OR, says he's seeing a growing number of customers that want to hook third-party software packages to their existing ERP systems. "We see a shift in which companies that have already done their initial ERP deployments now want to fine-tune their environment with bolt-on applications that were not part of their original ERP vendor's package," Anderson says.

An example of this new type of "bolt-on" application is EMA–Enterprise Marketing Automation–software from San Mateo, CA-based Rubric Inc. Priced at $200,000 and aimed at marketing firms and departments within corporations, EMA provides an array of management and reporting functions for marketing projects such as trade shows, advertising and email campaigns. Written in Java, the application uses a Web interface so that marketing professionals inside and outside the organization can collaborate on projects and track results.

Hal Steger, vice president of marketing at Rubric, credits the Internet and electronic trade–both e-commerce and business-to-business online transactions–with helping to expand the scope of ERP systems to include applications such as EMA. As electronic business becomes more integral to companies' core operations, the need to integrate those e-business applications with existing ERP systems increases.

"It's forcing companies to completely streamline the whole customer interaction process," says Steger. He adds that e-commerce is necessitating the integration of whole categories of applications, starting with front-end applications like Rubric's marketing software and e-commerce sales software, to fulfillment and accounting applications, and logistics and supply chain management packages. All of these products, up and down the line, now have to communicate with one another. "E-commerce is making even traditional businesses feel the need to look at revamping their entire systems," Steger says.

Quick Fixes

Some ERP vendors are responding by offering modules of their own that can be retrofitted into the existing ERP framework. For instance, German company SAP AG offers SAP Online Store, a module that retailers, wholesalers and manufacturers can use to sell products over the Web, and the SAP Business-to-Business Procurement module, which enables employees to purchase corporate goods and services via a Web interface. Oracle Corp., Redwood Shores, CA, introduced a new sales force automation package in September–Oracle Field Sales Online–which is touted as being tightly integrated with Oracle's other ERP applications.

Because more ERP vendors are trying to expand their systems, many customers may be able to avoid a major integration project by simply choosing a package from their existing ERP vendor. That's often the best, short-term solution, says J.P. Morgenthal, president of consulting firm NC.Focus, Hewlett, NY. "We talk a lot about the ability to have interoperability between all these different applications, but I still believe there's something to be said for single-vendor solutions. Nobody has to call in four different people to try to debug something," he says.

But for many customers, being locked into their ERP vendor's solution is not an acceptable option. Instead, they want to choose from among several possible solutions and hook the winner to their existing system. For instance, says Open Applications Group's Connelly, certain types of emerging applications–such as CRM–haven't been adequately addressed by all the ERP vendors.

"The ERP firms have scrambled to fill those voids. But, frankly, most of the time those solutions have been less than

optimal, and customers tend to be less tolerant of less-than-optimal solutions in areas like CRM," Connelly says.

For customers who must integrate their ERP package with one or two third-party applications, several ERP vendors, including SAP, J.D. Edwards & Co., Denver, CO, and PeopleSoft Inc., Pleasanton, CA, have–or are developing–APIs or other hooks by which developers can access the data and methods within an application. For example, PeopleSoft's Forms API enables PeopleSoft applications to route forms to electronic forms packages. Similarly, J.D. Edwards sells an e-commerce API that enables third-party e-commerce packages to communicate with the J.D. Edwards OneWorld ERP application.

APIs work fine for point-to-point integration between two or three applications, but they can become complicated when multiple ERP systems and third-party applications are involved. And companies need to make sure that the third-party application they choose supports the vendor's interface or API.

Customers can also turn to one of the many enterprise application integration (EAI) tools on the market. EAI applications are middleware tools that translate data and/or business processes from one software package to another. EAI is a new market with such growth potential that market research firm The Aberdeen Group, Boston, MA, has predicted it will reach $1 billion by 2001. Key vendors in this market include Wilton, CT-based TSI International Software Ltd., maker of Mercator, a data mapping tool for SAP R/3 software and other applications; Vitria Technology Inc., Mountain View, CA, maker of BusinessWare; Oberon Software Inc., Cambridge, MA, maker of the Prospero suite of tools; British company Frontec AMT International, which sells the AMTrix System; and CrossWorlds Software Inc., Burlingame, CA, with its United Applications Architecture.

EAI applications work in a variety of ways. Some offer interoperability in terms of the data being exchanged, while others focus on translation between business processes. Some are intended for use only with specific ERP applications, while others promise to link together an array of applications.

Although EAI tools are a godsend for the majority of firms that need to link one or two ERP packages, they could, ironically, create their own legacy problems for large companies with several divisions that have each used a different EAI tool to integrate their own systems. A company could wind up with an integrated ERP system in one division that can't communicate with the integrated ERP system of another. That's because, while many of the products are based on standards such as Object Management Group Inc.'s Common Object Request Broker Architecture (CORBA), not all are. And being based on standards does not in and of itself guarantee interoperability, says John Rymer, president of Upstream Consulting, Emeryville, CA. "A company can easily bring in a product based on standards and still find itself with islands of integration that are expensive to interconnect."

Hope for the Long Haul

One standard that does hold promise of providing some sort of consistent interface between systems is eXtensible Markup Language (XML). XML is an ASCII-based markup language similar to HTML but used to define the content, rather than the appearance, of data. When used to link ERP systems, XML would enable a piece of information identified via XML tags as being, say, an address on a sales order, an inventory count of a new product or an employee's overtime hours, to be recognized and translated by any other system that supports XML.

XML could aid in the transfer of information between different ERP packages, as well as EAI packages. "For example, TSI supports XML as an input or output format for Mercator. This facilitates the chaining together of integration software, if necessary," says NC.Focus' Morgenthal.

Paul Mockenhaupt, director of marketing and development for advanced technologies at Lawson Software, Minneapolis, MN, plans to support XML in the near future and thinks XML will be a key technology for ERP systems within the next few years: "If an ERP application doesn't support XML in six months, it's missing the boat."

Microsoft Corp., Redmond, WA, is promoting XML as a communications architecture for ERP and other applications. Earlier this year, the company announced BizTalk, an XML-based framework for enabling different applications, running on different platforms, to exchange information via the Internet. It has so far garnered verbal support from a dozen or so vendors, including J.D. Edwards, PeopleSoft and SAP. And in April, PeopleSoft announced its own XML architecture–Open Integration Framework–that's supposed to enable third-party applications to be integrated with PeopleSoft applications via a set of XML-based APIs. The technology won't be available until later this year, however.

In January, the Open Applications Group published a set of XML Document Type Definition (DTD) files to define interoperability APIs for various ERP functions, such as financials, human resources, manufacturing, logistics and supply chain components. "We see XML as the mechanism for defining the business content that's sent between applications," says Open Applications Group's Connelly.

XML is one component of another, broader set of specifications, called the Open Applications Group Integration Specifications (OAGIS), which would enable users to mix and match various ERP applications. The specification envisions a Business Object Document (BOD)–a standard interface between ERP applications that would translate the data and processes of one application to another. Hence, customers would need only one interface to link all of their ERP applications. Lucent

Technologies, for instance, is working with one of its suppliers to use BODs to develop a standard interface between the two companies' ordering systems. This way, the supplier can use one interface to take electronic orders from all of its customers, including Lucent. "They don't want to have to build a separate interface for each customer's ERP system," Lucent's Ambler says.

Of course, a standard is only as good as the number of vendors that support it. So far, a little more than two dozen ERP and EAI vendors have joined the Open Applications Group in verbal support of XML and OAGIS. Two of the most notable supporters of the standard are QAD Inc., Carpenteria, CA, a manufacturing ERP software vendor and SAP, which has a partnership with TSI International Software to produce OAGIS-compliant wrappers for SAP's Business Application Programming Interfaces (BAPIs).

Most of the other vendors, however, do not offer any such support, although a few have said they will provide it if customers specifically ask for it. In an effort to prod vendors into compliance, the Open Applications Group has launched a Customer Interoperability Council to encourage customers to become involved in the process. But when that might happen is still an unknown. And, until more ERP vendors support the specification, it won't help current customers with their integration woes. "You can have all the schema definitions you want, but if nobody builds software on them, they're useless," NC.Focus' Morgenthal says.

Do It Yourself

While XML and BODs provide cross-industry approaches to the problem of ERP integration, there's nothing that says each industry or business segment can't come up with its own integration standard. This has been happening in the oil industry, where oil exploration and production (E&P) companies have been struggling with their own form of ERP integration.

Houston, TX-based Petrotechnical Open Software Corp. (POSC) has created a common data model–Epicenter–to facilitate interoperability between E&P applications. At the same time, a sister group, the OpenSpirit Alliance of oil companies, is working on a component framework for E&P applications. The user interface for the OpenSpirit framework is built in Java for client-side portability, while the framework itself is written in Java and is based on CORBA.

David Archer, chief executive officer of POSC, attributes the demand for an integration solution to the increased reliance on off-the-shelf applications and on the consolidation within the E&P software market. "The mantra over the past few years has been 'Buy don't build,'" says Archer. "And then what's happened with these [software] suppliers over the past decade has been that many of the smaller players have been gobbled up, and their applications have been integrated within the larger packages. And there are still some smaller players around. So we've got quite a quilt-work of solutions out there."

Now, several E&P vendors are actively supporting the POSC and OpenSpirit specifications and incorporating at least some of them into their products. ERP vendors may soon follow suit; Oracle jumped on the POSC bandwagon earlier this year when it announced it would create a suite of products for the E&P industry based on the POSC and OpenSpirit specifications. Archer is optimistic that other ERP vendors will eventually follow suit. He says that the

Companies Mentioned in this Article

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Intentia International AB
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http://www.jdedwards.com
Circle 144

Lawson Software
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Microsoft Corp.
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4460 Hacienda Drive
Pleasanton, CA 94588
http://www.peoplesoft.com
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Carpinteria, CA 93013
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2121 S. El Camino, 10th Floor
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Vitria Technology Inc.
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Mountain View, CA 94043
http://www.vitria.com
Circle 154

intent of the POSC and OpenSpirit alliance is to "build things that are open and freely available" and he hopes that vendors will use those specifications and architecture in their products.

The Java platform also holds some promise for easing integration and interoperability efforts. While not exactly an "open standard," middleware product or data-exchange solution, Java does promote interoperability by virtue of its ability to run on any client or server platform equipped with a Java Virtual Machine (JVM). That's one reason why the OpenSpirit alliance chose to develop its framework in Java. "The fact that it's cross-platform helps in one level of interoperability, as does the fact that it's object-oriented, so that you end up with reusable components that can be employed in different situations," Archer says.

There are currently only a handful of 100% Java ERP applications on the market. Swedish ERP vendor Intentia International AB began shipping a pure Java version of its Movex software suite in February. Rubric's software is written in 100% Java, as is the code for the BizTone ERP software from BizTone.com Inc., San Jose, CA, which sells ERP software via a subscription-based rental model over the Internet.

While most ERP vendors do not yet have all-Java applications, most do offer some sort of Web-based Java interface to their products, enabling users to access the ERP system from any client without having to install proprietary software. And, increasingly, vendors are moving to provide more server-side support as well. SAP, for example, which already has a Java version of its SAP GUI, now provides a Java Remote Function Call (RFC) class library for making Remote Procedure Calls (RPCs) from an external Java application to an SAP application.

"You can program in an external Java development environment using the Java class libraries to execute the [SAP] business logic," says Steve Smith, product marketing manager for SAP. "That allows external Java applications to access SAP functionality and business logic. Another future plan is to allow Java applications to run inside SAP applications and allow people to develop using either ABAP [SAP's proprietary development language] objects or Java inside the SAP development framework."

One of the ways SAP is considering doing this is to develop Enterprise JavaBeans (EJB) versions of SAP objects. EJB is Sun Microsystems Inc.'s specification for creating Java-based business components. EJB components can run on any platform, as well as any vendor's EJB-compliant application server. Lawson Software also announced support for EJB in February. "We're generating Enterprise JavaBeans for the complete Lawson system," says Mockenhaupt. "We have some 3,300 back-end services that are being wrappered in Java. So you can incorporate those however you want to in any JDE [Java Development Environment]."

Rubric's Steger says he expects to see more customers using Java and EJB for internal development in the future. This, he believes, will give Rubric's application and other Java-based applications an advantage in being able to integrate more easily with those in-house applications. "We're seeing more and more infrastructures being developed in Java. If your ERP application is written in Java, it makes the integration with the rest of the Java structure a lot more seamless."

Lucent's Ambler agrees that Java and EJB hold promise as a cross-platform framework, but adds that Java also needs other standards, such as XML or OAGIS BODs for the exchange of data and business logic and CORBA as a transport mechanism, in order to provide full interoperability. In the end, he believes, if the industry could just settle on a few key standards and get behind them, integration would be a lot cheaper all-around.

"The frustrating thing is that if vendors would all agree to implement standards, everything could be a lot easier, a lot quicker and lot less expensive, which means we could do more things for the business. I know that using standards is the right answer and if we could all agree on the standards, we would all be a lot better off," Ambler says.

CryptoSwift Helps Meet Client Demands

by **MARK PETRIE**, Staff Editor

As a hardware-based solution for secure e-commerce servers, the CryptoSwift product line can significantly reduce SSL transaction time and increase the number of clients a Web server can serve.

Since its crude mainstream beginnings in 1994, the World Wide Web has evolved from a medium for broadcasting Rolling Stones concerts to a legitimate way of conducting big business. According to Cambridge, MA-based Forrester Research Inc., electronic commerce sales totaled $43 billion in 1998 and are expected to reach $109 billion by the end of 1999.

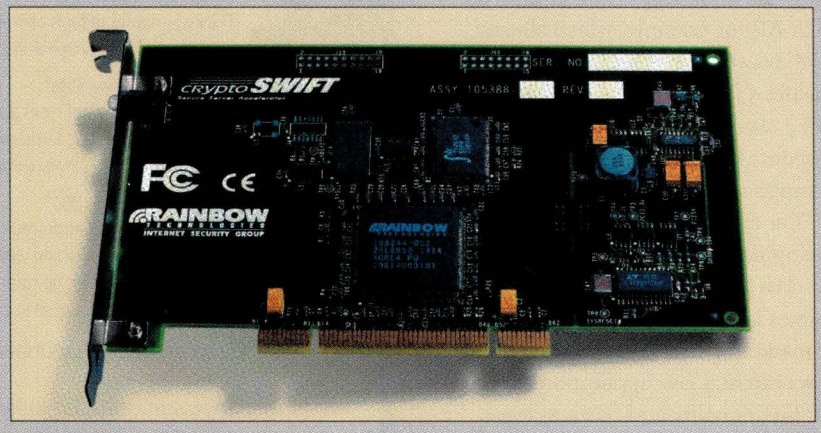
And Forrester isn't the only one with a bullish outlook. ActivMedia Inc., a Peterborough, NH-based market research firm, issued a report last year that predicts e-commerce revenue in the neighborhood of $1.2 trillion by 2002. Whether or not these predictions will materialize remains to be seen, but one only has to look at the latest feeding frenzy of Internet IPOs to realize that the hype surrounding e-commerce is quickly becoming a reality.

To support this staggering growth, network managers need to improve the speed and reliability of their Web servers. High-volume institutions, such as banks, brokerages and large retail stores, need the capability to process thousands of secure transactions over the Internet. Without proper planning, computationally intensive secure transactions, such as Secure Sockets Layer (SSL) and Secure Electronic Transaction (SET), can render an otherwise speedy server impotent. Formed in 1984, Rainbow Technologies, Irvine, CA, has been developing a solution to this very problem, and has become a leader in the field of encryption technology.

This month, Computer Publishing Lab takes a look at one of Rainbow's most popular offerings–CryptoSwift.

CryptoSwift is a hardware-based performance solution for secure e-commerce servers, and comes with either a PCI (CryptoSwift II) or Ethernet interface (CryptoSwift/EN). It supports SSL, IPSec, SET, `ssh` and ISAKMP. If you're an application developer, you will also be pleased to learn that Rainbow offers a CryptoSwift Software Development Kit (SDK).

At the heart of the CryptoSwift product line is a proprietary math coprocessor, which off-loads public key cryptographic operations from the CPU. As a result, it accelerates response time and frees up your Web server's CPU. According to Rainbow, your server will respond 50% to 90% faster if you add a single PCI card or CryptoSwift/EN.



With the CryptoSwift/EN 600 Ehternet Chassis or the CryptoSwift II-200 PCI board (above), your server will respond 50% to 90% faster, Rainbow says.

Installation

Rainbow sent us the CryptoSwift/EN 600 chassis and CryptoSwift II-200 PCI board for review. The CryptoSwift/EN series is designed for Solaris and HP-UX servers running Netscape Communications Corp. Enterprise Server. It connects to your existing Ethernet network (10/100BaseT) as a shared network resource. Installing the unit is straightforward, and we had it operational in minutes. Installation consists of establishing a direct serial connection and setting several networking parameters via a configuration utility. After you assign a hostname, IP address, subnet mask, gateway and the `syslog` IP address, CryptoSwift/EN should be live on your network. If not, the otherwise sparing installation manual has a couple of tips and troubleshooting suggestions.

For managers who prefer a PCI board solution to a network device, Rainbow also offers the CryptoSwift II. It plugs directly into your server's PCI bus and supports either Intel Corp. or SPARC architectures, along with various operating systems and Web servers (see Table 1). We installed the card in a Microsoft Corp. Windows NT Server 4.0 running Netscape Enterprise Server. The board comes with an installation CD, which includes drivers, documentation and a useful diagnostic tool.

Table 1. CryptoSwift OS/Server Support

Operating System	Web Server
Windows NT 4.0	Internet Information Server, Netscape
Linux	Apache, Stronghold
FreeBSD	Stronghold
Solaris 2.5/Intel	Netscape
Solaris 2.5/SPARC	Netscape
HP-UX B.10.20	Netscape

Table 2. Response Time/CPU Performance

Number of Threads	Without CryptoSwift		With CryptoSwift	
	Response Time (msec)	CPU Load (%)	Response Time (msec)	CPU Load (%)
0		4		4
1	732	75	198	7
2	1,228	94	191	12
3	1,705	98	188	17
4	2,319	100	187	23
5	2,310	100	181	27

Performance

To test the CryptoSwift/EN 600, we set up a 167-MHz UltraSPARC 1 with 128 MB of memory as the Web server, and several Pentium PC's running Windows NT 4.0 as clients. The Web server was running Solaris 2.5 with Netscape Enterprise Server 3.6 and strong bit cryptography (128-bit) enabled. We configured two secure ports on the server: One port would off-load the calculations to the CryptoSwift/EN 600, while the other port would leave the dirty work to the server's CPU. All systems were on the same segment of a 10-Mb Ethernet network. In addition to the UNIX server, we set up a Pentium Pro (200-MHz and 64-MB RAM) Web server to test the CryptoSwift II-200.

The performance of the Web server with and without CryptoSwift was compared using capacity and response time variables. Capacity is defined as the maximum number of threads (virtual clients) a server can accommodate before it reaches a steady state (100% usage of the CPU). Response time is the time elapsed from when a client sends a request to when the transaction is completed. Response times were gathered using a client performance tool called "show" (included with the Cyrpto-Swift software CD). This handy tool simulates any number of clients sending SSL requests to a specified Web server and port. Because response time and CPU usage may fluctuate within a range of values, we averaged times taken at 30-second intervals over a five-minute period. We did this with and without the CryptoSwift coprocessor active. CPU usage was measured using the `sar` command on the Solaris server and Performance Monitor on the NT server.

Table 2 compares the response time of a single threaded client requesting a 10-KB Web page from the server with and without the CryptoSwift/EN 600

Figure 1. Ultra 1/Solaris SSL Performance Load Comparison

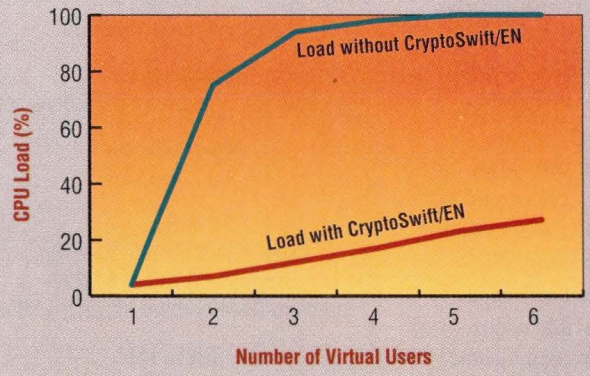
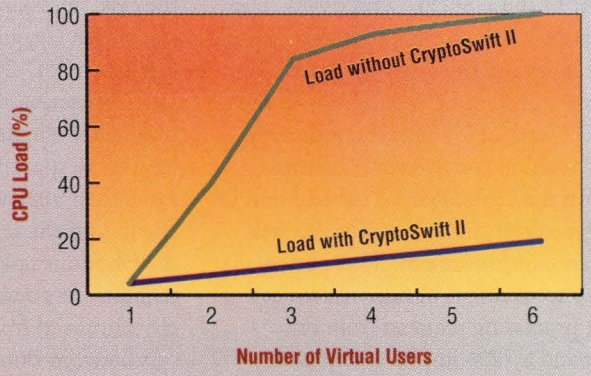


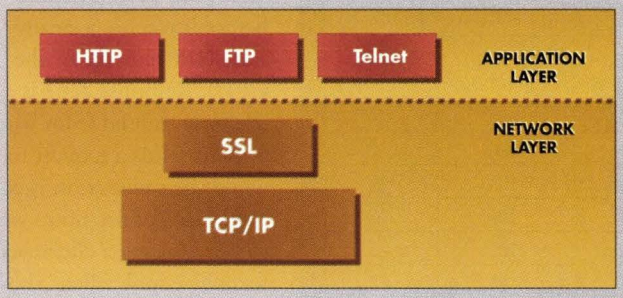
Figure 2. Pentium Pro/NT SSL Performance Load Comparison



Secure Sockets Layer

Secure Sockets Layer, or SSL, was developed by Netscape Communications Corp. in 1994 and has since become the de facto standard for secure communications between Web browsers and Web servers. The current version, introduced in March 1996, is 3.0. SSL provides three important functions: authentication, encryption and message integrity.

Sometimes thought of as a security extension of TCP/IP, SSL is actually a two-layered protocol that works on top of the transport layer and beneath application protocols such as HTTP, FTP, Telnet and Gopher (see figure below). One layer is the SSL Record Protocol, which encapsulates application protocols. The second layer is the SSL Handshake Protocol. This allows the server and client to authenticate one another (via an asymmetric or public key), to ensure that only the intended client can decrypt it (encryption) and that the message has not been tampered with during transmission (message integrity).



If you would like more information regarding SSL, security or how to implement it on your server, you may find the following links helpful:

- Internet.com's E-Commerce Watch
  http://www.webreference.com/ecommerce
- Netscape's SSL 3.0 Specification
  http://home.netscape.com/eng/ssl3/index.html
- RSA Data Security Inc.'s Planet SSL
  http://www.rsa.com/ssl
- VeriSign Inc.'s Security Center
  http://www.verisign.com

–mp

active. The test was repeated, each time increasing the number of virtual clients. Even with minimal server load (one client), the addition of the CryptoSwift/EN 600 improved response times by 70%. The performance benefits are even greater as more demands are placed on the server. With five virtual clients, response times improved by 92%.

Furthermore, the Web server without CryptoSwift/EN 600 reached capacity at 3.3 threads versus 98 threads with the unit (see Figure 1). Not only will existing users spend less time waiting, but your server can accommodate more clients without an adverse performance hit.

The performance numbers for the CryptoSwift II-200/Pentium Pro were similar to those of the UltraSPARC (see Figure 2). Without CryptoSwift's assistance, response time with one virtual client was 320 msec (versus 730 on the Ultra 1) and CPU load was noticeably lower with one or two virtual clients. As with the UltraSPARC, the addition of CryptoSwift made a significant performance improvement. There was a 33% improvement in response times when processing requests from one client and a 72% improvement with five clients. The server's capacity also improved from five virtual clients to 108 with the add-on board. This data is in line with Rainbow's claims. There were minor performance differences, but these can be attributed to differences in system and network hardware.

Conclusion

As organizations turn to the Internet for increased revenue, they need to consider whether their existing infrastructure is capable of meeting client demands. For companies that expect to process a large number of secure transactions, there are two options: increase the number of servers, or off-load the SSL/SET calculations to another processor.

For those that choose the latter, our tests indicate that CryptoSwift is up to the task. The benchmark results clearly show both CryptoSwift/EN 600 and CryptoSwift II-200 significantly reduce SSL transaction time and increase the number of clients a Web server can "serve." Response times improved by more than 90% with five concurrent clients and the server's CPU was spared the laborious task of processing SSL requests. As a result, our server's capacity improved from being able to process between three and five concurrent clients to more than 100–nearly a thirtyfold improvement.

The substantial improvement in performance, along with easy integration with your existing infrastructure, make the CryptoSwift/EN and CryptoSwift II ideal additions to your e-commerce arsenal. ⊸

CryptoSwift/EN 600 and CryptoSwift II-200

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Best Feature
Dramatically improves SSL processing

Worst Feature
Documentation

Price
CryptoSwift/EN 600 $13,989
CryptoSwift II-200 $4,299
Software Development Kit (SDK) $999

Circle 155

SUZANNE HILDRETH, Staff Editor

VPNs: Build or Buy?

A virtual private network (VPN) can be an effective way to reduce your company's remote access and LAN-to-LAN connection costs. But assembling your own VPN takes time and, usually, a substantial investment in equipment. With Y2K projects demanding priority, should you spend precious time and money building and maintaining your own VPN, or risk outsourcing the project to a VPN service provider?

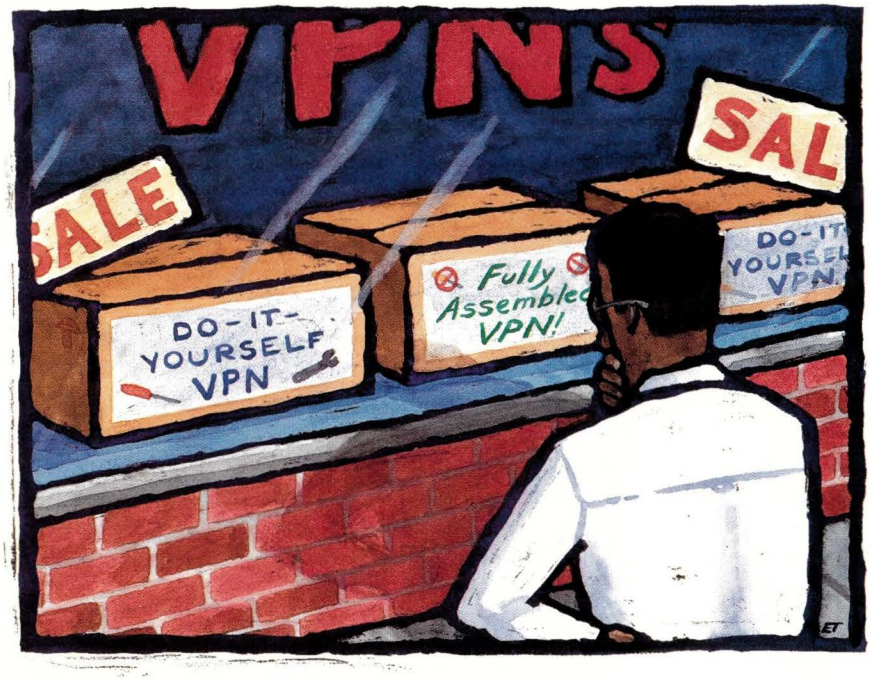


Illustration by ERIN TERRY

It's something David Pike, director of global network solutions for NCR Corp., Dayton, OH, asked himself when his company began shopping for a VPN service provider earlier this year. The answer, in NCR's case, was an unequivocal "yes" to outsourcing. "You get some investment protection [with outsourcing] in terms of equipment because the investment is made, fundamentally, by the provider," Pike says. "If a new technology comes along, we have the option to look at somebody else."

To outsource, or not outsource, is a question many IT managers are asking these days as the strain on resources increases and the number of VPN service providers grows. While outsourcing isn't necessarily cheaper than building your own VPN–in fact, it's likely to be more expensive–it offers a number of advantages, including protection from obsolete technology, less demand on your IT staff and, in most cases, a guarantee of adequate performance and security from the provider.

Essentially, a VPN is a mechanism for using a public network, such as the Internet, as a conduit for sending encrypted data between two secure endpoints. But the method by which a VPN is created can range from very simple to fairly complex. In the simplest of configurations, a VPN can be implemented with little more than an unmanaged Internet connection and some software on the sending and receiving end. On the other hand, the implementation can be a sophisticated arrangement of hardware VPN gateways, or VPN-enabled firewalls, strong security via smart cards, or security tokens, and network bandwidth management. Different vendors often provide different approaches to both the physical implementation and the inner workings of security and manageability, and with just about every networking vendor labeling its products a "VPN," sorting out the differences can be confusing.

Market confusion is one reason why many IT managers are opting to outsource all or part of their VPNs to third parties. Forrester Research Inc., a market research firm based in Cambridge, MA, estimates that U.S. companies will spend $602 million on VPN access services this year–up from $142 million last year–and that by 2002, U.S. purchases of VPN services will reach $8 billion. Similarly, Infonetics Research Inc., San Jose, CA, predicts that service provider revenue from VPN services will reach $9 billion by 2001. In addition, Infonetics says nearly 100% of the telecom Internet service providers (ISPs) it recently surveyed have plans to offer VPN services in 1999; as do 69% of national ISPs and 57% of local and regional ISPs.

If you want a VPN, but don't want to build one yourself, a number of third-party providers are ready to do it for you. Many telecommunications companies and national ISPs are adding VPNs to their menu of offerings. For example, Advanced Networks, a division of MCI WorldCOM based in Hilliard, OH, announced its SafeReach NT VPN service in January. SafeReach allows remote users to access their corporate networks through local dial-up or ISDN connections in 114 countries. Also, GTE Internetworking, Burlington, MA,

recently introduced a VPN service called VPN Advantage and New York City-based AT&T Corp.'s AT&T WorldNet Business Services division now offers AT&T WorldNet Virtual Private Network Service. Resellers and systems integrators are also getting in on the act. Consulting firm KPMG, New York, NY, offers iPass, a VPN service that bundles KPMG assistance in selecting hardware and software with a remote access service from iPass Inc., Mountain View, CA.

"Clients have been asking us to provide them with an integrated solution. They don't want to have to go out themselves and buy their equipment from one vendor, their authentication from another, their Internet access from still another and so forth," says David Moyer, senior manager for KPMG.

With VPN-1 RemoteLink from Check Point Software Technologies Inc., network managers can reportedly provide secure Internet connectivity to all locations throughout their network with a single, integrated product.

KPMG's provider, iPass, maintains a network of relationships with ISPs around the world, enabling it to provide remote access in 150 countries. Customers–resellers like KPMG, ISPs or corporations–can purchase the remote access service and use either iPass' VPN offering or their own VPN products on top of the iPass network.

Outsourcing to a knowledgeable provider can also offer a sense of security that comes from having an expert available for troubleshooting. A recent survey of the VPN market by TeleChoice Inc., a consulting firm based in Owasso, OK, found that customers with fully managed VPNs are more likely to be satisfied with their networks than those who build and manage their own.

Bob Schoettle, vice president of marketing for iPass, says outsourcing saves IT managers the headache of having to physically upgrade their VPNs every time branch offices or remote users need to be added to the network. "If you have to add 500 employees with remote access next week, it's as simple as equipping them with a password and the software on their laptop," Schoettle says.

But how much of the VPN can you–or should you–outsource? Unless your company happens to be a national ISP or telecommunications company with its own backbone, then you will at least have to outsource the transit portion of your VPN to an Internet access provider. However, a generic Internet access account can't give you much assurance that your VPN traffic won't get bogged down with the rest of the traffic on the Internet during peak hours. To ensure better performance, you may want to pay more for access from a provider that can offer you service-level guarantees (SLAs) on bandwidth, dial-in access and network availability. Some providers have their own private Frame Relay or Asynchronous Transfer Mode (ATM) networks over which much of the VPN traffic is routed, enhancing performance. You can also choose to have the ISP or VPN service provider select and install the necessary hardware and software, as well as assume the duties of technical support and ongoing maintenance. You can even ask the provider to handle the management of your security server for user access and authorization, although most firms prefer to manage this in-house.

Basically, what you outsource depends on the comfort level you have with your provider, says Skip Taylor, director of VPN product marketing for MCI WorldCom. "A customer says, 'I want to outsource this to lower my cost. But I also want to make sure I've got my security covered, and that I've got some performance guarantees, and that there will be someone to help me manage the solution end to end, and that I can get global access for remote users…,'" Taylor says. "With a plain vanilla ISP, the majority of those needs can't be met."

According to Susan Scheer, director of marketing for VPN vendor Cisco Systems Inc., San Jose, CA, there are four main elements involved in a VPN outsourcing arrangement that customers must evaluate. "A VPN must have quality of service, reliability, security and manageability. That's the value-add of a VPN. When you strip off those four things, all you have left is transport–the network pipes."

Reliability and Performance

Although most people think security is the most important aspect of a VPN, it's actually the VPN's performance that is most critical, says Chris Roekle, marketing director at Inverse Network Technology, a Sunnyvale, CA-based provider of service-level network management software. "If you're not able to get on to the network and have an efficient connection, the security is irrelevant," Roekle says. "A year ago, the VPN story was security, but the story for 1999 and beyond is going to be based on performance."

If the goal of your VPN is to provide remote access for mobile workers, then a key aspect of performance will be the number of points of presence, or POPs, the provider has in the geographic regions you need to service, as well as guarantees the provider can make in terms of its success rates for dial-up access. For example, GTE's VPN Advantage service boasts 97% busy-free dialing for remote access, with initial modem connect speeds of 26.4 KB/s or higher 99% of the time. Meanwhile, Concentric Network Corp., San Jose, CA, guarantees 100% network availability and a 95% connection success rate for dial-up service. When such guarantees aren't met, the provider typically offers some sort of financial compensation or service credit.

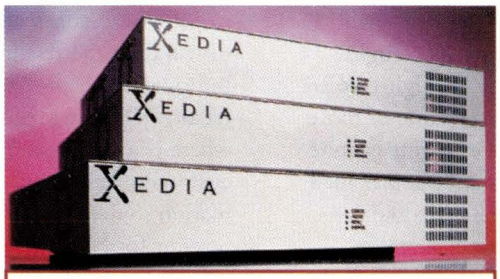
However, if your main goal is to provide a wide area network (WAN) for your company, you should be more concerned with overall network availability and speed. Providers currently measure this by guaranteeing a certain level of performance based on overall network averages. This may or may not be representative of an individual customer's experience.

"Most of the performance guarantees are based on averages of the backbone," says Roekle. "They poll all their routers every 15 or 30 minutes and that's how they come up with the data–based on hundreds of thousands of routers." While that is a useful measure of performance and can certainly give the

customer an idea as to what their own experience will be in terms of availability and network latency, Roekle says guarantees will eventually become more customer-specific. "For corporations to truly embrace the Internet for mission-critical applications, there needs to be more substantive data behind those performance claims." Inverse, for example, sells management software that allows an ISP or enterprise to measure performance between two specific points on a network.

Some vendors provide ATM or Frame Relay networks for VPNs. This way, VPN traffic doesn't have to compete for bandwidth with general Internet traffic and the provider can do a better job of managing the network's end-to-end performance. For instance, Intelispan Inc., the Scottsdale, AZ-based provider of a VPN service called exSPANd, has a national ATM/Frame Relay network that is linked to the Internet but physically separate from it. Using password and IP address identification and filtering, only authorized Internet traffic is allowed to enter the Intelispan backbone.

Down the road, VPN service providers will begin to offer guarantees for performance-sensitive traffic such as voice data or multimedia. For instance, a network might give higher priority to a streaming video transmission than to a file download because the video requires speedy transmission for it to be usable. While that's currently possible with traffic traveling over a single network, it's almost impossible to do for traffic that must traverse several networks. That's because, as yet, there is no single standard for prioritizing traffic over a network. "The Internet is an open architecture, but people have to standardize on all the features that people want, or things like quality of service can't happen," MCI's Taylor says.



Xedia Corp.'s family of Access Point T1/E1 and ATM QVPN routers are said to represent the industry's first multiservice access platforms to integrate standards-based IP routing, bandwidth management and VPN security with the performance and reliability needed to migrate business-critical applications to the Internet.

Manageability

Another issue to consider is what sort of management and reporting capabilities you want from your VPN provider. In most cases, VPN service providers offer subscribers some sort of Web-based access to network performance data and customer usage reports. If you want to do something more interactive, such as increase the number of users per port, you'll probably have to pick up the phone and call the company. However, some providers are starting to offer Web-based management options to customers. GTE's VPN Advantage boasts that its Web-based tools allow users to perform tasks such as conducting updates of remote configurations, adding/deleting users, controlling the issuance of digital certificates and monitoring performance-level data. Qwest Communications Corp., Denver, CO, has a remote access VPN service that allows corporate clients to have more control over their service, such as changing the number of ports in use at any given time.

However, these are not yet common service offerings, says Jeff Wilson, analyst with Infonetics. Few products currently support both end-user and service provider administration. "A lot of vendors are working on products that allow split administration, so customers can add and delete users and submit policy changes at a high level, but don't have to necessarily get into the details of how it's done," Wilson says. He predicts such tools will be available before the end of the year. "All service providers know they need to offer it, but not that many products right now enable it. It's coming, I'd say in the next six months."

Security

A VPN provides security through a combination of encryption, tunneling and user authentication/authorization. A firewall provides the main security defense by allowing only trusted, authorized users access to the corporate network. Beyond that, a VPN will usually include encryption and tunneling (encapsulating the data packets for transport through a public network). VPN providers may also provide security through private trunking–the sheer physical separation of VPN traffic from the public Internet onto a private network–and virtual IP routing, which uses separate route tables and closed user groups.

There are two key tunneling and security protocols the industry appears to be converging on. One is IP Security, or IPSec, which supports both encryption and tunneling. The other is Layer 2 Tunneling Protocol (L2TP), which is a standard for tunneling that was created through a merger between Microsoft Corp.'s Point-to-Point Tunneling Protocol (PPTP) and Layer 2 Forwarding (L2F) from Cisco. L2TP provides tunneling only, so it can be combined with IPSec for security or with Point-to-Point Protocol (PPP) for network access and password identification.

Companies can opt to have their service provider choose the security method for their VPN and can either manage it in-house or let the service provider do so–or they can handle the security side of the VPN entirely on their own. According to TeleChoice, most IT managers prefer to retain some control over their network's security, mainly in the areas of end-user administration and authentication. A company might opt to do its own encryption, for instance, or administer its own security server, but use the service provider for all other aspects of VPN management.

Cisco's Scheer says the decision of whether or not to outsource security usually has less to do with the size and IT resources of a company and more to do with the critical nature of the corporate data and the confidence the IT manager has in outsourcing in general. "A lot of times they don't want to hand their security policy over to their service provider. Most companies will, in fact, keep their security to themselves. But some who don't have the IT resources and don't understand [their security options] may let the service provider go ahead and cover it for them," Scheer says.

High Price?

VPN services have a number of price components, including initial consulting, per-usage fees and support/maintenance. According to a February report published by Stamford, CT-based market research firm Gartner Group Inc., a dial-up VPN service can be priced in terms of a flat fee–such as $30 per user for 20 hours per month–or on an hourly basis. A VPN service priced according to usage typically costs $.75 to $2 per hour for access and $.75 to $1.50 per hour for remote access server administration and encryption services, plus $.75 to $1.50 per hour for help desk inquiries. A company can opt out of services such as remote access server administration, if it prefers to handle them in-house.

But, experts say, that doesn't necessarily reflect the fairly broad range of price options on the market. "There's a wide disparity in pricing right now," says Inverse's Roekle. "The market is trying to figure out what to charge."

Much of the disparity in pricing stems from the fact that most VPN providers are focusing on large contracts with a lot of consulting services included, which are negotiated according to the volume of services, as well as products.

Down the road, Infonetics' Wilson says, providers will begin to offer package deals to smaller customers. "Right now, all major service providers are focusing on high-profit, high-profile deployments," he says. "But after some of those accounts are deployed and established, and everyone is done barking about them, I think they'll start to build some small and medium-size business solutions that are more like the Internet solution is right now–CPE [consumer premises equipment] bundled with service. But those aren't going to start popping up until after this year," Wilson says.

If you would rather construct your own VPN, see "If the Answer is Build..." at `http://webserver.cpg.com/features/cover/4.5/` for a list of some of the major vendors with VPN hardware and software on the market.

VPN 2000

As more companies opt for VPNs, price and service options should become more varied. One force that will help to drive more small and mid-size businesses toward VPNs is the increasing need for remote access for telecommuters and traveling employees. But another potentially popular application of VPNs is in secure business-to-business networks.

Increasingly, companies want to securely exchange information with their suppliers and customers. VPNs that operate over a public or private IP network offer a relatively easy way to do so. For example, one of the first such business-to-business VPNs, the Automotive Network eXchange, began operating in September 1998. ANX was developed by a coalition of major automakers, including Ford Motor Co. and Chrysler Corp., to enable automakers and their suppliers to conduct data transfer and electronic commerce.

Other business-to-business VPNs are likely to follow. "The stage is really set for VPNs as [a form of] secure communication in an extranet environment," says Inverse's Roekle. Intelispan Chief Operating Officer, Ron Loback, agrees. "Companies that have EDI [electronic data interchange] today are going to be allowed to eliminate the LAN and communicate directly with trading partners," Loback says. "Ultimately, what we're looking at [is] the creation of dynamic collaborative communities through rapid deployment of extranets."

NCR's Pike, for example, plans to offer VPN connectivity to distributors and customers to enable them to connect to the NCR network securely. Although NCR will also offer a regular extranet option–with just a password required for entrance and no encryption or other security over the network–many partners need the extra security of a VPN because they want to access or exchange more sensitive data, Pike says.

And because NCR has so many such relationships, it would be difficult to manage all the installation and support of VPN connections in-house. NCR received a total of 475 requests for external connectivity from customers and partners in 1998, Pike says, and another 2,600 new requests are likely in 1999. "Our big plan is to have a packaged Internet VPN solution. So when we get a request from a reseller, distributor or customer for access, we turn it over [to the service provider] and say, 'You manage it, you put it in, you provide the box and services, you manage the firewall,'" he says.

"If we can automate and link up our customers, partners, distributors and resellers more effectively, and provide more information electronically, that will drive down internal cost factors," Pike says. At the same time, "It puts you in a position where you can provide additional services and solutions to customers. And, of course, if we give resellers better information so they can sell more products, that will drive more revenue for NCR." ➸

Companies Mentioned in this Article

AT&T Corp.
55 Broadway, 3rd Floor
New York, NY 10006
http://www.att.com
Circle 160

Check Point Software Technologies Inc.
3 Lagoon Drive, Ste. 400
Redwood City, CA 94065
http://www.checkpoint.com
Circle 161

Cisco Systems Inc.
170 W. Tasman Drive
San Jose, CA 95134
http://www.cisco.com
Circle 162

Concentric Network Corp.
1400 Parkmoor Ave.
San Jose, CA 95126
http://www.concentric.net
Circle 163

GTE Internetworking
P.O. Box 3073
Burlington, MA 01803
http://www.bbn.com
Circle 164

Intelispan Inc.
14505 N. Hayden Road, Ste. 300
Scottsdale, AZ 85260
http://www.intelispan.com
Circle 165

Inverse Network Technology
215 Apollo Way
Sunnyvale, CA 94086
http://www.inversenet.com
Circle 166

iPass Inc.
650 Castro St., Ste. 500
Mountain View, CA 94041
http://www.ipass.com
Circle 167

KPMG
345 Park Ave.
New York, NY 10154
http://www.kpmgconsulting.com
Circle 168

MCI WorldCom
5000 Britton Road
Hilliard, OH 43026
http://www.wcom.net
Circle 169

Qwest Communications Corp.
555 17th St.
Denver, CO 80202
http://www.qwest.net
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Xedia Corp.
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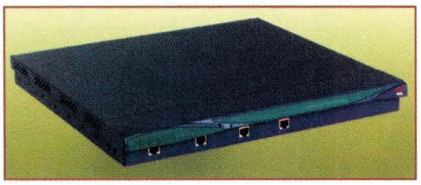
The product descriptions are compiled from data supplied by the vendors. To contact them for more detailed information, circle the appropriate reader service number on the card located elsewhere in this issue.

URL/New Products

New Load-Balancing Hardware/Software

Radware has unveiled Web Server Director (WSD) Pro+, the latest addition to its family of IP load-balancing hardware, and Version 6.0 of its WSD software.



The new software comes with Radware's Local Triangulation Technology, which enables WSD Pro+ to be bypassed in order to send traffic back to the client. By only processing inbound traffic, WSD Pro+ is capable of handling throughput rates of 445 MB/s for HTTP traffic and 902 MB/s for FTP traffic, Radware says.

WSD Pro+ is SNMP-compliant, which allows it to be managed by any SNMP-based management station, including MutliVu (MultiVu is available on HP OpenView for UNIX). In addition, WSD Pro+ ships with the company's own Java-based management tool, ConfigWare.

New additions to Version 6.0 of the WSD software include state mirroring, which enables redundant units to continually update each other's dynamic session tables; a utilization feature, which indicates the load on the WSD itself; and a feature that will load balance a site according to file type. WSD Pro+ ships with the new software and costs $14,552.

Radware Inc.
575 Corporate Drive, Ste. 205
Mahwah, NJ 07430
http://www.radwareusa.com
Circle 191

Turnkey Portal Software

Portal-in-a-Box from Autonomy is an all-in-one software package for creating Inter/intranet portals. The package is designed to give developers the ability to easily create and maintain information-rich portals with content drawn from an unlimited number of specified external and internal sources, including Web sites, text files, email messages, spreadsheets and Microsoft Corp. PowerPoint presentations, the company says. Rather than listing all of the content sources and providing links to those sites, the software automatically organizes the content by subject for easier navigation, Autonomy says.

Online publishers may set up subject categories, which describe the topics or provide sample documents. Once directory headings are established, Autonomy analyzes the information in all of the sources the system is set up to monitor and automatically files the content into the appropriate category, the company says.

A special feature allows visitors to receive customized newsletters by describing topics of interest. The software creates a newsletter based on those descriptions and alerts users whenever a subject of interest comes up in a chat room conversation or appears in a breaking news story.

Portal-in-a-Box is priced starting at $50,000 and runs on Solaris, Digital UNIX, IRIX, Linux and Windows NT.

Autonomy Inc.
301 Howard St., 22nd Floor
San Francisco, CA 94105
http://www.autonomy.co.uk
Circle 192

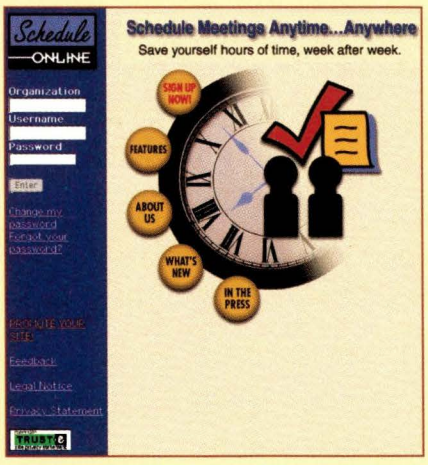
Free Online Calendar

Jintek has announced the availability of its free Web-based scheduling application, Schedule Online. With Schedule Online, users can set up Web-based corporate calendars to check on the availability of coworkers for meetings.

The service is provided through the Schedule Online Web site, so as long as users have access to the Internet, they can remotely view their calendar. The service also allows users to set up individual to-do lists and reserve resources such as conference rooms. All data is stored on Jintek's servers.

The company also offers a licensed version of the service, which can be run on its own hardware. Schedule Online is available on Solaris, Mac OS and Windows NT. A stand-alone version is priced at $100 for the first seat. Jintek has begun its own beta program for a 3Com PalmPilot synchronization module that would work with both the free Web service and the stand-alone product.

Jintek
3883 Ruffin Road
San Diego, CA 92123
http://www.jintek.com
Circle 190



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.

PCI-to-Fibre Channel Host Bus Adapters

Jaycor Networks has introduced two PCI-to-Fibre Channel host bus adapter cards. The 32-bit FCE-3210 and 64-bit FCE-6410 are high-speed host bus adapter cards designed for various mission-critical applications, including storage area networks (SANs) that use Fibre Channel technology. Supporting transfer rates of up to 200 MB/s in full duplex mode, the adapters reportedly use Jaycor's proprietary Emerald III integrated RISC multitasking protocol engine to manage the Fibre Channel-to-PCI bus link and command channel operations to reduce overhead and latency.

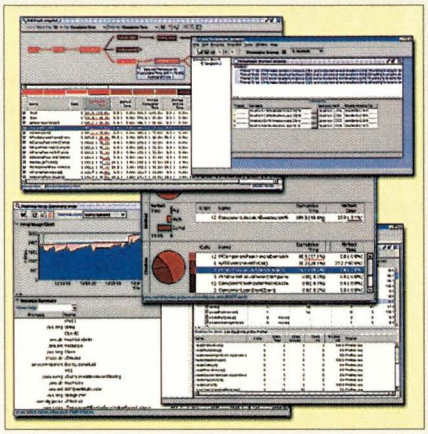
The cards come bundled with the company's new EZ Fibre software, a Windows NT-based configuration and management utility that simplifies card diagnostics and SAN installation. The adapters also come with either copper or fiber optic connections, comply with all Fibre Channel topologies (point-to-point, switched and arbitrated loop) and meet both Class 2 and Class 3 standards for data delivery, Jaycor says.

Both products support various operating systems, including Solaris, Linux, Windows NT and Mac OS. The FCE-3210 is priced starting at $745, while the FCE-6410 is priced starting at $895.

Jaycor Networks Inc.
9775 Towne Centre Drive
San Diego, CA 92121
http://www.jni.com
Circle 101

Java Tool Set Upgrade

KL Group has released JProbe 2.0, an integrated set of tools designed to help developers debug thread, memory and performance problems in Java applications. JProbe reportedly analyzes applications that are written with Sun Microsystems Inc. Java Development Kit (JDK) 1.1 and/or Java 2 and run on Solaris, as well as Windows 95/98/NT. The suite allows developers to diagnose



and eliminate code errors and inefficiencies by identifying problem areas–such as errant lines of source code–and displaying a graphical representation of memory usage and calling relationships, the company says.

The suite comprises four components, which are also available separately: JProbe Memory Debugger, for finding and plugging memory leaks; JProbe Performance Profiler, for pinpointing performance bottlenecks;

Fault-Tolerant RAID Storage

Unison Information Systems has unveiled two new RAID products, the Raid I/O Flyer II Fault Tolerant Disk Array for cost-effective data storage in mission-critical applications and the Raid I/O Flyer LVD (low-voltage differential) storage system.

The RAID I/O Flyer II Fault Tolerant Disk Array is said to incorporate a unique RAID controller that provides a high-performance RAID (levels 0, 1 or 5) subsystem at low cost. The RAID I/O Flyer II RAID controller talks to the host system via an Ultra Wide SCSI connection, while its drive channels support EIDE/Ultra direct-memory access (DMA) disk drives. This combination provides users with high-performance data availability at low cost, Unison says. The RAID array features data transfer rates of up to 40 MB/s and a storage capacity of up to 100.8 GB. It comes with six independent 3.5-inch IDE drives and costs $7,200.

Unison's RAID I/O Flyer LVD Ultra 2 SCSI storage system comes in either a rack-mount or tower design, both with hot-pluggable power supplies and support for up to 12 hot-pluggable SCSI disk drives and 436.8 GB of total storage. Each system is selectable for RAID levels 0, 1, (0+1), 3 or 5, or any combination of RAID levels in the same system. Pricing for the RAID I/O Flyer LVD storage system starts at $13,221 for 54.66 GB of storage.

Unison Information Systems Ltd.
21 Walsh Way
Framingham, MA 01701
http://www.unisoninfo.com
Circle 100

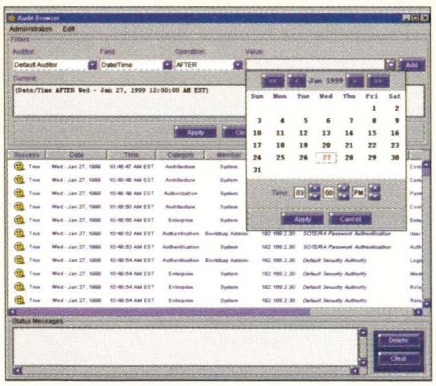
JProbe Coverage, for locating lines of untested code; and JProbe Threadalyzer, for predicting data race conditions and detecting thread deadlocks.

JProbe 2.0 runs on Windows NT and is available in two versions: JProbe Developer Edition for $999 and JProbe Profiler Professional Edition–with advanced profiling and remote data collection features–for $1,899. The Proffesional Edition includes a one-year service support package.

KL Group Inc.
260 King St. E.
Toronto, Ontario
Canada M5A 1K3
http://www.klgroup.com
Circle 102

Java-Based Security System

Aurora has released Soteria 2.0, a Java-based, platform-independent application security system. Soteria is said to add data security capabilities across a network by providing added security to corporate applications as an integrated security add-on.



In addition to being Java-based, Soteria offers Public Key Infrastructure (PKI) authentication, smart access controls and point-to-point encryption, Aurora says. Furthermore, it offers security capabilities based on membership and authorization. Developers can add this layer of security to their applications through a software tool kit that comes bundled with the product.

All application and infrastructure communications are secured by Secure Sockets Layer (SSL) encryption. Soteria is based on Sun Microsystems Inc.'s Java Development Kit (JDK) 1.1 and is interoperable with Enterprise JavaBeans and Common Object Request Broker Architecture (CORBA) 3.0. It runs on any platform that supports JDK 1.1. Soteria is priced per registered user with volume discounts. A typical installation costs $100 per user for 2,000 users.

Aurora Enterprise Solutions
12310 Pinecrest Road, Ste. 200
Reston, VA 20191
http://www.aurorasim.com
Circle 103

Solaris Drivers for PCI Adapters

Znyx has released Solaris drivers for its NetBlaster CompactPCI and PCI multichannel Fast Ethernet adapters. The new drivers support Solaris 2.6 and are available for both SPARC and Pentium platforms. Embedded in the drivers is Znyx's RainLink technology, which is said to provide redundant links with fast failover, and system-to-switch and system-to-system trunking. Znyx says RainLink provides fast deterministic failover by placing the secondary Ethernet channel in a hot standby state. When a failure is detected, RainLink automatically redirects traffic to an initialized secondary port.

RainLink system-to-switch trunking can be used to connect to Cisco Systems Inc.'s Fast EtherChannel compatible switch. In addition, the trunking capability can provide incremental scalability between 100 and 400 Mb/s, the company says.

NetBlaster CompactPCI is available in two-, four- and eight-channel models, supporting 3U and 6U PCI slots, hot swapping and front/rear panel I/O. Pricing for NetBlaster CompactPCI ranges between $699 and $2,699.

Znyx Corp.
48501 Warm Springs Blvd.
Ste. 107
Fremont, CA 94539
http://www.znyx.com
Circle 104

Redundant Media Converters Unveiled

Redundant copper-to-fiber media converters for Fast Ethernet networks are now available from Transition Networks. The TX-to-FX Redundant Media Converter designates a primary and secondary port. If the primary port fails, the converter will establish a link on the secondary port, the company says. The secondary port can then be used to carry traffic. The converter is designed so that only one of the four ports is active at any time, eliminating interference between the product and spanning tree protocols.

Transition Networks guarantees compatibility with any 802.3-complaint 10/100 port. The converters are available in both stand-alone and 16-slot chassis versions. The company also offers a Conversion Center, which allows the media converters to be deployed using a redundant power supply. The Conversion Center add-on is a 16-slot chassis that can convert many networking protocols, including unshielded twister pair-to-fiber conversion for Ethernet, Fast Ethernet, ATM, FDDI and Token Ring. The Conversion Center also supports single-to-multimode fiber conversions for these environments, as well as Gigabit Ethernet and OC-12.

Pricing for the TX-to-FX Redundant Media Converter starts at $699. The Conversion Center add-on costs $495.

Transition Networks Inc.
6475 City West Pkwy.
Minneapolis, MN 55344
http://www.transition.com
Circle 105

Disk Storage for UNIX, Mainframes

Storage Technology (aka StorageTek) has announced the 9393 Shared Virtual Array (SVA) enterprise disk storage system, supporting both mainframe and UNIX servers. According to StorageTek, the 9393 SVA reduces storage requirements by up to 40% compared with legacy disks when performing identical workloads.

The SVA offers up to 50% throughput improvement over previous versions, and when used in conjunction with 1,024 virtual addressing, SVA will provide 3 TB of dynamic virtual capacity per subsystem, the company says.

StorageTek has promised to deliver software that will enable single-point storage management control of open systems and mainframe storage assets by the end of second-quarter 1999. The

9393 SVA will initially support Solaris, but future versions will support HP-UX and AIX. SVA disk products currently support connections to OS/390; support for UNIX servers is expected by third-quarter 1999. Contact company for pricing.

Storage Technology Corp.
1 StorageTek Drive
Louisville, CO 80028
http://www.storagetek.com
Circle 106

LDAP Security Agent

Nexor has announced the availability of Directory Boundary Agent, a security product for Lightweight Directory Access Protocol (LDAP) directories residing on Solaris systems.

Combining firewall and directory technology, Nexor's Directory Boundary Agent is specifically designed for environments with multiple directory servers. It allows the publication of corporate contact information outside a guarded domain without compromising information security, the company says. Directory Boundary Agent is said to shield the source of directory information by cloaking the existence of internal directory servers, so that unauthorized users remain unaware of the source, amount and level of inaccessible information. According to Nexor, the agent allows IT managers to set various user restrictions, as well as filters, to protect sensitive data from being viewed at a branch level.

Directory Boundary Agent comprises two application processes that work together. The first is a connection handler to control LDAP client access to and from the guarded domain on the basis of IP network address and TCP port number. The second is a protocol handler, which accepts connections forwarded by the connection handler and enforces application-level security policies.

Directory Boundary Agent runs on Solaris and Windows NT and costs $7,500.

Nexor
18310 Montgomery Village Ave.
Ste. 100
Gaithersburg, MD 20879
http://www.nexor.com
Circle 107

Upgrades, Enhancements, Additions...

◆ Advanced Digital Information's Amass storage management software now supports AIX 4.3.2. With Amass storage management software, users can access data stored in automated storage libraries. Amass is said to present the library under a single mount point and files are accessible through communications protocols such as NFS, TCP/IP, RFS and AppleShare. **Advanced Digital Information Corp.**, 11431 Willows Road N.E., Redmond, WA 98073, *http://www.adic.com.* **Circle 108**

◆ Pinnacle Micro's line of RCD 6x24 CD Recorders now supports Solaris and IRIX, in addition to Windows 95/98/NT and Mac OS. The system records data at 6x speed and reads CDs at 24x speed. Its GUI supports Motif, X Window, OpenWindows and command-line interfaces. RCD 6x24 CD Recorders cost $999 each. **Pinnacle Micro Inc.**, 140 Technology Drive, Ste. 500, Irvine, CA 92618, *http://www.pinnaclemicro.com.* **Circle 109**

◆ Innosoft International has enhanced its Innosoft LDAP Proxy Server (ILPS) to provide automatic load balancing among multiple Lightweight Directory Access Protocol (LDAP) servers and transparent failover for high-availability directory services. ILPS Version 2.0 provides system managers with the ability to distribute directory searches across two or more mirror servers, the company says. It can also detect failure or removal of an LDAP server from a group and transparently map searches to other servers in the group. When it recovers, ILPS will transparently reintegrate the recovered server into the directory server group, Innosoft says. ILPS 2.0 is available for the following platforms: Solaris 2.6/7, Digital UNIX 4.0b on Alpha, AIX 4.3 on PowerPC, Red Hat Linux 5.1 on Intel, HP-UX, OpenVMS for Alpha and VAX, and Windows NT on Intel and Digital Alpha. It costs $4,800 for up to 15 concurrent connections and $12,000 for an unlimited number of connections. **Innosoft International Inc.**, 1050 Lakes Drive, West Covina, CA 91790, *http://www.innosoft.com.* **Circle 110**

◆ Optimizeit 3.0 Professional, a testing and profiling tool for Java applications from Intuitive Systems, is now available on Solaris. Optimizeit reportedly assists developers in creating and deploying enterprisewide Java applications through the use of a unique CPU profiler. The profiler offers both sampling and instrumentation profiling, so developers can tune CPU time measurement to the most efficient level of detail for each test session, while maintaining a low overhead. Also new to 3.0 is full support for Sun Microsystems Inc.'s Java 2 (JDK 1.2), as well as JDK 1.1. Optimizeit 3.0 Professional is available for $449 for Solaris and Windows 95/98. **Intuitive Systems Inc.**, 555 N. Mathilda Ave., Ste. 22, Sunnyvale, CA 94086, *http://www.optimizeit.com.* **Circle 111**

◆ Parametric has updated its product life cycle management software with the release of Windchill 2.1. New to Version 2.1 are Pro/Intralink Gateway, a feature for making engineering data outside a group available to the enterprise community; Info*Engine, an integration technology for linking software to engineering data that provides a general-purpose integration framework so data can be incorporated into Web pages; and ProductView visualization technology, which allows users throughout the enterprise to view all types of product-related information, including documents such as Microsoft Corp. Office files, two-dimensional drawings and three-dimensional models. Pricing for Windchill starts at $1,000 per enabled user. Both Windchill server software and client software run on Solaris, HP-UX and Windows NT. Client software is also supported on Windows 95. **Parametric Technology Corp.**, 128 Technology Drive, Waltham, MA 02453, *http://www.ptc.com.* **Circle 112**

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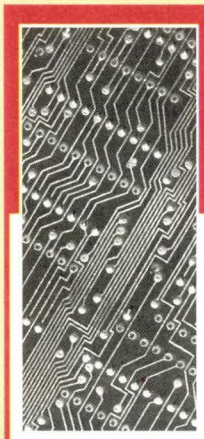

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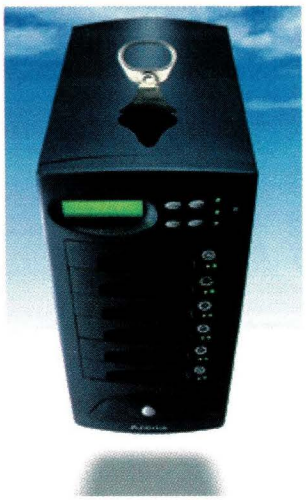

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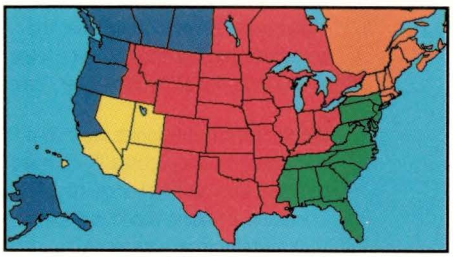

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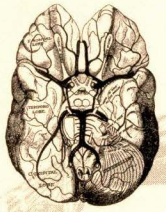

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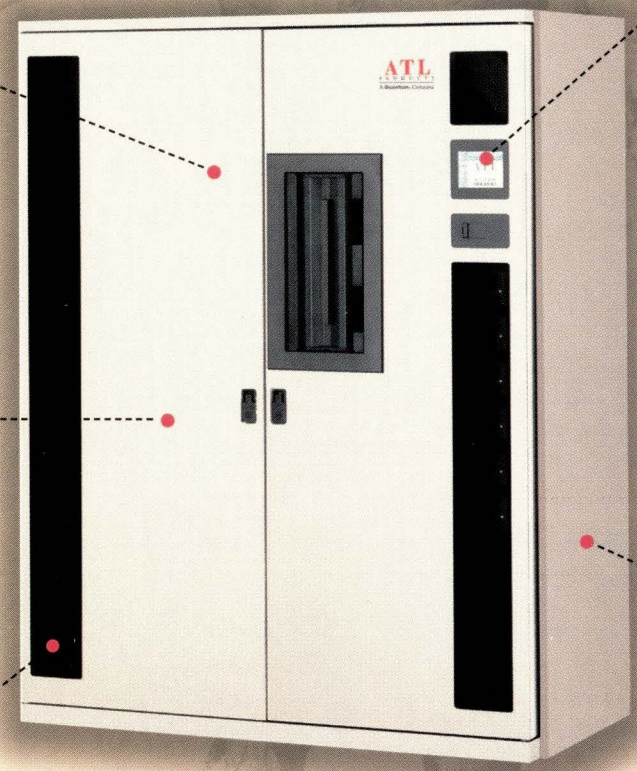
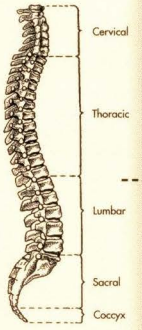
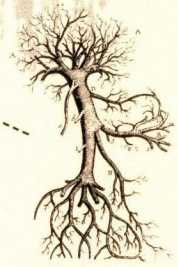


III. The Skeleton –*The human body has two arms and two legs. The P3000 delivers the same high availability (HA) design with redundant AC cords, power supplies and fans. Plus, the power supplies, fans and DLTtape drives can be hot-swapped.*

VII. The Spine – *The backbone of the P3000's design is a PCI expansion bus supporting SCSI interface, Fibre Channel, tape array and server PCI cards –"future proofing" your library with a modular upgrade path.*



Divisions of the Spine



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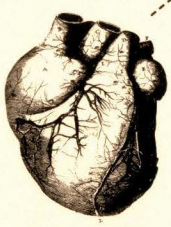

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