Server/Workstation EXPERT

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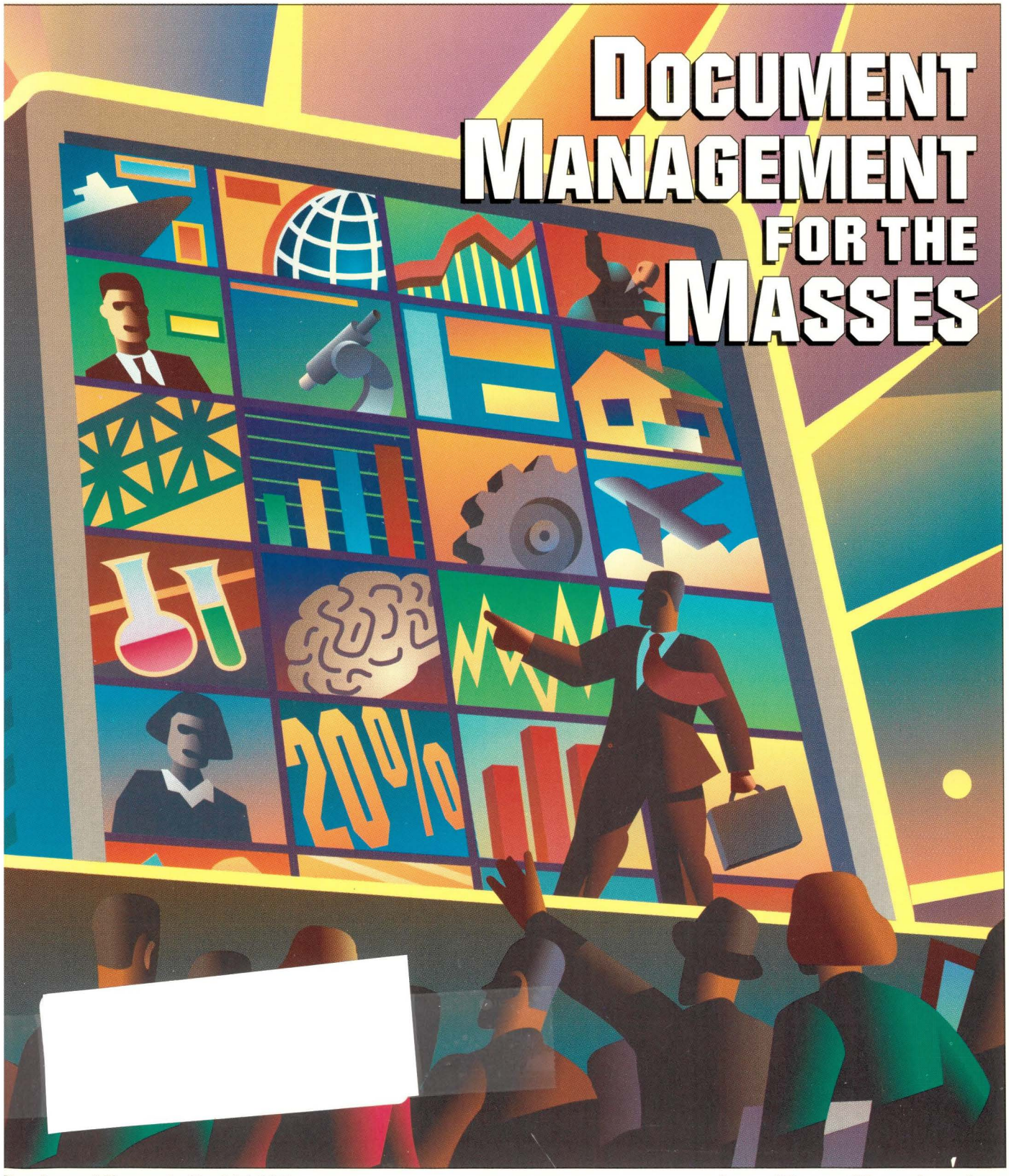

Review: Mirapoint's M1000

Java Class: Class Loaders

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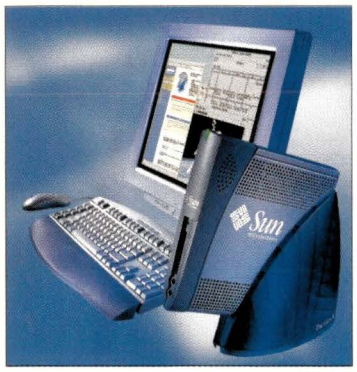

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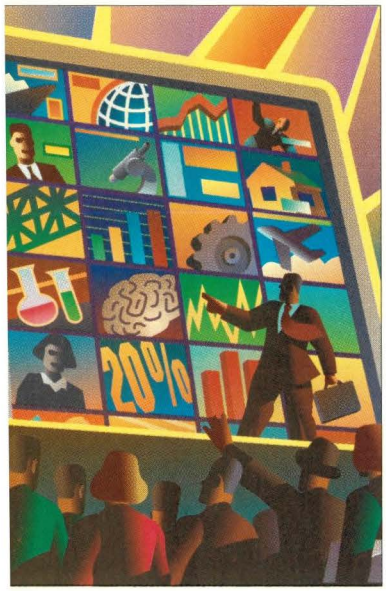

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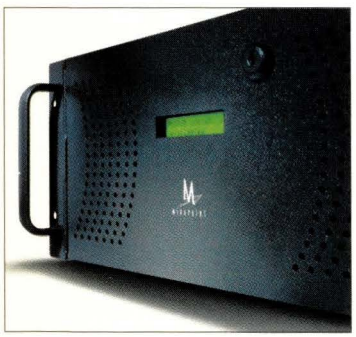

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Getting Loaded

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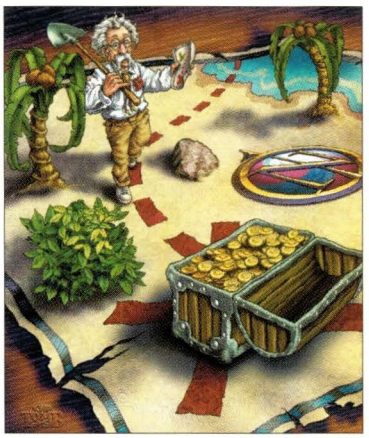

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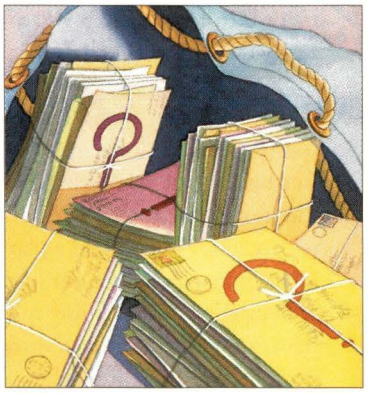

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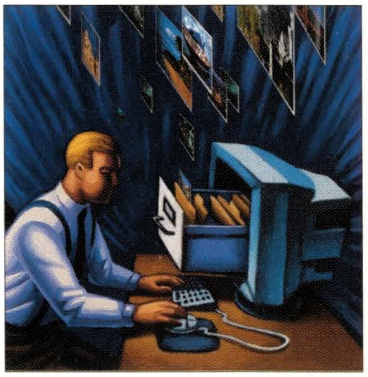

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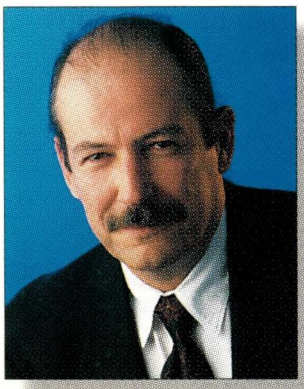

A Really Useful Web Application

Although it may seem that nothing but e-commerce on the Web gets any attention from the press these days, the marriage of the Internet and other mainstream applications is an event to celebrate. For example, this month's cover story "Document Management for the Masses," by Patrick Coleman, details how the Web has changed many disciplines–from cancer research to pharmaceuticals, from utilities to motor vehicle departments.

Pat begins by taking a look at how doctors and scientists at the Dana-Farber Cancer Institute have embraced new document management technology. The Boston, MA-based research hospital renowned for providing, and advancing, the treatments for cancer, needed a way to facilitate communication among researchers. "We wanted a platform for collaboration across seven different institutions, including our own," says Steven Singer, chief of communications at Dana-Farber. According to Pat, the platform had to bring together more than 700 people scattered throughout the Boston area. These included people from Harvard Medical School, Harvard School of Public Health, Beth Israel Deaconess Medical Center, Massachusetts General Hospital, Brigham and Women's Hospital and Children's Hospital Medical Center. I don't want to give the plot away. If you want to find out how an extranet and some new-breed applications solved this problem, take a look at Pat's story on Page 50.

Also in this issue, we review a new breed of hardware–the specialty appliance. Ian Westmacott, technical editor, test drives what he calls "email-in-a-box." It's actually three boxes, but who's counting. He concludes that many organizations might benefit from a product like the Mirapoint M1000, which can handle SMTP, POP and IMAP chores from one SNMP-managed point. Mirapoint claims the email server will handle up to 150,000 users. That might be enough capacity to handle all the mail about e-commerce and the Web we've been getting lately.

How many of you have received "Make money from the Web today" messages or "Don't miss this opportunity" invitations? How useful is that?

Doug Pryor

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Publisher S. HENRY SACKS shs@cpg.com

Editor-in-Chief DOUGLAS PRYOR dpryor@cpg.com

Managing Editor LISA BUCHER lisab@cpg.com

Technical Editor IAN WESTMACOTT ianw@cpg.com

Contributing Editor SIMSON L. GARFINKEL

Staff Editors PATRICK T. COLEMAN pat@cpg.com

SUZANNE HILDRETH sjh@cpg.com

Production Editor MICHAEL LETTS mletts@cpg.com

Art/Production Director JOHN W. KELLEY JR. jwk@cpg.com

Senior Designer BRAD DILLMAN bdillman@cpg.com

Production Assistant CAMILLE LORENZETTI camille@cpg.com

Circulation Director DEBORAH MOORE dm@cpg.com

Promotion Assistant TOM BROWN tom@cpg.com

Accounting Manager ROBIN YEARWOOD robin@cpg.com

Office Manager TINA JACKSON jamal@cpg.com

Business Manager SUSAN R. SACKS srs@cpg.com

World Wide Web
http://www.cpg.com

EDITORIAL OFFICES
1340 Centre St.
Newton Center, MA 02459
(617) 641-9101

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Will Sun Ray Brighten MIS?

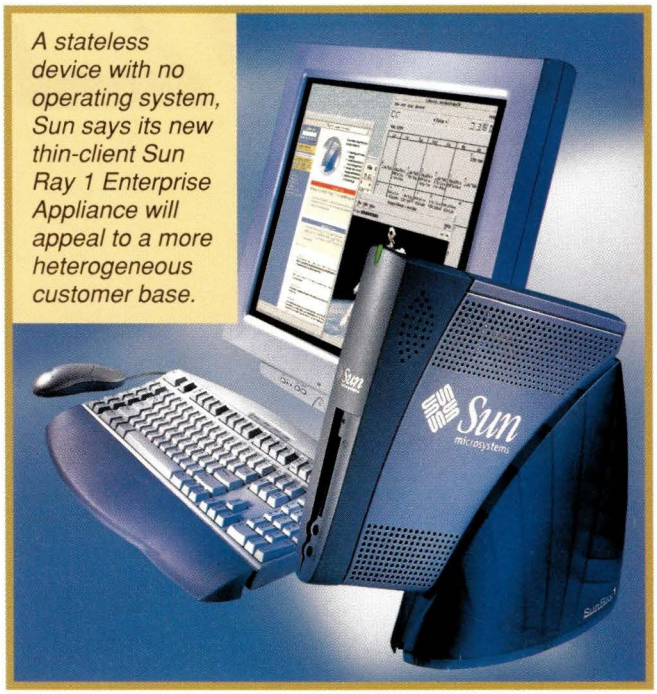
With the September launch of Sun Microsystems Inc.'s newest thin-client product, Sun Ray 1 Enterprise Appliance, the Palo Alto, CA-based company is trading in its Java-centric vision of network computing for a more pragmatic, multiplatform approach.

Sun Ray–which Sun is careful to call an appliance, rather than a thin client or Network Computer (NC)–is a stateless device with no operating system, virtually no memory (just 8 MB of RAM and 512 KB of Flash EPROM) and not even an on/off switch. It requires a dedicated 10BaseT or, preferably, 100BaseT fully switched connection to a Solaris server, and doesn't handle the graphical rendering of client information, but simply displays pixels transmitted by the server. (The full specifications can be found at `http://www.sun.com/products/sunray1/specs.html`.)

The new device also boasts a special feature called Hot Desk, designed for companies in which employees share desks or move around frequently. With Hot Desk, users can access their desktop from any Sun Ray appliance by either inserting a personalized smart card or logging on under their user name. It is aimed at transaction-oriented environments such as customer support, education, government and financial services. "Sun Ray makes sense in situations where you have a very high concentration of desktops, high bandwidth and redundant server infrastructure," says Sal Cobar, director of sales development and marketing for information appliances at Sun.

With its stripped-down architecture, and its ability to display UNIX, Windows and mainframe, as well as Java, applications, Sun Ray stands in marked contrast to Sun's Java-based NC, the JavaStation, which never took off and has languished in obscurity for more than a year. Unlike Sun Ray, the JavaStation was made to process Java applications on both the client and server and came equipped with a local operating system–the JavaOS–plus 32 to 64 MB of RAM.

But Sun hasn't sold very many of its JavaStations. International Data Corp. (IDC), a market research firm based in Framingham, MA, estimates only 10,000 units were sold in 1998, two years after it was introduced. Sun has announced no major deals this year for the NC and IDC estimated so few sales of the JavaStation in the first half of 1999 that it lumped it into its "Other" category. By contrast, IBM Corp., Armonk, NY, sold more than 66,000 of its Network Station NCs in the first half of this year, giving it 21.7% of the thin-client market, according to the IDC report, "1999 Enterprise Thin-Client Market Half-Year Update."



A stateless device with no operating system, Sun says its new thin-client Sun Ray 1 Enterprise Appliance will appeal to a more heterogeneous customer base.

The problem with the JavaStation, says Peter Lowber, research director for Gartner Group Inc., a market research firm based in Stamford, CT, is that client-side Java is simply too complicated for many IS shops to manage. "Java on the client side isn't feasible right now," Lowber says. "First of all, client-side applications haven't materialized yet. But, secondly, it's the difficulty and complexity of executing those applications and managing those applications on a thin client that has made for a lot of difficulty around the success of the initial JavaStation."

Sun Ray, by contrast, doesn't require any modification to existing software. Users access Solaris and other UNIX applications via the X Window System running on the server and Windows applications using the Citrix Systems Inc. Independent Computing Architecture (ICA) protocol. It runs Web- and Java-based applications via a server-side browser. The only requirement is Sun Ray Enterprise Server Software, which runs on a Solaris server and maintains session information and transmits screen image changes from application servers.

"Sun Ray certainly is simpler from a client perspective [than the JavaStation]–you don't have any management issues here," says Lowber. "This is the return of the dumb client, where you're not executing any code. You're not even doing the graphical interface rendering on the client."

Andy Bochman, director of Aberdeen Group Inc., a market research firm based in Boston, MA, agrees. "The discussions I've had with end users have

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Circle No. 4

More Beef for Thin Clients

While Sun is going for a thinner thin client, IBM is fattening up its line of Network Stations with two new additions offering more memory and better performance.

Network Station Series 2200 and 2800, priced at $559 and $799, respectively, feature Intel Pentium processors–233 MHz for the 2200 and 266 MHz with Multi-Media eXtension (MMX) for the 2800–and a base memory of 32-MB SDRAM (expandable to 288 MB) for the 2200 and 64-MB SDRAM (expandable to 256 MB) for the 2800. Both models come with 4-MB VRAM, 16-bit audio and two USB ports. In addition, the 2800 comes with two serial ports and one parallel port.

IBM is keeping its 300 and 1000 Network Stations, both based on the PowerPC chip, for the foreseeable future, but it is discontinuing its low-end Network Station 100. Eventually, says Howie Hunger, director of channels and marketing for IBM, the 300 and 1000 will also be phased out. "The 300 and 1000 will continue primarily for customers in the United States who are in the midst of deployments. The 2200 and 2800 will be what new customers will want to start with," says Hunger. The move to the Intel chip, he says, was made because IBM felt it offered a better price/performance ratio than the PowerPC chip.

The company is also upgrading its Network Station Manager software, the server application required for managing Network Stations. Version 2, Release 1 features a full-fledged Web browser–Netscape Communications Corp. Communicator 4.5 browser with support for streaming audio/video, PDF file viewing, Dynamic HTML, JavaScript and two-way email–as well as an upgraded Java Virtual Machine (JVM 1.1.8) and GUI. The Network Station Manager software runs on Windows NT, OS/400 and AIX-based servers.

Peter Lowber research director for Gartner Group Inc., Stamford, CT, says IBM is smart to beef up its processor and browser on the new Network Stations. "They're providing a little more power on these clients, realizing that, as business applications become more browser-based, you're not going to want to run the browser off the server all the time like you are with Microsoft's Terminal Server Edition." He adds, "And IBM has deployed a real version of a browser this time, whereas before they only had a very cut-down version of one [Netscape Navigator], which really didn't have the complete features that users really need."–*sjh*

indicated that Sun Rays are incredibly easy to use, both from a configuration and management point of view and from an end user point of view."

Toronto, Ontario-based Scotiabank, one of Sun's JavaStation pilot programs last year, has since abandoned its JavaStation project and is, instead, beginning a new pilot program using Sun Ray. "The JavaStation was too much of a software solution. [JavaStations] required configuration and they were complicated. We stopped testing them," says Gail Smith, senior vice president for Scotiabank, adding that the JavaStation implementation was predicated on the development of an in-house Java-based mutual fund application that never materialized. "[The Sun Rays] are an infrastructure issue, not tied to any application. So we can deal with them the same way we'd deal with a network upgrade," she says. Scotiabank will use Sun Rays to run Windows NT productivity programs, as well as in-house UNIX-based banking applications.

Sun hopes to woo Windows users by supporting the Citrix ICA protocol on Sun Ray.

Can Sun Ray Shine in the Windows Market?

Because Sun Ray can access UNIX, Windows, Java and even mainframe applications, it is much more likely to appeal to a wider, more heterogeneous customer base than did the initial JavaStation, says Bochman. "With the JavaStation it was like, 'OK, come and get the benefits of centralized computing, but check all your old applications at the door because you can't use them.' With Sun Ray, you can bring all the applications you want."

Sun hopes to woo Windows users by supporting the Citrix ICA protocol on Sun Ray and by bundling it with the StarOffice productivity suite, a Microsoft Corp. Office workalike for UNIX garnered from Sun's latest acquisition, StarDivision Corp., Fremont, CA. StarOffice, which runs on Solaris, Windows, Linux and OS/2, features an MS Office look-and-feel and file compatibility with MS Office formats such as Word (see "Sun Pushes Office Software").

"Sun Ray has two levels of Windows interoperability," explains Sun's Cobar. "You can use the ICA protocol to render applications running on an NT server within the Solaris [Enterprise] server and display it on Sun Ray. And with StarOffice, you have the file format compatibility with a [Microsoft] Office word processing document or spreadsheet."

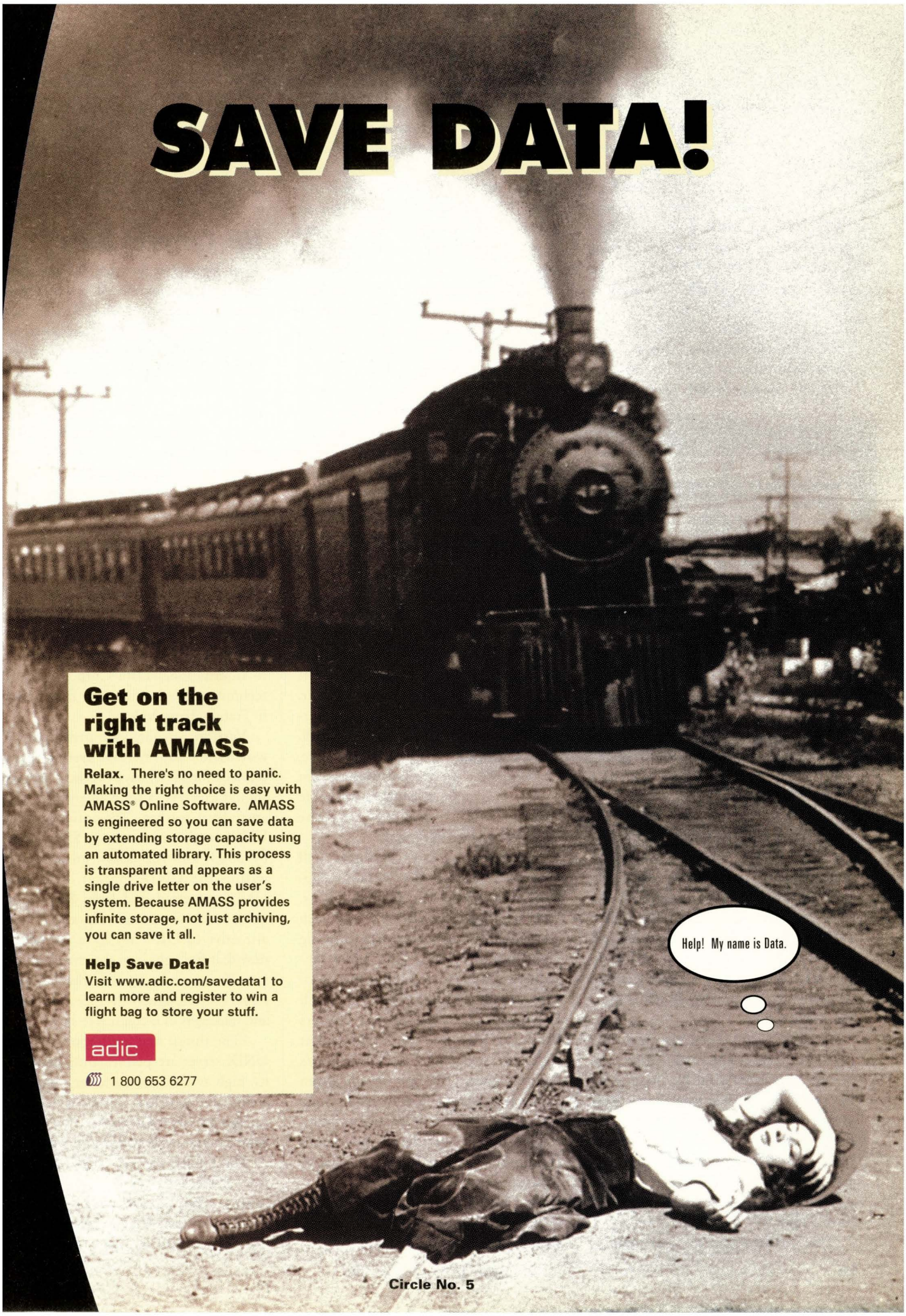
John Watkins, vice president of sales and marketing for Mirror Worlds Technologies Inc., New Haven, CT, maker of Lifestreams Office, an information management application that is bundled with Sun Ray, believes the wider availability of software for the product will make it more attractive to both UNIX and Windows users. "I think the drawback of the JavaStation is that there weren't enough readily available applications. My guess is [Sun Ray] will do much better," Watkins says.

However, Greg Blatnik, vice president of Zona Research Inc., Redwood City, CA, says Sun Ray's main market will be existing Sun customers, and that it won't have much impact on the Windows-based terminal market. "I don't view it as having a lot of influence outside of the customer base Sun would typically deal with."

Sun Ray can be purchased for $499 per desktop, plus $499 to $999 for the server software (depending on whether it's running on a single or multiple CPU server). It can also be leased for around $30 per seat, per month. The leased package includes a Sun Ray appliance, an Ethernet switch and Sun server and software.–*sjh*

Sun Pushes Office Software

It looks and feels like Microsoft Corp. Office software, but it's not from Redmond, WA. Thanks to Sun Microsystems Inc.'s purchase of StarDivision Corp., Fremont, CA–maker of the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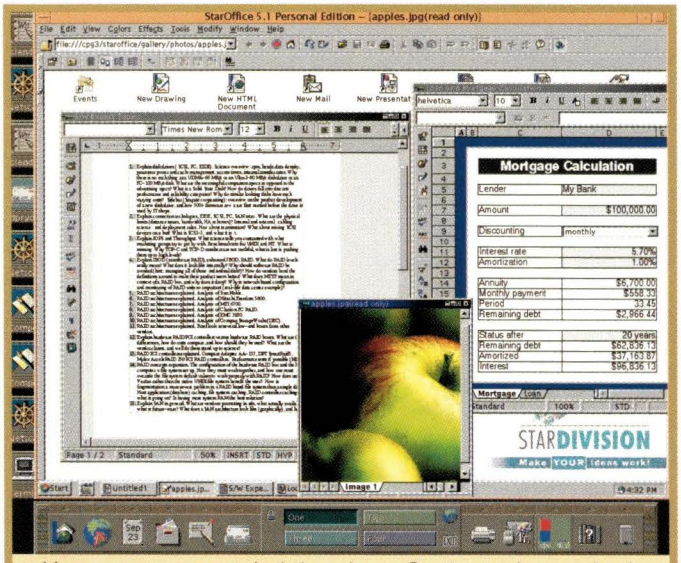
Circle No. 5

StarOffice suite–anyone looking for a UNIX word processing application akin to Word need only download it from the Web (`http://www.sun.com/products/staroffice/get.html`).

Sun's distribution system for the StarOffice software suite is simple: The company is giving it away to anyone willing to download it. According to Sun, the daily average for StarOffice downloads so far has been 21,000, and the first 25 days alone saw 522,000 downloads of the office productivity suite. Alternately, if users don't want to spend the time or consume the bandwidth downloading the suite, they can purchase it on CD for $9.95 (or $39.95 for CD software and printed documentation). Regardless of the package, the cost is still much less than the $480 price tag for MS Office 2000. "StarOffice has the features and ease-of-use you'd demand in an office software suite," says Ed Zander, president and chief operating officer at Sun, Palo Alto, CA.



Users can now get their hands on Sun's newly acquired StarOffice software suite for free.

In addition to the free giveaway, Sun plans to Web-enable StarOffice and deliver it as StarPortal by the end of the year. The aim is to enable any Web browser to access the same productivity tools currently offered in StarOffice (the core application would reside on a server), which harkens back to Sun's infamous tag line: "The Network is the Computer."

The StarPortal initiative also complements Sun's recent announcement of Sun Ray, a stripped-down workstation that relies on the power of a back-end server. With StarPortal, Sun Ray workstations will have access to valuable software. "There are times when you are going to use a traditional desktop," says Joyce Becknell, director of enterprise platforms and IT architectures for Aberdeen Group Inc., a research firm based in Boston, MA. "Sun's point is that people are using various clients to access the information they need. Sun believes this model will continue to take off and people are going to look for products and services that make that easier to do. Is Sun trying to sell desktops to beat Microsoft? Not at all."

But Sun does want to sell servers. "All that client software has to be put on the server. If you have more apps sitting on the server and more data sitting on the server, you need more servers," says Becknell. "That's the real issue. It's not whether Sun is going to sell more desktops; it's the increased reliance on servers."

According to Sun, StarPortal will allow Web sites to offer StarOffice applications as services to their customers. The Learningstation.com is one such company that is considering offering StarOffice to its more than 5,000 subscribers. The Learningstation.com provides schools with technical services such as educational software, but delivers those services through a thin-client approach. StarOffice fits the company's business model: "We have already begun negotiations with Sun to make StarOffice the default office and productivity suite to our users," says James Pennington, cofounder of The Learningstation.com, Charlotte, NC.

The StarOffice suite runs on Solaris, Linux and Windows NT, and comes with 10 applications, including a presentation tool similar to MS PowerPoint called StarOffice Impress, a word processing application called StarOffice Writer and a spreadsheet application called StarOffice Calc.–*ptc*

HP Targets ISPs

In September, Hewlett-Packard Co., Palo Alto, CA, announced new additions to its HP 9000 line of UNIX servers aimed at weakening Sun Microsystems Inc.'s hold on the Internet server market. The L-Class entry-level servers–which are priced starting around $16,000 and will replace HP's aging D-Class servers–are aimed at Internet service providers (ISPs), midsize companies and departmental applications, according to Craig Nunes, product line manager for the HP 9000.

Nunes says the entry-level server market is growing quickly, particularly among customers looking for servers to handle Internet-related tasks. HP currently holds a 16.3% share of the entry-level UNIX server market, second only to Sun's 49.2% share, according to International Data Corp. (IDC), a technology market research firm based in Framingham, MA.

Vernon Turner, vice president of worldwide commercial systems and services for IDC, says the new servers should give HP a solid offering in the entry-level market. "We anticipate the UNIX market to be about $38 billion by 2003, and the fastest growth area within the UNIX market is that of UNIX servers priced from $5,000 to $50,000. So you can see why this is very attractive to HP. They have a product now that fits right into that sweet spot," says Turner, adding that the L-Class servers are designed to appeal to ISPs and managers of e-commerce sites.

"The things that are important in a UNIX server are performance, scalability, high availability, clustering, manageability and security," Turner says. "The L-Class fits all those criteria. It's a very good Internet, ISP workload server."

The L-Class has two models, L1000 and L2000, both of which use the same chassis, allowing customers to upgrade without having to change boxes, HP says. The L1000 is a one- to two-pro-

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Circle No. 6

cessor PA-RISC 8500 server, equipped with either a 360- or 440-MHz chip, five PCI slots, up to 4 GB of memory, dual Ultra SCSI buses, one internal DVD/DAT drive and up to 72 GB of internal disk storage. The L2000 is a one- to four-processor unit equipped with 360- or 440-MHz PA-RISC 8500 processors, up to 8 GB of memory, dual Ultra SCSI buses, one internal DVD/DAT drive, 10 PCI slots and up to 72 GB of internal disk storage. The starting price for an L-Class server equipped with a single 360-MHz PA-RISC 8500 processor, 256 MB of RAM and 9 GB of storage is $15,975 for the L1000 and $21,725 for the L2000.

Designed for the ISP market, HP's new entry-level L-Class servers will replace the company's aging D-Class models.

Both servers come with an unlimited-user license for HP-UX 11.00, HP's UNIX operating system, as well as software development kits for the company's new E-speak technology for integrating various types of Internet applications, including HP's Web QoS Peak network management software and the HotSpot Java compiler from Sun. Customers will now also have a choice of integrated Web servers–the Netscape FastTrack Server from the Sun-Netscape Alliance (a joint venture between Sun and America Online Inc.) or the Zeus Web server from U.K.-based Zeus Technology Ltd.

IDC's Turner says the unlimited-user license for HP-UX will be especially popular with ISPs that typically want to pack as many users onto a server as possible and not have to worry about licensing issues. The integrated Web server software should also be a popular feature. "The integration of a Web server with the core OS typically produces noticeable performance gains in Web-based applications," Turner says.

Dell Enters Open Systems Storage Market

If you are feeling a bit hemmed in by the number of storage area network (SAN) vendors out there that cater to UNIX platforms, don't fret, because soon you'll be able to add Dell Computer Corp. to the list.

In September, the Round Rock, TX-based vendor known for its desktop PCs and Web-based direct sales model, announced it would make its first ever corporate acquisition. It handed over an estimated $340 million in Dell stock for ConvergeNet Technologies Inc., San Jose, CA, a technology company that has been developing what it calls a storage domain management platform for use in heterogeneous SAN environments.

The platform, still under development, is a joint hardware and software solution, and is expected to be on the market sometime next year, says Kevin Reinis, general manager of Dell Storage Products Division. With it, Dell plans to sell complete SAN solutions into server environments running not only Microsoft Corp. Windows NT, but Novell Inc. NetWare, Sun Microsystems Inc. Solaris and other UNIX varieties as well.

Dell has been a player in the storage market only since June 1998, when it introduced the Fibre Channel-based PowerVault 650F storage subsystem for Intel-based environments. Dell followed with the SCSI-based PowerVault 200S, the PowerVault 130T tape library and the Dell PowerEdge Expandable RAID Controller 2 (PERC 2), as well as the 700 series network-attached storage (NAS) "filers." This year, Dell took the plunge and announced that its PowerVault line would be SAN-capable in Windows NT environments.

By acquiring ConvergeNet, however, Dell is suddenly positioned to compete in a much broader market than it had previously–a market that, according to Reinis, Dell has been eyeing for some time. Estimated by Framingham, MA-based market research firm International Data Corp. (IDC) to reach 38 billion by 2002, Reinis says, "We had always planned to offer heterogeneous SAN solutions, but with the acquisition of ConvergeNet's technology, we will be able to do so that much faster."

That said, Dell will reportedly not go after the mainframe storage market, dominated by industry leaders like IBM Corp., Armonk, NY, EMC Corp., Hopkinton, MA, and Hitachi Data Systems Corp., Santa Clara, CA.

For Dell, and financial analysts as well, perhaps one of the most important aspects of the announcement is the fact that the company chose to acquire ConvergeNet, rather than partner with it. In the past, says David Hill, senior analyst for storage and storage management systems at Aberdeen Group Inc., an IT research company based in Boston, MA, Dell has struck up OEM relationships with storage vendors. Examples include Data General Corp., Westboro, MA, with its Clariion line, and Network Appliance Inc., Sunnyvale, CA, whose "filers" Dell resells under the PowerVault 700 brand. "With the ConvergeNet acquisition, we are reinforcing to our customers that we are very committed to the storage market," Reinis says.

But for SAN shoppers, the most compelling aspect of Dell's newfound market is what it might do to SAN prices. Indeed, Dell executives have repeatedly hinted that their heterogeneous SAN offerings will be priced significantly less than the competition's, with some analysts estimating as much as a 20% saving. "We're very aggressive both with our existing customers and our potential customers," says Reinis. "Our products will feature very compelling price/performance."

Certainly, Dell's presence in the market should help the SAN adoption rate, says Aberdeen Group's Hill. Whether Dell will spark price gouging of SAN products remains to be seen, however. "Prices will always drop over time," says Hill. "The first step is for [Dell] to get their products out the door."–*alexandra barrett, contributing editor*

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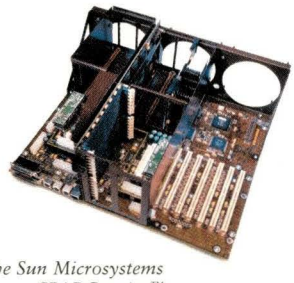

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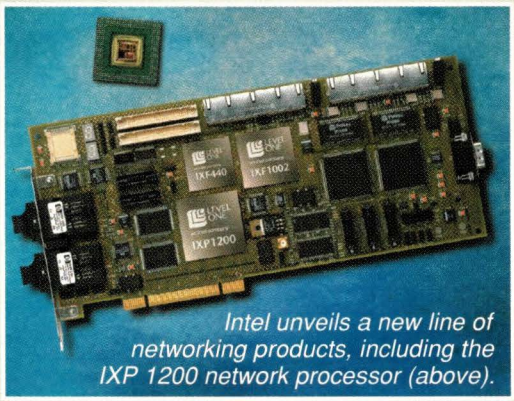
Intelligent Network Building Block

Intel Corp., Santa Clara, CA, has introduced the IXP 1200 network processor, a replacement for application-specific integrated circuits (ASICs) found in traditional networking equipment. The new chip is part of Intel's Internet Exchange (IX) architecture, a set of hardware and software packet-processing technologies. "Companies need a smarter generation of high-bandwidth equipment that can evolve at the same pace as technology," said Robert Pepper, vice president of the Intel Network Communications Group, in a prepared statement. "The IXP 1200 network processor is designed to provide that flexibility."

The IXP 1200 is software-programmable and allows network equipment vendors to develop new product features faster. The IX architecture is said to offer vendors increased flexibility over ASICs, which force OEMs to lock down feature sets at least one year in advance. The software-programmable nature of the architecture makes it easier to provide new functionality, Intel says.

Nathan Brookwood, analyst for Saratoga, CA-based market research firm Insight 64, says the IXP 1200 is a very interesting product and the IX architecture offers OEMs greater flexibility. "If vendors want to add a new level of proprietary, or make significant changes, they have to go back and alter the ASIC design," he says. "With a single IXP 1200, plus another interface, you can now build a product that is primarily software-driven and still has the same kind of functionality and flexibility that previously required dedicated hardware."

The IXP 1200 includes Intel's StrongARM processor core, along with six programmable RISC "micro engines." Each micro engine is designed to monitor a single line within a network switch and make sure each packet that comes in is directed out onto another line. One IXP 1200 processor can switch 2.5 million packets per second, according to Intel. "These micro engines are still faster than the data coming in on a single line," Brookwood says.



Intel unveils a new line of networking products, including the IXP 1200 network processor (above).

Network equipment vendors that are already planning to support the IX architecture include Broadband Access Systems Inc., Westborough, MA, Cabletron Systems, Rochester, NH, Cisco Systems Inc., San Jose, CA, and Newbridge Networks Corp., Kanata, Ontario.

In addition to the IXP 1200 network processor, a whole family of scalable switching and formatting engines has been unveiled as part of the company's IX architecture. All told, 13 products were released in September for use by OEMs in the development of network devices for LANs, WANs and Internet-related networks.–*ptc*

In addition, the L-Class servers can be upgraded to IA-64, Intel Corp.'s 64-bit Merced chip, when it becomes available sometime in mid-2000.–*sjh*

PCI Moves Up a Notch

Systems vendors that have milked the Peripheral Components Interface (PCI) I/O platform for all it's worth now have a new, faster version of the specification to which they can develop their systems. In October, members of the PCI Special Interest Group (http://www.pcisig.com) released the final specifications for PCI-X, the next-generation I/O interface intended for systems that require high-bandwidth I/O.

PCI-X ups the I/O ante by operating at 133 MHz, rather than the 66 or 33 MHz in previous PCI incarnations. Increasing PCI's clock speed "effectively doubles your bandwidth [upwards of 1 GB/s]," says Rich Baek, executive director for PCI SIG.

PCI-X, like PCI 2.2 (the current specification), is available in either 32- or 64-bit mode. Whereas the majority of systems vendors develop 32-bit PCI, higher end vendors such as Sun Microsystems Inc. rely on the 64-bit I/O interface. PCI-X is also designed to maintain backward compatibility with existing PCI cards.

PCI-X comes as especially good news for vendors selling systems into bandwidth-intensive environments such as Gigabit Ethernet, Fibre Channel or Ultra 3 SCSI. "Today's peripherals have taken all the bandwidth they can get out of PCI and they want more," says Peter Glaskowsky, systems technology analyst for MicroDesign Resources, Sebastopol, CA. PCI-X also features better electricals, says Glaskowsky, improving protocol support and enabling users to run more PCI buses in parallel on a single system.

PCI-X, therefore, is a win for systems and peripherals developers, "but it's not a huge win," says Glaskowsky. Going forward, the industry is looking toward System I/O, a merger of the NGIO Forum (http://www.ngioforum.org) spearheaded by Intel Corp. and endorsed by Sun and the Future I/O Consortium (http://www.futureio.org), which is fostered by IBM Corp. and Hewlett-Packard Co. This serial point-to-point interface promises to deliver much better sustained throughput than PCI-X–potentially, many gigabytes per second, according to Glaskowsky–but is not expected on the market for several years.

Meanwhile, PCI SIG, an industry forum with more than 850 members, is busy hammering out the details of two other important changes to the PCI specification. On one hand, PCI SIG is on the verge of releasing a new PCI specification for small footprint devices, mainly laptops, called Mini PCI. The spec is based on PCI 2.2, but

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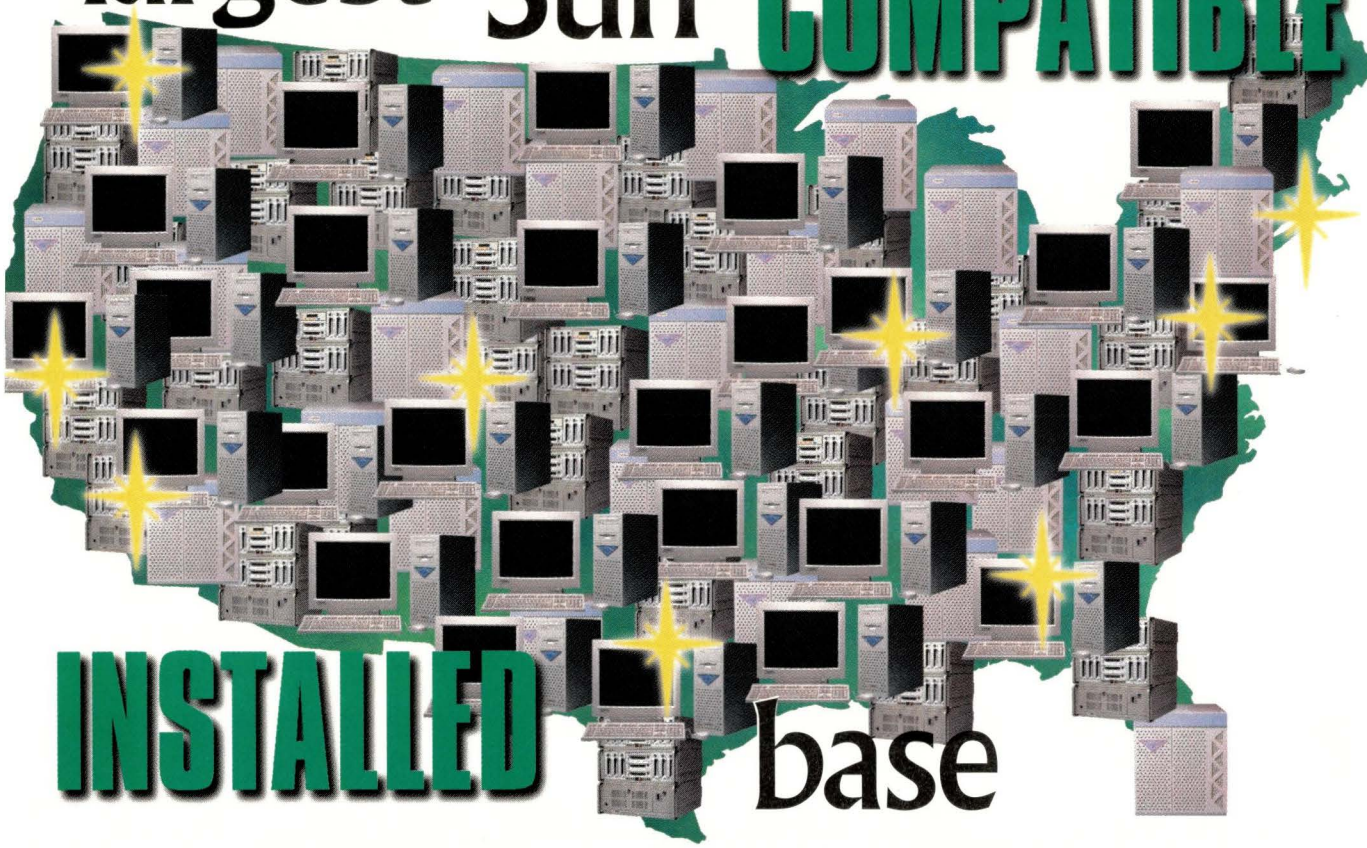

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introduces a much smaller footprint. Version 1.0 is slated for final approval by the end of the year, Baek says.

The advent of Mini PCI may cause laptop prices to fall, Baek says. To date, laptop systems manufacturers have not had the benefit of an industry standard I/O interface and, as such, have had to develop a system's I/O interface themselves. As a result, I/O typically resides directly on the motherboard, linking it to peripheral development. By removing motherboard development from the development of PCI modem and network interface cards (NICs), for example, Baek says Mini PCI will spawn a generation of Mini PCI daughterboard cards, reducing the development cost of laptops.

Also, reacting to the recent trend for shorter desktop chassis, PCI SIG has started work on a so-called Low-Profile PCI. The design reduces the height of the PCI card from more than 10 centimeters to approximately 8.5 centimeters. Currently labeled an Engineering Change Request (ECR), Low-Profile PCI is scheduled to turn into an Engineering Change Notification (ECN) before the end of the year, and become part of the current PCI 2.2 specification.

Systems where you can expect to see Low-Profile PCI components include some of the more cutting-edge "cool concept PCs," says Baek. Currently, if systems manufacturers want to achieve a shorter chassis, it's necessary to lay PCI cards parallel to the motherboard with the use of a riser card. Riser cards, however, add an additional $15 to $20 to the manufacturing costs, Baek says. Therefore, Low-Profile PCI could be the technology that allows desktop systems manufacturers to design decorative, rather than utilitarian, systems at consumer-friendly prices.–*alexandra barrett, contributing editor*

X Is Still Working

Citrix Systems Inc. is now offering X terminal access to Microsoft Corp. Windows applications. The Fort Lauderdale, FL-based maker of the WinFrame and MetaFrame products, which provide multiuser access to Windows applications, has unveiled a new addition to its product line to permit X11 users to operate within a MetaFrame or WinFrame environment.

The new technology, called UNIX Integration Services, allows UNIX accounts to be imported into an NT domain and allows UNIX passwords to be synchronized with NT domain passwords. "You don't have to manually

Linux Goes Thin

Linux, which is increasingly taking hold of servers and desktops, is now finding a niche in the thin-client market as well. This summer, Wyse Technology Inc., San Jose, CA, introduced its first Linux-based Winterm terminal, the Winterm Model 5355SE. Wyse, a leading maker of Windows CE-based terminals, says it decided to expand its line with a UNIX-based terminal to give customers with mixed-platform environments more options.

"The 5355SE is designed for companies who have collected technology for many, many years and want to be able to access everything they have on one desktop and have that desktop retain the simplicity of a terminal environment," says Jeff McNaught, vice president of marketing for Wyse.

The $899 terminal will feature a local Wyse Navigator browser–something that was not included on the Windows-based terminals–as well as the Citrix Systems Inc. Independent Computing Architecture (ICA) and X11 graphics display protocols for Windows NT and UNIX, respectively. It also includes The Santa Cruz Operation Inc.'s Tarantella application broker product, which allows users to access any UNIX, 3270 or Windows application via an embedded Tarantella client. The device does not come with a local Java Virtual Machine (JVM), but Wyse says it will provide an add-on flash card with a Netscape Communications Corp. Communicator browser and JVM on request.

Linux was chosen as the operating system because of its open-source nature, says McNaught. "We needed an OS that met several key criteria. It needed to be something that Wyse could control and optimize. We also wanted something that wasn't going to force us to charge the customer a lot of money."

The choice of a Linux operating system, which is based on the Linux distribution released by the Slackware Linux project (`http://www.slackware.com`), cuts $50 to $100 off the price of the Winterm terminal, compared to what it would cost if Wyse developed its own operating system or licensed a commercial platform, McNaught says.

Wyse announces its first Linux-based Winterm terminal.

A Linux-based terminal is not, of course, the same thing as a Linux desktop. It can't run Linux applications on the client. "We look at the OS in a terminal in terms of plumbing. So when customers say, 'Great, you have a Linux terminal. Now I can run Linux applications on it,' we remind them that it's a terminal not a Linux PC," McNaught says.

Wyse is not the only vendor to opt for Linux as the core for its terminal products. In September, Hewlett-Packard Co., Palo Alto, CA, announced a new line of thin-client products using Linux as its operating system. The L and X Series Entria line of terminals include a Linux core. The Entria L offers access to Windows applications via the ICA protocol, and the Entria X provides access to both Windows and UNIX applications via the ICA and X11 protocols, respectively. The Entria X also comes with HP's Chai VM JVM. Both models support a number of terminal emulators.–*sjh*

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Circle No. 9

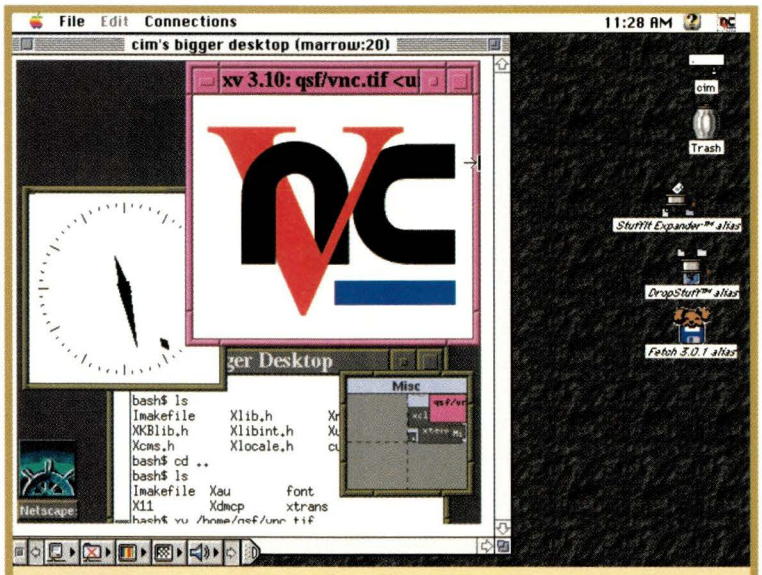
create all these user accounts. You can just import them from a UNIX NIS [Network Information Services] database directly into an NT domain," says Steve Piper, senior product manager at Citrix.

The $1,495-per-server software also allows users to integrate native Windows icons and file associations with their UNIX Common Desktop Environment (CDE) and to copy and paste graphics between X11 desktops and X11 WinFrame and MetaFrame sessions.

UNIX Integration Services does not use Citrix's Independent Computing Architecture (ICA) client software, which enables UNIX workstations, Windows PCs, Macintosh and Java desktops to connect to Windows applications running off a WinFrame server. Instead, UNIX Integration Services uses the native X protocol in X terminals. As such, X11 devices accessing applications via UNIX Integration Services can't take advantage of some WinFrame features, such as load balancing or low-bandwidth connectivity.

While any desktop equipped with X Window System software can take advantage of UNIX Integration Services, Piper says, the product is intended for X terminals that can't run an ICA client. That makes for a fairly small market–just about half a million desktops, according to Zona Research Inc., Redwood City, CA. "[X terminals are] fairly scarce as a product category," says Zona analyst Greg Blatnick. "I look at this as an incremental extension of Citrix supporting a wide variety of computing architectures and other protocols."

"It's a declining market, but Citrix prides itself on providing connectivity for a wide variety of clients," says Piper. "A lot of our customers have heterogenous networks, not only with UNIX, but DOS, 16-bit Windows, 32-bit Windows, Java, Macintosh, Web clients...so this just expands the alternatives."



Virtual Network Computing, developed by AT&T, allows PC users to view UNIX sessions running on another machine. In the above snapshot, a UNIX desktop is being accessed from a native Macintosh viewer.

Another free alternative for X terminals, or any desktop for that matter, is Virtual Network Computing (VNC), developed by AT&T Laboratories, Cambridge, U.K. Unlike UNIX Integration Services, VNC doesn't support a multiuser Windows environment, but enables a user on a non-Windows computer to view and operate a Windows desktop running on another Windows-based computer. It also allows PC users to view UNIX sessions running on another machine. Because the client viewer is stateless, a client crash has no effect on the application.

"We don't really see VNC as a competitor to Citrix or Microsoft's Windows Terminal Server," says Dr. Quentin Stafford-Fraser, research scientist at AT&T Laboratories. "They do their job well, but they are expensive and there are many situations where a much simpler remote access is useful." He says VNC has even greater utility in UNIX environments where a user may want to access his UNIX desktop from a variety of clients. "I do most of my work on a Linux-based PC and I just connect through a VNC viewer from wherever I happen to be," says Stafford-Fraser. "That same PC could also be used to access the desktops of other people."

VNC server software is available for Solaris 2.5 for the SPARC platform, Linux 2.0 for x86 computers, Digital UNIX OSF1 3.2 for Alpha, Mac OS 7.6.1+ and Windows 95/98/NT/2000. Viewers for VNC are available for all of the above server platforms, as well as Java, DOS, OS/2 and smaller devices such as 3Com Corp.'s PalmPilot and Windows CE-based devices. The software is available for download at `http://www.uk.research.att.com/vnc`.–*sjh*

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Circle No. 10

Ask Mr. Protocol

by Michael O'Brien

TOM BARRETT

"...a BGP speaker advertise[s] to its peers...in neighboring ASs only those routes that it itself uses."
– RFC 1771, "A Border Gateway Protocol 4"

"Perhaps the first thought here is, 'what are we trying to do?'"
– Peter J. Welcher

"Kick it again."
– Front-line router whacker

Crossing the Border with Mr. P.

Q: *We treat the Internet the same way we treat the phone system: dial up an IP address and you're talking to it, just like that. We don't pay any more attention to how that happens than we pay to the phone system. But something must determine how packets get from here to there. We hear a lot about routing in the Internet, but not much about how it happens. So, give! How does Mr. Protocol find his way around the Net?*

A: Mr. Protocol is positively delighted you asked because the answer is something that he's peculiarly well-suited to discuss: a protocol. The protocol that glues the Internet together is called Border Gateway Protocol Version 4, or BGP4. You'd think that by the fourth go-round things would be pretty much OK. Well, for the most part, they are. Some knotty questions come up when you try to apply BGP4 to new situations, but its stability and flexibility allow some amazing tricks to be pulled.

It should come as no surprise that Mr. Protocol, himself, does not use BGP4, or anything like it. He navigates the Net using a tropic mechanism. I don't mean "tropic" as in Bermuda, I mean "tropic" as in plant tropisms. Mr. Protocol tends toward data the way plants tend toward the sun. It's scary to watch him work. He just sniffs around in some Web browser or other (off-brand for sure, odd by preference, either Opera or, if he's feeling text-bound, Lynx), looking as if he has no idea what he's doing, where he's going, or why he's there. If he's looking for a good deal on a car, he'll be found reading a page on the biology of skunk cabbage. The next thing you know, he'll zip past some page advertising a great deal on a used L-1011 and bingo! There's an ad for a classic Stingray, driven by an archetypal Little Old Lady From Pasadena, on Sundays only, to the garden club, at speeds never in excess of 95 mph. Go figure.

Someone recently claimed that the Web is only 19 clicks across. That'd make it near optimal if you could find anything in about 25 clicks. Mr. P. usually does it in five. It's enough to make you sick.

The history of routing in the Internet is long and fraught with peril. Hosts in the ARPANET didn't have to worry about routing. For one thing, there was only one network. People with local area networks (LANs) were out of luck; there was still only one network. Hosts on the ARPANET sent messages addressed to other hosts, but the messages were sent to the local Interface Message Processor (IMP). IMPs were the only things that were actually on the ARPANET. Hosts were connected only to IMPs, and IMPs had all the network links. (IMPs were later renamed Packet Switch Nodes, or PSNs. Mr. Protocol doesn't care. IMP is a much better name and revisionists can go hang.) IMPs exchanged routing messages periodically, listing which routes were OK, which were broken and so on.

Some clever fellows at MIT hacked their IMP to generate a "broken" routing message. Because IMPs believed everything they were told by other IMPs, all IMPs being brethren in the flesh,

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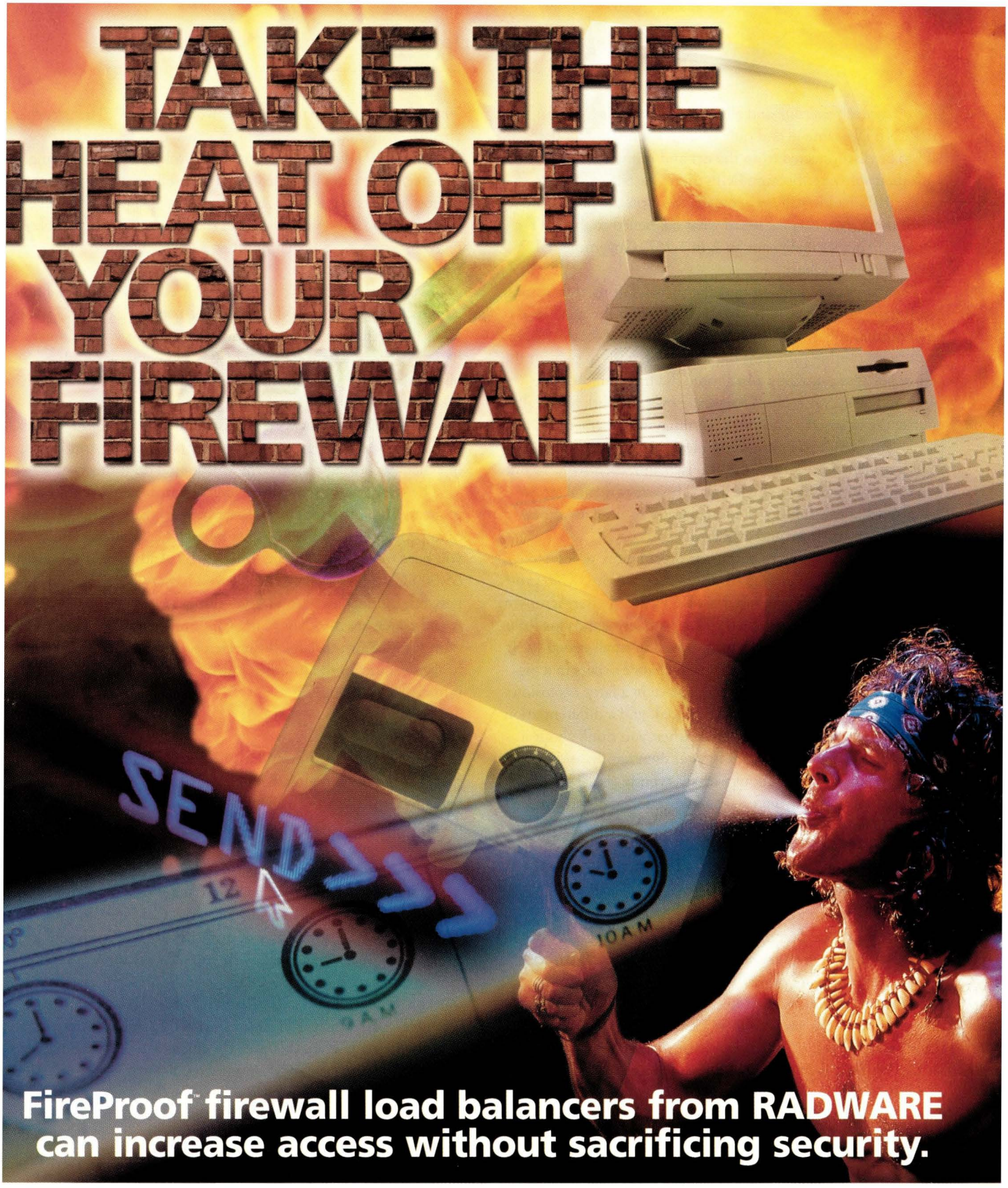

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Circle No. 11

liberté, égalité, fraternité and all that, all the other IMPs on the ARPANET became ill and quit talking. Eventually, all the IMPs had to be disconnected from the net and individually reloaded with their software. Because IMPs didn't have local storage, that meant BBN had to call every one of them on the phone and reload them. Mr. P. never heard what happened to the MIT students. They probably got an A in 1.287, Governmental Infrastructure Hackery.

There's a sizable body of queuing theory out there, but most routing protocols have been designed based on the misfeatures and eventual collapse of their predecessors. Even the ARPANET saw several routing protocols implemented, both to prevent the sort of collapse caused by a bad route (ha ha, no fools these boys) and to maximize load balancing over network links. Of course, the latter effort saw only minimal improvement because the government, in a cost-cutting measure, cut the number of transcontinental links from three to two and, eventually, to one. You can't load-balance a single link. This experimental result was arrived at painfully, over a long period of time, by experimentation, brute force and awkwardness.

Most early LANs had a routing protocol more or less stolen, Mr. P. is given to understand, from the Xerox Corp. XNS protocol. It didn't have a name, but a TLA (Three-Letter Acronym) was needed, so it was called RIP. This probably stands for Routing Information Protocol. RIP works well in small networks. It works poorly in big networks. When a change occurs in a big network, RIP packets fly all over the place in a large explosion.

Other routing algorithms were created, and a differentiation was eventually made. It makes sense when you think about it. There's the stuff you talk about in your own family, and then there's the stuff you talk about with everybody else. This led to a distinction between "interior" and "exterior" gateway protocols. An interior gateway protocol (IGP) is one that is used to do routing within a network, or set of networks that are under the same technical administration. In Nethead parlance, such a collection of networks under common technical administration is called an autonomous system (AS).

It turns out that the sort of properties that make a good IGP don't work very well in an exterior gateway protocol, which is designed to propagate routes between autonomous systems. Generally, IGPs are designed to converge quickly and are fairly chatty. To solve this problem, the Exterior Gateway Protocol (EGP) was created. It held the early Internet together.

EGP did not scale very well, which led to the development of the Border Gateway Protocol (BGP), now on its fourth iteration. All three redesigns of BGP were motivated by operational experience of doing backbone routing on the Internet. The latest redesign was the result of twin horrendous realizations on the part of the folks running the Internet backbone routers.

The first was that the assignment of IP address space had been done all wrong. Protocol designers like to break things up into classes, to make them easier to handle, and address space was no different. IP addresses are 32-bit binary numbers. This makes them easy to chop up into four eight-bit chunks called "octets." Now if you're running your own LAN, all of your machines will have related IP addresses–that is, the front part of the address of every machine on your net will be the same. That identical front part is the "network number." The part that changes from machine to machine is the "host address." The space of all IP addresses was originally broken down according to octets. One octet of network number followed by three octets of host address was a Class A network. You can put millions of hosts on a Class A network, but there are only 256 possible Class A networks, and that number is lowered for technical reasons to 126 or so.

Two octets of network number followed by two octets of host address let you put 65,000 hosts on the network. That's Class B. Class C has three octets of network number, but you can only have 255 hosts. There are scads of Class C network numbers, obviously. Unfortunately, this is a little rigid. There's no real reason why you couldn't chop up the pie at any bit boundary and have, say, 20 bits of network number and 12 bits of host address, even if it doesn't line up neatly on octet boundaries. And it turns out there are strong reasons why you should do it this way.

The strongest reason is there aren't enough network numbers to go around, otherwise. You either have to give Class A addresses to people who can't fill up that big of a network efficiently, or you have to give out bunches of Class Bs. And there aren't really 65,000 Class B networks, because you have to give a few bits of network number away to indicate things like which are the Class A and which are the Class C network numbers. Class B is about right for medium-to-large businesses, so there got to be hot and heavy pressure on the Internet address space, at least as divided into classes A, B and C.

No Vacancy

That was the first horrendous realization. The second was that it didn't really matter, because the number of networks being advertised on the backbone was so large that the backbone routers were going to run out of memory space for their routing tables, and out of CPU power to shove them around, long before they ran out of new network numbers to assign.

Backbone routers, which really are pretty sizable machines, have reporting capabilities which, as far as their operators are concerned, are the conceptual equivalents of large community-chest thermometers painted on the sides. At the top of the thermometer, where the words "OUR GOAL–>" should go, are the words: "ROUTING TABLE FULL–IMMINENT DEATH OF THE NET PREDICTED–FILM AT 11." The difference is that, unlike on Usenet, this time the threat was real. The red bar was nearing the top of the thermometer. If the space needed to hold a full routing table grew too large for the routers to contain it, large segments of the Internet would simply drop out of sight. Zero, Zip, Hasta Mañana, Black Hole, -30-, Game Over, Wasn't The Internet Wonderful, Too Bad It Was All A Flash In the Pan.

Something had to be done. Soon. The answer was to junk classes A, B and C and replace them with Classless Internet Domain Routing (CIDR). Under CIDR, the division between network number and host address can be placed anywhere in the 32-bit IP address. The network number can be any number of bits long. The fly in the ointment is the information on where the division is made must be carried with the address as part of the route. It can be conveyed in a number of ways. For end-user systems, it is most commonly expressed as a subnet mask,

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a 32-bit number that has ones where the network number is and zeros elsewhere.

It has been proposed that the number of networks could be vastly increased if one simply allowed this pattern of ones and zeros to be noncontiguous, that is, if you had a few bits of network number, a few bits of host address, a few more bits of network number, a few more bits of host address and so forth. This way madness lies. In fact, it amounts to a really complex way of doing 64-bit addressing. BGP4 doesn't do this.

Instead, each BGP4 routing update contains a tiny database of Network Layer Reachability Information (NLRI). The NLRI is a variable-length list of networks that are reachable via the route in question. These networks are expressed in pairs. The first element of the pair is the length (in bits) of the network number, and the second element is the actual network number. To make things line up right, enough bits are added to the right end of the network number to fill out an octet, but the value of the "extra" bits is ignored. The NLRI is made up of several, and potentially, many of these pairs.

This pulls off two tricks, one for each of the horrendous realizations. The first is that network addresses are no longer limited to classes set on octet boundaries. Network address space can be subdivided at the bit level, as required. The other trick is that a single routing update may contain reachability information for many networks. As routing updates come in, part of a BGP4 router's job is to aggregate the routes. If the same routing information applies to a number of different networks in a number of different updates received, the information may be combined into a single update. Similarly, if a more "general" update contains the same routing information as a more "specific" update (where general is defined as "fewer bits, but what bits are there are the same bits"), the specific update can be dropped. The more general route will cover the situation.

Many routing protocols in the past have exchanged information via datagrams. The idea was that if you dropped one or two, later ones would handle it, and in the meantime, you were occupying a lot less of your network with routing-related packets than if you'd sent them over a TCP connection. BGP4 doesn't do this. Routing tables on the backbone are large–on the order of 50,000 entries. When a BGP4 router starts speaking to a new neighbor, the first thing that gets passed is the entire routing table. We don't want to do this with datagrams. BGP4 uses TCP connections to communicate with its peers.

Once that routing table has been handed over wholesale, though, traffic cuts way back. BGP4 sends updates at measured intervals to cut down on extraneous traffic. And what traffic it does send only represents changes to the table. The whole table is sent only once per session, at the beginning.

The BGP4 specification establishes a "Hold Time" when two BGP4 peers start talking. If one side doesn't hear from the other within the "Hold Time," it disconnects and starts over. If no routing updates need to be sent, "keepalive" packets (with no data) are sent instead. Updates and keepalives are sent at a measured pace, however, never more than one per second. The suggested interval is one-third of the Hold Time value, so for large hold times, on a stable network, BGP4 packets may be infrequent. This behavior, of course, also determines how fast the network converges when a change in topology occurs (a very polite way of saying that smoke starts pouring from some router somewhere and some poor hapless outfit is suddenly no longer on the Net). Changes in topology spread with the speed that routing updates are exchanged, and this in turn is determined by the Hold Time chosen for the routers.

How do autonomous systems make use of this information? That's a little tricky. Information has to flow between the BGP4 routers and the IGP routers that glue the AS together, and it has to flow in both directions, at least potentially. The BGP4 router has to not only pass along routing updates that it hears from one external BGP4 router to the others with which it is speaking, but it has to inject routes for its own AS, and pass along to the IGP routers in its own AS whatever routing information about the Big Wide World they may need. One big rule in BGP4 is that no matter what kind of string, glue, prayer wheels and rice paper your AS may actually be glued together with, your BGP4 router has to advertise a single, consistent routing policy for your entire AS. How you ensure that it's telling the truth is up to you, but you'd better do it. In particular, if you are connected to the outside world by several BGP4 routers, you have to make sure they exchange information in such a way that they advertise consistent routes involving your AS. This requires a whole other side to BGP4, an internal protocol between BGP4 routers in the same AS, which ensures this consistency. Sometimes this is called iBGP, for "internal BGP."

But do you trust the updates? Remember the MIT fellows? BGP4 is firmly a member of the modern Internet: Every update comes with a "marker," which is typically a changing cryptographic code that is checked by the receiver that shares a cryptographic secret with the sender, enabling it to generate the marker code itself. No marker match, no update, ring the alarm.

Sometimes one can get away with ignoring BGP entirely. Because its purpose is to exchange routing information between autonomous systems, if you have a single router with a single connection to an Internet service provider (ISP), you don't need BGP4. You're much better off using a default route in that router to point to the ISP, and have it announce itself as "gateway to everything" on your network. Much, much simpler. You don't need to know about 50,000 routes if they all point in the same direction. It makes for an impressive signpost, though.

❖ ❖ ❖

Mr. Protocol recently became aware of the Information Technology Professional's Research Center Web page at `http://www.itprc.com`, which has excellent pointers to highly readable information about all phases of Internet technology.

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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Circle No. 13

by Peter Collinson, Hillside Systems

PAUL SCHULENBURG

Creating a Personal Environment

You will undoubtedly not be too surprised when I say that UNIX is a mature system. With more than 25 years of development, it has become more and more complicated as hordes of developers and users have added their own ideas or changed things to suit their needs. UNIX is stuffed with people's ideas; some good, some bad, some indifferent. You'll often find several different ways to achieve the same goal.

Sometimes, the parallel mechanisms are there because of evolution: some new and improved method has been developed and the old one has been left in place to supply backwards compatibility. On other occasions, the parallelism has been induced by separate development: two or more sets of developers have worked independently on the same problem and arrived at a different solution. Later, these solutions are integrated, and neither has been completely eliminated–again for fear of upsetting the customer base. In other cases, the parallelism has been engendered by cross-fertilization: one group has picked up on an idea from another but implemented it slightly differently for one reason or another.

The whole edifice that is UNIX has been constructed fairly slowly from a single coherent base and makes some sort of sense if you've watched it grow. However, the result can be deeply confusing to a novice who is presented with many different options but receives no guidance in deciding which path to choose.

Making it Work Differently

A minefield of confusion is created by the ability of a UNIX user to easily modify their view of the system to suit their needs. Tailorability is something that I push heavily in these pages because computers should be used to automate repetitive tasks. The machine should work for the human, and not vice versa.

I find myself constantly fiddling with my personal command set, adding new commands and removing old ones. For example, I have recently become a full-time `emacs` user and it has the habit of creating backup files in the current directory. The backup file is created with the same name as the original file and a tilde suffix (~). The editor can also regularly create autosave files, preserving the current editing status in a file whose name starts and ends with a hash sign (#). The safety features provided by these mechanisms are a *good* thing, but having to tidy up after you've stopped using the editor is a *bad* thing. Life is full of choices.

I suppose that I could have created a script that ran every night and removed these files, but it's better to intelligently clean up when you have finished the job rather than allow a robot to delete files in the middle of the night. A backup file that has been deleted is not a great deal of use. Consequently, when I'm done with a particular project, I realized that I was in the habit of typing:

```
$ rm *~ \#*
```

I've always been queasy about combining the wildcard star (*) with the `rm`

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command. It's just too easy to have finger trouble at the wrong moment and lose everything. The solution, I decided, was to create an alias to this command in my shell. I now have a command that performs this cleanup task using less keystrokes and, more important, that is consistently safe. It only does one well-defined and tested task, and I cannot delete all the files on which I am working.

I said, somewhat glibly, "I created an alias." Aliases are one way to change the environment to create a new command. There are other ways. I could have written a script and made a file that contains a new command. Or, I could have created a shell function to do the task. Why did I use an alias and not a script or a function? Why do we have these systems in the first place?

Shells

We need to find explanations by looking at the history of shells and the user's ability to change their environment. What follows is the sequencing of features that is my personal history. Other people will have arrived at the same point via different routes, depending on which UNIX systems they used and in what order.

The first system I used was UNIX Version 6. Its simple shell provided the familiar command structure that we have inherited today:

```
% command options list-of-files
```

Although, you should appreciate that everything on the command line *after* the name is defined and processed by the command itself. When you typed a command into the shell that was not an absolute pathname, it had the problem of finding the file that contained the command you wished to execute. It looked in standard known places–the current directory and `/bin` and `/usr/bin`–before giving up and saying `Command not found`.

Incidentally, the shell supported scripting, although there was no built-in programming syntax. All the statements in the script were commands. Essentially, the file was executed by reading the next line and running the command. However, to write programs, we need to be able to jump about the file, perhaps moving back up to create a loop, or skipping a section to allow for a test to fail. The trick was to write a command that would reset the point at which the shell read the next command by using the `seek` system call to change the kernel's idea of what was the next character to be read from the file.

For example, to jump to a point in a file, you would plant a label (a shell comment) at the appropriate point in the script and execute a `goto` command whose argument was the name of the label. The `goto` command reread the file looking for the label, and left the standard input channel so that a subsequent read would read data that followed the label. After the `goto` command exited, the shell read commands from that channel. There must have been some magic that allowed the shell to pass the command file into the `goto` command to make this happen, but I've lost those details.

Version 7

All this went away with UNIX Version 7. It had a spanking new shell and solved the problem of locating the files that correspond to commands by creating the mechanisms that we still use today. The Bell Labs development team tended to seek general solutions to problems and recognized that there were advantages to be gained by enabling processes to inherit information from their parents. When you log in, the login program knows quite a bit about you, and if it can pass that information into all the programs you run, then they can each be tailored more easily.

The solution was to add a new feature to the process model, the programmed world in which each process runs. At the moment of birth, a process inherits a set of *name=value* pairs, known as the "environment," from its parent. The environment is passed automatically from parent to child, no special action is needed to transmit it unchanged. A process can elect to alter an existing value or add a new pair, and changes to the environment are passed to all of its descendants.

One of the environment pairs, the `PATH` variable, was appropriated by shells to provide a list of places to look for commands. The initial setting of the `PATH` variable is established at login to a set of default directories. It would be something like the following:

```
PATH=:/usr/bin:/bin
```

The list is separated by colons and starts with an empty entry, which means that the shell first looks in the current directory. I should say that executing commands in the current directory is now deemed to be a bad thing because it can allow Mr. Bad Guy to place a command into your execution path.

The Version 7 shell also allowed the user to execute a start-up file, `.profile`, in their shell at login. The intention was to allow you to establish your own settings for environment variables. It was now possible to add a statement that set a new `PATH` in your `.profile` file. Note that it's important for the `.profile` file to be run by your shell and not in a subprocess, otherwise the file commands cannot create settings in your shell.

The ability to set up your own directory that could hold private commands that were accessible wherever you were in the file system tree greatly enhanced the user's ability to tailor the system. It became viable to create personal commands. The notion of having a private `bin` directory became universal.

The Version 7 shell was written by Steve Bourne and his program supported a proper programming language based on Algol 68. The language allowed complex scripts to be created. It suddenly became possible to write real commands that would combine frequently used personal command sequences. You could even decode arguments to scripts, so the command sequences could be used as templates that were applied to different files. The scripts lived in your private `bin` directory, and you could make them operate indistinguishably from the standard command set on the system.

On my site, a U.K. university, personal commands began to flourish in the early '80s. We had scripts that generated multi-column output from `ls` by piping the output to the `pr` com-

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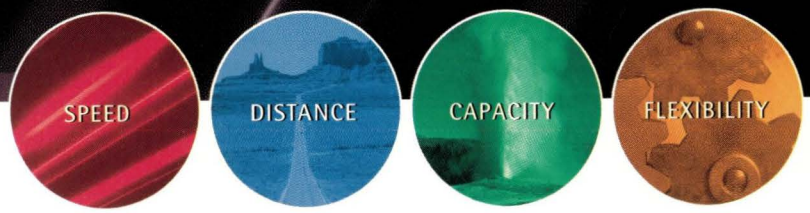

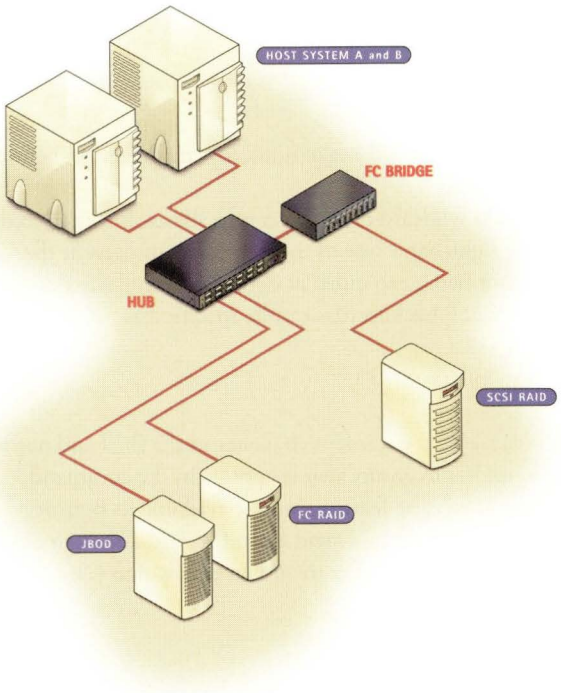

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Circle No. 15

mand. We had scripts that replaced the rm command by something that would copy unwanted files to a temporary directory to permit recovery of the files later (just like the Windows Recycle Bin). We even had people who implemented "Are you sure?" testing for the rm command (what is now the -i option).

Personal scripts could also create a support problem. Initially, many of my scripts that were used for system purposes didn't explicitly set their PATH or consciously use the absolute path to standard commands. When someone executed a system script, it inherited their PATH and so it was possible for it to pick up a private version of ls or rm. Suddenly, the command used by the system script was not behaving "properly" and the system script was broken. There were also wonderful unused opportunities for exploiting the script to compromise the system.

Experience is a good teacher. I now know that it's really a good idea to set a PATH (or use an absolute pathname to a command) to make sure the script is executing the correct commands. Also, you should never have a shell script that runs as root using the setuid bit to temporarily alter permissions.

From the user's point of view, it's also not a good idea to establish a private command that replaces a standard command with something that doesn't replicate the original functionality. First, it may confuse you at some later date when you've forgotten it's there. Second, it ruins your personal portability to other systems. For example, if you create a command (or an alias) that always adds the interactive switch into the rm command, and start relying on it, then you may be embarrassed when it's not there.

And Then Came...

At the outset, the released version of the Bourne shell for Version 7 didn't have shell functions, nor built-in commands. Both of these features came with the release of UNIX System III, whose version of the Bourne shell supported functions and had the echo and if commands built into the code.

When System III materialized, my university had converted to using BSD systems because they supported job control. However, to use job control, you needed to run C shell (csh). The actual timing of the invention of csh by Bill Joy is not too clear. To me, it has always betrayed its origins in the Version 6 shell by being very line-based. I am told that Bill started from scratch but was influenced by the early UNIX line-based shells. I have always believed that it was a parallel development with the Bourne shell, but by the time I started using it to talk to the machine in the early '80s, it had been integrated with Version 7 and had been influenced by the Bourne shell.

However, csh contains considerably more internal intelligence than was present in previous shells. The folks at Bell Labs continuously accused the Berkeley team of creeping featurism, and csh was not lacking in features. But it didn't creep; most of the features made it faster and easier to use. Nearly all of the features are considered standard on shells today.

The intelligence csh possessed gave it a set of built-in commands that made some common operations happen more quickly. For example, the echo command was part of the shell, saving the creation of a new process for this commonly used shell print command.

There were many new features too. The shell has better variable handing capabilities in the form of arrays, and arrays are used to manage the PATH list. Some csh variables are automatically mirrored into the environment, and a change to the path array is automatically copied into the PATH environment variable with appropriate translations.

The shell also supports command history. It remembers the commands the user types and allows the user to retrieve that information. Storage of command history is a huge win, minimizing keystrokes for maximal effect.

Command aliases were introduced by csh. Aliases can be defined in the shell start-up files (of which more later) and are intended to allow the creation of shortcuts for commands. If you want to use a command that lives in an unusual place, but don't want to access any other commands in the target directory, then you can define an alias:

```
alias emacs /usr/local/emacs/bin/emacs
```

Now when you type the word emacs as a command, it's replaced by the full path. Aliases like this are a win because it means you don't have to search a directory to start a new command.

You can also use aliases to add common prefixes into commands:

```
alias rmi rm -i
```

Now when I type

```
% rmi file
```

the command that is executed is

```
% rm -i file
```

and the -i flag to rm will make it ask for confirmation before the file is deleted.

You can add wildcard expansions into aliases, but you need to quote the right-hand side of the definition to prevent the wildcards from being expanded at definition time. My desire to clean up emacs backup files can be specified as

```
alias cleanup 'rm *~ #*'
```

The hash (#) sign is a comment character in the shell and needs escaping in quotes to ensure that it appears in the command.

This type of aliasing feature was not available in Bourne shell but was picked up by David Korn for ksh, although he changed the definition syntax to add an equals sign (=):

```
alias cleanup='rm *~ #*'
```

The lack of spaces around the equals sign is significant. You'll also find this alias syntax in bash, GNU's Bourne Again shell.

The csh and ksh syntax I described above doesn't allow you to take an argument from the end of a command and insert it into the center of the string, creating a complex command, say,

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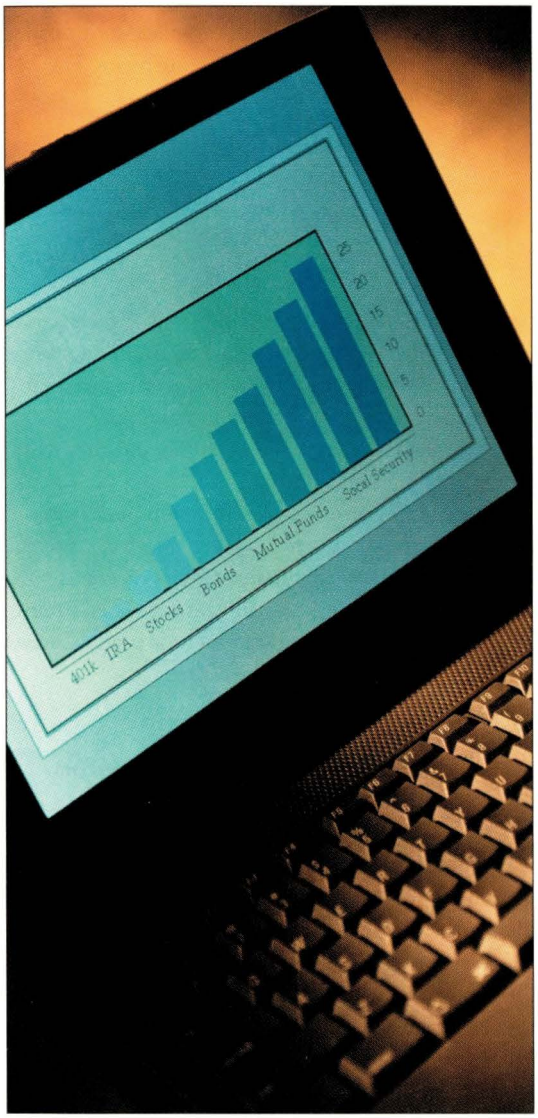

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```
% lm /bin
```

as a shorthand for

```
ls -l /bin | more
```

Of course, we want to be able to type any directory or file name instead of /bin and have the name pasted into the middle of the command. In fact, csh does permit this type of expansion by accessing its command history inside the alias definition (see *UNIX Power Tools* for more on this, a full reference can be found at the end of this article).

If you start creating aliases, then you will want to place them into your shell start-up file so that you don't have to retype them whenever you start a new shell. As we've seen, the early shells had a start-up file that was executed when you logged in, so obviously we could place the alias definitions in that. However, you'll often start new shells running from other commands, perhaps from inside your editor. These new shells will not run the start-up file because you are already logged in and so they will not see and establish the aliases.

To solve this problem, csh created a new "dot" file, .cshrc, that's run whenever a shell is started. Anything that needs to be run when you log in is placed in the .profile file, and anything that is needed by all shell invocations is placed into .cshrc. Both ksh and bash have adopted similar tactics, allowing the user to have two setup files.

When csh was introduced, people went mad on creating aliases, and .cshrc files containing hundreds of lines became common. Actually, the physical size of .cshrc files became a worry; significant processing time was added to the shell start-up. To counteract this, csh gained a flag (-f) that said: "Don't read the .cshrc file." I use aliases for commands that cannot be done any other way and for a few commands I use every day (like h for history). Less frequently used commands are placed in my private bin. Of course, with the advent of seriously fast computers, many of these speed concerns have vanished.

Functions

While csh was creating aliases, the Bourne shell camp was inventing functions. You'll recall that these were not present in early Version 7 releases and consequently didn't make it into Version 32V, on which the Berkeley systems are based. For some time, there were two versions of Bourne shell in common use; one with functions and one without. It took several years before shell programmers could safely write portable scripts that used shell functions.

Functions in any programming language enable the creation of a named sequence of statements that can be used and reused in the program. The statements obtain data from variables, and their values can be passed into the function as arguments. The statements may compute an answer, and the function will return it back to calling code. The function becomes a recipe for making something happen on different data.

Typing a command into any UNIX shell has similar properties to functions in a programming language. You provide a command with arguments, and it returns success or failure. Functions in the shell should behave like any command but are written in the shell's own programming language. They can then be used in any context where a regular command may appear.

Functions allow you to create a complex command definition that is eventually executed in the current shell. They are programmed in the same way as a regular command file. For example, they use the same argument-decoding syntax. With one exception (the exit statement), you can place script code from command files into functions with few surprises. For example, here's the lm command:

```
lm()
{
    ls -l "$@" | more
}
```

The "$@" is magic shell syntax that expands to arguments to the function to a list, while preserving any quoted arguments from the command line. We can now call this new command with any sensible set of parameters from the command line. The arguments will be passed into the ls command that will run with its output being sent to more.

The main coding difference between functions and command files is that functions must not use exit to force a termination of the command. Because the function is executed in the current running shell, a call to exit will cause the shell itself to terminate. In functions, the return statement is used wherever you would use an exit statement in the script.

Which Shall I Use?

In summary, we have three ways of creating private commands for the shell: aliases, functions and command files. I use a somewhat random mixture of all three. I have some command files in my own bin directory, but the number of these is small. I tend to use the bin directory as a place to put symbolic links to commands that I use infrequently but which live in odd places on the file system. Also, I have some symbolic links to the rlogin program that are named for the names of machines on my network. I can use rlogin to one of several machines by simply typing the machine name.

My .bashrc file contains several functions and aliases. I stick to the portable subset of bash commands so my .bashrc file is executable from ksh. Actually, on Solaris 2.6, /bin/sh is really ksh. Aliases are good for adding odd flags to standard commands to make them work the way you think they should. My functions are usually pretty complex and often can be done quite well by command files. As I mentioned above, there are whole sections on aliasing, functions and command execution in *UNIX Power Tools* by Jerry Peek, Tim O'Reilly, Mike Loukides et al. The book is into its second edition and is published by O'Reilly & Associates Inc. (ISBN 1-56592-260-3). ⊸

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

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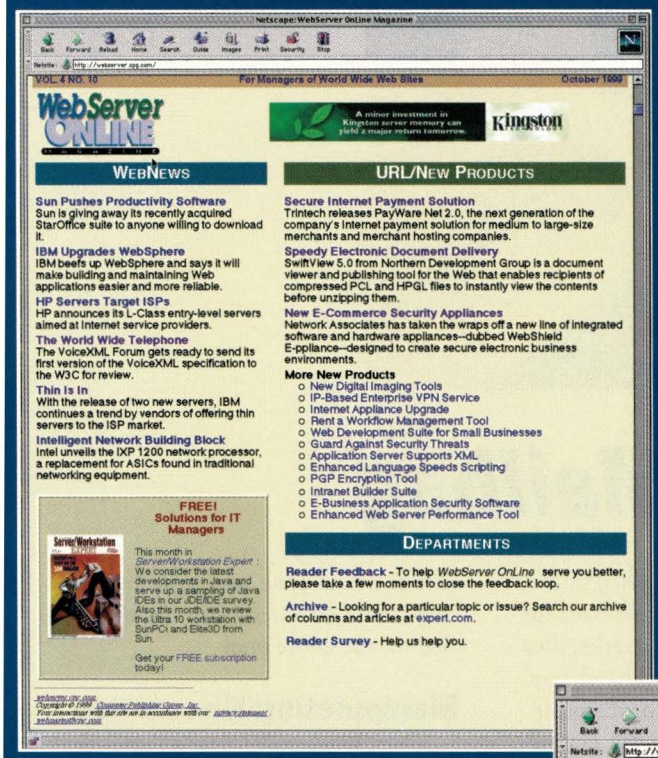
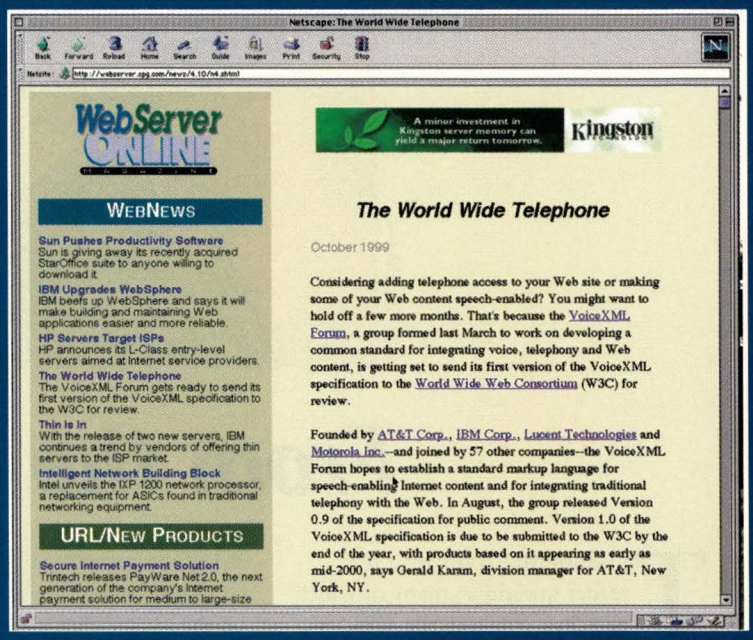
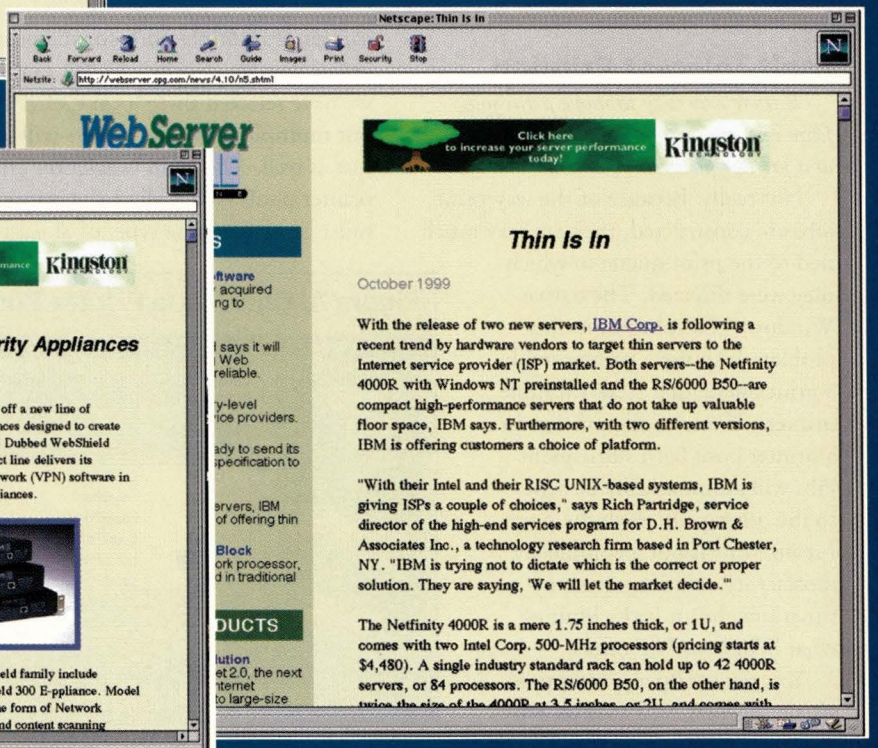
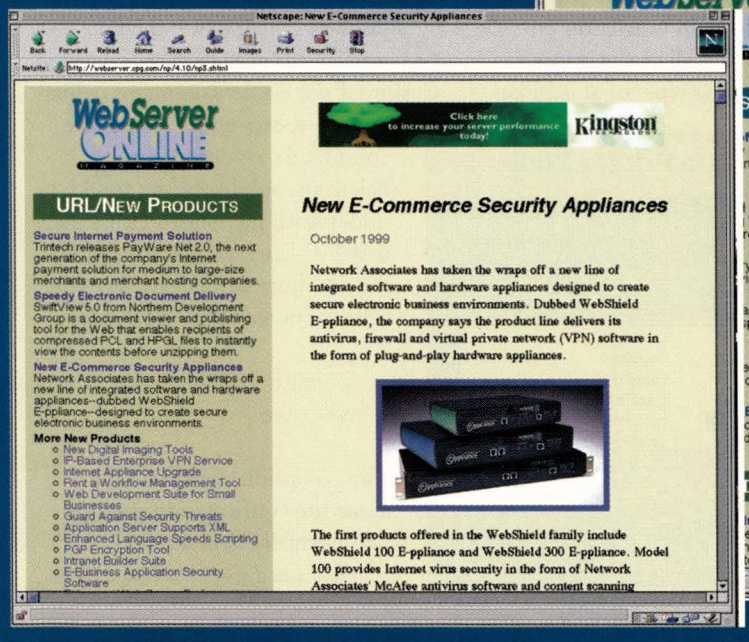








by Æleen Frisch

LOUISE GOLDENBURG

From the Mailbag

This month, I'll answer a few reader questions; many of which pertain to making the Windows NT user interface more efficient.

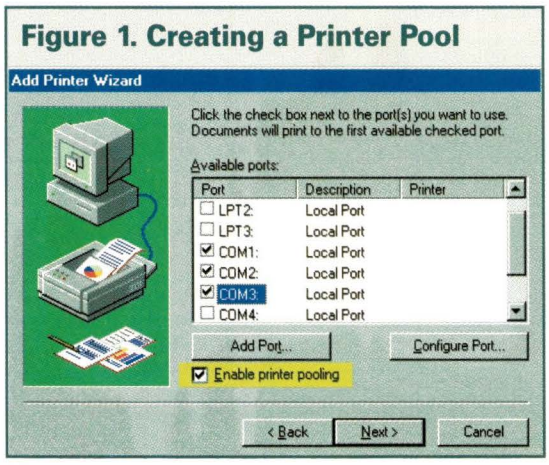
Fault-Tolerant Printing

Is there any way to move print jobs from one queue to another in the event of a printer failure?

Not really. Because of the way print jobs are constructed, they are very much tied to the print queue to which they were directed. The native Windows NT solution to this problem is to use a printer pool: a print queue that feeds multiple printers. If one of the printers in a printer pool fails, subsequent jobs will automatically be sent to the other printers in the pool. I realize this is not a completely satisfactory solution for many situations, but it is the limit of what Windows NT offers.

You can set up a printer pool via the normal **Add Printer** wizard. Printer pooling is specified by a checkbox below the Available Ports list on the second dialog in the series, illustrated in Figure 1. Once checked, you can select multiple ports for the print queue you are creating. In this example, we have selected three local COM ports, but multiple network printers will work just as well. The main restriction on printer pools is that all of the printers must be of the same type, or at least be able to emulate the same type, because only a single printer driver can be specified for the entire pool.

Figure 1. Creating a Printer Pool



Manipulating Directories

Does Windows NT have an equivalent to the `Deltree` *command to remove an entire directory tree?*

Windows NT does not include `Deltree`, but it does have an enhanced version of the `rmdir` command (which may be abbreviated to `rd`). The command's `/s` option says to delete any subdirectories found underneath the items in the directory list. For example, the following one-liner will delete the entire subtree rooted at `c:\new_data`:

```
c:\> rmdir /s /q
c:\new_data
```

The `/q` option suppresses the annoying confirmation prompt that normally appears.

How can I move an entire direc-

tory tree while retaining its current ownership and permissions?

The Windows NT Resource Kit includes the `scopy` utility, which can perform this function. It has several options: `/s` says to perform a recursive copy of all subdirectories under the specified item; `/o` says to copy owner information, in addition to current permissions (for example, ACLs), which are retained by default; and `/a` says to copy auditing information. For example, the following one-line command will copy the entire subdirectory tree under `c:\new_data` into `d:\scratch`, duplicating the current file ownership and permissions:

```
c:\> scopy
c:\new_data
d:\scratch\new_data /o /s
```

Note the syntax eccentricities: the options must follow the two parameters (*source* and *target*), and the name of the new directory must be explicitly stated in the target; otherwise, the contents of `new_data` are copied to `scratch`, but `new_data` itself is not replicated at the target location.

Service Pack Uninstall Cleanup

I've uninstalled a service pack, but the start-up screen still says that it is installed. How do I fix this?

The service pack information string is stored in the registry key `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\CSDVersion`. Change this value to a space to eliminate the message. Note that if you do this on a system where a service pack is installed, the operation has no effect, and the string will be reset automatically at the next system boot.

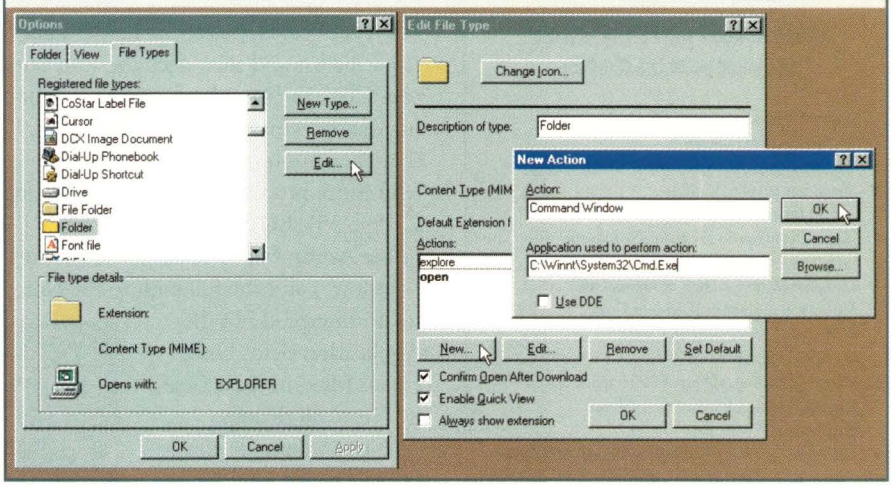
Customizing File Opening

Next, we'll consider two often-requested additions to the context menu, brought up by right-clicking on an item.

How do I make Notepad the default application for items without defined extensions?

This can be accomplished by setting an unnamed registry key of type `REG_SZ` under `HKEY_CLASSES_ROOT\Unknown\shell\Notepad\command` to the value `c:\winnt\system32\Notepad.exe %1`. You may do this by creating any missing keys in the path and then adding a value at this node. Leave the name blank, but specify the proper data type and set its value as indicated. Notepad will now attempt to open any item with an unregistered extension when you double-click on it. It will also appear in the right-click (context) menu for such items.

Figure 2. Adding Command Windows to the Context Menu



How can I open a command prompt for a selected folder?

The canonical solution for this request is as follows, which involves creating a new action associated with folders in Explorer: While running Win-

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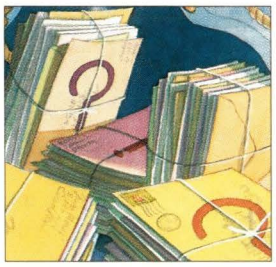
dows NT Explorer, select the **View=> Options** menu path and navigate to the File Types panel. Select the Folder item from the list and then click the Edit button. Click the New button in the resulting dialog. This will bring up a dialog that allows you to define a new action (the entire process is illustrated in Figure 2, Page 35). Enter a descriptive string in the Action field (we used "Command Window") and the full path to the command interpreter in the Application field. Once you've filled in these fields, exit from all dialogs.



Now, whenever you right-click on a folder, a command window will be opened and its default directory location will be the folder in which the selected folder resides; in other words, one level up from the selected folder.

An improvement on this scheme involves changing the Application field for the new action from the command prompt executable itself to a batch file like the following:

```
cd %1
c:\winnt\system32\cmd.exe
```

This way, you move into the selected folder first and then start the command window, which is the action I prefer. As always, be careful to specify the full path to the batch file in the action's Application field, and be sure that the batch file itself is properly protected.

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How can I specify key combinations for desktop items?

Let's begin by reviewing the predefined ones included with Windows NT involving the Windows key:

- Win-R opens the Run dialog.
- Win-F starts the file/directory search utility.
- Win-E opens a file browsing window (Explorer).
- Win-M minimizes all currently open windows; Win-Shift-M reverses a Win-M operation.
- Win-Break opens the System Properties dialog.

For all letters that are not otherwise assigned, Win-*X* selects desktop item(s) with names that begin with the specified letter, cycling through multiple items in turn each time it is pressed. When an item is selected, pressing Enter opens it, and Alt-Enter opens its properties dialog box (as usual).

You can also specify a key combination for any shortcuts on the desktop by selecting the item, opening its Properties dialog and navigating to the Shortcut panel. Once there, click on the Shortcut Key field and press the desired key (or combination); you can use function keys and Control-Alt key combinations.

Is there any way to disable Windows NT from putting "Shortcut to" at the beginning of shortcut names?

Yes there is. Edit the registry key `HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Explorer\link` to have a value of zero. This value's data type is binary, so make all of the digits zero, regardless of whether you choose to edit it in binary or hexadecimal format (32 zeros or 00 00 00 00, respectively). Once you've done this, all future shortcuts will have the same name as their referent item (if allowable). This technique applies only to the current user and, thus, must be repeated for each desired user. ⊸

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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by Jeffreys Copeland and Haemer

ALEX GROSS

"A picture is worth a thousand words."
– Anonymous

"If a picture were really worth a thousand words, people would draw that saying instead."
– Alan Haemer

Pictures

Once upon a time, a family would go on vacation and return with a dozen or more little yellow and red (or green and white) boxes of film to be developed. Not anymore. Copeland recently returned from a two-week swing through California with 60 MB of images loaded from his digital camera onto his laptop.

While he claims the family vacation was fun, we were both puzzled by what to do with the photos. They were interesting enough shots–San Francisco's Chinatown, beaches with fog, Santa Monica Pier in the sunset–but the file names, such as `IMG00003/EX_15/P0000234.JPG`, were no good for organizing the pictures. Worse, the software that loads the pictures onto the computer leaves the file with a date stamp matching the transfer time, not the time the picture was taken.

What do we know that can help us? Well, we know that the pictures are more or less in JPEG format, because our old favorite image-display tool `xv` says that's what they are. (JPEG stands for Joint Photographic Expert Group; it's a format that compresses the image by, among other things, intentionally throwing away some of the detail your eyes can't resolve.) But there's more data in the file than just the image. Let's take a look at one of the photo files:

```
$ mv IMG00003/EX_15/
   P0000234.JPG p2.jpg
$ strings p2.jpg
Exif
Minolta Co., Ltd.
Dimage EX
0200
0100
1999:07:26 14:33:16
Minolta Co., Ltd.
Dimage EX
erence Platform
JPEG
```

So there is a date buried in the data somewhere. In fact, that's even the date and time the picture was taken. So far, so good.

A little investigation reveals that the picture formats for digital cameras are covered by ISO standard 12234, "Electronic Still Picture Imaging–Removable Memory." (Which was on the Web for a while at the Photographic and Imaging Manufacturers Association Web site, but is no longer available.) The particular format of these images is called *Exif,* which was developed by the Japan Electronic Industry Development Association, or JEIDA. The text of the standard is available by mail order from Japan. Unfortunately, we are not that patient.

On the other hand, we can conclude (from ISO 12234) that while the Exif files contain the JPEG image, it is preceded by a TIFF-format list of data about the image, as a JPEG comment.

If you have no experience with images, right about now you should be asking, "What's TIFF?" It's the Tagged Image File Format originally

developed by Aldus, and now owned by Adobe Systems Inc. It is a kind of Swiss Army Knife for images, which allows you to include fairly arbitrary data as tags in the image. Let's take a quick tour...

The data part of a TIFF file begins with either the characters `II` if the file is in little-endian byte order, or the characters `MM` if it's in big-endian byte order. This is followed by a `short` containing the "arbitrary but carefully chosen" value of `42`. Finally, we have a `long` specifying the offset of the first image file directory.

An image file directory contains a set of tags. It begins with a `short` containing the count of entries in the directory, followed by the entries themselves. Each entry contains a `short` with a tag identifier, a `short` with the tag type, a `long` count for the tag and a `long` containing the tag value or a pointer to the tag data. For example, our image file entry could consist of the following (in little-endian order):

TIFF is a kind of Swiss Army Knife for images, which allows you to include fairly arbitrary data as tags in the image.

```
0f 01 02 00 12 00 00 00 6e 00 00 00
```

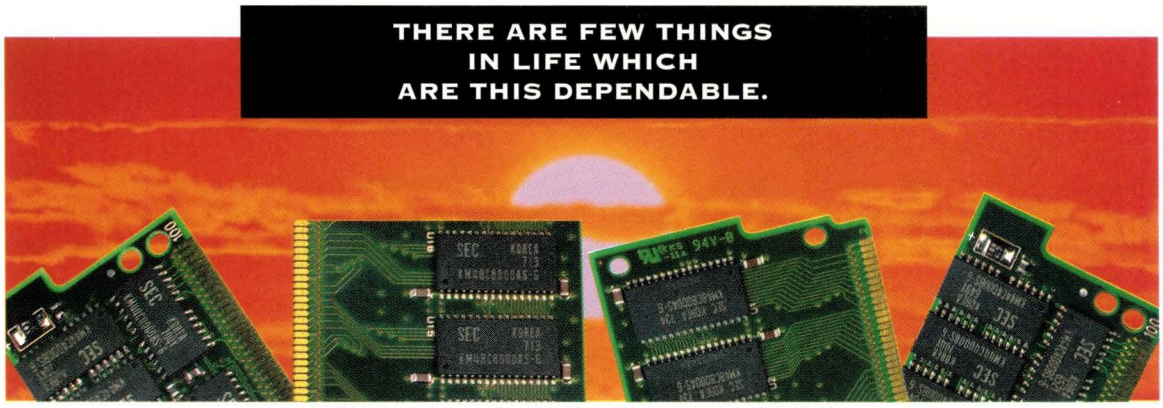
In other words, tag identifier `0x10f`, of type `2` (that is, ASCII), with count `0x12` (that is, 18 bytes long), at offset `0x6e` into the data. Sure enough, in our example file, 110 bytes (that is, `0x6e`) from the beginning of the TIFF data, we have 18 bytes (including the trailing `NUL`) reading "Minolta Co., Ltd." The image file directory (IFD) ends with a `long` representing the offset to the next IFD.

Organizing the Photos

We now know, in principle at least, how to dig out that date-and-time stamp inside the picture file. Given that date and time, we can write some software to rename those annoying file names, such as `P0000234.JPG`, to something more useful like `1999:07:26/14:33:16`, which will at least allow us to file the pictures by their date and time.

We should be stuck at this point. We don't know what the tag names are because we don't have a copy of the Exif specification. However, we do have a shortcut, because we can find software on the Web that reads TIFF and Exif files. Sometimes, an implementation is as good as a specification. (And we're lazy, so we'd just as soon find an implementation because it saves us rewriting code.)

We succeeded in our search when we discovered the gPhoto Web page, `http://gphoto.fix.no/`. The GNU digital camera application, gPhoto, comprises a suite of software for



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everything from loading images off the camera–we hadn't found this package yet and so had to use Windows software for that–to plug-ins for GIMP, the GNU image manipulation program. But for our purposes, it has a frighteningly useful little Perl module, `exif.pm`, that handles the processing of tags from Exif files. From there, we can construct a Perl script to do the renaming that we described above.

We begin with our usual setup:

```
#!/usr/local/bin/perl -w
#  $Id: file-pix.pl,v ...

## rename Exif files from digital camera
## based on the date and time the picture
## was taken

use POSIX;
use exif;
use strict;

sub usage {
   die "Usage: $0 [files...]\n";
}
```

Obviously, we need to remember to include the `exif` module we described earlier and to provide for a usage message.

Most of the work will be done in the `rename_picture` subroutine, which we'll build next:

```
# Extract the photo time, and rename the file
#  based on that time.
sub rename_picture {
   my $name = $_;
   my %tags = exif::dump_jpeg($name);
   my $ptime = "";    # time inside the photo
   $ptime = $tags{$exif::datetimeoriginal}{value}
      if($tags{$exif::datetimeoriginal}{count});
```

We use the `dump_jpeg` interface in the `exif` module to populate the associative array `tags` of TIFF tags from the file.

Given that array, we can get the time and date of the original picture. The `exif` module lets us know what tags have been used with a `count` for each possible tag; we use that information to ensure we've got a real value for the time stamp, otherwise we default to the initialized null value:

```
# now that we've got the timestamp,
#  such as 1969:07:21 00:15:23",
# we need to extract the components
my $re = "(\\d\\d\\d\\d):(\\d\\d):(\\d\\d) " .
   "(\\d\\d):(\\d\\d):(\\d\\d)";
die "bad date format in $_"
   unless $ptime =~ /$re/o;
```

We've used a shortcut above and set up a regular expression for getting the date components. We've done this mostly for typesetting purposes.

Given the time breakdown–year, month, day and so on–we can construct a date string, a time string, the new file name and a UNIX `time_t` of the timestamp. We do that next:

```
my $fdate = $1 . $2 . $3;
my $ftime = $4 . $5 . $6;
my $newname = $fdate . "/" . $ftime;
my $ctime = mktime($6, $5, $4,
   $3, $2 - 1, $1 - 1900,
   0, 0, 1);
```

We want to file the picture in a directory named for the date, `$fdate`. We don't want to create the directory if it's already created, and we want to stop if we can't create it. We use a very idiomatic Perl statement to do this:

```
mkdir $fdate, 0777 ||
   die "can't create directory $fdate"
      unless -d $fdate;
```

Once we've created the directory, we want to assure ourselves that we aren't about to overwrite an existing file. We check if the target name exists and issue a warning if it does:

```
if( -r $newname ) {
   warn "file $newname already exists";
   return;
}
```

Then we rename the old file to one with the `$ftime` for its

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name, and let the user know what we're doing:

```
rename $name, $newname   or
   die "can't rename $name to $newname";
print "rename $name, $newname\n";
```

Last, we change the times in the inode for the file so that they match the actual time the photo was taken:

```
   # now re-time the file, too
   utime $ctime, $ctime, $newname;
}
```

Because this is Perl, it is also very easy to change the naming scheme: for example, giving the pictures a name consisting of the date and time all in a single, large directory. We'll leave those modifications as exercises for the reader.

To finish up, we need a "main" program, which is pretty simple:

```
### main program
if( @ARGV ) {
   for( @ARGV ) {
      rename_picture($_);
   }
} else {
   usage();
}
```

Once we had a flock of pictures on our screen, we came up against another problem.

Color Blindness

As we've mentioned before, we often get some amusement out of Copeland's color blindness. Actually, Copeland's children get more amusement:

"Hey, Daddy! What color is this?"

"Um, orange?"

"Nope! Red! Ha ha!!"

Since the last time we mentioned color blindness, we've had some correspondence with Dr. Neil Cuadra of Cuadra Associates Inc., comparing Web sites and anecdotes about missing colors.

For example, Dr. Cuadra found a Web page at `http://www.geocities.com/Heartland/8833/coloreye.html` containing a selection of the Ishihara color perception test circles. Those are the arrays of colored dots, usually very carefully printed, your ophthamologist uses to check your color vision. You look at a circle of dots, and if you have normal color vision, you see a particular number. If your color vision is lacking in the range for that chart, you see a different number. (Both Dr. Cuadra and Copeland fail to see any numbers in most of the charts.)

He also pointed out to us that the nice folks at Design Matrix, Topanga, CA, have a Web page devoted to designing for people with color-vision problems (see `http://www.designmatrix.com/pl/cyberpl/cftcb.html`).

As an aside, we'll tell you that Design Matrix principal Gary Swift is an old friend from our Interactive Systems Corp. days and originally turned us on to architect Chris Alexander's idea of design patterns. The idea is that in designing things, some patterns of design recur, so it's helpful to understand what they are and to know how to use them. Alexander described his notions in an excellent book, *A Pattern Language* (published by Oxford University Press, 1977, ISBN 0-19-501919-9). Its companion volume, *Timeless Way of Building* (Oxford University Press, 1979, ISBN 0-19-502402-8), contains several hundred patterns for residential building. It was Alexander who inspired Erich Gamma and his merry band to adopt the idea for their book, *Design Patterns: Elements of Reusable Object-Oriented Software* (published by Addison-Wesley Publishing Co., 1995, ISBN 0-201-63361-2).

In any event, on the Design Matrix site, Swift provides a set of design patterns for visual design with color blindness in mind. We found his exposition particularly useful, and wish all magazine editors and Web designers were conversant with it. (Hey, you guys at *Wired*, take note!)

After that, in our search for design notes on color blindness, we tripped over `http://www.iarchitect.com/color.htm` at the Interface Hall of Shame, an online design critique. Also, we found the Web site for Lighthouse International, which has a number of additional clues for helping your color-blind readers, `http://www.lighthouse.org/color_contrast.htm`. (Paradoxically, we were led to these pages from a reference at *Feed Magazine*, `http://www.feedmag.com`. *Feed*'s navigation bar down the left side of the page is simply a series of colored squares, with no clue as to what any of them link to.)

That's a rather reference-dense recounting of our exploration on the subject. With luck, it will give you some things to think about the next time you design a Web page. Among Western Europeans, about 8% of males are color-blind (for more details see `http://www3.ncbi.nlm.nih.gov/htbin-post/Omim/dispmim?303800`). Remember that statistic when you start to build something that depends on colors.

That's all for this time. Next month, we'll think about slides. No, not photographic slides, but an alternative to using PowerPoint from Microsoft Corp. for your next presentation.

Until then, happy trails. ⊷

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

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

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

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by Jim Frost

LISA VAN DUSEN

Getting Loaded

One of the more interesting features of the Java language is that applications are always dynamically linked–assembled from component classes at runtime rather than in advance. This provides tremendous power, because portions of an application may be replaced without rebuilding the whole application. This makes Java applications both easier to maintain (patches are just bundles of replacement classes rather than entire applications) and far more flexible (end users may be able to provide their own extended functionality, for example, through plug-in beans).

But this functionality is somewhat limited in the standard implementation: classes must reside in a local file system; classes can only be packaged in a rigid directory structure or in `.jar` or `.zip` format archives; and changes to the class path are not allowed at runtime.

Fortunately, Java provides an escape hatch called the *class loader*. A class loader is simply a mechanism by which the programmer may retrieve classes via any necessary mechanism. A Web browser, for instance, needs the ability to load Java classes over the network from an HTTP server rather than from the local file system. Some applications may even manufacture classes at runtime to suit specific needs.

The class loader provides one additional benefit that is useful to certain applications: class namespace separation. Classes loaded from different class loaders are considered discrete to the Java Virtual Machine (JVM) even if they have the same class name. Again, this is useful to Web browsers because it provides a way for multiple applets residing within a single JVM to avoid stepping on each others' toes. It's also useful for applications whose classes are expected to change at runtime. You can't unload a class and reload it, but you can create a new class loader and load a new implementation of the same class.

This month, we will build an extensible class loader, a module for this class loader that will load class data from a URL and an application launcher that uses this class loader to launch applications that are downloaded via the Web.

Class Loader Framework

A custom class loader must extend `java.lang.ClassLoader` and provide the `loadClass()` method. This method performs two basic operations. First, it locates a `Class` object for the indicated class, creating it if necessary. Second, it resolves any references made by the indicated class to other classes.

Generally speaking, the only interesting part of a custom class loader is the creation of classes the system can't find on its own. As such, our custom class loader, `FlexibleClassLoader` (see Listing 1, Page 44), splits the task of loading a class into two areas: management of `Class` objects and the determination of byte codes from which to create new `Class` objects.

The determination of class byte codes is delegated to user-defined objects

Listing 1. The FlexibleClassLoader

```
public class FlexibleClassLoader extends ClassLoader
{
    /** Set of class finders used to locate class code. */
    private Vector classFinders = new Vector();

    /** Set of classes that we have already loaded. */
    private Hashtable loadedClasses = new Hashtable();

    /** Adds a new class finder to be used to locate class code. */
    public void addClassFinder(ClassFinder newFinder)
    { classFinders.addElement(newFinder); }

    /** Removes a class finder. */
    public void removeClassFinder(ClassFinder oldFinder)
    { classFinders.removeElement(oldFinder); }


    /** The heart of the flexible class loader: this method locates
     *  the class with the indicated name amongst the class finders,
     *  defines it, and returns it to the application. */
    public synchronized Class loadClass(String className, boolean resolve)
          throws ClassNotFoundException
    {
        // see if we have already loaded this class.
        Class clazz = (Class)loadedClasses.get(className);
        if (clazz != null)
            return clazz;

        // try to load the class from the local system if possible.  we
        // do this first because it's a lot faster at loading standard
        // classes than trying through the URLs.
        try {
            clazz = findSystemClass(className);
        }
        catch (ClassNotFoundException e) {}

        // if we didn't find the class locally, start looking with our
        // class finders.
        if (clazz == null) {
            Enumeration finderEnum = classFinders.elements();
            while (finderEnum.hasMoreElements()) {
                ClassFinder finder = (ClassFinder)finderEnum.nextElement();
                byte[] classBytes = finder.findClass(className);
                if (classBytes != null) {
                    clazz = defineClass(className, classBytes, 0, classBytes.length);
                    break;
                }
            }
        }
        if (clazz == null) // sorry, charlie
            throw new ClassNotFoundException(className);

        // save the class in the cache
        loadedClasses.put(className, clazz);

        // resolve the class if desired
        if (resolve)
            resolveClass(clazz);

        // done!
        return clazz;
    }
}
```

Listing 2. The ClassFinder Interface

```
public interface ClassFinder
{
    /** Locates a class, if possible.  If this class does not exist
     *  then null is returned. */
    byte[] findClass(String className);
}
```

called `ClassFinders` (see Listing 2). They may use whatever means necessary to find the byte codes, including loading them from the local file system, extracting them from an archive, downloading them from the Web or manufacturing them on the fly.

Later we will implement a `ClassFinder`, but for now let's investigate the implementation of `FlexibleClassLoader`.

Our class loader maintains a `Vector` of `ClassFinder` objects that are managed by the user using the `addClassFinder()` and `removeClassFinder()` methods. These objects will be consulted in sequence by the `loadClass()` method, whenever the class loader needs to find byte codes for a particular class. In effect, each `ClassFinder` object acts as a single element in a class path, allowing classes to be loaded from any number of disparate sources if desired.

All the interesting work is done by `loadClass()`, which performs its work in five parts.

When `loadClass()` is first called, it checks if the requested class is already loaded by consulting with a `Hashtable` of previously loaded classes. This is done not only for performance reasons but also for consistency: It is important that every time a class is requested, the same `Class` object is returned.

If the class has not been loaded already, then `loadClass()` attempts to find it in the local system using the `ClassLoader.findSystemClass()` method. Technically, this need not be done. You may load the system classes manually, but this has serious security implications and will almost certainly degrade performance.

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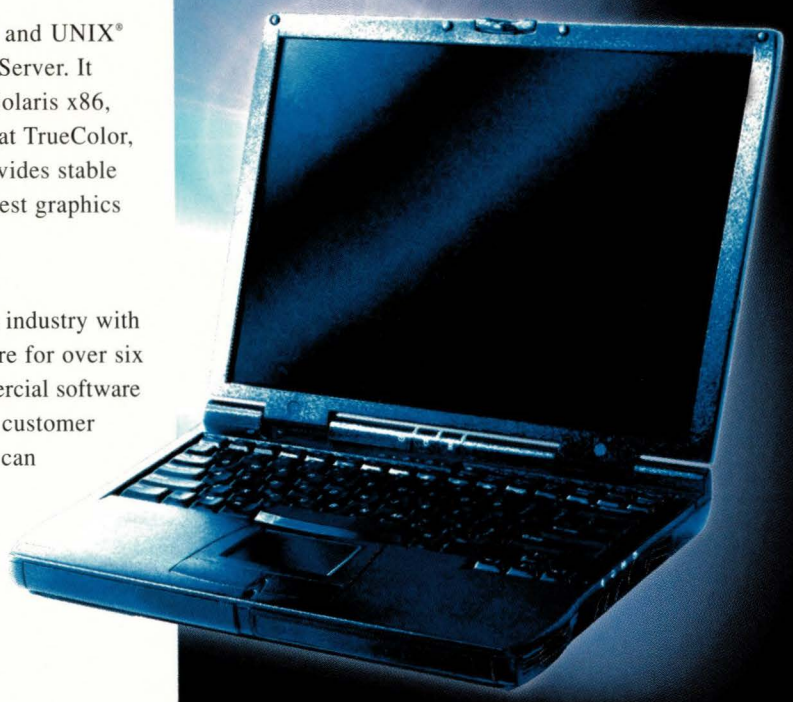

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Listing 3. The UrlClassFinder

```
/** A class finder that locates classes from a URL. */
public class UrlClassFinder implements ClassFinder
{
    private String baseUrl;

    /** Creates a new URL class finder rooted at the given URL. */
    public UrlClassFinder(String baseUrl)
    {
        if (!baseUrl.endsWith("/"))
            baseUrl += "/";
        this.baseUrl = baseUrl;
    }

    /** Locates a class, if possible.  If this class does not exist then null
     *  is returned. */
    public byte[] findClass(String className)
    {
        if (baseUrl == null)
            return null;

        // convert class name to file name
        className = className.replace('.', '/') + ".class";

        // build the URL for this class
        URL classUrl;
        try {
            classUrl = new URL(baseUrl + className);
        }
        catch (MalformedURLException e) {
            System.err.println("Malformed URL: " + baseUrl);
            baseUrl = null; // force future failures
            return null;
        }

        // open connection for the URL data
        InputStream classDataStream;
        try {
            URLConnection urlConn = classUrl.openConnection();
            classDataStream = urlConn.getInputStream();
        }
        catch (IOException e) {
            System.err.println("Error opening URL: " + e.toString());
            return null;
        }

        // copy the class data from the URL connection into an array
        // of bytes (this could be a lot more efficient)
        try {
            ByteArrayOutputStream classBytes = new ByteArrayOutputStream();
            for (;;) {
                int datum = classDataStream.read();
                if (datum < 0)
                    break;
                classBytes.write(datum);
            }

            // return the array of bytes
            return classBytes.toByteArray();
        }
        catch (IOException e) {
            System.err.println("Error reading class: " + e.toString());
            return null;
        }
        finally {
            try {
                classDataStream.close();
            }
            catch (IOExcepion e) {}
        }
    }
}
```

If the class cannot be found locally, `loadClass()` asks each of the specified `ClassFinder` objects if it can find byte codes for the class. If byte codes are found, then the `ClassLoader.defineClass()` method is called to turn the byte codes into a `Class` object.

If none of the `ClassFinders` are able to find the class, a `ClassNotFoundException` is thrown, indicating a failure.

At this point, we have a shiny new class and we save it for posterity in the `loadedClasses Hashtable`.

One last task remains: resolution of classes on which the newly loaded class depends. The JVM generally defers this task as long as possible to allow the program to load classes as it needs them rather than loading all of them up front. This allows the program to start up much faster, but means the JVM may not know that it can't find a necessary class until much later in execution. The boolean argument to `loadClass()` specifies whether or not the JVM would like to resolve dependent classes; if it's true, `loadClass()` must call `ClassLoader.resolveClass()`.

Loading Classes from the Web

Now that we have a framework for loading classes from various sources, we need one of those sources. One of the principle benefits of Java is supposed to be the ability to store the code centrally and download it on demand. Interestingly, it has historically relied on browsers for the network application framework instead. Unfortunately, browsers are notoriously buggy and must limit application functionality substantially for security reasons, so they are not ideal for this purpose. Whole companies have been founded around the idea that

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customers would pay for network application management systems. Why don't we put them out of business by writing one ourselves.

The first thing we need to do is create a `ClassFinder` that can download class files from a URL. `UrlClassFinder` does exactly that (see Listing 3). Each of these objects has a base URL, effectively the same thing as the *codebase* in applet terms. When `findClass()` is called, it converts the class name into a class file name by changing the package separator character (".") into a URL path separator character ("/") and tacking on the `.class` extension. It then concatenates this with the base URL to give the fully qualified URL for the class file. Using this, it constructs a `java.net.URL` object that it then uses to request the data for the class file from the server. Finally, it downloads the data into a local array that is returned to the `FlexibleClassLoader`.

Voilà, we can now load classes from anywhere on the World Wide Web. So how do we run them?

A Web-Based Application Launcher

Listing 4 implements an application launcher based on the `FlexibleClassLoader` and `UrlClassFinder`. The code is a little ugly, comprised primarily of error-handling code, but what it's doing is quite straightforward.

First, it creates a new `FlexibleClassLoader` that it uses to load the application's classes. Then, it walks its arguments looking for `-url` arguments, each of which specifies a repository in which class files may be stored, and constructs a `UrlClassFinder` for each. Once it has found all the `-url` arguments, it treats the next argument as the "main" class name (the class whose `main()` method is to be called to run the application) and all remaining arguments as the arguments to be passed to the application.

Having parsed the arguments and set up the class loader, it then attempts to load the specified "main" class using the class loader. If this succeeds, it uses reflection (discussed in some detail in "Building a Bean Pot," May 1999, Page 54, `http://`

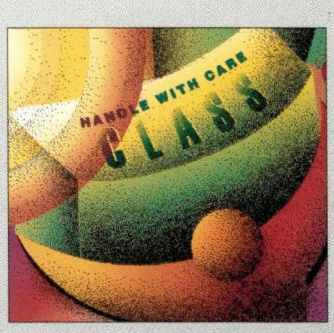
Listing 4. The UrlApplicationLauncher

```
public class UrlApplicationLauncher
{
    public static void main(String[] args)
    {
        // create the class loader
        FlexibleClassLoader classLoader = new FlexibleClassLoader();

        // add source URLs to the class loader
        int urlCount = 0;
        String mainClassName = null;
        String[] programArgs = null;
        for (int i = 0; i < args.length; i++) {
            if (args[i].equals("-url")) {
                classLoader.addClassFinder(new UrlClassFinder(args[++i]));
                urlCount++;
            }
            else if (args[i].startsWith("-")) {
                System.out.println("Unknown option '" + args[i] + "'");
                System.exit(1);
            }
            else {
                mainClassName = args[i];
                programArgs = new String[args.length - i];
                System.arraycopy(args, i, programArgs, 0, programArgs.length);
                break;
            }
        }
        if (urlCount == 0) {
            System.err.println("You must specify at least one -url argument.");
            System.exit(1);
        }
        if (mainClassName == null) {
            System.err.println("You must specify the application's 'main' class.");
            System.exit(1);
        }

        // load the specified main class
        Class mainClass = null;
        try {
            mainClass = classLoader.loadClass(mainClassName);
        }
        catch (ClassNotFoundException e) {
            System.err.println("Can't find class: " + mainClassName);
            System.exit(1);
        }

        // look up its main(String[]) method
        Method mainMethod = null;
```



```
        try {
            mainMethod = mainClass.getDeclaredMethod("main", new Class[] { String[].class });
        }
        catch (NoSuchMethodException e) {
            System.err.println(args[0] + " does not have a main() method.");
            System.exit(1);
        }

        // run the main(String[]) method with the given arguments
        try {
            mainMethod.invoke(null, new Object[] { programArgs });
        }
        catch (IllegalAccessException e) {
            System.err.println(args[0] + " has a main() method, but it is not public.");
            System.exit(0);
        }
        catch (Exception e) {
            System.err.println("Internal error: " + e.toString());
            System.exit(0);
        }

        // all done!
        System.exit(0);
    }
}
```

sw.expert.com/CA/SE.C10.MAY.99.pdf) to locate the `main()` method and invoke it with the specified arguments.

The code for the class loader and application launcher can be found at `ftp://ftp.expert.com/pub/JavaClass/11.1999/classloader.tar`. The `launchapp` script provided in this framework can be used to launch any Java application whose classes are found on a Web server. I've created a "Hello World" application and put it up on the Web; you may run it by typing the following one-liner at a UNIX shell prompt:

```
launchapp -url
http://jimf.ne.mediaone.net/~jimf/classes
HelloWorld
```

If you supply the `-verbose` option (not implemented in the print version), you can watch as it locates each of the classes used by the application.

There are a couple of caveats. First, running applications that come from sources you don't trust with this network application framework is dangerous. Applications run by the `UrlApplicationLauncher` operate without the stringent security provided by browsers. Second, this application launcher isn't quite industrial-strength; it requires the application's class files to be managed outside of a `.zip` or `.jar` archive and loads each of them individually. This is not particularly efficient, but it's easy to create a new `ClassFinder` that can download an archive and extract classes from it. We'll leave this as an exercise for the reader.

What Else?

While we have demonstrated using class loaders to launch applications, they are useful for a great many other things. Some Web application servers, for instance, compile dynamic HTML pages down into Java code and use class loaders to manage different versions. Application builders often use them to manage user-defined class paths. They can be used to create new class archive formats that are much more efficient than those supported by Java. It's even possible for a Java debugger to be implemented entirely by instrumenting classes as they are loaded through a class loader.

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

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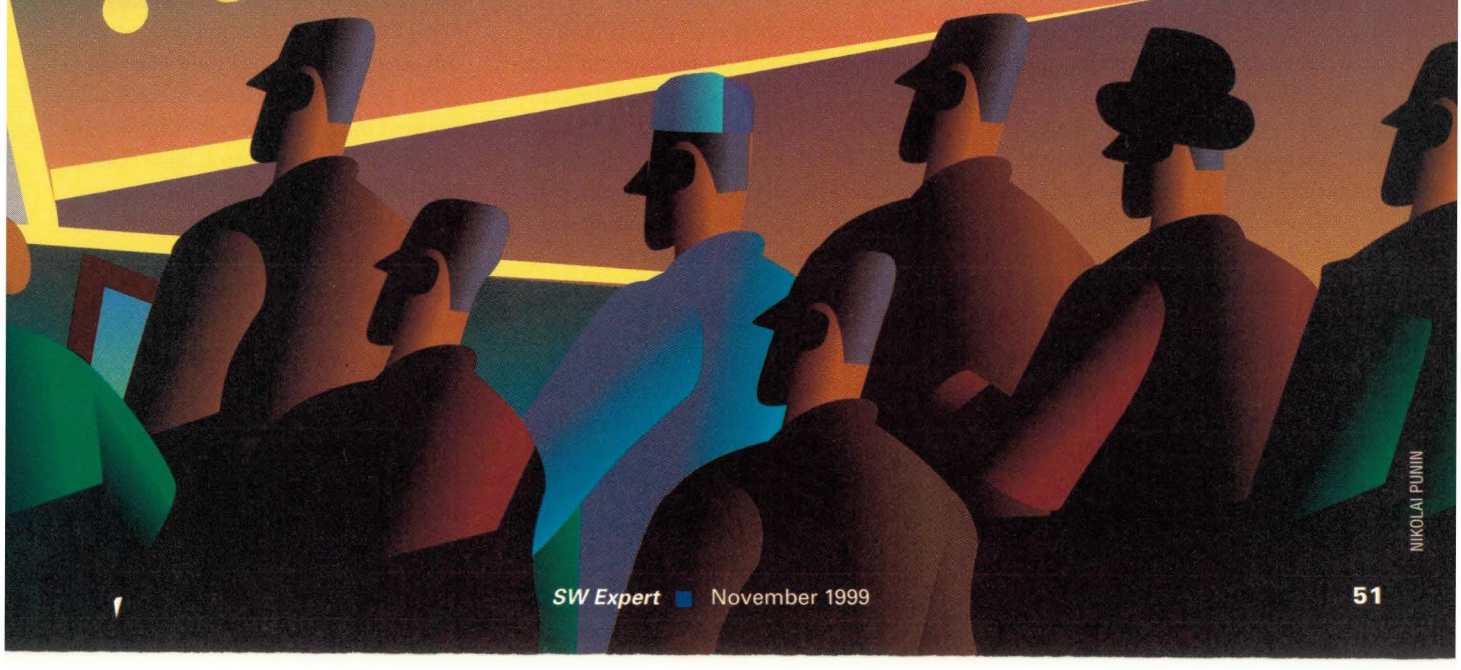
by Patrick T. Coleman, Staff Editor



NIKOLAI PUNIN

School of Public Health, Beth Israel Deaconess Medical Center, Massachusetts General Hospital, Brigham and Women's Hospital and Children's Hospital Medical Center. Dana-Farber wanted doctors and researchers working on diverse systems to have an easy means to share information. A mechanism was needed to check documents in and out, transfer clinical data, view images of cells and tissues and also provide security for sensitive scientific research.

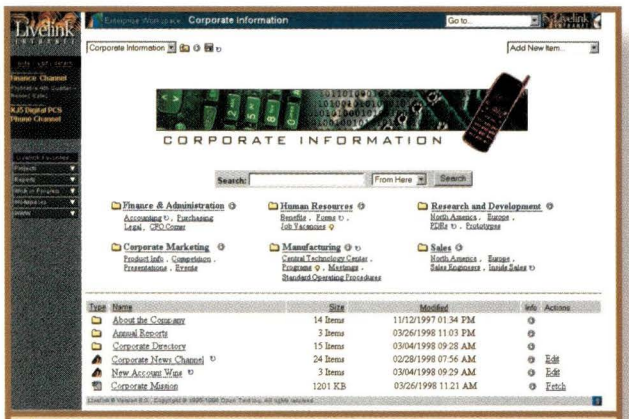
So, in a joint project, the Dana-Farber Cancer Institute and Harvard Medical School built the Dana-Farber/Harvard Cancer Center extranet. The application chosen to power the infrastructure was Livelink, one of a new breed of document management systems. Manufactured by Open Text Corp., Waterloo, Ontario, Livelink provides a Web-based interface for organizing information, such as documents and files, and enables group collaboration.

Dana-Farber runs Livelink on a Sun Microsystems Inc. Enterprise 3500 server with two 400-MHz processors, 2 GB of RAM and 200 GB of storage. Singer describers the setup as "beaucoup expandable." Livelink requires Netscape Communications Corp. Enterprise Server 3.6, and the back end has an Oracle Corp. Oracle 8.05 database running on a Sun Ultra 2 with two 400-MHz processors, 2 GB of RAM and a shared disk array.

Positioned as a knowledge management system by Open Text, Livelink is regarded as the next step in electronic document management, or EDM. "With the evolution of the Web, standard document management applications have not been able to do the job," says Dan Latendre, vice president of product marketing for Open Text. "We've created an integrated suite, which includes a document management engine, a search engine, a workflow engine, a collaboration engine and calendaring."

In general, EDM offers three key functions: creation, management and distribution. In the first half of the 1990s, EDM systems were typically used with an imaging application and documents were scanned in as images. These images would then be stored in a document repository. In the past few years, however, the technology has advanced to the point where EDM systems are being used to handle more than just image files. They are now used to manage compound documents, or information within computer files such as text, graphics, spreadsheets and tables.

"Compound management had been the dominant document technology over the last few years," says Frank Gilbane, the Cambridge, MA-based publisher of *The Gilbane Report*, a journal covering Web information technology. "When the Web hit, it changed document management as it changed everything else. Now there is a huge amorphous market of all kinds of applications that manage document information and manage data."



Open Text's EDM system, Livelink, provides a Web-based interface for organizing information.

International Data Corp. (IDC), a technology research firm based in Framingham, MA, breaks the EDM market into three segments: document-centric, business process-centric and enterprise-centric. But, says Silvia Springolo, market analyst with IDC, the boundaries between the three are blurred.

Document-Centric EDM

Document-centric EDM refers to software that offers the traditional capabilities of document management, alongside workflow, check-in/check-out and revision management. However, IDC says, its days are numbered. "The document-centric market is going to disappear. A lot of companies have migrated from this space into either content management or an information management space," says Springolo. "It is no longer enough to provide simple document management capabilities unless they are targeted toward a particular vertical market."

One such document-centric company, U.K.-based Cimage Enterprise Systems Ltd., is, as IDC suggests, staying true to the EDM course by serving the needs of a specific market. Targeting utilities, manufacturing and petrochemical companies, Cimage offers its Document Manager Server, which provides a scalable document vault to hold drawings and documents that users can access through either the DM Desktop client or DM-Net browser client. In a prepared statement from British Energy describing its use of Cimage technology, George Jenkins, the U.K. utility company's executive director, said it was the company's expertise that was a leading factor in choosing the technology. "[Cimage's] in-depth knowledge of the nuclear industry made it the obvious choice."

For vendors who are unable to target a specific vertical market, the focus is to move away from the document-centric EDM space. In May, after 10 years of providing EDM software, NovaSoft Systems Inc., Burlington, MA, changed both its name and corporate direction. The company reinvented itself as Factpoint Inc. and launched a Web-based content management suite with an emphasis on version control. Specifically, Factpoint is attempting to carve out a niche within content management, which provides an authentication system to protect content on the Web. Called Trustsite, the software is used to verify the source, quality and reliability of online content.

An IDC report, entitled "Future Opportunities for Document and Content Management Vendors," published in August, predicts the document technology market will assume a new phys-

iognomy in which the distinction between content management (CM) and document management (DM) will fade away. "The line between CM and DM will blur and a net distinction between the two markets will no longer exist," IDC says. "Companies will increasingly integrate both CM and DM capabilities in the same application, either as a single product or as multiple product modules. The key to success will become the ability to offer a complete solution on both sides of the equation."

This convergence of document management systems with content and knowledge management systems has changed the role of an EDM repository. At one time, there was a distinction between a data and document repository. Users of an EDM system wouldn't mix documents with other data. Now, that distinct is rarely made. "With content management and knowledge management becoming more popular, [vendors] don't discriminate between data and document repositories," says *The Gilbane Report*'s Gilbane. "They, by default, combine the two."

Business Process-Centric EDM

Business process-centric EDM, as defined by IDC, refers to applications targeted at specific vertical markets that manage documents in a way tailored to particular business practices. Whereas Cimage's product specializes in handling tens of thousands of drawings and documents associated with a given project, a business process-centric EDM system is designed to facilitate specific business practices. Eli Lilly and Co., a pharmaceutical company based in Indianapolis, IN, has used a business process-centric EDM system since 1994.

Eli Lilly runs Pleasanton, CA-based Documentum Inc.'s EDM Server to meet the needs of its medical research division, while also tackling the demands of other departments, such as legal, manufacturing and human resources. The tasks for each department vary. In the legal department, a great deal of imaging takes place with document repositories containing upwards of 1.5 million pages. In the medical and pharmaceutical research division, Documentum is required to manage the publishing of product paperwork for presentation to various drug regulatory agencies worldwide.

"A single submission for a drug could be hundreds of thousands of pages," says Scott Huston, project leader for document management services at Eli Lilly. "[Documentum's] product buys us a way to share documents across a workgroup, across the enterprise. Its ability to control version and the security model works well for us."

Perhaps the reason it works well is the approach Documentum takes in developing its products. "We've always tried to focus on solutions for business problems versus trying to go in and do engineering document management," says Dean Misenhimer, senior market-

Circle No. 29

ing analyst at Documentum. "We have applications that we release on top of our core product."

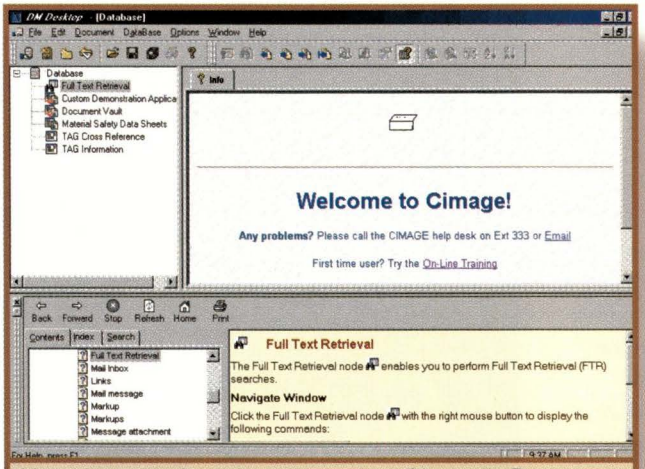
In June, Documentum released a major upgrade to its core product, Documentum 4i. The new offering is designed to manage content and automate the process with which content is associated. It's Web-based and comes with tools for application development and deployment. At the core of 4i is the EDM Server, which implements the Docbase document repository and provides features for controlling and managing business content and processes. The underlying framework then works with specially designed EDM components, such as process manufacturing, discrete manufacturing, financial services and government services.

FileNet Corp., Costa Mesa, CA, services the business process-centric EDM market with its Panagon product line. Panagon manages HTML/eXtensible Markup Language (XML) documents, Adobe Systems Inc. Portable Document Format (PDF) files, email, graphics and audio/video files, and delivers the content to desktops via either a browser or Windows interface. Panagon captures, indexes and stores document types into FileNet repositories located on the server. It enables an organization to consolidate all of the information associated with any given business transaction in a single electronic folder, FileNet says. Like Documentum, FileNet offers industry specific applications on top of its core product for organizations involved in banking, finance, health care, insurance, manufacturing and the government, among others.

Enterprise-Centric EDM

Enterprise-centric EDM systems refer to applications that provide a default environment for document creation, collaboration and publication within an organization. These are comprehensive systems implemented across the enterprise for all users and employees to access.

The Dana-Farber/Harvard Cancer Center extranet is an example of this type of EDM system. According to analysts, this implementation demonstrates a growing approach to document management: representing the organization's intellectual assets as a corporate portal. "Livelink can look like a big Web site," Open Text's Latendre says. But enterprise-centric EDM systems are not the only systems attempting to capture the look and feel of a portal. Most EDM vendors are attempting to structure their systems as a corporate portal. "We are really moving toward embracing the Web more and more," says Documentum's Misenhimer. "Whether it be on the Internet or with an intranet, you can design a Web site for viewing and pulling data dynamically right out of the content management systems, so as those documents change and as the status documents are going from one state to another, that is automatically reflected on the site."



Users access documents stored on Cimage's Document Manager Server using the DM Desktop client.

Another major player in the enterprise-centric EDM space is Lotus Development Corp., Cambridge, MA. Lotus offers Domino.Doc, which is designed to manage an organization's documents from authoring through to review, approval, distribution and archiving. Domino.Doc stores documents in their native format. Users can either access the documents in their native format, such as Microsoft Corp. Word, or publish them in a Web-friendly format like HTML or PDF.

EDM Included

A growing trend among vendors is to include document management capabilities within other applications. Enterprise resource planning (ERP) systems, like those from SAP Inc. and Baan Co., or product life cycle management systems, such as Mesa/Vista from Mesa Systems Guild Inc., Warwick, RI, now include document management features as well. No longer are EDM and ERP applications viewed independently of one another. "DM is more likely one of the functions of an ERP system," says Gilbane. "So the document management vendors are protecting themselves and developing relationships with the ERP vendors."

Part of what is driving this trend is the simple notion of data management. Controlling the versions and updates of, say, computer-aided design (CAD) data for product management and managing simple Word documents is, in many ways, very similar. "Data is data, and we're tending to blur the lines in what a document is," says Alan Hetch, vice president of Mesa Systems Guild. "Documents can be drawings, Word documents, CAD designs...."

Enterprise-centric EDM systems provide a default environment for document creation, collaboration and publication within an organization.

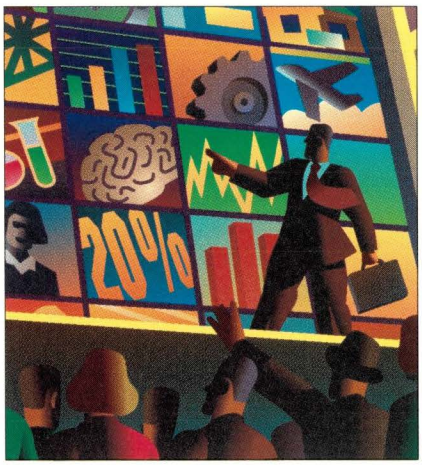
At the very least, if an ERP or prod-

uct management system doesn't provide enough document management capabilities, customers can integrate them, as well as existing legacy systems and relational databases, with an EDM system. But this integration is now the biggest hurdle facing both vendors and customers. One developing piece of technology that might help is XML.

"The biggest challenge facing EDM systems is integration," says Gilbane. "XML is one of the key technologies for alleviating the integration problem."

XML, a Web standard developed by the World Wide Web Consortium (W3C), can be used to create application-to-application data exchange. Created specifically for the Web, it combines the document presentation capabilities available in HTML with additional search and application functionality. Besides having the technical capabilities to provide application integration, it is also becoming a popular protocol.

XML is being supported by almost all EDM vendors on some level. For example, PDF is a popular document format supported by many EDM systems. Adobe Systems has provided support for XML within PDF-based forms as a type of live data. But PDF's



strengths are in its presentation of documents. XML's strength is in defining and transfering the data within a document. It is XML's ability to handle data within a document that helps ease the transfer of that same data between EDM systems. "XML is about data and PDF is about encompassing data elements and the presentation of the data," says Mark Royle, senior marketing manager for document solutions at Adobe, San Jose, CA.

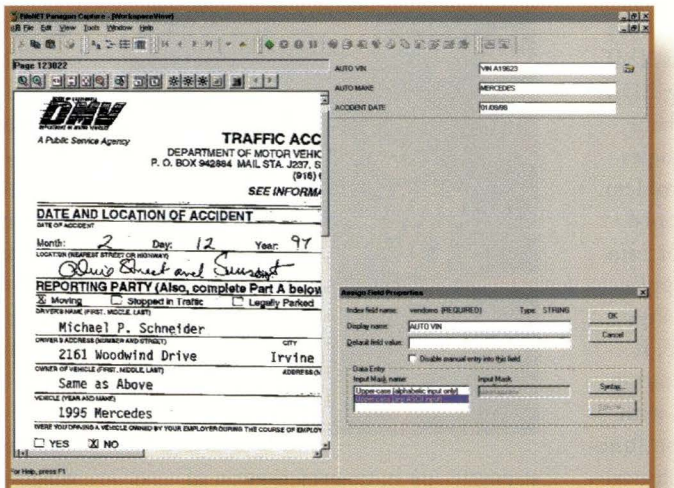
EDM: Strong and Growing

Though the EDM market is hard to define, it is nonetheless healthy. According to a 1999 report conducted by Gartner Group Inc., Stamford, CT, on behalf of the Association of Information and Image Management International (AIIM), an association for IT professionals in document-intensive businesses based in Silver Springs, MD, document technologies will experience a combined compound annual growth of 26% between 1998 and 2003. In addition, the overall revenue for document technology will grow from $13.2 billion in 1998 to an estimated $41.6 billion in 2003. A major factor driving this growth has been the explosion of the World Wide Web. The AIIM report found that companies

implementing Web-based content management systems doubled their spending limits for document management technologies between 1997 and 1998, and concluded that document management is "a vibrant market, energized by the emergence of the Web."

"The Web has exacerbated the whole issue of repositories and documents," says Priscilla Emery, senior vice president of information products and services at AIIM. "Just about everything a company owns is sitting out on a Web-based repository and many organizations realize that when they create a corporate intranet they need document management tools for overall maintenance of the site. So document management, document content management and document repository management [applications] have become big players in maintaining corporate intranets."

But with this change, vendors servicing the market have had to reevaluate their products and strategies. Before 1996, most document management systems were based on client/server or three-tier architectures. Today, many EDM vendors have abandoned the fat clients that traditionally accessed their systems and are moving to a browser interface. "The document management vendors were right at the forefront of being faced with the whole thin-client versus thick-client problem," says Gilbane. "They made most of their money selling lots of expensive clients. They had to adjust to that and, at this point, they pretty much all have Web clients."



Panagon from FileNet enables companies to consolidate associated data in a single electronic folder.

Back in 1994 when Eli Lilly first implemented Documentum, the company had to also purchase a fat client, Workspace, to access the document management system. Now, Eli Lilly is using the Web client provided free with the product. "Workspace was pretty much what they had out of the box," says Eli Lilly's Huston. "Documentum is moving away from fat clients toward Web-enabled interfaces, and we're trying to go with them."

Other vendors providing Web-enabled wares include Keyfile Corp., Nashua, NH, and PC Docs Group International Inc., Burlington, MA. In April, Keyfile unveiled Keyfile Active Document Workspace 5.0, a new Web-enabled client for its Keyfile document management server. Also in April, PC Docs Group introduced three Web-related document management products: PowerDocs 3.0, a document management client; DocsFusion 3.0, a server; and DocsFulcrum 3.0, a knowledge management search and retrieval tool. Documentum has also

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Web-enabled its wares. Documentum 4i includes a set of thin intranet clients to deliver content to a Web browser regardless of the client platform. In addition, Documentum 4i now integrates with Web tools and technologies such as XML, HTTP, Secure Sockets Layer (SSL) and Lightweight Directory Access Protocol (LDAP).

There was a time in the early days of EDM systems when not everyone could turn to a vendor for an off-the-shelf system. But, thanks to the Web, modern EDM systems are reaching more people throughout an enterprise. Furthermore, as EDM evolves into more than just document management to include a company's intellectual assets–such as audio, video and graphics–all departments within an organization will benefit from these technologies. Eventually, vendors say, EDM–along with the Web and evolving standards like XML–will provide users with a robust environment for gathering, managing and sharing documents.

Companies Mentioned in this Article

Adobe Systems Inc.
345 Park Ave.
San Jose, CA 95110
http://www.adobe.com
Circle 150

Cimage Enterprise Systems Ltd.
Easthampstead Road
Bracknell, Berkshire
U.K. RG12 1JZ
http://www.cimage.com
Circle 151

Documentum Inc.
6801 Koll Center Pkwy.
Pleasanton, CA 94566
http://www.documentum.com
Circle 152

Factpoint Inc.
10 Burlington Mall Road
Burlington, MA 01803
http://www.factpoint.com
Circle 153

FileNet Corp.
3565 Harbor Blvd.
Costa Mesa, CA 92626
http://www.filenet.com
Circle 154

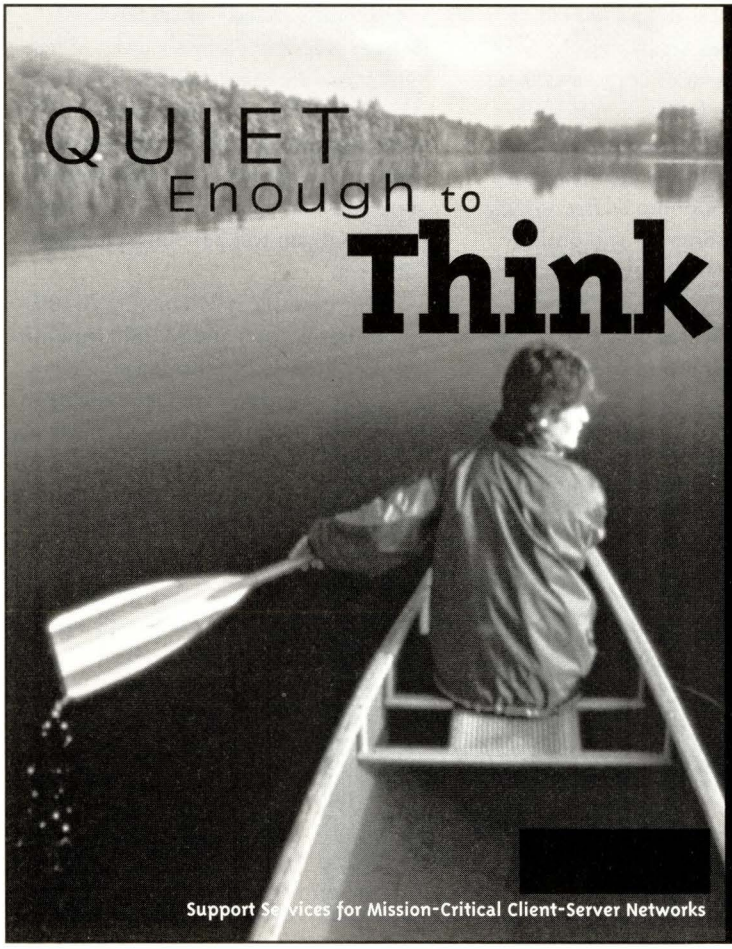
Keyfile Corp.
22 Cotton Road
Nashua, NH 03063
http://www.keyfile.com
Circle 155

Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
http://www.lotus.com
Circle 156

Mesa Systems Guild Inc.
60 Quaker Lane
Warwick, RI 02886
http://www.mesasys.com
Circle 157

Open Text Corp.
185 Columbia St. W.
Waterloo, Ontario
Canada N2L 5Z5
http://www.opentext.com
Circle 158

PC Docs Group International Inc.
25 Burlington Mall Road
Burlington, MA 01803
http://www.pcdocs.com
Circle 159



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Email-in-a-Box

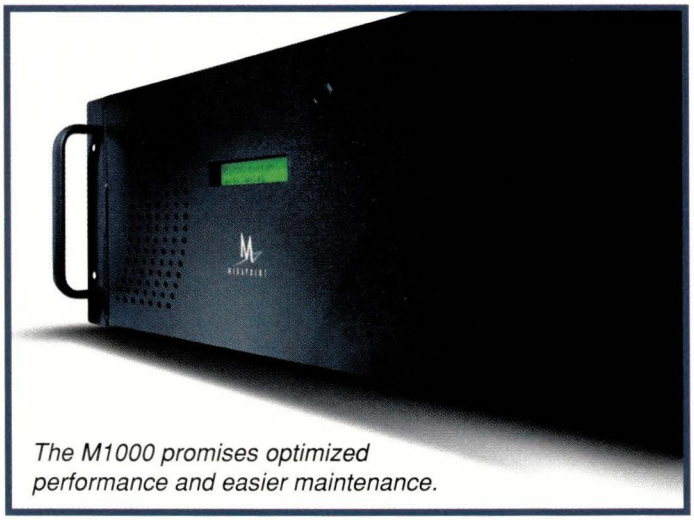
by **IAN WESTMACOTT**, Technical Editor

Despite a couple of hardware and software glitches, Mirapoint's M1000 lives up to the promise of a true email appliance.

There's a new class of computing products on the market dubbed "appliances" or "thin servers." Most of these products are special-purpose computers preconfigured for a single task. As a general rule, they are easy to set up and maintain. They represent another step away from the big iron of yesteryear, and are intended to reduce the need for IT support staff and further enable smaller companies to utilize advanced computing.

Take electronic mail, for example. It used to be that email was just one of the many jobs that a general-purpose server handled at an installation. The same server might also handle Usenet news, payroll and account management. Then, IT staff began to see that performance and reliability could be increased by segregating some of these functions on separate machines and, at the same time, hardware costs came down enough to make that feasible.

People began to tinker with these general-purpose servers to create specialized servers for specific tasks. You may buy the server without a monitor because you don't expect anyone to actually use it interactively. And then you shutdown the interface, because that just uses up memory, you turn off all the services you don't need and tune the server to your particular task. Tuning the UNIX kernel and specializing a server for a particular task became one of the arts of systems administration. Go into a large installation today and someone will proudly point out their email server, their Web server, their Domain Name System (DNS) server, their database server–all running on general-purpose machines painstakingly customized and optimized for a specific task.



The M1000 promises optimized performance and easier maintenance.

But why spend all the time and training to use a general-purpose computer for a specific task? Why not go out and buy an email server? It comes with the hardware it needs, has all the software it needs installed and is configured and optimized to handle email. You set it down, plug it in and walk away. When it comes time to maintain or administer the server, there is a specialized interface with only the options you need, and there is a single vendor to deal with for upgrades and support. This is an appliance, and you will be seeing a lot more of them.

One example is Mirapoint's M100 (300-user license) and M1000 (unlimited-user license) Internet email appliances; complete systems engineered for efficient email transfer, storage and access, and designed to minimize administration and maintenance. Mirapoint sent us an M1000 said to be able to handle up to 150,000 users. It supports Simple Mail Transfer Protocol (SMTP), Post Office Protocol (POP) Version 3, Interactive Mail Access Protocol (IMAP) Version 4 and Simple Network Management Protocol (SNMP).

Installation and Setup

It's misleading to call the M1000 email-in-a-box because it actually consists of three rack-mountable boxes: an uninterruptible power supply (UPS), a RAID array and the server itself. Our unit was configured with a 400-MHz Pentium II processor, 384-MB RAM and four 9-GB 10,000-rpm drives. All three boxes can be either mounted in standard 19-inch racks or stacked on the desktop. The server monitors the RAID array and UPS by way of the serial cables provided, and a SCSI cable allows communication between the server and RAID array. The server also features a VGA controller for diagnostics and a serial port for an optional TTY console.

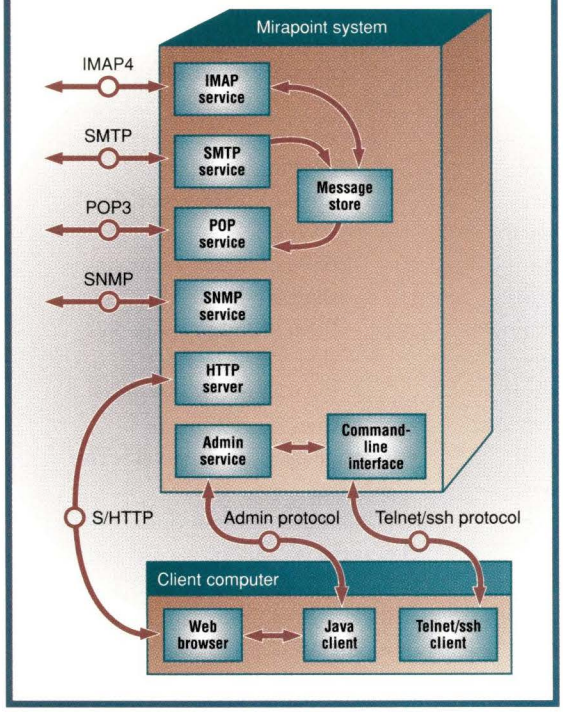
Once the hardware is installed, initial setup is performed either through the optional TTY console or an LCD/keypad on the front of the server (secured with a lock). Initial setup consists of establishing network parameters (such as IP address and hostname) and selecting an administrator password. Hardware installation and setup can be accomplished in about 15 minutes using the well-written installation manual.

Application setup and maintenance is performed either via a Java-enabled browser or Telnet session. The Java Administration Client must be installed on the Web client, which is performed automatically the first time the administration server is accessed from each new client. The Administration Client is not required for normal user profile access. The Telnet server provides both a user and administrator command-line interface. Optionally, the server can be equipped with the Secure Shell (ssh) and Secure Sockets Layer (SSL) protocol for secure communications.

Functionality

The Mirapoint server comprises several components (see Figure 1). The server implements SMTP for email transfer, POP3 and IMAP4 for user mailbox access and SNMP for network management. The server also includes a Legato Systems Inc. network backup client and the Remote Magnetic Tape Protocol for storage backups. There is no local backup option.

Figure 1. Mirapoint Software Components



The SMTP server implements DNS for host and network name resolution, Network Information Services (NIS) and Lightweight Directory Access Protocol (LDAP) for name resolution and user authentication and Network Time Protocol (NTP) for time synchronization. All are configurable from either the Administration Client or command-line interface. In addition, the server supports Kerberos authentication for IMAP clients that have this functionality.

The server supports distribution lists, virtual domains, spam control, forwarding and automatic reply. The distribution list feature allows you to create email aliases for groups of users, as well as an alias to receive bounced messages for each list. Distribution lists and their user members must be created by the administrator. In other words, normal users cannot add or remove themselves from lists and there are no archiving facilities.

Virtual domain support allows the Mirapoint server to process email for domains other than its own. Spam control support is offered via lists for relay and blocked domains. Administrators can create a list of relay domains, which are those domains for which the server will relay email, and a list of blocked domains, which are domains for which the server will not accept any email at all. These are static lists, however; the server cannot make use of dynamic lists such as DNS blacklists.

Each user can set up forwarding and automatic reply for their account. Users may change their password and set up access controls for their email directories on the server. Administrators may also set these options for individual users, as well as quotas on the amount of storage used by each.

The Administration Client also provides administrators with system monitoring and status capabilities, as well as access to system log files. Hardware status of the system, fans, RAID, individual disks and UPS can be monitored, as well as the email queue and network connections. The log files, Legato backup client and help system are provided as HTML documents. To view these, the Administration Client must be configured with your preferred browser, which it will launch automatically when you try to access one of these services.

Performance

It turns out that soon after we received our review unit, Mirapoint released a new version of its operating software, MiraOS, which the company sent to us on a 120-MB Super Disk. The Mirapoint server includes a Super Disk drive on the front panel alongside the LCD/keypad. Software upgrade consists of booting off the Super Disk containing the upgrade. However, in our case, the server would not boot off the disk and got into a state of repeatedly rebooting itself until we turned it off.

After reviewing our system crash and log files, Mirapoint support determined that one of the circuit boards in our unit was loose, causing intermittent errors. Reseating the board seemed to repair the problem, and Mirapoint says that a subsequent hardware design has fixed this problem. Suspecting that the Super Disk may also be bad, we upgraded the system

software directly from Mirapoint's FTP server. Software upgrades are available via anonymous FTP and can be downloaded directly to the Mirapoint server as an alternative to the disk upgrade.

The Mirapoint server provides two options for storage backup: an integrated Legato backup client and the Remote Magnetic Tape Protocol. To use the former, you will need to have a Legato backup server already set up and running. Legato backups and restores may be performed using the Administration Client. To use the Remote Magnetic Tape Protocol, you must have a server system up and running that implements the protocol. The Mirapoint manual includes Solaris-specific instructions, but any server system will do. Remote backups and restores are performed from the command-line interface. Both backup options follow symbolic links, which the server uses to store messages sent to multiple users in order to save space. This means that a system restored from a backup may take several times the disk space of the original system. It would be nice if link-following were an administrator option.

Performance evaluation of an email server system is difficult. There are many variables involved. The number of incoming and outgoing messages and their sizes must be considered, as well as the number of simultaneous client connections and their polling intervals (the frequency at which each client checks for new mail). All of these contribute to the work performed by the server. In its tests, Mirapoint considered several configurations, including the following:

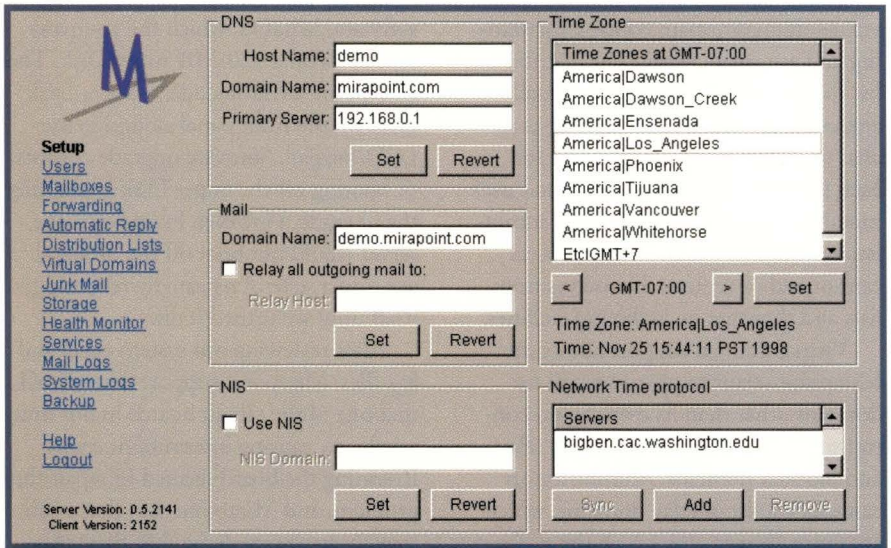
- 192 messages received per user, per day
- 16.5-KB average message size, with the distribution:
  - 35% of messages are less than 1 KB in size
  - 65% of messages are less than 2 KB in size
  - 90% of messages are less than 8 KB in size
  - 96% of messages are less than 10 KB in size
- Average user poll interval is five minutes

Under these assumptions, Mirapoint claims the M1000 server can support a sustained load of 1,750 IMAP users on a single system. In less strenuous configurations, which Mirapoint claims is representative of regional Internet service provider (ISP) load data, the M1000 is said to be able to support up to 150,000 POP users, making the cost of the M1000 less than 50 cents per user. Mirapoint would not provide us with its test software, however, so we could neither confirm its quality nor the test results.

Summary

Any site with more than a moderate amount of Internet email traffic, or for which email is a critical business function, can benefit from an email server appliance such as the Mirapoint family of servers. The Mirapoint M1000 Internet email appliance offers high availability with its UPS, RAID and storage backup options, broad support of industry standard protocols for client access and management and a range of robust security options for authentication and encryption. Add to this, decent single-vendor support and documentation, and the M1000 lives up to the promise of a true email appliance.

Although we encountered a few hardware and software glitches, the M1000 is well-designed and easy to setup and manage. And because the M1000 can support most of the email clients out there, your users shouldn't have any trouble with it either. ➸



The Administration Client provides system monitoring capabilities, as well as access to system log files.

M1000 Internet Email Appliance

Company
Mirapoint Inc.
2 Results Way, Ste. 100
Cupertino, CA 95014

Phone
(408) 517-1300

Fax
(408) 517-1325

Email
info@mirapoint.com

WWW
http://www.mirapoint.com

Best Feature
Easy to set up, manage and upgrade.

Worst Feature
Message sharing not maintained across backups.

Pricing and Configuration
As configured:
M1000-E1-P2Q;
MiraOS;
unlimited-user license;
400-MHz Pentium II;
384-MB ECC DIMM memory;
four 9-GB 10,000-rpm drives;
redundant hot-swappable power supplies/fans;
UPS
List price: $27,275

Entry level:
As configured, with no drives
List price: $20,265

Circle 160

NEW PRODUCTS

The product descriptions are compiled from data supplied by the vendors. To contact them for more detailed information, circle the appropriate reader service number on the card located elsewhere in this issue.

Free Performance Management Software

TeamQuest has announced TeamQuest Lite, a freeware server analysis application, which allows systems administrators to add a sophisticated, rules-based management application to their computer monitoring requirements, the company says.

TeamQuest Lite is designed to be run from a single desktop running Solaris or Windows NT, and reports in real-time on the operation and performance of up to five other Solaris or Windows NT systems on the network. TeamQuest Lite is said to use rule-of-thumb-based analysis to identify potential server problems. It maintains a current history of important performance indicators for each system and charts this behavior over time to pinpoint changing conditions.

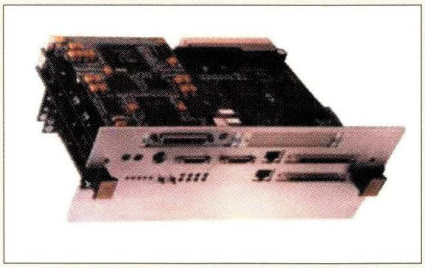
The application can be downloaded from the TeamQuest Web site. Once installation is complete, TeamQuest Lite is ready to use within five minutes, the company says, making it ideal for companies with minimal IT personnel.

TeamQuest Corp.
2410 Third Ave. S.
Clear Lake, IA 50428
http://www.teamquest.com
Circle 101

Dual-Processor UltraSPARC VME

The 400-MHz VME64 single-board, multislot USP-2 computer from Themis Computer is designed to offer the symmetric multiprocessing (SMP) power of Sun Microsystems Inc.'s Ultra 2 Model 2300 workstation.

The multislot VME computer implements a dual SMP Ultra 2 architecture. In addition, its pluggable UltraSPARC-II Ultra Port Architecture (UPA)-based processor modules are said to enable performance upgrades and simplify maintenance. It supports dual 10/100BaseT Fast Ethernet, dual Fast/Wide SCSI 2 for



high-availability applications and Sun's Elite3D graphics adapter for high-performance 3D graphics, Themis says. Memory on the USP-2 is expandable (from 64 MB to 2 GB) using memory mezzanine modules. Also, the computer's UltraSPARC-II processor modules support up to 2 MB of L2 cache.

Workstation I/O features include dual SBus peripheral controller expansion slots, or one SBus slot and one Elite3D graphics slot. The board also has an IEEE 1284-compatible bidirectional parallel port, floppy disk controller, two multiprotocol serial ports and two RS-232 serial ports. It supports 16-bit stereo audio,

Affordable Enterprise RAID

Dynamic Network Factory, a U.S. subsidiary of Japanese firm ADO Electronics Inc., has introduced its Enterprise series of RAID servers.

By connecting to a host server via a SCSI connector and using an on-board microprocessor, the Enterprise series disk RAID arrays are said to provide the security and performance of hardware RAID. According to Dynamic Network Factory, the Enterprise series provides an effortless step-by-step setup program that avoids the complications of time-consuming operating procedures.

The Enterprise product line offers 66 to 225 GB of storage on RAID levels 0, 1 and 5 and a 128-MB cache memory. Each server comes with a hot-swappable hard disk drive, power supply and cooling fans, independent fault-isolation capability and 2-MB SDRAM on each drive channel, plus 128-MB EDO (RAM with faster data output) on the RAID controller.

In addition, the Enterprise series makes use of an auto-rebuild power supply with alarm, reset and load-sharing capabilities, and supports Fast, Wide and Ultra Wide SCSI host channels to provide data transfer rates of up to 40 MB/s. The high-speed microprocessor, combined with the latest in chip set technology, makes the Enterprise series one of the fastest RAID server product lines on the market, the company says.

The Enterprise series is transparent and is compatible with most major operating systems, including UNIX, NetWare, Windows NT and Mac OS. Pricing starts at $4,995 for a 66-GB Enterprise RAID server and ranges to $11,250 for a 225-GB server.

Dynamic Network Factory Inc.
22445 Foothill Blvd.
Hayward, CA 94541
http://www.raidexpert.com
Circle 100

Sun keyboard/mouse and Solaris 2.5.1+. List price for the 400-MHz USP-2 starts at $25,140 for a base configuration comprising a single processor, one graphics slot and one SBus slot, 512-MB DRAM and 2-MB extended cache.

Themis Computer
3185 Laurelview Court
Fremont, CA 94538
http://www.themis.com
Circle 102

Bar Code Software Supports Linux

UniBar has announced that its popular bar code printing software, Barz_Out 3.0, now supports Linux, as well as Windows 95/98/NT and most major UNIX platforms. The Barz_Out client/server software works behind the scenes in existing applications to create instant bar code printing for invoices, purchase orders and other documents, UniBar says. It supports most popular enterprise applications, including Oracle, SAP and Baan, with no modification needed. In addition, it is easily installed as a printer filter with no hardware to install or upgrade, the company says.

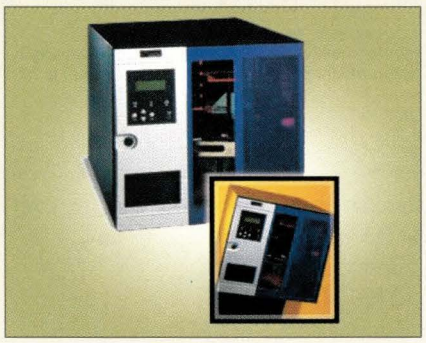
Barz_Out 3.0 for UNIX and NT costs $395 for one server and one printer license. Additional printer licenses cost $195 each.

UniBar Inc.
2731 S. Adams Road, Ste. 102
Rochester Hills, MI 48309
http://www.unibar.com.
Circle 103

Workgroup Media Storage Unveiled

StorageTek is now shipping a new automated tape library designed for workgroups. The 9738 automated tape library is available as either a 19-inch rack-mount or desktop system. Each library supports up to three StorageTek 9840 drives (up to 30 slots), which are said to offer 20 GB of storage capacity per cartridge. A fully configured 9738 library stores up to 600 GB of uncompressed data (or 1.8 TB compressed), the company says.

The 9738 comes with a camera-based bar code reader and automatic drive cleaning capabilities. Robotic controls are provided through a SCSI 2-based



media changer command set with Fast/Wide interface. In addition, the 9738 can perform random retrievals, giving users faster access to application data, StorageTek says.

The 9738 library supports Solaris, AIX, HP-UX, OS/400, IRIX and Windows NT operating systems. Pricing starts at $44,400 for a system configured with one 9840 tape drive.

Storage Technology Corp.
1 StorageTek Drive
Louisville, CO 80028
http://www.storagetek.com
Circle 104

MTI Follows Fibre Channel to the NorthStar

MTI Technology has announced the NorthStar series, a new line of products that combine Fibre Channel switched-fabric technology with existing Gladiator 6700 information servers and management services. By unifying these technologies in a single, fully certified product, MTI says it has simplified the deployment and management of storage area networks (SANs).

NorthStar is said to incorporate a complete set of modules necessary to implement an enterprise SAN solution. It is a fault-resilient, scalable (to 3 TB of data) storage system that incorporates the company's high-availability Gladiator 6700 RAID technology, MTI says. The system offers multiple concurrent host support for applications that require high bandwidth and transfer rates, including data warehousing, data mining and online transaction processing (OLTP) applications. Its switched-fabric technology reportedly enables the storage system to control the flow of data in the most efficient manner.

NorthStar includes MTI's DataAssure technology, which protects host/array data integrity; and WriteGuard, an MTI patented process that ensures writes-in-progress are completed in the event of a power failure. The system also features a built-in management processor that provides centralized administration of all aspects of storage configuration, fault notification and performance monitoring anywhere on the network.

To ensure high levels of data integrity and availability, NorthStar can be configured with the company's DataShield volume mapping software, which allows a large storage array to be partitioned into smaller units assigned to separate servers on a Fibre Channel-based SAN, MTI says. Data replication is handled by MTI's DataSentry technology. DataSentry is reportedly designed to keep mission-critical applications up and running during system and data center outages by providing continuous data access.

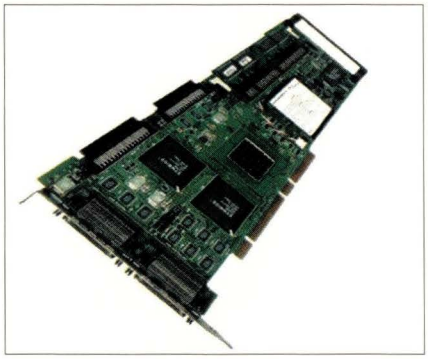
The NorthStar series supports a number of operating systems, including Solaris, AIX, HP-UX, IRIX and Windows NT. Pricing starts at $129,000 for an entry-level system and ranges to $400,000 for a fully configured system.

MTI Technology Corp.
4905 E. La Palma Ave.
Anaheim, CA 92807
http://www.mti.com
Circle 105

High-Performance RAID Controller

American Megatrends has released the MegaRAID Enterprise 1500 high-performance RAID controller for enterprise servers.

The Enterprise 1500 features an Intel Corp. i960RN processor with a 100-MHz internal JX core. With four Ultra 2 SCSI channels and a 64-bit



architecture, the Enterprise 1500 reaches sustained sequential throughput of 210 MB/s and a random I/O rate of more than 8,000 I/Os per second, the company says. In addition, the Enterprise 1500 features advanced management and configuration utilities, including WebBIOS, a RAID utility featuring a browser-based user interface; FlexRAID, American Megatrends' tool for online capacity expansion and RAID level migration; Power Console Plus, a Windows NT application, which creates and manages multiple disk arrays and controllers and monitors multiple RAID servers; and MegaManager, an online management utility that supports Solaris, SCO UNIX, Linux and NetWare.

Enterprise 1500 is the only 64-bit PCI RAID controller that offers a manufacturing upgrade path to support a data transfer rate of 160 MB/s per SCSI channel, the company says. The MegaRAID Enterprise 1500 RAID controller supports up to 15 devices per channel and RAID levels 0, 1, 3, 5, 10, 30 and 50 and Just a Bunch Of Disks (JBOD). It supports all major operating systems as well, including Solaris, SCO UNIX, Linux, UnixWare, NetWare, DOS, OS/2 Warp and Windows NT/2000. Contact company for pricing.

American Megatrends Inc.
6145-F Northbelt Pkwy.
Norcross, GA 30071
http://www.ami.com
Circle 106

Enhanced Java Testing Tools

Sun Microsystems has released enhanced versions of its JavaLoad and JavaStar testing software. The tools help companies reduce costs and balance IT staff resources by allowing developers to test enterprise applications during critical phases of development, as well as pinpoint bottlenecks and fix problems before deployment, Sun says.

With the increased demand for electronic commerce, Web-based order entry and enterprise resource planning (ERP) applications, JavaLoad and JavaStar offer companies the ability to test and evaluate these types of high-performance applications in simulated conditions before being deployed, Sun says.

JavaLoad 1.1 allows engineers and developers to target load-testing at every point in an application's life cycle. It includes support for the Java 2 Platform, Solaris 7 and NetDynamics 5 application server.

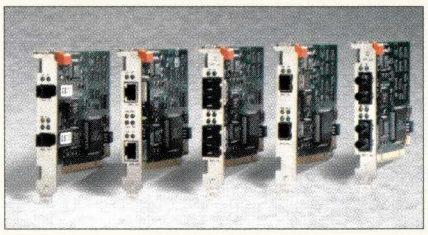
JavaStar 1.2 is a GUI-based testing tool that enables developers to build and play back user sessions on different platforms. It now supports Java Development Kit (JDK) 1.1.8 and the Java 2 Platform, Standard Edition.

Pricing starts at $45,000 for JavaLoad 1.1 and at $1,995 for JavaStar 1.2; site licenses are also available.

Sun Microsystems Inc.
901 San Antonio Road
Palo Alto, CA 94303
http://www.sun.com
Circle 107

NIC for High Network Availability

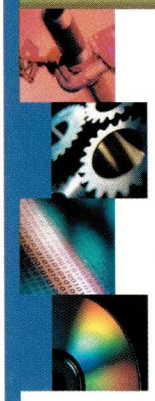
Lancast has announced AccessNIC 100, a dual-port network interface card (NIC) designed to provide high network availability for business-critical solutions.



Targeted at government agencies, as well as financial, medical and military organizations, AccessNIC 100 incorporates a single MAC dual-port technology that is said to make network access reliable and seamless. Using a single MAC address on dual ports, the NIC can be configured to provide data link redundancy by using a primary link for normal operation and a secondary link in the event of a hub, switch or cabling failure. The loss of the primary link is transparent to end users, the company says.

For applications that require controlled network access, one port may be connected to a switch, while a second

GOOD TOOLS ARE JUST THE BEGINNING...



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Circle No. 26

port remains open. This allows the user to isolate the workstation from the network by simply selecting which port is active, the company says. In addition, the administrator is reportedly able to select which data path will be used without having to physically move network connections.

AccessNIC 100 uses industry standard SNMP-based protocols for remote management and supports Windows 95/98/NT. Pricing ranges from $699 to $1,999 for dual single-mode fiber ports.

Lancast Inc.
12 Murphy Drive
Nashua, NH 03062
http://www.lancast.com
Circle 108

Free Flash

If you're a Solaris, Linux or IRIX user that finds it frustrating every time you come across a Web site using Macromedia Flash technology, take heart. Flash Player is now available free of charge for these operating systems.

Flash technology is used to create high-impact, vector-based Web sites that deliver motion, sound, interactivity and graphics. A Flash Player multimedia application is required to view these sites. Flash Player runs within the Web browser once it has been downloaded from the Macromedia Web site. In addition to the three newly supported operating systems, Flash is available for Windows and Mac OS, and comes with QuickTime, RealPlayer and certain versions of popular browsers.

Macromedia Inc.
600 Townsend St.
San Francisco, CA 94103
http://www.macromedia.com
Circle 109

Boundless Competes with Low-Priced Terminal

ADDS 60 from Boundless Technologies is touted as a low-cost competitor in the video display text terminal market. Priced at $477, ADDS 60 is said to provide a number of terminal emulations, including Wyse Technologies Inc. WY-60 and WY-50/50+, Digital Equipment Corp. VT-320, VT-220 and VT-100 and Boundless Technologies Viewpoint and PCTerm. In addition, it offers

advanced data access, data manipulation and display features that include cut-and-paste and Corel Corp. WordPerfect graphics support, the company says.

The terminal reportedly features selectable refresh rates up to 100 Hz and an ISO 9241.3-compliant mode to reduce operator eyestrain. There is also a power management feature to conserve power. ADDS 60 is compatible with a number of operating systems, including Solaris, AIX, SCO UNIX, HP-UX, VMS, Open VMS and Zenix.

Boundless Technologies Inc.
100 Marcus Blvd.
Hauppauge, NY 11788
http://www.boundless.com
Circle 110

New Converters to Extend Networks

Transition Networks has introduced its Long Haul media converters, which extend network distances up to 80 kilometers in metropolitan area networks and campus networks, the company says. The converters reportedly allow network managers to reach remote sites at full network speeds without using more expensive routers, cable modems or leased T1 lines.

The first three converters in the Long Haul series convert copper to single-mode fiber, and are available in distances of 40, 60 or 80 kilometers. Traditional copper-to-single-mode converters are limited to 20 kilometers.

Two additional converters in the Long Haul series convert multimode to single-mode fiber. The first converts multimode to single-mode fiber past the present limit of 5 kilometers to 25 kilometers in Gigabit Ethernet environments, while the second device extends past the present 20-kilometer limitation to 40 kilometers in Fast Ethernet and asynchronous transfer mode (ATM) environments, the company says.

The Long Haul converters are available as as stand-alone units or slide-in cards for Transition Networks' Conversion Center. Using optional redundant power and network management software, Conversion Center can convert many networking protocols, including unshielded twisted pair-to-fiber conversions for Ethernet, Fast Ethernet, ATM, FDDI and Token Ring, as well as single-mode-to-multimode fiber conversions for these and Gigabit Ethernet and OC-12 environments. Conversion Center can be managed under HP OpenView on Solaris, HP-UX and Windows NT, as well as NetView for AIX and Windows NT.

The copper-to-single-mode fiber converters cost $1,595, $1,995 and $2,555 for the 40-, 60- and 80-kilometer models, respectively. The 40-kilometer multimode-to-single-mode converter for Fast Ethernet and ATM environments costs $1,455. The Gigabit Ethernet multimode-to-single-mode converter is priced at $2,795.

Transition Networks Inc.
6475 City West Pkwy.
Minneapolis, MN 55344
http://www.transition.com
Circle 111

Enhanced Web Server Performance Benchmark

Standard Performance Evaluation Corp. (SPEC) has announced SPECweb99,x the latest version of its Web server performance benchmark.

Designed for Web server hardware and software vendors, the new benchmark is said to simulate access to an Internet service provider (ISP) that supports numerous Web pages for various organizations. The SPECweb99 workload simulates dynamic operations such as rotating advertisements and user registration on the site being evaluated, SPEC says. In addition, it emulates the number of simultaneous connections the server can support, according to a predefined workload, and mimics clients that send HTTP requests to the Web server over slow Internet connections.

SPECweb99 is specifically a Web server performance measure and does not

report on Web client, client/server or WAN performance. Future versions of SPECweb will address proxy, multimedia and encryption performance, SPEC says. SPECweb99 is available on CD-ROM for $800. Discounts are available for universities, nonprofit organizations and SPECweb96 licensees.

Standard Performance Evaluation Corp.
10754 Ambassador Drive, Ste. 201
Manassas, VA 20109
http://www.spec.org
Circle 112

Solid-State Storage with Fibre Channel Interface

Solid Data Systems has introduced Excellerator 800 FC, what it says is the first solid-state storage system with a Fibre Channel interface for host connections. The high-performance system is said to enable storage area networks (SANs) to reach their maximum performance potential by providing high-speed storage that can be allocated to those applications with the most pressing performance requirements.

Excellerator 800 FC reportedly enables users to achieve dramatic performance improvements in I/O-intensive applications such as electronic commerce, Web-based email/news and customer service. The system incorporates a 100-MB/s Fibre Channel host connection that supports the connectivity, bandwidth and distances necessary for server clusters and Fibre Channel Arbitrated Loop (FC-AL) configurations.

Excellerator 800 FC is a self-contained storage system that uses a Dynamic RAM (DRAM) architecture to turbocharge the performance of I/O-intensive applications running in real-time environments, the company says. It can support storage capacities of up to 5.4 GB, and is said to deliver data access times measured in microseconds (instead of milliseconds), making it up to 1,000 times faster than typical magnetic disk-based storage subsystems.

Excellerator 800 FC supports UNIX and Windows NT, and is priced starting at $27,225 for a 536-MB system.

Solid Data Systems Inc.
2945 Oakmead Village Court
Santa Clara, CA 95051
http://www.soliddata.com
Circle 113

Eight-Processor Server

Dell has introduced PowerEdge 8450, a new server that supports up to eight 550-MHz Intel Pentium III Xeon processors. The server is designed specifically for running compute-intensive applications. During in-house demonstrations, the 8450 was reportedly able to serve 22,000 Web pages per minute.

Dell designed the 8450 to conserve space. With a height of 7U, or 12 inches, up to six servers can be stacked in a standard rack-mount enclosure. In addition, PowerEdge 8450 comes with Dell's OpenManage Resolution Assistant, a problem management diagnosis and repair application designed to reduce system downtime and provide improved service and support, the company says.

PowerEdge 8450 supports Windows NT and is available on request with UnixWare or Solaris preinstalled. Prices start at $20,999.

Dell Computer Corp.
1 Dell Way
Round Rock, TX 78682
http://www.dell.com
Circle 114

RISC Processor Integrates PCI, Memory

Toshiba America has introduced the newly integrated TMPR3927 32-bit TX SystemRISC microprocessor. The TMPR3927 is said to integrate a memory controller and a PCI controller with a RISC processor. By integrating the PCI controller on the microprocessor, Toshiba says it eliminates the need for a separate PCI controller chip. Furthermore, the TMPR3927 is designed for easy migration from traditional embed-

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Sun microsystems

Circle No. 17

ded bus architectures, such as SysAD and VMEbus, to PCI bus architectures.

The TMPR3927 microprocessor operates at 133 MHz and includes an 8-KB instruction cache and 4-KB data cache. The TMPR3927 microprocessors cost $20 each in 10,000-unit quantities.

Toshiba America
Electronic Components Inc.
9775 Toledo Way
Irvine, CA 92618
http://www.toshiba.com/taec
Circle 115

Web-Enable True64 Apps

Tarantella, a Web-enabling application broker from The Santa Cruz Operation (SCO), is now available on the True64 UNIX platform. Tarantella is said to allow an organization to Web-enable applications without a complete rewrite. One of the benefits of it being ported to True64, SCO says, is users can now access Compaq Computer Corp.'s Telecommunications Management Information Platform (TeMIP). TeMIP provides network and services management for the telecommunications industry.

Tarantella is said to allow users to access any UNIX system, 3270 or Windows application from any Java-enabled client or Windows PC without installing additional software on the client. In addition to Tru64, Tarantella is available for Solaris, AIX, HP-UX and UnixWare. It costs $395 per user.

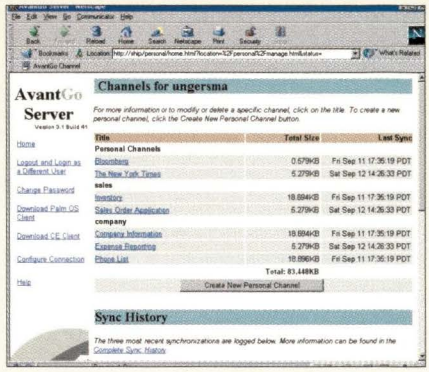
The Santa Cruz Operation Inc.
Encinal St.
Santa Cruz, CA 95060
http://www.sco.com
Circle 116

Handheld Desktop Connection

AvantGo has introduced AvantGo Enterprise 3, the latest version of the company's software suite for extending Web-based and client/server applications to handheld devices.

Enterprise 3–which includes AvantGo Server, AvantGo Client and the open-source Mobile Application Link–is designed to securely extend any business application to handheld devices using public or private networks, the company says. Using Enterprise 3, organizations can connect to non-Web-based data and applications, including C-based applications and data stored in Oracle, Sybase or flat-file databases. This allows developers to deliver virtually any data or application to remote users, the company says.

Other new and enhanced features include a flexible architecture for processing mobile transactions; enhanced security in the form of 128- and 56-bit Secure Sockets Layer (SSL) encryption; centralized user, group and system management, which allows systems administrators to deliver new applications and data to mobile users and groups of users; and support for Mobile Application Link, enabling one-button synchronization to multiple servers.



Enterprise 3 supports Palm Computing platforms and Windows CE-based devices, as well as Solaris, Linux and Windows NT operating systems. Pricing starts at $150 per user.

AvantGo Inc.
1700 S. Amphlett Blvd., Ste. 300
San Mateo, CA 94402
http://www.avantgo.com
Circle 117

Upgrades, Enhancements, Additions...

■ Sun Microsystems has announced the immediate availability of its 32-bit microSPARC IIep processor through the Sun Community Source Licensing (CSL) Web site (*http://www.sun.com/microelectronics/communitysource*). Sun is offering the 32-bit microSPARC IIep synthesizable processor, complete with integer unit, cache memory controller and PCI interface. The 32-bit microSPARC processor design is available to developers of embedded system-on-chip applications at no charge during the initial evaluation and development phase. Upon signing a commercial license agreement, vendors will be charged a percentage of the average selling price per chip. **Sun Microsystems Inc.**, 901 San Antonio Road, Palo Alto, CA 94303, *http://www.sun.com*. **Circle 118**

■ Visual Numerics' visual data analysis software, PV-WAVE 7.0, now has enhanced data analysis, data visualization and systems administration features. PV-WAVE 7.0 includes 76 new mathematical and statistical analysis routines, new array manipulation functions, an improved mapping module and the ability to export PV-WAVE graphics to Microsoft Corp. Office documents. In addition, PV-WAVE floating licenses can now be shared between Windows and UNIX platforms, with the server license running on either side. Rather than specifying which platform will serve as the PV-WAVE server, the systems administrator now has the flexibility to deploy the server license among various platforms, depending on resource constraints, Visual Numerics says. PV-WAVE 7.0 is available for Solaris, HP-UX, IRIX, Tru64 UNIX, AIX, Linux, Open VMS and Windows 95/98/NT. Pricing for the Windows and Linux versions starts at $1,500, while pricing for the UNIX and Open VMS versions starts at $3,495. **Visual Numerics Inc.**, 5775 Flatiron Pkwy., Ste. 220, Boulder, CO 80301, *http://www.vni.com*. **Circle 119**

■ Mesa Systems Guild has released Mesa/Vista 3.5 with new portal features. Mesa/Vista 3.5 is said to provide project managers and development teams with access to all data related to the project. With the added "MyVista" feature, the software allows team members to personalize views of projects. The MyVista page includes notices, action items, meeting lists and documents in progress, all arranged in a fashion that fits the end user's needs and preferences, the company says. Mesa/Vista also has a new set of security features. Administrators have the sole responsibility for adding or deleting users and can also create additional password fields to limit access to sensitive project areas. Mesa/Vista is available on Solaris, AIX, HP-UX and Windows NT. It costs $6,500 per server for an unlimited number of users. **Mesa Systems Guild Inc.**, 60 Quaker Lane, Warwick, RI 02886, *http://www.mesasys.com*. **Circle 120**

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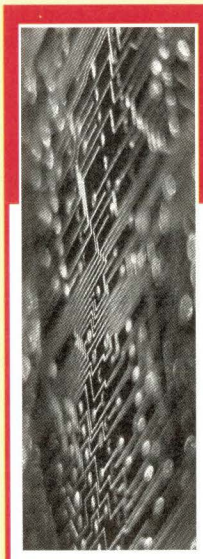

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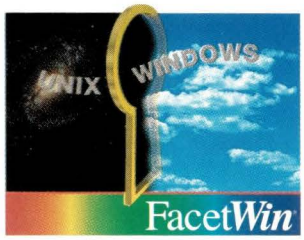

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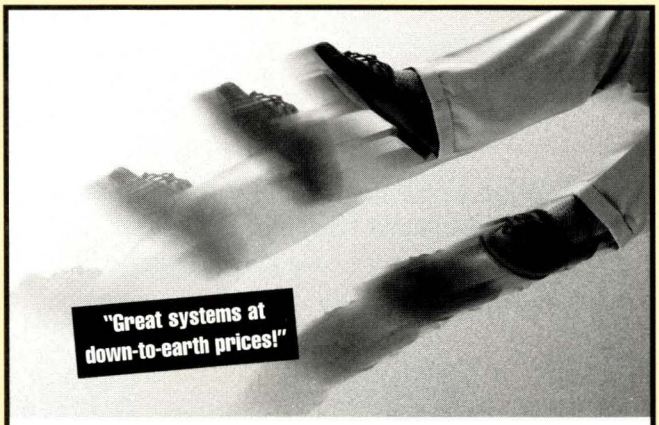

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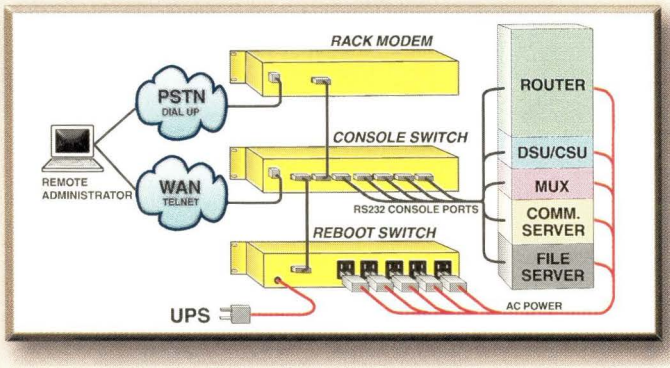

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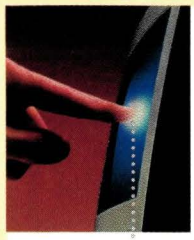

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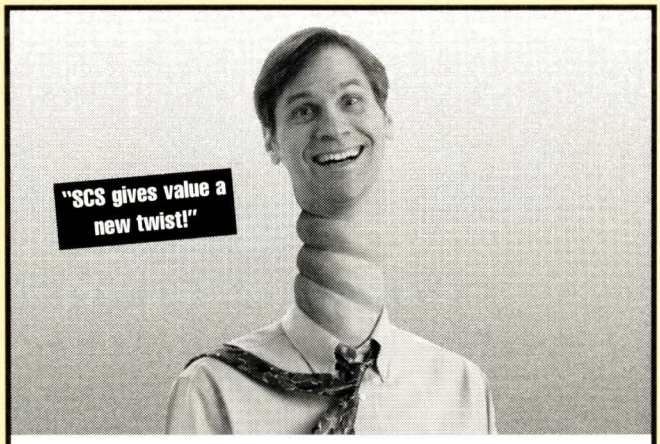

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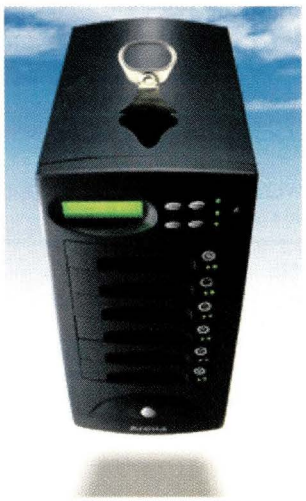

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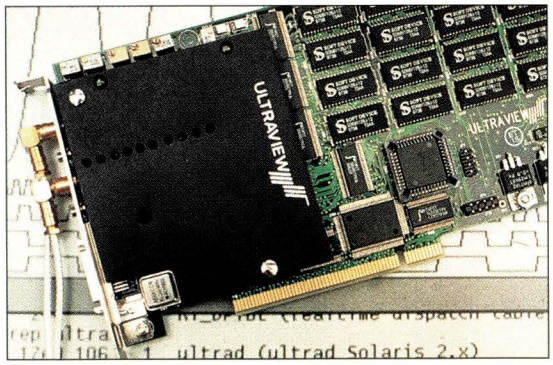

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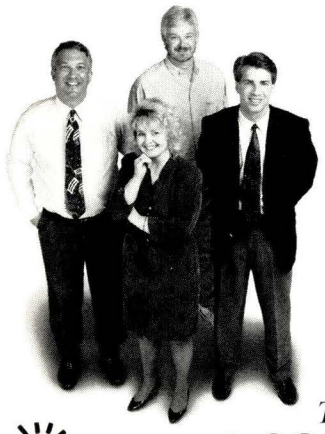

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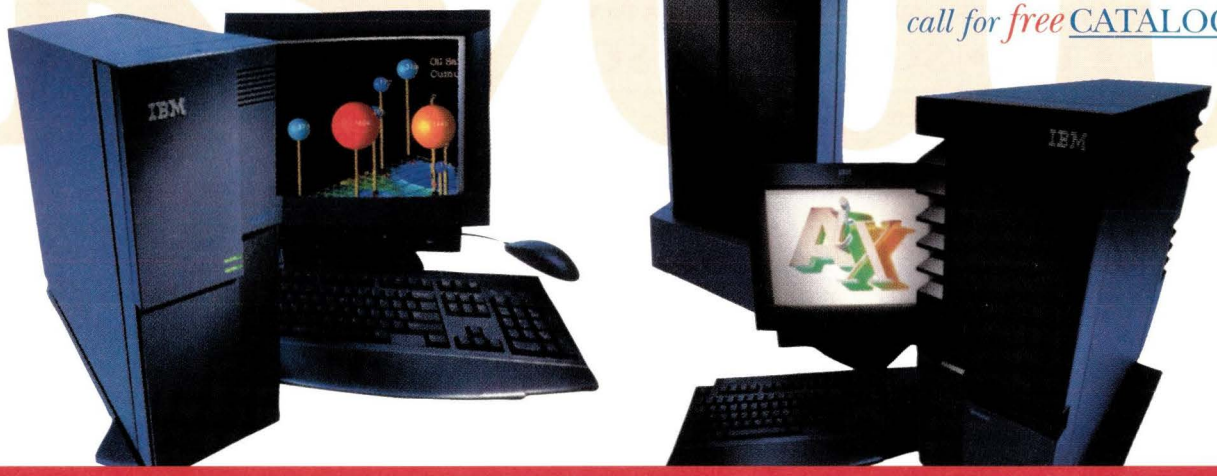

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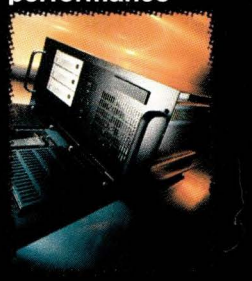

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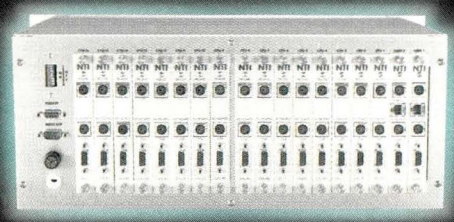

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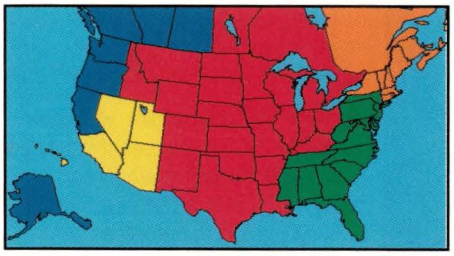

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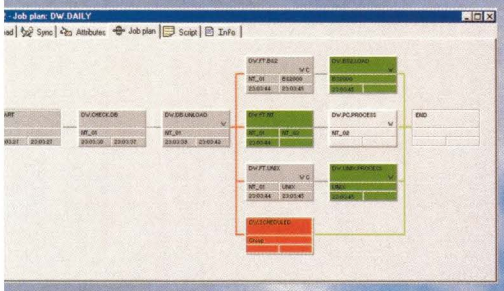

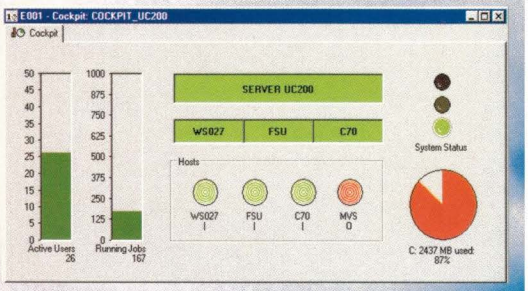

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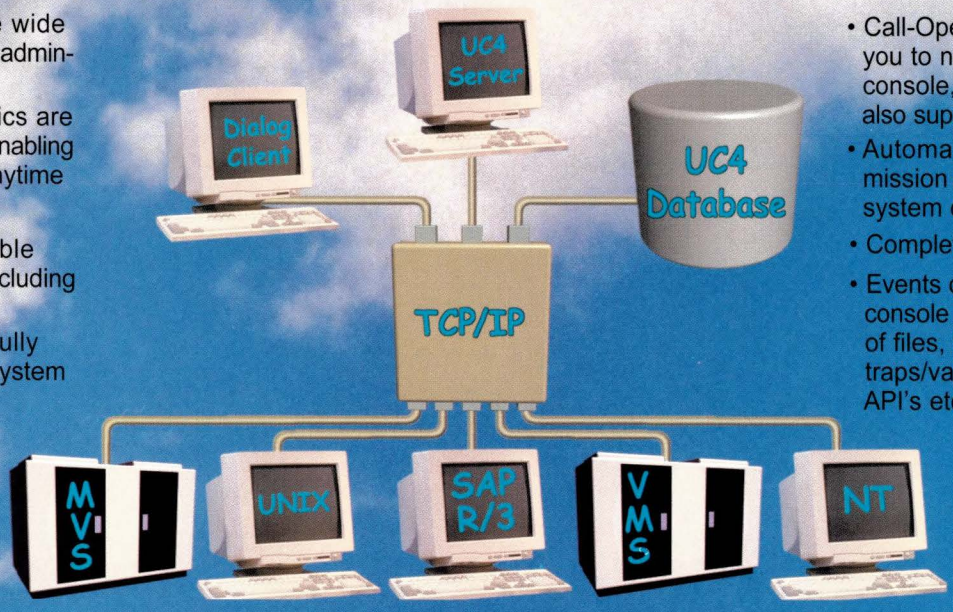

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