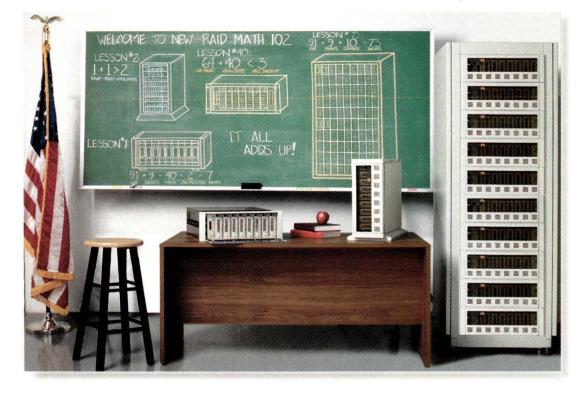


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Karen Watterson

Thanks to the Internet and the 'universal server,' RDBMSs have leaped from ho-hum to hot.



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When it comes to the computing infrastructure, the personal workstation is just the tip of the iceberg.

#### COVER ILLUSTRATION: PAUL ANDERSON

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## Feature 60 Using Solstice DiskSuite Kailash Jayaswal

A step-by-step guide to file system management, including data striping, data mirroring and logging file systems with Solstice DiskSuite.

## SUPPLEMENT begins Page 69 **RS/Magazine Feature 92** DB2: Unsung Hero Karen Watterson

Though overshadowed by Oracle's DBMSs, DB2 is a big market player with a multitude

## Columns

of application solutions.

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## Something Old, Something Blue, Something New

n this month's issue, the spotlight is truly on databases. In the cover story, Karen Watterson asks us to pause a minute to think about the amount of

data gathered by the world's OLTP systems-the banks, utilities, telecom companies, airlines and so on. It has to be a staggering bunch of ones and zeroes. Think about the changes in the trading volume of the New York Stock Exchange over the last 10 years. Again, staggering. What's made most of this data gathering possible? Advances in database architectures and, of course, better and better hardware. To find out more about parallelism, OLAP/ROLAP/MOLAP support, middleware, stored procedures, frontend triggers and so on, check out "RDBMS in the Spotlight," Page 44.

And if you don't get enough database details in SunExpert, turn to this month's RS/Supplement. In "DB2: Unsung Hero," Karen gives us an extensive guided tour of the tools and architecture for this often overlooked database. It is available in the Sun environment. A 1996 survey of 130,000 U.S. computer sites by Computer Intelligence, La Jolla, CA, finds 84% of those sites with 1,000 or more employees use DB2. Karen also maps out IBM's plans for the future of DB2 as it moves toward the "universal server" concept.

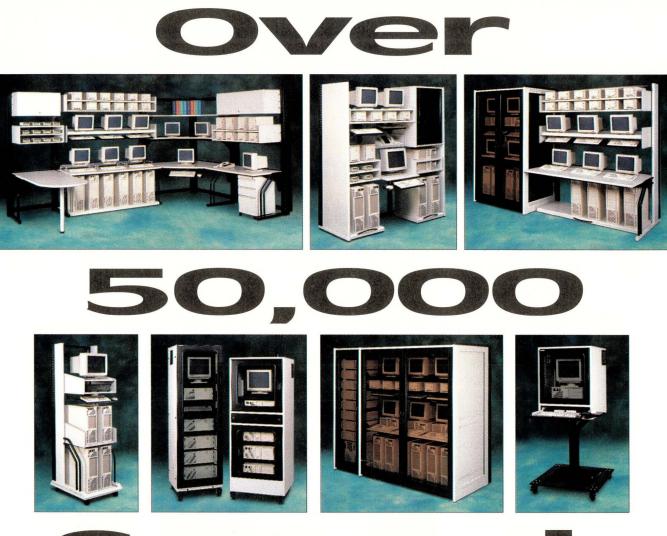
Last but not least, all of us want to thank Æleen Frisch for her years as the Systems Wrangler in RS/Magazine and the RS/Supplement. She has always been on top of what readers need in a sysadmin for AIX column. She's not leaving, though, so don't get too loco. Æleen will reappear in the August issue of *SunExpert* with a new column. If you are a regular follower of SunExpert, you may have guessed its subject by now. That's right! It's those dreaded two letters-N and T. The focus will be on what UNIX professionals-especially network managers and sysadmins-need to know to coexist with NT. Please let us know if you have ideas about the subject. You might not want to tell anyone, but we know from our demographic studies that more than 70% of you have at least one NT box.

Doug Payor

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## Sun, Microsoft Compete for Thin-Client Desktop

hile a recent spate of Network Computer (NC) announcements (both NC1 specification-compliant and thin-client network-ready devices) establishes no clear trend in the rapidly growing NC marketplace, there is the suggestion of a growing rift in the NC landscape between vendors investing in Java as the desktop of choice and those continuing to bank on Windows. In addition, many vendors, including Sun Microsystems Inc. and Microsoft Corp., are offering products that straddle both platforms.

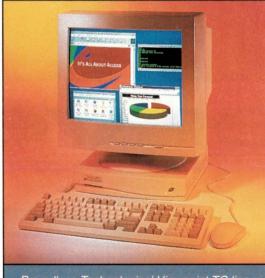
One "check-off" item that has been clearly established is a low-end retail price point of \$699, placed on thinclient devices as early as last spring and now available from vendors such as HDS Network Systems Inc., Boundless Technologies Inc., Hewlett-Packard Co. and Network Computing Devices Inc.

Like most vendors' NCs, HP's Net-Station thin-client line bottoms out at \$699, because, the company says, the NC1-specified \$500 retail price is too low to be able to include the technology that business users need, such as a highquality monitor and more than 4 MB of memory. Indeed, the Java Virtual Machine (JVM) itself requires more than 4 MB to run, says K.C. Chavda, marketing manager at HP's Panacom Division, Waterloo, Ontario.

"If you have a table and a chair, do you have an office? \$500 is an artificial price point created by the NC spec that is unreasonable for providing the capabilities that business users need," Chavda says.

Vendors are also ensuring that customers can choose from a range of machines, from those that offer text and Windows access (often using Citrix Systems Inc.'s WinFrame technology, based on the company's ICA protocol), to JVM desktops that conform to the NC1 Reference Profile, outlined in May 1996 by Sun, Oracle Corp., Apple Computer Inc. and Netscape Communications Corp.

Boundless Technologies, for example, in May announced a new line of thin-client devices, called Viewpoint TC, that lets users upgrade from a Model 100 Ethernet-ready text term-



Boundless Technologies' Viewpoint TC line of thin-client terminals adds support for Java and full NC Reference Profile compliance.

inal to the Model 200, which offers embedded Windows and a local Internet browser. The new terminal family is topped off with the Model 300, which adds Java support and an optional localized terminal-emulation module for full NC Reference Profile compliance.

Prices range from \$699 to \$869. Viewpoint Administrator software, the client utility that provides management, user support and maintenance, costs \$295 per user, or \$895 for a site license.

But the largest development is the ongoing tussle between Sun and Microsoft, being played out most noticeably in the comments posted to the Joint Technical Committee of the International Standards Organization (ISO), as systems and software vendors air their opinions on ISO standardization of Java (see "Industry Airs Opinions on Sun's Efforts to Standardize Java"). NC vendors want to be able to offer both Java and Windows on their devices. Some analysts state, however, that the thin-client NC is a whole new class of network citizen and, as such, Windows as a de facto OS on the device is not realistic. Java, on the other

> hand, will become much more attractive to business users, analysts say.

"The big fear right now is proprietary technology," says John MacGilvary, chief analyst for worldwide PC/ NC industry at Datapro Information Services Group, New York, NY. "Microsoft has been scrambling since Netscape Navigator was introduced, and a lot of business users like Microsoft's tools and applications. But the thought of Microsoft becoming the enterprise computing company makes them hold up their fingers in the cross sign, and say 'No...no...'"

Java and NCs are offering more of what people want

than Windows PCs, MacGilvary adds, because people buy functionality, not the device. Business users recognize the power and value of Java, but they wonder if they want to place that on a 20-yearold architecture, or invest in the future and buy a machine that exploits the utility of Java much more completely.

"Java running on an NC offers sound technical advantages over PCs, and it's sad to see some companies that don't want to have anything to do with any

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## News

new technology. The last time anyone bought a PC for its financial advantages was when notebook computers came out," MacGilvary says.

NC vendors such as Boundless Technologies are covering all the bases by introducing a modular thin-client line, in Boundless' case, the Viewpoint TC. "With the Viewpoint TC, we're targeting those companies who don't have Java in their plans yet. We don't ask that they plan ahead. Some companies will want text terminals, some Windows, some Java and some all of these in different parts of the company. The real point is to remain thin," says Terry Shagman, director of strategic alliances at Boundless Technologies.

Much confusion stems from the announcement of the NetPC specification, spearheaded by Intel Corp. and Microsoft, and announced in March 1996. The NetPC is the low-cost, Windows-based Pentium processorequipped desktop device that includes a built-in network adapter or modem in a locked case, and adheres to Microsoft's so-called Zero Administration Initiative. The latter is designed to let users easily upgrade software remotely, and to move between devices and still have access to their applications, data

Some

industry

see the

NetPC as

a direct

participants

response by

Microsoft

to the NC.

and customizable user environment. Some industry participants see the NetPC as a direct response by Microsoft to the NC, and to the Reference Profile's reliance on Java as its application foundation.

NC vendor HDS, which was the first company to offer a Java-ready machine in February 1996, also ships a low-end version of its @workStation for \$699, as

well as a range of machines featuring Windows, legacy and Internet access. Its latest model, announced in May, adds Windows printing capability, Windows floppy drive access, Windows multimedia and support for the Windows file-sharing system, Common Internet File System (CIFS). Here, too, we see a desire to offer plenty of Windows capability, while looking ahead to Java's preponderance on network terminals.

> Says Michael Kantrowitz, HDS executive vice president, two NC industry groups are coalescing, one around the Microsoft approach, which bases a thin-client desktop on Windows, and one around Sun's approach, which uses Java as the underlying platform.

"Microsoft's WinTerm thin client is effectively a next-generation dumb termi-

nal that can't connect to the Internet," says Kantrowitz. "It's entirely Windowsbased. On the other side of the industry split is the anti-Microsoft camp, if you will. Sun wants developers to write to

### Industry Airs Opinions on Sun's Efforts to Standardize Java

he future of Java is now in the hands of some of Sun's fiercest rivals. It's also in the hands Sun's allies. In March, the company transferred a formal application to the Joint Technical Committee (JTC) of the International Standards Organization (ISO) and the International Electrotechnical Commission (IEC). Comments from Sun's friends and foes are posted at the JTC's Web site (http://www.jtc1tag.org/sun\_pas.htm).

The list contains the usual suspects, including Sun's Network Computer Reference Profile co-collaborators, such as IBM Corp. and Apple Computer Inc., other major UNIX systems vendors and several standards bodies.

At press time, Sun was a mere six votes away from having its application to standardize Java rejected. Approval requires that two-thirds of the 38-member committee vote in favor. Right now 12 are for it and seven against it. Balloting ends in mid-July.

Not surprisingly, Sun's primary adversary in the proceedings is Microsoft Corp., who last year stated its intention to hand ActiveX over to The Open Group. Microsoft, and the other companies opposed to the application, state as their primary concern Sun's retention of Java's copyright and full ownership of the language.

"Microsoft opposes the...application [because] Sun wishes to retain full ownership and control over its Java specifications while simultaneously reaping the benefit of an ISO/IEC standard for its proprietary technology...Sun should correct the numerous process and intellectual property rights deficiencies in its proposal by first securing initial consensus with an open standards forum such as X/Open...," says Brad Silverberg, senior vice president at Microsoft, in the company's posted comments.

Longtime Java proponent IBM, on the other hand, stands behind Sun, sort of. "IBM endorses Sun's application...but with the restriction that their acceptance be limited to...only the Java Technologies as outlined in their application," writes Joel Urman, IBM's program director of standards.

Urman states that IBM takes issue with Sun's patent, copyright and trademark policies as stated in its application, and that Sun should clarify these things before gaining ISO certification.

The Institute of Electrical and Electronics Engineers (IEEE) opposes the submittal for another commonly cited reason, that Sun is a for-profit corporation, and Publicly Available Specifications (PAS) submittals should be limited to "groups of firms, such as industry associations or consortia...."

It appears that even if Sun wins approval, victory will have strings attached, because even positive comments are tempered by requests that the company clarify its plans for retaining ownership of Java. However, because the JTC submittal represents just one country-the United States-of more than 30 who would vote on final ISO acceptance, this round is far from the deciding factor in the process.-jsw

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## News

Java, so that the underlying OS is irrelevant. Their JavaStation is completely Java-based, but it runs Windows through emulation, which is kind of slow."

Kantrowitz says that while his company is continuing to expand its Windows access and features on the desktop, HDS has thrown its hat in the ring for Java as a long-term strategy, and intends to continue to offer better access to Java from its @workStations.

Sun's JavaSoft business unit, too, has shown it will walk the line between Windows and Java by introducing Java-PC software at the JavaOne Developers Conference in April in San Francisco. Scheduled to be available in the fall of 1997 for less than \$100, the software will convert Intel 486 or Pentium PCs running DOS or Windows into JVMs. It also includes JavaSoft's HotJava Views software, originally introduced in October 1996, with its email, scheduling, Internet access and name directory access capabilities.

JavaSoft officials say that when the company introduced the JavaStation in October 1996, customers wondered what they could do to make hundreds or thousands of installed PCs Java-compatible and, thus, produce a sort of fatclient Network Computer.

"When we developed Java for NCs, we also developed a version for the Intel x86 architecture," says Curtis Sasaki, JavaPC product manager at JavaSoft, "so it can reside on PCs, but it uses the JavaOS kernel, instead of DOS. A lot of people use PCs to access the Internet, and they have a couple of choices if they want to gain the ease of maintenance and universal data access offered by NCs. They can dump the old ones for Intel MMX systems, but that's a big investment, or they can install JavaPCs."

While a JVM PC running HotJava Views still carries the baggage of a fatclient's hard disk, processor and a highmaintenance OS, JavaSoft's Sasaki says that the idea is to preserve a company's hardware investment, and store home directories and files on the server.

HP is also putting its eggs in both the Windows and Java baskets by offering NC variants of its seven-year-old X terminal line, the NetStation mentioned above, and its HP Net Vectra PC line, a NetPC-compliant device announced in March. HP's Chavda goes so far as to voice what many in the industry believe, that the essence of the verbal jousting between Sun and Microsoft lies in Sun's desire to establish Java as the platform of the enterprise, supplanting the years-old DOS/Windows paradigm.

"Sun's whole strategy is to replace Microsoft. That's what the JavaPC is all about," Chavda says.—*jsw* 

## Sun Goes Gigabit Ethernet

Sun Microsystems Inc. will resell Alteon Networks Inc.'s Gigabit Ethernet network interface card and server switch under the Sun product names Gigabit-Ethernet adapter and SunSwitch, respectively. Together, the products will accelerate server and backbone performance to 1,000 Mb/s. The SunSwitch is a 10-port device that includes two fullduplex 1-Gb/s ports and eight 10/100-Mb/s ports to connect hubs, switches, routers, clients or other servers. The switch requires fiber-optic media, and with 62.5-micron multimode fiber, network nodes can be 300 meters apart, or with 50-micron multimode, the fiber distance can increase to 550 meters.

The Gigabit Ethernet Alliance, of which Sun is a steering member, has been hard at work for the last six months and, although standards aren't expected to be finalized until the first quarter of 1998, many early adopters are jumping on the Gigabit Ethernet bandwagon. "Sun has come early to the Gigabit Ethernet market because companies are demanding enhanced server-to-network performance to accommodate the increasing amounts of traffic due to intranets, the Web and Java computing revolution," says Neil Knox, vice president and general manager for Sun's Internet and networking products group.

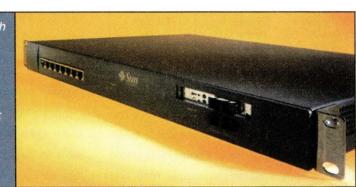
"The initial, key application for Gigabit Ethernet technology right now is connecting high-speed servers to the backbone," says David Callish, director of marketing communications at Alteon Networks. "It's a good way for users to taste-test Gigabit Ethernet." In the distant future, it may become a solution for the backbone itself, but right now it's too expensive and risky, in the eyes of users, Callish adds.

Sun seems to be interested in the lucrative networking market. The market for gigabit switching equipment alone is expected to grow to \$1.5 billion by the year 2001, says Ezmerelda Silva, senior analyst at International Data Corp., Framingham, MA.

"We think Gigabit Ethernet will play a major role in the future," says Steven Moustakas, director of network products for Sun. "We're looking very, very carefully at the overall networking market." Sun, it seems, is quickly attempting to become a player in the internetworking hardware market.

With more than 70 million Ethernet ports in networks today, according to Sun, there is a large installed base that will need higher performance solutions as users demand faster networking speed and adopt more intranet and Internet applications. Because it's based on existing Ethernet technology, Gigabit Ethernet is considered an easy migration path that protects companies' investments in Ethernet and Fast Ethernet technology. Also, management techniques for Gigabit Ethernet are said to be similar to the skills used by

The SunSwitch Gigabit Ethernet server switch is a 10-port device with two full-duplex 1-Gb/s ports and eight 10/100-Mb/s ports.



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## IBM, Oracle, BEA Join OLTP Forces

IBM Corp. has turned to Oracle Corp. and BEA Systems Inc. for a little help with providing an online transaction processing (OLTP) package. Called the RS/6000 Mission Critical POWER- solution, it includes preinstalled and pretested hardware and software. Specifically, the new package features the RS/6000 Scalable POWERparallel server, the Oracle Parallel Server 7.3 database engine and BEA's Tuxedo transaction processing monitor.

Typically, OLTP refers to the accessing and updating of information stored in a large database for the purpose of performing repetitive business processes, such as airline reservations or stocks trading. Before the announcement from IBM, anyone wanting to install an OLTP system with this particular combination of products could purchase everything separately and then put the pieces together on site. "Obviously, these three products all existed out in the marketplace," says Michael Maas, manager of transaction processing for IBM's RS/6000 division. "We've added a lot in the area of technical interaction to make it a robust, proven, low-risk combination of products."

The RS/6000 Mission Critical POWERsolution offers customers an easier way of installing this kind of OLTP system but does not offer much in the way of price savings. Despite the lack of savings, Peter Kastner, an analyst with The Aberdeen Group Inc., a Boston-based market research and consulting firm, sees this type of offer as good news. "Generally speaking, users get a lot more value if they have preintegrated products," Kastner says.

Together, the products offer a three-

## X Over the Web Materializes

n June 1996, the entity known as the X Consortium died and went to The Open Group, Cambridge, MA. The X Consortium's dissolution, while understandable at the time, left a lot of unanswered questions-namely, what would happen to Broadway, code name for the long-awaited release of Web-enabled X Window?

After an entire year out of the public eye, Broadway is in the news again. In May, NetManage Inc., Cupertino, CA, announced its Chameleon UNIXLink97 product, the first UNIX-to-PC connectivity product based on Broadway, or X11R6.3.

UNIX users have always been able to run X applications remotely. Utilities like rsh and rexec allow users to display X applications on another X terminal, while commercial PC X servers such as Exceed from Hummingbird Communications Ltd., North York, Ontario, let users display X applications on their Windows desktop. What Broadway brings, however, is the ability to run X at a decent clip over a low-bandwidth connection. Before X11R6.3, running X over a 28.8-Kb/s SLIP or PPP connection, for example, was unthinkably slow.

X11R6.3 speed enhancements stem from a three-way compression algorithm known as Low Bandwidth X (LBX), and sometimes as X.fast. According to Brad Weinert, director of product marketing at NetManage, it has seen a two to four times reduction in packet size since LBX was integrated into Chameleon. To that effect, Kaleb Keihley, X architect at The Open Group, says he now feels comfortable running X applications over a 28.8-Kb/s modem connection.

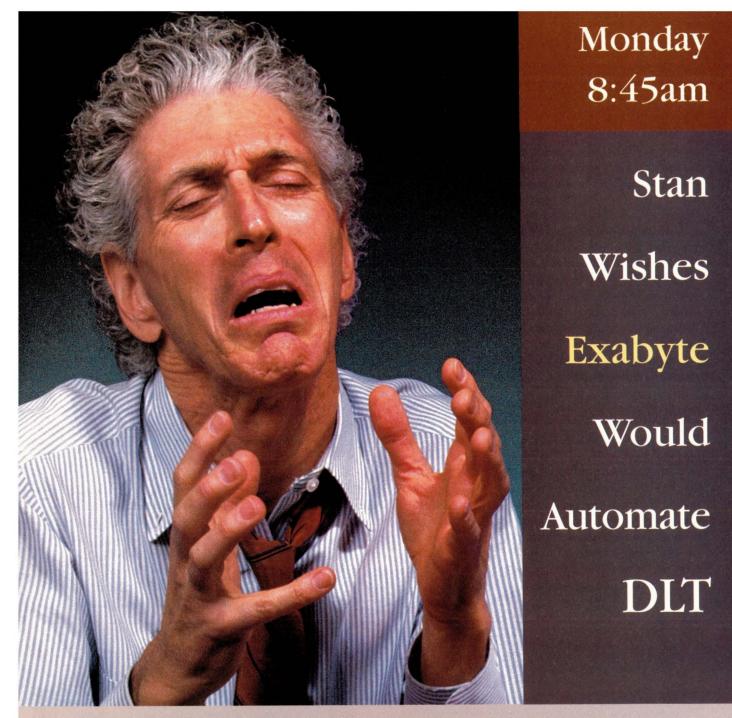
X11R6.3 also brings with it the ability to embed an X application directly within a browser. In the case of UNIXLink97, this is implemented as a Netscape plug-in.

Thus, to run an X application, all a user needs to do is click on a hypertext link that points to the application, and the application is launched automatically in the browser. X11R6.3 also introduces a primitive "sandbox" security model, which distinguishes between trusted and untrusted applications, and a firewall proxy, which gives the firewall the ability to decide whether or not to pass X packets on a per-user basis.

NetManage's Weinert says his company has been pleased with the interest level in UNIXLink97. "A majority of interested people are looking at [UNIXLink97] as an alternate way of accessing their legacy systems," he says.

"Redevelopment vs. redeployment," says Dan Mercer, senior systems programmer with Clear Systems Inc., Irving, TX, "those are our options." Mercer has been on a team developing a corporatewide UNIX application since 1991. Recently, senior IT executives ordered his team to give users in remote offices access to the application. Mercer, a UNIXLink97 beta tester, chose the Broadway solution because it would be much easier than porting the application to Windows NT.

The Open Group officials point out that X11R6.3 technology could also play an important role in the emerging Network Computer market. "NCI and Oracle are very pro X," says Ken Flowers, desktop program manager at The Open Group. To that end, engineers are hard at work on the next release of X, which promises features such as a smaller memory footprint, enhanced security and up-front protocol negotiations, whereby X would determine dynamically whether to treat the client as fat or thin. "LBX went a long way toward addressing the bandwidth problems X faced," says Flowers, "but we know we can do better."-as



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tier approach to OLTP, with BEA's Tuxedo operating as the middleware infrastructure that allows users to build and deploy open, mission-critical applications; and the Oracle Parallel Server database engine functioning as the parallel database. The Oracle database engine has a strong history of working well with the RS/6000 SP. According to IBM, the three products provide scalability and continuous availability. "IBM now feels comfortable with the RS/6000 SP, with the help of BEA Tuxedo and Oracle Parallel Server database, to do mission-critical online transaction processing that scales to very high levels," Kastner says.

Representatives from both Oracle and BEA say that scalability is one of the main strengths of the SP. "With a well-designed application, the SP can be scaled pretty much infinitely," says Pradeep Bhanot, director of marketing for Oracle Server. "The SP has tremendous throughput capabilities." BEA's Bob Buhl, vice president and general manager of Eastern regional sales, adds, "We feel that the SP is one of the highest performing platforms that we're going to be available on, and many of our customers have recognized that IBM has put together a very viable UNIX offering."

Availability is another major concern with OLTP. A company such as an airline, which relies on the sale of tickets, needs to have that service continuously up and running with minimal or no downtime. It is crucial that heavy demand does not bring a system to its knees. "If a machine is down, then their business essentially goes away," says IBM's Maas. "Availability is critical."

For staff at Intermountain Health Care (IHC), Salt Lake City, UT, scalability and availability were the two most important requirements for their OLTP system. "What we're looking for are uptime and scalability," says Blake Jensen, assistant vice president of information service at IHC.

The nonprofit health care organization primarily uses OLTP for aggregating clinical data and patient demographics collected from its 23 hospitals and clinics. IHC uses the RS/6000 SP, Oracle Parallel Server and BEA's Tuxedo, but it went through a long process of combining the third-party products into one system. The announcement that these offerings are now available in one integrated package was seen as a positive move by Jensen, who says the products are working extremely well at IHC with high availability and scalability, which he calls very good.

Customers can have the products preinstalled at the IBM's RS/6000 SP customization center and shipped as a single system. Optional software is available, including either IBM ADSM or Spectra Logic Corp.'s Alexandria backup and restore software. Big Blue is offering a single point of contact for servicing any of the three products.-ptc

## Updating the Office Suites

The major vendors of office suite software, Microsoft Corp., IBM Corp. through Lotus Development Corp., and Corel Corp., have either recently introduced or plan to introduce new versions of their products, with new Internet and intranet functionality.

Microsoft's Office 97 was the first to see the light of day. The software giant introduced the latest version of its market-leading application with much less fanfare than was seen with Windows 95 but still managed to make considerable noise. Office 97 includes some new features and some refinements to old standards. Microsoft Word, Excel, Power-Point and Access are still included, with

### **Intranet Search Tool for Solaris**

Corporate data housed on a Solaris-based intranet can now be searched with the help of two products from Littleton, MA-based AltaVista Internet Software Inc., a subsidiary of Digital Equipment Corp. This month, AltaVista plans to make the AltaVista Search Intranet eXtension 97 available, and later in the fall it will introduce the AltaVista Tunnel 97.

As the name suggests, the AltaVista Search Intranet eXtension 97 is a search engine for finding and indexing information on a company intranet. The Solaris release is based on the same technology used in AltaVista's well-known Internet search engine and even shares the same interface. The technology is described as a super-spider and, in the case of the intranet search tool, will crawl the various servers throughout an enterprise, as well as specified World Wide Web sites, indexing every word on all HTML pages, text documents as well as documents created with popular PC word processing applications, AltaVista says.

Brian Gentile, vice president of market development at SunSoft Inc., thinks that, in addition to a compre-

hensive cataloging of intranet information, the main benefit these products offer end users is speed. "It's a very fast search engine," Gentile says. "It's very comprehensive in terms of features, but even by speed alone it is one of the best products out there. That may be reason enough, in terms of intranet users, to use and deploy it."

In addition to its thorough search capabilities, the AltaVista Search Intranet eXtension 97 reportedly allows specified servers to be included or excluded from a crawl. Exclusion of a server or Web pages from indexing is achieved with the Robot Exclusion Protocol, which allows a site administrator to identify which parts of a site should or should not be indexed. Pricing for the AltaVista Search Intranet eXtension 97 starts at \$15,999.95 for 250 users.

The AltaVista Tunnel 97 is designed to give off-site workers access to a private network from anywhere over the Internet. Available this fall for \$995, the company says Tunnel 97 will be able to gain access through any brand-name firewall.-*ptc* 

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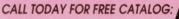
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some new features, but Microsoft has added a new desktop information manager–for integrating email, scheduling, contacts, tasks and document access–called Microsoft Outlook. Also included with Office 97 is Microsoft Internet Explorer, Camcorder and Photo Editor. The most important additions were tools for accessing, publishing and importing data from the Word Wide Web.

Like Office 97, Lotus' new office suite-SmartSuite 97-includes new versions of its standard applications such as Lotus 1-2-3 and Word Pro. This latest SmartSuite release was also designed with Internet and intranet technology in mind. Users can publish documents, spreadsheets, presentations, database information and calendars onto the World Wide Web or a company intranet. It supports industry standards such as HTML, GIF and JPEG file formats. Also being offered in the SmartSuite 97 package are templates that enable users to create their own Web pages. Documents can be opened and saved, using traditional dialog boxes, directly to and from an HTTP or FTP server, Lotus says.

Not to be left out, Corel says it plans to ship WordPerfect 8 later this summer. WordPerfect 8 will include Netscape Communications Corp.'s Communicator, a combination of Netscape's Navigator browser with email, groupware and Web development tools.

The new Internet and intranet features appear to be a definite bonus. For business users, the biggest advantage may be in being able to share and receive data via the corporate intranet. "One of the things that is a little bit confusing is the fact that people refer to the Internet, but what is having a much bigger impact on business, particularly as it relates to the average user desktop, is the [corporate] intranet," says Michael Pinckney, research director for Gartner Group Inc., Seattle, WA. "Where this software has a role in an organization is the intranet. Organizations are rapidly moving to use intranets, and the suites have a very good feature for addressing that, [whether] it's publishing to the intranet or using the intranet to share infor-

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mation to collaborate."

The key to Internet and intranet functionality lies with the ability for any suite user to be able to publish to the Web. Bill Bonner, PC specialist with Hitchiner Manufacturing Co. Inc., Milford, CT, has been able to create a personal Web site with little more than a self-taught HTML background. "[Lotus'] WordPro 97 is very good," Bonner says. "It doesn't handle all the real advanced tags, so occasionally I will have to go back in and tweak a few things by hand, but as a whole, I probably do 90% of the Web page design right in WordPro."

While the Internet and intranet capabilities are important for Bonner personally, the main advantage the office suite provides his company is in offering a complete, integrated package. "In the past we used WordPerfect and Lotus 1-2-3 separately, and each program worked differently. Menus, dialog boxes were all different, and they all had their own quirks," Bonner says. "By bringing it all into one office suite, you have that one consistent interface."

It's no secret that Microsoft is the number one provider of a complete office suite package with one consistent interface. The Office product line is the most popular productivity suite on the market. According to numbers gathered by Workgroup Strategic Services, a Portsmouth, NH-based organization that follows this market, Microsoft had 85% of the market in 1996. Workgroup predicts the Redmond, WA-based company will continue its dominance in 1997 and sees Lotus maintaining the number two position with just under 10% of the 1997 office suite market.

"Microsoft has a tremendous amount of momentum," says Gartner's Pinckney. "We don't see that changing because they do have the strongest product. Not that there is a big difference between SmartSuite [97] and Office 97, but SmartSuite certainly can't claim to be a far superior product, which would be required for Lotus to reverse the market trend away from Office."

Lotus and Corel hope to differentiate themselves from the rest of the market with Java suites or componentized suites. Both companies have already announced

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their intentions to introduce a Java suite product, while lesser known companies such as Applix Inc., Westboro, MA, have already started shipping their own versions of a Java office suite. While Microsoft has made no announcements, it is safe to assume that the company is looking at Java technology. "Obviously, we take a look at new tools and languages and things out there that we can use to make our suite appealing to people," says Kristin Larson, group product manager for Office. "But we haven't announced anything like that [a Java version of Office]." the desktop," says Microsoft's Larson. "The typical install is anywhere from 60 to 120 MB, depending on what you choose." Office 97 allows the user to install the features he needs with a tool called the Network Installation Wizard. The tool is designed so administrators can make a custom install of the specific applications needed on a particular desktop.

Lotus has announced plans to make available a component type of software that can be knitted together to build a hybrid suite. Lotus plans to release a beta version of the suite–code-named

> Kona-sometime this summer. Kona, a set of applets, will include a word processor, spreadsheet, charting capabilities, data access, graphics, project manager, personal information manager, email client and other features. The applets will be tied together with a consistent interface (codenamed InfoCenter) and include an interapplet data-sharing model known as InfoBus.

"We're building componentized software in disciplines that we already have a history with," says Bill

DeStefanis, director of electronic marketing business applications for Lotus. "We're spending a lot of time on componentized software delivery, migrating our experience in business applications to ActiveX- and Java-based developments."

Corel is offering a beta version of Corel Office for Java. The product is based on Corel's WordPerfect Version 7 suite, but only the core features. The Corel product includes Corel Word-Perfect for Java, Corel Quattro Pro for Java, Corel Presentations for Java, Corel Chart for Java and InfoCentral for Java on the client. On the server resides the file system management, file I/O, filters and some large application modules such as the spell checker and search engine.

One company already shipping a Java-suite product is Applix. Its Javasuite, Anyware Office, is designed as a thin client that can provide word processing, spreadsheets, graphics and an email client. The bulk of the application code resides on the server, leaving more room on the desktop.

This thin-client approach pleases the people trying to make Java a viable technology. David Brooks, vice president of advanced development for San Jose, CAbased Wyse Technology Inc., a manufacturer of Network Computers, likes the approach. "One of the things that vendors like us are going through right now is we don't have a real solid way of doing memory management. As Java OS matures and other operating systems come along and mature, then this problem will go away," he says. "Applix offers a very lightweight client that runs on the client side that communicates to the work horse, which is back on the server. The Applix product works very well."

The future of the componentized suite is still in question. "The Java suite doesn't really have a home today. It technically has a home because there is such a thing as Java Virtual Machine and there is such a thing as a Javaenabled browser, and there is such a thing as a Network Computer," says Gartner's Pinckney. "None of those things are widely deployed [except] Java-enabled browsers, but in terms of people really doing something with them, they are not. It won't be for at least 12 to 18 months before some of these Java applet-based solutions start to have an impact on the market."-ptc

## Oracle Stirs Up NC Market

More than a year after announcing the Network Computer Reference Profile (NC1) with Sun Microsystems Inc., IBM Corp., Apple Computer Inc. and Netscape Communications Corp., Oracle Corp. has had a busy couple of months, announcing its flagship NC software suite and the acquisition of a majority share of Netscape affiliate Navio Communications Inc.

Oracle's thin-client software subsidiary, Network Computer Inc. (NCI) announced in April its debut NC software products, NC Desktop and NC Server, which make up a suite of software for Network Computers (NCs)

"In an ideal world, from Microsoft's point of view, Java won't get all that far," says Pinckney. "[But they'll most likely] sell an ActiveX-based version of Office. Office is already ActiveX based, but [they'll likely sell] a more componentized version of Office where the components are based on ActiveX."

Whether you call it a "componentized" suite, Java suite or even an ActiveX suite, the new office suite grouping has distinct differences from the traditional office suites. A Java suite would be platform-independent and, instead of being a monolithic application that resides on the desktop, the office suite would be broken down into a series of applets. One benefit of this kind of suite is there won't be a 120-MB program sitting on the PC.

This notion of the desktop being eaten up is not one that Microsoft buys into. "This whole 120-MB thing is a little bit of a weird statement because you can install any amount of Office on



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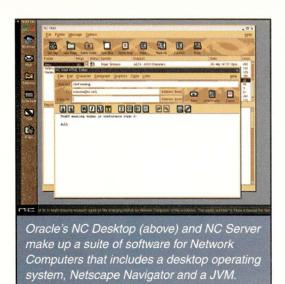


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that includes a desktop operating system, Netscape Navigator and a Java Virtual Machine (JVM).

More recently, Oracle has become a majority owner of Navio, effectively merging NCI and Navio under the NCI moniker. Navio develops and sells a Navigator Internet browser interface for NCs, including those offered by IBM, Hewlett-Packard Co., Tektronix Inc. and HDS Network Systems Inc. Navio products such as TV Navigator are also available for the home market. The first product using the TV Navigator browser, InterRakuTV, was announced in May and is available in Japan. The product was developed with NEC Corp. affiliate NEC Home Electronics.

Oracle originally outlined its plans for the NC software suite in May 1996 when the NC consortium coalesced, and NC Desktop and NC Server are the first products to come out of NCI, forming the core of the company's product line. The client software ships with what the company calls a "very cool" multimedia Video User Interface (VUI), a descriptor that is perhaps indicative of the company's sharp focus on the consumer market. The NC Server supports the Oracle Universal database, an application development environment, and applications ranging from email and word processing to general ledger and inventory management.

The latest NC consortium announcement, in March, expanded the profile with an ISO 7816-compliant smart card standard called OpenCard Framework, intended to ensure that any vendor's smart card can be used to access user information and files from any vendor's Network Computer, for applications such as Internet commerce. Along with NC Server and NC Desktop, NCI introduced NC Card smart card software as part of the new software suite.

The software runs on Intel Corp. architectures and Digital Equipment Corp.'s ARM and StrongARM microprocessors, manufactured by Advanced RISC Machines Ltd. DEC and NCI announced in March the Digital Network Appliance

Reference Design, upon which DEC will build its new line of Network Computers.

Oracle's other big NC-related announcement is being termed by Oracle and Netscape as a merger of NCI and Navio. The latter two companies, both formed last year and henceforth known as NCI, state as their unified charter to develop Navigator technology for consumer and non-PC devices, and to develop more business-oriented NC software. NCI and Navio both already had a presence in the consumer Internet

appliance and corporate and set-top box markets, and this synergy made the merger a logical move, according to all parties involved.

"Navio has a presence in the consumer market and NCI on the corporate side," says Randy Brasche, marketing manager at NCI. "And both the parent companies, Netscape and Oracle, have the server technology and Internet client

technology, respectively, so this really makes sense when you look at the overall Network Computer marketplace."

Navio's director of marketing, David Limp, adds, "We were missing the server side of the equation, so this meshed extremely well. We have contracts in the business space, with vendors such as HP and IBM [which uses Navio's browser on its NCs], and NCI has alliances with DEC and others, as well as the Oracle sales force."

The new entity will combine engineering, marketing, technology, brands and products of the two companies, and it will be based in the San Francisco Bay area. Jerry Baker will remain NCI's chief executive officer, and Wei Yan, president and CEO of Navio, will serve as Navio's president.

Mike Kantrowitz, executive vice president at one of Navio's first Network Computer partners, HDS, says that the merger was without a doubt a response to Microsoft Corp.'s recent moves in the consumer Internet market, most notably, its purchase of WebTV. HDS began shipping the Navio browser in December 1986.

"This merger is the result of Microsoft's purchase of WebTV. Instead of two companies, Oracle and Netscape, taking separate approaches to the consumer market, you have one company. It's now Netscape and Oracle vs. Microsoft and WebTV, and they are trying to replace Microsoft products with an open Internet technology," Kantrowitz says.

For Navio's part, Limp says the merger will add credence to the company's openly stated strategy in the NC market.

'It's now Netscape and Oracle vs. Microsoft and WebTV, and they're trying to replace Microsoft's products with an open Internet technology.'

– HDS' Mike Kantrowitz

"We're going to be able to show the industry that the Network Computer is very real, and there are deliverables behind the concept. The fact that the Internet and HTML and Java are the glue that tie this together is proof of that," Limp says.

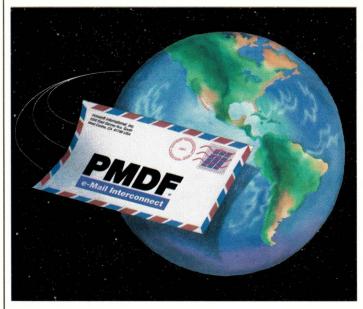
The base software, including the NC Desktop, NC Server and NC Card, is scheduled to ship in volume this summer, priced at

\$745 for a five-user server license, with additional named-user licenses available for \$149. In an apparent concession to Microsoft, the NC software comes with a Windows emulation option in the NC Connect module, which provides access to Windows applications, as well as 3270, 5250 and VT220 legacy applications.–*jsw* 

## Why UNIX System Administrators Need Internet Standards-based E-mail Integration

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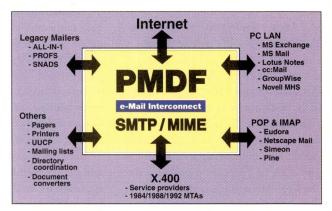
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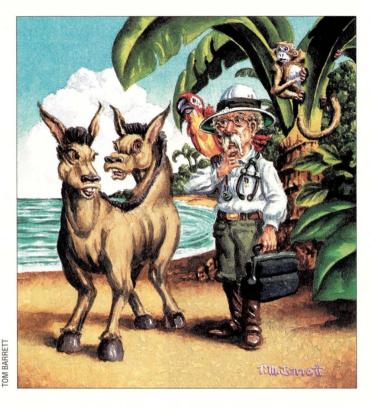
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## Ask Mr. Protocol

by Michael O'Brien



"E pluribus unum." – Wishful thinking on the part of broadcasters everywhere

*"In hoc signes, vincet."* – Marketeer having a dream

"Cave canem." – Marketeer's victim having a dream

## Mr. P. and the Pushmi-pullyu

OK, I want some real answers this week. Suddenly we're seeing router meltdown all over the backbone and you can't post to Usenet without getting megaspam email, and what is that?

Ah, no doubt you've noticed Mr. Protocol's spiffy new terminal, the one with a screen on both front and back, and two keyboards. I made a major mistake and left a classic Doctor Dolittle book out, and he must have gotten hold of it. Now, he thinks everything he reads is a protocol spec, if only he works at it long enough. On this one he got as far as the pushmi-pullyu, a sort of donkey with a head on each end that doesn't know if it's coming or going. That pretty much describes anyone who spends any amount of time talking to Mr. P., so he naturally thought he'd glommed onto something useful, and went and built one. You see the result.

The thing is, Mr. Protocol is trying to become comfortable, at a visceral level, with the future usage models of the Internet. The Internet is pretty visceral to Mr. Protocol. This is the sort of statement whose truth may be uncomfortably literal. How the Internet is used, then, is of prime importance to Mr. P.

For the Internet's entire history, the only usage model has been the one now called "pull." It seemed so obvious that, overall, it wasn't given a name, except for, perhaps, "client/server," which doesn't make for much of an improvement because, as we'll see, the other usage model also uses clients and servers, albeit differently.

Early applications on the ARPANET and the Internet have all been "pull" applications. In these applications, the user initiates a connection to some server somewhere, and pulls information over by requesting it. If you want a file, you run FTP and suck it over. If you want to talk to a foreign machine, you pull a connection over with Telnet and have at it. If you want to chat with other people on a MUD, you pull the MUD your way with a MUD client and so on. In a more abstract sense, it isn't information that's necessarily being "pulled." The pull is being applied to a service. The actual information flow may run in either direction. If you want to put a file onto a distant machine, you still run FTP and send the file over. In the literal sense, you're pushing the file, but the mode of interaction is still called pull because the first thing you did, as the user, was to manually pull up a connection to the foreign FTP server.

Historically, pretty much everything from Telnet to the Web has followed this usage model. You want a service, you go get it. Archie? You run archie, it connects to an archie server and looks things up. Gopher? You connect to a gopher server and hop around the menus. X Window? You fire up the clients and the servers, point the clients at the servers, and start sending information.

All the connections are proactive on the user's part with one major exception: mail. This has always been a service that runs asynchronously, without



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## Ask Mr. Protocol

user intervention in the delivery part. You sit there, logged on or not, and your mail piles up willy-nilly. Delivery agents take care of pushing the mail your way from the various points of origin. Hence the term "push" for this style of information flow.

#### Spam, Spam, Spam, Spam...

Not to say "pushy." Mr. Protocol has just heaved a giant box of fax paper at my head to remind me to mention that unwanted email seems to be getting out of hand these days. It has gotten to the point where the most innocent posting on a technical topic to any out-of-the-way Usenet news-

group now results in the receipt of vast quantities of spam. All sorts of defenses are being mounted in the war on spam email, from the personal to the corporate.

On the personal front, some users have altered their news posting environment so that their real email address does not directly appear in the posted article. Instead, a variant appears, and the signature file contains the (generally very simple) instructions on how to modify the address back in case you actually want to reply to the author. This defeats automatic address collection programs that sift through Usenet looking for email addresses.

On the corporate front, many places have stopped accepting mail from sites seen as being prime offenders. America Online supports a Web page full of Internet domain names from which mail will not be accepted

by AOL. Other places are quieter about it. Xerox Palo Alto Research Center has quietly altered its mailer to reject incoming mail if the host address in the SMTP envelope MAIL FROM: command represents a domain that has sent spam email in the past.

Of course, in many cases, the spamming is a one-shot affair in which a spammer at some other net has used the interdicted net as a transit net, via an overly permissive mailer that permits remailing to non-local addresses. Mr. Protocol, for instance, is unable to send mail to PARC researchers without forging the envelope (!) because someone at some time in the past slipped a spam through his provider's mailer.

Such activity is the mark of the truly desperate. And some people, at least, are becoming desperate, because no good method has so far suggested itself for dealing with the problem.

It can be argued that this is because email is, according to the classification of well-known Internaut Michael Gorlick, an example of "weak push." In weak push applications, the user must make some advance preparations to use the service. In the case of email, this consists of establishing an email address and publicizing it in some way. No one can get email right out of the blue; they have to have a mailbox first. Not only that, people who send email, even spam emailers, must know the address of that mailbox before the email even leaves their site. Other Internet services have recently appeared that obey the same model. Consider the Pointcast service, for example. This is a service that runs as a screen saver. Once registered with the Pointcast service, the user receives a stream of news, stock quotes and other juicy tidbits according to a profile he or she establishes...along with, be it noted, various advertisements, perhaps also targeted to the individual user. The "weak" part about this is that the user must register with the Pointcast server before any information can be sent, and the Pointcast user software polls regularly behind the user's back.

This method of connection has been elaborated considerably by a service called Castanet, by Marimba. This is sim-

> ilar to Pointcast, but with multiple information channels.

The makers of Castanet have decided, for marketing or other reasons, to change terminology. To Castanet, a server is a "transmitter," and a client is a "tuner" with one or more "channels" open. The transmitters transmit information over the channels, and the tuners pick what they want off of it. The transmitters do not transmit the same information over and over again. Instead, the application and the data are both transmitted over the channel, and from that point on, "state deltas" are transmitted. That is, the only information transmitted most of the time is information that has changed. This maximizes the use of the channel bandwidth.

Castanet is another example of "weak pull" because the user has to set up the tuner and

the channels, that is, he has to subscribe to the service, and the tuner has to periodically poll the channel for activity or updates. However, it looks like push to the user after it's set up: Information just flows in automagically.

But what about real push? Is there such a thing?

Mr. Protocol is glad you asked. Yes, but only just. The real future of Internet data dissemination, many researchers think, lies not with point-to-point services such as Pointcast and Castanet, but in a completely different type of Internet traffic called multicast.

#### The Future Is Multicast

On any given network, there are generally only two types of packets: unicast packets, sent to a specific IP address, and broadcast packets, intended for anyone who cares to pick them up. Most broadcast packets are either requests for information from machines that are just in the process of booting or are otherwise shy of information (such as an ARP request, to turn an IP address into an Ethernet address), or else they are general announcements of the "I'm here" variety. All of the services mentioned so far use the unicast packet type to send their information.

There is a third type of packet, developed much later than the first two types. It looks like a regular unicast packet, except for the address. Mr. Protocol has reported previously on the existence of Class A, B and C addresses, depending

In weak push applications, the user must make some advance preparations to use the service. In the case of email, this consists of establishing an email address and publicizing it in some way. corp:/acctg >ls general.ledger UX:ls: ERROR: Cannot access general.ledger: No such file or directory

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

corp:/mfg >ls inventory.cont UX:ls: ERROR: Cannot access inventory.cont: No such file or directory

corp:/mfg >ls order.entry UX:ls: ERROR: Cannot access order.entry: No such file or directory

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## Ask Mr. Protocol

on whether the address has one, two or three bytes of network number versus three, two or one bytes of host address. The address in a multicast packet is a Class D address. Class D is a segment of the IP address space whose use is reserved for multicast applications.

Packets with addresses in the Class D segment are treated differently by "multicast-aware" Internet routers. Each particular multicast address is used by a particular transmission, or multicast group. There can be more than one multicast trans-

mitter using the same address. Whenever a user wishes to join a multicast group, a message is sent to the nearest "upstream" router announcing a desire to join the group. This message is passed on upstream until a router is encountered that knows about the group. That router then remembers from which interface it received the request. When a member of a multicast group transmits a packet to the group's multicast address, the router that processed the member's "join" request transmits the packet upstream. The packet is then sent by each router to each interface from which a "join" request for that multicast group has been



seen. In this way, the packet goes to just those parts of the Internet where there are members of the multicast group. If everyone in a group is in the same city, multicast packets for that group will never leave the city.

In this way, multicast packets use only the resources they need to get to where they're going. The "tree-pruning" happens automatically, at routers, and no central transmitting site has to be aware of all of the receivers. In fact, no one is aware of all of the receivers, merely of which interfaces have members listening somewhere beyond them.

This service amounts to pure push. All a user does is say "I'm interested," and data comes flowing in. In fact, the "join" command doesn't even reach the transmitting site; the transmitter is totally ignorant of the specific identities of the receivers.

The multicast service is currently used to hold audio conferences on the Net. One or two multicasts carry "Internet radio," which works similarly to RealAudio as far as the user is concerned, except that there is no connection involved (multicast services use connectionless UDP packets), and the transmitter doesn't know how many receivers it may have. In the general case, a multicast audio conference is sort of like a conference room where everyone is hanging out to do their work. Anyone may speak up at any time, using a local microphone, and everyone in the group who hasn't muted their speakers will hear what the person has to say.

Local multicast groups can be set up inside corporations, or worldwide multicast groups can be established to carry audio and video feeds from conferences. The meetings of the Internet Engineering Task Force are carried on the multicast backbone (the MBONE), in both audio and video form.

The Internet is not yet multicast-aware as a whole. Instead

of one big multicast cloud, the Internet actually consists of a whole series of multicast-aware "cloudlets" (Mr. Protocol's term–never get him started discussing the weather) connected via "tunnels." These tunnels are router configurations that carry global multicasts from one cloudlet to another across areas of the Internet that do not yet know how to pass multicast join requests.

Because a single multicast address represents an entire multicast group, no matter how many members it has or

how widespread it is, there must be some central authority for assigning addresses to groups. Right now, the multicast user community is small enough that this is handled automatically as required.

Bandwidth is a different consideration. With the current generation of multicast tools, it requires about 200 Kb/s to carry a reasonably compressed live video feed with compressed audio to accompany it. A little thought will show that just a few full-scale video and audio multicast sessions would use up all of the available bandwidth on the Internet backbone via the tunnels. This is avoided in practice by gentlemen's agreements. Multicast sessions

with a large bandwidth requirement, and which are expected to be widely tunneled, are coordinated across a community of multicast users to avoid this.

#### Egalitarian Idea

Operationally, multicast sessions are made available through a special multicast session, which exists all the time, and which supports an application called the session director. The session director lists all the existing multicast sessions and gives the user a chance to join as many of them as he pleases.

The multicast service is an example of the Internet as it was originally designed to be: egalitarian. Pointcast, Castanet and other such services are market-driven, operating according to an economic model that has dominated all past mass media: distribution of edited content from a central site to subscribers whose only vote on the content offered is yea or nay, subscribe or don't. Multicast technology offers everyone the opportunity to be a media broadcaster. The central distribution schemes are forced to develop an elaborate technology of repeaters and caches to avoid "server meltdown" when too many people make demands of the central service. In multicast operation, this problem never arises because users need not interact with the current source of packets at all. And, in fact, any user may become a source of packets on a given multicast session. Though, of course, it would be highly antisocial to crash in on a conference session uninvited, in practice, the MBONE viewers of a session can ask questions of the speaker in real time.

Multicast operation is still in its infancy. Further developments are pushing toward a combination of the two: a reliable multicast service in which members of the multicast

## Ask Mr. Protocol

group each receive packets in the normal way, but if a packet is lost, the group may request a unicast retransmission of the missing data from the originator. This sort of service is being developed in a trial of the military's Global Broadcast System, which sends multicast information via a satellite link. Web pages may be sent via multicast to proxy Web servers at an arbitrarily large number of downlink sites. Missing packets may be requested via a terrestrial network serving as a back channel. Despite the resemblance, this does not amount to "weak push" because if there are no packets lost, the transmitter will never hear from the receiver, or even know of its existence.

There is a new generation of the Internet Protocol being prepared and tested for deployment. One of its new features is the existence of a "flow" field. Although the exact meaning of this field is still being worked out, it is intended to provide a way of grouping a sequence of packets together for the purposes of making quality-of-service decisions in routing. (Glimpse for the curious: Mr. Protocol, reading over my shoulder, just whacked me good for telling a whizzer. Any attempt to assign any specific meaning at all to this field has so far resulted in a spontaneous meeting of the Jim Corbett Memorial Protocol Design and Fisticuffs Society. This is a distinct improvement over the situation just a couple of months ago, when it invariably resulted in a spontaneous convocation of the Marinus van der Lubbe International Firebombing Society.) It exists separately from any notion of a connection because IP is a strictly connectionless protocol. Multicast is also connectionless, unlike TCP. So, the natural marriage of the flow field with a multicast service is one that was foreseen when the flow field was first introduced, and promises to make multicast operations a significant player in the future of the Internet.

New services are always fun to watch, especially when they use fundamentally new transmission methods. Mr. Protocol thinks that current usage of multicast technology is just the tip of the iceberg. *Mike O'Brien* has been noodling around the UNIX world for far too long a time. He knows he started out with UNIX Research Version 5 (not System V, he hastens to point out), but forgets the year. He thinks it was around 1975 or so.

He founded and ran the first nationwide UNIX Users Group Software Distribution Center. He worked at Rand during the glory days of the Rand editor and the MH mail system, helped build CSNET (first at Rand and later at BBN Labs Inc.) and is now working at an aerospace research corporation.

**Mr. Protocol** refuses to divulge his qualifications and may, in fact, have none whatsoever. His email address is amp@cpg.com.

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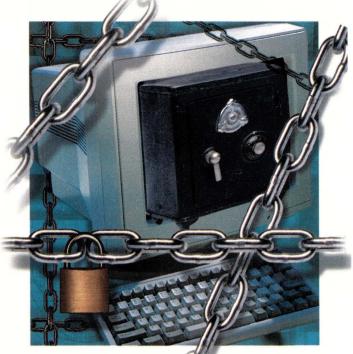
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Circle No. 42

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## Security on Track

t the end of April, I attended the SANS 97 Conference held in a hotel in the Inner Harbor in Baltimore. I somehow found my way into the security track of the conference and heard a number of very good talks aimed at stopping the bad guys from doing their bad things on my systems. My machines are connected to the Internet, so security is always a hot topic for me. People seem to be continuously finding new ways to exploit holes in systems, and a neat feature can turn into a massive hole overnight. However, things do get fixed because of the activities of organizations like the Computer Emergency Response Team (CERT) Coordination Center, who bring problems into the open. Also, many vendors distribute security patches to all comers, not just their own customers.

There are an increasing number of sites appearing on the Web that are dedicated to security issues. Many of them give information on extant holes, warning systems administrators of problems. Many sites offer prescriptions for trainee system crackers, giving them ways to exploit holes. Many attacks are carried out by naive people who have picked up a set of operations that might work and are using them to experiment. Such people don't often have a deep understanding of what they are doing. I even heard of one case where a cracker successfully became superuser on a UNIX system and then proceeded to type DOS commands.

Even if your systems are sitting behind a firewall, it makes sense to take basic precautions to deter the potential cracker who may be using a prescription to attack your site. This will help limit damage if your firewall is breached because of some oversight or misconfiguration. I can't say that I have heard about successful attacks through firewalls. This may be due to the efficacy of such systems, but then again, if I am running a company that makes firewalls, I will think hard about customer confidence before I broadcast any problem that my system is experiencing. I hope that such companies have enough guts to tell existing customers about problems and fixes.

#### The inetd Daemon

The first object of my attention on any unprotected system is the inetd daemon. To understand what it does, let's take a concrete example. Consider sitting at one machine and running telnet to connect to a remote system. The telnet program will first create a link to the remote machine using TCP/ IP by sending a connection request to a "well-known" port (number 23). On the target machine, some program must have registered an interest in receiving messages that are addressed to port 23. If not, the kernel in the target machine won't know where to send the messages and will reject them. In the early networking systems, the telnetd daemon was the program that registered this interest. At system bootstrap time, telnetd was run and said to the kernel, "OK, send all requests for port 23 to me." The program

then put itself to sleep until such a request materialized.

When telnetd was sent a connection request, it didn't want to deal with the request directly, because it's desirable to have more than one telnet connection to any one machine. Instead, it forked to generate a process that would deal with the connection. Having done its job, telnetd went back to sleep waiting for another connection. The child that it forked got on with the job of communicating with its client using a new port number. TCP/IP allows a server to reply to a connection request by saying: "Yep, I'll talk to you, but please use this port number."

In the early systems, there were many separate services that behaved in a similar way to telnetd. Doing a ps on such a system showed several processes, each offering a different service, sitting there waiting for a connection to be made from some client on the network. Sun co-founder Bill Joy had the bright idea of creating inetd, a single program whose job is to wait for connections to a great many services. When a connection is made, inetd forks and runs the appropriate program, whose identity and parameters are determined by a control file, /etc/inetd.conf. The contents of this file are read by inetd when it starts. The selection of the appropriate program is made by using the protocol type (UCP or TCP) and the port number used in the connection request.

Most vendors ship systems with everything in inetd. conf enabled and ready for use. This perhaps makes sense for installation purposes; systems are operational "out of the box." However, the first job of any system installer should be to go through the entries in the file and disable anything that is not used on that particular system.

There are several categories of programs in the Sun system that you may wish to turn off. First, the easy set, there are several programs that you will not be using. For example, if you don't plan to support uucp over the network, then this line can be removed. I tend to comment lines out of the file by inserting a # character rather than deleting them, which makes it easier to insert the correct lines later. When you change the contents of inetd.conf, you have to tell the running inetd to reread its control file. Find the process ID of inetd and send it a hang-up signal:

#### # kill -1 pid

Second, having got rid of the things that you know you don't need, you should examine the set of programs that supply information about the system or its users. For example, I usually turn off remote access to the ps and netstat programs. Many sites now turn off access to the fingerd and talkd programs, largely because they run programs that are suspect from a security point of view (or they did in the past).

Third, on a Sun machine, there are the services provided by Sun RPC (sprayd, rexcd and the like). These are usually turned off because they are not very secure due to weak authentication policies.



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Fourth, there are several services that are provided internally by inetd. They were originally designed for network testing and have been superseded by ping and traceroute. Such services include echo, which bounces a packet back to its originator, and discard, which acts like a /dev/null for network packets, consigning incoming packets to the great void. These services are not intrinsically risky but can be used by an aggressor who can flood your network in a denial of service attack.

#### **TCP Wrappers**

Hopefully, you will be left with a bunch of services that you wish to support on the machine. However, if the service is enabled in /etc/inetd.conf, then it will be available for anyone to use, and you may wish to have a policy that operates a finer grained control. Take for example, the

infamous Berkeley "r" programs: rlogin, rsh and rcp. These programs were created as a quick hack for "short-term" use on the Berkeley network and have lingered on. They are convenient, but provide "back-door" password-less access to machines with authentication being provided by a control file in the user's home directory. Because they are convenient, people are often happy to have the programs operating on their local network but wish to prohibit access to them from the outside world. The standard inetd

program does not provide this fine grain of access control, although there are versions of the program that do, I believe.

Another large problem with inetd is the lack of logging. With a vanilla system, it's up to the daemons that are forked by inetd to log accesses, and many of them just don't do that, or they only log successful attempts to use their services. So, for example, telnetd will call the login program to allow someone to log in, and a successful login is logged in the normal accounting files. Nothing logs unsuccessful attempts, so you will not see that cracker out there trying to guess passwords. Often the first indication of an attack on a system is a set of attempts to probe the services that are available on that machine, so it can be valuable to have this activity logged.

The current solution to the logging problem is to use a "TCP wrapper," the best of which is tcpd by Wietse Venema of the Department of Mathematics and Computing Science at Eindhoven University of Technology in the Netherlands. Venema calls the program suite: tcp\_wrapper.

The idea behind tcpd is simple. For each service, the inetd program runs the wrapper program, rather than the daemon. The wrapper program logs the call to the daemon, optionally does some checks on where the call to the service originated, and then calls the daemon as if nothing had intervened. The name of the daemon and any arguments that it may need are provided as arguments to the wrapper program, so setting up tcpd involves some minor changes to inetd.conf.

Access control to services based on the name of the client

machine is provided by a couple of files. The hosts.deny file allows you to specify that hosts can be refused access to certain activities. You can put the names of specific hosts, or use ALL to deny access to all hosts. The hosts.allow file permits access to specified services to certain hosts or networks. Hosts placed in here will override controls in the hosts.deny file. So, for example, I turn off access to the "r" program daemons for all hosts in the hosts.deny file but permit access to the programs from my network or certain other machines as the need arises.

Of course, the access control depends on the integrity of your network. It's important to ensure that packets that purport to come from your local machines have not been sent in from outside. The router that connects my network to the world is set up so that it will ignore any packets that arrive from the outside world pretending to come from a machine

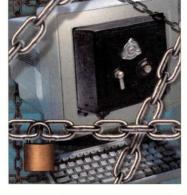
on my network. Filtering suspect packets that originate from an illogical place has become a basic precaution. If you don't do this, then you are vulnerable to several different attacks subverting programs that rely on the integrity of the data arriving from the network.

Also, using host names in the deny and allow control files means that you are relying on the integrity of the Domain Name Service (DNS). There have been attacks that used subverted address mapping from the DNS. However, it's not too easy to do a complete subversion job, and DNS is relatively secure.

I imagine that in the fullness of time, we will have to move to some DNS system that uses digital keys to ensure data integrity. Sadly, I feel that governmental action in many countries inhibits the free use of encryption, and so really secure DNS is some way off.

The topd program logs activity using the standard syslog system. I tend to compile the program so that it logs activity to a local facility number. I can then divert its output to a file that solely contains data from the wrapper program. Once you have done this, you can process the log automatically. I run it through a sed script every day to strip out common activities, and if the resulting file contains any data, I mail the text to myself. This allows me to trap "odd" things happening on the machine. I've caught a few probes onto my network in this way. On both occasions, polite mail to the person named by the NIC as the administrator of the machine has resulted in an explanation of the activity. Incidentally, I wish that the people who made my router would understand the need for full and frank logging of packets that it filters out of the data stream.

It's important to realize that a probe from a machine may not originate from a legitimate user of that system, and that system may have been compromised. Polite mail is essential. You may be dealing with someone whose machine has been cracked and has no idea of what is going on. Generally, my email to the administrator makes the point that their system may have been invaded, largely with the intention that they will deal with the problem quickly before their logs (if any) have timed out.



#### Passwords

The aim of many crackers is to get a login on your system, because the possibilities of becoming root are vastly improved if the cracker can operate as a user on your machine. The easiest way to get access is to get a password from a person. Many passwords are obtained by "human engineering," getting on the phone to the appropriate person and asking for a password. It should be site policy never to give passwords out unless you are sure of the identity of the person to whom you are talking. Human engineering takes courage, and so there is considerable focus for crackers to find ways to obtain the password file from your system automatically.

In his talk at SANS 97, Randy Marchany (from the Virginia Tech Computing Center) said that he found several password files from many machines obtained by the cracker that invaded his system. He had no idea where many of these files originated. He advises people to put something in the password file that identifies the home system so that the proper owner can be advised. I've decided to put my home URL in the name field in the password file for the www login on my machines.

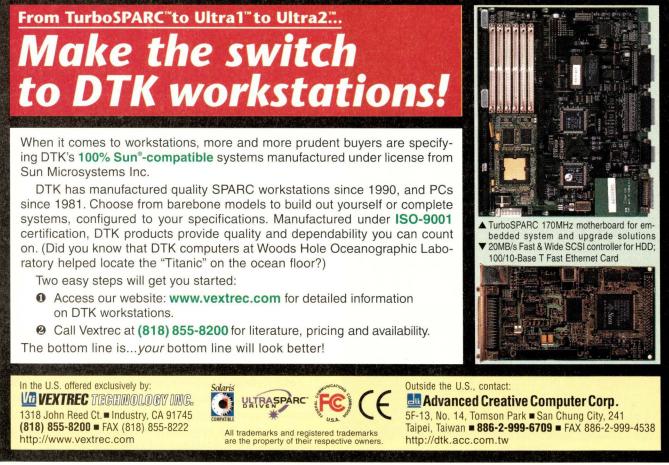
Your machine will provide many services that deliver files over the network, and these represent attack points to obtain your password file. Some of the services run with superuser privilege and so can be used to send the shadow password file should your system use this method of defense. The prime targets in the past have been sendmail and your Web server. It's a good idea to replace the current version of sendmail on your machine with the latest version from http://www.sendmail.org. Eric Allman takes security breaches very seriously and works hard to eliminate them from his code.

The CGI script directory is a common source of security holes on your Web server. Remove or disable (by ensuring that the file is unreadable) any CGI script that you are not using. A recent spate of attacks have used a script called nph-test-cgi that is distributed with several httpd programs. You should instantly check whether you have this and disable or fix it (see the appropriate CERT advisory notice for details).

If someone gets hold of your password file, then there are several programs available over the Net that can be used to break passwords. The main technique is brute force, the programs use a dictionary to supply a basic set of words, encrypt each word and see if the encryption matches the password in the file. The best cracking programs apply common transformations of the words. For example, they check for capitalizations or try replacing the letter "I" with the digit one or the letter "O" with zero.

Perhaps the best password cracking program for UNIX is Crack, written by Alec Muffett. It's currently at Version 5.0, I've come across several older versions sitting on machines on the Net. The program has been around for several years, and I recall the misplaced furor that ensued on Usenet when Muffett first made the program freely available.

If you obtain and run this program on your machine, and I suggest that you do, I predict that you will crack about 10% of your user's passwords. People don't often understand the need



Circle No. 16

to use strong passwords. They see the password as an annoyance. If you insist on using password aging on your system, then I predict that you will get more hits from the Crack program. I have said for years that password aging is a bad idea. It seems hard to get people to believe that aging systems force people to

create a personal algorithm used to generate their current password. The algorithm is bound to result in weak passwords. I said in my article "Passwords," February 1994, Page 24: "It seems a good idea to change passwords regularly. It doesn't seem a good idea to force this on people. Password aging systems are enthusiastically stupid and I believe that they may result in worse security." I was sent email from several people who didn't believe me.

It really is better to insist that users generate a good password and stick with it. Thinking of a good, memorable password is quite hard. Once you have one that is not easily broken, then why change it?

Of course, all the password security in the world doesn't help us much when logging into

remote machines over the Internet because the passwords travel down the wire as plain text. Many people have access to that text. There has been at least one incident where crackers stored a packet sniffing program on a network router and captured passwords as they flew by. If you are logging in from a public



Circle No. 51

terminal at a conference or perhaps visiting a Cybercafe to read your mail, then you need to be deeply suspicious about typing any passwords.

I use two forms of defense. The first is the S/KEY system by Phil Karn, who conceived S/KEY when working for

It really is better to insist that users generate a good password and stick with it. Thinking of a good, memorable password is quite hard. Once you have one that is not easily broken, then why change it? Bellcore in New Jersey. The code implements a challenge/response login system for UNIX, providing a one-time password. The idea of a challenge/response system is that when a user logs in, the host types something and the user responds. The "something" is different every time and the user has to compute the response in some way using the challenge as a key. The computation can be done with a handheld unit. The user types the challenge into the unit and the unit returns a number that is the response. The response is typed into the machine. I use my Psion 3a machine as my handheld unit. You can get S/KEY to print a list of challenges and their passwords. You then travel around with a bit of paper that you need to take great care of, print it

using a small font and keep it in a safe place.

I have started to use a more recent system for security. The ssh system provides encrypted communications between hosts. The system consists of a client that replaces programs such as rlogin and rcp with a secure encrypted communications path, talking to a daemon, sshd, running on the remote machine. The ssh system was created by Tatu Ylonen from Finland and is an excellent piece of software.

#### **Security Resources**

Thanks to Randy Marchany for two excellent talks at SANS 97 that gave me the idea to write this article. I wrote an article that described the role of inetd some two years ago ("TCP/IP and UNIX," September 1995, Page 26).

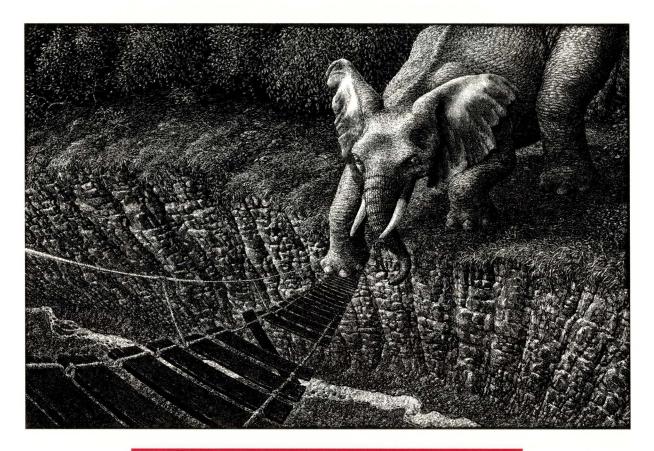
You can always find helpful security information on the CERT site: http://www.cert.org. Details about the nph-test-cgi problem can also be found on the CERT site. Following the link Cert Advisories puts you into the FTP site, and the file that you want is CA-97.07. nph-test-cgi\_script. In addition, the CERT FTP site features many tools that can help you ensure the integrity of your system. You'll find the current version of Crack here too, see ftp://ftp.cert.org/pub/tools/crack.

The tcp\_wrapper suite is available from ftp://ftp. win.tue.nl/pub/security; the current version is 7.6. S/KEY is a trademark of Bellcore and is available from ftp://ftp.bellcore.com/pub/nmh/skey.

Finally, the latest version of ssh is available for testing, see http://www.cs.hut.fi/ssh. 🝝

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

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JUDE MACEREN

## Waxing Rhapsodic

his column has spent quite a bit of time discussing topics related to Mac OS and Mach. Last year's series on "Civilizing Cerberus" (March to August 1996) discussed the use of Mac OS as a front end for a network of UNIX machines, including some coverage of MachTen and MkLinux. September's I/Opener ("Mach-Based UNIX Variants," Page 30) covered Machbased UNIX variants. This month's column continues these themes, covering Apple Computer Inc.'s upcoming Machand UNIX-based operating system, code-named Rhapsody.

The material in this column is based on presentations made at Apple's World Wide Developer Conference, WWDC (May 12-16, 1997, San Jose, CA). John Norstad, the author of Disinfectant, has written an interesting and insightful review of WWDC '97 and Rhapsody. It can be found at http://charlotte. acns.nwu.edu/jln/wwdc97.html.

Events are moving very fast in the Rhapsody development effort, however, so don't be surprised if some of the comments and speculations below have been overtaken by events by the time you read this column.

#### A Bit of History

Steve Jobs founded both Apple and NeXT Computer Inc., so it should come as no surprise that many of Apple's strong points are also present in NeXT's offerings. Like Mac OS, NeXT's OpenStep is strongly oriented toward ease of use and administration, graphical interaction and so on. Although some of the specifics differ (for example, a "recycle" icon has replaced the Mac OS trash can), the OpenStep user interface should not be difficult for any Mac OS user to learn.

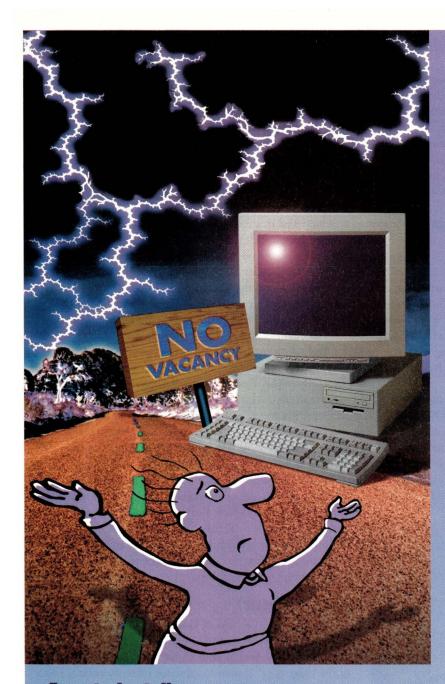
Under the covers, however, OpenStep is very different from Mac OS. For starters, it is based on BSD and Mach technology. This allows it to support preemptive multitasking, memory protection, strong networking and many other "modern" features that Mac OS has never supported. Yet, because of its ori-

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entation toward ease of use, OpenStep provides very simple systems and network administration interfaces.

And, in sharp contrast to Mac OS, OpenStep provides amazingly powerful tools for GUI-based software development. The OpenStep Interface Builder is a facile, intuitive and extremely powerful set of tools for creating GUI-based applications. OpenStep also supplies a mindboggling collection of built-in classes and methods, providing standardized ways of handling color and font issues, communication between applications, localization and so on. Because OpenStep uses Display PostScript, its applications are truly WYSIWYG; if something looks right on the screen, the user can count on it to show up correctly in the printed version.

In practice, all of this means that OpenStep applications are quite powerful, work together smoothly, and tend to have the same kind of consistency that makes Mac OS applications easy to learn. In short, OpenStep is an exceptionally powerful and pleasant user environment.



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## I/Opener

Like its predecessor, NextStep, OpenStep has received many accolades for its power and ease of use. Unfortunately, it has never gained enough market share to be taken seriously as a mainstream OS. And, given NeXT's position as a minor player in the OS wars, this situation was unlikely to change of its own accord.

With Apple's purchase of NeXT earlier this year, however, some new possibilities arise. Apple is in a position to throw both technical and marketing resources behind OpenStep, as well as making it the premier OS for its own systems. With this kind of backing, OpenStep is suddenly in a position to compete with Solaris, UnixWare and even Windows NT.

#### **Current Status**

At the end of 1996, OpenStep worked on Hewlett-Packard Co., Intel Corp., NeXT and SPARC (including Sun Microsystems Inc.) hardware. In the first part of 1997, it was ported to run on PowerPC hardware. A handful of ported OpenStep applications were demonstrated at the show, along with reports from developers as to the ease of porting (typically, only a recompile was needed).

During the same period, a "Blue Box" was developed, allowing both the Mac OS Finder and traditional Mac OS applications to run on PowerPC OpenStep. WWDC's application compatibility lab found problems in only four of the 400 applications tested; one of these, moreover, was written in 1984!

Apple and NeXT engineers have also been working on modifying the OpenStep user interface to look and act more



like the Mac OS. The goal of the "Yellow Box" is to retain the benefits of NeXT's user interface improvements (and large body of applications) without subjecting Mac OS users to a radically changed interface. Judging from the demos presented at the conference, the engineers were already making progress toward accomplishing this goal.

#### **Plans and Promises**

Having seen what the Apple and NeXT engineers had accomplished in a few months, most of the attendees (myself included) were inclined to give credence to Apple's descriptions of future wonders. Here are some of the highlights:

- Interface Builder will generate either Objective-C or Java. C and C++ routines can be linked in, if desired.
- The Yellow Box will be available on Rhapsody (both Intel and PowerPC versions), Mac OS, Windows 95 and NT.
- The Yellow Box runtime environment for Windows will be freely distributable by developers, with no licensing fees.

This means that a developer can pick up a copy of Rhapsody (either Intel or PowerPC), create nifty applications in an arbitrary mix of C-based languages, then sell them as Mac OS, Rhapsody and Windows applications. Although no mention was made of support for other systems, I strongly suspect that Yellow Box implementations for assorted UNIX variants are also in the pipeline.

This is a boon to developers and users, of course, but it also brings Apple into the mainstream of application development. If large numbers of Yellow Box applications get created, Apple and its users will benefit strongly. In addition, both Intel and PowerPC Rhapsody should be comfortable and powerful platforms for the Yellow Box, helping Apple to sell more software and (possibly) more machines.

#### **But Is It UNIX?**

There are many flavors of UNIX around; each has some number of adherents. I tend to prefer the "lean and mean" BSD-ish flavor found in SunOS, but I can see some benefits to the "large tent" System V approach taken by Solaris. I also enjoy the presence of assorted GNU System utilities on Linux.

All of these systems, however, present themselves as UNIX. Rhapsody, in contrast, is unlikely to present any of its UNIX underpinnings without a specific request. I don't see a major problem with this; most of my relatives would not enjoy using vi, let alone Perl.

On the other hand, I want the UNIX side of Rhapsody to be available to anyone who knows how to ask for it. There are many UNIX aficionados who also like Macintoshes; we are found in research labs, universities, dorm rooms and even corporate offices. If we can use both sides of Rhapsody, we can help it to be accepted in all of these places.  $\rightarrow$ 

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

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# Systems Administration

by S. Lee Henry



# **Message Authentication**

ast month's column was an introduction to authentication. The three major varieties (or uses) of the technology–user identity authentication, message origin authentication and message content authentication–were introduced before we went into more detail on the means by which users are authenticated.

This month, we look at message origin (sender) and message content (integrity) authentication. To begin with, let's briefly examine cryptography, the essential technology behind authentication. Those of us not working with message authentication may wonder about the connection between cryptography and authentication—what it is and how it works to "prove" that a message hasn't been altered or that it is from the purported sender.

O'Reilly & Associates' Dictionary of PC Hardware and Data Communications *Terms* provides succinct and useful definitions of encryption and related terms. It refers to encryption as "the process of changing a digital message (from plain text to cipher text) so that it can be read only by the intended parties (also called enciphering), or to verify the identity of the sender (authentication), or to be assured that the sender really did send that message (nonrepudiation)." The dictionary also clearly distinguishes private from public keys.

#### Cryptography

Private key (also referred to as "secret" or "symmetric" key) systems use the same key for both the encryption and decryption processes. As a result, the content of files encrypted with this technology can only be read by those who know the encryption key–presumably the sender and chosen recipients. Public key systems, on the other hand, use two different keys. One of these keys is more or less public, the other is secret. One key is used to encrypt the text, and the other is used to decrypt the text. The two keys have a relationship to each other in that each reverses the process that the other invokes. As a result, either key can be used as the encryption key as long as the other is used for decryption. This enables the technology to be used in two related but fairly opposite ways.

If the private key is used for encryption and the public key is used for decryption, we have a situation in which only the sender of a message could have encrypted it, but anyone (anyone with access to the public key, that is) can decrypt it. Whereas, if the public key is used for encryption and the private key is used for decryption, we have a situation in which anyone

**Disclaimer:** Regardless of everything that was said last month, proofs of identity based on what a person knows or has (not so much what he is) are spoofable to the extent that what he knows and has can be shared. If we whisper our passwords in our sleep or tell them to our friends because they're oh so clever, and leave our SecurID cards on our desks, no process on our systems will be able to tell the difference between us and the spoofers.

## Systems Administration

can send an encrypted message to the holder of the secret key, who is the only one who can read it. Each of these approaches is, in fact, quite useful.

What we have described so far suggests that public key systems generally involve the encryption and decryption of entire messages. Actually, this is not the case. It is more common for this technology to be used to generate what is called a digital signature, which is then attached to unencrypted messages as proof of their authenticity. The message itself is generally sent in clear text.

#### **Digital Signatures**

What are digital signatures, and how do they work? Well, to begin, let's briefly examine the motivation. One of the primary reasons that cryptography works so well is because the transformations from plain text to cipher text are easy to do but hard to reverse. The underlying mathematics particularly capitalizes on this feature in the functions that make up the encryption tools. At one end of the correspondence, there's some heavy computation going on, more than we'd likely want to encumber for every piece of email. Besides, if it is sender authentication that we're after, we might want to make it *available* to the recipient without making it *mandatory* to go through the throes of proving the sender's authenticity before reading the message. Most of us would prefer to save ourselves the trouble except for our more sensitive electronic correspondence.

With digital signatures, a quick "pass" (similar to generation of a checksum) over the message text creates a profile or



"hash" of the message. The range of values is large enough that any changes to the text practically guarantee a change of the resultant hash value.

The hash value is then encrypted with the sender's private key. The result is that anyone can 1) generate the same hash value from the message, 2) decrypt the digital signature using the sender's public key and 3) compare the computed and decrypted hash values to verify the integrity of the message content and the authenticity of the sender.

One of the key benefits of public key systems is that, unlike typical user authentication in which passwords are transmitted over the network in clear text, the private and the public keys are not transmitted (at least not in any context of the message itself) and are, therefore, not susceptible to being sniffed. The flip side of this, of course, is that public keys still have to be managed somehow. They need to be distributed, changed and inactivated as required.

Once public key systems are in popular use, we're likely to see some methodology for locating and verifying public keys as well. It is entirely possible, if strong approaches are not developed for public key management, that fraudulent public keys will be distributed as a means of authenticating impostors. ----

**S. Lee Henry** is on the board of directors of the Sun User Group and is a security services engineer at Infonet, a provider of virtual private networking, in El Segundo, CA. Email: slee@cpg.com.

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# **SUG** Notes

by John McLaughlin



ERIN TERRY

# The New Revolution

t's odd how often the iceberg analogy pops up. To most people, the visible part of their computing infrastructure is a personal computer or workstation. Many are unaware of the rest of the computing infrastructure that works away in the background. Of course, we computing professionals have some exposure to what lurks in the depths, and it's certainly not as simple as a formation of pure, sparkling ice!

As computers expand into every part of corporate America, we see more and more people migrating from the user community to the systems side of the house, and we have to deal with expanding the knowledge of our new colleagues. And herein lies the conflict of the day. To those who have dealt with only the tip of the iceberg, there is no need for minicomputers, mainframes are dead, and timesharing is something to do with vacations.

A couple of months ago, I was chatting with Bob, a fellow passenger en route to California–I was going to the SUG West Coast conference. I struck up a conversation with Bob when I noticed he was reading one of the 160+ Java books now available. Bob told me that he was a pre-sales engineer for a large chip design and fabrication company. I asked him why he was interested in Java, and Bob said it was something that he could run on his PC. "What about the other computers in your environment?" I asked. "What other computers? We're a PC company," was his puzzled reply.

At first I though he was joking, but then it dawned on me that Bob was as unaware of the bulk of his company's computing infrastructure as most people are of what's attached to the other end of their phone cable. (What kind of PBX do you have in your office? What's at the central office that supports your home telephone?)

Knowing a bit about Bob's company, I asked about the tools it sells for high-end chip design and Bob said, yes, the company does use Sun and Hewlett-Packard workstations. Bob pany's newest factory (fab!) and, yes, there were big UNIX boxes from Sun and HP there. Drilling in some more, Bob did recall that people around his office used 3270 terminal emulation. He was not sure what the terminals connected to or if such terminal emulators accessed mainframe applications. (I estimate that there are more than 30 million PCs in use today whose primary application is a terminal emulator to a minicomputer such as an AS/400 or a mainframe.) So here's a well-trained (noncom-

had recently taken a tour of his com-

So here's a well-trained (noncomputer) professional who has a model in his head of how computers are used at his own company that is, shall we say, incomplete?

So when you chat with non-systems people who think that they know something about computers, especially those who know only one flavor of PC, and they predict that UNIX is dead, don't tell them that they are wrong. Ask instead why more than 85% of corpoQuantum<sup>®</sup> Viking<sup>™</sup> gives your workstations and servers the blazing disk speed they're designed for – and at a very cool price! Because of their cost-efficient design, you get fast, Ultra SCSI-3, 7200-RPM disk drives for the cost of 5400-RPM drives. With Quantum Viking, you'll have it made in the shade with customers who want multimedia authoring workstations, workgroup servers, and other high-performance solutions.

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# SUG Notes

rate data is still on mainframes and why the \$20 billion midrange market (systems that cost from \$70,000 to \$700,000) is more than 50% UNIX and growing, according to figures I've read.

There's a revolution afoot that builds on this substantial multiyear, multitrillion-dollar investment. Those people who strive to replace that investment with products from one company, especially a PC company, are tilting at windmills. Those who use freedom and choice to evolve that infrastructure and add to it with an open systems philosophy will succeed.

We can present end users with a simple and beautiful model, thanks to Java and the Internet. However, we should let our users know that the required infrastructure that supports this view is not trivial, and experienced professionals are required to manage it.

Because there is a lot of power in the end-user community, we need to help our users understand enough of the complexity to make good decisions-business and technical.

Java has excited the imagination of the marketplace. As UNIX professionals, Java is not a threat—it's a boon. UNIX and open systems are the infrastructure components that support this inclusive revolution. Combinations of old and new components that are based on open standards are what we need. Yes, any vendor who can make its proprietary systems talk to open systems standards can participate in the revolution.

The old message of open systems and formal standards is more important today than ever before. It is a message that the workstation and minicomputer vendors took to heart. Now with Java, the PC marketplace will hear that same message. Long live the revolution! →

Author's note: Alex Newman is taking a month off for a much-needed vacation (SUG East was a huge success, but a lot of work). Pinchhitting for him this month is John McLaughlin, president of the Sun User Group's board of directors. He can be reached at flash@sug.org.

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# RDBMS in the Spotlight

Thanks to the Internet and the 'universal server,' RDBMSs have leaped from ho-hum to hot.

CLIENT/

SERVER

ause a minute and try to estimate the amount of data that's gathered each day by the world's online transaction processing sys-

tems (OLTPs)—all the banks, utilities, telecommunications companies, airlines, hospitals, insurance companies, governments, satellites, process monitoring devices and so on. Unless you're comfortable dealing with numbers like the national debt, you'll probably give up and roll your eyes.

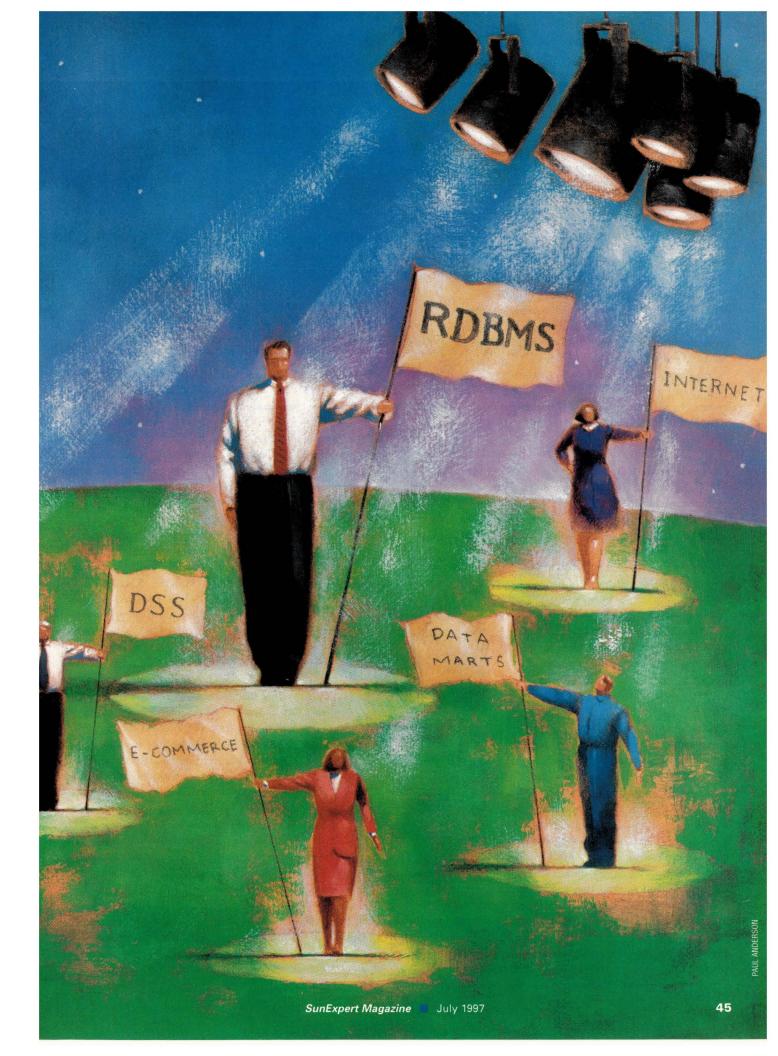
The point is that relational database management systems (RDBMSs) are the engines behind most of that data-gathering effort and are responsible for gathering and processing thousands of terabytes of data daily. Baby

boomers may remember the early days of RDBMSs some 20 years ago when RDBMSs were viewed as esoteric (after all, they were invented by a mathematician, E.F. Codd), poorly performing systems. RDBMSs were veiled in complex-sounding jargon like "normal forms," "two-phase commit" and "relational calculus," and required use of a new data "sublanguage" (whatever that was) called SQL.

Today, however, RDBMSs are basically commodity items. It really doesn't matter whether you buy from market leader Oracle Corp. or second- and third-place vendors Informix Software Inc. or Sybase Inc. You can basically count on all of them to deliver solid performance

### by Karen Watterson

44



and to be supported by a small army of partners, value-added resellers and independent software vendors. Until about a year ago, this was the state of the market, a rather ho-hum affair.

Then, twin waves rocked the marketplace: the so-called "universal server" and the Internet. Plainvanilla RDBMSs weren't enough anymore, declared the vendors, analysts and press. RDBMS vendors had to have an architecture for handling the increasing amount of "complex data" such as images, audio and video clips, programming objects like applets, and even books, movies and fingerprints.

RDBMS vendors also came under pressure to adapt their engines not only so data stored in RDBMSs could be safely accessed over the Internet, but also for use in electronic commerce and "distributed" applications in general. All of a sudden, the RDBMS market was ho-hum no more.

And that's where we are today. Although you're not likely to migrate your existing production OLTP or client/server systems to a different RDBMS vendor, you may want to take a fresh look at the marketplace as you begin rolling out new applications.

#### **Hub and Spoke**

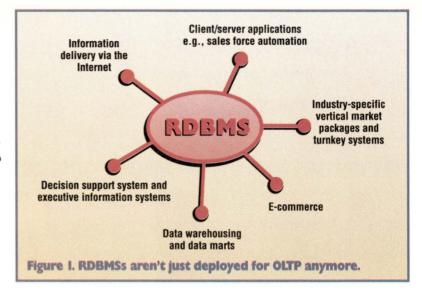
The fact is that RDBMSs are being used for a lot more than classic, heads-down OLTP systems (see Figure 1). They're also being used for decision support, traditional client/server applications, industry-specific vertical market packages, data ware-

houses and a variety of Internet applications including e-commerce. You might consider RDBMSs the heart of IS.

The big difference between OLTP systems and decision support systems (DSS) or business intelligence (BI) applications-both of which are sometimes used with data warehouses or data marts-is that the former focuses on getting data in, while the goal of DSSs and BI applications is to get the data back out. OLTP systems are optimized for concurrency (supporting lots of users simultaneously) and for processing many short transactions. DSSs, however, which are often read-only systems working off copies of production data, need to be optimized for ad hoc queries that often involve complex joins and may even deliver data-perhaps

over the Internet for subsequent slice-and-dice analysis.

RDBMSs are also a very important player in the client/server applications market where they serve as the unsung heroes in products from companies like SAP AG and PeopleSoft Inc., or in applications such as help desks and sales force automation products, to name a few. In fact, the major RDBMS vendors all have close working relationships with the major client/server vendors, often involving on-site teams. And it's not just a question of Oracle and SAP, for example, making sure their products



work well together, but also SunSoft Inc. working with both of them, sometimes establishing centers of competency, to optimize Solaris so it will remain the operating system of choice for the UNIX RDBMS market. (Technically, this translates into issues such as supporting kernel asynchronous I/O, which lets applications communicate directly with the I/O subsystem; direct I/O, which lets applications bypass buffer caches; and list I/O, which bunches I/O requests.) As Solaris Group Marketing Manager Kuljeet Kalcat observes, buying decisions aren't driven by operating systems, but by the "killer apps."

RDBMSs are also deployed "under the hood" in thousands of

vertical market turnkey applications. Progress Software Corp.'s Progress RDBMS, for example, isn't one of the "big five" RDBMSs (from Oracle, Informix, Sybase, IBM and NT-only Microsoft Corp.), but, like Computer Associates International Inc.'s CA-OpenIngres, is widely sold through the channel as the database engine for industry-specific applications.

In addition to being used for OLTP, DSS, classic (and homegrown) client/server applications and vertical market packages, any of which may have Web-enabled components, RDBMSs are also being used to house data marts or data warehouses. Search your favorite online computer store for titles including "data warehouse," and you're likely to come up with about 50 titles. Data warehousing is hot, along with related data mining and database marketing. Many organizations opt to leverage exist-

ing expertise and use one of the RDBMSs they already have inhouse, but others are using the new application domain as an opportunity to assess other vendors.

#### **Feature Sets**

If you're in the market for an RDBMS, what features should you look for? Or does it matter? Are they all pretty much interchangeable, commodity products? As SunSoft's Kalcat says, you should probably let your application help drive your deci-

**RDBMSs** are being

used for decision

support, traditional

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applications,

industry-specific

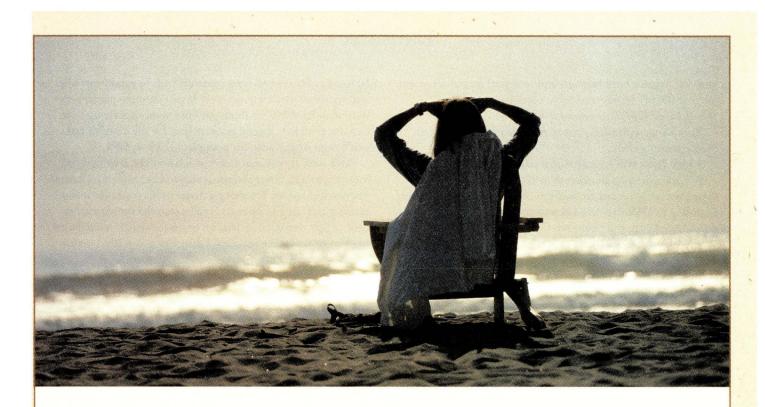
vertical market

packages, data

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sion and balance both business and technical factors. Here are some of the key business issues to consider:

• What RDBMSs are you using now?

By sticking with tools your staff already knows, you can reduce training costs.

• How important is going with a winner to you?

If market share and market dynamic are important, Oracle dominates with somewhere between 38% to 47% of the market, according to 1996 data from Framingham, MA-based International Data Corp. and Stamford, CT-based Gartner Group Inc.

• How eager are you to use "universal" or object/relational RDBMSs that support objects better than classic RDBMSs, which store objects indiscriminately as binary large objects (BLOBs) or simply use pointers to large external files?

Informix has been shipping its universal RDBMS since late last year; IBM has been rolling out "extenders" to DB2 for more than a year, and Oracle8 should be available on its Tier One platforms by the time you read this.

• How important is price? Scalability?

All the vendors now have inexpensive, low-end workgroup (NT) versions of their products that you can download for evaluation at no cost for 30 to 120 days. And most scale through symmetrical multiprocessing (SMP) and massively parallel processing (MPP) systems, but incremental costs of adding users, including remote users who access data over the Internet, vary widely.

• How important is it that your RDBMS vendor is a technology leader?

Informix, for example, despite being first to market with a universal server, didn't ship support for replication until late 1996. Perhaps surprisingly, IBM with its universal/common server seems to be leading in the technology leadership race to market.

• How important is the existence of a dynamic third-party tools and prebuilt applications market?

All of the "big five" vendors claim more than 1,000 thirdparty applications each, and almost all of them have set up data warehousing alliances.

• How important is technology transfer (from the RDBMS vendors to your staff) in the form of a rich developer program?

Once you've considered the business factors, you may want to mull over the technical issues. As mentioned above, RDBMSs have really become commodity items, so these are probably less important than their support for specific application areas such as object/relational technology, data warehousing and the Internet.

#### **Technical Differences**

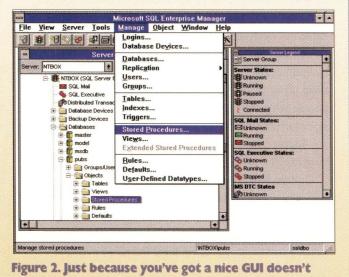
Although the RDBMS vendors seem to simply leapfrog each other with incremental features and benchmark performance (for more information, see the Transaction Processing Performance Council's Web site at http:// www.tpc.org), there are some technical differences:

• Parallelism. First of all, vendors offer different degrees of support for parallelism. It's easy to support parallel data entry, parallel data transfer or loading and parallel sorting, for example, but more difficult to support parallel replication or parallel query well. If you need the parallel version of an RDBMS, or think you may want to scale up to it, look for evidence of good performance for the kinds of tasks you'll want to perform, for example, OLTP or DSS.

Also, look at how much code will have to be rewritten and, most important, how good the management tools are. (Consulting services fees are becoming a major profit center for many vendors and can add up fast.) Finally, consider the algorithms used to partition data: by data set or schema-based, value-based, random (round-robin) or hash, because they will affect performance and maintenance.

• Built-in support for OLAP/ROLAP/MOLAP. Informix and Oracle both have their own online analytical processing engines. Informix's MetaCube falls into the relational OLAP (ROLAP) category; Oracle's Express, while fundamentally a multidimensional (MOLAP) server, can also be implemented as a ROLAP server. Oracle recently introduced a new end-user ROLAP tool called Discoverer. IBM has announced a partnership with OLAP vendor Arbor Software Corp. and should be offering a branded version of Arbor's OLAP server midyear, and Microsoft has purchased OLAP technology that's expected to appear in SQL Server 7.

• Indexes. Indexes are used for quick access to data, so they're very important in DSS and data warehousing applications. Bit-mapped indexes have been touted as particularly useful for data warehousing applications and data that has low cardinality (not many unique values in a given field). Other types of indexes are B-trees (the most common), clustered (data is stored in a physical order) and hash. B-trees store index data in a hierarchy (or tree) of pages with each index page typically containing many indexed entries along with pointers to the next page of index entries. The advantage of B-tree indexes over sequential access (the infamous table scan) is that instead of scanning pages that contain raw data, the RDBMS only needs to look at a few index pages until it finds pointers to the requested rows.



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• Middleware. Oracle, IBM, Informix and Sybase all sell networking and related middleware products, which you may need to perform extractions, replication and to maintain your Internet presence. Make sure you find out how that will interoperate with TCP/IP in supporting a variety of client operating systems and browsers, and whether the middleware can support connection pooling, as Net8 (Oracle's successor to SQL\*Net 2.x) does.

• Front-end tools. Again, each vendor has its own battery of end-user and developer tools that are clearly optimized for working with their respective server engines. But before buying into a vendor's tools, make sure you look beyond the simple feature sets at release cycles (Computer Associates' OpenRoad development tool for CA-OpenIngres, for example, isn't updated as rapidly as Sybase's Powersoft tools), deployment costs and support for standards such as ActiveX, Java and CORBA.

• Ease of maintenance. All RDBMSs come with their own management consoles and utilities (see Figure 2), but there's still a big difference between high-maintenance databases like Oracle with its hundreds of configuration parameters and more "lights-out" systems like Progress.

• Stored procedures, triggers and cursors. All vendors now support stored procedures, triggers and scrolling cursors, but they vary in the number of prebuilt and shareware versions of time-saving stored procedures they offer. Stored procedures are programs written in SQL but compiled and stored in the database server. They can contain reports or queries that are likely to be run more than once, or simply automate tedious DBA tasks. Triggers often represent so-called "business rules," checking, for example, that new account numbers are unique. Cursors mimic row-at-a-time processing in the set-based relational systems, and ultimately permit users to scroll back and forth in a list.

• Backup and recovery and replication. Based on how critical your application is, you'll have to decide whether you need online ("hot") backup, failover, and/or hot site backup, and how well the vendor's replication support (simple push or bidirectional) matches your needs.

• Security. The Internet has a heightened awareness of security risks, but RDBMSs come with very different types of builtin tools to help keep data safe. Oracle and Sybase, for example, support audit logs by both login attempts and object access, and Sybase even ships with an optional Audit Server, but DB2 and Informix require user-written DBA procedures and triggers to perform the audit function.

All major vendors, with the exception of Microsoft, offer special "trusted" versions of their products to customers who require high security. For the most part, however, the tools are there–it's just a question of using them. Make sure you understand what the default data access privileges are, whether or not to implement user identification and authentication external to the database via the operating system, whether database access passwords are encrypted (including by application programs), and that default accounts and passwords are changed.

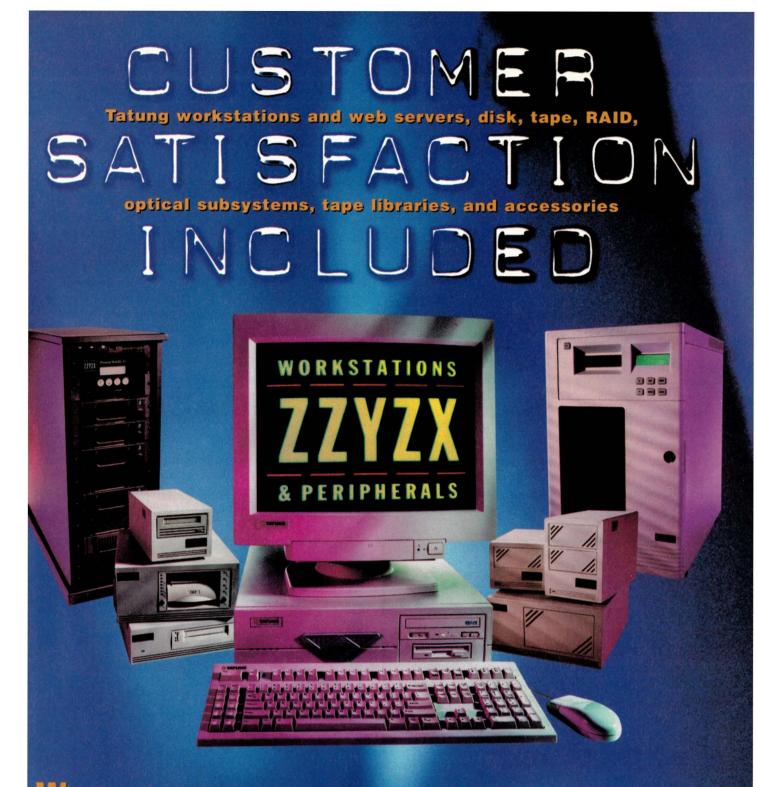
• Java and the Internet. Aside from SunSoft itself, IBM

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seems to be the database vendor with the most aggressive support for Java (see its Web site http://www.hursley.ibm. com/java), including database access via Java Database Connectivity, JDBC (a Java version of the widely used ODBC, Open Database Connectivity), but Sybase is also shipping JDBC-compliant jConnect and a development tool called PowerJ, and has added Java support to PowerBuilder. IBM, Oracle and Tandem Computers Inc. have also banded together in defining their own variation of JDBC called J/SQL, a Java language extension to standard SQL, much as the object database vendors have specified standard object extensions called OSQL.

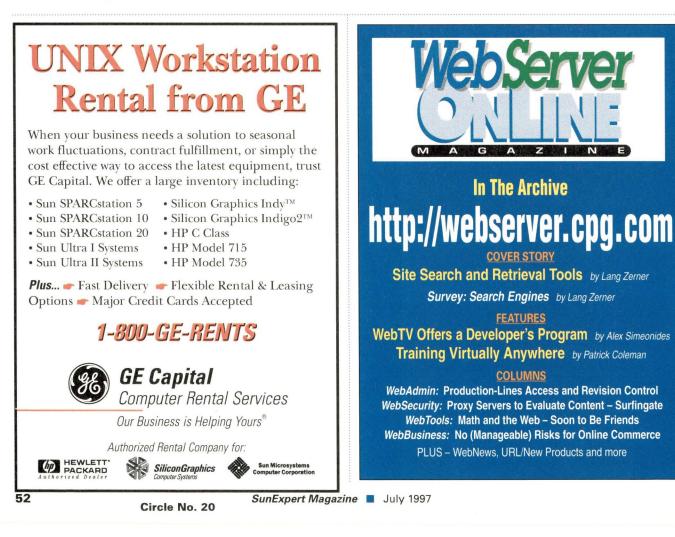
Oracle, IBM, Informix and Microsoft offer their own Web servers-including versions for doing e-commerce that are tightly integrated with their own RDBMS products, as you might expect. (IBM's e-commerce strategy is rich and complex-see "Full Speed Ahead," May 1997, Page 96, for details on IBM's net.Commerce and related products. As for Microsoft's Commerce and Site Servers, remember that, like SQL Server, they're Windows NT-only products.) Because this is a highly competitive and tangled market (Netscape Communications Corp. bundles Informix with its "low-end" Web servers and Oracle with its "high-end" commerce servers, but Oracle also sells its own Web server), it will be worth your while not only to shop around, but to carefully weigh the strategic importance of any Internet applications you deploy so that you don't get left with "orphan" products. • Mobile workers. Sybase's SQL Anywhere has been extremely popular in providing an easy-to-use, thin RDBMS that works like a SQL Server "lite." Oracle, similarly, offers excellent support for mobile workers via Personal Oracle Lite and Oracle Mobile Agents.

#### **Beyond the Big Five**

As mentioned earlier, Oracle, Informix, Sybase, IBM and Microsoft are widely seen as the market leaders in the RDBMS space, but NCR Corp.'s Teradata (successfully deployed in more than 500 Fortune 1,000 data warehouses, including what is reportedly the world's largest production data warehouse of 26 TB for retail giant Wal-Mart), Tandem's NonStop SQL (recently renamed ServerWare SQL and a dominant player in the ATM market), CA-OpenIngres (used in many verticalmarket applications), Progress RDBMS and Oracle Rdb are all viable alternatives. Other RDBMS vendors with small market shares include Cincom Systems Inc., Empress Software Inc., Software AG of North America Inc. (ADABAS), Unify Corp. and XDB Systems Inc. ROLAP vendor Red Brick Systems has also captured a small market share.

#### **ODBMS Renaissance?**

The object database management system (ODBMS) market is a curious one that, until the emergence of the Internet, seemed destined to be marginal at best. During the mid-'90s, when it looked like ODBMSs were gaining mind share,



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RDBMS vendors scurried back to their engines and started adding support for objects, thereby co-opting the ODBMS vendors. Indeed, the main new features in the forthcoming SQL3 specification relate to support for objects. ODBMSs were plagued with poor performance, lack of good tools (you pretty much had to be a Smalltalk or C++ programmer to work with them) and, as a result, they dropped off radar screens–with the possible exception of the telecommunications industry.

Today, however, there are indications that the Web, which is innately object-based and full of disparate content, could be the "killer app" for ODBMSs, and organizations are beginning to at least give them another look. Here are the major players: Gemstone Systems Inc., Fujitsu Software Corp./Computer Associates (Jasmine), O2 Technology, Object Design Inc. (ODI), Objectivity Inc., Ontos Inc., Poet Software Corp., UniSQL Inc., Unisys Corp. and Versant Object Technology Corp.

Despite the elegance and technological appeal of these products, however, it's unlikely that they will usurp the entrenched RDBMSs. (Of course, RDBMS naysayers said the same thing 20 years ago when COBOL programs based on CODASYL databases ran the world's OLTP systems.) ODBMSs are shared virtual memory extensions to applications that provide persistence for any data types. However,

ODBMSs don't come close to providing the sorts of management features and tools RDBMS vendors expect, for example, security, support by OLAP vendors and so on.

Object Design is the ODBMS market leader and should command your attention if for no other reason than that both Microsoft and Netscape have licensed its ObjectStore Persistent Storage Engine (PSE) technology for use in their browsers. PSEs are lightweight, persistent object stores-basically stripped-down versions of Object Design's "real" ODBMS, the ObjectStore database management system. You can download PSEs for ActiveX, C++ or Java from ODI's Web site at http://www.odi.com. To find out more about ODBMSs and the Object Database Management Group (ODMG) and OSQL specifications, check out the ODMG Web site http://www.odmg.org. Another excellent starting point for information about ODBMSs is Doug Barry's site of Barry & Associates, purveyor of object-oriented database information and consoles, at http://www.odbmsfacts.com.

#### Universal Servers: The Next Big Thing?

RDBMSs, remember, were designed (and optimized) to support OLTP systems. Additional configuration parameters were added to let us use them for DSS, client/server and data warehousing applications. Now, however, with the explosion of nonstructured data—from documents, Web pages, graphics, audio clips and so on—there's a growing need for systems that manage this data, too. Document management systems, ODBMSs and stand-alone Web site programs may offer good (if proprietary) solutions, but many organizations would prefer to have their RDBMS handle the data in a centralized fashion.

Universal servers-sometimes referred to as object/relational database management systems (ORDBMSs) or simply hybrid systems-are supposed to deliver a synthesis of relational and object database technologies. They promise more flexible data type support, a better fit with Internet architectures and distributed objects, but the products are only now beginning to appear, and the jury is still out. Large organizations aren't

> going to transition to a relatively untried technology overnight. It will take years, and there will undoubtedly be stories of catastrophic bugs and other disasters.

In the meantime, the universal server market is buffeted by Wall Street, as we have seen with Informix, one of the most aggressive universal server vendors. (After the initial euphoria surrounding Informix's shipment last December–for Solaris and Silicon Graphics Inc.'s IRIX only–of what it billed "the first universal server," Informix Universal Server [IUS], the object/relational bubble burst when Wall Street gave Informix a resounding vote of no confidence. Informix, the analysts said, was far more enamored with IUS than its customers were.)

Il out. Interestingly, the five major RDBMS vendors have each adopted different architectures for their universal servers. Here's a synopsis (in politically correct alphabetical order):

• IBM. IBM has been supporting object-relational data types including image, video, audio and text (similar to Oracle's ConText option) along with content-specific search engines that extend SQL in DB2 Common Server 2.1 since June 1996. The technology (see "DB2 Universal Database Architecture," Page 96) relies not on cartridges (Oracle), DataBlades (Informix) or a middle layer (Sybase), but instead on user-defined functions (UDFs) and user-defined data types (UDTs). However, DB2 Universal Server, due midyear, will better integrate the pointerbased approach to object data (early users had to download the "data extenders" from IBM's Web site) and offer a bevy of enhancements such as support for 64-bit memory, bit-mapped indexes, star joins and new ROLLUP and CUBE functions.

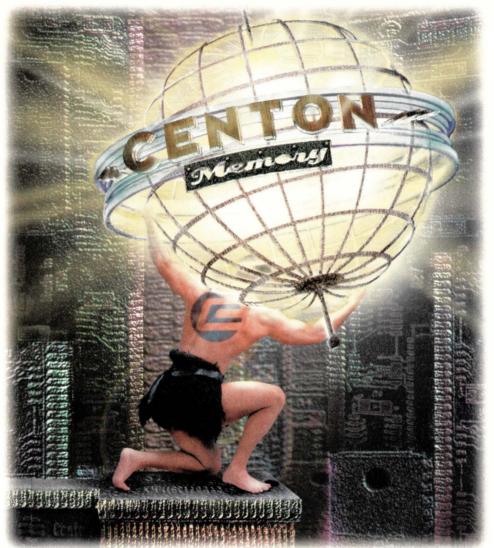
DB2 Universal Server, which combines DB2 Common Server and Parallel Edition into a common code base, also offers built-in support for user authentication by using Distributed Computing Environment (DCE), bidirectional replication and enhanced Internet support via net.data and JDBC. IBM is working with vendors such as Environmental Systems Research Institute Inc. (ESRI), which markets the popular GIS (geographical information systems) mapping software, to provide additional extenders.

• Informix. Informix Universal Server (IUS) represents a combination of the classic Informix Online Dynamic Server and the Illustra ODBMS from Illustra Information Technologies–an ODBMS vendor Informix acquired several years ago–into a tightly integrated single server that stores object data types natively. In fact, this innovative architecture, based on engine

promise more flexible data type support, a better fit with Internet architectures and distributed objects, but the products are only now beginning to appear, and the jury is still out.

**Universal servers** 

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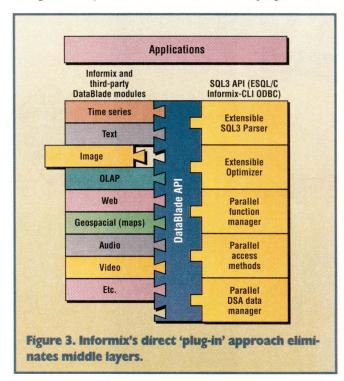
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extensions Informix calls DataBlades, was savagely attacked by Oracle even before Wall Street got into the act. Oracle's point was that "bad" DataBlades could crash or otherwise corrupt the database. Although this isn't likely, because Informix will be "certifying" DataBlades as well as giving users options for running DataBlades on the client, it was enough to give the user community pause. That's too bad, because Informix's direct "plug-in" approach (see Figure 3) should offer good performance by eliminating middle layers and should also be easier to program.



• Microsoft. Microsoft finally laid out its strategy to kill two birds with one stone (SQL Server and Windows NT 5.0) at its "Scalability Day" event in May. Basically, Microsoft SQL Server 7.0 (code-named "Sphinx") will offer "universal server" support through (surprise) a Windows-centric OLE DB (Object Linking and Embedding Database, successor to ODBC) approach. Basically, SQL Server will rely on OLE servers to store complex objects. SQL Server 6.5, like all other RDBMSs, already supports BLOBs, but no specific SQL extensions to handle all the different types of BLOBs that are possible. Rather than extend Transarc-SQL (T-SQL) further, Microsoft seems to favor a more client-centric approach that leverages the savvy already built into OLE servers such as Word and Excel. SQL Server 7.0 will offer other enhancements, of course, including support for Web-based management and a mobile version that will run under Windows 95.

• Oracle. Oracle's universal server, Oracle8, should be shipping by the time you read this. Although less "object-oriented" than originally envisioned when first announced more than two years ago, it appears to provide a reasonable migration path for the thousands of companies that run their business on an Oracle Server. Instead of simply offering "options" for spatial data or text searching, Oracle8 uses data cartridges to support these and other extended data types, including

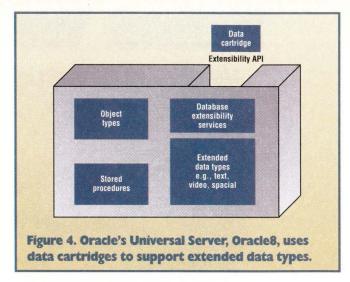


image and time series (see Figure 4).

Oracle8 has also been enhanced to support more users (30,000 instead of 3,000) and perhaps even more, thanks to connection pooling new in Net8. Oracle8 finally offers password management on the server and includes parallelized replication. Oracle will also ship a new developer tool (code-named "Sedona") for creating cartridges, expanding its widely used Designer/2000, Developer/2000 and Oracle Power Objects line of developer tools.

• Sybase. Sybase officially rolled out its three-tier Adaptive Server Architecture at the International Sybase User Group (ISUG) conference held in Orlando in April. Rather than taking either Oracle's cartridge or Informix's DataBlade approach, it has opted for a middleware layer called the Component Integration Layer, or CIL (see Figure 5). Adaptive Server, now in beta and due to ship for Solaris, HP-UX, AIX and NT by the end of the year, will support additional object data types via the component data store (CDS).

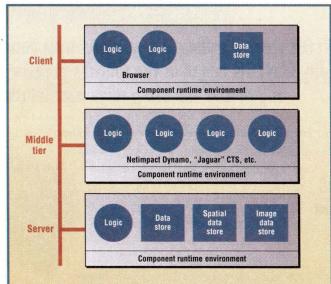
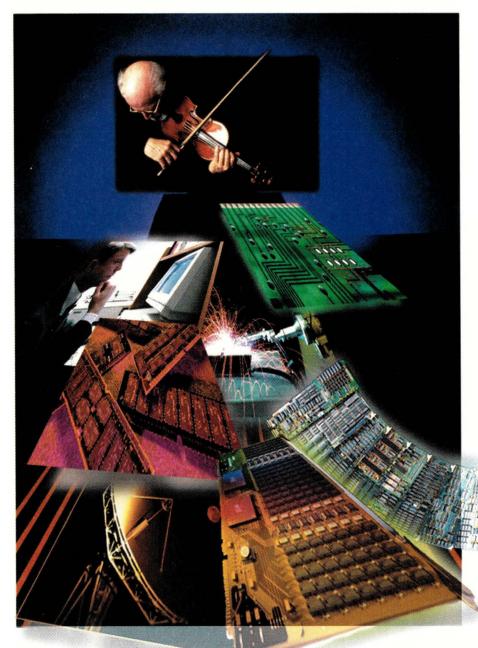


Figure 5. Sybase's Adaptive Server Architecture employs a middleware layer called the Component Integration Layer.

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Essentially, Adaptive Server users will purchase additional CDSs to support spatial data types including image store, image search, documents/text search and time series. Adaptive Server will also offer native support for DCE, Kerberos, Secure Sockets Layer and CORBA. Adaptive Server Enterprise 11.5 is in early beta; Sybase hopes to ship NT and UNIX versions by the end of the year. Although both 11.5 and an interim release of SQL Server 11.2 will offer better support for parallelism, Sybase isn't expected to offer row-level locking until 1998.

Elsewhere, Computer Associates has decided against a universal server approach in favor of a dual database strategy, maintaining its RDBMS, CA-OpenIngres, separate from its object-oriented engine, code-named Jasmine, licensed from Fujitsu and due to ship midyear. Progress, for its part, seems to be taking a wait-and-see approach and hasn't announced an object strategy.

#### So, What Are You Waiting For?

If you're smart, you're waiting not only for the marketplace to vote, but for the early adopters to debug the products for you. Nevertheless, universal server technology indeed looks like the next big thing, and it's time your advanced technology group takes a look–if it hasn't already. →

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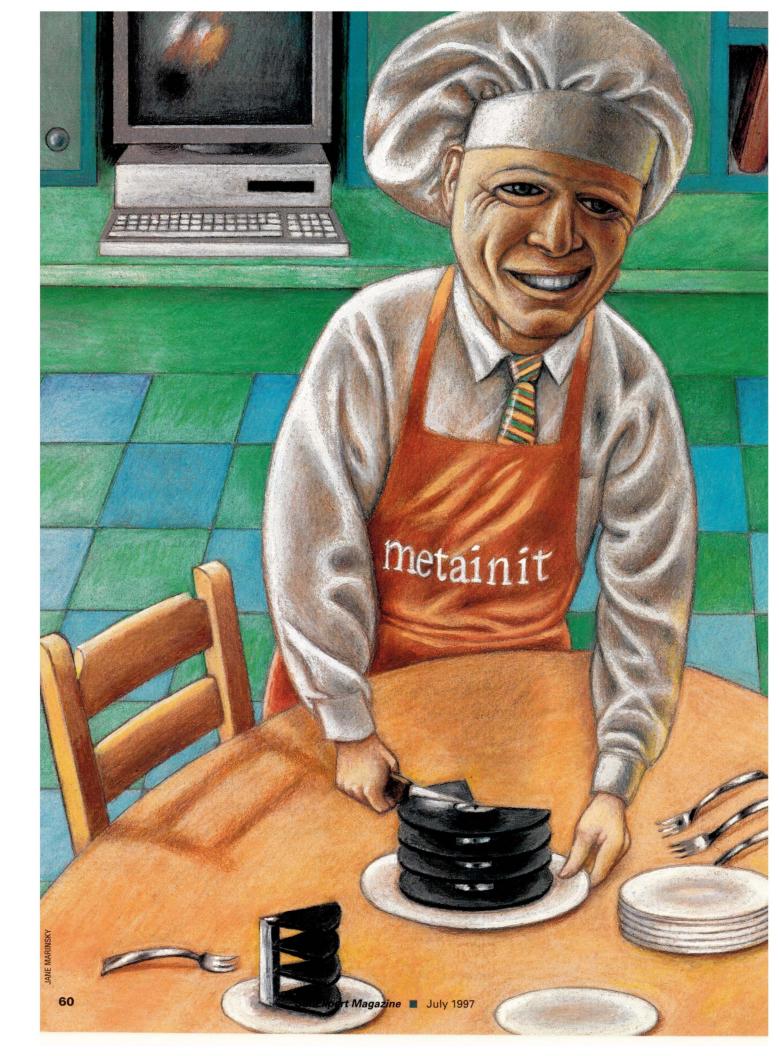
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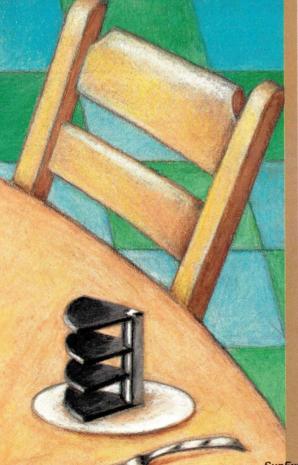
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A step-by-step guide to file system management, including data striping, data mirroring and logging file systems with Solstice DiskSuite



# Apps in Action

# USING SOLSTICE DISKSUITE

### by Kailash Jayaswal

ow that disks are becoming cheaper and users are demanding ever larger file systems, spanning multiple disks, online resizing, data mirroring and striping have surfaced as hot topics in systems manage-

ment. How can you accomplish these for your users? Solstice DiskSuite effectively tackles these and other tasks. It is included with the Solaris Server CD set and requires no licenses. This article describes some features of the Solstice DiskSuite and ways to implement it.

With DiskSuite you can stripe data, mirror data and log file systems. Striping allows you to create a file system with two or more disk partitions that are concatenated or striped. Striped file systems provide improved I/O rates as data is split into chunks and written to separate disks.

Mirroring distributes multiple copies of your data on different disks. If a disk with one copy fails, the file system can continue working with other copies of the data, residing on other disks.

UFS (UNIX File System) logging is useful for large file systems or file systems where data is constantly being modified. As a general rule, it is unnecessary to log file systems with mostly read activity. A file system with UFS logging has a master device (containing a new or existing file system) and a logging device. All file system writes are safely recorded in the logging device, which could be a disk partition or metadevice. The host system is then sent a message that the write operation to the file system has been completed. The host system goes ahead with the next operation. Later, the write to the logging device is rolled forward to the actual file system on the master device.

### Apps in Action

Because synchronous writes to the disk are reduced, local directory operations are faster. In addition, because the logging device stores only complete logs and all partially recorded logs are discarded, the file system does not need to be checked during reboots. This speeds the bootup process.

In addition to striping, mirroring and logging, DiskSuite handles hot spares and shared disksets. It also supports software RAID Level 5. Simply put, a hot spare is a disk partition configured to automatically replace a failed disk partition that is a component of a submirror or RAID 5 device.

A shared diskset is set of disks connected to and shared by two host computers. If one of the hosts fails, data on the diskset is still available through the other host. The disks in the shared diskset can be used for hot spares or file systems by both host computers. However, one of the two hosts is the implicit owner of the shared diskset. Besides using the shared diskset, each host has one or more local disks that are available exclusively to the host.

A RAID 5 device consists of three or more disk partitions (called components or columns). As with mirroring, a RAID 5 device continues functioning despite failure of a single component. RAID 5 offers some of the benefits of mirroring but at a lower cost and, like striping, provides improved I/O rates. Disk-Suite 4.0 is the first version to support RAID 5 configurations.

#### **OS** Requirements, Setup

To use Solstice DiskSuite 4.0, you need Solaris 2.3 or later running on Sun SPARC or Solaris 2.4 or later running on an Intel Corp. X86-based system. If you intend to use the UFS logging feature of DiskSuite 4.0, you need Solaris 2.4 or later. The diskset feature of DiskSuite 4.0 is supported on SPARC systems running Solaris 2.4 or a later and is not supported on X86. (Editor's note: Version 4.1 of DiskSuite is now available.)

As with most Solaris software from Sun, pkgadd is used to install DiskSuite 4.0.

#cd /cdrom/disksuite\_4\_0
# pkgadd -d `pwd`

The following packages are available for installation: SUN-Wabmd (DiskSuite Answerbook); SUNWmd (DiskSuite software, metadevice drivers, binaries, man pages and so on); and SUNWmdg (DiskSuite Tool, GUI interface). In addition, two DiskSuite start-up files are installed:

/etc/init.d/SUNWmd.init
/etc/init.d/SUNWmd.sync

#### Creating State Database Replicas

DiskSuite devices are called metadevices, and the disk partitions are usually referred to as components. Before using Disk-Suite you need to create at least three copies of the metadevice state database. The metadevice state database keeps DiskSuite operating and holds information about metamirrors, submirrors, concatenations, stripes, hot spares, error conditions and so on.

State database copies (517 Kb) or replicas can exist on either of the following:

• An unused partition that will be used to store only the metadevice state database.

• A disk partition that doesn't have a file system or swap and will later be used as a DiskSuite metadevice or logging device, with the exception of an OS file system (root, usr, swap).

To protect DiskSuite against controller or disk failure, put only one copy of the replica on each disk and make sure that the disks are attached to different controllers.

Once you have decided which partitions (or components) will contain the state database, you can use the metadb command to create the state database:

#metadb -a -f /dev/dsk/c1t3d0s4 \
 /dev/dsk/c0t3d0s6 /dev/c0t1d0s5

The above one-line command places one copy of the state database on each of the three specified partitions. The -a option is used to create a replica of the state database. The -f option forces the creation if no prior state databases exist. The following command is used to check the status of the state database:

#metadb -i

#### **Concatenated Metadevices**

Concatenated metadevices enable you to create a file system comprising multiple disk partitions that are accessed sequentially. One way to set up a metadevice is to edit the /etc/opt/ SUNWmd/md.tab file and run metainit. For example, the following line in /etc/opt/SUNWmd/md.tab defines a concatenated metadevice, d10, made up of three components:

/dev/md/dsk/d10 3 1 /dev/dsk/c0t2d0s3 1 \
 /dev/dsk/c1t2d0s3 1 /dev/dsk/c1t4d0s0

The default metadevice names run from d0 to d127 and are located in the /dev/md/dsk and /dev/md/rdsk directories. The number 3, in the example above, tells the system that the metadevice has three rows of components, and the number 1 means each row comprises one component. The metainit command is run to start using the metadevice:

#### # /usr/opt/SUNWmd/sbin/metainit d10

	Name		Size	Туре	Status	Use	
60	45%	+ 35, 54	14 Ca	Bariel).	Sti gene	· /	1
這	d11	130.16	Mbyte	Concat/Stripe	ок	Submirror of d10	
60							
18	d16	373.87	Mbyte	Concat/Stripe	ок	Submirror of d15	
60							
18	d21	300.16	Mbyte	Concat/Stripe	ок	Submirror of d20	
60							
118							
60							
13	d31	1.56	Cbyte	Concat/Stripe	ок	Submirror of d30	
l ilters:	Off			Selec	t All		24 iten

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## Apps in Action

In a striped metadevice, the partitions (or components) are accessed in an interlaced manner, not sequentially. The default interlace size in DiskSuite 4.0 is 16 KB for each component. Metadevices with components on different controllers offer better I/O rates than components on the same controller. In fact, striping partitions on the same disk may hurt performance.

To create a striped metadevice, d11, comprising three partitions, namely /dev/dsk/c1t2d0s3, /dev/dsk/c2t2d0s3 and /dev/dsk/c2t4d0s3, with an interlace size of 32 KB, add the following line in /etc/opt/SUNWmd/md.tab and run metainit specifying d11 to start using the metadevice:

/dev/md/dsk/d11 1 3 /dev/dsk/c1t2d0s3 \ /dev/dsk/c2t2d0s3 /dev/dsk/c2t4d0s3 -i 32k

Metadevice dll has one row of three components.

#### **Concatenated Stripes**

Concatenated stripes provide better performance than simple concatenations. Also, concatenating multiple stripes provides a way to expand striped metadevices. To create a concatenation of two stripes, where each stripe has two partitions, enter the following one-line command in /etc/opt/SUNWmd/md.tab and run metainit to begin using the metadevice:

/dev/md/dsk/d15 2 2 /dev/dsk/c1t0d0s3 \
 /dev/dsk/c2t0d0s0 -i 32k 2 \
 /dev/dsk/c1t4d0s3 /dev/dsk/c2t4d0s0 -i 16k

Metadevice, d15, first fills up /dev/dsk/c1t0d0s3 and /dev/dsk/c2t0d0s0 with an interlace size of 32 KB. It then starts filling /dev/dsk/c1t4d0s3 and /dev/dsk/ c2t4d0s0 with an interlace size of 16 KB.

There are a few caveats when creating a stripe or concatenation: First, all components must have the same disk geometry, that is, the same number of sectors per track, same number of tracks per cylinder and so on. Second, if you have components of different sizes in a stripe, the usable size of each component will be the size of the smallest one.

The performance of a stripe depends on the interlace value. If the I/O size is greater than the interlace size, data is written to, or read from, multiple disks. This improves I/O performance.

#### **Creating and Using File Systems**

By now you are probably wondering what operations can be performed on metadevices? Most of the standard UNIX utilities for file systems built on simple disk partitions are valid for file systems built on metadevices. Once you have initialized a metadevice using metainit, you can run newfs to create a new file system. For example, use the command fsck to check a file system and the mount and umount commands to mount and unmount. In addition, you can use the ufsdump and ufsrestore commands to back up and restore entire file systems. Metadevices may have an entry in /etc/vfstab:

/dev/md/dsk/d50 /dev/md/rdsk/d50 /app ufs 6 yes -

It is easy to convert a file system on a partition to a metadevice file system, and the process preserves data on the file system.

The following example converts a file system on /dev/dsk/ c1t2d0s7 mounted on /app to a simple metadevice /dev/ md/dsk/d20 with the above partition as its only component.

Step 1. Edit /etc/opt/SUNWmd/md.tab to add:

/dev/md/dsk/d2011/dev/dsk/c1t2d0s7

Step 2. If possible, unmount /app with #umount /app Step 3. Initialize the metadevice by running #metainit d20. If the file system cannot be unmounted in Step 2, use metainit -f.

Step 4. Edit /etc/vfstab to change the line

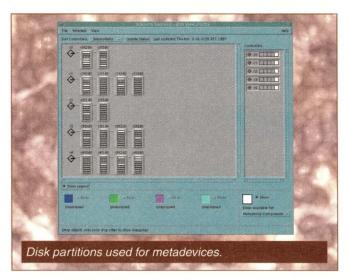
/dev/dsk/clt2d0s7 /dev/rdsk/clt2d0s7 /app ufs 6 yes -

#### to read

/dev/md/dsk/d20 /dev/md/rdsk/d20 /app ufs 6 yes -

Note that only the first two fields have to be changed. **Step 5.** If the file system was unmounted in Step 2, mount it; otherwise, reboot the machine to start using the metadevice. Mounted or unmounted metadevice file systems can be easily

expanded. For example, a device called d8 could be concatenated with another empty partition, say, /dev/dsk/c0t1d0s6, by using the metattach and growfs commands. First,



unmount the file system (if possible) on d8 and edit the /etc/ opt/SUNWmd/md.tab file to include the new partition for d8. Use the metattach command to concatenate the new partition to the end of the existing metadevice. For example,

#### #metattach d8 /dev/dsk/c0t1d0s6

Use the growfs command so that the file system occupies the entire metadevice. The growfs command will not affect data on the file system it expands. You can use the -M option of growfs if the device cannot be unmounted.

## Apps in Action

#### **Mirroring Data**

DiskSuite provides a way to replicate data by using mirrored metadevices called metamirrors. A metamirror has multiple submirrors, and each submirror contains one copy of the data. Mirroring data offers several advantages:

- Uninterrupted access to file system data despite hardware failure of the disk containing a copy of the data.
- The ability to perform online backups.
- Faster reads.

DiskSuite 4.0 allows up to three submirrors in a metamirror. Therefore, you can have up to three copies of the file system data in three different places.

The following six-step example creates a metamirror, named d10, with data currently on partition /dev/dsk/ c1t1d0s3 (which would become the first submirror, d11) and a new partition /dev/dsk/c2t4d0s3 (which would become the second submirror, d12).

Step 1. If possible, unmount the partition /dev/dsk/ c1t1d0s3.

Step 2. Edit /etc/opt/SUNWmd/md.tab to define d10, d11 and d12:

/dev/md/dsk/d10 -m /dev/md/dsk/d11 /dev/md/dsk/d11 1 1/dev/dsk/c1t1d0s3 /dev/md/dsk/d12 1 1/dev/dsk/c2t4d0s3

Step 3. Initialize both submirrors and metamirror:

```
# metainit d12
```

- # metainit d11
- # metainit d10

If the file system was not unmounted, use the -f option of metainit for submirror dll.

Step 4. Edit /etc/vfstab to be able to use the new meta mirror /dev/md/dsk/d10 instead of using the partition /dev/dsk/c1t1d0s3.

Step 5. If the device was not unmounted in Step 1, reboot the system; otherwise, simply mount it.

**Step 6.** Run metattach to copy data from the first sub mirror to the second:

#### #metattach d10 d12

The submirror d12 must be of equal or greater size than the first submirror, d11, to accommodate the data in d11.

To add or remove copies of data, you simply attach or detach submirrors to or from a metamirror. For example, a submirror containing a copy of the data can be taken offline for backups. Before taking a submirror offline, you have to lock writes to a file system using the lockfs command. Then use lockfs -i to unlock the file system and allow writes to continue.

There are numerous read and write options you can set for metamirrors. Reads can be made in a round-robin manner from all submirrors (default); divided among submirrors based on logical disk block address (geometric reads); or all reads can be directed from one submirror. Writes to submirrors can be done serially or in parallel. Parallel is the default write mode.

#### **RAID 5 Devices**

DiskSuite 4.0 supports RAID Level 5. A RAID 5 device contains three or more physical partitions. Despite hardware failure of a single component, data on the file system will continue to be available. A single sector on any component contains either a sector's worth of data or parity information for data located on corresponding sectors on other components.

Existing components can be replaced and new ones can be easily added to a RAID device. To guard against data loss caused by disk failures, a hot spare pool can be assigned for online replacement of failed components.

To define a RAID 5 metadevice, edit /etc/opt/SUNWmd/ md.tab and add an entry like the following:

```
/dev/md/dsk/d60 -r /dev/dsk/c0t0d0s4 \
/dev/dsk/c1t2d0s6 /dev/dsk/c2t0d0s3 -i 32k
```

Initialize it by running metainit. This example puts the three specified partitions in the RAID metadevice, d60, with an interlace size of 32 KB for striping data and parity regions on the three components.

#### Hot Spare Pools

A hot spare is a partition that can replace a failed component of a submirror or RAID device. As soon as a hot spare component is brought into a submirror or RAID metadevice, data on the hot spare component is built from data on another submirror or other RAID components. There is no downtime caused by this online, automatic replacement.

Once you have decided which partitions to use as hot spares, these partitions can be grouped into one or more hot spare pools in the /etc/opt/SUNWmd/md.tab file. The following lines define two hot spare pools, namely hsp001 and hsp002, each with two components:

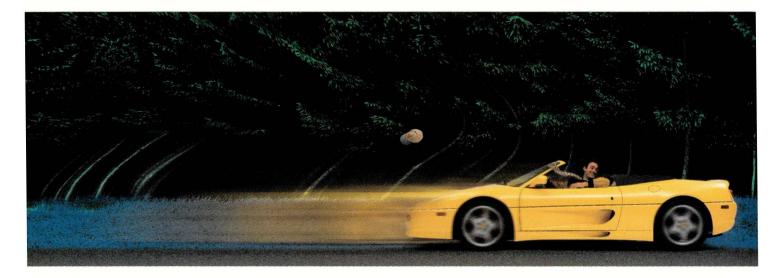
hsp001 /dev/dsk/c0t2d0s7 /dev/dsk/c1t2d0s3 hsp002 /dev/dsk/c1t2d0s3 /dev/dsk/c0t2d0s7

Each hot spare pool can be initialized and associated with a submirror or RAID device. If a component fails, the system searches the hot spares in the associated hot spare pool for a partition that is of an equal or larger size than the failed component. If one is found, the submirror or RAID device copies data to it. DiskSuite offers utilities to dynamically add, delete, replace and enable hot spare components in a hot spare pool.

DiskSuite has a wide range of features for those administrators who provide users with file systems spanning several disks, mirrored file systems, RAID 5, hot spares or dynamically expandable online file systems. With it, you can offer users improved I/O rates, increased capacity and better protection against disk failure.  $\rightarrow$ 

Kailash Jayaswal is employed by Astralray Engineering, San Jose, CA. He can be reached by email at jayaswal@ astralray.com or by phone at (408) 871-8000.

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Scalar 218 is flexible enough–and offers the compatibility–to back up any combination of Windows NT, NetWare, or UNIX systems.



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### SUPPLEMENT

# **RS**/Magazine

# Feature

# 92 DB2: Unsung Hero

Though overshadowed by Oracle's DBMSs, DB2 is a big market player with a multitude of application solutions. *Karen Watterson* 

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Columns illustrated by

DANIEL C. O'CONNOR





I enjoyed reading your article on

the Argus monitor ("Keeping an

AA

Eye on Those Daemons," April 1997, Page

67). Is there a similar or comparable program

to monitor normal system functions? I'd like

to know how well my system is running and

be able to answer questions such as: Are the

• Well, there might be. However,

require more than a few red light, green light

indicators. The question is greater than sim-

ply wondering if the system is up. We want

to know, in the terminology of parents, what

Time was when you could actually see

what your computer was doing by just look-

ing at it. In the old days, computers had lots

of lights that showed, through register values, what was going on. I recall working on a

Xerox Corp. Sigma 7. Just by watching the

address of the current instruction, which was part of the LED display on the front of the

machine, I could tell what percentage of time

was spent in user address space, what percent-

watching your UNIX system will

disks full? Are there any looping processes

using up the CPU? and so on.

Carson Manufacturing Inc.

John Fitzgerald

the system is "up to."

JAAIX



# What's the System Up To?

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

A wizard's apprentice AA super user AAA wizard

SunExpert Magazine 📕 July 1997

age was spent in the system code, sometimes even which system service was working.

We don't have the front-panel LEDs anymore, but let's look at some UNIX tools that will help us see what our system is up to.

#### vmstat at a Glance

Your first look at the system is with vmstat. This shows at a glance what the CPU is doing, how memory is allocated and what's happening with I/O. Figure 1 shows vmstat's output (with an argument of 5 for every five seconds) during a busy time on a well-loaded system. I have omitted the first display line, which shows counts since boot time and is not all that useful.

The cpu numbers are important. They show, from left to right, the percentage of time the CPU is working in user code, system code (in kernel mode), idle and waiting for I/O completion. There are some common patterns in this display. A system doing nothing will show the CPU idling, for example,

IS	sy	id	wa	
0	0	99	0	
1	0	99	0	
0	0	99	0	



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Circle No. 47

## **Q&AIX**

#### Figure 1. vmstat on a Busy System

kthr	mer	nory			pa	ge			f	aults			C]	ou		2
r b	avm	fre	re	pi	po	fr	sr	су	in	sy	cs	us	sy	id	wa	5
···· 0 1	2989	52064	0	0	0	0	0	0	343	2970	27	70	12	18	0	J.
1 1	2998	52055	0	0	0	0	0	0	381	3377	27	82	15	3	0	
1 1	3002	52051	0	0	0	0	0	0	328	2553	25	65	14	22	0	
1 1	3002	52051	0	0	0	0	0	0	364	3023	24	68	16	17	0	

A system busy with a CPU-intensive job, on the other hand, will put all the CPU time in user mode:

```
us sy id wa
99 0 0 0
99 1 0 0
99 1 0 0
```

And a job doing lots of disk I/O generally has a split of CPU between user and kernel modes:

us sy id wa 74 14 12 0 81 16 3 0 81 12 7 0

Notice there is no waiting if the disk cache can be used effectively. Otherwise, you will see some waiting:

us	sy	id	wa
4	30	1	64
5	31	1	63
7	42	1	50

The latter was the result of my running a find command. Disk caching is of little utility with the find command.

The other useful columns are paging statistics and the fault counts. A nonzero page-in count, pi, indicates virtual memory swapping, often the cause of a sluggish system. The interrupt count, in, is another indicator of I/O activity, as is the system call count, sy.

I've never been able to learn much from the memory columns. AIX tries to make good use of all the memory, so there's very little unused. Also, the numbers seem to be truncated when the system's memory reaches a gigabyte.

#### iostat Shows Disk Activity

If you see there's a whole lot of I/O going on, use iostat to see what's happening with the disks. Figure 2 shows a portion of the iostat command on a system showing disk I/O. The first line shows tty activity, light in this case, and the CPU percentages. Again, these have the characteristic mark of an I/O bound system, lots of system time and wait time. The rest of the display shows activity for each disk in absolute terms over the period specified.

It is easy to see from this report which disks are working and which are idle. In Figure 2, some irrelevant lines are omitted to make the figure tidy. As with vmstat, ignore the very first display, it merely shows activity since system boot.

A similar tool, netstat, can show activity related to network communications. It only shows totals since system startup and is not as easy to use as a monitoring tool.

#### monitor is Easy to Interpret

What we'd really like is a single display that shows all of those statistics: CPU, memory, I/O and communications. That's where the monitor program comes in. It combines the information of each of these programs into a single xterm.

#### Figure 2. iostat on a Busy System

# iostat 5					
tty: tin	tout avg	-cpu: %ı	ıser	% sys % idl	e % iowait
0.0	423.0	1	3.2	65.9 0.0	21.0
Disks:	% tm_act	Kbps	tps	Kb_read	Kb_wrtn
hdisk13	0.0	0.0	0.0	0	0
hdisk14	0.0	0.0	0.0	0	0
hdisk20	43.0	2447.8	19.1	12288	0
hdisk21	16.5	612.0	4.8	0	3072
hdisk22	0.0	0.0	0.0	0	0
hdisk23	0.0	0.0	0.0	0	0
hdisk6	2.0	12.7	3.0	0	64
hdisk7	0.0	0.0	0.0	0	0

#### Figure 3. monitor Display on a Busy System

AIX moni	tor v1.	14: ashur				Thu May	8 21:01:4	49 1997
Sys 55.6	% Wait	8.8% User	35.6%	Idle	0.0%	Refresh:	10.01 s	
0%		25%			50%	75%		100%
=======	======	===========	=====	======	========WWWWW	W>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	>>>>>
Runnable	proces	ses 4.99	load a	verage:	3.99, 3.31,	2.57		
Memory	Re	al V	irtual		Paging (4kB)	Process eve	ents	File/TTY-IO
free	0.5	MB 72	3.7 MB	1	47.2 pgfaults	1994 pswite	h	784 iget
procs	367.6	MB 30	0.3 MB		0.5 pgin	3334 syscal	.1	86 namei
files	655.9	MB			9.0 pgout	811 read		723 dirblk
total	1024.0	MB 102	4.0 MB		0.0 pgsin	212 write	418	0663 readch
					0.4 pgsout	0 fork	687	6465 writech
DiskIO	Tot	al Summary	,			0 exec		0 ttyrawch
read	4771	.4 kByte/s	5	Client	Server NFS/s	0 rcvint	i na sa	0 ttycanch
write	2005	.8 kByte/s	\$	5.1	0.0 calls	0 xmtint	- Company -	52 ttyoutch
transfer	s 67	.6 tps		0.0	0.0 retry			
active	11/	30 disks		3.0	0.0 getattr	Netw	read	write
				0.6	0.0 lookup	100	2151.2	2151.2 kB/s
TOPdisk	read	write	busy	0.5	0.0 read	fi0	2086.2	28.0 kB/s
hdisk21	4769	0 kB/s	90%	1.0	0.0 write	en0	0.7	2.3 kB/s
hdisk22	0	511 kB/s	15%	0.0	0.0 other		0	
hdisk20	0	460 kB/s	13%					
hdisk17	0	409 kB/s	9%				( THE	
hdisk24	0	332 kB/s	88				Come 19	
hdisk18	0	205 kB/s	5%			(A)		6
hdisk0	0	32 kB/s	15%				1 Y	
hdisk6	0	27 kB/s	3%		and the second s		1	2
hdisk2	0	27 kB/s	3%		A			
hdisk7	3	0 kB/s	1%		and a second sec			

Figure 3 shows sample output on one of our systems. The display is quite intuitive and easy to interpret. In this case, I already know something of what the system is supposed to be doing; it's part of an archive. Files are copied from the network onto a disk cache, and from there onto tapes. Looking at the display, I see a lot of system and user CPU time, some wait and no idle CPU. This is indicative of a busy system doing I/O.

I also see all the memory allocated, most of it to file buffers; little paging activity; a lot of disk activity, about 5 MB/s being read and 2 MB/s being written; no NFS activity; and 2 MB/s of data arriving on the FDDI (fi0) interface. All of this is consistent with what I expect of the system. Data arriving from the Internet is written to the disk cache. Data on the cache is being copied to tape. By watching monitor, I am confident the system is busy doing its job.

Get monitor by anonymous ftp from ftp.funet.fi, in the /pub/unix/AIX/RS6000 directory. The latest version, as of this printing, is monitor-2.1.2.tar.Z. It builds exceptionally easily. Using my AIX 4.2 system, I only had to untar the file and type make. No editing at all!

Well, now you know how to see what your system is up to. Next month, we'll try out a similar tool–but one with lights. ->



## Systems Wrangler

#### by Æleen Frisch



## AIX Network Monitoring and Tweaking

**Aleen Frisch** is Systems Wrangler for a very heterogeneous network of computers and workstations. She is also the author of the book Essential System Administration (O'Reilly & Associates Inc., now in its second edition). In her spare time, she enjoys painting and lounging around with her cats, Daphne and Sarah. Email: aefrisch@lorentzian.com. his month's column focuses on two useful network-related facilities: the netstat utility for monitoring network activity and the AIX-specific no command for setting networking kernel parameters.

#### Monitoring Network Activity

The netstat command is one of those multipurpose monitoring tools that UNIX is so fond of. It has a variety of options that control what information about network activity it displays. We'll look at its most useful options here. netstat's basic mode (without any options) displays a list of all current active network connections to the local host. Listing 1 shows an example of netstat's output in this mode.

On this system, *iago*, there are network connections to six other systems. The address forms for both local addresses and foreign addresses are *hostname.port*. Port numbers are translated to the corresponding service name on the receiving host. Thus, in our example, *iago* has four incoming rlogin sessions, from *lear*, *romeo*, *othello* and *godot*, and one outgoing rlogin session to *puck*. The two

#### Listing 1. Example Output in netstat's Basic Mode \$ netstat

	-				
Proto	Recv-Q	Send-Q	Local Address	Foreign Address	(state)
tcp	0	0	iago.1022	puck.login	ESTABLISHED
tcp	0	0	iago.1023	hamlet.1021	ESTABLISHED
tcp	0	0	iago.shell	hamlet.1022	ESTABLISHED
tcp	0	0	iago.login	lear.1022	ESTABLISHED
tcp	0	0	iago.login	romeo.1021	ESTABLISHED
tcp	0	3	iago.login	othello.1021	ESTABLISHED
tcp	0	0	iago.login	godot.1021	ESTABLISHED

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## Systems Wrangler

input (en0)		output		input (		Total)	out	cput	
packets	errs	packets	errs	colls	packets	errs	packets	errs	colls
								•	
668	0	664	0	0	668	0	664	0	0
847	0	843	0	0	847	0	843	0	0
1002	0	1000	0	0	1002	0	1000	0	0
1168	0	1164	0	0	1170	0	1166	0	0
911	0	909	0	0	911	0	909	0	.0
1068	0	1060	0	0	1068	0	1060	0	0
964	0	963	0	0	965	0	964	0	0

#### Listing 2. Sample Output for en0

#### Listing 3. Sample Output for the -i Option

Name	Mtu	Network	Address	Ipkts	Ierrs	Opkts	Oerrs	Coll
100	16896	<link/>		7020	0	7104	0	0
100	16896	127	loopback	7020	0	7104	0	0
en0	1500	<link/>	2.60.8c.2e.72.1	204568	0	217712	0	0
en0	1500	193.0.9	iago	204568	0	217712	0	0
s10	296	<link/>		42552	0	45903	0	0
s10	296	193.0.12	iago2	42552	0	45903	0	0

entries for *hamlet* are the result of an incoming rsh command used to execute some command remotely on *iago*.

netstat can also be run in a mode that continuously lists current network statistics. For example, the command

#### \$ netstat -I en0 5

will produce a summary line every five seconds for network interface en0, an Ethernet adapter (the default interface is the loopback interface 100). Sample output is shown in Listing 2. Note that we've omitted the initial line giving overall statistics since the last system reboot.

The left half of the display in Listing 2 gives the statistics for the selected network interface, while the right side displays the data for the network as a whole. During this period, this system experienced only moderate network traffic. Here, we see that all of the error and collision counts are zero, although small nonzero values need cause no concern.

The -i option to netstat lists all of the available network interfaces on the local system. Its output is given in Listing 3.

On this system, *iago*, there is an Ethernet adapter (having the Ethernet address 02:60:8c:2e:72:01). The netstat output also lists the network loopback interface and a SLIP connection to the 193.0.12 subnet via the alternate hostname *iago2*.

netstat -r - f inet lists the active routing tables for the TCP/IP protocol family. The resulting output is displayed in Listing 4. Currently, there are routes to three subnets, 193.0.10, 193.0.11 and 193.0.13. The Flags field indicates the status of each route. The code letter U indicates that the route is up, and G and H indicate routes to a gateway or a single host, respectively. The remaining fields show the current number of references to each route, the total number of packets sent via the route and the network interfaces involved. For example, we can see that the route to host *godot* is via a SLIP connection.

netstat -m displays memory use-oriented statistics for the network. The most important items in its output, shown in Listing 5, are the *mbuf* statistics. The memory buffers are used for the kernel data structures required for every network transaction. Running short of memory for *mbufs* will significantly degrade network performance.

Listing 4. Act	tive Routing	Tables	for TCP/IP	
Destination	Cateway		Flage	Pof

Destination	Gateway	Flags	Reis	Use	Interface
Route Tree for	Protocol Family 2:				
127	loopback	U	3	2290	100
193.0.9	iago	U	21	202857	en0
193.0.10	saturn	UG	0	0	en0 =>
193.0.10	saturn	UG	0	0	en0
193.0.11	crunch	UG	0	22	en0 =>
193.0.11	crunch	UG	0	0	en0
godot	iago2	UH	2	42567	s10
193.0.13	lear	UG	0	13	en0

The output shown in Listing 5 is divided into three sections. The first section gives overall memory usage statistics for the *mbuf* pools. Line 4 indicates the number of times network requests have been denied due to memory shortages. If this value is persistently nonzero, you will want to consider increasing the memory allocated for *mbufs*. The second section of

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## Systems Wrangler

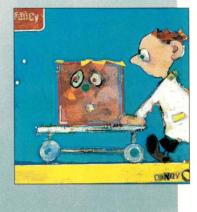
#### Listing 5. The mbuf Statistics

54 mbufs in use: 1 mbuf cluster pages in use 17 Kbytes allocated to mbufs 0 requests for mbufs denied 0 calls to protocol drain routines

Kernel malloc statistics:

\*\*\*\*\*\* CPU 0 \*\*\*\*\*\*

By size	inuse	calls	failed	free	hiwat	freed
32	760	2677	0	264	640	0
64	77	60618	0	51	320	0
128	218	32909	0	38	160	0
256	257	1163260	0	63	384	0
512	58	34444	0	30	40	7
1024	3	8567	0	17	20	0
2048	0	3490	0	6	10	0
4096	8	5634	0	8	120	0
16384	1	2	0	18	24	7
By type	inuse	calls	failed	memuse	memmax	mapb
mbuf	54	1159423	0	13824	29952	0
mcluster	1	22864	0	4096	32768	0



this output, headed by Kernel malloc statistics, gives a more detailed breakdown of current *mbuf* usage by buffer size (memory buffers are allocated in discrete chunks of increasing powers of 2). The final section, headed By type, lists the amount of actual memory consumed by *mbufs* as well as the maximum amount of memory that can be allocated for them, in the columns labeled memuse and memmax, respectively.

There are a few other useful netstat options:

• -r -s	List routing statistics.
• -s	Summarize overall statistics by protocol.
	T . II 1

• -D List overall packet count statistics by interface and by protocol.

#### When to Say no

AIX offers the no command for setting various kernel network options, hence its name. The form no -a will list the current settings of all settable options. Most of these never need to be modified by the systems administrator. In fact, you need to be careful when using the no command, as it does not perform error checking and will allow you to enter illegal or unworkable values for parameters.

The general syntax for setting an option using the no command is:

# no -o option = value ...

where *option* is the name of the option to be set and *value* is the value to be assigned to it. The form no -d *option* can be used to reset an option to its default value.

There are a few no options with which you should be familiar:

• ipforwarding – When this option is set to one, the system will forward IP packets not destined for the local hosts, allowing the system to act as a gateway between two subnets. The default value is zero.

• thewall – Maximum size of the memory buffer pool (in kilobytes). The default is 2,048, which corresponds to a pool size of 2 MB. If the system is short of memory for *mbufs*, you should consider increasing this value.

For example, the following no command enables IP forwarding and sets the maximum memory size for *mbufs* to 3 MB:

#### # no -o ipforwarding=1 -o thewall=3072

• tcp\_sendspace and udp\_recvspace – The options set the default socket buffer size for the system. The default value is 4,096, but the system network initialization files, /etc/rc. net and /etc/rc.bsdnet, set both of these options to 16,384, which improves TCP/IP performance.

Note that most no settings do not persist across system boots, so you will need to add any custom settings to one of the system initialization scripts-the end of /etc/rc.net is often a good location.

It is with mixed feelings that I announce my retirement from writing Systems Wrangler. In the 59 columns I've written since October 1992, I've learned a lot about the care and feeding of AIX systems, and I've enjoyed sharing that information with all of you. Thanks to all my faithful readers and correspondents for your insights, suggestions and witty quips over the years. I'm looking forward to my new column on Windows NT and hope to continue to hear from all of you in that context. by John S. Quarterman

Datagrams



## Haiti and Internet Governance, Part 1

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n March 6, 1997, REHRED (a French acronym for Haitian Telematic Network for Research and Development) received notification from the Internet Assigned Numbers Authority (IANA) that its registration of the top-level domain HT for Haiti was completed, and that registration was

visible in the InterNIC WHOIS server. InterNIC is the recording agency for all top-level domain registrations.

Just one week later, REHRED received an electronic mail message from IANA (see Figure 1) without any warning, discussion, nor even a copy of the fax from the Haitian government.

#### Figure 1

Date: Thu, 13 Mar 1997 16:10:31 -0800 From: iana@ISI.EDU Posted-Date: Thu, 13 Mar 1997 16:10:31 -0800 To: rehred@acn2.net Subject: Re: HT domain Cc: iana@ISI.EDU

#### Bernard,

We recently received a FAX from the Haitian government, asking us to redelegate the HT domain to another company for the time being. The Internic has been informed, and we suggest you stop all activity concerning the HT domain. FOCUS DATA has now been given the rights to the HT domain. Please comply with this decision. The Internic will redelegate the domain to this company ASAP. Thank you for your cooperation.

Josh and -jon Internet Assigned Numbers Authority

All the electronic mail messages REHRED exchanged with IANA as well as many others are available through its Web site, http://www.ht.refer.org/rehred/ domaine/. For Focus Data, apparently the Web server is http://www.haitiworld.com, which claims to be HaitiFocus.

#### The Old Rules: RFC 1591

It may seem normal for a national government to determine the assignment of a national domain. However, in IANA's own published guidelines, RFC 1591 of March 1994 (see http:// ftp.internic.net/rfc/rfc1591.txt), "Domain Name System Structure and Delegation" by Jon Postel, there is no

mention whatsoever of any involvement of national governments in the selection of registrars for toplevel domains. RFC 1591 does mention "significantly interested parties," and presumably a national government could be one of those. But the RFC 1591 does not say that such parties may determine the assignment of a domain, nor that a national government is in any way a specially designated party.

RFC 1591 does say:

"The IANA tries to have any contending parties reach agreement among themselves, and generally takes no action to change things unless all the contending parties agree; only in cases where the designated manager has substantially misbehaved would the IANA step in."

Clearly, IANA did not follow its own guidelines in this case. There was no indication from IANA that there was contention that needed resolution and no allegation of misbehavior on the part of the existing registrar.

What did the Haitian government actually request? After several inquiries from REHRED, IANA transcribed the fax (see Figure 2) and mailed it electronically to REHRED.

The wording is rather strange: "non-exclusive basis, the right to use Haiti's Top Level Domain." That reads like the government wants to be sure Focus Data can have subdomains under HT. It doesn't seem consistent with asking for Focus Data to be the registrar for HT because there really can only be one registrar for a top-level country domain and, thus, "non-exclusive" doesn't apply. It's also strange that the company actually appearing now in the InterNIC WHOIS database as the owner of HT is named Hintelfocus, not Focus Data.

It is hard to see how this fax could have been considered an authoritative request to reassign the HT domain without further clarification as to what it meant. Unless, of course, IANA had received previous correspondence asking how to get the domain reassigned and had told the interested party that a communication from the Haitian government would be sufficient or required. One would think it would be a simple matter of looking in the online files of domain requests that IANA keeps. Except that if IANA keeps such

Figure 2

MINISTETE DES AFFAIRES ETRANGERES

March 13, 1997 Port Au Prince, Haiti

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SM-105.97
```

Mr. Jon FOSTER Associate Director of Networking International Assign Numbers Authority (IANA) USC/Information Sciences Institute 4676 Admiralty Way, Suite 1001 Marina del Rey, CA 90292-6895 USA

Dear Mr. FOSTER:

The Ministry of Foreign Affairs of the Republic of Haiti is pleased to inform you that it has decided to grant to FOCUS DATA, on a non-exclusive basis, the right to use Haiti's Top Level Domain. FOCUS DATA is a company duly registered in Haiti as an Internet Service Provider (ISP).

Here are the specifications of the company's server located in Petion-Ville, Haiti:

Primary DNS Server Address
Secondary DNS Server Address
Primary Server Name
Secondary Server Name
E-Mail Address
FAX Number
Telephone Number

: 206.152.15.33 : 206.152.15.34 : ns.haitiworld.com : appsrv.haitiworld.com : cfilien@haitiworld.com : (509) 57-9040 : (509) 57-0377

The Ministry of Foreign Affairs of the Republic of Haiti would appreciate it if you would take the necessary steps to implement that decision.

Sincerely yours,

Fritz LONGCHAMP Minister

files, online or not, it is not clear where or how to access them. Transparency is lacking in this process.

This is also not the first time that IANA has suddenly changed the registrar for a national domain and then refused to reconsider its decision. The same thing apparently happened with DO, for Dominican Republic, see gopher://gopher.funredes.org:70/11/english/M3/M3.4/M3.4.14.

I know that when I mentioned to Jon Postel that people in Haiti were concerned about setting a precedent of a national government being able to dictate a top-level domain, he told me that HT would not be a precedent, because the precedent had been set long ago.

Meanwhile, REHRED has never accepted the domain reassignment for HT and has made it clear at each step that it does not do so.

IANA has been asked several times, by parties in at least three different countries, to observe that there is no agreement that the Haitian government actually did request for the HT domain to be reassigned, and that it might be appropriate to cancel the reassignment and revert to the previous assignment of the HT domain until the situation is resolved. Despite its own previous comment that the domain was reassigned "for the time being," IANA declined to do this and instead issued a new rule. This is no doubt true, and I haven't heard anyone argue against it. The only catch is that apparently most people involved in Haiti thought they already had an agreement among themselves and with IANA until IANA's abrupt reassignment of the domain.

Who should be the registrar for the Internet Domain System top-level domain HT? I don't know. My concern is with the process. I was asked by several people in half a dozen countries to observe, advise and comment on this situation, and finally to write and publish an article about it.

If the Haitian government didn't mean to redelegate authority for the HT domain, why doesn't it say so? Or if it did mean to, why doesn't it say just that? These are interesting questions. I can think of several possible reasons, for example, no government likes to admit a faux pas and probably at this point the ministry involved isn't going to stick its neck out again, which leaves the prime minister's or president's offices as the only recourse. What the real reason for lack of further communication from the Haitian government is, however, I do not know.

#### Is a Domain Worth the Controversy?

What are these people arguing about? In effect, the right to handle registration for domains under the TLD HT, and to run name servers for HT. Such a registrar could theoretically

#### **IANA's New Rule**

The email message from IANA (see Figure 3) promulgates a new rule of IANA procedure that IANA appears not to have documented elsewhere, so I quote it in full here.

As near as I can tell, IANA can make any rules it chooses to, so this new rule itself is not a problem. One may wonder about the wisdom of this specific rule, as there are few governments that understand the Internet and plenty of bad governments. Would one really want the old government of Zaire, for example, dictating anything concerned with the Internet? But let's put that aside for the moment.

REHRED has pointed out that this rule was only announced *after* it was applied. So the parties involved were expecting RFC 1591 to apply, complete with its rules of due process, and were caught by surprise.

IANA has pointed out (for example, in email messages sent to fewer addressees than the one printed below) that people in Haiti need to come to some arrangement among themselves.

#### Figure 3

Date: Thu, 3 Apr 1997 22:58:09 -0800
rom: postel@ISI.EDU (Jon Postel)
Message-Id: <199704040658.AA02499@zephyr.isi.edu>
o: rehred@acn2.net
C: iana@ISI.EDU, postel@ISI.EDU, isoc@isoc.org, lhl@cs.wisc.edu,
burack@isoc.org, heath@isoc.org, shahn@umd5.umd.edu, archie_marshall
@umail.umd.edu, george.sadowsky@nyu.edu, pimienta@funredes.org,
lanfran@bellanet.org, lanfran@yorku.ca, jsq@mids.org, mids@mids.org,
lpress@ISI.EDU, lgrodrig@conicit.ve, capaid@acn2.net, martine@acn2.
net, ebene@acn2.net, fdsmail@acn.com, cohan-brd@acn.com,
abruno@haitiworld.com, schillerjb@acn.com, patrick@ht.refer.org,
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domreg@internic.net, hostmaster@internic.net, sheila.laplanche@
syfed.ht.refer.org, cresfed@acn.com, secid@acn.com, mtptc@acn2.net,
gstgermain@acn2.net
Subject: Re: [NIC-961127.4583] HT seventh-step reaction

#### Hello:

I am sorry if you do not understand that we have explained to you that there is a rule we have adopted since RFC 1591 was published:

"Follow the expressed wishes of the government of the country with regard to the domain name manager for the country code corresponding to that country."

We have decided that this rule takes priority. We do not believe it is wise to argue with the government of a country about the TLD for that country.

-jon.

charge for its services, following the precedent of InterNIC, but no one in this case has suggested doing so or suggested registration fees as a topic of contention. So why do they care? The registrar gets to spend money to provide a service with few, if any, tangible benefits to the registrar. Who would want such a position?

There are a number of less obvious concerns. Among them are:

- The desire to fairly represent all of Haiti without favoritism.
- Concern that another party might not do so.
- Concern that another party may have ties to groups or ideologies that might cause favoritism or lack of competence.
- Technical competence.
- Managerial competence.
- Financial competence.
- Legitimacy: The registrar of a national domain is a stakeholder in national network policy decisions.

• Process.

That last item, process, is what has made this case something more than a bit of temporary local confusion.

There are still more plot twists in this tale of international intrigue, including a meeting of most of the affected parties that was held in Haiti and which appeared to produce a consensus on the part of all the attendees (including a Haitian government delegate), except Focus Data. That meeting nonetheless did not change IANA's decision. You can read all the gory details in the URL previously cited.

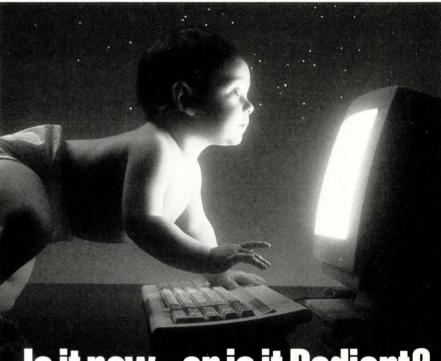
I don't want to get into the personalities involved. Suffice it to say that the people involved are from several different cultures and different educational backgrounds, not to mention that many of them consider each other personally offensive. I don't think these are the real issues, or at least they shouldn't be.

Let's get on to the bigger issues.

#### ALyC and Monroe

People in ALyC (a commonly used Spanish acronym for Latin America and the Caribbean) have been wary of the acts and intentions of their big neighbor to the north since even before U.S. President James Monroe declared that the United States would not tolerate interference in the western hemisphere from outside powers.

IANA is, insofar as it assigns names and numbers for the entire Internet, presumably not acting as an arm of the U.S. government. But it is nonetheless located in the United States and staffed entirely by U.S. nationals. More to the point, the organization to which IANA redelegated the HT domain allegedly has ties to a U.S.-based telecommunications company, MCI Communications Corp., while the organization from which the domain was taken is apparently entirely Haitian. And this was done with no due process and on the basis of a rule that was only pro-



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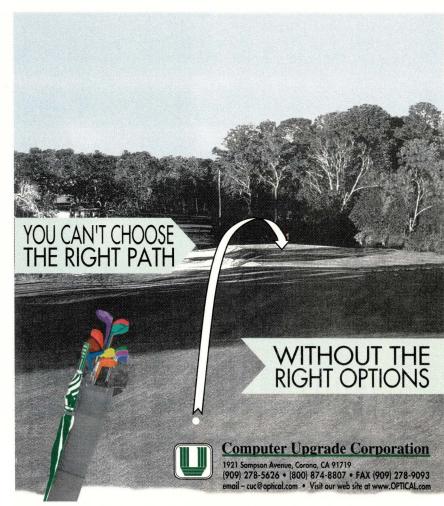
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mulgated after the fact. How could this situation not appear to favor a U.S.based multinational at the expense of a locally based company?

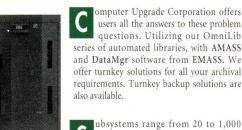
Such suspicions become even more rampant when one considers that the president of Hintelfocus (according to WHOIS -h rs.internic.net HINTELFOCUS) is Archie Marshall, a former assistant to Saul Hahn of the Organization of American States (OAS), who is in charge of ALyC networking and was involved in the sudden change of domain registrar for the Dominican Republic domain, DO, which we mentioned earlier.

Were any of these things factors in IANA's decision? I don't know, but they are more than enough to awaken ALyC fears of U.S. intervention, par-



ackup, restore and archive process have become a central issue in network management. The amount of data generated in networks is exploding at an average rate of 50% or more per year while the value of this data is continuing to increase dramatically. More distributed network environments are implementing Hierarchical Storage Management programs to help automate file management and save valuable magnetic disk space. A typical network has approximately 75% of it's files which have not been accessed within 30 davs.





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ticularly in a country that has a long history of U.S. armed occupation and even now has U.S. troops stationed there, however benign their purpose.

The point here is not to allege that IANA is an agent of U.S. imperialism; I don't know that it is, and I sure hope that it is not. It is rather hard to imagine Jon Postel acting from nefarious motives. However, IANA could not have done a better job of making people think it is an imperialistic tool if it had tried. The point is that IANA's actions in this case have been devoid of political common sense.

#### Nonprofit vs. Commercial

Larry Press, OTI emerging nations editor, goes into the issue of nonprofit research networks vs. commercial networks and the HT domain in his article "Seats at the Policy-Making Table" in the July/August 1997 issue of the Internet Society (ISOC) periodical, On The Internet (OTI), see http:// www.isoc.org/isoc/whatis/ publications/oti.html. In many countries around the world, nonprofit research networks have pioneered Internet access and then been overtaken by commercial networks. Networkers in ALyC have heard me go on ad nauseam about how nonprofit networks don't scale and only for-pay networks can handle Internet growth. Not to mention that MIDS is a forprofit corporation and one of our periodicals, Matrix News, is the oldest and the first nonacademic for-pay newsletter distributed over the Internet. Yet, one of the primary topics of that newsletter is research networks, including REHRED, see http://www.mids. org/mn/308/ht.html.

But we're not talking about running a network here; we're talking about running a domain registry, which is an endeavor with different financial and political parameters. In addition, the real issue here is not for-profit vs. nonprofit; the issue is decision processes.

#### **Continued Next Month**

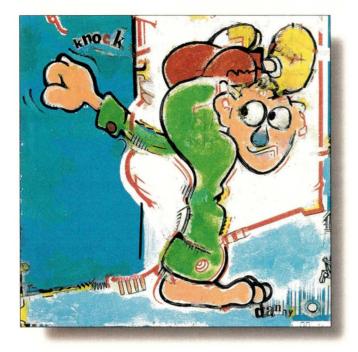
The next installment of this two-part series will examine who reviews IANA, where IANA came from, and what can be done about the Haiti situation. -•

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## Gimme the Secret Knock

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

seem to be spending a great deal of my time addressing complex security issues imposed by our networked application environment. I suspect the same is true for most systems designers and administrators. We all want to share information, but only with our close friends and neighbors. When it comes to electronic dollars and cents, you want to pick your friends very carefully. Network commerce is a fact of life, and we as developers and implementors must ensure the privacy and integrity of the data that flows through the wires of the cyber webs we spin. It's a difficult problem.

What I find interesting is that while we're all collectively scratching our heads and proposing elegant solutions to "network insecurity," real-world applications are still being deployed based on the use of a single password for authentication. Demand always seems to overcome paranoia even when money is involved. This means that we need to make certain our existing password infrastructure is in good working order while we continue to ponder the "what-ifs" of electronic access control and data encryption. The bottom line is that if you have to rely on passwords, make sure they're good ones.

#### **The Basics**

Let's begin with some basics. Any security system you design is going to be limited by both policy decisions and infrastructure restrictions. One will affect the other. For example, you can't require periodic password changes if your operating system doesn't support it. If you don't already have a good password system in place, here are a few things to think about that will assist you in refining base-level system security.

Begin by asking yourself what makes a good password? It has to be easy to remember but not a plain-text word or phrase like your mother's name or words from the dictionary. Does your operating environment support rules and restrictions on formulating and choosing good passwords? Does it provide mechanisms for requiring periodic password changes and enabling password expiration? How often should you require users to change their passwords? When will you expire passwords that have not been changed? Are encrypted password files readable by unprivileged users? It should be well understood by your user community that PASSWORDS MUST NOT BE SHARED. It really doesn't matter what

security system you put in place if the procedures aren't ardently practiced by the masses. Sometimes the old dogs will have to learn a few new tricks or a bad dog will come along and take away all the bones! Finally, who in your organization requires shared access to privileged accounts and how will you audit access?

In general, most operating systems support the password security requirements listed above. The following discussion focuses on how they are implemented in AIX. However, the concepts are extensible to other UNIX implementations. I'll also cover tools for converting other UNIX password files into the corresponding AIX format.

#### **Shadow Files**

One of the biggest problems with traditional UNIX password implementations is that the /etc/passwd file contains the encrypted password for each user and it is world-readable. Although the passwd command uses one-way encryption, crack programs can encrypt common strings and compare the results against the encrypted password represented in /etc/ passwd. In the 1960s, this was deemed to be an algorithm that would take hundreds or thousands of years of CPU time to compare all the possibilities. By using dictionaries and common password patterns, faster crypt() routines and higher speed processors available today, you can crack most common passwords in a reasonable period of time: a nice weekend project for a kid and a Pentium.

How do you fix this problem? You move the encrypted passwords into a secure file and directory that requires the use of secure setuid subroutines to access the information. This is what IBM has implemented in AIX. A placeholder character, !,

#### **Example 1. AIX Password File Structure**

/etc/passwd - mode 644

root:!:0:0:Almighty Overseer:/:/bin/ksh

/etc/security/passwd - mode 600

```
root:
```

```
password = asldfi0237xa0
lastupdate = 728707306
flags =
```

#### Example 2. Password Restriction login.cfg

/etc/security/login.cfg

	Def	Max	Rec	
pw_restrictions:				
maxage =	0	52	8	Max. weeks before update enforced.
minage =	0	52	1	Min. weeks before update allowed.
minalpha =	0	8	4	Min. number of alpha characters.
minother =	0	8	2	Min. number of non-alpha characters.
mindiff =	0	8	3	Min. chars different from old password.
maxrepeats =	8	8	1	Max. number of repeats for any character.

is inserted in the passwd field of the /etc/passwd file. A secure shadow password file, /etc/security/passwd, contains the encrypted password for each user (see Example 1).

#### **Rules and Restrictions**

Most users are not inclined to use esoteric passwords, and they do not like to change their password more than once in a lifetime. Unfortunately, this breaks the fundamental laws of account security. AIX allows systems administrators to remind users periodically that it's time for a password change and that they need to be imaginative in their new choice. Once the "maxage" limit has been exceeded, users are required to select a new password at next login. You don't want to be a nag, so don't require changes too often. Also, you don't want to require users to be so cryptic in their choice of password that they have to write it down on a sticky note posted on the front of their workstation.

Under AIX, you can tailor default password aging and character restrictions in the pw\_restrictions stanza in /etc/security/login.cfg (see Example 2) or in the "default" stanza of /etc/security/user files. Per-user restrictions may be set in /etc/security/user by invoking SMIT mkuser (see Example 3).

From time to time, you will have to reset a user's password and, thus, procedures must be in place to facilitate this event. It doesn't seem to matter whether a password is cryptic or a common word; people are just forgetful. A common complaint from systems administrators is that AIX requires root's password to be entered before allowing you to reset a user password. In fact, AIX does require root's password if you are not a member of the "security" group and if you don't use the pwdadm command (see Example 4) or SMIT to update passwords. As a member of the security group, you are still required to enter your own password to validate who you are before proceeding. There's always a cost to security.

#### **Superuser Access**

As mentioned earlier, care should be taken when deciding who has shared access to root's password and how it is used. Users with access to privileged accounts should first log in using their own nonprivileged account and then use the su command to setuid to privileged accounts. The su command logs all invocations to the /var/adm/sulog file. This provides an audit trail of who logged in and when,

and the success/failure for each su invocation.

AIX provides an additional level of su security by allowing the systems administrator to define whether an account can be accessed via the su command or restrict access to a particular set of group IDs (see Example 5). These restrictions are applied on a per-user basis in the /etc/ security/user file.

#### **Auditing Passwords**

Even with adequate password restrictions and rules in place, it is a good idea to periodically audit the passwords on your system. One of the ways you might do this is to employ one of the many password cracking tools used by the hacker community. Might as well use the tools of the trade. You can monitor newsgroups like alt.2600 for the latest and greatest password killer cracker.

If you're less inclined to play on the wild side of the street, try the COPS or SATAN packages available from Computer Emergency Response Team (CERT). These packages contain various tools and password crackers for validating network security. These tools are available via anonymous ftp from cert.org.

AIX also provides its own set of password validation tools. These tools are part of the larger security system called the Trusted Computing Base (TCB) (see Table 1). These tools may be invoked individually or as part of the overall system validation using the tcbck command.

#### Converting Password Files

If you are moving a large user community from another UNIX platform onto AIX, fear not, AIX provides a means for converting standard UNIX /etc/passwd files into the corresponding AIX format. The same tools used to audit password file consistency can be used to convert password files from other systems.

First, copy the password file onto AIX as /etc/passwd. Once the password file is available, execute the pwdck command to create /etc/ security/passwd entries:

# pwdck -y ALL

Next, create user stanza entries for each user in the /etc/security/ limits and /etc/security/ user files using the usrck command:

# usrck

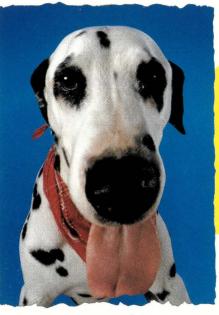
Finally, update /etc/group with any

#### **Table 1. TCB Password Validation Commands**

- pwdck Checks consistency of the /etc/passwd and /etc/security/passwd files. grpck Checks consistency of the /etc/group and
  - /etc/security/group files.
- usrck Validates entries in the /etc/security/user file.

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#### Example 3. SMIT mkuser

Days to WARN USER before password expires

Password CHECK METHODS

Password DICTIONARY FILES

NUMBER OF PASSWORDS before reuse

WEEKS before password reuse

Weeks between password EXPIRATION and LOCKOUT

Password MAX AGE

Password MIN AGE

Password MIN LENGTH

Password MIN ALPHA

Password MIN OTHER

Password MAX REPEATED

Password MIN DIFFERENT

Password REGISTRY

Number of days to warn user with message at login.

Rules for validating proper passwords.

Word dictionaries used to validate passwords.

How many passwords before reuse.

How long before reuse.

How long after expiration before restricting access.

Maximum time before requiring a password change.

Minimum time before a password can be changed.

How short a password can be.

Minimum number of alphabetical characters.

Minimum number of nonalphabetical characters.

Maximum repeated characters allowed.

Minimum number of different characters required.

Authentication mechanism.

#### **Example 4. Resetting a Password**

# pwdadm sleepy

Changing password for "sleepy" <your> Password: sleepy's New password: Re-enter sleepy's new password:

#### **Example 5. su Restrictions**

robin:

su = <true/false>
sugroups = <ALL|list>

Users may su to this account. Groups that may su to this account. GIDs and group members that existed on the old system. Once updates have been completed, execute the grpck command to create /etc/ security/group entries:

# grpck

If you happen to be working under an enhanced security environment such as Distributed Computing Environment (DCE), you can synchronize AIX password information with the DCE registry using the passwd\_import and passwd\_ export commands. For example, invoke passwd\_import to read your existing AIX password information and initialize your DCE registry. The passwd\_export tool can be used to read from the registry and create AIX password files.

# passwd\_import
AIX password data to DCE registry.

# passwd\_export
DCE registry to AIX password data.

As uneasy as we are when it comes to network security and password systems, you have to admit that they do an admirable job of providing basic access control. Sure there is a fair amount of network hacking, but consider the number of machines and operating systems in the world that depend only on passwords for access control. Judicious use of tools like .rhost files or enhanced systems such as Kerberos and DCE can take the technology one step further by eliminating clear-text passwords flowing between systems over a network. These tools will reduce your exposure to network eavesdropping attacks. Secure Sockets Layer (SSL) protocol provides a similar function when using passwords in a Web environment. Maybe all we need to do is use the audio and video support on most workstations and implement the old secret knock routine. Two knocks and the big gorilla gives you the once over before letting you access your bank account. 🔸

### Work by Jeffreys Copeland and Haemer



#### Jeffrey Copeland

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## Practical RCS

mkdir RCS ci -l \*

hese two lines are 90% of what you need. If you're waiting for a bus, or for a compile to finish, or eating lunch, we can help you kill some time. Kill, yes. Waste, no. If you already use Revision Control System (RCS), then by the time you're done reading this column, you'll feel more comfortable about what's going on underneath and you'll know some new tricks. But if you don't use RCS, start now.

Not knowing about the basics of RCS is as silly as not knowing the basics of sed or awk. It's a fundamental and useful tool, freely available, that runs on just about every kind of machine you can imagine, UNIX and non-UNIX. We use it daily.

## 'Use the Right Tool for the Job' – *Mr. Natural*

What's the job that RCS is the right tool for? Revision control. If you already know about revision control, skip this section.

Last month, we talked about how to make backup copies of files. We've all inadvertently deleted files, so we don't have to be sold on the idea of making snapshots of our work, but making frequent copies clutters up our directories, uses up a lot of space and becomes hard to organize and administer.

A lovely, and now venerable, alternative is provided by Walter F. Tichy's RCS, which lets you store all your backup snapshots of a file in a single repository.

To illustrate some advantages of RCS, let's look at a real example: pclmain.c, a file from one of the products that we work on. We have versions of pclmain.c that date back to 1992. The file itself is currently 642 lines long, and we have 152 distinct versions. Some of these versions are intermediate development versions, but others are actually parts of commercial releases, currently in the field, which require ongoing maintenance.

And pclmain.c is only one of 445 files that we use to build our interpreter for Hewlett-Packard's PCL printer language, which is just one of many components that go into our products.

Keeping track of all of this variation could be a tremendous amount of work. However, all the versions of pclmain.c are stored in a single file, pclmain.c, v, which is only about 5,500 lines long, nearly 1,000 of which are administrative notes

### Work

outside the source code itself.

The file has grown substantially in the last five years. However, even if it had stayed at its original size (about half its current size), storing all our revisions would have required more than 10 times as much space if we had stored them as complete files.

So RCS saves space and keeps the file system namespace manageable. What else?

• RCS automatically assigns identifiers to every stored revision, to permit future retrieval. We can also group components of a system under a single symbolic name, rather than needing to know the identifying number for each individual source component.

• RCS tags each revision of a file with the name of the person who made the revision and the exact time the revision was made. It also stores the author's comments on the revision external to the code itself, cleanly separating revision history from sources while joining the two physically, so there's no danger that one or the other will be lost.

• RCS controls access to the files, allowing everyone to read any version (RCS calls these "revisions") of a file, but only letting one person at a time lock a version of the file to make changes.

One of the things we like about vi is that we're not afraid to make global, sweeping changes; if we make a mistake, we can always undo them with a single keystroke. RCS gives us a filelevel "undo" key. We keep even trivial files (such as this column) under RCS control, confident that whenever we go down a dead-end street, we can always retreat to an earlier version–all the way back to our first draft, if necessary.

#### How's It Work?

Let's look at an example:

```
$ echo "Use the right tool for the job." > jeff
$ ci jeff
jeff,v <-- jeff
enter description, terminated with single '.' or
end of file:
NOTE: This is NOT the log message!
>>
```

Here, we create a test file, then use the ci (check-in) command to put it under revision control. We'll use ci again later to check in revised versions of our file, but ci can tell that our test file isn't already under revision control, so it begins by asking for a description of the file, NOT the log message!. We type in an answer:

```
>> This is a test file
>> to illustrate the basics of RCS.
>> .
$ ls
jeff,v
```

#### Figure 1. File jeff,v Under Revision Control

```
$ nl jeff,v
1 head 1.1;
2
    access;
3
    symbols;
 4
    locks; strict;
 5
    comment
               @# @;
 6
     1.1
     date 97.05.02.16.50.41; author jsh; state Exp;
 7
 8
    branches;
 9
    next ;
 10
    desc
     @This is a test file
 11
 12
    to illustrate the basics of RCS.
 13
     a
 14
    1.1
 15
     log
 16
    @Initial revision
 17
    a
 18
    text
 19
     @Use the right tool for the job.
 20
```

(Note: The UNIX n1 command numbers the nonblank lines of a file.)

When we started, we had a file called jeff. Now, we have a file called jeff, v. What does it look like? (See Figure 1.)

Fact number one: It's a simple UNIX text file; you can read and make sense of it. (If we had tried to put a binary file under revision control it would have worked, but the extra information added by RCS would still have been ASCII.)

In Figure 1, lines 1 to 5 contain administrative information. We'll talk more about them in a minute, but they contain keywords, such as head and locks, together with values, such as 1.1 (the last version number).

Fact number two: It's a file full of key-value pairs. Lines 10 to 13 contain the description we typed in. Notice that the key is desc, but the value–our description–is surrounded by @ characters. This is how RCS represents strings. If we have an @ sign within our text, RCS handles that by duplicating our @ sign.

The remainder of the file is a series of versions, or "deltas," which let us extract any given version of the file. The easiest way to see how they work is to add a few versions and look at the file again (see Figure 2).

What is all this stuff? Well, first, let's look at the current revision, which we get by checking it out:

```
$ co jeff
jeff,v --> jeff
revision 2.1
done
$ ls jeff*
jeff jeff,v
```

We now have both an RCS file, jeff, v, and the current version of the file, jeff (which is up to revision 2.1). We

## Work

know what the RCS file looks like, but what about the other one?

\$ cat jeff #\$Id:jeff,v 2.11997/05/0217:44:44 jsh Exp \$

Snowy, Flowy, Blowy, Showery, Flowery, Bowery, Hoppy, Croppy, Droppy, Breezy, Sneezy, Freezy.

-- George Ellis, "The Twelve Months,"

This, too, is a regular file, even though it's very different from where we began. (How often do you suppose *Sun-Expert* prints poetry? Though contrast this with the names of the months in the French Revolutionary Calendar used between 1792 and 1806: Vintage, Fog, Sleet, Snow, Rain, Wind, Seed, Blossom, Pasture, Harvest, Heat and Fruit.) The first line may look mysterious, but it's only there because we put it there; it isn't required for RCS.

Now, let's look at the RCS file shown in Figure 2. Lines 1 to 5 are still administrative, global information about the file, and tell us that the most recent version is now 2.1.

Lines 6 to 17 list the individual revisions. Among other things, they tell us the number of each revision, who created it, which revision it was created from, and when it was checked in.

We occasionally find that we want a version of a file from a specific date or time. Accordingly, RCS takes dates and times very seriously. The check-in date is stored in UTC (what we used to call "Greenwich Mean Time"), which means that even if you have the RCS file on a file system that's NFS-mounted across time zones (yes, we sometimes do that!), the date will still make sense.

On the other hand, it's critical that all the machines that manipulate an RCS file have their clocks synchronized. On Suns, you can do this using rdate. For other machines, there are publicly available packages that use the Network Time Protocol. If all else fails, you can even create your own time-synchronization utility, which we showed you how to do a few months ago in *RS/Magazine* (see "Let's Synchronize Our Watches," January 1997, Page 30, or check out the software on our Web page at http://www.alumni.caltech. edu/~copeland/work.html).

The next part, the description, is unchanged. This is provided by the person who created the file and describes the file as a whole, not any particular revision, so there's no reason that creating new revisions should change anything. Comments on individual revisions will come later.

But what do you do if you want to change the description? This brings us to the catch-all command rcs. A quick look at the rcs man page reveals that this command lets you do all sorts of out-of-the-ordinary operations, including things like rcs -t- 'Here's

#### Figure 2. File jeff,v with Some Revisions

```
$ nl jeff.v
    head 2.1;
1
2
    access;
3
     symbols;
4
     locks; strict;
5
     comment
               @# @;
6
     2 1
7
     date 97.05.02.17.44.44; author jsh; state Exp;
8
    branches:
9
    next 1.2;
10
    1.2
     date 97.05.02.17.40.38; author jsh; state Exp;
 11
12
    branches;
13
    next 1.1;
    1.1
14
    date 97.05.02.16.50.41; author jsh; state Exp;
15
16
    branches;
17
    next ;
18
     desc
19
     @This is a test file
 20
    to illustrate the basics of RCS.
 21
 22
    2.1
 23
    100
     @A third version, which changes a line.
 24
 25
    The file is now so different
 26
    that we've given it a new major revision number.
 27
    a
 28 text
 29 @# $ Id:$
 30
    Snowy, Flowy, Blowy,
    Showery, Flowery, Bowery,
 31
 32
    Hoppy, Croppy, Droppy,
 33
    Breezy, Sneezy, Freezy.
 34
          -- George Ellis, "The Twelve Months,"
 35
     a
 36
     1.2
 37
     100
 38
     @Create a second revision by adding a few lines.
 39
     a
 40
     text
 41
     ad1 1
 42
     al 1
 43
     Use the right tool for the job.
 44
     d7 2
 45
     a
 46
    1.1
 47
     log
 48
     @Initial revision
 49
     a
 50
     text
 51
     @d2 5
 52
     a
```

#### a new description. '

Fact number three: When all else fails, the rcs (1) man page often provides a solution. (This is, we note, a corollary of the more general Fact number zero: RTFM.)

The remainder of the file is a series of "deltatext" segments, each consisting of a revision number, a log comment and a string enclosed, as always, within @ symbols. The first of these, the "head" or "top-of-the-tree" revision, is the current version of the file. The command co jeff retrieves a copy of that text.

Before we go any further, we'll digress to point out line 29, the RCS Id keyword. RCS provides several such keywords, described in the co(1) man page, which let RCS insert various kinds of descriptive text into files as they are checked out. In Figure 2, the checked-out version of our file is labeled with the name of the repository, the version, the date and time that the version was created, and the developer who created it.

The deltatext segments that follow are instructions on how to reconstruct each version from the version that follows it. For example, lines 36 to 45 say that Version 1.2 can be constructed from Version 2.1 by deleting line 1, (line 41), adding one line after line 1 (line 42), the text of which is "Use the right tool for the job" and then the information on line 43 of the RCS archive tells us to delete several lines starting at line 2 of the file.

Of course, these instructions look just like instructions to ed. Instead of reinventing the wheel, RCS just uses existing UNIX tools to generate these deltatexts. A quick glance at the man page for diff or diff3 will show you that both these utilities have options that generate ed scripts of this sort.

Broken down like this, the RCS file becomes quite comprehensible, and you can imagine that it would be simple both to generate and to interpret such files. You may be thinking you could write your own RCS substitute without much trouble. You probably could. For example, Brian W. Kernighan and Rob Pike do just that in *The UNIX Programming Environment* published by Prentice-Hall, 1984, ISBN 0-13-937699-2. Their ci equivalent, put, is a 30-line shell script, counting blank lines and comments. Their co equivalent, get, is three lines longer. "get is more complicated than put," they comment dryly, "mostly because it has options."

So what makes RCS any better than a roll-your-own version, and why has it swept the field, nearly completely displacing commercial competitors and its intellectual parent, SCCS (an older, historically important, UNIX version control system developed at AT&T by Marc Rochkind)? We can't speak for anyone else, of course, but we like it for these reasons:

#### 1. It doesn't break.

Once you put a source under RCS (or anything like it), the RCS repository stores the accumulated history of that file: who worked on it, when it changed, why it changed and so on. In practice, RCS files are kept, used and maintained for years, and nothing that handles them can ever afford to break. RCS files become like the family jewels, and you can't afford to have them stepped on when you run into an obscure error condition that someone's forgotten to consider.

#### 2. It's available in source code form, for free.

Not only does the price fit everyone's budget, but the availability of source means that as your organization switches from Suns running SunOS to DEC Alphas running OSF/1 to Pentium Pros running Linux, your old RCS files will migrate smoothly from each system to the next. In fact, there are versions of RCS for DOS, Windows and OS/2 for the unconvertible Microsofties out there.

#### 3. It's easier to use than not to use.

First, RCS comes with scads of options and several auxiliary commands, but almost all of the work is done with two basic commands, ci and co, which you can learn in less than a minute.

Second, we all back up old versions in various ways, but with RCS, you end up backing them up into a single file and not cluttering up the directory listing. Better still, if you create a subdirectory called RCS, RCS will automatically store and look for its repository files in that directory. (See the first couple of lines of this column for an example.)

Third, several other ubiquitous UNIX software development tools, including emacs and GNU's version of make, know about RCS and RCS files. Fourth, RCS is built around simple command-line tools and normal files. UNIX has long made it relatively easy to build elaborately tailored interfaces on top of simpler ones, and graphics toolkits such as Tk now make it possible to layer on an attractive GUI. Going the other way is another story: It's usually extraordinarily hard to take an elaborate, integrated, one-size-fits-all, source-code-control database and tailor it for environments not contemplated by the vendor.

In addition to the three commands we've already mentioned—co, ci and rcs—RCS provides a handful of other useful, related utilities—including ident, rcsclean, rcsdiff, rcsmerge and rlog—that have their own man pages, which we encourage you to look over (review Fact number zero).

#### 4. It's a de facto standard.

RCS is certain to be installed at nearly every company you will ever work for, and on almost every machine that you will ever work on. Time invested in learning RCS will continue to pay back for years, and once you've learned it, the knowledge will stay useful across projects, machines and employers. What's more, it's easy to continue to build your knowledge over the years by rereading the man pages every few months to learn something new.

#### Some Drawbacks

Over the years, we've learned that whenever someone tries to sell us on a new tool, product or idea, the question that cuts through the hyperbole faster than any other is this: "What's it *not* good for?" If we get an answer like, "It's good for *everything*. You should always use it," we say, "Gosh, thanks. Well, will you look at the time? We really must be going." Haemer was the first of us to discover this trick, which he applied at the first Usenix Conference on "very high-level languages" in October 1994. He asked everyone what C++ *wasn't* good for. The sometimes interesting answers are discussed in his conference report

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in the February issue of the Usenix newsletter ;*login*:. What are RCS' shortcomings?

#### 1. It's space intensive.

Whenever you have a lot of users looking at each file simultaneously, it's space intensive. RCS lets you extract a copy of any version you want, but if five people each get their own copy, then they take up five times as much disk space as a single copy.

#### 2. File locking can be abused.

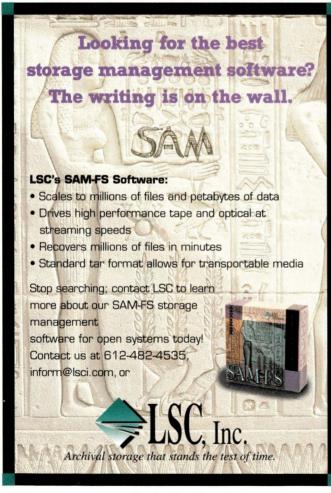
We once took charge of a source-code-control database with thousands of source files. A little investigation uncovered dozens of files that had been locked for years, most of them by employees who no longer worked at the company.

#### 3. There is no way to force useful log comments.

This one is a little like complaining that there's no way to force programmers to write readable, maintainable C or Perl, but it's still a problem. We have seen too many log comments like "Fixed bug." (To be honest, we've even written too many like that ourselves.) Worse still, there's not even a way to force nonempty log comments.

#### 4. RCS is built to handle files, not projects.

No project we've ever worked on has been confined to a single file. When we work on particular releases, we don't want



to say, "Give me Version 1.3 of foo.c and Version 2.91 of main.c and ..." we want to say, "Give me Release 2.02 of the product." Similarly, when we make changes, we're typically checking in new versions of a suite of files rather than a single file. Moreover, RCS has no provision for saying: "When we check out revisions older than January 1, 1995, the checkedout file should be called jeffrey, but for all newer revisions, the file should be called jeff."

On a related note, if we delete a file from a project, we must not delete the RCS file–otherwise, we could never reconstruct older releases–but RCS has no convenient way of marking the RCS files that correspond to deleted files. Files added partway through a project pose analogous problems.

One way to handle these sorts of problems is to abandon RCS for a product that has the needed functionality. This throws the baby out with the bath water. Another is to write a layer on top of RCS that provides the needed functionality. Most of us who have been in the UNIX industry for several years have done this more than once.

The good news is, that's no longer necessary. A few years back, Brian Berliner, at Prisma, wrote such a layer, called Concurrent Versions System (CVS), that has many of the advantages of RCS: It's mature, it's stable, it's well-designed, it's available in source form and it's free. Next month, we'll talk about CVS.

Until then, happy trails. -•

## ALPHANUMERIC PAGING FOR UNIX

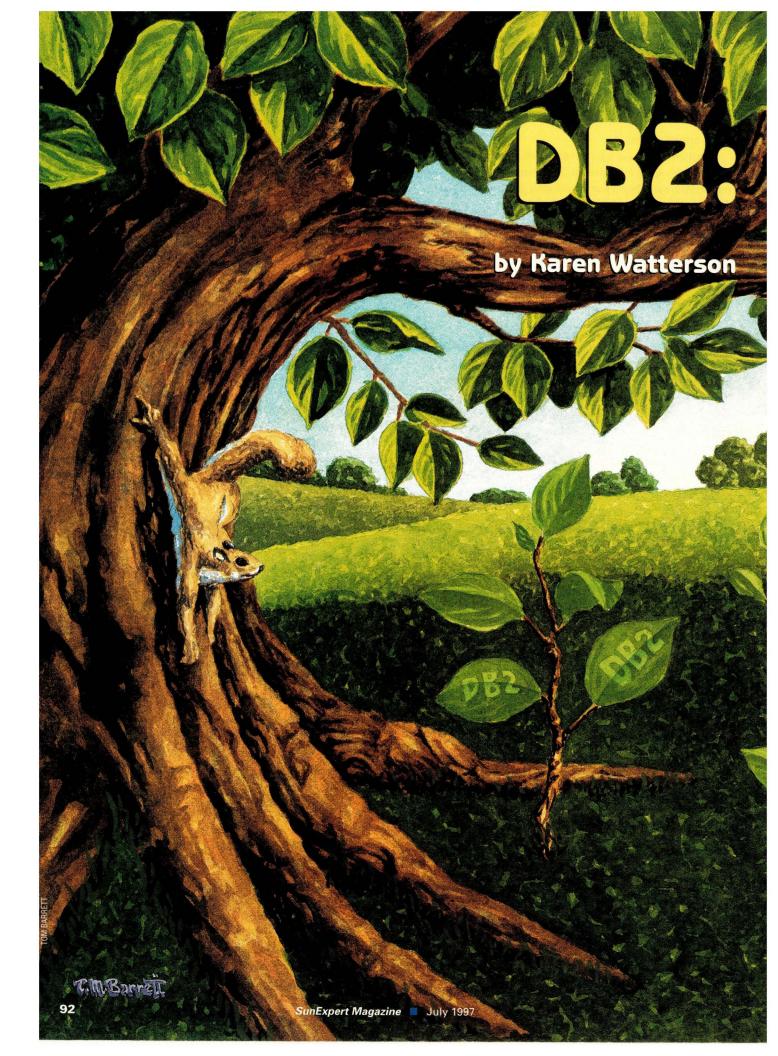
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Though overshadowed by Oracle's DBMSs, DBZ is a big market player with a multitude of application solutions.

> aybe IBM Corp. is so busy making money on its hardware and consulting services that it doesn't have time to market DB2 the way it could. Granted, databases aren't IBM's core competency the way they are market leader Oracle Corp.'s. But still, DB2 doesn't get the respect it deserves, especially on the RS/6000. After all, according to IBM, there are more than a million copies of DB2 installed worldwide: more than 750,000 on OS/2; 250,000 on A5/400s; 7,000 on MV5/05/390, another 7,000 on VM and VSE (SQL/DS), and close to 10,000 on UNIX platforms.

Another way of looking at the numbers, says Janet Perna, general manager of data management for IBM's software solutions division, is to realize that DB2 is used by more than 100,000 corporations and 30 million users worldwide. And, according to a 1996 survey of 130,000 U.S. computer sites

## Databases

conducted by La Jolla, CA-based Computer Intelligence, 84% of the sites with more than 1,000 employees use DB2. In other words, even though Oracle always seems to come out on top with market share numbers, DB2 is a very big player with solutions for just about any application need.

Most customers still use DB2 for online transaction processing (OLTP) applications, but a growing number are har-

nessing its power for decision support and data warehousing and for doing ecommerce. L.L. Bean and Eddie Bauer, for example, both use RS/6000s, DB2 and Net.Data to do business over the Web. As Perna says, referring to Geoffrey Moore's books (Crossing the Chasm and Inside the Tornado, both from HarperCollins Publishers Inc.), object-relational and multimedia are still deep into the technology phase-perhaps only just beginning to move into the visionary phase. Nevertheless, Perna says that increasing numbers of DB2 customers are both interested in data warehousing (IBM's Visual Warehouse is a \$20,000 bundle for creating 50-GB data marts, but DB2 itself can host much larger data warehouses), and using technology offered by DB2based products such as Digital Library.

So DB2's Universal Server (planned for release by the time you read this or soon after) deserves your scrutiny, and IBM even makes it easy for you to do just that. Surf to http://www. software.ibm.com/data, and you

should find a link that invites you to

download a free 60-day evaluation copy of DB2 for Windows 95 or NT. This isn't an "Oracle Lite" type product–it's the real thing, a general-purpose "universal server" that lets you do OLTP, data warehousing and data mining, even over the Web if you so desire. Read this month's cover story on universal servers ("RDBMSs in the Spotlight," Page 44) for more about where DB2 is today and where it's going–as well as a

### IBM's 'data extender' approach expands the traditional DB2 system catalog tables with additional metadata tables.

look at the other RDBMS and ODBMS vendors. In this article, the focus is more DB2-centric, with an emphasis on using the DB2 Universal Server.

And, by the way, if you haven't checked out IBM's database page (http://www.software.ibm.com/data) recently, you should, because it gives you a great overview of IBM's database-related tools (see Table 1).

#### TABLE 1 **IBM's Database Tools Business Intelligence:** Intelligent Decision Server **Intelligent Miner** 57 **MediaMiner Visual Warehouse** 100 **DataGuide** Information Integration: DataJoiner **DataPropagator** Web-Enablement Solutions: Internet Connection Server (COR Net.Data DB2 World Wide Web Connection **JDBC** for DB2 **Database Systems Management:** DataHub for UNIX **DB2 Performance Monitor DB2 Visual Explain DB2** Estimator **DB2** Enterprise Control Center **Content Management: EDMSuite** Digital Library

#### **Common Server Yields to UDFs, UDTs**

Today, IBM maintains three separate code bases: IBM DB2 2.1 Common Server (for AIX, OS/2, Solaris, HP-UX, SCO, SINIX, Windows NT and 95), DB2 for MVS Version 4.1 (Version 5.0 is in beta) and DB2/400. All three siblings share an increasingly consistent SQL that's "close to SQL92 Entry Level" compliant, says IBM's Perna, but aren't likely to ever be

consolidated because of backward compatibility problems–the mainframe and AS/400 versions of DB2 are simply too tightly integrated into the MVS and OS/400 operating systems.

DB2 was the first RDBMS to ship support for object-relational data types (such as image, video, audio and text), starting in June 1996, and is poised to expand that with the DB2 Universal Database (UDB) Server. Plus, with user-defined functions (UDFs) and user-defined types (UDTs), users can define their own. IBM's "data extender" approach expands the traditional DB2 system catalog tables with additional metadata tables: one of these has information about which extenders are installed, and other tables are created as needed, per database table and per extender. No cartridges, no Data-Blades, no new middleware API to master-just a few UDTs to use in your Data Definition Language and some UDFs to qualify your data in INSERT, DELETE and UPDATE statements. Developers also have the option of running the extenders either inside or outside DB2's kernel address space.

Depending on the data extender you choose, you'll use the UDFs to harness special search engines (see "DB2 Universal Database Architecture") that support, for example, IBM's innovative Query By Image Content.

You may not need to use the multimedia extensions, however, because IBM has enhanced its base data types with a binary large object (BLOB) data type that can now accommodate up to

2 GB of data, character large objects (CLOBs) and double-byte character large objects (DBCLOBs).

Even if you aren't interested in using DB2's multimedia extensions, UDB offers many new features, especially for data warehousing or data mart applications, including support for 64-bit memory, bit-mapped indexes, star joins and new ROLLUP

and CUBE functions. DB2 Universal Server, which combines DB2 Common Server and Parallel Edition into a common code base–symmetrical multiprocessing (SMP) and massively parallel processing (MPP) support is offered at no extra cost–also offers built-in support for user authentication and directory services using Distributed Computing Environment (DCE), bi-directional replication, and



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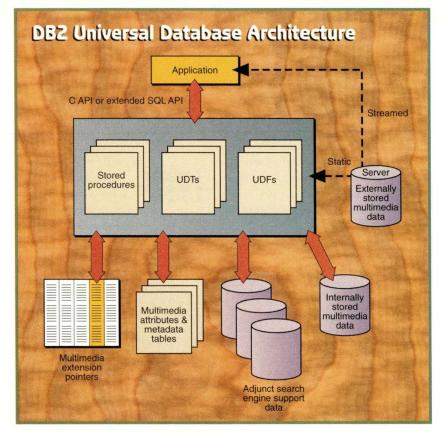
## Databases

enhanced Internet support via Net.Data and Java database connectivity (JDBC).

DB2 for AIX and Windows NT now offer double-byte character capabilities required to support Asian customers with native-language interfaces and clustering support in a variety of operating environments for load sharing and redundancy, point-in-time tablespace and table-level recovery, and fast restart. DB2 is also certified with C2 level security and ships with support for more clients, including Apple Computer Inc. Macintoshes and Silicon Graphics Inc. systems.

IBM is also working with vendors such as Environmental Systems Research Institute Inc. (ESRI), which markets the popular GIS (geographical information systems) mapping software, to provide additional extenders, and with firms such as SAP America Inc. to make sure SAP for DB2 continues to be what IBM says is the best platform choice for a tightly integrated application/database combination for S/390, UNIX, AS/400 and NT users. (IBM and SAP have just opened a new IBM/SAP integration and support center at IBM's Santa Teresa Laboratory in San Jose, CA, augmenting the SAP and IBM teams

already in place at SAP's Walldorf, Germany, headquarters.) Earlier this year, IBM and Arbor Software Corp., Sunnyvale, CA, announced that they will work together to integrate technology from Arbor's Essbase directly with DB2, creating a new online analytical processing (OLAP) offering called the IBM DB2 OLAP server. The new server, which will allow networked clients to access multidimensional data through Web browsers and is scheduled for delivery later this year, matches similar OLAP products from Oracle (Express) and Informix Software Inc. (MetaCube).



SAP and Arbor are just two of IBM's 1,000+ partners with more than 2,000 products that work with DB2 (for more information, see http://www.mfi.com/softwareguide/ DB2-Solutions), and, as you saw from the list of tools on IBM's database page, IBM has a slew of its own products that work with DB2 to provide the following:

- Heterogeneous data access, i.e., to non-IBM data, with DataJoiner (ODBC and JDBC are built into DB2 along with Distributed Relational Database Architecture, DRDA).
- Web enablement with Net.Data.

### **Companies Mentioned in this Article**

#### Arbor Software Corp.

1325 Chesapeake Terrace Sunnyvale, CA 94089 http://www.arborsoft.com Circle 180

#### Environmental Systems Research Institute Inc. (ESRI)

380 New York St. Redlands, CA 92373 http://www.esrl.com Circle 181

IBM Corp. Contact local sales office

#### Informix Software Inc.

4100 Bohannon Drive Menio Park, CA 94025 http://www.informix.com Circle 182

Lotus Development Corp. 55 Cambridge Pkwy. Cambridge, MA 02142 http://www.lotus.com Circle 183

Microsoft Corp. One Microsoft Way Redmond, WA 98052 http://www.microsoft.com Circle 184

#### Oracle Corp.

500 Oracle Pkwy. Redwood Shores, CA 94065 http://www.oracle.com Circle 185

#### SAP America Inc.

300 Stevens Drive International Court Three Philadelphia, PA 19113 http://www.sap.com Circle 186

## Databases

- E-commerce with Net.Commerce.
- · Data warehousing using data marts with Visual Warehouse (management component available on NT or OS/2 only), including optional Visual Warehouse Adapter extension to support IMS and VSAM data files.
- Data mining with Intelligent Miner.
- Analysis with Lotus Development Corp.'s Approach and Intelligent Decision Server.
- Developer tools like VisualAge for BASIC (with support for ActiveX as well as CORBA), VisualAge for Java-and other VisualAges for Cobol, Smalltalk and C++.

#### **Getting Started**

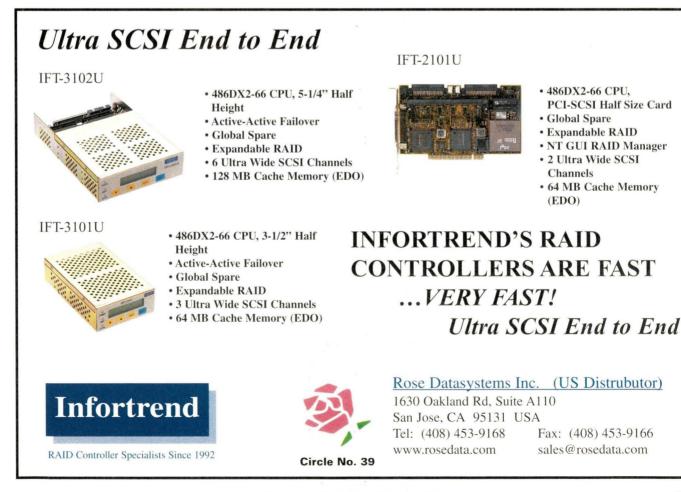
Prodded by competition from Microsoft Corp. and even Oracle, IBM has made DB2 installation a lot easier than it used to be. Still, the beta copy I reviewed included a 179-page installation manual. Although you might get away with installing Microsoft's NT-based SQL Server without reading the manual, DB2, like Oracle, is a bit more complex. It pays to read that manual carefully and even attend database administrator (DBA) classes.

The manual provides useful information on planning the installation along with all the combinations and permutations you may need, such as host access, help migrating data from previous versions, access to DB2 from the Web and/or API access via the DB2 Software Developer's Kit. (You have to

install database extenders from a separate CD-ROM.) The manual also has about 50 pages devoted to installing client software and configuring DB2 communication with CCA, and a helpful appendix on suggested naming rules. DB2's entire manual set is available on CD-ROM in PostScript format, with subsets also available in HTML and Adobe Systems Inc. Acrobat PDF format.

Once you've installed DB2 and logged into the system, I'd recommend installing the SAMPLE database to get your feet wet-similar to the pubs database that ships with SQL Server or the starter database you can create during Oracle installation. With SAMPLE, IBM makes it easy both for DBAs who are new to DB2 and developers who want to experiment with DB2. You'll find easy-to-follow steps in the installation manual-even instructions on how to get started writing your own Java or Call Level Interface/Open Database Connectivity (CLI/ODBC) program. ->

Karen Watterson is an independent San Diego, CA-based writer and consultant specializing in client/server and data warehousing issues. She writes monthly columns for Windows NT Magazine and DM Review, is editor of Pinnacle Publishing's Visual Basic Developer and SQL Server Professional newsletters, and has written two books for Addison-Wesley: Visual Basic Database Programming and Client/Server Technology for Managers. Email: 1119390@mcimail.com.



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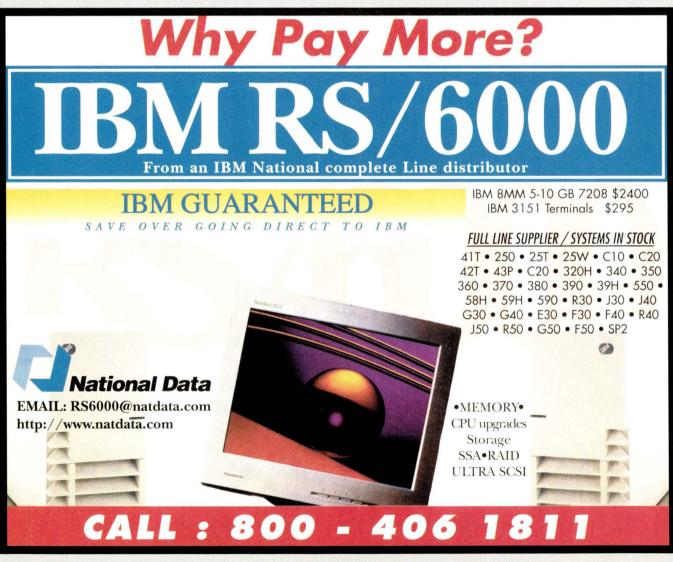
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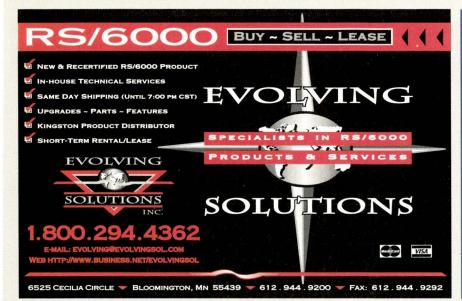


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## RS/Magazine **MARKETPLACE**



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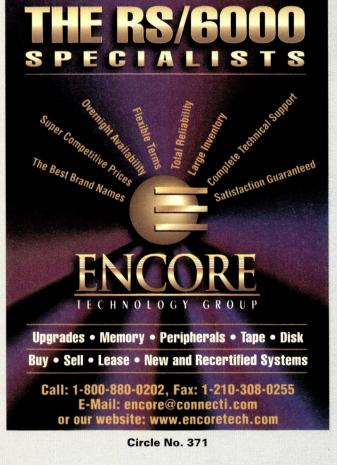
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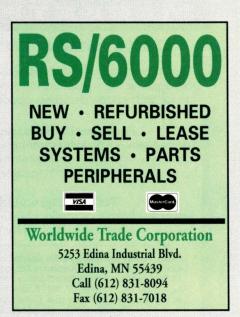
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Circle No. 352

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.

NEW PRODUCTS

#### Box Accelerates Veritas File System

Sites running Veritas Software Corp.'s Veritas File System and Volume Manager may want to consider MegaRam-VA, a Veritas accelerator from Imperial Technology, which is said to improve the software NFS-RAID throughput by 2



to 1. Imperial suggests that large database environments are good candidates for the new MegaRam-VA technology because they have fast I/O throughput requirements.

The MegaRam-VA uses solid-state disk technology to improve system performance. The company says access time for the MegaRam-VA is 0.035 msec, or about 3,000 times faster than conventional disk technology. MegaRam-VA also offers a 20-MB/s sustained data transfer rate.

MegaRam-VA appears to the host to be just another SCSI disk. A built-in data retention system ensures that no data is lost due to power outages.

The product ships in six models. Prices range from \$6,250 to \$9,750.

Imperial Technology Inc. 2305 Utah Ave. El Segundo, CA 90245 http://www.imperialtech.com Circle 101

#### **EIS Offers Ultra AX Clone**

EIS Computers, a provider of low-cost UNIX workstations, has come up with an offering built around Sun Microsystems Inc.'s Ultra AX motherboard. This new platform, named Fusion, is a step up from EIS' Dual Pentium Pro chassis. The company is positioning Fusion as a midrange SPARC workstation and departmental server with flexible configuration options.

One sample configuration includes an Ultra I CPU running at 170 MHz with 512 KB of cache and 64 MB of DRAM. It is packaged in a rack-mount chassis and offers an Enhanced Integrated Drive Electronics (EIDE) interface, 12X CD-ROM. A 2.5-GB hard drive comes standard as well as a 1.44-MB floppy, PS/2 keyboard and PS/2 three-button mouse. The monitor is a ViewSonic V17GS with 1,280 by 1,024 at 66-Hz resolution. This model also includes a 2-MB Enhanced Data Out (EDO) DRAM PCI video card.

### Automated Tape Libraries Triple Capacity

**S**pectra Logic has released the Spectra 5000 family of automated tape libraries. Based on new 4mm DDS-3 tape drives, the Spectra 5000 series delivers double the data transfer rate and triple the data capacity of previous 4mm DDS-2-based tape libraries, Spectra says. The new libraries offer up to 1.4 TB of compressed data at aggregate transfer rates of up to 34.6 GB/hour.

An entry-level, single-drive, 20-tape cartridge model is being offered, which boasts 240-GB

(480-GB compressed) capacity and a 4.3-GB/hour (10.75-GB compressed) transfer rate. If required, users can install up to three more drives to increase data transfer to 17.2-GB/hour (43-GB compressed). Customers can upgrade to 40 cartridges for 480-GB (1.2-TB compressed) capacity or a maximum of 60 cartridges for 720-GB (1.8-TB compressed) capacity.

The Spectra 5000 tape libraries feature a Windows-

like graphical user interface and use a touch-screen design. Functions include cartridge entry/exit port password security, drive and library condition status and a queued unload feature that simplifies off-line media vaulting and archiving. An optional bar code reader is offered for cartridge inventory and management functions. The new 4mm DDS-3 drive technology offers a 200,000 mean time between failure rate at a 20% duty cycle. The 5000 series is said to support many industry backup

and hierarchical storage management packages.

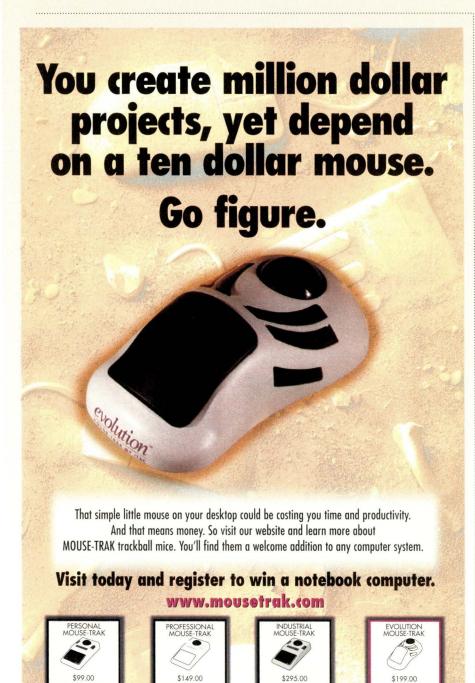
Prices range from \$8,550 to \$30,420, depending on the number of drives, cartridges and other options. **Spectra Logic Corp.** 1700 N. 55th St. Boulder, CO 80301 http://www.spectralogic.com **Circle 100** 

## **New Products**

The price for such a configuration is \$6,599. Tower and desktop versions are also available.

Fusion will run any software application compatible with a Sun workstation, including all Netscape Communications Corp. servers. EIS integrates a wide variety of Internet and intranet software products, including storefront, security, credit card payment and high-performance Web and database servers onto Fusion servers to develop turnkey Web commerce solutions for customers.

Other supported peripheral options include a Sun UltraSPARC II CPU, 250-MHz, 1-MB cache plug-in replacement card, Sun Creator Graphics 2D or 3D video accelerators and a PCI Fast/ Wide Ultra SCSI host adapter. Contact EIS for pricing and availability.



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Circle No. 27

#### **EIS Computers Inc.**

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

#### SPARCalike Web Servers Unwrapped

Ross Technology, maker of the hyper-SPARC microprocessor and Solaris-compatible systems, has announced two highperformance Web servers. These systems are designed as cost-effective alternatives to Sun's Netra i family of Web servers, the company says.

The hyperSTATION Web Server systems, in either 200-MHz or 125-MHz configurations, come fully equipped with Netscape Communications Corp. Suite-Spot, for full Internet functionality. SuiteSpot includes Netscape's Enterprise Server, Catalog Server, Proxy Server, Mail Server and News Server.

The 200-MHz hyperSTATION RTHS30-WEB is configured with 256 MB of RAM, a 7,200-RPM 4-GB disk drive, a 7,200-RPM 2-GB OS/application drive, 100BaseT Ethernet, 6X CD-ROM and Solaris 2.5. The 125-MHz hyper-STATION RTHS20-WEB has 64 MB of RAM, a 7,200-RPM 2-GB disk drive, 10BaseT Ethernet, 6X CD-ROM and Solaris 2.5. Pricing for RTHS30-WEB and RTHS20-WEB is \$23,950 and \$14,650, respectively.

Ross Technology Inc. 5316 Hwy. 290 West Austin, TX 78735 http://www.ross.com Circle 103

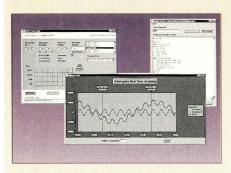
#### Applets Can Process Analog-to-Digital Data

A new Java-based toolkit called the NetAcquire Java Toolkit from Real Time Integration reportedly enables Java applets to acquire, process and update real-time analog and digital data over an Ethernet network. The Java applets, the company says, rely on a TCP/IP network to communicate with the NetAcquire server, which contains analog-to-digital conversion hardware.

The NetAcquire toolkit contains a package of Java classes that provides stream-based communications with the

104

## **New Products**



NetAcquire server hardware. The classes are responsible for handling all low-level details of network I/O, flow control and error handling. Sample applications are also included, featuring real-time charting, industrial process control, laboratory monitoring, distributed test and measurement and real-time simulation.

The NetAcquire server hardware runs an optimized real-time operating system with an onboard Intel Corp. 486 processor. Sensor inputs include voltage, current, digital signal and contacts; and control outputs include waveform, pulse and levels. The NetAcquire server also includes a Web server, allowing developers to upload their Java byte code, making the applets available to the entire organization.

Applets written with the NetAcquire Java Toolkit run on any Java-enabled browser, and the toolkit is compatible with JavaSoft's Java Developer's Kit 1.0.2. The NetAcquire control hardware is priced at \$5,495, and the Java Toolkit costs \$495.

**Real Time Integration Inc.** 10900 N.E. 8th St., Ste. 900 Bellevue, WA 98004 http://www.realtimeint.com Circle 104

#### **XEDIT Emulator for UNIX** Introduced

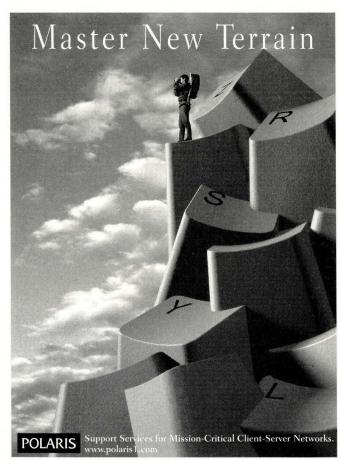
Treehouse Software has unveiled SEDIT, a UNIX editor that emulates mainframe XEDIT and PDF editors.

SEDIT provides both character- and GUI-based editing modes. According to the company, it also provides many features not found in XEDIT/PDF, such as cut/copy/paste, unlimited undo, copy/move of rectangular blocks of text, search and replace of FORTRAN or C variables, interaction with compilers and more. SEDIT also includes an FLIST-like utility that simplifies the browsing of UNIX directories.

Also unveiled by Treehouse is S/REXX, a UNIX macro language that emulates the IBM mainframe REXX language. S/REXX can be used to create macros for SEDIT, perform systems administration functions and even develop applications, the company says. S/REXX supports programs of virtually unlimited size, containing any number of nested parentheses, variables and so on.

S/REXX supports Motif or OpenLook dialog boxes, with buttons, toggles, input zones and so on. S/REXX also interacts with C programs and UNIX system commands. The software is available for IBM AIX, HP-UX, SunOS and Solaris, Silicon Graphics IRIX and other UNIX flavors.

Also available is the S/REXX Debugger, a GUI-based debugging environment for the S/REXX macro language. The



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## **New Products**

S/REXX Debugger reportedly allows the user to step through the execution of S/ REXX programs, locating and fixing bugs.

SEDIT with a fixed CPU-specific license costs \$600; a floating license costs \$660. A fixed-license S/REXX costs \$600, and a floating license costs \$660. An S/REXX Debugger fixed license costs \$300; \$330 for a floating license.

Treehouse Software Inc. 409 Broad St., Ste. 140 Sewickley, PA 15143 http://www.treehouse.com Circle 105

#### ORB Features CORBA Security Services

A new Object Request Broker (ORB) from ICL, the DAIS ORB, is said to be the first of its kind to offer Common Object Request Broker Architecture (CORBA) security services, as specified by the Object Management Group (OMG). OMG hopes the inclusion of a security framework in the CORBA architecture will result in its widespread acceptance in business environments.

CORBA security services are said to equip the DAIS ORB with the following functionality: user authentication, access control, security associations (e.g., exchanging of credentials), message protection, automatic auditing of user actions, and security and policy administration.

DAIS ORB runs on more than 30 platforms, including Solaris, AIX, HP-UX, Windows NT and 95, as well as VMS and OS/2. Support for development languages includes C, C++, Visual C++, Visual Basic, Java, COBOL and OLE. DAIS ORB is compliant with other CORBA-compliant ORBs.

DAIS ORB costs \$2,995, and CORBA security services cost \$150 per user.

ICL Inc.

11490 Commerce Park Drive Reston, VA 20191 http://www.icl.com Circle 106

#### ODBC Driver Unlocks Nonnormalized Files

Basis International has announced Release 1.1 of its ODBC (Open Database Connectivity) Driver, which is said to allow business software developers to access legacy data without having to normalize files. The driver lets users unlock Business Basic data files created using Basis' BBX programming language, the company says. BBX is a multiuser, multitasking version of Business Basic, released in 1985, that runs on several UNIX flavors, including AIX and SCO, and Windows and DOS operating systems.

Release 1.1 of the 32-bit ODBC Driver can read and write both nonnormalized and normalized data files. Legacy data is commonly nonnormalized, thus fields may have subfields, data may be aligned on half-byte boundaries and more than one type of record may exist in the same file. With the ODBC Driver, Basis says, any application can access nonnormalized Business Basic files. Without the driver, legacy data would have to be converted to a normalized format. The ODBC Driver also provides international character set translation, time stamps and support for shared drives.

License fees cost \$150 per copy; volume discounts are available.

Basis International Ltd. 5901 Jefferson St. N.E. Albuquerque, NM 87109 http://www.basis.com Circle 107

#### All-in-One SCSI Converter, Extender, Isolator

Atto has introduced SCSI Sidekick, an OS-independent SCSI signal converter, SCSI bus extender and bus isolator. Sidekick is said to enable administrators to combine single-ended and differential SCSI devices, triple SCSI cable lengths and remove a single SCSI device without taking down the entire system.

Sidekick converts the SCSI signal from the host adapter, enabling communication between single-ended and differential SCSI devices on the same SCSI bus. This way, users are said to benefit from noise reduction and extended cabling found in



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differential SCSI devices, while working with low-cost, single-ended products.

Sidekick also addresses the cabling limitations of Ultra SCSI, Atto says, by "repeating" incoming SCSI signals before sending them to their target device. Meanwhile, Sidekick protects itself against heavy bus operations with a 1.5A fuse.

SCSI Sidekick is equipped with a number of features to make integration easy, the company says. For example, a male connector allows a direct connection with another device, and a dual connector enables multiple configurations. Other features include dual porting, built-in auto-termination circuitry, a choice of form factors  $(3^{1}/_{2}-$  and  $5^{1}/_{4}-$ inch) and bidirectional operation.

The Atto SCSI Sidekick is available for a suggested retail price of \$295.

Atto Technology Inc. Audubon Technology Park 40 Hazelwood Drive, Bldg. 106 Amherst, NY 14228 http://www.attotech.com Circle 108

### Java Development Platform Builds Agents

ObjectSpace has announced Voyager, a Java development platform for building agent-enhanced distributed Java systems. Available as shareware downloadable from the ObjectSpace Web site, Voyager lets Java developers create network applications for desktop computers and embedded consumer devices. The system borrows concepts from Object Request Brokers (ORBs) and integrates them with Java and agent technology.

Voyager is said to be able to remotely construct and communicate with any Java class, including third-party libraries, without source code, and can construct objects remotely using regular Java construction syntax. It can remotely execute static methods and automatically rethrow remote exceptions to the caller. It passes and returns serialized objects by value.

The Voyager system takes up only 70 KB when stored in a compressed .jar

file (150 KB uncompressed), and requires JavaSoft's Java Developer's Kit 1.1.

ObjectSpace Inc. 14881 Quorum Drive Ste. 400 Dallas, TX 75240 http://www.objectspace.com Circle 109

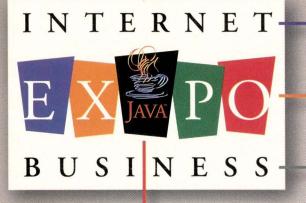
#### **Corel Ships WordPerfect 7**

Corel has shipped Corel WordPerfect for UNIX, a word processing package that offers drawing and charting capabilities. The suite of products supports text editing, spreadsheet creation and direct import of database information. Corel WordPerfect for UNIX is available for both character terminals and X Window systems and is available in English only.

Corel WordPerfect Suite 7 for UNIX supports a variety of UNIX operating systems, including IBM AIX 4.1.4, HP-UX 10.01, SunOS 4.1.3 and Solaris 2.5. The Windows version of WordPerfect is now up to Version 8.0.







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New features include 130 fonts, 5,400 quick-art/4,500 clip-art images, 200 photos, 187 textures and 28 ExpressDocs documents. New features tailored for the X Window System are said to include Internet Publisher, QuickCorrect, Make It Fit, a customizable interface, Spell-As-You-Go, unlimited undo/redo, page numbering x of y, database import of Oracle, file compatibility with DOS and Windows, and a remote window to other X terminals.

Corel WordPerfect 7 for the X Window System requires 9 MB of memory for the first user, 2.5 MB memory for each additional user and 43 to 104 MB of hard disk space, depending on platform and install options. Corel Word-Perfect 7 for character terminals requires 2 MB of memory for the first user, 1.5 MB of memory for each additional user, and 31 to 40 MB of hard disk space, depending on platform and install options.

Corel WordPerfect 7 for UNIX has a list price of \$495, with upgrades available for \$249.

Corel Corp. 1600 Carling Ave. Ottawa, Ontario Canada K1Z 8R7 http://www.corel.com Circle 110

#### Automate Problem Diagnosis

System Management ARTS has announced InCharge Event Correlator, a software product designed to identify the root cause of network, system and application problems. InCharge is based on the company's patented Codebook Correlation and Diagnostic Modeling technologies. Target users of InCharge include network and system managers who require high levels of system availability, the company says.

InCharge reportedly diagnoses problems by analyzing network, system and application data. Codebook Correlation relies on the fact that every problem causes particular symptoms in the networked system as a whole, often propagating far from the original faulty component, the company says. These symptomatic events create a unique "code." Diagnostic Modeling recognizes that each element has



characteristic problems. Thus, InCharge relies on Codebook Correlation to do a fast comparison of monitored data and events with problem codes, the company says. And because codes contain redundant symptoms, lost events and false alarms do not affect the accuracy of the result.

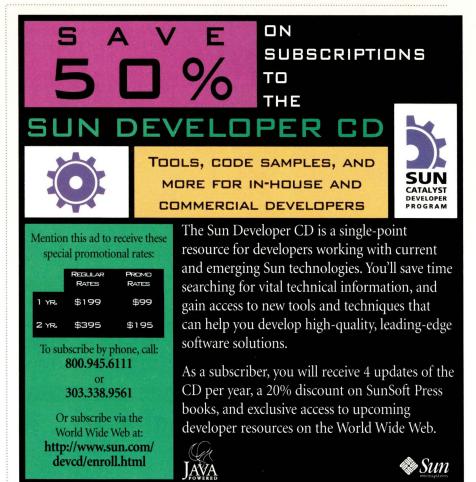
InCharge cross-correlates network, system and application data and events; automatically generates correlation rules and updates them when the topology changes; tolerates lost and false alarms; provides SNMP, CORBA and proprietary data and event sources support; and has a Java-based GUI, the company says. InCharge Event Correlator is available for Solaris and will be available on HP-UX and Windows NT later this year. Pricing starts at \$25,000.

System Management ARTS Inc. 14 Mamaroneck Ave. White Plains, NY 10601 http://www.smarts.com Circle 111

#### Event Correlator UPS with Power-Saving Features

A line of uninterruptible power supplies (UPSs) from Exide Electronics Group are said to be the smallest rackmount units available at their power level.

Called the NetUPS SE line (also marketed by Exide's subsidiary, Deltec Electronics, under the PowerRite Pro II moniker), the UPSs occupy  $3^{1}/_{2}$  inches of rack space in the 1000VA and 1500VA units and less than  $5^{1}/_{2}$  inches in the 2000VA and 3000VA units. All four devices are bundled with LanSafe III power management software and feature hot-swappable batteries and



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network/modem surge protection. When used with Exide Electronics' PowerPlexer cards, the devices can support multiple operating systems and network protocols simultaneously.

The units are also equipped with the company's Advanced Battery Management (ABM) and buck and double-boost voltage regulation to help battery service last longer. ABM technology warns users 60 days in advance of pending battery failure. It also has a load-shedding feature that controls individual power receptacles on the back of the UPS and schedules the less critical devices to shut down first upon a power failure, the company says.

The NetUPS SE and the PowerRite Pro II are protected by a 10-year prorated warranty. Pricing starts at \$699 for cabinet units, and at \$829 for rack-mount units.

Exide Electronics Group Inc. 8609 Six Forks Road Raleigh, NC 27615 http://www.exide.com/exide Circle 112

#### Ultra Enterprise Server Training Offered

Polaris, a company that provides professional services for mission-critical client/server networks, has announced the addition of Ultra Enterprise Server Education to its curriculum.

The courseware is designed to give students the skills they need to master installation, configuration and maintenance of the Ultra Enterprise Server line. Students are trained using the Ultra's 64-bit Ultra-SPARC processor technology, enhanced memory and bandwidth capabilities, Solstice SyMONr monitoring features and other server capabilities, Polaris says. The course trains students to configure a system; configure and interpret Power On Self Test results; and troubleshoot and repair a faulty system to the field replaceable unit (FRU). These and other topics are taught in a program that emphasizes personalized attention and the real skills

students need for their everyday work environments, the company says.

Ultra Enterprise Server Education is available at Polaris locations in Massachusetts, The Netherlands and at customer sites. The course costs \$3,500 and lasts four to five days. An additional training course for Ultra 1 and 2 users can be taken after the server course.

**Polaris Service Inc.** 

257 Cedar Hill St. Marlboro, MA 01752 http://www.polaris1.com Circle 113

#### Schedule Manager for Data Warehouses

Prism Solutions has announced Prism Schedule Manager, a software package that automates data warehouse production planning, and scheduling and managing the transport of information from operational sources into a data warehouse.

Designed to simplify the data warehouse planning process, Prism says, the software lets users graphically construct a plan or schedule that defines execution parameters for each step in the production process. Once assigned, all job control language, scripts, programs and scheduling information is uploaded in a single step from the user interface to the sources and targets. The software can also capture metadata from the operations process, which can then be used to audit changes to warehouse schedules, plan future warehouse versions, conduct failure analysis, identify resource load demands, tune warehouse performance and communicate the time that jobs were run and specific tables affected, Prism says.

Integrated with the Prism Warehouse Executive, which automates the design and construction of a data warehouse, Prism Schedule Manager consists of four components:

• Application Services–Administration, planning and monitoring facilities for Windows NT or 95 development seats.

• Sentinels–Components for UNIX or NT platforms that act as communications vehicles between sources and targets and the Windows-based user interface.

• Integrator for CA-7–An optional component that allows production schedules created with the Prism Schedule Manager user interface to be uploaded to the mainframe and controlled by CA-7.

• Developer Toolkit–Users can integrate the Prism software with other schedulers by writing interpreters to map command sets of the two packages.

The Prism Schedule Manager carries a \$7,500 license fee, which includes the Application Services and two Sentinels. Additional Sentinels cost \$1,000 each. The CA-7 Integrator costs \$10,000.

Prism Solutions Inc. 1000 Hamlin Court Sunnyvale, CA 94089 http://www.prismsolutions.com Circle 114

#### Gigabit Ethernet Switches Unveiled

Acacia Networks has added Gigabit Ethernet to its NovaSwitch family of high-bandwidth, stackable and programmable 10/100/1000 LAN switches. The NovaSwitch 10000gx Gigabit Ethernet switch and the GigaLink 1000 Gigabit Ethernet module are both stackable and designed for high-speed connections to servers and the LAN backbone.

The 10000gx reportedly provides 10 switched, autosending 10/100-Mb/s ports plus one 1000Base-SX Gigabit Ethernet port. Four 10000gx switches can be stacked to support up to 38 10/100-Mb/s ports, and up to four Gigabit Ethernet ports, Acacia says.

The GigaLink 1000 Gigabit Ethernet module is IEEE 802.3z-compatible and costs \$2,995. This module is said to support short wavelength fiber optics for up to 300 meters of 62.5/125-micron multimode fiber (or 550 meters of 50/125-micron fiber).

The NovaSwitch 10000gx includes 10 10/100 ports and one GigaLink port for \$7,945.

Acacia Networks Inc. 650 Suffolk St. Lowell, MA 01854 http://www.acacianet.com Circle 115

#### Web-Ready Windows-to-UNIX Software Out

The Santa Cruz Operation (SCO) has introduced SCO Vision97, an Internetready version of its Windows-to-UNIX integration product. SCO Vision97 includes SCO XVision Eclipse, SCO

VisionFS, SCO SQL-Retriever, SCO TermVision and SCO SuperVision.

SCO Vision97 is installed and managed from a central UNIX server. This reduces the time and resources required to support and manage Windows users who need access to UNIX applications and services, the company says. Configuration changes, and the distribution of software to individual Windows PCs can be accomplished without the PC being connected to the network, and occurs when the user reconnects, SCO says.

SCO Vision97 includes Internet integration features such as Internet Workgroups, Windows Internet Naming System (WINS), encrypted passwords, ActiveX and JavaScript support.

SCO Vision97 costs \$395 for a single-user license or \$14,750 (\$295 per user) for a 50-user license. All SCO Vision97 products run on SunOS and Solaris, AIX, HP-UX, Digital UNIX, SCO UnixWare, Open Server and Open Desktop Release 3, DG-UX, Dynix and SINIX. The Santa Cruz Operation Inc. 400 Encinal St. P.O. Box 1900 Santa Cruz, CA 95061 http://www.sco.com Circle 116

#### Maxoptix Ships 22-GB MO Library

Maxoptix has announced its MX335 magneto-optical (MO) library. This product is an expansion of the MX family of  $5^{1}/4$ -inch jukeboxes and is targeted at



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comprehensive information tool.

Subscribe Today: email: cdware-form@sun.com http://www.sun.com/sunsoft/cdware/ fax back: (510) 372-8582 small LANs and single-user environments. The MX335 is an ISO-compliant MO library with a 22-GB capacity and offers backwards compatibility. It is based on Maxoptix's 640-MB drive, the 640s.

Compatible with any PC, Macintosh or UNIX system via standard SCSI cable, both the 640s and the MX335 are reportedly read/write compatible with ISO-standard 640-, 540-, 230- and 128-MB media.

The MX335 has a 35-disk capacity, 3-MB/s data transfer rate and an average seek time of 35 msec. Maxoptix suggests it as an extension to existing online storage. It can be used for applications such as document imaging, CAD/CAM, Internet authoring or video and sound editing. The MX335 supports all four ISO-standard 3<sup>1</sup>/<sub>2</sub>-inch MO disks and LIMDOW media. List price is \$3,995.

#### Maxoptix Corp.

3342 Gateway Blvd. Fremont, CA 94538 http://www.maxoptix.com Circle 117

#### UPX1000 PCI-Bus, UltraSPARC-Based Systems

Axil Computer has announced the availability of its UPX1000 workstation and server family of PCI-bus, Ultra-SPARC-based systems. The systems come with either a 167-MHz or a 250-MHz UltraSPARC processor and PCI I/O.

The systems' UltraSPARC processors rely on the Ultra Port Architecture (UPA) crossbar switch system bus for high-speed memory and graphics I/O. The UPX1000 is capable of digital multimedia because of the UltraSPARC's Visual Instruction Set (VIS), which uses only 3% of the processor. The VIS performs on-chip encoding and decoding of MPEG-2, Axil says.

UPX1000 comes bundled with Solaris Internet Server Operating Environment, Solstice WebScout, Sun WebServer, Sunscreen SKIP and Solstice Internet Mail Server. Pricing for the UPX1000 family starts at less than \$8,500, which includes a 167-MHz UltraSPARC processor, 12X CD-ROM, 64 MB of memory and Solaris runtime.

Axil Computer Inc. 3151 Coronado Drive Santa Clara, CA 95054 http://www.axil.com Circle 118

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## Upgrades, Enhancements, Additions...

Softway Systems has announced a major upgrade of its OpenNT UNIX operating subsystem for Windows NT. This latest release, OpenNT 2.0, adds support for socketsbased networking, X11 Windowing System, OSF/Motif development environment and extended multiuser capabilities, including a telnet server. OpenNT consists of several products: OpenNT Workstation 2.0, a single-user UNIX subsystem for Windows NT, which costs \$379; OpenNT Server 2.0, which adds a multiuser shell login to the NT Server and costs \$979 for a 25-user license; OpenNT Software Development Kit 2.0, a development kit for porting and developing UNIX character-based, network and graphical applications and costs \$199; and OpenNT, which is an implementation of the OSF Motif 1.2.4 Window Manager and Motif libraries for compiling Motif applications natively on Windows NT and costs \$99. Softway Systems Inc., 185 Berry St., Ste. 5514, San Francisco, CA 94107, http://www.softway.com. Circle 119

Visual Thought 1.3, a diagramming and flowcharting tool from Confluent used to model business processes and object-oriented software designs, adds several new features. It now runs under native Windows 95/NT, in addition to SunOS, Solaris and HP-UX. Visual Thought also includes a new image editor, which allows the editing of images contained in an object; support for more image formats (TIFF, FrameMaker MIF, GIF89a and Web imagemaps); and several usability enhancements, such as Drop & Split, Create & Connect and Delete & Connect. The package comes on a CD-ROM, and pricing starts at \$495 for a single-user license. Confluent Inc., 132 Encline Court, San Francisco, CA 94127, http://www.confluent.com. Circle 120

Version 3.0 of On-Line! Detective for Sun Servers, an online tool for diagnosing and repairing hardware-related problems in Sun systems, has been announced by SoftTech Solutions. SoftTech claims the program's fullcolor photographs and diagnostic flowcharts can substantially reduce the time it takes to troubleshoot a hardware problem. This latest version features hypertext information on all Sun part numbers, and new support for disk drives, SBus boards and SPARC Storage Arrays, as well as guidelines for mixing SCSI technology with SPARCservers 1000, 2000, Ultra Enterprise 3000 and Disk Arrays. The product comes on either a UNIX- or PC-compatible CD-ROM for a onetime price of \$1,995, plus a \$495 yearly subscription fee, which entitles licensees to three updates a year. SoftTech Solutions, 3525 Elizabeth Lake Road, Ste. A, Waterford, MI 48328, http://www. stsolutions.com. Circle 121

➤ Black & White Software has released Version 2.0 of DB/Enable, a software development kit that consists of a set of CORBA-based adapters for encapsulating relational databases as object-based servers. With this version, DB/Enable offers a C++ interpreter, used to test code on the fly; a three-tier architecture based on CORBA IIOP; optimized connections across multiple dissimilar databases; and the ability to store relational database queries such as dynamic SQL and stored procedures as reusable objects. DB/Enable also includes a "convenience library" of encapsulated user interface classes, said to ease the process of porting applications to Motif, Windows or Java. Add-on tools such as the XRT family of widgets and Web/Enable for Java are also available through DB/Enable's Full Integration Manager. DB/Enable runs on Solaris 2.x and HP-UX 10, on top of the company's UIM/Orbix development tool, or Iona Technologies Ltd.'s Orbix Object Request Broker. It costs \$3,000. **Black & White Software Inc.,** 1901 S. Bascom Ave., Ste. 700, Campbell, CA 95008, http://www.blackwhite. com. Circle 122

A new econometrics module is now available for Leading Market Technologies' Expo product, an analytics package for the financial community. The Expo/Econometrics module is said to be the first package to offer a full suite of econometric tests, model estimation and forecasting techniques to traders working with real-time financial data. Tests include ARCH, rolling regression, multivariate regression, seasonal adjustment with moving averages, post-regression residual tests and multicollinearity testing. Expo/Econometrics costs \$3,995 and is available for SunOS, Solaris, HP-UX, AIX, Digital UNIX and Windows NT/95. Leading Market Technologies Inc., One Kendall Square, Cambridge, MA 02139, http:// www.lmt-expo.com. Circle 123

Legato Systems has announced the latest release of its popular storage management suite, NetWorker 5.0 for UNIX. The focus of the new release is on easing the administration of distributed, heterogeneous clients, Legato says. NetWorker 5.0 also benefits from a large language localization effort; the concept of Saveset Staging and Disk File as supported devices; prioritized client backup; and detailed disaster recovery manual generation. NetWorker 5.0 for UNIX is available for Solaris, AIX and HP-UX and costs \$3,000. Legato Systems Inc., 3210 Porter Drive, Palo Alto, CA 94304, http://www.legato.com. Circle 124

SCH Robot Version 6.0, from SCH Technologies, now supports robotic tape libraries from Emass Inc., allowing customers to back up data to a wider range of tape media formats through SCH's Reelbackup and Reellibrarian backup software packages, the company says. SCH Robot has been integrated with Emass' AML/2, AML/E, AML/J and AML/S libraries, which support tape sizes such as 4mm, 8mm, DLT, Sony DTF and IBM Magstar. This integration allows customers to use state-of-the-art backup software without having to reinvest in contemporary tape media technology, the company says. SCH Robot runs on most UNIX systems and is available as part of the Reelbackup system, which starts at \$1,000. SCH Technologies Inc., 895 Central Ave., Cincinnati, OH 452022, http://www. sch.com. Circle 125



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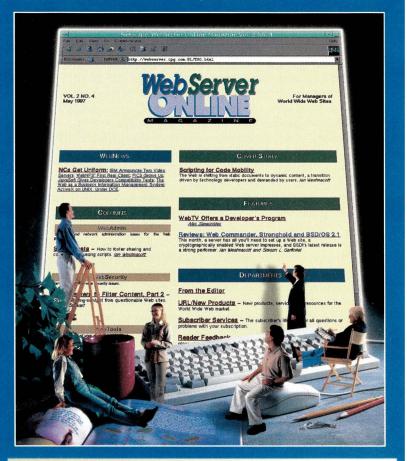
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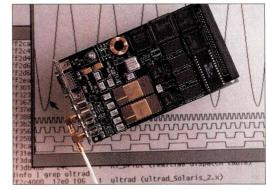
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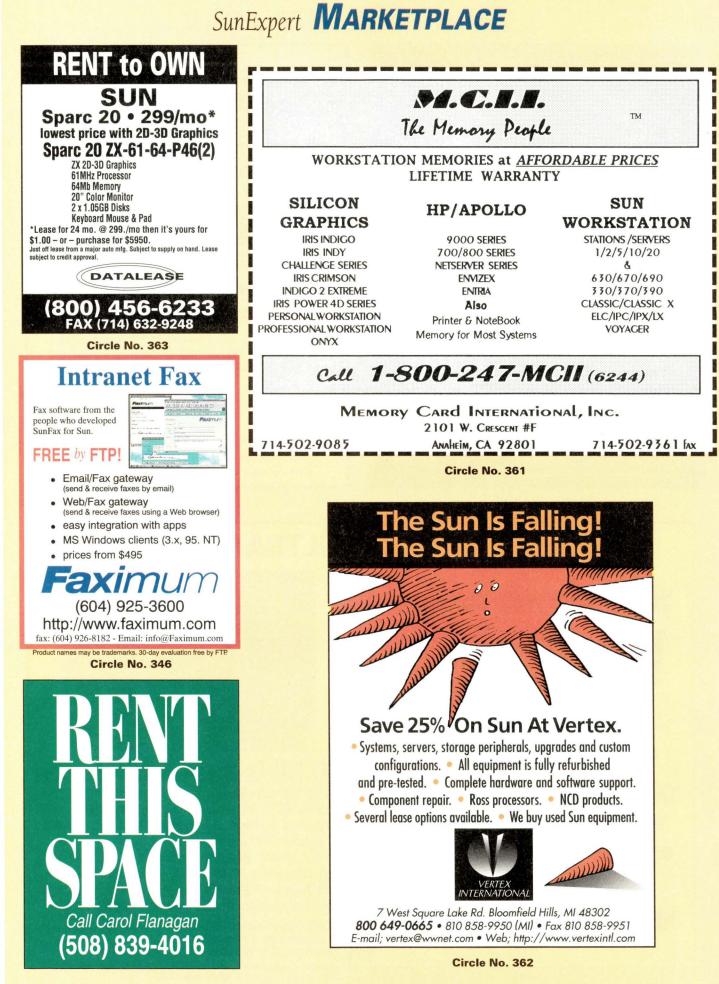
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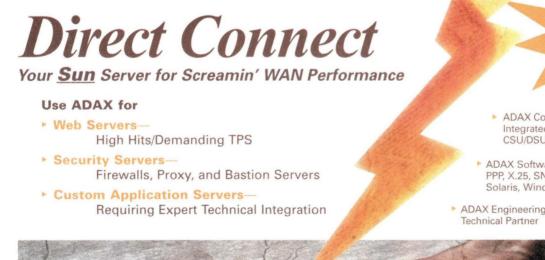
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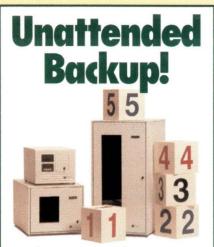
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