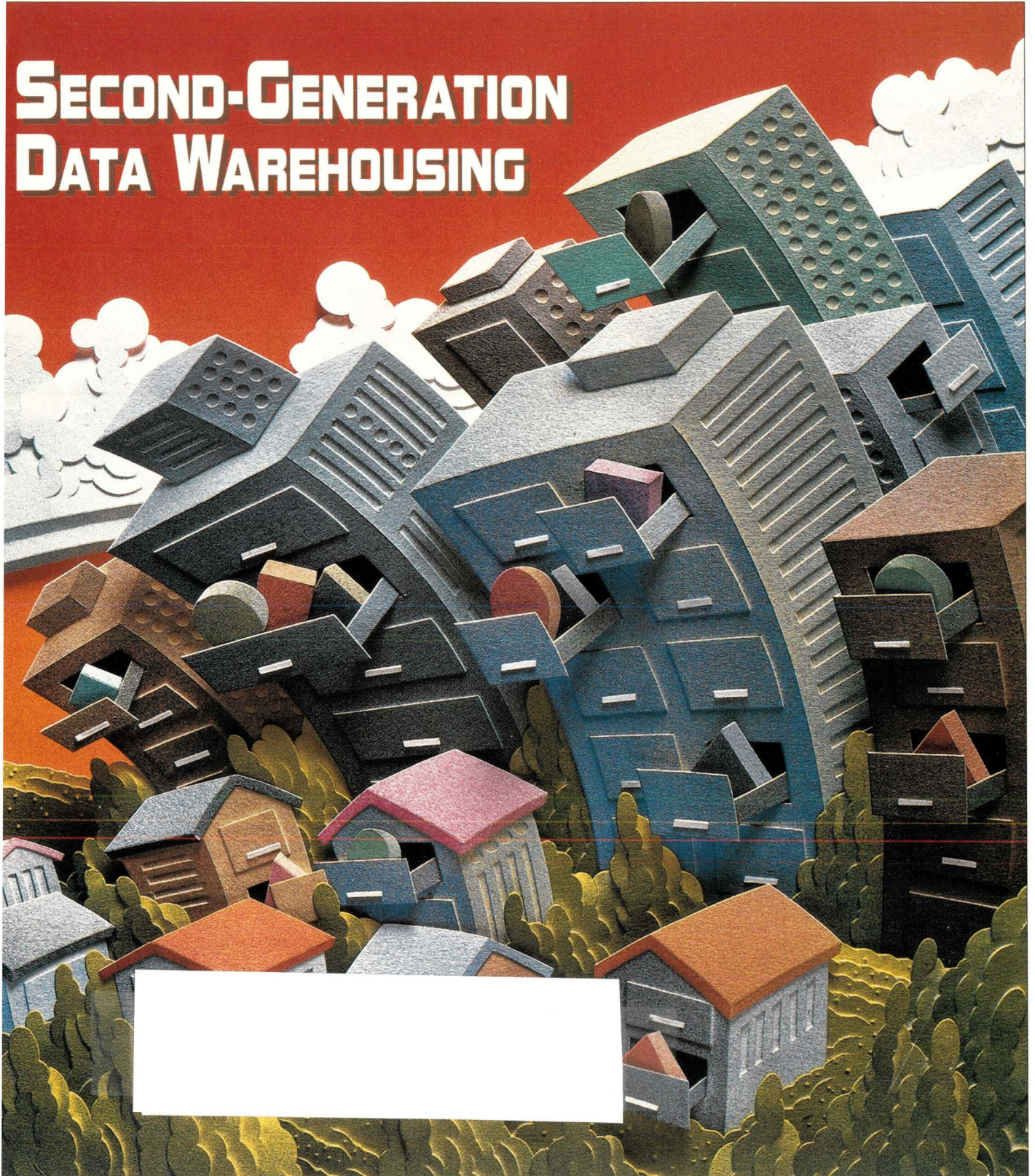


SUNEXPERT

OCTOBER 1998
Vol. 9 No. 10 \$5.50

The Server/Workstation Magazine

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Reviews: PCI SPARCs

UNIX Basics: Perl Primer

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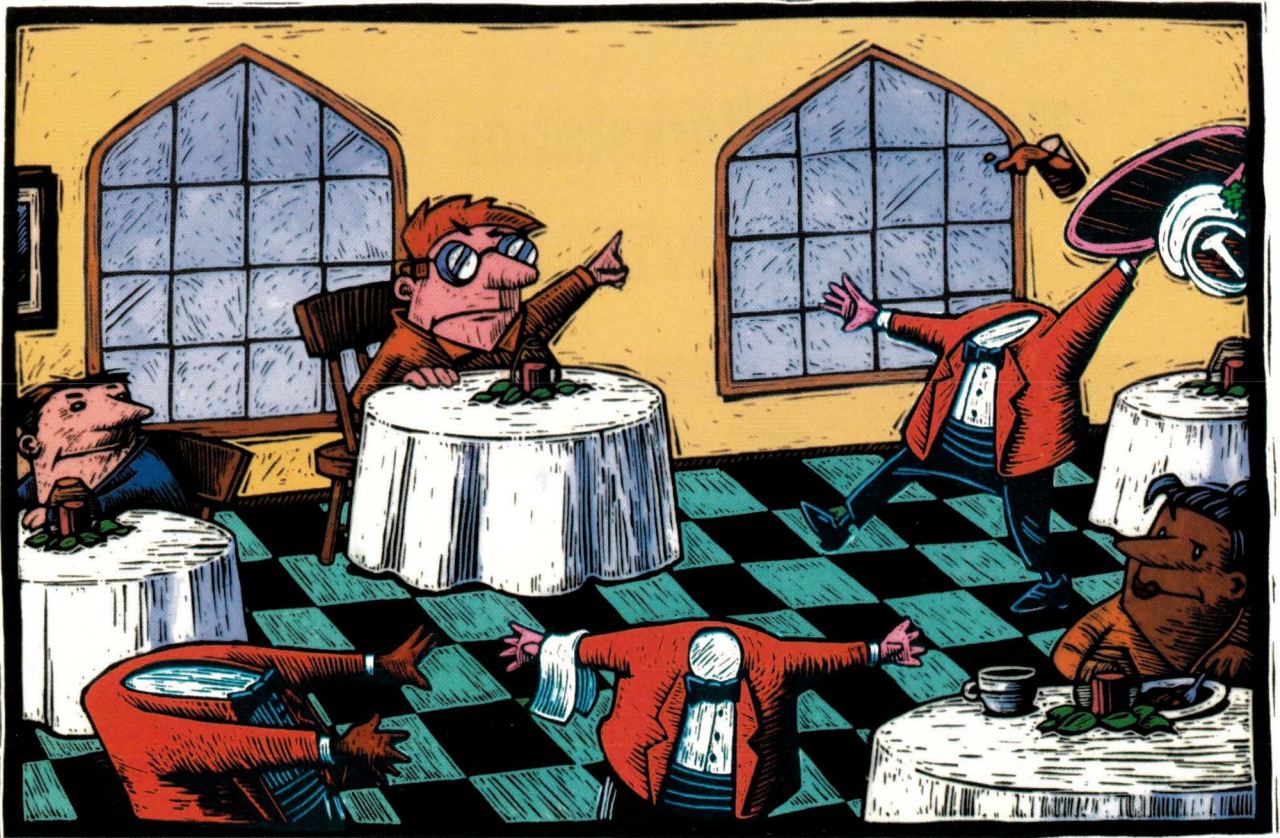


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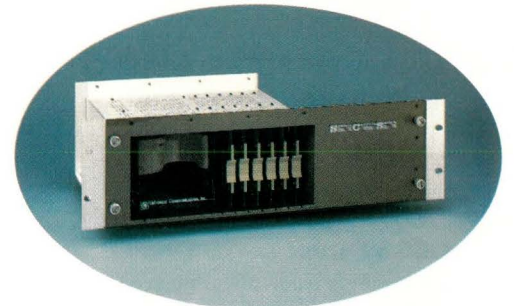
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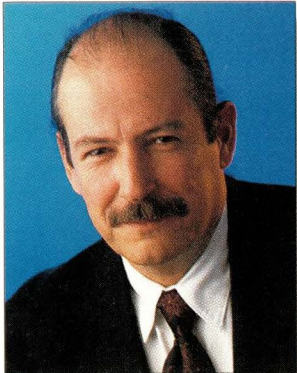
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EDITORIAL

dpryor@cpg.com



Movement

Nine years and counting. Next month, *SunExpert* will begin its 10th year as the best hands-on magazine about server/workstation computing. During this time, we have seen dramatic and exciting

changes in the Sun landscape. Why am I waxing nostalgic? Because we are about to leave our digs and strike out for a new home. For the second time in our history, we've outgrown our offices. We will be writing our stories, editing our copy, reviewing products and serving up our Web pages from a new location. After October 20, our mailing address will be

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Please use this address if you want to send us a note about anything in this or future issues. We're always ready to hear good or bad news about what we do. Out of these shiny, new headquarters, we will continue—maybe for another 10 years—to be Sun-watchers as well as commentators on the server/workstation business.

One indication of how much the UNIX server/workstation market has changed is the subject of this month's cover story by Karen Watterson, "Second-Generation Data Warehouses," Page 58. In 1989, had we even heard of data marts, warehouses and OLAP as we trekked to our Usenix conferences? Now, shows and conferences devoted to these topics attract more attendees and participants than those early UNIX gatherings. According to Karen, DCI's April conference in San Francisco and July show in New York City attracted more than 5,000 attendees each. (DCI, Andover, MA, specializes in high-technology education, trade shows and management consulting.) And these people are buying a lot of hardware and software. Research firm International Data Corp. (IDC), Framingham, MA, predicts U.S. firms will spend \$24 billion on data warehousing by 2001. Karen suggests that if you combine that with the money being spent on enterprise resource planning and management—which Boston, MA-based AMR Research Inc. expects to be as much as \$52 billion by 2002—you'll understand why data warehousing specialists are coming out of the woodwork.

Now that's a big change. Just think of all the data being packed away on big UNIX boxes. I wouldn't want to have to move it.

Doug Pryor

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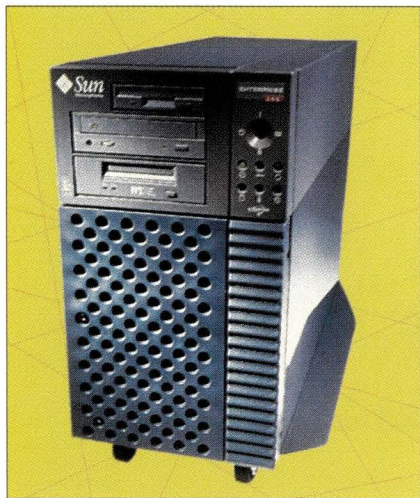
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SunExpert NEWS

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Sun Bolsters Workgroup Line

Sun Microsystems Inc. has expanded its line of workgroup servers with the introduction of the Enterprise 250. The new server is designed to run applications critical to business operations, such as databases, Web server software, groupware and enterprise resource planning (ERP) applications, and is positioned to compete directly with Intel Corp.-based Windows NT (Wintel) systems. "We are seeing more and more of these hard business [applications] being deployed on smaller servers," says Dave Douglas, director of workgroup server marketing at Sun in Burlington, MA.



At \$9,995, the Enterprise 250 is set to go head-to-head with Wintel systems and carries with it several features previously only available on Sun's high-end servers.

The Enterprise 250 is a one-to-two processor box. It comes with either one or two 250- or 300-MHz processors installed and carries several features previously only available on Sun's high-end servers, such as remote server management, integrated Web serving capabilities and rack-mount configurations. It ships with a 32x CD-ROM drive and accommodates up to 2 GB of memory, six

internal disk drives (with a maximum internal storage of 108 GB) and four PCI slots. Priced at \$9,995, industry analysts believe it can go head-to-head with Wintel systems. "[The 250] is definitely in position to compete with the Intel-based systems," says Jerry Sheridan, director and principal analyst at Dataquest Inc., San Jose, CA. "It's probably [priced] a little higher [than the Wintel systems], but then the justification is it offers additional functionality."

That is certainly Sun's position: It sees two distinct segments in the workgroup server market. One is for servers that provide file and print services at around \$3,000. "That whole area we see as being controlled by Intel and Microsoft," Douglas says.

The other is where Sun hopes machines like the 250 will succeed, running demanding enterprise applications along the lines of data marts, data warehouses, ERP and Internet applications. "Our value proposition is we offer good reliable servers with good scalability that are high performance," Douglas says.

One early customer to be sold on the machine is Jorge Herrera, systems administrator at Brown Publishing Co., a newspaper publisher based in Mason, OH. In particular, Herrera believes the machines offer a great deal of performance and potential for growth at a competitive price. "The cost is very attractive," he says. "It's priced very effectively and it's expandable."

The Enterprise 250 will be used as a data center for one of the company's 12 divisions. It will run circulation and advertising management systems. Even though Herrera says the price is competitive with other systems on the market, he doesn't think people will purchase the 250 simply for the price. "I don't think it is for people trying to save money."

Herrera says the 250 "gelled" with the demands that would be placed on the

system and the type of applications he was planning to run.

Sun's focus on the low end is a somewhat unique approach compared with UNIX vendors like IBM Corp., which also offers Windows NT-based systems. "We are much more aggressive in this market than the other [UNIX hardware] vendors," says Douglas. "HP and IBM have retreated from their UNIX offerings and generally pitch NT systems down in these price points."

There are indications that Sun's strategy is paying off. International Data Corp. (IDC), Framingham, MA, recently published a report that Sun shipped more UNIX servers in 1997 than any other vendor in the space, topping both IBM and Hewlett-Packard Co. (see "Sun Tops UNIX Server Space," September 1998, Page 8).

Furthermore, the introduction of the 250 fills out the workgroup product line. At press time, Sun's workgroup server family comprised the Ultra Enterprise 5S, 10S, the Enterprise 2, 450 and now the 250. The 250 will occupy the mid-range space between the Enterprise Ultra 5S, 10S and the Enterprise 450. "[Sun] needed to add some different models to their workgroup area," says Dataquest's Sheridan. "There was a need there for an entry-level server with some additional horsepower and the 250 satisfies that demand."—*ptc*

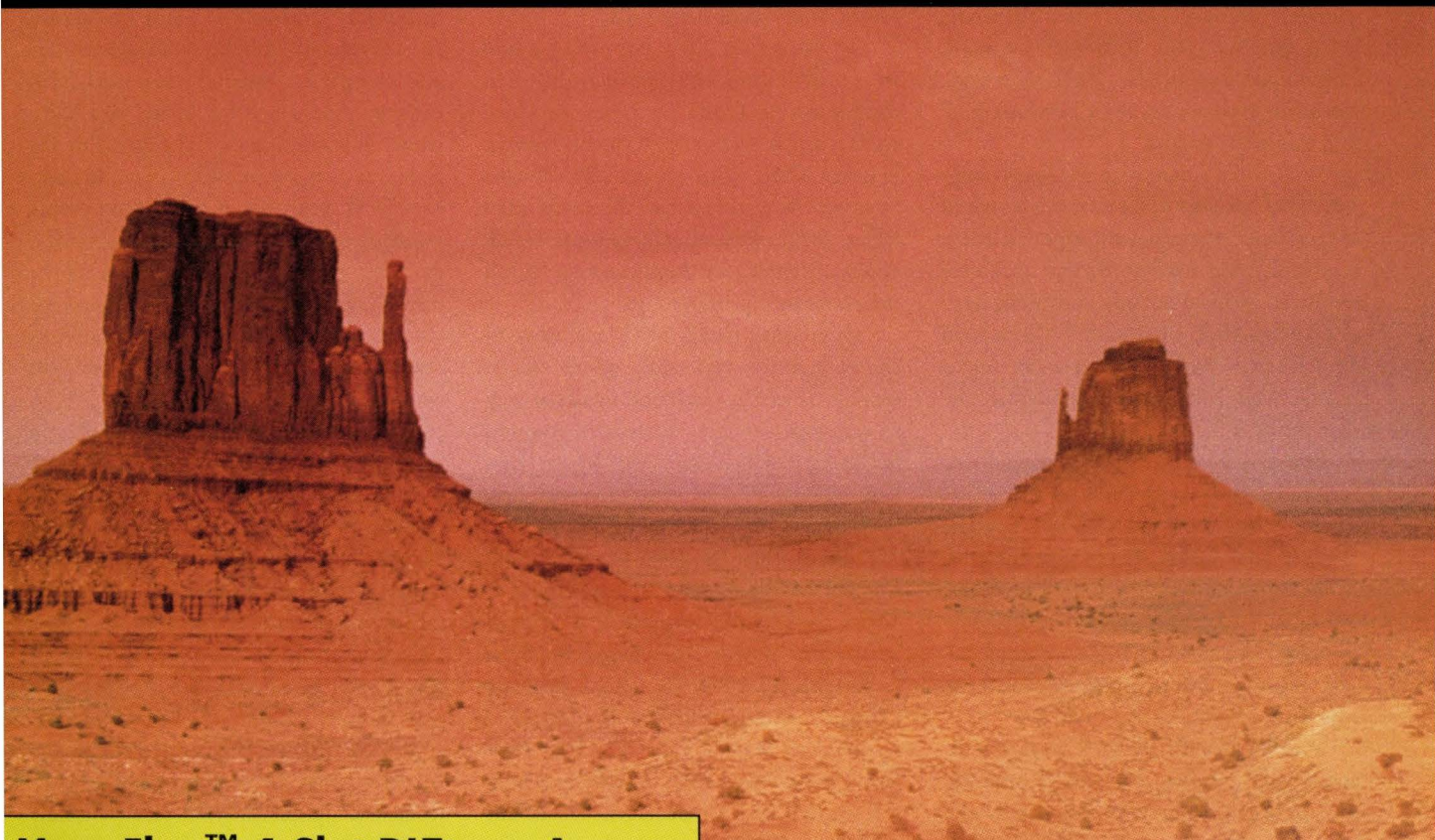
XML Inside

A flurry of announcements in August and September from vendors of eXtensible Markup Language (XML)-based products presage a busy year ahead for the nascent technology. XML, a specification formally released in February by the World Wide Web Consortium (W3C), the international organization charged with developing open standards, provides a blueprint for formatting data through the use of simple ASCII tags.

Since then, a number of companies have unveiled products supporting the

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new technology. Here's a sampling of the activity by XML proponents over the past few months: Microsoft Corp., Redmond, WA, and DataChannel Inc., Bellevue, WA, announced a jointly-developed, Java-based XML parser for interpreting XML files; Object Design Inc., Burlington, MA, released its XML Object Manager, a database development tool that enables software developers to create XML-based Web applications; Poet Software, San Mateo, CA, and Inso Corp., Boston, MA, both released new versions of their respective XML-based content management and publishing tools; and SAP AG, Walldorf, Germany, announced support for XML as a standard for exchanging data between SAP and nonSAP systems.

XML, like Hypertext Markup Language (HTML), is a subset of the Standard Generalized Markup Language (SGML), which is often used to format technical manuals, archival records and other large documents. But whereas HTML is used to define the appearance of a document on the Web, XML is used to identify the data inside it.

For instance, an XML-based form might include tags such as `<date>`, `<name>` and `<email>` to identify the various data fields. Later, information could be sorted by identifying those tags. Without such tags, it would be near-impossible to sort out those respondents, say, who own Sun computers from those who live in Sun City, AZ.

Another benefit of XML is that it is, as the name implies, extensible, meaning that users can invent new data tags at will without having to worry whether other XML applications will be able to interpret them. A new tag is simply treated as a new category of data.

Michael Goulde, vice president of the Patricia Seybold Group, a research firm based in Boston, MA, identifies three distinct, functional markets for XML technology: "The first group is the traditional users of SGML, developers of product documentation and technical manuals. The second group of people are content developers who need to make it easier for people to find information on Web sites. And the third set is those who are developing distributed applications (three-tier applications), who are frustrat-

ed with the problem of how to interchange data between applications."

While HTML has been mainly a client-side technology for presenting Web pages in browsers, XML offers benefits for both client- and server-side applications.

On the client, for example, XML-enabled browsers or GUIs can offer better querying and search capabilities for electronic commerce sites. "We're seeing a lot of interest in structuring content so you can parse it and deliver it in different ways, and search it more effectively," says Phil Costa, analyst at Giga Information Group Inc., Cambridge, MA.

On the server, XML is proving useful as a middleware link between different data sources. Coco Jaenicke, product marketing manager for Object Design, believes XML will be especially valuable as a way to translate data from different legacy databases and applications. "XML acts as a common denominator for all data formats," Jaenicke says.

That could make XML a winner in the electronic data interchange (EDI) market, as well as in vertical markets, such as financial services, manufacturing and health care, which have large legacy databases that need to be integrated with new applications and data sources.

Case in point: St. John Health System hospital in Tulsa, OK, recently announced its decision to use an XML-based back-office system—Interchange 98 from Columbia, MD-based Sequoia Software Corp.—to manage its vast store of medical records and clinical data. The new software will reportedly enable medical personnel and administrators to do broader medical record searches over the hospital intranet. Another company, DHL Worldwide Express, a global shipping firm headquartered in Redwood City, CA, is adding XML technology from webMethods Inc., Fairfax, VA, to enable customers to pull detailed shipping information from existing, legacy databases and Web sites.

Patricia Seybold's Goulde says it's difficult to pinpoint the market potential of XML because the language has such a wide range of possible applications. Whereas HTML has been tied to just a couple of product categories—Web browsers and Web publishing tools—XML has much broader possibilities.

"Nobody's going to be 'buying' XML," says Goulde. "They're going to be buying products that, because of XML, can do a bunch of things they weren't able to do before."—*sjh*

On Time with JavaOS for Business

In April, Sun Microsystems Inc. and IBM Corp. announced a partnership to develop a new Java operating system for enterprise applications, slated for release sometime "mid 1998." And in August, in a display of timeliness rarely seen in the computer industry, Sun and IBM did just that, releasing Solaris and Windows NT versions of the JavaOS for Business software development kit and an OEM adaptation kit for hardware vendors wishing to port the JavaOS to other chips and devices. Two of the initial customers for the OEM package will be Sun's and IBM's own network computing divisions, both of which plan to have Network Computers (NCs) equipped with the new operating system available first-quarter 1999.

The new JavaOS for Business—a collection of systems software and a Java Virtual Machine, which requires approximately 8 MB of memory per client—will take its place next to Sun's existing JavaOS for Consumers and JavaOS for NCs, which will be superseded by this new operating system.

Unlike JavaOS for NCs, JavaOS for Business has more server-side functionality. Specifically, it has two new features designed to make managing a network of NCs much simpler: JavaOS Services Directory, which stores user profile information, including applications used and security information; and JavaOS Services Loader, which selectively downloads software as needed. "When you use JavaOS for NCs and you want to run an application, you have to download the entire application to your device before you can use it. What the JavaOS Services Loader does is download parts of the application as they're required," says Jim Hebert, Sun's general manager for consumer and embedded systems. JavaOS for Business also makes it possible to reconfigure an

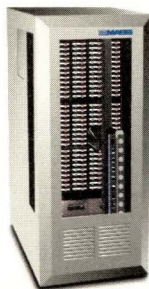
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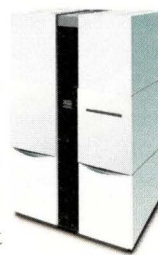


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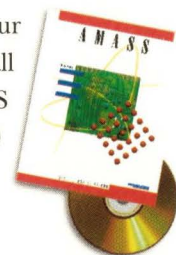


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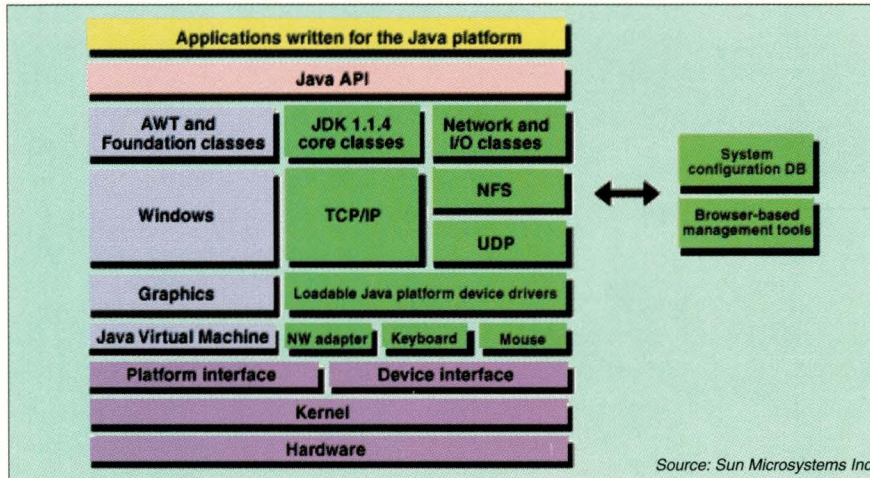


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According to Sun, JavaOS for Business operating system software represents the next step in centrally managed, thin-client computing: an operating system that takes full advantage of the power and flexibility of Java technology.

NC without having to reboot it.

But perhaps the most important feature of JavaOS for Business is the engineering and marketing support that IBM has put behind it. It's a partnership that should give more credibility to the operating system and to the NC market as a whole. Madhu Siddalingaiah, principal at consulting firm and Sun JavaStation customer, PraxisNet Inc., Alexandria, VA, believes the partnership is good news for NCs. "It shows that they're [Sun and IBM] both committed to network computing," he says.

Michael Barnes, senior analyst with the Hurwitz Group Inc., a Framingham, MA-based analyst firm specializing in strategic business applications, says IBM's more practical view of the network computing market—namely as a market for terminal replacement—is a good balance to Sun's desire to proselytize the Java platform. "It's significant that IBM is supporting it because IBM understands the value of NCs from a very practical perspective, and that's specifically terminal replacement."

Sun, however, is showing signs of adopting a more pragmatic approach toward network computing with its increasingly vertical-market focus. Sun has begun marketing its JavaStation as a solution to specific, niche-market applications, such as retail sales, reservation systems and other data-entry environments. JavaOS for Business, pitched as an operating system for transaction-oriented applications, will include support for

Sun's JavaPOS (Point of Sale) standard for retail applications. Sun and IBM are also planning to enlist manufacturers of specialized hardware peripherals, such as airline ticket printers, to develop device drivers for the JavaOS.

That kind of niche-market approach is a positive step toward getting more business customers to understand and even purchase NCs, says Tom Kucharvy, president of Summit Strategies Inc., a high-tech consulting firm based in Boston, MA. "A more vertical positioning of the product is helpful. The more application-specific they can be—in terms of the types of users that can get specific benefits from it—the better they are."

But targeting niche markets may not be enough to sell businesses on JavaOS and network computing. There needs to be off-the-shelf applications available as well. While Sun and IBM both claim there are 1,200 commercial Java applications currently on the market, most of those applications are development tools, application servers and middleware, says Evan Quinn, director of Java research for International Data Corp. (IDC) in Mountain View, CA. He estimates about two-thirds of the existing commercial Java application market, which he projects to be worth \$500 million in 1998, are infrastructure products such as application servers. While JavaOS for Business is useful in that it provides a framework for future Java NC application development, it will take time for that market to develop, says Quinn. "This is an

announcement that's a couple of years away, at least, from having a significant commercial impact. Although we'll probably see some early adopters, [and] some early devices, inside of a year, it will take years for the market to mature."—*sjb*

Sun Gives It Away

In a concerted effort to lure developers to the Solaris platform—or to keep them from jumping ship—Sun Microsystems Inc. has begun giving away Solaris licenses to researchers and developers for the cost of the media plus shipping and handling. The licenses can be used for any non-commercial purpose, whether it be teaching, research, software development or software testing. Licenses are available for both Solaris SPARC and Solaris x86. Developers can request their copy of Solaris at <http://www.sun.com/developers>, while students and educators should go to <http://www.sun.com/edu/solaris>.

"Our goal with this program," says Gary Hornbuckle, director of developer programs at Sun, "is to get as many people experimenting with and experiencing Solaris as want to." Hornbuckle says that Sun has heard from various sources, including both Usenet and academic customers, that they would like to try Solaris, but aren't sure they want to spend the money. This feeling is reflected in the early success of the Free Solaris program: Ten days into the program, Sun received more than 15,000 license requests—about three times what it had hoped for, Hornbuckle says. Sun also reported the signing-on of 18,000 new Sun Developer Connection members.

Sun could not reveal exactly who was requesting the licenses, nor could it divulge from where (what geographic region) most license requests were coming. However, Hornbuckle did confirm that most license requests were for the Solaris x86 platform. "This only makes sense," says Hornbuckle. "If you have a SPARC, you already have Solaris."

Solaris is by no means the first UNIX operating system software to be offered free for noncommercial use. In 1996, the Santa Cruz Operation (SCO) Inc., Santa Cruz, CA, announced it would deliver free noncommercial licenses of both

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Circle No. 6

SCO OpenServer and SCO UnixWare. More to the point, Linux, originally created by Linus Torvalds and maintained by the open source community, has long been available to anyone for free. In addition, commercial support for Linux is available for as little as \$49.95 from vendors such as Red Hat Software Inc., Research Triangle Park, NC.

The Free Solaris program follows a spate of announcements by prominent independent software vendors (ISVs) that they will support the Linux operating system in future products. Database vendors head the list: Oracle Corp., Redwood Shores, CA, announced in July that it would port the Oracle8 database, as well as Oracle Applications, to the free UNIX platform; and Informix Systems Inc., Menlo Park, CA, has announced that Informix-SE, a free, "easy-to-manage database for small-to-medium range applications," will be released on commercial Intel Corp. versions of Linux from Caldera Inc., Orem, UT, and S.u.S.E. GmbH of Germany.

Messaging vendors have also jumped on the Linux bandwagon. Netscape Communications Corp., Mountain View, CA, which has long offered a Web browser client on Linux, will add server-side support for its Messaging and Directory servers. Not to be outdone, Innosoft International Inc., West Covina, CA, is shipping its Innosoft Directory

Services on RedHat Linux 5.1.

Customers are the main factor behind the decision to port to Linux. "The single most important factor behind our decision to port to Linux was the Informix users' group," says John Downey, senior marketing manager for Linux at Informix. "It has consistently been the number one request from users for a long time."

Also, many applications already exist on Linux, but simply haven't been released commercially. "Our developers work on a mix of Solaris SPARC and x86 in the office, but when they go on the road, they all have Red Hat Linux on their laptops," says Greg Lavender, director of technology at Innosoft. "We had the Linux version sitting around for the past year, but hadn't bothered to release it commercially until Netscape announced that they were planning on porting to Linux."

Analysts corroborate the ISVs' perception that free UNIX is increasingly popular. According to a recent study by Datapro, Delran, NJ, the total number of enterprises using Linux grew by 27% in 1997. The number of new Linux installations is also increasing, according to research firm International Data Corp. (IDC), Framingham, MA. In 1997, Linux vendors shipped 1.84 million client licenses and 240,000 server licenses, representing a 20% growth over the previous year, IDC says. The number of

free Linux licenses shipped is estimated to be 10 times the number of commercial licenses. IDC's Dan Kusnetzky, program director of operating environments and serverware, estimates there were between 15 and 20 million new Linux installations in 1997.

There's no doubt Linux is growing, but analysts question just how much impact it will have in commercial settings. "Linux still represents a very small proportion of total UNIX shipments," says George Weiss, analyst at Gartner Group Inc., Stamford, CT, "nor is it throwing out NT." Instead, Weiss says, Linux is finding its own niche, mainly among Internet service providers (ISPs), rather than in core commercial settings.

That said, Sun is clearly unhappy about the prospect of losing developers to other platforms, Linux, Windows NT, or otherwise. Consequently, look for further developer incentives over the next couple of months. "[The Free Solaris program] is not everything that we want to do for developers," says Sun's Hornbuckle. For example, Sun recently launched the Developer Essentials Foundation Edition, a developer subscription program to receive a bundle of Java development tools for just \$195 per year. In a nutshell: "Sun as a corporation has made a major commitment to being a better business partner that it has been in the past," Hornbuckle says—*ab*

S70: First to Feature 64-Bit Chip

IBM Corp.'s RS/6000 line received a boost in performance thanks to the release of the second-generation 64-bit processor. The RS/6000 S70 is the first machine to ship with the 262-MHz RS64-II chip, which is more than double the speed of its predecessor, the 125-MHz processor.

Equipped with the new chip, the RS/6000 S70 is being offered at an introductory price of \$125,000—the same price tag the S70 had when it was introduced in October 1997. The original S70, a four-way system equipped with the 125-MHz chip, now sells for \$85,000, which is a 30% reduction in price, IBM says. "This is a very aggressive price reduction as well as performance increase on the S70 family," says Brian Sweeney, vice president of RS/6000 enterprise servers for the IBM server group.

The new RS64-II S70 runs AIX and is available in four-, eight- and 12-processor versions. In addition, the RS64-II doubles the size of the Level 2 cache from 4 to 8 MB. The improvement in performance is being heralded by industry pundits as a positive step for IBM's high-end UNIX line. "The S70 is right up there in the pack elbowing

[other high-end UNIX systems]," says Rich Partridge, service director for parallel open systems hardware at D.H. Brown Associates Inc., a research and consulting firm based in Port Chester, NY. "For a while, they had some difficulty putting together some large SMPs and their chips weren't the fastest in town. I think IBM is showing a resurgence."

The 64-bit chip, and the improved memory that comes with it, addresses some of the performance needs of certain applications such as databases. For example, the chip will allow more data to be stored within the memory, limiting the number of times it is necessary to access information from a magnetic medium, which, in turn, offers greater performance.

IBM also reiterated its plan to introduce an attachment for the S70 that will allow it to act as a high node on the RS/6000 SP, while physically sitting outside the supercomputer. The attachment will allow the S70 and the SP to communicate via a low-latency, high-bandwidth connection. "We plan to introduce the switch attachment for the S70 in the fourth quarter of this year," says IBM's Sweeney.—*ptc*



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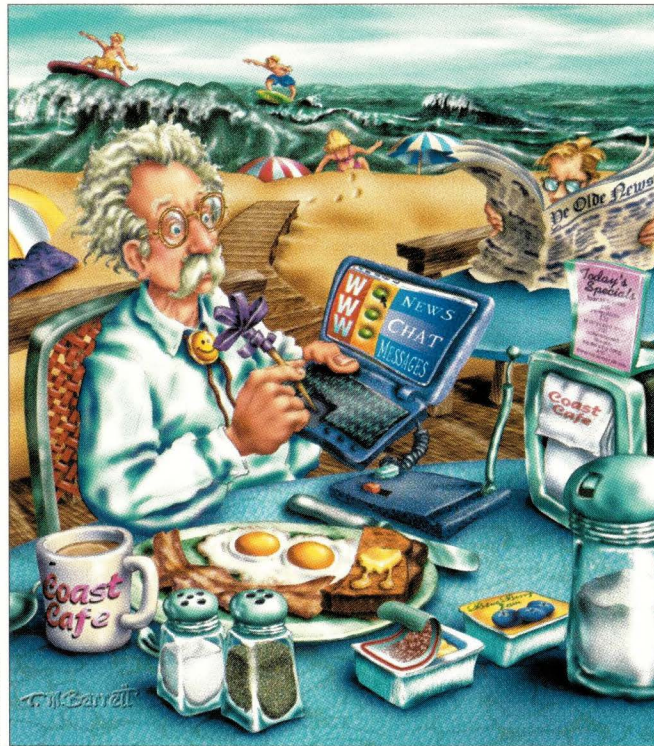
And Here.

And Here.

Here.

Ask Mr. Protocol

by Michael O'Brien



TOM BARRETT

"Pressing the power switch in toward the Ricochet while it is on will give you an approximate signal strength indication."

– Ricochet FAQ

"More iced tea with your CNN?"

– Waitress at the Sidewalk Café

"This damn beach is so full of yuppies only the busboys think wireless Web surfing is remarkable."

– Overheard

Mr. P.: Wireless Once Again

Q: *Oh no. Antennas again?*

A: Oh yeah.

Mr. Protocol rarely leaves the house because the roofless part of the world is shy of high-speed data jacks. When he does leave, he tends to stay close to home. This presents problems, at least for him.

On a normal business trip, there are telephones with data jacks in all the hotel rooms. Admittedly, 28.8 Kb/s isn't quite the same as the near-T1 rates of the cable modem at home, but considering that if a Net connection doesn't exist at all, Mr. P. doesn't exist at all, he'll take what he can get. It's somewhat sad to watch, though, sort of like watching someone trying to eat steak through a straw.

Now, as readers of these regular epistles may have gathered, Mr. P. isn't the easiest person to be around, even at home. That's why any amanuensis of his is bound to become a habitué of café society, and not only Internet cafés

either. No, we're talking about the real thing here, cafés with character, cafés full of caffeine junkies, cafés with 'tude...and no Internet connection.

Admittedly, plunking Chez Protocol down in the middle of Venice, CA, was perhaps not the smoothest technical move anybody ever made. This is the roller-skating capital of America, not the Silicon anything. Diversity is key, and the head of the local Internet service provider (ISP) is also head of the ISP Consortium and testifies before Congress and all, but it's not as if Venice manufactures anything besides art and myth. It does have a cybercafé, which is more than many communities can boast, but most of its dens, hangouts, bars, clubs, restaurants and unclassifiable places of aggregation are free of any technology more advanced than a flush toilet.

Which gives Mr. Protocol's amanuensis a hundred different places to hide.

Mr. Protocol is not aware of any of this, because he's not aware of anything (or anybody) not itself Internet-aware.

However, it has not escaped his attention that there are certain lacunae spotting his perception of my presence. These, he felt, were unacceptable and had to be remedied.

I protested. "How," I asked, "am I to remain in touch with you when there are no Internet connections handy? Just because you don't recognize the existence of places like that doesn't mean they don't exist. What's a body to do?"

Mr. Protocol was glad I asked. This just made my day.

His answer, as usual, was to throw things at me. Far from indicating aggression, this is one of his chief forms of communication. Beaming me in rapid succession with eight empty cartons of Big Stuf Ding-Dongs indicates that it is time for a grocery trip or a fuel run, depending on how you look at it. (It should be noted here that Mr. P. was intrigued no end by the news that Pop-Tart strawberry filling is now classified by the Fed as a flammable substance. It unnerved me. I began to get an inkling

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Circle No. 7

Ask Mr. Protocol

that Mr. Protocol's rather unusual metabolism might actually be more startlingly direct than I'm prepared to deal with.)

This time he threw interesting things at me. The first was a Toshiba Libretto CT-70. This is a full-up Pentium processor PC about the size of a trade paperback book. It runs Windows 95. Whoop-de-do.

Whoop-de-do indeed, however, because it can run things no WinCE device can touch. Mr. Protocol loves that abbreviation, by the way, as it so exactly describes his reaction to the technology in these bleak, post-Newtonian days.

In particular, the Libretto can be connected to the next device he beamed me with, which was a flat black box about 0.25 inches thick and about the width and height of a nontrade paperback book. This black slab is a model of simplicity. It has one power jack, one data jack, one battery slot, one flip-up antenna about half the length of a pencil, one power switch and one LED. All in all, it looks like the Internet version of that old box with a switch on it that, when turned on, would flip up a lid and produce a hand that turned it off again.

This box is a radio modem made by a company called Metricom Inc., Los Gatos, CA, for a service called Ricochet. The first thing I noticed about it was that it hurt a lot less than the Libretto as it bounced off my head. The next thing I noticed was that you could connect it to the serial port on the Libretto. After that, it was only a matter of time until I realized my Internet-free café days were over.

First Full-Service Wireless ISP

Metricom has been mentioned in previous months. It started out as a company that created a wide-area wireless network for carrying data from electric power meters back to a central facility, eliminating the need for meter readers. This technology broke the hearts of a lot of dogs who richly deserved it.

Metricom made the observation that the technology used in its network had the potential to provide much more capacity, and carry much more diverse data, than one packet of electric meter data per month. What followed was the invention of the first full-service wireless ISP. A subscriber to the Ricochet service can connect to Metricom as an ISP through the radio modem exactly as they would to a normal dial-up ISP, without the need for a phone line. The modem will run for several hours on battery power, but can also be used at home to free up a phone line. The modem's nominal speed is 28.8 Kb/s.

There are several interesting properties of this setup. Ricochet is a flat-rate service, not per-packet as with other wireless carriers such as Ardis and RAM Mobile Data. This means you can leave your Ricochet connection up 24 hours a day, seven days a week, with the modem plugged into the wall, and Metricom doesn't care. Not to mention that your regular phone line is left free.

The Ricochet service is not based on widely spaced cellular towers. The coverage area of a Ricochet "site" might be called a microcell, but only in relation to a wide-area network. The Ricochet radio sites are boxes slung under the arms of street lamps from which they draw their power. These radios, under ideal conditions, are spaced about half a mile apart. Packets are routed geographically. Each radio knows its position and

it knows which of its neighbors are closer to the local hub site. Routing amounts to passing packets to the next radio in line, which is geographically closer to the packet's destination.

This architecture leads to some limitations. In a busy system, there is a sort of "implosion effect" as packets from users pass inward toward the hub. From the end user's point of view, this can result in a perceived slowdown of the effective data transfer

Ricochet is a flat-rate service. This means you can leave your connection up 24 hours a day, seven days a week and Metricom doesn't care.

rate. Also, because of the microcellular architecture, there may be many store-and-forward light pole radios between the end user and the hub. This can lead to latencies; occasionally, long ones. Of course, if the system you're trying to talk to is not some server on the main part of the Internet, but another Ricochet host, then the geographic route taken by your packets goes across the grain of most of the other flows.

The most serious limitation, however, is overall availability. There are currently only three areas in the United States that are served by Ricochet networks: the San Francisco Bay area, Seattle and Washington, DC.

Mr. Protocol snuck in owing to the fact that Metricom has also installed a number of "mini-networks." Various airports, corporate campuses and other enterprises have been wired up for Ricochet service. One such area happens to cover West Los Angeles and Santa Monica, and it was this installation that Mr. P. pointed me to.

Overall, the experience was a delight.

It doesn't make any sense to sit in a cybercafé with a radio modem, so my main base of operations became the old Venice landmark, the Sidewalk Café. This establishment is located on Ocean Front Walk, which is the pedestrian walkway along Venice Beach. Trying to concentrate on anything while at Venice Beach is almost always a losing proposition unless you choose your times carefully. I chose breakfast.

It isn't profitable to try to categorize people who choose to eat breakfast at Venice Beach. This is not a highly refined area, or rather, it is highly refined, but that refinement bears no relationship to social norms. It is not that there is much overtly bizarre or antisocial behavior to be seen here at 9 a.m. so much as it is a place where exactly that sort of behavior is guaranteed to be seen only a few hours later.

At this hour, there are no crowds. There are people, strollers, locals, tourists and bums, none moving rapidly. Large delivery trucks ply the pedestrian mall, making morning deliveries of beer, soda, baked goods and so on. The street vendors set up along the ocean side of the walk—psychics, artists and henna tattoo parlors, each consisting of a large sign showing designs and two chairs. A man walks by, obviously a local. He wears a vest but no shirt, and his torso and arms are covered with brilliantly colored tattoos extending up and over the top of his bald head.

The café staff are preparing for a busy day, spending more time gossiping among themselves than serving customers. The Sidewalk Café is the prime spot for seeing and being seen, so

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Circle No. 8

Ask Mr. Protocol

for most of the day, a line of customers waiting to be seated will extend outside the door, but not now. It is only a quarter full, and the sun rising behind the café floods the white sand beach beyond with morning light.

In front of me, the Carlos Castaneda Omelet. To my right, iced tea. To my left, the Internet. The Libretto and its radio modem are so small that most people don't notice.

And it fits right in. The Web connection at the breakfast table is no different than the morning paper, and about six or eight hours more current—not to mention comprising a great many more stories. By the time I finish breakfast, I've read about as much text as I would have read in the morning paper. The content is much more varied and much better tailored to my interests, and the package in which it comes is far easier to manage at a food-covered restaurant table than a full-size newspaper. I've also done more people-watching than most folks accomplish in a week, but Metricom doesn't get the credit for that.

Because Metricom acts as a full-service ISP, breakfast can also serve as time for email, although the Libretto keyboard is not actually something that a normal human can touch-type on. The Ricochet modem is designed to be glued onto the outside cover of a full-size notebook computer, but I chose not to cram one of those onto a restaurant table.

The dubiously seductive nature of Venice Beach aside, going through this experience makes it clear that this is an evolutionary, not a revolutionary, step. Within its service area, the combination of a Ricochet radio modem and a full-powered palmtop computer is like having the Internet in a book. The only wire involved is the 6-inch cable connecting the palmtop with the radio modem. Of course, it's a book that has two different pieces, both of which have to be recharged, but basically, it's a book.

In use, there were noticeable delays at times. Some of these were attributable to the Internet's continual growing pains, but at other times, pages would hang in midstream until I stopped the transfer and reloaded the page. TCP isn't supposed to get into this sort of hole and it's not one I see very often on a wireline dial-up connection. However, there were no permanent hang-ups. Behavior was about the same overall as it would be while dialed into a busy provider, with the bonus that, thanks to the system's design, there's no such thing as a busy signal. Things may slow down at times, but you'll always get a connection.

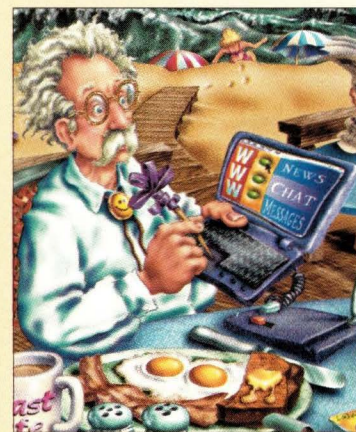
Is Ricochet in Your Future?

So if you spring for the \$349 modem and the \$30 per month flat fee, what does the future hold? Metricom says it plans to start limited trials of a higher-speed network in mid-1999. This network will provide end-user speeds of 128 Kb/s or higher, which would be equivalent to a 2B ISDN connection. For places lacking cable modem access, this would rock, especially given the drearily high cost of ISDN from a phone company that hasn't grasped reality yet. However, this does most folks no good because Metricom, in spite of more than a dozen signed agreements with various municipalities around the United States, has yet to announce service availability

in any of them beyond the original three. Seattle is a recent addition to the fold—for a long time there were only two service areas—so this picture may change if the venture capital holds out.

The question becomes one of competition. Supposedly, over the next three to six years, half a dozen or so new services will appear, selling satellite Internet connections. No one really knows what the market for these services will be, although the investors certainly believe they are making some highly educated guesses. Ricochet is fundamentally an urban service, whereas the satellite customers are expected to consist of corporate representatives sent into rural areas, beyond cellular coverage.

Within its service area, the combination of a Ricochet radio modem and a full-powered palmtop is like having the Internet in a book.



It is probable that, except in certain vertical markets (where, ironically, Metricom got its start), the Ricochet service will provide a lower-cost, lower-speed alternative to satellite services. However, it would be silly to take this as received truth. The current truth is that no one, not even the people investing many billions of dollars into flight hardware, really knows what the market model is going to be for satellite data. About all we know now is that at least some of the companies are finding out they've paid for flaky flight hardware. Military satellites cost a lot of money because they undergo a lot of testing. "Cheapsats" only work when you can afford to lose a few. Some current ventures are close to losing all of them, however. It can only be assumed that the design review meetings in these places have become less than cordial.

The satellite telephone services don't enter into this picture. Although they are much earlier to market than the satellite data services (Iridium should be available by the time you read this), they will only be able to support data connections at 1,200 to 9,600 bits per second, while charging about \$3 per minute for the privilege. Using these services for data is only for those situations where "data" is far more desirable than "no data."

Urban cellular services are also poor competitors to Ricochet. Pricing on these services is high because the circuit-based cellular voice system reaches saturation at a far lower usage level than the packet-based Ricochet. Cellular systems must operate at a low average usage level in order to provide service during the occasional peaks, or many calls will be dropped. Ricochet can afford to drop a few packets because TCP connections will only be slowed down somewhat by this, hence, Ricochet can

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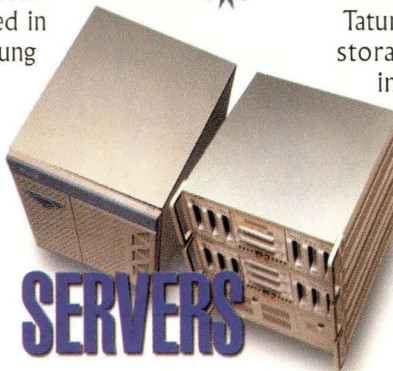
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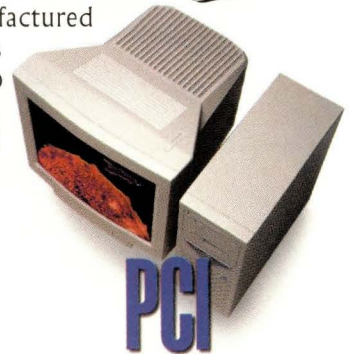
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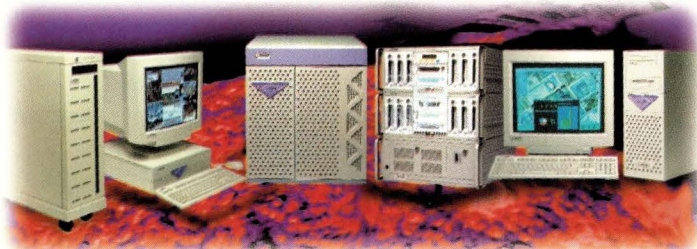
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Circle No. 11



Ask Mr. Protocol

operate at a much higher saturation level and charge lower prices accordingly. The Ricochet radios are also much cheaper than cell sites, although there are more of them.

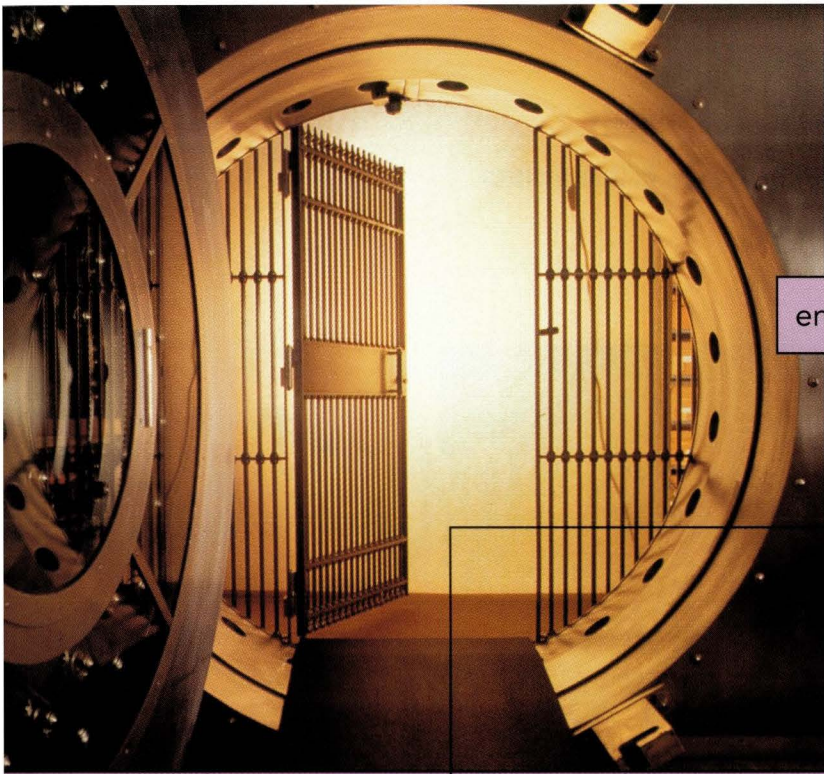
If you are lucky enough to be a commuter between areas served by Ricochet, it is absolutely, completely the right answer. No hotel phone charges, no calling 800 numbers to discover the local access number, no cases of "the phone's over here but the desk is over there." In fact, you can do Internet business over breakfast. It is not unreasonable to think of doing a live, Web-based presentation on a video projector from your Ricochet setup at a customer's site, because there are no worries about letting your computer onto the customer's network or having them provide you with a computer. You don't have to be on their network, you can be on Ricochet...assuming the delays don't bollix you. If your application is not highly network-intensive, it's worth thinking about.

In the long-term, there's no saying whether the Ricochet model is going to be a runaway success or not. Right now, everything on the Internet looks like a runaway success, at least for a while. About all we can say is the only services that look like probable competition are still several years away from coming to market. Now it's up to Metricom to start enlarging its service area in a serious way. Meanwhile, here's to Web surfing at the beach. ⇐

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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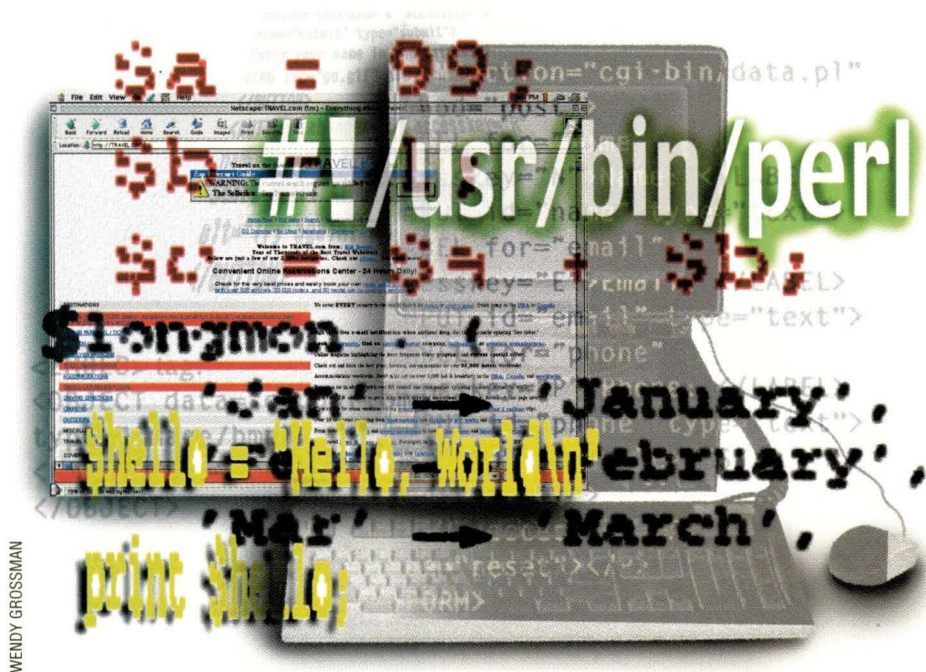
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UNIX Basics

by Peter Collinson, Hillside Systems



Getting Started with Perl

I must confess that I have only picked up Perl in the last year or two. I was going to say that I was a recent convert to Perl, but that statement would have had religious overtones, and I cannot say that I have become a devotee. I just use it when it's appropriate. I've gone past the point where I become a zealot preaching for or against a particular system or programming language. Also, it seems I only manage to learn new languages when I have a need to do so. Usually, I am engaged in a task to get something done and having to fight with a new language gets in the way. I use what I know.

The force that has made me pick up Perl is the need to create CGI scripts for the Web, and I seem to be engaged in this activity more and more these days. Perl is a very "big" language, in the sense that there are a great many syntactic features, built-in functions and routines. You can treat this wealth strictly on a need-to-know basis, and I certainly did this at the start, picking up my Perl book when I reached a stage where I wanted to do

something new. Actually, there are many different ways of programming a task in Perl, and it's possible to get by with only a small subset of what is available. Nevertheless it makes sense to keep reverting to the book to see if there's a better way to do something.

It never makes sense to reach the nirvana of the Nineteenth Stage of Perl Devotedom, where you seek to express your program in the minimum number of characters and lines, making the result impenetrable to mortals. Perl is accused of being a "write once, read never" language. However, it is Perl programmers, not the language, that should be accused, I suppose.

I always felt that early versions had too much magic. Magic, in the sense that simple operations have side effects, setting some variable or other, and that programmers were originally encouraged to write obscure programs that used these side effects. Good code is easily understood by others, and this means that what is happening in the source code should be plain

to see. You should be able to understand what is happening without having a huge background knowledge of special symbols, oddly named variables and the side effects of some statements. It seems to me the most recent version of Perl, Version 5, is beginning to learn this lesson and it's now possible to write straightforward, maintainable, easy-to-read code.

Another great Perl plus is there is a vast body of library routines you can use to create your programs more quickly. The language is distributed with a set of libraries that are documented in books and online. In addition, there's the Comprehensive Perl Archive Network (CPAN), a large set of user-contributed code available via the Internet. I am only now beginning to look at these libraries and use them. I made a conscious decision to avoid them at the start because I feel that when a language is new and unfamiliar, the last thing you want to do is spend time fighting with (and possibly debugging) someone else's code.

Also, when you use a predefined

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UNIX Basics

library you are buying into a view of how to achieve something, and that view can be enabling or it can be constraining. I worry about the constraint. There are some portability issues, for example, CPAN code will sometimes only work with certain versions of Perl (and also later versions, we hope). If you write a program that depends on a library and want to move it elsewhere, then you have to port the library with your code and there's a chance you'll end up working to get someone else's library to operate in the target environment. Debugging other people's code is not advised when you are new to a language and only understand a small part of what is available.

Finally, you have the decision of which version of Perl to choose. Perl underwent a large change with the release of Version 5. Perl 5 is not backwards compatible and will not run some Perl programs written for previous versions. On my BSD/OS system, this has led to the situation where Perl 5 is installed as `perl5` and the `perl` command is actually late Version 4. If you are new to the language, then I advise you to use Perl 5 because this is the version that all the books document. You can always find out the version in use on your machine by typing `perl -v`.

Scripts

Well, by now you should have gathered that Perl is a programming language. It's actually a scripting language. You write a program into a file, and when you use `perl` on that file, the program is compiled *and* run, assuming that the compilation succeeds. Getting a Perl program to execute is a one-stage operation. On UNIX, you can also make the file itself into an executable command by making the first line:

```
#!/usr/bin/perl
```

and setting the execute bits on the file:

```
$ chmod +x file
```

Now, when you attempt to use the file as a command, the kernel notices the `#!` and starts the program that is found by using the absolute path following the `#!` character pair. The file itself is passed into that running program and, for Perl, will be compiled and run. This general mechanism is available for all interpreters.

Script languages have the disadvantage that you need to run a compiler and syntax-check the code every time you use the command. This has become less of a problem now that CPUs are very fast. The advantage of scripts is speed of development, you just change the source and have a new program.

Perl was originally a "very unsafe" language, that is, there was not much help for the programmer to eliminate typos and other inaccuracies that would creep in. Recent versions have included somewhat stricter checking (that needs to be requested) and an option to the interpreter, `-w`, which makes the interpreter moan about variables that are used only once and variables that are used before being set (among other things).

So you will often see

```
#!/usr/bin/perl -w
```

at the start of a Perl program to turn on this option. Incidentally, most systems only permit one argument after the path name at the start of a script file.

Constants and Variables

Probably the best way to learn Perl is to read other people's code, after having read as many books as you can cope with. The main book (see below) is dense and is often better dipped into to find what you are looking for. When I was on the learning curve, I spent a lot of time searching books for equivalent examples for what I was trying to do. This article should give you a basic grounding so you can examine other people's code to learn more.

Let's start with a brief description of constants and variables. In any programming language, named variables are used to store information, and Perl is no different. Where Perl diverges from many languages is it uses an initial magic character to tell the interpreter how the variable is to be treated. The code

```
$hello = "Hello, World\n";  
print $hello;
```

is a complete Perl program. You can type it into a file, perhaps called `hello.pl`, and say

```
perl hello.pl
```

As you can see, Perl programs consist of statements terminated with a semicolon—actually, Perl's syntax follows the rules of the C language. You could put the statements on the same text line if you wish, it's the semicolon that indicates the end of the statement. The first line sets the variable `hello` to the string `Hello, World` terminated by a newline character indicated by backslash-n. The double-quoted string is a constant, but one that will be examined by Perl to see if it can find special characters (or variables) that need replacing. Perl borrows the quote syntax from the Bourne shell and also supports single-quoted strings, where the constant value is not examined for possible character or variable replacement. There are also other methods of quoting strings.

The dollar symbol before the variable `hello` tells Perl to interpret the variable as a *scalar*, holding a single value. Perl supports arrays too. They are numbered from zero and individual elements are accessed



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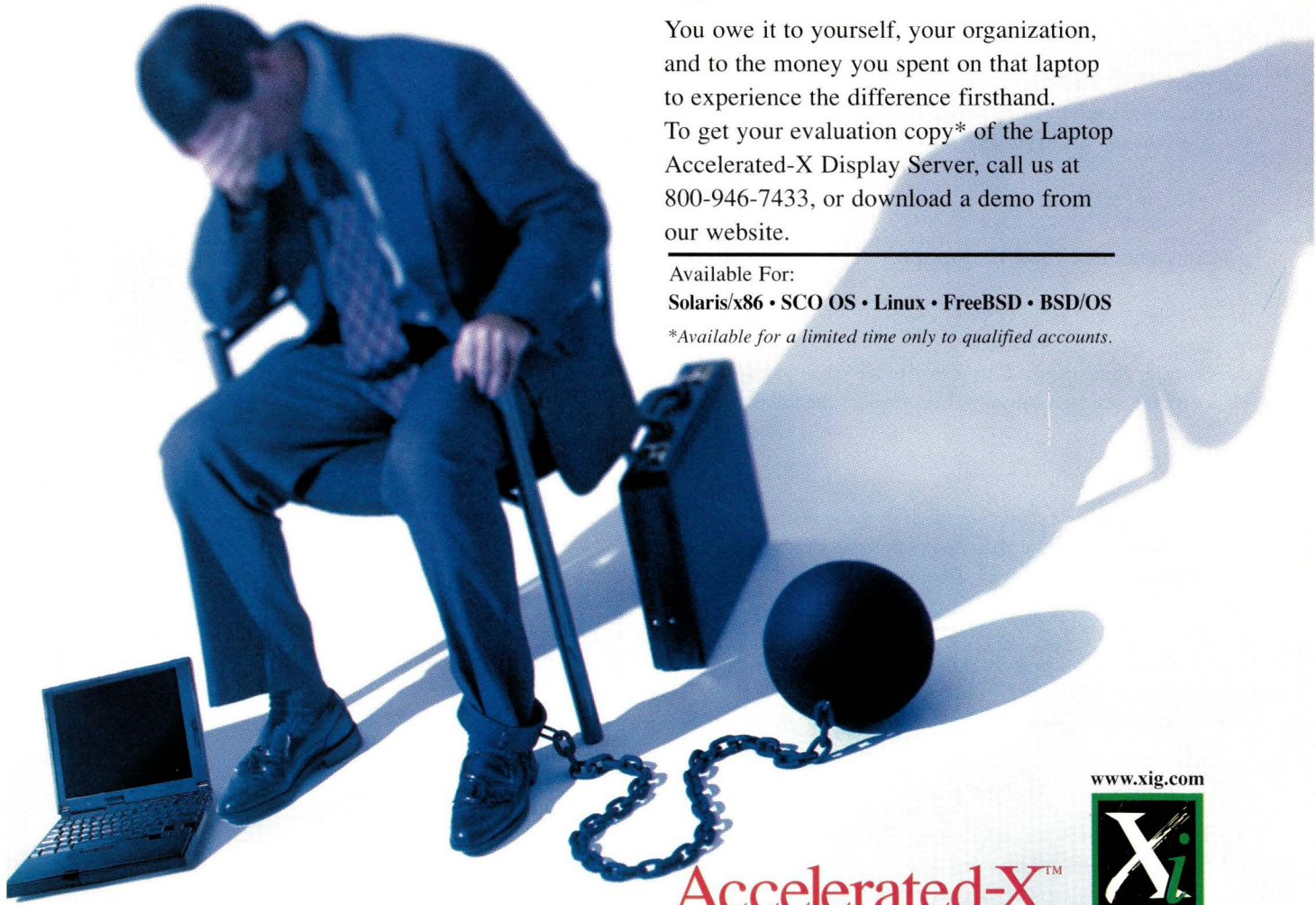
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by writing something like this:

```
$array[6]
```

If we want to talk about the array as a whole, then @ is used before the name. The other magic characters that you will see before names are &, which is used to show that the variable is the name of a function or routine, and %, which is used to indicate an associative array (more on these later).

Scalar variables can hold numeric values (9, 9.9, 99.99 and so on) and text strings. You don't have to tell Perl that a variable is to hold one particular type or another. The way that a variable is interpreted is determined by context. Perl provides a set of primitive string operators and ensures that they are distinguishable from the set of numeric operators. So,

```
$a = 99;  
$b = 1;  
$c = $a + $b;
```

will give you the numeric answer "100" in the variable "c." Other languages will overload the plus operator to supply string concatenation; Perl doesn't, you use the dot operator to join the strings. The line

```
$c = $a . $b;
```

will place "991" into the "c" variable. The use of special operators to denote the type of operation is particularly relevant when you test values in if statements. For example,

```
if ($c == 999) { ...
```

performs a numeric equality test, while

```
if ($c eq "99") { ...
```

does a string comparison. This is easy to see when you are testing a variable against a constant, but consider the following:

```
if ($a eq $c) {
```

Here, we are forcing a string comparison to be made. Incidentally, Perl has acquired the ability to place an operator before an assignment statement from C. So,

```
$v = $v + 200;
```

will take the value of the "v" variable and add "200" to it, placing the answer back into "v." This can also be written as

```
$v += 200;
```

which saves keystrokes. I mention this because I recall having difficulty in understanding what

```
$s .= "appended";
```

meant. This is similar to our first example; that is, the string "appended" is added to the end of the "s" variable. In fact, Perl is very good at handling strings and provides a number of built-in routines that enable you to take the strings apart and put them back together again in a different order.

There's one other piece of assignment syntax that you'll see everywhere, the bind operator =~, whose significance is often lost when you first start reading other people's Perl. There are several built-in functions that apparently take no arguments. In early versions of Perl they operated on a hidden magic variable, \$_, which accessed the "last" result. The functions are all string-processing ones and I don't want to go into their full ramifications in this article. Perhaps the simplest one to explain is the substitute command. The s command allows you to replace some part of one string with another. Therefore,

```
s/old/new/;
```

replaces the first occurrence of the string "old" in the magic variable \$_ with "new." In many recent Perl programs, you'll see the bind operator being used to supply an operand for the command:

```
$changethis =~ s/old/new/;
```

The operator =~ applies the s operator to the value of \$changethis and, in this case, also replaces the old value with the result of the substitution.

Arrays and Lists

Perl has good support for handling arrays. In fact, programmers often think of arrays in terms of lists of objects, and Perl uses round brackets ubiquitously to define lists. We can create a list as follows:

```
@hello = ("Hello, ", "World\n");
```

This creates a list of two elements in an array. Notice that I am using the @ to indicate the loading of an array. Now we can talk about each element by using standard array syntax, as follows:

```
print $hello[0], $hello[1];
```

However, we have not printed the space between the words, so perhaps we can employ the following:

```
print "$hello[0] $hello[1]";
```

In fact, I rarely seem to have ordered data in my programs, apart from days of the week or months of the year. I'll use something like this:

```
@dow = ("Sunday", "Monday",  
(and so on)
```

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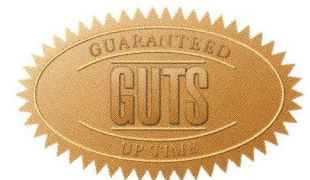
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and access it via a statement such as

```
print $dow[$today]."\n";
```

assuming that “Sunday” is coded as a numeric value of zero in the variable “today.” The last piece of the statement adds a new line using string concatenation and is another common idiom.

The other type of array that Perl supports is the *associative* array, where indexes are not increasing numerical values but may be any string. This type of array is often called a *hash* in Perl documentation. I first came across associative arrays in *awk* and I suspect Perl borrowed them from that language. However, Perl has its own syntax to set up constant values, for example,

```
%longmon = (  
    'Jan' => 'January',  
    'Feb' => 'February',  
    'Mar' => 'March',  
);
```

We can now access the data, turning a short-form name into a long-form:

```
print $longmon{'Jan'};
```

Note the use of curly braces to indicate the associative lookup.

I tend to use associative arrays in my scripts to store string constants used by the program for things like file names or URLs, so I can localize the values that I use in the script into one place, making for easy editing.

Associative arrays are of great use when indexes are taken from variables. For a real example, suppose we generate a Web enquiry form with a drop-down menu that specifies different destinations for where the data is to be sent, allowing the user to choose to send the form to sales, management, enquiries and the like. I am providing contact forms more and more now because it seems that email addresses on Web pages are targets for spammers. When the user makes a selection, we can arrange for the Web form to return a string that is a lookup string into the list of real email addresses, and use an associative array to perform the translation:

```
$mailto = $lookup{$formval};
```

We could use a regular array here but then we would have to code the values from the form appropriately, where “sales” returns zero, “management” returns one and so on. However, it’s much more natural, and makes for easier maintenance, for the form to return a string that maps onto a readable string in the program.

Perl also allows you to place lists on the left-hand side of an assignment statement, moving multiple values from one place to another. So we could say

```
($sun, $mon, @rest) = @dow;
```

making use of the `dow` array I created earlier to assign “Sunday” to the `$sun` variable, “Monday” to the `mon` variable and the rest of the `dow` array to `rest`. You’ll find that the construction is mostly used to process the returned list values from functions, and very nice it is too.

Functions and Procedures

Hopefully, every Perl program that you see will be well structured and split into small procedures, each doing one thing well. Some people only believe in using functions and procedures if the code is used more than once, thus saving code. Well, this is actually incorrect thinking. Procedures and functions should be used to separate code into logical sections. A good rule of thumb is to separate control (going round a loop several times, or testing values in `if` statements) from actions (doing the work that needs to be done in the loop or `if` statement branch). Control should be placed in one routine and actions in another, then, by picking sensible names for the action routines, all the code will become more readable.

Functions and routines are introduced by the keyword `sub`, which is followed by the name used to call the procedure. The body of the routine is enclosed in curly braces:

```
sub hello {  
    return "Hello, World\n";  
}
```

When you call the routine, you should precede it with `&`. Well, the “main” book says, “ampersand is optional when it’s unambiguous,” a statement of deep mystery to a novice. One place you need it is

```
$hello = &hello;
```

when you are calling a routine with no parameters. If the routine has bracketed parameters, then it’s not needed (I think). Incidentally, it’s perfectly OK to have a scalar variable called `hello`, a function called `hello` and an array called `hello`. All three names refer to distinct objects. However, if you actually do this, may deep woe be upon you and your house because it will confuse everyone who reads your code.

If you are used to other programming languages, you’ll find the way Perl handles parameters seems somewhat arcane. You make a routine call such as

```
$val = r($a, $b, $c);
```

which is familiar. When you define the routine, there are no “formal” parameters, you pick up the variable values from the magic “last value” variable, which is assumed to contain a list of values. So we could define

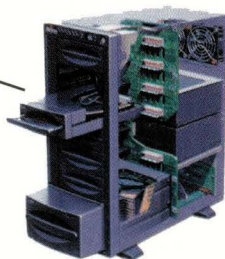
```
sub r {  
    @args = @_;  
    ...  
}
```

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UNIX Basics

placing all the routine parameters into an array. Notice how we use the @ character before the underscore to tell Perl that we want to treat the arguments as a complete array. Alternatively, if we wanted to place the values into some variables, we could use the list-assign syntax that we saw above:

```
sub r {
    ($one, $two, $three) = @_;
    ...
}
```

Another common idiom is to use the shift operator:

```
sub r {
    $one = shift;
    $two = shift;
    $three = shift;
    ...
}
```

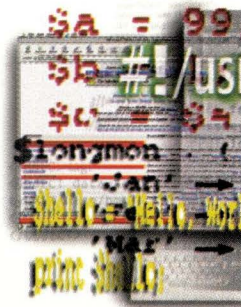
The shift operator returns the first element of a list, removes it and leaves the remaining elements intact. All this seems pretty weird and wonderful, but it seems to work and provides great flexibility when creating routines.

Perl is a big topic, and I've only managed to scratch the surface here. Obviously, there are omissions from the above

text, so please don't email me saying "you missed this." The intention was not to present an exhaustive syntactic description but to get across some of the basics, allowing further progress.

The "main" book you will need is *Programming Perl, 2nd Edition*, by Larry Wall, Tom Christiansen and Randal L. Schwartz, published by O'Reilly & Associates Inc., 1996, ISBN 1-56592-149-6. Just in case you didn't know, Larry Wall is the originator of Perl. This book is dense and is really a manual with examples. My copy is very well-thumbed. *Learning Perl, 2nd Edition*, by Randal L. Schwartz and Tom Christiansen, again from O'Reilly & Associates, 1997, ISBN 1-56592-284-0, is actually a good place to start.

You can get Perl source (and libraries) from CPAN. The main URL is <http://www.perl.com>, a site run by the aforementioned Tom Christiansen. ➔

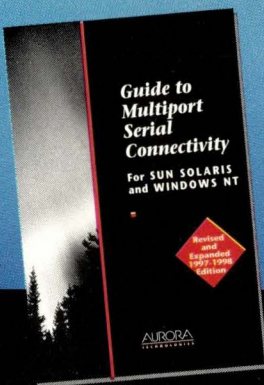


Peter Collinson runs his own UNIX consultancy, dedicated to earning enough money to allow him to pursue his own interests: doing whatever, whenever, wherever... He writes, teaches, consults and programs using Solaris running on a SPARCstation 2. Email: pc@epg.com.

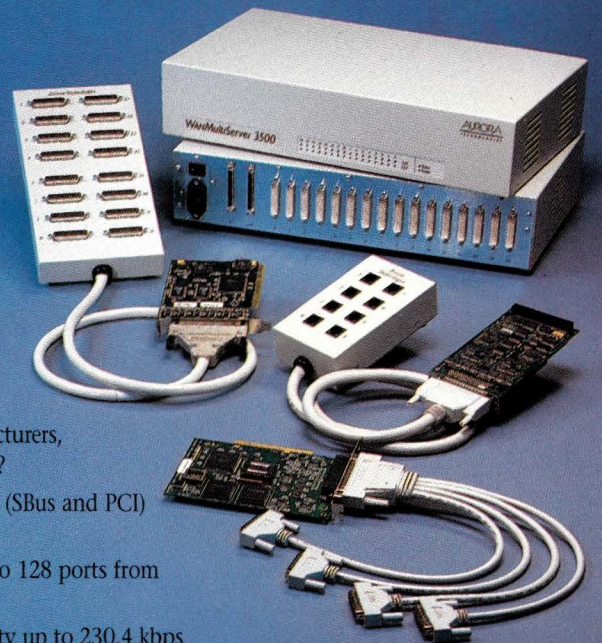
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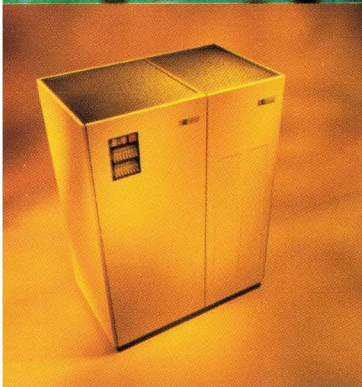


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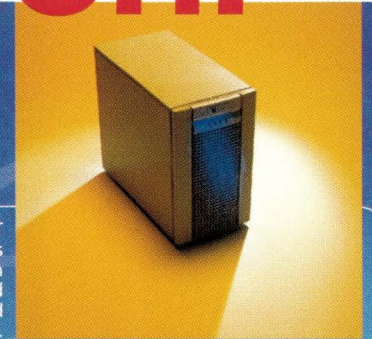
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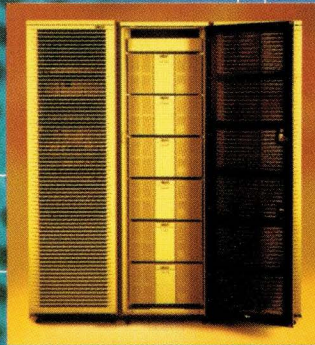
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I/Opener

by Richard Morin, Technical Editor



KEN CONDON

DES Vérités

The Data Encryption Standard (DES), a cryptographic standard promoted by the U.S. government, can be broken in an average of four to five days by a machine that fits in a small closet and can be built for around \$50,000. That anyone would try to break the DES standard, much less succeed, might well prove disquieting in many circles.

On the other hand, some truths (des vérités) are bound to be disquieting to folks who are holding onto comfortable fictions. And, when government officials use fictitious security as a way to oppose real security, it is only proper they should be shown up.

Consequently, I think we owe a debt of gratitude to John Gilmore and Paul Kocher (members of the DES Cracker team) and the Electronic Frontier Foundation for demonstrating the weakness of DES. O'Reilly and Associates Inc. should also be commended for publishing, *Cracking DES* (described below). Finally, RSA Data Security Inc. deserves

credit for sponsoring the "DES Challenges," which provided a safe and public forum for a demonstration to take place.

The EFF's *Cracking DES: Secrets of Encryption Research, Wiretap Politics and Chip Design*, published by O'Reilly and Associates, 1998, ISBN 1-56592-520-3, explains both the motivation and the design—including source code and schematic diagrams—for the EFF's DES Cracker machine (see "DES Cracker"). Much of the material in this column is drawn from this book and associated material online.

So, How Weak Is DES?

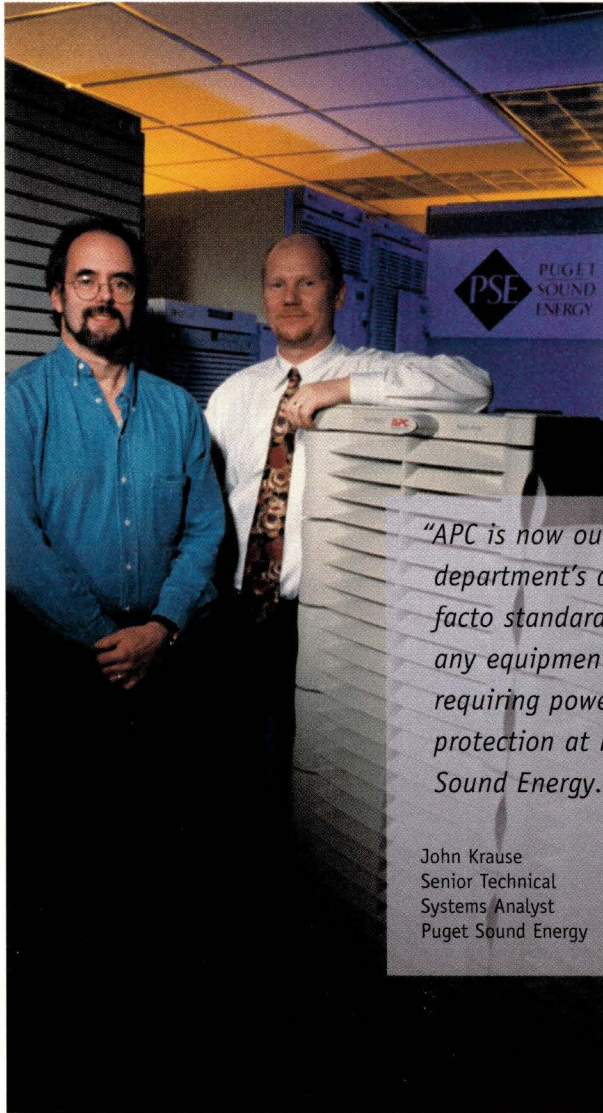
DES Cracker can search an entire 56-bit "key space" in nine days, so no key can survive longer than that. Most, of course, will fall more quickly, with the average being four to five days. The 40-bit standard the U.S. government allows to be exported (with little paperwork) is vastly less secure: The DES Cracker machine can decode a typical 40-bit key in several seconds.

Key length is, in a word, key. A 56-bit key space holds 2^{16} times as many keys (65,536, to be exact) as a 40-bit space. Because the DES Cracker does a "brute force" examination of the entire key space, finding a needle in a 56-bit haystack takes much longer than finding one in a 40-bit haystack.

DES Cracker can search a 56-bit key space in nine days, or 777,600 seconds. Dividing 777,600 by 65,536 gives us about 12, thus, the machine can search the entire 40-bit key space in around 12 seconds. Because of the law of averages, the typical key will be found in half that time (six seconds).

The agencies whose "Black Budgets" slip through Congress each year are certainly capable of spending \$50 million to crack DES keys; I would be amazed if they have not already done so. And, conservatively, a \$50 million DES Cracker (that is, 1,000 \$50,000 machines) could crack a 56-bit key in about 13 minutes; 40-bit keys would fall in a hundredth of a second. Moreover, there

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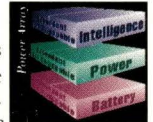
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is nothing to prevent even faster machines from being built. The EFF's DES Cracker could easily be reengineered with faster chips or redesigned with subtler strategies. One engineer, who wishes to remain anonymous, has already come forward with a design that would be 10 times as cost-effective.

In short, DES is not a secure standard: 56-bit DES is not suitable for financial transactions; 40-bit DES is not suitable for much of anything. Nonetheless, the U.S. government insists that both standards are trustworthy.

The Government's Story

Although several papers have been written about the weaknesses of DES, little or no credence has been given to them by the U.S. government. In fact, it appears that a deliberate campaign of disinformation is in place.

"...And we do not have the computers, we do not have the technology to get either real-time access to that information or any kind of timely access.

If we hooked together thousands of computers and worked together over four months we might, as was recently demonstrated, decrypt one message bit. That is not going to make a difference in a kidnapping case, it is not going to make a difference in a national security case. We don't have the technology or the brute force capability to get to this information."

— Louis Freeh, Director of the Federal Bureau of Investigation, June 26, 1997, before House Committee on International Relations.

Freeh may be correct about hooking together "thousands of computers"; DES was intentionally designed to be time-consuming for software to crack. But then, the FBI would know that, wouldn't it? Wouldn't it also know that chips can be made that are more efficient at scanning DES keys?

In short, the FBI is either incompetent or attempting to mislead Congress. In the first case, those people involved should be fired. In the second, they should answer charges of perjury, contempt of Congress or some such. In neither case, however, should we be allowing their assertions to guide our cryptographic policy.

The RSA Challenge

In an effort to dramatize the weaknesses of 56-bit DES and using a prize of \$10,000 as bait, RSA Data Security issued two "DES Challenges" (<http://www.rsa.com/DES>). In the first of these, a project code-named DESCHALL linked together tens of thousands of volunteer computers around the Internet. After searching about a quarter of the 72 quadrillion possible keys, the project succeeded in decrypting RSA's DES

Challenge text: "Strong cryptography makes the world a safer place."

DES Challenge II, in contrast, was won by a single computer system (albeit heavily assisted by special-purpose hardware). The EFF's DES Cracker found the RSA's key in less than three days and probably could have cracked any key in nine days or less.

RSA will continue to host DES challenges; the next one is scheduled for January 13, 1999, at 9 a.m. PST. I would not be at all surprised to see the results announced before the end of that day.

Publish or Perish

Although "computer-readable" versions of cryptographic source code are classified as "munitions" by the U.S. government (and hence must be cleared for export by the Department of Commerce), printed materials are (at present) protected by the First Amendment. Consequently, it is quite possible to export books containing material that would otherwise be illegal to export in electronic form. As a friend of mine frequently observes, "Logic has nothing to do with

DES Cracker

The Electronic Frontier Foundation's DES Cracker (<http://www.eff.org/descracker.html>) consists of an unexceptional personal computer, augmented by a special-purpose, massively parallel array of "search units." These search units sift through the key space, discarding any "uninteresting" keys. The few keys that survive are passed to the PC for a closer look.

The PC, in this instance, has a generic Intel Corp. Pentium with a 90-MHz CPU, 1-GB disk and 64 MB of RAM. Initially, the software was run in a DOS Window under Microsoft Corp. Windows 95. It was later ported to Linux, however, to allow for remote debugging and operation.

Each unit is capable of searching about 2.5 million keys per second. There are 24 search units per chip, 64 chips per board and 24 boards. Thus, the aggregate search speed is 92,160 (24 x 64 x 24 x 2.5) million keys per second (or, in round numbers, 92 billion keys per second).

Although some test cases stressed the PC's processing speed (by passing large fractions of the keys through for reexamination), the PC's speed was not a limiting factor in RSA Data Security Inc.'s Challenge II. A larger and/or faster array might have required a faster "driving" machine, but this would have been easy to obtain.—rdm

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it.” In reaction to this situation, however, a rather peculiar set of books have been published.

First, we have Bruce Schneier's *Applied Cryptography: Protocols, Algorithms, and Source Code in C, 2nd Edition*, published by John Wiley & Sons Inc., 1995, ISBN 0-471-12845-7. This is a wonderful book, even better than the first edition. It explains the background, theory and motivation of a range of cryptographic issues, in a way that even I can understand.

If you live outside the United States or Canada, however, and want the source code for the examples, you will have to key (or scan) them in. The floppy disks can't be exported legally, according to the U.S. Department of Commerce, because the source code on it is computer-readable and broken up into files. Right.

In reaction to this, Philip R. Zimmerman published *PGP: Source Code and Internals*, MIT Press, 1995, ISBN 0-262-24039-4. Although the book is now out of print, and was never very readable, it served an important purpose. It provided a legally exportable copy of the complete source code for Pretty Good Privacy (PGP).

In this instance, the publisher took care to provide scanning instructions and to give each source code file its own chapter. So much for “computer-readable and broken up into files,” but the U.S. Department of Commerce has been curiously silent on the subject, to date.

To make the process of publishing source code both easier and more reliable, Colin Plumb, Phillip R. Zimmerman et

al. then published *Tools for Publishing Source Code via OCR*, Warthman Associates, 1997, ISBN 1-891064-02-9. This book is not widely distributed, but it is available on request from Printers Inc. (the email address is orders@pibooks.com).

Now, *Cracking DES* builds another link in the chain. The entire source code for DES Cracker is published (with checksums) and the technical design and the machine's hardware specifications are included as well. This is a construction manual for DES Cracker, thinly disguised as a political work.

I'm sure that FBI Director Freeh would have a few words to say to the Founding Fathers, given the chance to do so. “These !@#\$ creeps are using your First Amendment to...” On the other hand, I think a few of the Founding Fathers would have had some pungent things to say in return.

Lacking their return, however, it's up to all of us to confront Freeh and his allies, possibly quoting one Founding Father, in particular:

“They that would give up essential liberty to obtain a little temporary safety deserve neither liberty nor safety.”

– Benjamin Franklin, 1759

Richard Morin operates Prime Time Freeware (info@ptf.com), which publishes mixed-media (book/CD-ROM) freeware collections. He also consults and writes on UNIX-related topics. He may be reached at Santa Forda Computer Laboratory, P.O. Box 1488, Pacifica, CA 94044 or by email at rdm@cfc1.com.



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voyager II

Systems Administration

by S. Lee Henry



DAVE RIDLEY

Fired!

UNIX is wonderful. Solaris is wonderful. And I am... a poor fit? For the first time in my 19-year career, I have been fired. By the time you read this column, a month or more will have passed and I may, once again, be gainfully employed. Right now, as I write this, I am staring down the nozzle of a flamethrower. Fired.

My first impulse on hearing the news was to try on every reassuring thought. Good technical people are in high demand. Systems administrators are needed everywhere. The Bay area is a "hotbed" of the computer industry. Some of the best people in the field have been fired; haven't they? It didn't help. Several hours later, I was still trying to come to terms with my boss's dispassionate words and my very personal humiliation.

Round two was a din of employment platitudes. The best time to get a job is when you have a job. Most good jobs are found through personal contacts; don't even look at the want ads. Think of this as an opportunity.

Then came the soul-searching. Why had this happened to me? Did I deserve to be fired? Did I see it coming? Was he right to say I was a bad fit, overqualified at best? Had I made a major mistake in taking a job, which was so far afield from the emphasis of my career?

And last came the practical issues. What will I do? Should I plan to tell potential employers that I'd been fired? Would my desperation hurt my chances of finding a good job? Would having been fired lower my market value? And, how would I tell my wonderful new stepfamily that our income was at risk? Was it possible that I might lose them along with the job once my financial resources dried up?

All's Well that Ends Well?

By the time this major life challenge has had months to work itself out, I may have encouraging things to say about keeping your chin up, maintaining confidence in your technical talents and the task of finding a good position in a skill-

hungry industry. If you are in a similar position to mine, or suspect there may be an ax upstream of you, these distilled words might be comforting—or as hard to swallow as a picture of a Big Mac. Once I am pulling into the parking lot of my next employer's shiny building, I may have forgotten what it feels like before the happy ending comes into focus. The sense of betrayal, the humiliation and the fear that I am fighting to hold down right now might dissipate into chuckles of "Oh, well, I never *really* believed I'd end up on the soup lines." The view from the bottom has its own lessons to teach.

It's Not a Job, It's a Choice?

Several big life decisions led me to the point of being fired in the second most expensive place to live in the United States. The first of these was more than 15 years ago. I made the decision to abandon programming as a profession and move into systems administration. Like many of you, I enjoy the variety of work the job entails. Systems administration

has both breadth and depth. There are seemingly endless things we must understand and new systems and tools (some of us fondly refer to these as new "toys") forever on the horizon. Anything we have to do more than twice, we automate. This gives us more time to spend "playing" with the latest item in our bag of tricks. We also need to know not only how a tool or service works, but how many such things work together. For many sysadmins, the constrained chaos of our work is very satisfying.

I try to recall the countless times I've had a head-on collision with a problem I'd never seen before. Most of these problems wound up being solved—and in fairly short order. What remains of them is a confidence that being stumped from time to time is OK. I've been there before. I've "think" my way out. And, frankly, most of the major breakthroughs I made in moving from novice to senior sysadmin came from pushing through these "stumped" places. I've even come to welcome problems, in moderation, for the way they shake me up and force me to learn something new.

The second decision, which has left me "marinated in Marin," took place roughly a year and a half ago when I left the Washington, DC, area to move to the West Coast and embark on a new life with a man I'd met and fallen in love with over the Internet. I traded a good portion of my financial and professional stability for a chance at a deeply honest and loving home life. I took a job doing UNIX work and supporting authentication services for a global networking company (Infonet). Once I figured out which side the ocean was on (west equals water, east equals everything else), I was more or less settled. Aside from spending all my free time staring at brake lights on "the 405" (the San Diego Freeway), I was happy in Los Angeles (La La Land).

Roughly six months ago, I moved to the San Francisco Bay area, accepting a lead position in a teensy-weensy software development company. A respectable computer geek, I had met both my step-husband ;-) and my new boss on the Internet. Unlike my previous positions, this one had little need for UNIX wizardry or anything else I do very well. But, as with most teensy-weensy companies, every-

thing I did had a potential impact on whether or not we would succeed. This was a very compelling thought for someone who had spent most of her career buried in the bowels of large IT organizations, never getting a chance to walk on deck to see where we were headed.

What Now?

Being fired is hard on the ego. Years of promotions, awards and accomplishments do little to soften the blow. I have, in my decisions and in my actions, failed. Lacking the hindsight that next month or the month after that might bring, I find myself quoting my dear departed grandfather—"I see" said the blind man to his deaf daughter" (apologies to any challenged readers out there). As long as the worst case scenario is still possible, the platitudes do not suffice. They are like words spoken by someone who doesn't understand to someone who cannot hear.

As for how I will handle job interviews, I will admit to being fired—at least when I am asked. To do anything less would be to base what could be one of

my most significant relationships on deception. If this costs me, so be it. I will explain as simply and honestly as possible the circumstances of the job from which I was fired. Interviewers will not want to sit through half an hour of blood and guts. They will simply want to gauge whether or not I was incompetent or irresponsible.

I will pass my résumé on to friends, visit Web sites to look for career links and make sure I don't miss any of the special interest groups that I have been regularly attending. Any of the like-minded technologists that I meet could be an introduction to a satisfying position. As with secondhusbands, it only takes one.

Finally, I will continue to believe that the profession I have chosen for myself as a Solaris et al. systems administrator is a good choice and needs my talents. ➔

S. Lee Henry no longer works for InCap Corp. She lives on a sailboat with her step-family in Marin County, CA. She would love to hear from other survivors of "the ax." Please send your sympathies and offers of employment to slee@cpq.com.



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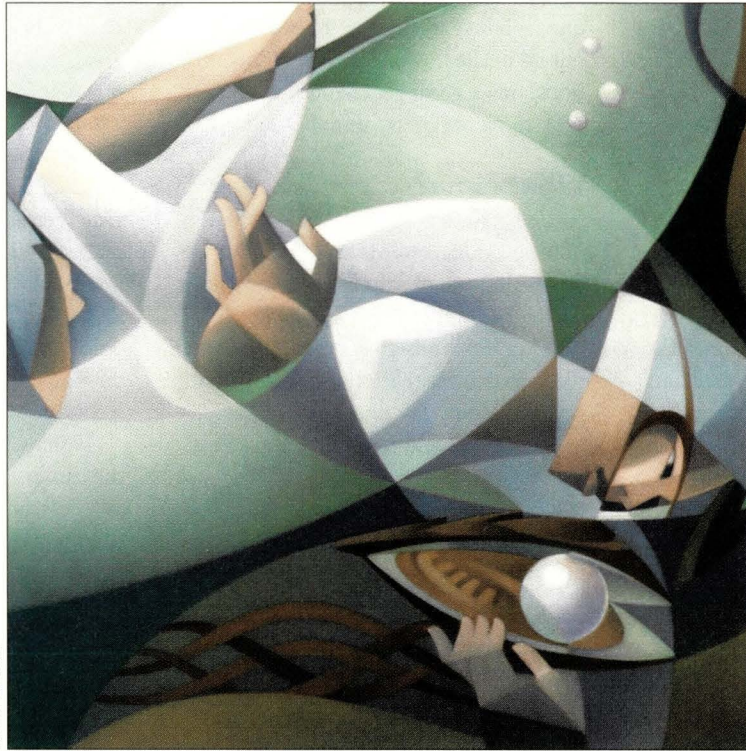


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Perl and Windows NT

As I write this, I have just returned from the second annual Perl Conference in San Jose, CA. As was the case last year, I returned excited about Perl, wanting more time to write programs with it. Given this inclination, I've decided to postpone the second part of my discussion of performance monitoring under Windows NT and devote this column to Perl for Win32.

Perl has many advantages over the built-in Windows NT scripting language. For one thing, it's a powerful command language with all the essential and desirable control structures and data types, including associative arrays/hashtables. Perl's built-in support for basic mathematical operations and regular expressions make actions like expression parsing and arbitrary command output straightforward. In addition, it is very easy to mix regular NT commands—those that are built-in and those provided by third-party tools—into a Perl script. All in all, Perl's features and flexibility have made it ideal for rapidly developing applications.

Despite all these virtues, the earliest

versions of Perl for Win32 were a bit disappointing at times because they were more limited than the UNIX version. While most of the core language became available in the NT environment relatively quickly, the module support for NT was far less rich than that for UNIX. However, this is no longer the case.

Where can you find Perl for Win32? You can get the binaries and source code from the ActiveState Tool Corp. Web site, <http://www.activestate.com>, and the Perl modules from the Comprehensive Perl Archive Network (CPAN) Multiplex Dispatcher site, <http://www.perl.com/CPAN>.

Perhaps the most important event is the release of the so-called merged version of Perl for Win32. Previously, there were two separate versions of Perl for Windows: the distribution prepared by ActiveState and another based on the core Perl distribution. Modules written

for Windows NT and/or Windows 95/98 sometimes worked with only one of the two, unless their developers made a special effort to produce two versions of the module. At any rate, as of August, this state of affairs is no more, and there's now a single, unified Perl for Win32 version.

In addition to the standard features of the language, the Win32 port includes a number of built-in functions, referred to as "extensions," which implement operations unique to that environment. The script in Listing 1 demonstrates the

Listing 1. Script Using Win32 Extensions

```
# exts.pl -- Win32 Extensions Demo

$u=Win32::LoginName;
$n=Win32::NodeName;
$d=Win32::DomainName;
print "Win32::LoginName = $u\n",
      "Win32::NodeName = $n\n",
      "Win32::DomainName = $d\n\n";

($s, $m, $n, $b, $id) = Win32::GetOSVersion;
print "Win32::GetOSVersion =\n",
      " string=$s\n major=$m\n minor=$n\n",
      " build=$b\n id=$id\n";
```


usage of some of these extensions. Here is the resulting output:

```
C:\> perl exts.pl
```

```
Win32::LoginName = Administrator
Win32::NodeName = VALA
Win32::DomainName = BOREALIS

Win32::GetOSVersion =
```

```
string=Service Pack 3
major=4
minor=0
build=1381
id=2
```

Win32::GetOSVersion returns a list of five strings, including the operating system's service pack level, version numbers and build number.

Listing 2. The df3.pl Command

```
# df3.pl

use Win32::AdminMisc;

# Get list of local file systems
@drives = Win32::AdminMisc::GetDrives(DRIVE_FIXED);

print "\n\t\tTotal\tFree\tUsed\nDrive\tFS Type\t MB\t MB\t MB\n",
      "-----\n";

foreach $let (sort @drives) { # loop over drives in order
    Win32::SetCwd("$let");
    $ftype=Win32::FsType(); # Get the type of filesystem

    # Get total space and free space for each drive
    @size = Win32::AdminMisc::GetDriveSpace($let);

    # Convert to MB, compute used space and print
    $tot = int ($size[0] / (1024 * 1024));
    $free = int ($size[1] / (1024 * 1024));
    $used=$tot - $free;
    print "$let\t$ftype\t$tot\t$free\t$used\n";
}
```

In addition to the Win32 extensions, there are various modules available for Perl under NT, including both a "standard" set of modules, known as the Win32 modules, and a set of "unofficial" ones (see "Useful Modules for Perl under NT"). We'll see many examples of them in this column.

One of the UNIX utilities I miss most on Windows NT systems is `df`. Listing 2 shows the Perl script I am currently using to remedy this deficiency. Here is an example of its use:

```
C:\> perl df3.pl
```

Drive	FS Type	Total MB	Free MB	Used MB
C:\	NTFS	598	104	494
D:\	NTFS	1364	1178	186
E:\	NTFS	1342	1332	10
F:\	NTFS	250	13	237
G:\	NTFS	439	118	321
H:\	FAT	499	148	351

Listing 3. User Account Management Facility

```
# newpass.pl

use Win32::NetAdmin;
use Win32::UserAdmin;
use Getopt::Std;

# Make sure we're who we should be
exit if (not Win32::IsWinNT());
$whoami=Win32::LoginName();
if (not ($whoami eq "Administrator" or
    Win32::NetAdmin::LocalGroupIsMember
        ("", "Administrators", $whoami))) {
    print "$whoami is not an administrator account\n"; exit; }

# Parse command line args: -g <group> -- specify group
#                               -l -- verbose output
getopts('lg:');
$logging=$opt_l;
$group=( $opt_g ne "" ) ? $opt_g : "Domain Users";

Win32::NetAdmin::GetGroupMembers("", "$group", \@userlist);
foreach $user (@userlist) {
    chop;
    Win32::UserAdmin::UserGetAttributes("", $user, 3, \%stuff);
    $stuff{"USER_PASSWORD_EXPIRED"}=1;
    Win32::UserAdmin::UserSetAttributes("", $user, 3, \%stuff);
    print "Processed user $_\n" if $logging;
}
```

This example lists the drive letter, file system type and total, free and used space (in megabytes).

The script shown in Listing 2 uses the module `AdminMisc` (written by Dave Roth) and the extension `Win32::FsType`. The `GetDrives` function returns an array containing all of the drive letters requested by the caller (in this case, we've asked for only those corresponding to local disk partitions) and the `GetDriveSpace` function returns an array containing the total and free space within the partition as its two elements (both expressed in bytes). The final section of the script converts these values to megabytes, computes the amount of used space and prints the output line for each drive in turn.

As a systems administrator, I find the command-line user account management facilities somewhat lacking under Windows NT. Perl is also an appropriate tool to fill this gap. Listing 3 presents a simple example of this: a script to force all of the users within a specified local group to change their password at their next login (something that is wise after certain sorts of security events have occurred).

The script begins by specifying the modules it will be using. It then checks that it is being run on a Windows NT system by either the Administrator user account or a member of the Administrators

Listing 4. Perl Script Using Tk Module

```
# motd.pl
use Tk;

# Translate the MOTD_DIR envir. variable
$dir = $ENV{"MOTD_DIR"};
if ($dir == "") { $dir = ".\\"; };
# Open the text file
open MOTD, "$dir\Motd.TXT" || exit;

# Get the date from the file's first line
$first_line=1;
while (<MOTD>) {
    if ($first_line) {
        chop;
        ($date,@junk)=split();
        $first_line=0;
    } # Append everything else to this variable
    else { $text_block .= $_; }
}

# Create and fill the window ...
my $main = new MainWindow;
$label=$main->Label(-text => "Message of the Day");
$label->pack;
$text=$main->Scrolled('Text', -relief => "sunken",
                    -borderwidth => 2,
                    -setgrid => "true");
$text->insert("1.0", "$text_block");
$text->pack(-side=>"top", -expand=>1, -fill=>"both");
$status = $main->Label(-text=>"Last updated on $date",
                    -relief=>"sunken",
                    -borderwidth=>2,
                    -anchor=>"w");
$status->pack(-side=>"top", -fill=>"x");
$button=$main->Button(-text => "Close Window",
                    -command => sub{exit});
$button->pack;
MainLoop;           # Tk's main event loop
```

Useful Modules for Perl under NT

Standard Win32 Modules

Win32::ChangeNotify	Routines to monitor file system changes.
Win32::Eventlog	Routines to read/save event log entries.
Win32::NetAdmin	Routines to determine the primary domain controller, create/modify user accounts and administer groups.
Win32::NetResource	Routines to manipulate shares.
Win32::Process	Routines to create/kill/suspend/resume a process, set a process's priority class and other controls.
Win32::Registry	Routines to display/modify registry keys.
Win32::Service	Routines to query/manipulate services.

Other Useful Modules

Win32::AdminMisc	Enhanced user account administration routines.
Win32::UserAdmin	Enhanced user account manipulation routines.
Win32::FileSecurity	Routines to display/modify access control lists.
Win32::OLE	Routines to exploit OLE capabilities via Perl programs.
Win32::Shortcut	Routines to create/manipulate Windows NT shortcuts.
Tk	Routines for creating GUIs.
Tie-Registry	Alternate method for accessing registry via a tied hash.
Win32API	Facility to run a standard Win32 API function via Perl.

group (exiting if these conditions are not met). Then the script processes its command-line arguments using `Getopt`. Finally, the script retrieves the list of users in the group specified on the command line (or the Domain Users group if the `-g` option is omitted). It then uses the `UserGet/SetAttributes` routines from the `UserAdmin` module (written by Ashley Meggitt and Tim Ritchey) to retrieve information for each user account and set the password-expired flag. These routines require a reference to a hash as their final argument (after the server name, user account name and detail level); the assignment statement between the two function calls illustrates the method for modifying one of the hash's component values.

There are several facilities for creating graphical objects from within a Perl script, including the `Win32::GUI` and `Tk` modules, I prefer the latter because it allows me to create scripts that will work unchanged on both UNIX and NT.

Listing 4 shows a simple Perl script using the `Tk` GUI facility. It is designed to be run from each user's login script and creates a graphical Message of the Day window. The script locates and opens `Motd.TXT` and then extracts the date stored in the file's first line. The rest of the file is placed into the script variable `$text_block`.

The second half of the script contains the `Tk` function calls necessary to create and display the various window items the user will see, including a scrollable text area, a status area and a Close Window button. As each item is created, its attributes are specified and it is activated via its `pack` method. The final line is the routine that runs the event loop and handles user interactions with the window and its components.

As a final example, consider the script below. It stops and restarts the service specified as its argument:

```
# cycle.pl
use Win32::Service;

exit if $ARGV[0] eq "";      # no service given
$service=$ARGV[0];
print "Attempting to cycle service $service ...\n";
Win32::Service::StopService('', $service);
Win32::Service::StartService('', $service);
```

Of course, the `net stop service & net start service` command will perform the same function just as easily. However, if you want to include more complicated logic for determining which service to cycle and whether or not to do so, the Perl script can be easily extended to add such features.

One area we have not had time to look at is how one can access the NT registry from within a Perl script. There are a couple of different options for this, but they will have to wait for a future column. In the meantime, I hope these examples have inspired you to look into Perl for Windows NT. If you have any specific questions about Perl under NT that I can address in a future column, drop me an email. ➔

Aleen Frisch is systems administrator for a very heterogeneous network of UNIX and NT systems. She is the author of Essential System Administration and Essential Windows NT System Administration (both from O'Reilly & Associates Inc.). Email: aefrisch@lorentzian.com.

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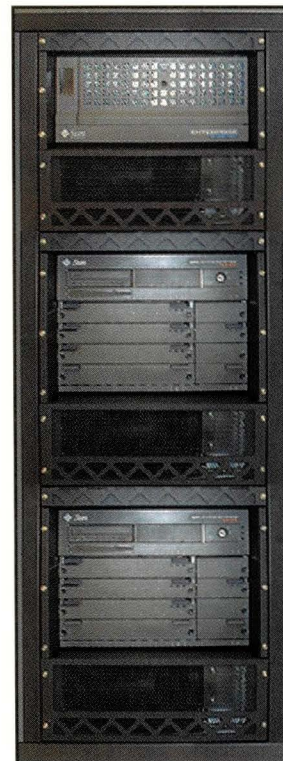
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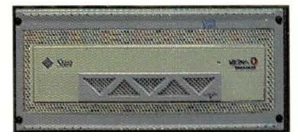
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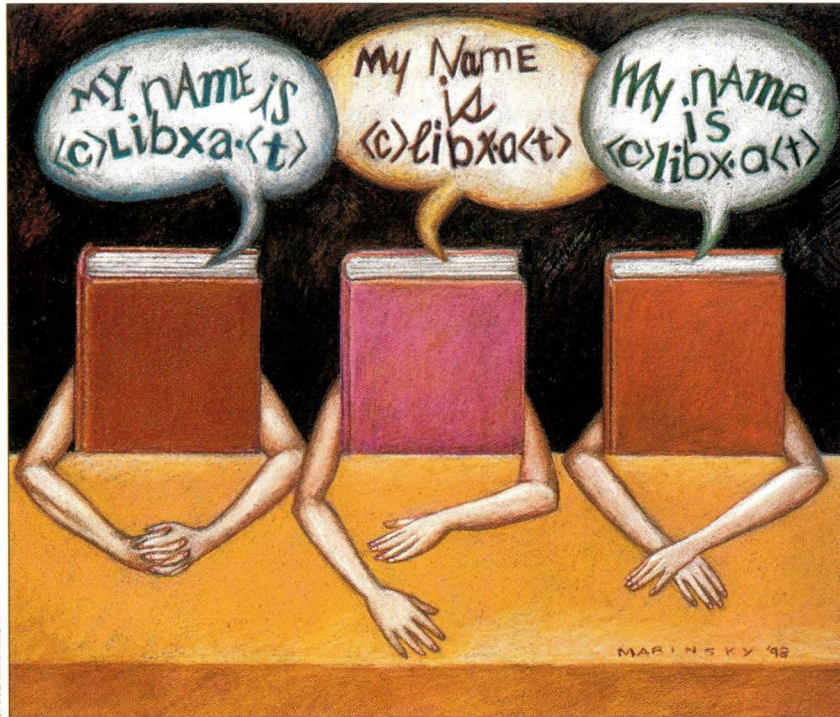

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Circle No. 22

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Two Routines, Same Name

Q: I have a problem trying to link with two incompatible libraries. Each has a procedure I want to use. The problem is both procedures use the same name. How can I call two different procedures that take the same name?

I tried having one of the names changed, but was told that's unlikely to happen. Is there a way around this? ▲▲▲

Anonymous

A: Don't you hate it when that happens? Actually, your problem isn't as rare as you think. I encountered a similar difficulty some time ago while trying to link a program that used both Distributed Computing Environment (DCE) and Kerberos. As you may recall, DCE security is derived from a version of Kerberos and carries with it many of the same routine names. It happens that this particular problem is easily solved.

The AIX loader allows us to rename symbols in libraries and other object files. In this case, we want to build a part of the program—the module—that

calls one of the redundant names, renames the conflict and then uses the resulting object file as input to the final program load.

Suppose we have an existing program that uses a function, `cos`, from a homemade library, `libx.a`. Let's imagine "cos" stands for "class of service" and so, at the time of its writing, `cos` was a reasonable name. Now suppose we have to make some changes to the program and need to compute the cosine of some angle using the `cos` routine from `libm.a`. The problem is there are too many programs using `libx.a` to easily change all of them, and IBM Corp. and the various standards boards are not likely to rewrite the math libraries either. Somehow, we must load two different `cos` routines into the same program.

The task will be more difficult if we try to access both copies of `cos` from the same source file:

```
...
/* Find the class of service */
d = cos("david");
```

```
...
/* Get the cosine of ang */
c = cos(ang);
...
```

In this case, neither the compiler nor the linker could figure out what's being asked.

How to proceed depends on how easy it is to change the conflicting calls. We have several choices. Suppose we separate the new routines that use the math library into a single source file, `mtools.c`. We want to be able to prelink these tools with the math library, rename all `cos` references in the prelinked file and link the modified module into the program. A makefile used to do this might resemble the one shown in Listing 1.

There are some points to note. First, we also renamed the `__start` symbol. This is the default entry point to a program. You may be able to avoid this by not specifying `-bnogc`, but then you have to manually export all your symbols. I think my way is easier. Second, each symbol has a "dot" form as well. I don't

Listing 1. Makefile to Rename Symbols

```
# make a tools library from our mtools source
# renaming the cos and __start symbols

math_lib.o:    mtools.o
    cc -o tools.o math_lib.o \
        -berok -bnoglink -bnox -bnogc \
        -lm \
        -brename:cos,NOTcos \
        -brename:.cos,.NOTcos \
        -brename:__start,NOT__start \
        -brename:.__start,.__NOTstart

# make the product using the tools library
$(PROD):      $(SUBS) math_lib.o
    cc $(OPT) -o $(PROD) $(SUBS) math_lib.o
```

know what each one is for, but it seems best to rename both. Third, we also specified several `-b` options. The documentation tells us that the `-r` loader option is equivalent to the collection: `-berok -bnoglink -bnox -bnogc`. However, that doesn't always work. The compiler also uses a `-r` flag, which tells it to keep compiling even when there are serious errors. You may recall that the compiler passes all unused options on to the linker. If the compiler happens to use the `-r` option, it doesn't get sent to the linker.

Experience seems to indicate that if the compiler is actually invoked (that is, you have `.c` files) `-r` does not get passed. If, on the other hand, you don't actually compile anything (no `.c` files) then `-r` does get passed. Safety suggests using the explicit parameters.

An alternative solution is to change the name we use when calling the duplicate procedure. This is feasible only if we are calling that procedure once or twice; otherwise, it complicates the code. We can rewrite our first example as follows:

```
...
/* Find the class of service */
d = cos("david");
...
/* Get the cosine of ang */
c = mlib_cos(ang);
...
```

where we pretend the math library procedure is now called `mlib_cos`, instead of `cos`. Next, we have to create such a math library. It's not very difficult.

```
cc -o math_lib.o \
    /usr/lib/libm.a \
    -berok -bnoglink -bnox -bnogc \
    -brename:cos,mlib_cos \
    -brename:.cos,.mlib_cos \
    -brename:__start,__NOTstart \
    -brename:.__start,.__NOTstart
```

Now link the program with

```
cc -o prog prog.o \
    math_lib.o.
```

Whenever possible, I use the former method, that is, prelinking the procedures that conflict. It has the advantage of always calling routines by their proper names. You must always take steps to ensure that subsequent readers of the code know what's going on.

The problem of conflicting names sometimes arises when people try to mix FORTRAN and C. Both languages have `getenv` procedures that retrieve environment variables. The two are incompatible, of course. Usually, one prelinks the lesser-used language and renames that version's `getenv`, as we described above.

My Experience

The only example I have personally encountered happened when I needed to incorporate Kerberos password checking into a program that used DCE Remote Procedure Calls (RPCs) for communication. DCE's security is similar to, but incompatible with, Kerberos, so I knew there would be symbol conflicts when I tried to load both libraries. In this case, I didn't know ahead of time which symbols would be duplicated, but I knew there would be several. To find them, I linked all the objects without using any renames. I prebuilt the Kerberos portion and renamed every symbol that showed up as a duplicate.

All this can be avoided by choosing symbol names wisely. That is why, as we grow as programmers, we tend to use longer names for our procedures—especially when those procedures are going into a common library. →

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.

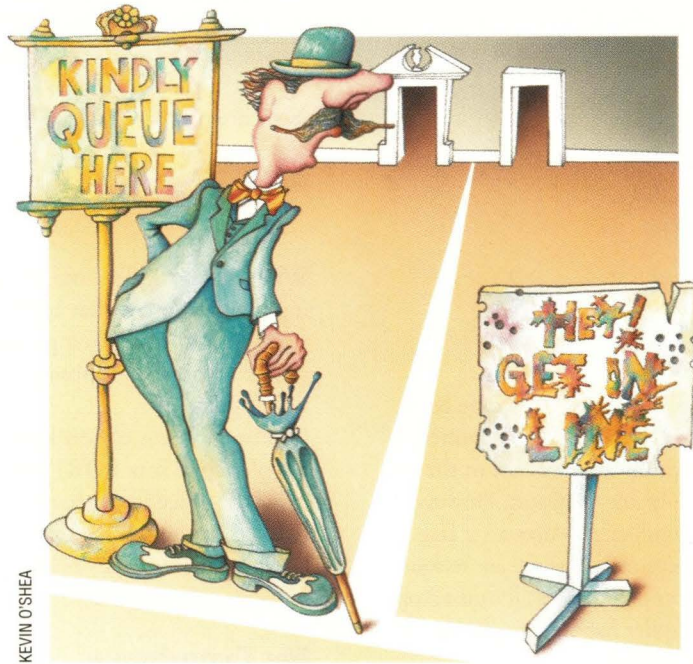
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Datagrams

by John S. Quarterman



Request Systems

In previous columns I've mentioned various request queues, otherwise known as, or related to, trouble ticket systems, help desk management, call tracking, bug tracking, problem management or project management. (There are subtle distinctions among these terms, but I won't distinguish them here.) If you only need one request queue, any number of software packages will work. This month, I will describe three: `req`, JitterBug and `wreq`.

req: An Old Standby

The request queue system we have used for years is `req` (see `ftp://ftp.ccs.neu.edu/pub/sysadmin/`). It's a great improvement over having no request queue at all, I can assert unequivocally. Without a system like this, you end up with everyone trying to keep copies of all relevant messages in their own mail folders and no common corporate memory.

We have traditionally used `req` to record customer requests as they come in

via telephone, fax, email or the Web. Telephone and fax requests require front-desk personnel to type them in and send them into the request queue by email; the other two forms of request are automatically sent by email into the request queue system. When `req` sees an incoming message with no item number, it assigns one and keeps the item number in the `Subject`: line:

```
Subject: [MIDS-12134]
Internet host information
```

Most mail user agent software packages will preserve the `Subject`: line on replies, so `req` can file further messages in that thread together. We usually discuss each item internally via email. Sometimes, we change the text of the `Subject`: line to something more informative than what the user originally sent, for example,

```
Subject: [MIDS-12134] hosts
per county
```

The request queue system can still track a message for the item as long as the magic code, in this example, `[MIDS-12134]`, remains the same. This is the method most request queue systems use for filing messages by subject. It even works for reply messages sent to the user who made the request, because their mail system will usually preserve the magic code in the `Subject`: line as well.

`req` has a powerful command-line interface, which can assign items to specific staff members, set priorities and resolve, reopen or merge items, among other things.

The command-line function our staff uses the most is for viewing the recorded messages in a queue item. A typical item may come in from the customer one day, get a response from one of our statisticians the same day, a response from a programmer the following day and the original front-desk operator who recorded it may need to respond to the customer on a third day. Our staff is often handling several tasks at once and no one can be

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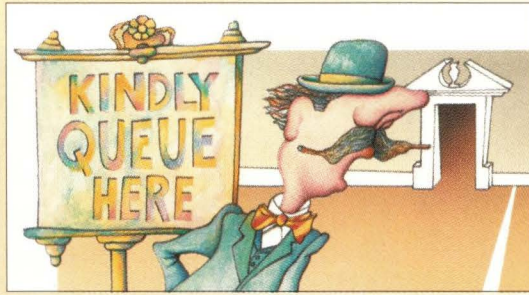
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The biggest problem with req in my opinion is it isn't designed to support multiple queues.



expected to remember all the interleaved details of each one, so it is necessary to be able to refer to what has been going on in each case.

In addition, a new customer request may be similar to one we have already answered from another customer in the past. The old item is often still in the queue and so we can find and review it.

There is no Web interface to `req`. There is no easy way to separate two or more items once they have been merged. This can become a big problem if an overzealous staff member merges several items that are not related.

The biggest problem with `req` in my

opinion is it isn't designed to support multiple queues. As the number of staff members and customers increases, the number of messages everyone sees related to the queue increases rapidly. Simply wading through mail takes up a lot of everyone's time and can become annoying when we don't actually need to do anything with most of the messages passing by. One way to alleviate such traffic is by having several smaller, more focused queues. This can be done with `req`, but only by modifying the software or installing it as several different, complete software installations.

A Single-Queue System

A nice new single-queue request system is JitterBug (see <http://samba.anu.edu.au/jitterbug/>). It has a clean Web interface with no frames or Java, just HTML and CGI via a single C program. It uses the Web server's authentication—it doesn't require its own additional authentication—and has Frequently Asked Questions (FAQ) support.

One of the drawbacks of JitterBug is it expects all updates to queue items by support personnel to be done via the Web interface, not via email. And, as mentioned, it only supports one queue at a time. You can run multiple copies of JitterBug, but that doesn't address the need to move items between queues. Nonetheless, one copy of JitterBug for one queue per project is how the Samba team, Jitterbug's authors, use it. For example, there is a JitterBug for Samba itself (<http://samba.anu.edu.au/samba/>) and a JitterBug for `rsync` (<http://samba.anu.edu.au/rsync/>), which is one of my favorite new Internet facilities.

wreq: For Multiple Queues

The request queue system we are currently using is `wreq` (see <http://www.math.duke.edu/~yu/wreq/>). `wreq` has many advantages, the most important to us being that it can handle multiple queues with little setup overhead. The user interface is Web-based, which means most people shouldn't need much training to use it.

`wreq` has some disadvantages. The Web interface is unnecessarily baroque in that it requires both frames and JavaScript. It is complicated and has its own authentication login and password in addition to those handled by the Web browser. There is also no command-line interface, so there is no alternative to the Web interface.

Of course, there is the argument that `wreq`'s Web interface is complicated because the program has many features and functions. While that can be interpreted as another definition for baroque, there is nonetheless some substance to that argument.

`wreq` has facilities to handle several types of information that apply across

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queues. These are FAQs, Technotes (like FAQs, but not necessarily in direct answer to questions), syslogs

wreq supports the concept of cooperating wreq servers. This can be very useful in a distributed environment.

(presumably for system logs) and even something called SOS (which are general calls for help from stymied support personnel). Text from items in FAQs or Technotes can be included in responses to regular group items. You can

also turn a regular queue item into a FAQ or Technote item.

There are also the usual active and resolved pieces of each group. For each one of these, you can assign an owner and a priority, you can move an item to another group or merge it with another

item in the same group, you can resolve it and unresolve it and, most important, you can review the messages recorded for an item. These are the kinds of functions we look for in a request queue system.

But here's what I mean when I say the Web interface is baroque. Regarding wreq's own login sequence, the entry to it is through the bottom right of the lower-right frame. How do you know to look there? Well, either somebody tells you or you eventually stumble on it.

Meanwhile, how do you merge two items? First, you log in. Second, you must select a queue. Third, you must select an item and, finally, you select merge. You may be wondering, where does it say "merge?" Not in the list of commands in the lower-left frame, but below the item text in the lower-right frame. You can't see it if the queue item contains more than a few lines unless you have a very large screen or you scroll down past the message. Obvious, eh? Nonetheless, it does work.

Digging around in the Web inter-

face reveals some useful unheralded features. For example, there are automatically compiled statistics concerning numerous aspects of usage that should satisfy most desires for overviews and avert the necessity to write a special report generator (as we did for req). Fortunately, most interaction with wreq is via email, as is the case with req.

Finally, wreq supports the concept of cooperating wreq servers, so you can delegate some groups to one server and other groups to another. This can be very useful in a distributed environment.

With wreq, we now have separate lists for categories, such as customer requests, specific software projects, systems administration, accounting, statistics, public relations, legal, medical and



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dental. OK, those last two are just jokes, but it's probably only a matter of time. Each list is distributed only to those personnel who need to use it in the course of daily business. For example, staff members on the accounting list are almost completely different from those staff members on the statisticians list. Thus, the statisticians don't need to listen to all the accounting chatter, or

vice versa. Yet anyone who needs to look at an item in any queue can do so through the usual `wreq` Web interface. And, while it was necessary to have someone in charge of assigning each item to an owner with a single, large `req` queue, it is less important with the multiple, smaller `wreq` queues because there is a one person responsible per queue.

Many thanks to Yunliang Yu and his cast of supporting developers at the Duke University mathematics department for writing `wreq`. I wouldn't be so hard on it if I didn't think it was useful enough to deserve the scrutiny.

Other Request Systems

There are a number of alternative systems out there. The JitterBug Web pages point to two lists of request queue and related systems:

- Dave Eaton's Problem Management Tools Summary, <http://www.iac.honeywell.com/Pub/Tech/CM/PMTTools.html>

- Linas Vepstas' Project Management and Bug Tracking for Linux, <http://linas.org/linux/pm.html>

Note there are some errors in these lists; for example, the latter claims RUST (or Requests, Users and Sysadmin To-do tracking system) is actively maintained. But as long as you're willing to carefully review any item before you actually use it in production, these lists are a great resource. →

John S. Quarterman is president of Matrix Information & Directory Services Inc. (MIDS), which publishes Matrix Maps Quarterly, Matrix News (monthly) and the MIDS Internet Weather Report (daily). John has written or coauthored seven books, but the best known one is still The Matrix. For more information, see <http://www.mids.org>. He can be reached by email at jsq@mids.org, by voice at (512) 451-7602 or by fax at (512) 452-0127.

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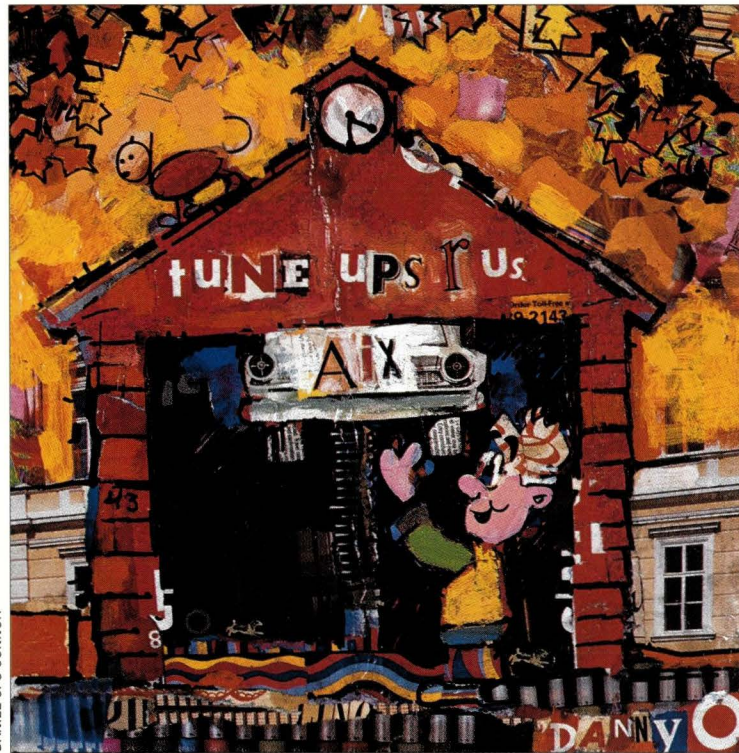
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DANIEL C. O'CONNOR

AIX Tune-Up

System monitoring and tuning; it's a tough job, but somebody's got to do it. Although hardware is getting cheaper by the day, most of us still don't have an unlimited equipment budget. This means making do with what we have. So, when the masses begin to wail, "Why is my email so slow?" it's time to roll up your shirt sleeves, pop the hood and start tweaking the operating system to squeeze a bit more headroom from the existing resources.

Performance tuning is an endless cycle of gathering state information, estimating and modeling resource demand trends and adjusting system variables to meet those estimates. Workloads rarely remain static. Over time, the resource and process mixtures change; applications are modified or replaced; and the hardware and network environment evolves. This means your tuning profile must also wax and wane to meet the workload and resource profiles. The hardest part is developing procedures for gathering pertinent historical data

to build workload models.

Before you begin the tuning process, you must first assemble a reliable set of workload trend information. You have three options when it comes to collecting and aggregating usage data. You can a) monitor each subsystem individually with the standard UNIX tools and then manually correlate the data from the various subsystems; b) use an automated tool that acts as a wrapper, combining the output from the various UNIX monitoring commands (these tools collect and reformat the data to provide systemwide views and historical trend reports); or c) let someone else do all the data collection and report generation for you. As we shall see, option c) isn't just a systems administrator's pipe dream.

Roll Your Own

If you prefer to do system monitoring the old-fashioned way, then take a look at the commands listed in Table 1 and Table 2. Even if you elect to use one of the automated tools, it's a good idea to

familiarize yourself with the basic commands to better understand how data is collected. To gain access to the full set of AIX monitoring commands and tools, you will first need to install the `perfergent.tools` fileset.

Begin by looking at overall system performance with tools such as `sar` and `ps`. Once you've collected enough information to identify particular problem areas, you can zoom in by using commands tailored to particular subsystems. Examples of such tools include `iostat` (for I/O subsystems such as disk and tape), `vmstat` and `svmon` (for virtual memory and paging) and `netstat` (for network statistics). Tools such as `trace`, `filemon`, `gprof` and `tprof` are helpful when you've narrowed your focus to individual applications and/or datasets. In addition, you can experiment with different system configurations using commands such as `rmss`, to simulate real memory constraints; `schedtune`, to modify scheduler parameters; and `vmtune`,

to test virtual memory settings. Then, to optimize your file system and disk volume configurations, use `fileplace` and the various logical volume commands.

Automated Monitoring Tools

For those of you who prefer a single-interface GUI tool for collecting performance data, IBM Corp. has repackaged a number of standard UNIX performance monitoring commands into a set of three diagnostic and capacity planning tools called Performance Diagnostics Tool (PDT), PerfPMR and Performance Toolbox. Each tool is installed as a separate fileset on AIX and is available from IBM. PDT and PerfPMR are part of AIX V4 but are not installed by default. Performance Toolbox is an add-on application for AIX and is not part of the base operating system.

PDT is a system monitoring tool that runs as a daemon and generates daily reports to `/var/perf/tmp/PDT_REPORT`. The `pdt_config` command is used to configure data collection options and to start the PDT monitor. PDT is usually run under `cron` to take snapshots of system activity at specified intervals and to generate associated reports. It provides a high-level view of the overall system but isn't very specific when it comes to identifying problems with individual subsystems. PDT is a good general-purpose reporting tool when used in conjunction with utilities that provide additional subsystem detail. PDT components reside in the `/usr/sbin/perf/diag_tool` directory.

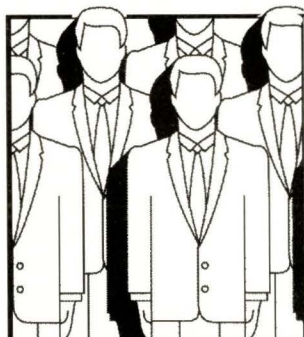
PerfPMR is designed to gather system statistics geared toward problem reporting and resolution. After installing the fileset, invoke the `perfpmr` command during your heaviest workload to create a baseline profile of your environment.

Run the `perfpmr` command again when you have made adjustments to the system. The two performance datasets can then be compared to gain insight into optimum resource configurations. PerfPMR resides in the `/usr/sbin/perf/pmr` directory and generates output to `/var/perf/tmp`.

Performance Toolbox is a graphical tool for collecting and displaying system performance information. It is an excellent crystal ball for looking at system-wide usage statistics in real time. Data for monitored systems are collected by local or remote server daemons, which can then be referenced via the X11/Motif-based client, `Xmpref`. The client

Even if you elect to use one of the automated tools, it's still a good idea to familiarize yourself with the basic commands.

can be tailored to display particular subsystem information using graphs, charts, dials or text. You can also use the client to perform custom correlations between subsystem data elements. For more information on Performance Toolbox, see the IBM redbook "Performance Toolbox for AIX Guide and Reference," SC23-2625.



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Table 1. Standard UNIX Tools

uptime, rup	Load averages and current users.
ps	Process table statistics.
sar	Snapshot of system activity.
vmstat	Process queue, memory, paging, interrupts, CPU statistics and so on.
iostat	Usage statistics on CPU/IO subsystem.
pstat	Display contents of various systems tables.
netstat	Information on network activity.
nfsstat	Information on NFS/RPC interfaces.
Acctcom, Acctcms	Process/display accounting information.
gprof, time, timex	Application profiling/usage statistics.

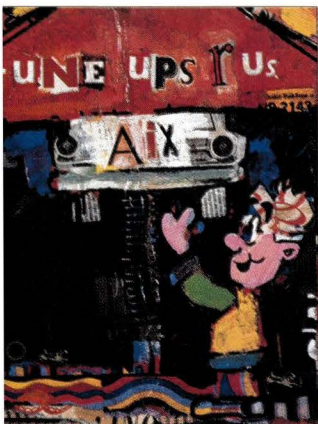
Table 2. AIX-Specific Tools

trace, trcrpt	Record/report system events.
filemon	File system performance information.
fileplace	Tune file placement on logical/physical volumes.
rmss	Simulate real memory configurations.
svmon	Snapshot of virtual memory.
netpmn	Monitor network activity.
no	Set network variables.
lockstat	Report kernel lock statistics.
tprof	Profile an application.
schedtune	Set scheduler parameters.
vmtune	Set virtual memory parameters.
lslv, lvmake,	Display/tune logical/physical volumes.
lvedit, lvextend,	
reorgvg	

You'll also want to look at the public domain `monitor` package written by Jussi Maki, a programmer for the Center for Scientific Computing in Finland. The package provides near-real-time statistics on CPU, memory and I/O usage. An ASCII text-based interface allows it to be used with most display types. `monitor` is similar to the `top` program found on other flavors of UNIX. This is a nice tool for gathering quick snapshots of system state during periods of peak resource demand. It supports both uniprocessor and multiprocessor systems. In the latter case, `monitor` does a nice job of breaking down workload by processor on a single screen. On the downside, `monitor` does not retain historical data. The `monitor` system may be downloaded via anonymous FTP to `ftp://aixpdslib.seas.ucla.edu/pub/`.

Let Someone Else Do the Work

The simplest solution to system monitoring is to let someone else do the work for you. IBM has stepped up to the task and will provide basic monitoring and monthly reporting for free! All you have to do is obtain the System Expert for AIX software on CD-ROM or download it via `http://systemexpert.services.ibm.com`. You must register each system you'd like monitored. The software will audit system performance, hardware/software configuration changes and security exposures. System data is sent to a collection server via network or dial-up connection. The server analyzes the data and generates reports and alerts, which are sent to the customer.



In addition, a for-fee, full-service offering is available, which provides the customer with additional report detail, including daily reporting, alert notification and a real-time display interface called the Real Time Viewer (pricing is based on registered

configuration). The viewer runs under X11/Motif or Netscape Communications Corp. browsers. System Expert for AIX is supported for AIX 3.2.5 and 4. For more information, contact your local IBM sales office, visit the System Expert Web site or call 1-800-CALLAIX.

Time for a Tune-Up

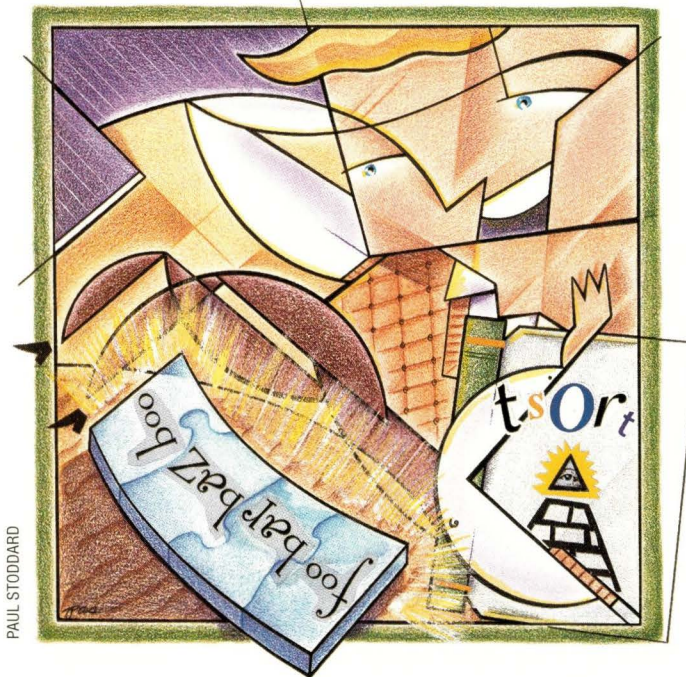
The problem with articles like this one is they never tell you how to fix your particular performance problem—that's because everyone's workload and configuration profiles are different. Only you know your environment well enough to experiment with different configurations and make changes to production systems; that's why they're paying you the big bucks, right? The bottom line is know your workload. If you're lucky, you can achieve some constraint relief by simply reorganizing your application scheduling. The CPU and memory subsystems are probably the next easiest subsystems to explore. While, tuning the I/O subsystem is probably going to take the most effort. I recommend reading *Accelerating AIX: Performance Tuning for Programmers and System Administrators*, by Rudy Chukran (published by Addison-Wesley Publishing Co., 1998, ISBN 0-201-63382-5). The book is designed for both systems administrators and program developers. It describes in detail how to monitor and tune AIX and application programs.

IBM is willing to monitor your system for you and *Accelerating AIX* will tell you how to use the tools described above to improve performance. Nothing can hold you back now. It's time for a tune-up. →

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.

Work

by Jeffreys Copeland and Haemer



Novus ordo seclorum.
– The Great Seal of the
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Puzzle Posters, Part 2

This column is a continuation of last month's. Let's briefly review how we got here. First, perusing `comp.lang.perl.misc`, we found an interesting puzzle posted by Tim Bunce (shown below).

One response to Tim's puzzle came

from Nat Torkington: "You install a full set of tools, like the Lord God Almighty intended. *Repent, ye prisoner of Bill! The Day of Judgement is at Perl! Your messengers are obviously just poor substitutes for reliable pipe communication, which you'd have if you had a real operating*

system and not a scurrilous piece of tool-challenged coprophilia!"

Not only did we think the response was funny (it parodies postings by Nat's friend and coauthor Tom Christiansen), we also realized Nat was correct: preprocess the data, then pipe it to that venerable UNIX utility, `tsort`.

We sent our solution to Tim and he wrote back saying that Nat had been right for another reason: his operating system (from some company in Redmond, WA) doesn't come with a `tsort`. We volunteered to write Tim one in Perl.

Lazily, we simply looked up a `tsort` implementation from Jon Bentley's book, *More Programming Pearls*, published by Addison-Wesley Publishing Co., 1988, ISBN 0-201-1189-0. Bentley, in turn, reused the algorithm from Don Knuth's *The Art of Computer Programming*. (We might have done the same thing, except someone has walked off with our copy of Knuth.)

Finally, we wrote a column explaining the overall solution and promised we'd

A list of names in a specific order is given to a set of messengers in a remote land. The messengers travel independently to a destination where they give the names to you. The problem is that the messengers quite often, say 70%, miss out one or more names and occasionally, say 10%, get the order wrong. Names are never added, repeated or changed, only missed or reordered. The messengers always think they've got it right. For example,

Original list:	foo bar baz boo
Messenger A says:	foo bar boo
Messenger B says:	bar boo baz
Messenger C says:	foo bar baz boo
Messenger D says:	boo foo bar baz
Messenger E says:	foo bar baz
Messenger F says:	foo baz boo

The problem is to find the full list of names and the original order.
Tim

Listing 1. Our Perl Code

```

1  #!/usr/local/bin/perl -w
2  # $Id: tcsort,v 1.5 1998/08/04 20:29:07 jsh Exp jsh $
3  use strict;
4  use vars qw($opt_b $opt_d);
5  use Getopt::Std;
6  my $usage = "usage: $0 [-b|-d] [filename]\n";
7  getopts("bd") or die $usage;
8  die $usage if ($opt_b && $opt_d);
9  my %pairs;# all pairs ($l, $r)
10 my %npred;# number of predecessors
11 my %succ;# list of successors
12 while (<>) {
13   my ($l, $r) = my @l = split;
14   next unless @l == 2;
15   next if defined $pairs{$l}{$r};
16   $pairs{$l}{$r}++;
17   $npred{$l} += 0;
18   ++$npred{$r};
19   push @{$succ{$l}}, $r;
20 }
21 # create a list of nodes without predecessors
22 my @list = grep {!$npred{$_}} keys %npred;
23 while (@list) {
24   $_ = pop @list;
25   print "$_\n";
26   foreach my $child (@{$succ{$_}}) {
27     if ($opt_b) {# breadth-first
28       unshift @list, $child unless --$npred{$child};
29     } else {# depth-first (default)
30       push @list, $child unless --$npred{$child};
31     }
32   }
33 }
34 warn "cycle detected\n" if grep {$npred{$_}} keys %npred;
35 =head1 NAME
36 tcsort - topological sort
37 =head1 SYNOPSIS
38   tcsort [filename]
39 =head1 DESCRIPTION
40 =over 2
41 Does a topological sort of input pairs.
42 For a more complete description, see the tsort(1) man page,
43 For a fine explanation of the algorithm, see the October 1998
44 Work column in SunExpert, or the references given below.
45 =back
46 =head1 OPTIONS AND ARGUMENTS
47 =over 8

```

write a second column about `tsort` implementation. This is it.

So what's a `tsort` and why does UNIX have one, anyway?

Suppose you have a list of ordered pairs. Turning them into a single, ordered list, in which the second element of each pair is always after the first, is called *topological sorting*. The `tsort` utility performs topological sorts.

An example will help. If you know that A is before B, A is before C and B is before C, then the correct list order is A B C.

Things are not always this simple, however. Suppose, for example, we add more information: A is before Z and Z is before C. Now, the order could be A B Z C or A Z B C. Either of these two orders is a correct topological sort of the input data.

"But Z and B could be tied," you helpfully point out. Sure. This is even a problem with regular sorts. If we sort the following numbers, 2 1 3 2 2, the number twos can come in any order. `tsort` and `sort` try only to produce a single, ordered list consistent with the data. `tsort`'s only restriction is that there must be no cycles in the input data. If A is before B, B is before C and C is before A, `tsort` is stumped.

(The three number twos in our example remind us that there are sentences that you can speak but cannot write. For example, "There are three 'tuuz' in the English language: 't-o,' 't-o-o' and 't-w-o.'" Out loud, this sentence is factual and not at all artificial. Putting it on paper requires either rewording the sentence or using an artificial spelling, such as "tuuz," that you won't find in any dictionary. This lovely example is courtesy of the late Col. Alan G. Haemer, U.S.A.F.)

But why does UNIX come with a special utility to do topological sorting? Who uses it?

One way to find out is to look through all the executables in your path for any use of `tsort`:

```

for i in $(echo $PATH | sed 's:/ /g')
do
  grep -l tsort $i/*
done

```

The only utility we could find when we did this was `x11perfcamp`. Note that if you `grep` for `sort`, instead of `tsort`, you'll see a big difference.

"But surely," you say, "this can't be all it's used for." Correct. And herein follows a history lesson.

Back in the old days, computers were much slower; you could often go out for coffee while your programs compiled and linked. Programmers did all sorts of things to minimize compilations that we no longer have to do, such as actually thinking about code before compiling it. One thing that helped

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```

48 =item B<[-b|-d]>
49 breadth-first or depth-first (default) traversal
50 =item B<filename>
51 Optional input file.
52 Input format is pairs of white space-separated fields,
53 one pair per line.
54 Each field is the name of a node.
55 Output is the topologically sorted list of nodes.
56 Ignores lines without at least two fields.
57 Ignores all fields on the line except the first two.
58 =back
59 =head1 AUTHOR
60 Jeffrey S. Haemer, <jsh@boulder.qms.com>
61 =head1 SEE ALSO
62 tsort(1), tcsh(1), tchrist(1)
63 Algorithm stolen from Jon Bentley (I<More Programming Pearls>,
64 pp. 20-23), who, in turn, stole it from Don Knuth
65 (I<Art of Computer Programming,
66 Volume 1: Fundamental Algorithms>, Section 2.2.3)
67 =cut

```

was being able to link precompiled versions of utility routines into your executable. This removed the requirement to recompile, say, `printf()`, each time you compiled `hello, world`. An advance built on top of this was the ability to collect related, compiled object files into libraries, such as

```
/usr/lib/libc.a.
```

Linkers (1d on UNIX systems) allowed you to search through one or more libraries for routines that your program called but didn't define. Unfortunately, even searching libraries could be time-consuming. For example, if your code called `strdup()`, the linker would search `libc.a` to find `strdup.o`. But `strdup.o`, in turn, calls `malloc()`, so a second search of `libc.a` was needed to find and extract `malloc.o`. And because `malloc.o` calls `fprintf()`...and so it goes.

This could all be done with a single pass through the library by arranging the object files in an order that put each object file in the library before the external functions it called.

Starting to sound familiar?

To accomplish this, the `lorder` utility was written to find and list all the pairwise dependencies among object files and a second utility, `tsort`, took these dependencies and put them in the right order. This list, in turn, was given to `ar`, which created libraries in the order it was told.

On modern systems, a much-enhanced `ar` does all the work for you (and in a different way). Nevertheless, UNIX systems still come with `tsort`. After all, it works. And you can still occasionally use it to solve problems like the one posed by Tim.

If, just for fun, you want to see the pair at work, try this:

```

$ mkdir /tmp/tsort_demo
$ cd /tmp/tsort_demo
$ ar x /usr/lib/libc.a # extract copies
# of all .o files
$ lorder *.o | tsort

```

The tree-linearization news article code we wrote in our July and August columns ("Cathedrals, Bazaars, and News Readers," Page 57 and "Virtual Threaded News Reader," Page 54, respectively) was related to this problem: The news problem can be partially solved with `.CR tsort`.

Question for our readers: Does anyone know why UNIX always comes with Bessel functions of the second kind, `y0`, `y1` and `yn`?

An Implementation

Enough already. Listing 1 contains our code. Herein follows a dramatic reading.

Lines 1 through 3 are our usual, cowardly boilerplate. We want Perl to tell us about our stupid mistakes, and we keep the code under Revision Control System (RCS) so we can retrieve older versions with fewer stupid mistakes. Lines 4 through 8 do argument parsing and handle the usage message. Lines 9 through 11 declare some hashes, and it's worth

pausing here for a minute to talk about the data structures.

We're going to keep all the elements to be sorted as arbitrary strings. Each input line (for example, "age beauty," to mean "age comes before beauty") has two elements. Unless this pair has been seen before, which we'll track by defining a hash element, `$pair{"age"}{"beauty"}`, an input line will have at least two effects:

1. The hash entry `$npred{"beauty"}`, which counts the number of predecessors of `beauty`, will be incremented.
2. `beauty` will be added to the list of successors of `age`, `$succ{"age"}`. Note that `$succ{"age"}` will be a reference to an array containing all the successors of `age`.

Lines 12 through 20 populate these structures. The remaining lines traverse these structures, printing them out as the sorted list.

So how do they work? The margins of this column aren't large enough to illustrate that lines 21 through 31 provide a topological sort, so we'll leave this as an exercise for our readers. We will, however, give you more of a hint than you'll find in either Knuth or Bentley, and show you how to get two different `tsorts` from one piece of code.

Traversing Trees

Let's start by talking about tree traversal. The most familiar way to traverse a tree is with a depth-first search. Here's our favorite algorithm for a depth-first search:

- Start with an empty stack.
- Push the root of the tree onto the stack to initialize.
- Pop the stack, print what you find and push its children back on the stack in its place.
- Continue until the stack is empty.

Work

Consider a trimmed-down UNIX directory tree as an example: Push the root onto the stack (/); pop off the root and print it, then push its children on (/etc /lib /usr); next, pop off the first child, /etc, print it and push on its children (/etc/rc /etc/passwd /lib /usr); pop again, print /etc/rc, push on any children of /etc/rc; and continue like this until the stack is empty.

In a tree, a parent can only be linked to its immediate children. In an arbitrary, cycleless graph, parent nodes can also have links to offspring nodes farther down the tree.



Not only is this easy, but replacing the stack by a queue gives a breadth-first traversal instead.

This is essentially what lines 21 through 31 are doing, with a twist. In a tree, a parent can only be linked to its immediate children. In an arbitrary, cycleless graph, parent nodes can also

have links to offspring nodes farther down the tree. To handle this complication, we keep track of how many untraversed predecessors each node has and only push it on the queue when none remain.

To keep track of this, we only consider a node of the graph a "child" eligible to be pushed on to @list, when we've just printed its immediate parent. How do we know when we're at the immediate parent? We use the hash %npred to keep track of how many predecessors are left. When the node is out of predecessors, it's really a child. In essence, we're turning a graph into a tree as we traverse it.

We'd like to thank Tim Bunce again for his entertaining and educational puzzle and Nat Torkington (and, indirectly, Tom Christiansen) for just the right clue.

Until next time, happy trails. -->

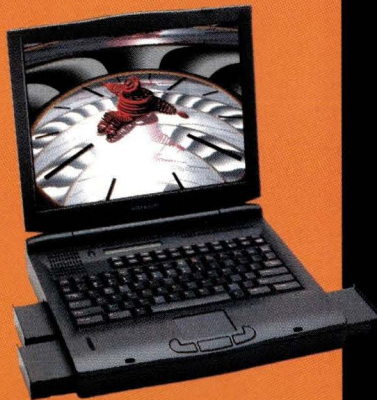
Jeffrey Copeland (copeland@alumni.caltech.edu) lives in Boulder, CO, and works at Softway Systems Inc. on UNIX internationalization. He spends his spare time rearing children, raising cats and being a thorn in the side of his local school board.

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

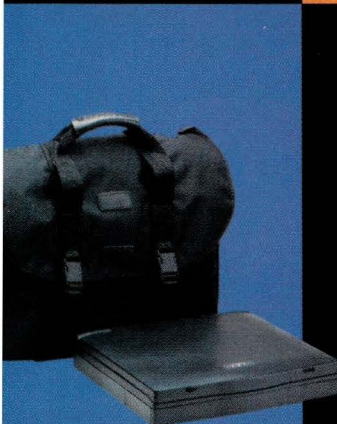
Note: The software from this and past Work columns is available at <http://alumni.caltech.edu/~copeland/work.html>.

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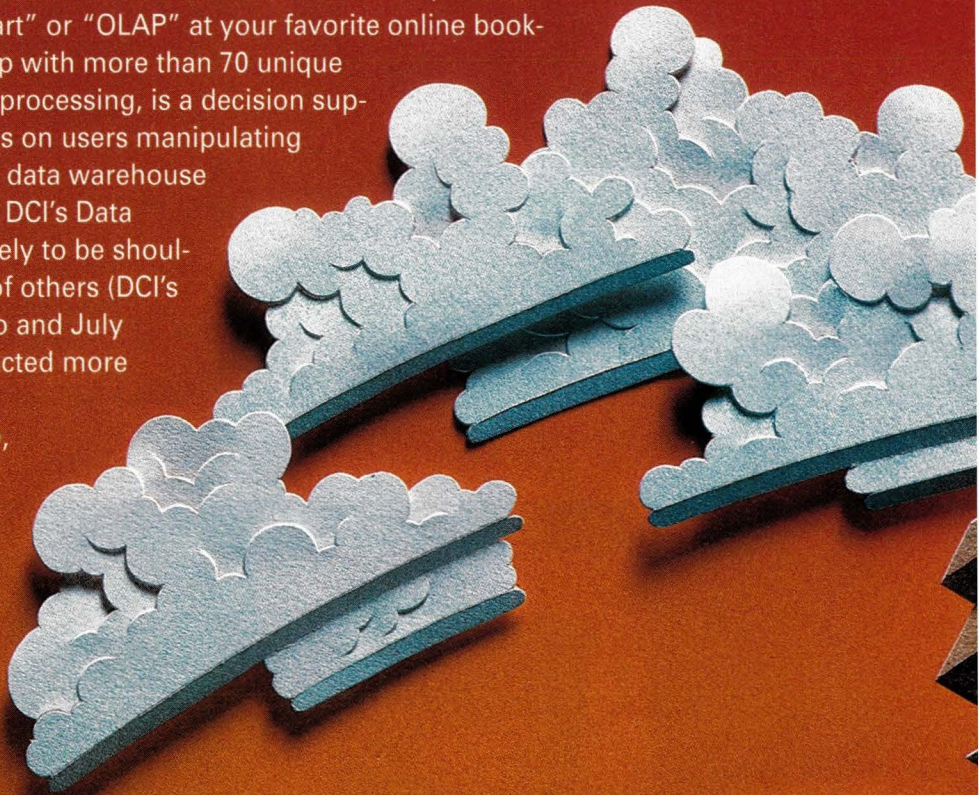
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SECOND-GENERATION DATA

It seems data warehouses have finally come of age and so-called data warehousing specialists are literally crawling out of the woodwork in an attempt to meet the demand for bigger, better and faster data exploring techniques.

You don't have to be the proverbial rocket scientist to know that data warehousing is hot. Conduct a search for "data warehouse," "data warehousing," "data mart" or "OLAP" at your favorite online bookstore and you're likely to come up with more than 70 unique titles. (OLAP, or online analytical processing, is a decision support technique that typically relies on users manipulating "cubes" of data delivered from a data warehouse or data mart.) Attend a show like DCI's Data Warehouse World, and you're likely to be shoulder to shoulder with thousands of others (DCI's April conference in San Francisco and July show in New York City each attracted more than 5,000 attendees).

International Data Corp. (IDC), a Framingham, MA-based market research firm, predicts U.S. companies will be spending \$24 billion per year on data warehousing by 2001. Combine that with the money being spent on enterprise resource planning and management (ERP/ERM), which Boston, MA-based AMR Research Inc. expects to be near \$52 billion per year by 2002, and it's no



WAREHOUSING

by Karen Watterson



Data Warehouses

wonder data warehousing specialists are coming out of the woodwork. Indeed, there are so many hardware and software vendors, global enterprise integrators, systems integrators, value-added resellers (VARs) and consultants competing for your attention—and budget—that it's getting harder and harder to know who to partner with. But one thing is certain: you want to make sure not only that they can deliver today—providing you with the technology you need to stay competitive—but that they'll be around tomorrow.

Been there, Done that

If you're a mid-size or large organization, chances are you already have at least one data warehouse or data mart under your belt. According to a 1997 software strategies service report conducted by Forrester Research Inc., Cambridge, MA, based on interviews with 50 Fortune 1,000 MIS managers, large enterprises have already built an average of 3.8 data warehouses/marts—and that number is expected to increase to 5.7 by 2000. With so many waiting to be built, it's a veritable construction boom.

In other words, data warehousing has come of age. Yes, some projects are being delayed in order to fund and staff more urgent Y2K issues, but, by and large, organizations are scurrying to weave data warehousing into their IT infrastructure, creating what is being called the "information supply chain." Data warehouses are no longer seen as risky and expensive multiyear projects, but something organizations need—and protect—in order to maintain a competitive edge.

Interestingly, when asked about a July press release announcing its decision to use a Sun Microsystems Inc. Enterprise 10000 "Starfire" server and Sun StorEdge arrays to run its—or one of

its—warehouses, Internet-based bookseller Amazon.com Inc. declined to furnish any details. "You're poking around the most sensitive part of our digital body. As a practice, for competitive reasons, we don't talk about warehousing and what we're doing with software. Sorry to have to clam up—I hope you'll understand that it's very competitive out there," says a staffer who requested anonymity.

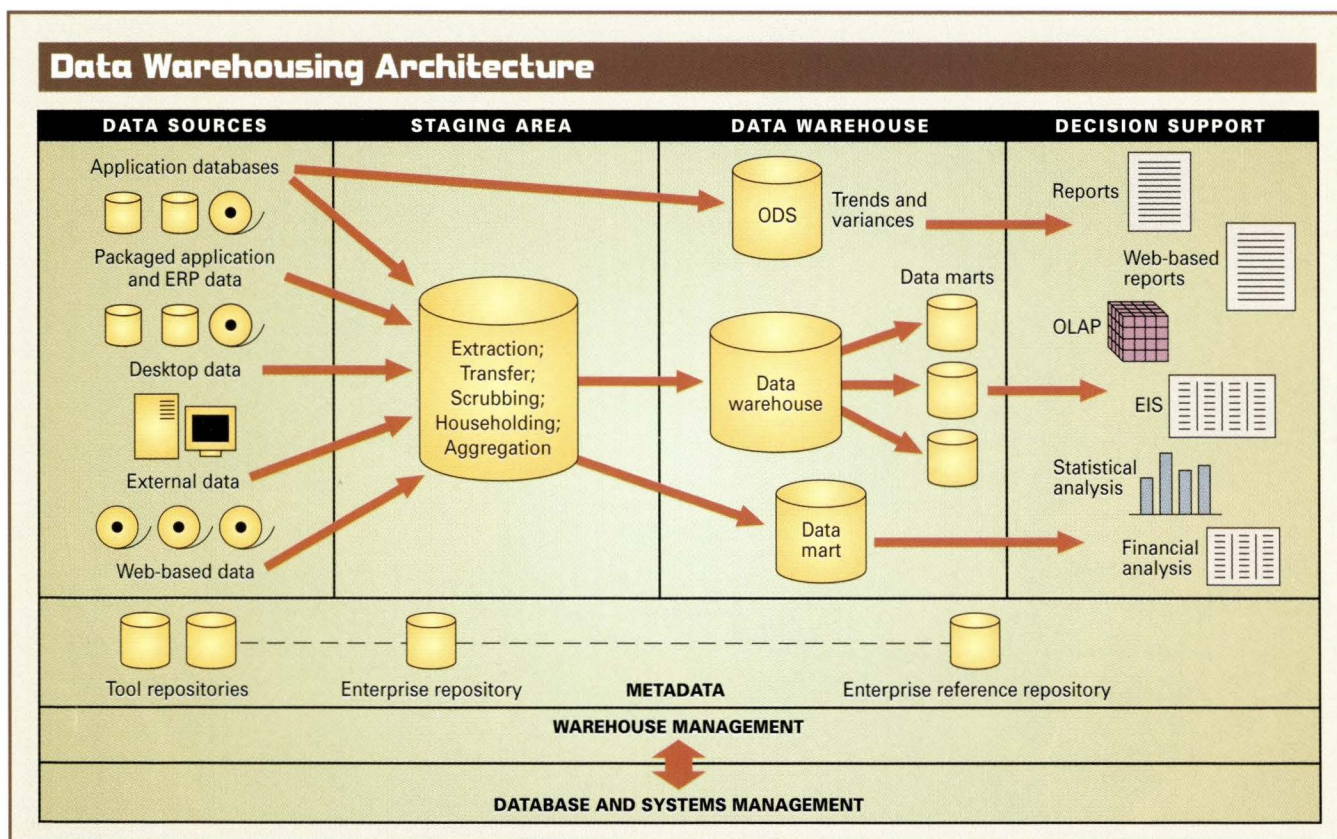
If you've read Geoffrey Moore's books *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers* or *Inside the Tornado: Marketing Strategies from Silicon Valley's Cutting Edge* (both published by HarperBusiness, ISBN 0-88730-717-5 and 0-88730-765-5, respectively), in which he describes the life cycle of new technology-based products in terms of the gulf or "chasm" between the market for early adopters and the market for more pragmatic buyers, you'll realize the data warehousing industry is "inside the tornado" today.

There are several key trends that signal the maturing of the data warehousing industry:

- Bigger data warehouses
- Faster implementations
- Better data currency
- Widespread Web enablement
- Integration with supply chain
- Integration with customer relationship management
- Emergence of standards

Industry-Specific Methodologies

According to San Mateo, CA-based Emergent Corp.'s Chief Executive Officer, Ken Rudin, there are probably more than one hundred organizations worldwide with terabyte-scale data



Data Warehouses

warehouses. (According to NCR Corp., Dayton, OH, 50 of them run on NCR servers.) Rudin, who frequently speaks on techniques for building scalable data warehouses on behalf of his information systems consultancy, says the technology for building large data warehouses is better understood than the techniques. "What you need," says Rudin, "are the techniques to leverage the tools correctly—in a word, a methodology." Like its "Big Five" competitors (the original "Big Six" accounting firms are now the "Big Five": Andersen Consulting; Coopers & Lybrand and Price Waterhouse have joined forces as Pricewaterhouse Coopers; Deloitte & Touche LLP; Ernst & Young LLP; and KPMG Peat Marwick LLP), Emergent has developed a suite of industry-specific methodologies. For example, the telecommunications industry uses data warehousing for churn management (the problem of consumers jumping from one long-distance carrier to another); the financial market leverages the data in warehouses for risk assessment and fraud detection; the health care industry wades through masses of data for a better understanding of outcomes management (the process of tracking diagnoses with treatments); retail relies on data warehouses for customer segmentation information; and the manufacturing industry uses them for inventory management.

"Methodology" isn't the tainted word it used to be (see "Data Warehousing Methodologies," Page 63). Methodologies not only play a key role in successfully planning for and building large, scalable data warehouses, but also in building them fast.

According to Roger Eberlin, senior consultant for Hewlett-Packard Co.'s data warehouse practice, "You need to be able to deliver valuable reporting capabilities within six months or you won't be funded for the next budget cycle." Eberlin, who strives to deliver a data warehouse/mart prototype to each client within 90 days, agrees that a methodology is key to meeting these aggressive development timelines. Do faster implementations mean building data marts in lieu of data warehouses? Often it does, although Eberlin prefers to construct "subject-area collections," which can grow into an enterprise data warehouse. (Surprisingly, there's little consensus on the exact distinction between data marts and data warehouses, but most people agree that data marts tend to be workgroup, division or subject-area subsets of a larger, perhaps unbuilt and purely theoretical, enterprise data warehouse.)

"Today, customers are building new business applications, such as customer relationship management and campaign management [applications], as extensions of the data warehouse," he says. "These new applications are part of a controlled, closed-loop system. Data warehouses have moved from being read-only storage facilities for monitoring a business, to being the basis for analytical engines required to feed process workflow, generate information for closer customer intimacy and provide information to reorganize organizational processes and structures. Warehouse content must now be expanded to contain resultant measures based on initial analytics and segmentation. It requires writeable content based on customer dialogs and responses to the efforts of call centers, direct marketing and sales representatives," Eberlin says.

Although most consultants and IT staffers would prefer that

data marts be dependent spin-offs from a single, enterprise data warehouse, it is becoming more acceptable to take a bottom-up approach toward that goal. And vendors have been swift to offer "quick start" data mart bundles. When Microsoft Corp.'s Windows NT-based SQL Server 7.0 ships later this year, "quick start" data marts will undoubtedly take on a new meaning. This is because SQL Server will ship with its own OLAP server built-in and, according to Microsoft, will make it possible to build data marts and decision support applications in days instead of months (or even years), at a fraction of the cost of today's implementations.

Better Data Currency

Along with bigger data warehouses—some organizations are already planning for petabyte-scale storage—there's also a trend to make them more real-time. Business demands for greater data currency in data warehouses are largely being met by more powerful computers and storage systems. For example, when book publisher Random House Inc., New York, NY, performed the initial load of one year's worth of shipment data earlier this year, it took less than one day, thanks to the combination of its six-CPU Sun Enterprise 4000 server, SPARCstorage Arrays and Informix Software Inc. Dynamic Server 7.2. And every week it adds 500 GB of store-level sales data from one of the large retail bookstore chains.

Ideally, data warehouse users would like up-to-date information from "the system." But that would require preparing real-time scrubbed extracts of operational data stores and integrating them with what might be hundreds of other data sources. Performing such real-time refreshes isn't realistic because it overtaxes the online transaction processing (OLTP) systems. Most organizations update some data daily, some weekly and some monthly.

According to David Bruce, manager of database systems at Random House, rebuilding multidimensional cubes of data using PowerPlay from Cognos Corp., Burlington, MA—a task that used to take nine or 10 days using an earlier system with different hardware—now takes between nine and 10 hours. "It used to be that we'd make important decisions based on partial information," Bruce says. "We'd base small store decisions on big store data because we had to take what we could get. Now it's all there—all stores, large and small, from all of our divisions, in one, big, fully-accessible data warehouse." The next step for Random House is to move to a Web-based decision support system.

Many organizations take a two-pronged approach, maintaining both "operational data stores," or ODSs, which are snapshots of a portion of OLTP data used for making operational decisions, and "normal" data warehouses and/or data marts.

Another trend worth watching, according to Forrester Research analyst Frank Gillett, is the evolution of general-purpose analysis programs into browser-based tools and applications that deliver data from a middle-tier interactive analysis server. Vendors such as Actuate Software Corp., San Mateo, CA, and SQRIBE, Menlo Park, CA, are leading the way in providing Yahoo!-style access to reports, while vendors like Broadbase Information Systems Inc., Menlo Park, CA, and AlphaBlox

Corp., Mountain View, CA, are building interactive analysis server platforms that provide developers with reporting and analysis capabilities that can be added to purpose-built browser applications.

Widespread Web Enablement

We all know the Internet is changing the way we do business and, even as IT scrambles to maintain larger, more up-to-date data warehouses, business users are clamoring for data delivery via the Web. Human resources departments are even beginning to find that potential hires will ask for details about the level of data they'll have "at their fingertips" if they join the firm. Almost all vendors associated with data warehousing offer Web support, as Comcast Corp.'s applications manager Jim Scott discovered.

Comcast, a diversified global leader in entertainment services and telecommunications based in Philadelphia, PA, is involved not only in wired (including cable) and wireless telecommunications, but also content through principal ownership and/or a controlling interest in QVC, Comcast@Home, Comcast-Spectator and E! Entertainment cable television networks. Comcast needed a tool to allow several hundred staffers at 70 sites across North America to access its data warehouse. Of particular interest was access to financial data, such as open purchase orders and capital information—data that was buried in a variety of data stores, including Oracle Corp.'s Oracle Financials. A mainframe-based reporting system routinely delivered some 70 different reports to each site using a bursting mechanism, so each site only received relevant data. Comcast could have used Oracle's SQL*Plus programming to tackle access to the Oracle Financials data, but a data warehouse solution seemed easier and smarter.

With the help of outside consultants to review the current and potential reporting systems, Comcast finally settled on Palo Alto, CA-based Brio Technology Inc.'s Brio Enterprise suite of tools and a Sun E4000 machine as its data warehouse server. In its quest for the right technique, Comcast looked for tools that required minimal administration but offered Comcast's three levels of end users—power users, analysts and report consumers—the right mix of query and analysis capabilities. According to Scott, users find Brio easy to use, but he also likes the fact that Brio's Web-based distribution system is basically zero maintenance and distributes data to end users on-demand.

Camelot Music Inc., North Canton, OH, the nation's third largest prerecorded music retailer, also relies on the Web for its data warehousing endeavor, according to Charlie Marsh, Camelot's Vice President and Chief Information Officer. Camelot Music, which as recently as 1996 relied on an outside firm to manage its customer data, has now replaced its original loyalty card program (where stores manually punched members' cards each time they made a purchase) with an electronic system. The current system, which uses Informix Dynamic Server Extended Parallel Option running on a four-processor Sun ES5000 equipped with 2 GB of RAM and 400 GB of storage, receives nightly sales data from more than 500 Camelot Music retail stores across the country via dial-up connections. In return, the

stores, which use HP 9000s running HP-UX and Oracle, receive daily reports with updated member point balances. According to Marsh, "We are currently running a pilot with an Intel [Corp.] Pentium running Solaris with Java in the stores."

The Camelot system was largely developed by ICL Inc., Reston, VA, and uses a combination of ICL's PrecisionRetailing and Vienna, VA-based MicroStrategy Inc.'s DSS Server/DSS Agent (for data warehouse access, querying and reporting by corporate staffers). Camelot relies on ICL's PrecisionRetailing to do targeted coop mailings from major music distributors (offering members, for example, discounts on early releases). Marsh plans to offer more features via the Web, including the ability for customers to join and access member information.

Integration with Supply Chain

The first thing most packaged application and ERP customers want from a data warehouse is the ability to offload reporting from their SAP AG, Baan Co. or PeopleSoft Inc. application. HP's Eberlin is already seeing a lot of interest in ERP-based data warehouses and expects the trend to grow. (Eberlin also recommends that packaged application customers examine the database license(s) associated with their ERP packages. Site licenses can save money when it comes to building data warehouses.)

This summer, Walldorf, Germany-based SAP AG shipped its much anticipated Business Warehouse (BW). However, while SAP customers were waiting for BW, almost a dozen, more nimble vendors moved in with their own solutions. As Framingham, MA-based analyst firm Hurwitz Group Inc. reported in July, "One category of vendors is focused on either extracting SAP R/3 data and making it available to nonSAP data warehouses, or on providing nonR/3 data for BW." Hurwitz lists the following companies among those providing users with the means to create SAP-based data warehouses: Acta Technology, Palo Alto, CA, and its ActaLink for SAP; Cognos is reselling as Cognos Accelerator for SAP; Business Objects, San Jose, CA, and Influence Software Inc., Sunnyvale, CA, which both provide data marts populated with R/3 data; and additional vendors, including Prism Solutions Inc., Sunnyvale, CA, and Evolutionary Technologies International Inc., Austin, TX, whose conversion tools (Prism Warehouse Executive and ETI Extract, respectively) have been certified by SAP.

That's not to imply that only SAP is adding data warehousing functionality to its product line, or that third-party vendors are ignoring the likes of Baan and Peoplesoft, but the SAP market seems to be the most mature at this point.

Integration with CRM Programs

Finding ways to integrate data warehouses with customer relationship management (CRM) programs represents another hot spot in the world of data warehousing. According to Randy Grossman, senior vice president of customer data management and analysis with Boston, MA-based Fleet Financial Group, one of the nation's largest regional financial institutions, his company began planning for a data warehouse in 1995. After some six months of research, Grossman and his team proposed build-

Data Warehousing Methodologies

If you thought methodologies went the way of CASE tools, you're wrong. Data warehousing methodologies are emerging as everything from detailed recipes for building data warehouses and templates replete with the distilled wisdom and best practices of industry-specific implementations, to ill-disguised bait for selling expensive consulting services.

A good methodology represents technology and knowledge transfer and is only as good as the people who put it together. It will reflect their experience, domain expertise and wisdom. Methodologies, however, aren't magic; they are more like recipes. As Mark Theissen, product manager for Sunnyvale, CA-based Prism Solutions Inc.'s Iterations methodology, puts it, "Just because you have the cookbook doesn't mean you'll be a great chef." Methodologies, however, like recipes, can be adapted and reused.

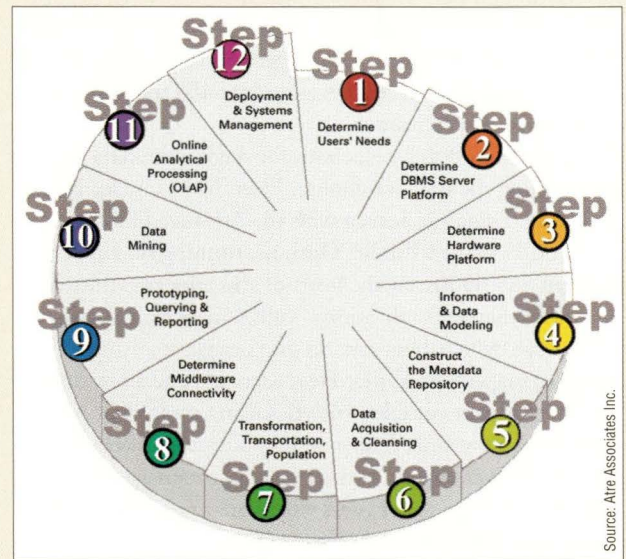
Prism's Iterations is arguably the leader in the data warehousing methodology market. According to Theissen, Iterations is a "full blown" methodology based on Prism's experience with more than 400 data warehouse implementations. Iterations started out as an internal document, but was expanded to serve as a vehicle for knowledge and technology transfer to its customers. "Our consulting model isn't to spend a year with our customers," says Theissen. "We want to go in there, get them up and running and let them go from there." Iterations 2.0, which costs \$35,000 and includes three days of training and two days of consulting, is a product-independent methodology. One of its strengths, according to Theissen, is it is customizable but has generic "starter" road maps for data warehousing, data marts, operational data stores and new or iterated subject-area deployments.

Iterations consists of 30 modules, 150 activities—including templates for 150 deliverables—and 600 tasks. "We started with a blank sheet of paper," says Theissen, "and didn't try to adapt an existing project or process management product."

J.D. Welch, who was instrumental in creating Prism's Iterations methodology, has now created his own, the DataWing Warehouse Developer. "My methodology is iterative, like Prism's, but what I wanted to provide was a much simpler product at a significantly reduced price. I decided to base the product in HTML and make the contents very dynamic," says Welch. DataWing Warehouse Developer costs \$999 for a single-user license and \$2,999 for a corporate site license.

Another popular methodology has been developed by Earl Hadden, principal of Hadden & Co. Management Consultants, Mahattan Beach, CA, and is one that has been licensed by Software AG, Reston, VA, among others. The latest version represents the collaborative efforts of Hadden and European data warehousing expert Sean Kelly, founder of the Skibbereen, Ireland-based Data Warehouse Network. Hadden-Kelly Data Warehouse Method Release 4.0 is available either on consulting assignments through Data Warehouse Network's methodology partners or as a commercial release, which is priced at \$20,000 and includes five days of training/consulting.

According to Hadden, the Hadden-Kelly DataWarehouse



Atre Associates' 12-step data warehouse/mart chart outlines the most important factors in building a successful data warehouse.

Method offers the most complete evolutionary approach with different paths for enterprise warehouses down to data marts and addressing specific, tactical information needs. "We have also put in a major step to evaluate the characteristics of the user[s] called Analytical Modeling. This helps determine whether a data mart [and therefore star schema] is needed and how the data exploitation should be addressed," Hadden says.

James Martin & Co., Fairfax, VA, also offers a comprehensive methodology, one that senior consultant Vijay Sankaran likens to a blueprint. In addition to offering the basic methodology (available on a per seat basis), the company also offers templates for particular industries or tasks, such as property casualty risk analysis for the insurance industry.

According to Sankaran, Web enablement of data warehouses is an important trend. "By adding Web-enabled solutions to a data warehouse, you extend that data warehouse to the entire enterprise and provide access to customers as well as to partners. This is critical in building cybercorps because it enables your company to be even more responsive to customer needs."

(James Martin, founder of the company, introduced the term "cybercorp," which is short for cybernetic corporation, in his book, *Cybercorp - The New Business Revolution*, published by Amacom, 1996, ISBN 0-8144-0351-4. According to Martin, a cybercorp has the following characteristics: constant monitoring, immediate reaction, continuous change, global nature, extreme virtualness, customer intimacy, knowledge obsession, endless learning, ruthless simplification, innovative technology and complex software.)

There are other methodologies. Most of the "Big Five" offer data warehousing methodologies or "best" practices, generally as a component of consulting services.—kw

ing an enterprise data warehouse and developed a detailed business case to justify their recommendation. They obtained the go-ahead, along with a \$38 million budget, and started work in earnest in the summer of 1996. Almost two years later, in July, the data warehouse went live with a 350-GB initial load. Fleet, partially as a result of significant merger and acquisition activity, had to work with 34 data sources and some 450 transform programs, according to Grossman.

Fleet uses Sun 6000 servers both for staging the data and for maintaining the data warehouse. Fleet, like Camelot Music, uses Informix Dynamic Server, with the Advanced Decision Support and Extended Parallel Options, running on a pair of clustered Sun 6000s. At the heart of the project is Boston, MA-based Exchange Applications' ValEX marketing management software, which Fleet's marketing people are using for campaign management. Other Fleet users include a few dozen PhDs, who perform complex analytics using tools like SAS Institute Inc.'s Enterprise Miner, and application development staffers who deliver custom reports to senior management. Each of the three groups of users works off its own dependent data mart, not the data warehouse itself.

Grossman is confident the bank's projected savings and revenue will have a significant impact on the bottom line. He's also proud that he delivered under budget and "almost" on time (July 1998 instead of March 1998).

Of course, not everyone can afford a \$38 million project. But the major customer care and relationship management vendors, like the packaged application vendors mentioned above, are responding to customer demand for better integration. Even one-to-one marketing gurus Don Peppers and Marsha Rogers of Marketing1to1, Stamford, CT, are promoting data warehouses as an important vehicle for achieving mass customization. Fortunately for all of us, standards promise to make that easier than you might expect.

Standardization

There are several efforts underway to standardize methods for exchanging metadata information. Metadata, the "data about data" that's often stored in proprietary or undocumented repositories, is being tackled both by the Meta Data Coalition and by the OLAP Council (see "Data Warehousing Resources").

It's not just the obvious candidates such as computer-aided software engineering (CASE) tools and data warehouse extraction suites that store metadata, almost all sophisticated programs have some facility for persisting various variables, settings and other metadata. Today, the Meta Data Coalition spearheads an important effort in defining a specification, called Meta Data Interchange Specification (MDIS), that will ensure metadata exchange and interoperability. The underlying MDIS metadata model is broad enough to accommodate any type of storage

Data Warehousing Resources

Recommended Web Sites

- Atre Associates Inc.'s 12-Step Road Map for Data Warehouse/Data Mart Implementation
<http://www.atre.com/navigator>
- Data Warehousing Institute
<http://www.dw-institute.com>
- German OLAP and Data Warehouse Forum
<http://www.winf.ruhr-uni-bochum.de/olap/index.htm>
- International Data Warehousing Association
<http://www.idwa.org/>
- Larry Greenfield's Data Warehousing "Central"
<http://www.starnetinc.com/pwp/larryg/index>
- Meta Data Coalition
<http://www.mdcinfo.com>
- OLAP Council
<http://www.olapcouncil.org>
- Seth Grimes', Alta Plana Corp., OLAP Site
<http://altaplana.com/olap>
- Software Product Expertise (SPEX) Evaluation Kits for OLAP Servers
<http://www.checkspex.com/catalog/97DWO.htm>
- The Data Administration Newsletter (TDAN)
<http://www.tdan.com>
- The OLAP Report
<http://www.olapreport.com>

Recommended Reading

- *Data Warehousing, Data Mining, and OLAP*, by Alex Berson and Stephen J. Smith, published by McGraw-Hill Inc., 1997, ISBN 0-07-006272-2
- *Data Warehouse Toolkit: Practical Techniques for Building Dimensional Warehouses*, by Ralph Kimball, published by John Wiley & Sons Inc., 1996, ISBN 0-471-15337-0
- *Intranet Data Warehouse*, by Rick Tanler, published by John Wiley & Sons Inc., 1997, ISBN 0-471-18004-1
- *Multidimensional Manager: 24 Ways to Impact your Bottom Line in 90 Days*, by Richard Connelly, Robin McNeill and Roland Mosimann, 1996, free from Cognos Corp. (<http://www.cognos.com>)
- *OLAP Solutions: Building Multidimensional Information Systems*, by Erik Thomsen, published by John Wiley & Sons Inc., 1997, ISBN 0-471-14931-4
- *Oracle Data Warehousing (for Oracle 7.3)*, by Michael Corey and Michael Abbey published by McGraw-Hill Inc., 1997, ISBN 0-07-882242-4
- *Oracle8 Data Warehousing*, by Michael Corey, Michael Abbey, Ian Abramson and Ben Taub, published by McGraw-Hill Inc., 1998, ISBN 0-07-882511-3
- *The Data Model Resource Book: A Library of Data Models and Data Warehouse Designs*, by Len Silverston, Bill Inmon and Kent Graziano, published by John Wiley & Sons Inc., 1997, ISBN 0-471-15364-8

Data Warehouses

facility or format—relational tables, ASCII files or customized format repositories. MDIS sounds great in theory but, as of this writing, no commercial products supporting it have shipped.

A similar problem plagues the OLAP Council's Multi-dimensional Application Programming Interface, or MDAPI 2.0, an elegant, platform-independent, open standard for OLAP interoperability. Although it's supported by industry heavyweights such as Oracle, Cognos, IBM Corp. and Arbor Software Corp. (now Hyperion Solutions Corp.), Microsoft's competing OLE DB for OLAP seems destined to dominate the market.

Into the Tornado

In this article, you've seen today's trends in data warehousing and OLAP; you've read how some industry pioneers have leveraged their data warehousing efforts to gain competitive

advantage and you've heard that data warehousing is now a key component of most organizations' infrastructures. Data warehouses are no longer associated with the multi-year budget-draining projects you read about a few years ago. They're mainstream. Has your organization bridged the chasm? →

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 Publishing Co.: *Visual Basic Database Programming* and *Client/Server Technology for Managers*. Email: karen_watterson@email.msn.com

Companies Mentioned in this Article

Acta Technology

1001 Elwell Court
Palo Alto, CA 94303
<http://www.acta.com>
Circle 150

Actuate Software Corp.

999 Baker Way
San Mateo, CA 94404
<http://www.actuate.com>
Circle 151

AlphaBlox Corp.

800 Maude Ave.
Mountain View, CA 94043
<http://www.alphablox.com>
Circle 152

Baan Co.

11911 Freedom Drive, Ste. 780
Reston, VA 22090
<http://www.baan.com>
Circle 153

Brio Technology Inc.

3460 W. Bayshore Road
Palo Alto, CA 94303
<http://www.brio.com>
Circle 154

Broadbase Information Systems Inc.

173 Constitution Drive
Menlo Park, CA 94025
<http://www.broadbase.com>
Circle 155

Business Objects

2870 Zanker Road
San Jose, CA 95134
<http://www.businessobjects.com>
Circle 156

Cognos Corp.

67 S. Bedford St.
Burlington, MA 01803
<http://www.cognos.com>
Circle 157

Data Warehouse Network

P.O. Box 7
Skibbereen
Cork, Ireland
<http://www.indigo.ie/~datawave>
Circle 158

Data Wing

11916 S. Woodridge Road
Sandy, UT 84094
<http://www.datawing.com>
Circle 159

Evolutionary Technologies International Inc.

4301 Westbank Drive, Ste. 100
Austin, TX 78746
<http://www.eti.com>
Circle 160

Hyperion Solutions Corp.

1344 Crossman Ave.
Sunnyvale, CA 94089
<http://www.hyperion.com>
Circle 161

IBM Corp.

Contact local sales office
<http://www.ibm.com>
Circle 162

ICL Inc.

11490 Commerce Park Drive
Reston, VA 22091
<http://www.icl.com>
Circle 163

Influence Software Inc.

845 Stewart Drive
Sunnyvale, CA 94086
<http://www.influencesw.com>
Circle 164

Informix Software Inc.

4100 Bohannon Drive
Menlo Park, CA 94025
<http://www.informix.com>
Circle 165

James Martin & Co.

3050 Chain Bridge Road, Ste. 600
Fairfax, VA 22030
<http://www.jamesmartin.com>
Circle 166

Microsoft Corp.

One Microsoft Way
Redmond, WA 98052
<http://www.microsoft.com>
Circle 167

MicroStrategy Inc.

8000 Towers Crescent Drive
Vienna, VA 22182
<http://www.strategy.com>
Circle 168

Oracle Corp.

500 Oracle Pkwy.
Redwood Shores, CA 94065
<http://www.oracle.com>
Circle 169

PeopleSoft Inc.

4440 Rosewood Drive
Pleasanton, CA 94588
<http://www.peoplesoft.com>
Circle 170

Prism Solutions Inc.

1000 Hamlin Court
Sunnyvale, CA 94089
<http://www.prismsolutions.com>
Circle 171

SAS Institute Inc.

SAS Campus Drive
Cary, NC 27513
<http://www.sas.com>
Circle 172

SAP America Inc.

(Division of SAP AG)
701 Lee Road
Wayne, PA 19087
<http://www.sap.com>
Circle 173

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PCI SPARC Systems for the Desktop

by IAN WESTMACOTT, Technical Editor

As Sun's UltraSPARC systems move into high gear, Computer Publishing Lab reaches under the hood to examine the new Ultra 5, 10 and 60 models and their Tatum COMPstation counterparts.

Now several years into Sun Microsystems Inc.'s UltraComputing vision, the line has some new members that offer the first significant technological changes from the original Ultra systems. An entry system built largely with PC components, the Ultra 5 is aimed at program development and two-dimensional graphics applications. An entry-level graphics system, the Ultra 10 offers increased expansion and performance over the Ultra 5. At the high end, the Ultra 60 offers multiprocessor performance in an uncompromising power desktop package.

All three systems feature new generations of the UltraSPARC processor, support for PCI I/O buses and a new graphics option, the Elite3D. The new systems also suggest a refocusing on the high-end desktop market for Sun. Having won the market from Apollo in the '80s, which was then its bread and butter, it seems Sun turned its attention to building server products. At the same time, the UltraComputing vision was

born in the form of the Fusion Project, whose goal was to develop a next-generation workstation for an expanding market with more and more demanding users and applications.

And there was competition for that expanding market from companies such as IBM Corp., Digital Equipment Corp., Hewlett-Packard Co. and Silicon Graphics Inc. But who would have guessed that Microsoft Corp.'s Windows NT would be knocking at the door of the high-end desktop and middle-tier, looking to dom-

inate the landscape? With its economies of mass production, its tremendous installed base and a marketing machine bar none, this was unanticipated competition. With its recent UNIX integration announcements, such as partnerships with UNIX players HP and DEC, and its licensing of integration software from the likes of Mortice Kern Systems Inc., Microsoft's intentions are clear. So with its traditional competition dropping from the market like flies, and Microsoft coming full speed, Sun has had to refocus on the changing high-end desktop market.

PCI

In the late '80s and early '90s, the UNIX workstation market was fragmented. And while the different operating system versions were similar enough to

make cross-platform development possible, proprietary hardware all but excluded hardware vendors from the market as a whole. In particular, every workstation vendor had its own I/O bus—SBus, TurboChannel, MCA and so on—which meant graphics card vendors had to produce different cards and develop different drivers for each system. No wonder the third-party peripherals market never took off for any one vendor's system.



With the release of its latest UltraSPARC systems, the Ultra 5, 10 and 60, Sun is refocusing its efforts on the high-end desktop market.

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A healthy supply of third-party add-ons is critical in the desktop market, and by adopting the PCI bus in these SPARC systems, Sun has made them available to a large community of cross-platform adapter card manufacturers using the PCI standard. The adoption of the PCI bus does not allow one to just drop in any of the thousands of PCI cards available—Solaris drivers need to be developed first—but the list of PCI cards available for Solaris systems is growing steadily, and it is much easier to port driver software than to redesign a whole new piece of hardware.

The PCI specification is fairly broad, covering form factors, connector types, power requirements and operating parameters. The Ultra 5 and 10 systems support PCI Version 2.1 with a 33-MHz bus, 32-bit 5-volt short and long cards and Energy Star compliance. The bus is connected to the CPU and memory via a PCI host bridge operating at 66 MHz. The Ultra 60 includes a 33- and a 66-MHz bus. Both buses support 32- and 64-bit 3.3- and 5-volt short and long cards (the first consumer products supporting 64-bit, 66-MHz PCI buses).

In order to support the PCI buses, these systems include new versions of the UltraSPARC processor with a PCI bus module (PBM) preinstalled. The PBM is compliant with PCI Version 2.1 and supports up to four PCI bus masters. It is optimized for 16-, 32- and 64-byte transfers with single 64-byte DMA and PIO read/write buffers. The PCI address space is noncachable

for CPU references. Coherent DMA is supported, and all memory reads and writes are cache coherent.

Sun, and its customers, hope this cross-platform standard will rejuvenate the third-party peripherals market for its desktop products. While we haven't seen a rush of vendors to support the platform, there has been a steady stream of PCI adapters announced for it (see "SPARC PCI Adapters"). Sun offers a range of developer resources, including a PCI Developer's Kit, to support third-party vendors (see <http://www.sun.com/pci/dvlp.html>). While SBus, Sun's proprietary bus, is faster than PCI in most implementations, it seems Sun will standardize on the latter. According to Ultra Product Line Manager Chris Scheufele, Sun will standardize on PCI as an economical bus with good performance and a large segment of cross-platform, best-of-breed manufacturers.

Elite3D

High-performance graphics are also critical to the desktop market, and this was one of the original goals of the Fusion Project. With the visual instruction set (VIS), Creator graphics hardware, fast graphics/CPU/memory communications channels via the UPA and, later, support for the OpenGL standard, the UltraComputing family has focused on high-performance graphics from day one. With these new systems, Sun has introduced new graphics hardware, the Elite3D m3

and m6 systems. The m6 is a two-card set using the UPA graphics connector (horizontal and vertical versions support both PCI and SBus systems). The m3 is a single-card implementation in vertical form factor only. The m3 is available with Ultra 10 systems, while the m6 is available with the Ultra 60 and Ultra 2 systems.

The Elite3D systems significantly boost three-dimensional rendering performance over Creator3D, while maintaining full API compatibility. The Creator3D series 3 card, for example, achieves 3.7 million 3D vectors per second, the Elite3D m3 achieves 4.9 million and the m6 achieves 8.2 million 3D vectors per second. With a published CDRS 3D graphics performance benchmark of 125, an Ultra 60 Elite3D m6 system outperforms an SGI Onyx2 Reality workstation (CDRS 92) at one quarter the price.

Like the Creator3D, the Elite3D systems make use of 3D RAM (memory that includes on-chip ALUs) to provide a 1,280-by-1,024 76-Hz double-buffered 24-bit frame buffer with 28-bit Z-buffer. The systems are also stereo-ready at 960 by 680 112 Hz. Elite3D systems implement UPA64S, a slave-only 64-bit subset of the UPA, for communicating with the graphics subsystem. Buffered writes can be sent to the frame buffer at up to 400 MB/s, and Elite3D systems can update a 1-megapixel window (1,024-by-1,024-by-8-bit or 640-by-480-by-24-bit), that's full-screen color in real time.

SPARC PCI Adapters

The list of Sun Microsystems Inc.-branded PCI adapter cards for SPARC/Solaris had 17 entries in mid-September, including network interfaces, low-end graphics cards and SCSI adapters. The list of third-party cards had about 60 entries, including graphics cards, network adapters (such as ATM, FDDI and Hippi), audio/video adapters, telephony, PCMCIA and a range of I/O cards for serial, SCSI and other protocols. A handful of real-time data acquisition cards are also available (see <http://www.sun.com/pci>).

We obtained a pair of LMC5200-Solaris PCI/HSSI wide-area network (WAN) adapters from LAN Media Corp., Sunnyvale, CA, maker of a range of broadband connectivity solutions. The LMC5200P is a 32-bit 33-MHz PCI adapter

with Solaris drivers, which offers data bit rates from 1.5 to 52 Mb/s. The device driver also provides streams-based connectivity at the application layer. These adapters are useful for Internet and intranet applications requiring high-performance host-based WAN connections, such as firewalls, Web servers and messaging servers.

Installation is straightforward: drop in the card, copy and untar the driver, drop it in the kernel drivers directory and reboot. For this application, a few routing commands are also needed to bring up and configure the new interface. We installed an adapter in both the Ultra 5 and Ultra 60, connected a null modem cable between them and had a 52-Mb/s link up in less than 15 minutes.—*iw*

Product Reviews

UltraSPARC II

At the heart of the new Ultra systems are the UltraSPARC II and UltraSPARC Iii processors. The Ultra 5 and Ultra 10 include the UltraSPARC Iii at 270 and 300 MHz, respectively, while the Ultra 60 includes the UltraSPARC II at 296 MHz (models 1300 and 2300) or at 360 MHz (models 1360 and 2360). These processors use a new process technology (0.35 micron five-layer metal CMOS) and have higher clock frequencies than their predecessors. The Iii supports a 256-KB to 2-MB Level 2 cache, while the II supports a 0.5- to 16-MB Level 2 cache. All these processors conform to the SPARC V9 specification and are binary compatible with all SPARC processors.

Besides new process technology, the UltraSPARC II offers a larger maximum external cache size (16 MB versus 4 MB) and higher maximum cache (4,000 MB/s versus 3,200 MB/s) and memory bandwidth (1,600 MB/s versus 1,333 MB/s). The II also implements software data prefetch (SPARC V9 prefetch instruction). Prefetching allows applications to give the processor hints as to what data will be used in the near future. This in turn allows the processor to attempt a prefetch of the data into cache, so that it is close at hand when the application needs it. This instruction was previously unimplemented.

The UltraSPARC i-series offers the UltraSPARC processor in a single-chip package. Using the 0.35 micron five-layer process and Ball Grid Array with flip-chip bonding techniques to provide increased pin count (587) and bandwidth, the i-series incorporates four UltraSPARC ASICs and 18 memory buffer chips on a single chip. The end result is lower overall system cost and increased reliability. However, Level 2 cache is limited to 2 MB.

In a demonstration of UltraSPARC technology at the Design Automation Conference in San Francisco in June, Sun displayed a 500-MHz Ultra 60 workstation. The system achieved this speed by employing speed-sorted processors and cryogenic super-cooling technology from KryoTech Inc., West Columbia, SC, an NCR Corp. spin-off.

According to Sun Senior Product Manager Alex Rublowsky, you won't see such a workstation on the market anytime soon, but it demonstrates the headroom available in the current UltraSPARC architecture.

Computer Publishing Lab obtained four PCI-based SPARC systems for review: an Ultra 5 and Ultra 60 Model 1300 from Sun, and a COMPstation U10/300 and COMPstation U60/2300 (Ultra 10 and Ultra 60 Model 2300 compatibles, respectively), from Tatung Science and Technology Inc. The Tatung units are fully compatible with their Sun counterparts and offer greater configuration flexibility and a lower price tag by using less expensive components.

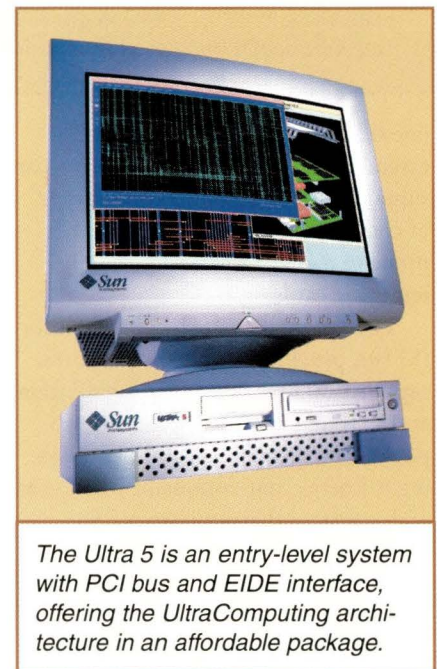
Sun Ultra 5

The Ultra 5 is based on a 270-MHz UltraSPARC Iii processor with 16-KB instruction/16-KB data on-chip caches and 256-KB external cache. The system supports up to 512-MB RAM (64-MB standard), 4.3-GB internal disk capacity, 1.44-MB floppy disk drive, 24x CD-ROM drive and onboard PGX graphics (third-party PCI graphics adapters are also supported). The system includes two long and one short 32-bit PCI slots, but no UPA slot and no SCSI—the Ultra 5 uses EIDE through the PCI bus (though SCSI PCI adapter cards may be used). No monitor is provided with the standard configuration. The published SPEC results for the system are 9.16 SPECint95 and 10.1 SPECfp95; our tests (using Sun compilers and Sun-supplied configuration files) achieved 9.07 SPECint95 and 9.13 SPECfp95 in single-user mode.

For software, the Ultra 5 includes Solaris 2.6 hardware, enhanced Common Desktop Environment (CDE) 1.2, JDK/JVM 1.1.3, Object Database Connectivity (ODBC) 2.11, Netscape Communications Corp. Communicator 4.04, OpenGL SDK and runtime 1.1.1, XIL SDK and runtime 1.3 and answerbook documentation preinstalled.

Our review unit was pretty standard, except that it included 128 MB of RAM, a 17-inch color monitor and a copy of SoftWindows 95, a Windows 95 operating environment for Solaris from Insignia Solutions Inc. (see "SoftWindows 95 for

Solaris," Page 70). The Ultra 5 comes in a desktop enclosure, but not the Sun "pizza box" you may be accustomed to. The unit is a more desktop-standard 4.4-inches high (approximately the size of the Ultra 1 system), though unmistakably a Sun system of the usual high manufacturing quality and recycled plastic material. Floppy and CD-ROM drives are accessible from the front, as well as a power suspend/resume button. The rear panel sports a 10BaseT/100BaseT autosensing Ethernet port, 25-pin synchronous/asynchronous serial port, 9-pin asynchronous serial port, 25-pin bidirectional parallel port and line-in/line-out and microphone-in/speaker-out 16-bit audio ports.



The Ultra 5 is an entry-level system with PCI bus and EIDE interface, offering the UltraComputing architecture in an affordable package.

Inside the box, while it is well-constructed and comprises high-quality parts, we found some design problems. The memory SIMM slots are located in the front corner of the motherboard, underneath the floppy drive, requiring its removal to access the slots. A second half-height bay above the floppy drive, while empty in our configuration (an optional PCMCIA adapter card makes use of this bay), would also have to be emptied if an option were installed there. Rather than being inserted vertically into the motherboard, PCI adapter cards are inserted horizontally into an extender board, which is inserted vertically into the motherboard, two on

SoftWindows 95 for Solaris

SoftWindows 95 is a follow-on to SoftWindows 2.0 from Insignia Solutions Inc., Fremont, CA, maker of virtual machine/emulation technology and onetime vendor of NTrigue, a Citrix WinFrame remote Windows access product subsequently sold to Citrix Systems Inc., Fort Lauderdale, FL. Sun Microsystems Inc. signed a distribution agreement with Insignia early this year to offer a SoftWindows 95 option with its Ultra systems for \$225. SoftWindows 95 also runs on HP-UX 10.20, AIX 4.1.4 and IRIX 6.2. A Mac OS version is also available.

SoftWindows 95 emulates an Intel Corp. Pentium processor through interpretation and dynamic compilation. Pentium instructions are sequentially read and translated into host RISC instructions, while frequently executed code segments are recompiled into native RISC. SoftWindows 95 supports all Windows 95 applications that do not require special multimedia or graphics support (SoftWindows 95 supports SVGA in all VESA modes). SoftWindows 95 has extensive PC networking support through an Insignia NDIS- and ODI-compliant

network driver, which communicates directly with the host's network driver. This allows PC client networking software to run unmodified. In addition, all major PC network operating systems are supported and a WinSock 1.1-compliant dynamic link library (DLL) is preinstalled. SoftWindows 95 supports PC storage device protocols, including floppy drive and CD-ROM drive access. Hard drives are implemented as Solaris UFS files, up to 500 MB in size, and access to UFS and NFS directories is supported through the SoftWindows 95 File Sharing Architecture.

Compared with previous efforts, SoftWindows 95 is impressive as a Windows emulation product, with broad application support and easy maintenance. But it is just that, an emulation product. What SoftWindows 95 gives you is access to a broad range of Windows applications and network operating systems, but it does not provide a high-performance Windows environment. Running SoftWindows 95 on the Ultra 60 Model 1360 is roughly equivalent in performance to Windows 95 running natively on a low-end (sub-100 MHz) PC.—*iw*

one side, one on the other. While the extender board is attached to a cross-bar support at the top, we found this type of configuration to be delicate and prone to damage when adding and removing cards.

The optional 17-inch color monitor (\$710), provided for review purposes, supports up to 1,024-by-768 resolution at 85 Hz and includes VESA DPMS power management capabilities, making it Energy Star-compliant when used with a system that supports VESA DPMS (as are the Ultra systems). The nonglare picture tube has a dot pitch of 0.27mm, and a 15-pin (HD15) RGB input signal connection is also included. A large front-panel adjustment pad includes bubble-style buttons, which control position, size, brightness, contrast, degauss, orthogonal correction, trapezoid correction, pincushion correction, color temperature and moiré.

The Ultra 5 is an entry-level system, making use of a PC chassis, PC power supply, PC memory and PC hard drives, together with the PCI bus and EIDE interface, to drive the price to a sub-\$3,000 level. While this is not a number-crunching powerhouse, nor a graphics screamer, it does provide the UltraComputing architecture in an affordable package—appropriate for software development and 2D design.

There isn't much in the way of expansion in this system. It will be more at home in a network setting, rather than as a stand-alone personal workstation.

COMPstation U Series, Model 10/300

The Ultra 10 comes in two models, Creator3D and Elite3D m3, depending on the graphics option included. The systems are based on a 300-MHz UltraSPARC IIi with 512-KB external cache (double that of the Ultra 5), support up to 1 GB of RAM (twice the limit of the Ultra 5) and include one UPA slot (not available on the Ultra 5) and four full-size 32-bit PCI slots. Like the Ultra 5, the Ultra 10 uses an EIDE interface and does not support SCSI (except through an optional adapter card). The standard software configuration is the same as the Ultra 5.

In this category, we looked at the COMPstation U10/300 from Tatung, an Ultra 10-compatible. What differentiates the U10/300 from the Ultra 10 is Ultra Wide SCSI on the motherboard, rather than EIDE, and an additional PCI slot. Ultra Wide SCSI gives the U10/300 a potential 40-MB/s throughput to disk, whereas the EIDE interface of the Ultra 5 and 10 maxes out at 16 MB/s. Moreover, Tatung offers greater configuration flexibility, such as 32x

CD-ROM drives, an Asynchronous Transfer Mode (ATM) option and up to 18 GB of internal storage, and will build systems to customer specifications. For software, the U10/300 includes Solaris 2.6 and CDE preinstalled.

The U10/300 comes in a tower enclosure, with three half-height drive bays accessible from the front panel. The rear panel includes a 25-pin synchronous/asynchronous serial port and a bidirectional parallel port, autosensing 10BaseT/100BaseT Ethernet port and Ultra Wide SCSI port. Audio I/O is an option, but was not installed on our unit. The inside of the box is very clean, with memory SIMM and PCI slots mounted vertically on the motherboard and easily accessible. Two (externally inaccessible) half-height drive bays are located above the power supply in the rear. Cable runners are provided to route cables around the motherboard and away from other components. The only odd thing is the fan, mounted at an angle above the CPU, is no where near the vents to move heat outside the box.

Our review unit included a 300-MHz UltraSPARC IIi with 512-KB external cache, 256 MB of RAM (64 MB standard), 4-GB hard drive with Ultra Wide SCSI, 3.5-inch floppy disk drive, 20-inch color monitor (optional), Creator 3D graphics (ATI Technologies Inc. PCI GX graphics is standard) and 32x CD-

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Tatung's COMPstation U10/300 is an Ultra 10-compatible with Ultra Wide SCSI on the motherboard instead of EIDE, giving it a potential 40-MB/s throughput to disk.

ROM drive (optional). Configured price: \$7,575. The optional 20-inch color monitor has a 0.31 dot pitch and supports up to 1,280-by-1,024 resolution. A flip-down door on the front panel provides access to adjustment buttons, and an On Screen Display (OSD) provides adjustments for brightness, contrast, centering, size, rotation, pin-cushion, convergence, color temperature, input selection and signal frequency.

The Ultra 10, like the Ultra 5, is an entry-level system designed for economy but provides more memory and storage expansion than the Ultra 5. A larger external cache and higher clock speed gives the Ultra 10 approximately 25% higher benchmark numbers. The Ultra 10 can also be equipped with

high-end graphics options, including Elite3D m3, making use of the UPA graphics connector. With price points under \$10,000, the Ultra 10 provides decent 3D graphics price/performance in an entry-level system. The main advantage of the U10/300 is the Ultra Wide SCSI interface, rather than EIDE on the Ultra 10. While the maximum throughput of Ultra Wide SCSI is 40 MB/s, as opposed to EIDE's 16-MB/s limit, according to Sun Ultra

10 Product Manager Steve Gregory, in configurations of two disk drives or less, the EIDE interface performs as well as the SCSI interface. The advantage comes when you want more than two drives, or larger drives. This is because IDE/EIDE is single threaded, meaning that one command must complete before another starts, whereas SCSI commands may be overlapped. Moreover, EIDE uses the CPU to transfer data. In a single-drive/single-user system, EIDE may actually be slightly faster than SCSI, but with multiple devices and multitasking software, SCSI makes more sense. Using the EIDE interface, the Ultra 10 supports up to two 4.4-GB internal hard disk drives, while the U10/300 supports up to two

9-GB internal hard disk drives.

At the time of review, the Elite3D m3 was not an option for the U10/300, but, according to Tatung, the next version of the U10/300 will offer it.

Sun Ultra 60 Model 1360

The Ultra 60 comes in four models; models 1300 and 2300 are based on single and dual 296-MHz UltraSPARC II processors, respectively, while models 1360 and 2360 are based on single and dual 360-MHz versions of the processor, respectively. All models include 16-KB instruction/16-KB data on-chip caches. The x300 models include 2-MB Level 2 cache and 4.2-GB hard disk drive standard, while the x360 models include 4-MB Level 2 cache and 9-GB hard disk drive standard, all models support 18.2 GB of internal storage.

The standard configurations include 128 MB for the single-processor models and 256 MB for dual-processor models, and all models support up to 2-GB RAM. Creator3D graphics is standard on all models, while Creator and the Elite3D systems are supported, as well as third-party PCI graphics cards. All models include two UPA graphics slots (to support dual-headed systems), two UPA processor slots and four full-size PCI slots. In addition, the Ultra 60 includes

Power Management

SUN PARC workstation customers have been seeing incremental steps toward a comprehensive power management solution from Sun Microsystems Inc. for some time. A keyboard power button here, a power management application there, but few use or trust these features. Now, with the Ultra 5, 10 and 60, Sun's power management solution seems to have matured. The new workstations are fully Energy Star-compliant (see <http://www.epa.gov/energystar.html>), which means both the systems and monitors can automatically enter a low-power "sleep" mode (consuming less than 30 watts and 8 watts of power, respectively) after a certain amount of inactivity.

For the system, this is accomplished by the use of a configurable power management daemon, which monitors the system for inactivity. For Solaris 2.6, the default definition of inactivity is no keyboard stroke, no mouse movement, no TTY characters input or output, no disk reads, no network file system (NFS) requests and a one-minute load average no greater than 0.04. Once the system has been idle for some period of time (default is 30 minutes), the power management daemon

will execute configurable procedures for each device in the system to ready it for power down. The daemon will then save a statefile containing checkpoint information to disk (any UFS location) and power-off the machine.

When power is reapplied, instead of booting, the system reads the checkpoint information from the statefile and resumes the state that existed when the system was suspended. That is, any login session and applications running when the system powered down are resumed. While not appropriate for server systems, power management works well with desktop systems, and it's easy to use. The Solaris localization configuration, which runs on new systems when first booted, now also prompts for power management settings, allowing users to enable or disable the service and set the default time-out. We ran power management with the default settings on all our review systems, and except for one snag, it worked as advertised. The snag was, in one case, when resuming a session on the Ultra 5, the system froze before it was restored. We had to reboot the machine to get it back.—iw

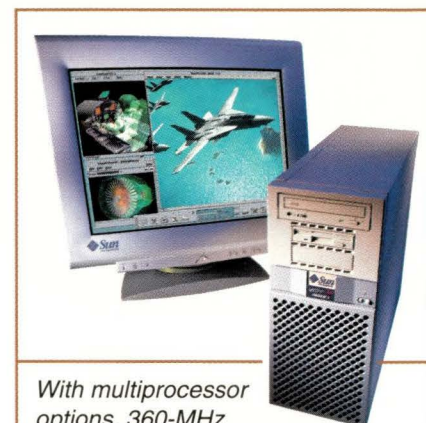
Product Reviews

two Ultra Wide SCSI channels (internal and external) on the motherboard. The published benchmarks for the Ultra 60 Model 1360 are 16.1 SPECint95 and 23.5 SPECfp95; our results, using Sun compilers and Sun-supplied configuration files, were 16.04 SPECint95 and 22.89 SPECfp95 in single-user mode. The Ultra 60s do not include any software, only right-to-use (RTU) licenses; media must be purchased separately for \$75.

The unit Sun sent us was not off the line, but rather a review unit, which had already seen a number of other evaluation labs and, consequently, was a little beat-up. However, this gave us an opportunity to experiment with some-

thing we otherwise wouldn't have. It seems that all the shipping of the unit had loosened the power cable of the CPU cooling fan, so that by the time we got it, the fan ran intermittently. This, of course, caused the CPU to overheat under normal operating procedures. But, rather than running until the CPU melted into its socket (which it certainly would have because we had no idea the fan wasn't working properly), a sensor that monitors internal temperature alerted the system, which subsequently shut down gracefully whenever the CPU got too hot. Reseating the fan's power cable fixed the problem.

The tower enclosure has two 3.5- and one 5.25-inch drive bays accessible from



With multiprocessor options, 360-MHz CPUs, 120-MHz UPA, dual Ultra Wide SCSI channels and high-end graphics options, the Ultra 60s are true power desktops.

Company	Address			Phone	URL	Circle 177	
Sun Microsystems Inc.	901 San Antonio Road, Palo Alto, CA 94303			(650) 960-1300	http://www.sun.com		
Product name	Ultra 5	Ultra 10 Creator3D	Ultra 10 Elite3D m3	Ultra 60 Model 1300	Ultra 60 Model 2300	Ultra 60 Model 1360	Ultra 60 Model 2360
Introduction date	January 98	January 98	January 98	January 98	January 98	May 98	May 98
Processor	UltraSPARC III			UltraSPARC II			
Clock speed	270 MHz	300 MHz		296 MHz		360 MHz	
On-chip cache size	16-KB instruction cache, 16-KB data cache						
External cache	256 KB	512 KB		2 MB		4 MB	
SPECint95 ¹	9.16	12.1		13.0		16.1	
SPECfp95 ¹	10.1	12.9		18.3	23.5	23.5	29.5
Main memory	64 to 512 MB	64 MB to 1 GB		128 MB to 2 GB			
Disk capacity				4.2 to 18.2 GB (Ultra SCSI)			
• Internal enhanced	4.3 GB	Up to 2 4.3 GB					
• Internal floppy	1.44 MB manual eject	1.44 MB manual eject					
Graphics ²	Onboard PGX graphics, third-party PCI	Onboard PGX graphics, Creator, Creator3D, Elite3D m3		Creator and Creator3D series 3, Elite3D m3, Elite3D m6, PCI-based add-on 8-bit PGX			
3D vectors/sec.	-	3.7 M	4.9 M	3.7 M Creator3D; 4.9 M Elite3D m3; 8.2 M Elite3D m6			
3D triangles/sec. 25 pixel/tris	-	1.3 M	3.0 M	1.3 M Creator3D; 3.0 M Elite3D m3; 5.9 M Elite3D m6			
Viewperf CDRS-03	-	50.6	74	51.8 Creator3D; 75.1 Elite3D m3; 126.1 Elite3D m6		53.6 Creator3D; 76.5 Elite3D m3; 139.3 Elite3D m6	
Viewperf DX-03	-	9.0	20.1	8.7 Creator3D; 17.8 Elite3D m3; 17.9 Elite3D m6		11.0 Creator3D; 23.3 Elite3D m3; 25.6 Elite3D m6	
I/O slots							
• Graphics (UPA)	N/A	1		2		2	
• PCI	3 (2 long, 1 short)	4 full-size		4 full-size		4 full-size	
Entry configuration	64-MB RAM, 4.3-MB disk, 24x CD-ROM, floppy, onboard PGX graphics	128-MB RAM, 4.3-MB disk, 24x CD-ROM, Creator3D or Elite3D m3 graphics		128-MB RAM, 4.2-GB disk, Creator3D graphics	256-MB RAM, 4.2-GB disk, Creator3D graphics	128-MB RAM, 9-GB disk, Creator3D graphics	256-MB RAM, 9-GB disk, Creator3D graphics
Pricing (\$)	2,495 (no monitor)	6,505 (w/ 17-inch monitor)	9,405 (w/ 17-inch monitor)	13,245 (w/ 21-inch monitor)	20,520 (w/ 21-inch monitor)	15,245 (w/ 21-inch monitor)	22,520 (w/ 21-inch monitor)

¹ Performance numbers are preliminary and subject to change.

² Check price for system configurations.

Product Reviews

the front panel, while the rear panel includes two 25-pin asynchronous serial ports, one 25-pin bidirectional parallel port, one Ultra Wide SCSI port, one autosensing 10BaseT/100BaseT Ethernet port, media independent interface (MII) for fiber/coax cables and line-in/line-out and microphone-in/speaker-out 16-bit audio ports. Inside the box, the Ultra 60 is well-constructed and solid, though very tight. Unlike the Ultra 5, PCI slots are mounted vertically on the motherboard, as is the processor on a UPA daughter card. This time, the memory SIMM slots are located behind the power supply, making it difficult to upgrade memory.

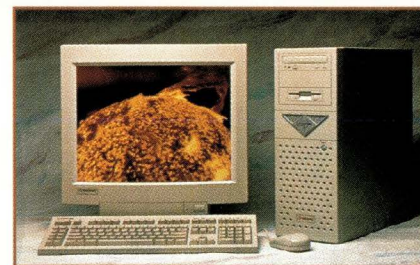
The standard 21-inch color monitor included with the Ultra 60 (it costs \$1,650 for the Ultra 5 and 10 systems) supports both HD15 and 13W3 input signal connections and up to 1280-by-1024 resolution at 76 Hz. The front panel features power, input, brightness, contrast and autosizing/centering buttons as well as a menu OSD button. The monitor meets the power-saving guidelines of VESA, Energy Star and NUTEK (see "Power Management," Page 71). The OSD has separate menus for color, centering, convergence, zoom, size, language and geometry settings through which just about every conceivable adjustment is available. For example, geometry settings include rotation, pin-cushion, pin balance, keystone and key balance. The zoom feature enlarges and

reduces the screen image, and the power saving delay time can also be adjusted. OSD menu languages include English, French, German, Spanish, Italian and Japanese.

While the Ultra 5 and Ultra 10 are price-conscious, the Ultra 60 systems are concerned with performance. With multiprocessor options, 360-MHz CPUs, 120-MHz UPA, providing 1.9-GB/s throughput, dual Ultra Wide SCSI channels, dual PCI buses, including one at 66 MHz, and high-end graphics options, these systems are true power desktops. They will find a home in EDA, MCAD, MCAE and other application areas that demand uncompromising compute and graphics power. And with prices starting at \$15,000 and staying under \$25,000, you may not have to tap the capital equipment budget.

COMPstation U Series, Model 60/2300

The U60/2300 includes dual 300-MHz processors with 2-MB external cache, compatible with the Ultra 60 Model 2300. Unlike their Sun counterparts, the U60 systems include Solaris 2.6 and CDE preinstalled. Also unlike the Ultra 60s, and the U10/300, external Ultra Wide SCSI is optional and provided via a PCI SCSI adapter card (occupying one of the four PCI slots). Like the U10/300, audio I/O is optional; however, according to Tatung, it will be standard on the next version of the U60/



Tatung's U60/2300 has one main advantage over the Ultra 60—its \$15,900 (configured) price tag.

2300. Again, Elite3D is not an option, but should be on the next version.

While the system enclosure is identical to that of the U10/300 (there isn't even a label to distinguish the two), the rear panel and inside of the enclosure are completely different, owing to different motherboards. Asynchronous/synchronous 25-pin serial and 25-pin parallel ports, an autosensing 10BaseT/100BaseT Ethernet port and MII are available on the rear panel, as is Creator/Creator3D (optional) if so configured. There is one UPA graphics slot and two UPA processor slots.

Like the U10/300, the inside of the box is spacious and all components are accessible. The processors are mounted vertically on the motherboard via UPA daughter cards, which are directly connected to a fan with external venting. Five half-height drive bays are available, as with the U10/300. Standard on the U60/2300 is 128-MB RAM, 4-GB hard

disk drive, ATI PCI GX graphics and Solaris 2.6 with CDE 1.1 preinstalled. Our review unit included 256 MB of RAM, a 20-inch color monitor (as with the U10/300), 32x CD-ROM and Creator3D graphics. Configured price: \$15,900.

The main advantage of the U60/2300 is price. Around 30% cheaper than the Ultra 60, it may be worth forgoing the second UPA graphics slot, second SCSI channel and Elite3D. ➡

Company	Address	Phone	URL	Circle 178
Tatung Science and Technology Inc.	1840 McCarthy Blvd. Milpitas, CA 95035	(408) 383-0988	http://www.tsti.com	
Product name	COMPstation U10/300	COMPstation U60/2300		
Processor	UltraSPARC Ili	UltraSPARC II		
Clock speed	300 MHz	300 MHz		
On-chip cache size	16-KB instruction cache/16-KB data cache			
External cache	512 KB	2 MB		
SPECint95	N/A			
SPECfp95	N/A			
Main memory	64 MB to 1 GB	128 MB to 2 GB		
Disk capacity	Up to 2.9 GB; 1.44 MB	Up to 2.9 GB; 1.44 MB		
Graphics	PCI; Creator; Creator3D	PCI; Creator; Creator3D		
I/O slots	1 UPA; 5 short PCI	1 UPA; 4 full-size PCI		
Entry configuration	64-MB RAM; 4-GB disk; ATI PCI GX graphics	128-MB RAM; 4-GB disk; ATI PCI GX graphics		
Pricing (\$)	3,800 (no monitor)	12,050 (no monitor)		

Directing the Way to Secure Applications

It's 11 p.m. Do you know where your data is? Snug as a bug in a rug in the hands of longtime employees and trusted business partners? Or being erased by that nut you fired last week and discussed in a competitor's board room?



In this age of widespread public internetworks, security tops the list of concerns for many organizations. Further exacerbating these concerns is the fact that sensitive data, once tucked away behind a firewall, is increasingly finding its way onto the Web, thanks to the flood of new intra/extranet applications. So while firewalls do a good job of keeping intruders out of truly private networks, what do you do when you want to place sensitive information on your Web site? In other words, is there any convenient and reliable means of keeping the public away from only marginally public information?

Before the days when applications had Web-based GUIs, you could achieve a reasonable level of security by doing nothing at all: If you didn't want someone accessing an application, you simply didn't install it on their desktop. With Web-based applications, however, security is an added chore. Information placed on a Web site is public by default and rendering it private can be a difficult job.

Of course, ensuring 100% security is difficult, if not impossible, regardless of the application. But depending on the level of security you are hoping to achieve, modern-day directory services are increasingly being equipped with the basic features an IT organization needs to provide employees and business partners with secure access to Web-based applications, without having to worry that unauthorized users will view or tamper with the data.

In the world and IT departments alike, directories are everywhere, whether

they are as low-tech as last year's *Yellow Pages*, as essential as the `etc/passwd` file that keeps track of your UNIX users or as comprehensive as a Fortune 500 company's global X.500-based directory.

In general IT terms, a directory service is used to identify available network resources and make them accessible to users and applications. Examples of resources stored in a directory include network hosts, peripheral devices such as printers and "person" information such as email addresses and privileges.

The trend among IT departments, according to analysts, is to organize directory information scattered throughout an organization into a single, comprehensive directory that keeps track of information about users and resources in a central location. Applications, in turn, can go to that directory for information rather than having to keep track of it locally.

In terms of security, using a directory is appealing in more ways than one. At the most basic level, establishing a centralized repository of "person" information helps ease potential security gaps that occur from lax administration. For example, when an employee leaves the organization, an administrator can simply revoke his or her employee privileges in the directory rather than manually dismantle a slew of privileges scattered throughout the organization.

Directories are also good places to store profile information about a given user, for example, information to help the server identify users when they log in and to help determine which users have access to certain resources. These features are referred to as authorization and access control, respectively. Thus, a modern

Before you plug in a load balancer take a close look at the numbers.

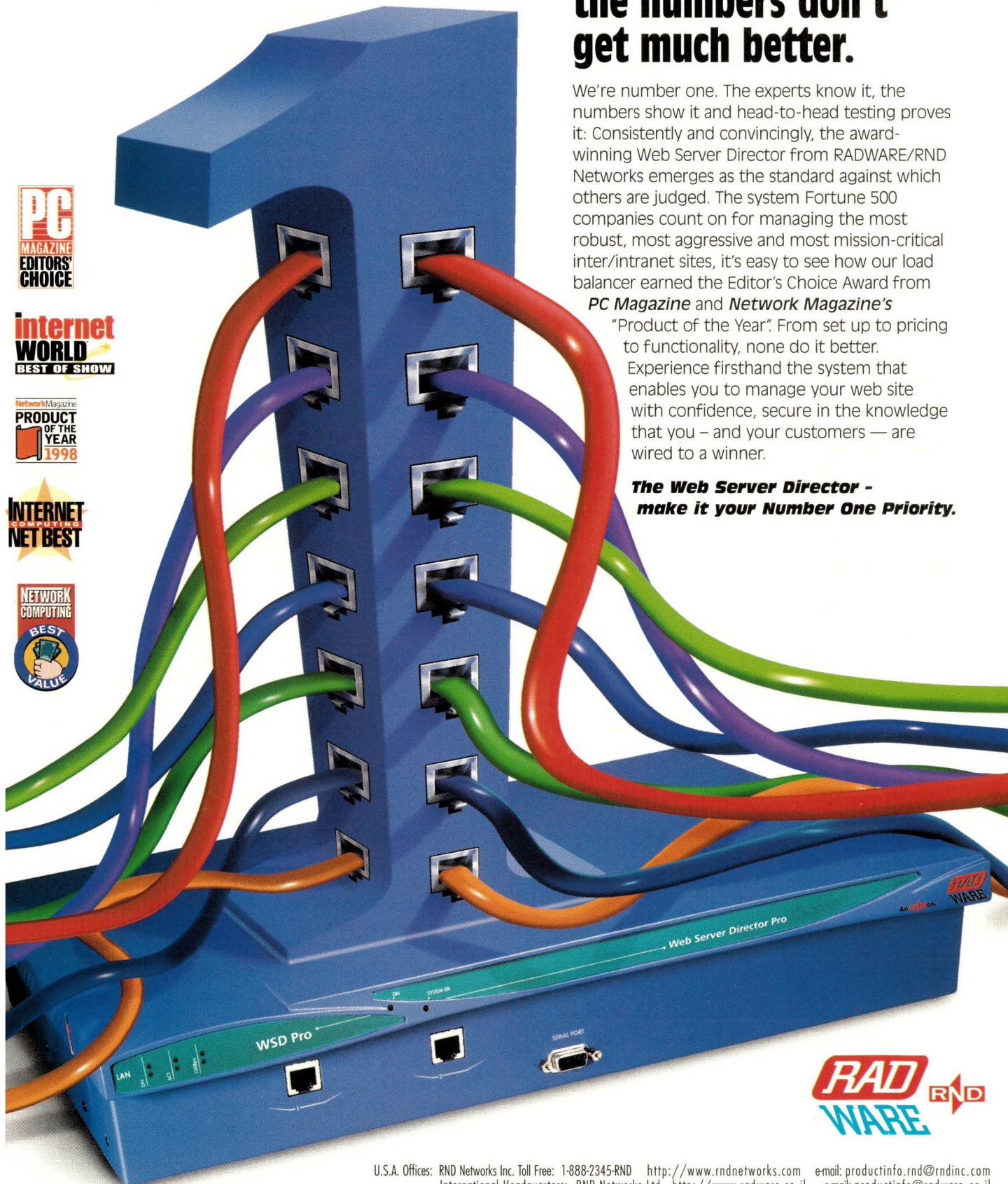
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Circle No. 33

directory server should be able to perform two crucial security functions: authenticate a user and, once the user is connected, keep track of what resources the user accesses on the system.

Directories for Our Web-Based Times

When it comes to the Web, most observers regard the Lightweight Directory Access Protocol (LDAP) as *the* directory technology of choice. As its name implies, LDAP was designed to access directories—specifically, directories based on the X.500 standard. “Lightweight” refers to the fact that LDAP runs over TCP/IP and not over the OSI stack like its heavyweight predecessor, Directory Access Protocol (DAP). Ultimately, this means LDAP clients can be made relatively thin, fitting comfortably into a browser or a WinCE personal device.

A directory server should be able to perform two crucial security functions: authenticate a user and keep track of what resources the user accesses.

Since it was first proposed in 1995, LDAP has evolved into more than just an access protocol to X.500 directories. These days, LDAP is being used as the access mechanism to all sorts of directories, whether they're X.500-based or otherwise. Examples of directories that support LDAP include Netscape Communications Corp.'s Directory Server, ICL Inc.'s i500 directory, Novell Inc.'s NetWare Directory Services (NDS), Sun Microsystems Inc.'s Directory Server and, eventually, Microsoft Corp.'s ActiveDirectory, which will be released with Windows NT 5.0.

According to industry observers, LDAP's current momentum in the

Internet directory services space can be traced to one source: Netscape, which announced in 1996 that it would invest substantial resources toward developing LDAP. “There's no doubt that Netscape fueled the market's interest in directories in general, and in LDAP in particular,” says Ed Harrington, director of i500 Americas for ICL. To further the development of the LDAP protocol, for instance, Netscape employs one of LDAP's original developers, Tim Howes, formerly of the University of Michigan and chair of the Internet Engineering Task Force (IETF) LDAP working group.

But another factor in LDAP's rise has been its potential for use as a robust security framework. “It has really been a two-pronged assault,” says ICL's Harrington, “the focus on the infrastructure capabilities of directories, as well as the increased interest in X.509 security standards.” Version 2 was able to store X.509 certificates, so-called digital certificates, the foundation for security infrastructures based on public-key cryptography.

LDAPv3, the latest version of the specification published in December, adds support for a few more security features, including Transport Layer Security (TLS), more commonly known as Secure Sockets Layer, or SSL. With TLS support under the hood, communications between a client and an LDAP server can now be encrypted, preventing hackers from “listening” in on the conversation. LDAPv3 also supports stronger authentication mechanisms, says Sharon Boeyen, senior consultant for the Advanced Security Technology Group at Entrust Technologies Inc.,

Richardson, TX, a maker of public key-based security solutions. Among them is Challenge Response Authentication Mechanism Message Digest 5 (CRAM MD5), a password-based scheme that performs checksums to ensure that communications have not been tampered with during transmission. LDAPv2, on the other hand, supported either public access—not very secure—or clear text login and password strings, which is vulnerable to intruders.

So-So Security

That said, LDAP still does not support “strong” authentication in the sense of a public-key infrastructure (PKI). Without strong authentication, write permissions to the directory cannot be granted to end users, thereby seriously limiting the directory's effectiveness. Many LDAP vendors do offer PKI as part of their LDAP solutions, but buyers should be aware that these are proprietary implementations, says Michael Simpson, director of marketing for Novell in Provo, UT. “Anyone who's doing strong authentication is doing it in a proprietary manner, that's the bottom line,” Simpson says.

For larger organizations, LDAP is lacking in several key, functional areas, says Entrust's Boeyen. One major drawback to LDAP is it defines no standard for replication—the process of copying information between geographically distributed servers. “If you have 100,000 users in the directory, it might be nice to keep information about the users in your department closer to home,” says Boeyen. Nor does LDAP define the process of “chaining” (or passing on requests) from one server to another. In practice, this means that if a user wants to make a directory query, he or she must know which directory server in particular to turn to. Finally, many industry insiders think LDAP does not adequately support access control, although the IETF is reportedly reviewing proposals.

Deploying a nonstandard LDAP server becomes a problem when you want it to interact with other LDAP servers, says Tom Patterson, product marketing manager at CyberGuard Corp., a security products and services company based in Fort Lauderdale, FL. “Synchronization and updating your directories is still the key. If you have control over all of the LDAP servers out there, it's efficient, but if you need to coordinate your directories with other companies, it's not something that works.”

Of course, not everyone is enthusiastic about LDAP. “Eventually, LDAP users are going to run into difficulties,” says Colin Robbins, product marketing manager at Nexor Ltd., an X.500 vendor based in the United Kingdom. Robbins is also one of the original authors of the LDAP specification. LDAP, Robbins says, is a good access protocol, but has been charged with handling too many responsibilities. And as the IETF loads up LDAP with the features it needs to support a respectable directory server, some observers feel LDAP is losing its original lightness. “DAP was overly complex,” says Entrust's Boeyen, “but as of LDAPv3, a lot of the complexity has been added back in.”

So despite the market enthusiasm for LDAP, industry insiders agree that, at least when it comes to large, distributed organizations, LDAP alone is not yet ready for prime time. On the flip side, X.500-based directories excel in all the areas where LDAP fails: strong authentication, access control, replication and chaining. “X.500 is now where LDAP would like to be,”

says ICL's Harrington. Most X.500 vendors now also support LDAP as an access protocol to their directories, ensuring that they can be used as the foundation for intra/extranet applications. "Currently, for large, distributed organizations, using a combination of the two technologies [X.500 and LDAP] makes the most sense," Boeyen says.

All this begs the question: If X.500 does everything that LDAP doesn't, why are we bothering with LDAP at all? The answer, it seems, lies with the market's perception that X.500 is difficult to implement and that many of its features are overkill. "There are elements of the X.500 protocols that, although defined, have not been implemented by the majority of X.500 vendors because there doesn't seem to be any market for them," says ICL's Harrington. Among these rarely implemented features Harrington cites the Directory Operations Protocol (DOP) and context tagging. In contrast, useless features are not likely to make it into IETF-fostered LDAP, he says, given the IETF's policy of only considering features for standardization that have already been implemented.

Despite LDAP's drawbacks, analysts are enthusiastic about its popularity. "We've needed a standard, simple-to-use way of accessing directory information for a long time," says David Ferris, president of Ferris Research, San Francisco, CA. "True, LDAP doesn't support replication and access control, and it would be good if it did. But the question is really: Will the proprietary extensions prove adequate for most people? I suspect that they will." ->

Companies Mentioned in this Article

CyberGuard Corp.
2000 W. Commercial Blvd.
Ste. 200
Fort Lauderdale, FL 33309
<http://www.cyberguard.com>
Circle 180

Netscape Communications Corp.
501 E. Middlefield Road
Mountain View, CA 94043
<http://www.netscape.com>
Circle 184

Entrust Technologies Inc.
2323 N. Central Expressway
Ste. 360
Richardson, TX 75080
<http://www.entrust.com>
Circle 181

Nexor Ltd.
Rutherford House
Highfields Science Park
Nottingham, U.K. NG7 2PZ
<http://www.nexor.com>
Circle 185

ICL Inc.
11490 Commerce Park Drive
Reston, VA 22091
<http://www.icl.com>
Circle 182

Novell Inc.
2180 Fortune Drive
San Jose, CA 95131
<http://www.novell.com>
Circle 186

Microsoft Corp.
One Microsoft Way
Redmond, WA 98052
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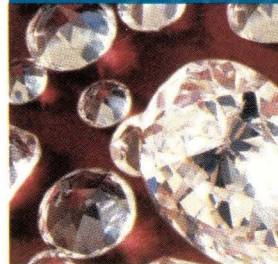
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Circle No. 34

Electronic Commerce: The Search for Gold

Whether it's a small mom-and-pop shop that's looking to pick up a little extra cash or a major manufacturer, it doesn't matter, everyone wants a piece of the pie known as e-commerce.



The potential for doing business on the Internet is huge. Hundreds of billions of dollars are expected to change hands via the Internet by the millennium, and that's a chunk of change that is hard to ignore. Forrester Research Inc., a market research firm based in Cambridge, MA, predicts that business-to-business electronic commerce alone will reach \$327 billion by 2002. As a result, companies have begun to change their philosophy toward the Web. Instead of just offering marketing information, businesses are attempting to commerce-enable their sites. "People have moved from the information stage to really starting to implement transaction," says Katherine Webster, group manager of electronic commerce market development at Sun Microsystems Inc., Menlo Park, CA.

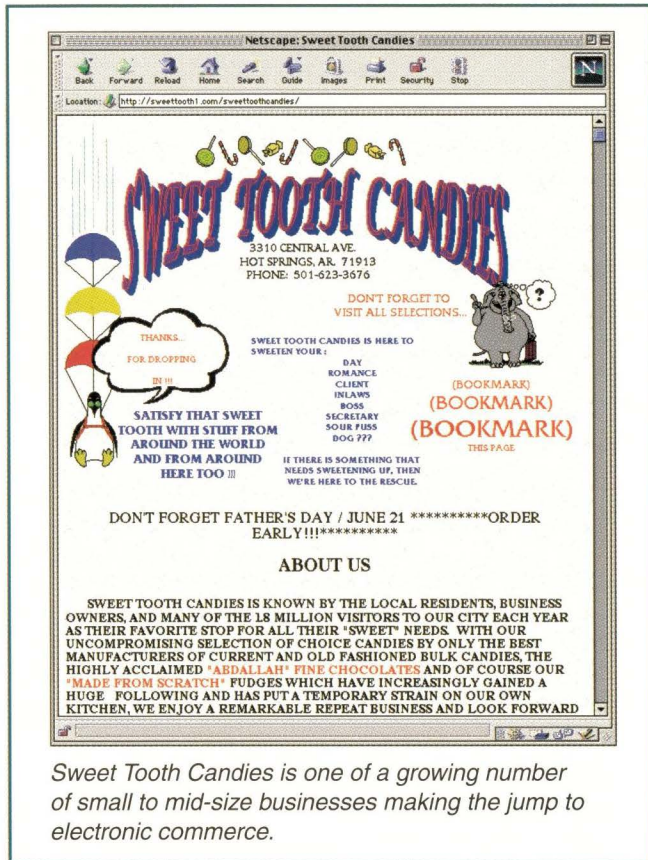
In March, Zona Research Inc., Redwood City, CA, published a global survey of 112 firms with 500 or more employees. It found that 79% of those surveyed were currently using their site strictly for marketing purposes, 10% actually conducted some type of Internet-based sales transactions and 44% planned to implement some type of electronic commerce within the next 24 months. Vernon Keenan, a director at Zona Research, says, "In the next five years, we see the gap between marketing and selling on the Internet closing."

While many industry pundits see the future of electronic commerce as bright, the fact is there are companies claiming success today. Dell Computer Corp. (<http://www.dell.com>) and Amazon.com have become the poster children for Internet business and are often touted as examples of successful Web merchants. These companies have blazed the e-commerce trail shouting out along the way, "That's gold

in them hills." To find it, vendors are lining up to offer complete software packages to help the virtual prospectors mine the Web for their fortune.

Trevor Stout, chief executive officer at Breakthrough Software Inc., San Jose, CA—one of many companies offering such tools—started his first company, Internet Business Solutions, in 1994. The company created database-driven sites written in custom C with embedded Structured Query Language (SQL). "That's what a lot of people did back in the beginning," says Stout. But it was a time-consuming process that led him to think there must be a better way. So with Breakthrough Software, he took the experience he had building custom commerce Web sites and built a Web store development application called Internet Business and the newly released ShopZone application. The idea being, let's not keep re-inventing the wheel and write custom code, but rather take what was learned building e-commerce sites and create a tool that speeds up development.

The market for these packaged applications is still young and evolving. Forrester predicts that the U.S. electronic commerce software market will increase by 3,000% in the next five years, from \$121 million in 1997 to \$3.8 billion by 2002. In addition to market growth, the competitive landscape changes from month to month with companies either disappearing or being bought out by larger industry players. For example, in May, Open Market Inc., Burlington, MA, one of the old-timers in the electronic commerce software business founded in 1994, acquired ICentral Inc., Provo, UT, maker of ShopSite, an e-commerce application. And in June, Yahoo! Inc. agreed to buy Viaweb Inc., Cambridge, MA, a company



Sweet Tooth Candies is one of a growing number of small to mid-size businesses making the jump to electronic commerce.

that offers a service for building Web stores. “The start-ups are either disappearing or being consolidated into one of the large players,” says Ian Finley, manager of product marketing for Open Market.

This volatility in the marketplace is creating a level of uncertainty in the minds of developers. A vendor that is here today might be gone tomorrow. “I want to know what’s going to be around,” says Paul Schneider president of Blue Sun Multimedia, a Brighton, MA-based Web design firm. “Who should I trust?”

As well as the uncertainty about which companies will still be in the game this time next week, there are concerns regarding the newness of these applications and their reliability in handling business-critical tasks. Users are still questioning whether to build a commerce site from scratch or to put their faith in one of the packaged applications on the market.

If they choose to build a site themselves, they must write custom programs that provide customer authentication, order and payment processing, order tracking features and back-office functionality, such as order maintenance for the Web merchant. There must also be mechanisms in place for customer service, database integration and sales tools that can provide specials on select products. With a commerce server software package many of these features are provided, thus eliminating the need to piece together the e-commerce system (or write each component separately). “Our biggest competition is still custom CGI scripts and shopping carts,” says Scott Sedlyk, director of brand marketing at iCat Corp., Seattle, WA, maker of several e-commerce software products,

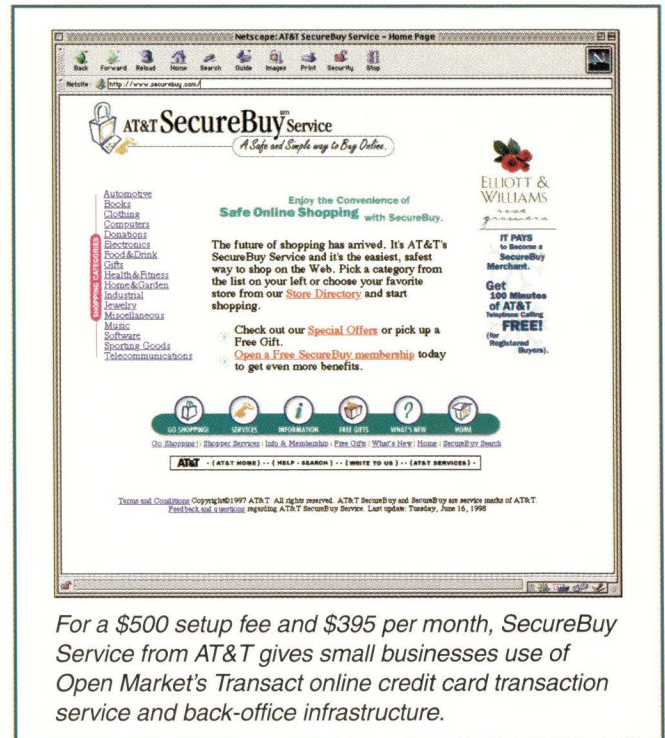
including Electronic Commerce Suite. “They’re easy to implement. That’s why they’re so broadly used, but an inherent problem is that they are not scalable.”

The CGI script and shopping cart approach is the route Mike and Margo Williamson, owners of Sweet Tooth Candies, Hot Springs, AR, decided to take when building their e-commerce site (<http://sweettooth1.com>). Much of the work was done by Mike, who had little development experience. “I took a little programming back in 1974,” he says. “You still punched punch cards and wrote the whole program out by hand back then.”

In December 1997, Mike started to build a site that could receive orders for gourmet chocolate and jelly beans that he and his wife sold at their Hot Springs store. Within a couple of weeks, he had an informational site up and running, then in June he added an order form. The couple is currently waiting for B.M.V. Trade Inc. & Dinos Servers, Hallandale, FL, the company that hosts the Sweet Tooth Candies Web site, to add the shopping cart that comes as part of the service agreement. Until the shopping cart is up and running, orders are taken over the phone or via email. A Secure Server ID from Mountain View, CA-based VeriSign Inc. has been established to enable Secure Sockets Layer (SSL) transactions to process credit card orders when the shopping cart is up and running. Scalability and integration into a company database were not issues. “We just have a little mom-and-pop shop here,” Margo says.

Cost has been kept to a minimum. The site was designed using Microsoft Corp.’s FrontPage 98, which the Williamsons bought for \$149, and the site is hosted by B.M.V. Trade for \$20 per month. In addition, the couple established credit card accounts through Total Merchant Services for around \$1,000. “Actually, that was the onetime biggest outlay,” Mike says.

For other companies considering the move to electronic



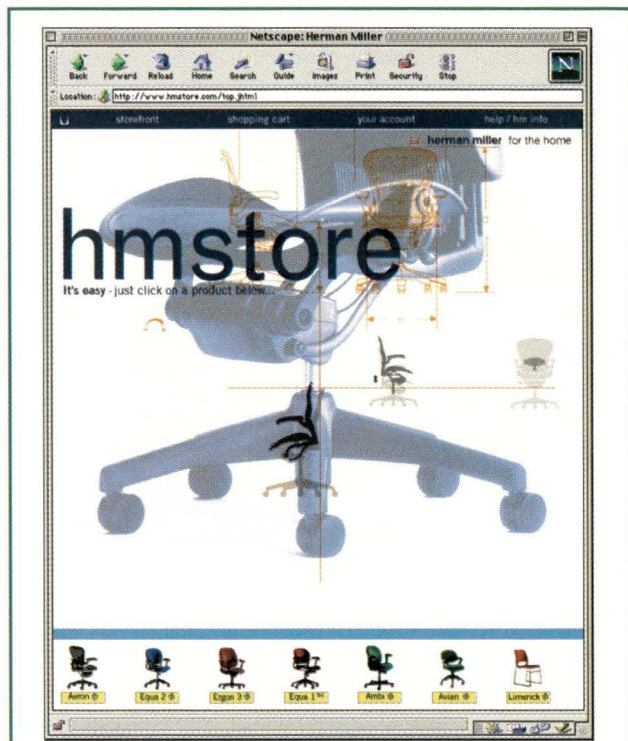
For a \$500 setup fee and \$395 per month, SecureBuy Service from AT&T gives small businesses use of Open Market's Transact online credit card transaction service and back-office infrastructure.

commerce, scalability, reliability, availability and integration are extremely important. The question is to what extent. Open Market's Finley says the market is going through an evolution where people are beginning to realize that there are different e-commerce applications for different needs. Prices for these products can range anywhere from \$1,000 to \$250,000.

The notion that a company like AT&T Corp., Basking Ridge, NJ, could take the same approach that the Williamsons did with Sweet Tooth Candies is almost comical. Most CGI scripts and shopping cart programs couldn't handle the demands of AT&T's SecureBuy Service (<http://www.securebuy.com>). The telecommunications giant offers the service to anyone interested in adding online transaction capabilities to their site. The driving application behind the service is Open Market's Transact e-commerce product, which provides order processing and customer service features. AT&T's main concern was the application had to be reliable. It would serve as an integral part of making other people's commerce sites run smoothly.

SecureBuy offers small businesses that can't afford the \$100,000 to \$250,000 needed to buy Transact the ability to use the product for \$395 per month. This includes credit card transactions, services and back-office infrastructure. There is a \$500 setup fee and the first 500 transactions are free. Each subsequent transaction costs \$3. "Instead of spending the hundreds of thousands of dollars for Open Market software, you, as a small business, can utilize the SecureBuy Service to do that," says Ron Koskinen, marketing director at AT&T.

Industry analysts typically view packaged applications in two categories. The high end, for sites that receive heavy traffic, includes products such as Open Market's Transact and Redwood City, CA-based Broadvision Inc.'s One-To-One. Pandesic LLC, Sunnyvale, CA, whose product is described by its creators as "an e-business solution," also falls into this category, although



In order to simplify the process of building a completely integrated system, Herman Miller chose only to offer select products online.

Pandesic takes a percentage of electronic commerce sales. In return, the company handles integration and maintenance issues similar to an Internet service provider.

The second category features less expensive products designed for small to medium-size companies and includes Oracle Corp.'s Internet Commerce Server, Netscape Communications

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236	237238

Corp.'s CommerceXpert, IBM Corp.'s Net.Commerce, Microsoft's Site Server Commerce Edition and iCat's Electronic Commerce Suite. These products cost between \$1,000 and \$10,000, but might not come with all the necessary components to build a commerce Web site from scratch.

Rick Miller, Internet analyst with International Data Corp. (IDC), Framingham, MA, warns that even though some applications might seem cheaper on the surface, there could be additional costs. "See what else you need to implement that solution," Miller says. "You might have to have some other applications running."

There's Help Out There

The outsourcing approach that AT&T's SecureBuy Service offers is a common method used by companies to develop their sites. Furniture retailer, Herman Miller Inc., Zeeland, MI, chose that route with the Dynamo Relationship Commerce suite from Art Technology Group (ATG) in Boston, MA. Herman Miller's commerce site went online in June (<http://www.hmstore.com>). In evaluating its options, Ray Kennedy, general manager for Herman Miller, felt ATG had the technical skills to build a completely integrated system. "We had to make sure that our databases were ready to accept the information that was coming off the e-commerce products," Kennedy says.

To simplify the process, the company decided not to offer the complete Herman Miller product line and chose only to offer certain products. A specific database was designed for the select products and a direct connection was made to the company's delivery service provider.

When a sale is made, an electronic purchase order is sent to the company's manufacturing facility, which gathers the supplies to build the product. Once the product is assembled, it is then shipped from the distribution facility to the delivery service. "We really wanted to do the full integration," says Kennedy. "It's essentially a seamless transaction."

Unlike Herman Miller, The Hugely Fun Toy Store operates solely online (<http://www.hugelyfuntoys.com>), but it is another example of a company that has taken the outsourcing route. The company, owned and operated by NJ-based TV-Free L.L.C., hired Atypica, a software development consulting firm based in Bedford, MA, who used WebSpeed from Progress Software Corp., also based in Bedford, to develop an online toy store. The key issue for Charles Levin, managing partner for Hugely Fun Toys, was speed in handling heavy transaction loads. "I knew with the Internet that people would access it with slow modems and old browsers," says Levin. "I had concerns regarding speed particularly when you got into a transaction mode. I want to be able to process the order quickly."

Levin says the company is growing at a rate of 15% per month and it has not had to reconfigure the system since it was launched in June 1997 because the toy store planned for the upper limits in terms of transaction load, the number of fields required for the database and pipeline speed. The Hugely Fun Toy Store has a T1 line to the Internet and the site is hosted on a Microsoft NT 4.0 server using Secure Web from O'Reilly & Associates Inc., Cambridge, MA, with pay-

Using a T1 line to the Internet and hosted on a Microsoft NT 4.0 server, The Hugely Fun Toy Store Web site was designed specifically to handle the upper limits in terms of transaction load, the number of fields required for the database and pipeline speed.

ment processing provided by Reston, VA-based CyberCash Inc.'s Register software. Credit card orders are protected via SSL-based security. "It's much better investing a little more up front than having to redo later on," Levin says.

Customer Service and Personalization

The move toward seamless integration between the storefront and a company's back office is considered to be an important goal for any e-commerce site. By having real-time access to a database, customers can check the availability of a product, current pricing and even the status of an order. With that in mind, some merchants are trying to incorporate more involved customer service features. Outrigger Hotels & Resorts of Honolulu (<http://www.outrigger.com>) continually adds new features to its site to strengthen its ties with customers planning to stay at one of its properties in Hawaii.

Launched in 1994, the Outrigger site initially only provided information on its locations throughout the Hawaiian Islands. But within the first six months, a simple email reservation feature was added. Now the company takes credit card reservations, delivers information on all of its locations and has recently added the ability to connect Web-based customers with its phone operators via an audio connection over the Internet. The company is using AT&T's InteractiveAnswers service, which allows a visitor on the Outrigger site to connect directly with one of its customer service operators. There is an icon on the site that bridges the call over the network along with the data connection. This enables the operator to answer

direct questions or push specific Web pages out to the user's browser. "We were looking to help add back some personal touch to making a reservation," says Bill Sthay, vice president of reservations for Outrigger Hotels & Resorts. "In our environment, the caller usually has a number of questions they need to get answered before they are willing to make the reservation. We were finding that people were browsing the Web site and then calling us."

With the addition of the InteractiveAnswers service, Sthay found calls from the site are usually shorter since the customer is getting the information they requested faster. The site generated more than \$1 million in sales in 1997, which Sthay says is less than 1% of the company's total revenue but he knows its importance will grow. "It's not a major part of our business right now, but we know it will be integral over time," Sthay says.

Other companies are attempting to improve customer service with the personalization of their Web sites. This can include having a person fill out a form regarding product preferences using either a user ID/password login or cookies, or the merchant can have special offers presented directly to the customer to encourage a sale based on their interests and past purchases. Hugely Fun Toys, for example, attempted to gather information on children's birthdays in order to send email to parents reminding them about its products. The company found that parents were more interested in privacy protection than they were in hearing about specials, so it abandoned the process. "It's more important to make naviga-

tion from a content standpoint very user friendly," Hugely Fun Toys' Levin says, "Privacy issues were much more of a concern than the personalization."

Most vendors feel personalization is a future evolutionary step for electronic commerce, but the priority should be on the functionality of the site. To maximize that experience means minimizing downtime and quickly processing transactions. "We see personalization as something talked about a lot but very few companies are doing it," says iCat's Sedlyk. "The technology itself we see as being important but it's probably about a year away. Our recommendation to developers is to focus on the core. Build the database properly and then add on features over time."

AT&T's Koskinen adds, "I haven't seen a lot of direct one-to-one personalization and I'm not sure if that is really required. What is required is understanding who your target audience is and tailoring your message for that audience."

The Future

Both the vendors selling packaged electronic commerce applications and the companies attempting to build commerce sites themselves hope the road ahead is paved with gold. One of the main issues for the future will be tighter integration with the back end in order to maximize a customer's experience. In addition, vendors will continue to attempt to win the trust of the developers so they'll stay in business and so that the developers will have the application to meet their needs. In a report released by IDC in June, entitled *The Gray Sheet: Anatomy of a CyberSale*, IDC's Miller says that not all Web merchants will require the best-of-breed products offered by the likes of Open Market and IBM. "For many upstart Net entrepreneurs, a simple solution will suffice."

"For e-merchants, big factors influencing the build, buy or outsource decision include the implementation and maintenance costs associated with commerce servers," says Miller. "Also, big customers for commerce servers have to take into account scalability issues when they plan solutions designed to handle large numbers of merchants."

For many e-commerce merchants it's too early to tell whether or not their Web venture is going to be a success. Sweet Tooth Candies' Williamson is still optimistic about the future of his Web store. He says that once he is listed with all the major search engines and begins to aggressively promote the site, it will be an excellent source of revenue for the candy shop. "I'm still excited about it and I'm anticipating business from it," he says. "I see unlimited potential."

Herman Miller's Kennedy believes his site will be a success. Although Herman Miller's commerce site has only been online since June, the next version is currently in the works for launch in the fall. "We see it as a new and emerging distribution channel for the company," Kennedy says. "We are really attempting to build customer relationships."

For Hugely Fun Toys' Levin, the unique nature of electronic commerce makes it an ideal environment for establishing ties with customers. "It's a wonderful platform for building and continuing relationships that you don't normally have with a walk-in type business," he says. ➤

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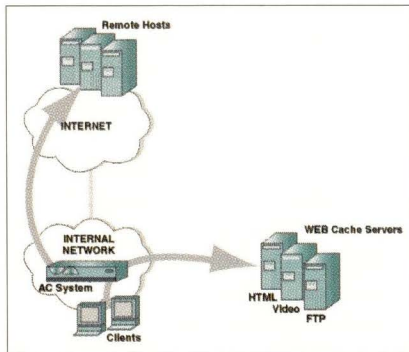
Computer Publishing Group, 1340 Centre Street,
Suite 102-103, Newton Center, MA 02459
Telephone 617-641-9101 Fax 617-641-9102
www.cpg.com

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URL/New Products

Add-On to Improve Network Performance

Allot Communications has introduced a new member to its bandwidth management product line. Cache Enforcer is a cache redirection solution for improving network response time and reducing wide-area network (WAN) traffic, according to the company.



The problem with caches, Allot says, is they are not centrally managed and, as a result, bring with them additional administrative overhead. Sitting in front of the WAN or Internet link, Cache Enforcer is said to automatically set policies for individual users according

to predetermined guidelines, improving the cache/hit ratio and, thus, improving response time and reducing WAN congestion. Cache Enforcer is available as a software add-on to Allot's AC200 and AC300 bandwidth management products and costs \$2,995.

Allot Communications Inc.
292 E. Main St.
Los Gatos, CA 95030
<http://www.allot.com>
Circle 191

RealNetworks Unveils Multimedia Package

RealSystem G2 from RealNetworks is described as an open, extensible standards-based streaming media system, which delivers rich media experiences through synchronization and playback of multiple media types. According to the company, RealSystem G2 includes a powerful new music codec that will increase the frequency response of audio by 80% for both 28.8 and 56 Kb/s modem connections. In addition, new video post-filtering capabilities are said to create smoother images for end users.

It is built on industry standards, implementing the Synchronized Multimedia Layout Presentation (SMIL), an internet standard recently approved by the World Wide Web Consortium (W3C) to enable Web authors to create synchronized multimedia presentations, and Real-Time Streaming Protocol (RTSP), a standard client/server protocol for streaming media.

RealSystem G2 runs on Solaris, AIX, HP-UX, Digital UNIX, IRIX, Linux, Windows 95/NT and Macintosh platforms; a free beta version can be downloaded from the company's Web site.

RealNetworks Inc.
1111 3rd Ave., Ste. 2900
Seattle, WA 98101
<http://www.real.com>
Circle 192

Tool Supports 400+ Media File Types

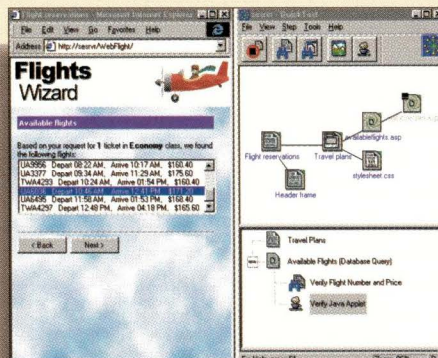
Arriba Soft has announced its flagship product, Arriba Express, a media management tool that supports more than 400 media file types, including images, sound, video, animation and text, the company says. With Arriba Express, users can easily capture, view, edit and reuse media of all kinds, as well as integrate them with popular third-party media creation and publishing tools, the company says. Arriba Express runs on Windows 95/NT and is available for \$149 per user from the company's Web site.

Arriba Soft Corp.
200 E. 5th Ave., Ste. 108
Naperville, IL 60563
<http://www.arribasoft.com>
Circle 193

Testing Tool for E-Commerce Applications

Mercury Interactive has unveiled a functional testing version of its popular line of Astra Web-based products. Astra QuickTest, the first icon-based functional testing tool for electronic business applications, is said to simplify and automate the entire test process, testing both business processes and data sets.

To examine a business process, for example, a typical test might consist of having a user log into an account, query a database and enter a transaction, the company says. Astra QuickTest runs on Windows 95/NT and sells for \$3,995.



Mercury Interactive Corp.
1325 Borregas Ave.
Sunnyvale, CA 94089
<http://www.merc-int.com>
Circle 190

Traffic Management for Application Servers

Organizations that run their Web-based applications from a Windows NT-based server can now relieve congestion resulting from Internet, intranet

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.

and extranet IP traffic thanks to a new product from Ukiah Software. Net-Road TrafficWare for NT Application Servers—TrafficWare AS, for short—is deployed directly on the NT application server instead of at the wide-area network (WAN) gateway point. In this way, TrafficWare AS can monitor all application traffic, whether it is destined to stay on the local-area network (LAN) or go out over the Internet, the company says.

TrafficWare AS requires no additional hardware and delivers a full range of IP traffic management features, including traffic profiling, monitoring, control, reports and alarms. TrafficWare AS supports Ethernet 10/100 and Token Ring interfaces, and can be deployed on NT application servers such as Microsoft Corp. Internet Information Server (IIS), Microsoft Exchange and Citrix Systems Inc. MetaFrame. A single-server license costs \$1,995 and a five-server license costs \$8,250.

Ukiah Software Inc.
2155 S. Bascom Ave.
Campbell, CA 95008
<http://www.ukiahsoft.com>
Circle 194

Chili!ASP for Solaris

Chili!Soft now offers the power of Active Server Pages (ASP) to enterprise UNIX-based environments, enabling development and deployment of “true” cross-platform Web-based applications, the company says. Chili!ASP is described as a Web application environment with support for rapid application development (RAD) tools, easy database connectivity and a component-based framework to create mission-critical enterprise applications. Web developers can use ASP-supported scripting languages such as JavaScript and Visual Basic Script.

Chili!ASP for UNIX will initially be available for Netscape Communications Corp. Enterprise Servers running on Solaris 2.5. Per-server pricing for the UNIX version starts at \$7,000 for the first CPU and \$6,000 for each additional CPU.

Chili!ASP is also available for Netscape's FastTrack and Enterprise servers on Windows 95/NT, Lotus Develop-

ment Corp.'s Domino Server on Windows 95/NT and IBM Corp.'s Internet Connection Server (ICS) for Windows NT; contact company for pricing.

Chili!Soft
2700 Richards Road, Ste. 103
Bellevue, WA 98005
<http://www.chilisoft.com>
Circle 195

Portable Network Analyzer Revamped

Sniffer Portable Analysis Suite from Network Associates has been overhauled. The company calls it the only network analyzer to troubleshoot and optimize all local-area and wide-area network (LAN and WAN) topologies, including Gigabit Ethernet, full-duplex 100 MB and high-speed serial interface (HSSI).

Sniffer Portable Analysis Suite supports simultaneous network analysis and monitoring, which is said to improve the efficiency of troubleshooting problems on the network. A one-year license for Sniffer Portable Analysis Suite costs \$12,995.

Network Associates Inc.
3965 Freedom Circle
Santa Clara, CA 95054
<http://www.nai.com>
Circle 196

Messaging Server for ISPs

Software.com, a developer of Internet email server software, has announced a new version of its email system designed for Internet service providers (ISPs). InterMail 4.0 reportedly enables ISPs to offer mailbox accounts with different features, including Web-based email and family mailboxes. The product is also designed to enable hosted business messaging. ISPs can offer classes of service with varied options, IMAP4 support, delegated administration and private domains, the company says.

InterMail 4.0 runs on UNIX platforms from Sun Microsystems Inc., Digital Equipment Corp. and Silicon Graphics Inc. Pricing starts at \$495 for a 100-user license.

Software.com Inc.
525 Anacapa St.
Santa Barbara, CA 93101
<http://www.software.com>
Circle 197

Enhanced Web Site Creation Tool

Boomerang Software has unveiled a 32-bit Windows version of its Internet/Intranet Design Shop Gold Web site creation, management and publishing program. To complement this new software, Boomerang also offers basic and professional Web site hosting services for a monthly fee starting at \$9.95.

This new version offers features such as full-site import functions and built-in integrated site upload, the company says. Other features include a frames generator and multiple frames manager for easy creation, sizing and placement of frames. Netscape Communications Corp. Navigator and Microsoft Corp. Internet Explorer browsers are also supported.

Internet/Intranet Design Shop Gold 32-Bit runs on Windows 95/98/NT and costs \$99.

Boomerang Software Inc.
90 Concord Ave.
Belmont, MA 02178
<http://www.boomerangsoftware.com>
Circle 198

Junk File Removal System Out

WebSweep from Luckman Interactive is a new utility that is said to clean all the clutter, cookies and “junk files” that accumulate on the hard drive during an Internet session. Users can set up the software to automatically clean their system on a daily or weekly basis, or alternatively can view and select individual files to be deleted using the interactive mode. An online tutorial explains the purpose of all the Internet files that WebSweep can find and remove.

If you're worried about privacy, this product can also instantly remove all traces of Web surfing sessions from your computer, the company says. WebSweep runs on Windows 95/NT and costs \$19.95.

Luckman Interactive Inc.
1055 W. 7th St., Ste. 2580
Los Angeles, CA 90017
<http://www.luckman.com>
Circle 199

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The *SunExpert Electronic Archives* are available in the cross platform-friendly PDF format. The free viewing software, Adobe Acrobat Reader 3.0, can also be downloaded from the archive site.

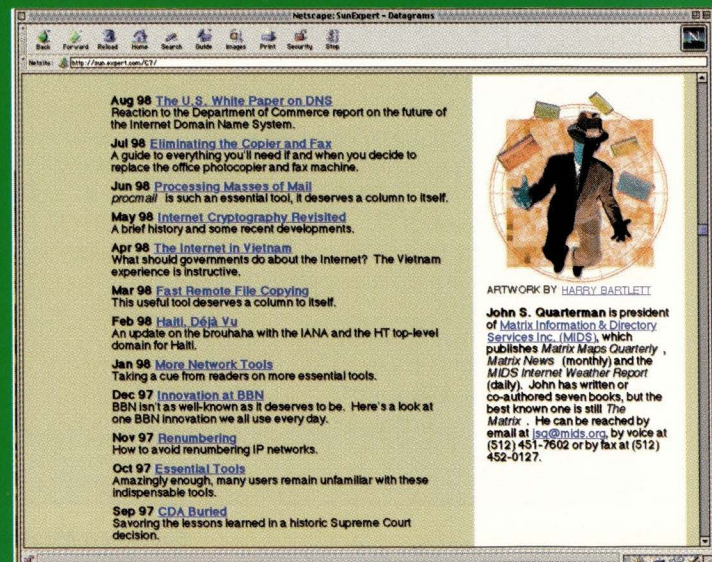
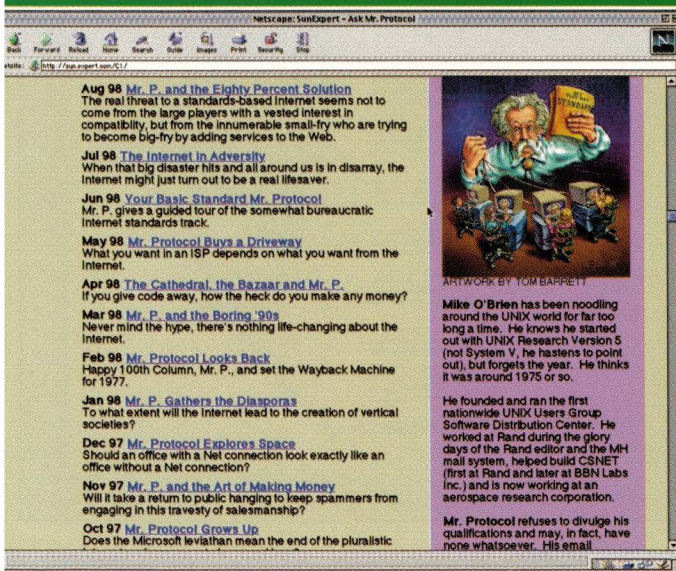
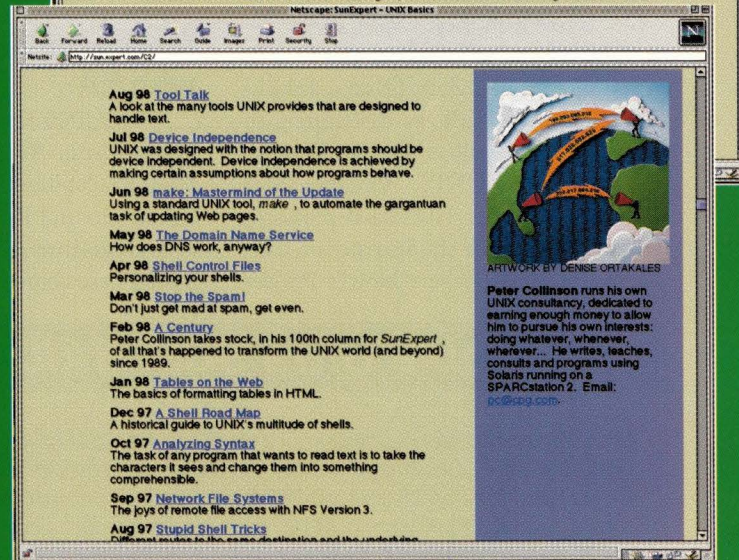
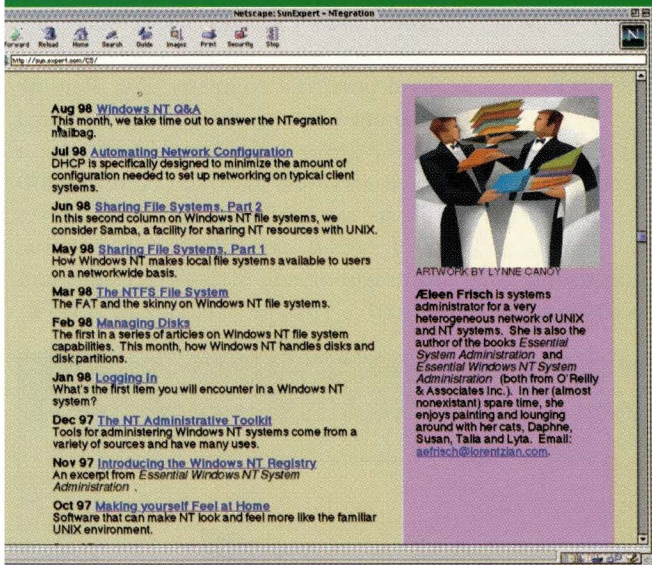
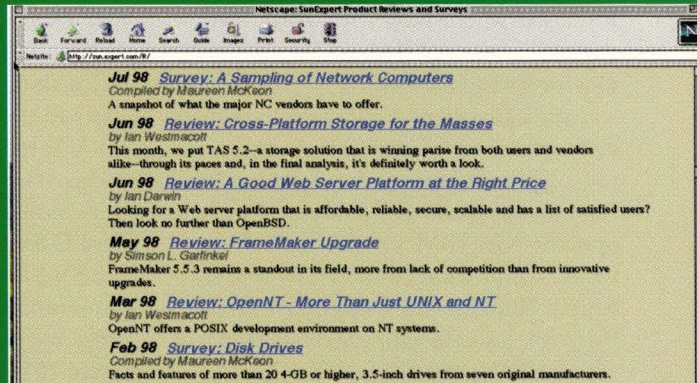
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- Considering new backup software? Or a new RAID system?
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NEW PRODUCTS

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

Install Anywhere Option for Java Developers

Zero G Software, a start-up specializing in Java installer authoring tools, has announced major industry support for InstallAnywhere Now!, the entry-level version of its multiplatform installation tool for Java applications.

InstallAnywhere Now! will be bundled with several software tools, including Apple Computer Inc.'s Mac OS Runtime for Java (MRJ) Software Development Kit, IBM Corp.'s VisualAge Object Connection Partners CD, Inprise Corp.'s JBuilder and ObjectShare Inc.'s Parts for Java. InstallAnywhere Now!, which the company says is valued at \$149, is free with these products.

Like all the products in the InstallAnywhere family, Zero G says, InstallAnywhere Now! allows developers to quickly build installers that can simultaneously support UNIX, Windows, Mac OS and any other Java-based platform for distribution via the Internet or CD-ROM. InstallAnywhere Now!'s Project

Wizard interface reportedly enables multiplatform installers to be built in six easy steps, thus, saving Java developers the time-consuming process of building separate installers for each platform.

In addition, InstallAnywhere Now! allows developers to create clickable Java application launchers with custom icons, making Java software as easy to use as native applications, Zero G says. More information about the InstallAnywhere family of products is available on the company's Web site.

Zero G Software Inc.
118 King St., Ste. 415
San Francisco, CA 94107
<http://www.zerog.com>
Circle 101

Automated DLT Library with HA

The P3000 Series Automated DLT Library from ATL Products features a High Availability (HA) design similar to HA servers and RAID systems. Targeted at storage-intensive applications, the P3000 base configuration features up to

16 DLT drives and 332 cartridges for 288-GB/hour throughput and 11.6-TB storage capacity.

The product comes with single connector hot-swap DLT drives, power supplies and fans, as well as redundant power supplies and additional AC sources. The hot-swap components allow for nondisruptive maintenance, while the redundant AC components allow online replacement and continuous uptime in the event of a single-component failure, ATL says.

The P3000 features an icon-based touch-screen GUI, which allows for easier configuration and operation. With simple point-and-click operations, users can identify or query the status of drives, cartridges, bins and the load port, the company says. Remote management is achieved via optional WebAdmin software, which uses a Java-enabled browser. The P3000 library can support 80 DLT7000 drives and 1,660 cartridges for a native throughput rate of 1.44 TB/hour and a native storage capacity of 58 TB;

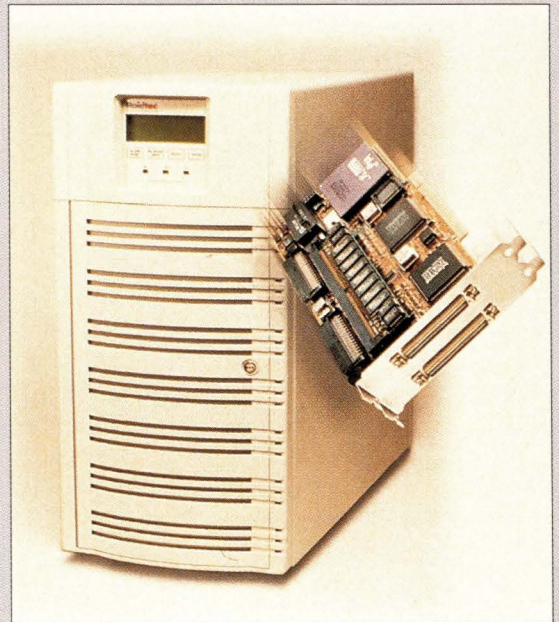
Affordable Ultra SCSI RAID Subsystem

Raidtec has announced an incremental boost in performance for SCSI-based solutions. The FlexArray UltraRAID comprises an UltraRAID PCI-based caching controller and up to two FlexArray T subsystem enclosures to provide a subsystem suitable for applications requiring 12 to 252 GB of memory and data transfer rates of 40 MB/s, Raidtec says.

FlexArray UltraRAID is a PCI-based RAID controller that supports 8 to 32 MB of cache, two Ultra Wide SCSI drive channels, custom Ultra SCSI ASICs and RAID levels 0, 1, 3 or 5. The RAID controller supports multiple virtual concurrent arrays, allowing up to eight simultaneous logical arrays, each with its own selectable RAID level, the company says.

The FlexArray T Ultra SCSI RAID enclosures support up to seven 3.5-inch, industry-standard 9- and 18-GB Ultra, Wide and Narrow SCSI drives. A typical 126-GB configuration with 18-GB drives costs \$22,000.

Raidtec Corp.
400 Overlook Business Park, Bldg. 12
1360 Union Hill Road
Alpharetta, GA 30004
<http://www.raidtec.com>
Circle 100



New Products

contact ATL for pricing.

ATL has also announced its PowerStor L500 DLT Library for small to mid-size UNIX and NT networks. The PowerStor L500 is positioned as a high-performance library, supporting three DLT drives in a single 7-inch high rack-mount or 7-inch wide desk-side enclosure. With support for up to three DLT drives and 14 DLT cartridges, the PowerStor L500 delivers 54 GB/hour back-up performance and 490 GB of storage, ATL says. Pricing for PowerStor L500 starts at \$12,000.

ATL Products Inc.
2801 Kelvin Ave.
Irvine, CA 92614
<http://www.atlp.com>
Circle 102

Control for Embedded Java Development

Network device vendors can now easily add Java-based configuration, management, monitoring and control capabilities to their products by using Rapid Logic's JavaControl, a new Software Development Kit (SDK), the company says. With it, a device's embedded functionality can be exposed to higher-level Java applets running in Java-enabled Web browsers, without having to embed a Java Virtual Machine (JVM) into the device.

The JavaControl SDK makes use of the company's OpenControl Backplane (OCB), which Rapid Logic describes as a "write once, present anyhow" device management framework. OCB provides a unified data access model that reportedly allows vendors to hook up a device's C-based functions and SNMP MIB variables to Java applets, HTML pages, email alerts and command-line interface. It also provides a bidirectional communications layer to avoid performance problems associated with using TCP for network management applications, the company says.

JavaControl's brokering scheme, the Applet Broker, manages applets and applet communications. Applet Broker handles communications between the Web browser and the embedded device via UDP, eliminating the need for a JVM. Stored in the device, Applet Broker can enable functionality such as

real-time graphs, reports and charts, the company says.

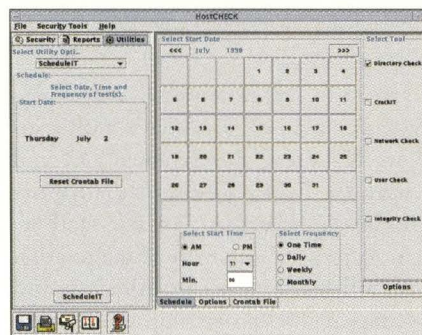
JavaControl also comes with the JavaControl Integration Tool, a visual rapid application development (RAD) tool, which is said to condense the process of Java-enabling a device into three steps: discovering the embedded elements in the device, hooking embedded elements up to the Java layer and building the customized Java applet. The Integration Tool comes with several preconfigured JavaBeans for displaying charts, switches, gauges and other elements.

JavaControl is available in royalty and royalty-free pricing options, with base packages starting at \$45,000 per target product.

Rapid Logic Inc.
1040 Marina Village Pkwy.
Alameda, CA 94501
<http://www.rapidlogic.com>
Circle 103

UNIX-Based Security Tools

DMW Worldwide has introduced HostCHECK for UNIX, an integrated suite of tools that is said to deliver immediate enterprise security improvements and allows users to bring security expertise in-house. The suite includes a Java-based GUI and a vulnerability database that contains approximately 2,000 validated exploits.



HostCHECK features nine modules that each focus on a specific security aspect of a UNIX-based host machine. These include Evaluate, Assess, Manage Configuration, Correct and Improve, Protect and Monitor, and Intelligent Monitoring and Reporting.

HostCHECK runs on Solaris 2.3+, SunOS 4.1.x, HP-UX 9/10, Digital UNIX 2.x, IRIX 6.x, AIX 4.x, Linux 2.x

and FreeBSD. HostCHECK for UNIX costs \$295 per host; contact vendor for multihost, site license pricing.

DMW Worldwide LLC
4965 N. 30th St.
Colorado Springs, CO 80919
<http://www.dmwworldwide.com>
Circle 104

TraderSwitch Saves Desktop Space

TraderSwitch from Raritan Computer reportedly enables users to control a Sun Microsystems Inc. workstation and a PC running any operating system via a single Sun keyboard and mouse.



Aimed at traders/brokers, TraderSwitch, consolidates the keyboard and mouse to save space on the desktop, while maintaining the continuous video display from both systems, the company says. The user switches between the workstation and PC by either pressing a single key on the keyboard or by pushing a button on the front panel of TraderSwitch. It requires no external power and has a dedicated keyboard/mouse emulator for each computer being controlled. TraderSwitch costs \$645.

Raritan Computer Inc.
400 Cottontail Lane
Somerset, NJ 08873
<http://www.raritan.com>
Circle 105

FullTime Offers Clustering Middleware

FullTime Software, formerly Qualix Group Inc., has introduced a line of clustering middleware for balancing application performance across groups of servers: FullTime Cluster 4.0, FullTime Data 4.0, FullTime Awareness Modules and FullTime Software Development Kit (SDK).

Available now, FullTime Cluster 4.0 supports up to 100 nodes in a cluster and is designed to allow users to manage groups of resources across multitier or cross-platform nodes. With the soft-

New Products

ware, FullTime says, users can relocate resource groups based on events such as time of day or load fluctuation. Available for Solaris and Windows NT, it costs \$10,000 for a two-node cluster configuration. FullTime plans to add versions for HP-UX and AIX by the end of the year.

FullTime Data 4.0 is designed to offer high-performance, real-time data replication across local-area and wide-area networks (LANs and WANs). Only changes in protected data are captured and forwarded to the targeted nodes. In addition, the company touts its abilities for data exchange, synchronization and data sharing among remote sites.

FullTime Data is available for Solaris, HP-UX and Windows NT; pricing starts at \$5,000 for an entry-level, two-node cluster configuration. FullTime Awareness Modules and SDK will be available later this year.

FullTime Software Inc.

177 Bovet Road, 2nd Floor
San Mateo, CA 94402

<http://www.fulltimesoftware.com>

Circle 106

Enterprise Image Servers Out

Live Picture has announced new versions of its Live Picture Image Servers, designed to give Web users the ability to view and control images in real time without the need for a Web browser plug-in. These products are designed for use in electronic commerce environments, image asset management, medical imaging and defense and intelligence applications, the company says.

Live Picture offers three new versions of the Image Servers: Enterprise Edition, Open Enterprise Edition and Developer Edition. A fourth version, the Standard Edition, was released in February.

The Enterprise Edition Image Server is said to provide controlled access to images of varying resolution and the ability to track which images are being viewed. Enterprise Edition features a multithreaded, load-balancing architecture that enables network operators to distribute multiple versions of an image of varying resolution from a single file, Live Picture says.

The Open Enterprise Edition features

APIs that support integration with enterprise imaging systems, electronic commerce servers and databases. With Open Enterprise Edition, Web site developers can build linkable "hotspots" into images, which can query a database and dynamically generate new HTML pages containing related information and high-resolution images.

The Developer Edition is a limited-capacity version designed for systems integrators, value-added resellers (VARs) and independent software vendors (ISVs). It controls special image monitoring capabilities such as universal viewing for zooming into images using only a browser, optional Java-based viewers and plug-ins and multithreading support for all HTTP servers, the company says.

The Live Picture Image Servers (Enterprise Edition, Open Enterprise Edition and Developer Edition) are priced from \$20,000 to \$60,000. They run on Solaris 2.5.1+, Windows 95 and NT 4.0 and are compatible with Netscape Communications Corp. FastTrack and Enterprise 2.0+ servers, Microsoft Corp. Internet Information Server (IIS) 3.0+ and Apache.

Live Picture Inc.

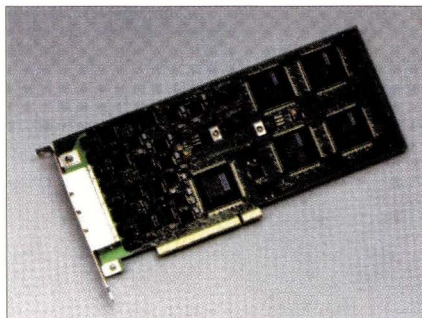
910 E. Hamilton Ave., Ste. 300
Campbell, CA 95008

<http://www.livepicture.com>

Circle 107

Ethernet Adapters for Solaris/NT

Aurora Technologies has two new Ethernet adapters for Solaris and Windows NT users, the Explorer EX1 and Explorer EX4. The cards support 10/100-Mb Ethernet networks and are said to provide automatic configuration capabilities for easy installation and optimized CPU processing.



EX1 is a single-port Ethernet adapter, while EX4 is a four-port adapter, which provides the equivalent of four separate Ethernet adapters on one PCI bus. Aurora says that in addition to conserving PCI bus slots, the EX4 PCI-to-PCI bridge reduces the PCI bus load, thus, ensuring maximum performance.

The Explorer EX1 and Explorer EX4 cost \$450 and \$1,350, respectively. Both adapters come with drivers supporting SPARC Solaris, Solaris x86 2.5+ and Windows NT 4.0.

Aurora Technologies Inc.

176 Second Ave.

Waltham, MA 02154

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Circle 108

UltraSPARC Rack-Mount Server Unveiled

Integrrix has introduced the RS4 UltraSPARC Rackmount Server, designed specifically for Internet service providers (ISPs), embedded systems manufacturers and telephone companies.

The RS4 features up to four 250-, 300- or 360-MHz UltraSPARC CPUs. In addition, it offers six PCI slots and one 1.6-GB/s dual UPA interconnect. The RS4 supports up to 4 GB of main memory with 36 GB of storage on two internal hot-swappable Ultra Wide SCSI hard disks and more than 16.2 TB of external storage, Integrrix says. Also, the RS4 uses Sun Microsystems Inc.'s Ultra AXmp motherboard, a four-way embedded multiprocessor board.

The system is housed in a 19-inch rack-mount enclosure and runs Solaris 2.6. The RS4 costs \$25,000.

Integrrix Inc.

2001 Corporate Center Drive
Newbury Park, CA 91320

<http://www.integrrix.com>

Circle 109

DSP Board Supports Four C6x Processors

Blue Wave Systems has announced the PCI/C6400, a high-performance digital signal processor (DSP) board that is said to offer 6,400 million instructions per second (MIPs) of processing power through a single PCI slot. The PCI/C6400 supports up to four Texas Instruments TMS320C6201

New Products

(C6x) processors and is optimized for multichannel processing of media streaming tasks, the company says.

The PCI/C6400 uses a Lucent Technologies Inc. T8100 Timeslot Assigner to provide a fully Enterprise Computer Telephony Forum (ECTF)-compliant H.100 speech bus interface. With this interface, timeslot traffic is reportedly kept off the host bus, offering synchronization and transfer of voice data between other H.100-equipped boards. Each DSP has access to 16 MB of synchronous dynamic random access memory (SDRAM). In addition, an optional Motorola Inc. MPC860 PowerQUICC processor allows critical real-time, onboard control, signaling and data management tasks to be handled independently of the host processor, Blue Wave says.

Pricing starts at \$2,350 for OEM quantities. The PCI/C6400 supports Solaris 2.x and Windows NT systems.

Blue Wave Systems Inc.

2410 Luna Road, Ste. 132

Carrollton, TX 75006

<http://www.bluews.com>

Circle 110

Professional Tcl Tools

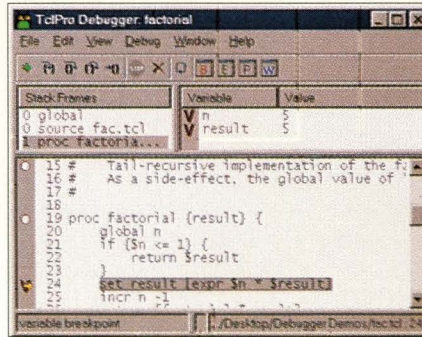
Scriptics, the company formed to further the Tcl scripting language, has announced its flagship product, TclPro, a suite of software development tools. TclPro is the first commercial product to be based on the Tcl language, which, according to the company, is currently used by more than 500,000 developers.

Four separate tools make up TclPro: TclPro Debugger, TclPro Checker, TclPro Wrapper and TclPro Compiler. Also included is the latest 8.0.3 release of the open source Tcl core, as well as a handful of popular Tcl extensions—[incr Tcl], [incr Tk] and [incr Widgets]—for object-oriented functionality.

TclPro Debugger provides developers with standard debugging capabilities, such as breakpoints, single stepping and variable display, and a remote debugging capability, which allows developers to debug applications running on other machines and Tcl interpreters embedded in other applications, Scriptics says. TclPro Checker analyzes code statically

to find potential problems such as programming errors, Tcl version incompatibilities and slow constructs.

TclPro Wrapper packages multifile Tcl distributions into a single executable for easier distribution. An added benefit is Wrapper reportedly protects against unwanted upgrades of core Tcl libraries. Finally, TclPro Compiler translates Tcl scripts into portable byte codes for intellectual property protection.



This first release of TclPro is available on Solaris, HP-UX and Windows 95/NT platforms. A single-user license costs \$1,000, with technical support pricing starting at \$200. A free evaluation copy is available from the company's Web site.

Scriptics Corp.

2275 E. Bayshore Road, Ste. 101

Palo Alto, CA 94303

<http://www.scriptics.com>

Circle 111

Xerox Printer Management Software Out

Xerox has announced Version 1.2 of its PrintXchange print management software for Solaris and Windows NT. Unlike vendor-specific management software, PrintXchange supports virtually every printer on the market, Xerox says.

PrintXchange provides solutions for network traffic flow problems and printing cost inefficiencies by enabling IT administrators to balance the flow of output across large networks, the company says. Systems administrators are said to benefit from having a centralized source to configure printers, troubleshoot problems, redirect print jobs to low-cost printers and track usage. Users can query printer features and job backlogs before submitting a print job, thus, eliminating needless errors and delays during printing.

Based on the ISO 10175 standard, PrintXchange provides additional features such as load balancing, access control, priority-based scheduling and operator-controlled job promotion, allowing for more flexibility in controlling the network printing infrastructure, Xerox says.

Two kits are available for developing PrintXchange-compliant products: Software Development Kit (SDK) for clients and applications and Device Development Kit (DDK) for printers, fax machines, email systems and other output devices. The same open, standards-based APIs are available on all PrintXchange platforms, which means the system can be expanded with additions that can be easily transported from server to server, Xerox says.

Companies supporting PrintXchange include Digital Equipment Corp., Sun Microsystems Inc. and Fuji Xerox Co. Ltd. The product costs less than \$75 per seat for client/server software.

Xerox Corp.

Xerox Square

Rochester, NY 14644

<http://www.xerox.com>

Circle 112

Laptop Display Server Supports Solaris

Xi Graphics' latest addition to its line of X services, Laptop Accelerated-X Display Server Version 4.1 for Sun Microsystems Inc. Solaris and Santa Cruz Operation Inc. (SCO) laptops, features "hot key" switching between external and internal displays, as well as local client acceleration, automatic display centering and high-quality graphics performance, the company says.

Laptop Accelerated-X Display Server for Solaris and SCO supports PseudoColor (16 to 256 colors), High-Color (32,768 to 65,536 colors) and TrueColor (16.7 million colors). It is fully compatible with the native X Window System and the Common Desktop Environment (CDE) and costs \$249.95.

Xi Graphics Inc.

1801 Broadway, Ste. 1710

Denver, CO 80202

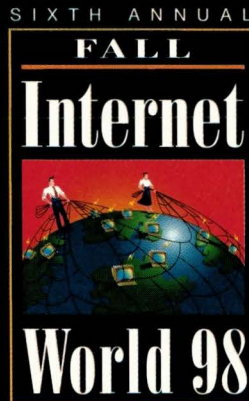
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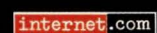
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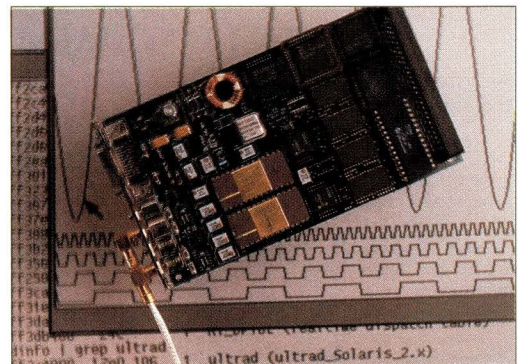
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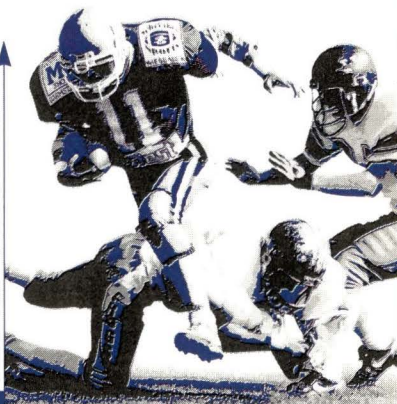
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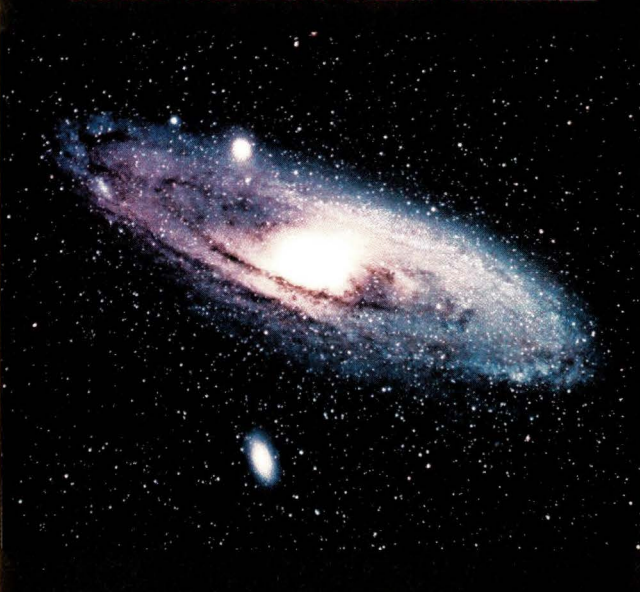
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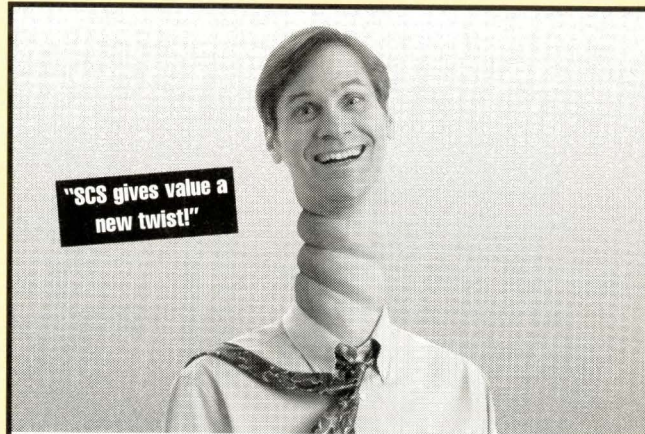


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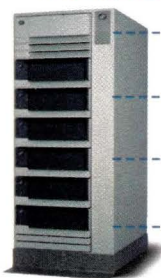
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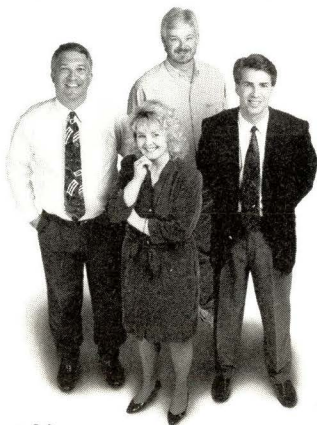
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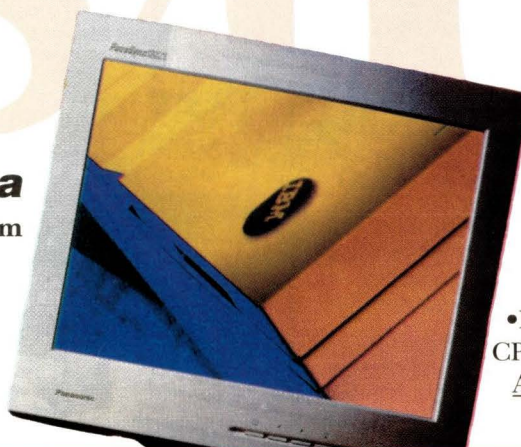
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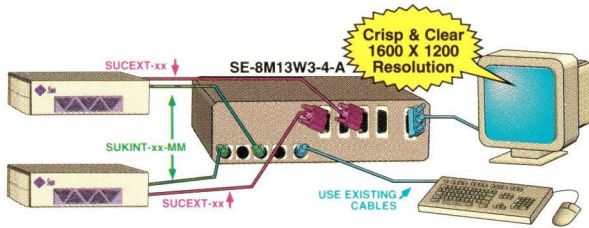
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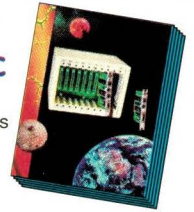
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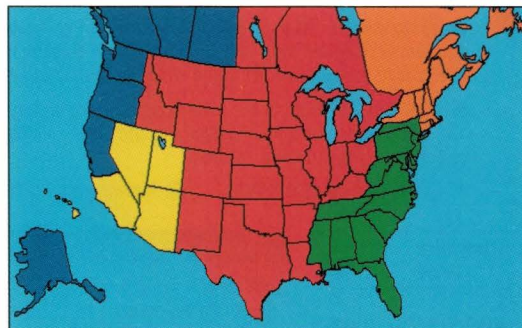
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