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The Server/Workstation Magazine

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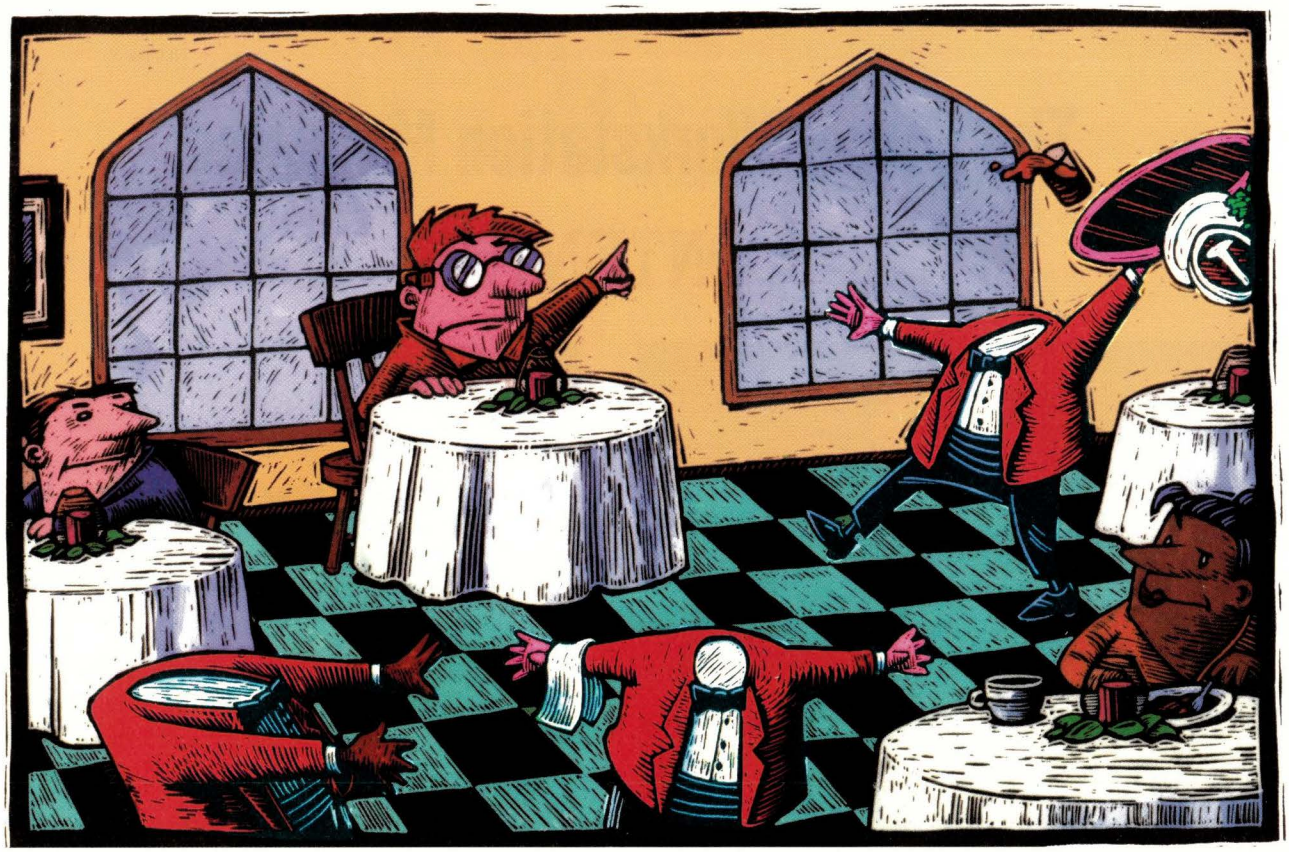

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compiled by Maureen McKeon, Research Editor

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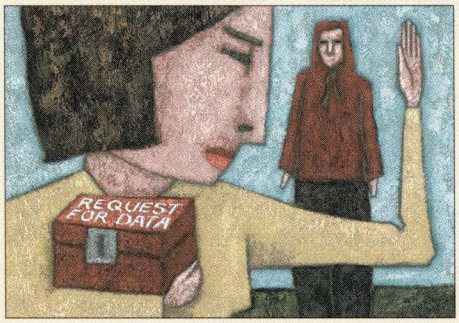
by John N. Stewart

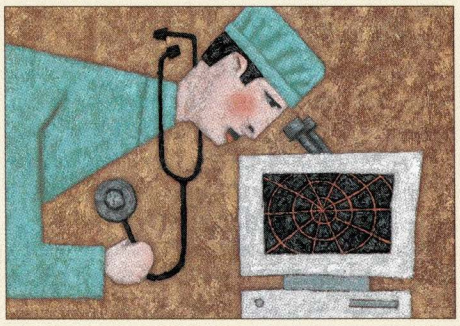
Keeping personal information personal is a growing concern on the Internet. P3P is designed to do just that.



90 Test Your Site with Web-Based Tools

by Paul A. Trunfio

When it comes to building a Web site, one often overlooked area is making sure it works. Testing your site is a neccesity and, fortunately, there are many Web-based tools to get you started.



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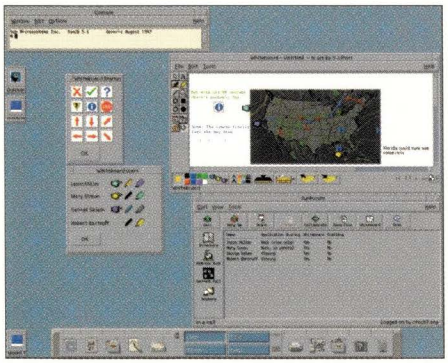
New Products, services and resources for the World Wide Web market.

Illustrations by STEPHEN SCHILDBACH



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SUNEXPERT Magazine (ISSN 1053–9239) is published monthly by Computer Publishing Group, 320 Washington St., Brookline, MA 02446. Telephone (617) 739-7001. Periodicals Postage Rates paid at Boston, MA, and at additional mailing offices. Posted under Canadian IPM #0235873. This publication is free to qualified subscribers as determined by the publisher. Subscription rates are $60 per year in the United States, and $95 (surface mail) and $150 (air mail) outside the United States. Subscription requests can be sent to Circulation Department, *SUNEXPERT* Magazine, 320 Washington St., Brookline, MA 02446 or electronically mailed to circ@cpg.com.

POSTMASTER, please send all address changes to *SUNEXPERT* Magazine, Circulation Department, 320 Washington St., Brookline, MA 02446. Please allow 6-8 weeks for change of address. Include your old address as well as new–enclosing, if possible, an address label from a recent issue.

Material for publication should be sent to the attention of Doug Pryor at the above address or electronically mailed to dpryor@cpg.com. Letters sent to the publication become the property of the publication and are assumed to be intended for publication and may be used so. *SUNEXPERT* Magazine is not sponsored or endorsed in any way by Sun Microsystems Inc. All information herein is believed to be accurate to the best of our ability.

EDITORIAL

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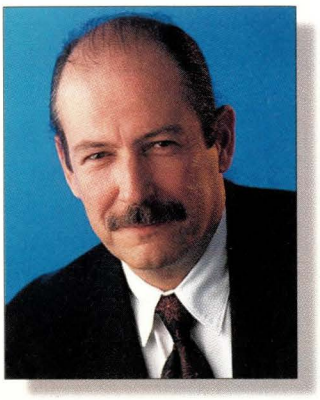

Java, Java, Java

No. This is not a *Seinfeld* episode, but it could be a show about write once, run anywhere, rather than nothing or yada, yada, yada. It seems Java is finally becoming something other than a way of putting flaming logos on Web pages.

Performance, security and functionality–these are the three hurdles Java must leap on its way to enterprise programming lingua franca status. This month's cover story, "Weed Your Code," Page 68, by Staff Editor Suzanne Hildreth, explores how developers view Java's approach to these key issues. Her article investigates how many developers are evaluating, implementing and deploying impressive new enterprise applications and architectures built around Java (see "Java in the Middle," Page 74).

When Java first appeared in 1995 it was more or less seen as a way to enliven Web sites. A few months later, it was being used to create mini-programs, so-called applets, that could be pushed out over the Internet. As Suzanne says, "Today, Java has developed far beyond its applet origins and is now being employed in a variety of enterprise applications."

If current research proves to be even close to correct, computing is in for a total restructuring. International Data Corp. (IDC) claims that more than 45% of U.S. companies are using Java. IDC also predicts that by 2002, the market for Java applications will reach $1.86 billion, up from the projected $464 million this year. Similarly, Zona Research Inc. forecasts a tripling of the Java tool market from $58 million to $180 million, between 1997 and 2000 (for a sampling of tools flooding the market, see Maureen McKeon's JDE/IDE survey of more than 30 Java development tools, Page 78).

To spur the market, Sun has released the Enterprise API collection. These include classes for building Java-based mail applications and for adding naming and directory services. Very important APIs, but the real eye-catcher is the Enterprise JavaBeans specification. Enterprise JavaBeans (EJB) is a framework for putting together server-side components. According to Suzanne, "The Java community has been fairly vocal about its support for the EJB framework, mainly because it promises to make server-side applications faster and easier to construct."

Could it be that someday when your boss says you don't know beans, he or she is talking about your hacking ability? Let us know if you're working with Java by dropping us a note to `editors@cpg.com`. We'd love to hear from you.

Doug Pryor

SUNEXPERT
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Sun Enters Application Server Market

Sun Microsystems Inc., Palo Alto, CA, has signaled its intent to strengthen its application server business with the planned acquisition of a pioneer vendor in the market, NetDynamics Inc. The deal, announced July 1, required an additional 60 to 90 days to receive regulatory approval before the merger could be finalized (merger was not finalized at press time). Once the acquisition is approved, it will make Sun a major player in this growing market overnight.

The privately held NetDynamics, headquartered in Menlo Park, CA, reportedly generated revenue of $13.3 million in 1997. The company will provide Sun with 150 channel partners, systems integrators and resellers, which make up 50% to 60% of its business. Furthermore, NetDynamics will bring with it more than 650 enterprise customers who are developing and producing Web business applications, such as supply-chain integration, mainframe legacy and database integration and deployment of enterprise resource planning (ERP) systems.

"Their market development, business development and the length of their customer list were really at the top of our priorities," says Jonathan Schwartz, director of enterprise products at Sun. "They were leading the pack of application servers and as much as anything else were defining what an app server really was."

NetDynamics' bread and butter is the manufacturing of software used by developers to create a middle tier that links Web-based client systems to back- end data sources and applications. The company's flagship product is NetDynamics 4. Industry analysts disagree over which vendor is the current market leader, but most award either NetDynamics or Netscape Communications Corp.'s Kiva Software top honors–exact market share figures have not been documented.

"Our numbers actually have NetDynamics as the market leader for 1997 but we haven't gone out and done an official market sizing," says Evan Quinn, director of Java research at International Data Corp (IDC), Framingham, MA. While IDC has not released a complete report, preliminary research indicates that as of year-end 1997, the Web application server market generated approximately $200 million in revenue and during the next three or four years that figure will grow to an estimated $1 billion.

The market was built by companies like Kiva Software Corp., NetDynamics, WebLogic Inc. and Art Technology Group, all of which recognized that if Web applications were to scale, it would be necessary to offer transaction processing capabilities and interoperability with different software, operating systems and data resources. Now the start-up vendors that defined the space are in the midst of a shakeup with acquisitions and increased competition from larger companies. In December, Netscape purchased Kiva Software, and companies such as IBM Corp., which entered the market in June, and Oracle Corp., a player since 1996, are all fighting for business in this developing market.

"The market got launched by these nouveau vendors but what is happening is we're in the midst of consolidation," says IDC's Quinn. "Now you have four major vendors [IBM, Netscape, Oracle and Sun] with a story along this line."

Once the acquisition is approved, Sun will face the challenge of working NetDynamics into its operation. This is certainly a problem all companies face after a merger, but, in particular, there are some technical aspects to the NetDynamics product that need to be addressed. For one, NetDynamics 4 sup-

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ports Microsoft Corp.'s Virtual Machine for Java. "We believe the Sun [Java] Virtual Machine provides superior functionality and compatibility," says Sun's Schwartz. "NetDynamics has made a different determination and that is certainly something we are going to be looking at going forward."

In addition, the server software is not written competely in Java; the database libraries are written in C++. "It was one of those trade-offs that we made in functionality," says Steve Zocchi, vice president of business development at NetDynamics. "Going into Sun and replacing existing C++ code in our servers isn't a big deal and obviously we'll have a lot more resources to do it."

Also, NetDynamics 4 was released without many of the Java APIs. However, NetDynamics contends that it will not be very difficult to implement those APIs in the software. Prior to the deal, NetDynamics promised to deliver full support for Enterprise JavaBeans in the early part of 1999. "Obviously, it won't all happen at once," says Zocchi. "What our customers want is a pragmatic delivery of the Java APIs."

One key aspect of a Web server application is its ability to operate in a multiplatform environment. Several industry analysts have indicated that Sun needs to prove it is capable of delivering products that work well in a Windows environment. "It's going to be extremely important that Sun understands and respects the Microsoft architecture," says Mark Huey, senior research analyst with application delivery strategies at Meta Group Inc., Stamford, CT. "If you want to be an app server in today's world you have to work with NT."

Sun says it has already proven it can work well with Microsoft. "If you look at Sun's business in general there is not a single shop that we do business with that doesn't buy Microsoft products," says Schwartz. "We are very well aware of what it takes to work in heterogeneous environments. In fact, more aware than Microsoft because that is what we do for a living."

Shwartz adds: "From our perspective, NT and Solaris are the two operating systems that matter on the server so it only made sense that we are there with a product that recognizes that."

Both Sun and NetDynamics have lauded the merger. As far as NetDynamics is concerned, it now has the financial resources and strength of a global company like Sun, which reported revenue of $9.79 billion for fiscal year 1998. From Sun's perspective, it is now a player in a growing market. The deal also offers Sun a product to encourage the development of Java on the server. No announcements of when new products will be introduced under the merger were made at press time.–*ptc*

Commercial Support for Tcl

While Sun Microsystems Inc., Palo Alto, CA, is busy promoting its Java-centric view of the world, Dr. John Ousterhout, former distinguished engineer at SunLabs, has left Sun and started a private company to further develop the Tool Command Language (Tcl, pronounced "tickle") scripting language, which he created in 1988 while at the University of California at Berkeley.

The resulting company, Scriptics

Sun Tops UNIX Server Space

In the world of UNIX servers, no company shipped more than Sun Microsystems Inc. in 1997. In a study released by International Data Corp., a Framingham, MA-based market research company, Sun moved from number three in the server market to number one in terms of units shipped, surpassing 1996 coleaders IBM Corp. and Hewlett-Packard Co.

Sun recorded a 75% increase in units shipped from 1996 to 1997, moving 104,993 servers, compared with only 59,988 the previous year. "Where you see the real movement is on the entry server space with the 450 and the Ultra Enterprise 2," says Jay Bretzmann, vice president of worldwide systems research at IDC. "Sun just sold a ton of units."

The overall number of units shipped in the UNIX server space was 501,851 in 1997, compared with 423,693 in 1996. IDC claims that Sun has the momentum in this market because it doesn't offer a Microsoft Corp. Windows NT alternative at the entry level like competitors IBM, HP and Compaq Computer Corp. "Their pure-play UNIX focus has served them well," Bretzmann says.

Sun also made significant gains in server revenue in 1997. While Sun finished in third place with $4.49 billion, behind IBM with $4.85 billion and HP with $4.66 billion, it made considerable gains in closing the gap from $2.84 billion in 1996. "They definitely have the momentum right now," says Bretzmann. "Yes, they're [number] three [in terms of revenue] but they closed the gap considerably."–*ptc*

Table 1. Overall Number of Units Shipped

1997 (top five listed)		1996 (top five listed)	
Sun	104,993	IBM	73,294
IBM	88,087	HP	72,558
HP	81,850	Sun	59,988
Compaq	40,701	Compaq	31,794
DEC	29,119	DEC	24,868
Total market	501,851	Total market	423,693

Table 2. Server Revenue (in billions of dollars)

1997 (top three listed)		1996 (top three listed)	
IBM	4.852	IBM	4.209
HP	4.661	HP	3.804
Sun	4.486	Sun	2.839

Source: International Data Corp.

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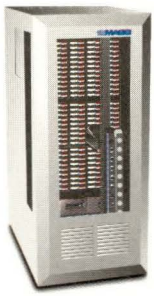

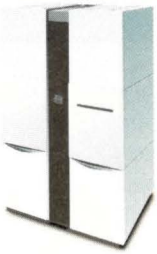

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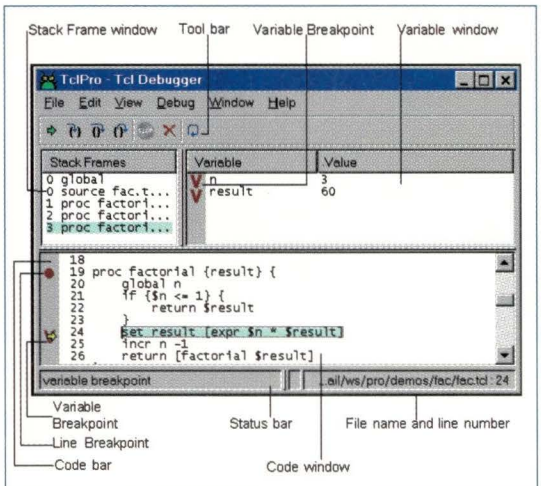
Corp., Palo Alto, CA, made its debut in July and bills itself as the "Tcl Platform Company." On the company's agenda are plans to enhance the existing open source Tcl platform. Scriptics has also pledged to create professional Tcl development tools and to provide commercial support, training and consulting to Tcl users. TclPro, a Tcl integrated development environment (IDE), is the company's first commercial tool offering and is currently in beta. Interested developers can download a copy from the company's Web site, `http://www.scriptics.com`.

Tcl, and its accompanying GUI-building toolkit Tcl/Tk, is used by an estimated 1 million developers worldwide, the company says, largely in vertical markets such as financial services, telecommunications and the military. As a lightweight, general-purpose scripting language, Tcl gets used in a variety of ways. "I think of Tcl as the ultimate vacuum filler," says Phil Sutherland, senior analyst at The Aberdeen Group in Boston, referring to developers' propensity to use Tcl to string disparate applications together.



Scriptics Corp., which bills itself the 'Tcl Platform Company,' opened its doors in July with its first commercial offering, TclPro.

Overall, analysts are positive about Scriptics and how it will impact existing Tcl developers. "You always need a commercial advocate behind a product, especially as it moves to a broader base of users," says John Rhymer, president of Upstream Consulting, Emeryville, CA. "This is what Tcl needs if it's going to go beyond the early-adopter types."

"A lot of organizations are uncomfortable using freeware in their corporate software," adds Aberdeen's Sutherland. "The existing Tcl installed base wasn't getting fully served by traditional means such as Internet forums."

As a business, Scriptics will no doubt rely on its existing installed base of corporate developers. There are also those who believe Tcl is poised to play a more important role on the Web than it has so far. Currently, developers tend to use either Perl, JavaScript or, if they're in a pure Microsoft Corp. environment, VB Script to script Web pages, but rarely Tcl. These scripting languages all have strikes against them, however: Perl is not commercially supported, JavaScript is limited in scope and VB Script is Microsoft-specific. "The Web," says Upstream's Rhymer, "is the challenge before them."

Scriptics and Tcl are also set to take advantage of an emerging trend in software development: the issue of components and component assembly. In the recent past, most applications were developed using monolithic system programming languages such as C and C++, Ousterhout says. As compiled and strongly-typed languages, they offered developers a large degree of control over their code. On the flip side, developing with a system programming language can be unwieldy and slow. Scripting languages, by comparison, are interpreted and weakly typed, which makes for less efficient, but much more flexible and easy-to-evolve code. Thus, today we talk more about "assembling" applications from preexisting code or components, rather than "developing" applications from scratch.

Analysts doubt that scripting languages in general, and Tcl in particular, will really walk away with the market for component assembly. "I think that to use Tcl for full-fledged enterprise application integration, that might be a bit of a reach," says Aberdeen's Sutherland. "But I do think that Scriptics is going to give Tcl a big boost."–*ab*

IBM Embraces Freeware

IBM Corp. has tapped The Apache Group's HTTP server for inclusion in its WebSphere Application Server (made available June 30). The selection of Apache is being seen by industry analysts as a major endorsement of the free server software, as well as something of a snub to one of IBM's industry allies, Netscape Communications Corp.

The Apache Group is a collaboration of international software developers. It began in 1995 as a grass-roots effort to write patches and updates to server software developed by the National Center for Supercomputing Applications (NCSA). Eventually, the project developed into a complete rewrite of the NCSA software, resulting in the Apache HTTP server. Although the Apache Group is a nonprofit organization that doesn't conduct major marketing campaigns, its HTTP Web server has grown from having a 1% market share in 1995 to more than 50% in July, according to an ongoing survey of Web server usage by Netcraft Ltd., a U.K.-based networking consultancy.

IBM says it will provide commercial enterprise-level support to the Apache HTTP server as part of the WebSphere Application Server package by the end of the year. In addition, IBM will support Apache on all platforms that WebSphere runs on. These include AIX, Solaris and Windows NT. IBM will also become a full participant in the Apache HTTP Server Project, providing code through the existing process set up by Apache.

While Apache's success in capturing market share is truly an Internet success story, it still hasn't been able to make significant inroads into the corporate market that, in general, expects support and services for products. However, with IBM providing its muscle, all that could change. "It does add a lot of credibility to the Apache Web server," says Jeff Reser, product manager for the WebSphere Application Server at IBM. "And it adds a better choice for IT managers. They can now go out and get Apache and know that there is going to be support [for it]."

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with Norwest Mortgage Inc., Des Moines, IA, was searching for a Web server more than a year ago, Apache wasn't a viable choice because of a lack of support. "We're the number one mortgage company in the United States," says Rae. "The solutions that we pick must be supportable. Sometimes using things like Apache are not always in the cards. The fact that IBM is willing to stand behind it would definitely make it a player in larger organizations."

The notion that Apache could be a feasible option to a large corporation is taken by some to be a threat to Netscape's Enterprise Server and Microsoft Corp.'s Internet Information Server (IIS). "In a sense, it certainly is a blow to Netscape," IBM's Reser says.

But statements such a these have left the people at Netscape scratching their heads in confusion. Netscape says it has a strong relationship with IBM, noting it is one of Big Blue's largest OEM partners. For example, FastTrack Server and Enterprise Server are distributed on a number of IBM products, including the RS/6000. "What's confusing to us about the Apache announcement as it relates to WebSphere is we don't see the strategic fit," say Raj Gossain, product market lead for Web and application servers at Netscape.

Specifically, Gossain sees WebSphere positioned as an application server designed for commerce-related or business-critical implementations. In his opinion, Apache doesn't have all the necessary pieces, such as Secure Sockets Layer (SSL) support, directory support and centralized management, necessary to accomplish this type of work. "I think it is somewhat confusing that they are positioning the WebSphere product line as an application server [because] Apache doesn't necessarily fit that target demographic," Gossain says. "Architecturally, it can't compete with respect to Netscape Enterprise Server and even [Microsoft] IIS, for that matter."

IBM says Domino Go Webserver will be phased out over time as it emphasizes Apache, but Webserver will continue to play an important role on the OS/390 and OS/400 platforms as well as in software packages like Net.Commerce.–*ptc*

UNIX Takes on NT Pricing

Since the beginning of the UNIX vs. NT debate, one area in which UNIX systems couldn't compete was the price of applications. Today, this pricing disparity still exists, but there are signs the gap is closing.

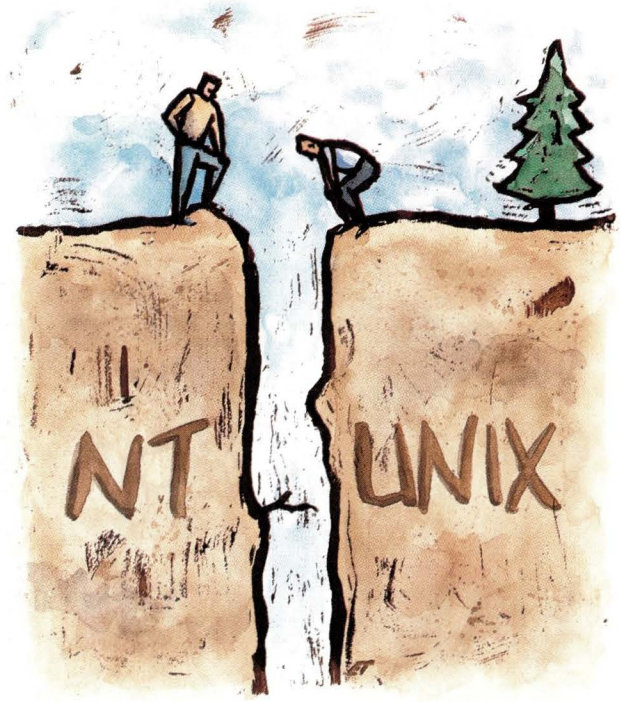
To highlight this change in pricing, Sun Microsystems Inc., Palo Alto, CA, launched a program in January called PriceParity, which identifies software development tools vendors who offer comparable pricing across both Solaris and Windows NT operating environments. As of mid-August, the PriceParity program included 49 companies.

"What we are seeing is a growing trend in the market for developers to offer solutions on UNIX at the same price point as NT," says Scott Clinton, group product manager for developing markets at Sun. "This has been happening over the last [eight] or [10] months."

Historically, when comparing the UNIX and NT worlds, it was a comparison of PC-based systems priced below $10,000 with UNIX high-end machines ranging in price from $15,000 to $100,000. "There is a different mind-set in the UNIX world than there is in the Windows world. The Windows market has lower price points because that is what the market is willing to pay, as opposed to the UNIX market, where they are used to paying more," says Todd Scallan, director of business development at Black & White Software Inc., Campbell, CA. "What it boils down to is you want to charge the market what it will bear."

It's this notion that upsets UNIX users. "It frustrates me," says Mark Davis, director of information systems at Lake Taylor Hospital, Norfolk, VA. "The prevailing mentality is if you can afford a UNIX machine then you can afford to pay more for your software."

While hardware pricing does have an effect on software pricing, another major factor contributing to the differential is volume. According to San Jose, CA-based market research firm Dataquest, shipments of Windows NT operating systems totaled 7.2 million in 1997, compared with 1.49 million for all UNIX operating systems combined. In addition, Dataquest predicts that NT shipments will grow to 13.95 million in 1998 and 25.84 million in 1999, compared with projections of 1.74 million in 1998 and 2.15 million in 1999 for UNIX. Based on volume, in order for UNIX applications to generate as much revenue as NT applications, a company must charge more. That's one of the reasons offered, for example, for the price difference of Adobe Systems Inc.'s FrameMaker 5.5 for NT ($895) and UNIX ($1,495).



ERIN TERRY

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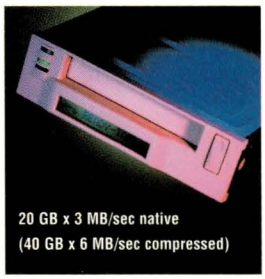

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"It's a fairly equivalent product offering," says Marion Melani, group product manager at Adobe Systems, San Jose, CA. "The volume for selling the Windows NT products is much higher than the potential market and the actual volumes we do on UNIX."

Melani also says there are additional costs to support FrameMaker for UNIX. Providing technical support for engineers and developers with UNIX workstations does drive up costs "slightly," she says.

Added costs for support and development of a product with a lower market share can drive up prices in all types of markets. Eric Mitchell, president of the Professional Pricing Society, an association of pricing professionals based in Atlanta, GA, says, "In some cases, where the support costs are higher because there is less volume or demand, prices are higher."

There is also the notion that with UNIX applications you're getting more for your money. An application that runs on a UNIX machine must match the scalability and availability features associated with the system, and NT doesn't put the same type of demands on an application. "Up until recently, UNIX software tended to be a lot more complicated in terms of features and functionality," says Jim Geisman, president of Marketshare Inc., Wayland, MA. "That tends to keep prices up."

But change is in the air. With Microsoft Corp. working to develop a version of Windows NT to handle the industrial-strength applications that UNIX handles, companies like Sun are working to offer less expensive products. Earlier this year, Sun released the Ultra 5 and Ultra 10 workstations priced at $2,995-$4,495 and $5,595-$10,295, respectively. These prices are much more in line with PC or NT workstation pricing. The introduction of these products is an indication that Sun will push the volume model that Microsoft and PC manufacturers have had great success with. "I think with our new 5- and 10-based systems, you'll see us leaning more toward a units-shipped approach," Sun's Clinton says.

Furthermore, Sun plans to continue to push its PriceParity program. In addition to inviting more vendors to participate, Sun says it will work on promoting these products through marketing and strategic agreements.

Independent of Sun's efforts, companies like Black & White Software are attempting to offer the same, or similar, price points. Its Object/Observer, a diagnostics and message tracking tool, carries an entry-level price of $17,000 for both operating systems. "We're trying to break the mold a little bit," Black & White's Scallan says.

In many cases, the disparity in pricing will continue. As long as NT continues to grow, software vendors can generate sufficient revenue with a PC-based pricing model over the premium pricing strategies associated with UNIX. Plus, as long as UNIX users are willing to pay more, most software vendors won't turn down the extra money.

"It all goes back to what the market will bear," says Adobe's Melani, "[But] if all of the UNIX software vendors dramatically lower their prices we would definitely watch it. We would have to be sensitive to that."–*ptc*

Installing Software Gets Easier

You can pretty much bet that Sun Microsystems Inc., Palo Alto, CA, will never get rid of the Solaris command line completely, but it is making a valiant attempt to simplify routine administration tasks such as installing software.

Case in point, Sun has announced a partnership with InstallShield Software Corp., Schaumburg, IL, maker of the popular InstallShield "application deployment" tool for the Windows platform. In case you're not familiar with the InstallShield product, think of the blue-screened wizard that steps you through the process of installing Microsoft Corp. Windows software, and according to InstallShield, is used by an estimated 92% to 95% of Windows independent software vendors (ISVs).

Under the terms of the agreement, Sun and InstallShield are coauthors of Solaris Web Start Wizards included in the Solaris 2.6 distribution, which makes use of InstallShield's ease-of-use know-how and Sun's expertise in networking and distributed applications. The resulting set of Java classes will be included in the InstallShield Java Edition tool and as an API in the forthcoming Solaris 2.7 operating system to be released later this year.

Ultimately, this collaboration will enable developers to build cross-platform installations of both Java and Solaris applications, as well as facilitate the ease with which administrators install networked applications, Sun says. "All the headaches that go with getting someone up and running will be a thing of the past," says Tom Goguen, Sun Senior Product Manager for Solaris.

Solaris Web Start Wizards software makes use of InstallShield's ease-of-use know-how and Sun's expertise in networking and distributed applications.

Developers who wish to take advantage of the InstallShield Java product can download the developer's toolkit for Solaris Web Start Wizards from Sun's Web site, `http://www.sun.com/solaris/webstart`.–*ab*

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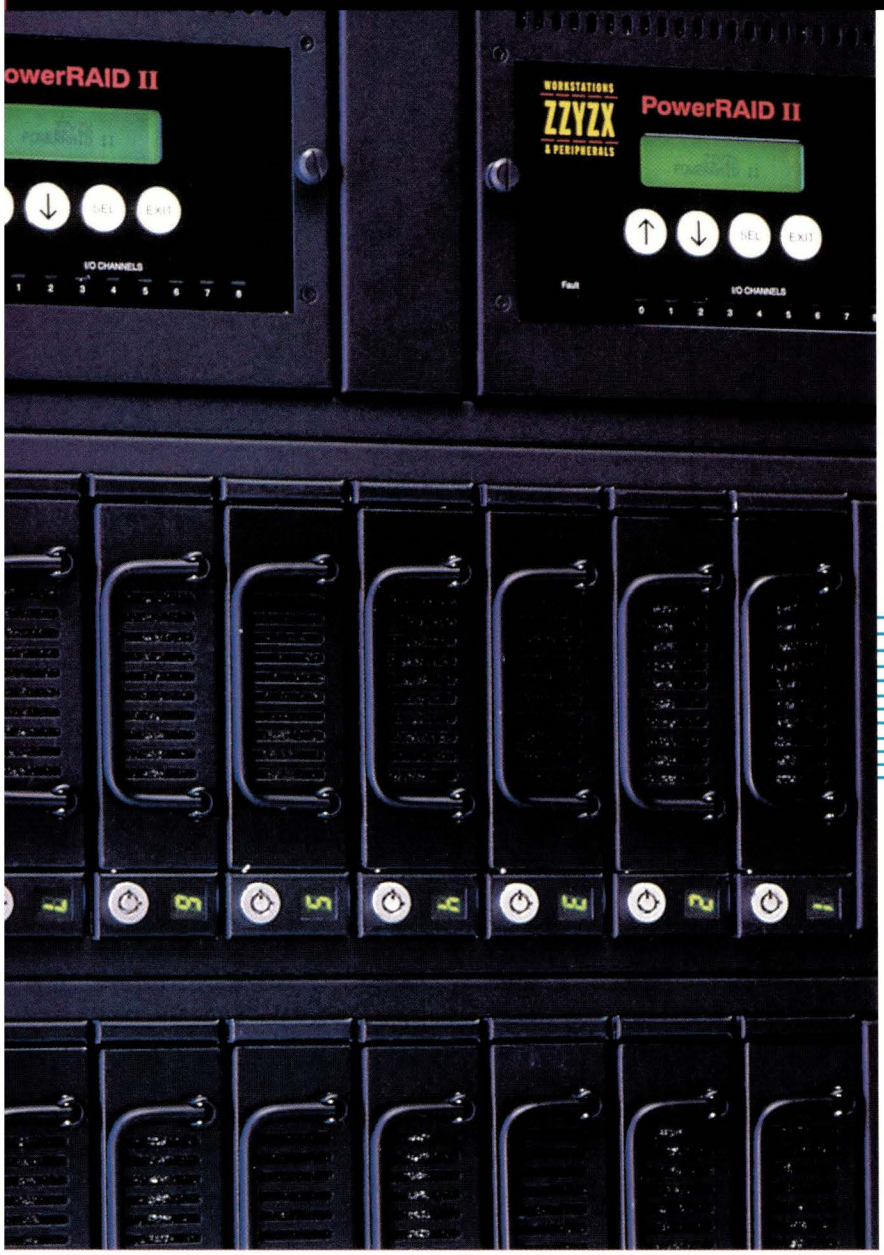

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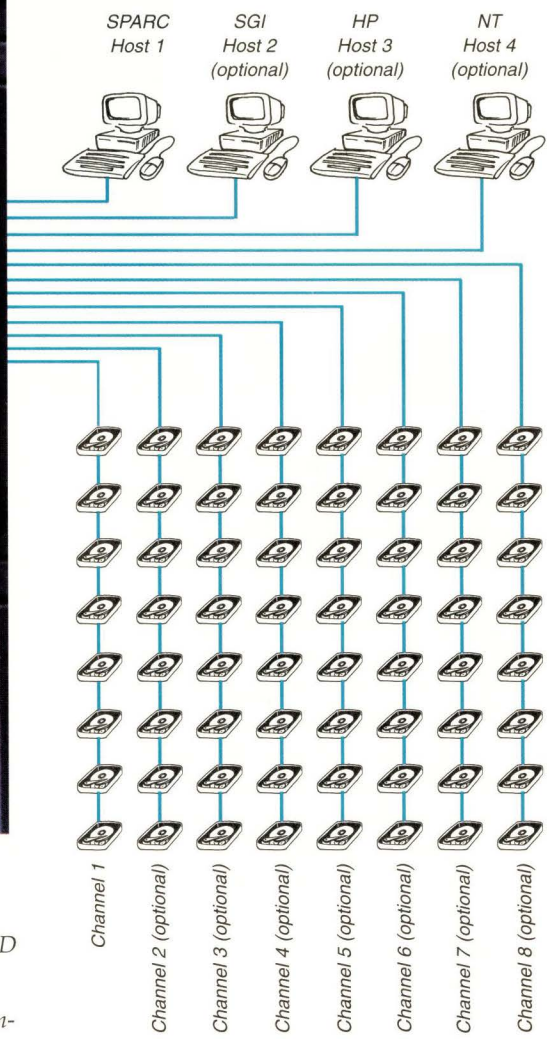

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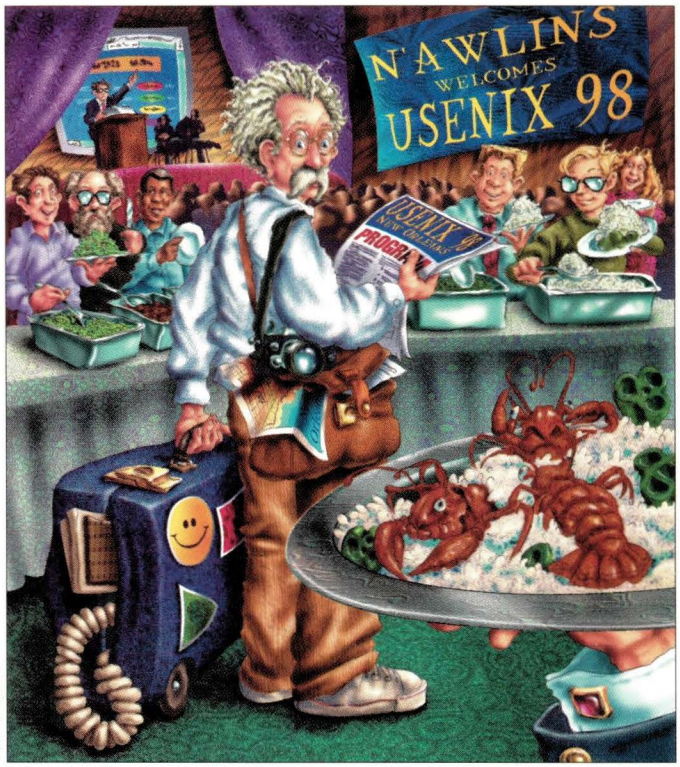
by Michael O'Brien



TOM BARRETT

"We learned three things from watching this faith healer:
1) God speaks on 37.95 MHz.
2) God is a woman.
3) God sounds just like the reverend's wife."
– The Amazing Randi

"As technical conferences go, this one's fair-to-middling. But in 20 years of UNIX meetings, I've never eaten so well."
– One USENIX 1998 Conference attendee

"Why is Richard Stallman dressed like Jesus, with a disk platter for a halo?"
– Another, more easily puzzled, attendee

Mr. P. at the Cajun Conference

Q: *Now, where the heck have YOU been? I thought you guys never went anywhere. In fact, I wasn't aware that Mr. Protocol could go anywhere.*

A: We hardly ever do. And you're almost right about Mr. Protocol, but they're doing wonderful things with Toshiba Librettos these days.

But, in fact, we have only recently returned from the USENIX 1998 Technical Conference in New Orleans.

So what's a USENIX?

Mr. Protocol is glad you asked.

These columns have generally adhered to the pleasant fiction that what happens in the universe of UNIX just happens–sort of like rain or earthquakes. The Internet protocol suite is looked after by the Internet Engineering Task Force (IETF), which meets three times a year, but what about UNIX in general?

There has been a users group for UNIX since the earliest days of its emergence from Bell Labs. Originally, the group was known, funnily enough, as the UNIX Users Group. However, about the time the Bell patent attorneys began to get the idea that a post-divestiture AT&T might actually make a go of it as the world's largest computer company, they began to get stroppy about the trademark. The mountain that was AT&T rumbled mightily and produced the 3b2, which was just about able to squeak on a good day (users squeaked too, when they found out AT&T had solved the problem of forcing users to type "sync" before turning off the 3b2 by the simple expedient of omitting any physical power switch). The lawyers still had their way and the organization changed its name to USENIX, a choice which made the lawyers chuckle loudly in appreciation of the neat trick that had been played.

USENIX has always had a strong academic bent to its activities, mostly because early versions of UNIX a) didn't really work very well–the only systems worse were all the others–and b) cost commercial users $20,000 for a site license and academic institutions $150. The first commercial UNIX license was bought by The Rand Corp., which despite being a not-for-profit degree-granting institution, didn't fool the patent attorneys at Bell Labs one bit. Rand (these days spelled RAND for some reason, but we'll use its name at that time) took UNIX in both hands and darn near throttled the bejeezus out of it. In the process, it created named pipes, record-oriented I/O, a "keyprint" system that identified users by timing the intervals between keypresses for various letter combinations and a diskless real-time operating system, which ran a Network Control Program to put a VAX UNIX system on the ARPANET. Rand also produced the first full-screen editor for UNIX, the MH mail system, and enough bugs to keep at least one UNIX hacker happy for the next 10 years, ripping bogosities out of the kernel.

Rand was far from unique in its attitude. At $150, the UNIX operating system was a wonderful teaching tool, and

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the fact that actually using its source code to teach formal courses was a blatant violation of trade secret protection, was an unfortunate complication easily circumvented by ensuring that all the students who would have taken such a course were put to work hacking on the kernel instead of studying it formally.

And UNIX needed hacking. Its file system was at times violently unstable, and an entire generation of systems administrators learned at a visceral level the importance of backups. Feeling a need for mutual support, these people began to come together.

At first, they met regionally. SRI International, formerly the Stanford Research Institute, hosted a couple of West Coast get-togethers, and Mel Ferentz, then of City University of New York (CUNY), brought about 40 people from the East and Midwest together in a Brooklyn classroom for a day or two.

These early meetings didn't seem all that surprising to the participants, but they might seem surprising to today's management. For one thing, no conference schedules were produced before the event because there weren't any. In fact, formal presentations of any sort were rare. Usually, the only formal presentation would be Ken Thompson and/or Dennis Ritchie getting up and rambling for a bit about what they were doing to UNIX back at Bell Labs. For the rest of the meeting, sometimes for two entire days, the schedule was written on the fly. First, someone would be selected by consensus to run the meeting. Sometimes this person was the meeting's host, sometimes not. Next, people would raise their hands and suggest topics for discussion and the host would write them down. The topics would be consolidated and ordered, again by consensus, and considered one by one until people ran out of energy. A typical day's session lasted 18 hours. There was no hall conversation because the meeting was nothing but a big hall conversation, with only a light smear of order imposed.

Between race conditions in the kernel and utilities that were missing, these early meetings never ran out of things to talk about.

Many, if not most, of the topics had to do simply with keeping UNIX running. Between race conditions in the kernel and utilities that were missing either because Bell Labs didn't need them or didn't happen to own the relevant hardware, these early meetings never ran out of things to talk about. It wasn't until around 1978 that the USENIX Association decided it was finally time to organize a program of refereed papers and the conferences began to take on the shape of other academic conferences.

It was at that point the meetings lost their singular focus and began to differentiate into interest groups with distinct, if sometimes overlapping, concerns. Eventually, new splinter organizations would form, such as the Large Installation System Administrator's group (LISA). Some groups were formed in reaction to the academic emphasis of USENIX. In the early days, the UNIX Users Group was virulently, even violently, anticommercial. Some academics believed commercial involvement would kill UNIX, driving it into mediocrity. People who notice that the Solaris boot program is larger than the Release 6 UNIX kernel, can draw their own conclusions, but the fact is over time USENIX has moderated its anticommercial stance. It has never entirely lost it, though, which resulted in the formation of organizations such as `/usr/group` and Uniforum to provide a venue for commercial UNIX organizations and businesses.

At this same time, new features were added to the USENIX conferences. Days could still run to 18 hours for the determined, but evenings were now given over to Birds-of-a-Feather sessions, or BoFs. These were borrowed from the DECUS meeting format, DECUS being the user group for Digital Equipment Corp. Because UNIX ran primarily on DEC machinery, there was a certain overlap in attendance between USENIX and DECUS conferences. BoFs have remained a part of USENIX conferences from that day to this.

Most BoFs are organized around a particular commercial or free software product, or a particular area such as Web server security or the oral folklore of UNIX. The conference organizers typically hold a thumb up to each BoF proposal they receive, squint over the top of the extended digit and estimate the drawing power of the BoF. They then pick a room of the appropriate size. About 75% of the time, they're close to the mark. The other 25% of BoFs are interesting, either from the perspective of lack of oxygen, or from the echo effect of a ballroom with 17 people in it. In the really, really interesting cases, even the largest ballroom isn't big enough, and the BoF will draw a crowd larger than the plenary opening session. Back when Berkeley UNIX was a going concern, the Berkeley UNIX BoF would draw a gigantic crowd, even more ornery, countercultured, vociferous and opinionated than the usual USENIX crowd.

All Aboard the Flagship!

Which brings us to New Orleans, and the current look of USENIX conferences. The USENIX Association now runs about seven or eight special-purpose workshops per year, very successfully, on topics as diverse as object-oriented languages and administration of mixed Windows NT/UNIX installations. Its flagship conference, however, has always concerned itself with the UNIX operating system proper. It interprets that charter liberally, accepting papers on network performance and caching strategies as well as file systems and schedulers.

The New Orleans conference was in many ways a typical USENIX conference of latter days. The conference is now held once a year, in order to ensure a high quality of submissions. The main tracks of the current conference include invited papers as well as refereed papers. The invited papers at this year's conference included an overview and retrospective of the first efforts to port UNIX to architectures other than the PDP-11 (two simultaneous ports were done to the Interdata platform by groups who knew nothing about each others' efforts) and a paper on the mixing of operating systems via microkernels.

Among the refereed papers were submissions on scalable kernel performance for Internet servers, dynamic C++ classes

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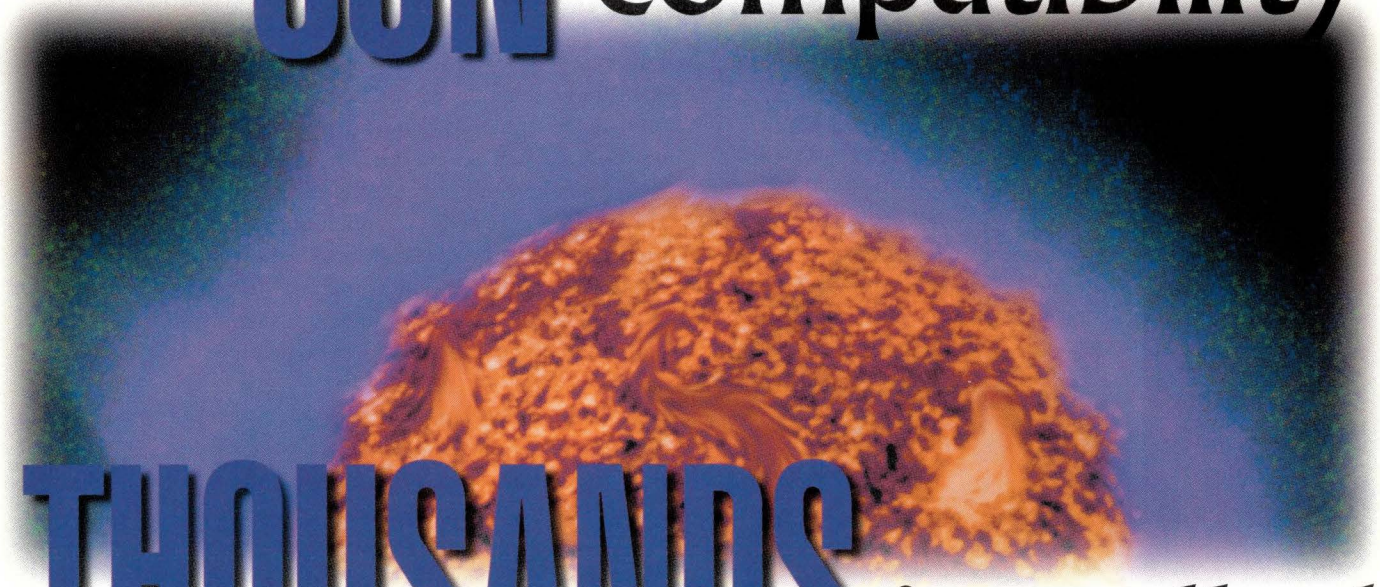

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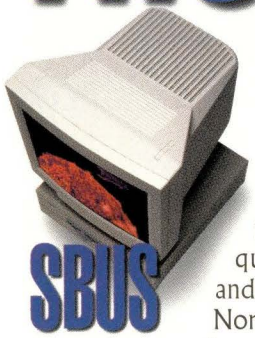

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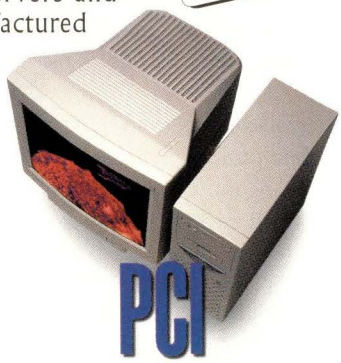

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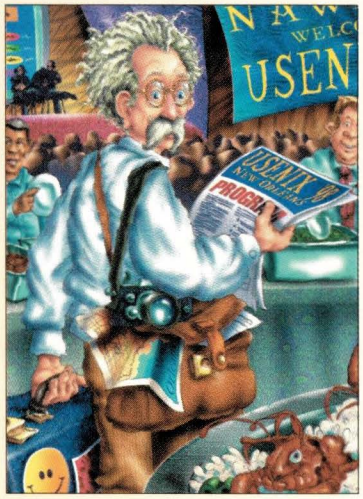
and an entire session entitled "Neat Stuff." Several of the sessions concerned themselves with network performance, mostly for Web servers. One paper from Lucent Technologies Inc. documented a new, experimental operating system called Eclipse, which attempts to address the knotty question of providing Quality-of-Service guarantees for processes by introducing the notion of "reservation domains," which ration system resources to processes. Eclipse is, in the main, a UNIX-like operating system, and the authors, having come up with a fairly interesting new resource allocation policy, plan to implement that algorithm in various free source operating systems such as Linux and FreeBSD.

The papers in the Freenix track are more concerned with getting the damn thing working. In this respect, they are just like the presentations at early UNIX meetings.



Which brings us to an interesting point: Of the conference's four technical tracks, two–that is, half the conference–were devoted to free source UNIX systems. These two tracks, collectively called the Freenix tracks, were devoted to papers based on one or another of the UNIX-like systems with freely available source code: Linux, FreeBSD, NetBSD and OpenBSD.

The papers in the main USENIX tracks have, over the years, evolved away from the "how-I-did-it" stories, which academics find profoundly uninteresting and UNIX hackers find to be pure gold. They are now much more academically "sound," which means they represent (at some level) truly original work in computer science.

The papers in the Freenix track are more concerned with getting the damn thing working. In this respect, they are just like the presentations (and before that, the conversations) at early UNIX meetings. The obvious reason for this is that the Freenix world now finds itself in the same situation that the UNIX world used to be in–source to these operating systems is freely available, but commercial support is not.

These operating systems are much more freely available than UNIX ever was. They can be downloaded from the Internet, which did not exist in the early days of UNIX. They are free from licensing constraints. This has resulted in a healthy, if not explosive, growth in the number of installations of these systems as a whole, even in the face of Microsoft Corp. dominance in the industry. And right now, the only conference that covers them all is USENIX.

The whole notion of conferences is peculiar. Formally, one goes to the conference to hear people present papers. This is good. This is familiar stuff. This is what people have been doing for centuries. The elaborations placed on the academic conference by academics, however, has on the face of it made attending a conference a useless exercise. Originally, people came to conferences to present their work. Until they got up on stage, no one, but no one, knew what they were going to say. The only reason they were allowed on stage in the first place was because of their reputation: Everyone knew that whatever they said, it was likely to be both intellectually sound and intellectually stimulating. Most modern academics, however, are neither, so unless you want to eliminate the notion of conferences altogether, some pretty drastic revision had to be done.

At that point, the refereeing system was introduced–a group of (anonymous but presumably qualified) reviewers goes over every paper submitted and accepts only those that are indeed sound and interesting. And, to save everyone taking frantic notes, the papers are collected well in advance of the conference and sent to the printer to provide a volume of conference proceedings to be read later.

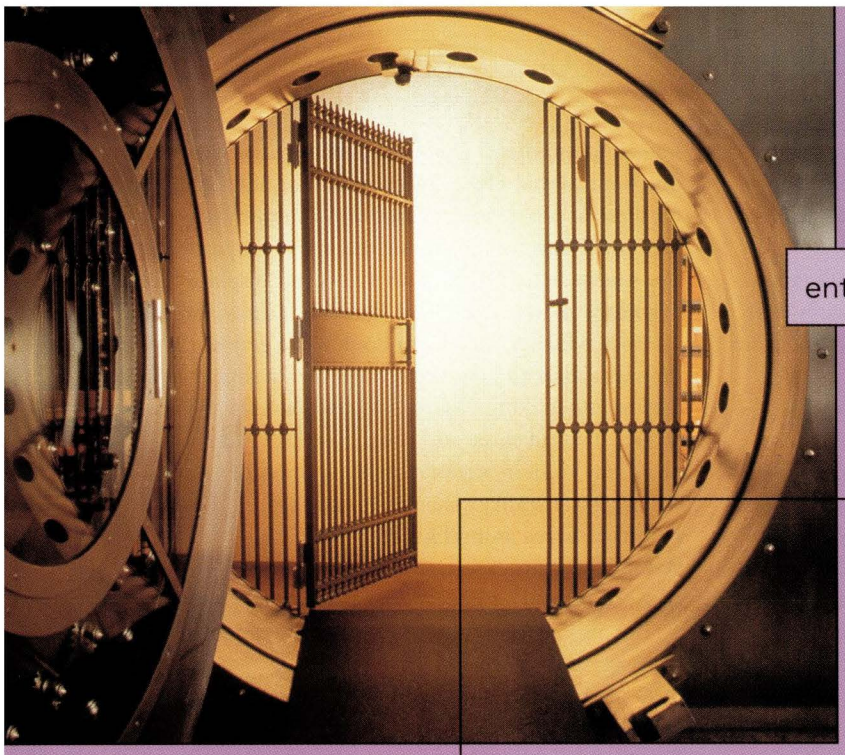
Note that the early UNIX meetings were just like old-time academic conferences: no referees, no proceedings, because in the beginning, no one knew anyone, so no one was known to be good enough to referee or bad enough to need it. Later, everyone knew everyone, so everyone knew who to believe.

Refereeing is needed only after a community has grown to the point that the majority are unknown to one another. USENIX actually needs this. So, surprisingly, does Freenix. Enough people are doing enough work that some refereeing of papers is actually needed.

Treading the Hallways

So, if you can buy the proceedings, why come to the conference?

This is where USENIX is gold. The reason you come to the conference is the people who wrote the software you use, and the people most immediately concerned with maintaining it, are there too. They're there because they want to trade information with their peers. And if you're wound up tightly enough in the industry, so do you. The secret is not in the conference hall. The secret is in the hallways, the hospitality suites, the party rooms and the vendors' exhibition. This is where you find out the information you didn't know you needed, because you didn't know it existed. This is where you see the X Window System running on FreeBSD on a Toshiba Libretto–a full-up top-of-the-line UNIX system running on a palmtop. This is where you find out that not only does someone know how you really are supposed to run IP over an ATM network, they've written a book about it. Most notably, *TCP/IP Over ATM: A No-Nonsense Internetworking Guide*, by Berry Kercheval (Prentice-Hall Inc., 1998, ISBN 0-13-768599-8). And this is where you find out which operating systems on which hardware can really act as mail or file or Web servers without crumbling under heavy load, which ones are real nightmares to administer and which are hopeless, directly from



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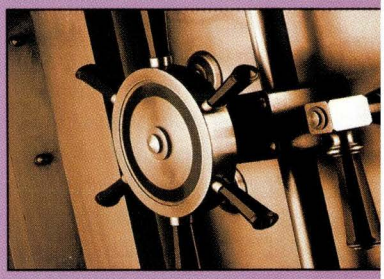

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the people who have tried it. And you can buttonhole these people and quiz them to learn if they really know what they're talking about and you have the benefit of listening to them answer other people's questions.

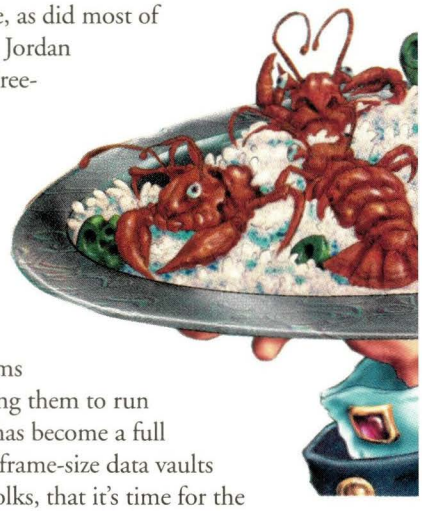
You also learn where the bodies are buried. The full range of information that can be garnered at these conferences can't be printed in a magazine because slander laws apply even if the information is true.

What interests one person will not interest another. Most of the really long-term UNIX hands, for example, were mentioning a confluence of several facts. First among them is that The Santa Cruz Operation Inc. (`http://www.sco.com`), which via a highly baroque sequence of corporate acquisitions now owns the UNIX trademark, is selling personal UNIX source licenses for "ancient" versions of UNIX for $100. This license grants you the right to obtain the source code for all versions of UNIX from Release 1 through System 32/V. This, in turn, gives you the right to obtain source code for all the releases of Berkeley UNIX up through 4.3BSD, not just the unencumbered 4.4BSD.

This is conjoined with the fact that the PDP UNIX Preservation Society (`http://minnie.cs.adfa.oz.au/PUPS/`) has gathered together a set of software emulators for the PDP-11 hardware, which is rigorous enough to boot these early versions of UNIX, thus, allowing people who haven't seen Release 5 UNIX in 20-odd (usually very odd) years to reexperience the hair-raising file system corruption, which the bugs in its interrupt locking code invariably provided.

To most attendees, these conversations, when overheard, resulted either in snorts, ill-concealed laughter or an irritated tendency to vacate the vicinity. Everyone today knows that UNIX is a stable platform with a pretty well bulletproof file system. Up until about 10 years ago, that sentence would have induced hysterical laughter in anyone familiar with any version of UNIX. The thought of having all those old bits around to play with, including full source, exerts a horrified fascination over at least some of the people who lived through the years of their first appearance. It's sort of like learning that scientists can now clone dire wolves. Any cave dweller who remembers those things would be sure to question the wisdom of this, but might still find themselves wondering, in the odd moment, if they could still deal with one. No, they can't clone dire wolves, they're starting with woolly mammoths instead, but the principle applies.

What the New Orleans USENIX Technical Conference demonstrated is UNIX still enjoys the full blush of success, but is making the transition to a "mature" product. No startling announcements of entirely new versions were made. No one went to war. However, there are not only enough versions on show to prove that development is healthy, all of the versions seem to be holding or gaining market share, particularly in the free source arena. Sun Microsystems Inc. displayed some truly impressive storage engines at the vendor show, including one number, which looked like a double-size gray refrigerator whose drawers slid in and out under their own power. It was positively frightening-looking to someone who thought the mainframe's day had come and gone. FreeBSD had most of its core team in attendance, as did most of the other free source systems. Jordan Hubbard waved around his FreeBSD/X Windows/Libretto answer to the Palm Pilot.



But although there are many versions of UNIX, most of them can run each other's software. Porting, while still an issue, is less of a problem because many of the free source systems made kernel additions allowing them to run each other's binaries. UNIX has become a full industry solution, from mainframe-size data vaults to palmtops.Which means, folks, that it's time for the next revolutionary change.

Meanwhile, New Orleans, at 95 degrees and 95% humidity, was exerting its own peculiar charm over the attendees. Creole sauce and jambalaya practically ran in the streets, as the conference hotel was at the edge of the Vieux Carré. One attendee was heard to remark, "As technical conferences go, this one was so-so, but in 20 years of UNIX meetings, I've never eaten so well."

Every conference should be the best at something. ⊸

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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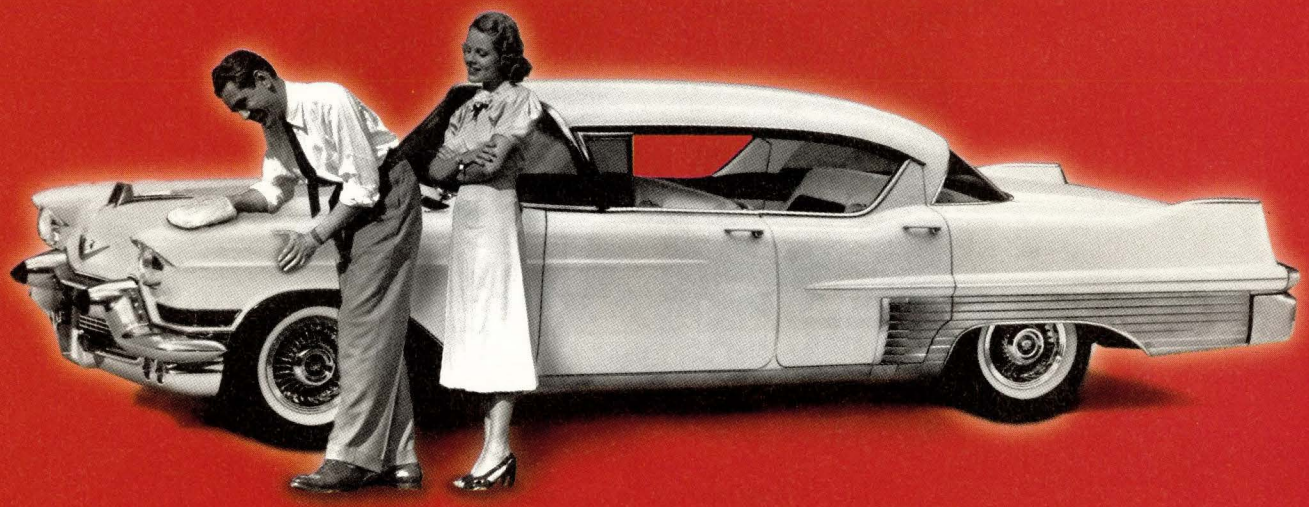

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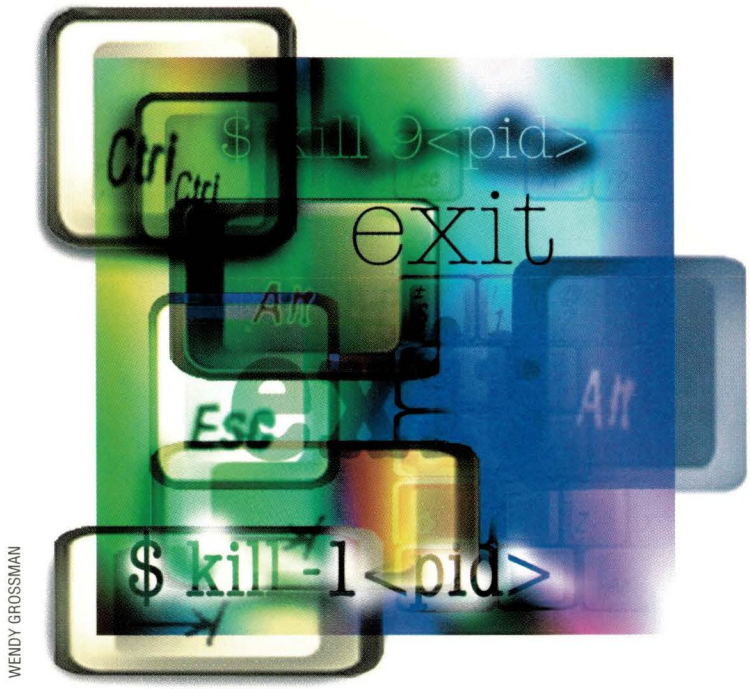

WENDY GROSSMAN

Signals

One of the many aspects of Mr. Gates' products that niggle me is the inability to stop something from happening. You start an application doing something by mistake and find yourself pounding random keys to stop it. Will this stop with the Escape key? Should I hit Break? Should I use Control-C? Should I use Control-Alt-Delete? At least when you use the latter key chord on Windows NT you have the ability to kill the offending process using the Task Manager, always hoping that the application resources are recovered properly by the system. Starting activities erroneously happens all too often. The problem seems to trouble me more these days, because age has caused me to be marginally optically challenged and I get one-off errors on menus with little apparent effort.

I suppose that the inability to stop things from happening occurs on UNIX too, but it's much more rare and is usually a feature of a system failure or a badly programmed application. UNIX was designed to allow the keyboard user to send an emergency message to an application and for that application to be stopped in its tracks. Control is then returned to the user, where it should be. The emergency message is part of a system of simple interprocess communications (IPC) called *signals*.

A UNIX system consists of a memory-resident kernel and many processes that do all the work. Processes are programmed using a model where each process exists alone, running in a virtual machine. A process has access to an address space and talks to the outside world via system calls that switch into the kernel. A process cannot directly see other processes running on the machine and cannot interfere with the address space of other processes unless special arrangements are made to share memory. Processes talk to the kernel mostly using data streams. I discussed stream I/O concepts in my column entitled "Device Independence" (July 1998, Page 28). Sending data from one process to another doesn't happen directly, the data is passed into the kernel from the sending process and is read from the kernel by the receiving process.

This isolationist model has many positive aspects. It means that if a process fails for one reason or another, its misbehavior cannot randomly affect another process, possibly causing unexpected events or strange unprovable data corruptions. The action of each process is deterministic, "garbage in" will mean "garbage out," but it will be the same garbage every time. The safety that the process environment supplies is particularly important for the C language, where errors in coding can easily cause a program to spray data over its address space. The process model limits the damage.

Signals are part of that model. A signal is not actually a message. It's a bit in a word in the control block for the process that's maintained by the kernel. When the kernel wishes to post a signal to a process, it simply sets the appropriate bit. When the kernel next decides to run the process, it looks at the set of signal bits

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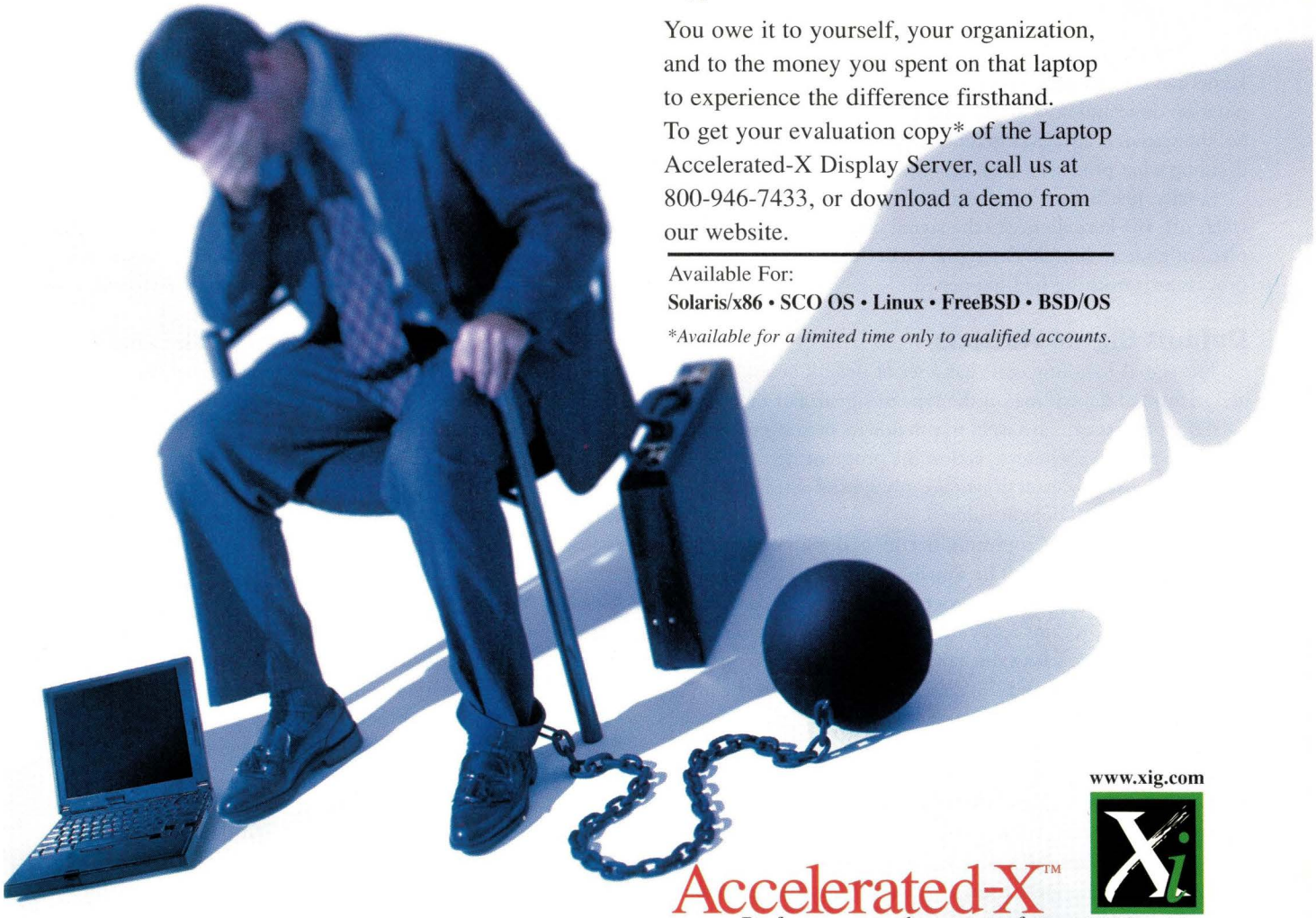

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and, if any are set, will start the process running using some special code to handle the signal.

Well, you may have been confused by "when the kernel next decides to run the process" and you have a right to be, surely a process is running all the time? On a processor with a single CPU, a process will run until it makes a system call, which will be serviced by switching into the kernel. If the system call takes some time, perhaps reading some data from a disk, the process is generally put to sleep until the data is ready. When the data materializes, the process is ready to go and can be placed in the run queue, where it is allowed to have some more CPU cycles. Of course, the process isn't aware of this sleeping time, as far as it's concerned it has made a system call and had some data returned.

You will find that core files materialize on all UNIX systems from time to time and, in general, they signal that something has failed and can be deleted.

The hardware may also cause a switch into kernel mode. The hardware will interrupt the CPU when a device completes some physical action, causing a switch into the kernel to service the peripheral. One device that's always present is a clock that ticks away at regular intervals allowing the kernel to share the CPU more fairly between the running processes. The kernel can see that one process has managed to get some computation done and now it's the turn of another process to run. So, the system is always switching in and out of kernel mode, deciding what process is to be run next and starting that process.

Finally, just before a process is resumed at the point where it left off, the kernel checks the signal bits and calls a special piece of code to handle the signal rather than restarting the process as if nothing had happened.

Default Signal Actions

The signal-handling code has a set of default actions that are performed depending on the type of signal. For most signals, the process can also elect to provide its own signal-handling code and take whatever action the programmer sees fit. However, most processes don't take any special action and just follow the standard default rules.

The first, and most common, default action makes the process exit immediately. The signal-handling code will call the `exit` system call and the process will finish. Note that the process exits, it's not really terminated by the system. The `exit` system call takes a value and this is passed to the process that started the command. By convention, on a normal exit, a zero value is used to mean the successful termination of a program. The signal code will set some bits in this returned value, so the calling process can see that its child has died because it received a signal. Of course, some programs don't care about this information. Some just inform the user. For example, shells print out a message saying the process has died because of a signal. Some processes depend on knowing what has happened to one of their children and will take special action when a nonzero value is returned.

The second default signal action causes the execution state of the program to be dumped into a file called `core` and then the process will exit as above. Of course, memory hasn't been "magnetic core" for some considerable time, so the name of this file betrays its antiquity. Recent releases of 4.4BSD have tended to use a name that relates to the original command, so if the dump is from a program called `fiona`, the core dump will be in a file named `fiona.core`. Using a command-specific name helps get around the problem of `core` files being overwritten by several crashes of different processes.

The execution state of the program can be useful if you're debugging a program or want to attempt to find out what it was doing before it was sent the signal. Debugging programs can use the core dump to investigate the state of the program's address space. Core dumps can be large, programs often have immense address spaces that rely on the virtual memory capabilities of the operating system and the host computer. To overcome the problem of filling up disks with immense core files, most recent versions of UNIX have limits that prevent the file being written if it will be larger than a predefined size.

Core dumps also present a security hazard. If I can get a core dump from the `login` program immediately after you have typed your password, then I can see your password in plain text (if I know how to use an appropriate debugger). Again, this problem is fixed on most current UNIX systems. One step is to prohibit anyone from obtaining a core dump from a program that has the `setuid` bit set in the file where the command lives in the file system.

You will find that `core` files materialize on all UNIX systems from time to time and, in general, they signal that something has failed and can be deleted. Although, if you have the knowledge, it may be worth your while trying to deduce what provoked the dump. On Solaris, the `file` command will tell you the name of the program that was responsible for the core, which can be useful.

The third default action for a signal is actually an inaction, the signal is ignored. In reality, if the programmer hasn't set up a special signal-handling routine, then an ignored signal is simply not posted. The fourth and final system action is to suspend the process. Most of the documentation calls this action "stopping" the process. I tend to resist using this term because it implies finality. The process is only halted temporarily and "suspending" is a more accurate term.

Using Signals

As I said, the programmer can specify that a routine in the process should be called when the signal occurs, rather than taking the default action. There are a number of reasons why this is desirable, why a program may wish to trap signals. What follows examines some possibilities and is by no means an exhaustive list.

First, a common case: If a program creates a temporary file, it's nice to be able to clean up when the user wants it to stop. Thus, the code will catch the signal, delete the file and exit. The program is doing what the user wants–stopping, but being tidy too.

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Second, if a program is interactive, an editor, for example, you may wish to use the signal to stop the current command in the editor rather than causing the whole program to exit, which will lose the file you are editing. Again, the program is doing what is natural: The shell is an interactive program and doesn't die when the user emits a signal from the keyboard. The interactive program is mimicking that behavior.

Third, there are several background processes that trap the "hang-up" signal and on its receipt will call a routine that rereads their configuration file. The signal is acting as a restart facility and is an example of a simple piece of interprocess communications.

As a final example, there is a class of programs to which you might want to send a message. A good example is a line printer spooler, which will sit waiting for files to appear in its spooling directory so that it may print them. It's not very efficient to make such a program continuously look for work. It's more productive to send it a message that says, "there is work now," and this message can be a signal. Actually, these days, many such programs are programmed with sockets so that a datagram is sent to tell it to spring into life and print something.

Catching Signals

To catch a signal, the programmer specifies that one of the routines in a program is to be called when the signal occurs. A call to the handling code is seen as an "unexpected" routine call to the program. In modern terms, signals create simple multithreading in the program, where there are two distinct paths in the code sharing the same data space.

In the original UNIX systems, care had to be taken in the data space of an application that was to continue to run after a signal had been caught. It was possible to have races, problems with shared data and all the evils of multithreading, but there was no support for mutual exclusion and locking that we expect in multithreaded environments today.

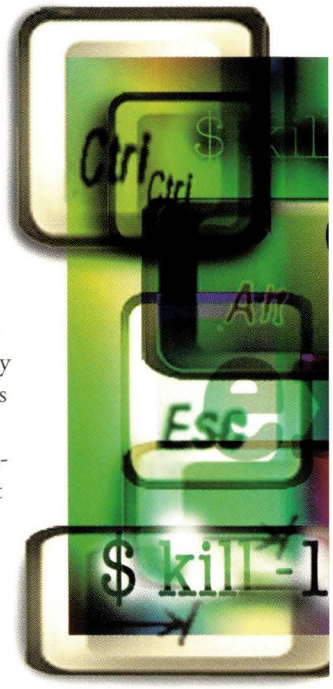
The basic design of signal handling was somewhat flawed because it was not really envisaged that signals would be used as an IPC mechanism. When the signal-handling routine was called, the kernel reset the action for that signal back to the default. Usually, the first action in the handling routine was to reestablish the handling routine. However, this left a small window of opportunity where a signal could arrive, the routine was called, the default action was now in force and some code was needed to be executed to set up the handler. Another signal that arrived before the handler was reestablished could cause the process to take the default action, rather than calling the catching routine.

I recall spending an enormous amount of time wondering why my line printer spooler would occasionally crash, creating a core dump. At the time, UNIX didn't have a spooler and so I had written one. I never got to the bottom of the problem, and it was years later when I realized the signals were being set back to the default and the default for the signal I was using created a core dump.

The problems with unreliable delivery of signals caused the team at the University of California to develop many solutions that appeared in successive BSD releases. The final model that exists in most modern UNIX systems treats signals like hardware interrupts to the virtual machine that is the process. When the kernel calls the signal-handling routine for a particular signal, that signal is *masked*. If the signal arrives while the handler code is being called, then it will be posted, but the catcher routine will not be called until its first call exits or takes action to allow the signal. The 4.4BSD signal model was adopted by POSIX (with some changes) and forms the basis of signal handling today.

Sending Signals

The standard terminal handler allows the user to send three signals to all the processes attached to the terminal. You can bind these signals to different keys using the `stty` command. The first, the interrupt signal (`SIGINT`), is usually bound to Control-C on most UNIX systems. The default action for the interrupt signal causes the running processes to exit. The second, the quit signal (`SIGQUIT`), is usually bound to Control-\ and causes a core dump and an exit. The quit signal is of more use to programmers and software developers than mortals. The third signal (`SIGTSTP`) is usually bound to Control-Z and delivers the suspend signal, stopping the processes from running. The terminal interface can also automatically deliver a signal telling all its processes to die when a carrier drops, which happens when a phone line is disconnected. By default, a process will exit when it receives the `SIGHUP` signal. This signal gave rise to a UNIX command, `nohup`, which starts a user-defined command that ignores the `SIGHUP` signal. This was originally used by people who wanted to dial in, start a background job and then disconnect the phone line, leaving the background job running.



The `kill` command is used to send a signal to one or more processes. By default, if you simply supply it with a process ID, it will send the terminate signal (`SIGTERM`) to the appropriate process. The default action for this signal causes the process to exit. However, `SIGTERM` can be caught and ignored.

To kill a process dead, you need to send the kill signal (`SIGKILL`). This signal cannot be caught or ignored and is guaranteed to kill the process (assuming that it's not waiting on some system event that will never happen). You can deliver the mortal blow by saying

```
$ kill -s SIGKILL <pid>
```

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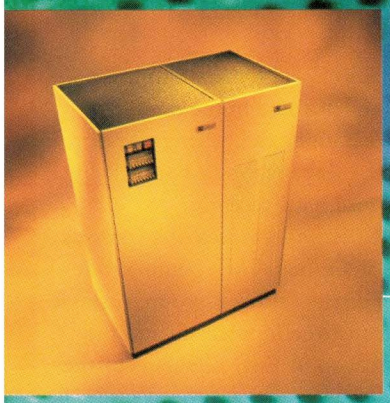

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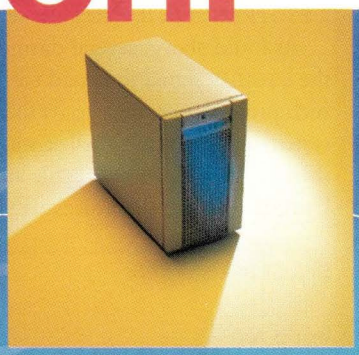

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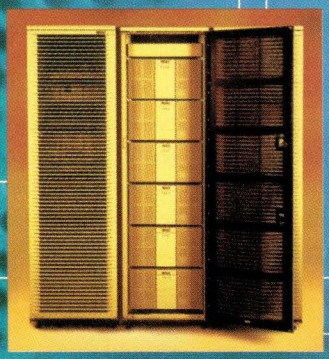

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```
$ kill -9 <pid>
```

which sends signal number 9, which happens to be SIGKILL on my system (and probably on yours too, it's one of those immutable constants that we know and love). You do need to be circumspect in your use of SIGKILL; if the process maintains temporary files, then it may expect to clean up and will do so when it is sent a SIGTERM. The usual strategy is to send a SIGTERM and, if that fails, send a SIGKILL.

As I said above, several daemon processes are coded to use the SIGHUP signal to reload tables. Many modern versions of such programs create a .pid file in some known spot on the file system and provide a shell script that "restarts" the daemon. The shell script reads the .pid file and sends the SIGHUP signal. Using ps to find the process ID and typing

```
$ kill -1 <pid>
```

works too.

Sending Signals to the Right Process

Of course, you hit Control-C on the keyboard without a thought and see the current running foreground process exit because it received a SIGINT signal. Actually, there is a sophisticated mechanism ensuring that only the "right" process (or processes) receives the signal.

The first UNIX systems used the notion of the "controlling terminal" to decide which processes should receive a signal from the keyboard. All the processes that are talking to the terminal will be sent the signal. This seems reasonable, but let's go through things slowly and see what the implications are.

When you login to a historical UNIX system, your shell is connected to your terminal. There's only one process and it will ignore the interrupt signal because shells cling to life and don't want to die when you type Control-C. Now you type a command name into the shell and start another process. You think of this as the "foreground" process because the shell goes to sleep until the command exits. In reality, you have two processes running on the machine with equal status, but one is waiting for the other to die. Typing Control-C will cause a signal to be sent to both processes. The shell is still ignoring it and the "foreground" process will exit, assuming it has taken no special action to handle the signal. The shell is woken up because the foreground process has died and you can type a new command.

Next, you start a command sequence that contains several processes connected by pipes. Again, when you type Control-C, all the processes are sent the signal. The pipeline processes die and the shell wakes up. This does the "right" thing.

What happens when you start the pipeline but add an ampersand at the end of the line making a "background" process? When you type Control-C, the signal gets sent to all the processes and will kill your background pipeline sequence as well. However, killing the background commands is not "correct" behavior. When we place something in the background, we don't want it to die when we type Control-C, the keystroke is supposed to be killing only the foreground process.

We need to program our shell so that when it starts a background process, that process will ignore the SIGINT signal. If the background job consists of several processes, then all the processes need to ignore the interrupt signal. So, now when Control-C is typed, processes in the "background" (and the shell) are ignoring the signal and remain running. All other processes see the signal and will die. Again, we seem to have what is the correct intuitive behavior.

But, how do we kill our background processes? The only way is to use the ps command to discover their process IDs and then use the kill command to send SIGTERM or SIGKILL.

Well, the above state of affairs existed for some time on UNIX until job control was implemented in the early '80s. Because job control was a BSD notion, and by then "System V was considered a standard," the mechanism was not really picked up in the System V world until quite recently.

Job control works by implementing the idea of a "process group." When the shell starts a command or a command sequence, that job is placed in a distinct process group. A single number is retained in all the constituent processes and the kernel is able to use that number to identify members of the group. The shell is able to manipulate which process group has control of the terminal by loading the group number into the terminal interface with a special system call.

Now when you type Control-C, the SIGINT signal is only sent to the processes in the process group currently loaded into that terminal. As a result, the shell can define foreground processes (those in the process group that is loaded into terminal) and background processes (all other process groups). Background processes are not allowed to read from the terminal, they are put to sleep if they attempt to do so. You can also optionally make background processes wait politely to output to the terminal should this be desirable. Job control defined a new standard signal, usually bound to Control-Z, which temporarily suspended a running process. Using a few keystrokes, the user had the ability to control which processes were in the foreground and which were in the background.

Job control was a big leap forward, it allowed users on terminal lines to multiplex several tasks on the same screen. It's argued that it is of limited use today where we have the ability to create several virtual terminals on our workstations. However, I still use job control because it's fast and it's easier to type Control-Z than reach for the mouse and open a new window.

Further Reading

There's loads of information on how signals are implemented in 4.4BSD in *The Design and Implementation of the 4.4BSD Operating System*, by Marshall Kirk McKusick, Keith Bostic, Michael J. Karels and John S. Quarterman, published by Addison-Wesley Publishing Co., 1996, ISBN 0-201-54979-4. ⊸

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

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Circle No. 14

Sun microsystems

I/Opener

by Richard Morin and Vicki Brown

KEN CONDON

Scripting Languages

"The focus of this book is the implementation of programming-language features that are at a high-conceptual level–features that are easy for human beings to use as opposed to features that fit comfortably on conventional computer architectures. The orientation is generality and flexibility, rather than maximum efficiency of execution."

– *The Implementation of the Icon Programming Language*,
by Ralph E. Griswold and Madge T. Griswold
(Princeton University Press, 1986, ISBN 0-691-08431-9).

Although many programmers use scripting languages on a regular basis, the exact definition of a "scripting" language remains rather fuzzy. Worse, the terms "high-level" and "interpreted" share much of the same conceptual space. This month's column attempts to map out the major characteristics that define these powerful and increasingly popular languages.

Because scripting languages have developed in an evolutionary manner (through mutation and cross-fertilization), we will take a historic approach in describing them. First, we'll look at the traditional bugaboo of efficiency. Second, we'll trace the development of scripting and interpreted languages. Finally, we'll try to bring the discussion back together (:-).

Efficiency

Historically, the most efficient way to make use of a computer's time has been to program it in machine language: numeric instructions for a particular computer architecture, for example, IBM Corp.'s 360. In practice, however, this programming is done in assembly language, which allows the use of macro definitions, mnemonic instruction codes, symbolic variable names and so on. This level of programming, in any case, allows the programmer to specify the computer's actions in meticulous detail. Unfortunately, it also *requires* the programmer to specify the computer's actions in meticulous detail. And, because machine (and hence, assembly) language programs are written for a particular computer architecture, they are extremely limited in portability.

For these reasons, programmers developed "compiled" languages such as C, COBOL and FORTRAN. A compiler translates the program source code into machine language for a particular computer. This frees the programmer to concentrate on more interesting things, such as data structures and algorithms, leaving many of the machine-dependent details to the compiler.

If the compiler does its job well, the resulting program will run almost as fast

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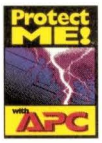

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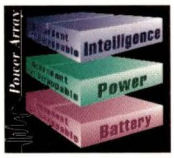

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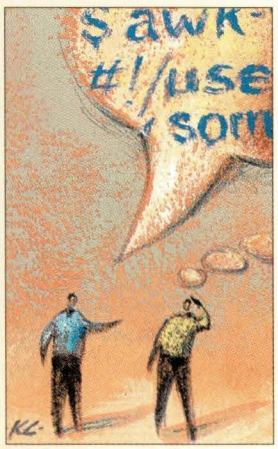
as the "perfect" hand-coded assembly language program it has replaced. In fact, because compilers can be painstaking at optimization, compiler-generated code will occasionally be better than the near equivalent human-generated code. This is fortunate because modern processor architectures, such as RISC, are optimized to work well with compiled languages. They also have features that can be difficult for human programmers to handle, for example, reduced instruction sets, delayed branch instructions and explicit parallelism.

These days, assembly language is reserved for high-performance device drivers and other applications where execution speed and code size are far more important than development costs.



As a result, compiled languages have largely replaced assembly language as the tool of choice for most programming tasks. A computer science curriculum may spend one semester teaching assembly language, but that's all. And few graduates will ever be asked to use what they learned. These days, assembly language is reserved for high-performance device drivers and other applications where execution speed and code size are far more important than development costs.

Job-Control Languages

Applications, whether written in assembly language or compiled languages, need to be "introduced" to the operating system in order to function. In batch-processing systems, job-control languages, such as IBM's OS JCL and DOS, perform this introduction. They can invoke programs and make I/O connections, use variables and so on. Their control-flow structuring is primitive, however, extending only to conditional execution and file-based modularity.

The command languages found on early minicomputers (and still, sadly, on MS DOS and Windows machines) are simpler to use, but add only looping capabilities. UNIX shells, in contrast, have well-developed programming features, including arithmetic operations, functions and simple data structures.

Along with increasingly powerful shells, the UNIX community has developed hundreds of user commands. Most have options that allow the user to specify variant behavior; some (for example, `awk` and `sed`) are reasonably complete programming languages in and of themselves.

By combining built-in shell commands with user commands, "shell scripts" can accomplish a great deal in a small amount of code. Many UNIX shell scripts are simple combinations of commands, with enough calculation and control flow to achieve the desired result. A few are more complicated, relying more on program logic and less on commands. The heritage from job-control languages is never entirely hidden, however.

Interpreted Languages

Lately, more and more serious programming is being done in interpreted languages. Instead of compiling the source code into machine instructions, these languages "interpret" the source code–or a precompiled set of abstract "byte codes"–on the fly. This allows interpreted languages greater flexibility and power, at some penalty in execution speed. But because of the speed of modern computers, the cost of using such an "inefficient" approach may be completely invisible to the user.

The UNIX standbys, `awk` and the shells, are in this category, of course, but so are Icon, Java, Perl, PostScript, Python, ReXX, Tcl, Visual Basic and assorted Lisp variants. A quick look through the "system files" shipped with a typical UNIX system, for instance, reveals a substantial number of interpreted shell scripts. Clearly, these programs could have been written in C. The fact that they were not indicates that execution speed was considered to be less critical than other factors, such as flexibility and maintainability.

The benefits (ease of development and maintenance) can be substantial. A program in one of these languages may be 10 to 100 times shorter than the equivalent code in a complied language such as C. The cost–typically, a 3x to 10x speed penalty–may be insignificant (or at least acceptable), depending on the size of the calculation, the frequency with which it will be run and the speed of the processor.

Much of the gain comes from "gluing" together preexisting components, sometimes other shell scripts! The remainder comes from the increased expressive power–string manipulation operators, associative arrays, automatic garbage collection and so on–available to interpreted languages.

In some interpreted languages, such as "fourth-generation" database languages, this power comes at a great cost in flexibility. These languages are, thus, "high-level" but limited in scope. The UNIX flavors of high-level languages, in contrast, tend to retain their general-purpose capabilities.

Defining a Scripting Language

Although a number of modern programming languages qualify as scripting languages, there is no firm consensus on the exact meaning of the term, or even on what factors differentiate a script from any other sort of program.

In the Macintosh community, an AppleScript is an interpreted piece of code that can direct Apple Computer Inc. Mac OS applications (including the Finder) to perform given functions. Watching an AppleScript run is kind of fun: windows and dialog boxes appear, change and disappear, all without human interaction. The target application must be written to accept each given function request, however, so the versatility of this approach is somewhat limited. PreFab Software Inc.'s PreFab Player (`http://www.prefab.com`) extends AppleScript's capabilities, allowing arbitrary mouse and keyboard actions to be scripted.

In the UNIX world, the definition of a scripting language

gets fuzzier. Any language that is optimized for ease of use and expressive power tends to be included in the set. Thus, some "scripters" would include Icon because its designers, as quoted above, are much less interested in machine efficiency than in programmer efficiency. Others, like Dr. John K. Ousterhout, the inventor of Tcl/Tk, have more specific requirements.

Ousterhout contends that scripting languages will handle many of the programming tasks of the next century because they are optimized for combining existing bits of functionality (for example, libraries and programs), rather than writing programs from scratch. His paper, "Scripting: Higher Level Programming for the 21st Century," *IEEE Computer*, March 1998, presents this view in a clear and thought-provoking manner (see `http://www.scriptics.com/people/john.ousterhout/scripting.html`).

All scripting languages are interpreted, but the converse is not the case. A number of interpreted languages, including APL, BASIC, Icon and Java, lack features that make scripting languages good at gluing together applications. Perl and UNIX shells, for instance, make it easy to run (pipelines of) commands, using the output as input data to the script; Java does not.

Nonetheless, there are strong reasons why scripting languages are interpreted. Interpreted languages can do "late binding" of functions and storage locations, allowing the program to use a given variable as a string, then a number and so on. They tend to be portable across machine architectures and operating systems. Finally, they can accept or generate code on the fly, allowing greater flexibility.

How all this is accomplished becomes merely an implementation detail. In a few interpreters, for example, UNIX shells, the program source code is parsed each time it is executed. This is a bit profligate, however, so most interpreters parse the code into a set of abstract "byte codes" instead, reserving execution-time parsing for special cases. Finally, some language systems, for example, Java, allow the byte codes to be distributed for use on other machines.

I'll Know it when I See it

Although an exact definition may be difficult to formulate, most people seem to be able to agree on what constitutes a scripting language. At least, they tend to agree that certain languages can be called scripting languages! Scripting languages tend to possess the following high-level features:

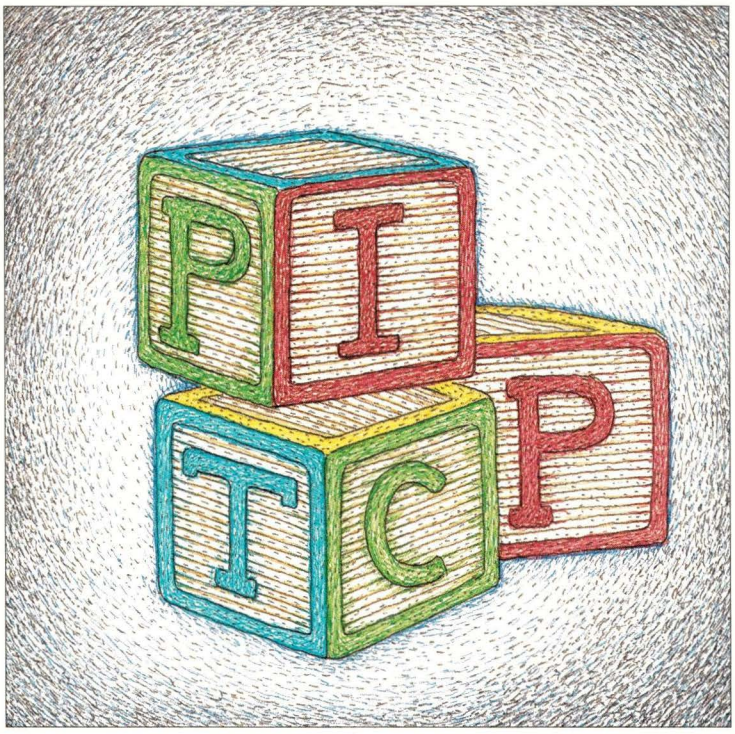
- Processor and OS independence – Unlike a "binary executable," the code should be able to work in any target environment.
- Late binding – Internal details related to data types should be resolved as necessary, rather than at "compile time," allowing greater flexibility.
- Runtime evaluation of code – It should be possible to generate or import source code at "runtime," then evaluate (execute) it.
- Various built-in, high-level features that would otherwise be difficult to write "from scratch" – These include string manipulation operators, regular expressions and associative arrays.
- Less "administrative overhead" – Scripting languages tend to make simplifying assumptions about data types, default values, memory allocation, array sizes and so on.
- Optimization for programmer efficiency – This includes the ability to glue together existing components.
- Optimization for certain types of applications – This includes text manipulation, data filtering, system administration, GUIs and Internet applications.
- Rapid prototyping – The ability to get a working program up and running (and debugged!) in far less time than with "system programming" languages like C.

There will always be room for compiled languages, just as we still see some use of assembly language. Scripting languages are increasing in popularity, however, and their powerful feature sets already make them the languages of choice for a large variety of applications. ⊷

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 Canta Forda Computer Laboratory, P.O. Box 1488, Pacifica, CA 94044 or by email at `rdm@cfcl.com`.*

Vicki Brown *has been working with UNIX systems since 1983. She started working with Perl in Fall 1995 because with Perl she could do pretty much everything she wanted (and needed) to do on the Macintosh, without the benefit of UNIX and a shell :-).*

by S. Lee Henry



DAVE RIDLEY

Cozy Up to Your TCP/IP Stack

Much to the delight of those of us who remember editing C source and compiling new kernels, modification of TCP/IP settings is now done in Solaris "on the fly." Changes take effect immediately; you don't even need to reboot. The trick, however, hasn't changed much since the days of moving `./vmunix` to `/vmunix`. Knowing which parameters to change, and what to change them to, can make the difference between a network that sings and one that can't even hum a tune.

The best place to start with any kind of system tweaking is to know where you're starting from. Taking the time to become familiar with your network statistics and understanding what they tell you is critical to assessing the impact of changes you might make. The biggest challenge is knowing which of the many numbers available to you tell you what you need to know.

There is a large number of statistics that can be viewed using the `netstat` and `ndd` commands. For the most part, these statistics are counters, or settings, and are expressed in instances of bytes, segments or milliseconds since last boot (that is, since the interface was initialized).

When thinking about network performance and statistics, it's important to note the major difference between connection-oriented and connectionless protocols. I hate to dredge up tired analogies, but the image of a phone call as a connection-oriented (you call, make a connection, talk flows in both directions and then you hang up) and a letter as a connectionless protocol (you drop your love letter in the mail and hope that h/she gets it) are still appropriate. Keep these images in mind as you look at your connection-oriented (TCP) and connectionless (UDP) statistics.

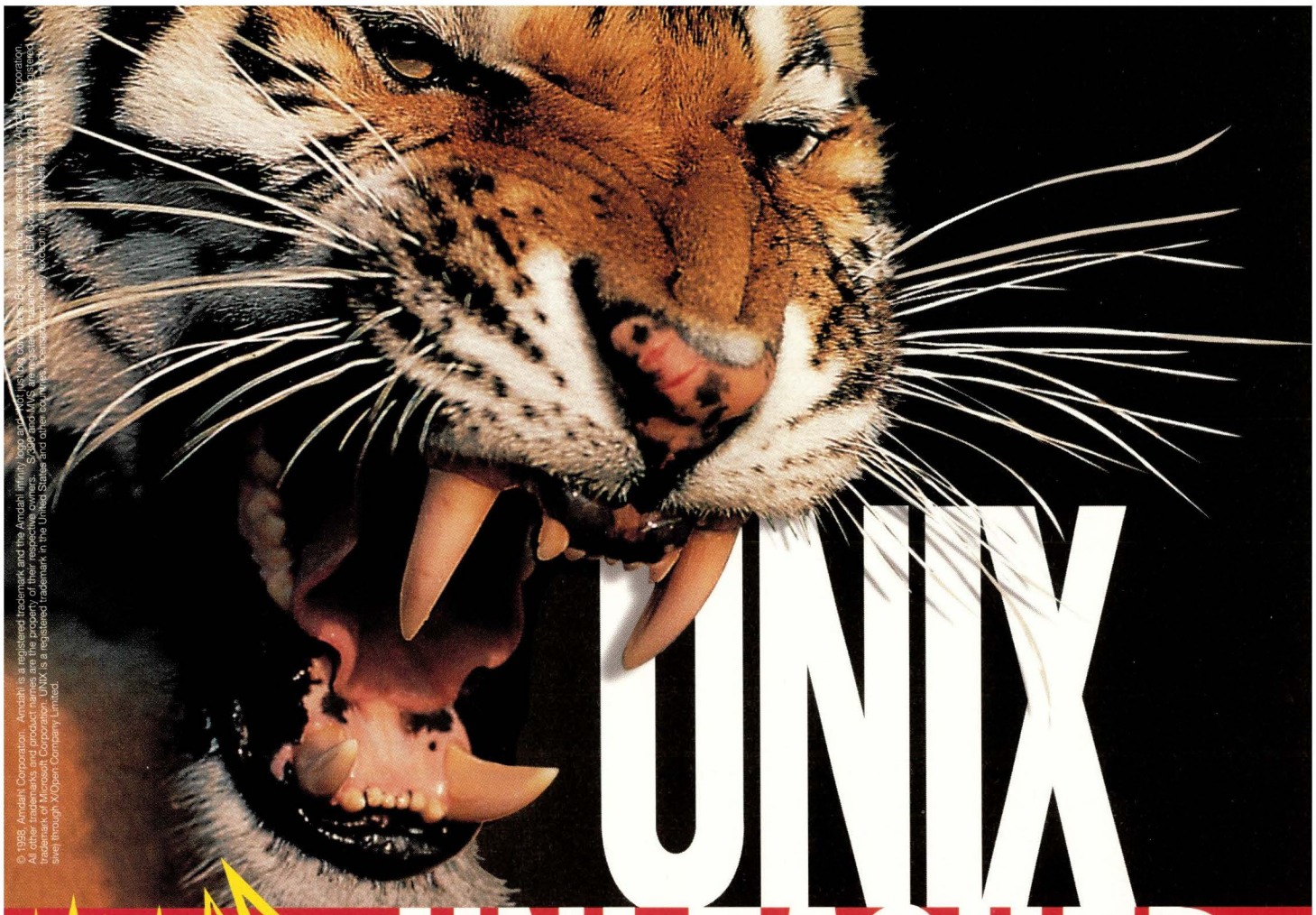
Baby Steps

If you find yourself alone on a fairly idle system, you may have an opportunity to watch some of the network statistics change in response to your activity. If you were to run the following command:

```
netstat -s | grep Active
tcpActiveOpens      =  4407
tcpPassiveOpens     =  6424
```

followed by a quick `telnet` session to another system and then the same command again, you would notice that the statistic, `tcpActiveOpens`, increases by one. This represents the number of outgoing TCP connections since the interface was brought up. The corresponding statistic, `tcpPassiveOpens`, represents the number of incoming connections. If the counts displayed make sense to you, you probably have a good "feel" for how busy your system is and how it is used. If the numbers surprise you, you might want to watch them more closely and determine why these numbers are not what you had expected.

If you start and stop several `telnet` sessions in quick succession, you might notice another important characteristic about network connections–they lag "reality." That is, even after you're finished with the connection it may still be "alive"



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from the system's point of view. In the example shown below, several connections are reported to be in the TIME_WAIT state that follows the close of a session. In fact, opening and closing connections takes a little time. Familiarity with the states that TCP connections go through, and the handshaking that must transpire before they are established, is an important part of understanding the dynamics and the timing constraints affecting performance on your network.

The following lines are a small portion of the output of the command netstat -a, which displays the state of sockets as well as routing table entries (ongoing TCP connections are reported as ESTABLISHED):

Figure 1. netstat -a Output

```
Local Address  Remote Address  Swind  Send-Q  Rwind  Recv-Q  State
-------------  --------------  -----  ------  -----  ------  ------
      *.110          *.*        0       0      0       0    LISTEN
      *.smtp         *.*        0       0      0       0    LISTEN
boson.telnet    fermion.2364    8505    0      8760    0    ESTABLISHED
```

Figure 2. Calculating the Percentage of Retransmissions

```
#!/bin/sh
RETBYTES=`netstat -s | grep tcpRetransBytes | awk -F= '{print $3}'`
OUTBYTES=`netstat -s | grep tcpOutDataBytes | awk -F= '{print $3}'`
echo $RETBYTES $OUTBYTES | awk ' { print substr($1 / $2 * 100,1,4) "%"
}'
```

```
boson.telnet  fermion.2364  8180  1  8760  0 ESTABLISHED
boson.telnet  fermion.2376  8477  0  8760  0 TIME_WAIT
boson.telnet  fermion.2614  8479  0  8760  0 TIME_WAIT
boson.telnet  fermion.2615  8626  0  8760  0 TIME_WAIT
```

The third line of the output in Figure 1 represents a telnet session between the hosts boson and fermion. The first and second lines show connections in the LISTEN (waiting for requests) mode. You may recognize the port address 110 used by POP3 and the process smtp, both associated with email exchange.

As you become familiar with the statistics available to you, and what they can tell you about your network, you might benefit from looking at various collections of statistics. For example, those including the word "Fail." Although there aren't many of these, if you find abnormally high counts in any of these numbers, it's probably worth your while to investigate:

```
netstat -s | grep Fail
tcpAttemptFails    =   2   tcpEstabResets    =   7
ipReasmOKs         =   0   ipReasmFails      =   0
ipFragOKs          =   0   ipFragFails       =   0
```

Failed connections are not necessarily a symptom of network problems. If I try to telnet to a system that won't allow me to connect, the tcpAttemptFails statistic increases by one, as you can see below:

```
boson.particles.com% telnet 208.208.245.123
Trying 208.208.245.123...
telnet: Unable to connect to remote host:
Connection refused
boson.particles.com% netstat -s | grep Fail
     tcpAttemptFails  =  3  tcpEstabResets  =  7
     ipReasmOKs       =  0  ipReasmFails    =  0
     ipFragOKs        =  0  ipFragFails     =  0
```

You might also want to take a look at retransmissions. In connection-oriented protocols like TCP, data is present if it doesn't reach the destination–for example, if the transmission is incomplete. Retransmissions by themselves are not terribly relevant, but as a percentage of overall packets sent out, the number is significant. The simple script shown in Figure 2 computes a percentage from the two relevant statistics.

If you're curious about the number of current TCP connections, try the following command to display the current count. Notice how a quick count of sockets in the ESTABLISHED state confirms this number (it may not be a busy network where connections are established and dropped quickly and often):

```
netstat -s | grep Curr
   tcpCurrEstab    =  24   tcpOutSegs    =208666
netstat -P tcp -a | grep "ESTABLISHED" | wc -l
   24
```

Know Your Commands

The two commands that will tell you how your TCP/IP network is running are netstat and ndd. netstat has numerous options, allowing you to select different information. Notice in the above example the netstat -s command displays statistics for each protocol. If you use the command netstat -P tcp, you will see a display of statistics related to the TCP protocol. The command netstat -a displays information about sockets and routing table entries. You can also combine options and look at, for example, only TCP sockets using the command netstat -P tcp -a.

I've cut out most of the lines in the excerpt below, but ask that you look at the column titled "State." I've referred to some of the states that a socket goes through in the process of setting up, using and then dropping a connection. Table 1 includes a full list of possible states. You may not see all of these in your displays because sockets pass through some of these states quickly. If you toss out a quick command to group and count sockets by state, you'll likely see numerous sockets in the ESTABLISHED and LISTEN states, for example,

```
netstat -P tcp -a | tail +5 | awk '{print $7}' | sort |
awk -f count_same ESTABLISHED 23 IDLE 4 LISTEN 31
```

You can also get a convenient listing of counters related to your network interface by using the netstat -k command,

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SYNTAX

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Table 1. Socket States

CLOSED	Not in use.
LISTEN	Listening for incoming connections.
SYN_SENT	Trying to establish a connection.
SYN_RECEIVED	Synchronizing the connection.
ESTABLISHED	The connection is established (in use).
CLOSE_WAIT	Waiting for the socket to close.
FIN_WAIT_1	Shutting down the connection.
CLOSING	Closed, then remote shutdown; awaiting acknowledgment.
LAST_ACK	Remote shutdown, then closed; awaiting acknowledgment.
FIN_WAIT_2	Socket closed; waiting for shutdown from remote.
TIME_WAIT	Wait after close for remote shutdown retransmission.

which reports on more kernel counters than you're likely to ever need (see Figure 3), and cuts down the display to a specific section with a simple awk script like the one shown below:

```
# { POS = index($1,":") if (POS > 0) {
CURR_STAT = substr($1,1,POS-1)
if (CURR_STAT == STAT)
    DISPLAY = 1
else
    DISPLAY = 0
} if (DISPLAY == 1)
print $0 }
```

For a list of the statistics you can view or adjust with the ndd command, choose the protocol you're interested in and substitute it into the syntax `ndd /dev/[protocol]`, for example, `ndd /dev/tcp`. Then, to ask about the setting of a particular statistic from the displayed list, use the syntax `ndd /dev/[protocol] [statistic name]` as shown in the following example:

```
# ndd /dev/ip ip_icmp_return_data_bytes 64
# ndd /dev/ip ip_forwarding 0
# ndd /dev/tcp tcp_conn_req_max_q0 1024
```

Figure 3. netstat -k Output

```
boson.particles.com% netstat -k | awk -f by_stat STAT="hme0"
hme0:
ipackets 381770 ierrors 44168 opackets 165190 oerrors 0 collisions 9210
defer 0 framing 0 crc 4 sqe 0 code_violations 0 len_errors 0
drop 0 buff 0 oflo 0 uflo 0 missed 0 tx_late_collisions 0
retry_error 0 first_collisions 0 nocarrier 1 inits 16 nocanput 0
allocbfail 0 runt 0 jabber 0 babble 0 tmd_error 0 tx_late_error 0
rx_late_error 0 slv_parity_error 0 tx_parity_error 0 rx_parity_error 0
slv_error_ack 0 tx_error_ack 0 rx_error_ack 0 tx_tag_error 0
rx_tag_error 0 eop_error 0 no_tmds 0 no_tbufs 0 no_rbufs 0
rx_late_collisions 0 rbytes 94419219 obytes 70463591 multircv 358
multixmt 0
brdcstrcv 204493 brdcstxmt 582 norcvbuf 0 noxmtbuf 4
```

The first statistic displays the size of an icmp (ping) reply. The second (a boolean) command tells you that IP forwarding is turned off. The third command displays the size of the queue for connections still in the handshaking stage (Solaris 2.6 or later). You can use commands like these to display or to change settings, but be very careful in making changes because the consequences of changing parameters can be severe.

There is a listen queue, which limits how many connections can be waiting to get through the connection handshaking sequence. If the size of the queue isn't large enough, you can lose connections. This problem is much more likely to occur on a Web server, which stretches those connection profiles we used to consider normal to a higher order of magnitude, in terms of demand. On the other hand, Web servers running on Solaris 2.6+ will take advantage of significant efficiency improvements for connection-intensive systems.

As with much of the work associated with running a large and potentially complex network, the best strategy is to a) become familiar with what is normal and healthy for your site by collecting and mapping statistics, and b) recognize when the network statistics available to you have strayed from the norm. If you don't have time to become a TCP/IP wizard, this approach will give you a working knowledge of how your network runs.

Although it is easy to change network parameters with ndd, you will rarely want to do so. Since Solaris 2.6, the default values work quite well, even for the busiest Web sites. Make sure you keep track of what you've changed and that you can reverse the process if you don't like the effect.

Other Resources

Another way to become familiar with your network's performance without getting too deeply into the guts of TCP/IP is to download and set up the Symbol Engine Toolkit (see `http://www.sun.com/sun-on-net/performance/se3`). There isn't nearly enough room in this column to describe the toolkit and how to use it, but you can think of it as a tool that allows you to automate performance monitoring.

If you want to learn everything you can about TCP/IP, you can't do much better than W. Richard Steven's *TCP/IP Illustrated, Volume 1: The Protocols*, published by Addison-Wesley Publishing Co., 1994, ISBN 0-201-63346-9. And if you want to become a performance guru, then keep an eye out for books and articles by Adrian Cockroft. ⊸

S. Lee Henry *takes care of systems and software at InCap Corp., a software developer based in Marin County, CA. She lives on a sailboat in San Rafael and spends her spare time writing, singing and enjoying her family. You can send her an email by addressing it to* slee@cpg.com.

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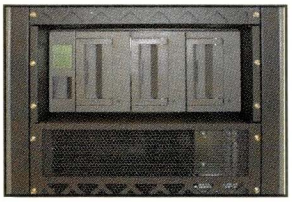

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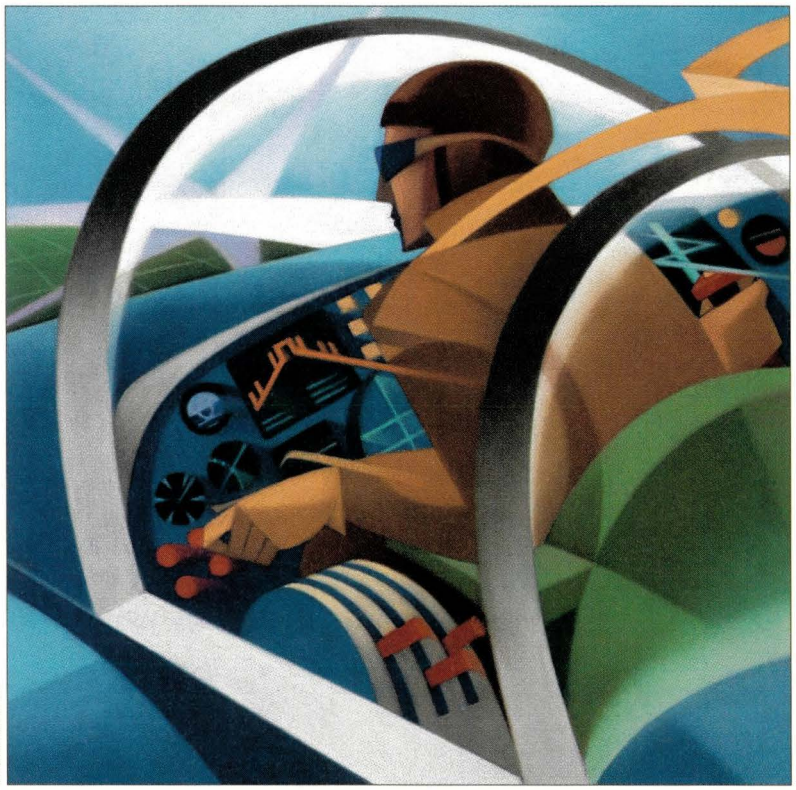
by Æleen Frisch



LYNNE CANNOY

Monitoring System Performance

If you've ever worried about performance on a UNIX system, you probably already know quite a bit about monitoring and optimizing performance on Windows NT. While the tools you use for these jobs vary from system to system, their basic concepts and goals remain the same. This month, we'll look at system performance on Windows NT by using the Performance Monitor facility provided for monitoring, recording and analyzing performance-related data.

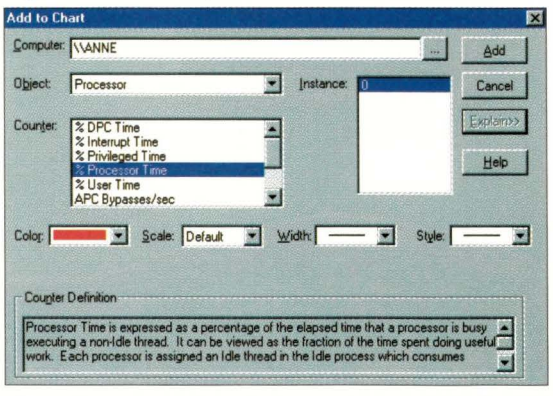
Performance Monitor can be used to display and track performance statistics. Start it via the Start=>Programs=>Administrative Tools (Common)=>Performance Monitor menu path or by running the `perfmon` command. The facility can track and plot the values of various system resource statistics known as *counters*. There are three main types of counters: the current (instantaneous) values of a system statistic; the average values over some time period; and the difference between the two statistics. Sets of counters can be defined and saved for repeated use (via the File=>Save Settings menu path).

There are a multitude of counters available, which are grouped into subsets based upon the system object with which they are associated. The most important counters are listed in Table 1.

Performance Monitor can operate in several distinct modes. The most important distinction is between data collection, known as logging, and data viewing. Logging consists of collecting and recording specified system performance data over a specified time period for later analysis. There are three formats you can use to view performance data: chart, alert and report. Data viewing can be performed on live data or from previously-collected data, and the performance data can be displayed in graphical or textual form. The items under the View menu select which operating mode is active.

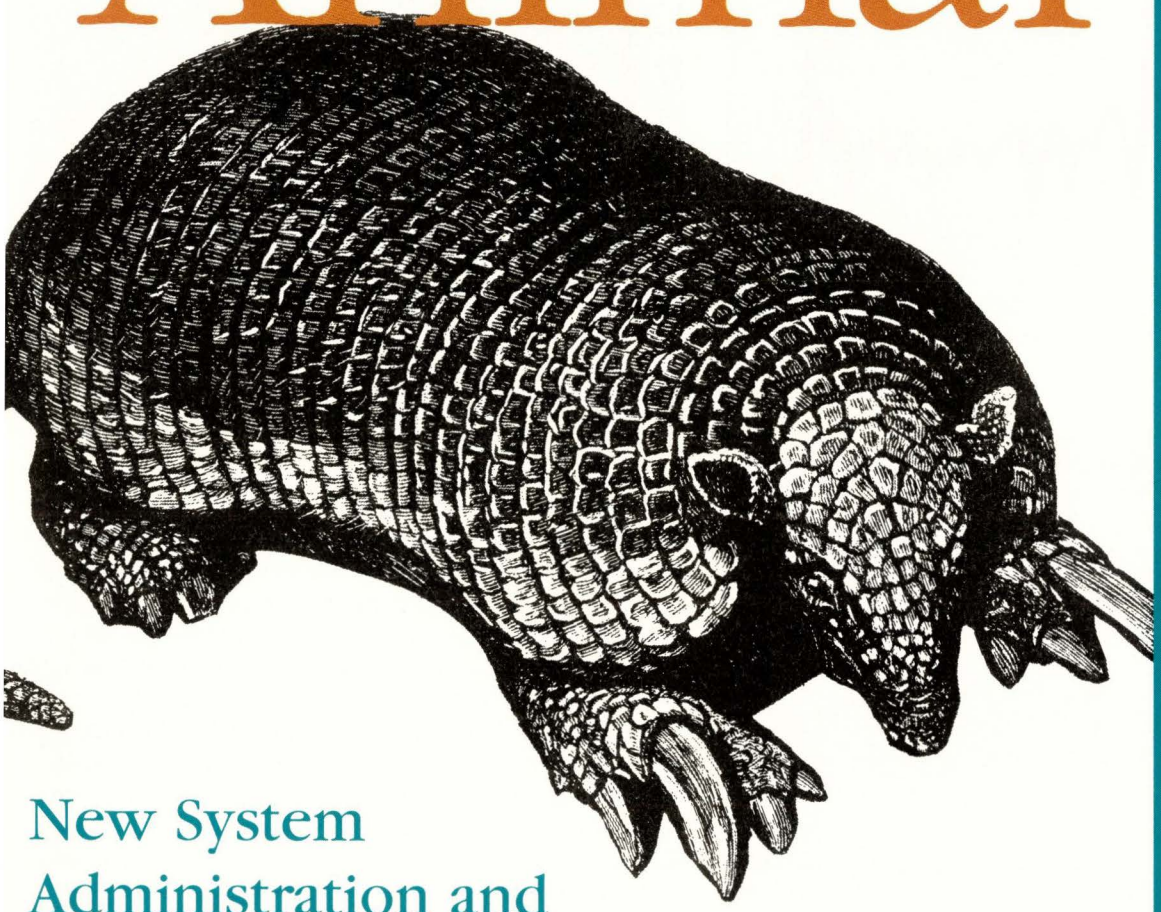
As an example, we'll create a simple chart plotting total system CPU usage and the portion of it consumed as privileged usage: CPU time devoted to operating system servicing of process requests. We select View=>Chart and File=>New Chart to create a new chart and then Edit=>Add to Chart to add counters to it. The resulting dialog box is illustrated in Figure 1.

Figure 1. Adding a Counter to a Chart



This dialog box allows you to specify the system you want to monitor via the Computer field.

A Different Kind of Animal



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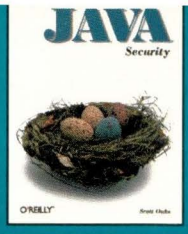

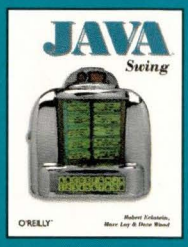

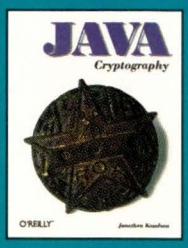

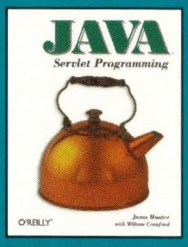

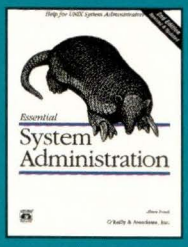

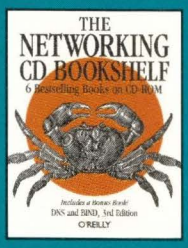

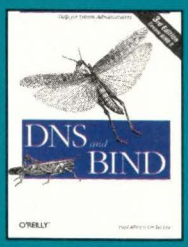

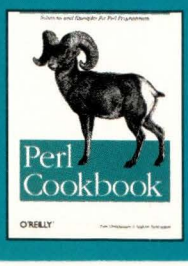

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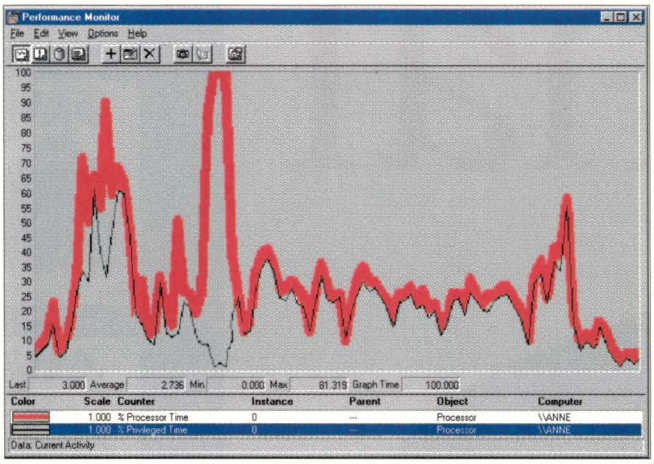
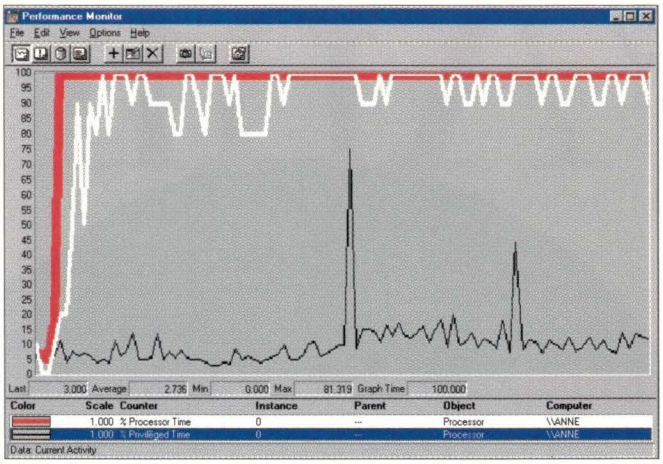
Figure 2. Total CPU Usage



The above chart plots total system CPU usage (red line) and %Priviledged Time (black line).

Figure 3. CPU Usage on an Active System



The white line plots Context Switches/sec and indicates there are too many jobs for the system, causing it to constantly switch from one job to another.

Table 1. Performance Monitor Objects

System
Counters related to system performance as a whole. The most important of these are related to system CPU use and process/thread scheduling. The Processor object includes similar counters for individual CPUs in a multiprocessor system and the Process and Thread objects allow you to monitor the same data for an individual process or thread.

Memory
Counters indicating current use of real and virtual memory, including paging statistics.

Paging File
Counters indicating current use of the system paging files.

Physical Disk/Logical Disk
Counters related to current disk I/O activity and transfer rates for physical disk partitions and file systems, respectively. Because they add an additional load on the system, these counters must be enabled before they can be monitored. The `diskperf -ye` command will enable them at the next system reboot.

Network
Counters for monitoring network usage and performance statistics. The Network Monitor Agent must be installed from the NT distribution CD before these counters are available.

Server
Counters providing statistics about the system as it functions as a server, including ones related to shared resources and network sessions.

Browser
Counters related to the browser service, including both servicing browser requests and general browsing facility administrative overhead (for example, browser elections and data replication).

Cache
Counters related to the use of system memory as a file system cache, including cache hit and miss statistics.

This dialog allows you to specify the system you want to monitor via the Computer field. We will be monitoring the local system, so we go directly to the Object field and select Processor. The %Total Processor Time may now be selected from the Counter list box. This counter indicates what percentage of the total system CPU capacity is currently in use. Clicking the Explain button enables the Counter Definition field (at the bottom of the dialog box) in which a brief description of the currently-selected counter appears automatically.

The Instance field allows you to specify which instance of a counter that applies to multiple system objects is desired (for example, which particular disk, or file system in the case of disk I/O counters). In our case, there is just one instance on our single processor system (`processor 0`) and, in this case, the same counter in the System object would be equivalent.

The four fields below the counter list allow you to specify how the line plotting this counter will appear in the chart. Once we've configured the counter the way we want it, clicking the Add button will add it to the chart.

We use a similar process to add the %Privileged Time to the chart. The results are displayed in Figure 2.

The thick red line indicates total CPU use, while the thin black line plots privileged time. Note that most CPU time is spent as privileged time in this example, except for one brief period near the middle of the chart. This means that few of the available CPU resources are being used for the actual execution of user processes and may indicate a performance problem on this system. It is certainly a situation that requires further investigation.

These are the most important counters for monitoring and analyzing overall system CPU performance:

- **Processor: % Processor Time** – This should generally range no higher than 75% to 80% on general server systems. On systems devoted to running applications, however, this counter may approach 100% provided that no other performance problems are indicated.
- **Processor: %User Time and Processor: %Privileged Time** – Comparing these counters to the total system CPU usage levels

will indicate the percentage of CPU time being consumed as operating system overhead (that is, not accomplishing actual work).

• **System: Processor Queue Length** – The number of processes that are ready to run but have to wait for the processor to become free. This counter should generally remain below 2 or 3.

• **System: Total Interrupts/sec** – The number of times the operating system interrupts a running process per second (should remain below 10). Along with the **System: Context Switches/sec** counter, it provides a measure of how often the CPU is switching between distinct processes (more frequent switching results in greater system overhead).

Figure 3 illustrates a system with a different sort of CPU-based performance problem (the thick red line again indicates total CPU usage and the thin black line plots %Privileged Time). The amount of operating system overhead on this system is not significantly affecting performance. However, the total CPU usage is nearly constant at 100%. The white line, which plots Context Switches/sec, gives us an indication of the source of the problem: too many jobs for the available CPU capacity of the system, resulting in the system constantly switching from one job to another.

The same data can be plotted in Performance Monitor's report view. This view provides specific numeric values for the counters being monitored.

System memory usage is often a significant source of performance problems. These are the most important counters for monitoring system memory use:

• **Memory: Available bytes** – Indicates the amount of physical memory available. This counter should generally be a few megabytes in size.

• **Memory: Pages Input/sec and Memory: Pages Output/sec** – When physical memory is scarce, the system writes some memory pages out to disk via a process known as paging. These counters indicate the pages read in from disk and written out to disk, respectively. The **Memory: Pages/sec** counter is the sum of the two and should remain below 20.

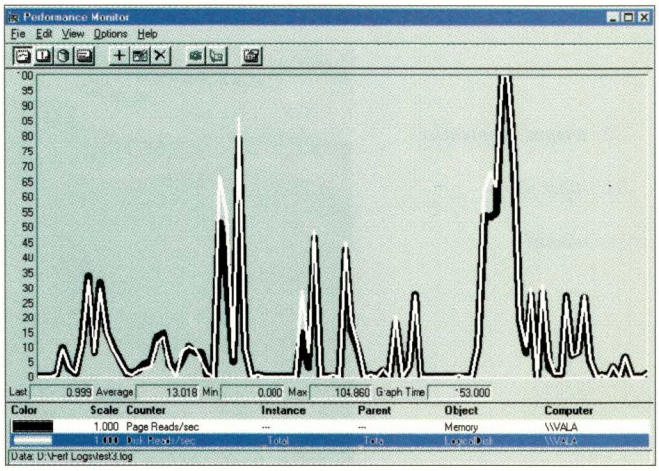
• **Paging File: %Usage** – The percentage of the available paging space that is in use. Consistently high values for this counter indicate the need to add additional paging files.

Figure 4 shows two charts illustrating counters related to system memory. The chart at the top compares the number of disk read operations per second with the number of read operations corresponding to paging activity. The chart below it plots similar data for write I/O operations. In both cases, total disk I/O is plotted in white and paging-related I/O is indicated by a black line.

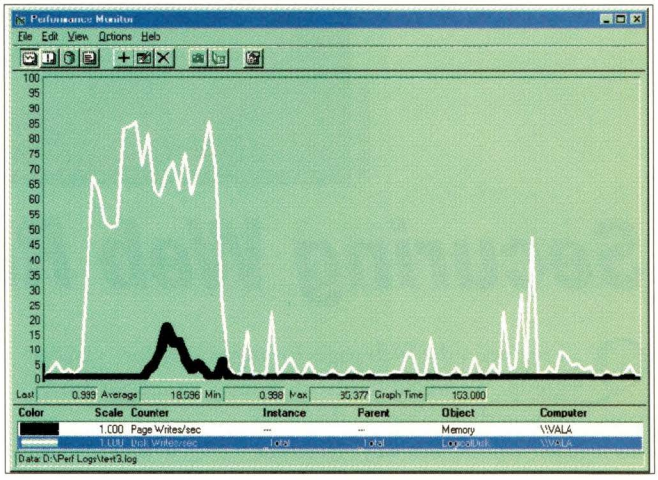
We can see that most of the current disk read I/O on this system is due to paging activity. This is not necessarily a problem, however, because normal process startup involves paging in from disk, but it should be investigated further. In contrast, little of the current disk write I/O is devoted to paging (and so it must be resulting from process disk writes). All in all, it is unlikely that a memory shortage is a bottleneck on this system.

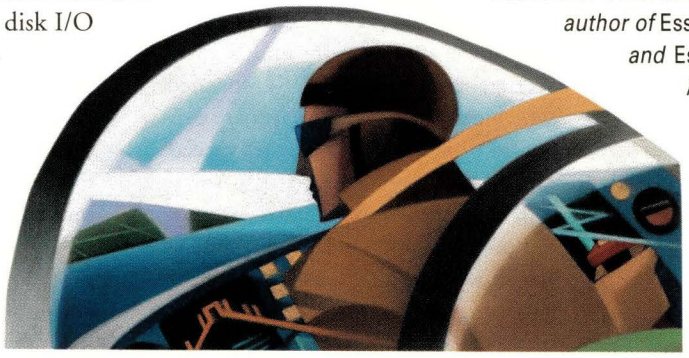
Next month, we will continue our look at system performance by examining data from systems under stress. ⊸

Figure 4. Paging Rates Compared with Disk I/O



The chart above compares disk read operations per second with the number of read operations corresponding to paging activity. The chart below plots similar data for write I/O operations.





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

by Jim Fox

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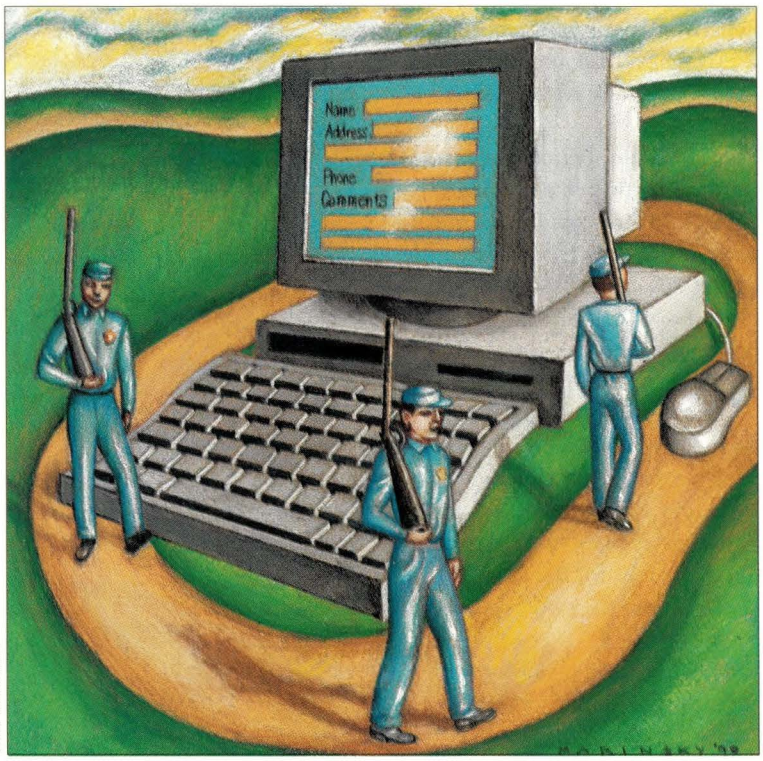

JANE MARINSKY

Securing Web Registration Forms

Q: I maintain the Web pages for my group. We would like to include some forms on those pages so that users can register with us. But we're reluctant after hearing so much about security problems relating to forms in Web pages.

How can we be secure and still have clients let us know who they are and what they want? AA

Susan Baker
IMSC Corp.

A: Including forms on your Web pages is easier than it looks and, if you're careful, it's safe. Just remember: never trust any user data; check each and every character. Let's review Web forms and then look at some ways to process them.

A simple form, which requests a name and address, might look like the following:

```
<form method="get"
 action="register.cgi">
<p>
Name <input type="text"
 name="user" size=40>
<p>
e-mail <input type="text"
 name="email" size=40>
<p>
<input type="submit"
 value="Submit">
<input type="reset"
 value="Cancel"> </form>
```

where the "action" is, in this case, the next page to "get." When the user selects the "Submit" button, the browser issues a `GET` request for the `register.cgi` page and will append a question mark and the user's data to the end of the request. Each datum is URL-encoded, which generally means spaces are converted to plus signs, and other special characters are replaced by their ASCII representations and separated from one another by ampersands. A response to the above form might look like this:

```
user=Jim+Fox&email=fox@x.com
```

Your Web server will put the response into the `QUERY_STRING` environment variable, which is available for your CGI script. Try it and see for yourself. Use the following script for `register.cgi`:

```
#!/bin/ksh
print "Content-type: text/html"
print ""
env
```

When you submit the form you'll see the environment that was passed on to the CGI program. In it, you'll find the `QUERY_STRING` variable.

The other forms method is `POST`. It tells the browser to send your response (that URL-encoded string) as extra text after the next request–rather than as part of the request itself. In this case, your CGI script has to read the data from its standard input. The `CONTENT_LENGTH` environment variable tells your program how long the response is. You have to read exactly that much data.

In this case, you cannot easily use a

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Figure 1. Python Forms-Handling Script

```
#!/usr/local/bin/python

import cgi, string

def html_headers():
 print 'Content-type: text/html'
 print ''

def html_footers():
 print '</html>'

def send_form():
 print '<head>'
 print '<title>Registration</title>'
 print '</head><body>'
 print '<p>'
 print '<form method="GET" action="penv.cgi">'
 print '  Your Name <input type="text" name="username" size=30>'
 print '  <p>'
 print '  Wanted : <input type="radio" name=cat value="c"> Catalog'

 print '  <input type="radio" name=cat value="b"> Brochure'
 print '  <p>'
 print '  e-mail <input type="text" name="email" size=30>'
 print '  <p>'
 print '  <input type="submit" value="OK">'
 print '  <input type="reset" value="cancel">'
 print '</form>'
 print '</html>'

def send_ok(client, email):
 print '<head>'
 print '<title>Accepted</title>'
 print '</head><body>'
 print '<p>OK, your registration was accepted'
 print '<p>Name:' + client
 print '<p>email:' + email
 print '</html>'

def do_html():
 html_headers()
 try:
   form=cgi.FieldStorage()
   client=form['username']
   email=form['email']
 except (KeyError, TypeError):
   send_form()
   return


 send_ok(client.value, email.value)


do_html()
```

shell script because it's not easy to read a specified number of characters. Shell scripts usually read one line at a time, which wouldn't work.

Reading Forms with Python

Most people working with simple forms use a compiled language or a scripting language, such as Perl or Python. For aesthetic as well as practical reasons, I prefer the latter, so let's see how to process that form with Python.

Python is a very clean, convenient, easy-to-use, object-oriented, interpretive language developed in 1991 by Guido van Rossum, the principle author, who then worked at Stichting Mathematisch Centrum (CWI) in Amsterdam, The Netherlands, but is now with the Corporation for National Research Initiatives (CNRI) in Reston, VA. van Rossum, who still works on Python, is assisted by countless worldwide library and module contributors. Python is available for most popular operating systems, including UNIX and Microsoft Corp. Windows.

If it's not already on your system, you can pick it up from the official Python source, the Python Software Activity (PSA) Web site, at `http://www.python.org`. Python is free and comes with excellent documentation.

Figure 1 shows a Python script that will send a form and process the reply. This is possible because the initial request does not include the encoded reply variables. If the script doesn't see any variables it knows to send the form. Figure 2 shows what this form will look like with a Web browser.

Notice we haven't done anything with the client's response except copy it to a file. You probably want to do more, but that's where the danger lies. Suppose we want to send an automated email response, which seems simple enough. We might include the following routine to issue the message, using the submitted

value for our client's email address:

```
import os
def send_reply(email, subject):
os.system('/bin/mail -s ' + subject + email)
```

That will work if we have a nice client. But what if the nefarious hacker from `evil.com` enters this data as his email address?

```
nefarious@evil.com; rm *
```

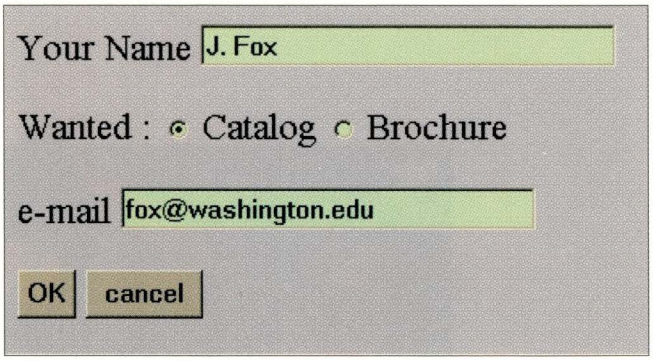
Notice it contains a standard email address with something that looks like a UNIX command following it. Using that bogus email address, you send the following command:

```
/bin/mail -s received bogus@evil.com; rm *
```

to a shell on your system, where it will be interpreted as two separate commands. The first sends mail; the second removes all files from the current directory. You see the potential for harm.

Never trust any data you receive from a client browser. If you merely write the information to the end of a file you should be safe because you can look at that file and respond by hand. If you must automate an action based on a form, check all values for legitimacy. I suggest you check each character for validity, rather than trying to scan a file for the invalid ones. This way, you are less likely to overlook something.

Figure 2. Example Form



The Python script used to create this form will send the form and process the reply.

Incidently, if you're as enamored with Python, as are some of my colleagues, consider attending the 7th International Python Conference to be held November 10-13, 1998, at the South Shore Harbour Resort in Houston, TX. That's the cool, non-hurricane season (see the PSA Web site for details).

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`.

by John S. Quarterman

HARRY BARTLETT

A Historic Conference

A historic conference about the Internet was held in July. Even if it had accomplished nothing, it would still have been historic because of the diversity of the attendees. But, I do think it accomplished a few things.

The Global Internet Alliance Workshop (GIAW), held July 1 and 2 in Reston, VA, was the first in a series of three conferences coordinated by the International Forum on the White Paper, or IFWP (`http://www.ifwp.org/`), an ad hoc coalition of professional, trade and educational associations representing Internet groups from around the world.

I was an active participant at the conference, and my point of view is, I hope, evident in this report. I have, however, made every effort to provide pointers to Web pages where you can find more information on all sides. For example, see `http://www.domainhandbook.com/giaw.html`, the conference handbook, and `http://www.scup.org/ifwp/`, which contains photographs taken during the conference.

The workshop was prompted by the release of the U.S. government white paper on the Internet Domain Name System (DNS), which was the topic of my column last month (see "The U.S. White Paper on DNS," August 1998, Page 46). The white paper, docket number: 980212036-8146-02, entitled "Management of Internet Names and Addresses" was issued on June 5 by the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce (see `http://www.ntia.doc.gov/ntiahome/domainname/6_5_98dns.htm`). GIAW was intended to discuss the formation of the entity the white paper recommended to reorganize the Internet Assigned Numbers Authority (IANA).

The conference attendees included lawyers, programmers, representatives of trade associations, telecommunications companies, financial companies and media content companies, university professors, prospective new global top-level domain (gTLD) owners and many other parties. I counted 164 names on the attendee list; however, some only attended one day of the two-day conference, so the daily attendance was slightly less–more like 150. The number is impressive, given that we only had about three weeks notice of the event and there was no agenda until less than a week beforehand.

The diversity is more impressive. The short notice cut down on geographical diversity, but there were attendees from Malaysia, Hong Kong, Singapore, Mexico, Canada, South America and Europe, not to mention large groups from California and Texas, in addition to those attendees from the local Washington, D.C. area.

Legitimacy by Consensus

As noted in last month's column, IANA has a legitimacy in Internet governance that the U.S. government does not. How, then, does a workshop of this type acquire legitimacy in reorganizing IANA and in general Internet governance? The same way IANA did: by

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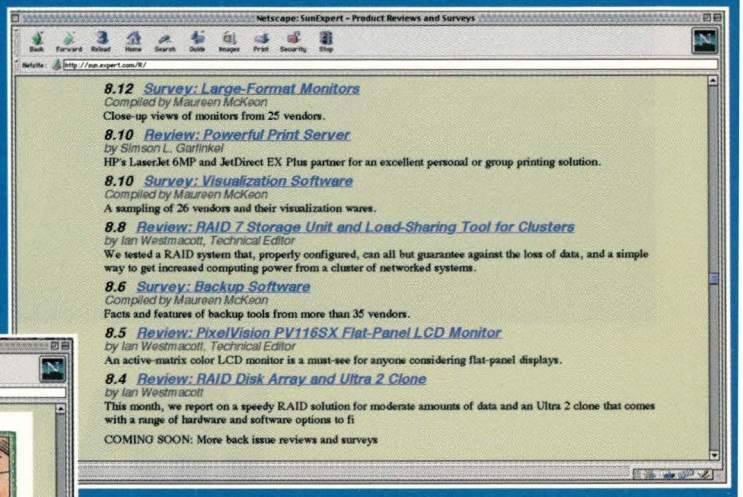

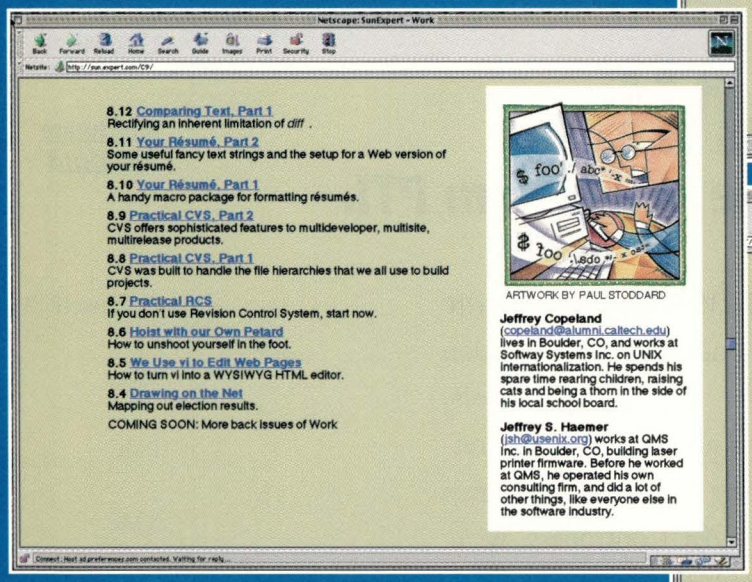

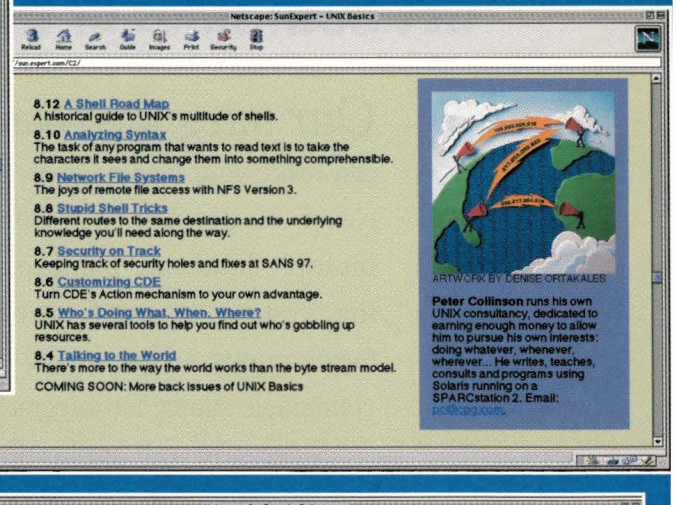

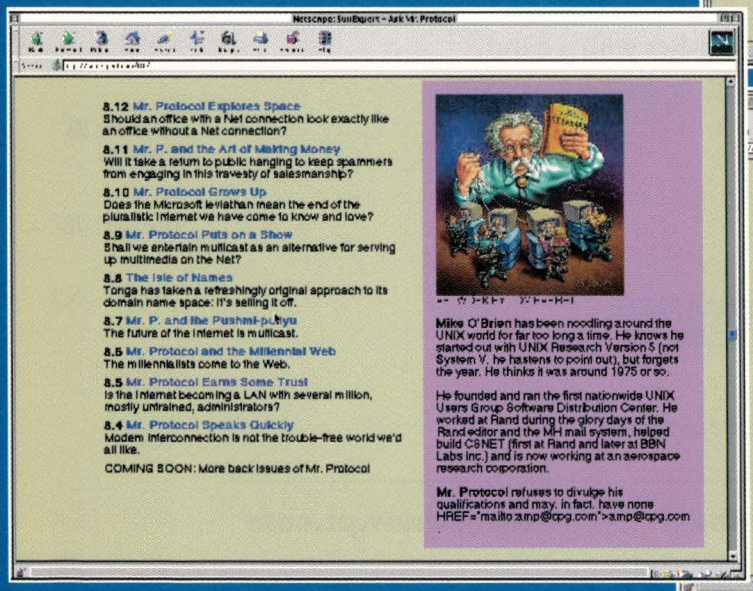

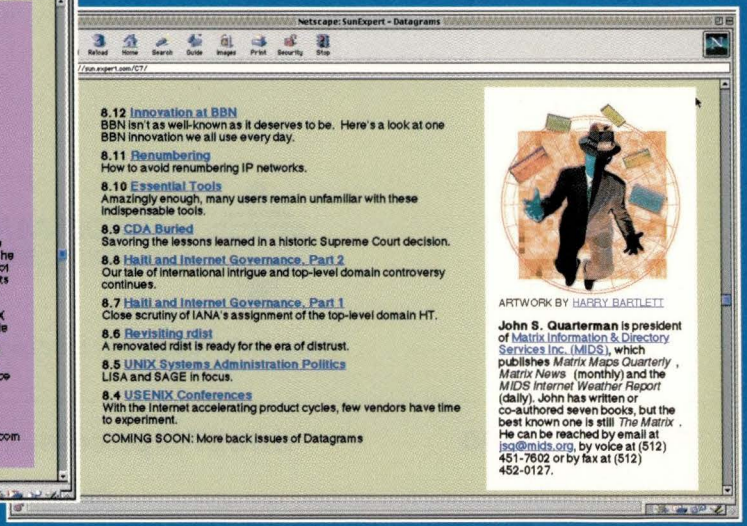

consensus of the Internet community.

The Internet community is much larger and more diverse than it was in the old days, but many elements of it were represented at this workshop. Numerous and diverse enough for this workshop in itself to represent the consensus of the Internet community? No.

Enough so that this workshop and the two follow-up workshops held July 24 and 25 in Geneva, and August 12 and 13 in Singapore–plus perhaps more workshops that may be scheduled in the future–can represent the consensus of the Internet community? Yes.

That was the IFWP process recommended by this workshop and I have not yet seen anyone take serious objection to it. If the IFWP process can succeed in its goals of openness and transparency, it may achieve the long-sought after goal of consensus on Internet governance.

Conference Agenda

The opening session consisted of a speech by Ira Magaziner, senior advisor for domestic policy to the president, summarizing the U.S. government's position, a statement from Jon Postel of IANA being read (see `http://www.iana.org/intforum1.html`) and a few words from Prof. Tamar Frankel, the conference chair. Then, Frankel announced we were going to immediately break into three smaller groups, as was scheduled (not without quite a bit of contention). Frankel supplied a lengthy paper for discussion (available on the GIAW Web site), and its major sections were the basis for the group topics. The three discussion groups for the first day were as follows:

A. Profile of the new entity
B. Board of directors and membership
C. Members' rights and liabilities

At the end of the day, the groups reported back to the main body. The second day's groups were as follows:

D. Implementation
E. Domain names and trademarks
F. Security and privacy

The subject of group D was a bit vague, but in practice it was a continuation of groups A and B, having to do with methods of appointment of the interim board. At the end of the second day, the groups again reported back to the main body. For example, group D reported a consensus that the interim board should not add any new gTLDs.

The main accomplishment of the discussion groups was to gain consensus on several items. The most important of these, from my point of view, were made in the report from group B. The very first item of consensus was that: "All processes must be open, fair and transparent at all levels."

As I said in front of the whole group at the end of the workshop, let's have no more steering group meetings that don't publish minutes and no more conference organizers handing off to others without telling anybody: transparency, transparency, transparency. (I was reminded later that Ira Magaziner had used the same phrase in his speech at the beginning of the workshop.)

Note that openness (participation by all parties) and transparency (visibility of all parts of the process) are not necessarily the same thing. In the case of transparency, perception is reality, in the sense that it doesn't matter how transparent the actual process may be if there is no perception of transparency. For example, it is not enough to permit everyone to comment. Comments must be acknowledged. The outcome of the current process isn't necessarily going to be open or transparent just because we want it to be, nor is it going to be accepted as such without a lot of work.

Internet Stakeholders

Group B also recommended that: "As a whole, the IFWP participants should act as the principle incorporators of the new organization." In other words, we can be considered stakeholders. There seems to be no definitive wording of this second consensus item. The word "stakeholders" has caused quite a bit of confusion because it is inherent of large incorporated organizations, and group B did not intend such a limitation. Here is a clarification from the conference notes for that group:

"We tended to agree, and this is the most difficult one to word so as not to disenfranchise anybody, as a whole the IFWP participants, and I'm talking this conference and all the conferences that will come from now, and even perhaps some that haven't been convened yet, will act or should act as the principle incorporators of the new corporation. At some point, you have to decide who the stakeholders are and at least the impression I got is, for now at least, we are the stakeholders. We need to define a broader group, but right now we're the stakeholders."

Even that clarification isn't clear because it does not explicitly mention online participants who don't attend a meeting. Christopher Ambler, identifying himself as "the reporter/moderator of that group," posted yet another clarification online:

"It was later clarified, after a question, that by 'IFWP participants,' group B intended to convey the concept of 'everyone at this and the two planned IFWP meetings, everyone at any other IFWP meetings that are convened, everyone at any other open-process meeting and everyone who participates online.' I suppose we left out anyone who submits their comments via carrier pigeon, so if anyone feels disenfranchised as a result, please let me know, and I'll make sure and add such a note to my summary of group B's progress."

An even more basic agreement was on consensus as the means of determining decisions in these groups. It wasn't universally applied; group B used it, but one of the other groups decided by unanimous vote. That other group was careful to choose only those results that got a unanimous vote, but that's not quite the same thing as consensus, because it means a single person can veto a result.

Many people at GIAW argued that the Internet Engineering Task Force, or

IETF (http://www.ietf.org/), process of rough consensus couldn't be applied to the current tasks or participants because the IETF has homogeneous participants and this process does not. Yet a lot of what I saw happening in group B, and the above recommendations from group B, look a lot like the IETF process. Everyone had a chance to speak; everyone who spoke was heard; no consensus was reported if there were many objections; yet a single objection was not enough to prevent a consensus. For that matter, the IETF may not be as homogeneous as some nonIETF participants seem to think.

I also think everyone should remember that the IETF process was a large part of the reason why we now have the Internet, which has grown at a higher rate (almost doubling annually) for a greater period of time (10 years) than any other technological medium in history, incorporating many new participants as it grows; the same Internet that so many people now want to control.

Appointing Council

Group B struggled with the list of stakeholders from the white paper. Much of the discussion focused on how to make a 15- (or any small number) member board of directors representative of a long list of stakeholders that would reflect regional interests. After a few hours, everyone seemed to agree it was impossible because of simple arithmetic. The approach then tried was to have the board appoint a set of three councils: one for IP address issues, one for domain name issues and one for protocol issues. The existing regional IP address assignment organizations–namely Réseaux IP Européens, or RIPE (http://www.ripe.net/), Asia Pacific Network Information Center, or APNIC (http://www.apnic.net/), and the American Registry for Internet Numbers, or ARIN (http://www.arin.net/), would fit under the IP address council. The existing Internet Architecture Board, or IAB (http://www.iab.org/iab/), along with the IETF would be the protocol council, and IAB and IETF would continue doing the same things they have always done. The board of directors of the new entity would oversee these councils. This council structure is very similar to the one suggested by IANA's Postel.

There was also much wrangling over whether to concentrate on the composition of the interim board, which would then handle the rest, or to carefully constrain the interim board and not worry so much about who was on it. The consensus seemed to be on the latter approach.

Trademarks

On the second day, group E met to discuss domain names and trademarks. The group was divided into (at least) two distinct camps. Even characterizing the two camps is tricky,

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and I'm sure that I can't do it accurately because I didn't attend that group. But perhaps a simplistic description would be: Those for an assumption that domain names are appropriate for trademarks and those for trademarks to be considered as a legal issue distinct from domain names. Group E was unable to reach a consensus. One item the group members did agree on was to allow for the creation of various rapid alternative dispute mechanisms–different organizations could provide different dispute mechanisms. The other item of consensus was that there are legitimate rights to domains other than trademark rights. Possibilities might include a company name, a person's surname and parody or political speech being used as a domain name. This may seem so obvious as not to need saying, but apparently it does.

I continue to assert (as I did before and during the meeting) that trademarks did not belong on the agenda for GIAW. GIAW was supposed to discuss the new IANA entity, not details of dispute policies.

I wasn't particularly surprised that the trademark lawyers in attendance mostly reiterated their positions, most notably, greater rights for trademark holders in the Internet than in other domains. (Although I was a bit surprised at the lengths at least one of them went to to avoid listening to other opinions, which included twisting in the chair to turn away from anyone who expressed another opinion.) The sad surprise to me was the number of Internet old-timers who were willing to concede everything to large trademark holders. Why? The best reason I got from them was because they believed eventually there would be a court case that would rule in favor of the trademark side and against any structure we had built that did not already concede to them. Such opinions were often expressed by technical people who were not lawyers; the lawyers present who were familiar with both the technology and trademarks did not tend to say such things.

I will probably write a separate column on the trademark issue, but for now let's end the topic with this quotation:

"I know no safe depository of the ultimate powers of society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion by education." – Thomas Jefferson, September 28, 1820
(Thanks to Peter Rony for finding and posting this quotation.)

Organization (or Lack of)

This was not the best organized conference it has been my pleasure to attend. This is a rather sore topic for many of the attendees (and nonattendees). The root of the problem was the short time interval between the June 5 release of the U.S. Commerce Department white paper and the September 30, 1998, target date it specified for the formation of the new corporation with an interim board.

The proximate cause was extended to infighting among various factions, including a stated intention by one party to "overwhelm" the workshop, combined with inexperience on the part of the organizers. Having spent a lot of time on this organizational subject before and during the conference, I don't want to spend much more on it here. As near as I can tell, no single faction managed to overwhelm, dominate or warp the workshop.

So let's use just one example of inexperience to give the flavor of it. While we were shuffling around choosing groups, Frankel took the microphone again to announce that all members of the press should leave, so that the participants could speak freely. There was nothing about this press exclusion on the GIAW Web pages or in the handouts. She arrived at this decision on the spur of the moment, with no discussion with anyone.

I have to admit I wasn't paying attention to what she was saying, and it didn't sink in until I realized Mikki Barry, president of the Domain Names Rights Coalition (`http://www.domain-name.org/`), muttered, "She threw Gordon Cook out!" Cook writes an online newsletter called the *Cook Report* (`http://www.cookreport.com/`). He's been a fixture in the Internet community since the 1980s. He's clearly a participant, not an outsider. When I mentioned this to Frankel, she said she had been told that, but had stepped aside from making such decisions. I told her it was very strange that she would throw him out and not take responsibility for inviting him back in. She nonetheless refused to do so, and she directed me to a group of people who were outside with Cook. I told her that if she threw him out, she would have to throw me out. Dave Farber, the Alfred Fitler Moore Professor of Telecommunication Systems at the University of Pennsylvania, noted that he also edits a publication. Don Heath of the Internet Society (`http://www.isoc.org/`) agreed that his organization publishes more than one periodical, so he would also qualify.

Tony Rutkowski (`amr@netmagic.com`) asked the participants if there was any objection to reporters being present as long as they did not quote for attribution. There was no objection, and Cook and the rest of us rejoined the workshop. Meanwhile, an hour of everyone's time had been wasted for nothing. The next day, the same subject came up again and was not fully disposed of until the participants asked Frankel for the final word, which was that reporters were welcome as long as they did not quote for attribution. Note that they asked Frankel, even though she claimed to have stepped aside from making such decisions. Power, once acquired, cannot be abdicated easily without agreement from those who gave it.

I don't consider the above anecdote to fall under the non-attribution agreement, because it was about that agreement. I also don't mean to unduly criticize Frankel, who readily admits she is not a conference organizer. I think that if she had been paired with a professional conference organizer, many such glitches could have been avoided. I hope future workshops avoid this problem.

On the Internet Grapevine

There are rumors circulating that IANA's Postel has already appointed an IANA Transition Advisory Group (ITAG) that's proceeding to implement the white paper. While it is understandable that he would want a group of advisors in these trying times, we hope ITAG isn't making final decisions. The sense of the GIAW attendees on this

subject was pithily summarized by one person: "If the fix is in, please stop wasting these people's time."

An unsigned news story appeared shortly after the conference claiming that: "A United States Postal Service proposal to take control over the .US domain gathered support at the Global Internet Alliance Workshop (GIAW) conference in Reston, VA, today [July 2, 1998]" (http://www.internetnews.com/bus-news/1998/07/0203-postal.html). No such item was on the agenda, and no such item was reported from any of the discussion groups. It is documented that Postel has been discussing handing over .US to the U.S. Postal Service, but this workshop neither discussed nor supported such a move.

Interestingly enough, the story that appeared in the above URL was replaced a few days later with a completely different story that lauds the workshop for going smoothly and mentions in passing that, "A proposal from the United States Postal Service regarding control of the .US domain was not formally discussed, as reported earlier."

Follow-On Meetings

The GIAW meeting in Reston, VA, made recommendations that were handed on to the next meeting, which was held on July 24 and 25 in Geneva, Switzerland. The Geneva meeting, just completed at press time for this column, built on the Virginia recommendations and produced a reasonable consensus, despite more ham-handed organization from the steering committee.

In between, there was a separately-organized meeting held in Brussels, Belgium, previously called by the European Union. That meeting also handed on some recommendations to the Geneva meeting, which, to use the European term, "harmonized" them with the first GIAW recommendations. The Geneva meeting handed on to the third scheduled IFWP meeting, held August 12 and 13 in Singapore.

Meanwhile, the Argentine chapter of ISOC held an "informational" meeting in Buenos Aires on August 20 and 21 (see http://www.cabase.org.ar). At least a dozen of the attendees at the first GIAW meeting went to the workshop in Geneva and a somewhat smaller number indicated they would also attend the conference in Singapore, so there is some continuity.

It appears that so far the IFWP process is turning out to be not nearly as bad as it could have been, and thanks to the efforts of the many participants, it even shows signs of possibly producing a real and sufficiently complete consensus in time for the September 30 deadline.

We'll see. I hope it works. We're running out of chances to get it right.

***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 co-authored 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.*

by Jim DeRoest

DANIEL C. O'CONNOR

Hardening AIX Security

It wasn't that long ago that I broached the subject of system security (see "Passwords–Keep 'em off the Wire" and "Keeping Watch over the Flock," February and March 1998, pages 66 and 77, respectively). Yet, here I am, once again pounding the security pulpit. Network hacking and probing incidents are definitely on the rise. I believe this is largely due to the computer gaming persona acquired by this kind of activity. We've got game show-like challenges from the vendor community, offering cash prizes to anyone who can break their products' security. There are glitzy yearly gatherings and conferences that cater to the hacker community such as DEF CON (see Table 2). Web sites like `http://www.rootshell.com` offer a variety of hacking FAQs and plug-and-play toolkits tailored to get anyone started probing the network like a pro. Yes, you too can be a hacker. It's easy to get started. No experience required.

Hacking is a fact of life on the Internet. We, as systems administrators, need to be aware of this and take steps to address the problem. This means staying informed, communicating with one another and ensuring that the systems we manage are secure. Most of the incidents here at the University of Washington are due to computers that have not been properly secured. Often, these systems are setup using the default set of services and then put in a corner and forgotten. So what I'm offering this month is a set of tables, checklists and glossaries that I hope will assist novice systems administrators in securing their environments. There's no guarantee they will keep your systems hacker free, but they should reduce the level of exposure and provide avenues for gaining additional information.

System Security Checklist

The following is a list of things you can do to improve the security of your AIX-based computers. Although they address AIX configuration issues, the following procedures can be extrapolated to other UNIX environments:

Maintain current service levels – The first order of business after installing a clean copy of AIX is to apply the latest security patches to the operating system. You can download current fix sets using the FixDist tool from IBM Corp.'s technical support site (`http://service.software.ibm.com`).

FixDist is an FTP interface tool that allows you to search and request patches from the AIX product maintenance database by keyword, Program Temporary Fix (PTF) number or Authorized Program Analysis Report (APAR) number. FixDist will ensure that all requisite fixes are included with each patch level selected for download. A companion tool called TapeGen can be used to collect and stack fix sets onto media that can then be read by System Management Interface Tool (SMIT). A simple way to keep informed regarding problems and fixes is to subscribe to IBM's problems summary fax service (1-800-IBM-4FAX).

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Figure 1. TCP Wrappers /etc/inetd.conf Entry

```
ftp     stream tcp nowait root /usr/sbin/tcpd /usr/sbin/ftpd ftpd
telnet  stream tcp nowait root /usr/sbin/tcpd /usr/sbin/telnetd telnetd
login   stream tcp nowait root /usr/sbin/tcpd /usr/sbin/rlogind rlogind
```

Figure 2. Alternative Authentication Method

```
/etc/security/login.cfg

    method_name:
        program=your_program

/etc/security/user

    auth1=method_name
```

intended role. By default, AIX will automatically start a common set of service daemons associated with a given subsystem type. For example, the TCP/IP subsystem will enable service daemons such as `ftpd`, `telnetd`, `rlogind`, `rexecd`, `rshd` and `sendmail`. You may not need all these services if the machine is to be used only as a mail server. Each additional service could expose additional interfaces to probing and hacking. Check the following configuration files to verify and eliminate any services that aren't required:

```
/etc/inetd.conf
/etc/tcpip
/etc/inittab
/etc/rc.net
```

Wrap it up – Use a filter program like "TCP Wrappers" to restrict and log access to the services you offer (see Table 1). TCP Wrappers is an easy-to-use application, which allows you to restrict access to services by domain name and IP address. Specify which services to monitor by adding an additional field in the `/etc/inetd.conf` file that invokes the `tcpd` service (see Figure 1). Access controls for individual sites are then listed in the `/etc/hosts.allow` and `/etc/hosts.deny` files.

Limit access channels – It's always an uphill battle arguing for or against restricting access to servers. A compromise must be made between convenience for support purposes and maintaining tighter security. Restricting logins solely to the system console can be problematic in situations requiring off-site connections for troubleshooting. Conversely, vanilla `telnet` or remote shell logins are subject to network eavesdropping. In situations where console-only access is not mandated, enforce the use of secure channel tools such as the Secure Shell (Ssh) when accessing a server from a remote site. Ssh can be used with Telnet, "r"-commands and X11 (see Table 1).

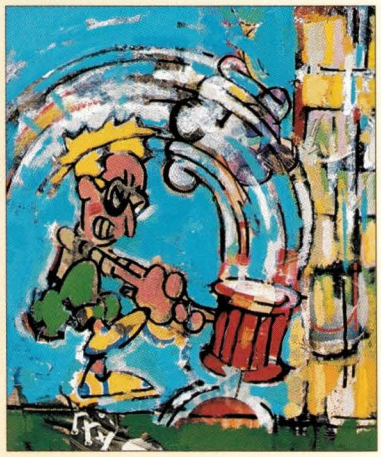
Minimize the number of accounts and groups – Limit access and permissions to only those users who actually require access to the system. Avoid the temptation of mirroring `/etc/passswd` and `/etc/group` files across systems to simplify administration tasks. For multiuser environments, consider implementing account expiration policies related to use.

Enforce password rules – Everybody likes a password that is easy to remember. Unfortunately, this is the Achilles' heel of many a system. AIX provides a nice table-driven set of controls for enforcing the use of passwords across your systems. These security controls can be defined as either systemwide defaults in `/etc/security/login.cfg` or on a user-by-user basis in `/etc/security/user`.

AIX stores its password and group information across a set of files located in both the `/etc` and `/etc/security` directories. It's a good idea to periodically check the consistency of these files using the `pwdck`, `grpck` and `usrck` commands. Validate the security of password name space by running it through one of the common password cracker programs listed in Table 2 and Table 3.

Alternative authentication methods – You might want to consider augmenting your account/password authentication methods by including secondary authentication such as the use of a smart card or PIN number. You can define alternative authentication methods in the `/etc/security/login.cfg` file. Designate the method with a unique stanza name followed by a `program=` field, which identifies the path to the method program. You can then select an alternative (or additional) authentication method either as a systemwide default or on a user-by-user basis by including the stanza name in the `auth1=` and `auth2=` fields of the `/etc/security/user` file (see Figure 2). Another option would be to replace the default authentication method with Kerberos, Distributed Computing Environment (DCE) or a one-time password system such as S/Key (see Table 1).

In situations where console-only access is not mandated, enforce the use of secure channel tools when accessing a server from a remote site.



Permissions and setuid – A nice feature of the AIX file system architecture is that you can restrict use of the setuid bit on a per-file-system basis. You might consider eliminating setuid on `user` and `temp` file systems. It's also a good idea to regularly scan your file systems for world writeable files. You can use a tool like the COPS package listed in Table 1, or invoke the `find` command from a nightly `cron` job. For example,

```
find / -perm -0002 type f -o -type d  -print
```

Don't relay packets – Unless your system is acting as a router or gateway, don't forward packets. This will help prevent the proliferation of spoofed IP packets. Spoofed packets contain bogus source IP addresses to either hide the identity of the sender or masquerade as a legitimate host on your network. Enter the following commands from the command line:

```
no -o ipforwarding=0      Turn off IP forwarding
no -o nonlocsrcroute=0    Turn off source routed forwarding
```

It's also a good idea to turn off response to broadcast pings (see command below). These can be used to flood a network with traffic by denial of service attacks.

```
no -o bcastping=0         Turn off broadcast ping response
```

Don't relay mail – Most people consider anonymous mail spamming to be a form of network hacking. Keep your systems from participating in anonymous mail relaying by making certain your `sendmail` service doesn't forward mail that does not have either a sender or recipient address corresponding to your domain. You can do this by checking for your domain name in the `sendmail` rule sets defined in `/usr/lib/sendmail.cf`.

Web servers – Make sure your Web server runs in `chgroot` mode on a separate file system to restrict Web access to other operating system files and directories. If you support the use of CGI scripts, then check arguments carefully for escape character sequences that may provide access to other operating system commands.

Event logging – Archive and monitor the system logs created by the various AIX subsystems. Whenever possible, use the `syslogd` daemon to route log events to a single secure machine dedicated to maintaining log information. This will minimize log tampering by individuals who cover their trails and it will allow you to monitor multiple computers from a single site. Syslog configuration is recorded in the `/etc/syslog.conf` file:

```
*.debug @log-archive.domain    Send debug events
                               to log-archive
```

Other important logs to monitor and archive include:

```
/etc/security/failedlogin      Failed logins
/var/adm/sulog                 Set user ID requests
/var/adm/pacct                 Command and process activity
/var/adm/wtmp                  Connect time information
/etc/utmp                      Connect time information
```

Auditing – Periodically check the integrity of your system by invoking the AIX Trusted Computing Base (TCB) auditing system. You can use the `tcbck` command to do an extensive examination of the overall operating environment according to the event types listed in the `/etc/security/sysck.cfg` file:

```
tcbck -p ALL    Audit full system environment
```

Table 1. Security Toolkit

- Computer Password and Oracle System (COPS)

`ftp://ftp.cert.org/pub/tools/cops`

This is a longtime staple application for auditing UNIX security and integrity.

- courtney

`ftp://ciac.llnl.gov/pub/ciac/sectools/unix/courtney`

Detects Security Administrator Tool for Analyzing Networks (SATAN) network probing.

- crack

`ftp://ftp.cert.org/pub/tools/crack`

An age-old password-guessing utility. Use the NIS `mrgpwd` command to convert the AIX `/etc/security/password` file before running crack. A callable library version called "cracklib" is also available to be used as a password validation method.

- gabriel

`ftp://www.lat.com`

A SATAN probe detector.

- lsof

`ftp://aixpdslib.seas.ucla.edu`

A nice utility that lists processes with open files and sockets.

- S/Key

`ftp://thumper.bellcore.com/pub/nmh`

Single-use password system.

- SATAN

`ftp://ftp.win.tue.nl/pub/security`

Nice tool for checking network and NFS security. Easy-to-use Web interface.

- Secure Shell (Ssh)

`http://www.cs.hut.fi/ssh/`

Secure communications channel for Telnet, FTP, "r"-commands, X11 and so on.

- TCP Wrappers

`ftp://ftp.win.tue.nl/pub/security`

A great middleware tool for filtering and logging connections to your system. This is a must-have application for any UNIX environment.

- tiger

`ftp://ftp.tamu.edu/pub/security/TAMU`

Another lean and mean security validation tool.

- tripwire

`ftp://ftp.cert.org/pub/tools/tripwire`

A system auditing tool similar to COPS and the AIX Trusted Computing Base (TCB) auditing system.

Table 2. 'Black Hat' Info

- Alt2600
  `http://www.2600.com`
  Newsgroup and magazine for discussing system, network and telecommunications hacking.
- Chaos Computer Club
  `http://www.berlin.ccc.de`
  German group devoted to providing hacking information and tools.
- DEF CON
  `http://www.defcon.org`
  Yearly gathering of hackers and security experts.
- Hack FAQ
  `http://morehouse.org/bin/hackfaq.htm`
  Information on how to get started in the hacking world.
- LOpht Heavy Industries
  `http://www.l0pht.com`
  Contains hacking information and tools.
- Phrack Magazine
  `http://www.phrack.com`
  Home to one of the oldest known groups devoted to hacking information.
- Rootshell
  `http://www.rootshell.com`
  Large Web site with listing of hacking tools.

Table 3. 'White Hat' Info

- Bugtraq
  `http://www.geek-girl.com/bugtraq/`
  UNIX and Windows NT security advisory list.
- CERIAS/COAST
  `http://www.cerias.purdue.edu`
  Center for Education and Research in Information and Assurance Security/Computer Operations Audit and Security Technology at Purdue University.
- Computer Emergency Response Team (CERT)
  `http://www.cert.org`
  Featuring security advisories, bulletins and support.
- President's Commission on Critical Infrastructure Protection (PCCIP)
  `http://www.pccip.gov`
  Users can advise and assist President Clinton by recommending a national strategy for protecting and assuring critical infrastructures from physical and cyber threats.
- RFC 2196, 'Site Security Handbook'
  `http://www.ietf.org`
  The Internet Engineering Task Force (IETF) handbook on security procedures for systems administrators.
- SANS Institute
  `http://www.sans.org`
  This site includes a security newsletter and support information.
- Security World Wide Web Site
  `http://www.alw.nih.gov/Security/security-www.html`
  Index of security Web site links.
- The U.S. Department of Energy, Computer Incident Advisory Capability (CIAC)
  `http://ciac.llnl.gov/ciac/`
  Featuring security advisories, bulletins and support.

Virus scan – AIX provides a virus scanning application called "virscan." The `virscan` command reads a set of known virus signatures from the `/usr/lib/security/scan/{virsig.lst,addenda.lst}` files. These signatures are bit strings that may be found in system files and executables.

In order to be effective, you will need to keep the virus signature information up-to-date (check the IBM software support site for updated signature lists):

`virscan` *<PathName>* Invoke virscan on a directory tree

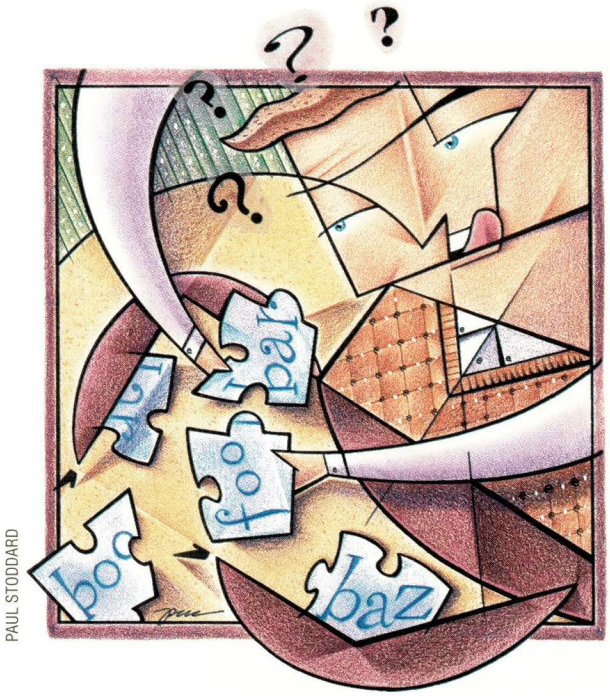
Try a Bit of Hacking Yourself

The best way to verify that your system is secure is to use the same tools used by those network miscreants, hackers. Table 2 lists a number of sites where you can obtain informational FAQs and toolkits for cracking networks and computers. Table 3 lists information and tools for detecting intrusion attempts and improving the overall security of your environment.

Make sure you stay informed. This includes monitoring the various security newsletters and advisories available to systems administrators and communicating with your peers. I'd also recommend that you read a couple of excellent articles on known system and network vulnerabilities and what you can do to limit your exposure to them. The first article, entitled "Trends in Computer Attacks" by Elias Levy, appeared in the May 1998 issue of the USENIX Association's *;login:* newsletter (see `http://www.usenix.org/publications/login/contents/contents.may98.html`). A similar article, entitled "Security Loopholes," by Lisa Jaworski can be found in the May 1997 issue of *UNIX Review*. Remember, the old adage about the "weakest link in the chain" applies equally well to network security. ➸

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`.

by Jeffreys Copeland and Haemer



PAUL STODDARD

Puzzle Posters

All work and no play makes Jeff a dull boy.
– Jeffs

In the past two weeks we've gotten a lot of new machines in our office. Even after they were installed and, mostly, working, they had a few lingering problems. The most persistent problems involved email and, for a variety of reasons, we were stuck with the job of solving them; this is not we hasten to add because we know anything about email.

We quickly became frustrated and did what we often do when we can't solve a problem: We procrastinated by reading Usenet news.

Here's what happened next:

First, we perused `comp.lang.perl.misc`. Among the threads was a flame war initiated by Tom Christiansen, who posted an article stating his views that a) Perl is a glue language, b) any demand that a problem be solved entirely in Perl is misdirected and c) many posters' problems could be solved by installing an operating system from a source other than Microsoft Corp. You can imagine the sorts of responses this generated.

Christiansen is, among other things, the asbestos-coated author of major chunks of the Perl online documentation and coauthor of some key books on Perl. His Web site, `http://www.perl.com`, is a fine starting place for all things Perl-related. Whether you agree with his views or not, he's hard to trivialize.

Skipping past this, we found an interesting puzzle posted by Tim Bunce (see below).

```
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
```

We considered a couple of simple-minded solutions, which didn't work. Then we tried a couple of other fixes to the mail problem, which also didn't work. So we went back and read some other responses to Tim's puzzle, which also didn't work. Then, we read one posted by Nathan Torkington, to wit:

```
Tim.Bunce@ig.co.uk (Tim Bunce) (Tim Bunce) writes:
> The problem is to find the full list of names and the
original order.

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!

Tom^WNat
:-)
```

Figure 1. The Tools Approach

```
1   #!/usr/local/bin/perl -wl
2   # $Id: tbpuzzle,v 1.2 1998/06/26 14:02:11 jeff Exp $
3   use strict;

4   die "usage: $0 [filename]\n" if grep /^-./, @ARGV;

5   my $right_of;

6    # $right_of->{X}{Y} is
7    #  Y_right_of_X - X_right_of_Y
8    #
9    # A positive value means that Y is usually to the
10   #  right of X, #  and we'll infer that this was
11   #  the original order.

12  while (<>) {
13   my @message = split;
14   for (my $l = 0; $l < @message; $l++) {
15    for (my $r = $l+1; $r < @message; $r++) {
16     ++$right_of->{$message[$l]}{$message[$r]};
17     --$right_of->{$message[$r]}{$message[$l]};
18    }
19   }
20  }

21  open TSORT, "| tsort" or die "can't open '|tsort' \n";

22  foreach my $l (keys %$right_of) {
23   foreach my $r (keys %{$right_of->{$l}}) {
24    print TSORT "$l\t$r" if ($right_of->{$l}{$r} > 0);
25   }
26  }

27  close TSORT or die "can't close '|tsort' \n";

28  =head1 NAME

29  tbpuzzle - solve the Tim Bunce puzzle
```

For more on Nat, see the biographical material in *Perl Cookbook* by Tom Christiansen and Nathan Torkington, O'Reilly and Associates Inc., 1998, ISBN 1-56592-243-3.

Laughing, we realized that although Nat was teasing Tim, he was right. We, like the other posters, were trying to do a stand-alone solution, when the tool to solve the problem was already available: `tsort`. (If you've never used `tsort`, be patient; we'll talk more about it next month. For now, we'll say that `tsort` produces a single list from a collection of ordered pairs. Each input pair, *[X,Y]*, says *X* must come before *Y* in the final list. This is called *topological sorting*. See the man page on your system for more details. You don't have a man page for `tsort`? Go back and read Nat's message.)

We wrote a few lines of code to solve the problem and sent them off to Tim with copies to Nat and Tom for their amusement. Reasoning that when *X* precedes *Y* in the original list it will still precede *Y* in most garbled messages, we simply order each pair of words, then pipe the result to `tsort`. The next day Tim replied, confessing that Nat had been right for another reason–he really did need an all-Perl version because he needs to run the script on a Microsoft operating system, which has no `tsort`. "That should be easy to write," we said, foolishly, and told him we'd send him a Perl version of `tsort`. We spent some time tying ourselves in recursive knots, trying to write a simple topological sort. Next to this, the email problem looked easy, so we solved that instead.

After we gave up trying to write `tsort` ourselves, we searched the Web and found little more than man pages. (A Python implementation is provided at `http://www.pythonpros.com/arw/kjbuckets/tsort.py`. It requires a special Python extension module for graph operations, which we would have had to get and then translate.) Completely frustrated, we finally consulted our bookshelf. (Remember books?) Our copy of Knuth is missing, so we looked at Jon Bentley's *More Programming Pearls* (Addison-Wesley Publishing Co., 1988, ISBN 0-201-1189-0), and it had what we needed–note the spelling of "Pearls." His chapter on associative arrays reviews and implements topological sorting in less than four pages. That evening, we read the explanation and wrote a version in Perl. The next morning, we came to work bright and early, typed in the code and mailed it to Tim.

So before we launch into code, we think it's worth pointing out the unexpected moral to this story: using a tools approach sometimes keeps you from having to reimplement the wheel. But even when you *have* to reimplement the wheel, a tools approach can break problems into simple pieces.

The Solution

In the rest of this column, we'll talk about the first part of the solution. Figure 1 includes our tools-oriented solution.

Lines 1 and 3: Use the default `-w` flag to gener-

```
30  =head1 SYNOPSIS

31    tbpuzzle [filename]

32  =head1 DESCRIPTION

33  =over 2

34  Solves this puzzle, posed by Tim Bunce, <Tim.Bunce@ig.co.uk>
35  in B<comp.lang.perl.misc>:

36  A list of names in a specific order is given to a set of
37  messengers in a remote land.

38  The messengers travel independently to a destination where
39  they give the names to you.

40  The problem is that the messengers tend to be forgetful:
41    They often miss out one or more names (but not all).
42    They occasionally get the order wrong.
43  (The only significance is that most of the messages will
44  have the right ordering of names.)

45  Names are never repeated or changed, only missed or reordered.
46  You don't know how long the original list of names was and
47  it's possible that all the correctly ordered messages are
48  missing one or more names. (The messengers always think
49  they've got it right.)

50  For example:

51    Original list:    foo bar baz boo

52    Messenger A says: foo bar boo     # bar missing
53    Messenger B says: bar boo baz     # reordered

54    Messenger C says: foo bar baz boo # complete
55    Messenger D says: boo foo bar baz # reordered
56    Messenger E says: bar             # foo baz boo missing
57    Messenger F says: foo baz boo     # bar missing
58    Messenger G says: foo bar baz     # boo missing
59    Messenger H says: baz boo         # foo bar missing
60    Messenger I says: bar boo         # foo baz missing

61  The problem is to try find the full list of names and the
62  original order as far as is possible.

63  =head1 OPTIONS AND ARGUMENTS

64  =over 8

65  =item B<filename>

66  Optional input file.
67  Input format is one list of white space-separated
68  names per line.

69  =back

70  =head1 AUTHOR

71    Jeffrey S. Haemer, <jsh@boulder.qms.com>

72  =head1 BUGS

73  Assumes that "reorderings" are only minor disruptions of the
74  original order, not, for example, inversions.

75  =head1 SEE ALSO

76  tsort(1)

77  =cut
```

ate warnings and the lint-like `strict` module to cut down on unintentional errors that even a program can see (line 1 also uses the `-l` flag to automate end-of-line processing). Line 2 is the Revision Control System (RCS) ID. We're not just the presidents of the "RCS Club for Men," we're members.

Lines 5 through 11 set up a pointer to a doubly indexed hash, the meaning of which is explained in the comment. (Yes, yes. We confess that we should say this is a reference to a hash of references to hashes and that `$right_of->{X}{Y}` is just syntactic sugar for `${${$right_of}{X}}{Y}`. If Perl can have syntactic sugar, so can English. (Historical exercise: Who invented the term "syntactic sugar"?)

Lines 12 through 20 read in one line at a time and then use this doubly indexed hash to keep track of how often each element occurs before each of the other elements. Every time we find *X* to the right of *Y*, we increment `$right_of->{X}{Y}`, and every time we find *X* to the left of *Y*, we decrement it. Note that `$right_of->{X}{Y}` will be positive if and only if *X* is found to the right of *Y*, more often than not. This is really quite a robust statistic. It will work so long as the "frequent" deletions leave each pair of nodes represented somewhere in the input data set and the "occasional" rearrangements don't swap the order of any pair of nodes more than half the time.

Lines 21 through 26 pipe the results to `tsort`, which uses the individual, pairwise orderings to come up with an overall order.

Lines 28 through 76 are the man page in "plain old documentation," or pod, format. This is ignored by Perl, but can be processed by tools from the standard distribution into various formats from Web pages to UNIX man pages. Pod-style documentation lets us keep the documentation and the code in the same file, so they're less likely to get out of sync. Note that we've deliberately put an updated form of the original problem statement into the file, so that someone using the program doesn't need to read this column to understand the problem being solved.

Next month, we'll consider `tsort` and discuss why UNIX has one. Until then, happy trails. ⊸

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

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

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

Weed Your

Thread support, faster compilers and better database connectivity make this three-year-old language a weed killer for enterprise developers.

In the late 19th century, the Japanese vine kudzu was transplanted into the southern United States. Thanks to a preternatural growth rate that can reach one foot per day, kudzu now covers some 7 million acres, as well as thousands of houses, barns, trees, fences and abandoned cars. It has been derisively nicknamed the "mile-a-minute weed."

Microsoft Corp.'s Windows operating system, introduced to the U.S. computer industry in 1985, has behaved a lot like a high-tech version of kudzu, rapidly taking over the desktop market and, now, snaking its way into enterprise computing in the form of NT. And, just as many people in the South are irritated by the constant presence of kudzu, so too do many in the computer industry view Windows with a certain amount of annoyance. Southerners yearn for a way to slow the onslaught of their weed; UNIX aficionados long for an operating system that can halt the steady creep of Windows.

But unlike the "mile-a-minute weed," Windows may at last have a serious challenger.

Java, many believe, will not only slow the growth of Windows in corporate computing, but may even result in an evolutionary change in how enterprise applications are developed and deployed.

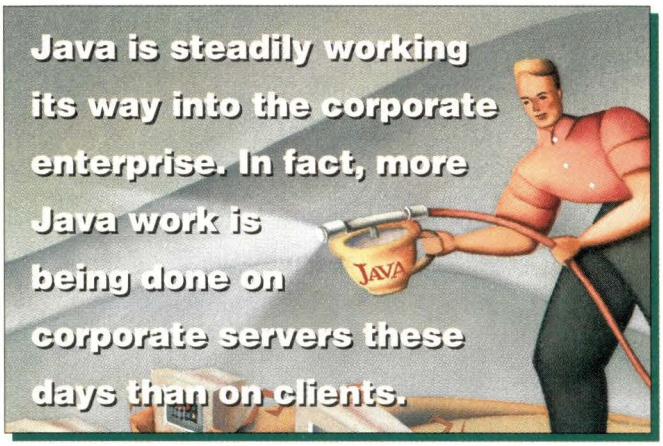
Created by Sun Microsystems Inc. in 1995, Java first took root in the industry as a way to liven up Web sites and, later, for creating mini-programs, so-called applets, that could be pulled out over the Internet. Today, Java has developed far beyond its

REBECCA RUEGGER

Code

by Suzanne Hildreth, Staff Editor

applet origins and is now being employed in a variety of enterprise applications. All told, Java is now used in more than 45% of U.S. companies, according to figures from International Data Corp. (IDC), a research firm based in Framingham, MA. By 2002, IDC predicts the market for Java applications will hit $1.86 billion, up from the projected $464 million this year. Similarly, Zona Research Inc., a Redwood City, CA-based Internet research firm, forecasts a tripling of the Java tool market, from $58 million to $180 million, between 1997 and 2000.



Despite the fact that Java is barely three years old, corporate IS departments are using it in a surprisingly wide variety of enterprise applications, many of which could not have been accomplished without one or more of Java's unique characteristics. For example, by the end of October, the 6,000 employees at the Ohio Department of Transportation (DOT) in Columbus, will be able to enter their time sheets and vacation requests into any of the department's 3,000 workstations connected to a Vines network from Banyan Systems Inc., Westboro, MA. That's because the DOT's new payroll and leave system was written in Java and, therefore, can be accessed from just about any available desktop. While employees will benefit from the convenience of being able to enter their personnel data from any Java-capable desktop, the DOT's IS department appreciates the rapid application development (RAD) qualities of Java and the JBuilder Java development tool from Inprise Corp., Scotts Valley, CA, it uses. Although this was the Ohio DOT's first Java project, the programmers were nonetheless able to finish the prototype in just three months–and the entire system in about twice that. "Our deadline to finish was May 4. That represented just six months from the time we started executing the project," says John Lavkulich, administrator for application services at the Ohio DOT.

In Memphis, TN, a Federal Express Corp. package sorting hub relies on a Java package from Vitria Technology Inc., Mountain View, CA, to transmit real-time shipping information to managers using a mix of Sun and Hewlett-Packard Co. workstations and Intel Corp.-based PCs. The Federal Express shipping managers are able to enter queries and receive updates on the status of any of the 1.5 to 2 million packages that pass through the hub each day. Dick Davis, manager of infrastructure design at Federal Express says the company briefly considered migrating to an NT system, but decided the Java-based application, Realtime Analyzer, running on an existing Sun Enterprise 5000 server, better met its needs both in terms of cross-platform compatibility and scalability. "With all the shipments we get in here each day, high performance is a very big requirement," says Davis. "We just weren't comfortable with the scalability of NT."

Daiwa Securities America Inc. in New York City is using Java to tie together its trading desks and back-end trade processing systems. Daiwa's director of information technology, Jeff Borror, says the heart of the system is a middleware product, the ActiveWeb Integration System from Active Software Inc., Santa Clara, CA, which uses JavaBeans-based agents to shuttle data between the front- and back-end systems. Daiwa is currently conducting a pilot test with the largest of the four back-end systems, running on a Cupertino, CA-based Tandem Computers Inc. mainframe. Three other back-office systems, running on a Sun E3000, an IBM Corp. AS/400 and a Windows NT server, respectively, will be brought in sometime in 1999.

As Daiwa Securities, Federal Express and the Ohio DOT illustrate, Java is steadily working its way into the corporate enterprise. In fact, more Java work is being done on corporate servers these days than on clients. A 1997 survey of mid-size, U.S.-based companies conducted by Zona Research found that 43% of commercial software development involves some type of Java project, and that 97% of those surveyed plan to deploy at least one Java application on the server.

Legacy Apps: Fertile Ground for Java

Java is unique in that it is both a platform, with its Java Virtual Machine (JVM) acting as a soft CPU, and a programming language. It is this dual nature that makes Java so attractive to many corporate IS managers.

As a hardware-neutral platform–capable of running on almost any CPU/OS combination, be it Solaris, AS/400 or Windows NT–Java offers a solution to the problem of what to do with legacy systems that are too costly to uproot and move to a new platform, but too important to abandon. Normally, the only option would be to keep existing systems going for as long as possible, while planning how to transplant the vast stores of data and applications to a new system sometime in the future. Java offers an alternative: An IS manager can create Java middleware to link the legacy databases and programs to the new systems. And because Java applications can run on any server or workstation with a JVM, much of the old hardware investments can also be salvaged.

Java's cross-platform portability offers a second bonus: the ability to develop and debug on one operating system and deploy on another. This allows developers to work on an application from any machine–be it UNIX or Windows. "I develop stuff on my 95 laptop and bring it in here to run on our Suns and HPs. It's a tremendous advantage when your design and development isn't restricted by your runtime environment," Daiwa's Borror says. In fact, Madison Cloutier, president of Tower Technology Corp., Austin, TX, which makes the TowerJ Java compiler and deployment tool, says many corporate programmers are developing Java applica-

tions completely independent of the eventual deployment platform. "We see a decoupling of development from deployment," Cloutier says.

As a programming language, on the other hand, Java has a number of advantages. Being a pure object-oriented language, it enables developers to produce applications in Java much faster than in C or C++. In addition, Sun has developed two Java component architectures–the JavaBeans and Enterprise JavaBeans (EJB) specification–for creating reusable objects or "beans." With enough beans on hand, a programmer could conceivably assemble a program without having to write more then a few lines of code.

Java's automatic garbage collection helps speed development as well. With C and C++, a lot of programming time goes into debugging memory management problems, such as memory leaks. Cloutier says it's not uncommon to see as much as 70% to 80% of a C++ programmer's debugging time spent on memory management. Java eases that problem via automatic garbage collection, which frees up memory held by unused objects for use by new ones. Automatic garbage collection doesn't completely solve the problem of memory leaks, but it does reduce it considerably.

"Developers tend to write better code, faster, so you can deploy applications faster," says Andrzej Jan Taramina, chief technology officer for Accredo Systems Corp., a custom application development firm based in Kanata, Ontario. And cleaner code, he adds, makes maintenance easier down the road.

Java's built-in networking capability is another benefit. Because Java is a brand-new language, developed alongside the Internet and local-area network (LAN)/wide-area network (WAN) technology, it has a good deal of network functionality embedded in its structure. "Java has built-in networking classes that let you work with socket connections or open hundreds of URL connections to a Web site. For instance, with just a couple of lines of code, you can open up a connection to any other machine on the Internet that's not behind a firewall," says Stephen Gower, president of Javaquariaum, a Java consulting company based in Cedar Falls, IA. "Java was built with the networked world in mind."

Daiwa's Borror used Java's networking and I/O features to develop a report printing program and credits Java with making it possible for him to complete it in just 10 hours, instead of several days. "It would take the average C programmer, who'd never done any file I/O, print I/O and network I/O before, about a week to figure it all out and then implement it on all the different platforms we have," Borror says.

In addition to basic network functions contained in the `Java.net` class, Java has a library of classes called `java.rmi`. Remote Method Invocation (RMI) enables a Java program running on one computer to access the objects and methods of another Java program running on a different computer on the network. RMI is suitable only for Java-to-Java communication, however, cross-language communication still needs to be conducted via the Common Object Request Broker Architecture

(CORBA). While the Java Developer's Kit (JDK) 1.1 doesn't include full support for CORBA, meaning that developers must purchase third-party Object Request Brokers (ORBs) to do the job, JDK 1.2–due out this month–will. JDK 1.2 will have both a CORBA API and a CORBA-compliant ORB for invoking Java objects.

Enterprise Java Nears Fruition

Despite its many advantages, the question still remains: Is Java fit for enterprise-level, mission-critical applications? The answer is a qualified "yes." Java has grown quite a bit in the past three years, and more so in the past three months. And many of the problems that have hampered Java's utility as an enterprise development language, namely performance, security and functionality, are disappearing.

PERFORMANCE: The number one reason most developers say they won't use Java is inadequate performance. Jason Mac-Entee, the new technology officer for the North Carolina DOT in Raleigh, is one such developer. A little over eight months ago, Mac-Entee evaluated Java's performance and wasn't happy with what he saw. "I believe I could've written the same application in Visual Basic and had it run a hell of a lot faster." While he is comfortable using Java on the client, he's not prepared to put Java to work in a server-side application–at least, not yet. "I'd seriously have to reexamine [Java] before I'd write any mission-critical applications with it," Mac-Entee says.

The truth is Java isn't fast enough yet for every enterprise application. Most experts agree programs that require a lot of CPU time–such as engineering analysis packages, data visualization programs or other computationally-dense applications–are going to be poor performers in Java. But for most other applications, Java is quickly approaching C and C++ performance. Anecdotal estimates by users of Java's current performance put it at around 60% to 80% of the performance of native C and C++ programs.

But, in the past six months or so, several factors have emerged to give Java a boost in speed. New just-in-time compilers (JITs) are improving performance by doing a better job of optimizing Java code at runtime, performing more intelligent and efficient garbage collection and providing support for multithreading. Support for native threads–something Sun added to its JVM for Solaris earlier this year–also speeds performance by mapping Java threads to individual Solaris kernel threads; in a many-to-many model, this enables Java programs to take advantage of the native multithreading model. Under the old model, Java threads were piggybacked onto a single native thread.

The real performance boost may come by the end of this year, when Sun has promised to release its HotSpot JIT. Currently in beta, HotSpot will use a faster garbage collection technique called generational garbage collection. Generational garbage collectors work by separating old objects from newly created ones and by only performing garbage collection on old objects. HotSpot will also improve on thread synchronization, enabling threads to execute more rapidly by analyzing and prioritizing threads, according to Frank Rimalovsky, Sun's product line manager for JDK releases.

In addition, HotSpot speeds performance through adaptive optimization. The HotSpot JIT analyzes the code before compiling it, selecting only the most performance-critical parts to optimize at runtime. Scott Stanchfield, an instructor with the MageLang Institute, a Java training firm based in San Mateo, CA, says he's seen early versions of HotSpot run Java code as much as two times faster than similar C++ code once the program has been loaded into memory. Programs running under HotSpot tend to take a bit longer to load because the virtual machine spends time analyzing the code for potential performance bottlenecks. But Stanchfield thinks the trade-off of a slower load time for faster overall application performance is worth it. "An extra second of waiting during load time isn't usually as noticeable as your program performing slower overall," he says.

But HotSpot isn't out yet and, in many cases, Java code doesn't quite perform up to par with comparable C and C++ code. To improve the performance of server-side applications, some developers are choosing to compile Java code down to native code. While that violates the write-once-run-anywhere credo of 100% Pure Java enthusiasts, it does offer a practical alternative to programmers who plan to run a program on only one or two platforms and, therefore, don't require Java's cross-platform capabilities. And it retains some of Java's cross-platform benefits, because the original byte code can be run as a 100% Pure Java application at some future date when JVMs get up to speed.

Some Java application development tools include native compilation. SuperCede Inc., Bellevue, WA, for example, offers SuperCede, a Java development package that contains a native compiler for creating Windows executables. In addition, there are standalone compilers on the market. One company that offers a product specifically for Java-to-native code compilation is Tower Technology, which takes Java source code or byte code and compiles it into a native UNIX or NT executable.

Of course, simply writing cleaner Java code will improve performance quite a bit. Despite Java's relatively simple object-oriented structure, it's still easy enough to produce an inefficient program. As Sriram Sankar, chief executive officer of Metamata Inc., a Fremont, CA-based maker of Java debugging tools, says, "In Java, you can still make mistakes. For instance, garbage collection won't work if you continue to hold onto the memory with a reference." Another common mistake is to constantly create new objects instead of reusing existing ones, says Kevin Clarke, president of Objectsoft Inc., Chicago, IL, which makes the BrewMaster Java code management tool. "Your biggest performance boost is going to come from writing good code," says Clarke. He suggests springing for one of the Java profilers on the market. Three currently on the market are JProbe Profiler from KL Group Inc., Toronto, Ontario, Optimize It 2.0 from Intuitive Systems Inc., Sunnyvale, CA, and Metamata's suite of debugging and profiling products, including Metamata Audit, which checks Java code against 50 rules of good Java programming style.

SECURITY: From the client point of view, the Java sandbox–which protects the client's files and resources from being accessed by a remote applet–ensures a fairly high level of security. But, ironically, it was the sandbox that made early versions of Java unsuitable for use on corporate intranets. The early implementation of Sun's sandbox model treated all remotely downloaded applets as untrustworthy and did not allow them to access system functions. That worked fine for Internet users, whose systems could be damaged by a malicious applet, but wasn't very practical in a corporate intranet setting, where remote applets are coming from the company's own server. These users expect programs to be able to access basic system resources, such as writing to a file and printing. "A year ago, the state of the Java VM inside browsers was such that it was much too restrictive. So you couldn't even write to local disk files or to the local printers," Daiwa's Borror says.

Fortunately, Java's security framework now has more options. JDK 1.1, which shipped in early 1997, first introduced the idea of a trusted versus untrusted applet. Trusted applets–coming from a predefined, trusted source such as a company's branch office or business partner–could be given freedom to access system resources. Untrusted applets would still be subject to the sandbox. JDK 1.2 will expand the security options still further. "In 1.2, we're introducing the notion of a more flexible, policy-based security access control," says Sun's Rimalovsky. "An IS manager can assign very fine-grained permissions, depending on the [security] policies, in effect for each source." That means an applet or application coming from one host might have complete access, while one coming from a different source might be allowed access only to read files in a specific directory, but nothing else.

JDK 1.2 also adds three new network security features: keytool, for storing certificates and creating public/private keys to transmit encrypted files; jarsigner, for signing and verifying Java Archive (JAR)–a format for aggregating many files into one for faster downloading to a client–files; and policytool, an administrative GUI for creating security policies.

ENTERPRISE FUNCTIONALITY: When Vlad Kroutik, director of emerging technologies for Cambridge Technology Partners, a consulting firm and systems integrator based in Cambridge, MA, set out to develop a back-office inventory and order-processing system for a Midwestern manufacturing company two years ago, he quickly ran up against the limitations of Java. Kroutik found that many of the things he took for granted, such as communicating with Object Database Connectivity (ODBC) databases, were not available in Java. "We had to put a lot of effort into building the framework to make some very basic things work," Kroutik says.

Kroutik's initial experience was with JDK 1.02, the most current JDK at that time. JDK 1.02 lacked a number of functions that have since been incorporated into successive versions. One critical addition was Java Database Connectivity (JDBC). It gives Java applications a tool to access back-end databases via Structured Query Language (SQL). "JDBC made it easy for a developer to write database calls regardless of what the underlying database looked like," Sun's Rimalovsky says.

Database access options are still improving. In addition to JDBC, another standard for embedding database queries in Java applications, called SQLJ, has recently been developed by a coalition of vendors, including IBM, Tandem and Oracle Corp. And Sun's new Java Blend product, based on the JDBC API and Object Query Language (OQL), makes it possible to map Java objects to tables in relational databases.

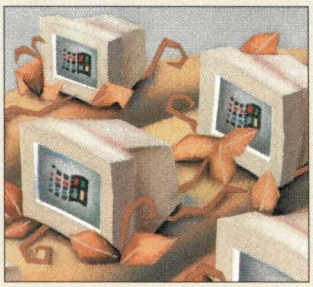
In March, Sun released its Enterprise API collection. These APIs include classes for constructing Java-based mail applications and for adding naming and directory services, in addition to an improved version of the JDBC API.

The Enterprise API that has received the most attention by

Java in the Middle

If you want to use Java to create a flaming logo on your Web site, all you need is a Java applet and the appropriate tags in your HTML page. But if you want to build and deploy an enterprise Java application, you're most likely going to require a Java application server. An application server sits in the middle of a three-tier (or *n*-tier) distributed architecture. It holds the Java business logic and communicates with clients on the front end, other servers such as Web servers or file servers in the middle and databases on the back end via the Java Database Connectivity (JDBC) API.

Application server products, which generally cost $10,000 and up, have been growing like weeds in the past year. It's now possible to find a server to meet a wide range of needs–including load-balancing tools and even application deployment. The latest version of Tengah from WebLogic Inc., San Francisco, CA, for instance, boasts a feature known as Tengah Zero Administration Client (ZAC), which enables an IS manager to configure the server to automatically distribute software and updates to all clients on the network. Another application server product, Apptivity, from Bedford, MA-based Progress Software Corp., is a combination Java application server and integrated development environment (IDE) that performs load balancing and license management. The GemStone/J application server from Beaverton, OR-based GemStone Systems Inc. features persistent storage of objects and data, which allows multiple users to share common business objects and data on a network. This in turn allows the server to handle a larger quantity of objects and data in its available memory. Novera Software Inc., Burlington, MA, makes both an application server, for things such as load balancing and managing JDBC database connections, and a management server, for license management and access control.



The application server market is likely to become much more niche-oriented, according to Evan Quinn, director of Java Research for International Data Corp. (IDC), Framingham, MA. "We think there will be some natural, niche markets emerging. So, for example, one might try to offer a best-of-breed application engine, whereas another might focus on providing best-of-breed development tools along with a good application engine, and someone else might try to be the best at integrating with legacy databases," he says. It's also likely to become more consolidated as the market matures. The recent purchase of Menlo Park, CA-based application server vendor NetDynamics Inc. by Sun Microsystems Inc. is, no doubt, a harbinger of things to come.

There are a few basic characteristics someone shopping for a Java application server needs to consider. Scalability is a key issue. If you want to distribute your applications across multiple machines, you'll need an application server that provides some type of load balancing.

Other features to look for include how many concurrent connections it can support; what management functions–such as runtime monitoring–it offers; how well it interfaces with legacy applications such as IBM Corp.'s Customer Information Control System (CICS) transaction-processing monitor; and what sort of development tools are included in the package or, conversely, how many third-party IDEs it supports.

Cliff Berg, chief technology officer for systems integrator Digital Focus Inc., Chantilly, VA, says application servers that lock you into a proprietary IDE or set of components can limit your options down the road. "Application toolkits that require you to use their IDE are sometimes very problematic…The trend is to let you chose the IDE you want to use," Berg says.

You'll also want to know what support it has–or plans to add–for Sun's Java specifications such as Java Foundation Classes (JFCs), Java Servlets, Enterprise JavaBeans (EJBs) and the upcoming Java Developer's Kit (JDK) 1.2. "A big concern is whether the vendor is committed to moving you seamlessly to the appropriate standards that you care about," says Dennis Moore, vice president of marketing for Progress Software's Apptivity application server product.

Some vendors are adding support for the new specifications, but many haven't yet done so. SilverStream Software Inc., Burlington, MA, for example, does not currently support the EJB specification in its SilverStream application server and, instead of JFCs, it employs a proprietary library of user interface classes. Proprietary class libraries are fine as long as all your clients and other servers support those libraries; otherwise, you'll have to bundle them along with any applications that use those classes.

"If you lock yourself into a proprietary server technology, you lock yourself out of other things you may want to have on your system. For instance, if you want to buy off-the-shelf EJBs, they may not work [if your server doesn't support the Enterprise JavaBeans specification]," says Scott Dietzen, vice president of marketing for WebLogic.–*sjh*

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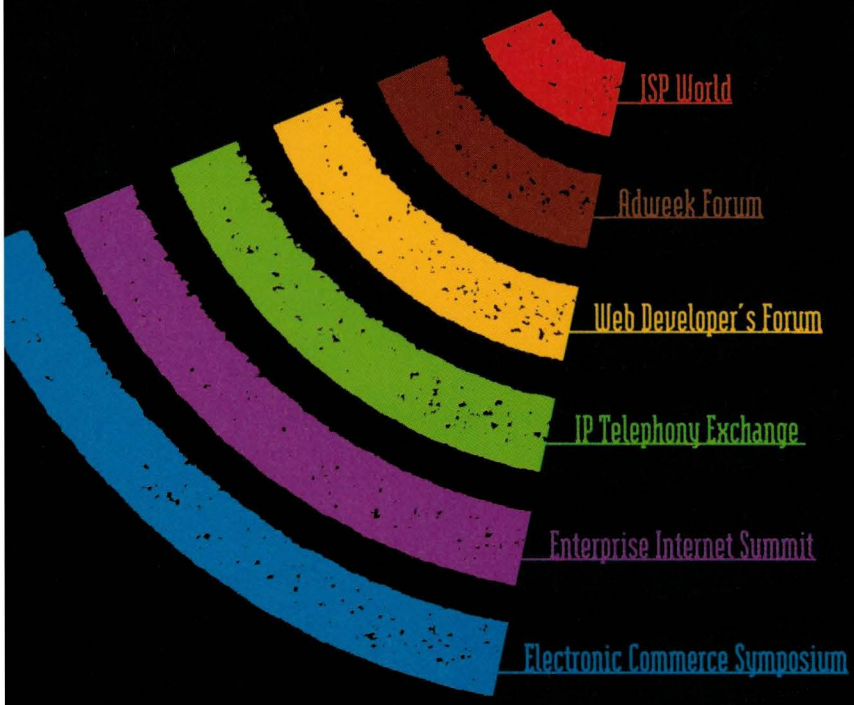

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far, however, is the Enterprise JavaBeans (EJB) specification. Enterprise JavaBeans is a framework for building server-side components to carry out back-end business functions. An example of an EJB product is San Francisco, CA-based Athena Design Inc.'s Integer, an EJB spreadsheet engine. While few EJB products have entered the market, many Java application servers and development tools vendors have rushed to incorporate EJB support into their applications. The Java community has been fairly vocal about its support for the EJB framework, mainly because it promises to make server-side applications faster and easier to construct. "It's the idea that I can write my business logic at one time and in one place and never have to worry about it again. That's going to bring my development time down," says Steve Alexander, president of Digital Focus Inc., a systems integrator based in Chantilly, VA. "We're basing our entire software strategy on EJB."

Sun's Java Foundation Classes (JFCs) are also garnering a fair amount of praise. JFC, which is supported by JDK 1.1 and will be incorporated into the core classes of JDK 1.2, is a set of all-Java GUI components–code-named Swing–and foundation services for constructing user interfaces. JFC/Swing builds on its predecessor, the Java Advanced Windowing Toolkit (AWT), which was disliked largely because it offered only a small selection of user interface functions. It was difficult to construct anything but the most spartan of GUIs with the AWT. The new JFC, however, not only has a broader assortment of tools–frames, pull-down menus, tabs, sliders, tables, treeviews and toolbars–but allows programmers to customize the interface to whatever underlying platform it's running on. So an application could have, say, a Motif-style interface when running on a UNIX box, a Windows-style interface on a PC or a Java-style GUI when running on a Network Computer.

Developers who want an even broader selection of user interface features can turn to any of the dozens of third-party vendors selling user interface editing tools. Just about all commer- cial Java integrated development environments (IDEs)–including Silicon Graphics Inc.'s CosmoCode, Symantec Corp.'s Visual Cafe for Java and IBM's VisualAge for Java–provide a set of GUI editing tools. There are also a number of products for constructing specific types of interfaces, such as scientific applications or electronic commerce interfaces. Sun has its Java Commerce Client and Commerce JavaBeans Component products that include user interface components for common electronic commerce activities.

Companies Mentioned in this Article

Active Software Inc.
3255-1 Scott Blvd., Ste. 201
Santa Clara, CA 95054
http://www.activesw.com
Circle 150

Athena Design Inc.
350 Bay St.
San Francisco, CA 94133
http://www.athena.com
Circle 151

GemStone Systems Inc.
20575 N.W. von Neumann Drive
Beaverton, OR 97006
http://www.gemstone.com
Circle 152

IBM Corp.
Contact local sales office
http://www.ibm.com
Circle 153

Ilog Inc.
1901 Landings Drive
Mountain View, CA 94043
http://www.ilog.com
Circle 154

Inprise Corp.
1000 Enterprise Way
Scotts Valley, CA 94086
http://www.inprise.com
Circle 155

Intuitive Systems Inc.
599 N. Mathilda Ave., Ste. 19
Sunnyvale, CA 94086
http://www.intuisys.com
Circle 156

JScape Corp.
8321 E. Evans Road., Ste. 100
Scottsdale, AZ 85260
http://www.jscape.com
Circle 157

KL Group Inc.
260 King St. E.
Toronto, Ontario
Canada M5A 1K3
http://www.klgroup.com
Circle 158

Metamata Inc.
2140 Peralta Blvd., Ste. 213B
Fremont, CA 94536
http://www.metamata.com
Circle 159

Novera Software Inc.
Burlington Office Centre
25 Corporate Drive
Burlington, MA 01803
http://www.novera.com
Circle 160

Objectsoft Inc.
350 West Erie, 2nd Floor
Chicago, IL 60610
http://www.objsoft.com
Circle 161

Oracle Corp.
500 Oracle Pkwy.
Redwood Shores, CA 94065
http://www.oracle.com
Circle 162

Progress Software Corp.
14 Oak Park
Bedford, MA 01730
http://www.progress.com
Circle 163

Silicon Graphics Inc.
2011 N. Shoreline Blvd.
Mountain View, CA 94043
http://www.sgi.com
Circle 164

Sun Microsystems Inc.
901 San Antonio Road
Palo Alto, CA 94303
http://www.sun.com
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SuperCede Inc.
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http://www.supercede.com
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10201 Torre Ave.
Cupertino, CA 95014
http://www.symantec.com
Circle 167

Tower Technology Corp.
1501 W. Koenig Lane
Austin, TX 78756
http://www.twr.com
Circle 168

Vitria Technology Inc.
500 Ellis St.
Mountain View, CA 94043
http://www.vitria.com
Circle 169

WebLogic Inc.
550 California
San Francisco, CA 94104
http://www.weblogic.com
Circle 170

JViews from Ilog Inc., Mountain View, CA, is a library of Java classes for creating network layout and map displays. Another vendor, JScape Corp., Scottsdale, AZ, makes PowerPanel, a tool that lets users create a business-oriented interface formatted as a two-sided notebook or a tabbed file-folder. The only drawback with these third-party libraries is they're not part of the JDK, so they must be bundled with the application whenever it's downloaded over the network. For applications running over a corporate intranet, that's not likely to be a problem, but it could be if it's being accessed by remote users via a dial-up modem.

Java Still Needs Pruning

There is, of course, still work to be done before most corporate developers will choose Java with as much confidence as they chose Solaris, AIX, Windows NT or any other veteran enterprise platform. Java, as a young technology, is still a bit too unpredictable for some developers' tastes.

There's the ongoing skirmishes between Sun and Microsoft over Microsoft's refusal to fully implement the Sun Java standards in its products, namely the Internet Explorer Web browser and J++ Java development application. And there's also the constant change that's occurring within the Sun standard itself.

In a manner reminiscent of *Jack and the Beanstalk*, the Java JDK seems to mutate and expand every few months. New APIs, such as the Enterprise API and JFCs, are heralded as evidence that Java has rapidly matured into an enterprise-ready technology but, at the same time, lead many developers to believe that they simply can't keep up with all the new features.

"There's a lot of interest, but some people are holding back just to see if this technology will be stabilized," says MageLang's Stanchfield. "A lot of companies are concerned about the stability of the Java platform, especially when they see Sun kicking out new releases every six months."

As Madhu Siddalingaiah, principal at Inter/intranet consulting firm PraxisNet Inc., Alexandria, VA, says, "Java has pretty much all the stuff you need, but it takes a long time for one person to digest it all."

The imminent arrival of JDK 1.2 also elicits a certain amount of unease, especially among those developers who remember the pain of migrating from JDK 1.02 to JDK 1.1, which contained significant changes. "Some of the early adopters of Java got burned by having to go back and rewrite things. We found out there was no easy transition plan. You couldn't just rewrite part of the code, you had to rewrite all of it," says Steve Liszewski, enterprise consultant for Greenbrier & Russel Inc., a software consulting and training firm based in Schaumburg, IL. "That was a bit of a shock to us, and seemed to go against the initial promise of Java. I'm afraid JDK 1.2 will have stuff like that again."

Sun says JDK 1.2 will not cause the kind of migration trauma that 1.1 did. Unlike the 1.0-to-1.1 transition, for example, there will be no change to Java's event model. The structure of the language will stay pretty much the same, but Sun will add several new features and functions, such as support for CORBA, more flexible security policies and JFCs. Of course, many of these new additions won't be supported by the 1.1- and 1.0-based JVMs currently on people's desktops. In the short-term, Sun's solution is its Java Plug-In product, a Java runtime environment that can be pushed to those Windows 95, NT and Solaris desktops not equipped with the latest JVM. In the long run, Sun's goal of making HotSpot the industry standard JVM could encourage users and vendors to upgrade their JVMs to a JDK 1.2-compatible version.

But for now, developers such as Accredo's Taramina, plan to continue using JDK 1.1, while keeping a close eye on 1.2 developments. "JDK 1.2 is right around the corner, so I'm trying to straddle the line by writing to the 1.1 standard, while using things like the JFC/Swing classes," Taramina says.

Sun has spent the past three years hothousing Java into a fairly feature-rich language. The next three years will, hopefully, be used to prune a few of its errant shoots and excess thorns. Sun's Rimalovski says the company does indeed plan to slow the flood of JDK point releases to a more manageable and "little more predictable" pace–probably after the first revision to 1.2 comes out.

What will the next three years bring for Java and enterprise computing? If the analysts and pundits are correct, we can expect server-side Java to play a substantial role in corporate networks.

And, perhaps, in three years, Windows NT 5.0 will have finally shipped, Windows 98 will actually work and kudzu will have vanished from the southern U.S. landscape. ⊸

JDE/IDE Survey

compiled by MAUREEN MCKEON
(based on information supplied by the vendors)

Key:

— = Information not available from vendor
N/A = Not applicable
IDE = Integrated Development Environment
JDE = Java Development Environment
JDK = Java Developer's Kit
JIT = Just-in-Time (compiler)
RAD = Rapid application development

Company Product	Apple WebObjects	BulletProof JDesignerPro	Chami.com WebIDE for Java	Data Representations Simplicity for Java	Forté Software WebEnterprise
Memory required	53 MB	11 MB	N/A	3 MB	40 MB
Development environments	Solaris, HP-UX, OpenStep, Windows NT	All that support JDK	Any with Internet access	Solaris, HP-UX, IRIX, AIX, Linux, Windows 95/NT	Solaris, HP-UX, AIX, Digital Alpha OSF/VMS, Windows 95/NT
Debugger	Yes	Yes	No	No	Yes
Trace points	Yes	Yes	No	No	Yes
Conditional breakpoints	Yes	Yes	No	No	Yes
Programming and IDE tools	Yes	Yes	Yes	Yes	Yes
Compiler (native)	Yes	No	No	No	Yes
Action points	Yes	No	No	No	Yes
Display change variable	Yes	No	No	No	Yes
JIT compiler	No	No	No	No	No
Visual/RAD Tools	Yes	Yes	No	Yes	Yes
Editor	Yes	Yes	Yes	Yes	Yes
Additional Java class libraries	Yes	Yes	No	Yes	No
Java native method support	Yes	Yes	No	Yes	No
Complete support for 100% Pure Java	Yes	Yes	No	Yes	No
Source-code analysis	No	No	No	Yes	No
JDK 1.1/1.2 support	Yes	Yes	Yes/No	Yes	No
Incremental compilations/debugging	No	No	No	Yes	No
Unit testing	No	No	No	No	No
System testing	No	No	No	No	No
Package relies on Sun's JDK	—	Yes	Yes	Yes	Yes
Interface	HTML/Java browser	Application GUI, browser applet	Web IDE	Application GUI	HTML front end, Java GUI painter
Applet viewer used	No	N/A	N/A	N/A	N/A
JavaBeans development	Yes	Yes	No	Yes	Yes
Suited for team development	Yes	Yes	No	Yes	Yes
Built-in version control	No	No	No	No	Yes
Ability to integrate outside configuration management tools	Yes	No	No	No	Yes
Is this product a configuration management tool?	No	Yes	No	No	No
Is this product a testing tool?	Yes	No	No	No	No
Ability to integrate with computer-aided test tools	Yes	Yes	No	No	Yes
Ability for users to add their own objects to palette	Yes	Yes	No	Yes	No
Online documentation	Yes	Yes	Yes	Yes	Yes
Printed manuals	Yes	Yes	No	No	Yes
Time to configure	Less than 1 hour	12 hours	None	1 minute	Less than 1 hour
Free trial version available	No	Yes, *http://www.bulletproof.com/JDesignerPro/*	Yes, *http://www.chami.com/webide/*	Yes, *http://www.datarepresentations.com/tryout.htm*	No
Upgrade available for download	Yes, patches	Yes	Yes	Yes	Yes
How often will upgrades be available	Every 6 months	Quarterly	Variable	Monthly	Contact vendor
24x7 support	No	No	No	No	Yes
Telephone support	Yes, toll-free	Yes, toll-free	No	No	Yes
Email support	Yes	Yes	Yes	Yes	Yes
Technical support and pricing	Many levels	$200/hour, free email support	N/A	Free	Part of maintenance contract
List price ($)	Developer 1,500, deployment starts at 7,500, floating licenses are not available	995, floating licenses are not available	Freeware, floating licenses are not available	89, floating licenses available	8,000-15,000 per application server

JDE/IDE Survey

Company Product	Fuego Technology FuegoBUILDER	Hartware Technologies JavaMan	IBM VisualAge for Java 2.0	InfinityEdge Systems JaWiz	Innovative Software Object Engineering Workbench for Java
Memory required	9 MB	2 MB	—	20 MB	3 MB
Development environments	Any with JVM	Windows 95/NT	AIX, OS/2, Windows 95/NT	Windows 95/98/NT	Windows 95/NT
Debugger	No	No	Yes	Yes	No
Trace points	No	No	Yes	Yes	No
Conditional breakpoints	No	No	Yes	Yes	No
Programming and IDE tools	Yes	Yes	Yes	Yes	Yes
Compiler (native)	No	No	Yes	No	No
Action points	No	No	No	Yes	No
Display change variable	No	No	Yes	No	No
JIT compiler	No	No	No	No	No
Visual/RAD Tools	Yes	No	Yes	Yes	Yes
Editor	No	Yes	Yes	Yes	Yes
Additional Java class libraries	Yes	No	Yes	No	No
Java native method support	No	Yes	Yes	Yes	No
Complete support for 100% Pure Java	Yes	Yes	Yes	Yes	Yes
Source-code analysis	No	Yes	Yes	Yes	Yes
JDK 1.1/1.2 support	No	Yes	Yes/No	Yes/No	Yes
Incremental compilations/debugging	No	Yes	Yes	Yes	No
Unit testing	No	Yes	No	No	No
System testing	No	No	No	No	No
Package relies on Sun's JDK	No	No	Yes	Yes	No
Interface	Application GUI, command-line, browser applet	Application GUI, browser applet	Application GUI, command-line, browser applet	Application GUI, command-line, browser applet	Application GUI
Applet viewer used	JDK AppletViewer, any browser using JDK 1.1 plug-in	JDK AppletViewer, any browser	JDK, Internet Explorer, Navigator	—	—
JavaBeans development	No	Yes	Yes	Yes	Yes
Suited for team development	Yes	Yes	Yes	Yes	No
Built-in version control	No	Yes	Yes	Yes	No
Ability to integrate outside configuration management tools	Yes	Yes	Yes	Yes	Yes
Is this product a configuration managment tool?	No	Yes	Yes	No	No
Is this product a testing tool?	No	Yes	No	No	No
Ability to integrate with computer-aided test tools	Yes	Yes	Yes	No	Yes
Ability for users to add their own objects to palette	No	Yes	Yes	Yes	No
Online documentation	No	Yes	Yes	Yes	Yes
Printed manuals	Yes	No	Yes	No	No
Time to configure	Less than 1 hour	1 minute	—	10 minutes	15 minutes
Free trial version available	No	Yes, *http://homepage.dave-world.net/~hartware/*	Yes, *http://www7.software.ibm.com/vad.nsf/Data/Document2341*	Yes, *http://www.infinityedge.com/jawiz/registration.htm*	Yes, *http://www.isg.de/oew/java/demo.*html
Upgrade available for download	—	Yes	Yes	Yes	Yes
How often will upgrades be available	—	Biweekly/monthly	Variable	Monthly	Monthly
24x7 support	—	No	Yes	No	No
Telephone support	—	Yes	Yes	Yes	Yes
Email support	—	Yes	Yes	Yes	Yes
Technical support and pricing	Contact vendor	Free for registered users	Contact vendor	Free	Free
List price ($)	2,400, floating licenses available	19, floating licenses available	Contact vendor	249, floating licenses available	395, floating licenses are not available

JDE/IDE Survey

Company Product	Inprise JBuilder 2	Metrowerks CodeWarrior Professional	Microsoft Visual J++ 6.0	Modelworks Software JPadPro	NetBeans Developer 2.0
Memory required	700 MB	80 MB	180 MB	2.5 MB	4.1 MB
Development environments	Windows 95/98/NT	Windows 95/NT, Mac OS	Windows 95/98/NT	Windows 95/98/NT	Any with JVM
Debugger	Yes	Yes	Yes	Yes	Yes
Trace points	No	No	Yes	No	Yes
Conditional breakpoints	Yes	Yes	Yes	Yes	Yes
Programming and IDE tools	Yes	Yes	Yes	Yes	Yes
Compiler (native)	No	Yes	No	No	No
Action points	No	No	Yes	No	No
Display change variable	No	Yes	Yes	No	Yes
JIT compiler	Yes	Yes	Yes	No	No
Visual/RAD Tools	Yes	No	Yes	No	Yes
Editor	Yes	Yes	Yes	Yes	Yes
Additional Java class libraries	Yes	Yes	Yes	No	No
Java native method support	Yes	Yes	Yes	No	Yes
Complete support for 100% Pure Java	Yes	Yes	Yes	Yes	Yes
Source-code analysis	No	Yes	No	Yes	Yes
JDK 1.1/1.2 support	Yes	Yes/No	No	Yes	Yes/No
Incremental compilations/debugging	No	No	No	No	No
Unit testing	No	No	No	No	No
System testing	No	No	No	No	No
Package relies on Sun's JDK	Yes	Yes	No	Yes	Yes
Interface	Application GUI, command-line	Application GUI, applet viewer	Application GUI, command-line, browser applet, dynamic HTML	Windows multi-document interface with multiple tool panels	Application GUI
Applet viewer used	—	Metrowerks applet viewer, Internet Explorer	Any browser supporting JDK 1.1	JDK AppletViewer, Internet Explorer, Navigator, other	Built-in Web browser, any external HTML browser
JavaBeans development	Yes	Yes	No	Yes	Yes
Suited for team development	Yes	Yes	Yes	Yes	Yes
Built-in version control	Yes	No	Yes	No	Yes
Ability to integrate outside configuration management tools	Yes	Yes	Yes	Yes	Yes
Is your tool a configuration managment tool?	No	No	No	No	No
Is this product a testing tool?	No	No	No	No	No
Ability to integrate with computer-aided test tools	Yes	No	Yes	Yes	No
Ability for users to add their own objects to palette	Yes	—	Yes	Yes	Yes
Online documentation	Yes	Yes	Yes	Yes	Yes
Printed manuals	Yes	Yes (additional charge)	Yes	No	No
Time to configure	Less than 1 hour	Less than 1 hour	Less than 1 hour	—	5 minutes
Free trial version available	No	Yes, *http://www.metrowerks.com/lite*	Yes, *http://www.microsoft.com/visualj*	Yes, *http://www.modelworks.com/download.html*	Yes, *http://www.netbeans.com/register.html*
Upgrade available for download	Yes	Yes	Yes	Yes	Yes
How often will upgrades be available	Variable	Variable	—	Every 4-8 weeks	Monthly
24x7 support	—	No	Yes	No	No
Telephone support	Yes	Yes	Yes, toll-free	No	No
Email support	No	Yes	Yes	Yes	Yes
Technical support and pricing	Many levels	One year free for registered users	Contact vendor	Contact vendor	Free
List price ($)	2,495	449, site licenses available	Contact vendor, floating licenses are not available	59, floating licenses available	Contact vendor, floating licenses are not available

Company Product	NobleNet Nouveau	ObjectShare Parts for Java (Lite, Standard and Professional editions)	Objectsoft BrewMaster Lite	Penumbra Software Super Mojo	Progress Software Apptivity 2.1
Memory required	25 MB	75-150 MB	6 MB	32 MB	16 MB
Development environments	Solaris, HP-UX, AIX, SCO, Windows 95/98/NT	Windows 95/98/NT	Any with JVM	All that support JDK	Solaris, Windows NT, Mac OS, any JVM
Debugger	No	Yes	No	Yes	Yes
Trace points	No	No	No	No	Yes
Conditional breakpoints	No	Yes	No	No	Yes
Programming and IDE tools	Yes	Yes	Yes	Yes	Yes
Compiler (native)	Yes	No	No	No	Yes
Action points	No	No	No	No	Yes
Display change variable	No	Yes	Yes	No	Yes
JIT compiler	No	Yes	No	No	Yes
Visual/RAD Tools	No	Yes	No	Yes	Yes
Editor	No	Yes	Yes	No	Yes
Additional Java class libraries	No	Yes	No	No	Yes
Java native method support	No	Yes	Yes	No	Yes
Complete support for 100% Pure Java	No	Yes	Yes	Yes	Yes
Source-code analysis	No	No	Yes	Yes	Yes
JDK 1.1/1.2 support	Yes	Yes	No/Yes	Yes	Yes
Incremental compilations/debugging	No	No	No	No	Yes
Unit testing	No	No	No	No	Yes
System testing	No	No	No	No	Yes
Package relies on Sun's JDK	No	Yes	Yes	Yes	No
Interface	Command-line, management GUI	Application GUI, browser applet	Application GUI, command-line	Application GUI	—
Applet viewer used	N/A	Default is JDK AppletViewer	—	—	—
JavaBeans development	No	Yes	No	Yes	Yes
Suited for team development	Yes	Yes	Yes	Yes	No
Built-in version control	No	Professional Edition	No	Yes	Yes
Ability to integrate outside configuration management tools	No	No	Yes	Yes	Yes
Is this product a configuration managment tool?	No	No	No	No	No
Is this product a testing tool?	No	No	No	No	No
Ability to integrate with computer-aided test tools	No	No	Yes	Yes	Yes
Ability for users to add their own objects to palette	Yes	Yes	Yes	Yes	Yes
Online documentation	Yes	Yes	Yes	Yes	Yes
Printed manuals	Yes	Yes	No	No	Yes
Time to configure	—	2 minutes	30 minutes	Less than 30 minutes	5 minutes
Free trial version available	No	Yes, *http://www.objectshare.com/p4j/p4jtrial.htm*	Yes, *http://www.objsoft.com*	No	Yes, *http://apptivity.progress.com/java/apptivity/trial.htm*
Upgrade available for download	Yes	Yes	Yes	Yes	Yes
How often will upgrades be available	Customer driven	Every 3 months	Every 4-6 months	Quarterly	2-3 times per year
24x7 support	No	No	No	Yes	No
Telephone support	Yes	Yes	Yes, toll-free	No	Yes
Email support	Yes	Yes	Yes	Yes	Yes
Technical support and pricing	Free	Contact vendor	Contact vendor	Free	Many levels
List price ($)	5,000, floating licenses are not available	149 (Lite), 795 (Standard), 1,495 (Professional), floating licenses are not available	250, floating licenses are not available	50, floating licenses are not available	1,995, floating licenses available

Company Product	Riverton Software HOW 2.0 LE Professional Edition for Java	S Cubed JIG	SilverStream Software SilverStream 2.0	Soft As It Gets ED for Windows	softwarebuero m&b WipeOut
Memory required	85 MB	2.33-4.5 MB	40-70 MB	4.7 MB	5 MB
Development environments	Windows 95/98/NT	UNIX, Windows 95/NT	Windows 95/NT	Windows 95/98/NT	Solaris, HP-UX, Linux, FreeBSD
Debugger	No	Yes	Yes	No	Yes
Trace points	No	No	No	No	No
Conditional breakpoints	No	No	No	No	Yes
Programming and IDE tools	Yes	Yes	Yes	Yes	Yes
Compiler (native)	No	No	Yes	No	No
Action points	No	No	No	No	No
Display change variable	No	No	Yes	No	Yes
JIT compiler	No	No	Yes	No	No
Visual/RAD Tools	Yes	No	Yes	No	No
Editor	No	Yes	Yes	Yes	No
Additional Java class libraries	No	No	Yes	No	No
Java native method support	No	No	Yes	No	No
Complete support for 100% Pure Java	Yes	No	Yes	No	No
Source-code analysis	No	No	No	No	Yes
JDK 1.1/1.2 support	Yes/No	Yes	Yes/No	Yes	Yes
Incremental compilations/debugging	No	No	No	No	No
Unit testing	No	No	No	No	No
System testing	No	No	No	No	No
Package relies on Sun's JDK	No	No	No	No	No
Interface	Application GUI	Application GUI	Application GUI, browser applet	Application GUI	Command-line
Applet viewer used	N/A	—	All browsers	—	—
JavaBeans development	Yes	Yes	Yes	No	No
Suited for team development	Yes	Yes	Yes	Yes	Yes
Built-in version control	No	No	Yes	No	Yes
Ability to integrate outside configuration management tools	Yes	No	Yes	Yes	Yes
Is your tool a configuration managment tool?	No	No	No	No	Yes
Is this product a testing tool?	No	No	No	No	No
Ability to integrate with computer-aided test tools	Yes	No	Yes	Yes	Yes
Ability for users to add their own objects to palette	Yes	No	Yes	No	No
Online documentation	Yes	Yes	Yes	Yes	Yes
Printed manuals	Yes	No	Yes	Yes	No
Time to configure	Less than 1 hour	15 minutes	2 hours	20 minutes	15 minutes
Free trial version available	Yes, *http://www.riverton.com/howle/welcome.htm*	Yes, *http://www.scubed.cc*	Yes, call vendor (888) 823-9700	Yes, *http://www.getsoft.com/download.html*	Yes, *http://www.softwarebuero.de/products.html*
Upgrade available for download	Yes	Yes	Yes	Yes	Yes
How often will upgrades be available	—	Monthly	Variable	Every 6 months	1-2 times per month
24x7 support	No	No	Yes	Yes	Yes
Telephone support	Yes	No	Yes, toll-free	Yes	No
Email support	Yes	Yes	Yes	Yes	Yes
Technical support and pricing	$1,800 per year	Free	$125-7,500	Free	Contact vendor
List price ($)	2,995, floating licenses are not available	Contact vendor, floating licenses are not available	495 (single), 2,495 (5 users), 4,495 (10 users), floating licenses are not available	169 Web download, 199 w/printed manuals, site licenses available	Free (Standard Edition), 49 (Pro Edition private), 149 (Pro Edition commerical), floating licenses available

JDE/IDE Survey

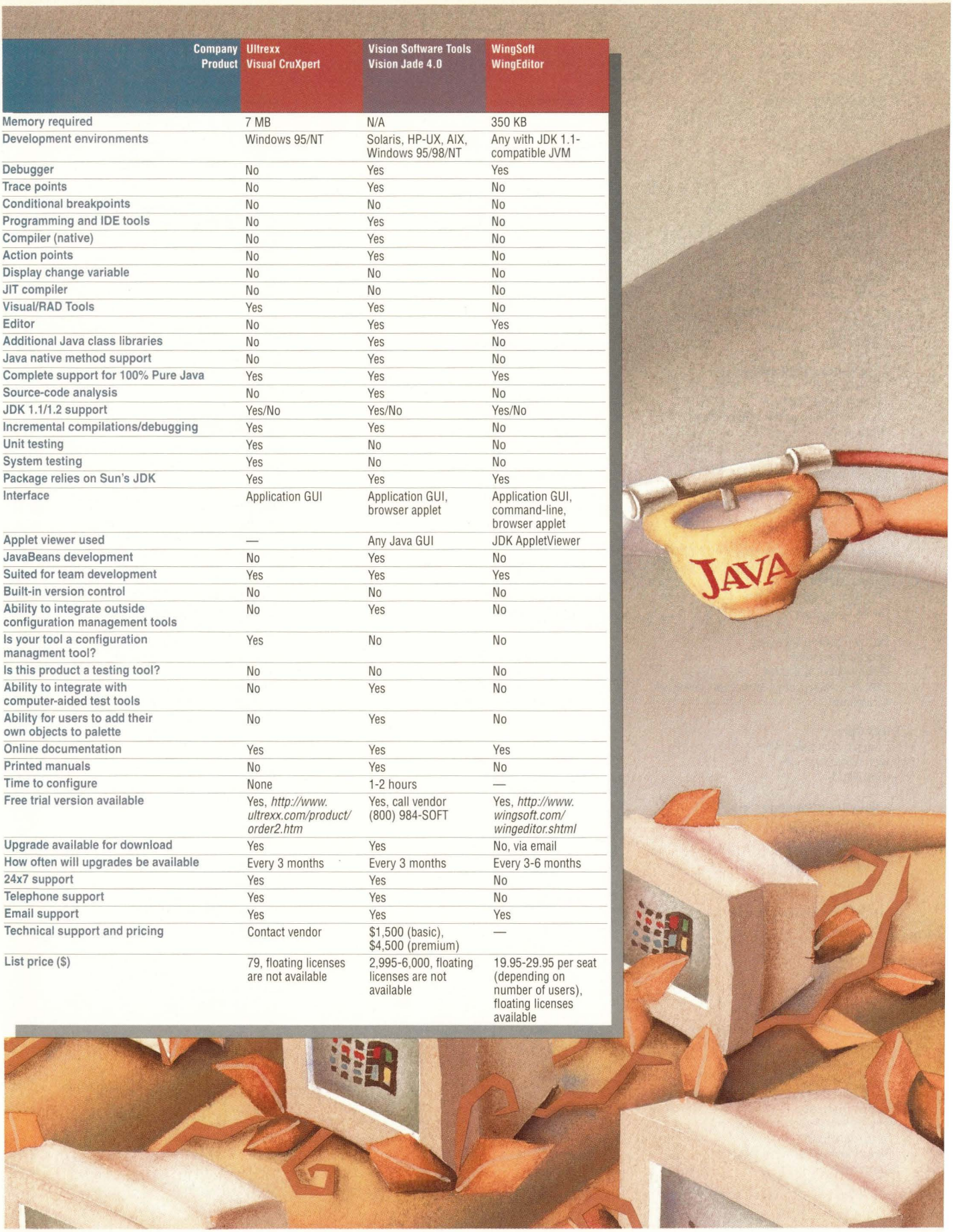
Company Product	Step Ahead Software Javelin	Sun Java Workshop 2.0	Sun Java Studio 1.0	SuperCede SuperCede for Java Professional Edition	Sybase PowerJ Enterprise
Memory required	539 KB	32 MB	32 MB	48 MB	110 MB
Development environments	Windows 95/NT	Solaris, HP-UX, SCO, Windows 95/NT	Solaris, HP-UX, SCO, Windows 95/NT	Windows 95/NT	Windows 95/NT
Debugger	No	Yes	No	Yes	Yes
Trace points	No	No	No	Yes	No
Conditional breakpoints	No	Yes	No	Yes	Yes
Programming and IDE tools	Yes	Yes	No	Yes	Yes
Compiler (native)	No	Yes	Yes	Yes	Yes
Action points	No	Yes	No	Yes	No
Display change variable	No	Yes	No	No	Yes
JIT compiler	No	Yes	No	No	Yes
Visual/RAD Tools	Yes	Yes	Yes	Yes	Yes
Editor	Yes	Yes	No	Yes	Yes
Additional Java class libraries	No	Yes	Yes	Yes	No
Java native method support	No	No	No	Yes	No
Complete support for 100% Pure Java	No	Yes	Yes	Yes	Yes
Source-code analysis	Yes	Yes	No	No	No
JDK 1.1/1.2 support	Yes/No	Yes/No	Yes/No	Yes	Yes/No
Incremental compilations/debugging	No	No	No	Yes	Yes
Unit testing	No	Yes	No	No	No
System testing	No	Yes	No	No	No
Package relies on Sun's JDK	Yes	Yes	Yes	No	Yes
Interface	Application GUI, browser applet	Command-line, browser applet	Application GUI	Application GUI, command-line	Application GUI, browser applet
Applet viewer used	JDK AppletViewer	HotJava browser	—	SuperCede applet	Navigator, Internet Explorer, any Java-enabled browser, JDK AppletViewer
JavaBeans development	No	Yes	Yes	Yes	Yes
Suited for team development	Yes	Yes	No	Yes	Yes
Built-in version control	No	Yes	No	No	Yes
Ability to integrate outside configuration management tools	No	Yes	Yes	Yes	Yes
Is your tool a configuration managment tool?	No	No	No	No	No
Is this product a testing tool?	No	No	No	No	No
Ability to integrate with computer-aided test tools	Yes	Yes	Yes	No	Yes
Ability for users to add their own objects to palette	Yes	Yes	Yes	Yes	Yes
Online documentation	Yes	Yes	Yes	Yes	Yes
Printed manuals	Yes, additional charge	Yes	Yes	Yes	Yes
Time to configure	Less than 5 minutes	Less than 5 minutes	Less than 5 minutes	Variable	10 minutes
Free trial version available	Yes, *http://www.stepahead.com.au/javelin.htm*	Yes, *http://www.sun.com/workshop/java*	Yes, *http://www.sun.com/studio*	Yes, *http://www.supercede.com/devcom/downloads.html*	Yes, call vendor (888) 8SYBASE
Upgrade available for download	Yes	Yes	No	Yes	Yes, patches
How often will upgrades be available	4-5 times per year	—	—	Variable	2-3 times per year
24x7 support	No	No	No	No	Yes
Telephone support	Yes, toll-free	Yes	Yes	Yes	Yes, toll-free
Email support	Yes	Yes	Yes	Yes	Yes, via Web site
Technical support and pricing	Free setup, $10 per 5 minutes telephone	$35/incident, $75/incident (developer-specific support)	$35/incident, $75/incident (developer-specific support)	$195/incident, $600/5 incidents, $3,000/year	Contact vendor
List price ($)	59, floating licenses are not available	129, floating licenses are not available	99, floating licenses are not available	995, floating licenses are not available	1,999, floating licenses are not available

JDE/IDE Survey

Company Product	Symantec Visual Cafe for Java	TakeFive Software SNiFF+J	Tek-Tools KAWA 3.0 IDE	TopSpeed Clarion 4 Internet Edition	Ultrexx CruXpert (Lite, Standard and Professional editions)
Memory required	120 MB	52 MB	4 MB	114-374 KB	3.8-5.9 MB
Development environments	Windows 95/98/NT	Solaris, SunOS, HP-UX, AIX, Linux, Digital UNIX, Unix-Ware, Reliant UNIX, Windows 95/98/NT	Windows 95/NT	Any 32-bit Windows platform	Windows 95/NT
Debugger	Yes	Yes	Yes	Yes	Yes
Trace points	Yes	Yes	No	Yes	No
Conditional breakpoints	Yes	No	No	Yes	No
Programming and IDE tools	Yes	Yes	Yes	Yes	Yes
Compiler (native)	Yes	Yes	No	Yes	Yes
Action points	Yes	No	No	Yes	No
Display change variable	Yes	Yes	Yes	Yes	No
JIT compiler	Yes	No	No	Yes	No
Visual/RAD Tools	Yes	No	No	Yes	Yes
Editor	Yes	Yes	Yes	Yes	Yes
Additional Java class libraries	Yes	No	No	No	Yes
Java native method support	Yes	Yes	Yes	No	Yes
Complete support for 100% Pure Java	Yes	No	Yes	No	Yes
Source-code analysis	Yes	Yes	No	Yes	No
JDK 1.1/1.2 support	Yes	Yes	Yes	No	Yes/No
Incremental compilations/debugging	Yes	Yes	No	Yes	Yes
Unit testing	Yes	No	No	Yes	Yes
System testing	Yes	No	No	Yes	Yes
Package relies on Sun's JDK	No	Yes	Yes	No	Yes
Interface	Command-line, Internet Explorer, Communicator	Application GUI	Application GUI, command-line, browser applet	N/A	Application GUI, command-line
Applet viewer used	Visual Cafe applet viewer, Internet Explorer, Communicator	—	JDK AppletViewer, any viewer	Internet Explorer, Navigator	—
JavaBeans development	Yes	Yes	No	No	No
Suited for team development	Yes	Yes	Yes	Yes	Yes
Built-in version control	Yes	Yes	No	No	No
Ability to integrate outside configuration management tools	Yes	Yes	Yes	Yes	Yes
Is your tool a configuration managment tool?	No	Yes	No	No	Yes
Is this product a testing tool?	No	No	No	No	No
Ability to integrate with computer-aided test tools	Yes	Yes	Yes	No	No
Ability for users to add their own objects to palette	Yes	No	No	No	Yes
Online documentation	Yes	Yes	Yes	Yes	Yes
Printed manuals	Yes	Yes	No	Yes	Yes
Time to configure	10 minutes	10-20 minutes	5-10 minutes	10 minutes	10 minutes
Free trial version available	Yes, *http://www.symantec.com/domain/cafe/downloads.html*	Yes, *http://www.takefive.com/download.htm*	Yes, *http://www.tek-tools.com/kawa*	Yes, *http://www.topspeed.com/tsprodupd.htm*	Yes, *http://www.ultrexx.com/product/order2.htm*
Upgrade available for download	Yes	Yes	Yes	Yes	Yes
How often will upgrades be available	Variable	Twice per year	3-4 times per year	Variable	Every 3 months
24x7 support	Yes	No	No	Yes	Yes
Telephone support	Yes	Yes, toll-free	No	Yes, toll free	Yes
Email support	Yes	Yes	Yes	No	Yes
Technical support and pricing	Many levels, up to $25,000	Included with maintenance contract	Free	Many levels	Contact vendor
List price ($)	99 (Web Edition), 299 (Professional Edition), 799 (Database Edition), floating licenses available	1,750 per node, floating licenses available	49, educational pricing available, floating licenses are not available	749	99 (Lite), 299 (Standard), 995 (Professional), floating licenses are not available

JDE/IDE Survey

Company Product	Ultrexx Visual CruXpert	Vision Software Tools Vision Jade 4.0	WingSoft WingEditor
Memory required	7 MB	N/A	350 KB
Development environments	Windows 95/NT	Solaris, HP-UX, AIX, Windows 95/98/NT	Any with JDK 1.1-compatible JVM
Debugger	No	Yes	Yes
Trace points	No	Yes	No
Conditional breakpoints	No	No	No
Programming and IDE tools	No	Yes	No
Compiler (native)	No	Yes	No
Action points	No	Yes	No
Display change variable	No	No	No
JIT compiler	No	No	No
Visual/RAD Tools	Yes	Yes	No
Editor	No	Yes	Yes
Additional Java class libraries	No	Yes	No
Java native method support	No	Yes	No
Complete support for 100% Pure Java	Yes	Yes	Yes
Source-code analysis	No	Yes	No
JDK 1.1/1.2 support	Yes/No	Yes/No	Yes/No
Incremental compilations/debugging	Yes	Yes	No
Unit testing	Yes	No	No
System testing	Yes	No	No
Package relies on Sun's JDK	Yes	Yes	Yes
Interface	Application GUI	Application GUI, browser applet	Application GUI, command-line, browser applet
Applet viewer used	—	Any Java GUI	JDK AppletViewer
JavaBeans development	No	Yes	No
Suited for team development	Yes	Yes	Yes
Built-in version control	No	No	No
Ability to integrate outside configuration management tools	No	Yes	No
Is your tool a configuration managment tool?	Yes	No	No
Is this product a testing tool?	No	No	No
Ability to integrate with computer-aided test tools	No	Yes	No
Ability for users to add their own objects to palette	No	Yes	No
Online documentation	Yes	Yes	Yes
Printed manuals	No	Yes	No
Time to configure	None	1-2 hours	—
Free trial version available	Yes, *http://www.ultrexx.com/product/order2.htm*	Yes, call vendor (800) 984-SOFT	Yes, *http://www.wingsoft.com/wingeditor.shtml*
Upgrade available for download	Yes	Yes	No, via email
How often will upgrades be available	Every 3 months	Every 3 months	Every 3-6 months
24x7 support	Yes	Yes	No
Telephone support	Yes	Yes	No
Email support	Yes	Yes	Yes
Technical support and pricing	Contact vendor	$1,500 (basic), $4,500 (premium)	—
List price ($)	79, floating licenses are not available	2,995-6,000, floating licenses are not available	19.95-29.95 per seat (depending on number of users), floating licenses available



Companies Mentioned in this Survey

Apple Computer Inc.
1 Infinite Loop
Cupertino, CA 95014
http://www.apple.com
Circle 250

BulletProof Corp.
15732 Los Gatos Blvd., Ste. 525
Los Gatos, CA 95032
http://www.bulletproof.com
Circle 251

Chami.com
P.O. Box 4174
Fort Walton Beach, FL 32549
http://www.chami.com
Circle 252

Data Representations Inc.
P.O. Box 519
Summit, NJ 07902
http://www.datarepresentations.com
Circle 253

Forté Software Inc.
1800 Harrison St.
Oakland, CA 94612
http://www.forte.com
Circle 254

Fuego Technology Corp.
5910 N. Central Expressway, Ste. 300
Dallas, TX 75206
http://www.fuegotech.com
Circle 255

Hartware Technologies
1206 Dover Road
Bloomington, IL 61704
http://homepage.dave-world.net/~hartware/
Circle 256

IBM Corp.
Contact local sales office
http://www.ibm.com
Circle 257

InfinityEdge Systems GmbH
Rungstrasse 25-27
10179 Berlin
Germany
http://www.infinityedge.com
Circle 258

Innovative Software GmbH
Kaiserstrasse 65
60329 Frankfurt am Main
Germany
http://www.isg.de
Circle 259

Inprise Corp.
100 Enterprise Way
Scotts Valley, CA 95066
http://www.inprise.com
Circle 260

Metrowerks Inc.
9801 Metric Blvd., Ste. 100
Austin, TX 78758
http://www.metrowerks.com
Circle 261

Microsoft Corp.
One Microsoft Way
Redmond, WA 98052
http://www.microsoft.com
Circle 262

Modelworks Software
4882 Old Brook Circle
Colorado Springs, CO 80917
http://www.modelworks.com
Circle 263

NetBeans Inc.
Pod Hajkem1
180 00 Prague 8
Czech Republic
http://www.netbeans.com
Circle 264

NobleNet Inc.
337 Turnpike Road
Southboro, MA 01772
http://www.noblenet.com
Circle 265

ObjectShare Inc.
16811 Hale Ave., Ste. A
Irvine, CA 92606
http://www.objectshare.com
Circle 266

Objectsoft Inc.
350 West Erie St., Ste. 200
Chicago, IL 60610
http://www.objsoft.com
Circle 267

Penumbra Software Inc.
4015 Holcomb Bridge Road, Ste. 350
Norcross, GA 30092
http://www.penumbrasoftware.com
Circle 268

Progress Software Corp.
39899 Balentine Drive, Ste. 350
Newark, CA 94560
http://www.progress.com
Circle 269

Riverton Software Corp.
One Kendall Square, Bldg. 200
Cambridge, MA 02139
http://www.riverton.com
Circle 270

S Cubed
P.O. Box 468572
Atlanta, GA 31146
http://www.scubed.cc
Circle 271

SilverStream Software Inc.
One Burlington Woods, Ste. 200
Burlington, MA 01803
http://www.silverstream.com
Circle 272

Soft As It Gets P/L
12 Fairview Grove
Glen Iris
Victoria 3146
Australia
http://www.getsoft.com
Circle 273

softwarebuero m&b
Weststrasse 9
D-04425 Taucha
Germany
http://www.softwarebuero.de
Circle 274

Step Ahead Software Party Ltd.
169 Pacific Hwy., Ste. 1
Hornsby
New South Wales 2077
Australia
http://www.stepahead.com.au
Circle 275

Sun Microsystems Inc.
901 San Antonio Road
Palo Alto, CA 94303
http://www.sun.com
Circle 276

SuperCede Inc.
110 110th Ave. N.E.
Bellevue, WA 98004
http://www.supercede.com
Circle 277

Sybase Inc.
6475 Christie Ave.
Emeryville, CA 94608
http://www.sybase.com
Circle 278

Symantec Corp.
10201 Torre Ave.
Cupertino, CA 95014
http://www.symantec.com
Circle 279

TakeFive Software Inc.
20813 Stevens Creek Blvd., Ste. 200
Cupertino, CA 95014
http://www.takefive.com
Circle 280

Tek-Tools Inc.
4300 Alpha Road, Ste. 123
Dallas, TX 75244
http://www.tek-tools.com
Circle 281

TopSpeed Corp.
150 E. Sample Road
Pompano Beach, FL 33064
http://www.topspeed.com
Circle 282

Ultrexx Corp.
2125 Western Ave., Ste. 302
Seattle, WA 98121
http://www.ultrexx.com
Circle 283

Vision Software Tools Inc.
2101 Webster St., 8th Floor
Oakland, CA 94612
http://www.vision-soft.com
Circle 284

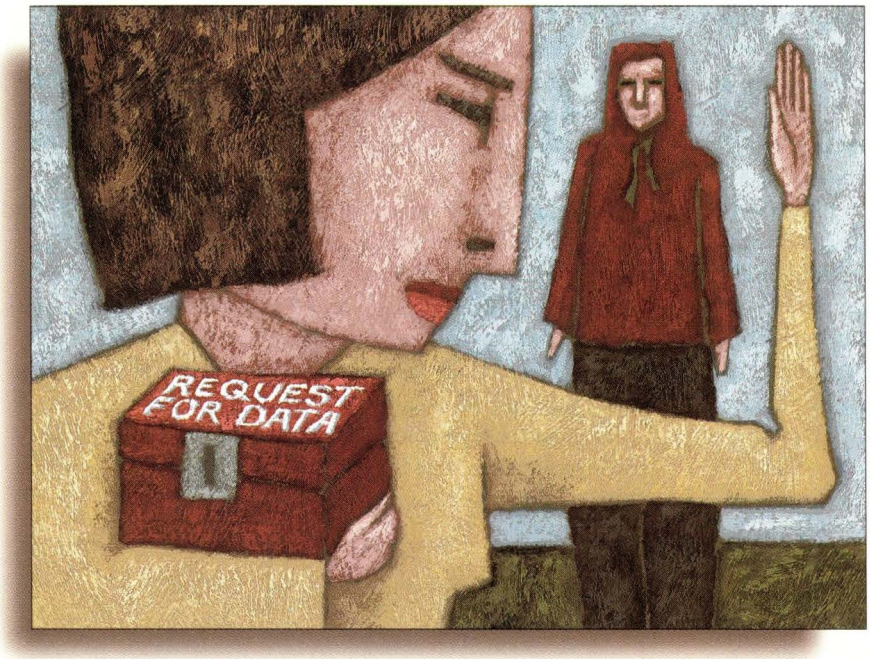
WingSoft Corp.
P.O. Box 7554
Fremont, CA 94537
http://www.wingsoft.com
Circle 285

JOHN N. STEWART

John N. Stewart is the director of systems engineering for Digital Island Inc. (jns@digisle.net).

P3P - Platform for Privacy Preferences

Keeping personal information personal (be it your full name, the Web sites you recently visited or the last financial transaction you completed online) is a growing concern on the Internet.



Illustrations by STEPHEN SCHILDBACH

Applications such as automated travel systems and electronic desktop banking offer unprecedented features, but also store personal information such as social security numbers, bank account numbers and, possibly, credit card numbers.

The World Wide Web Consortium (W3C) headed by Tim Berners-Lee (inventor of the World Wide Web) has identified certain areas where the Web as an information technology needs further structure. One such area is secure storage and exchange of information.

Since the middle of last year, the W3C has been working on a framework whereby information could be exchanged through electronic conversation (and that conversation would be conducted via a universal language). It is thought that a universal language will enable diverse technologies to communicate with one another, for instance, a handheld computer could speak with an answering machine.

The goal here, as is often true with W3C activities, is interoperability. Having diverse technologies being able to exchange information benefits the end user immensely. Another end-user benefit is avoiding repetition. Wouldn't it be nice if you could avoid having to retype your address and phone number for every Web site that requests it? And, instead, be prompted with, say, "Web site A has requested your personal profile, send?" and have it sent automatically. This model can be extended to your credit card information, personal habits (hobbies, sleep schedule, favorite foods and so on) and other information about yourself. This kind of information is frequently requested by more than one institution and it soon becomes tedious if you have to retype it numerous times.

The flip side to having all this information only a click away is ensuring it doesn't go just anywhere and everywhere. That is what the Platform for Privacy Preferences (P3P) Project is all about–framing information into profiles and then deciding what information is fully public, public to only certain institutions or people and what information is private.

The first working draft of the P3P Project was released in May (see `http://www.w3.org/p3p`). P3P is intended to extend information security policies, assisting the end user in protecting (more than anything) personal information about themselves in the electronic world. It is clearly based on "honesty first" and openness policies, with regard to specified personal data. Numerous companies and institutions have been primary contributors to the development of P3P, including America Online Inc., AT&T Corp., the Center for Democracy and Technology, Digital Equipment Corp., IBM Corp., Massachusetts Institute of Technology, Microsoft Corp. and Open Market Inc. The products that will support P3P have not yet been advertised, but P3P's principal strengths lie in configuring browsers. It is expected that the popular browsers will integrate this standard after it is accepted by the Internet Engineering Task Force (IETF).

One of the main attractions of P3P is that it hasn't been implemented yet, which means it can be rewritten and corrected over time. P3P is a method-

ology, which seems to support open communications–tell the user what is happening and what information is being passed back and forth.

The P3P Architecture

Information comes in many forms, be it localized to a machine the user is currently using, or available via a Lightweight Directory Access Protocol (LDAP) server or some database request. The P3P architecture relies on the ability of the user-agent (email readers, electronic news readers, Web browsers and so on) to read, and possibly write, the end user's information.

P3P is building itself around Trust Engines (TEs). TEs are combinations of users' inputs for information type, preferences and access information (who is able to access what, when and how). In short, a TE is a set of controls on a set of information.

The P3P architecture relies on the ability of the user-agent (email readers, electronic news readers, Web browsers and so on) to read, and possibly write, the end user's information.

A concrete example will help clarify this. I can configure the Trust Engine Manager (TEM) to filter out any profanity when my four-year-old son is reading on the Internet. Furthermore, to help coax him into bed on time, I can configure the TEM to stop his ability to access the Internet after 8:30 p.m.

If the user-agent is P3P-compliant, the next time my son might run into a profane statement in an online book, the service will "Request a Practice," regarding the information–the response to the request will state the restrictions I have imposed (no swear words and only before 8:30 p.m.). This is called the "Transfer of Practice." If the book is OK (no profanity) and it is before 8:30 p.m., my son is permitted to start reading. If something is amiss, the "Agreement" returns the response, "I don't agree," and the transfer of data is stopped.

The communication is lightweight, which is a big win. The command set is simple, not overblown, and not yet mainstream (all things in time). This combination allows handheld computers, mainframes or even household appliances to speak the same language that ultimately protects the information stored inside.

P3P Statements and Requests

It is not uncommon to have request/response pairs in computing and the P3P model is no different. P3P supports eight statements/requests. A P3P statement is a form of interaction, such as an Agreement (described below), and a P3P request is a query for more information. These requests are used to negotiate private transactions between the end user's software (a browser) and the destination that is making the request (a Web site). The eight statement/requests are as follows:

- Request for Data
- Request for Transfer of Data
- Transfer of Data
- Request for Practice
- Transfer of Practice
- Request for Preferences
- Transfer of Preferences
- Agreement

Request for Data allows a service–email, electronic commerce transaction and so on–to ask for information from the user-agent (browser). The user-agent can either reply with that information without human interaction or request the information from the user (via a dialogue box, for example). In other words, this is the "I need the user to somehow get me this data" request.

Request for Transfer of Data is a request to transfer the P3P data (and data types), according to the rules that have been defined. This is the "I need this P3P data" request.

Transfer of Data means all is well, the agreement concerning who can do what is complete and the information can be transferred. As part of this interaction, the data requested is then transferred.

A Request for Practice is the start of the conversation to find out what, if any, information can be transferred. It is the "So, can you give me the information, or is it protected?" request.

Transfer of Practice is the response to a Request for Practice; it states what can and cannot happen with the protected information. It is basically the answer to "So, how is the information protected?" in P3P language terms (still under development).

Request for Preferences allows a service to ask for an end user's preferences. This is the "So, tell me about your hobbies" request (the answer can be wide ranging preferences).

Security in the News:

■ As reported on Bugtraq (`http://www.geek-girl.com/bugtraq`) on June 24, TextCounter–a free, server-side program used to count how many people have visited your site–has been patched to fix a remotely exploitable security hole. Patched versions are now available in Perl and C++ from `http://www.worldwidemart.com/scripts`.

■ Based on research done by Daniel Bleichenbacher at Bell Laboratories Inc., RSA Data Security Inc. (`http://www.rsa.com`) has reported software which uses its Public-Key Cryptography Standard #1 (PKCS#1) for key establishment–for example, a Web browser that talks to a Secure Sockets Layer (SSL)-based secure site such as `https://www.foobar.com`–has a potential security vulnerability, whereby the negotiation could be discovered, the key guessed and the transmission decrypted by a malicious user. The Computer Emergency Response Team (CERT) Coordination Center has published a summarized report concerning the vulnerability (see `ftp://ftp.cert.org/pub/cert_advisories/CA-98.07.PKCS`), but to date, there have been no known user exploits and this information is based entirely on research.–*jns*

Transfer of Preferences answers the Request for Preferences, but it can also redirect the request to a different source–for example, if the user doesn't keep the preferences on the end machine, then maybe the information is in LDAP or X.500.

Agreement could actually be called disagreement, because there are three answers to this response: yes, no (but keep trying to negotiate) and "final no" (that is, we won't be talking anymore on this issue).

More Information

Lincoln D. Stein, the keeper of the WWW Security FAQ (`http://www.w3.org./Security/Faq/www-security-faq.html`), has published a step-by-step book on Internet security issues entitled, *Web Security – A Step-by-Step Reference Guide*, from Addison-Wesley Publishing Co. (ISBN 0-201-63489-9).

There is an email list which discusses the current issues available at: `http://www-security-request@ns2.rutgers.edu`. Send the email message "subscribe" and a list handler will return more information to you.

The Bugtraq list is also an excellent resource that includes many of the exploits. To subscribe, send an email to `best-of-security-request@suburbia.net` with "subscribe bugtraq" as the body of the message.

Discussion about proxies is also happening on the firewalls list. Send email to `majordomo@greatcircle.com` and put "subscribe firewalls" as the body of the message.

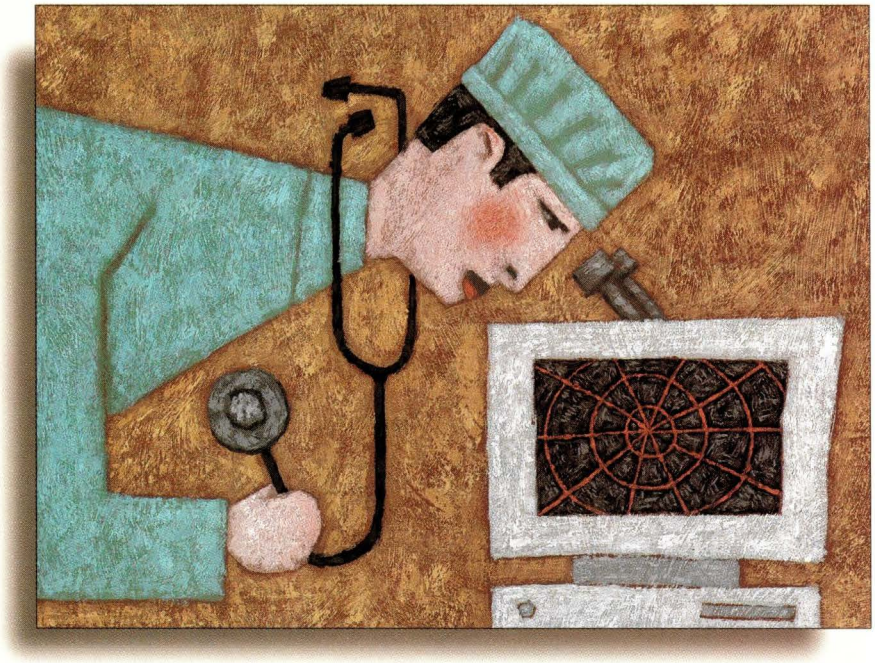
For a comprehensive email list, summarizing current news items, join the Internet Security News email list. To subscribe, send email to `majordomo@sekurity.org` (yes, that is spelled correctly!).

PAUL A. TRUNFIO

Paul A. Trunfio is research associate and director of education programs at the Center for Polymer Studies at Boston University (trunfio@bu.edu).

Test Your Site with Web-Based Tools

When it comes to building a Web site, one area that is often overlooked is making sure it works. Although not quite as glamorous as creating fancy images, animations, scripts and layouts, testing your site is a necessity. Fortunately, there are many tools available to get you started.



One of my dreams in life is to someday build my own kit airplane. The kit arrives at your doorstep, you follow the instructions and, slowly, piece together an airplane. In the world of Web site development, it seems the trend is to quickly throw something together and call it a day. There's much talk about what the latest "hot" new product is for putting more fancy elements onto your site, but when you get down to the nuts and bolts of it, making sure everything works is vastly more important. In many ways, building a Web site is a lot like building an airplane. Would you trust your building skills and fly the plane right after you built it without even testing it first? Or, after initially testing to see if it's airworthy, how many hours would you fly the plane before testing it again?

The Need for Testing

A couple of months ago, I moved my work site over to a new machine and a new Web server. I also ended up moving several directories, which were spread across several machines, onto one machine. Many of the links changed and, as a result, some of the links were broken. I got the server configured and fixed all the links. After clicking around a bit, everything seemed fine and I concluded that the site was healthy. An hour or so later, I got a message from someone saying that one of my pages crashed their machine. Because it was hidden a few levels deep, it was not immediately obvious there was a mistake. It contained some MIDI music, and one of the things I had forgotten to do when I set up the server was to add the MIME type for MIDI. The result: The browser crashed when trying to load that page.

The willy-nilly, wait-and-see approach I adopted doesn't matter too much if your site gets minimal traffic, but if your site garners revenue from your visitors, a "fix-it-before-anyone-uses-it" approach is a necessity.

When it comes to testing a Web site, there are three areas of concern: performance, accuracy and functionality.

Network and server performance is where it all begins. A slow server over a slow network will yield less-than-ideal results. Cameron Laird and Kathryn Soraiz professed in *WebServer OnLine's* June WebAdmin column, "Web Server Speed Tests" (see `http://webserver.cpg.com/wa/3.6`), that "performance should always be understood in relation to a specific goal." In other words, the right solution depends on what the goals of the site are. In addition to their advice, they offer a handy script for measuring server performance. In this column, I will look at another way to increase performance, without increasing the speed of the server or the amount of bandwidth–namely, to squeeze fewer packets through the bandwidth you already have available.

Making sure the syntax of your site and its links are correct is perhaps even more important. Aside from your site actually being down, there's nothing more embarrassing than HTML errors or bad links. Fortunately, these problems are easy to fix and just require a little time to implement.

Finally, proper site functionality is the most difficult to test because it is somewhat fuzzy and impossible to completely test. How robust is your site? Does it

work only on Version 4.0 browsers? Is it browser specific? Does it work on all platforms? These questions are especially important if you are adding a lot of bells and whistles that will sometimes work only on a particular browser or platform. Because fixing a site that is functionally inept is a difficult task at best, it's important that the issue is dealt with during the design phase so that problems don't arise when the site goes public. This is not to say you should develop for everybody, but browser and platform compatibility need to at least be considered and a decision made as to your site's requirements.

Although there are a number of commercial tools available for doing these kinds of tests, I want to focus on the Web-based tools you can use for free this very minute.

Performance Enhancing

One way to increase the performance of your Web site is to reduce the size of the pages you are sending to the client. Although this will not increase your bandwidth, it will decrease the number of bytes you are actually sending, thus, increasing effective bandwidth.

The free HTML Page Squisher from Imagiware (see "Useful Online Testing Resources"), will strip away any unnecessary HTML information. You probably think the amount of extraneous text is negligible in terms of saving bandwidth. Suprisingly, you can save quite a bit. I ran a test on the table of contents page from last month's *WebServer OnLine* (see `http://webserver.cpg.com`) and found that while only a little under 11 KB in size, after stripping away the extraneous HTML with Page Squisher, the document was reduced nearly 30% to 8 KB. Although it's true that for a single hit this is a tiny saving, after 10,000 hits, you could save nearly 30 MB! Stripping away the HTML like this makes the page's source hard to read, and because *WebServer OnLine* is hand-edited, such squishing may not be for everyone. Imagiware also offers an HTML Formatter, which indents markup blocks to make the HTML source more readable.

Another way to ease the bandwidth problem is to reduce the size of your images. Most developers have probably never heard of the "browser-safe" color palette (which contains only 216 colors common to Microsoft Corp.'s Internet Explorer and Netscape Communications Corp. Navigator), nor do they tend to experiment with different image-compression formats. GIF Wizard from Raspberry Hill Publishing Inc. (`http://www.gifwizard.com`), GIF Lube from AtWeb and GIFBot from Monte Sano Software (see "Useful Online Testing Resources") will examine your images and offer more bandwidth-efficient, compressed versions. Of course, if you're already using an image-creation tool like Macromedia Inc.'s FireWorks (`http://www.macromedia.com/software/fireworks`) or ImageReady from Adobe Systems Inc. (`http://www.adobe.com/prodindex/imageready/main.html`), such a test won't be necessary because these tools do the optimization for you.

If you think the size of your images are already tiny, take a closer look. GIF Wizard, for example, reduced my site's logo from a 19-KB GIF to just 7.6 KB by using a 16-color palette–a reduction of nearly 40%!

One way to increase the performance of your site is to reduce the size of the pages you are sending to the client.

Link Checking

There's nothing more embarrassing than to get email from someone telling you there's a broken link on your site. Fortunately, it is one of the easiest problems to fix because link checking can be automated. Monte Sano Software's Link Check, for example, will check up to 200 pages or 500 links for free. If you have more than that, I suggest you check out Linklint 2.1 (`http://www.goldwarp.com/bowlin/linklint`), a Perl shareware program from Bowlin Software and Consulting.

HTML Validation

There are several tools available to check for HTML source accuracy. Staying current with HTML specifications ensures that your documents are portable and that different browsers will accurately render them.

The World Wide Web Consortium (W3C) offers a free, online validation service, which is based on a Standard Generalized Markup Language (SGML) parser (see "Useful Online Testing Resources"). HTML is, simply stated, an SGML application that is defined through a Document Type Definition (DTD) file. The validator works by checking your HTML code against the concrete rules defined in the DTD.

Useful Online Testing Resources

- AtWeb Inc.'s Web Site Garage (`http://www.websitegarage.com`) has a whole host of tests available, including a browser compatibility check, link check, spell check and a somewhat subjective page design check.
- Imagiware Inc.'s Doctor HTML site (`http://www2.imagiware.com/RxHTML`) tests for a wide range of problems by examining HTML, spelling and links. There is also an HTML Formatter to help lay out your source and an HTML Page Squisher to weed out extraneous text from your HTML.
- Monte Sano Software LLC's NetMechanic site (`http://www.netmechanic.com`) offers a number of resources, including an online HTML validation tool that can evaluate your site for HTML 4.0-compliance, an image size-reduction tool, a tool for checking links and a server speed testing tool.
- The World Wide Web Consortium (W3C) offers an online HTML Validation Service (`http://validator.w3.org`), which validates HTML 4.0 pages.

To validate your pages, you have to declare your document type by adding a bit of markup to the top of your page. For strict HTML Version 4, without the use of Cascading Style Sheets (CSS) or frames, you would start with the following line:

```
<!DOCTYPE HTML PUBLIC "_//W3C//DTD HTML 4.0//EN"
"http://www.w3.org/TR/REC-html40/strict.dtd"
```

To validate using CSS or frames, the document type declaration is slightly different and explicitly defined at the W3C Web site.

Once you have taken care of conforming to the HTML 4.0 recommendations, you can make it clear to your visitors that you have designed a validated page by including the validator logo on your site and a link to the W3C site to validate your page, as shown in Figure 1.

Browser Compatibility

Everyone knows that testing your site on different browsers can be a real hassle because it requires many configurations. The Web Page Backward Compatibility Viewer from Delorie Software (`http://www.delorie.com/web/wpbcv.html`) is a Perl script that will display your page by showing only those features you select.

AtWeb's Browser Snapshot will display 18 screen shots in various browser versions (Netscape 2.0 through 4.0 and Internet Explorer 3.0 and 4.0) for a fee of $9.99 per single use or $99.99 per annual license fee for one URL.

To find out more about these and other Web-based tools, be sure to check out CIO Communications Inc.'s list of Web resources (`http://www.cio.com/resources`), Lynda Weinman's Web links (`http://www.lynda.com/dwg/links.html`), Mecklermedia Corp.'s Web Developer's Virtual Library (`http://www.wdvl.com`) and Rick Hower's Software QA/Test Resource Center (`http://www.charm.net/~dmg/qatest/qatweb1.html`).

Now that you have several concrete Web-based testing tools under your belt, you may want to do some subjective testing. A site can be completely accurate, have images as small as possible and still "look terrible." Unfortunately, testing does not measure aesthetics. So, if you're bored and looking for something to do during lunch, besides blindly surfing around the Web, do a little testing. Your Web site, and your visitors, will thank you.

Figure 1. Adding the Validator Logo

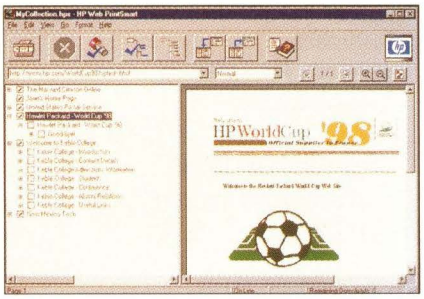
```
<A HREF="http://validator.w3.org/?http://www.yourserver.com/page.html"<IMG
BORDER=0 SRC="http://www.yourserver.com/validator.gif" ALT="Valid HTML
4.0!" HEIGHT=31 WIDTH=88</A
```

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

URL/New Products

PrintSmart Scans, Formats, Prints Web Data

Hewlett-Packard's Web PrintSmart 1.0 is said to automatically search for and print information found on the Internet without user intervention.



PrintSmart will scan Web sites, search keywords and automatically format and print the results, HP says. Business users can schedule PrintSmart to generate and print reports while they are away from the office and can program it to regularly search for specific information on the Web, such as classified ads for a particular product, industry press releases or news articles about competitors. The application allows users to add a table of contents, page numbers and an index of links, as well as change the style and size of fonts. Web PrintSmart works with all HP LaserJet and DeskJet printers and can be downloaded for free from the company's Web site.

Hewlett-Packard Co.
3000 Hanover St.
Palo Alto, CA 94304
http://www.hp.com
Circle 176

Web Mining, Traffic Analysis Tool

Marketwave has announced Hit List Commerce Edition, the latest addition to the company's Hit List product line. With Commerce Edition, Marketwave says, users can perform Web analysis to discover business correlations and trends by integrating and analyzing Web traffic with business data. This latest version features on-the-fly calculations, a QuickList X-Treme tool for processing large volumes of Web traffic data and DNS Xpress for performing large volumes of reverse Domain Name System (DNS) lookups in parallel without affecting the Web Server.

Available for $995, Hit List Commerce Edition runs on Windows 95/98/NT, but supports Web servers on any platform and links to any ODBC-compliant database. In addition, Marketwave offers data collectors that run on Solaris. The only requirement is that analysis and report generation must be done on Windows-based machines.

Marketwave Corp.
Two Union Square, 46th Floor
Seattle, WA 98101
http://www.marketwave.com
Circle 177

Oracle Serves Up Multimedia

Oracle has announced Oracle Video Server 3.0, a software package for delivering video and audio on the Web. Oracle Video Server 3.0 includes

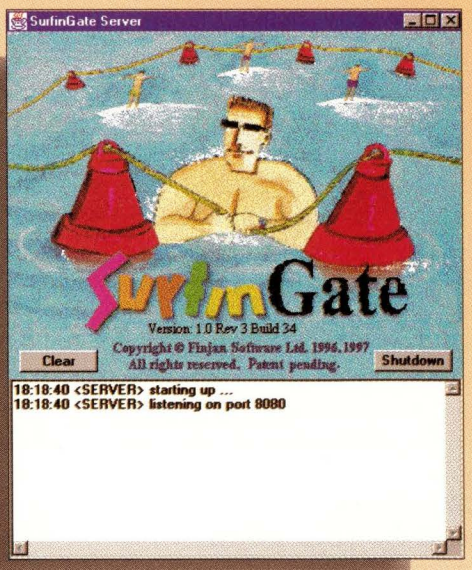
Mobile Code Security Inspector

Finjan has introduced a server-side solution, SurfinGate 4.0, that it says allows the secure deployment of Java and ActiveX through content inspection, as well as secure access control for JavaScript, Visual Basic Script and cookies.

Through dynamic resource allocation of HTTP requests, this latest version of SurfinGate can reportedly handle an increased number of client mobile code requests, improving performance on the Internet or corporate intranet for large-scale organizations with thousands of users. SurfinGate 4.0 boosts performance by redirecting only mobile code elements, such as Java and ActiveX, to the SurfinGate server instead of requiring all HTML content to pass through it, the company says.

Pricing for SurfinGate 4.0 ranges between $1,250 and $18,500, depending on platform and number of users. It runs on Solaris 2.5.1/2.6 and Windows NT.

Finjan Inc.
2860 Zanker Road, Ste. 201
San Jose, CA 95134
http://www.finjan.com
Circle 175



support for Digital Video Broadcast (DVB) standards, and can deliver data over Digital Subscriber Loop (DSL), digital cable networks, satellite systems and standard LAN networks. Oracle has added several new features to this latest release, including fast-forward, rewind, pause and play, which allow viewers to control video playback. In addition, content providers can schedule and broadcast programs at predetermined times, Oracle says.

Oracle Video Server 3.0 supports the Video Encoding Standard API for connecting real-time video encoders to video storage devices and comes with RAID-protected disk storage and automated near-line robotic tape storage devices. A point-and-click Java-based user interface is provided for easy management, the company says. Pricing for Oracle Video Server 3.0 is $295 per concurrent stream.

Oracle Corp.
500 Oracle Pkwy.
Redwood Shores, CA 94065
http://www.oracle.com
Circle 178

Proxy Server Combination Tool

Start-up CSM-USA has introduced a product that is said to cover a variety of business needs such as firewall protection, access-control filtering, message privacy, organizational distribution and cost effectiveness in one package. CSM Proxy 4.1 Enterprise Edition is designed to help users alleviate incompatibility problems between software from different vendors.

According to the company, CSM Proxy 4.1 Enterprise Edition is scalable enough to fit organizations with as few as two or as many as 10,000 clients. It operates on Solaris, Linux, Windows 95/NT or Digital Alpha platforms, but will serve virtually any native application. CSM Proxy 4.1 Enterprise Edition is priced at $995; a free, 30-day trial version is available from the company's Web site.

CSM-USA Inc.
360 S. Fort Lane, Ste. 1B
Layton, UT 84041
http://www.csm-usa.com
Circle 179

UNIX Web Server Log/Analysis Package Out

Urchin ISP 1.3 from Quantified Web Systems is specifically designed for Internet service providers (ISPs) and Web hosting companies. It is a Web site/Web server statistics application for Solaris and IRIX platforms. Support for more flavors of UNIX is on the way, the company says.

Designed to run on a nightly basis, Urchin will create Web-based reports for every Web site running on a server and build a Webmaster Report, which compares all the sites on a machine and ranks them according to transferred data (measured in megabytes), the company says. In addition, Urchin sends out a weekly email report to the Webmaster of each site with a brief synopsis of site activity, including hits, visitors, the top five referrers (with links) and a link to where the complete report can be viewed online. Urchin ISP 1.3 costs $349; a trial copy can be downloaded from the company's Web site.

Quantified Web Systems Inc.
2165 India St.
San Diego, CA 92101
http://www.quantified.com
Circle 180

Business-to-Business Internet Sales

Nucleus Information Systems has announced enhancements to its CoreCommerce software suite. CoreCommerce is designed specifically for business-to-business Internet sales and enables firms to offer real-time product selection, pricing, availability, order placement, shipment and invoice tracking on commerce sites, the company says. New features include online returns processing–allowing customers to access invoices and indicate items they might wish to return–and shipment tracking, with support for Federal Express Corp. (FedEx), United Parcel Service of America Inc. (UPS) and Airborne Express services. In addition, CoreCommerce offers electronic data interchange (EDI) transaction support. CoreCommerce runs on UNIX and Windows NT platforms; pricing starts at $100,000.

Nucleus Information Systems LLC
1500 Broadway, 31st Floor
New York, NY 10036
http://www.nis-inc.com
Circle 181

Embedded Web Server Upgrade

Agranat Systems has released Version 3.50 of EmWeb, its embedded Web server. This latest release adds EmWeb macros and new run-time APIs that support the Internet Printing Protocol (IPP). The new macros reportedly allow customers to develop interactive and dynamic Web-based interfaces without having to write code or recompile the embedded application. In addition, IPP support enables corporations to send in-house presentations over the Web to a commercial printer for enhancement and duplication, the company says.

EmWeb allows developers to embed C code in HTML documents, providing dynamic content, and to integrate HTML forms with applications quickly and easily, the company says. EmWeb fully supports XML, HTTP 1.1, Transparent Content Negotiation (TCN) and HTML. EmWeb works with any standard browser, while maintaining a 25-KB footprint.

Pricing varies according to the number of seats and platforms required; contact company for details.

Agranat Systems Inc.
1345 Main St.
Waltham, MA 02154
http://www.agranat.com
Circle 182

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.

Automating DNS Admin

DNS Boss has introduced a GUI management tool that helps automate and streamline Domain Name System (DNS) maintenance. Using a Solaris-based GUI, DNS Boss reportedly automates the installation and maintenance of DNS primary, secondary or caching-only servers.

Additional features include automatic creation of forward, reverse and loopback DNS databases for hundreds of domains; automatic increments of DNS database serial numbers; "safe mode" deployment, to preview changes before they are propogated to the production environment; and secure access to DNS databases, to prevent unauthorized users from making changes to DNS data.

DNS Boss is available for SPARC or x86 platforms running Solaris 2.5 or 2.6. Pricing is based on the number of hosts being served and starts at $1,000 for 10 hosts (a free trial version is available via the Web).

DNS Boss
100 E. Middlefield Road, Ste. 5-B
Mountain View, CA 94043
http://www.dnsboss.com
Circle 101

Fibre Channel Storage for OLTP

The Gladiator 6300 Array from MTI Technology is said to provide fault-tolerant storage for high-volume online transaction processing (OLTP) environments and large enterprise database applications. The Gladiator's Fibre Channel architecture supports speeds up to 100 MB/s and permits up to 128 devices to be connected at distances up to 10km using copper and optical cables, MTI says.

Gladiator 6300 features more than 300 million instructions per second (MIPS) of processing power, up to 64 MB of processor cache and up to 256 MB of mirrored write-back cache, plus a built-in system to monitor, configure and provide alert status via a standard Ethernet network connection.

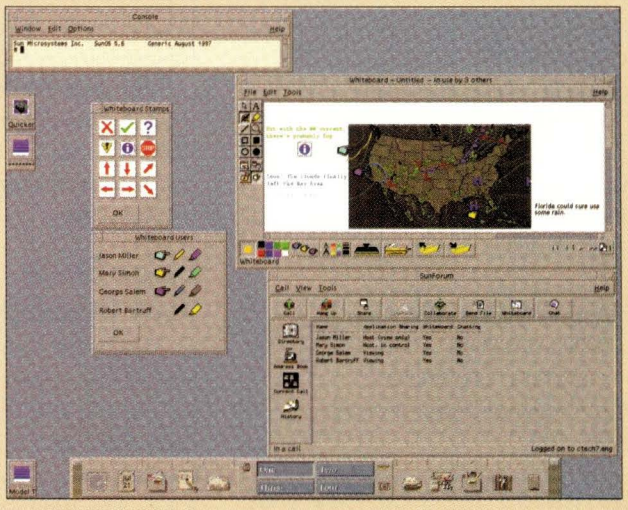
In addition, Gladiator 6300 implements multiple RAID levels including 0, 2, 0+1 and 5–and supports several operating systems, including Solaris, AIX, HP-UX and Windows NT. Gladiator 6300 Array configurations can be scaled from 18.2 GB to 1.7 TB of usable storage capacity in a single cabinet.

SunForum Suite Debuts

Solaris users can now conduct real-time collaboration with colleagues on Windows and Macintosh machines thanks to Sun Microsystems' SunForum suite of data conferencing tools. Designed to work with any operating system that has a data conferencing program adhering to the International Telecommunications Union (ITU) T.120 standard, SunForum features an electronic whiteboard application, file transfer utility, chat utility and a shared clipboard, Sun says.

Available for free from Sun's Web site at `http://www.sun.com/desktop/products/software/sunforum/index.html`, SunForum is said to allow multiple users to view the same content on their workstation screens, wherever they may be. The application host determines whether to allow shared control–for collaboration–or to provide view-only access.

Remote users participating in a conference need to be running either the SunForum application, Microsoft Corp.'s NetMeeting, PictureTel Corp.'s LiveShare Plus or another T.128-based shared application utility. However, users don't need to have a copy of all the other applications being shared in the conference. For example, Microsoft Word does not have to be loaded on each client in order for participants to be able to view and manipulate a shared Word file. When in "collaboration" mode, participants can make changes to the document as if it was loaded on their own system, Sun says. The whiteboard application provides a common desktop conference board in which a user can reportedly "snap" any text or graphics displayed on their monitor and make changes using annotation tools, or personalized pens and highlighters. Different colors on the whiteboard distinguish who made what changes.



In addition, the suite's text-based chat utility is designed to ensure that participants can communicate with one another even when using a low-bandwidth connection.

SunForum is designed for the Sun Ultra workstation running Solaris 2.5.1+. Installation requires 10 MB of disk space and a TCP/IP connection.

Sun Microsystems Inc.
901 San Antonio Road
Palo Alto, CA 94303
http://www.sun.com
Circle 100

Pricing ranges from $53,200 for an entry-level system to $535,500 for a fully configured system.

MTI Technology Corp.
4905 E. La Palma Ave.
Anaheim, CA 92807
http://www.mti.com
Circle 102

New Line of Switches, Hubs

Edgepoint Networks has announced several new Ethernet switches and switchable hubs. The new product line, called EdgePlus, is divided into three groupings: EdgeStar 200, EdgeStack 300 and EdgeSwitch 400.

EdgeStar 200 comprises two models: one switch comes with 12 10-Mb/s dedicated ports and two autosensing switchable 10/100 ports, the other offers twice as many 10-Mb/s dedicated switched ports and two autosensing switchable 10/100 ports.

EdgeStar 200 switches support network management functions such as RMON, MIB and in-band management for Telnet. SNMP support can also be added, the company says.

EdgeStack 300 is a 16-port autosensing 10/100 fully switchable hub that is stackable. EdgeSwitch 400 is a dedicated switch providing autosensing 10/100 capabilities on each of 12 ports and is designed to function as a central switch.

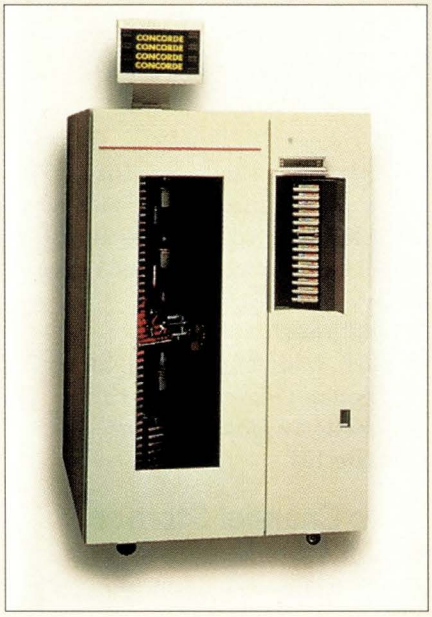
The EdgePlus product line is sold through resellers and distributors; contact company for pricing.

Edgepoint Networks Inc.
2238 Martin Ave.
Santa Clara, CA 95050
http://www.edgepoint.com
Circle 103

Automated Tape Library Out

Concorde Technologies has launched the 60/3000 OpenScale Tape Library. It incorporates Digital Linear Tape (DLT) and supports mixed media, multiple host connections and offers advanced pass-through capabilities, the company says.

Users have the ability to link together six library modules as well as automatically allocate and manage drives, Concorde says. It supports DLT4000, DLT7000, 36-track 2x-3490E and



Storage Technology Corp.'s helical-scan Redwood (SD-3) tape drives. Each library module can be configured with with up to 10 DLT drives, or four 2x-3490E or Redwood tape drives.

A fully configured 60/3000 tape library can hold 60 DLT drives and nearly 3,000 DLT cartridges using either DLT4000 or DLT7000 tape drives. Pricing for the 60/3000 OpenScale Tape Library starts at $92,000.

Concorde Technologies Inc.
9770 Carroll Center Road, Ste. F
San Diego, CA 92126
http://www.concordetech.com
Circle 104

Large-Scale Java Development Suite

Metamata, a start-up formed by ex-Sun Microsystems Inc. employees, has announced the first four components that make up its integrated, advanced productivity and quality Metamata Suite 1.0.1. The products–Metamata Browse, Metamata Debug, Metamata Audit and Metamata Metrics–reportedly complement and enhance standard visual integrated development environments (IDEs) for building mission-critical applications in Java. Metamata says it has designed this suite of products with a core Java engine ensuring seamless integration, as well as the ability to add new components easily.

The components are as follows: Metamata Browse is an intelligent Java source code browser; Metamata Debug combines a Java command-line interpreter and a fully functional debugger for debugging large-scale applications; Metamata Audit is a source code quality analysis tool, which evaluates code for programming errors and style issues against standard Java principles and coding practices; and Metamata Metrics calculates static metric measurements incrementally on different portions of Java source code.

The Metamata Suite works with any Java 1.1 runtime environment and all four components offer a full Java Developer's Kit (JDK) 1.1-compatible Java front end and execution environment.

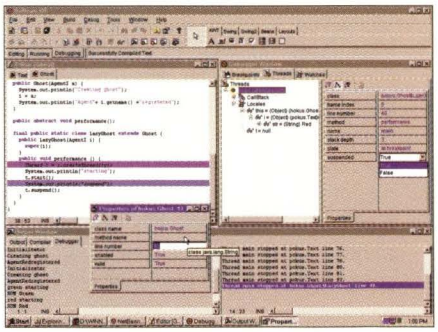
A basic version of Metamata Browse is free from the company's Web site (an advanced version costs $95). Metamata Debug and Metamata Audit cost $295 and $395, respectively, and Metamata Metric is priced at $500 for the basic version and $995 for the advanced version (volume discounts are available).

Metamata Inc.
2140 Peralta Blvd., Ste. 213B
Fremont, CA 94536
http://www.metamata.com
Circle 105

IDE Based on JFCs

NetBeans has announced what is reportedly the first integrated development environment (IDE) built entirely in Java and based on the Java Foundation Classes (JFCs) framework. NetBeans IDE uses the JavaBeans component model, which, when combined with the IDE's extensive use of templates, wizards and code generators, makes for a consistent and easy-to-use development environment, the company says.

NetBeans IDE can be used on a wide variety of platforms, the company says, including Windows NT, OS/2,



Linux, Solaris and other flavors of UNIX, including some JavaVirtual Machines (JVMs). The IDE itself is made up of JavaBeans components and can be used during all phases of development (editing, compilation, execution and debugging), the company says. NetBeans IDE also adheres to the Java Developer's Kit (JDK) 1.1 JavaBeans event model.

NetBeans IDE ships in two versions: Developer and Enterprise. NetBeans Developer is designed to work from a desktop PC and provides developers with JavaBeans components, a JFC-based forms editor, an integrated debugger, a text editor with syntax coloring, applet generation support and multiple virtual desktops. NetBeans Enterprise is intended for use in multiuser, multiplatform environments and enables users to design distributed applications based on Java Remote Method Invocation/Common Object Request Broker Architecture (RMI/CORBA) frameworks, share virtual file systems, debug remotely and access source control systems, the company says.

Currently in beta, NetBeans IDE is 100% Pure Java-certified and can be downloaded for free from the company's Web site. It is scheduled for full release later this year; pricing will be announced at that time.

NetBeans Inc.
Pod Hajkem 1
180 00 Prague 8
Czech Republic
http://www.netbeans.com
Circle 106

Software Management Service Unveiled

Intraware has announced SubscribNet, a software update management service designed to track more than 50 applications from a broad range of vendors. With SubscribNet, IT professionals can receive notification on software downloads, bug fixes and updates, the company says. In addition, the service offers a centralized account management program for applications.

Intraware provides only relevant information regarding a user's licensed software. For example, when a new version is available for a specific license, Intraware will notify the customer of its availability.

SubscribNet can track downloads and purchases by account, department and contacts throughout an organization, the company says. In addition, users can post notes throughout their enterprise regarding a software release to provide feedback on things such as installation, internal testing or version standards. Applix Inc., Check Point Software Technologies Ltd., Marimba Inc., RealNetworks Inc., Oblix Inc. and Netscape Communications Corp. are just a few of the companies that have their software tracked by the SubscribNet service.

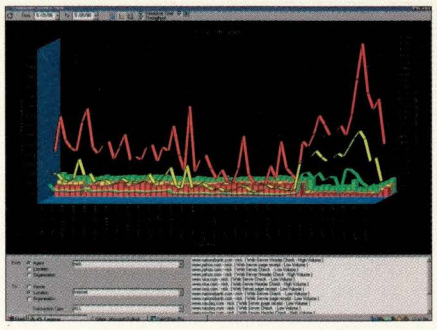
SubscribNet is priced either as a percentage of software pricing or on a per-product basis; contact company for details.

Intraware Inc.
25 Orinda Way
Orinda, CA 94563
http://www.intraware.com
Circle 107

Tool to Prevent Application Brownouts

By measuring the performance of an application as it is experienced by end users, Response Networks says it can help reduce the incidence of application "brownouts," that is, when applications become so slow they are almost unusable. To this effect, the company has introduced VeriServ 1.0, a Verified Service Level Management (VSLM) tool, which measures application availability and response time across departmental and geographic boundaries, supply chains, extranets and virtual private networks (VPNs).

The company says VeriServ is successful where other monitoring tools fail because other products are network- or systems-centric, don't scale well or cannot cross organizational boundaries. Unlike other tools, which deduce application performance by analyzing a collection of network statistics, VeriServ reportedly runs real-time end-to-end tests to determine actual application response time. VeriServ can also provide early warning monitoring; real-time and historical reporting and analysis; extensibility to third-party



applications; and platform, network and operating system independence.

Pricing is based on usage and starts at $10,000. It's available for Windows NT or 95, with a Java/UNIX version scheduled for release later this year.

Response Networks Inc.
700 N. Fairfax St., Ste. 210
Alexandria, VA 22314
http://www.responsenetworks.com
Circle 108

Gateway to Manage Network Devices

Legato Systems has announced a new media management product aimed at distributed enterprise systems with complex media and device management needs. Legato SmartMedia acts as a gateway for device and library sharing, controlling application requests for media from a central location. Centralized management of distributed libraries means increased manageability and an overall reduction in operational costs, the company says.

Legato SmartMedia reportedly monitors each connected device, providing timely information, such as drive errors or temperature readings that require immediate action, to ensure higher device availability. Instead of dedicating drives to an application and having them sit idle while other applications are left requiring more drives than they are assigned, SmartMedia enables users to share drives across all applications, Legato says.

The software is available for Solaris and Windows NT. Pricing for SmartMedia starts at $5,175.

Legato Systems Inc.
3210 Porter Drive
Palo Alto, CA 94304
http://www.legato.com
Circle 109

Upgrades, Enhancements, Additions...

■ Intuitive Systems has released OptimizeIt 2.0, a Java language profiling tool. OptimizeIt can reportedly help developers test and improve the performance of Java applications, applets and JavaBeans by helping them identify problems, such as excessive memory allocation or inefficient processor use. This latest version includes an improved CPU and time profiler, as well as a new object reference browser. Also included are "hot spot" detectors and the ability to export data as ASCII or HTML, the company says. Priced at $389, OptimizeIt 2.0 is available for Solaris and Windows NT. **Intuitive Systems Inc.,** 599 N. Mathilda Ave., Ste. 19, Sunnyvale, CA 94086, *http://www.intuisys.com.* **Circle 110**

■ Storage Computer's StorageSuite line can now accept 18-GB disk drives, effectively doubling the capacity and improving performance over the current version. Equipped with the new 7,200 RPM 18-GB drives, the company's StorageSuite products can provide more than 870 GB of usable space, simply by replacing existing drives (replacing the storage controller is not necessary, the company says). Pricing ranges from $60,000 to $650,000 at approximately $0.67/MB. **Storage Computer Corp.,** 11 Riverside St., Nashua, NH 03062, *http://www.storage.com.* **Circle 111**

■ TriTeal has announced WinTED 3.0, the latest release of its integration software tool that allows Windows desktops to access, execute and display UNIX applications and files. With WinTED 3.0, users have access to multiple UNIX and NT network resources directly from a Windows desktop, the company says. New features include an Application Integrator, which gathers applications, file types and icon data from multiple UNIX servers and integrates that data into the Windows Start and Explorer menus. This enables UNIX and Windows files to coexist and allows users to launch UNIX and Windows files from the same desktop. TriTeal has also added a new toolbar for launching applications, called Front Panel, which includes configurable hot keys, support of for large and small icons and autodock and autorotate capabilities. WinTED 3.0 costs $248 and supports Solaris 2.5 and 2.6, HP-UX 10.20, AIX 4.1.3 and 4.2.1, IRIX 6.2, 6.3 and 6.4, and SunOS 4.1.3 and 4.1.4. **TriTeal Corp.,** 2011 Palomar Airport Road, Ste. 200, Carlsbad, CA 92009, *http://www.triteal.com.* **Circle 112**

■ Computer Associates International has announced Enterprise/Remote Site Management (E/RSM), an extension to the company's Unicenter TNG management tool. With E/RSM, remote devices, such as desktops in field offices or laptops used by a mobile sales force, can be managed via Unicenter TNG enterprise management and control functions. It enables IT managers to update software, synchronize email, maintain inventory and asset control, update virus protection, as well as examine disk space and identify deficiencies to correct problems before they occur, the company says. Because these remote sites connect to the central office through dial-up lines, E/RSM is said to provide built-in authentication and encryption capabilities as well as checkpoint restart in case file transfers are interrupted. The server component of E/RSM runs with Unicenter TNG, while the client is located on the distributed desktop. It provides enterprise management for TCP/IP, SNA, IPX/SPX and DECnet networks, and works on a broad range of operating systems, including Solaris, AIX, HP-UX, IRIX, Windows NT and NetWare. Pricing starts at $2,500. **Computer Associates International Inc.,** One Computer Associates Plaza, Islandia, NY 11788, *http://www.cai.com.* **Circle 113**

■ Marimba has remodeled its Castanet product, an erstwhile leader in the push marketplace, for use as an application distribution and management (ADM) tool. With Version 3.0, Castanet can now maintain applications that reside inside or outside the firewall, as well as distribute applications written not just in Java, but in Visual Basic, C and C++, the company says. When included as part of Marimba's product suites, Castanet 3.0 includes a certificate manager and license installer; new application and file packagers; and a Tuner packager, transmitter reporter and channel copier. Pricing for Castanet 3.0 starts at $10,000. **Marimba Inc.,** 440 Clyde Ave., Mountain View, CA 94043, *http://www.marimba.com.* **Circle 114**

■ Rational Software has announced the latest version of its performance profiler, Quantify. With Quantify 4.2, developers can optimize application performance by identifying bottlenecks. Rational has added support for Java in addition to C/C++ applications. With a Java monitoring interface, each byte of Java code is timed as it runs through the Java Virtual Machine (JVM). This information is correlated with Java source codes and components to give developers detailed timing data on the entire application, the company says. Quantify supports the profiling and optimization of mixed-language applications and works with JVM 1.1.6 for Java on Solaris. It is priced at $1,398, plus $250 for support. **Rational Software Corp.**, 18880 Homestead Road, Cupertino, CA 95014, *http://www.rational.com.* **Circle 115**

■ Smart Storage has announced it's shipping a UNIX version of SmartCD software. Available for HP-UX, AIX and Solaris, SmartCD 3.5 for UNIX is said to improve the performance and manageability of a CD storage system. New features include a GUI, enhanced device support and licensing module. The new GUI enables all jukebox functions to be managed centrally, including configuring devices, adding CDs, building and mounting a file system, setting and controlling cache size and recording CDs. Smart Storage says the new licensing module enables it to offer all of its UNIX products in evaluation versions. Available via the company's Web site or demo CD, these versions are fully functional and "live" for 14 days. SmartCD 3.5 for UNIX supports devices from Cygnet Storage Solutions Inc., JVC Information Products Company of America, Kubik Enterprises Inc., Panasonic Communications and Systems Co., Pioneer New Media Technologies Inc., Plasmon Data Inc., Plextor (a subsidiary of Shinano Kenshi Co. Ltd.) and Sony Electronics Inc. and costs $580. **Smart Storage Inc.,** 100 Burtt Road, Andover, MA 01810, *http://www.smartstorage.com.* **Circle 116**

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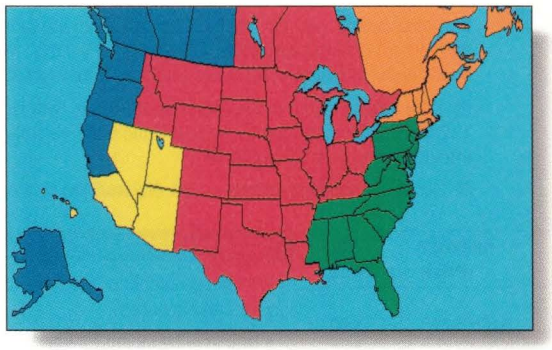

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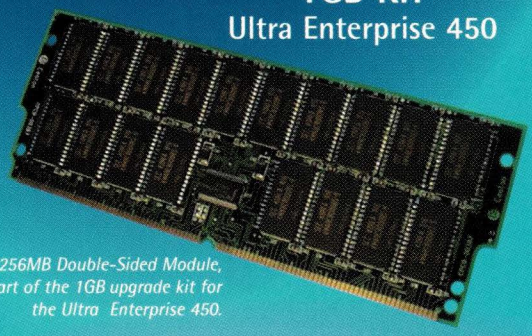
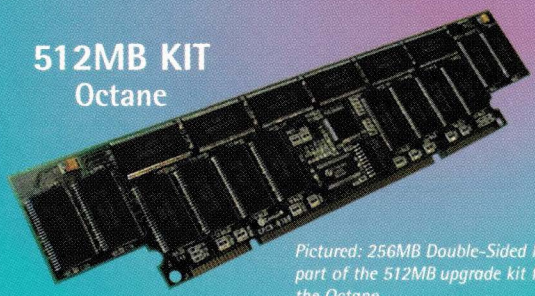


Pictured: 256MB Double-Sided Module, part of the 1GB upgrade kit for the Ultra Enterprise 450.

512MB KIT
Octane



Pictured: 256MB Double-Sided Module, part of the 512MB upgrade kit for the Octane.

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