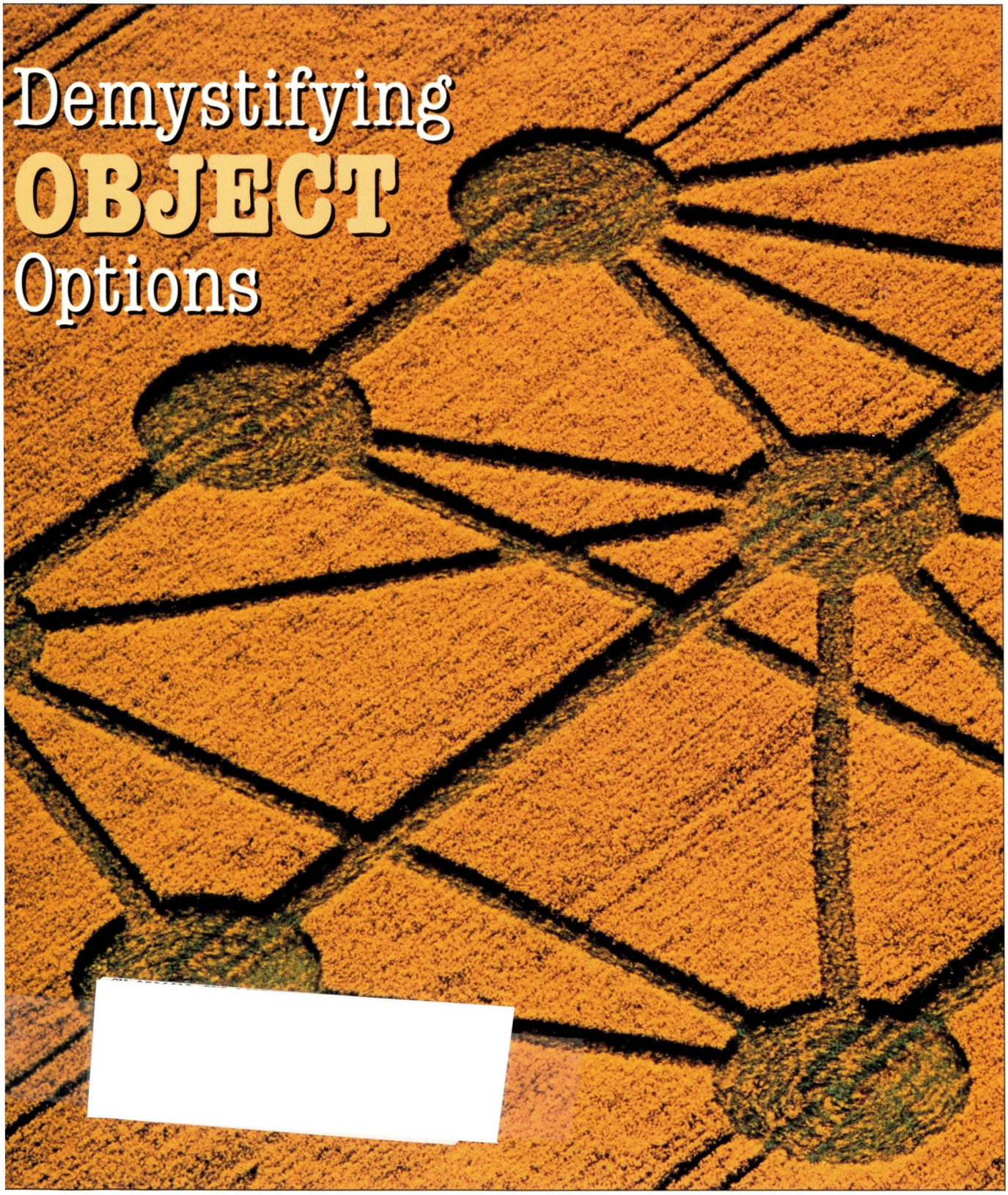
Server/Workstation EXPERT

APRIL 2000
Vol. 11 No. 4 $5.50
http://sw.expert.com

Server-Based Computing Solutions

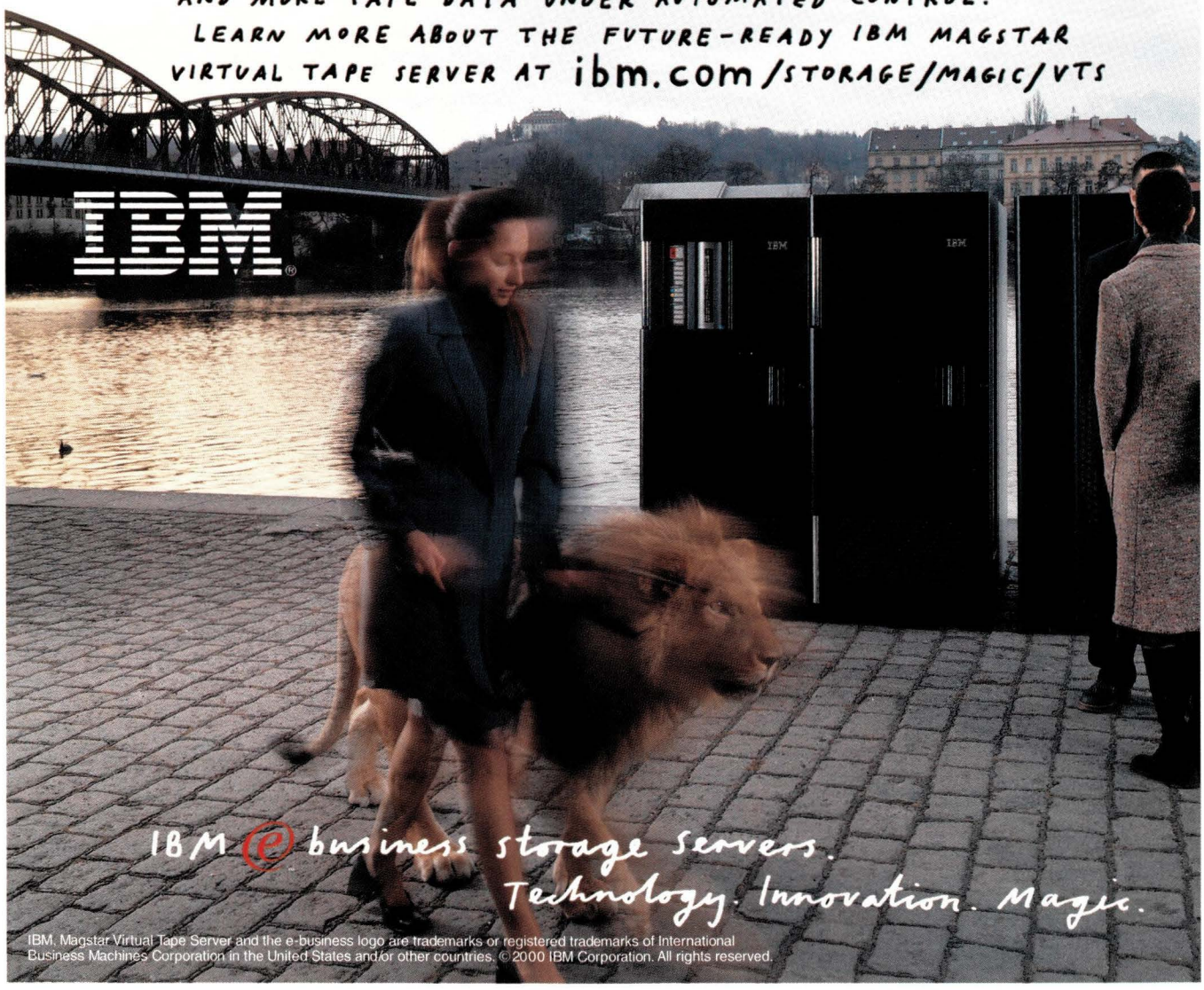


orage: Bus Protocols

Java Class: JTrees

CAN YOU FIND THE DATA IN THIS PICTURE?

IT'S EASY. THERE ARE ALMOST 200 TERABYTES OF DATA ON THE IBM MAGSTAR® VIRTUAL TAPE SERVER, AND LIKE MAGIC, YOU CAN BRIDGE THE DATA TO A SECOND SYSTEM IN A REMOTE LOCATION. WITH ITS BUILT-IN INTELLIGENCE, THE IBM MAGSTAR VIRTUAL TAPE SERVER PROVIDES LOGICAL VOLUME STACKING FOR NEAR-100% TAPE CARTRIDGE UTILIZATION — RESULTING IN REDUCED TAPE OPERATION COSTS AND MORE TAPE DATA UNDER AUTOMATED CONTROL. LEARN MORE ABOUT THE FUTURE-READY IBM MAGSTAR VIRTUAL TAPE SERVER AT ibm.com/STORAGE/MAGIC/VTS



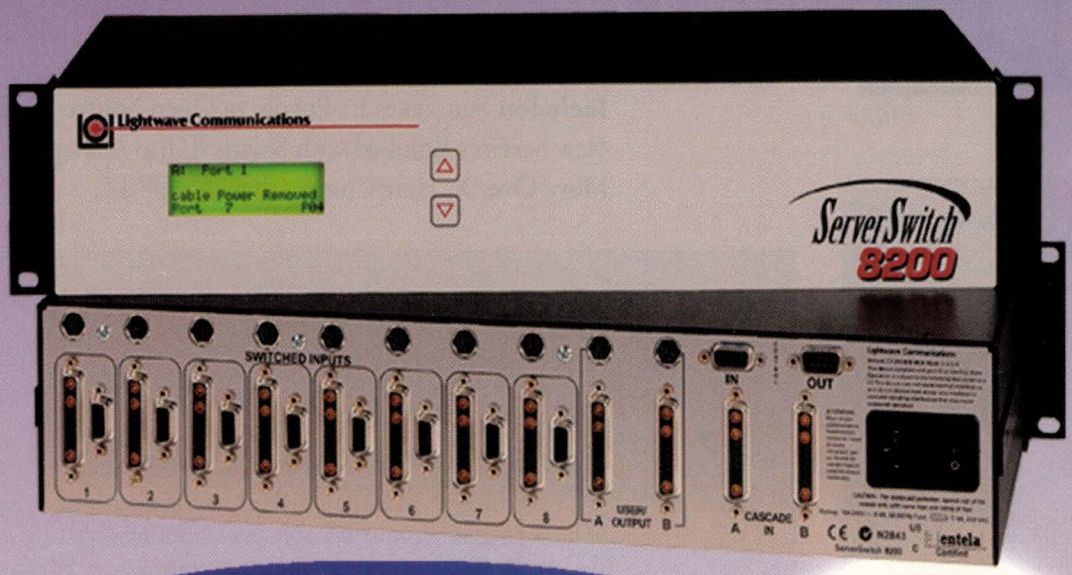
IBM e business storage servers.
Technology. Innovation. Magic.

IBM, Magstar Virtual Tape Server and the e-business logo are trademarks or registered trademarks of International Business Machines Corporation in the United States and/or other countries. © 2000 IBM Corporation. All rights reserved.

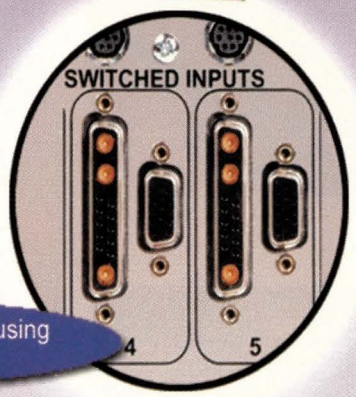
Two Heads Are Better Than One!

Two User, Eight Server KVM Switch

with On-Screen Display for SUN Computers



- Consolidate monitors and keyboards
- Allows 2 users to interact with up to 120 servers
- Transparent to all Sun monitors and keyboards
- No Single Point of Failure if power is lost
- Industry Standard Cabling using 13W3 or HD15 cables



The ServerSwitch 8200 is an active KVM switching device which allows keyboard, monitor and mouse signals to be switched transparently among two users and eight Sun computers without interruption of active server processes. The ServerSwitch 8200 is fully compatible with Sun keyboards, mice and monitors. Video connection is easy using standard 13W3 or HD15 cables.

Let us help you simplify your life. Call us at: 800-871-9838

Lightwave Communications

USA: www.lightwavecom.com
Europe: www.lightwavecom.de

In Australia, Phone: 61-39-652-7226
In Europe, Phone: 49-89-306-3810

Circle No. 1

Server/Workstation EXPERT

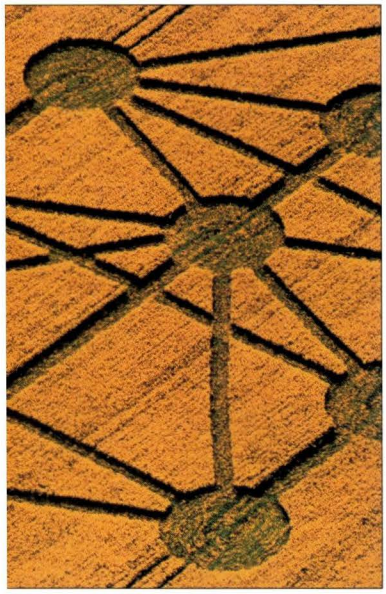
The leading publication for server-based computing solutions

PAGE 8

Contents

8 News

Includes: Sun Takes Its Encore to Open-Source Developers; New Services Bundled with Solaris 8; Jiro Manages Storage; Move Over X, Here Comes Citrix for UNIX.



PAGE 52

52 Cover Story

by Karen Watterson

Demystifying Object Options

Whether you're a shop that prefers to build your own components or not, the good news is distributed computing is getting easier. Today, the field has narrowed to two competing architectures: J2EE and Windows 2000 DNA.

Departments

6 Editorial
24 Reader Feedback
60 New Products
67 Server/Workstation Marketplace
80 Advertisers' Index

PAGE 60

COMING NEXT ISSUE
eCommercial UNIX

BONUS DISTRIBUTION
For Advertisers of the June Issue:

- 2000 USENIX Annual Conference
  San Diego, CA
- JavaOne
  San Francisco, CA

SERVER/WORKSTATION EXPERT Magazine (ISSN# 1524-4849) is published monthly by Computer Publishing Group, 1340 Centre St., Newton Center, MA 02459. Telephone (617) 641-9101. Periodicals Postage Rates paid at Boston, MA, and at additional mailing offices. Posted under Canadian IPM #0235873. This publication is free to qualified subscribers as determined by the publisher. Subscription rates are $60 per year in the United States, and $75 (surface mail) and $125 (air mail) outside the United States. Subscription requests can be sent to Circulation Department, *SERVER/WORKSTATION EXPERT* Magazine, 1340 Centre St., Newton Center, MA 02459, or electronically mailed to circ@cpg.com.

POSTMASTER, please send all address changes to *SERVER/WORKSTATION EXPERT* Magazine, Circulation Department, 1340 Centre St., Newton Center, MA 02459. Please allow 6-8 weeks for change of address. Include your old address as well as new–enclosing, if possible, an address label from a recent issue. All rights reserved. © Copyright 2000, Computer Publishing Group. No part of this publication may be transmitted or reproduced in any form by any means without permission in writing from the publisher.

Material for publication should be sent to the attention of Doug Pryor at the above address or electronically mailed to dpryor@cpg.com. Letters sent to the publication become the property of the publication and are assumed to be intended for publication and may be used so. All information herein is believed to be accurate to the best of our ability.

Columns

20 Ask Mr. Protocol

by Michael O'Brien

To Every Link there is a Reason

Mr. P. points out that the Internet is good for a lot more than delivering *Notting Hill* over a 20-Mb/s connection. It's also good for delivering *Love Story* over the same connection.

26 UNIX Basics

by Peter Collinson

A Programming Primer

To understand how things work in UNIX, programmers need a grasp of the basic ideas behind programming languages and systems.

32 Storage

by Alan Benway

Taking a Ride on the Bus

The next leg of our journey introduces us to the two most common I/O interface technologies in use today: ATA and SCSI bus protocols.

38 NTegration

by Æleen Frisch

Understanding ACLs

A detailed look at NTFS file- and directory-level security via access control lists.

42 Work

by Jeffreys Copeland and Haemer

More Sex

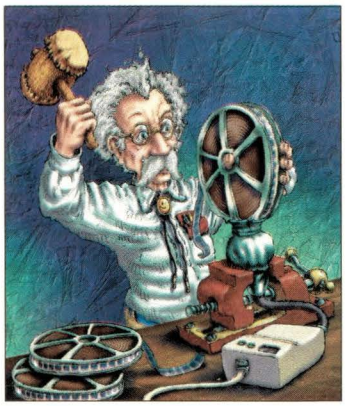
Continuing on from last month, the Jeffs try to answer the question: Why is sex always the same?

48 Java Class

by Jim Frost

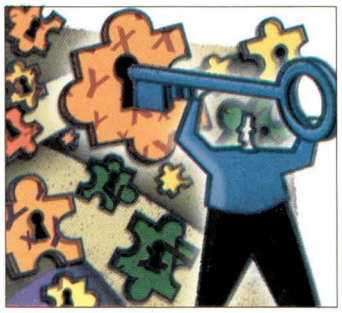
Trees, Glorious Trees

It's time to turn our attention to the folder selection panel of our Java-based IMAP client and its *JTree* widget.

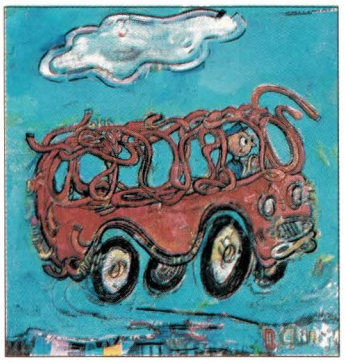


PAGE 20

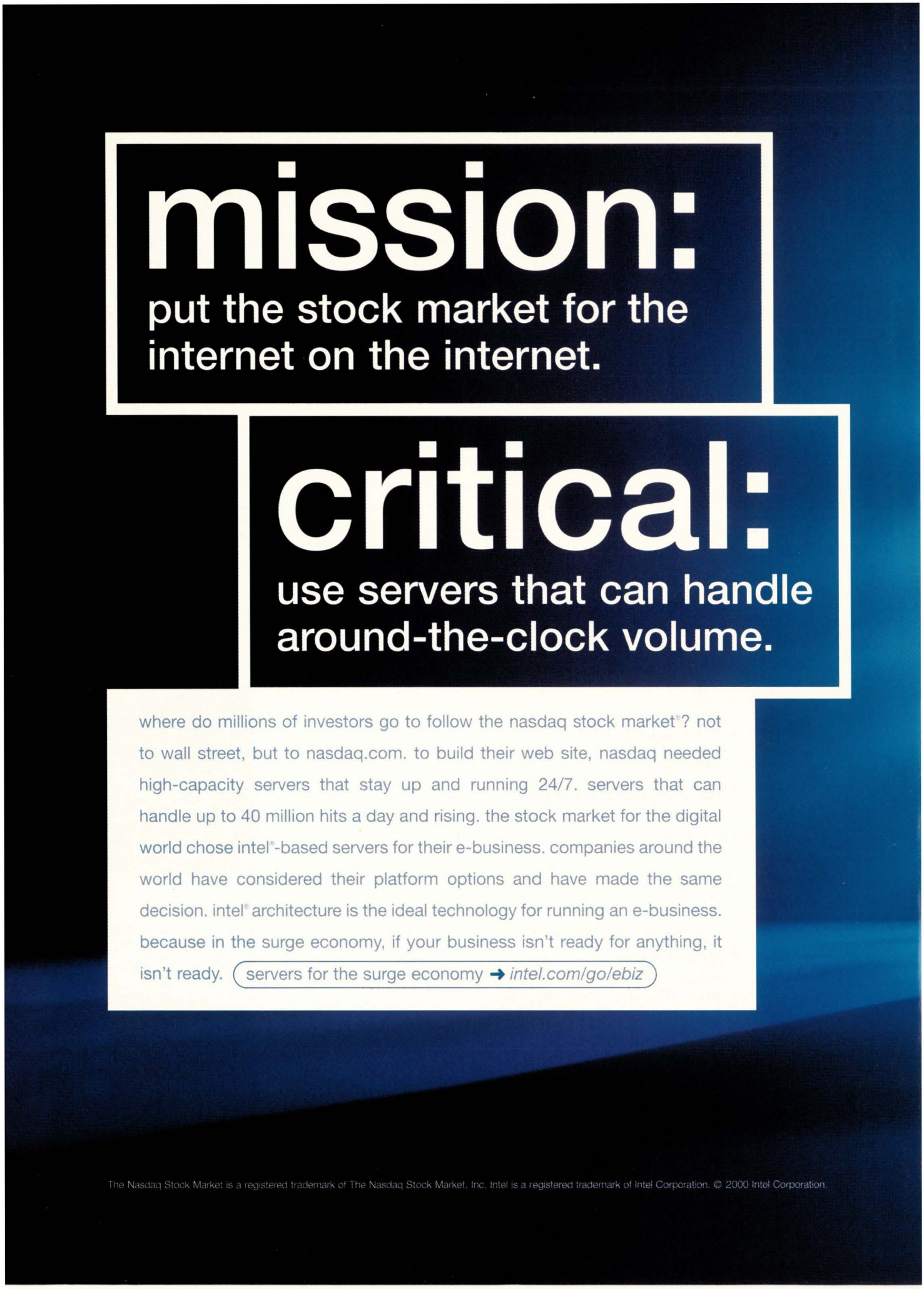
PAGE 38

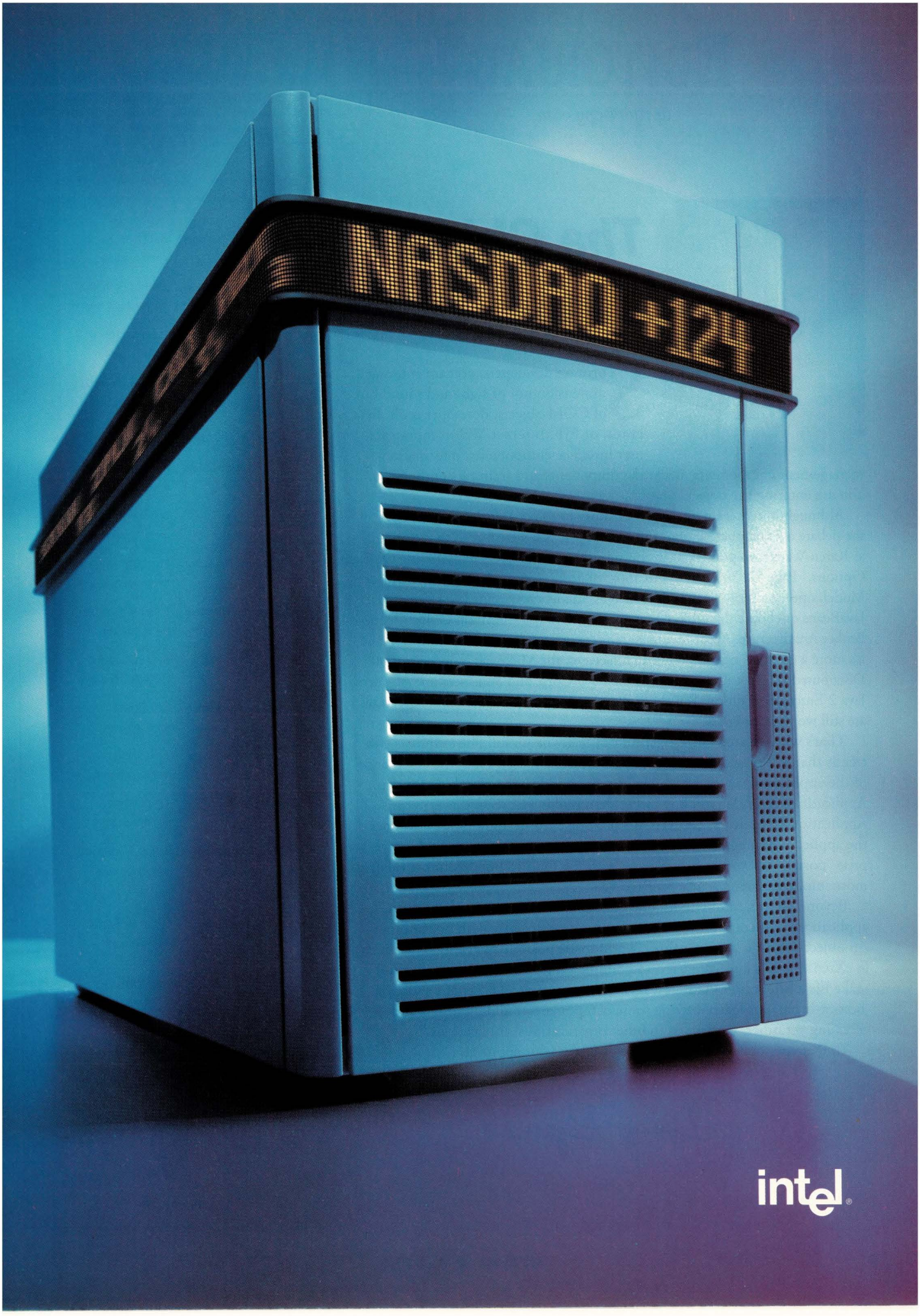


PAGE 42



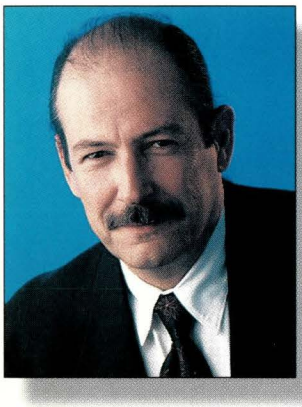
PAGE 32


mission:
put the stock market for the internet on the internet.
critical:
use servers that can handle around-the-clock volume.
where do millions of investors go to follow the nasdaq stock market®? not to wall street, but to nasdaq.com. to build their web site, nasdaq needed high-capacity servers that stay up and running 24/7. servers that can handle up to 40 million hits a day and rising. the stock market for the digital world chose intel®-based servers for their e-business. companies around the world have considered their platform options and have made the same decision. intel® architecture is the ideal technology for running an e-business. because in the surge economy, if your business isn't ready for anything, it isn't ready.
servers for the surge economy → intel.com/go/ebiz
The Nasdaq Stock Market is a registered trademark of The Nasdaq Stock Market, Inc. Intel is a registered trademark of Intel Corporation. © 2000 Intel Corporation.


NASDAQ +124
intel

EDITORIAL

dpryor@cpg.com



The Object Zone

Software developers, you are entering a dimension not of sight and sound but of COM objects, developer tools, beta beans, or EJB, Internet/Web components, user interface components, information management components, network components and training components. You are entering the object zone.

Although it may seem like ancient history to some, as little as a year ago, the debate over competing object models raged. You were forced to pick sides, as Karen Watterson points out in this month's cover story, "Demystifying Object Options," Page 52. You had to buy into Microsoft Corp.'s Component Object Model, opt for a more open model such as Sun Microsystems Inc.'s Enterprise JavaBeans or choose the Object Management Group's Common Object Request Broker Architecture. According to Karen's reporting, the field has narrowed and it's more a question of competing architectures: the Microsoft Windows 2000 Distributed Internet Architecture or the IBM Corp. and Sun-Netscape Alliance Java 2 Enterprise Edition. But she also discovers that both of these architectures are still works in progress.

That's where Karen's investigation can really be useful. She examines two trends that will or should influence your object strategy. First, the emergence of the application server, which handles the middleware plumbing for you. Application servers let you buy rather than build. The second is Enterprise Application Integrators. EAI vendors provide custom middleware that does the application integration and maintains a repository. Some provide enterprise "portals" for you or provide you with the tools to build your own. For more info, see Karen's article on Page 52.

Beyond all this competition, one fact remains. Companies want their applications and components to communicate efficiently with one another. An object-agnostic, service-centric world made possible by technologies such as eXtensible Markup Language and Simple Object Access Protocol would make life a little easier. As Karen says, "It's becoming a lot easier to adopt a 'best-of-breed' approach–buying some components, building others and accessing yet others embedded in other organizations' applications."

To that end, our cover story is submitted for your approval.

Doug Pryor

SW EXPERT

April 2000 Vol. 11 No. 4

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 Suzanne Hildreth
sjh@cpg.com

Simon Ross
sross@cpg.com

Production Editor Domenic Argentieri
domenic@cpg.com

Art/Production Director John W. Kelley Jr.
jwk@cpg.com

Senior Designer Brad Dillman
bdillman@cpg.com

Production Roy Porter
roy@cpg.com

Circulation Manager Tina Jackson
jamal@cpg.com

Promotions Manager Tom Brown
tom@cpg.com

Accounting Manager Robin Yearwood
robin@cpg.com

Business Manager Susan R. Sacks
srs@cpg.com

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

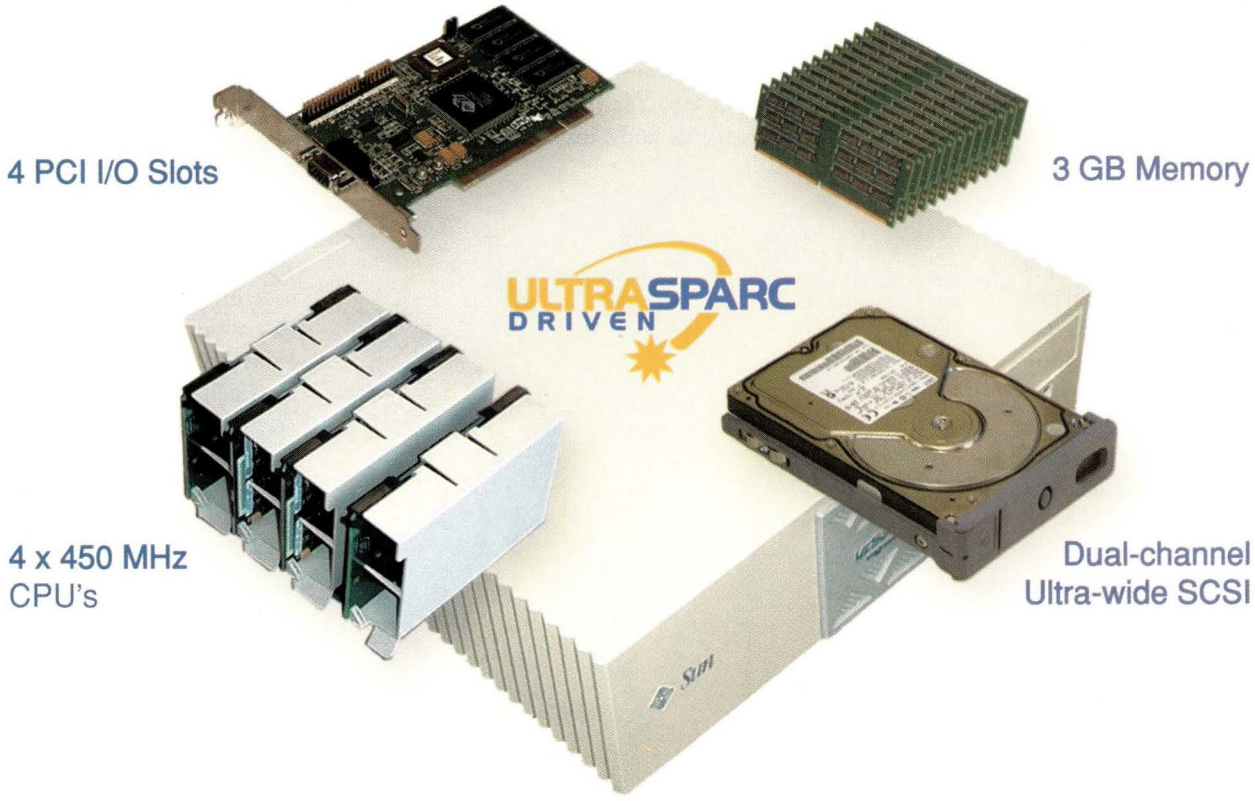
Editorial Offices
1340 Centre St.
Newton Center, MA 02459
(617) 641-9101

BPA INTERNATIONAL

Printed in USA

Unbelievable!

Picture your Sun Ultra 2 configured with *4* Ultra II 450 MHz CPU's & *3* GB of Memory



Cycle Computer Corporation

CALL FOR INFORMATION: 1-800-672-1200

Sun AUTHORIZED VALUE ADDED INTEGRATOR

©1999 Cycle Computer Corporation 20245 Stevens Creek Blvd. Cupertino, CA 95014 **www.cyclecc.com**

Sun, Ultra, and SPARC are trademarks of Sun Microsystems and SPARC International. All other trademarks are property of their respective owners.

Circle No. 27

Sun Takes Its Encore to Open-Source Developers

As the popularity of the open-source movement has grown, major commercial software vendors have fallen over one another to show their enthusiasm for open-source principals. Now even Sun Microsystems Inc., Palo Alto, CA, has joined the pack.

Sun recently released the source code for its TI-RPC, Transport-Independent Remote Procedure Call, technology for the Network File System (`http://soldc.sun.com/tools/tirpcintro.html`). NFS allows network users to access shared files stored on computers distributed on a network. Sun turned over the NFS standard to the Internet Engineering Task Force (`http://www.ietf.org`) in 1998, but continues to hold the source code to its own implementation of NFS, which uses TI-RPC. The IETF is currently working on Version 4 of the NFS protocol.

ROBERT BURGER

Contrary to earlier reports in the trade press, Sun isn't releasing the source code to its NFS implementation, says Bev Crair, Sun Engineering Manager, however, it is releasing the rights to the NFS trademark. According to Crair, Sun decided to release the source code to this latest version of TI-RPC, which contains some new security features, because several of Sun's development partners needed access to it in order to test their own implementations of NFS v.4.

Sun has released TI-RPC under a new license, the Sun Industry Standards Source License, which allows developers to use, modify and distribute TI-RPC code. That's a switch from how Sun has handled its Java technology, which has been made available under the Sun Community Source Code License (SCSCL). That license prohibits distributions of modified Java code without written permission from Sun. Also, developers must pay fees to Sun to distribute source code for commercial purposes. The company has generated a great deal of controversy by declining to release its Java technology to an industry standards body, instead retaining control over it via its restrictive license. Sun also released the source code for its Solaris 8 operating system in January, but only for educational and research purposes, or for personal use, and prohibits developers from sharing the source code with any third party not registered with Sun.

Sun has submitted its new license to the Open Standards Initiative (`http://www.opensource.org`), the group that certifies licenses as meeting the definition of open source. Eric Raymond, president of the OSI, couldn't give an opinion as to what the company's chances were for gaining OSI approval, but did comment that there were some aspects of the license which could be seen as deviating from a strict definition of open source. But, he says, "It's an improvement over the SCSCL. There's no way we'd ever certify the SCSCL. That's a proprietary license masquerading as open source."

The OSI has certified more than a dozen open-source licenses, including the commonly used General Public License (GPL). So why didn't Sun use the GPL or a similar license? According to Danese Cooper, manager of Sun source-licensing programs, the company opted against using the GPL because of concerns Sun's partners had about using that license. "The GPL has a mechanism in which basically any source code contributed to a GPL licensed effort becomes GPL itself. So by bringing in GPL code, you can render all your existing code as open source," Cooper says. In contrast, she says, the Sun license does not require vendors to expose source code that has been integrated with the TI-RPC code, instead requiring only that developers provide a specification and reference implementation.

Sun may be finally showing support for open-source concepts with its TI-RPC release, but the company is still a long way from being perceived as an enthusiastic member of the open-source community, Raymond says. "Sun is deeply and annoyingly inconsistent. On one hand, they promulgate completely unacceptable licenses like the SCSCL, and then they come up with a maybe-acceptable license like this Industry Standards Source License."

Whether this license will encourage

Integrix UltraSPARC™ Servers have your number

7 x 24 x 365

RS480
4U, Ultra AXmp+, Redundant Power

RS450
Ultra AXmp+, Quad CPU support

iTS1100
Ultra AXi, NEBS Certified

RS280
2U, Ultra AXi/AXe, Redundant Power

All day, every day. Integrix UltraSPARC™ servers have the numbers your Network demands.

Small numbers: 2U to 5U 19"compact form factors for all internet applications.

Fast numbers: Support of up to four CPU's with top of the line processing speeds from up to 450MHz.

No numbers: Hot-swappable power supplies let you make changes with zero downtime.

Your numbers: The bottom line...Integrix servers are cost effective, flexible solutions from the Data Center to the Central Office.

Add it all up...Integrix UltraSPARC™ servers have your number. And they support Solaris and Linux applications. To find out more about how you can get the most computing power and highest density for the money, here's the only number you need: **800.300.8288.**

integrix®

www.integrix.com

Circle No. 3

the open-source community to warm up to Sun remains to be seen. As Tom Henkel, research director for Gartner Group Inc., a market research firm based in Stamford, CT, says, "Sun's image in the open-source community is one of great suspicion at this point."–*sjh*

New Services Bundled with Solaris 8

Formally released on January 26 in New York City, Solaris 8 includes a number of features designed to make Palo Alto, CA-based Sun Microsystems Inc.'s Solaris operating system more competitive on the high end. Three features in particular–automated dynamic reconfiguration, expanded hot-patching capabilities and Live Upgrade–are aimed at reducing downtime in mission-critical environments.

"Everybody worries about unplanned downtime. That's the ugly one that gets the press. But the bigger issue is planned downtime: 80% of total downtime happens to be planned downtime," said Anil Gadre, vice president and general manager of Sun Solaris software, at the Solaris 8 launch.

Live Upgrade, as its name implies, allows administrators to install and configure an upgraded operating environment image without bringing the system down. The new version of Solaris can be installed on a free disk partition, without necessitating any downtime, and then be activated at the next system reboot. "It means you can upgrade to Solaris 8 while the system continues to run. Just reboot once and you're up and running. You can [use the feature to] fall back to Solaris 7 as well," says Tom Goguen, group manager for Solaris at Sun.

Hot patching enables administrators to do emergency work on the kernel itself while the system remains active. "We don't recommend that you do this a lot, but it does help people get through critical situations and then plan some downtime later on," Goguen explains.

Dynamic reconfiguration, a feature from the mainframe world that Sun introduced with Solaris 7, has been improved to support multipathing and load balancing. It allows administrators to off-load a process from a faulty component and replace that component without shutting down the affected server. Dynamic reconfiguration now supports load balancing and dynamic switching of network paths to I/O controllers or network interface cards. Another, related feature that is new to Solaris 8 is automated dynamic reconfiguration, which enables administrators to instruct the system on what predetermined actions it should take when a hardware configuration or system event occurs, Sun says.

Jerry Trimm, chief technical officer of Polaris Service Inc., a UNIX and NT consulting and technical support company based in Marlborough, MA, believes the enhanced dynamic reconfiguration capabilities will be especially attractive to customers with 24x7 system demands. "If I need to add additional processors or memory (and I can't afford to bring the system down), by having dynamic reconfiguration I can just add those components in and bring them online. It never impacts my users."

With Solaris 8, Sun has abandoned its practice of selling extensions to the operating system, which provided extra functionality for extra cost.

Other additions to the Solaris 8 product line include improved Sun Cluster software with support for clustering of up to four 64-processor systems (with support for eight systems to be added later this year) and two systems management tools, Resource Manager and Bandwidth Manager. Resource Manager, originally part of the Solaris 7 Enterprise Server, has been upgraded and combined with Bandwidth Manager, a new product that enables network traffic to be prioritized based on user or application type. Bandwidth Manager prevents any one user or application from hogging network bandwidth, while Resource Manager does the same thing for system resources such as CPU and memory. "Resource Manager and Bandwidth Manager are really aimed at the future data center–that being some combination of the stability and long-term care you get in a traditional data center combined with Internet agility," Sun's Goguen says.

The availability of more sophisticated management tools like Bandwidth Manager and Resource Manager, plus other additions such as support for advanced Internet standards like IPv6 and IP Security (IPSec), Polaris' Trimm says, will make Solaris 8 attractive to customers. "Customers are interested in all of the capabilities of Solaris 8, and that's probably going to push it along a little faster. Not a lot of them made the jump to Solaris 7, but we may see 8 taking off a little bit faster," he says.

With Solaris 8, Sun has abandoned its practice of selling extensions to the operating system, which provided extra functionality for extra cost. While a few key products (such as Sun Cluster and Resource Manager/Bandwidth Manager) are priced separately, most of the functionality has been rolled into the basic platform. With Solaris 7, on the other hand, customers opted to buy one of three extensions: Easy Access Server, which offers administrative aids and Windows NT interoperability features; Enterprise Server, for mission-critical environments; and ISP Server, which offers services specific to the needs of Internet service providers (ISPs).

Features previously included with Enterprise Server have either been folded into the new operating system or, as in the case of clustering and resource management, made into separate add-on products. Easy Access Server has evolved into the Solaris 8 Admin Pack, which includes Solaris AdminSuite 3.0.1 (formerly Solstice AdminSuite) for administering distributed systems and Solaris Management Console 1.0.2 for configuring and administering Solaris servers. And the ISP Server extension has been replaced by a bundle of iPlanet software from the Sun-Netscape Alliance. Purchasers of Solaris 8 will now get iPlanet Directory Server and development licenses for iPlanet Web Server, iPlanet Application Server and iPlanet Webtop software copackaged with the operating system.

Rave Computer Association, Inc.

RAVE Systems

Best of both worlds -
Engine by Sun and Body by Rave

Rave Systems feature:
- Original Sun board platforms
- Original OEM interchangeable components
- Solaris operating system
- Certified technical support
- One year warranty

Additional Rave Services:
- Private labeling
- Flexible lease packages
- Technical support
- Extended warranty available
- On-site maintenance services
- Linux OS available

Sun AUTHORIZED VALUE ADDED INTEGRATOR · SOLARIS · ULTRASPARC DRIVEN

Rave Signature Series Systems feature Sun's latest UltraSPARC™ technology integrated into our multiple chassis options, and we use only quality components to build our systems. Every Rave Signature Series System go through extensive testing prior to shipment.

Our customers know that when they purchase Rave Systems from Rave Computer Association, they're getting quality and reliability inside and out. Call today at **1-800-966-7283** or send an e-mail to info@rave.com

Rave Computer Integrated Options - featuring integrated Sun boards
Redundant 4U Rackmount-AXmp
Redundant 6U RackMount-AXmp
Tower & Rackmount-UltraAXdp

Rave Computer Association, Inc.
1-800-966-7283

More information about Rave Computer Association and our Rave Systems can be found at: www.rave.net

Fax: (810) 939-7431 E-mail: info@rave.com
Leasing Available. Call 1-800-500-7283

UL · ISO 9002

Sun, Sun Microsystems, and the Sun logo are trademark or registered trademarks of Sun Microsystems, Inc., in the United States or other countries. All other trademarks are the property of their respective companies. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. in the United States and other countries. Products bearing SPARC trademarks are based upon an architecture developed by Sun Microsystems, Inc. All other products or service names mentioned herein are trademarks of their respective owners.

Circle No. 13

Tom Henkel, research director for Gartner Group Inc., a market research firm based in Stamford, CT, thinks the dropping of Sun's three extensions to Solaris, which could be potentially difficult for customers to adjust to as they migrate up to Solaris 8, will be generally good news in the long run. "It holds the prospect for a more stable product looking forward," he says.

Overall, however, Henkel doesn't see it as having a radical impact on Sun's position in the UNIX marketplace. "Sun has been on top for some time and I'm not sure Solaris 8 dramatically changes the landscape. Sun is obviously making some enhancements aimed at tuning the product to improve performance. But I didn't see anything in there that dramatically moves the ball forward," Henkel says.

Solaris 8 costs $75, with the Resource Manager/Bandwidth Manager add-on priced starting at $4,000 and Sun Cluster software priced starting at $2,000. More information is available at Sun's Solaris Web site (`http://www.sun.com/solaris`).–*sjh*

Jiro Manages Storage

Storage area networks (SANs) promise to enable companies to consolidate multiple storage systems, which would simplify management and improve performance. While those benefits are enticing, the technology is now just emerging and corporations are finding a dearth of SAN management tools, as well as standards to collect performance data from different vendors' storage products.

At the end of January, Sun Microsystems Inc., Palo Alto, CA, unveiled its plans to help customers address those issues. The company announced Jiro, a set of Java Application Programming Interfaces (APIs) designed to ease communications among applications, services and devices on heterogeneous networks. Jiro is part of Sun's Federated Management Architecture (FMA) specification, which features source code that allows developers to create interoperable, distributed and automated SAN management applications.

Sun also made its Jiro Technology Developers Release software available to third parties for building management applications that help customers configure, monitor, diagnose and troubleshoot network devices, systems, storage and applications in an automated fashion. The Sun software defines basic management services such as events, logging, scheduling, transactions and security. Sun says it is attacking a problem area for customers. "While SANs offer customers tremendous benefits, they are not easy to deploy and manage," says Denise

Move Over X, Here Comes Citrix for UNIX

The world of Windows-based terminals has finally come to UNIX. In January, Citrix Systems Inc., Ft. Lauderdale, FL, unveiled a Solaris version of its flagship MetaFrame product for serving up applications to PCs, workstations and handhelds via the company's Independent Computing Architecture (ICA) client protocol. In the same way that MetaFrame for Windows enables remote access to Windows applications running on a central server, MetaFrame for Solaris will now allow clients to access server-based Solaris applications.

According to Andy Poulter, product manager for Citrix, initial purchasers of the new product will likely be current MetaFrame for Windows customers who have both Windows and UNIX systems in their organizations. "They may have some UNIX in their environments and want a consistent way to get to them," says Poulter, adding that he expects pure-UNIX customers to follow. "[Existing customers] will latch onto it first because they know Citrix and they know our product set. I think people in a straight UNIX environment are more likely to come onto it if they want to be able to diversify their client platform. They may have a lot of people who don't need a full UNIX workstation on their desktop, where a PC would be more appropriate. We give them a very effective way of getting back to the UNIX environment from that PC."

The Solaris version will soon be followed by other UNIX versions, Poulter says. "We're going to work on a range of platforms. All the ones we support with ICA clients we're considering as possibilities for MetaFrame for UNIX." MetaFrame clients currently exist for a range of UNIX platforms, including Solaris, Tru64 (formerly Digital UNIX), HP-UX, AIX, IRIX, SCO UNIX and Linux.

MetaFrame for Solaris, like its Windows cousin, also includes a number of administrative functions such as load balancing, session shadowing (in which tech support staff can monitor and, if need be, take control of a remote user's session) and application publishing features for deploying and updating applications across an enterprise from a central point.

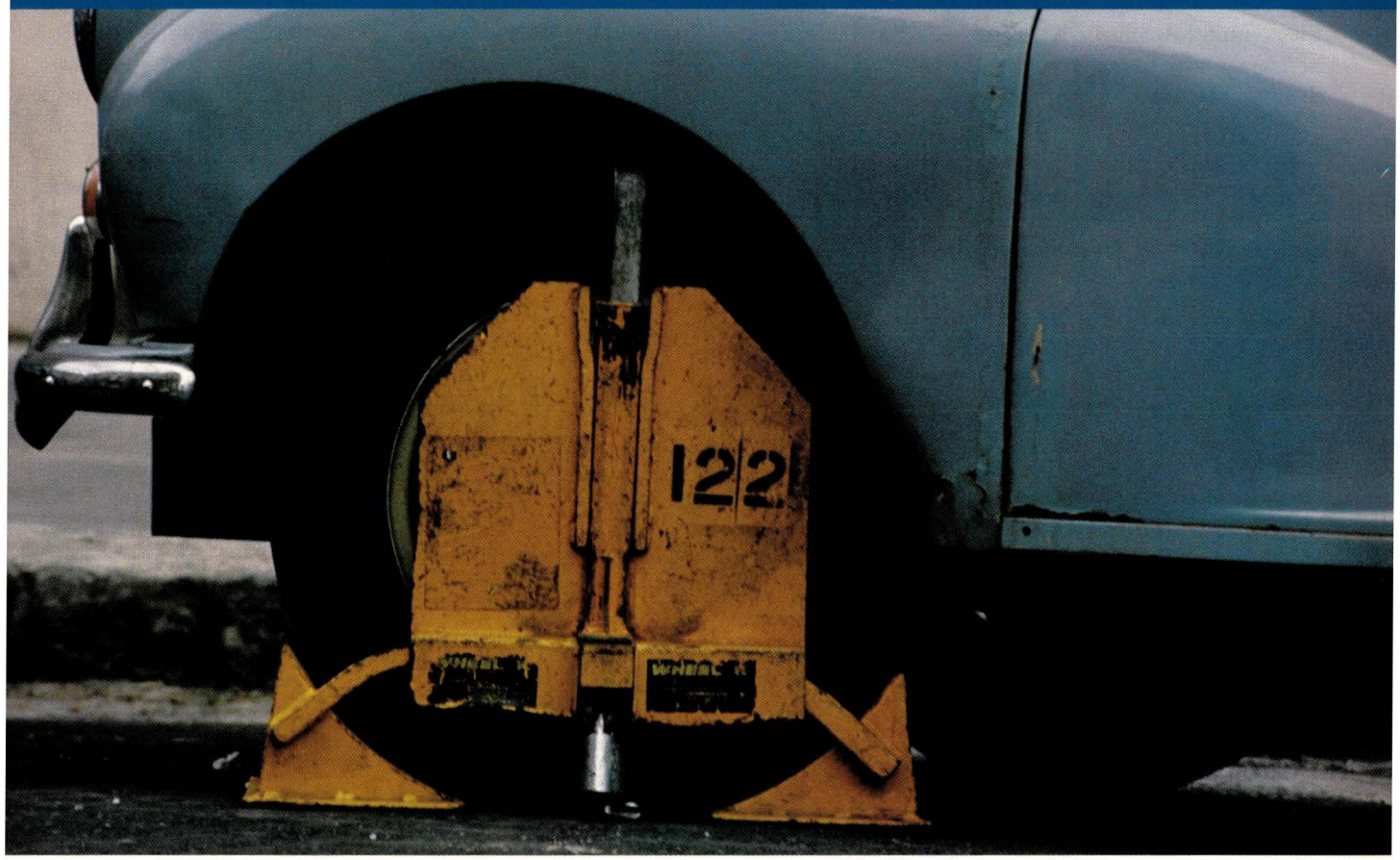
How much impact will a UNIX MetaFrame have on X Window, the traditional method by which UNIX applications are served up to workstations and PC clients? Not a lot, at least in the short term, says Greg Blatnik, managing director for Zona Research Inc., a Redwood City, CA-based market research firm.

"Applications have a real long half-life and they tend not to disappear in a very rapid fashion. People have made investments in development and modification, so I don't think the application base [for X] will necessarily disappear. But I do think that ICA will be an attractive alternative to the X-based protocol," says Blatnik. "For one thing, its performance is probably going to be better overall than the performance you would typically see with X applications, particularly over low-speed lines, which can exist if you're working remotely. ICA was designed to require a small amount of bandwidth."

According to Citrix's product literature, the ICA protocol was designed to operate over connections as low as 14.4 Kb/s by transmitting only minimum amounts of data, such as mouse clicks, keystrokes and screen updates. That low-bandwidth feature is likely to appeal particularly to application service providers (ASPs) who are using MetaFrame to distribute Windows applications to remote customers and can now branch out into UNIX applications as well, Blatnik says.

Pricing for MetaFrame for Solaris was not available at the time of writing, but Poulter says it will be similar to that of the Windows product. MetaFrame for Windows 2000 costs approximately $5,000 for a license with 25 concurrent ICA clients.–*sjh*

What's stopping you from making more money?



Reliable AXmp+ embedded server solutions from Sun Microsystems and Bell Microproducts keep network traffic zipping right along.

Every time a system goes down, so does profitability. That's why it's important to call Bell Microproducts — the premier distributor for Sun Microsystems' reliable SPARCengine™ ULTRA™ AXmp+ motherboards.

The ULTRA™ AXmp+ features a whopping 4GB RAM capacity — twice that of the original AXmp — to give plenty of headroom for running more revenue-generating applications. What's more, the extremely reliable combination of SPARCengine™ processors and the robust Solaris™ operating environment keeps those valuable applications up and running. Add to that the scalability of four-way multiprocessing, the cost-effectiveness of PCI-bus compatibility, and the convenience of a standard, 19-inch rack-mount format and you have a solid foundation for embedded applications.

Thanks to our strategic partnership with Sun Microsystems, Bell Microproducts can deliver ULTRA AXmp+ embedded server solutions any way you want — components, kitted, or integrated solutions.

The Sun Microsystems SPARCengine™ Ultra™AXmp+ Motherboard

So call us now at (877) 919-BELL (2355) and ask for the AXmp+. You'll receive a FREE gift and be eligible to win a Sun Microsystems workstation (a $10,000 value)! You can also register online at www.bellmicro.com.

Sun microsystems

© 1999 Bell Microproducts, Inc. and Sun Microsystems, Inc. All rights reserved. Sun, Sun Microsystems, the Sun logo, Solaris, and Ultra are trademarks or registered trademarks of Sun Microsystems, Inc. in the United States and other countries. All SPARC trademarks, including the UltraSPARC Driven logo, are used under license and are trademarks or registered trademarks of SPARC International, Inc. in the United States and other countries. Products bearing SPARC trademarks are based upon an architecture developed by Sun Microsystems, Inc. All other product and corporate references may be trademarks or registered trademarks of their respective companies.

For more information

call 877-919-BELL (2355)

or visit us at www.bellmicro.com

BELL MICROPRODUCTS

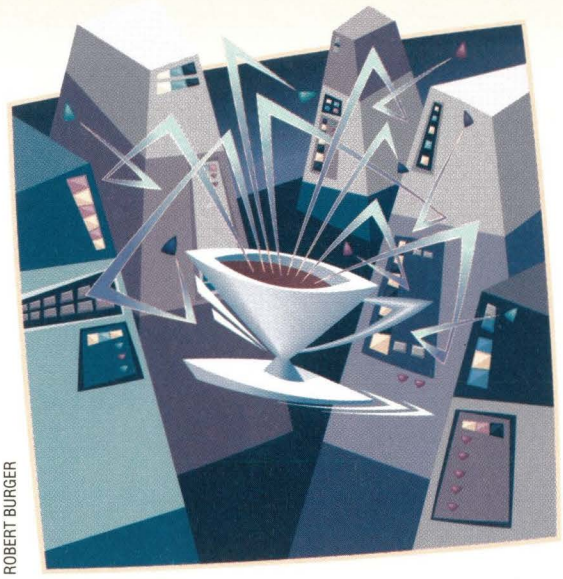
Circle No. 5

Shiffman, vice president of marketing for Sun Network Storage at the company's Menlo Park, CA, office.

Storage management is becoming a significant problem for many companies. Corporations involved with Internet commerce and systems such as data mining now see their data requirements increasing at an explosive rate. The data deluge means companies must regularly add more storage.

Traditionally, corporations managed storage in an autonomous manner, adding storage to overworked servers. SANs offer corporations server-independent, scalable, centralized storage systems by moving a company's storage components from individual servers to a separate dedicated network. On a SAN, a dedicated server usually controls all storage devices and acts as a gateway between an enterprise network and storage subsystems.

SANs enable companies to centrally manage pools of storage that can be allocated among multiple servers and scale as needed. Also, a company can better allocate its available storage. A firm may have spare storage space in one area but be short in another. In a SAN, all the resources become a pool that's assignable to individual systems with minimal user interaction.

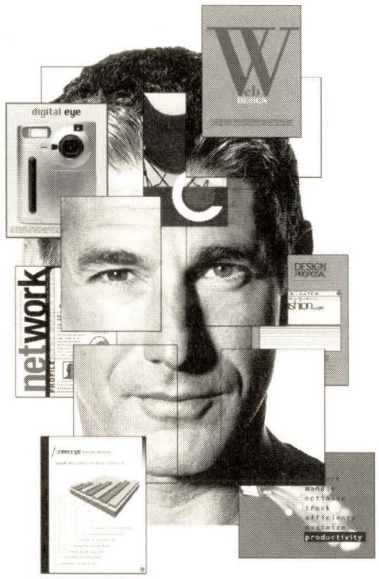


ROBERT BURGER

Companies often use SANs for backup applications because they offer a good way to keep massive, streaming amounts of traffic from clogging a network. By building a separate network for storage and backup, a production network is free to support server-to-client and server-to-server transactions.

To date, storage vendors and the makers of host bus adapters, switches and hubs have relied on proprietary products to connect different SAN components. While current SANs can interface with servers running a variety of operating systems, there is little or no interoperability on the storage side. "To build a multivendor SAN now requires that the user do a lot of the integration work itself," says Michael Adams, industry analyst with Giga Information

Ideas like his deserve a printer like ours.



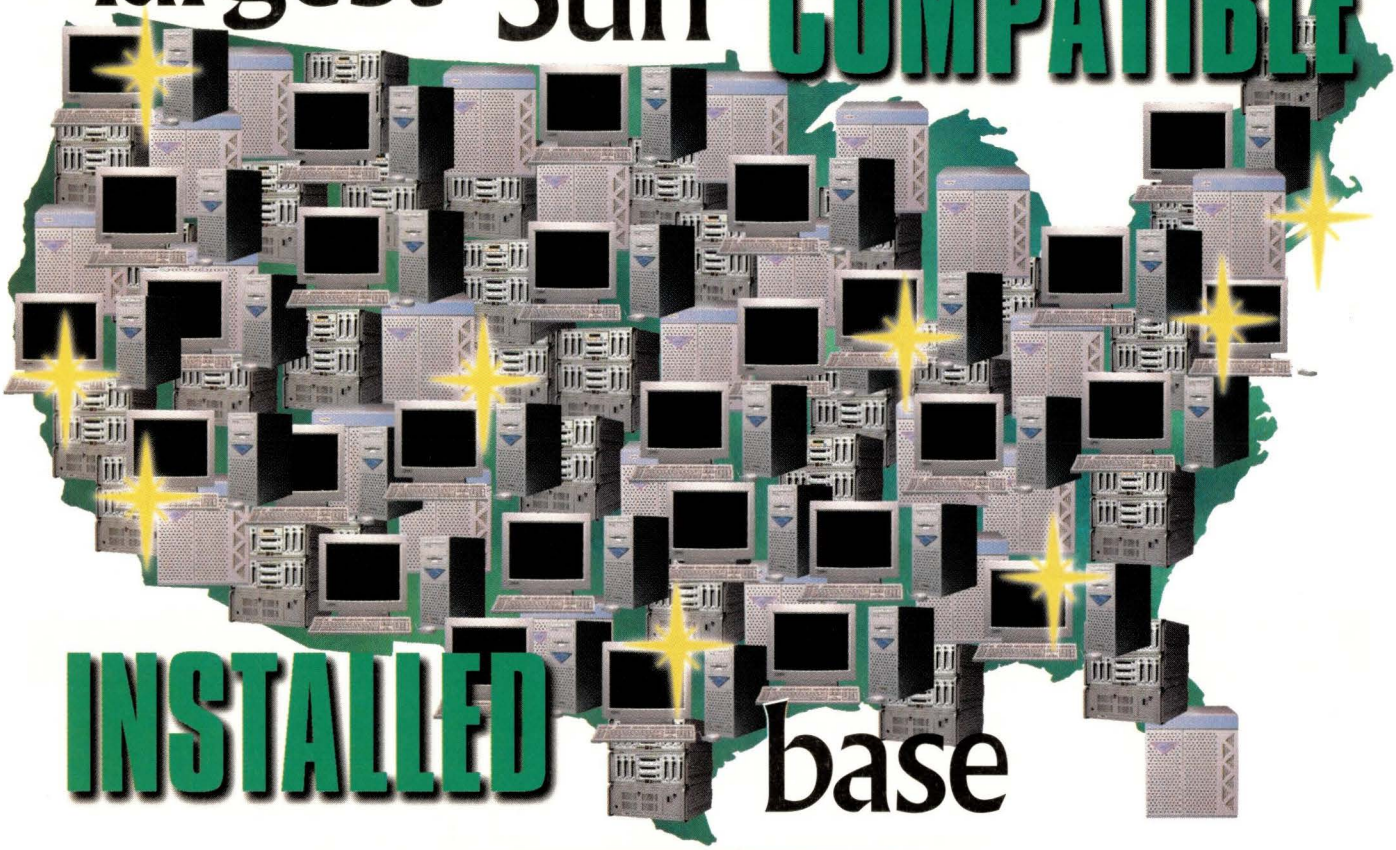
The new Solaris™ Ready Printers from Lexmark.
Your ideas never looked so good.

Visit www.lexmark.com/solaris for a special offer on Solaris Ready Printers from Lexmark.

SOLARIS READY

Circle No. 6

largest Sun® COMPATIBLE INSTALLED base



Single, Dual or Quad Processors

SERVERS

And the numbers just keep on growing. Tatung has 10's of thousands of high quality workstations, servers and storage systems installed across North America and is second only to SUN in SPARC-based computing.

ULTRASPARC™ DRIVEN

SPARC Compliant SCD 2.1

All Tatung systems are manufactured in the U.S. and are available across the country from our regional sales offices.

WORK STATIONS

Rely on Tatung for a broad line of powerful workstations and servers that use the latest in 100% Sun UltraSPARC microprocessors and are priced less than comparable Sun systems.

Visit our web site www.tsti.com or call 1-800 659-5902 today for the nearest office and we will power up a system for you.

Desktop and Rackmount Solutions for Commercial and Industrial Applications

Tatung's full line of UltraSPARC workstations, servers and storage.

TATUNG®
SCIENCE & TECHNOLOGY, INC.

The Intelligent Choice in SPARC Computing Solutions

Phone 1-800-659-5902 or (408) 383-0988
email — mkt@tsti.com
website — www.tsti.com

©1999 Tatung Science and Technology, Inc. All trademarks are property of their respective owners. 18GDA

Circle No. 7

Group, a Cambridge, MA-based market research firm.

The Jiro APIs will help address that problem, Sun says, and make SAN products more plug-and-play. Sun worked with a handful of third parties, including Veritas Software Corp., Mountain View, CA, to develop FMA, and is now soliciting third-party support for its interfaces.

Yet, Sun isn't alone. The Storage Networking Industry Association, a vendor consortium with 135 members, including Sun (`http://www.snia.org/`), has also recognized the need for SAN standards. The group selected the Common Information Model (CIM) specification from the Distributed Management Task Force as the foundation for its Internet Enterprise Storage Resource Management (ESRM) standard. SNIA's first prototype application, which was unveiled in October, was an interactive browser-based ESRM application that performed some basic capacity and asset management functions.

Sun's Shiffman does not see a conflict between Jiro and ESRM. "SNIA's standards are concerned with how management applications access information; Jiro provides a complete framework so third parties can build SAN management systems," she says.

Giga's Adams is not so sure there are clear-cut distinctions. "While Jiro will benefit companies with Sun servers, I'm not at all convinced that it will be implemented on EMC, IBM, or HP storage products," he says.

How widely adopted the various standards initiatives will be should become clearer during the year. ESRM-compliant and Jiro-based products are expected to arrive by mid-2000. "Once users have the tools to manage their SANs, I expect rapid adoption of the technology," predicts Sun's Shiffman.–*paul korzeniowski, freelance writer*

Mission-Critical Linux

Linux aficionados can find a Linux port for just about every type of client and server hardware on the market. And now there's even one for big iron mainframes. Late last year, IBM Corp.,

Email on the Airwaves

The Sun-Netscape Alliance, Mountain View, CA, is aiming for a piece of the nascent wireless Internet access market. In January, it unveiled a new wireless access server for Internet service providers (ISPs) and companies looking to offer wireless access to mobile workers and others who need an alternative to line-based Internet service.

Founded last year by America Online Inc., Dulles, VA (which purchased Netscape Communications Corp. in March 1999), and Sun Microsystems Inc., Palo Alto, CA, the Alliance has a portfolio of iPlanet solutions that includes Internet billing and payment software, Web and application servers, and software for messaging and directory services. This newest addition, the iPlanet Wireless Server, is an application that allows businesses to deliver email, calendar and messaging access to wireless devices via standards such as the Wireless Access Protocol (WAP) and Handheld Device Markup Language (HDML). The application can also sense what type of device is being used and dynamically customize the information to fit the appropriate screen size and user interface.

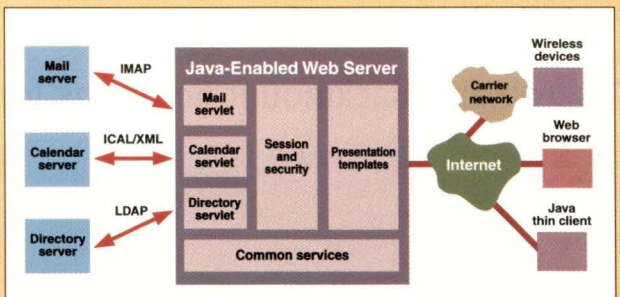
Because the software relies on eXtensible Markup Language (XML) style sheets to describe device requirements, it can be made to support new devices very quickly. The server acts as an intermediary between wireless networks and the Internet, translating XML, Internet Messaging Access Protocol (IMAP) and Lightweight Directory Access Protocol (LDAP) data from back-end mail and directory servers, and sending that data to WAP and HDML gateways. The gateways, in turn, send it to the user's handheld device. The wireless server, which is priced at $7 per registered user, is designed to work with the iPlanet Messaging, Calendar and Directory servers.

According to Korak Mitra, vice president of messaging and collaboration products for the Sun-Netscape Alliance, the iPlanet Wireless Server is aimed specifically at service providers, companies with large numbers of mobile workers and content portals that wish to sign up subscribers by offering unique services.

Wireless access is a market that International Data Corp., a market research firm based in Framingham, MA, has predicted will take off in 2001. Overall, the number of wireless Internet users is expected to increase from 7.4 million in 1999 to 61.5 million in 2003 in the United States alone, according to IDC.

Vernon Turner, vice president of worldwide commercial systems and services for IDC, says wireless access is an important component of Sun's Internet strategy. "Today [Sun is] well-equipped to manage the wired phase of the Internet. However, the second phase is clearly wireless, which has a huge potential outside the U.S. market, where wireless is much more advanced. To Sun, wireless is the second wave of the ISP opportunity."

Despite the fact that Sun is one half of the Sun-Netscape Alliance, Sun's Solaris isn't the only platform iPlanet products support. The Alliance recently announced that it would be expanding the number of iPlanet products that support the IBM Corp. AIX operating system. By the end of the first half of this year, AIX versions of the iPlanet Application Server, Calendar Server and Certificate Management System will join existing AIX releases of the iPlanet Web Server, Messaging Server and Directory Server. Other assorted e-commerce applications, such as those for corporate procurement, billing and merchandising, will also be ported to AIX.–*sjh*



The new iPlanet Wireless Server allows businesses to deliver email, calendar and messaging access to wireless devices.

Source: Sun-Netscape Alliance, Mountain View, CA.

From 20 to 200 servers, only a scalable Power Array™ gets reliability done *right*

APC Symmetra® Power Array™: N+1 redundancy for 100% uptime

Data access is critical to both your internal and external customers. Now that applications like messaging, Web integration and E-commerce are deemed mission-critical, losing power to your storage and processors is not an option.

You need to be ready for the unexpected. APC's Symmetra Power Array is the single most highly available UPS in the marketplace. Since power problems are the leading cause of downtime, make sure you're prepared.

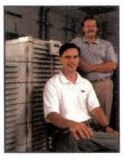
Consider how Symmetra protects your business:

- **N+1 redundancy design assures continuous availability** – If a module fails, the others instantly begin supporting the full load.
- **Scalable power** – Additional 4 kVA modules can be added to expand to 16 kVA of power capacity (4 unit frame is expandable to 8 kVA)
- **Serviceable while load is up and running** – Additional battery modules increase runtime and all the modules are hot swappable, meaning no downtime.

Now you can easily manage power to your systems. APC MasterSwitch™ in your communications and computer racks can save you time and money by helping your staff to manage power proactively.

PowerView™ is a hand-held control panel for network administrators that configures and controls UPSs in rack, computer room, and datacenter environments.

Installing or reconfiguring your modular Power Array couldn't be any simpler.



"Not having a Symmetra in place would have resulted in lost data, corrupted hard drives and lost time to recover. The Symmetra system has more than paid for itself during this one outage."

- Bob Lesher and Charlie Bise, Information Technology, Exel Logistics

APC is a leader in the field of power availability. Our technology grows with your business and can help power protect your new applications as you roll them out. Contact APC today and let APC's Legendary Reliability™ work for you.

APC Symmetra® Power Array™ was recently granted US Patent No. 5,982,652.

APC®
Legendary Reliability™

Enter to WIN A FREE Symmetra Power Array. Register now. All entrants will receive a FREE Power Availability Kit.

To order: Visit *http://promo.apcc.com* Key Code s477z • Call 888-289-APCC x1535 • Fax 401-788-2797

©2000 American Power Conversion. All Trademarks are the property of their owners. SY4A9EF-USc • PowerFax: (800) 347-FAXX • E-mail: apcinfo@apcc.com • 132 Fairgrounds Road, West Kingston, RI 02892 USA

Circle No. 8

Armonk, NY, ported the open-source operating system to its S/390 enterprise servers. Customers can now run Linux in one partition of the machine while the traditional OS/390 operating system runs in another.

"It's targeted initially at current 390 customers who have a need for network consolidation," says Daniel Frye, program director for Linux technology and strategy at IBM.

While Linux on the mainframe isn't on everyone's "must-have" list, the announcement points to an increasing effort to push Linux up the ladder into more mission-critical, enterprise-level environments. A MERIT (`http://www.meritproject.com/`) survey of IT professionals at the 1999 annual Computer Associates International Inc. user conference held in New Orleans found that 49% of respondents rated Linux as "important to essential" to their enterprise computing strategies and that 40% had plans to deploy Linux in network management applications, while 39% planned to use Linux for database management.

Linux is rapidly evolving and more vendors are stepping up to bat with software solutions to make Linux more scalable, available and reliable in the enterprise.

But is Linux ready to take on such high-end tasks? Not quite yet, says Bill Claybrook, research director for Linux and UNIX platforms at market research firm Aberdeen Group Inc., Boston, MA. "The hype for Linux is about 12,000 miles ahead of where it's really at."

Linux, says Claybrook, still lacks a few key features needed to make it a truly enterprise-class operating system. For one thing, there aren't many Linux-based, enterprise-class systems management tools. "Linux is just starting to get vendors who have tools for systems administration," he says. "If I move five or six Linux boxes into an installation that's currently running NT and UNIX, I want to be able to use the same systems management tools and the same backup-and-recovery tools that I'm using on NT and UNIX. And Linux right now is sort of lacking in that area."

Linux will probably catch up to the systems management capabilities of commercial UNIXes within a year or so, Claybrook says, as vendors like Computer Associates begin moving their systems management tools to Linux. Computer Associates' ARCserveIT backup-and-restore software was ported to Linux in December.

The Linux community also falls short in terms of high-availability solutions such as clustering, says Claybrook. "One of the limitations of Linux on the enterprise is its high-availability requirements. There are [vendors] working on clustering solutions, but none of them are at the level you think of in terms of true clustering capability. They can do failovers and some form of load balancing, but for the most part, they're not at the same level that UNIX clustering is," he says. Some of the functionality missing from current Linux clustering solutions includes single system image, cluster file systems and journaled file systems. Other clustering solutions, such as the Beowulf Project clusters (`http://www.beowulf.org/`), are aimed more at clustering for performance and workload sharing rather than for high availability and fault tolerance.

A 1999 report entitled, "Linux: How Good Is It?" from D.H. Brown & Associates Inc., Port Chester, NY, supports Claybrook's position. The report's comparison of leading Linux and UNIX platforms faulted Linux for not having sufficient high-availability clustering capabilities, journaled file systems (which keep a log of activity for backup and recovery purposes), logical volume managers and support for large files. The report did credit the operating system with having made progress in the areas of remote systems management and technical performance clustering for scientific applications, however.

But what Linux lacks today, it may have tomorrow. Linux is rapidly evolving and more vendors are stepping up to bat with software solutions to make Linux more scalable, available and reliable in the enterprise. Some recent examples:

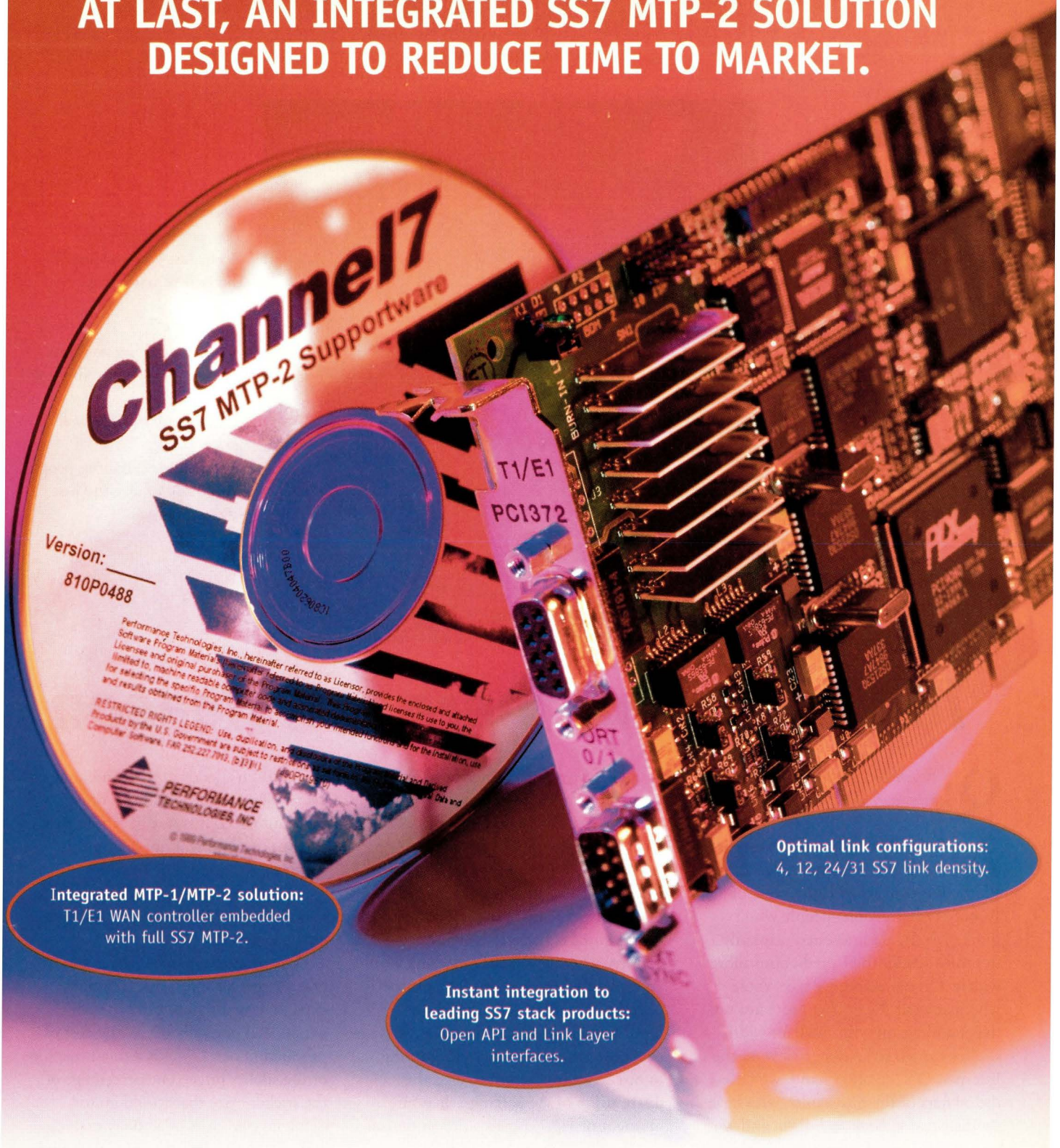
- Veritas Software Corp., Mountain View, CA, announced in January a Linux strategy and road map that includes a Linux port of its Veritas Volume Manager, Veritas File System, Veritas Cluster Server and Veritas NetBackup Server.
- Linux distribution vendor TurboLinux Inc., San Francisco, CA, in January unveiled its new enFuzion clustering technology, which features support for clusters with hundreds of nodes and offers automatic failed job rescheduling, load balancing and resource sharing.
- SGI, Mountain View, CA, introduced in January the SGI Advanced Clustering Environment (ACE) for Linux, aimed at compute-intensive environments in education and research, energy and electronic design automation.
- MTI Technology Corp., Anaheim, CA, announced in February that its Vivant enterprise-class storage solutions will now support Linux.
- The Trillion Project, an effort by a coalition of vendors to create a 64-bit port of Linux for the forthcoming Intel Corp. Itanium chip, plans to comlete a final version later this year. It will include support for high-end capabilities such as clustering, large file systems and performance monitoring.

While SGI's ACE product won't offer high-availability features such as single system image, Joseph Wei, director of marketing for Intel and Linux servers at SGI, says the company is also planning to port its IRIX-based IRIS FailSafe clustering product for high-availability environments to Linux. And SGI has already put its XFS journaled file system technology out into the open-source community.

"When you talk about single system image and clustered file systems, you have to remember that some of these technologies now available on high-end UNIX systems took years to develop and to get to a state of maturity and stability," says Wei. "The momentum for Linux only picked up 12 to 18 months ago, and it is already maturing at a fast pace."

IBM's Frye agrees, "There are a number of challenges to making Linux a full enterprise OS. It's not there today. But over time it may well be. And having customers use Linux on platforms like the 390 will help accelerate that maturation."–*sjh*

AT LAST, AN INTEGRATED SS7 MTP-2 SOLUTION DESIGNED TO REDUCE TIME TO MARKET.



Channel7™ from Performance Technologies is a fully-integrated hardware/software solution that delivers maximum performance, configurability and scalability. And our established relationships with leading SS7 stack vendors result in shorter development times and faster time to market.

PTI has equipped more SS7 systems than any other WAN OEM provider in the world. Our proven reputation for delivering innovative SS7 solutions to the world's leading telecom equipment manufacturers continues to grow with Channel7.

PERFORMANCE TECHNOLOGIES, INC
Connectivity Solutions for the 21st Century

e-mail: Channel7@pt.com • www.pt.com • 716-256-0200

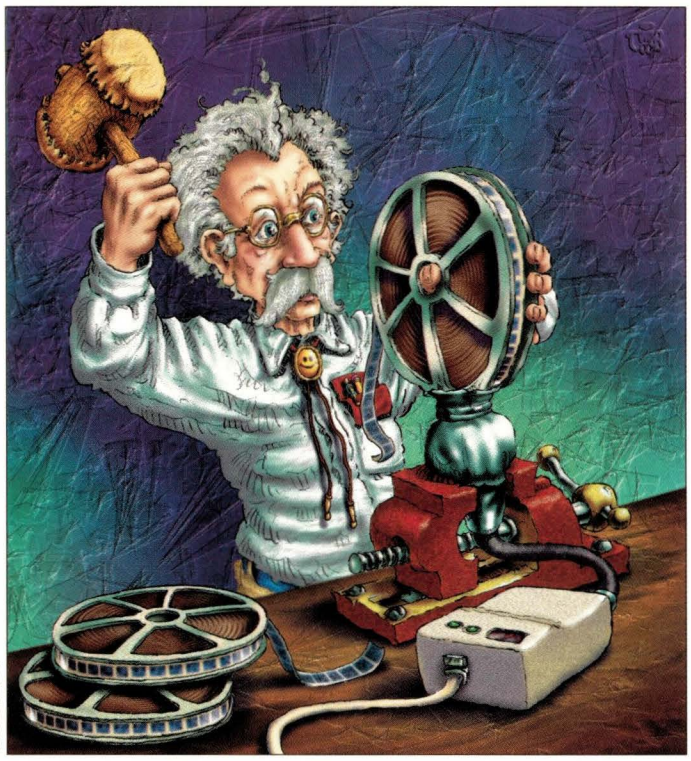
Ask about our Channel7 Partner Program

Channel7 is a trademark of Performance Technologies, Inc.

Circle No. 9

Ask Mr. Protocol

by Michael O'Brien



TOM BARRETT

"Network Congestion–buffering."
– The last you ever see of that video news story

"<Silence>"
– The only thing you hear from that Internet radio link

"America Online Acquires Time-Warner."
– Headline describing people who don't believe the first two quotations

To Every Link there is a Reason

Q: *When do I get to watch feature films over the Internet?*

A: Soon. The only interesting part about this question as far as Mr. Protocol is concerned is the value of "soon." Other people–people who, unlike Mr. P., are interested primarily in profit–scatter their predictions more widely. On one hand, we have those who just want the pocket protector set to get a move on with the bandwidth so they can go sell pay-per-view on the Internet. On the other hand, we have the owners of the film vaults, who have product dating back to Edison and who aren't letting go of a thing until they can be guaranteed a way to protect their interest in their own property. To date, this has already led us to situations ranging from baroque to looney.

On the baroque side, we have such technomarvels as the late and only somewhat lamented DIVX format for distributing films on hard copy. This format led to the creation of movies that could be viewed only once or a limited number of times, then you threw the media away. On the looney side, we have Norwegian police raiding the home of a 16-year-old for reverse-engineering the encryption used in the DVD format. This is looney, at least on the surface, because Norway is a country where reverse-engineering is an explicitly legal activity. The source code for the program in question, DeCSS, was introduced into a U.S. court by copyright owners attempting to obtain an injunction against the distribution of the software. In a rare moment of legal comedy, they forgot to put the filing under seal, so the source code was available not only on various Web sites not under U.S. jurisdiction, but also down at the courthouse, for anyone who wanted to look at it.

Not only is the cat out of the bag on this one, the cat is still flying through the air, claws outstretched, raking everyone in its path and heading for an uncertain landing. No doubt, in the two months this column spends in the chute, one or even several more acts in this drama will have unfolded. It is nearly certain that the final curtain will not fall on this spectacle for some time to come.

Why should we care what people do about playing DVDs? Mr. Protocol is glad you asked.

The production of DVDs is a moderately expensive process. It's not as expensive as the store prices of DVDs would lead one to believe. The cost of production of a DVD is a small fraction of the sticker price. The percentage of the sticker price that would go to defraying the costs of actually making and advertising the movie is much higher, or at least it would be, if it weren't for the fact that movie studios uniformly spread the profits from their actual moneymaking movies around among all the projects that never even make it to the theater, let alone those that never recover all their costs. It resembles schmear more than money. The sticker price is not actually based on the cost of

RADWARE – Served At The World's Finest Networks

The Web Server Director (WSD) family of products – premier products in global Internet traffic management.

Today you may have one Internet location and tomorrow 100. Make sure the traffic management solution you pick can grow with your network. RADWARE's award winning load balancers are optimized for global as well as local traffic management.

Products like the Web Server Director (WSD) add scalability, optimize use of your resources and provide fault tolerance to any local or global server farm. For the best in Internet traffic management, always ask for RADWARE.

U.S.A. Offices: RADWARE Inc. Toll free: 1-888-234-5763 e-mail: info@radware.com
International Headquarters: RADWARE Ltd. e-mail: info@radware.co.il

http://www.radware.com

Always On-Line

RADWARE

Circle No. 10

production of either the physical product or the information on it (the movie). It is based on an attempt to maximize the sticker price times the number of people willing to buy it at that price. The logical extreme would be to make movies solely for some crazy old goat with $100 billion to spend and no sense, and charge him $350 million for the one copy of the movie that gets sold. If there were a way to advertise this in such a way as to actually hit that target, and be sure the old goat liked the film, we wouldn't have any movies available on DVD for the general public, or in any other format for that matter. Only the uncertainty of hitting that magic target precludes this. The very rich do have entertainments not shared by the rest of us.

But why bother with pressing DVDs at all? The ideal scenario would be to keep the copyrighted information safe on a corporate server and download it on demand. The corporate server controls whether or not the downloading operation takes place, so the finances are secure. The only thing that prevents this is that, right now, there is no delivery system that would allow it. What's more, such a delivery system is not on the near horizon, as the popular press would have you believe.

Mostly, it's a matter of quality. This is a murky area, just like the postage stamp–sized streaming video available to dial-up users. Streaming video gets much, much better with a cable modem connection, but it is still nowhere near as clear as the image on a regular television set. And remember, a television image, even at the higher resolution of the PAL or SECAM formats, isn't nearly as high-resolution as a computer monitor. That's why the TV Typewriter, from way back in the early days of personal computing, was just about the last of its kind. This means that if we were able to show a movie with the full resolution of current monitors, we'd have something gorgeous. It's this idea that has many a start-up pumping venture capital dollars down the well, trying to make this a reality. Unfortunately, that reality isn't here yet, and there are several problems to be overcome before we get *Notting Hill* on the computer monitor.

Oh no, not Bandwidth Again!

First, there's bandwidth. The fastest speed currently available for home use that's within the ballpark of being reasonably priced is 1.5 Mb/s inbound, with roughly 256 Kb/s outbound, via cable modem. Digital Subscriber Line (DSL) service is distinctly in second place in the market, as a late arrival. However, telephone companies are making DSL service available at a greater rate than cable television companies are rolling out Internet service. Also, cable modem companies are beginning to demonstrate that they have poured their dollars into expanding their service areas at an early stage, rather than improving infrastructure in their existing areas as customer density grows. Most cable modem areas hit a "knee" in service quality after about a year, where download rates suddenly vary wildly and packet loss rates skyrocket. There is no similar groundswell of complaints from the DSL customer base, though a fair percentage of their number seem to come from the ranks of disaffected ex-cable modem subscribers. And while DSL advertises rates "beginning at" about the same cost as a cable modem and advertises speeds "up to" those of a cable modem, you don't get both at once. The speed offered by DSL at the cable modem price point is only a fraction of the cable modem's speed, and getting a DSL connection that's the same speed as a cable modem costs the moon.

The problem is that the top 1.5-Mb/s speed of a cable modem service, even during the early days when the nominal and actual download speeds are within shouting distance of one another, isn't enough to display a high-quality, real-time movie. A five- to tenfold increase in available bandwidth might be enough, given adequate compression, but that's not a data rate that's being rolled out to any but the most exceptional of homes. DSL may reach those speeds eventually, though there is likely to be trouble obtaining that sort of performance over the existing copper wiring in the "local loop" connection between the telephone

The holidays are coming...what to get those precious grandkids? Maybe some futuristic, high-tech gizmo. Or the latest craze. Then suddenly you flash on your favorite Lionels and you know the time is right

So you opened the carton where they've been for years and painstakingly cleaned every part. You rewired, added new track and bought some cool accessories. And when at last you pushed the throttle, the locomotive started smoking...better than it used to.

Ah, the toys ofchildhood...lovingly restored to absolute perfection. A gift they'll treasure. A family tradition.

That's how we feel about computers.

New isn't always better.

Get on the fast track to performance and savings

Many of today's leading companies are using our Repowered computers every day in mission critical applications. Because they perform as good – or better – than new. Because they are backed by a totally risk-free guarantee. And because the savings are substantial...regardless of your current discount! So make tracks to our website and discover the savings for yourself.

Click on www.radiantresources.com for aggressive pricing, net specials - and the chance to configure and instantly price systems that will travel with you into the future.

Look who's Repowering with Radiant

If you want to know how reliable our computers are, just ask the companies using them in production environments – large telecommunications companies, internet service providers, brokerage firms, online stock trading and quotation services, web hosting and development companies... and, would you believe – a disaster recovery company!

So don't get railroaded into always thinking new. 'Cause like the workhorse performance of our 1937 Lionels, new isn't always better – especially when it comes with our better-than-new, best-in-the-industry Radiant guarantee. And a high-speed ticket to spectacular savings!

Call Toll-Free–800-500-7675

Radiant Resources, Inc.

Repowered Computers For The Next Generation

1913 Atlantic Avenue, Suite R-3
Manasquan, NJ 08736
973-442-5555
Fax: 973-442-5550
www.radiantresources.com

Major Credit Cards Accepted.

Circle No. 12

central office and the subscriber's house. Cable modem companies are liable to have to rework most or all of their infrastructure to do it.

In the earliest days of cable TV, the body that laid out the standard for inline cable amplifiers specified that these amplifiers should allow two-way traffic on the cable, foreseeing the day when a high-speed, two-way data pipe to people's houses would be a good thing. The cable companies uniformly said, "Yeah, right!" forcing the standards body to include an addendum stating that one-way amplifiers also met the standard, and then built about a million miles of one-way cable. They've been installing "just good enough" material ever since. For example, coaxial cable is supposed to have a shield around a central conductor. In the ideal, this shield is a solid piece of metal. For practical purposes, it's often a thick braid or mesh of metal. If one examines the coaxial cable used to connect your house to the cable drop on top of the pole in the back alley, one will find that the braid in that cable has the density of a fishnet stocking: it's barely there at all. The high signal loss of this kind of cable makes it "just good enough" to get a readable signal to your house. It's useless for data.

The typical cable modem installation requires replacement of the cable leading from the pole to the house to get a high enough quality connection for data. That the cable connection from the back of the house to the cable modem inside is prominently labeled "DATA" should come as no surprise–the data gets the good stuff and the TV makes do with the bad stuff. This "just good enough" policy means that most or all of the cable infrastructure will have to be replaced before cable companies can deliver high-speed data to the house.

A bigger impetus than the Internet may lead them to do just that, however. The data requirements of High-Definition Television (HDTV) are considerable. This, more than the Internet, will be the driving force behind any upgrade in speed of the cable modem networks. Because the Federal Communications Commission mandates the cutover from today's National Television Standards Committee (NTSC) broadcast standard to the new digital HDTV broadcast standard, the cable television networks will be forced to follow. HDTV already consists of a very high-speed digital stream, with high image resolution by definition.

One fly in this ointment is that the image data stream does not consist of raw image data. The data is instead highly compressed. The compression used is a "lossy" algorithm, which means there is information missing from the reconstituted image. The algorithm is designed such that in most cases the information that is missing is nothing that viewers would notice, but not all images conform to this notion. Certain scenes look very peculiar under this sort of compression, most notably the floors of basketball courts. Lots and lots of parallel lines at an angle to the horizontal make for very bad compression.

There are more insects in the unguent. Most notable is that even if speeds throughout the Internet were upgraded to allow the transmission of high-quality video, movies would still look terrible. Anyone who's used any of the Internet's current media streams knows this.

HDTV over cable or over the air works fine because it's a steady stream of data originating from a single source. It transits few if any routers, and experiences uniform delays. This is not the Internet environment, at least, it isn't today's Internet. Connections on the Internet typically pass through 20 or more routers between source and destination. Even relatively low-speed Internet streaming media applications, such as Internet radio, exhibit hitches and glitches, as packet loss and delays exhaust even the substantial buffers used in current streaming applications.

RSVP, Please

The peculiar thing about this is that at least one solution has been thoroughly worked out and is in general implementation, but goes unused. This is the bandwidth management scheme using the Resource Reservation Protocol (RSVP). This protocol is available in all Cisco Systems Inc. routers, these being the most common backbone routers in the Internet. But almost no one uses it, outside of a few internal corporate nets. For whatever reason, it just never caught on,

READER FEEDBACK

To help *SW Expert* serve you better, take a few minutes to close the feedback loop by circling the appropriate numbers on the Reader Service Card located elsewhere in this magazine. Rate the following column and feature topics in this issue.

	Interest Level		
Feature:	**High**	**Medium**	**Low**
Demystifying Object Options	175	176	177
Columns:			
Ask Mr. Protocol–To Every Link there is a Reason	178	179	180
UNIX Basics–A Programming Primer	181	182	183
Storage–Taking a Ride on the Bus	184	185	186
NTegration–Understanding ACLs	187	188	189
Work–More Sex	190	191	192
Java Class–Trees, Glorious Trees	193	194	195

probably because no one worked out an appropriate charging algorithm. Mr. Protocol has described RSVP in some detail in past maunderings, but in brief, it allows an application to reserve bandwidth on the Internet, across an arbitrary number of routers, from source to destination. RSVP doesn't actually enforce the reservation, but acts as an accounting system to make sure that bandwidth isn't oversold. Enforcement modules are dependent on the link layer in the network. Asynchronous Transfer Mode (ATM) switches manage bandwidth by different mechanisms than Ethernets, for example. All, however, are able to interact with their local RSVP daemons to manage the available bandwidth in accordance with existing reservations.

This software is available, and it works, at least to a first approximation. Whether for reasons of charging or for other reasons, it has never caught on. Yet something will be required to perform this function before solid high-speed streaming applications become a reality. Anyone who has tried to listen to the National Public Radio news using the audio channel available in RealNetworks Inc. RealPlayer knows what that's all about. One working group in the Internet Engineering Task Force (IETF), called Differentiated Services, attempts to solve the problem by giving routers enough intelligence to figure out which packets are high priority and which are low priority by examining their contents and recognizing streaming media data on the fly. Obviously, this is a tough row to hoe, but if applications don't make their own reservations, something like this will be required to give them appropriate quality of service.

The above view of the Internet regards the user as a passive consumer of entertainment. Anyone reading this screed doubtless reads enough other sources to recognize that there is a large debate about this. The debate suffers from a certain forlorn air usually accompanying the closing of the door to an empty barn. To which Mr. Protocol replies: Nuts. The conclusion is not foregone. The media moguls who see no other use for the Internet do not actually know, yet, whether such a use would be profitable. Oh, digital channels to the home will carry high-speed entertainment data, that much seems certain. It works so much better than analog because one can play all sorts of tricks to protect one's investment in intellectual property. Whether those channels will be part of the open Internet, though, is anyone's guess. If the Internet does not evolve the necessary bandwidth management tools on its own, the moguls will presumably underwrite as much infrastructure as is necessary to carry their product. If they roll their own, however, the usefulness of the open Internet to their efforts would be questionable. Routers only route what they understand.

This whole mess resembles the wars in the early days of the electric power industry: AC, DC, 50 cycles, 60 cycles.... Of course, in that case, agreement only needed to be reached on a continental basis. The power grid of North America stops at the oceans. The Internet is global. As a result, there are more players, more angles and a whole lot more money than the early power industry saw. Some form of strained accommodation will be the likely result, with all sides claiming victory; just as they did with ATM, which some network mavens today consider an abortion, despite its widespread deployment. In some circles, the usefulness of ATM in the construction of network backbones amounts to a religious argument. ATM is rarely selected as the result of a bottom-up choice. In most cases, an ATM solution is prescribed at the outset by people high up in the chain of command. Sort of like IBM Corp. used to be.

The Internet still has a few surprises left. As much as it is a great leveler in the political and philosophical arenas of pure and free speech, it is also a great leveler in the marketplace, as all manner of hot new ideas are tried, retried, tweaked, squeaked, polished and demolished. Online bookstores. Online match-makers. Online auction houses. Online brokerage houses. Online cardhouses. Online cathouses. Online doghouses. You get the idea. The Net is full of ideas. Mostly bad, a few good, fewer than that, really popular.

Two guys get an idea. They want to start a Web site where they post cutting-edge techno-news. A short paragraph describing an embedded link, and why they think it's important. And behind each paragraph, a threaded discussion conducted by the readership. Not only that, but the readership, or a random subset of it, rates the comments up or down. Highly-rated comments bubble to the top of the heap for everybody. Presto, you have Slashdot (`http://slashdot.org`). Pretty soon Andover. net buys Slashdot, keeping the crew in place. Pretty soon someone else buys Andover. net, keeping the crew in place. Pretty soon we're talking about big money.

A Finnish grad student writes a UNIX look-alike based on some manuals. Thanks to the Net's mediation, Linux starts to gain ground on Microsoft Corp., gaining large mindshare and even some market share, spawning an incredible number of Linux-related sites on the way. Then some of those sites start spawning corporations with incredible IPO run-ups.

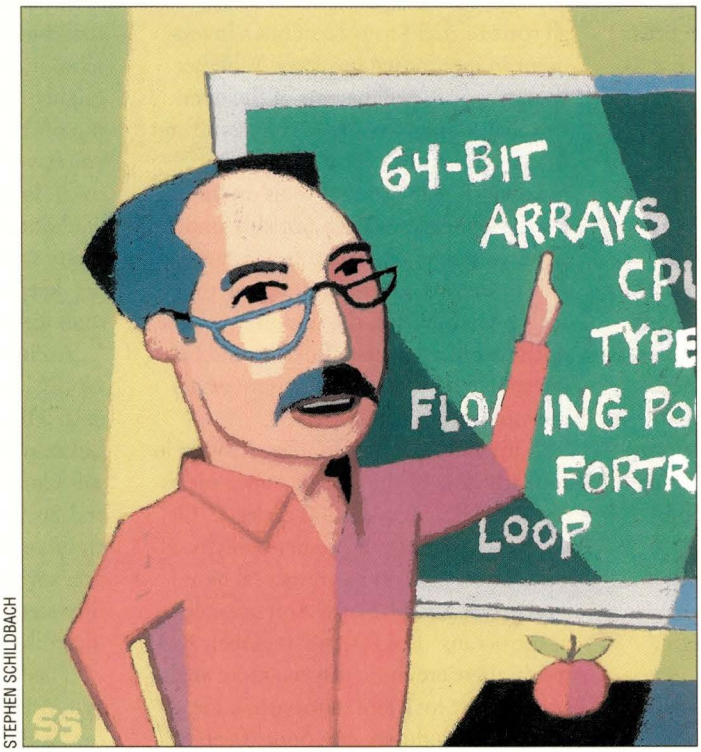
The Internet is good for a lot more than delivering *Love Story* over a 20-Mb/s connection. At a minimum, it's also good for delivering *Carrington* over the same connection. Or your choice of versions of *Pride and Prejudice*. Or every WWF bout ever fought. Your option. But there's more going on than that. Every mass medium in history–and it's not a terribly long history–has been turned into a broadcast medium. Despite the doomsayers, it's going to be very difficult for that to happen to the Internet. It's just too easy to put up a site, and have it grow naturally. The race doesn't go to the swiftest. It goes to the most interesting. ⊸

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`.

by Peter Collinson, Hillside Systems



STEPHEN SCHILDBACH

A Programming Primer

I'm always writing bits of programs for this column, programs that perhaps use the UNIX tools or employ one shell or another. While I was considering what to write this month, it occurred to me that I often make assumptions that underpin the nature of programming. I often don't realize that I am taking these implied concepts for granted, because I've been writing programs for more than 30 years, and they've become second nature.

In many ways in those 30 years, the nature of computing has changed, with each step along the path building on what went before. My son's idea of how his computer actually works is colored by the view that he is presented by the operating system he has grown up with: Windows. When we discussed this, it hadn't really occurred to him that many of the facets of the system he uses were not easily supported by the underlying hardware. He had not comprehended that Windows presented him with an interface that bends the reality of the hardware in a way that is intended to make the system easier to use.

Programmers who were familiar with the way programs worked created the UNIX tools and shells, and many of the concepts used in programming have found their way into the tools that we all use every day. To understand this, let's take a peek at the ideas in programming languages and systems.

I started my programming career by learning FORTRAN IV. FORTRAN was the creation of computer language pioneer, John Backus, whose task in 1954 was to develop a new compiler for the IBM 704 computer. FORTRAN took around 25 man-years to develop. Saul Rosen says in his 1967 book, *Programming Systems and Languages*, "Like many of the early hardware and software systems, FORTRAN was late in delivery, and didn't really work when it was delivered." Somehow, I feel that not much has changed.

FORTRAN is an abbreviation of FORmula TRANslation, and was designed as a scientific language, allowing sets of familiar mathematical expressions to be turned into computer programs. It was groundbreaking. Before it existed, people had tried to create languages, but most programs had to be expressed in machine code. Initially, a human would create the binary codes for the instructions to be executed. Later, the machine helped somewhat. With assembly languages, humans wrote programs using words rather than numbers and the system translated those words into the appropriate binary code. However, in both cases, the programmer wrote code for the machine, and each statement mapped onto something the machine understood as a single instruction.

How Things Work

The way that computers work hasn't changed in any fundamental way since those early days. If we neglect all the peripherals, a basic computer consists of a Central Processing Unit (CPU) and

Redapt relates

Redapt™ Systems & Peripherals relates to you, the discerning, intelligent buyer **looking for the best** prices, the best quality, and the best service when it comes to pre-owned Sun Microsystems hardware, peripherals, and software. **Redapt means results you can bank on**: Redapt Sun equipment goes through rigorous testing, is guaranteed, and is backed by a knowledgeable staff that adapts, at a flash, **to your specific needs.**

Let us relate to you and fulfill your specific Sun needs—**quickly, accurately, and affordably**.

Contact us today at **1-888-800-5633** or visit us on the Web at **www.redapt.com.**

redapt© systems & peripherals

Synonymous with quality when it comes to all things Sun™.

© 2000, Redapt Systems & Peripherals, Inc. Redapt is trademark of Redapt Systems and Perhipherals, Inc. Sun is a trademark of Sun Microsystems, Inc.

Circle No. 23

some memory. The CPU contains *registers* that hold numbers, and all the real work that the CPU performs happens in those registers. The maximum number of binary digits these registers hold gives us the *word length* of the computer. We are now moving toward using 64-bit machines. Nowadays, we are used to thinking in bytes, groups of 8 bits. It was not always so, I did my Ph.D. with a PDP-8 whose word length was 12 bits. For the record, the PDP-8 was manufactured by Digital Equipment Corp. and was the first widely used minicomputer.

The arithmetic unit in the CPU works with whole numbers (usually called *integers*). With a fixed word length, this gives a maximum and minimum number that can be stored. In some ways, I am sure there's an element of magic for many people in the way computers deal with numbers. We all know that numbers are stored as binary patterns, and the computer has the capability to perform a set of fixed operations on the binary patterns. My January column discussed the representation of negative numbers in computers (see "The Time," Page 24, `http://sw.expert.com/C2/SE.C2.JAN.00.pdf`). In fact, what I described was one way to represent positive and negative numbers. The method I talked about is designed so that adding positive and negative integer numbers together "works." The reality is that when we type two numbers into a computer, there are many ways of representing the numbers in binary and we don't really care as long as the result that's printed on the screen is correct, and the result is achieved speedily.

We often want to perform operations on numbers that are not just integers, called *real* numbers. To do this, we adopt a binary representation, enabling the computer hardware to operate on the binary patterns to create the correct answer at the end of the day. If the CPU only supports integers, then we need to use a binary representation that can make use of primitive integer operations. We write a program or a portion of a program that can deal the mapping of our chosen binary representation of real numbers into a set of integer operations and back again for storage.

Consequently, to handle real numbers, we need to use a binary pattern that represents the number in a different way from the way that integers are stored. Perhaps we'll adopt a scheme where some portion of the word will be the integral part of the value, and some portion will be the fractional part. This coding method is often called *fixed-point* number representation.

However, for scientific calculations, we want to deal with very large or very small numbers. This is done with *floating-point* numbers. Floating-point numbers also split the binary pattern into two chunks. Actually, I don't want to get into the actual mathematics behind the representation because it's not easy to explain simply. Suffice it to say that the representation allows a wide range of fractional numbers to be stored and manipulated arithmetically. Floating-point arithmetic is most often done using an additional piece of CPU hardware called the *floating-point unit.*

Incidentally, the representation of floating-point numbers isn't particularly compact. It has been usual to use 64 bits for the storage of the numbers for some time. Another problem is that the way the numbers are stored can sometimes result in imprecise calculations. I didn't say "incorrect," I said "imprecise." Essentially, the representation is prone to "rounding error," where a number cannot be accurately represented and may be rounded to the nearest figure. For this reason, I rarely use floating-point numbers for monetary calculations. It's easier and more accurate to make programs work in pence rather than pounds (or cents rather than dollars on your side of the big pond).

Memory

The memory of the computer contains binary patterns. Some of the memory will hold the program that is executed, so the binary numbers in that part of the memory are values that are understood by the CPU to be instructions. Some of the memory will hold data on which the program operates. Most computers cannot tell the difference between stored instructions and data. So, they cannot object when a programming error attempts to add two instructions or treat some stored data as part of the program.

The best way to visualize memory is to think of it as a set of boxes placed end to end, such that we can say, "put this item in box number 500," or "get me the contents of box number 4506." Each memory location has an address that the CPU uses to identify it. The CPU obtains the value of a memory location by sending the address for the location that it needs to the piece of hardware that controls the memory, and is returned a value. It can also load the memory by sending some data and an address.

When we start the computer running, we load a special CPU register, called the *program counter,* with the first address of the program that's stored in memory and say "Run." The CPU now goes into a loop. First, it fetches the contents of the memory location that's stored in the program counter. Second, the contents are assumed to be an instruction for the CPU. Third, the instruction is decoded and the appropriate action is taken. Finally, the program counter is incremented to automatically point at the next memory location in the program.

The program, then, is a set of instructions that are executed sequentially. This is normally called the *flow of control.* Each instruction is at a primitive level. For example, "load this register from this memory location," or "add these two registers together," or "place the contents of this register in memory location number 272386."

We can affect the flow of control by loading the program counter. It's easy then to create a loop, jumping back to the start of the program. We can also load the program counter conditionally, depending on the result of a test. Often this is expressed as "if the result of the last operation was zero, then jump to this memory location." Of course, we can often test different aspects of the last operation, like "was it nonzero?" or "was it negative?"

High-Level Languages

FORTRAN was born into a computing world where it was the norm to program in fairly low-level machine instructions. Programs were hard to write, and even harder to debug.

The original FORTRAN paper by Backus (and others) is reprinted in Rosen's book and goes to great lengths to justify the time saved by using FORTRAN over previous methods. It seeks to calm the fears of the people who doubted its efficiency. Yes, it really could generate programs automatically from complex statements that ran as fast as those that were hand-coded.

Another feature of FORTRAN was apparent when I started to use it. It allowed programs to be portable from machine to machine. I didn't need an IBM machine to run FORTRAN. By creating what we think of today as a "model" of how a computer worked and supplying a method of mapping the model onto the underlying hardware, you could take a program written for one machine, translate (or compile) it, and run it on another.

Some elements of the FORTRAN model are still in use today. For example, a program is a series of statements that are executed in order from the first line to the last. This idea arises from the way that the computer itself works. Essentially, the flow of control in a program is similar to the flow of control in a computer. This notion is so deeply embedded in almost everything we do that it seems almost a truism to talk about it in any great depth.

Most statements in FORTRAN perform some form of arithmetic and generate a result that is stored in memory. We label the memory address with a name and call it a *variable*. The statement looks like an algebraic equation:

```
A = B*C + D*E
```

The `A` here is the destination of the value of the computation that takes place on the right-hand side of the statement. The right-hand side is written in familiar algebraic form that we all learn at school, so we know that the above example means multiply `B` by `C` and add that result to the product of `D` multiplied by `E`. If we want something different to happen, we use brackets:

```
A = B*(C + D)*E
```

This type of statement is called an *assignment* statement, because we are computing a value and placing it into a variable. There's often a need to include constant numbers on the right-hand side of an assignment statement, and you just write them in as needed.

However, the use of the equals sign for assignments can sometimes be confusing to the mathematically trained mind. It doesn't mean "mathematical equality," it means use the left-hand variable as a destination for the computation.

The problem of the interpretation of the equals sign is made plain by the idea of incrementing a variable, written like

```
I = I + 1
```

which says take the value from the memory location, add one to it and put it back in the same memory location. Programs often contain statements like this. We use `I` to control a loop, counting the number of times that a section of the program is executed.

Types

What about dealing with floating-point numbers? How do we force one calculation to be done using integer arithmetic and another to use the floating-point unit? This is a question about the *type* of variables. Knowing the type has also been important on many machines because a floating-point number occupies twice the number of bits an integer does. Also, the language compiler will wish to generate different instructions to handle a floating-point add operation than it uses to execute an integral one. However, there is nothing in the statements above that overtly indicates the type of the variables that are being used.

FORTRAN adopted a simple policy. If a variable name started with `I`, `J`, `K`, `L`, `M` or `N`, then it holds an integer, otherwise it contains a floating-point number. The choice of letters came from common mathematical practice. We are left with this legacy today. Many programmers use `I`, `J`, `K`, `L`, `M` or `N` for simple counters and other integral values.

As time went on, it was realized that just being able to invent a variable as the program unfolded was a large source of bugs. You could mistype a variable name and nothing would spot that there was a problem. Most modern languages insist that you declare all variable names. You say at the start of the program: "These are the variable names I intend to use," and the compilation process will detect any mistypings and complain loudly.

Arrays

The objects that you did have to declare in FORTRAN were arrays. You used a `DIMENSION` statement to tell the compiler that a particular variable name was to be tied to the start of a contiguous section of memory. The size of the array, essentially the number of variables the array can store, is given by the `DIMENSION` statement. The standard variable typing rules that depend on the initial letter of the array name were also applied to the array, so the array would have a type and elements from the array would behave correctly in arithmetic statements.

An array is essentially a section of memory that contains *n* variables, where *n* is the size of the array. Some way is needed to access each element of an array, because few languages are able to handle arithmetic operations on the whole array. The convention is to use a subscript in brackets:

```
Z = A(1) + A(3)
```

This will add the first variable to the third and place the result in `Z`. Some languages use square brackets for array access rather than round ones, largely because it makes things easier if the compiler can distinguish between the round brackets used to impose precedence on arithmetic expressions and those brackets used to indicate an array access. Also, some languages define array indexes to run from zero to *n*-1.

You can place an array reference anywhere in the code where a variable is written normally. The real power of arrays emerges when you replace the value inside the subscript brackets by a variable. To sum the values of an array, you'd say something like the following:

```
  SUM = 0.0
  DO 5 I = 1,1000
5 SUM = SUM + A(I)
```

The best way to understand this is to walk through it. The first statement sets the accumulator to zero. The `DO` statement sets up a loop whose last statement is marked by the label `5`. Each time around the loop, `I` will take new value. It starts at 1 and is incremented by one until it is equal to 1,000, at this point the loop terminates and control passes to the statement immediately after the end of the loop.

The first time around the loop, `I` will be 1 and the contents of the first array element will be added into `SUM`. The next time, `I` will be 2 and `A(2)` will be added in and so on. Eventually, the sum will be calculated.

In a very few lines, we can achieve a task that not only would be a bore to write out, but doing so would also be prone to errors. Notice also that by replacing the 1 and 1,000 in the `DO` loop by variables, we can calculate different sections of the array using the same basic code. If you think about this idea, what's happening is that we are using data (the contents of the start and stop variable for the loop) to control the program. I often write very general programs that are data-driven in this way.

All the main languages support arrays. Many, including FORTRAN, support two-dimensional arrays aimed at scientists that wish to program operations on matrices. Many scripting languages support *associative arrays*, where the index is not a number but a text string. Again, the idea is to allow the programmer to write code that processes a single element. I use associative arrays an immense amount in Perl, often to allow me to data-drive the general-purpose code I have written.

Evolution

We have always been standing on the shoulders of someone else's efforts as computing has developed. What has happened has been often conditioned by what went before. FORTRAN provided high-level access to a set of underlying facilities provided by a machine. The primitive objects in the FORTRAN world mapped pretty closely onto what the machine could do.

However, programmers have wanted or needed to handle other types of data in a simple fashion. For example, I suspect nearly all the programs I have written in my life have been concerned with handling text and not numbers. In C, which was designed as a high-level assembler, with primitive operations mapping directly onto the hardware, strings are handled as arrays of characters. A set of standard routines is implemented to provide the functionality I need as a programmer. Other programming languages have handled strings by allowing the syntax of the language to cope, so in many languages, you can join strings together:

```
world = "world";
str = "hello " + world;
```

This looks like familiar assignment syntax, but it is doing complex string handling using a set of hidden routines. One of the reasons for doing this is it feels natural for the programmer to extend their assumptions about variables and assignments into the field of string handling.

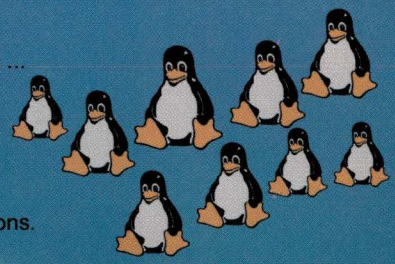
Further Reading

In this article, I've referred to one of my undergraduate texts that still lives on my working bookshelf. It's called *Programming Systems and Languages,* edited by Saul Rosen and published by the McGraw-Hill Book Co. in 1967. It seems to have predated ISBNs. I suspect the book is out of print, so hit your local library if you are interested. It contains a bunch of early papers on language design and development, the legacy of which we are still living with today. ⊸

***Peter Collinson** runs his own UNIX consultancy, and is 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 an UltraSPARC/10. Email:* `pc@cpg.com`.

DCG Computers, Inc.

When You're The Best, Your Clients Will Brag About You!



"DCG is the most experienced company today providing Alpha/Linux solutions ...
... DCG has the expertise and the knowledge to provide excellent Linux solutions, as evidenced by their new Beowulf offerings. There's simply no other company that can confidently provide this class of solution.

While others talk about providing a Beowulf solution, DCG delivers it! "

Bruce Faust
Founder of Carrera Computers and NekoTech, both of whom provide Alpha solutions.

"It is this level of service that makes all the difference to us. With computer systems available from a multitude of firms, at almost commodity prices, it is quality of a vendor's service that distinguishes it from the rest of the pack. This is where DCG Computers really stands out."

MIT, Cambridge, MA

"DCG Computers provided us with a highly cost effective means to perform scientific computations.
We found DCG Computers to be competent, prompt and courteous in providing us with this machine. It is our intention to do more business with DCG Computers and have recommended DCG Computers to our colleagues here at NASA Ames.

...I recommend DCG Computers, Inc.
to anyone wishing a cost effective purchase of a Beowulf Cluster."

NASA Ames Research Center

Alpha processor

LINUX AND BEOWULF SPECIALISTS

Building the *Fastest Systems* in the World

Tel:603-622-7171 Fax:603-622-7272

For a complete list of solutions visit us at www.dcginc.com

SUPPORT FOR LINUX, DIGITAL UNIX, OPENVMS, AND WINDOWS NT

All trademarks and registered trademarks are the sole property of their respective owners

Circle No. 15

by Alan Benway

DANIEL O'CONNOR

Taking a Ride on the Bus

On this next leg of our journey through the Storage Wilderness, we'll be investigating the two most common I/O interface technologies in use today: Advanced Technology Attachment (ATA) and Small Computer Systems Interface (SCSI). ATA has been using a 16-bit parallel wire bus, but a new serial bus is in the works in ATA-5. SCSI has used 8- and 16-bit parallel wire buses, as well as serial wire and serial fibre buses. Another bus protocol is in the works–the IEEE 1394 FireWire. We'll examine FireWire in a future column once there are FireWire disks to discuss.

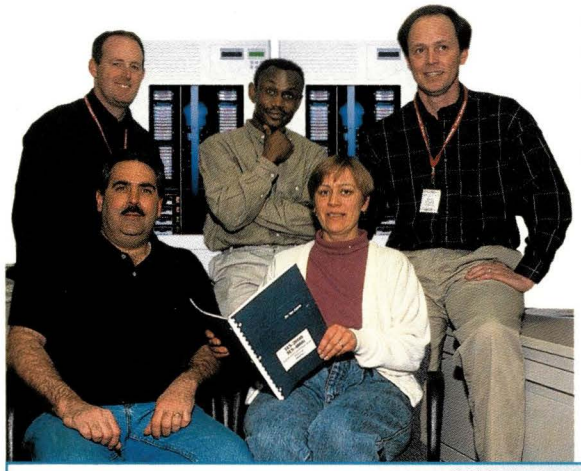
In this column, we'll consider the idea of protocols in general and discuss the ATA interface standards. Next month, we'll be digging into a lengthy discussion of the complex SCSI protocols and some of the many pitfalls to avoid when setting up SCSI devices. In the context of our discussion, a "protocol" is a specification that describes all of the details of the cables, connectors, timings and electrical signals that define a particular bus (often called a channel). The protocol must also specify the rules on how to use the bus. These rules are implemented in the commands that manage the devices and the movement of data across the bus. And what is a bus? It is the physical connection (using either copper wires or a fiber-optic cable) that provides for the attachment of I/O devices to a host computer's bus controller.

Another way of stating this is: a protocol defines a connection technology or, more commonly, an interface standard. Such protocols can be quite complex, especially as bus speeds are increased, causing small details to become more important. A parallel copper bus is comprised of signaling lines (like flags in software) for the bus controller to manage the devices, as well as data lines over which commands or data travel between the controller and devices. On serial bus technologies, such as Fibre Channel, FireWire, or IBM Corp.'s proprietary Serial Storage Architecture (SSA), device control signals, commands and data must all pass serially down the same bus.

Protocols may be formal or informal. They are formal if they have been set down in writing–usually by an industry standards body such as the American National Standards Institute (ANSI). Protocols are informal when, though they are not (yet) established as a standard by a standards body, they are already being used by some vendors who don't want to wait for completion of the slow, formal process. Protocols are typically modified over time with refinements or extensions to the original concepts. This accommodates issues that were not foreseen when the protocol was devised. Usually, the name of the protocol is changed to reflect this update, such as SCSI-2 and SCSI-3.

There have been a number of protocols for connecting disk drives or disk subsystems over the years, some of these have also been designed to support other I/O devices such as tape drives, optical drives (magneto-optical, CD-ROM,

THE MOST IMPORTANT INVENTIONS OF THE 20TH CENTURY ARE BACKED-UP ON QUALSTAR TAPE LIBRARIES.



"Every Patent in the United States is processed at RTIS Government Services. That says it all for why backup and retrieval are important. We did considerable investigation before choosing Qualstar libraries with Sony AIT tape drives. The performance has been outstanding"

David Allingham Network Administrator, RTIS Government Services

We couldn't have said it better ourselves. Call today and discover why the leading IT Professionals worldwide are choosing Qualstar.

SONY AIT-2 Inside

1-800-468-0680

TEL: (818) 592-0061 • FAX: (818) 592-0116

E-MAIL: sales@qualstar.com • WEB: www.qualstar.com

QUALSTAR®

SIMPLY RELIABLE

AIT is a registered trademark of SONY.

The Tape Library Experts

Circle No. 16

DVD-ROM and so on) and scanners. Generally, one does not want to mix the various types of devices on a bus used for disk drives (more on this subject later).

Mainframe and supercomputer systems for years have used other types of interface standards for the connection of external disk controllers and disk banks. These include Block Multiplexer Channel (BMC), Enterprise Systems Connection (ESCON), as well as various proprietary fiber optic-based channels. These bus technologies are limited to transfer rates in the 3- to 9-MB/s range. Some high-performance systems have also supported the use of High-Performance Parallel Interface (HIPPI) 1-3 at rates of 75 to 100 MB/s.

Older minicomputers used Intelligent Peripheral Interface (IPI) and Hewlett-Packard Interface Bus (HPIB) protocols (both under 5 MB/s) for their disk-connection technology. UNIX workstations and servers, essentially the modern replacements for minicomputers, have employed IPI, HPIB and SCSI protocols. PCs have used the Seagate Technology Inc. (ST) 506/412, ATA and SCSI protocols as their connection technologies over the years. Recently, a new bus technology known as Fibre Channel–this includes Fibre Channel Arbitrated Loop (FC-AL) and Fibre Channel Switched (FC-SW)–has emerged as a 100-MB/s-plus technology. Note that Fibre Channel-attached disks still employ the SCSI protocol, so the only difference is in the media and interface logic.

It is useful to note that the ATA and SCSI standards each consist of dual-layer protocols: an upper-level logical layer and a separate lower-level transmission layer. The logical layer defines the commands and handshaking, while the transmission layer defines the electrical characteristics, the coding schemes and the parallel or serial transmission procedures. The lower layer may be replaced (as with the upcoming serial ATA-5 protocol) without disturbing the upper layer.

What sort of things are in a protocol, you ask? Using the SCSI parallel wire standard as an example, a protocol includes things such as:

- Number of data and signaling wires on a bus and their meanings.
- Clocking rates for these wires under various bus states.
- Defining command and data logical "phases" on the bus.
- The timing windows in which various command or data phases must complete.
- The voltages and grounds present on the bus (single-ended vs. differential).
- The desired electrical impedance of the working bus and how to manage this using termination.
- Cabling lengths and connector spacing factors for maintaining usable waveform shapes on the bus.
- Number of devices attached to a bus and their order of precedence.
- The use of bus parity for data integrity and how to recover when it is bad.
- The use of synchronous transfer mode for data phases.
- Defining the required (and optional) capabilities for the bus controller.
- Defining the required (and optional) capabilities for the devices, or SCSI targets.
- Defining the commands issued by the controller and how targets must respond.

The following sections will describe details about the various ATA and SCSI protocols. I will use the more common terms of interface or standard in place of protocol from here on in.

ATA Standard

The ATA standard was defined in the late 1980s by the Small Form Factor (SFF) Committee, a group composed of engineers from various disk manufacturers, including Western Digital Corp. This work was then handed over to ANSI, where the X3T9.2 Task Group developed it into a low-cost disk-only interface standard for the newly developing PC market. It was then adopted by IBM and first used in its PC-AT, the successor to the first hard disk-based PC, the 5-MB PC-XT, which used the (ST) 506/412 interface. The ATA standard was on its way to widespread usage fairly quickly.

Note that most users, and several vendors, refer to the ATA standard as the integrated drive electronics (IDE), or enhanced IDE (EIDE) standard; however, the correct name for this protocol is ATA. IDE merely describes the concept of incorporating the drive's controller (not to be confused with the bus controller) into the drive. These were separate parts on most computer systems at the time. Along the way, through both sloppy usage and vendor misuse, the term IDE improperly came to be used to describe the entire standard, as well as the class of devices that used it. Today, few people seem to have any idea what ATA stands for. Now that the newer IDE standards are often referred to by their proper names (like ATA-3), this naming problem leads to a lot of consumer confusion. Let's sort this particular Storage Wilderness briar patch once and for all!

ATA-1

The original ATA standard defined the 40-wire, 18-inch ribbon cable and 40-pin connector, support for a master and slave disk on the cable and the signaling and clocking managed by the disk (not by the bus controller). ATA also specified the command set used by the operating system's ATA driver to directly control the disks. There is no ATA (or IDE) controller as such on the host computer, as is the case with SCSI. A motherboard's IDE interface is little more than connection logic that allows the device to interface to the host's main I/O bus without causing problems. This logic includes the connectors, as well as some buffering and signaling logic. By the way, "logic" is a general term used to refer to the hardware and its embedded software (firmware) that performs some function.

ATA-1 (ANSI standard X3.221-1994) defined programmed I/O (PIO) modes of 0, 1 and 2. These had peak transfer rates of 3.3, 5.2 and 8.3 MB/s, respectively. Note that the PIO mode 2 rate was also the limit of the then-used 16-bit Industry Standard Architecture (ISA) bus in PCs. Only disk drives were defined under this standard. There was no error detection on the bus, and the drives weren't required to perform any either.

ATA-2

By late 1991, the ISA (8-bit, 8-MHz) and Enhanced ISA (EISA, 16-bit, 8-MHz) system buses had become a major system bottleneck in PCs owing to the vastly increased amounts of data required by the graphics card to support Windows. With the advent of the 32-bit, 33-MHz VESA Local Bus in 1992, ATA-1 disks instantly became the system bottleneck. Additionally, in 1993, the new high-performance Peripheral Component Interconnect (PCI) 2.0 bus standard (a 32-bit, 33-MHz mezzanine bus, not a local bus) was approved and quickly came to market. ATA-1 disks were far outclassed by the performance of these new buses.

The industry got together again in the SFF Committee and created the ATA-2 extension (ANSI standard X3.279-1996). However, owing to what I gather were competitive impulses, Western Digital called its implementation of ATA-2, EIDE. Western Digital was the first vendor to market with ATA-2 disks, so this name pretty much stuck. Seagate Technology and Quantum Corp. called their respective implementations Fast-ATA–a more correct term to use–but who's ever heard of that? By now, IDE had already been the incorrect but dominant term used for several years, so for most people EIDE seemed natural.

The new definitions of PIO modes 3 and 4, as well as the new direct memory access (DMA) mode, were introduced. Now transfer rates of 11.1 and 16.6 MB/s were available on PCs with the faster 32-bit buses. However, only about 7.8 MB/s was actually achievable and drives were limited to a maximum transfer rate of about 10 MB/s. Some plug-and-play features were defined, as was the use of the Logical Block Address (LBA) mode for disks larger than 504 MB (a limit imposed by the motherboard BIOS via the Cylinders Heads Sectors, CHS, protocol and its use by Microsoft Corp.).

ATA-3 (ANSI standard X3.298-1997) was a revision of the formal ATA-2 standard and added various improvements for reliability at the faster speeds. It also allowed for the use of Self Monitoring Analysis and Report Technology (SMART). SMART was added to provide the host with warnings (mostly heat-related) about an impending disk failure. No new performance levels were introduced with ATA-3.

ATA-4

The ATA-4 standard (ANSI standard X3.317-1998) defined the UltraATA33 mode. By making use of the positive and negative transitions of the strobe line (or clocking signal), and by using DMA transfers, a burst rate of 33-MB/s was achievable under UltraATA33. A new "IDE" ribbon cable with 80 wires (40 new grounds, same 40-pin connector though) was also specified to control bus errors. To ensure that data weren't being mangled at these higher rates, ATA-4 defined the first use of bus error detection on ATA by the use of a Cyclical Redundancy Check (CRC). Here is how Western Digital described this new feature in its white papers: "The CRC is calculated on a per-burst basis by both the host and the hard drive, and is stored in their respective CRC registers. At the end of each burst, the host sends the contents of its CRC register to the hard drive, which then compares it against its own register's contents. If the hard drive reports errors to the host, then the

Trust an Eclipse to cover the Sun

With each system you sell and install, you put your equipment on the line. And your reputation. And your future. The last thing you need is an unhappy customer.

That's why when you're installing the Sun Ultra AXmp, the premier motherboard in the industry, make sure it's covered by the best chassis in the industry, the Eclipse from RackMaster.

We've designed rugged reliability and fault resiliency into the Eclipse beginning with the first true 2n+1 hot swappable power supplies. That means less downtime for your customers and less hassle for you.

And, that's just the beginning.

To insure reliability and durability, the Eclipse features:

- Individual cooling fans in each power supply
- 3 hot-swappable 90 CFM fans in the cooling cage
- Full monitoring capability
- Plenty of space to mount additional components in the 6U cabinet
- Pull-out motherboard mount for quick, easy servicing

All in a great looking, tough, fault, resilient chassis.

Discover why the Eclipse is the best choice for your system. Call us at:

1-800-480-4384

www.rackmaster.com/eclipse.htm

RACKMASTER®
Simply, the best

Circle No. 17

host retries the command containing the CRC error."

New SCSI-like features provided for in ATA-4 include command queuing and overlapped I/O. When combined, these functions allow for multitasking I/O commands at the drive level–if the host operating system supports this capability. Command queuing and overlapped I/O mean that multiple I/O requests can be received by a disk before it starts to respond to the first one. It is no longer necessary (as with all previous ATA protocols) for the host to issue a single command to a disk and wait for the command to complete before serving up another. Support for this new feature requires significant changes to the host file system, the host ATA driver and the ATA-4 disk controllers. Therefore, you don't see the feature yet. One disk vendor recently told me that Windows 2000 will later support ATA-4 command queuing and overlapped I/O. I expect Linux ATA drivers will as well.

The use of this new mode (as in any previous changes to the ATA standard) requires motherboard (or a PCI UltraATA33 adapter card), disk and operating system driver updates to support it.

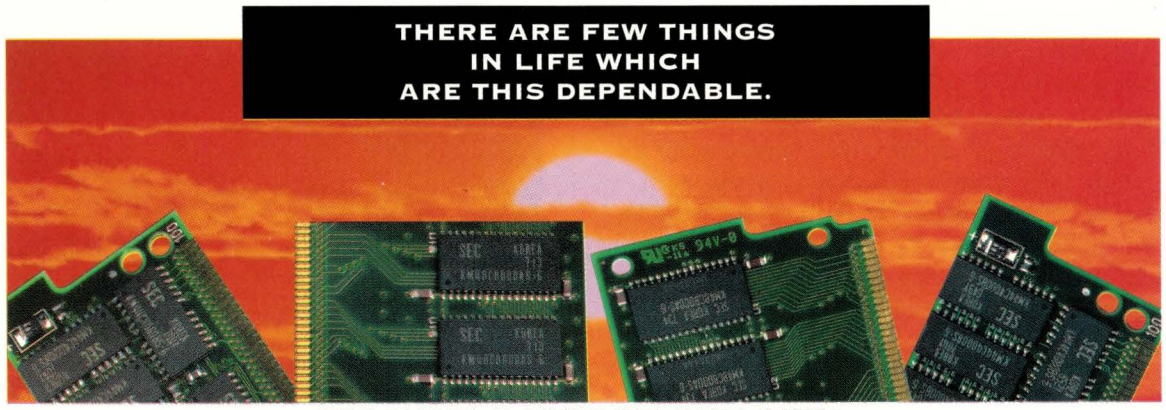
ATA-5

The recently deployed UltraATA66 protocol is going to be defined in the forthcoming ATA-5 standard. This pre-release to ATA-5, doubles the substainable burst rate over that of UltraATA33 by reducing the setup time for transfers to half that of previous versions. More data can be transferred in bursts owing to more efficient use of the bus.

A major enhancement to the ATA standard defined in the ATA-5 draft is that disks will include automatic (or off-line) internal sector integrity checks, as with SCSI disks. This is an extension to the SMART technology introduced in ATA-3. There are two new UltraATA66 disk product lines that include this new caqpability: the DiamondMax Plus 40 series drives from Maxtor Corp. (MaxSafe) and the Expert series from Western Digital (Data Lifeguard). By the way, the Maxtor series also includes (uniquely, as far as I can ascertain) dual processors in what the company calls DualWave technology. This series is already labeled as ATA-5 in Maxtor's literature.

There is a new ATA bus protocol being developed in ATA-5 as well. This will create a high-performance serial bus that will attach a single device to the ATA connector (on either the motherboard or adapter card). This will be analogous to the present use of the SCSI-3 protocol over the serial FC-AL bus. This will reduce the connection footprint on the devices and eliminate the problems faced with the stiff ATA cables in PC cabinets that are limited to a length of 18 inches. With the upcoming use of 2.5-inch form factor drives, this will create many new possibilities for both users and vendors. When I asked one vendor if this was a faster version of FireWire, he said, no, serial-ATA is all new. FireWire is primarily intended for consumer electronics applications, and isn't fast enough for systems disks.

As with ATA-4, the use of the new UltraATA66 interface will



WE HAVE A FEW OF OUR OWN.

Xcel Technology's Sun® workstation memory upgrades are the most dependable come rain or shine. Xcel manufactures the best quality, pricing, availability, compatibility, service and support, into each and every Sun upgrade. All Sun® upgrades are engineered and manufactured in-house to meet exact OEM specifications. Xcel offers a lifetime warranty, toll-free tech support, and 100% customer satisfaction for all Sun products. All products are tested in the machines they were actually designed for, this guarantees 100% compatibility. Xcel technology manufactures its Sun upgrades in 32MB, 64MB, 128MB, 256MB, 512MB, and 1GB modules as well as 2GB, 4GB, 9GB kits. All workstation upgrades are guaranteed compatible for your Sun workstation system. Xcel Technology provides advanced qualified PCB's, same day assembly and shipping, build-to-order programs, contract assembly, component sales, custom packing solutions, design and engineering, PCB sales, private label manufacturing, and advanced testing. Xcel Technology will develop a customized solution to meet yours or your customer's needs. For 24/7/365 support and service access Xcel's Internet site at www.xceltechnology.com. For more information on the latest Xcel Technology Sun memory upgrade solutions, please call an Xcel Account Executive at 800.288.1518.

If you don't, you may get scorched.

105 N. Point Drive, Lake Forest, CA 92630
U.S.: P 949.461.7095 F 949.859.8780 800.288.1518
ASIA: KRON ELECTRONICS P 011.822.589.0469 F 011.822.589.0434
www.xceltechnology.com

Circle No. 18

require a new motherboard, an 80-wire ribbon cable and disks that support this mode. For most users, an UltraATA66 PCI adapter, such as the ones from Promise Technology Inc., will probably be used to add this capability to a system instead of upgrading to a new motherboard.

ATAPI

Now, here is an odd creature lurking in the Storage Wilderness. ATA is a protocol for disk drives. But what about all of those ATA CD-ROMs, DVD-ROMs and tape drives coexisting on the same IDE cable as a disk? In order to make the standard interface on a PC more flexible, the SFF Committee came up with the ATA Packet Interface (ATAPI). The ATA command structure for disks and for these other types of devices are totally different. So, a special protocol that piggybacks on the underlying ATA protocol was developed. Sounds a bit nasty, eh? Actually, this isn't very different from operating multiple network protocols (such as TCP-IP, Appletalk, IPX and so on) over the same physical local area network (LAN). A special ATAPI driver is installed in the operating system (first seen in Windows 95 for PCs), in addition to the ATA PIO/DMA driver. Commands and data are sent to ATAPI devices in "packets," which appear to be normal bursts of data to an ATA disk on the same bus.

ATA was meant to be fairly simple in scope in order to reduce costs. This underlying premise is still there, although one could argue that the latest directions in ATA protocols and disk design make it appear that it is trying to "catch up" to SCSI. But what would be the point in creating a SCSI clone under the alternate name of ATA, especially if they end up at the same price point? One vendor I talked to, felt that the future price point differential between SCSI-3 devices and ATA-5 devices would remain as it is today. Their feeling was that ATA drives are far more of a commodity item than SCSI drives, and that the typical buyer is bothuninformed and uninterested in advanced features and only cares about the cost.

I stated in my first column (see "The Storage Wilderness," Page 30, `http://sw.expert.com/CB/SE.C11.JAN.00.pdf`) that individual ATA drives were faster than their SCSI counterparts. The higher grade UltraATA33/66 7,200-rpm disks can run circles around similar 7,200-rpm SCSI drives. Now, let's see why this is so.

In a nutshell, ATA disks do very little in comparison to SCSI disks. ATA protocols do not have the overhead that SCSI protocols do. Most ATA drives do not perform any error detection or correction. (See the documents at `http://www.maxtor.com/techdocs/ms.htm` and `http://www.westerndigital.com/products/drives/drivers-ed/lifegtp.html` for an idea of what Maxtor and Western Digital are doing with some of their newer drives.) They do not look for–and mark as unusable–sectors that have gone bad. They do not run integrity checks when idle, reading sectors and comparing the CRC checksums for validity. In the case of ATA drives, these kinds of tests are usually a function of user-initiated, host-based software such as Microsoft's Scandisk (Windows 95/98). ATA disks are also incapable of multitasking (that is, accepting multiple I/O requests), as are most SCSI disks. And ATA buses do not have the complex command and data phases required for supporting seven or 15 devices, as on a SCSI bus.

An ATA drive–not a bus controller–controls the IDE bus and bursts data to the host in a dedicated fashion. It does not share the bus with the other device (if any) until its I/O request has been completed. Also, it does not have a mechanism to detect if there are any errors in the transfer (until now with ATA-4). The micro-management of the ATA disk by the operating system also means that performance is quite sensitive to CPU speed. Even on a fast Pentium III-500 system, 60% to 100% of the CPU will be consumed by any sizeable ATA I/O transfer. A SCSI device typically consumes only about 5% of the CPU, because the bus controller performs much of the work. SCSI drives are intended for use with an operating system that supports preemptive multitasking, such as UNIX or Windows NT, and they have been a much better choice on servers and RAID solutions. ATA drives are meant for single-user, single-tasking desktop systems, where they do an excellent job.

Next month, we'll find ourselves deep in the swamps of the Storage Wilderness. We'll investigate the SCSI protocol, the major advantages that SCSI disks have over ATA disks and some quicksand to avoid. There are two main protocols in use–namely, SCSI-2 and SCSI-3–and several variations to deal with, including Fast SCSI, Ultra SCSI, Ultra2 SCSI and now Ultra160 SCSI. There are narrow (8-bit) and wide (16-bit) versions for most, and three incompatible types of bus: single-ended (SE), differential (D) and the new lower cost low-voltage differential (LVD). Stay tuned!

Further Reading for Truth Seekers

The official sites for interface standards and work in progress:
- ATA–*http://www.t13.org*
- SCSI-2–*http://www.t10.org*
- SCSI-3–*http://www.t11.org*

For more in-depth ATA disk information, see some of the interesting white papers at the following Web sites:
- *http://www.maxtor.com/technology/*
- *http://www.quantum.com/src/whitepapers/whitepapers.htm*
- *http://www.storage.ibm.com/hardsoft/diskdrdl/library/technolo.htm*
- *http://www.westerndigital.com/products/drives/drivers-ed*

Information is available at the following sites for testing ATA drives:
- *http://www.quantum.com/src/whitepapers/wp_dps.htm*
- *http://www.westerndigital.com/service/diagnostics.html*

Also, the Storage Review Web site (*http://www.storagereview.com*) offers information on performance tests of current (and older) disk drives and controllers (under the Reviews button).

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

by Æleen Frisch

LOUISE GOLDENBERG

Understanding ACLs

One of the advantages of the NTFS file system is its much improved security over the earlier FAT-based file systems. In fact, NTFS file systems provide excellent mechanisms for protecting file system contents from unauthorized access. File- and directory-level security is implemented via access control lists, or ACLs (which is pronounced either by naming the letters in the acronym, "a-see-ell," or as in the word "tackle" minus the "t"). An ACL consists of a list of names and associated permissions; each individual item is known as an access control entry (ACE). The ACL for a file or directory may be viewed or modified by pressing the Permissions button on the Security tab of the item's Properties dialog box (accessible from the right-click menu, as always).

An ACE can be created for a variety of user account-based entities: individual user, group, global user or group from a trusted domain, or one of the built-in pseudo-groups automatically defined by Windows NT (Everyone, referring to any user; Interactive, which applies to any currently logged-in user; Network, for permissions that apply to remote access of a file/directory; and Authenticated Users, limited to users that have been authenticated by presenting a valid username and password). An ACE also contains the permissions which have been granted to that user/group for the file/directory in question.

At this point, we will focus on the permissions facility present in Windows NT 4.0, saving consideration of the modifications that come with Windows 2000 for later. NT 4.0 defines six basic atomic file/directory permissions:

- Read (R): View file contents or list files within a directory.
- Write (W): Modify file contents or add items to a directory.
- Execute (X): Run a program or make a directory your current working directory.
- Delete (D): Delete a file or directory.
- Change Permissions (P): Change the permissions for a file or directory.
- Take Ownership (O): Become the owner of a file or directory.

Any subset of these permissions may be granted to a user. For convenience purposes, however, Windows NT assigns names to commonly-used combinations of these individual settings, which are known as permissions sets. For files, these are Full Control (corresponding to all permissions), Change (RWXD), Read (RX) and No Access (none of the permissions). Any other setting is referred to as Special Access.

Here is an example ACL:

```
Rachel:    Change (RWXD)
Dennis:    Read (RX)
Phil:      No Access
Bldg1:     RWX
Bldg2:     X
```

The above example has five entries, three corresponding to users and two to groups (respectively). ACLs are interpreted as follows whenever the operating system must decide whether or not to grant

some particular access to a file. First, if any entry applying to the requesting user denies access to him, then access is denied. Second, if no entry applies to the user, then access is again denied. Finally, the permissions granted in all of the entries that apply to the user are combined and he receives all of them (in other words, they are unioned together).

In the case of the above example, user `Phil` will never be granted access to this file because of the ACE denying it to him; this is true regardless of his group membership. `Dennis` will have `RX` access to the file unless he is a member of group `Bldg1`, in which case his access would be `RWX`. Users other than `Rachel` who are members of the two listed groups will have exactly the access given to the group(s) they belong to. Members of the group `Bldg2` are granted only `X` access, for example. This is the minimum access required to run a program; you do not need `R` access to the file. In contrast, `R` is required and is sufficient by itself to execute a script.

You may wonder about the efficacy of denying `D` access while granting `W` access. This combination will prevent a user from deleting a file, but it does not prevent her from deleting its entire contents. Thus, `W` access alone protects against some kinds of user mistakes, but not against certain deliberate malicious actions.

Note that users can create ACLs that prevent administrator access temporarily to a file or directory. However, administrators can always change the ACL itself and thereby regain access to the file.

ACLs for directories are very similar. Figure 1 shows an example directory ACL. As the figure illustrates, directory-based ACEs have two permissions sets within them. The first specifies access to the directory itself, and the second is used when ACLs for new files and subdirectories are created within that directory (as we will see shortly).

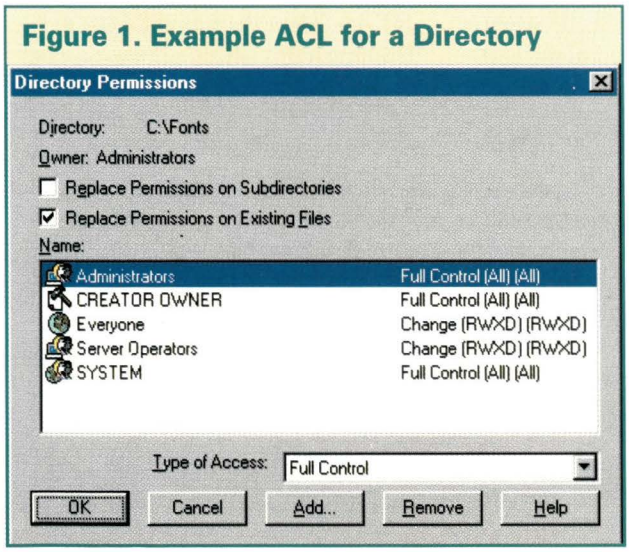
There are several additional permissions sets defined for directories:

- Full Control: `RWXDPO`, `RWXDPO`
- Change: `RWXD`, `RWXD`
- Add and Read: `RWX`, `RX`
- Add: `WX`, `Not Specified`
- Read: `RX`, `RX`
- List: `RX`, `Not Specified`
- No Access: `None`, `None`

There is also a difference between the permissions set Full Control and explicitly assigning all permissions within the first permissions item (that is, Full Control = `RWXDPO`). When Full Control is granted for a directory, then the corresponding user/group is automatically allowed to delete every file within the directory regardless of any file's individual permissions settings. This behavior is required for POSIX compliance. If you do not want to grant this level of access, then you can explicitly assign each individual permissions item to the user/group instead; the latter doesn't include directory contents deletion rights.

ACLs for new files and subdirectories are derived from the ACL on the directory in which they are created. The particular user creating the item has some effect on the resulting ACL, but the permissions applied to it do not follow from that user, as they do in other environments. For a new file, the ACL is a modified copy of the directory's ACL, constructed in general by propagating the second permissions list in each ACE. There are two exceptions to

Figure 1. Example ACL for a Directory



DAYSTAR
enterprise systems
Your COMPLETE source for refurbished Sun equipment. We refurbish, upgrade and custom-configure all Sun Microsystems equipment to save you money.

DayStar delivers value driven technology with convenience and common sense.
888.878.0809
www.daystarsys.com
DAYSTAR
enterprise system
DayStar Enterprise Systems
111 Corning Road, Suite 116, Cary, NC 27511
Circle No. 19

this procedure, however. First, ACEs with `Not Specified` as the second permissions entry do not appear in the new ACL. Second, any permissions appearing in the ACE for Creator/Owner (a special pseudo-user present only in ACLs for directories) are used to create or augment the ACE for the user who owns the new file.

Here is a sample ACL for a directory:

```
Rachel:   RWXD, Full Control
Dennis:   RX, R
Phil:     No Access, No Access
Bldg1:    RWX, RX
Bldg2:     X, Not Specified
Creator/
Owner:    RWXD, RWXDP
```

If `Rachel` creates a new file in this directory, the following will be the ACL attached to it:

```
Rachel:   Full Control
Dennis:   R
Phil:     No Access
Bldg1:    RX
```

Each ACE within this ACL is created from the second set of permissions within the corresponding ACE in the parent directory's ACL. There is no ACE for the group `Bldg2` because its second permissions list is set to `Not Specified`. Finally, the Creator/Owner entry has no effect on `Rachel`'s entry in the ACL for the new file because she already has Full Control from her own ACE.

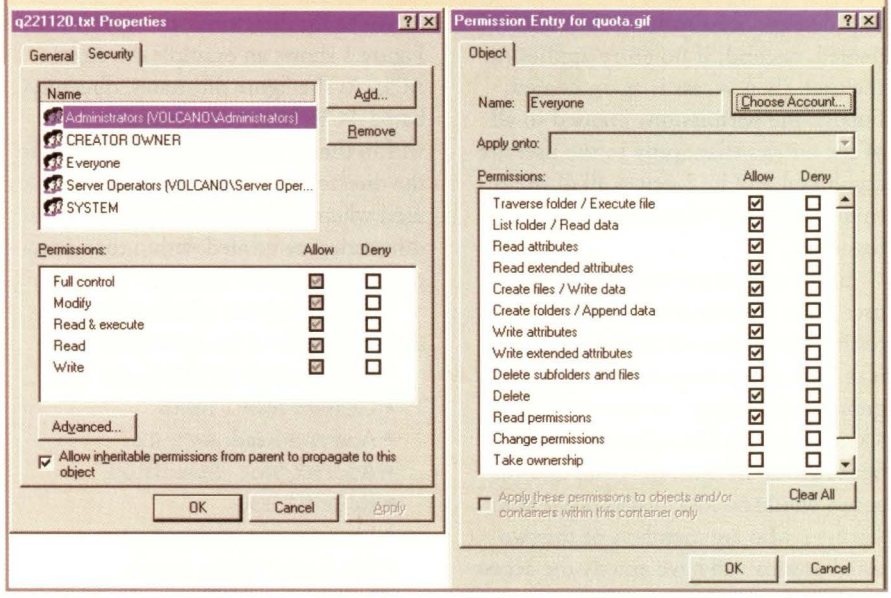
Now suppose user `Dennis` is a member of the group `Bldg1`. If you create a file in this directory, most of the component ACEs will be the same as the ones for `Rachel`'s file. However, his own entry will be augmented with the second permissions list for Creator/Owner, making it `RWXDP`. If a different member of the same group created a file within this directory, the ACL for that file would contain all of the entries found in the ACL for `Rachel`'s file, along with an additional entry for the creating user, granting him `RWXDP` access.

The situation is similar for newly-created subdirectories. In this case, both permissions lists are used to create the entries in the new ACL. Additionally, entries within the parent directory's ACL with `Not Specified` in the second permissions list are propagated to new subdirectories (rather than being excluded, as they are for new files). Finally, when an additional ACE is added to the new ACL, because the subdirectory's creator did not have an explicit ACE in the parent directory's ACL, the second permissions list within that ACE is set to `Not Specified`.

ACLs may be modified using the graphical interface available via the file/directory Properties menu. This is a simple solution and works fine for a single file or directory; however, changing or viewing the ACLs for many files this way would soon become tiresome. Fortunately, there are a variety of command line-based utilities, which are much more usable and efficient for this purpose. Some of them are summarized in Listing 1.

Windows 2000 extends and builds upon the ACL facility in Windows NT 4.0. These changes eliminate the few limitations inherent in the previous

Figure 2. Windows 2000 ACL



Listing 1. Commands for Displaying and Manipulating ACLs

- `cacls`: A fairly awkward and inconvenient command for examining/modifying ACLs provided by Windows NT.
- `dumpacl`: A freely-available graphical ACL summary report utility provided by Somarsoft (*http://www.somarsoft.com*).
- `LogACL`: A utility from NextLog (*http://www.nexlog.com*) that provides an SQL-like query language for ACLs. It works in combination with the Windows NT `cacls` command to modify ACLs. Pricing starts at $81 per single logical drive.
- `NTSec`: A package of utilities from Pedestal Software (*http://www.pedestalsoftware.com*) that features several excellent commands for modifying ACLs, including from within scripts; a C-like query language for examining/listing ACLs; and a facility for recording all existing ACLs and applying/reapplying them to the same/another system. Pricing starts at $65 per single workstation.
- `perms`: A command to display ACEs for a specified user/group (Windows NT Resource Kit).
- `showacls`: It provides a very detailed ACL listing for a file/directory (Resource Kit).

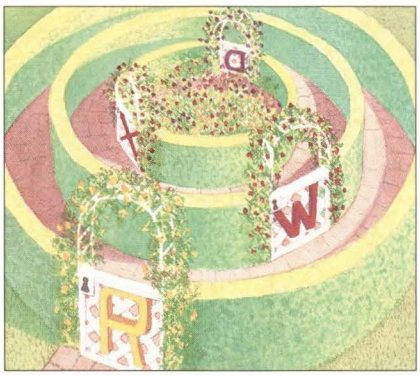
scheme. Let's take another look at the sample ACL we considered earlier:

```
Rachel:    Change (RWXD)
Dennis:    Read (RX)
Phil:      No Access
Bldg1:     RWX
Bldg2:     X
```

Suppose that `Sam` is a member of the `Bldg1` group. This facility allows no mechanism for denying write access for the corresponding file to `Sam` while granting it to every other member of the group, except by creating an ACE for every single user within the group. The desired permissions are capable of being granted, but only in a way which is at best very inconvenient. Figure 2 illustrates two dialog boxes from the Windows 2000 interface to ACLs.

Windows 2000 modifies the ACL facility in several ways:

• Additional basic permissions are defined. The right-hand dialog in Figure 2 shows a nearly complete list of them. We can see that the permissions required to create files and subdirectories are now distinct from one another. Similarly, the ability to read an item's current permissions is now separated from the ability to modify them.



• Permissions can be explicitly denied, as well as explicitly granted. Accordingly, in order for access to a file/directory to succeed, the requesting user must be both explicitly granted the required permission and not specifically denied it. Thus, to continue our ongoing example, the `Bldg1` group can be granted `RWX` access as before and `Sam` can be denied `W` access, producing the desired result in a straightforward manner.

• Permission inheritance for new items from the parent directory may now be disabled or enabled on a per-directory basis.

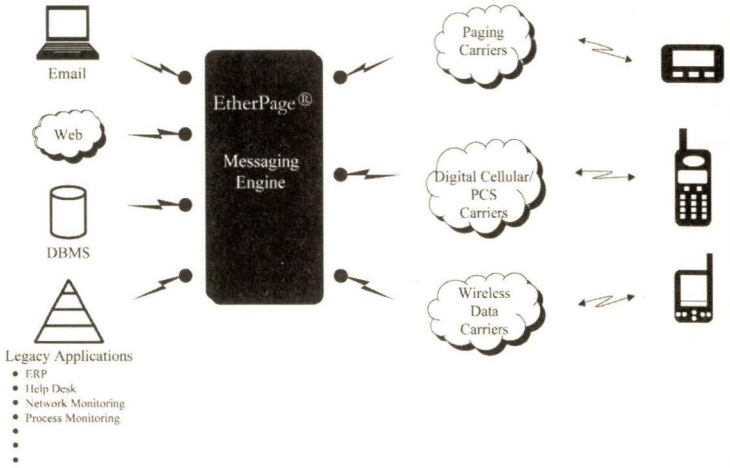
As with many of the changes that have been introduced with Windows 2000, the ACL facility has changed more in the way it looks than in the way it functions. In this case, the changes made are unequivocally improvements, and they provide the systems administrator with further flexibility and options with regard to securing the file system. ⊸

***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`.

Wireless Messaging Gateway Provides Robust, Reliable Delivery of Messages Anytime, Anywhere

MobileSys™

- **Integrates seamlessly with network monitoring tools, help desks, and other legacy applications**
- **Extremely reliable: designed for mission-critical, 24x7 applications**
- **Highly scalable**



Tel: (650) 934-9006 www.mobilesys.com

Circle No. 20

by Jeffreys Copeland and Haemer

ERIC MUELLER

"Bother: Annoyance; frequently confused with 'pother,' which means uncalled-for interest in something, usually sex."
– James Thurber and E.B. White, *Is Sex Necessary?*

"We cannot tell you everything we know about the gastropods because we know, possibly, more than is good for us."
– Ibid.

More Sex

Our question for this month continues to be, "Why is sex always the same?" And you're only thinking what you are right now because you didn't read last month's column. You should be ashamed of yourself. We'll recap for those readers who don't have a copy at hand.

Last month, we asked a question and began writing the software to answer it. Our starting point was to notice that almost all species use two kinds of chromosomes to determine sex (though there are some thought-provoking variations on that theme). Our question was, roughly, "Just what the heck's going on here, anyway?"

To attack this problem, we built a simple module, `Mendel.pm`, to let us write programs to simulate genetic crosses. This module uses another module, `Nhash.pm`, to handle numeric hashes–hashes whose keys are strings, but whose values are numbers. To start this month, we'll divulge that module to you (see Listing 1).

Here's our blow-by-blow exegesis.

Lines 1 through 5 are boilerplate that we use in all modules: a shebang line, including the compulsory `-w` flag; an RCS ID; a package identifier; and the compulsive `use strict;` invocation.

Line 45 is also boilerplate and guarantees a successful return from `use`. Without it, the compiler may complain. Why we should have put this in isn't clear to us. If a file ends in `.pm`, and is being used, one might think the compiler could figure out to supply its own `1;` and get on with the rest of the program. We remember having to finish FORTRAN programs–does anyone else remember FORTRAN?–with

```
STOP
END
```

which annoyed us for the same reasons.

Lines 47 through 72 are the manual page, in `pod` format, which includes examples of how to use `Nhash`. In the real world, the man page would be bigger and describe each function, but we have a page limit for this column, which we'll already exceed.

We also use `Carp.pm` (line 4), which lets us call `carp()` and `croak()`, instead of `warn()` and `die()`. Why these? Suppose you're using a module, `Voting_machine.pm`, from which you call the subroutine `vote()` early and often. If it dies with a message like

```
vote fraud at
Voting_machine.pm line 14
```

you can't tell which of the many instances of `vote` in your code may have been the culprit. If, however, `vote()` is written to call `croak()`, instead of `die()`, you'll get a message like the following, instead:

```
vote fraud at ./election line 6
```

In other words, if you're a module writer creating utility routines that you expect others to call frequently, `Carp.pm` lets you issue less self-centered complaints than `warn()` and `die()`.

The remainder of the module is a suite of operators that reveal this is not just a module, but a class. What distinguishes a class from a garden-variety module? Attitude. Most of the functions in a class expect an object as the first argument. This object is a "blessed reference" to something (usually a hash, but it can be anything from a scalar to a typeglob). At least one of the functions in a class (usually `new()`) lets you construct objects. You can read more about objects that are in well written detail in `perlobj(1)`, the man page for Perl objects. For a really thorough treatment, we like *Object-Oriented Perl* by Damian Conway (published by Manning Publications Co., 1999, ISBN 1-884777-79-1).

In our class, lines 6 through 9 are our constructor. The subroutine `add_nhash()` (lines 10 through 20) adds two `Nhash` objects. Any keys that correspond in the two have their values added. Any keys in either object, but not the other, have their values preserved. `scale_nhash()` (lines 22 through 32) multiplies each value of a hash by a scaling factor. `print_nhash()` (lines 34 through 43) prints a numeric hash.

To us, the noteworthy lines are 21, 33 and 44. These let us say

```
$b = 5*$a;
```

instead of

```
$b = $a->scale_nhash(5);
```

The former is how we *think* of the operation. One way to evaluate programming-language features is to ask how hard it is to say what we mean. We do not want recursion in our languages because we need it. You can do everything with loops and stacks in FORTRAN66, which lacks recursion. We want recursion in our languages because we think about some problems recursively: How do you traverse a tree? Traverse each of its subtrees. Recursion lets us say this the way we think about it. Operator overloading gives us this, too.

Trivially, operator overloading also lets us change the names of methods without changing the code that uses them. In an earlier version, `scale_nhash()` was called `mutiply_nhash()`. When we changed the name, the damage was localized; none of code in the our examples had to change.

The awake reader is surely asking himself, why does

```
$b = 5*$a;
```

Listing 1. Nhash.pm

```
1  #!/usr/bin/perl -w
2  # $ID: Nhash.pm,v 1.10 2000/02/06 02:44:46 jsh Exp $

3  package Nhash;
4  use Carp;
5  use strict;

6  sub new {
7   my $class = shift;
8   return bless( {@_}, $class );
9  }

10 sub add_nhash {
11  my ($a1, $a2) = @_;
12  my %s;

13  croak "both args must be nhashes\n"
14   unless (ref($a1) eq 'Nhash' and ref($a2) eq 'Nhash');

15  %s = %$a1;
16  foreach (keys %$a2) {
17   $s{$_} = defined $s{$_} ? $s{$_} + $a2->{$_} : $a2->{$_};
18  }

19  Nhash->new(%s);
20 }

21 use overload ('+' => \&add_nhash);

22 sub scale_nhash {
23  my ($a1, $s) = @_;
24  my %g;

25  croak "arg must be scalar, the other an nhash\n"
26   unless (ref($a1) eq 'Nhash') && !ref($s);

27  %g = %$a1;

28  foreach (keys %g) {
29   $g{$_} *= $s;
30  }
31  Nhash->new(%g);
32 }

33 use overload ('*' => \&scale_nhash);

34 sub print_nhash {
35  my $a = shift;
36  my $s;

37  while (my ($key, $val) = each(%$a)) {
38   $s .= defined $s ? ", " : "(";
39   $val = sprintf("%0.2f", $val);
40   $s .=  "$key => $val";
41  }
42  $s .= ")";
43 }

44 use overload ('""' => \&print_nhash);

45 1;

46 __END__

47 =head1 NAME

48 Nhash - numeric hash

49 =head1 SYNOPSIS

50  use Nhash;
```

Continued on Page 44

```
51  my $a= new Nhash (Jo => .7, Jeff => .5);
52  print "a is $a\n";

53  my $b = 2 * $a;
54  print "2*a gives $b\n";

55  $b = $a * 2;
56  print "a*2 gives $b\n";

57  my $A = new Nhash (Jo => .4, Jeff => .2, Nan => .4);
58  print "A is $A\n";

59  my $c = $A + $a;
60  print "A + a is $c\n";

61 =head1 DESCRIPTION

62  Nhash handles hashes whose keys are strings, but whose values
63  are numeric. It provides operator overloading to add hashes
64  (adding values for identical keys) and to multiply the hashes
65  (i.e., all the values) by a scalar.

66  More description goes here.

67 =head1 AUTHORS

68 Jeffrey Copeland <copeland@alumni.caltech.edu>
69 Jeffrey S. Haemer <jsh@usenix.org>

70 =head1 SEE ALSO

71   perl(1)

72 =cut
```

Listing 2. Nhash.pm Output

```
a is (Jo => 0.70, Jeff => 0.50)
2*a gives (Jo => 1.40, Jeff => 1.00)
a*2 gives (Jo => 1.40, Jeff => 1.00)
A is (Jo => 0.40, Jeff => 0.20, Nan => 0.40)
A + a is (Jo => 1.10, Jeff => 0.70, Nan => 0.40)
```

work at all? Why doesn't it have to be

```
$b = $a*5;
```

It can be either, and the reason is the same as the one we confided last time about sex in ants: it is all done with mirrors.

We're sure there are folks out there who suspect us of having concocted this entire example to illustrate and play with operator overloading. Are we the kind of people that would do that? [*N.B., "Personally, I think the other Jeff probably is."–Jeff*]

Having walked you through our module, `Nhash.pm`, let's try it out. Listing 2 shows the output from the examples in the documentation.

And now, Back to our Program...

OK, all the pieces we need are in place. We'll restate our problem for those of you who either didn't read last month's column or don't remember the details.

Typical mammals have two kinds of sex chromosomes, *X* and *Y*. Normal individuals have two sex chromosomes; what they have determines their sex.

Chromosomes	Sex
XX	Female
XY	Male

(What's a *YY*? No way of guessing. To be a *YY* you'd have to get one *Y* from each parent, and you can't get a *Y* from mom.) Because fathers make equal numbers of *X*- and *Y*-bearing sperm, they have 50% sons and 50% daughters, and both sex chromosomes persist in the population. This equilibrium is also very stable: even when disease, war, predation, or some other calamity, changes the sex ratio dramatically, it bounces right back to 50:50 in the next generation of newborns.

Our tropical fish has a sex-determining scheme that looks like this:

Chromosomes	Sex
XX	Female
XY	Male
XZ	Female
YY	Male
XZ	Female

(Having a *Z* makes you female. If you lack a *Z*, having a *Y* makes you male.)

Will all three chromosomes persist or have we accidentally wound up being evolutionary peeping Toms? If they persist, what are the equilibrium proportions of the five types and the two sexes? Are the proportions stable, or will perturbing the equilibrium send us careening to a different peak in the evolutionary landscape? We've written code to find out (see Listing 3).

As you can see on line 61, we start with an example where the proportion of *XX* to *XY* is 80:20, and by the following generation it has bounced back to 50:50. After that (beginning at line 66), we try the more complicated cases of our three-chromosomed tropical fish. Listing 4 (Page 46) shows our output.

Aha. We can wind up with an equilibrium with all three chromosomes, though not necessarily in a single generation. And, when we do–at least in these examples–the sex ratio is 50:50. (Of course, that doesn't prove it always is.) Knocking the equilibrium about does matter; the last two examples each end up with a 50:50 sex ratio and all three chromosomes, but their equilibria differ. In a sense, an *XX/XY* system (or its inverse, the *YY/YZ* system used by birds and butterflies) is an extreme case of these. You can have more than two kinds of sex chromosomes and still have equilibria with 50:50 sex ratios, but batter the proportions around enough to

lose all but two, and you've lost them for good. And because populations are discrete, not continuous, that's always a real risk–especially on an evolutionary timescale.

A (Very) Little Math

But why 50:50? Last time, we sketched Sir R.A. Fisher's argument that evolution would select for such a system, but it isn't obvious that this odd system would produce one.

We posed this puzzle to our friend, Andrzej Ehrenfeucht, at the University of Colorado, a fine mathematician who walked away mumbling about systems with *N* kinds of sex chromosomes and generalized rules. Despairing of ever getting a useful answer, we went home to try to work on the problem ourselves. The next day, after far too much high-school algebra, we arrived at a proof that the sex ratio would be 50:50, no matter where we started. Excitedly, we called Andrzej, who said, "Mmm, yes...in *your* problem it will always be 50:50." He had, of course, solved the general problem. Without going through the details, we'll sketch his simple reasoning.

Suppose that each individual in a species has a pair of sex chromosomes, that each mating is between one male and one female and that each parent contributes one sex chromosome to each offspring–in other words, normal Mendelian genetics. Suppose, without loss of generality (See? Math), that at least one of these sex chromosomes is called *Y*. Finally, call the equilibrium fraction of males *p*, the frequency of *Y* in males *m* and its frequency in females *f*.

What's the overall fraction of *Y* among all sex chromosomes in all individuals in the species? Clearly, $mp + f(1-p)$. And because the next generation gets half its chromosomes from each parent, the proportion in the next generation will be $0.5m + 0.5f$. But this is an equilibrium, so either $m = f$ or $p = 0.5$.

Think about that. If there is a sort-of-sex chromosome, and an equilibrium, then that equilibrium will have a 50:50 sex ratio. By

Listing 3. Sex Test

```
1  #!/usr/local/bin/perl -w
2  # $ID: t3,v 1.9 2000/02/06 02:45:00 jsh Exp $

3  # code to try out Mendel.pm

4  use Mendel;
5  use strict;

6  use vars qw($P @males @females);

7  sub P {
8   my $t = shift;
9   my $p;

10  if (defined $P->{$t}) {
11   return $P->{$t};
12  } elsif ($t eq 'M') {
13  foreach my $m (@males) {
14    $p += $P->{$m} if defined $P->{$m};
15   }
16  } elsif ($t eq 'F') {
17  foreach my $f (@females) {
18    $p += $P->{$f} if defined $P->{$f};
19   }
20  } elsif ($t eq 'ALL') {
21   foreach my $a (@males, @females) {
22    $p += $P->{$a} if defined $P->{$a};
23   }
24  }
25  return $p;
26 }

27 sub one_gen {
28  my $totals = new Nhash();

29  foreach my $m (@males) {
30   foreach my $f (@females) {
31    next unless ($f && $m);
32    my $out = cross($f, $m);
33    next unless (P($m) && P($f));
34    $totals += ($out * ((P($m)/P('M')) * (P($f)/P('F'))));
35   }
36  }
37  $totals;
38 }

39 sub sex_init {
40  my ($sex, $proportions) = @_;

41  @males = genotypes('M', %$sex);
42  @females = genotypes('F', %$sex);
43  $P = new Nhash %$proportions;
44  die "Proportions don't add to 1" unless feq(P('ALL'), 1);
45  return $P;
46 }

47 sub feq {# floating point equals
48  my $fzero = 0.001;
49  my ($n1,$n2) = @_;
50  abs($n1 - $n2)/$n1 < $fzero;
51 }

52 sub sex_equilib {
53  foreach (0..100) {
54   printf "\t$P\n";
55   printf "\tpercent males(t=$_) = %0.2f\n\n", P('M');
56   last if feq(P('M'), 0.50);
57   $P = one_gen();
58  }
59 }
```

Continued on Page 46

"sort-of-sex chromosome," we mean that possessing it makes its bearer more likely to be one sex than the other. An extreme example of this is the *Y* chromosome in mammals, which makes its bearer a male. We're not requiring anything that extreme. Even if having a *Y* makes you a little more likely to be male, you'll end up with an even sex ratio.

Surprisingly (to us) a sex chromosome, in nearly any conventional sense, makes the number of males and females equal, almost no matter how odd the scheme is.

What kind of schemes does this logic skip over? How about the following?

Chromosomes	Sex
XX	Female
XY	Male
XZ	Male
YY	Female
YZ	Male
ZZ	Female

Here, no single-sex chromosome predisposes you to being either sex. If you have two of the same kind of sex chromosome, you're female; otherwise, you're male.

Does this always reach a 50:50 equilibrium? Can you construct a system that doesn't? We've shown you how to write code to let you explore such questions; we're eager to read the answers you send us.

(And where are all the science fiction stories about such systems? Haemer is eager to read some. Copeland, who has administered the Hugo Awards and has read a lot more bad science fiction than Haemer, knows better.)

Until next time, happy trails. ⊸

Jeffrey Copeland *(*copeland@alumni.caltech.edu*) is currently living in the Pacific Northwest, where he spends his time writing UNIX software in a large development organization and fighting damp rot.*

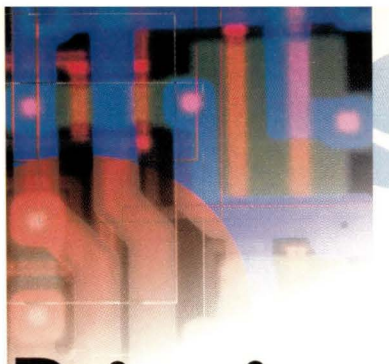
Jeffrey S. Haemer *(*jsh@usenix.org*) works at QMS Inc. in Boulder, CO, building laser printer firmware. Before he worked for QMS, he operated his own consulting firm and did a lot of other things, like everyone else in the software industry.*

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.

```
60 my (%sex, %proportions);

61 print "A simple case:\n\n";

62 %sex = (XY => 'M', XX => 'F');
63 %proportions = (XY => .2, XX => .8);

64 $P = sex_init(\%sex, \%proportions);
65 sex_equilib;

66 print "Not such a simple case:\n\n";

67 %sex = (XX => 'F', XY => 'M', XZ => 'F', YY => 'M', YZ => 'F');
68 %proportions = (XX => .3, XY => .1, XZ => .1, YY => .3, YZ => .2);

69 $P = sex_init(\%sex, \%proportions);
70 sex_equilib;

71 print "An extreme case :\n\n";

72 %sex = (XX => 'F', XY => 'M', XZ => 'F', YY => 'M', YZ => 'F');
73 %proportions = (XX => .8, XY => .1, XZ => .1);

74 $P = sex_init(\%sex, \%proportions);
75 sex_equilib;
```

Listing 4. Case Studies

```
A simple case:

   (XX => 0.80, XY => 0.20)
   percent males(t=0) = 0.20

   (XX => 0.50, XY => 0.50)
   percent males(t=1) = 0.50

Not such a simple case:

   (XX => 0.30, XY => 0.10, XZ => 0.10, YY => 0.30, YZ => 0.20)
   percent males(t=0) = 0.40

   (XX => 0.07, XY => 0.53, XZ => 0.03, YY => 0.15, YZ => 0.22)
   percent males(t=1) = 0.68

   (XX => 0.11, XY => 0.30, XZ => 0.15, YY => 0.21, YZ => 0.24)
   percent males(t=2) = 0.51

   (XX => 0.11, XY => 0.33, XZ => 0.12, YY => 0.17, YZ => 0.28)
   percent males(t=3) = 0.50

   (XX => 0.11, XY => 0.31, XZ => 0.13, YY => 0.18, YZ => 0.26)
   percent males(t=4) = 0.50

   (XX => 0.11, XY => 0.32, XZ => 0.12, YY => 0.18, YZ => 0.27)
   percent males(t=5) = 0.50

An extreme case:

   (XX => 0.80, XY => 0.10, XZ => 0.10)
   percent males(t=0) = 0.10

   (XX => 0.47, XY => 0.47, XZ => 0.03, YZ => 0.03)
   percent males(t=1) = 0.47

   (XX => 0.46, XY => 0.47, XZ => 0.03, YY => 0.01, YZ => 0.03)
   percent males(t=2) = 0.49

   (XX => 0.45, XY => 0.49, XZ => 0.02, YY => 0.01, YZ => 0.03)
   percent males(t=3) = 0.50
```



Storage Area Networks

Bringing Storage into the Networked World

SAN CONFERENCE 2000

May 30 - June 1, 2000

Doubletree Hotel
San Jose, CA

FOCUS OF INTEREST INCLUDES:

- Disk, tape, and RAID controllers
- Hubs, switches, and routers
- RAID
- Test equipment
- Storage management software
- High-availability systems
- Network management tools
- Storage subsystems
- Design, consulting, and integration services
- Disks, tapes, and CD-ROMs
- Network-attached storage (NAS)
- Cabling and interconnect
- ICs and other components
- Development tools
- Operating system utilities and drivers

SAN
conference 2000

CORPORATE SPONSORS

ADAPTEC
ANCOR COMMUNICATIONS
CMD TECHNOLOGY
INFINITY I/O
MCDATA
SOFTWORKS
TRUESAN NETWORKS
VMIC

LEAD MEDIA SPONSORS

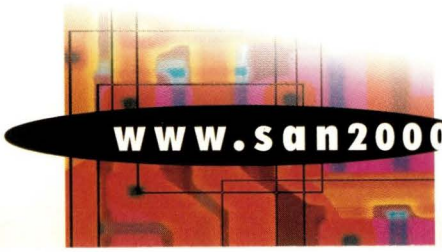
COMPUTER TECHNOLOGY REVIEW
STORAGE INC.
STORAGE MANAGEMENT SOLUTIONS

MEDIA COSPONSORS

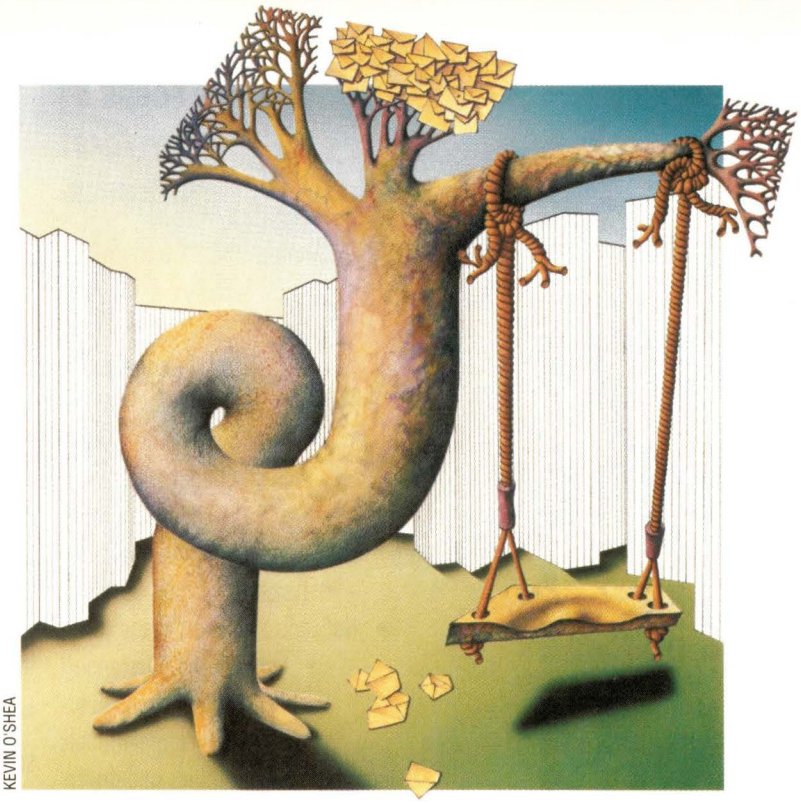
BUSINESS COMMUNICATIONS REVIEW
BUSINESS SOLUTIONS
COMMUNICATIONS NEWS
MASS STORAGE NEWS
SERVER/WORKSTATION EXPERT

For more information about SAN CONFERENCE 2000:

www.san2000.com/sw
e-mail: conference@sanconference.com
800.351.6000 • 408.297.8484 • Fax 408.291.8679



by Jim Frost



KEVIN O'SHEA

Trees, Glorious Trees

The two most interesting Swing widgets for most developers are the `JTable` and the `JTree`. In previous months, our effort to produce a Java-based IMAP client has focused on how to manage a `JTable`; at this point, our message summary panel that's implemented with the `JTable` is useful, if not polished. We'll get back to it when we're cleaning up the interface, but for now it's time to turn our attention to the folder selection panel and its `JTree` widget.

To save space, only the portion of code that we're actively discussing is shown here. You can download the complete code package from `ftp://ftp.expert.com/pub/JavaClass/04.2000/postal.tar`.

Design and Implementation

The design of the `JTree` widget is very similar to that of the `JTable`: the `JTree` widget acts as a layout and display front end for data in a tree format that is maintained by a `TreeModel`. A `TreeModel` maintains a set of `TreeNode` objects, and these are what are rendered by the `JTree`.

As with the `JTable`, there is usually a little effort necessary to customize the model for the particular task at hand, but unlike the `JTable`, the standard tree model (`DefaultTreeModel`) is usually useful as is. Rather, the effort goes into customizing the individual nodes. This is particularly the case if, as in our folder selection widget, you would like to populate the tree as the user drills down into it rather than reading it all up-front.

The `FolderSelector` class (see Listing 1) implements the panel that displays our tree of folders for the user to select from. Its constructor assembles the basic parts of the `JTree`: the *root node*, under which all other nodes will be placed; the *model*, into which the root node is placed; and the `JTree` component itself, which renders the model and its associated nodes.

We want our folder selector to display a tree for each server that Postal can interact with, but the `JTree` only allows a single root node. To get our intended effect, we create a dummy root node and instruct the `JTree` not to display it by calling `JTree.setRootVisible(false)`. As we will discover later, this creates a small complication.

A Maze of Twisty Little Nodes

Every node in the tree model must implement the `TreeNode` interface. This interface describes a *static* node: one that cannot change throughout its life. You can't add or remove children from it once you've created it. Usually this is not what you want, so there is a `MutableTreeNode` interface that defines standard methods for dynamically modifying a node. The standard implementation of the `MutableTreeNode` is the `DefaultMutableTreeNode` (whose name, while descriptive, is irritatingly long since you're going to use it a lot). We'll construct our tree out of instances of `DefaultMutableTreeNode` or of subclasses.

Our invisible root node is just a placeholder for servers that are defined as part of Postal's configuration, so no specialization is necessary for that node and we simply create a `DefaultMutableTreeNode` to act as the root. All of the children of this node represent IMAP servers, and their children (and their children's children) represent actual folders on the servers. For performance reasons, we'd prefer to delay the connection to the server and the downloading of all of its folders for as long as possible. This requires some `TreeNodes` that are a little smarter than average.

We have two types of nodes, *servers* and *folders*, so we create two classes to implement them called: `ServerNode` and `FolderNode`. Both of these have some common functionality in that they want to dynamically load their contents. This means they have to override a few of the standard `DefaultMutableTreeNode` methods so that the contents can be loaded the first time they are needed. Because this functionality is common to both nodes, we create a common superclass for them both, `AbstractSelectorNode`, which overrides the appropriate `DefaultMutableTreeNode` methods and calls the `refresh()` method if necessary.

Both the `ServerNode` and `FolderNode` must implement the abstract `refresh()` method, and in each case they call the appropriate method to obtain the list of folders or subfolders and add them as children.

The `ServerNode` contains one other specialization. The `JTree` needs to know whether or not a node has (or can have) children so that it can display the appropriate gadgets next to the node. A `ServerNode` will always have at least one child folder, but we don't want to ask for the list of folders until the server is actually selected–both for performance reasons and because we may have to prompt the user for a password and we don't want to do that if we don't have to. To force the `JTree` to display the node as a folder, we override the `isLeaf()`

Listing 1. The FolderSelector Class

```
public class FolderSelector
  extends JScrollPane
  implements TreeSelectionListener, ServerListener
{
  private Dispatcher dispatcher;
  private JTree tree;
  private DefaultTreeModel model;
  private DefaultMutableTreeNode root;

  public FolderSelector(Dispatcher dispatcher)
  {
    this.dispatcher = dispatcher;
    root = new DefaultMutableTreeNode();
    model = new DefaultTreeModel(root);
    tree = new JTree(model);
    tree.setRootVisible(false);
    tree.getSelectionModel().addTreeSelectionListener(this);
    setViewportView(tree);

    // add ourselves as a listener for server events.
    dispatcher.addServerListener(this);
  }

  // ServerListener interface implementation

  /** Called whenever a server is added. */
  public void addedServer(Server newServer)
  {
    ServerNode serverNode = new ServerNode(newServer);
    model.insertNodeInto(serverNode, root, root.getChildCount());
    tree.expandPath(new TreePath(root.getPath()));
  }

  /** Called whenever a server is removed. */
  public void removedServer(Server newServer)
  { /* not yet implemented */ }

  // TreeSelectionListener interface implementation

  public void valueChanged(TreeSelectionEvent e)
  {
    TreePath path = e.getNewLeadSelectionPath();
    if ((path == null) || (path.getPathCount() < 1))
       dispatcher.fireFolderSelectionEvent(null);
    else {
       // last element in path is the node that has been selected
       AbstractSelectorNode node = (AbstractSelectorNode)
                        path.getPathComponent (path.getPathCount() - 1);
       // if this is a server node, expand on selection
       if (node instanceof ServerNode)
           tree.expandPath(new TreePath(node.getPath()));
       dispatcher.fireFolderSelectionEvent(node.getFolder());
    }
  }

  // Inner classes

  /** An abstract class used as a base class for the folder selector's
   *  tree nodes. This overrides several methods in its superclass to
   *  get on-demand child node population. */
  abstract class AbstractSelectorNode extends DefaultMutableTreeNode
  {
    private boolean valid;

    public abstract Folder getFolder();

    protected abstract Server getServer();

    abstract void refresh();

    protected boolean isValid() { return valid; }
```

Continued on Page 50

```
  protected void markValid() { valid = true; }

  public Enumeration children()
  {
    if (!valid)
        refresh();
    return super.children();
  }

  public TreeNode getChildAt(int index)
  {
    if (!valid)
        refresh();
    return super.getChildAt(index);
  }

  public int getChildCount()
  {
    if (!valid)
        refresh();
    return super.getChildCount();
  }

  public int getIndex(TreeNode node)
  {
    if (!valid)
        refresh();
    return super.getIndex(node);
  }

  /** New implementation of add() that avoids calling our
   *  implementation of getChildCount(). This is necessary to
   *  avoid infinite recursion problems.
   */
   public void add(MutableTreeNode newNode)
   {
    insert(newNode, super.getChildCount());
   }
}

/** A tree node that is used to represent a Server object. */
class ServerNode extends AbstractSelectorNode
{
  private Server server;

  private Folder defaultFolder;

  ServerNode(Server server) { this.server = server; }

  public Folder getFolder() { return null; }

  protected Server getServer() { return server; }

  protected void refresh()
  {
    // retrieve a list of folders from the server and populate
    // the server node with them as its children.
    Enumeration folderEnum = server.listFolders();
    if (folderEnum != null) {
        while (folderEnum.hasMoreElements()) {
          Folder folder = (Folder)folderEnum.nextElement();
          add(new FolderNode(folder));
        }
    }
    markValid();
  }

  public boolean isLeaf()
  {
    return false; // a server node is never a leaf
  }

  public String toString()
  { return server.getDescription(); }
}
```

method, which returns true or false depending on how many children the node has, and force it to always return false.

Some Complications

Now that we've built the model, we have to provide a way to populate it with servers. We do this with the `FolderSelector.addedServer()` method, one of the callbacks of the `ServerListener` interface, and here's where we find that complication I mentioned earlier.

By default, `JTree` nodes are closed (their children are hidden). In our case, however, we've hidden the root node of the tree–thus hiding all of its children. We want to force the root node to be expanded so that all of the server nodes are visible all the time. Fortunately, the `JTree` provides a very nice method, `expandPath()`, for doing exactly that. This method is a little awkward to use because it wants a list of all the nodes between the root and the node you're really interested in, so that it can expand all of them. Fortunately, the `DefaultMutableTreeNode` object has a utility method, `getPath()`, that returns this list of objects. However, it returns it as an array, not as the `TreePath` object required by `expandPath()`, so you must create a new `TreePath` object for the path returned by `getPath()`. A little balky, but not too bad.

Now, you'd think that all we have to do is to force the root node to be expanded right after we create it and everything will be happy. Unfortunately, that doesn't work (presumably because you cannot open the root folder until there is something in it), so we instead force expansion right after we add server nodes to the root in the `addedServer()` method.

User Interaction

At this point, our folder selector allows the user to walk through the configured servers and all of their folders. All we have to do now is add the ability to notify the message selector when a new folder is selected.

As with the message selector, the `JTree` generates selection events, but

unlike the JTable, these selection events actually have the information we want in the event. This simplifies selection management considerably.

We've set up our tree object to allow only one selection at a time. This makes sense because we can display only one folder at a time and folder-wide operations (such as delete) are rare enough that there's little gain in supporting multiple selections. Because we can only have one folder selected, we use the get NewLead SelectionPath() method to retrieve the Tree Path to the newly selected folder from the TreeSelection Event. If this fails (for example, because the selection was cleared), we send a null folder selection event, causing the message selector to clear out its table.

```
class FolderNode extends AbstractSelectorNode
{
  private Folder folder;

  FolderNode(Folder folder) { this.folder = folder; }

  public Folder getFolder() { return folder; }

  protected Server getServer()
  {
    return ((AbstractSelectorNode)getParent()).getServer();
  }

  protected void refresh()
  {
    Folder[] childFolders;
    try {
        childFolders = folder.list();
    }
    catch (MessagingException e) {
       dispatcher.fireErrorEvent
                ("Cannot list child folders for " + folder.getName(), e);
       childFolders = null;
    }
    if (childFolders != null) {
        for (int i = 0; i < childFolders.length; i++) {
          add(new FolderNode(childFolders[i]));
       }
    }
        markValid();
    }

  public String toString() { return folder.getName(); }
 }
}
```

A lot of programmers like to build nice, consistent user interfaces that behave the same way regardless of context. This makes for clean programming but it can be irritating for a user, either because it's not intuitive or because it causes additional effort. A really good example of where this falls down is in the Open Look interface Sun Microsystems Inc. promoted for years. Menus were always hooked up to the third mouse button and the first mouse button meant either "select" or "do something." Where AT&T Corp. (who designed Open Look) went wrong is with menu bars: it had the first mouse button fire an action on the menu, rather than dropping the menu. If you wanted to *see* the menu you had to use the third mouse button.

I always found this terribly confusing because menu bar items would act like buttons when what I really wanted was to see the menu. Perhaps part of the confusion was the result of having used a number of other GUIs that had this particular interaction model, but I don't think so. I think that firing the default menu action was an option to the menu (and therefore should have been bound to the option button) rather than the primary function of the menu bar item. So, while the interface was arguably consistent, it was confusing.

While playing around with Postal during development of the folder selector I noticed a similar issue with the interface. Simply selecting a folder should cause a login process to occur, if it hasn't already. This may require the user to be prompted for a password. Unfortunately, the dialog box for the prompt will intercept the second click in a double-click, thus making the user select, enter their password, then go back and double-click to see the server's folders. This is much more effort than is necessary and is something you'll do each time you start the program. To smooth out this wart, the selection handling code watches for server selections and, when it sees them, forces the folder to expand. Now when you're done with logging into the server, the folders are already visible. This small change made the interface a lot smoother, although it violates the consistency where a double-click is usually necessary to open or close a folder.

There's still a minor glitch in the interface: the selection event that causes the server login process invokes a modal dialog. This happens on mouse-down, and by the time mouse-up occurs, mouse events are locked out from the selector panel. This causes a beep to occur. It's a little complicated to fix so we'll leave it for another column.

A Few Other Things

In addition to filling out the folder selection panel, this month's version implements a password-prompt dialog so that passwords don't have to be stored in the configuration file, and implements a configuration file loader that allows multiple IMAP servers to be defined. We don't have the space to describe them here, but take a look at the PasswordRequestor interface, the PasswordDialog class and the Configuration class in the source package.

At this point in the development process, we have a reasonably functional mail reader. It's still only doing half what even the simplest mail client must do, however. Next month, we'll add the other half when we implement a message composer. ⊸

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

Demystifying Object Options

Whether you're a shop that prefers to build your own components or not, the good news is distributed computing is getting easier. Today, the field has narrowed to two competing architectures: J2EE and Windows 2000 DNA.

A year ago, you lost sleep over competing object models. Should you buy into Microsoft Corp.'s Component Object Model (COM) or standardize on more open models such as Sun Microsystems Inc.'s Enterprise JavaBeans (EJBs) or Object Management Group's Common Object Request Broker Architecture (CORBA) that pretty much everyone else was embracing? Today, the field has narrowed and it's more a question of competing architectures: the Microsoft Windows 2000 Distributed Internet Architecture, or DNA (see Figure 1), on one hand, and the IBM Corp. and Sun-Netscape Alliance Java 2 Enterprise Edition, or J2EE (see Figure 2), on the other. Either one of them can serve as the foundation of an organization's distributing computing environment–and both want to be the market leader.

Unfortunately, both of these architectures are still works in progress, and although the future seems to hold the

by Karen Watterson

STEVE ALEXANDER

promise of an object-agnostic, service-centric world greased by technologies such as eXtensible Markup Language (XML) and Simple Object Access Protocol (SOAP), we're not there yet.

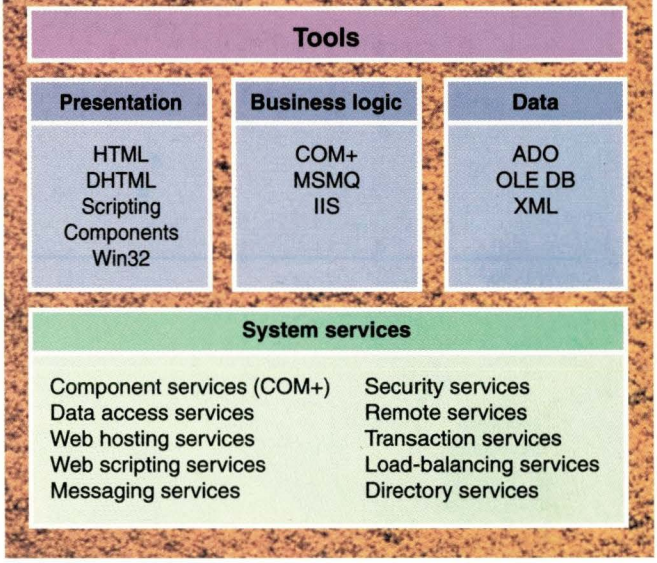
Components for Sale

We have made progress, though. Today, when you build distributed applications, it's becoming a lot easier to adopt a "best-of-breed" approach–buying some components, building others and accessing yet others embedded in other organizations' applications. Perhaps the world of "software IC chips" that Brad J. Cox outlined in his seminal *Object-Oriented Programming: An Evolutionary Approach* (published by Addison-Wesley Publishing Co., 1991, ISBN 0201548348) is finally becoming a reality. Michael Blechar, vice president and research director of application development tools and technology for Stamford, CT-based market research firm Gartner Group Inc., thinks so. "By 2003, at least 70% of the total number of new applications will be built primarily from 'building blocks' such as software components and application frameworks, increasing both products speed to market and enterprises ability to cope with change."

There's evidence to support Blechar's claim. Consider, for example, the emergence of component brokers such as ComponentSource, Marietta, GA, and Flashline.com Inc., Cleveland, OH. ComponentSource, which was founded in the United Kingdom in 1995, has built the world's largest repository (more than 2000) of open-market software components for all leading platforms. Although COM components currently represent the lion's share, ComponentSource has a growing inventory of Java components. Flashline, probably the second largest component vendor, offers some 400 discrete COM and Java components. It's interesting to see how the two companies categorize their offerings. ComponentSource categorizes components a variety of ways (see Table 1), not only by component type but by tool type, for example, applet, servlet, add-in or wizard; by source code language; by compatible containers, for example, Visual Basic 6, Delphi 5, or VisualAge C++; and by component function, for example, financial or file-handling components.

Flashline, launched in late 1998, has established four major categories: Java products, COM products, developer tools and beta beans. Java components are further categorized as EJBs, Internet/Web components, user interface (UI) components, information management components, network components, or training components. COM objects are similarly categorized by function: UI, information management, Internet, or training.

Figure 1. Windows 2000 DNA Architecture



Source: Microsoft Corp., Redmond, WA

Why should you be interested? Well, we're fundamentally talking about the age-old buy vs. build argument. In today's Internet time, the argument seems to be in favor of buying market-tested tools; and quality assurance is essentially a service offered by the component brokers. The brokers are attracting tool vendors you might not expect, such as EDS Corp., Plano, TX, a supplier of e-business management tools and information solutions. According to Gary Barnett, analyst with London, U.K.-based research and IT consulting company Ovum Inc., "This kind of initiative is exactly what is needed to boost the open market for components." Big Five consultancy PricewaterhouseCoopers LLP, New York, NY, meanwhile, predicts the open market for software components will be worth $1 billion by 2002.

What Exactly are Components?

According to Neil Ward-Dutton, Ovum Principal Consultant and co-author of the 1998 report, *Componentware: Building it, Buying it, Selling it*, a software component is a unit of software that "implements some known function and hides the implementation of that function behind one or more unambiguous 'interfaces' that it exposes to its environment." In other words, components know something about themselves and can be interrogated.

Ward-Dutton thinks the component market can be usefully divided into only two major categories: technical services and business components. Technical services components are associated with tasks like

Table 1. Component Types According to ComponentSource

ActiveX (OCX)	VisualAge C++ Class Library
ActiveX Designer	Static Link Library
Dynamic Link Library (DLL)	Windows Foundation Class (WFC)
Visual Basic Extension (VBX)	COM Object/ActiveX DLL/In-Process Server
Visual Component Language (VCL)	COM Object/ActiveX EXE/Out-of-Process Server
Visual Basic Class Library	COM Add-in for Office 2000

database connectivity, security, interprocess communications (IPC), or handling UI functions. Business components, on the other hand, typically handle middle-tier business logic and encapsulate business rules.

For Microsoft, components are basically COM objects. If today's COM objects are third-generation components (earlier generations were called Visual Basic Extensions, or VBXs, and ActiveX Controls), fourth-generation COM objects, which will be part of Microsoft's Next Generation Windows Services, are far more likely to be associated with Web services. For example, COM+, which is part of Microsoft's Windows DNA 2000 framework (`http://www.microsoft.com/dna`), doesn't refer so much to an object model or components as to Windows' role in delivering component services. Ovum's Ward-Dutton says the value proposition of components is morphing from one of providing services to individual enterprises to a broader one of providing services for Internet communities.

Sun, of course, sees components a bit differently. In the glossary on its `http://java.sun.com/developer` site, it defines the J2EE platform as an environment for developing and deploying enterprise applications, which consists of a set of services, APIs and protocols that provide the functionality for developing multitiered, Web-based applications. The J2EE platform defines four types of components: enterprise beans, Web components, applets and application clients.

An enterprise bean is a component that implements a business task or business entity, and can be either an entity bean or a session bean. An entity bean is an enterprise bean that represents persistent data maintained in a database and can either manage its own persistence or delegate this function to its container. Entity beans are always identified by a primary key. Session beans, as you might expect, usually exist only for the duration of a single client/server session. They're enterprise beans that have been created by a client to perform operations such as calculations or database access. They can be stateless or maintain state via their EJB container.

The second type of component in Sun's J2EE view of the world includes Web components. These come in two flavors: servlets and JavaSever Pages (JSPs). A servlet is a Java program that extends the functionality of a Web server, generating dynamic content and interacting with Web clients using a request-response paradigm, while a JSP is a text-based document using fixed-template data and JSP elements that describe how to process a request to create a response. JSPs are essentially Sun's response to Microsoft's Active Server Pages (ASPs). The goal of JSPs is to make it easy for programmers to script Web sites using a combination of HTML, XML and calls to components. As of early 2000, Sun is working closely with the non-profit Apache Software Foundation (`http://www.apache.org`) to hasten the latter's support for JSPs and XML.

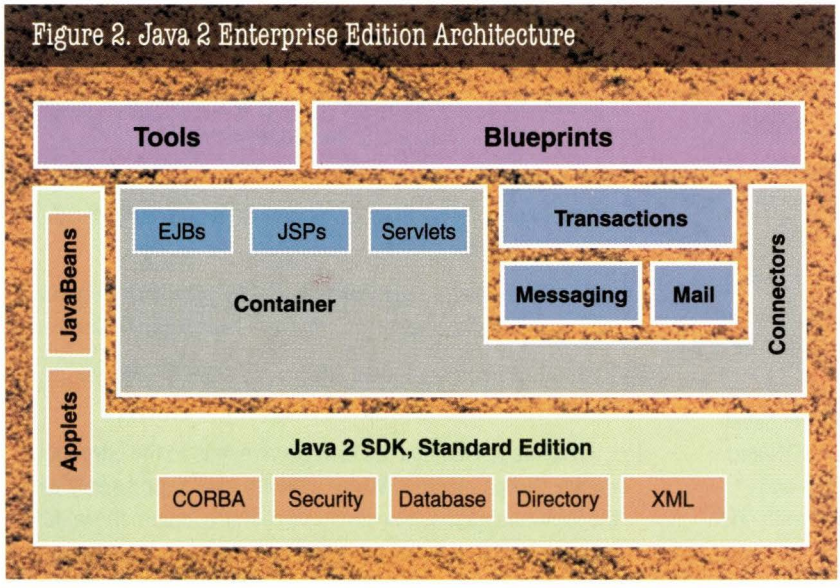
JSPs are essentially Sun's response to Microsoft's ASPs. The goal of JSPs is to make it easy for programmers to script Web sites using a combination of HTML, XML and calls to components.

The other two types of components from Sun's point of view are client components: applets, which are Java components that usually execute in a Web browser, and application clients, which are basically Java programs that execute in a Java Virtual Machine.

So much for a brief survey of the component landscape circa early 2000. As the new millennium dawns, you'll still find passionate debates about object models; see, for example, "EJB vs. COM+," a debate hosted by the Austin Foundation for Object-Oriented Technology (AFOOT) at `http://www.middleware-company.com/debate.html`. In this debate, Roger Sessions, founder of ObjectWatch Inc., Austin, TX, and sometimes viewed as Microsoft's poster boy for COM and COM+ (he had been associated with CORBA), weighs in against Ed Roman, chief executive officer of The Middleware Co., Austin, TX. Both have written popular books promoting their respective preferences.

In the debate, Roman points out that "the new idea with components is that you declare the needs that you have on the middleware side of things by setting properties on your comp1onents and then the application server fulfills those properties. So, for example, with CORBA, you would use a transaction API to begin and commit a transaction. With EJB, instead of doing that, you can just set a property on your component that says, 'I always need a transaction when my component runs,' and the container will make sure this always happens. This saves you time, because you don't have to program to these APIs anymore." He also points out that there's a "big laun-

Figure 2. Java 2 Enterprise Edition Architecture



Source: Sun Microsystems Inc., Palo Alto, CA

dry list" of things that we rely on middleware to do in distributed applications, and that it's not the kind of stuff you want to write yourself. Although many companies have been "home brewing" this stuff in the past, what you really want to do is let the professionals handle this–professionals like IBM, Sun, BEA Systems Inc. and Oracle Corp. They ship products that handle all of this middleware plumbing for you. Their products are called application servers. Application servers give you these middleware services, allowing you to buy rather than build, Roman says. In EJB terms, an application server is called an EJB container or an EJB server.

Roman stresses that middleware is hard to write and that basic middleware services already exist in the form of application servers. What he doesn't say is that many application servers support both COM objects and EJBs. In fact, many organizations don't give–pardon the pun–a bean about which object model an application server uses. They want a product that solves a business task and provides services.

Is Software Dead?

Marc Benioff, chief executive officer of dot-com start-up Salesforce.com, San Francisco, CA, reportedly said at this year's IDG DEMO 2000, held in February in Indian Wells, CA, that "software is dead." Perhaps taking a cue from his erstwhile boss Larry Ellison, who two years earlier declared that "client/server is dead," Benioff was saying that his company provides the service associated with sales force automation software. Forget about buy vs. build arguments. Forget about beans vs. COM objects. Salesforce.com will provide the service for you.

Whether you think of today's hosted application services as a throwback to the days of timesharing or just another form of outsourcing, the point is they're often a cost-effective alternative. According to Tony Wind, vice president of research and development and product management for Seagate Software, Scotts Valley, CA, a vendor of decision support and business intelligence software, including Crystal Reports, Crystal Info and Holos, Seagate is considering host-

Interview with David Gee

David Gee, newly hired vice president of marketing for Sun Microsystems Inc.'s Software Products and Platforms (SPP) division, granted *SW Expert* an interview from Cebit 2000, Hannover, Germany.

SWE: Will Sun ever become an enterprise software vendor–more than just a hardware vendor that sells management and operating systems software in order to drive hardware sales?

Gee: I joined Sun about three months ago from IBM in order to build Sun into a world-class software player. With Forté, StarOffice and NetBeans, we've made three major software acquisitions in recent months, and we'll make more acquisitions as needed. I want SPP to provide an end-to-end story: from Solaris and all flavors of Java to iPlanet, StarOffice and Forté Fusion. We're working on integration now, and we've already got an Early Access version of StarPortal available.

SWE: There was some initial confusion in the market about whether you were promoting iPlanet as a portal or portal builder. How are you going to integrate it into the mix?

Gee: iPlanet has its own branding. Although the aim is to bring all the software under the SPP umbrella, iPlanet, for various legal reasons, will have to remain an outlier for the next 12 to 18 months.

SWE: What are you doing to get your message out to the developer community better, like Microsoft does with MSDN and TechNet, and like IBM does with its developerWorks and alphaWorks? Even Oracle's doing a pretty good job with OTN, the Oracle Technology Network.

Gee: I'm firmly committed to developers. I'm hiring some awesome team members who know how to reach out to developers and I've set MSDN and developerWorks up as benchmarks. Do you know the Java Developer Network has 1.7 million members? Well, I want to be a lot more in their face.

SWE: 1.7 million members is impressive, but what about the 7 million Visual Basic coders Microsoft claims, for example?

Gee: Look for our new ad campaign targeting "Uber coders." Seriously, though, I'm going to take the message worldwide. Do you realize that JavaOne is already the single largest developer event in the world? And we had 25% more presentation submissions this year than last. I want to make it clear that Java is *the* platform. It's the only one that you can count on to scale from servers to embedded devices.

SWE: What happened to the 100% Pure Java program? Are component vendors like ComponentSource making certification irrelevant?

Gee: No, we're going to rejuvenate it. Certification will be increasingly important as platforms and form factors proliferate.

SWE: Sun has been quoted as saying JSPs are the way to go, as opposed to servlets. Is this correct?

Gee: Absolutely. We need JSPs to serve pages to the burgeoning mobile device market. We are working very aggressively with the Web and application server vendors to ensure the widest support for JSPs. That's very high on my agenda right now.

ing report servers for its customers. For "commodity" services, hosted applications seem to make economic sense. Of course, there are cultural, political and security issues associated with the decision to go with an application service provider, and each organization needs to work up its own costing model.

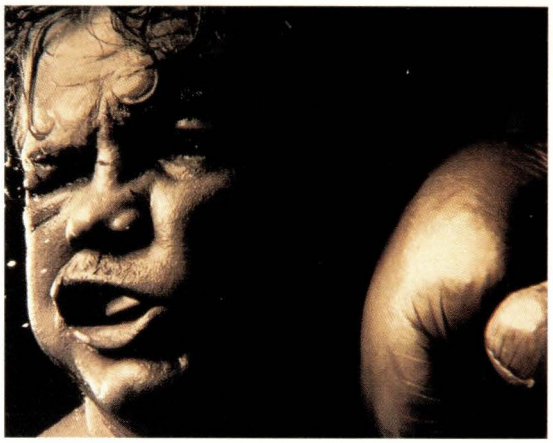
Enterprise Application Integrators

The fact is most organizations want their applications (and their components) to communicate intelligently and efficiently with one another. Today, enterprise application integrators (EAIs) promise to help glue together your applications. They may add "wrappers" around legacy applications the way Seattle, WA-based host connectivity vendor WRQ Inc.'s new Apptrieve, or Bellevue, WA-based Attachmate Corp.'s eVantage products do. EAIs generally provide custom middleware that does the application integration and maintains a repository. They may provide you with either enterprise "portals" or the tools to build your own. According to Framingham, MA-based research and consulting company Hurwitz Group, the major EAIs include Active Software Inc., Santa Clara, CA; Neon Systems Inc., Sugar Land, TX; Software Technologies Corp., Monrovia, CA; Tibco Software Inc., Palo Alto, CA; and Vitria Technology Inc., Sunnyvale, CA. According to Bill Roth, product manager for Java enterprise products at Sun, "EAI is a symptom of a problem. It should ultimately be a feature of a larger product"–referring to the possibility of providing the glue via J2EE's connectors.

Whether you think of today's hosted application services as a throwback to the days of timesharing or just another form of outsourcing, the point is they're often a cost-effective alternative.

Unfortunately, the application server/EAI market today is extremely crowded as old guard client/server and business intelligence vendors, along with newer Web server vendors, scurry to reposition themselves as your one-stop shopping source for distributed services. Even database vendors like Oracle, Redwood Shores, CA, and enterprise resource providers (ERPs) like SAP America Inc., Newtown Square, PA, are weighing in with ventures such as Oracle Business OnLine (`http://www.oracle.com/businessonline`) and MySAP.com (`http://www.mysap.com`).

Ovum's Ward-Dutton estimates there are between 20 and 30 application servers, and lists BEA Systems, Sunnyvale, CA; Iona Technologies Inc., Waltham, MA; Inprise Corp., recently acquired by Corel Corp., Ottawa, Ontario; Progress Software Corp., Bedford, MA; IBM (WebSphere), Armonk, NY; and the Sun-Netscape Alliance (iPlanet), Mountain View, CA; as some of the top players.



LOTS OF HITS KNOCKING YOU OUT?

Fight back with digitalNATION, the world's leading dedicated server company.

Put our world-class data center in your corner.

- Uninterruptible power supply with 99.8% network uptime
- Connections to more than a dozen Internet backbones
- Total control over your server
- Industry's best performance guarantee
- 100% Cisco-powered network®
- Server monitoring 24/7
- All server hardware and maintenance provided
- 50 GB transfer/month
- Dedicated 10 MB connection
- Over 5 years experience hosting Sun® dedicated servers

LET US BUILD YOU A CUSTOMIZED SUN DEDICATED SERVER OR...

CONSIDER THIS FEATURED SUN PACKAGE:

Ultra 2 — Dual
256 MB
9 GB SCSI — Drive 1
9 GB SCSI — Drive 2
4 IPs
Apache webserver

$1,500 Monthly

NT®, LINUX® AND COBALT® SERVERS ALSO AVAILABLE.

digitalNATION
A VERIO COMPANY
877.565.1999
(Toll Free)
5515 Cherokee Avenue
Alexandria, Virginia 22312
email: sales@dn.net

www.dedicatedserver.com

Circle No. 21

Works in Progress

As mentioned earlier, the major competing object models from Sun and Microsoft are both works in progress. Microsoft needs to deliver SQL Server 2000, Commerce Server 2000 and Host Integration Server before the first stage of Windows DNA 2000 is really complete. And it's not expected to deliver the next version of Visual Studio, which will allow programmers to create next-generation COM+ Web components until sometime in 2001. (Visual Basic will also be gaining support for true inheritance in that release of Visual Studio.)

BizTalk represents a major departure for Microsoft because it moves Microsoft from a technology focus to a Web services focus, albeit in a nonrevenue-generating mode.

More interesting, perhaps, is how "open" Microsoft's Next Generation Web Services will really be. XML and the SOAP protocol seem to be poised to liberate Microsoft customers from the chains of COM. But one Microsoft independent software vendor (ISV) who requests anonymity says, "The shift of Microsoft from proprietary technology to supporting a standard such as XML, even at the component level, is a bit curious–and makes me wonder what tricks they have up their sleeves."

He's not alone. Will customers essentially have to buy into Microsoft's version of XML and its BizTalk server in order to do e-commerce with COM-centric partners?

The idea seems to be that anyone is welcome to develop a set of XML schemas that conform to the BizTalk Framework. These schemas are then submitted to the BizTalk.org ("org" has such a nice nonproprietary sound, doesn't it) Web site (`http://www.biztalk.org`) for testing and validation, before being made publicly available. The BizTalk steering committee, which consists of key industry influencers, including the American Petroleum Institute, Baan Co., Boeing, Clarus Corp., Commerce One, Concur Technologies, the Data Interchange Standards Association (DISA), J.D. Edward & Co., Merrill Lynch, Microsoft, Open Applications Group (OAG), PeopleSoft Inc., RosettaNet and SAP, reviews and approves the final BizTalk Framework specification.

Then, individuals or organizations can use published, public XML schemas from BizTalk.org within their applications.

Companies Mentioned in this Article

Active Software Inc.
3333 Octavius Drive
Santa Clara, CA 95054
http://www.activesoftware.com
Circle 150

Attachmate Corp.
3617 131st Ave. S.E.
Bellevue, WA 98006
http://www.attachmate.com
Circle 151

BEA Systems Inc.
2315 N. First St.
San Jose, CA 95131
http://www.beasys.com
Circle 152

ComponentSource
2878 Johnson Ferry Road, Ste. 150
Marietta, GA 30062
http://www.componentsource.com
Circle 153

Corel Corp.
1600 Carling Ave.
Ottawa, Ontario
Canada K1Z 8BR
http://www.corel.com
Circle 154

Flashline.com Inc.
1300 E. 9th St., Ste. 1310
Cleveland, OH 44114
http://www.flashline.com
Circle 155

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

Iona Technologies Inc.
200 West St.
Waltham, MA 02451
http://www.iona.com
Circle 156

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
http://www.microsoft.com
Circle 157

Neon Systems Inc.
14100 Southwest Freeway
Ste. 500
Sugar Land, TX 77478
http://www.neonsys.com
Circle 158

ObjectWatch Inc.
11414 Pencewood Drive
Austin, TX 78750
http://www.objectwatch.com
Circle 159

Oracle Corp.
500 Oracle Pkwy.
Redwood Shores, CA 94065
http://www.oracle.com
Circle 160

Progress Software Corp.
14 Oak Park
Bedford, MA 01730
http://www.progress.com
Circle 161

Salesforce.com
101 Spear St., Ste. 203
San Francisco, CA 94105
http://www.salesforce.com
Circle 162

SAP America Inc.
3999 West Chester Pike
Newtown Square, PA 19073
http://www.sap.com
Circle 163

Seagate Software
920 Disc Drive
Scotts Valley, CA 95067
http://www.seagatesoftware.com
Circle 164

Software Technologies Corp.
404 E. Huntington Drive
Monrovia, CA 91016
http://www.stc.com
Circle 165

Sun Microsyems Inc.
901 San Antonio Road
Palo Alto, CA 94303
http://www.sun.com
Circle 166

Sun-Netscape Alliance
501 E. Middlefield Road
Mountain View, CA 94043
http://www.iplanet.com
Circle 167

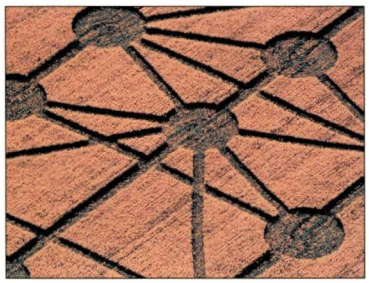
The Middleware Company
12405 Alameda Trace Circle, Ste. 1137
Austin, TX 78727
http://www.middleware-company.com
Circle 168

Tibco Software
3165 Porter Drive
Palo Alto, CA 94304
http://www.tibco.com
Circle 169

Vitria Technology Inc.
945 Stewart Drive
Sunnyvale, CA 94086
http://www.vitria.com
Circle 170

WRQ Inc.
1500 Dexter Ave. N.
Seattle, WA 98109
http://www.wrq.com
Circle 171

Businesses will also have the option of publishing the schemas on a secure Web site for private use between trading partners. The goal is to get a set of common XML schemas that are tuned to promote the most popular types of e-commerce and business-to-business (B2B) transactions. The Hurwitz Group sees BizTalk as representing a major departure for Microsoft because it moves Microsoft from a technology focus to a Web services focus, albeit in a nonrevenue-generating mode (at this time), and that BizTalk sets the stage for a grander vision that could put Microsoft at the center of an XML e-commerce hub.



Sun needs to beef up the current release of J2EE and EJB 1.1 with EJB 2.0 in order to provide better support for persistence and messaging (partners couldn't agree on a reference implementation for the Java Message Service). And, as far as the J2EE platform goes, some developers are beginning to speak of code bloat, a criticism generally reserved for Microsoft. J2EE consists of nine technologies: EJB 1.1, CORBA, JSPs, the Java Servlet API, the Java Naming and Directory Interface (JNDI), Java Database Connectivity (JDBC), the Java Message Service, Java Mail and the evolving Java XML. It's probably still not as big and complicated as CORBA or Distributed Computing Environment (DCE), but some members of the Java community seem to be beginning to wonder if J2EE isn't beginning to look like a product designed by committee. Sun's Roth says we can expect a maintenance release for J2EE this spring and EJB 2.0 sometime in 2001.

But whether you're a shop that prefers to build your own components–or at least, some of them–or not, the good news is that distributed computing really is getting easier. XML and the Microsoft-drafted SOAP, a protocol based on XML that promises to handle remote procedure calls across the Internet in a nonproprietary fashion, seem destined to provide the glue that makes distributed computing a "given"–the way object-oriented programming and components are today.

No, we haven't solved all the problems associated with distributed computing. There are still legacy applications (and proprietary repositories) to integrate. We're still developing standards to integrate mobile and wireless devices into our new distributing computing models. Developers are getting more adept at creating modular components. We just need better tools and servers that let us mix and match them. ➸

Karen Watterson is an independent San Diego, CA-based consultant who specializes in database and data warehouse design. She's editor of industry newsletters on Visual Basic and SQL Server and has just completed a book on SQL Server, *10 Projects You Can Do with Microsoft SQL Server*. Email: karen_watterson@email.msn.com.

Server/Workstation REPRINTS

Keep up with the latest in server and workstation technology with the best minds in the industry. Use reprints to promote, inform, and sell.

Reprint Management Services™ provides you the opportunity to obtain reprints of reviews, articles, and features in ***Server/Workstation Expert***.

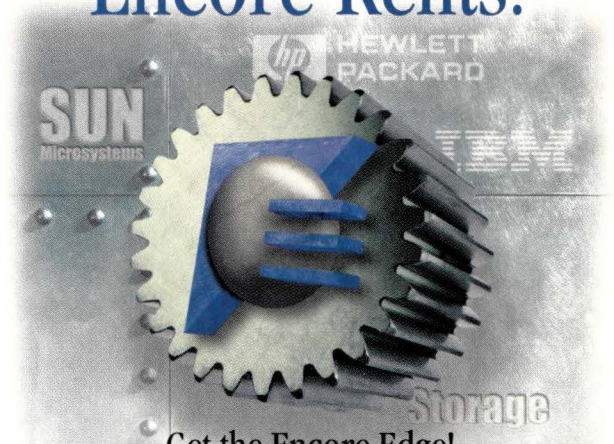
High-quality editorial reprints will help your company in many ways:

- Increased EXPOSURE for your product or service
- Credible, believable information that consumers TRUST
- Excellent SALES tool for trade shows, mailings and media kits
- Powerful EDUCATIONAL RESOURCE for consumers and employees

Reprints are completely customized to your needs. Call today for additional information!

CATHY HENSEL
Reprint Operations Specialist
REPRINT MANAGEMENT SERVICES™
1811 Olde Homestead Lane
Lancaster, PA 17601
Phone: (717) 399-1900
Fax: (717) 399-8900
Email: sales@rmsreprints.com

Encore Rents!



Get the Encore Edge!
Rental Solutions For UNIX Professionals
Short-term Application Development • Special Projects
Product/Software Evaluations • Benchmarks
Relocation Projects • Quick Backup & Recovery Solutions
Peak Load Production Resource • Budget Limitations
Servers • Workstations • Upgrades • Storage
Get it all for less. Guaranteed.

ENCORE TECHNOLOGY GROUP
unixvalue.com

1-800-880-0202
www.encoretech.com Please e-mail to: sales@encoretech.com

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.

Cross-Platform Multimedia Development

MetaCard has released Version 2.3 of its flagship product, a multimedia authoring tool and GUI development environment for UNIX/X11 (including SunOS, Solaris, IRIX, AIX, UnixWare and Linux), Windows and Mac OS. According to the company, MetaCard 2.3 is the easiest way to build graphical applications, computer-based training (CBT) and online documentation.

No preprocessing, recompiling, redesign or platform-specific debugging is required to deploy an application on all platforms simultaneously, the company says. MetaCard is said to have a fully functional development environment on all supported platforms, with cross-platform support for advanced controls such as auto-scrolling hierarchical menus and built-in support for most popular audio, video and image formats.

The advanced graphical integrated development environment (IDE) includes a layout editor, script editor and debugger, and is highly customizable to suit individual needs, MetaCard says. MetaCard's easy-to-use, high-level language, MetaTalk, reportedly offers the flexibility of advanced features like associative arrays and regular expressions combined with the power and productivity of Perl.

MetaCard 2.3 costs $995 for a single-user, all-platform license (a single license can be used on any supported platform, there's no need to purchase a separate license for each). A free MetaCard Starter Kit is available from the company's Web site. The starter kit is a fully functional GUI development tool, but there is a limit on the length of scripts that can be created with it.

MetaCard Corp.
4710 Shoup Place
Boulder, CO 80303
http://www.metacard.com
Circle 101

NDMP Backup, Recovery Tool

Workstation Solutions has released Quick Restore 2.6, a centralized enterprise Network Appliance Inc. NetApp filer-to-UNIX server Network Data Management Protocol (NDMP) backup and recovery solution.

NetApp allows filers to be backed up to a central server with an attached tape library. Organizations that have centralized backup and recovery operation through one or more servers can protect filer-resident data on the same server, the company says. Users can select various configurations, including backup from

New Rugged Trackball Input Device

ITAC Systems has announced two versions of its new Dome Mouse-Trak input device–versions that support PS/2 and Sun Microsystems Inc. systems–for medical and industrial automation applications.

According to ITAC, the Dome Mouse-Trak products offer more ruggedness than industrial trackballs and better precision and control than sealed touchpads. Built with a rugged, ergonomically designed case, the devices use a deformable dome mounted over a miniaturized motion encoder mechanism to capture user inputs. The user moves the top of the dome much as they would move the ball in a normal trackball device to communicate the desired direction and speed of cursor movement, the company says.

The devices are said to be ideally suited for extremely dirty environments, such as mines, and applications such as clean rooms where aggressive use of cleaning solutions make use of other input devices not viable. In both medical and industrial applications, ITAC says, loss of mouse functions can result in serious and expensive system downtime at critical moments. The new Dome input devices offer very high tolerance for environmental contaminants at an affordable price. Pricing starts at

$200 for a single device (quantity discounts are available).

ITAC Systems Inc.
3113 Benton St.
Garland, TX 75042
http://www.mousetrak.com
Circle 100

a filer to a UNIX or Linux server's tape library; backup from a filer to a local tape device for fast performance; backup from a filer to another filer's tape device via the network; or backup from a UNIX, Linux or Windows NT server to a filer with a local tape device. Contact vendor for pricing.

Workstation Solutions Inc.
5 Overlook Drive
Amherst, NH 03031
http://www.worksta.com
Circle 102

Excel Plug-in for Enterprise Queries

Metagon Technologies has introduced DQview, a Microsoft Corp. Excel plug-in that allows enterprise queries to be created and embedded in Excel spreadsheets. DQview uses the enterprise data access engine of Metagon's DQbroker (sold separately) to allow Excel users access to any data in the network, regardless of database, platform or location, the company says.

DQview creates queries that are presented using an intuitive GUI. Each query is sent to the enterprise database system in order to access data from disparate sources on various servers, even nonrelational databases, the company says. The program then sends the joined data directly to Excel with no need to change from one program to the other, Metagon says. DQview costs $299.

Metagon Technologies LLC
P.O. Box 2810
Charlotte, NC 28106
http://www.metagon.com
Circle 103

Subscription-Based Internet Filter Appliance

Internet Products has introduced iPrism, a dedicated server appliance for monitoring and filtering Internet usage that installs easily and transparently into a network without modification to existing hardware or software. iPrism, offers network administrators the reliability of a dedicated hardware device, combined with control of the company's Internet access policy, the flexibility to assign access privileges based on individual requirements and the ability to monitor and manage Internet usage, the company says.

iPrism staff continuously review Internet content (approximately 15,000 new sites are reviewed each week). The sites are then categorized within a master database of more than 40 classifications, the company says. It can oversee nearly all Internet services, including Internet Relay Chat (IRC), RealNetworks Inc. RealAudio, Microsoft Corp. NetMeeting, Telnet and FTP, in addition to HTTP.

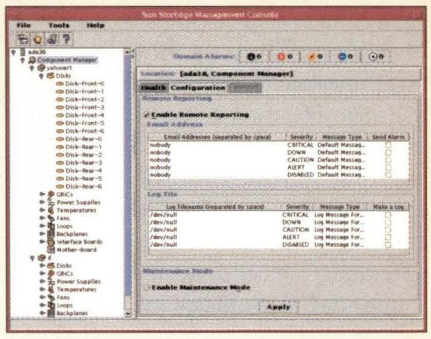
Once the iPrism appliance is installed, access profiles can be defined for groups and individual users, with each assigned different access privileges and optional password authentication, the company says. Once configured, iPrism requires minimal maintenance because the URL database is downloaded automatically. This offers companies the reassurance that the latest Internet sites are being reviewed and added to the corporate database, Internet Products says.

iPrism is Java-based and can be managed from any workstation with a Web browser. It is available for 67 cents per workstation, per month based on a 250-workstation subscription.

Internet Products Inc.
10350 Science Center Drive, Ste. 100
San Diego, CA 92121
http://www.internetproducts.com
Circle 104

Sun Storage Management Software Suite

Sun has unveiled a suite of storage management software products that are designed to simplify the management of enterprise data storage resources. According to Sun, Sun StorEdge Management Console software provides a centralized interface for enterprise storage management and supports plug-in tools that perform specific management tasks, such as the Sun StorEdge Component Manager, which can monitor one or more storage enclosures for abnormal conditions and activities. The software is Java-based and incorporates Jiro technology for true interoperability



and platform independence, Sun says.

StorEdge Management Console software is said to provide a central point from which administrators can manage and remotely monitor their Sun StorEdge systems. It allows them to monitor an entire storage configuration from a single screen and to drill down to individual systems and components as needed. The software will eventually offer a variety of plug-in tools, including performance tuning for applications like OLTP and data warehousing, Sun says.

Sun StorEdge Management Console software and the StorEdge Component Manager plug-in are available now for the Sun StorEdge A5000, A5100 and A5200 arrays, with plans to support all future arrays and storage devices. The software is provided free of charge with the purchase of any of the aforem entioned arrays and to existing array customers under SunSpectrum service contracts. List price is $21,000 for the Sun StorEdge Management Console software and $1,500 for the Sun StorEdge Component Manager plug-in. The software supports Solaris 2.6 and 7, with plans to add Windows NT support in a future release.

Sun Microsystems Inc.
901 San Antonio Road
Palo Alto, CA 94303
http://www.sun.com
Circle 105

High-Speed Access System

Imperial Technology has announced MegaRam-370, a high-performance solid state storage system that provides high-speed access and increased network availability, the company says.

The system, which takes less than an hour to install, has a storage capacity of 8 GB and is available in a variety of

configurations, the company says. The MegaRam-370 has a 40-MB/s Ultra SCSI interface and offers access times of less than .05 msec, Imperial Technology says. It can accommodate between one and four 3.5-inch form factor, solid state disk devices, each of which may be exchanged without interrupting system operation. Contact company for pricing.

Imperial Technology Inc.
2305 Utah Ave.
El Segundo, CA 90245
http://www.imperialtech.com
Circle 106

Tadpole-RDI Unveils Powerful SPARC Laptop

Tadpole-RDI has announced a new, more powerful portable workstation. The UltraBookIIi weighs 7.5 pounds and comes equipped with a 440-MHz UltraSPARC-IIi processor, up to 1 GB of main memory and 24 GB of removable disk capacity.

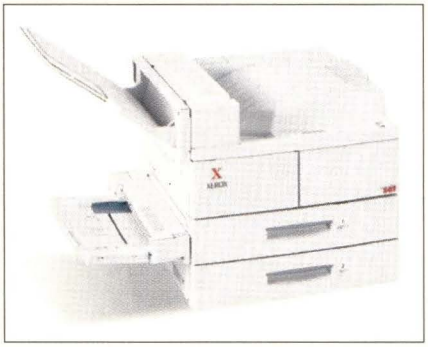
Graphics options are PCI-based cards from ATI Technologies Inc. or Sun Microsystems Inc. Creator 3D buffered 24-bit graphics. The UltraBookIIi's 14.1-inch Thin Film Transistor (TFT) active matrix LCD provides resolutions of 1,024-by-768 pixels. It boasts a 97-key keyboard, three-button integrated trackpad and 3.5-inch floppy disk drive, and supports either one Type III or two Type I/Type II PCMCIA cards. The portable computer also comes equipped with external interfaces for Fast Ethernet networking, Ultra Fast/Wide SCSI, two RS-232C serial ports, one parallel port and additional ports for external monitor, mouse/keyboard and floppy disk drive. It comes with Solaris 2.5.1+ preinstalled and is priced starting at $11,995.

Tadpole-RDI Inc.
2300 Faraday Ave.
Carlsbad, CA 92008
http://www.tadpolerdi.com
Circle 107

Monochrome Laser Printers for Workgroups

Xerox has announced a new family of workgroup monochrome laser printers–the DocuPrint N Series–that offer speeds ranging from 20 to 40 pages per minute (ppm) at prices ranging from $999 to $2,949.

The DocuPrint N2125 is a 21-ppm printer, priced at $1,299, and aimed at small workgroups (a non-networked version of the N2125 costs $999). For medium-size workgroups, the DocuPrint N2025, priced at $1,599, prints at 20 ppm. Another member of the family, the DocuPrint N2825 costs $1,899 for 28-ppm printing speeds. For larger workgroups, there are the DocuPrint N3225 and N4025 models. The N3225 costs $2,449 and prints at 32 ppm, while the N4025 costs $2,949 and prints at 40 ppm.



All of the DocuPrint N Series network laser printers come with Adobe PostScript 3, a built-in Ethernet adapter, an embedded Web server and 32 MB of upgradable memory for optimal print quality and speed. In addition, each printer provides several convenience features such as remote printing and email alerts. The printers come with one year of onsite service and a three-year warranty.

Xerox Corp.
800 Long Ridge Road
P.O. Box 1600
Stamford, CT 06904
http://www.xerox.com
Circle 108

Remote UNIX/NT Administration

From a single UNIX or Windows NT administration station, users of Network Shell Version 3 from Shpink Software are said to be able to manage multiple UNIX and NT machines. Network Shell allows systems administrators, webmasters, VARs and resellers to perform secure, automated and interactive systems administration of remote hosts without the need to Telnet or establish a remote shell connection to each host individually, the company says.

With Network Shell, routine tasks that need to be performed on both Windows and UNIX machines can be done by launching scripts from a single host. This allows administrators to manage expansive networks such as Web farms. Web site administrators can replicate content on mirrored Web, e-commerce and FTP sites, and gather remote statistics, Shpink says. VARs and resellers can reportedly use Network Shell to monitor and manage remote devices and hosts over the Internet.

Pricing for a single UNIX/NT server license for Network Shell 3.0 starts at $199 per machine and includes one Network Shell client license for a UNIX host. Each Network Shell client for Windows NT requires a separate license, priced at $199 each.

Shpink Software
3612 Santiago St., Ste. 100
San Mateo CA, 94403
http://www.networkshell.com
Circle 109

Adaptive Relationship Management Technology

Targetbase has introduced its Adaptive Relationship Management (ARM) solution, what it calls a fundamentally different approach to customer relationship management (CRM) that incorporates strategy and analysis, patented technology and brand-building communications. ARM technology is offered as a suite of services or a hosted software application for the business-to-consumer marketplace.

Targetbase says it goes beyond standard data warehousing by integrating marketing communications and analysis expertise with the collection and distribution of customer data on an enterprisewide level. Targetbase's ARM solution reportedly enables organizations to implement CRM on three levels–from the adoption and application of CRM to the highest level of CRM, whereby businesses are able to manage their customer relationships on a one-on-one basis.

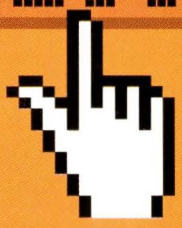
Built on a three-tiered architecture with an open systems approach, Targetbase's patented technology is said to offer unparalleled flexibility. The user interface, object layer and database layer are

Decisions, decisions.

Solutions, solutions.

All business is e-business this April in Chicago.

COMDEX® 2000



Now that you know your business is definitely headed for e-business, you need to compare the products and services that will get you there. Welcome to COMDEX/Spring 2000 and WINDOWS WORLD.

This is the event where IT professionals, corporate managers, developers and distribution professionals find the solution-building technologies they need to compete in the Internet economy.

And this is the event that added special programs on Linux, e-comm management, infosecurity and wireless technologies — just to make sure you'll be as competitive as possible.

With all the technology choices out there, you only have one more decision to make. Be there.

technology decisions for the internet economy

Don't miss COMDEX/Spring and WINDOWS WORLD, co-located with LINUX Business Expo.
April 17 - 20, 2000 • McCormick Place, Chicago

To register for your FREE expo pass or to learn more about the events, go online today. Interested in exhibiting? Call Arnie Wolfson at 781-433-1573 or e-mail arnold_wolfson@zd.com.

www.comdex.com

©2000 ZD Events Inc. All Rights Reserved. COMDEX is a trademark of ZD Events Inc., registered in the U.S. and other countries. Other names and logos may be trademarks or registered trademarks of their respective holders. SP00-6675 1/00

all separate, allowing various interface applications, programs and databases to be used. The platform supports Informix and Oracle databases, and it is fully scalable. Contact company for pricing.

Targetbase
7850 N. Belt Line Road
Irving, TX 75063
http://www.targetbase.com
Circle 110

Free Java Development Tool

JBuilder 3 Foundation from Inprise is a cross-platform development environment for creating Java 2 applications for Linux, Solaris and Windows NT systems. The product is available for free download from the Inprise Web site at `http://www.borland.com/jbuilder/foundation`.

JBuilder 3 Foundation is aimed at Java developers who desire a high-productivity integrated development environment (IDE) to rapidly develop, compile, run and debug applications using JBuilder visual tools, as well as traditional coding methods. Key product features include the AppBrowser, to simplify code management; CodeInsight, to reduce syntax errors and speed coding; and the Java 2 Platform graphical debugger. In addition, users can customize and extend the environment to suit their development needs using the Open Tools API, which enables easier integration of tools and components from third-party vendors.

Inprise Corp.
100 Enterprise Way
Scotts Valley, CA 95066
http://www.inprise.com
Circle 111

Technologies to Simplify Storage Management

Veritas has announced its Veritas V³ SAN Initiative, which provides the technology necessary to efficiently manage storage area networks and to support rapidly changing e-business environments, the company says. Using V³ SAN Initiative technologies, users will be able to design their first-generation SAN installations to build scalable enterprise storage solutions capable of delivering high-level availability, the company says.

Veritas V³ SAN Initiative combines three new technologies: the V³ SAN Access Layer, host-based technology that extends existing Veritas software products to take advantage of new SAN hardware capabilities; the V³ Storage Appliance, a software suite that allows OEM partners and integrators to embed storage services into SAN equipment; and V³ SAN Management Tools, a family of modular management agents and applications that provide centralized visualization, monitoring and automation of logical SAN resources.

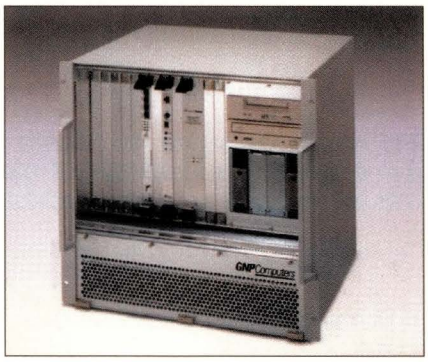
All three V³ SAN Initiative technologies will be available for UNIX and Windows NT platforms in first-quarter 2000. Contact company for pricing.

Veritas Software Corp.
1600 Plymouth St.
Mountain View, CA 94043
http://www.veritas.com
Circle 112

CompactPCI Servers for Telecom Providers

The new compactPCI cServer and cNode from GNP Computers are described as hot-swappable central office servers with Fast Ethernet network interfaces.

The cServer is a completely cutomizable, high-performance telecommunications computer platform product leveraging off-the-shelf technology to meet a customer's specific requirements, GNP says. It features a Network Equipment-Building System (NEBS) Level 3-compliant design, DC/AC power and an eight-slot backplane, and can be configured with up to four internal 9.1- and 18.2-GB hot-swappable drives and fixed internal CD-ROM and DAT drives. Like the cServer, the cNode also meets the NEBS Level 3 standard and features DC/AC power in a four-slot backplane, with up to two 9.1- and 18.2-GB hot-swappable drives.



Pricing starts at $20,000 for the cServer and at $12,000 for the cNode.

GNP Computers Inc.
555 E. Huntington Drive
Monrovia, CA 91016
http://www.gnp.com
Circle 113

Enhanced SAP Software

Ardent Software has expanded its data integration product suite, DataStage XE, by offering enhanced SAP support with its Packaged Application Connection Kit (PACK) for SAP R/3.

An integration product suite for data warehouse creation and management, DataStage Extract PACK for SAP R/3 is said to allow users to extract data directly from SAP R/3 systems natively and integrate them with data from other sources. The suite includes a set of built-in libraries for complex transformations and to help with integration that adheres to the SAP standard interface protocol, Business API (BAPI), the company says.

DataStage Extract PACK for SAP R/3 is available for Solaris, AIX, HP-UX and Windows NT. Contact vendor for pricing.

Ardent Software Inc.
50 Washington St.
Westboro, MA 01581
http://www.ardent.com
Circle 114

E-Business Analysis Server

Oracle has released Express Server 6.3, the latest version of its software used to analyze financial, customer, sales, marketing and business data generated by a business operating on the Internet, the company says.

Express Server 6.3 is designed to forecast and analyze customer behavior, market promotions and sales projections. It is said to offer more than 300 built-in, server-based calculations, including forecasting, trending and statistics. In addition, it provides flexible partitioning routines and includes the Geneva Forecasting Engine from RoadMap Technologies, which automates statistical analysis, predictive model building and

model interpretation processes, the company says. Express Server 6.3 also integrates with Oracle's family of business intelligence tools, Oracle Reports and Oracle Discoverer.

Explorer Server 6.3 costs $3,995 and runs on UNIX (including Solaris, AIX and HP-UX) and Windows NT.

Oracle Corp.
500 Oracle Pkwy.
Redwood Shores, CA 94065
http://www.oracle.com
Circle 115

Tatung Debuts Four-Way Server

Tatung Science & Technology has introduced the COMPstation U4MP Series Model 4450, a high-end server that supports up to four 450-MHz UltraSPARC-II processors and 4 GB of memory. The new system is said to expand Tatung's use of the PCI I/O bus as an integral design component of the company's SPARC-based workstations and servers. As Tatung's highest-performing quad-processing system to date, the COMPstation 4450 is now shipping in rack-mount and tower configurations.

The rack-mountable version, the COMPstation 4450R, features a compact chassis design that reportedly fits into existing Internet service provider (ISP) server banks and adapts easily to OEM, communications, commercial and industrial requirements. Standard configurations include four 450-MHz UltraSPARC-II processors, 1 GB of RAM, 9 GB of hard disk storage, dual Ultra Wide SCSI channels (internal and external), two serial ports, one parallel port and a Fast Ethernet interface.

The rack-mount server supports up to two 66-MHz, 64-bit PCI devices and four 33-MHz, 64-bit PCI devices. In addition, it features nine drive bays suitable for eight 5.25-inch slots and one 3.5-inch slot. Options include up to 4 GB of RAM, 280 GB of hard disk storage, Asynchronous Transfer Mode (ATM) connectivity and Ultra Wide SCSI with additional external or internal channels.

The tower cabinet model, the COMPstation 4450T, can support 14 to 18 drive bays to provide extra drive capacity and includes four durable wheels for easy mobility. Pricing starts at $32,530 for a standard rack-mount configuration and at $34,000 for a tower configuration.

Tatung Science & Technology Inc.
1840 McCarthy Blvd.
Milpitas, CA 95035
http://www.tsti.com
Circle 116

Remote Site Backup Tool

ATL Products has unveiled LANvault, an integrated remote site backup solution that combines a backup appliance, central management console and customer service Web portal, the company says.

Designed for global corporations that are experiencing explosive growth of remote data but are finding conventional data protection systems unreliable, LANvault is easy to deploy, easy to use and returns the control of remote site backup to a central IS, ATL says.

LANvault comprises three components: LANvault Backup Appliance, which consists of a high-performance DLTtape library integrated with a dedicated backup server that plugs into Ethernet and is preloaded with either Computer Associates International Inc.'s ARCserveIT or Veritas Software Corp.'s Backup Exec; LANvault Central Management Console, which provides control of remote sites via a Web-based application that runs on any Windows NT workstation connected to the network; and LANvault Customer Service Web Portal, which is maintained by ATL for registration, configuration management and communication, and provides email alerts to inform administrators when and

Try Out The Latest Software

FREE

Software Solutions For The Solaris™ and Java™ Environments.

Sun Solutions *NOW!*

Try It *NOW!*

Visit the Sun Solutions *NOW!* Web Site to find new and exciting solutions for the Solaris™ and Java™ environments by Sun's third-party software vendors. Check out the latest applications and stay current on new technologies as they hit the market—sometimes even *before* they're in full release.

Over 500 Software Products

This is the largest collection of downloadable demos and trial software written for Solaris and Java on the Internet. We've added the complete Sun Solutions Catalog with over 14,000 product listings.

www.sun.com/downloads

Circle No. 24

Sun microsystems

where upgrades/updates are needed for software or firmware, ATL says.

Pricing for a single LANvault appliance is $9,999. The cost of a typical LANvault data protection solution for 100 remote sites, including system design, acquisition, deployment and administration, is estimated by ATL to be $1.2 million over three years.

ATL Products Inc.
101 Innovation Drive
Irvine, CA 92612
http://www.atlp.com
Circle 117

Shock-Proof Supercomputer

Patmos International has announced Perpetua, which it describes as a compact, single-box supercomputer that can replace an entire server room and provide higher performance, redundancy and disaster resistance than any competing product.

Perpetua is said to employ the power of parallel, distributed processing in an integrated, modular platform. Designed for mission-critical applications where performance and 100% uptime are critical, every processing and data storage element in Perpetua is redundant and

interlinked, the company says.

In addition to full redundancy, where every data element and processing operation is available through three independent, fully coordinated sources, Perpetua includes two uninterruptible power supplies (UPS) and a backup power generator. The system's cabinet is capable of withstanding an earthquake up to 7.5 on the Richter scale and includes a waterproof and fireproof streaming tape backup system in only four square feet of floor space, the company says.

A standard Perpetua system has eight hot-swappable, distributed server nodes, called n'Boxen modules, and features load-balancing across nodes in the event of a failure. In addition, each element in the system is connected by internal, dual full-duplex Fibre Channel networks for a maximum transfer rate of 1.065 Gb/s.

The system's n'Boxen modules are based on the x86 platform, so it can run any x86 application/operating system, including UNIX, Linux and Windows NT. Each n'Boxen has a separate hard disk for program storage and data, which is said to eliminate conflicts between the operating system and the data stream. Systems administration is through the company's Parapoise Universal Manager, which provides a single Java-based control panel for all operational control, including topology. Pricing for a base configuration starts at $39,000.

Patmos International Corp.
12104 Ocean Gate Way
Ocean City, MD 21842
http://www.patmosinternational.com
Circle 118

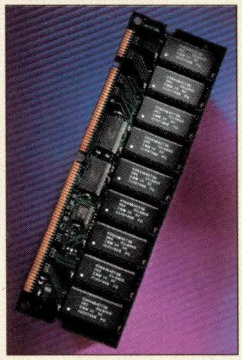
Low-Cost Backup Tool

PerfectBackup+ for Linux, an automated backup software application from Merlin Software Technologies, is said to back up Linux, UNIX, Windows and Macintosh systems. The software product provides backup scheduling and remote backup, encryption, robotics modules, enhanced security and many other features with both a graphical and character-based interface for Red Hat Inc. Linux 6.0/6.1, SuSE Inc. Linux 2.2/2.3 and Caldera Systems Inc. OpenLinux 2.3.

The product's $69 price tag includes all updates and support for one year. Annual subscription costs $24 for updates, maintenance and support. Previous versions of PerfectBackup+ are available as a free download for SCO UnixWare and ODT, Solaris for Intel and SPARC, FreeBSD 2.2+, BSDI and HP-UX 10.

Merlin Software Technologies Inc.
6450 Roberts St., Ste. 420
Burnaby, British Columbia
Canada V5G 4E1
http://www.merlinsoftech.com
Circle 119

Upgrades, Enhancements, Additions...



■ Camintonn has unveiled a new line of memory upgrades for the IBM Corp. Netfinity 8500R Server PC. Camintonn says the new memory is designed to meet increasing demands for both scalability and performance from data center servers. The memory modules offer capacities ranging from 256 MB to 1 GB, with a maximum system memory of 32 GB. Camintonn memory for the IBM Netfinity is currently available in 128-, 256- and 512-MB configurations. Pricing is as follows: 504674RC-PC100/R3 (128 MB) is $420; 504374RH-PC100/R3 (256 MB) is $800; and 504574RH-PC100/R3 (512 MB) is $1,800.
Camintonn Corp. Inc., 22 Morgan, Irvine, CA 92618. *http://www.camintonn.com.* **Circle 120**

■ Relational Tools for Servers, a suite of enterprise data management tools from Princeton Softech, has added support for the Informix database. Other supported databases include Oracle, Sybase, SQL Server and DB2. Relational Tools facilitates the editing of complex data and heterogeneous data movement from multiple databases in disparate operating environments, the company says. Built on Princeton's Relationship Engine technology, Relational Tools for Servers is said to include industrial-strength data management tools, which enable users to extract, move and edit data from the most complex databases, regardless of how many tables or relationships are involved. Pricing starts at $15,000 for 10 seats, with support for one specified database environment. **Princeton Softech Inc.**, 1060 State Road, Princeton, NJ 08540, *http://www.princetonsoftech.com.* **Circle 121**

Server/Workstation Marketplace

The high-impact, cost-effective and powerful advertising section reaching over 100,000 technical product specifiers and buyers.

To advertise call Carol Flanagan at **(508) 839-4016** *Email: caflanag@aol.com*

RS/6000 Sun Microsystems

AS/400 HP9000

www.flagshiptech.com

FLAGSHIP
TECHNOLOGIES INC.

BUY, SELL, RENT, LEASE

Flagship Technologies is your best source for AS/400, RS/6000, HP9000 and Sun Microsystems equipment and service. We staff certified technicians, supply new and used parts, offer OEM parts, and conduct advance exchange as well as complete upgrades.

Minneapolis (AS/400,RS/6000 & Sun Micro). . **800-416-8900** 612-516-1300

Atlanta (HP9000). **888-740-4600** 770-569-8188

Circle No. 402

NuProducts from Nu Horizons!

Provide your customers with best-in-class product and service!!

Call Nu Horizons Electronics, an authorized Sun Microsystems Distributor, for all of your microelectronics needs.

- **Motherboards**
- **Processor modules**
- **Memory**
- **Solaris and JAVA OS**
- **I/O Cards**
- **and more....**

Sun microsystems
AUTHORIZED MICROELECTRONICS DISTRIBUTOR

NU HORIZONS
NU HORIZONS ELECTRONICS CORP.

Call 1-877-NUHO-SUN
Open from 9:30AM to 8:00PM EST
www.nuhorizons.com/sunsales
EMAIL: sunsales@nuhorizons.com

Circle No. 320

Voted #1
SUN & SGI
Hardware Store

LOWEST PRICES

Memory Upgrade Kits, OEM Brackets, SCSI, Fiber, Internal,10k Drives 4GB to 50GB, SCSI Cards, Sun Storage, Tape Drives, RAID, DLT, Media...
Shop Now ON-LINE & Save!!

Huge Savings * Fast Delivery

PO's Accepted Fortune 1000
MCAC.com, Inc
eBusiness Storage Company
Toll Free: 1-888-MCA-7898
Fax: 949 453.9914
www.mcac.com sales@mcac.com

Circle No. 300

G-2 Systems

....the intelligent choice!

Sun Microsystems and more . . .

- Systems
- Spares
- Repairs/Advance Exchange
- Peripherals
- Best Power UPS's
- Export Specialists

Buy...Sell...Trade

Major Credit Cards Accepted

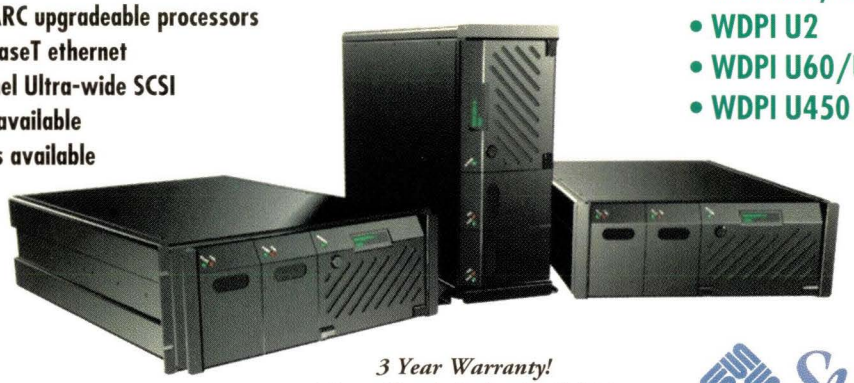
G-2 Systems, LLC
2 Henshaw Street
Woburn, MA 01801
sales @g-2systems.com
www.g-2systems.com
Tel: 781-937-0010
Fax: 781-937-0808

Circle No. 346

New Sun microsystems Compatibles!

- Original Sun Ultra AXI/AXMP motherboard
- Original Sun UltraSPARC upgradeable processors
- Integrated 10/100 BaseT ethernet
- Integrated dual-channel Ultra-wide SCSI
- Maintenance options available
- Custom configurations available

- WDPI U5/U10
- WDPI U2
- WDPI U60/U250
- WDPI U450



3 Year Warranty!
More Chassis Styles Available!

BUY • SELL • LEASE
PARTS • REPAIR • TRAINING

Sun Authorized Microelectronics OEM

WORLD DATA PRODUCTS

www.wdpi.com 800-553-0592 E-mail: info@wdpi.com

Circle No. 363

X7004A	$720	NEW
X2244A	$3700	NEW
X2580A	$8900	NEW
E6500, BASE SYSTEM	$74,000	USED
A1000 STORAGE 218GB	$20,750	NEW

NOTE: New Equipment Features 1Yr. Returns To Trinicomp Warranty

SUN® Specials

Ultra 80
- 450 MHz CPU
- 256MB memory
- PGX32 graphics
- 9GB drive
- Sound card
- Country kit

$18,500
New, with 1 Yr. Return to Trinicomp warranty

TriniComp SYSTEMS
2 Centennial Drive, Peabody, MA 01960

fax: 978-531-6037
email: sales@trinicomp.com
Call 978-531-7366
www.trinicomp.com
All trademarks are property of their respective companies

Circle No. 420

QUICK RESPONSE TO YOUR INFORMATION REQUESTS

For more information on the products/services advertised in this section, please circle the appropriate reader service number(s) on the reader inquiry card located elsewhere in this issue. OR
You can E-mail your requests for more information using the reader inquiry card numbers.

Here's how:

E-mail address: **ica@ica.cc**

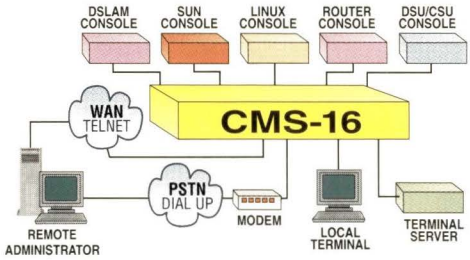
Include

1. Magazine name and issue date
2. Your name and address
3. Reader inquiry numbers, separated by commas, for which you need more information.

Console Management Over Telnet!

Access Network Serial Console Ports . . . From Anywhere!

The CMS-16 Console Management Switch provides secure, in-band and/or out-of-band access to RS232 console ports and maintenance ports on UNIX servers, routers, and other network equipment. System administrators can access remote devices in order to change configuration parameters, connect users to restricted ports, collect buffered data, and perform a variety of other control related functions.



- ✓ Sixteen (16) RS232 DB9 Serial Ports
- ✓ 10Base-T Ethernet Port
- ✓ TCP/IP Security Features
- ✓ Port-Specific Password Protection
- ✓ Non-Connect Port Buffering
- ✓ Modem Auto-Setup Command Strings
- ✓ Co-location Features
- ✓ AC and 48V DC Powered Models

Visit website for complete NetReach™ product line.

wti western telematic inc.

(800) 854-7226 • www.wti.com

5 Sterling • Irvine • California 92618-2517 • (949) 586-9950 • Fax: (949) 583-9514

Circle No. 324

SUN . DIGITAL/COMPAQ

Your Global Source

- Ultra Workstations
- Enterprise Servers
- Alphastations/servers
- MicroVAX & VAX
- CPU's
- Memory
- Disk/Tape
- Spare parts

BUY · SELL · TRADE
UNUSED · USED · REFURBISHED

Asterix,LLC

Phone: 678.366.3512
Fax: 678.366.3514
Email: sales@asterixllc.com

www.asterixllc.com

Asterix, LLC

Circle No. 301

ATLANTIC

PERIPHERAL SYSTEMS
"SUPER" SPARC™ VALUES!

MEMORY
64MB SS20——$250
64MB Ultra 1——$275
128MB Ultra 2——$495
256MB Kit Ent. Server——$1,095

STORAGE
2.1GB SGT 'cuda Int/SCSI——$425
4.3GB SGT 'cuda Int/SCSI——$650
9.0GB SGT 'cuda Int/SCSI—— $950
9.0GB SGT Cheetah Int/SCSI $1,295

SPECIAL!
23GB SGT Elite Int/SCSI——$1,895

WORKSTATIONS
SS Ultra 1, 2——CALL FOR QUOTE!

NOW! VISIT OUR WEBSITE!
WWW.ATLANTICPS.COM
912-929-7099 FAX 912-929-7098
E-MAIL: atlanticps@mindspring.com

Circle No. 340

LOWEST PRICES ON MEMORY

DEC, HP, IBM, SGI

SUN, ROSS SIMMS, DIMMS

Clearpoint Enterprises, Inc.

Save time, money dealing directly with Manufacturer

"If My Memory Serves Me Right ...It Must Be Clearpoint"

25 Birch St.
Milford, MA 01757
(800) 253-2778
(508) 473-6111
Fax (508) 473-0112
www.clearpoint.com
Email: memory@clearpoint.com

Circle No. 362

anything & everything 4 Sun

On Line ...
www.anythingSun.com

410-820-8100
Ames Sciences, Inc.
501 South Street, Easton, MD 21601
Fax 410-820-8179
sales@anythingSun.com

Circle No. 331

SYSTEMS & CPU's

Ultra 1/170E-C3D-128mb-2.1GB-CD-F1	$ 2,995.00
Ultra 2/1167E-C3D-128mb-2.1GB-CD-F1	$ 6,995.00
Ultra 2/2300-C3D-128mb-2.1GB-CD-FL	$12,995.00
Ultra 60-300mhz-C3D-128mb-4.2GB-20"	$ 8,495.00
Ultra 60-360mhz-C3D-128mb-4.2GB-20"	$ 9,195.00
Enterprise 450 Dual 300mhz	**$15,200.00**
Enterprise 250 Dual 300mhz	**$ 9,995.00**
Enterprise 4000 0Base	$12,500.00
S5/170mhz-64mb-2.1GB-CD-FL	$ 1,995.00
S5/85-32-1.05GB-TX1N	$ 850.00
X1191A 300mhz Ultrasparc cpu	$ 2,850.00

MEMORY & DISKS

Sun 1GB SS5\20	$ 135.00
Sun 2GB SSV20\Ultra	$ 275.00
Sun 4GB SS5\20\Ultra	$ 565.00
Sun 9GB Ultra\Array	$ 850.00
Sun X7004A 256mb kit\Ultra	$ 995.00
Sun X7022A 256mb EX000\EX500	$ 895.00
Sun X7023A 1GB memory kit EX000\EX500	$ 3,495.00
Sun Storage Array 112 no drives	**$2,250.00**
Sun Storage Arrays	Call

GRAPHICS

TX1/TX4/**MGX+ 4mb 24 bit**	$175/$595/$275
Creator/Creator3D	$325/$695

ENTERPRISE

EX000 X2601A system board	$ 3,895.00
EX000 X2611A I/O board	$ 4,750.00
EX000 X2560A 336mhz\4mb cpu	$ 5,495.00
EX000 X2550A 250mhz\4mb cpu	$ 2,695.00
EX000 X2570A 400mhz\4mb cpu	$ 8,890.00

Axil Ultra 2 base system 0mb $1,495.00!! Qty limited
Performance Technology UFW scsi sbus $275.00 New!!

Large inventory of hardware including spare parts, workstations, peripherals, memory, and 3rd party products.

Industry leading 18 month warranty

Check our web page for weekly specials - www.gshiis.com
Email: sales@gshiis.com techinfo@gshiis

* Call for full product line and availability. * Trades accepted, and purchase options available on all excess used equipment.

VISA American Express MasterCard SPARC International Member

GSH Intelligent Integrated Systems, Inc.
95 Fairmount Street Fitchburg, MA 01420
Tel: **(603) 529-7880** Fax: **(603) 529-7884**

Circle No. 353

UNIVERSAL CAPITAL FUNDING

SUN MICROSYSTEMS
WORKSTATIONS
PRINTERS SERVERS MEMORY
OPTIONS DISK TAPE

800-883-9339

BUY • SELL • RENT • LEASE •
UPGRADE • EXCHANGE

UNIVERSAL CAPITAL FUNDING
15695 Medina Road, Plymouth, MN 55447
VOICE (612) 551-9309 FAX (612) 551-9311
EMAIL: lyonts@winternet.com

Circle No. 431

WANTED TO BUY

SUN

Cash Paid Now For

All Enterprise Servers
Ultra 1 & 2, 30 & 60
SUN Disk & Disk Arrays
Memory & Enterprise options

SAVE on OFF LEASE & REFURBISHED SYSTEMS
Systems available for sale, lease or rent
CALL NOW FOR QUOTE

DATALEASE

(800) 456-6233
FAX (714) 632-9248
sales@datalease.com

Circle No. 454

E.L.I. SYSTEMS inc.

Refurbished SUN Equipment

139 Hampshire St., Cambridge, MA 02139

System Specials

Ultra 2, 200 MHz, 20" monitor, 3D F/B, 128 MB RAM , 4.2 GB	$8,000
Ultra 30, 20" monitor, 300 MHz, 128 MB, 3D, 4 GB disk	5,000
Ultra 1/170E, 20" monitor, 3D, 64 MB RAM, 2.1 GB disk	2,300
Sparc 20, 85 MHz, 20" monitor, GX F/B, 64 MB RAM, 2.1GB disk	1,750
Sparc 5 model 110, 20"monitor, GX F/B, 64 MB RAM, 2.1 disk	1,450
Ultra 60, 300 MHz, 20"monitor, 128 MB RAM, 9 GB, graphics card	7,100

Sun Base Systems

E250/450 Enterprise	Call
Ultra 2	4,800
Ultra 1/170E	1,300
Ultra 30	2,000
Sparc 20	450
Sparc 5 110	550
Ultra 60	4,000

Monitors

16" Sony color	$125
17" Sony color	300
19" Sony color	325
20" Sony color	400

Call 1-800-447-1156

CPU Modules

X1188A 200 MHz, 1MB cache	$600
X1190A 250 MHz ,1 MB	1,500
X1191A 300 MHz, 2 MB	2,000
X1192A 360 MHz, 4 MB	2,700
X1194A 400 MHz, 2 MB	3,300
X2244A 400 MHz, 4 MB	4,500
501-2953 SM 81	400
Sparc 10/20 CPU's	Call

Memory

X70002A (2x32) 64 MB Kit	$330
X7003A (2x64)128 MB Kit	425
7004A(2x128)256 MB Kit	775
7005A (2x256)512 MB Kit	2,600
X7022A 256 MB RAM Kit	400
X7023A 1 GB RAM Kit	3,100

Disk Drives

Seagate 1GB N/WC	$150/125
Seagate 2.1 GB N/WC	200/175
Seagate 4.2 GB N/WC	325/350
Seagate 9.0 GB N/WC	400
Seagate 18 GB	750

Call for Additional Items

motherboards, SBUS cards, graphics cards, PCI solutions, disk storage options, RSM storage options, and network connectivity

PHONE 617-547-1113
FAX 617/354-1417
E-MAIL sunsales@eli.com
WEB http://www.eli.com

Circle No. 394

Customer Blown Away By Low Prices

Work Stations • Servers • Peripherals • Parts
Sales • Rentals • Leases • Exchanges • Repairs
Maintenance • 120 Day Warranty

Call today to buy, sell or trade SUN, HP and Silicon Graphics equipment with Security!

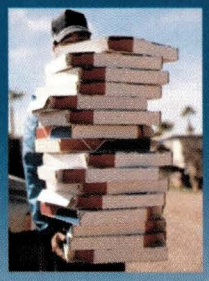
SECURITY COMPUTER SALES

2340 County Road J. • White Bear Lake, MN 55110
651/653-5200 • 651/653-4300 • Sales@Securitycomputer.com

Circle No. 388

Starion ST-10R Rackmount Server

Pizza Box vs. Starion ST-10R



Weight: ..... .2 lbs.
Width: ..... 20.0"
Depth: ..... 20.5"
Height: ..... 2.5"
Speed: ..... 30 minutes
Contents: ..... Pizza
Uses: ..... Container
Quantity .... Driver can carry up to 16
NOTICE .. Driver carries less than $20.00

Weight: .....28 lbs.
Width: .....20.0"
Width @ Chasis: .....18.0"
Depth: .....20.5"
Height: .....3.5"
Speed: .....Up to 440 MHz
Contents: .....UltraSparc Driven Sun Microsystems Solaris
Uses: .....Cache Server Web Server, RADIUS Server Solaris Firewall
Quantity .....20 Servers fit in a 72" rack
NOTICE .....Ready to install @ $3,750.00

GULFCOAST WORKSTATION

800.587.7882
www.gcw.com
We Deliver Sun Solutions

Sun SOLUTION PROVIDER

Circle No. 376

HAVING TROUBLE FINDING IT PROFESSIONALS?

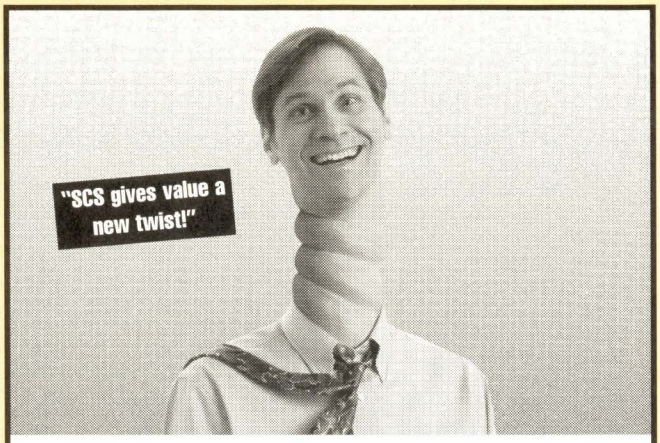
Look no further...

Let the EXPERT work for you!
Advertise to 100,000+ IT professionals*...

* Software Developers, Systems Analysts, Website Developers, Systems Integration Managers , Engineering Managers, Network Directors, etc.

Call Carol Flanagan at

(508) 839-4016



Customer's Head Spins Over Great Deals

Call today to buy, sell or trade SUN, HP and Silicon Graphics equipment with Security! Unbeatable service, unbeatable value -- No wonder so many people are going ape.

SECURITY COMPUTER SALES

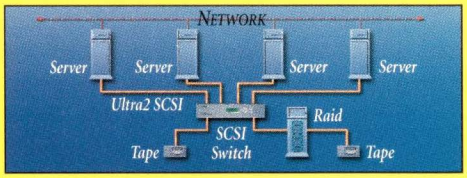
2340 County Road J. • White Bear Lake, MN 55110
651/653-5200 • 651/653-4300 • Sales@Securitycomputer.com

Circle No. 401

Solutions For Networks!

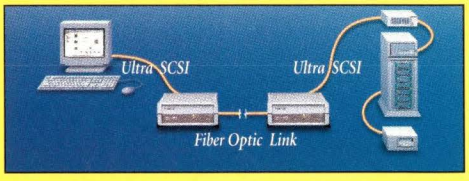
Share SCSI Peripherals Between Multiple Hosts

- Easily reconfigure servers and SCSI devices on a network
- 6x4, 4x2, 2x2 SCSI port switching
- LAN Port Connection



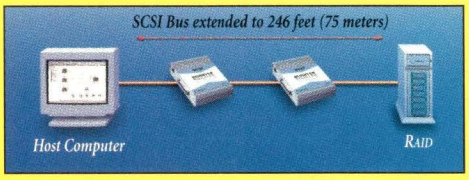
Centralize SCSI Devices for Easier Management

- Locate tape backups in one place
- Secure backup devices
- Remote RAID mirroring
- Extends cable distance up to 10 km



Increase Flexibility in Locating SCSI Devices

- Expands SE/LVD bus
- Up to 80 Mbyte/sec throughput
- Improves signal quality
- MSCS cluster compatible



APCON
Solutions for Networks

Corporate Headquarters
APCON, Inc.
17938 SW Upper Boones Ferry Rd.
Portland, OR 97224, USA
Phone (503) 639-6700 Fax (503) 639-6740

Regional Sales Office
APCON, Inc.
Santa Clara, CA — USA
Phone (408) 727-7022
Fax (408) 727-7024

www.apcon.com
e-mail: info7@apcon.com

Circle No. 442

SPATCH

TIRED OF BABYSITTING YOUR SYSTEMS?

Use Spatch instead.

Spatch can be configured to alert your pager or phone with full text every time your system hiccups.

WITH SPATCH YOU CAN RELAX!

Starting at only $199

770-840-7377

DOWNLOAD A FREE DEMO AT WWW.SPATCH.COM

Circle No. 453

Customer Goes Ape Over Great Service

Call today to buy, sell or trade SUN, HP and Silicon Graphics equipment with Security! Unbeatable service, unbeatable value -- No wonder so many people are going ape.

SECURITY COMPUTER SALES

2340 County Road J. • White Bear Lake, MN 55110
651/653-5200 • 651/653-4300 • Sales@Securitycomputer.com

Circle No. 438

EXA- Bitten ??
DLT- Bitten !!

Rent or Buy refurbed,or
Send Your Repairs to the
BEST Quality Source for
8mm & DLT Tape Drives and Libraries

SUN Microsystems Servers
Rent, Buy, Sell, Spare Parts, Repairs
IMMEDIATE DELIVERY

WEX

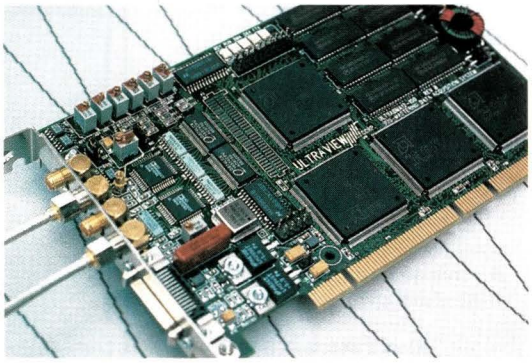
West Coast Computer Exchange, Inc.
11167-A Trade Center Drive
Rancho Cordova, CA 95670

Call: 916-635-9340 or FAX: 916-635-9485
Catalog at Web Site: www.wccx.com
email: sales@ wccx.com

Circle No. 368

FAST PCI DMA A/D

64 Bit DMA



100 MS/s DATA ACQUISITION

Acquire hundreds of megabytes of continuous analog data directly to Sun memory.

- AD12-100DMA - Dual 12-bit 25 MS/s A/D
- ADDA12- 100DMA - Dual 12-bit 25 MS/s A/D + Dual 14-bit 15 MS/s D/A
- AD8-100DMA - Dual 8-bit 50 MS/s A/D (or single 8-bit 100MS/s A/D)

ULTRAVIEW CORP.
34 Canyon View
Orinda, CA 94563
Tel: (925) 253-2960

www.ultraviewcorp.com
sales@ultraviewcorp.com
Fax (925) 253-4894

Circle No. 375

Do your **customers** expect **you** to **predict** the future?

www.clairvoyant.com/swe

Capacity Planning

for e-commerce and Internet-based networks

Clairvoyant
tel 408.861.1110
fax 408.861.1117

Circle No. 447

RENT TO OWN

SUN E250

$355/mo*

1 x 400MHz Processor
256Mb Memory • 18.2Gb Disk
PGX32 Graphics • 32x CD-ROM
Keyboard Kit
Solaris 7 Media

• Lease for 36 months with $1.00 buyout or purchase for $9,995. Subject to supply on hand and credit approval.

DATALEASE

(800) 456-6233
FAX (714) 632-9248
sales@datalease.com

Circle No. 455

FILL THOSE IT POSITIONS

Please call Carol Flanagan at
(508) 839-4016

Sun & HP

BUY SELL TRADE

Workstations and Servers

Boards Monitors Disks Tapes Mass Storage Solutions

♦ Same Day Shipping ♦ Competitive Pricing
♦ Custom Configurations Available

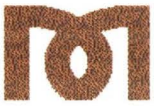
DEPOT REPAIR CENTER

♦ 30% To 50% Cost Savings ♦ One Year Warranty
♦ Overnight "Swap" Service

ACC, Inc.
AdvanTec Computer Company
4125 Business Center Drive Fremont, CA 94538
Phone: (510) 440-9700 Fax: (510) 440-9709
E-mail: sales@advanteco.com
http://www.advanteco.com

Circle No. 439

Ph# 800-426-3090
Fx# 847-317-2622
www.meridianleasing.com



570 Lake Cook Road
Suite 300
Deerfield, IL 60015

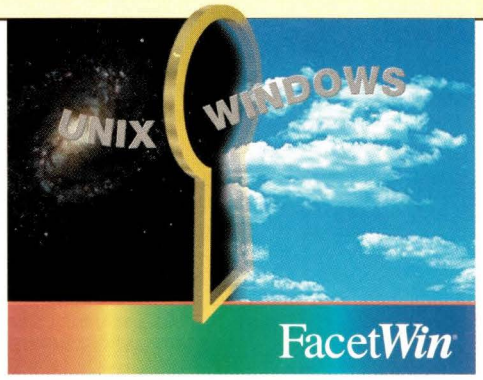
MERIDIAN

TECHNOLOGY LEASING SERVICES

Product Manager:	Al Cosenza	acosenza@meridianleasing.net	847-317-2270
Compaq Servers:	1500s, 2500s, 4500s, 5000s, 6500s and PC equipment		
DEC Alphaservers:	8400s, 4100s, 2100s, 1000, 1000A, and Storage Works		
HP:	All K Products, Workstations, Disk and Tape		
Product Manager:	Jason Davis	jdavis@n2nsolutions.com	847-592-3969
Cisco:	N2N Solutions, acquired by the Meridian Group in July, 1999, designs and supports end-to-end internetworking solutions, from systems analysis to support. A high-profile business partner of Cisco Systems, Inc., N2N Solutions is authorized to sell Cisco products and services throughout the United States.		
Product Manager :	Tom Haug	thaug@meridianleasing.net	847-317-2198
IBM RS/6000:	Servers, Workstations, Parts, and Peripherals		
Sun Microsystems:	Ultra Workstations and Enterprise Servers		

From leading-edge connectivity to commonplace data center solutions, The Meridian Group is a mainstay in the competive information technology (IT) leasing and reseller services business. We now enter our 21st year of meeting the IT needs of corporate America. Solidly positioned to take advantage of market changes and opportunity. In a hectic world, we continue to earn our clients' business by consistently delivering reliable service and leading edge technology at reasonable prices.

Circle No. 450



The ultimate in Windows to UNIX connectivity

FacetWin makes Windows®95/NT® to UNIX integration easy and affordable.

- **File & Print Services**
  No need for NFS or ftp… files and printers on UNIX systems simply appear as local resources to your PC, and are ready to use!
- **Terminal Emulation**
  World class terminal emulation from the terminal experts that brought you FacetTerm®. Set up a UNIX application with a Windows icon in one minute!
- **Graphical Administration**
  Graphical properties administration from Windows with context sensitive help.
- **Plus, check out these cool features:**
  - PC Backup/Restore
  - Modem Server
  - Remote Computing Support
  - Email Server

Just ask for a **FREE EVALUATION** copy of FacetWin, or check out our web site at www.facetcorp.com.

Connecting Windows to UNIX… the Windows Way!

FacetCorp

tel: 800/235-9901 • 972/985-9901
fax: 972/612-2035
info@facetcorp.com
www.facetcorp.com

FacetWin is a registered trademark of FacetCorp. Other names are properties of their respective holders.

Circle No. 421

Your Total Solution

MOUNTING HARDWARE SOLUTIONS

ENCLOSURE SOLUTIONS

RAID SOLUTIONS

From Mounting Kits to Cables to full-featured Enclosures to Custom Product, CI Design offers product that is designed to exceed your design needs. To find out how we can become your Total

CI DESIGN
A Better Design • A Better World®

www.ci-design.com
U.S.A. Costa Mesa, CA 1-800-576-5487
The Netherlands, Maastricht, 31(0)43-358-5520
U.K. Basingstoke 44(0)1256-332-723

Circle No. 428

RS/6000 Products

ExpressPoint
Technology Services

R/S 6000
SAVINGS UP TO 75%
- Whole machines
- Parts
- Repairs
- Logistics management
- Features
- Upgrades

800-328-7723

Jeff Karschnik x5760
email: jeffk@expresspoint.com

Tim Balko x5706
email: tbalko@expresspoint.com

Circle No. 372

RS/6000

NEW • REFURBISHED
BUY • SELL • LEASE
SYSTEMS • PARTS
PERIPHERALS

Worldwide Trade Corporation
5253 Edina Industrial Blvd.
Edina, MN 55439
Call (612) 831-8094
Fax (612) 831-7018
www.RS-6000.com
e-mail rs6000@wavetech.net

Circle No. 342

Server/Workstation Marketplace

MEMORY UPGRADE SOLUTIONS FOR YOUR SERVERS & WORKSTATIONS

COMPAQ
PROLIANT SERVERS & PROFESSIONAL WORKSTATIONS

Sun
ENTERPRISE
3000-6000
64MB, 256MB, 1GB KIT
ULTRA
1, 30, 60
128MB, 256MB KIT

SiliconGraphics
OCTANE
64MB, 128MB, 256MB
512MB KIT
O2
64MB, 128MB, 256MB KIT

DELL
POWER EDGE 6300 SERIES

IBM
NETFINITY
INTELLISTATION
RS/6000

Gateway™
E3200

HEWLETT PACKARD
3000, 9000

Tel: (949) 454-9888
Fax: (949) 454-9499
email: corporate@kingmax.com

KINGMAX

All company logos are registered trademarks of their respective trademark owners.

Circle No. 379

The one and only source for **all** your IT needs

ONE SOURCE CORP

www.onesourcecorp.com

Circle No. 345

Why Pay More?

IBM RS/6000

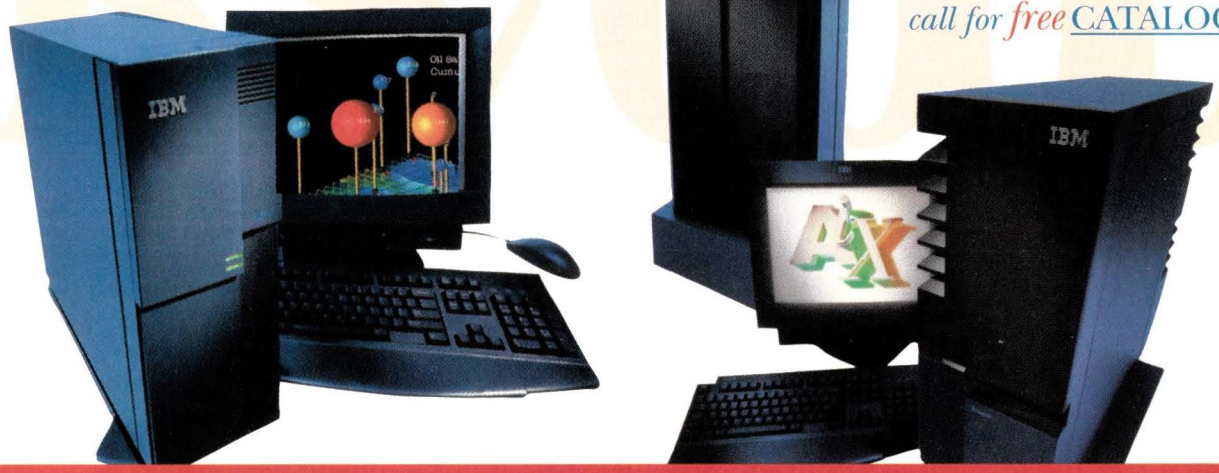
SAVE OVER GOING DIRECT TO IBM

FULL LINE SUPPLIER / ALL SYSTEMS IN STOCK

National Data

EMAIL: RS6000@natdata.com

call for free CATALOG



CALL : 800 - 406 1811

Circle No. 343

RS/6000 BUY ~ SELL ~ LEASE

- New & Recertified RS/6000 Product
- In-House Technical Services
- Same Day Shipping (Until 7:00 PM CST)
- Upgrades ~ Parts ~ Features
- Kingston Product Distributor
- Short-Term Rental/Lease

EVOLVING SOLUTIONS INC.

EVOLVING

SPECIALISTS IN RS/6000 PRODUCTS & SERVICES

SOLUTIONS

1.800.294.4362

EVOLVING@EVOLVINGSOL.COM

WWW.EVOLVINGSOL.COM

3989 County Road 116 ▼ Hamel, MN 55340 ▼ 612 . 516.6500 ▼ Fax: 612 . 516.6555

Circle No. 357

EXPRESS Computer Systems

BUY – SELL – RENT

SUN MICROSYSTEMS

IBM RS/6000

- SYSTEMS
- PERIPHERALS
- DISK UPGRADES
- PARTS
- MEMORY UPGRADES
- PROCESSOR UPGR.

800-327-0730

Keith DiCarlo Ext. 459

Fax: 949-474-9250

kdicarlo@ecsunix.com

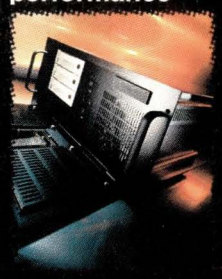
www.ecsunix.com

Circle No. 404

Running Out Of Floor Space?

-Rackmountable Sun AXI / AXMP
-Up to Quad CPU performance
-Ultra Wide SCSI
-2 Year Warranty

ULTRASPARC DRIVEN



Welcome to Computer Connection, your total Sun solutions provider. Desktop, and Rackmount Sun Compatibles at affordable pricing. Refurbished Sun Systems, and Servers, at savings up to 70% off list price.

Affordability
Defy your budget constraints with money saving solutions

Availability
Systems, Servers, Upgrades, Parts. One of the largest inventories available.

Reliability
Up to 2 year warranties on new and refurbished equipment.

Stability
Over 15 years providing solutions to customers ranging from fortune 100 companies to individuals

Now THAT's Better...

Introducing the best selling Sun compatible, the CompCon E450. Rackmountable, Quad cpu performance at 1/3 the size of the Sun E450. And for the desktop, the CompCon U10. Ultra Wide SCSI, and a "pluggable" cpu are just a few of its highly upgradable features.

Computer Connection
of Central New York, Inc.

101 First St. Utica, NY 13501
800-566-4786
www.ccny.com -info@ccny.com

Refurbished Sun Hardware up to 70% off List Price!

Circle No. 352

SUN-IBM-HP

NEW! Search our on-line catalog at
WWW.OSEXPRESS.COM

SOFTWARE	LIST	OURS
WordPerfect 7.0 1st user	495	395
Netscape SuiteSpot Pro	6995	6145
VSI*FAX Gold Fax Software	2395	1995
VSI*FAX Gold Windows Client 10-user	590	520
FrameMaker 1-user (floating license)	2500	2295
Adobe Acrobat 1-user	295	245
Informix On-Line Dynamic Server 1-usr (min. 10)	1500	call
Informix On-Line WorkGroup Serv 1-usr (min. 5)	295	call
Informix 4GL Development 1-user (min 3)	900	call
Term Communications Software	695	595
LP Plus Print Manager/Spooler 4-printer	695	575
SoftWindows MS-Windows Emulator	549	475
Spatch alphanumeric paging SW 4-user	499	425
DoubleVision Remote Support S/W	795	665
Uniplex II+ (20-user)	5500	4895
Disk_Pak Disk Optimizer/Defragger	1495	1230
Cheyenne Arcserve/Open Backup S/W	1995	1395
Legato Networker Backup S/W	2500	1950
Hummingbird PC X-Server Win NT/95	545	395
Hummingbird Maestro NFS Server - Win NT	195	169
QUANTUM DLT TAPE LIBRARIES		
160/320GB, 36GB/hr, autoloader, barcodes	n/a	6995
280/560GB, 36GB/hr, autoloader, barcodes	n/a	11495
OTHER HARDWARE		
HP 8GB External 4mm DAT Tape Drive	1150	925
HP 24GB External 4mm DAT Tape Drive	1550	1195
HP Laserjet 8000N, 24ppm, 16MB, 10/100BT	3279	2895
Mannesman Tally MT-661 800lpm Line Printer	7999	6795
Seagate Cheetah 9.1GB Ext. Ultra Wide SCSI	1495	875
Plextor 32X External CD-ROM Drive	395	255
Young Minds CD-Studio (ntwk CD-writer Sys.)	8339	Call
Digi PortServer II 16-port Terminal Server	2395	1890

100's of other UNIX products available!

Other Platforms: SCO, SUN X86, WIN NT, DEC, SGI, DG

Open Systems EXPRESS!™

Your direct source for UNIX, Win NT & networking products

45 Whitney Road, Suite B8, Mahwah, NJ 07430

Free Shipping! **1-800-445-9292** Fast Delivery!
(call and ask for our free catalog!)

Fax: 201-847-8899
E-mail: sales@osexpress.com

MC/VISA/AMEX/
DISCV/C.O.D./Net,

Circle No. 413

RENT THIS SPACE

Call Carol Flanagan

(508) 839-4016

RENT to OWN

SUN®
E450

2 x 400MHz Processors
512Mb Memory
PGX 32
2 x 18.2Gb Disk
32x CD-ROM • Floppy

$998/mo*

*Lease for 36mo. then it's yours for only $1.00 - or - purchase for $28,500.

DATALEASE

(800) 456-6233
FAX (714) 632-9248
sales@datalease.com

Circle No. 316