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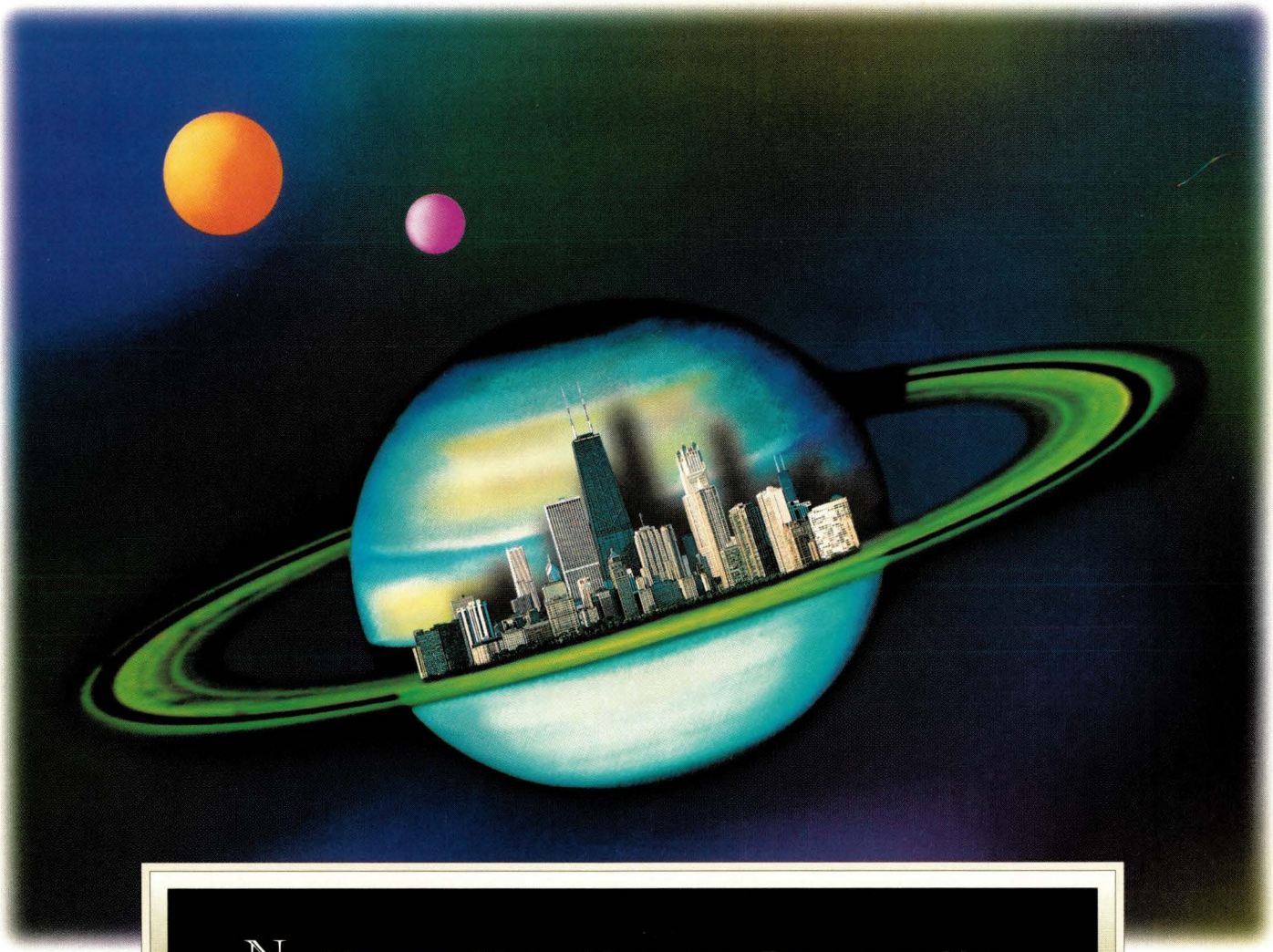

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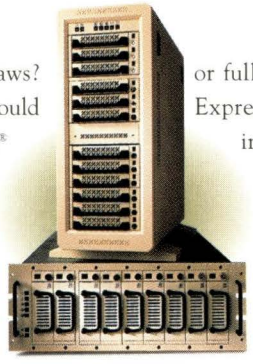

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Rebecca Ruegger

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SUNEXPERT
serves the UNIX workstation environment, emphasizing Sun, SPARC and Sun-compatible systems.

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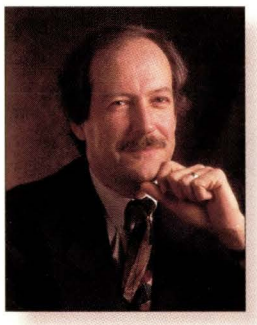
Editorial

Getting with the Programming

If your list of New Year's resolutions mentions anything involving Java or object-oriented programming, you'll want to look closely at this month's feature section–and perhaps have your head examined, but that's another story.

Leading off the section is Jeff Sutherland, senior vice president of engineering at IDX Systems Corp., Boston, MA. IDX develops information systems for the health care industry. Jeff's feature, called "The Java Revolution," makes a number of points about the relationship among Java, and C++, Microsoft, Netscape and Sun that frankly had not occurred to me. He says, "The combination of Sun Microsystems Inc.'s Java and Netscape Communications Corp.'s Navigator is the first credible strategy to free the software industry from the iron grip of Microsoft Corp." In essence, the combination is a Trojan horse inside the Microsoft fortress. That sentence is the inspiration for the cover illustration and fighting words among many industry pundits. He also makes a strong case and gives concrete examples of how component-based software design with advanced development environments combined with methodologies that promote reuse can ameliorate the widely acknowledged software crisis.



"Learning to Program the Object-Oriented Way," by Robert I. Pitts, takes you step-by-step through a discussion of a usable C++ program. Along the way, Robert gives some pointers (no pun intended) about object-oriented concepts and clarifies a few object terms such as encapsulation, inheritance and polymorphism. You'll want to pay special attention to his figures. By tracking through all of them, you'll get a pretty good fix on the relationship, especially the contrasts, between C and C++.

If you were just beginning to think that Java was bad for your health, take a look at the lead news item for this month. Sun's new JavaStation has been sighted on and about the network.

Doug Pryor

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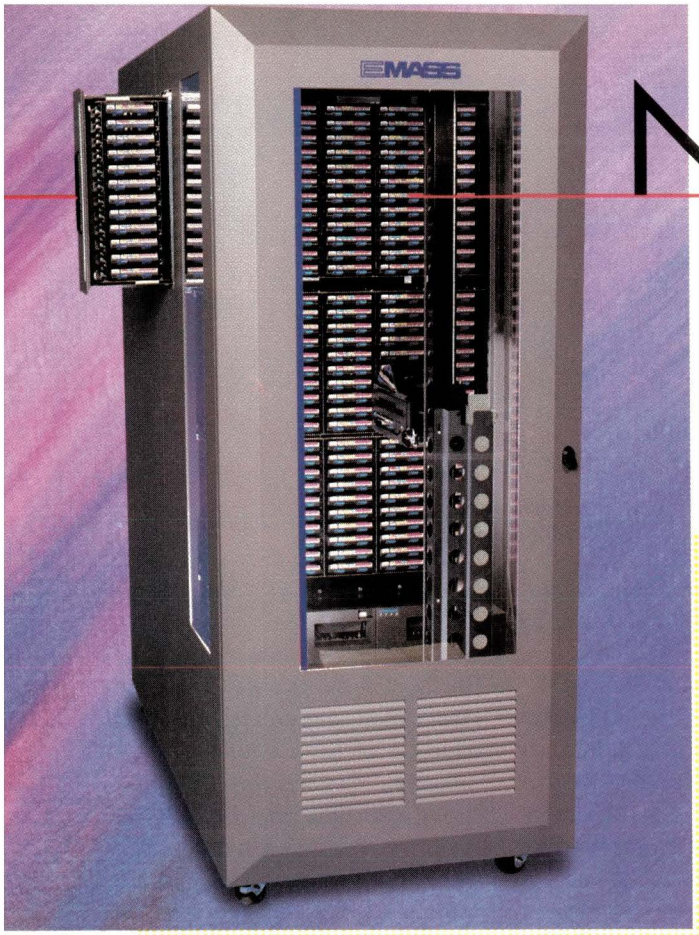

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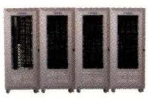
Add Three Expansion Modules		788	27.6 TB	16	144 MB/sec

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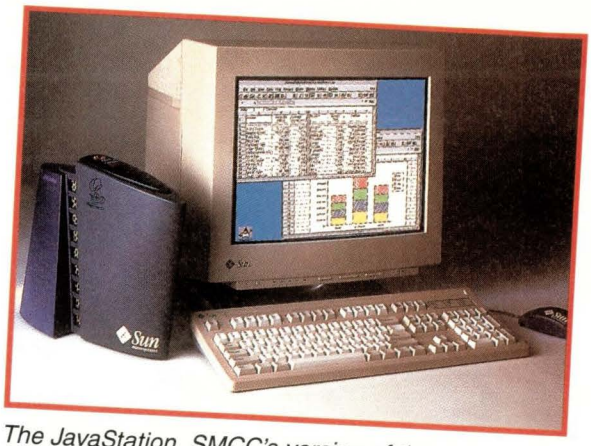
NEWS

JavaStation, Netra j Unveiled

During a lavish two-day media event in New York last October, Sun Microsystems Computer Co. unveiled its version of the network computer–the JavaStation. The JavaStation was announced alongside its companion server, the Netra j. Also, several Sun partners came out in support of the JavaStation initiative, revealing new products and services for the JavaStation environment.

The JavaStation adheres to the NC Reference Profile specification put forth last May by Sun Microsystems, Netscape Communications Corp., Oracle Corp., Apple Computer Inc. and IBM Corp. The JavaStation has a color monitor, keyboard and mouse, audio output and a built-in Internet-style network interface (TCP/IP, HTTP). It also supports standard graphics and audio formats (GIF, JPEG, AU, WAV) and comes with a built-in browser–Sun's HotJava.



The JavaStation, SMCC's version of the network computer.

The first JavaStation release, a low-end model, starts at $750 and is based on a 100-MHz microSPARC-II processor, with 8 to 64 MB of RAM. It includes a PS-2 104/105 keyboard, PS-2 style mechanical mouse, 800-by-600 14-inch color monitor, 10BaseT Ethernet, one RS-232-C synchronous serial port (DB-9), 8-bit indexed color (800-by-600-pixel resolution) and 16-bit CD-quality audio, with speaker and headphone output. It runs Sun's new JavaOS operating system and comes equipped with Sun's HotJava browser as standard.

Brian Haley, product manager for the JavaStation at SMCC, says the JavaStation runs on a microSPARC chip rather than on Sun's Java chip because, "The Java chip isn't quite ready yet…Once the chip gets to that point, we can expect to see much better performance," Haley says. He expects a JavaStation equipped with the microJava (middle-of-the-line) chip by the end of this year.

JavaStation Gets a Reaction

Even before Sun made its JavaStation announcements, the industry was countering them. On October 28, the day before the JavaStation launch, Microsoft Corp. and Intel Corp. made a joint announcement of their intent to build the NetPC. The NetPC, as described by Microsoft, is "a new member of the PC family, not a replacement, which allows PC vendors to build systems…that lower the cost of owning PCs."

In a way, the Windows/Intel Corp. chip-based NetPC can be seen as Microsoft's preemptive defense against the JavaStation. The JavaStation, as well as the host of other network computer devices coming to market, have been positioned as threats to the Windows/Intel PC hegemony of the low-end desktop market. Other network computer vendors that have, or have plans to, come to market with a network computer include HDS Network Systems, Oracle Corp. subsidiary Network Computer Inc. and IBM Corp.

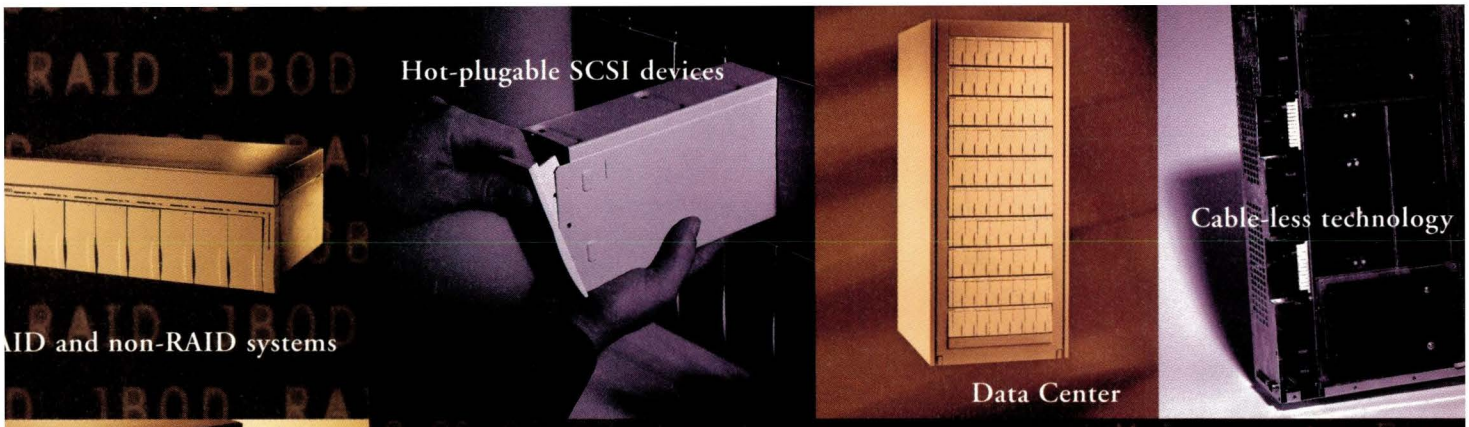
Jeff Morgenthal, program director at D.H. Brown and Associates, a Port Chester, NY-based consulting firm, has his own term for the state of the computer industry: "EAM," or Everybody Against Microsoft. "It's the embodiment of George Lucas' *Star Wars*, with the Jedi knights ganging up on the Evil Empire, hoping that this will be the shot that brings down the Death Star," Morgenthal jokes.

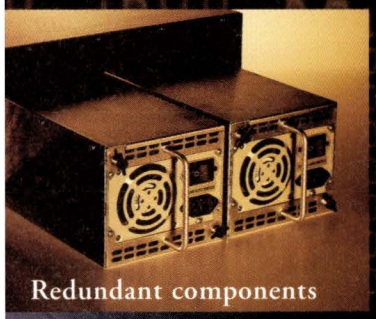
Sun et al's principal ammunition is a dollar amount arrived at by the Gartner Group, a Stamford, CT-based IT research firm. The Gartner Group estimates the cost of owning and maintaining a PC in a corporate networked environment runs to around $11,900 per year. In contrast, Sun Microsystems has arrived at a $2,500 price tag for the JavaStation.

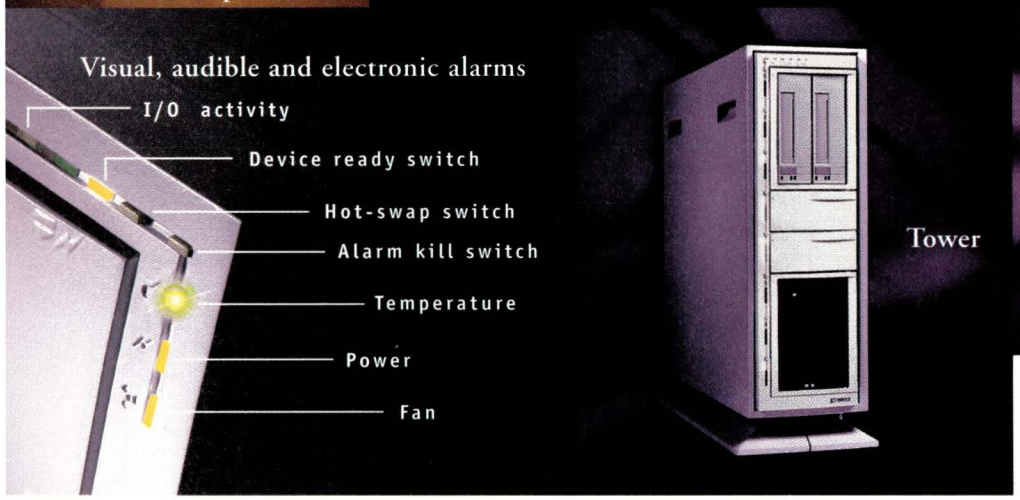
The Gartner Group's cost of ownership figures paint a pretty picture for the NC, and no one disputes the idea that maintaining a PC network is very expensive. However, some analysts are wary of the Gartner Group's figures. "I'd be interested to see how they came up with that number," Morgenthal says.

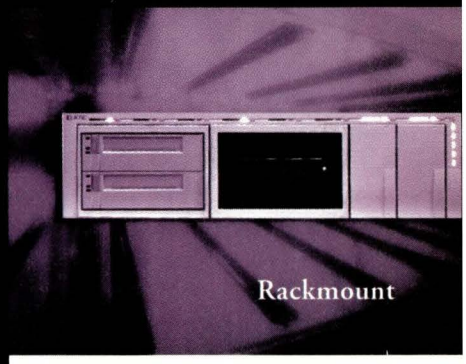
There's also the possibility that there will be hidden costs associated with the JavaStation. Theo Forbath, a consultant for Northeast Consulting Resources Inc., in Boston, points out that "we won't be able to say if there are any hidden costs until they [JavaStations] go into production."

Despite the $11,900 battle cry, Sun is not directly marketing the JavaStation to the PC market, but rather, to environments where a full-fledged PC would be overkill. Forbath says the "JavaStation has the potential to solve very important problems that used to be handled by dumb terminals." Hence, when designing the HotJava Views user environment, Sun engineers looked to the "transaction worker" as their target user rather than the power user, who will probably continue to be serviced by today's high-end Pentiums.–*as*

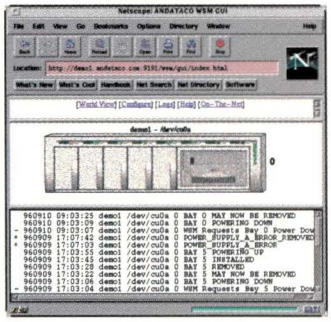








Netscape™ GUI interface



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If you don't like the funky version of the JavaStation, it also comes in a more conventional boxy design.

As integral to the discussion of what the JavaStation does have is what it does not. Most notably, the JavaStation has no hard disk, floppy, CD-ROM, slots, jumpers or moving parts.

The JavaOS is a new offering from JavaSoft and is written entirely in Java. It is said to be a compact operating system that includes the Java Virtual Machine (JVM) and basic system functionality. The operating system itself resides on the server and is downloaded automatically upon start-up, and loaded into memory. It reportedly loads in less than 5 MB of memory, and analysts who saw the JavaStation launch report that the machine took "about a minute" to boot.

In the next six months, the JavaStation will support Flash RAM, says Haley. "The JavaOS will be burned into the memory. But when you boot up, it will go out over the network and make sure that it has the latest version. If it doesn't, then it'll load JavaOS over the network and update its Flash RAM at the same time."

As a diskless device, the JavaStation is fully dependent on the Netra j server. The Netra j is itself a member of Sun's UltraSPARC-based family of servers, running Solaris, but configured with special software to support a JavaStation environment. "Like all Netras, the Netra j comes configured for a given task right out of the box," says Aneesh Shrikhande, senior product manager for the Internet and Networking Products Group at Sun. For example, the Netra NFS is a specialized file server, while the Netra i is an Internet server.

It is conceivable, says Shrikhande, that another server could be used to administer a JavaStation environment. Already, Sun will be offering a JavaStation software upgrade pack to owners of the Netra i. But, Shrikhande says, users who are installing JavaStations will want the ease of use that the Netra j provides.

Some of the software components provided by the Netra j include everything that you would find in the Netra i, including Netscape's Enterprise Server, FireWall-First! and InterScan's VirusWall; plus, JavaStation graphical administration tools; Java Desktop Environment Package (JavaOS, HotJava and JavaStation boot services); NIS Server components (password and automount maps) for JavaStation users; Contributed Library developer tools; OpenConnect's OC:// WebConnect Gold secure SNA connectivity software (eight-user license); and the OpenConnect OpenVista GUI builder for Java clients (one-user license).*–as*

Sun Cuts Ultra Prices, Bundles Software

Sun Microsystems Inc. recently announced a series of price reductions for some models in the Ultra 1 workstation and Ultra Enterprise server lines, as well as the bundling of Internet and network monitoring software with its Ultra systems.

The Ultra Creator3D line, the company's high-end graphics offering, gained a new base configuration that reduces the entry-level price for Sun's 24-bit graphics workstations. The Ultra 1 Model 140 Creator3D ships with a 17-inch color monitor, 64 MB of memory and a 2-GB hard disk for $13,999. The same base unit equipped with an 8-bit Turbo GX graphics board carries a new price tag of $7,995.

In its press material, Sun officials mention a recently announced Microsoft Corp. Windows NT/Intel Corp. workstation, stating that the price on the GX-equipped machine brings it within the price range of the new Professional Workstation series from Compaq Computer Corp. (see "Compaq Targets UNIX Market with NT/Intel Machine").

Sun also announced price cuts of up to 38% on its Ultra Enterprise servers and doubled the memory in most configurations. New price tags have been affixed to the Ultra Enterprise 1, Ultra Enterprise 2 and Ultra Enterprise 150 servers, and there are now lower upgrade prices for users of the SPARCserver 4, SPARCserver 5 and SPARCserver 20 systems. For example, the Ultra Enterprise 1 entry-level system, with a 143-MHz processor, 10-Mb/s Ethernet connection, 10-MB/s Fast SCSI, 64 MB of memory and 2-GB storage now costs $7,495.

Regarding the software bundles, Sun announced that it would offer the Solaris Internet Access PlusPak at no extra cost to Ultra workstation customers. Current Sun customers can upgrade for $99. Solaris Internet Access PlusPak is a suite of tools for Internet users of Solaris, and includes a Web browser and HTML editor; Sun's Java Virtual Machine and a Java-based Desktop browser; video and audio Tools; and network wrappers that give users of either the Common Desktop Environment or OpenWindows access to Solaris FTP and Telnet.

In addition, purchasers of the Ultra Enterprise 150 server receive Sun's Solstice SyMON system management tool.*–jsw*

Printxchange Coalition Bears Fruit

The Printxchange coalition, made up of Xerox Corp., Sun Microsystems Inc. and Digital Equipment Corp., has finally borne fruit. Sixteen months after it was formed in September 1995, the coalition has announced that Version 1.0 of the Printxchange software will go into beta in March. It also announced that vendors will be free to license the Printxchange Device Development Kit (DDK) and Software Development Kit (SDK), and partake in the Printxchange

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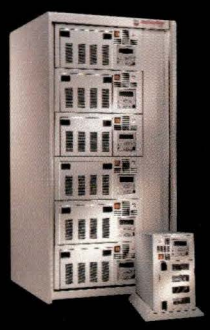

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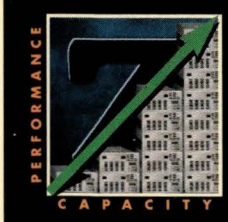

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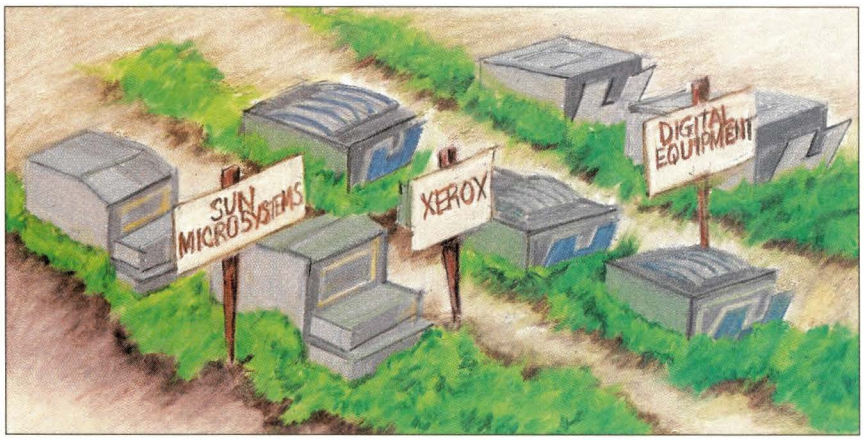
The object of the Printxchange coalition, as expressed by Xerox, the organizing member of the coalition, is to create a platform-independent network printing service where users can access any printer, anywhere in the enterprise. This, Xerox says, will reduce the administrative hassles and costs associated with multiplatform network print management.

The Printxchange environment depends on independent system software modules, including a client program that initiates printing requests, a spooler and a print supervisor that handles the requests and monitors the printers. The architecture, Xerox says, mimics that of the Palladium print system from Massachusetts Institute of Technology's Project Athena.



JOHN W. KELLEY JR.

For the time being, users wanting to work with Printxchange must look to the product offerings from coalition members. SunSoft will issue a standalone Printxchange program for Solaris in March, as will DEC for its Digital UNIX. Xerox will equip its publishing, production and desktop printers with Printxchange software in March.

SunSoft warns, however, that Printxchange is not necessarily a replacement for the SunSoft Print Client (SPC) and the Sun Printing Assistant (SPA). "The two [SPC and Printxchange] focus on different markets," says Kuljeet Kalkat, group marketing manager for the Solaris products group. "SPC is designed for ease of use and is well-suited for workgroup printing."

Printxchange, on the other hand, focuses on the needs of a large enterprise or university. In those multiplatform environments, Printxchange's rich feature set is more appropriate, Kalkat says.

At this writing, Lexmark International Inc., the Lexington, KY-based printer manufacturer, is the first and only licensee of the Printxchange SDK and DDK. Lexmark will integrate Printxchange into its MarkVision print management product, and its Optra family of network laser printers.

However, Rob Justus, Printxchange development manager at Xerox, says the coalition is in discussion with several other vendors. According to Justus, the vendors fall into three categories: the first, he says, is printer vendors (of which Lexmark is one); the second, vendors of print management software; and third, systems vendors to license Printxchange for integration into their OS.

Printxchange's success will depend on how much support the coalition can garner for it. So while it is too early to tell how the coalition's efforts will pan out, Justus believes that Printxchange differentiates itself enough from other network print services–IBM's Printing Systems Manager and Hewlett-Packard Co.'s Distributed Print Service, for example–to stand a good chance.

In particular, Justus rests his hopes on the availability of the APIs. "The most important attribute of the Printxchange system, which will make vendors want to partner with us, is the fact that we've created and published our own APIs," Justus says.

Another facet of the Printxchange initiative is the agreement between Xerox and Novell Inc. to develop a two-way gateway between Printxchange and Novell's NetWare Distributed Print Services (NDPS). Justus estimates that the gateway will be released in the second half of 1997.

In a related announcement, Hewlett-Packard Co. has entered into an agreement whereby Xerox will write a gateway between HP DPS and Novell NDPS environments. The availability of these gateways should help bridge the gap between UNIX and PC network printing environments, Justus says.

Future plans for Printxchange include porting the software to other operating systems. "A distribution agreement with Microsoft is not inconceivable," Justus says. Also, "the use of Java [as a means of expanding on the number of supported client platforms], will play a very important role in the near-term future," he says.–*as*

HP, SCO Get 'COSE' and Then Some

Consistent UNIX is not the oxymoron it used to be. First there was the designation of so-called "common UNIX APIs" in 1993, called Spec 1170. Then came the Common Open Software Environment, and the subsequent establishment of the UNIX 95 brand, now under the auspices of The Open Group. It seems the sprawling operating environment has become somewhat more cohesive, making it easier for software developers to support a range of hardware architectures that run UNIX. In the end, this brings down the cost of off-the-shelf software, according to UNIX system vendors.

Marching in step with these developments, Hewlett-Packard Co. and The Santa Cruz Operation Inc. (SCO) have teamed up to co-develop a new UNIX operating system for their Intel Corp. microprocessor-based platforms. Currently in the works, the new OS will grow out of a technology merger between the companies. They have already announced two drafts of still more common APIs, which can be used by software developers to port their applications to the new environment, and to upcoming Intel hardware architectures.

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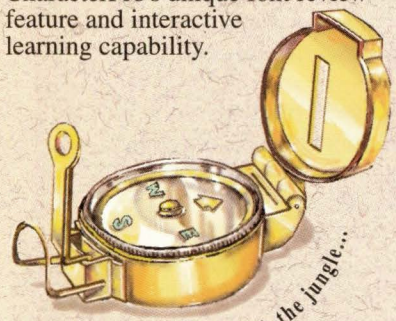

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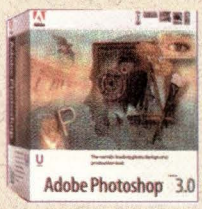

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Circle No. 3 on Inquiry Card

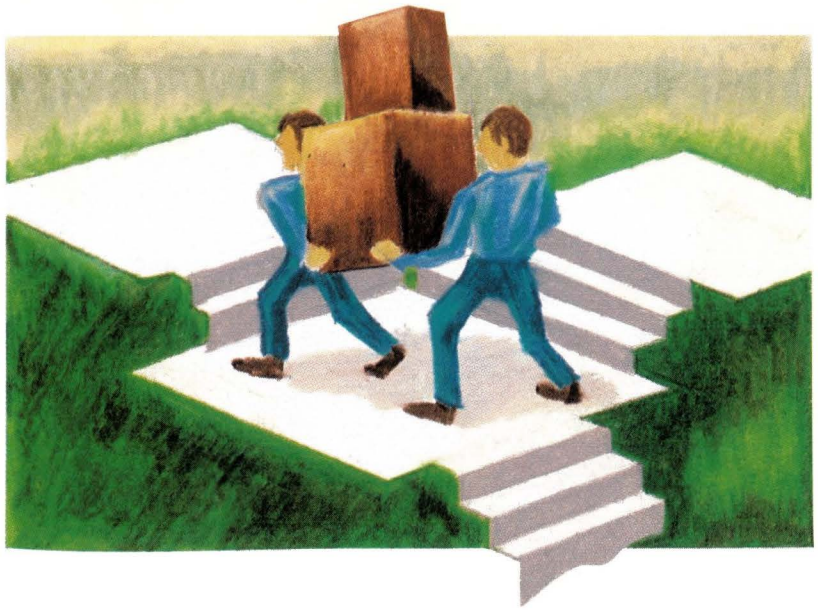
for Intel's IA-64 microprocessor architecture, otherwise known as the Merced chip. This is, of course, the 64-bit follow-up to the Pentium Pro, a 32-bit architecture, and will no doubt appear on a lot of desktops in the coming years. HP and SCO will ship the new UNIX iteration in addition to their current UNIX offerings, HP-UX and what SCO now calls Gemini I (and will call Gemini 64 for Merced). The new OS will also appear on the companies' Intel-based desktop machines.

The two companies began developing this UNIX OS more than a year ago along with input from Novell Inc., Orem, UT, home of UnixWare, among other broadly used software environments. The next set of APIs is scheduled to be available this month, and the OS in 1998.

The co-development agreement was originally announced in September 1995, and the first set of specifications was published in February 1996.

According to the companies, this operating system will be a natural extension of the previous common APIs, using those as building blocks to a larger specification.

"We are working together to consolidate our two UNIXs and to target the result at the new Intel platform," says Victor Krutul, director of strategic planning at SCO. "This is really about sharing technologies...We are not trying to compete with Spec 1170 [UNIX iterations], but to provide a way for the base of tens of thousands of UNIX applications to move forward to the new [Intel] platform."



JOHN W. KELLEY JR.

Billie Abrams, marketing manager at HP's Open Systems division in Cupertino, CA, adds, "SCO has been the volume leader shipping UNIX on Intel, and along with UnixWare from Novell, we are looking to move those forward to the new Intel architecture."

Both companies stress that the new UNIX variant follows what they call a three-dimensional architecture (3DA, for short), which makes it accommodating to potential future technological enhancements in hardware, as well as to future UNIX applications on Intel, without losing its compatibility strengths.

With 3DA, the kernel is split three ways, according to SCO's Krutul. It isolates processor-specific functions, system-specific interfaces and internal interfaces. In contrast, the heretofore "monolithic" architecture OSs, such as

New Benchmark for Web Sites

Sun Microsystems Inc., database vendor Oracle Corp., and Cupertino, CA-based Portal Information Network have announced a benchmark for Internet and intranet services. Called the Internet Transaction Mix (ITM) benchmark, the test is meant to determine whether a particular hardware/software combination will be able to scale upward to accommodate new users, and if so, how many. ITM measures things such as log-in/log-outs per day, email retrieval sessions and other transactions.

The three companies behind the ITM have excellent reasons to support benchmarks and other tools for the commercial Web. Sun and Oracle have both bet much of their future on the Web as a business medium. Portal sells billing and customer control software for Web-based sales operations.

All three companies say these benchmarks are needed in an age in which Web-centric business computing has increased, but few metrics exist to measure Web-based system performance. In corporation after corporation, the browser is emerging as the standard user interface, and the Web the means by which a company addresses its customers and sells its products.

Indeed, some industry observers speculate that what the Web needs now is not only performance benchmarks, but also performance management tools–much like database performance management tools. "A question to ask," says Norton Greenfeld, president of Implements Inc., Wayland, MA, "is are there any tools out there to help you analyze the performance of your Web sites?"–*mjt*

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the old MVS 370, were not as easy to port to varying hardware architectures, among other restrictions.

The 3DA approach uses layers to "separate" much of the OS from the hardware, making it easier for software developers and for moving the OS to other architectures when the time comes, Krutul says.

The common APIs, announced in October, include those listed in Spec 1170, as well as those falling under the UNIX 95 brand OS, and add another couple thousand, bringing the total to about 4,300. The two companies are working closely with some UNIX software heavyweights to ensure that a range of applications will run on the new Intel architecture. These include Oracle Corp., Mentor Graphics Corp. and Fujitsu Ltd.'s Software Group.

"There was a lot of analysis done about applications and their APIs. Spec 1170 is a core set of APIs, and we added others that specify APIs for the Internet, networking and security, among others. It's a much more comprehensive spec," adds HP's Abrams.

To see the APIs, go to either company's Web site: `http://www.sco.com` or `http://www.hp.com`.–*jsw*

Compaq Targets UNIX Market with NT/Intel Machine

Desktop PC stalwart Compaq Computer Corp., Houston, TX, announced in October a Microsoft Corp. Windows NT/Intel Corp. Pentium-based machine aimed squarely at users of UNIX workstations.

While NT is no longer viewed in the UNIX community as the weapon Microsoft will wield to gain control of the domain occupied by large UNIX systems vendors, Compaq hopes the combination of increased processing power, relatively low cost and software availability on NT/Pentium machines will have an impact, at least at the low end of the UNIX workstation spectrum.

The company, whose new machine is called the Compaq Professional Workstation, will try to attract attention at UNIX sites making purchase decisions where CAD, financial analysis and interactive imaging have a strong presence. When IT officials eye purchase prices and performance of NT/Pentium machines alongside those of even low-cost UNIX workstations, many will consider the Intel architecture, says David Parsons, director of workstation marketing in North America for Compaq.

In fact, market research firm International Data Corp., Framingham, MA, predicts that sales of NT-based machines will make up an increasing percentage of workstation sales over the next several years. In 1996, roughly 3,000,000 UNIX workstations were sold worldwide. In 1997, NT workstations are predicted to account for 60% of the total workstations shipped worldwide, and in the year 2000 that figure is expected to rise to 80%.

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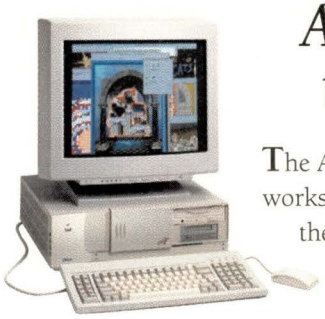

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- Axil's Ultima 1/200 not only offers a modular CPU for future upgrades, but also has a 1MB level 2 cache vs. Sun's 512KB.
- 3D Graphics is optional with Ultima 1.
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Circle No. 31 on Inquiry Card

station uses Intel's 200-MHz 32-bit Pentium Pro processor and ships with Windows NT Workstation 4.0. The company's press material clearly states its desire to attract UNIX customers using workstations from the big systems vendors, including Sun Microsystems Computer Co., Hewlett-Packard Co., IBM Corp., Digital Equipment Corp. and Silicon Graphics Inc.

"We think economics are going to dictate what people buy," says Parsons. "There are compelling economic reasons to buy the Intel architecture, both regarding initial price and support costs for UNIX/RISC workstations. If a company can get the same or better performance in a $10,000 low- to midrange performance workstation and also run, say, Microsoft Office and other widely used productivity applications, they will look at it as an option."

To help its cause in the UNIX marketplace, Compaq worked with several software developers that cater to MCAD, financial and interactive-content user segments to ensure that their applications run smoothly on the new machines. These software vendors include Parametric Technology Corp., Structural Dynamic Resources Corp., Dow Jones Telerate, SoftImage Inc. and Adobe Systems Inc.

The availability of this type of software, along with shrink-wrapped NT, will attract the attention of UNIX users, according to Parsons.

"In the financial industry, for example, a large portion of proprietary applications are written in C++, and people are cross-compiling them for NT. Commercial applications developers are also doing this. In addition, 30% of a company's hardware is exchanged for new machines every year. And when people are replacing those UNIX workstations, they'll take a look at these," he adds.

Another way Compaq will attempt to attract the attention of UNIX users is by co-marketing PC-to-UNIX connectivity software from Hummingbird Communications Ltd. to enable its customers to access UNIX and legacy applications using Hummingbird NFS Maestro and NFS Maestro Solo software.

Other systems vendors such as IBM and HP, both occupying substantial space in the UNIX workstation and desktop PC markets, understandably see spaces for both architectures, often coexisting when NT machines are used as a front end to UNIX servers.

HP has been selling a Pentium Pro/Windows NT systems for some time. The HP Vectra XU began shipping in May, along with the HP Vectra XW, which also supports OpenGL graphics.

Denis Segerval, HP's North American product manager, sees the environments commingling at user sites where, for example, data gets warehoused on a UNIX system, and an NT-based workstation running Parametric Technology's Pro/Engineer CAD software can access that data using SoftPC NFS client software.

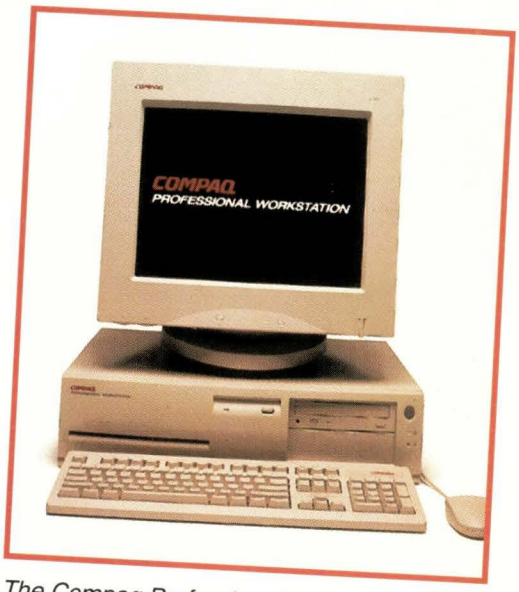
"A lot of UNIX customers already have NT somewhere else in their environment. They already understand NT and often use it as a front end to the UNIX environment," Segerval says.

He adds that while price points and performance are factors in new workstation purchases, wholesale conversions from UNIX to NT are unlikely due to the shake-up that would result in network infrastructures and productivity.

IBM officials, too, see the Intel architecture running alongside UNIX workstations more frequently than supplanting them. At the upper end of the performance scales especially, NT on Intel is not a threat.

"We see the higher end stuff continuing to be the domain of UNIX/RISC, but those people are looking at the Intel architecture as a new alternative at the low end. We see that as a new market but not as a market that will encroach on the UNIX/RISC workstation market," says Bill O'Leary, media relations manager for IBM's RS/6000 division.

Compaq's new workstations cost from $4,300 to $10,200, and ship with a range of memory, storage and graphics capabilities.



The Compaq Professional Workstation is the company's NT/Intel-based machine aimed at the UNIX workstation market.

The company states that performance figures, based on the SPECint95 benchmark, for a $6,700 model, configured with 64 MB of memory, one Pentium Pro processor, a 2-GB hard drive, Matrox Graphics Inc. Millenium graphics subsystem, and 21-inch monitor, are comparable to Sun's Ultra 2 series 1200 ($29,995) with a 200-MHz UltraSPARC chip and similar memory, storage and graphics configurations, as well as a $19,995 HP B160L, which has a 160-MHz PA-7300LC processor.

According to Compaq, this Professional Workstation model scored an 8.08 in the SPECint95 benchmark test. The Sun Ultra 2 scored a 7.75. It should be noted that at the time of the announcement, the company had not yet submitted these results to the SPEC newsletter.

Compaq did not disclose the results of the new machine's floating-point performance, however, and given the Pentium's processor's renowned floating-point sluggishness, the Compaq machine probably will not keep up with the Ultra 2 in that category.–*jsw*

Compiled and edited by John S. Webster.

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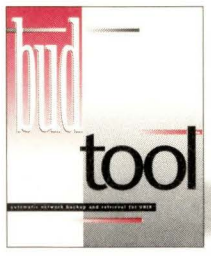

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Circle No. 26 on Inquiry Card

by MICHAEL O'BRIEN

"Where am I?" – Ballad of the Lost Traveler

"Morbius was too close to the problem." – Forbidden Planet

"What do you mean you don't know how to read a map?" – A small detail

Mr. Protocol Takes It from the Top

Q: *It's a relatively simple question this month. I've got a contract that'll earn me about eight gajillion dollars (before tax). I know how to do all the stuff I'm supposed to do. But I need to make sure I put it all together right. I figure networks are in the business of putting things together. Can Mr. Protocol help?*

A: You sound like you've been down at the Council In Charge Of Putting Things On Top Of Other Things. But you're right. The trick is to get the big picture right. God is also in the details, of course, but that's another kind of talent: Finding people who can get the details right. But you don't know what details to get right until you've gotten the big picture right. Unfortunately, people who have not built a thing yet, who are rhapsodizing about "The Big Picture," usually look silly and are easily parodied.

Shortly after the close of the Zorkolithic Age, when people were bored with teaching fundamental skills in the primary grades, someone had the bright idea that the trick was to teach problem-solving, not rote memorization. Now, anyone below the age of 12 knows that the correct way to solve any real problem is either to pound on someone, or avoid being pounded on oneself. Above this age, a process of elaboration and sublimation leads to such developments as politics, mass murder and corporate management. The cognitive skills being introduced were useful mainly for those who preferred playing with blocks. There are ways and there are ways to get the blocks to pile up.

Let's take your own problem. Hmmm. Hmm. I see. Well, according to your business plan, the purpose of your start-up is to "Combine the emergent technologies of wireless communication and the Global Positioning System to facilitate development and deployment of a universal navigation and locationing service, adapting to market share and market targeting requirements peculiar to the mobile marketplace, rapidly transitioning to a state such that the corporate visionaries (that's us) get filthy stinking disgusting fat-faced rich."

Hmmm, and down here in Section 47 of the Corporate Master Plan, right below the beachfront vacation rights in Aruba, there's this little section that reads, "Technical details to be worked out by techno-weenies on straight salary."

OK, that all seems clear enough. You just need a little help figuring out how to get from Corporate Vision to Blueprint #18249A. Just that one weeny little step. No problem. No problem at all. And if you'll step right this way while Mr. Protocol gets to work on those grotty little details, I'll direct you to some refreshment. I have a lovely cask of Amontillado that I've been saving for just such an occasion. Right down these steps...

Well, that was easier than it might have been. Still, it's an interesting question. Let's see if we can figure out how to come up with something use-

TOM BARRETT

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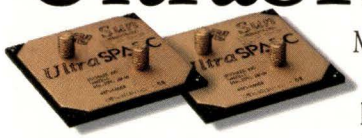

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27GDA

ful, and at the same time, display a little of the thought processes that go into designing a new service. What new service? Mr. Protocol is glad you asked.

Driving 007 Style

A division of Rockwell makes a navigation system which anyone can install in their cars for a mere $3,000. At this price, it's a rich man's toy, or a middle-class man's toy if the man happens to rent the right sort of car at the right airport from Hertz or Avis. The system displays a moving road map of the area around your car, with a little "You Are Here" marker moving along the road showing where you are, James Bond style.

The Global Positioning System, as Mr. Protocol has had occasion to mention before, is a constellation of satellites run by the U.S. Department of Defense, thereby guaranteeing several annoying properties that we needn't belabor now. Suffice it to say that the system will give your location to within 300 feet, and usually much better than that, anywhere on earth. Put one of these in a car and you can't get lost.

Except, of course, you can. There are several ways to get lost. First, the system only works outdoors, with an unobstructed view of large portions of the sky. Put it in a concrete canyon and reliability becomes very shaky. (The Rockwell system has sensors attached to the car's axles in order to be able to integrate wheel revolutions and turns to provide a dead reckoning capability that tides the systems over periods of loss of GPS signal.)

But more pointedly, just because you know where you are doesn't mean you know where everything else is. A bare readout of latitude and longitude is useless. We navigate by roads and landmarks, not by absolute position. Some translation is necessary to make the information useful, and the best presentation yet found is a moving-map display.

The Rockwell system shows a cartoon, colored-line-on-black-background map of surrounding roads, which is continuously updated. A synthetic voice warns of upcoming freeway exits and surface street turns.

The big trick in all of this is the map. It must be imported into the system in digital form and tied to GPS coordinates. The Rockwell system handles this by recording maps of major metropolitan areas onto ROM PC Cards (what used to be called PCMCIA cards before the industry boys rewrote the glossary again). These cards are available for a fairly steep price for a new area, representing money for Rockwell, money for whatever company it has hired to provide the maps, and money for whomever that company had to pay to get real paper maps to start with.

The system performs beautifully until you drive off the edge of the map. Then the GPS system is happy to continue to tell you exactly where you are, but the information suddenly becomes much less useful.

What this means is that the system performs beautifully until you drive off the edge of the map. Then the GPS system is happy to continue to tell you exactly where you are, but the information suddenly becomes much less useful. It's as much fun as driving off the edge of a paper map, except that new maps are not available at the gas station and cost a boodle anyway.

Mapping Out Problems

Can this situation be rectified? That's our design problem.

One solution is to convince at least one major chain of gas stations to carry cards for their areas. This isn't too likely because sales volume, at least initially, would be vanishingly small, and that's a lot of money to tie up in inventory. Check the "try me in 10 years" box on this one.

How about the telephone? This is a little closer. It requires a few changes to the system. Suddenly, we're not just buying the maps and plugging them in; we're downloading them. This means we're using flash RAM cards, which are more expensive but which we can rewrite as needed. Eventually, you could accumulate a library of areas you needed, just as you would collect the ROM cards. But now you don't have to send away for them, or go off to find a dealer, you just download the new maps over the phone. Mr. Protocol knows of no modem manufacturers who make a modem designed for a computer with the form factor of a car, though, and it's hard to get high-speed connections from pay phones.

Cellular phones? Now this is actually feasible. There are cellular modems that could do the job, and the only impediments are the airtime charges, and having your mobile phone tied up talking to your navigation system. Still, this could work.

How about noncellular? This may be it. It doesn't tie up your cellular phone, and you get to choose a communications system with whatever bandwidth the mapping needs, and no more. Let's play with this concept a bit more.

There's a technique used by most of the major design systems (the ones where they charge so much money for the training seminars that they don't even have to advertise), called "scenario generation." This term is based on the desire to use as few words as possible to describe something, without quite being culpable of not describing it at all. It might better be called, "What would the ideal system be like?" Or, more simply, "Let's pretend." Remember the building blocks back at school? This is their descendant.

Ideally, we'd like an infinite map. We'd like it to be impossible to run off the edge of the map. No matter how far we drive the map should just be there, with no further attention on our

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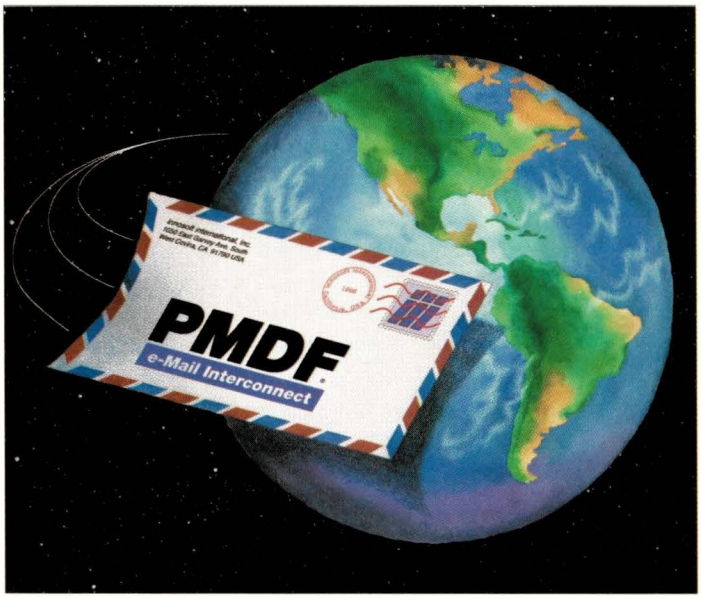

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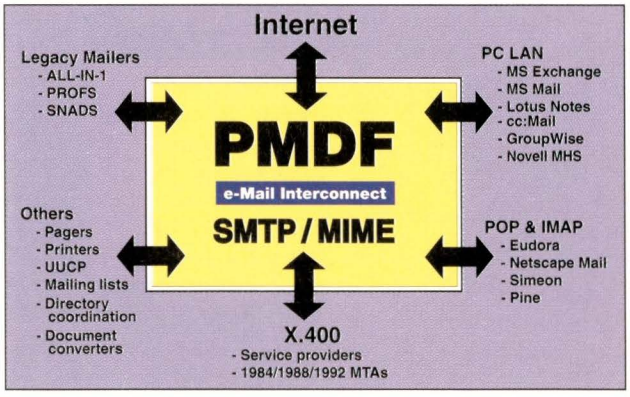

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part. Is this possible? Well, yes, approximately. We could arrange for new map areas to be downloaded automatically, using wide-area wireless network services. The critical question is, just how would this work?

The maps in a GPS system are stored in vector form, because the storage requirements of an image map are too great. Even so, the map of an entire metropolitan area is too large to be downloaded over the air in a reasonable period of time, using any wide-area wireless service now available.

Looking to the future, Teledesic Corp.'s Teledesic Network system is designed to provide gigabit networking connectivity to any location on the planet. This system, assuming it ever flies, could do the job of downloading an entire city to a moving car in a short period of time. The cost estimates for a service like this might not even be too astronomical because the airtime for a bulk transfer like this would be short compared with the time between requests. Even if you're just passing through a city, it takes time to drive from one end of a Rockwell GPS map to the other. Outside a city, roads are few enough that even a huge area of land can be represented in detail with a small vector map.

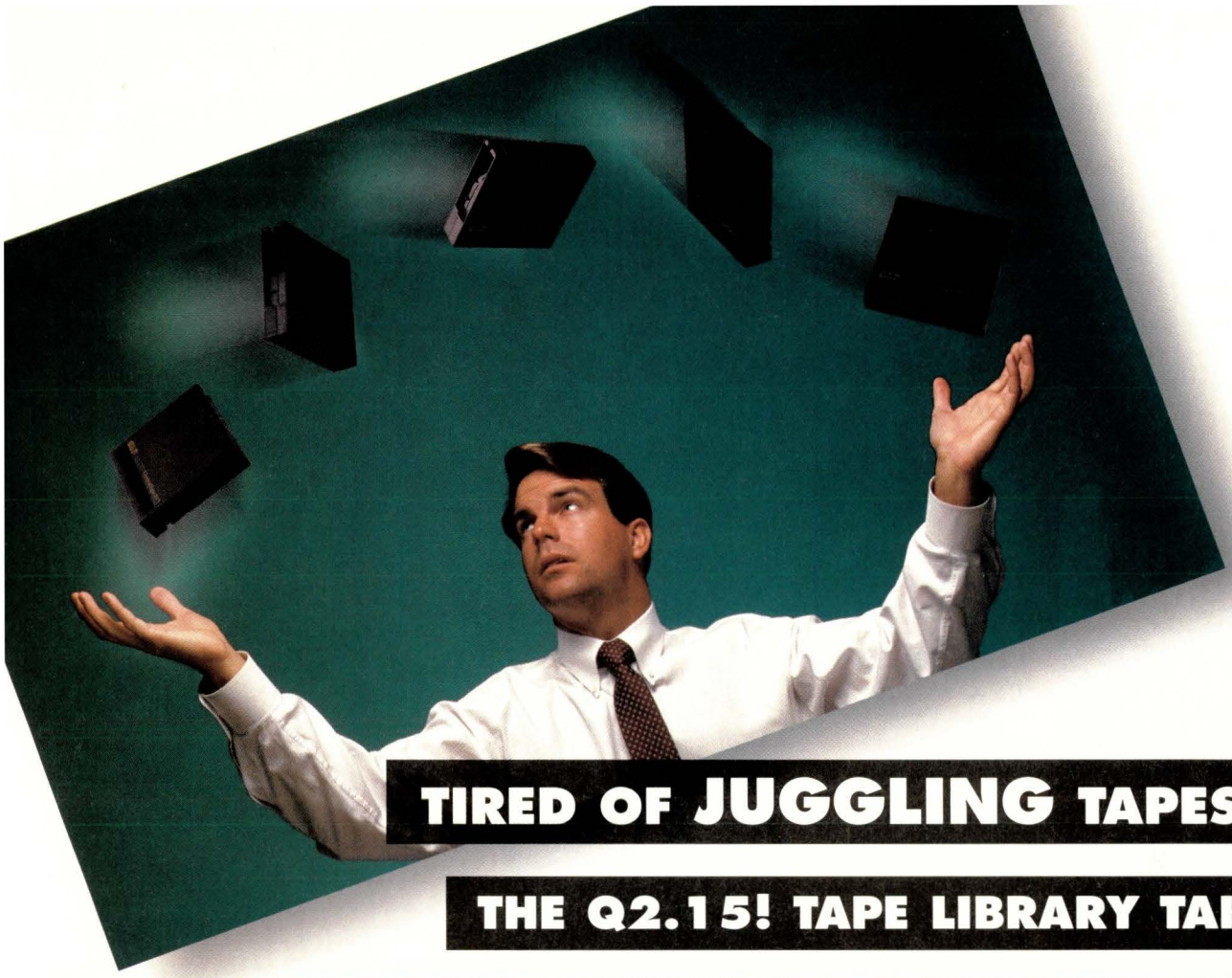
It might not be necessary to wait for Teledesic's 600 or 900 satellites, or however many it is this month. Let's take a closer look at the problem and see what we can do, or get away with.

Driving in a city takes one of two forms. Either you live in the city, or travel there extensively, or you're just visiting and trying to get from here to there. In the former case, you would purchase a PC Card map, just like today. It's cheaper to own the map than to download it repeatedly as you travel.

However, if you're just visiting a city, you don't need the entire map. You only need the portion of it that you're driving over: the streets you're on, and the streets that cross. This usually represents only a small fraction of the actual area of the city, at least for any given trip.

Let's think, then, about a subscription service to download just the parts of a city map that you need. You shove your flash RAM card into the GPS navigator in your car from a participating rental agency, and drive off. The card contains a key that securely identifies you to a wireless service through an inexpensive radio modem. Most wireless services now can handle transfer rates of 9,600 to 28,800 b/s. Ardis and RAM Mobile Data are down at the 2,400 baud level or so, but even that might work.

The other question is, how much data is required? Vector maps store very cheaply in terms of memory requirements. The cartoon maps need not even be composed of straight lines. A technique for storing the coefficients of higher-order approximations to curved lines has been developed by the scientists at ParaGraph Inc., which allows them to store a very creditable representation of a complex and detailed sketch by Picasso in about 50 Kb. Road maps



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are not this messy, at least not ones that are useful for driving with. This means that a large sectional map can be downloaded in a few seconds of airtime.

Now, how do we update? It doesn't make sense to send screenful-by-screenful increments. The airwaves would be continually tied up with requests and responses. Also this sort of "just-in-time" display leaves you at the mercy of transmission glitches and delays. Ideally, you'd like to be able to fetch enough data at a time to make use of the fact that these wireless services are usually better at bulk data transfer than they are at highly interactive tasks.

The best bet might be to divide the city up into squares or hexagons, and download a section at a time. Several divisions might be requested at the same time, if one were to drive across a corner, but this would be balanced out by the time spent driving across the newly acquired "territory." An intelligent system might note the direction of travel, and begin a request well in advance of the appearance of the new territory on the display, at the risk of never using the prefetched section if the driver made a turn.

A Question of Money

None of this makes sense without making money. This brings up the question of billing. It's easy enough to dream up a new service, but it has to fulfill certain criteria to be useful.

- It has to be a real no-brainer to use.
- It has to be genuinely useful to a large number of people.
- It has to be cheap enough so that people are willing to use it.
- It has to be expensive enough to fulfill the corporate vision of making everyone involved filthy stinking disgusting fat-faced rich.

So far, our system does pretty well. You stick a card into the slot when you rent the car. Here's a touchy point, though. Does the map information that you suck over the air reside on a memory card that you own and can keep to use on future trips? Or do you only have the use of the information for the duration of your car rental on this trip? One advantage of the former version is that it encourages repeat customers. Because most business travelers visit the same set of locations in a city on every visit, it will only take a few visits before they will have built up a library of map information sufficient to avoid further airtime and map charges on future visits. Their cost remains only the base rental cost of the system.

This is also true of us, the map providers, because we don't have airtime charges to send them further map information, either, unless they decide to splurge on finding one of those unfindable restaurants out in the suburbs. (There's an idea worthy of Hercules' friend Salmoneus: have restaurants partially underwrite the cost of map charges for getting to them.)

On the other hand, perhaps we want

the customer to incur recurring map charges on every visit, as a profitable line. We get money every trip. Except of course we don't, because it won't take the customer long to learn the way on his own and dispense with our services entirely on future trips. No, it would seem our repeat business is going to be more in the way of a low-cost insurance policy–a way of making sure that we don't get lost if we miss our exit–and most of our big charges will come from newcomers to the city.

Once we begin two-way request-response systems over the air, of course, it's only a matter of time before the services expand to include feature-finding services and advertising. "Eat at Phred's! Phind Phred Phree! Punch Button A!" Already we see ways to abuse the system and it's not even built yet. "Phred" just happens to be located down the block from our real destination, so we punch Button A instead of entering the address of our real destination. Perhaps good old Phred will have to swipe our card to prove we were there before the charges are dropped from our bill.

People who wonder why the price of a new product is always so hard to come by in advance of release may be getting a glimmer of why this is so. Price is always the hardest part of any new design. How much will people be willing to pay for this? How high is up? This is why people get actual degrees in marketing and learn how to run focus groups without letting them turn into the schoolyard-pounding sort of problem solving. It's also why test marketing is so popular. This is a difficult service to test-market, though, because it's only really useful if it's universally available and expected.

Would such a system work today? Perhaps not, at $3,000 per system, minus the smart card and verification schlog. Will such a system come along in the future? Almost undoubtedly. Will it look like this? Mr. Protocol ventures to say that it will, but then, Mr. Protocol ventures to say almost anything, which is why I'm the one who signs all the contracts around here.

Meanwhile, it's back to the drawing board. ⊸

Mike O'Brien has been noodling around the UNIX world for far too long a time. He knows he started out with UNIX Research Version 5 (not System V, he hastens to point out), but forgets the year. He thinks it was around 1975 or so.

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

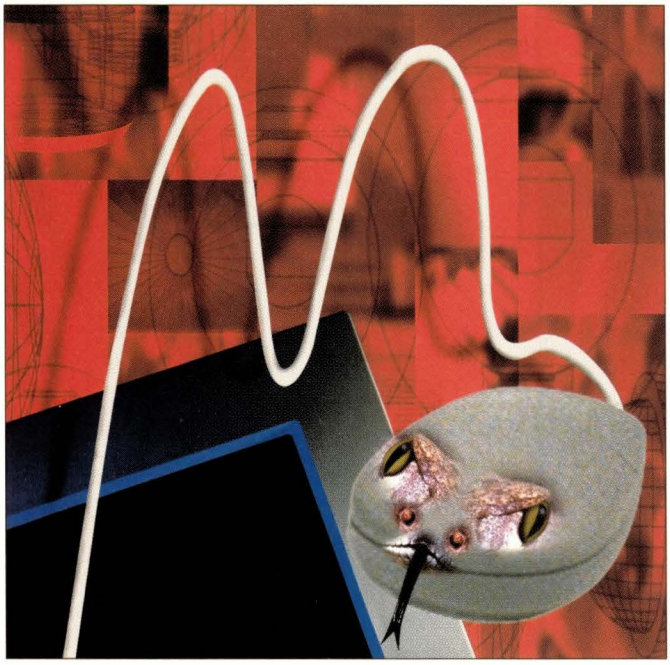
Mr. Protocol refuses to divulge his qualifications and may, in fact, have none whatsoever. His email address is amp@cpg.com.

by PETER COLLINSON, Hillside Systems

The Trouble with Windows

Recently, I've been wondering whether I am slowly turning into a dinosaur. I am not sprouting three horns or acquiring T-Rex teeth, but I am beginning to consider the possible extinction of the UNIX species. More of my work seems to be migrating to various Windows-based systems with their supposedly friendly mouse-driven GUI interfaces. For example, I'm generating images for my Web site using Corel Corp.'s suite of graphics programs. I'm doing more document writing using Microsoft Word because that is what the customer wants.

However, and perhaps here's the dinosaur bit, I keep returning to my UNIX systems to do any substantial job. I return to a command line-based interface, like an old friend, whenever I want to process many files, or perform some repetitive task on a set of files. I return to my UNIX editor for text generation and I often import that text into Word as a final formatting step.



Now, I am not one of those people who resists change at all costs. I like to look at new things that come along. If I don't like something, I usually spend time to make sure that my dislike has better reasons than "the system is different from that which was there before." In computing, it's easy to trundle along using what you know now and never pick up anything new.

What worries me is that the world seems to have totally and unquestioningly embraced the GUI-based Microsoft interface. With NT, Microsoft seems to have understood that to kill off UNIX, it will have to make a system that does not crash at the slightest problem. After all, crashing machines and lost work are tangible problems, problems that people undoubtedly complain about.

What's interesting is that the business world has leapt for Microsoft-based products in the certain knowledge that there is no effective support for the software. Microsoft and PC software vendors are about as approachable and responsive to complaints as the proverbial dead whale that was hard to kick up a beach.

It's less obvious to me whether users ever ask if the human interface to the Windows system is "correct" in some intangible, perhaps academic sense. Microsoft has pushed the Windows GUI at users, who simply accept it. Basically, I think about the interfaces that I use, and I consider that current GUI-driven interfaces leave a lot to be desired.

To be sure, many problems are caused by poorly thought-out design at the application level, rather than intrinsic, fundamental difficulties with the system. But even apart from poor design in applications, I believe that the interfaces don't scale; they only work well for simple operations. Once things start becoming complicated, the interfaces stop being friendly and begin to be battlefields where the user fights the system to get the work done.

To expand a little on what I mean, let's look at something simple. One of the things that we do all the time is move files about the file system. It's one of the fundamental operations that are needed in any operating system. Of course, "moving files" sounds simple but isn't. Do we want the

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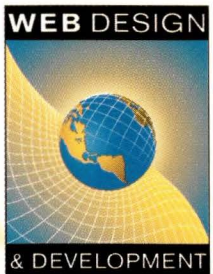

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original file left in place? Are we relocating the file or just renaming a file? If we are moving files from one part of the file system to another, then we need to know something about the destination directory. Will we overwrite some important file at the destination?

In Windows, copying files is visual. You open two windows on the screen, one for the source directory and one for the destination. You click on the file that you want to move and drag it into the destination directory. The system realizes what you are doing and copies the data from the source to the destination directory. Sounds easy? Yes, and it should be. Drag and drop is intuitive and works well, or should.

However, on my NT 4 system, brain-dead design decisions kick in. My view of human interfaces is that it's important to be consistent. If the system acts one way while presenting some image to the user, then the system should always act in that way. So drag and drop should always be consistent in the way that it handles files. However, on NT, if I drag and drop files within a single disk, then the system assumes that I wanted to relocate the file and will delete the original. If I am copying files to another disk or another machine, then the system thinks that I want a copy and leaves the original file alone.

There are undoubtedly good reasons why the drag-and-drop action has different results depending on context, but I think that it should not. To be fair, there is an attempt to show the change in state because the cursor changes shape when I enter the different windows. However, I had not noticed this change until it was pointed out to me by a seasoned Windows user. So the effect on the GUI was not as pronounced as it might be. Now that I have noticed the visible indication of what will happen, I expect to use drag and drop more often.

Up to now, I have always copied files using the `File` menu, which is predictable but fiddly. I select a file that I want to copy from the source window, use `Cut` and `Copy`, depending on what I want to happen, find the destination window and `Paste` it in. When I first used this mechanism, I thought it was a tad counterintuitive, and although I have become used to the metaphor, I don't necessarily feel it's a valid one.

Let's add a further complication. If I want to selectively copy several files from a directory, then I need to select those files before `Cut`ting or `Copy`ing them. This is done visually, using one of the things that I hate about GUIs: secret key combinations. To select more than one object you hold down the Control key and click with the mouse on several files. Alternatively, you can hold down the Shift key and select a range of files. It's quite hard to find out about the Shift option. I only discovered it by accident because it's next to the Control key.

I detest these secret options because the whole point of the Windows GUI is that everything a user can do is visible. A menu option may not be available and be grayed out, but the choice remains visible. I don't agree with this modus operandi, but that's another issue.

Since the fundamental theory behind the interface design is that everything is visible, users don't expect to look for the secret parts of the interface that the mode-changing keys represent. Also, when you discover the keys, there is nothing in the interface that tells you that your mouse clicks will do something different because you have a key pressed on the keyboard. I am not sure what should change, but it would be simple to use a new cursor shape to indicate the selection mode.

Incidentally, while writing this column, I've discovered another feature about these file lists. You can type letters into the keyboard and the selection box will jump to an appropriately named file. I've also learned from the help files that in Windows Explorer, and only in Windows Explorer, you can group files by capturing the files inside a box controlled by holding down the mouse button.

Command Lines

Now I am going to talk about UNIX command line input, and you are all going to think that I am saying it's better. Your hands are poised to send me mail saying you are convinced that I am a UNIX junkie and I don't want to alter. Well, that's not true. I make considerable use of the file-copying systems on NT and rarely use its command line interface. In fact, my NT keyboard usually lives on top of the monitor so I have to reach up for the Control or Shift keys. I don't intend to say that UNIX is better, but I am using UNIX as an example of a well-developed human interface to illustrate where I believe there are shortcomings in the GUI-based systems.

If we return to our file copying example, you know that we copy single files on UNIX by using either the `cp` or `mv` commands. The basis of using a command line is that we supply arguments to a program that does the work for us. To use the system, we have to learn that the commands exist and know their names. Certainly, UNIX command names can be extremely counterintuitive. Like Windows' hidden keys, UNIX hides its features and we have to seek them out. However, UNIX doesn't hide this fact from its users. People are supposed to Read The Fine Manual.

We don't have to learn anything particularly special about how commands are used. After a short time of using UNIX, people acquire an expectation of how commands on the system will behave, how they are controlled, and how they are used in combination with other commands.

It's true that users sometimes don't appreciate why certain aspects of command invocation operate the way they do, for example, why does

```
$ cat afile bfile > afile
```

not work intuitively? It's reasonable to expect that the command adds the contents of `afile` and `bfile` and places the result back into `afile`. It doesn't work because the shell opens the output file `afile` before it executes the `cat` command, so the contents of `afile` have been set to zero before the `cat` command has a chance to execute. On UNIX there is a consistency of result, even if the result is sometimes bad.

When telling someone else about a UNIX command, we usually just have to say the name of the command and perhaps give some indication of any odd arguments the

program may have. The user then understands how to use that command. It's a little like language acquisition, the user is given a new verb (*to flipple*) and will know how to cope with the past tense (*I flippled*) or how to create an adverb (*it went flipplingly*).

This preknowledge of use is an aspect of the UNIX user interface that is often forgotten. People hold up the `find` or `dd` commands with their odd arguments as examples of why

It's a very short step from this single file copy statement to one that moves many files. Very early on, UNIX users are taught that they can move many files using shell file name expansion characters.

UNIX is hard to learn. But once users understand the arguments, they will know how to make `dd` read from a file, or how to make `find` output go into the `sort` program.

If we are copying single files, then we will expect to do some typing. Not only will we type the name of the command, but also the names of the source and destination files. The system helps us by maintaining the current working directory for a process, so file names can be typed relative to that directory. However, if we are copying files across the file system, we will expect to type the full path name for at least one of the file arguments. Over time, UNIX has developed several ancillary mechanisms that help us to input long path names with more ease.

The first of these mechanisms was perhaps the tilde character, allowing the user to specify their home directory trivially and in a position-independent manner. Later, automatic file and command name completion was taken from the Tenex system and implemented.

I make considerable use of the ability of the `bash` shell to expand path names dynamically. If I type the first few letters of a file name and hit the Tab key, then the shell will look in the directory that the file is in, and, if a unique match is found, will complete the file name automatically. Path name specification has become as easy as clicking with the mouse in a dialog box: You type a character, hit tab for expansion, type another character, hit tab again and so on.

The other feature of which I make considerable use is the character-based cut and paste using the mouse that is supplied by the X Window manager. This lets me sweep out a set of characters in one window with one mouse action and insert the characters into another window using a single mouse click.

However, there is no escaping that even with these aids, it's much easier to use drag-and-drop mechanisms that visual GUIs give us. It's harder on UNIX, which wants us

to build up a text line like

```
% cp srcfile /usr/file/dest/srcfile
```

ready for execution to make a file copy. Typing this line takes considerably more basic knowledge of the system than the equivalent drag-and-drop action.

However, this knowledge is a building block. It's a very short step from this single file copy statement to one that moves many files. Very early on, UNIX users are taught that they can move many files using shell file name expansion characters. The command

```
% cp src* /usr/file/dest
```

copies all the files starting with the string `src` to the destination directory, ignoring any other files. A simple pattern is used to specify a group of source files and perform a command several times using the matched files as arguments.

Again, there's some basic knowledge that is needed about expansion of file names. The expansion is done by the shell, which then calls the command with the expanded list. Placing the expansion in the shell sometimes has odd effects but makes sense because the expansion can be used consistently with all commands. We are not dependent on the application writer to provide correct implementation of this part of the human interface.

Using pattern-matching characters to generate arguments also means that we don't have the possible problem of missing a file that we want to copy. Once we've issued the command we know that all the files that we have specified will be copied. We don't have this certainty on Windows when copying many files via selections in dialog boxes. It's very easy to miss files that we should have copied, and so we have to spend time making sure that the destination directory contains all the files that we want it to hold.

UNIX also offers other types of pattern matches, which helps us to pinpoint the files that we want to copy. For example, the question mark character matches any single character, so `??` will match all the file names that are exactly two characters long. This option is perhaps much less useful than the ability to match character ranges. For example,

```
$ cp [a-ln-z]*.c /usr/dest
```

copies all the files that don't start with the letter "m" to the destination directory.

Learning Loops

I suppose the next step in complexity that follows on from the ability of the shell to expand file names is the use of the `for` or `foreach` loop that shells support. When this is coupled with the shell's ability to manipulate strings, we move onto a new plane of usefulness. Here's something I type into the machine without thinking twice:

```
$ for name in *.c
> do
>       mv $name $name.old
> done
```

or in `csh`

```
% foreach name (*.c)
?       mv $name $name.old
? end
```

Both are shell loops, the `for` or `foreach` statements supply a shell variable name that is set to different values while the statements in the loop are executed. In this example, the variable name will be successively set to each of the names of the files in the current directory that match the pattern `*.c`. The string `$name` in the `mv` commands is replaced by the contents of the variable before the command is executed. The loop executes several `mv` commands, each one moving one file from its old name of say `program.c` to a new name of `program.c.old`.

Moving the file names back to their original positions uses a new command and a new concept in the shell:

```
$ for name in *.c.old
> do
>       dest=`basename $name .old`
>       mv $name $dest
> done
```

or in `csh`

```
% foreach name (*.c.old)
?       set dest = `basename $name .old`
?       mv $name $dest
? end
```

The new command is `basename`, and its job is to deconstruct strings. For example,

```
% basename fred.c.old .old
fred.c
```

The command is given an argument containing the file name that we want to take apart, and the string that we expect will occur at the end of that string. It prints its result to standard output. This is where we apply the new concept. The backquote operator takes the result of a command that it executes and reads the data back into the shell. In fact, we then place the result of the command into a shell variable `dest`.

Now, we have not come very far. None of these loops use constructs that are very far removed from typing a single command. The basic knowledge that was learned to copy a file extends seamlessly to give us the ability to express complicated file copies involving the renaming of selective files. Because the shell is a language, we can insert any processing element in the loop, applying a command selectively to a set of files. Also, it's a very short step from here to take one of the loops and create a new command file that can be used to save typing.

This type of complexity is just not easily available with GUI-based interfaces, and the lack of it hurts. To be fair, there are attempts made to provide script-based programming interfaces for various tools. But a huge leap in knowledge is needed to go from using the GUI to using a script.

Many of the systems have internal script languages based on some variant of BASIC. For example, these articles are written using a subset of `troff` markup but are dispatched using RTF format. I automatically generate the RTF using Word. I first pass the source file through a small C program to generate some markup and then into Word for processing by some macros that I have written, translating my limited `troff` constructions into Word markup.

One of the Corel packages provides an event recorder, so you can teach it some action sequence and redo the sequence on new data. But it turns out that not all the actions are recorded, and it's hard to parameterize the actions. I will confess to have given up when I discovered that it would not record all the actions that I needed to take an AVI movie and split it into one file per frame. I ended up making all the key clicks by hand in an error-prone way.

Finally, the Corel suite has a script editor and debugger. Sadly, this is made very hard to learn. The printed manual says, "We can do all these neat things and you'll find all the details in the on-line help." But there is no effective way of progressing sequentially through the on-line help so that you might have some chance of learning how to use the package. Click on the Help button in the package and you are presented with a nice-looking finder. When you select an item in the finder, you get a screenful of text, but the finder goes away. There is no easy way back to the place that caused the text to be displayed. You have to start the finder from the beginning each time.

In Summary

Again, don't think I am advocating that we should all use the UNIX command line because it's somehow superior to the GUI-based Windows interface. I'm not. I am simply pointing out several deficiencies in the current GUI-based interfaces, deficiencies that seem to have no easy solution.

First, I believe the lack of the notion of a current working directory, or at least the lack of coherent handling of the current directory, to be a serious deficiency. Commands work fine when you read and write data in one directory, but once you start moving data from one point in the file system to another then each application seems to deal with the current directory in its own way. I seem to spend an inordinate amount of time using those file finder dialog boxes.

Second, the fundamental problem is that Windows has no easy way of using its applications in a batch fashion except by using some human as a sequencer, whose job is to sit there and press the buttons. It's not easy to use the applications as part of some other tool, and consequently, there is very little extensibility. We are forced to rely on the designers of the package thinking about all the ways we might want to use their programs.

Third, having a interchangeability of data is a good thing. The common denominator on UNIX is text files. Most of the tools use text as their building blocks, allowing users to create new processing elements, transforming new data in new ways. The power to create new processing elements is firmly in the hands of the users. I will agree that these users have a learning curve to surmount.

Windows tries to achieve the same end with objects. Where objects do fit together, they fit together well. The problem is that the fitting together needs an expert programmer, and the required expertise is far from trivial to learn. With Windows, the power remains firmly in the hands of the developers, and I see this as a problem.

Fourth, scalability is a must. I should be able to process many source files as easily as I can deal with one. This appears to be a serious problem with current Windows systems.

Finally, there really is insufficient attention paid to the way that the GUI works. It's very inconsistent, and it's usually impossible to obtain the reasons why it behaves in the way that it does. I find this is my biggest objection. ➸

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`.

by RICHARD MORIN, Technical Editor

UNIX Administration Notes, Part 1

Looking through some lecture notes for a decade-old course on UNIX systems administration, I ran into some material that still seems timely today.

JACQUES COURNOYER

Systems Administration Mythology

All of us, at one time or another, encounter some rather peculiar mythology concerning systems administration. I know that you don't believe these myths, but you may be able to use some ammunition when discussing these issues with your peers (and/or management):

• **Systems administration is optional.** UNIX loves to create files: log files, temporary files, spool files and so on. And, unfortunately, it doesn't always clean up after itself. With all this activity, it is quite possible for things to break. If they don't get fixed, they can break worse. File system damage, in particular, tends to propagate over time.

• **System administration is just "housekeeping" (and thus insignificant).** No more (or no less!) insignificant than ordinary "housekeeping." A properly administered system runs efficiently and cleanly, and presents an image of order. A poorly administered system causes inefficiency and frustration for all of its users.

• **Anyone can do it.** No. A system manager must be a competent UNIX user and must have a reasonable set of attitudes (more on this later) about the task. There is also some basic knowledge of systems administration that is needed, but much of this can be picked up along the way.

• **Only gurus can do it.** No. Some parts of systems administration are very tricky, to be sure, but most systems administrators are not gurus. It is helpful to have a guru on call, however.

• **Somebody else will do it.** Not if you're the only user or the owner of the system. This makes you the systems administrator. Aside from occasional "help" from passing system crackers, you're on your own. Nor can you count on the vendor to automate everything or even to set things up right in the first place.

• **Security isn't important here.** OK, you run a nice, loose shop, and everyone is completely honest. Or perhaps this is your own private system, sitting in your den. Well, there are nasty people out there with modems and Internet connections, for starters. Failing that, some of your employees or friends may not be as honest as you'd like.

The best reason for security, however, has to do with human error and damage control. A secure system will keep your users from shooting off each others' feet when they make mistakes.

Professional Attitude

An important component of effective systems administration, attitude is particularly crucial if the system is going to have more than one user. Some users, on receiving the root password, decide that they are now the local deity. Maybe so, but there are limits:

• **Omniscience.** Read the manual; don't just assume you know everything. Besides, vendors occasionally change things around. It is also useful to ask users about their needs and preferences. They have a totally different perspective from yours, so you may be surprised (and enlightened) by what you hear.

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• **Infallibility.** Don't stay logged in as root all the time, and be very careful when you take on root authority. Fingers have been known to slip, and UNIX assumes that anyone who is logged in as root knows what s/he is doing.

• **Omnipotence.** As the systems administrator, you are pretty much in charge of things. You can take the system down whenever you like, throw away anybody's files, and generally do whatever you like. In a word, don't. Users have a right to expect courteous behavior on your part, and it is only proper to provide it.

Scheduled downtime, for instance, should be announced well in advance. It should also take place during times (e.g., weekends) when the system would normally have few users on-line and when you have time to fix anything you break.

• **Immortality.** You won't be around forever, so leave some notes around for your successor(s). Be sure to write the really critical stuff into a bound notebook. Remember, when the system is down, so is your on-line documentation.

Raison D'être

So much for political indoctrination. Now let's look at some specific reasons for performing systems administration:

• **To protect the integrity of programs and data.** You don't want things to get lost, stolen or sabotaged. Neither do your users. As the systems administrator, your task is to make sure that bad things either don't happen or can be resolved with minimal losses.

• **To help the system run smoothly.** UNIX isn't Windows, let alone MS-DOS or Mac OS. It is a big, hairy, complex operating system that requires both proper setup and continuing support to work properly.

• **To integrate new devices and users into the system.** As new devices and users are added to the system, the systems administrator must modify and/or create assorted files to reflect this. If this is done in a sloppy manner, the result will be security holes, inefficiency and possible loss of data.

• **To add desired features to the system.** The UNIX distribution can't possibly include every package you might want. Consequently, there are many freely redistributable utilities and proprietary packages you may want to add.

Levels of Systems Administration

There are several levels of systems administration:

• **Elementary.** These tasks constitute most of an administrator's duties. They involve adding and removing users, backing up files, moving files around and so forth.

• **Intermediate.** Now we get into trickier stuff, such as restoring files, installing new devices and versions of UNIX, setting up UUCP links and network connections, etc.

• **Advanced.** These activities should really be done by gurus, but ordinary systems administrators sometimes get pulled into them. They include hacking sendmail, modifying device drivers and repairing clobbered file systems.

• **Specialized.** Each site has certain subsystems it cherishes, and these involve a certain amount of administration. The skills may range from elementary to advanced, and the system manager simply gets to cope as best s/he can.

This column introduces most of the elementary tasks, touches on a couple of intermediate tasks, and leaves the rest alone. If you are running a small stand-alone system, making few changes to the configuration, this column may meet most of your needs. Regardless, I suggest that you peruse a good UNIX systems administration text, such as Evi Nemeth's *UNIX System Administration Handbook*, second edition (Prentice Hall, 1995, ISBN 0-13-151051-7).

Bringing It Up, Shutting It Down

• **System start-up.** UNIX can usually handle start-up by itself, unless something has gotten severely damaged. Let the normal start-up procedure take care of things, noting any peculiarities. If it has real trouble, it will let you know.

Leave some notes around for your successor(s). Be sure to write the really critical stuff into a bound notebook. Remember, when the system is down, so is your on-line documentation.

• **Normal shutdown.** The system will need to be shut down occasionally for preventive maintenance, adding devices and so on. Use `/etc/shutdown`, giving an explanation and a reasonable amount of warning, for example,

```
# shutdown -h 5 "Need to add a disk drive."
```

When the machine has successfully shut itself down, you may power it off.

• **Rapid shutdown.** Occasionally, something untoward will happen, making it is necessary to shut the system down at once. If possible, follow the above instructions, using a suitably short amount of time. Otherwise, use the following command:

```
# shutdown -h now "Disk drive is screeching."
```

• **Panic shutdown.** Smoke has just started to pour out of a critical piece of system hardware. Pull the plug! (You can clean up the mess later.) You may lose some files, but you should have backups for most of them. In any case, the hardware is a bit more critical at this point.

• **Accidental shutdown.** A large truck has just eaten your utility pole, and the power will be off until the utility company gets things put back together. Unplug the system and leave it that way until the power seems to have stabilized. Power companies have a tendency to switch things on and off a bit when they are getting the power back in service. Your computer system is very vulnerable when it is starting up; being interrupted could cause it to lose or damage files.

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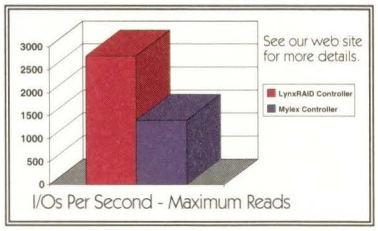

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Security Basics

Security issues have to do with protection of resources from loss or harm. Computer equipment is expensive and should be protected. Data can be far more valuable (often irreplaceable) and deserves even more protection. I don't want to breed paranoia, but I do suggest that you treat security issues with respect. A modicum of caution now could prevent a great deal of anguish down the road.

Before I get into a discussion of software-related security issues, give some thought to the physical security of your installation. What would prevent someone from simply walking off with components or even entire systems? Is there anything to prevent a cracker from sniffing packets from your LAN? Do you have a regular system in place for performing system backups? Are your backups cataloged and well protected? Do you cycle through your media, retiring it at some point? Do you keep some of your backups off-site, in case of disaster?

UNIX systems assume that there will be a multitude of users, both local and networked. The system accepts responsibility, by and large, for keeping these users out of each others' way. It does have an administrative account (root) with complete authority, but access to the root account is, or at least should be, guarded with extreme care.

UNIX security is implemented via access permissions for all processes, directories and files on the system. Access permissions tell UNIX which users have what kinds of access; UNIX then enforces these restrictions.

As shipped, most UNIX systems have reasonably secure permissions. Let your vendor know if you find a problem. As the systems administrator, you are responsible for maintaining this security. If you open up the permissions on a directory or a file, make sure you haven't allowed any undesirable access to take place.

User and Group IDs

UNIX tracks a user ID (UID) and a group ID (GID) for each file and process. The UID identifies the owner of the item in question. In most cases, the owner is the only user who will have anything to do with the item.

In cases where more than one user (but not everyone on the system) needs to have access to an item, the GID comes into play. The GID identifies a specific group of users (listed in the `/etc/group` file) as having a special (usually increased) amount of access to the item. For instance, a file might be totally accessible by its owner, readable by members of its group, and not accessible at all by anyone else.

Here is a brief summary of key points about user and group IDs:

- Files get their UIDs from their creator.
- Files generally get their GIDs from the enclosing directory.
- Users get their (shell's) UID and GID from `/etc/passwd` at log-in time. They are:
  - Passed to all subprocesses
  - Overridden by setuid and setgid routines

– Checked against every file at "open" time
– User and group names are translated to/from IDs via `/etc/passwd` and `/etc/group`.

File Permissions

Access to files and directories is controlled by their permissions and by the permissions on the directories above. Note: To access a file, you must satisfy the restrictions not only on the file, but for each directory on the path to it.

UNIX supports three sets of permissions: user, group and other. These are checked, in order, with the first matching test controlling access. That is, if you are the file's owner, only the first set of bits will be checked for you.

Each set contains three mode bits: read (`r`), write (`w`) and execute (`x`). The interpretation of these bits varies somewhat, depending on the nature of the item. For files, the bits are interpreted as follows:

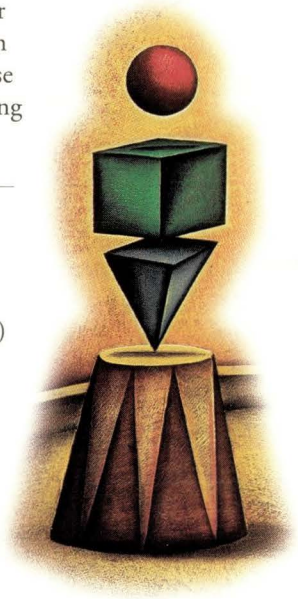
- Read permission allows data to be read from a file.
- Write permission allows data to be written into an existing file.
- Execute permission allows a file to be run as a command.

In the case of shell scripts, read permission is also needed. For directories, the interpretations are analogous but a bit subtler:

- Read permission allows a directory to be read, by `ls` or shell wild-carding–use of pattern-matching metacharacters.
- Write permission allows a directory to be written, as in creating or removing files.
- Execute permission allows a directory to be used in a path name (passed through on the way to a file).

Note: It is a relatively common practice to remove read permission from a directory while retaining execute permission. This keeps stray users from snooping around and allows the owner to say "Pick up `~rdm/A123fW`" to a friend without much fear of any unauthorized party gaining access.

Next month, Part 2 will consider which files reside in the file system and how to deal with permissions. Note: The author would like to acknowledge Jim Joyce and Doug Merritt, whose material played a part in writing this column. ⊸



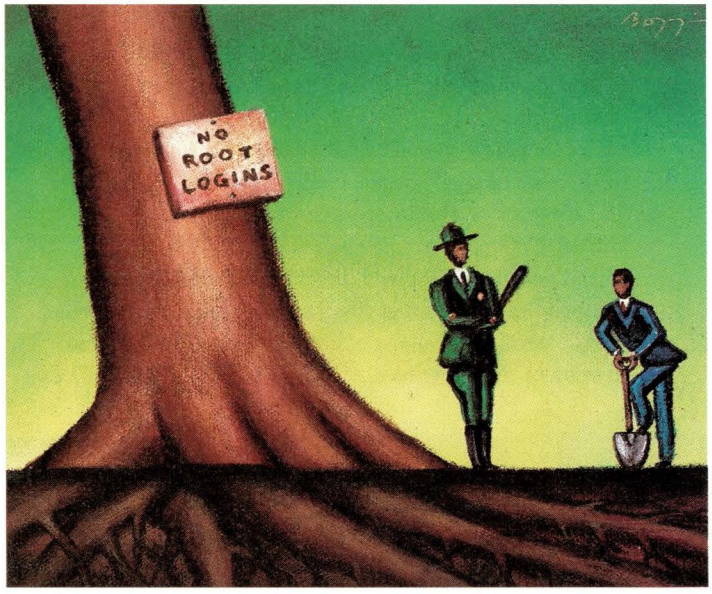
Richard Morin operates Prime Time Freeware (`ptf@cfcl.com`), which publishes mixed-media (book/CD-ROM) freeware collections. He also consults and writes on UNIX-related topics. He may be reached at Canta Forda Computer Laboratory, P.O. Box 1488, Pacifica, CA 94044 or by email at `rdm@cfcl.com`.

by S. LEE HENRY

Monitoring the Mighty Root

Probably the single most significant security vulnerability in UNIX is the all-powerful superuser. Contrary to the limitations that ordinarily come into play in "real life," the superuser has unlimited access in most every implementation of UNIX and requires no collaboration or approval from any other user. Ripe for abuse, this situation requires those of us with root (i.e., superuser) privilege to be both unusually ethical and unusually careful, and makes root access the Holy Grail of hackers.

Protecting against the unauthorized access and abuse of root privilege is a job that could keep any number of sysadmins busy around the clock. Just in case your site can't afford to provide this kind of coverage, let's consider some less aggressive things the typical site might do to limit the risk.



JAMES BOZZINI

Changing Passwords

The root password should be changed more frequently than most user accounts. Depending on the sensitivity of the particular system and its data, this could be anywhere from every week to every couple of months. For extremely security-conscious systems, you might want to go to a onetime password system, such as S/Key or OPIE. If more than one individual needs this access, you can assign multiple user names (same UID) to the root user so there is no need for complicated coordination.

Disallow direct root login except on the console, and then only if the console is truly secure. In SunOS, you can disallow all direct root logins. This is important because if more than one person has the root password, log files will not capture who the individual logging in really is.

If you disallow root login on the console, however, be sure to have local logins (i.e., in the `/etc/passwd` file) for all sysadmins who might need access to the system. If NIS or NIS+ fail for some reason, you will need someone to be able to log in–short of far more drastic procedures.

In SunOS, the "secure" designator in the `/etc/ttytab` file permits local root login:

```
console  "/usr/etc/getty cons8"      sun      on local secure
ttya     "/usr/etc/getty std.9600"   unknown  on
```

This section of the `/etc/default/login` file restricts root login to the console in Solaris–i.e., root cannot login anywhere else:

```
# If CONSOLE is set, root can only login on that device.
# Comment this line out to allow remote login by root.
#
CONSOLE=/dev/console
```

It is also a good idea to disallow root logins over the network. This will help "contain" a problem if an unauthorized person learns your root password.

Who Can su?

SunOS had the wheel group, which could be used to explicitly list those individuals allowed to execute an `su` to root. Although this feature does not exist in Solaris, you can consider limiting use of the `su` command by making it only executable by root and the sysadmin group (group 14). However, this doesn't prevent your users from locating and downloading their own copy of `su`.

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Circle No. 32 on Inquiry Card

Limiting the use of trusted hosts is an extremely effective way to limit the spread of unauthorized root access. If you are in an environment with multiple sysadmins, it's a good idea to run checks of `/.rhosts` files through `cron`. It is not unusual for even fairly senior sysadmins to give a system "temporary" trust, but then forget to remove the host name from the `/.rhosts` file when it is no longer needed.

Because root on hosts listed in the `/.rhosts` file has the same authority as the local system's superuser, this privilege should be carefully monitored.

When trusted hosts are necessary, or when the benefit provided to system managers outweighs the risks of their use, the direction of trust between your systems can be extremely significant. Generally, the best approach is to have a single system that many other systems trust, rather than a more complicated relationship where host A trusts host B and host B trusts host C and host D and so on. The latter is hard to control and allows more routes to a system than you will likely want to expose it to.

NFS mounts can provide root access to mounted file systems if the remote superuser access feature is explicitly requested. Don't use this feature except when there's a real need for it. This, like trusted hosts, exposes one system to the activities of a possibly rogue root on another.

Making Routine Checks

Gauging and monitoring the status of your network with regard to root privilege is a good thing to do periodically. Here's what I suggest:

1) You might have a `cron` job that checks whether the root password has been changed in the last month and sends you mail if it has not. There are several ways this could be done. One way is to save root's "encrypted" password in a protected file along with a date and compare it to the current password.

2) You can check to be sure that the policy decisions you've made regarding direct root logins are not changed in practice by modifications to the files in question. You might do this by comparing the active file to an earlier copy, or by using software that monitors changes in system files, for example, TripWire.

3) You can routinely search for "extra" copies of `su`. Because Trojan horse `su` commands are one way that hackers might try to get the root password, or yours, for that matter, this is a good idea in general.

```
chaos# find /home -name su -ls
```

4) You can create "maps" of your trusted host matrix. Try to capture the essence of who trusts whom and pick out vulnerable systems.

```
Host A      Host B      Host C
======      ======      ======
Host B      Host A
Host C
```

In the example above, Host A trusts B and C, C trusts no one. Although in this example, Host B doesn't trust Host C, a superuser on Host C can gain access to Host B through Host A.

5) Keep and routinely check the `sulog` to see who is using the `su` command, especially those using `su` to gain access to the root account.

This file may get very large, so it's a good idea to use a script to reduce the data to counts of each pair of real and effective users:

```
slee-root: 359 times
mrbill-root: 2 times
mrbill-gumby: 11 times
```

This type of data showing how many times each user has used `su` to become another user can be very handy. ⊸

S. Lee Henry is on the board of directors of the Sun User Group and spends most of her weekdays spreading UNIX wisdom at TASC in Reston, VA. She also is an adjunct professor for Eastern Michigan University. In her infrequent spare time, she writes short stories, sings and plays her collection of percussion instruments.

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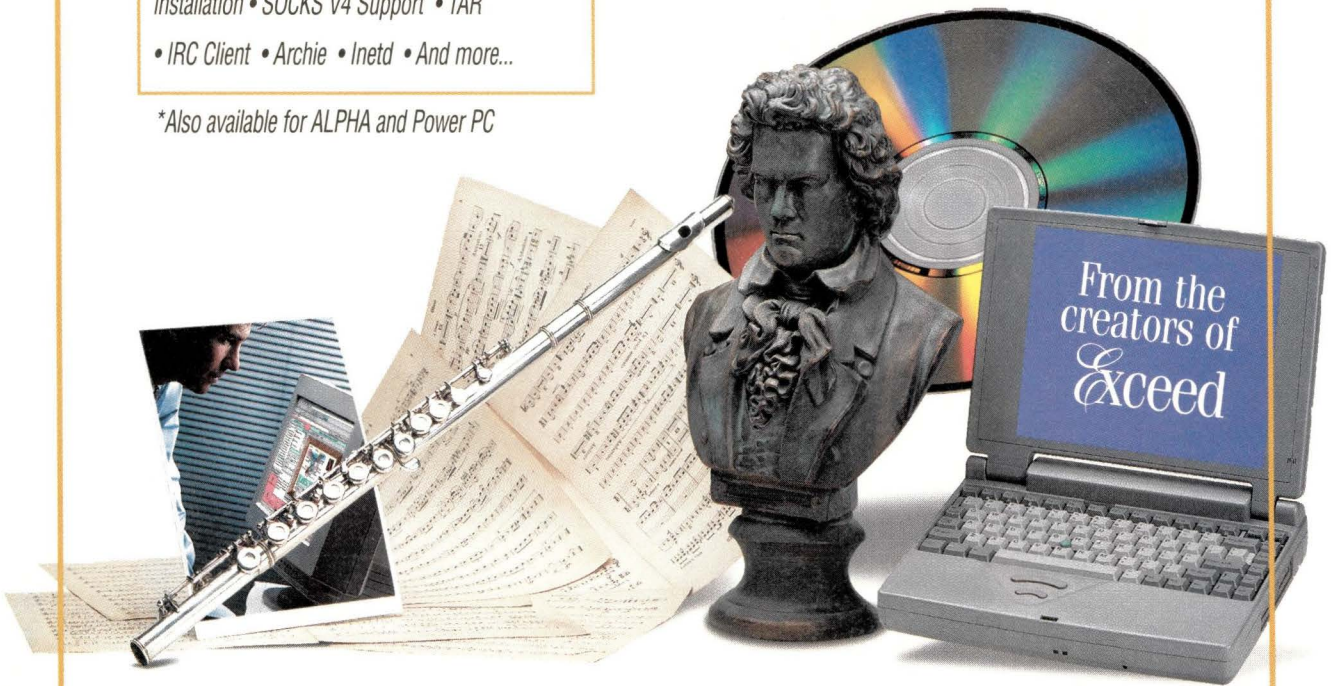

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The Java Revolution

by JEFF SUTHERLAND

Java is the cleverest attempt at a Trojan horse yet. The Netscape browser grabs screen real estate, and Java delivers the goods right into the heart of Microsoft territory, breaking its lock on the desktop.

The combination of Sun Microsystems Inc.'s Java and Netscape Communications Corp.'s Navigator is the first credible strategy to free the software industry from the iron grip of Microsoft Corp. As a result, every leading software and hardware vendor has rallied around Java, and even Microsoft has had to join the pack and support Java in its products.

Every major C++ vendor will become a Java vendor to survive in the C++ marketplace. C++ owns about 42% of the market for development of object-oriented applications, according to a June 1995 *Object Magazine* article titled "Objects important to redesign, O-O 4GLs outracing Smalltalk?" In the future, a substantial portion of the C++ market will turn into a Java market.

The popularity of Java has had a significant impact on Smalltalk and C++ developers, because Java can be viewed as a crippled Smalltalk for C++ programmers. It avoids the complexity of C++ by introducing features that have been part of the Smalltalk environment for 20 years. More important, it can be

seamlessly distributed over the World Wide Web. It is free, totally portable, runs on every major hardware platform, and is supported by every major hardware and software vendor.

Java Can't Do Anything Really Useful Yet

Smalltalk is running in 15% to 20% of the production, object-oriented, client/server business applications, according to an Executive Brief in the June 1995 issue of *Object Magazine*. Most of the rest are running C++. Java, on the other hand, is not running in these applications yet because it is not robust, performance is poor, and Java development environments are not ready for prime time. Java is useful for cute applets on Web pages and little else.

For example, Java is now being used for registration applets in development efforts for one of the leading Internet news providers, Individual Inc., Burlington, MA. However, the lack of tools, slow performance and security restrictions have prevented deployment of Individual Java tools on Individual's Newspage sites.

While Java has been designed to deal with the security issues posed by the Internet, it cannot effectively deal with client/server development on corporate intranets. For example, consider the security restrictions that are built into the Java applet execution environment:

- A Java applet can communicate only with the server that distributed the applet to the client machine.
- A Java applet cannot evoke an executable on a client machine.
- A Java applet cannot write to ROM or disk on a client machine.

Consider one of the simplest of all client/server applications: updating a local computer clock to atomic time. I use a Java application, TickTock, that calls the U.S. Naval Observatory atomic clock server (violating security restriction 1), evokes an operating system call on my local machine (violating security restriction 2), and writes the current time to my system clock (violating security restriction 3). This is one of the simplest of all client/server applications, and it cannot be run as an applet.

Table 1. Smalltalk, C++, OO COBOL and Java: The Good (1), the Bad (3), and the Ugly (2)

		Smalltalk	OO COBOL	C++	Java
Flexibility	Dynamic binding	1	2	2	2
	Dynamic classes	1	3	1	2
	Multiple inheritance	3	2	2	3
	Roles/interfaces	2	3	3	1
	Function pointers/ lexical closure	1	2	3	3
Ease of use	Class libraries	1	3	3	2
	Learning curve	1	3	2	1
	Speed of development	1	3	2	2
	Portability	2	3	3	1
Support	Tools	1	1	3	3
	Multiple vendors	2	1	3	1
	Internet aware	3	3	3	1
Performance		2	1	3	3
Risk	Garbage collection	1	3	3	2
	Memory leaks	1	3	1	1
	Overwriting memory	1	3	1	1
	Ready for prime time	1	1	2	3
Total (low = best)		25	40	40	32

Today, even Sun does not recommend building major client/server production systems with Java. Its performance and garbage collector limitations are similar to the first Smalltalks implemented in the 1970s. Nevertheless, Java stacks up pretty well against other major object-oriented languages.

Table 1 originally appeared in my article for *Object Magazine*, "Smalltalk, C++, and OO COBOL: The Good, the Bad, and the Ugly." The table is extended to include Java; it has been critiqued by many members of the `comp.lang.smalltalk`, `comp.lang.c++`, and `comp.object` newsgroups. Despite isolated objections to particular entries in the table, the ratings are adjusted to reflect a widespread consensus of opinion in the newsgroups. Java stacks up remarkably well for a new language.

Much of the leading compiler talent on the planet is now dedicated to providing good Java tools, improving Java performance, giving Java a state-of-the-art garbage collector, and generally getting Java ready for prime time. As can be seen from Table 1, with good tools, excellent performance and a robust environment, Java will outrank Smalltalk as a software development language. I estimate that the Smalltalk community has about one year to respond to this problem.

Can Java Help with the Software Crisis?

It is not news that there is a software crisis. The news is that it is getting worse: It costs $70 billion per year to maintain 10 billion lines of legacy code in the United States alone, according to Moisey Lerner, "Software Maintenance Crisis Resolution: The New IEEE Standard" in *IEEE Software*, August 1994.

By 1995, according to the January 16, 1995 issue of *PC Week*, 31% of new projects were canceled at an estimated cost of $81 billion and 52.7% of projects were over budget for a $59 billion loss. In *Guerilla Programmer*, July 1995, Ed Yourdon concludes that developer productivity has dropped 13% since 1993 and the ratio of best to worst organization

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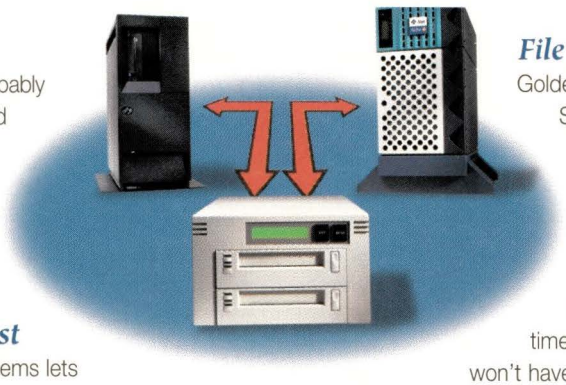

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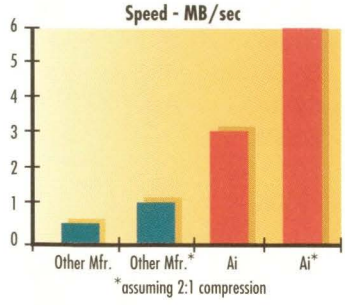

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software productivity has widened from 4:1 in 1990 to 600:1 in 1995. (*Guerilla Programmer* is no longer published, but back issues are available from Cutter Information Corp., Arlington, MA.)

How will Java alleviate this problem? Java does not produce any more functionality per line of code than C++, according to Software Productivity Research, Burlington, MA (`http://www.spr.com/library/langtbl.htm`). Its automated garbage collection might reduce lines of code required by 40%. The elimination of pointers in the language significantly reduces debugging time and eliminates memory leaks, producing more robust applications.

But another computer language won't solve our software productivity problems. Only component-based development with advanced development environments (nonexistent in Java) can really help. We need enterprise solutions based on business object design and implementation. New approaches to software development and higher levels of engineering skill are required. Future enterprise solutions will be Web-based, but when will Java be able to support them?

Why Component-Based Development?

The global market has become an intensely competitive environment moving at an accelerating rate of change. Gradual improvements in productivity and enhancements in quality are no longer enough to maintain market leadership. Reducing the time to market of new products and rapid evolution of old products and applications are key success factors.

Accelerating product evolution requires reinventing the processes that bring products to market and eliminating processes that do not add value. Because modern corporations have embedded many rules and procedures for product delivery in computer systems, the software applications that run the business must undergo significant change. To gain the strategic advantages of speed and flexibility, corporations must remodel their business processes, then rapidly translate that model into software implementations.

Another computer language won't solve our software productivity problems... We need enterprise solutions based on business object design and implementation.

Business process reengineering (BPR) sets the stage for continuous evolution of business processes to meet rapidly evolving business requirements. Implementation of software systems that support BPR requires business objects that can both simulate corporate procedures and translate smoothly into software objects. Well-designed business object implementations can be easily modified as the business changes.

Business Objects as Reusable Components

Early adopters of object technology asserted that packaging software in object classes would allow software to obtain some of the benefits of Moore's Law as seen in IC chip fabrication, according to Brad Cox in *Object-Oriented Programming: An Evolutionary Approach,* Addison-Wesley. Some projects have achieved major productivity benefits.

For example, a maintenance management system at General Motors originally written in PL/I was rewritten in Smalltalk under a contract with Electronic Data Systems Corp. and achieved a 14:1 increase in productivity of design, coding and testing, says David Taylor in his book *Object-Oriented Information Systems: Planning and Implementation,* John Wiley & Sons. A detailed analysis of this project recounted by Taylor shows 92% fewer lines of code, 93% fewer staff months of effort, 82% less development time, 92% less memory needed to run and no performance degradation.

While many isolated projects have used object technology to achieve dramatic productivity gains during the past decade, this success has not translated into broad improvements across

Table 2. Marcam Return on Investment for OO Project

Perceived advantage	Advantage improvement	Probability of occurrence	Incremental cost	Return on investment
Time to market	$100M	.4	$3M	$27M
Flexibility	$100M	.2	$2M	$18M
Productivity	$2M	.8	$300K	$1.3M
Quality	$1M	.9	$200K	$700K
Other costs	$0	–	$500K	$500K
Code size	$0	–	$0	$0
Reuse requirements	$0	.9	$10K	-$10K
Total			$6M	$47.5M

Source: Marcam Corp.

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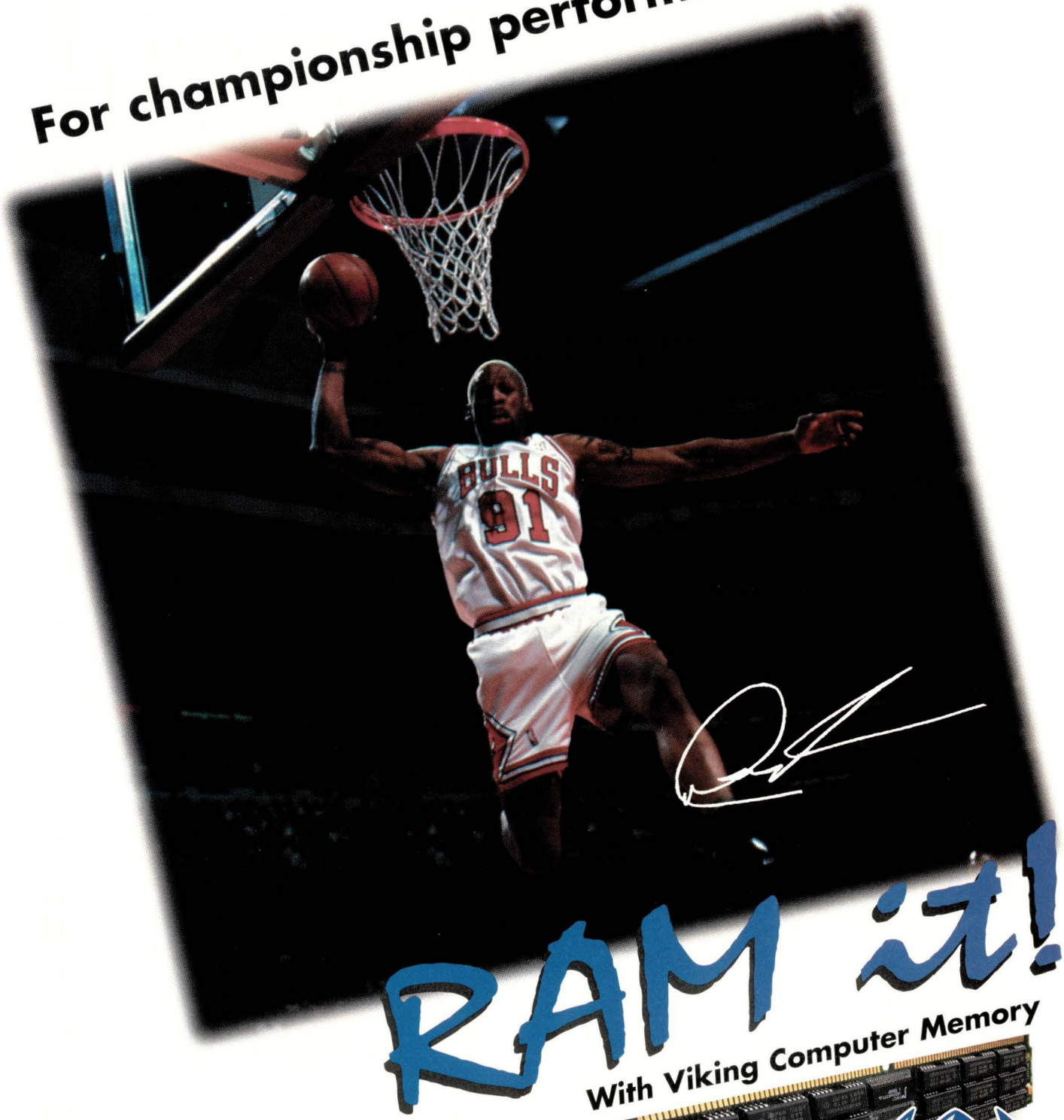

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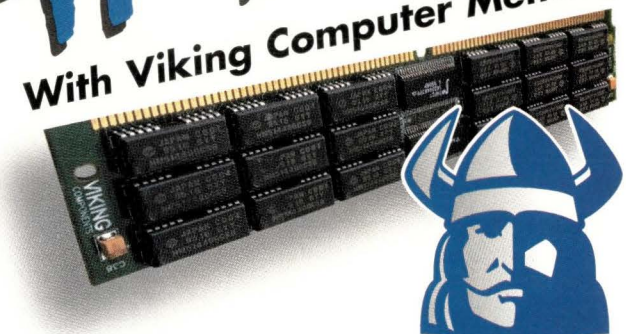

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the software industry. In 1995, Meta Group Inc., Stamford, CT, reported that, "despite the promise of reusable objects, most IT organizations have realized a scant 10% to 30% productivity improvement from object technology." Failure to achieve larger productivity gains was attributed to:

- Data-centric, task-oriented application development
- Methodologies and cultures that do not promote reusability
- Few linkages between BPR-defined business processes and IT support initiatives.

While productivity gains from object technology in recent years have been limited, some companies have been able to achieve dramatic returns on investment by bringing products to market sooner, with the flexibility necessary for rapid tuning of the products to meet changing market conditions.

For example, in "What's the ROI on Objects," *Software Magazine*, May 1996, an analysis of return on investment (ROI) from object-oriented development of robotics software by Marcam Corp., Newton, MA, showed a $45.7 million return on a $6 million investment. Return was calculated by multiplying the value of an improvement by the estimated probability of its occurrence and dividing by the cost of the improvement. A spreadsheet is shown in Table 2.

Business objects are designed to support a clearly defined relationship between BPR-defined business processes and software implementation of these components. Using an object-oriented development methodology yields quick time to market, and good object-oriented design allows for rapid evolution of business objects in response to market conditions. The bottom line is that object technology is a necessary, but not sufficient, condition for large returns on investment. It must be combined with focus on delivering business object components that enable fast and flexible delivery of new or enhanced products in the marketplace.

The Need for a BOA

As business models are renewed, software architectures must be transformed. A business object architecture (BOA) is an effective solution for dynamic automation of a rapidly evolving business environment.

Dynamic change requires reuse of chunks of business functionality. A BOA must support reusable, plug-compatible business components. The two primary strategies now being used for implementing client/server systems to support reengineering of business processes are visual fourth-generation languages and classical object technology. While both of these approaches are better than COBOL, neither of them can effectively implement business objects.

Building Business Object Components

A group of objects is the ideal unit of reuse. These groups of objects should behave as a higher-level business process and have a clearly specified business language interface. Business components are encapsulated with a protocol that allows efficient communication with other objects on the network.

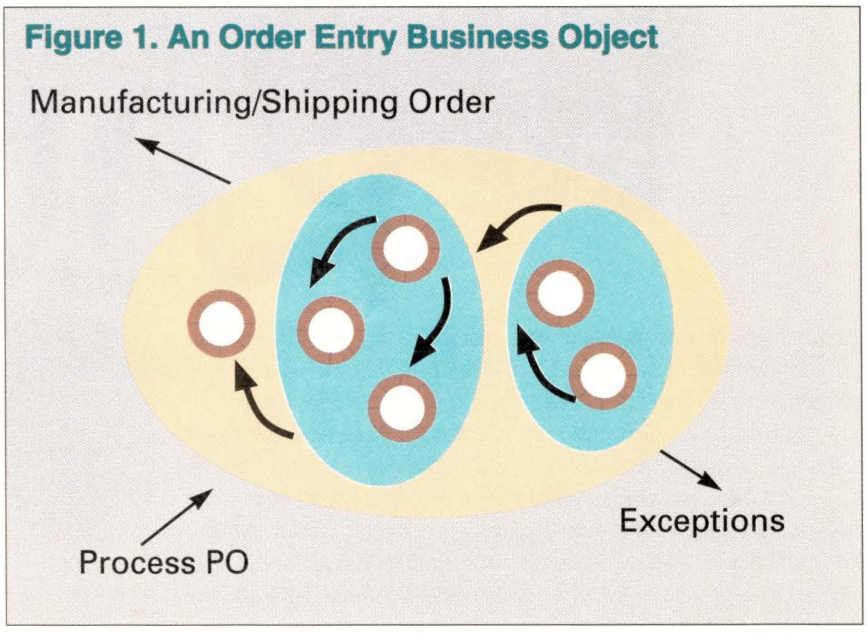
Consider a typical client/server application, such as the order entry system shown in Figure 1. This system takes a purchase order as input and produces a validated order as output. The internals of this component should be a black box to the external world. The resulting order is input for another subsystem or, alternatively, an exception condition is raised if the purchase order is not valid for processing.

To support plug-compatible reuse, a business component must be encapsulated in two directions. The external world must not know anything about component internals, and the internals must not know anything about external components, other than allowing interested objects to register for notification of specific events or exception conditions.

The internals of a business component are made up of other encapsulated business components. For example, when a purchase order passes through the membrane of the order entry business object, an internal component must see it, validate it, look up customer information, inventory availability and catalogue pricing, and build an order that is consistent with business rules and procedures. Each of these tasks is accomplished by embedded components, many of them communicating with external data sources.

External databases must be encapsulated as business objects or reuse will not be easily achieved. There must be a database access component that causes values from any kind of database to materialize as objects inside the business component. Whether object-oriented, relational or other database access is required, a set of class libraries designed to automate

Figure 1. An Order Entry Business Object



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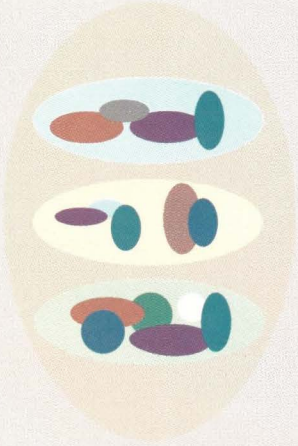
this interface will result in a major savings in development resources. For more information, see "The Hybrid Object-Relational Architecture (HORA): An Integration of Object-Oriented and Relational Technology" by J.V. Sutherland, M. Pope and K. Rugg. It is part of the Proceedings of the 1993 ACM/SIGAPP Symposium on Applied Computing, ACM Press.

An order entry business object will typically have multiple user interfaces. A clerk may be taking the order over the phone, entering purchase information, validating customer records and credit data, and reviewing an order for consistency and customer acceptance. Other users may require different presentation screens.

User interfaces are difficult and time-consuming to build at the code level. Today, much of this process can be automated. They should be encapsulated as separate objects that communicate by message passing to the order entry object. Failure to do this will limit reuse and waste valuable programmer time on laborious, time-consuming maintenance tasks. Users should be able to create interface objects with simple object-oriented tools. Subsequently, the programmer should be able to easily snap user interface objects onto the order entry object.

Figure 2. Client/Server Component



A simple order entry client/server component, illustrated in Figure 2, has at least three large-grained components, one or more presentation objects, a business component that models the business process, and a database access component that shields the application developer from database access languages, database internals and network communications.

Business object programmers focus their efforts on building business components, or large-grained business objects, which can be easily distributed on the network.

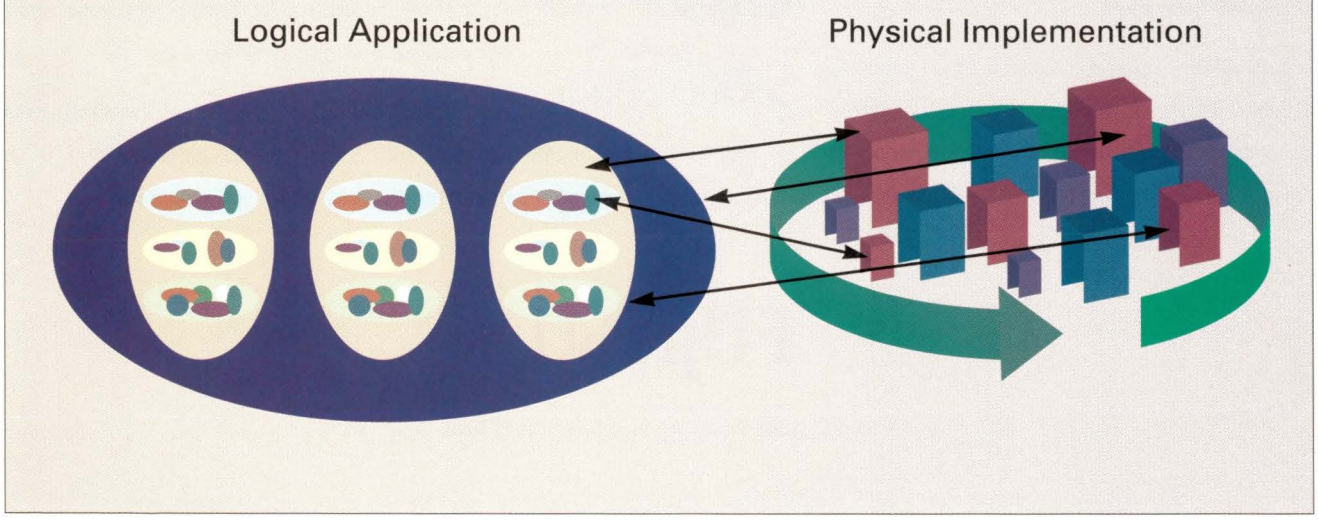
Distributing Business Objects

System evolution, as show in Figure 3, will invariably distribute these business objects to maximize network performance and processor utilization, and to ensure proper control, integrity and security of information. Business reengineering implies implementing a distributed environment where components encapsulating business functionality can be migrated to nodes on the network that allow maximum flexibility, salability and maintainability of a business object system.

Business objects made up of nested components allow distribution of these components across a network. Figure 3 shows the logical application as a coherent set of nested client/server components. Deployment of this large-grained object may include distributing subcomponents across multiple heterogeneous computing resources in dispersed locations. Thus, an application designed on one processor is scattered across a network at runtime.

Developers of business information systems are beginning to take advantage of building applications with Object Linking and Embedding (OLE) components. At Object World in San Francisco, Allied Signal won the *Computerworld* Award for best object-oriented application of 1995. Allied reengineered a supply manage-

Figure 3. Application Business Object with Nested Client/Server Components



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ment business process that took 52 steps to purchase a single part; now it requires only three steps to complete the same transaction. The old process required seven people and took nine weeks to produce an approved purchase order. The new Supply Management Specialist Tool (SMST), developed with the ObjectStudio advanced development environment from Vmark Software Inc., Westboro, MA, allows one person to complete the same process in nine minutes for established suppliers with long-term agreements in place. In the case of new suppliers, where a Request for Quote (RFQ) is required, the process takes nine days.

In this example, cycle time of the process is reduced 2,400:1 for established suppliers, and 5:1 for new suppliers. Cost reduction in operational staff is 7:1. The impact of improvement in business efficiency leading to greater customer satisfaction and resulting market share is far greater than any reduced costs in operations overhead or development time and is the prime objective for the use of business object design tools to ensure success of business process reengineering practice.

A Web-Based Solution

To enhance competitiveness in an environment of accelerating change, businesses are turning to Web-based solutions for intranet client/server applications. Some potential benefits are:

- Thinner clients
- Reduced network costs
- Automated software distribution
- Lower development and maintenance costs
- Transparent portability dramati cally reduces complexity
- Simpler technology for MIS to implement
- Infrastructure for distributed business object architecture

Building nontrivial client/server applications on the Web requires more than HTML programming. Current approaches as shown in Figure 4 are not object-oriented. CGI invocations must return a new screen on every interaction, and context is lost. Every CGI access reopens the

Figure 4. Typical CGI-based Web Interaction

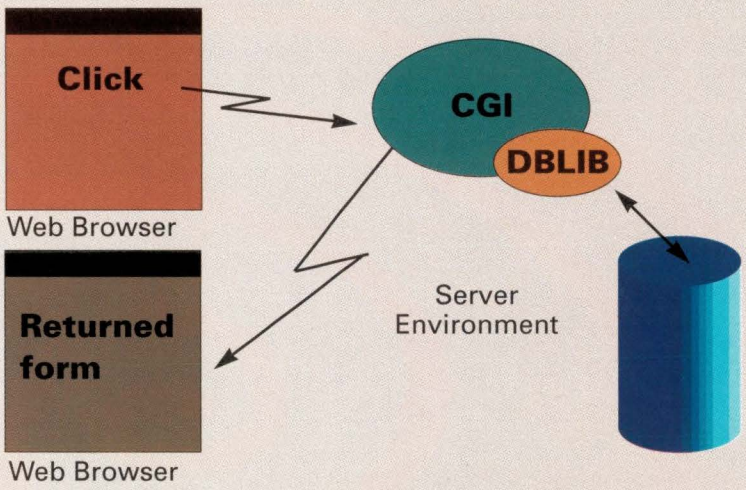


Figure 5. Enhanced Java/CGI Implementation

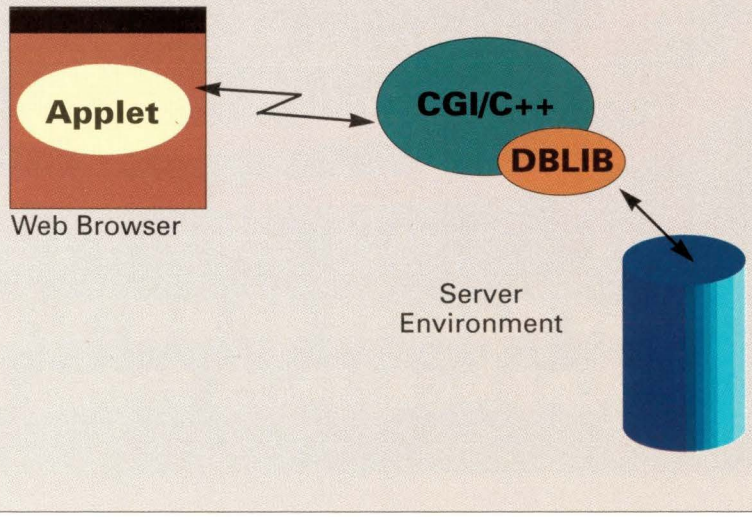
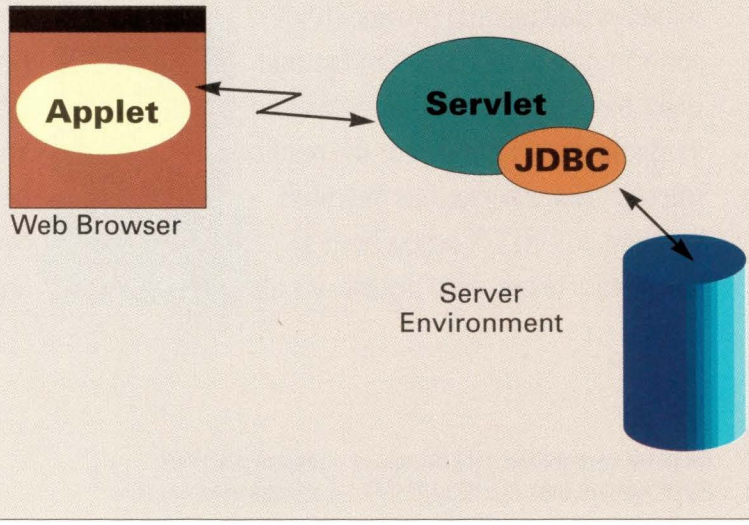


Figure 6. Applet/Servlet RMI Implementation



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database, dramatically reducing performance characteristics of the application. Working around these problems requires a high level of technical skill and significant development resources not normally available to corporate MIS shops.

Current development in Internet companies is typically focused on an object-oriented implementation that improves maintenance and enables reuse. C++ CGI components are used to maintain open database connection for sessions, radically improving performance. Figure 5 shows how Java applets communicate with the C++ components to maintain context between screen interactions.

The minimal environment needed to easily implement client/server applications on the Web is outlined in Figure 6 and includes:

- Remote method invocation across the network, dramatically simplifying programming
- Java applets or servlets can initiate action, and peer-to-peer communication is supported between applets and servlets. A simple example is the need for a servlet stock ticker that can update a browser applet.
- Servlet/JDBC optimization of database performance and simplification of object to relational table mapping.
- Database connections automatically held open for session and proper management of multiple simultaneous connections to the database.

Current Impediments to Java Client/Server Applications

The lack of tools to simplify implementation of the architecture in Figure 6 is a major inhibiting factor for movement to Java-based client/server applications. The lack of a robust, bug-free, integrated Java development environment is a second impediment. The third major handicap for building these applications is lack of a component-based development environment required for building business object architectures.

Industry acceptance of the Sun's Javasoft JavaBeans Specification, released in October 1996, is required for building standard Java components, and OMG standardization of a business object facility is a core requirement for building standards-based business object architectures from Java components. During the coming year, these standards should stabilize, and robust tools for building Java applications will become available. (See Object Management Group Common Facilities RFP 4: "Common Business Objects and Business Object Facility." OMG TC Document CF/96-01-04. You can get a copy at `http://www.omg.org/cftfrfp4.htm`.)

Table 3. Projected Evolution of Three-Tier Web-Based Applications

	GUI	Business rules	Database	Issues
Recent past	Client applet	Server CGI	ODBC	Performance tools
1996	Client applet	Server Java API	JDBC	Performance tools
1997	Dynamic client applet partitioning	Client/server	JDBC	Component technology tools
1998	Applet sent to server	Multiple servers	Multiple servers	Security

Conclusion

Tools for integrating Java, objects, databases and the Web are in a primitive state, and most corporations are still unable to implement nontrivial Java client/server applications on the Web. However, it seems that evolution of Java tools is very fast, and the component technology infrastructure needed to implement these applications will begin to become available later this year. Before the end of this century, we will have the capability to move applets seamlessly from client to server, as well as from server to client, enabling a new generation of knowledge-based application agents that surf the Web (or the corporation) without human intervention.

Corporations that take advantage of business object architectures will significantly shorten product cycles, and Java will play a major role sometime before the year 2000. Consulting groups that use business objects will significantly underbid their competition and deliver new systems on time and under budget. Because a business object architecture will allow software to change as rapidly as the underlying business processes, corporate viability will be enhanced by early implementation. Laggards will pay the price. They are already easily outmaneuvered in the marketplace by enterprises embarking on large-scale implementation of global distributed object systems based on Internet technologies. ⊸

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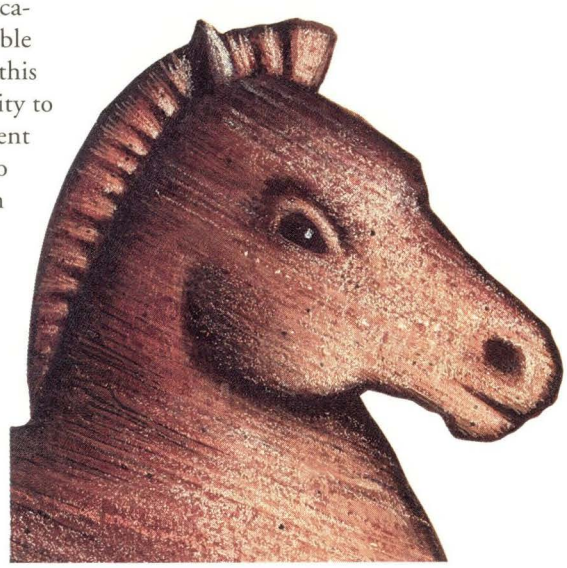

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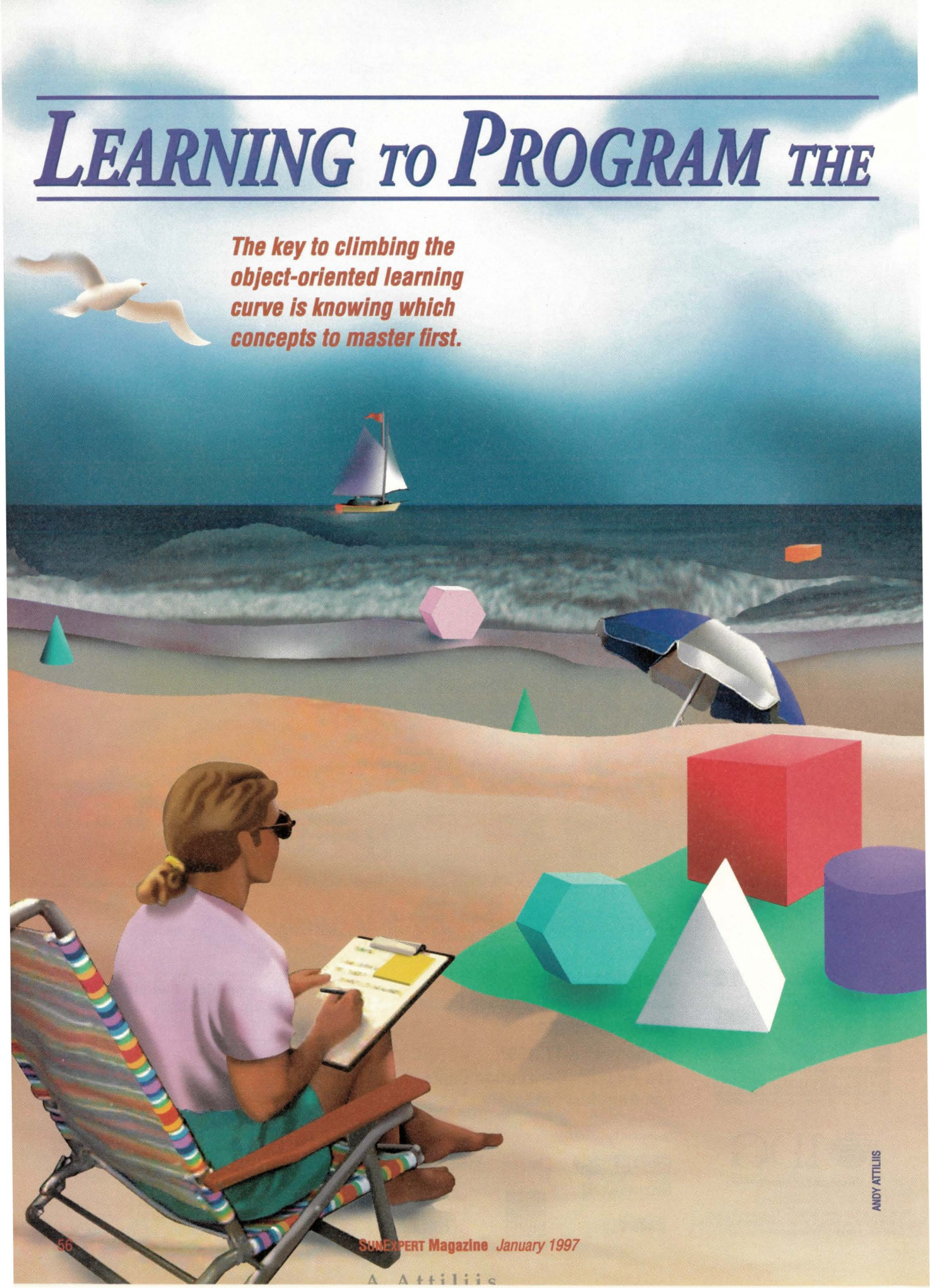
LEARNING TO PROGRAM THE

The key to climbing the object-oriented learning curve is knowing which concepts to master first.



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OBJECT-ORIENTED WAY

by ROBERT I. PITTS

Learning to program well in an object-oriented (OO) language can be a long process, but knowing what skills to master first will make the learning process smoother. A good understanding of general object-oriented concepts and how to implement them in a particular OO language should precede delving into the "syntactic and semantic sugar" of the language.

Recently, I looked at some programs I wrote years ago in object-oriented versions of Pascal and in C++. My understanding of OO programming has come a long way since then. Although I was using OO languages, these old programs revealed that I wasn't thinking in an object-oriented way. Programmers who are beginning the process of learning an OO language should be encouraged. With practice, you can learn to integrate OO methodologies into your programming repertoire.

This article will present the concepts necessary to begin OO programming. I'll compare code in C and C++, illustrating

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how OO concepts can simplify programming tasks. My intention in showing C++ code is not to teach the language but to give something concrete to look at and compile. Once I have discussed the basic OO concepts, I'll describe how objects fit into three OO languages: C++, Objective-C and Java. Finally, I'll give some hints about what types of language capabilities the programmer can ignore when beginning to learn an OO language.

General OO Programming Concepts

Modern OO languages provide three capabilities that can improve the design and structure of programs: *encapsulation*, *inheritance* and *polymorphism*. Any procedural language can be used to implement these capabilities, but support for them is built into OO languages. While some procedural and functional languages support encapsulation and polymorphism, inheritance is a distinctly object-oriented concept.

A fundamental property of procedural languages is that data and functions are separate entities. For example, in C, data is stored in data types such as `int` and `float`, in arrays of various types or in user-defined types such as a `struct`. There is no way to *couple* a function that operates on an `int`, for example, with all `int` variables.

Programmers creating new data structures in C define new data types and new functions. For example, Figure 1A shows an *employee* data type. Employees have a *name* and a *pay rate*, which are held in a structure given the type name `EmployeeT`. A programmer using this structure would create variables of type `EmployeeT`.

Data structures typically don't just store information but also have some associated functionality. For employees, we would like to be able to print their names and calculate how much to pay them each week. To do this, Figure 1B shows the definition of three employee functions: `EmployeeSetData`, `EmployeeGetName` and `EmployeePay`. Each function takes an `EmployeeT` pointer, specifying the employee to operate on, and possibly other parameters. For example, `EmployeePay` also takes the number of hours worked

Figure 1. C Implementation of an Employee Data Structure

Key: Data type definition(s); Data functions/methods; Uses (data structure/class)

```
#include <stdio.h>
```

A

```
/* Type definition for an employee. */

typedef struct {
    char name[30];
    float payRate;
} EmployeeT;
```

B

```
/* Functions for an employee. */

void EmployeeSetData(EmployeeT *employeePtr,
                     char lastName[],
                     char firstName[],
                     float newPayRate)
{
    sprintf(employeePtr->name,
            "%s %s", firstName, lastName);
    employeePtr->payRate = newPayRate;
}

const char *EmployeeGetName(
                  EmployeeT *employeePtr)
{
    return employeePtr->name;
}

float EmployeePay(EmployeeT *employeePtr,
                  float hoursWorked)
{
    return employeePtr->payRate * hoursWorked;
}
```

C

```
/* Example use of an employee. */

int main(void)
{
   EmployeeT empl;
   float amount;

   /*
    * Set up one employee and print out
    * his name and pay.
    */

   EmployeeSetData(&empl, "Jones", "Bill", 25.0);

   /*
    * We don't want to "peek" at the name field
    * by doing something like:
    *
    *   printf("Name: %s\n", empl.name);
    *
    * This may break if the EmployeeT data type
    * is changed. Instead, we'll use the function
    * provided for us to access an employee's name.
    */
   printf("Name: %s\n", EmployeeGetName(&empl));

   amount = EmployeePay(&empl, 40);
   printf("Pay: %.2f\n", amount);

   return 0;
}
```

in a week.

Even this initial implementation of an employee data structure, made up of a new data type and some functions, shows some level of *encapsulation*.

Encapsulation

Encapsulation means that the *implementation* of a distinct part of a program, such as a data structure, should be isolated and hidden from other parts of the program. Thus, users of our employee data structure should only know that there is some type named `EmployeeT` and functions to set an employee's data, to get an employee's name, and to calculate an employee's pay.

Figure 1C shows how a programmer might use our employee data structure. To create a new employee, the `EmployeeT` variable, `empl`, is defined. Moreover, performing an operation on this employee requires calling an employee function, passing it a pointer to the employee, plus any other arguments.

Thus, using an employee doesn't require knowing that the `EmployeeT` type is a structure with two fields. If this type were changed, programs that peek into its fields may break. If, however, the user accesses employees through the employee functions, such as `EmployeePay`, then changes in the data structure can be isolated to employee functions.

Figure 2A illustrates another way to construct the employee data structure by using C++. Now, the data and functions of an employee are part of a single entity, a class named `Employee`.

Note that the C++ functions don't need a pointer to the employee to operate on. Furthermore, in the employee functions, the fields of an employee, such as `name` and `payRate`, are referenced without an employee pointer. This is possible because a call to an employee function will always be associated with a particular employee. For example, Figure 2B shows the creation of two employees, `empl1` and `empl2`. When a call is made to an employee function, it is done in concert with the employee to operate on, as in:

Figure 2. C++ Implementation of an Employee Data Structure

```
#include <stdio.h>
```

A

```
/*
 * The class Employee contains both the
 * data and functionality of an employee.
 */

class Employee {
protected:
  /* Data */
  char name[30];
  float payRate;

public:
  /* Functionality */

  void setData(char lastName[],
               char firstName[],
               float newPayRate)
  {
       sprintf(name,
               "%s %s", firstName, lastName);
       payRate = newPayRate;
  }

  const char *getName()
  {
       return name;
  }

  virtual float pay(float hoursWorked)
  {
       return payRate * hoursWorked;
  }
};
```

B

```
/* Example use of employees. */

int main(void)
{
    Employee empl1, empl2;

    /*
     * Set up the 1st employee and print out
     * his name and pay.
     */
    empl1.setData("Jones", "Bill", 25.0);
    printf("Name: %s\n", empl1.getName());
    printf("Pay: %.2f\n", empl1.pay(40));

    /*
     * Set up the 2nd employee and print out
     * her name and pay.
     */
    empl2.setData("Doe", "Jane", 27.5);
    printf("Name: %s\n", empl2.getName());
    printf("Pay: %.2f\n", empl2.pay(38));

    return 0;
}
```

Figure 3. C Implementation of a Manager Data Structure

```
#include <stdio.h>

/* Type definition for a manager. */
typedef struct {
    char name[30];
    float payRate;
    int isSalaried;
} ManagerT;
```

```
empl1.setData("Jones", "Bill", 25.0);
.
.
.
empl2.setData("Doe", "Jane", 27.5);
```

Both `empl1` and `empl2` have separate name and pay rate data; thus, `empl1.setData()` operates on the data of `empl1`, and `empl2.setData()` operates on the data of `empl2`.

These employees, `empl1` and `empl2`, are instances of the class `Employee`–instances are also called *objects*. Like a new type in C, a class in C++ is just a "template" for a new data type. You don't actually get storage for an employee until you define or dynamically allocate an `Employee` object.

The distinction between a class and an instance of a class, i.e., an object, is very important. Throughout this article, I will use both terms in similar situations because they are intimately related.

The idea behind encapsulating a data structure into a single entity is as follows: We are often trying to model real-world entities, like an employee, which have both data and functionality. Isn't it more natural to have a single construct that can implement both parts?

Inheritance

Being able to implement objects as a single programming construct doesn't complete our analogy with the real world. For example, suppose we also need to deal with *managers* in our program. Managers are a "kind of" employee. We might keep more information about managers, such as whether they are paid by salary, and calculate their weekly pay in a different manner.

Using a procedural language like C, we might write a manager data structure like that shown in Figure 3. Its data type, `ManagerT`, differs from the `EmployeeT` type only because it has an additional field, `isSalaried`. It has the same functions as employees, with new names that begin with `Manager`; however, `ManagerPay` calculates pay differently than `EmployeePay`. There is also an new function that sets the `isSalaried` flag.

```
/* Functions for a manager. */

void ManagerSetData(ManagerT *mgrPtr,
                    char lastName[],
                    char firstName[],
                    float newPayRate)
{
    sprintf(mgrPtr->name,
            "%s %s", firstName, lastName);
    mgrPtr->payRate = newPayRate;
}

void ManagerSetSalaried(ManagerT *mgrPtr,
                        int salariedFlag)
{
    mgrPtr->isSalaried = salariedFlag;
}

const char *ManagerGetName(ManagerT *mgrPtr)
{
    return mgrPtr->name;
}

float ManagerPay(ManagerT *mgrPtr,
                 float hoursWorked)
{
    if (mgrPtr->isSalaried)
      return mgrPtr->payRate;
    /* else */
    return mgrPtr->payRate * hoursWorked;
}
```

```
/* Example use of managers. */

int main(void)
{
    ManagerT mgr1, mgr2;

    /*
     * Set up the 1st manager and print out
     * her name and pay.
     */

    ManagerSetData(&mgr1, "Smith", "Jane", 1700.0);
    /* Has a salary */
    ManagerSetSalaried(&mgr1, 1);

    printf("Name: %s\n", ManagerGetName(&mgr1));
    printf("Pay: %.2f\n", ManagerPay(&mgr1, 40));

    /*
     * Set up the 2nd manager and print out
     * his name and pay.
     */

    ManagerSetData(&mgr2, "Danish", "Tom", 46.5);
    /* Doesn't have a salary */
    ManagerSetSalaried(&mgr2, 0);

    printf("Name: %s\n", ManagerGetName(&mgr2));
    printf("Pay: %.2f\n", ManagerPay(&mgr2, 40));

    return 0;
}
```

The problem is that C requires us to do unnecessary work because we cannot easily reuse the data type and functions that we created for an employee when defining a manager.

The solution lies with the OO concept of *inheritance*. If a manager inherits from an employee, then it gets all the data and functionality of an employee. We can then add the new data and functions needed for a manager and *redefine* any functions that differ for a manager.

Figure 4A shows a C++ implementation of the new class `Manager` that *inherits* the data and functionality of `Employee`. The only things included in the body of the class definition are the new data `isSalaried`, a way to access this data via the function `setSalaried`, and the redefinition of `pay`.

Figure 4B shows that the `Manager` class can be used much like the `Employee` class. Less work was required to create a manager data structure because we reused our employee data structure.

Because we now have one class that inherits from another, we have the beginnings of a class hierarchy. Figure 5A shows how classes `Employee` and `Manager` fit into this hierarchy. If needed, this hierarchy could be extended to include more classes. For example, to add a new type of employee, such as a supervisor, a class `Supervisor` could be created. Two choices of where to place a supervisor in the hierarchy are shown in Figures 5B and 5C.

One choice is to think of a supervisor as a kind of `Manager`. Figure 5B shows the hierarchy using this choice. The `Supervisor` class directly inherits from `Manager` and *indirectly* inherits from `Employee`. Another choice is to think of a supervisor as a special kind of employee. This is shown in Figure 5C, where `Supervisor` *directly* inherits from `Employee`. We can say that `Supervisor` *inherits* from `Employee` when there is either a direct or indirect inheritance relationship.

Polymorphism

Polymorphism is something that programmers have already seen in non-object-oriented languages. The `NIL` pointer in Pascal is a pointer that takes on the same type

Figure 4. C++ Implementation of a Manager Data Structure that Reuses the Employee Data Structure

```
#include <stdio.h>
```

A

```
/*
 * The class Employee contains both the
 * data and functionality of an employee.
 */

class Employee {
protected:
    /* Data */
    char name[30];
    float payRate;

public:
    /* Functionality */

    void setData(char lastName[],
                 char firstName[],
                 float newPayRate)
    {
        sprintf(name,
                "%s %s", firstName, lastName);
        payRate = newPayRate;
    }

    const char *getName()
    {
        return name;
    }

    virtual float pay(float hoursWorked)
    {
        return payRate * hoursWorked;
    }
};
```

```
/*
 * The class Manager gets everything an
 * Employee has, adds additional functionality,
 * and redefines how pay is calculated.
 */

class Manager : public Employee {
protected:
    /* Data */
    int isSalaried;

public:
    /* Functionality */

    void setSalaried(int salariedFlag) {
        isSalaried = salariedFlag;
    }

    virtual float pay(float hoursWorked)
    {
        if (isSalaried)
          return payRate;
        /* else */
        return payRate * hoursWorked;
    }
};
```

as the pointer it is compared with or assigned to. In C, the + (plus) operator performs integer addition with `ints` and floating-point addition with `floats`. In some "typed" functional languages, a function that operates on many different types can be defined.

All of these examples describe the use of objects or operations that behave differently depending on the context in which they are used, in other words, they exhibit polymorphic behavior. The type of polymorphic behavior that is of most interest to object-oriented programmers occurs when an object is asked to perform a function such as "calculate your pay" and produces different results depending on the *class* of the object. This type of polymorphism helps reduce the amount of code needed to do similar things with different types of objects.

Suppose we need a function to print the weekly pay of an employee. Figure 6 is C code that defines a function, `PrintPay`, which prints out the pay for any type of employee. It requires a parameter, `kindOfEmployee`, which indicates the type of employee, telling the function to calculate the pay for either a plain employee or a manager.

In Figure 7, our C++ implementation using the classes `Employee` and `Manager` is much simpler because we use the polymorphic behavior of the function `pay`. The function `PrintPay` will ask the employee sent to it to perform the `pay` operation. If the object sent is an `Employee`, then the employee version of pay will get performed. Likewise, if the object sent to `PrintPay` is a manager, then the `Manager` version of `pay` will get performed. Thus, the C version of `PrintPay` has to decide which operation to perform based on a flag. I call this the "casing syndrome." Every time a new type of employee is added, the switch must be augmented with another case.

In contrast, the C++ version takes advantage of the polymorphic behavior of the `pay` function. If a new class that inherits from `Employee` is added later, then objects of that new type can be passed to `PrintPay` without modification to `PrintPay`. The differences in calculating pay are in how `pay`

B

```
/* Example use of managers. */

int main(void)
{
    Manager mgr1, mgr2;

    /*
     * Set up the 1st manager and print out
     * her name and pay.
     */

    mgr1.setData("Smith", "Jane", 1700.0);
    /* Has a salary */
    mgr1.setSalaried(1);
    printf("Name: %s\n", mgr1.getName());
    printf("Pay: %.2f\n", mgr1.pay(40));

    /*
     * Set up the 2nd manager and print out
     * his name and pay.
     */

    mgr2.setData("Danish", "Tom", 46.5);
    /* Doesn't have a salary */
    mgr2.setSalaried(0);

    printf("Name: %s\n", mgr2.getName());
    printf("Pay: %.2f\n", mgr2.pay(40));

    return 0;
}
```

Figure 5. Hierarchies of Employee-Related Classes

Figure 6. C Function to Print Either an Employee or a Manager's Pay

```
#include <stdio.h>

/* Type definition for an employee. */

typedef struct {
    char name[30];
    float payRate;
} EmployeeT;

/* Functions for an employee. */

void EmployeeSetData(EmployeeT *employeePtr,
                     char lastName[],
                     char firstName[],
                     float newPayRate)
{
    sprintf(employeePtr->name,
            "%s %s", firstName, lastName);
    employeePtr->payRate = newPayRate;
}

const char *EmployeeGetName(
                  EmployeeT *employeePtr)
{
    return employeePtr->name;
}

float EmployeePay(EmployeeT *employeePtr,
                  float hoursWorked)
{
    return employeePtr->payRate * hoursWorked;
}
```

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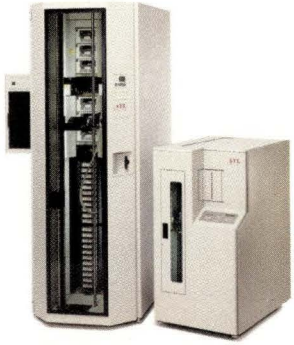

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is *implemented* and not in how it is being *used*. Thus, the differences are isolated to those classes where the pay function is defined.

Language-Specific Issues

The languages I will discuss–C++, Objective-C and Java–all have the notion of a "class," where a class defines the data and functionality that each object of that class will have. In practice, each language uses its own terminology for the data and functions of a class. For example, in C++, data are usually referred to as *data members*, while functions of a class are referred to as *member functions*. For the rest of this article, I'll use the terms *data* or *data members* for data, and the term *methods* for functions, regardless of the language I am discussing.

There are some important differences between these languages that, although not directly related to their object-oriented features, programmers new to the language should recognize. Most notable are two features of Java: *exceptions* and *garbage collection*.

Exceptions and exception handling were features added to C++ and are typically used optionally. Java, however, includes exceptions from the ground up, and programmers will have to deal with them.

To reclaim unused objects, the Java runtime system implements automatic garbage collection. In contrast, C++ and Objective-C programmers must worry about destroying dynamically allocated objects. Even at the beginning of the learning process, it is probably a good idea to train yourself to deallocate objects no longer in use when programming in C++ and Objective-C.

The differences that I am most interested in, however, are in how objects fit into each language. For each language, I will describe how classes are used in the language, how objects (instances of classes) are passed around, and what libraries of classes come with the language.

Two Hybrid Languages

C++ and Objective-C are hybrid languages because they provide the ability to program using procedural, object-oriented or a mixed set of styles. Essentially, these languages are C with some additional OO features. Nonetheless, the set of

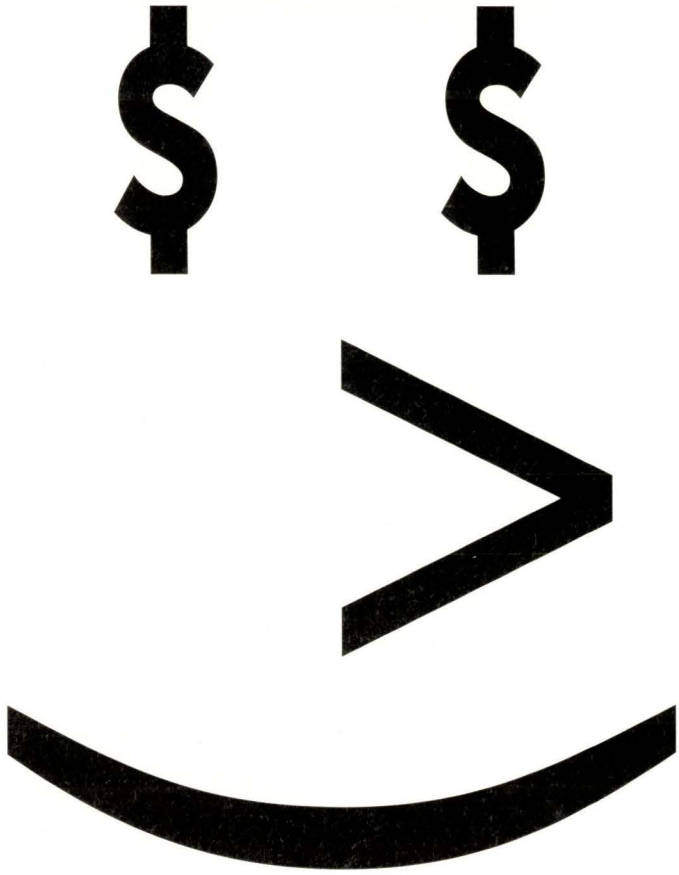
```
/* Type definition for a manager. */

typedef struct {
    char name[30];
    float payRate;
    int isSalaried;
} ManagerT;
```

```
/* Functions for a manager. */

void ManagerSetData(ManagerT *mgrPtr,
                    char lastName[],
                    char firstName[],
                    float newPayRate)
{
    sprintf(mgrPtr->name,
            "%s %s", firstName, lastName);
    mgrPtr->payRate = newPayRate;
}

void ManagerSetSalaried(ManagerT *mgrPtr,
                        int salariedFlag)
{
    mgrPtr->isSalaried = salariedFlag;
}

const char *ManagerGetName(ManagerT *mgrPtr)
{
    return mgrPtr->name;
}

float ManagerPay(ManagerT *mgrPtr,
                 float hoursWorked)
{
    if (mgrPtr->isSalaried)
      return mgrPtr->payRate;
    /* else */
    return mgrPtr->payRate * hoursWorked;
}
```

```
/* Enumeration for the kind of employee. */

typedef enum {EMPL_PLAIN, EMPL_MANAGER} KindOfEmployeeT;

/*
 * A function to print any kind of
 * employee's pay.
 */
void PrintPay(void *employeePtr,
              KindOfEmployeeT kindOfEmployee,
              float hoursWorked)
{
    float amount;

    switch (kindOfEmployee) {
        case EMPL_PLAIN:
        amount = EmployeePay(
                   (EmployeeT *)employeePtr,
                   hoursWorked
                 );
        break;
      case EMPL_MANAGER:
        amount = ManagerPay(
                   (ManagerT *)employeePtr,
                   hoursWorked
                 );
        break;
    }

    printf("Pay: %.2f\n", amount);
}
```

```
/* Example use of an employee and a manager. */

int main(void)
{
    EmployeeT empl;
```

continued



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features found in C++, which has a *lot* of features, and in Objective-C differ quite a bit.

C++ adds the `class` data type to the types already provided by C. New classes can be added just like a new type of `struct`; however, a class encapsulates both data and functionality, can inherit from another class or be inherited from, and can have methods that exhibit polymorphic behavior.

Like other types in C, a class in C++ specifies a "template" for what an object will look like. In order to get an object of this type, a variable must be defined or dynamically allocated.

In C++, objects are usually passed around via pointers or references to an object (a C++ reference is a pointer that doesn't need to be dereferenced). C++ requires that an object passed to a function expecting an `Employee` pointer, for example, receives a pointer to an object that is either of class `Employee` or some other class that inherits (directly or indirectly) from `Employee`.

Returning to Figure 7, this means we can pass a pointer to an object of type `Employee` or type `Manager` to the function `PrintPay`. We are guaranteed that this passed object has a *pay* method because all objects of type `Employee` or some class that inherits `Employee`, like `Manager`, either inherit the method `pay` or redefine it. Thus, the existence of a particular method for an object can be checked at compile time.

A consequence of this strict type checking of passed objects is that it is more difficult to construct classes that can deal with many different types of objects–they must all inherit directly or indirectly from a particular class. Nonetheless, newer versions of C++ have a `template` mechanism that simplifies the creation of classes that must handle different types.

Finally, while C++ has the capability to add new classes to programs, the language distribution does not come with a full set of usable classes. Instead, it provides a small set of classes for performing I/O operations that you may use in place of C's `stdio` library.

Like C++, Objective-C also adds the notion of a *class* to the functionality provided by C. Programmers define a class by specifying what data and methods the class will have. Because the OO model used by Objective-C was inspired by the purely object-oriented language Smalltalk, the model

```
ManagerT mgr;

/*
 * Set up employee and print out
 * his name and pay.
 */

EmployeeSetData(&empl, "Burke",
                "John", 25.0);

printf("Name: %s\n",
       EmployeeGetName(&empl));
PrintPay(&empl, EMPL_PLAIN, 40);

/*
 * Set up manager and print out
 * her name and pay.
 */

ManagerSetData(&mgr, "Kovacs", "Jan",
               1200.0);
/* Has a salary */
ManagerSetSalaried(&mgr, 1);

printf("Name: %s\n",
       ManagerGetName(&mgr));
PrintPay(&mgr, EMPL_MANAGER, 40);

return 0;
```

Figure 7. C++ Function to Print Either an Employee or a Manager's Pay

```
#include <stdio.h>
/*
 * The class Employee contains both the
 * data and functionality of an employee.
 */
class Employee {
protected:
    /* Data */
    char name[30];
    float payRate;

public:
    /* Functionality */

    void setData(char lastName[],
                 char firstName[],
                 float newPayRate)
    {
        sprintf(name,
                "%s %s", firstName, lastName);
        payRate = newPayRate;
    }

    const char *getName()
    {
        return name;
    }

    virtual float pay(float hoursWorked)
    {
        return payRate * hoursWorked;
    }
};
```

used by Objective-C differs from C++.

Some Objective-C distributions come with a library of generally usable classes. These classes include *strings*, *sets* and *ordered collections*. If nothing else, all Objective-C distributions have the core `Object` class. Every class will inherit from `Object` because it provides some general functionality.

Objects in Objective-C are not passed around with the strict constraints used by C++. Instead, there is a generic `id` type, a kind of handle to any type of object. Therefore, if a method receives an object as a parameter via an `id`, the *method* must make sure the object is of the proper type if necessary, because the compiler cannot help.

On the upside, this means that a method "print" could be called on any object. The method will be located at runtime. On the downside, if "print" does not exist for this type of object, then a runtime error will occur.

Java, a Purely OO Language

Unlike C++ and Objective-C, which are hybrid languages, Java is a purely object-oriented language. This means that the only way to create new data types is by creating new classes. Moreover, functions must belong to a particular class. With these restrictions, all data is in the form of objects, except for a few primitive types like `int` and `float`, but there are "wrapper" classes for even these.

Java comes with a standard library of classes. Some of these classes reflect Java's relation to Web programming, such as classes for windowing and network communications. Java, however, is usable as a general-purpose language, and there are many general-purpose classes, such as *strings* and *files*. Like Objective-C, Java has a rooted class hierarchy. Every class inherits from the `Object` class, which provides some general capabilities for all objects.

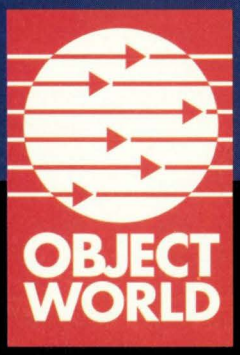
As a language intended to be platform-independent, Java doesn't have true pointers. Instead, objects are stored via *references*. Like C++, there must be type-compatibility between the type of a reference and the type of the object it refers to. For example, suppose we had the Java classes `Employee` and `Manager`, where `Manager` inherits from `Employee`. An `Employee` reference can refer to either an employee or a manager object. Because objects are passed to methods via references, the same compatibility rules apply to method parameters. Unlike C++, Java has an extra "interface" mechanism that allows the passing of objects from different class hierarchies to a method.

```
* The class Manager gets everything an
* Employee has, adds additional functionality,
* and redefines how pay is calculated.
*/
class Manager : public Employee {
protected:
  /* Data */
  int isSalaried;

public:
  /* Functionality */

  void setSalaried(int salariedFlag) {
       isSalaried = salariedFlag;
  }

  virtual float pay(float hoursWorked)
  {
       if (isSalaried)
           return payRate;
       /* else */
       return payRate * hoursWorked;
    }
};

/*
 * A function to print any kind of
 * employee's pay.
 */

void PrintPay(Employee *employeePtr,
              float hoursWorked)
{
  printf("Pay: %.2f\n",
          employeePtr->pay(hoursWorked));

}
```

```
/*
 * Example use of an employee and a
 * manager.
 */

int main(void)
{
    Employee empl;
    Manager mgr;

    /*
     * Set up employee and print out
     * his name and pay.
     */

    empl.setData("Burke", "John", 25.0);

    printf("Name: %s\n", empl.getName());
    PrintPay(&empl, 40);

    /*
     * Set up manager and print out
     * her name and pay.
     */

    mgr.setData("Kovacs", "Jan", 1200.0);
    mgr.setSalaried(1); /* has a salary */

    printf("Name: %s\n", mgr.getName());
    PrintPay(&mgr, 40);

    return 0;
}
```

"90% of all U. S. companies will be using objects by the year 1998."*

*Information Week, July 29, 1996.



The other 10% will wish they had.

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Implementing OO Concepts

In each language I have described, new data types can be created by writing new classes. Using a class to represent a data structure provides a level of *encapsulation* in itself, but all three languages also have the capability to enforce the "boundaries" of a class by making some data or methods inaccessible to programmers using objects of that type.

For example, in Figure 7, the `name` and `payRate` fields are not directly accessible to someone using an `Employee` object such as `empl`. The only way to get at these data members is via a method that accesses them, like `setData`. Of course, someone *implementing* the `Employee` class will need access to these data members and has free rein to use them. Thus, the access restrictions are mainly on instances of a class, although there are also rules on how data and methods can be accessed after they are inherited.

In C++ and Objective-C, new classes are typically defined in header files that are then *included*. A class definition contains *declarations* for class methods; however, the actual *definition* of a method may be found elsewhere as compiled source code or libraries. What data and methods are accessible or inaccessible is specified as part of the class definition in the header file, which leaves the possibility that someone could replace a header file, changing the intended access restrictions.

In contrast, all Java code is translated into a binary format. Thus, information about what is accessible is more difficult for a human to alter, making Java's access mechanism a bit more secure.

Taking advantage of *inheritance* is a matter of defining new classes that inherit from other classes. In principal this is simple, but it takes good design to reuse classes in a robust way.

For example, recall that Figure 5A represents a hierarchy of employee classes, where Figure 5B and 5C represent choices of where to add a new `Supervisor` class. Creating a class named `Supervisor` is easy enough, but should it inherit from plain `Employee` or the special `Manager` class? If the organization you are representing views a supervisor as part of management, then you may already be given the answer. Nonetheless, this is a decision not to be taken lightly.

For example, in C++, if we want to be able to pass a `Supervisor` to a function that takes a `Manager` pointer, then we'll need to make `Supervisor` inherit from `Manager`, giving the hierarchy of Figure 5B. But, a supervisor might be very different from a manager and instead we might choose for `Supervisor` to inherit directly from `Employee`, as in Figure 5C. These decisions are application-dependent.

To take advantage of method polymorphism, programmers define methods that will be later redefined in classes that inherit those methods. In C++, methods that are polymorphic must begin with the keyword `virtual`. This allows C++ to do some optimization when it knows that a method is not polymorphic; otherwise, more overhead is incurred because the actual method to call must be determined at runtime.

In Objective-C and Java, all methods exhibit polymorphic behavior automatically. Thus, both languages incur the overhead of locating methods at runtime. Because C++ requires the programmer to decide *a priori* what methods will be polymorphic, the class designer must give some thought to how programmers might create new classes that inherit this class. In general, this is something that the designer should do anyway and can lead to more robust class designs.

Syntactic and Semantic Sugar

When languages include syntactic or semantic features that represent convenience more than new functionality, we refer to these features as syntactic or semantic "sugar." They are often nice features to have but are not essential.

One syntactic feature present in C++ and Java is the ability to overload method names. For example, within a single class there can be two methods named "print." One might take no parameters, and one might take the name of a file. C++ and Java can distinguish these two methods by the number and types of their parameters.

This type of overloading sounds like the method polymorphism I described earlier. In fact, it is not. These "print" methods are really two different methods, not two definitions of the same method. From this point of view, method name overloading is a piece of syntactic sugar that simply avoids having to use two method names.

On the semantic side, C++ has a lot of situations where special methods that the programmer defines for a class will be called implicitly. These include constructors, destructors and conversion operators, which initialize and copy objects, destroy objects and convert objects to different types.

A good plan for programmers trying to learn OO programming is to ask, "Is this feature necessary to implement the OO concept I am trying to learn?" If the answer is "No," then learning that feature can be safely deferred.

Putting Theory into Practice

Object-oriented programming is about using the capabilities of encapsulation, inheritance and polymorphism to write modular, reusable code. A manageable plan for learning an OO language is to explore these concepts one at a time. For example, programmers should first become comfortable with encapsulating data structure as classes. Later, a programmer can practice reusing code through class inheritance, and finally, learn to use method polymorphism to keep differences in functionality inside classes.

Most programmers probably don't have an isolation booth and all the time in the world to learn a language. They have deadlines for producing usable programs. To write programs in an OO language, you have to understand much of the syntax and semantics of the language. Nonetheless, it is important to remember that the path to better programs is a good understanding of object-oriented concepts. ➸

Advanced Visual Systems AVS/Express 3.0

by IAN WESTMACOTT, Technical Editor

This month, we investigate Advanced Visual Systems' latest release and discover power and complexity hidden beneath an easy-to-use interface.

If you do any kind of advanced data visualization and imaging, you are probably familiar with Advanced Visual Systems' products. Formed in 1992, Advanced Visual Systems makes a suite of software products for analyzing and displaying large amounts of data, including its Application Visualization System (AVS) and AVS/Express. In June 1996, AVS unveiled what it called a "major new release," AVS/Express 3.0, and we examined this latest offering.

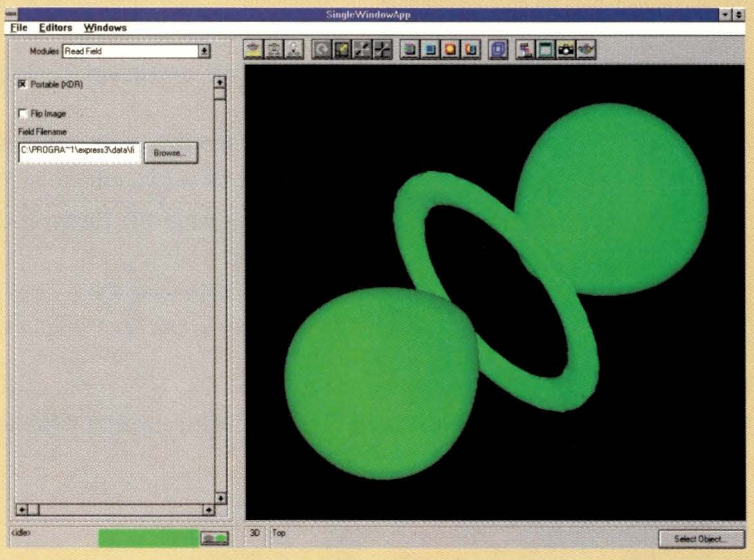
AVS/Express is the successor to AVS5 and represents two products–AVS/Express Visualization Edition and AVS/Express Developer Edition. The Developer Edition is a superset of the Visualization Edition, and includes extended libraries, system component customization and the ability to create stand-alone applications, C++ class and Object Linking and Embedding (OLE) objects. AVS calls these "visual intelligence" products, and they offer a complete environment for transforming complex data into visual information.

Installation and Documentation

We installed the Developer Edition on an Ultra 1 Creator3D with 128 MB of real memory and 500 MB of virtual memory. We also installed it on a Microsoft Corp. Windows NT machine, running on an Intel Corp. Pentium Pro 200-MHz processor with 160 MB of real memory and 450 MB of virtual memory.

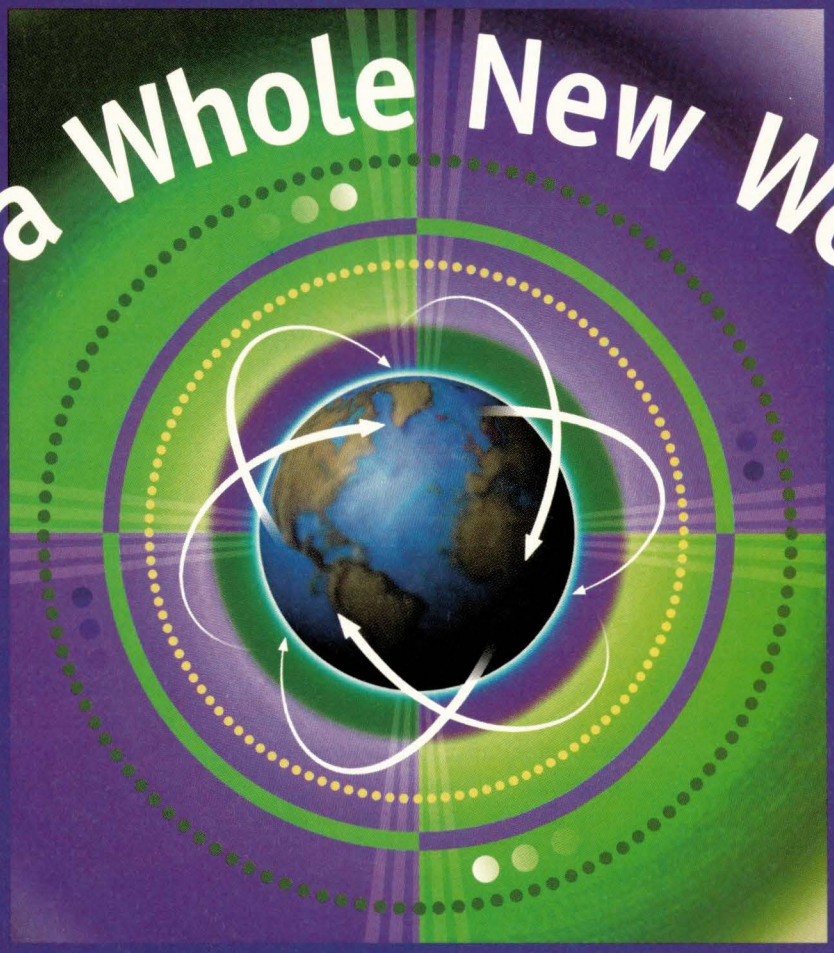
AVS/Express is available for all major UNIX workstations as well as Windows NT and Windows 95 PCs. New platforms added in this release include Windows 95, HP-UX 10.10 (Database Kit not supported), Digital UNIX 3.2, SunOS 4.1.4 and 5.5, SGI IRIX 5.3 and 6.2 (Database and Annotation and Graphing Kits not supported, and no printing support) and IBM RS/6000 AIX 4.1. AVS expects to have a release for the Digital Equipment Corp. Alpha running Windows NT by the time you read this.

Despite the daunting amount of documentation–13 manuals totaling about 35 lbs.–with four manuals dedi-



AVS/Express delivers impressive performance, both on the Ultra and the NT, although the NT faltered on visuals such as the Hydrogen Isosurface.

It's the Web, the Server, Java and ActiveX, NT and UNIX



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Data Visualization: Science or Art?

As you would expect, AVS/Express has applications in many scientific areas, including technical engineering analysis, CAE, medical imaging and GIS. But, according to the company, AVS/ Express is being used in some unexpected areas as well, such as semiconductor simulation, telecommunications and data mining applications. Even Computer Publishing Group has used AVS renderings from time to time. Most recently, Advanced Visual Systems used the AVS/Express application to create the December 1995 cover of *SunExpert* magazine. Advanced Visual Systems' renderings have appeared in a number of publications, including *Computer Graphics World.–iw*

cated to installation, AVS/Express installation is fairly easy. A *System Prerequisites* manual lists requirements for each of the supported platforms, which differ from platform to platform but mostly center around hardware and software display, compiler and memory configurations.

For example, on our Sun running SunOS 5.5 and equipped with a Creator3D framebuffer, we had to configure the framebuffer to use gamma-corrected visuals, update the `LD_LIBRARY_PATH` environment variable to locate shared libraries, and check our swap space and shared memory segment sizes. All of this is clearly detailed in the manual. For NT boxes, all that is required is to check the virtual memory size.

The next step is licensing, and all versions make use of the FlexLM licensing facility, including the Windows platforms. All versions include the FlexLM binaries if you don't have them, but in order to run FlexLM on a Windows platform, you must have a TCP/IP stack installed.

Actual installation consists of simply copying the files from the CD onto your system; a script is provided for UNIX platforms and an installation wizard for Windows platforms.

The documentation is all clearly written and designed to get any type of user up and running quickly. There is an *AVS/Express for AVS5 Users* manual for AVS5 customers and a *Getting Started* manual for new customers. The former focuses mainly on compatibility and upgrade issues, such as the AVS5 Compatibility Kit–not available on the Windows platform–which allows you to run AVS (2 through 5) modules, networks and scripts in the AVS/Express environment. The latter offers an intuitive step-by-step tutorial on using AVS/Express.

All the Kit manuals–*User Interface*, *Data Visualization*, *Graphics Display*, *Annotation and Graphing*, *Database*–follow this lead with step-by-step tutorials covering the major components of each kit. Kudos to the AVS documentation team for a job well done.

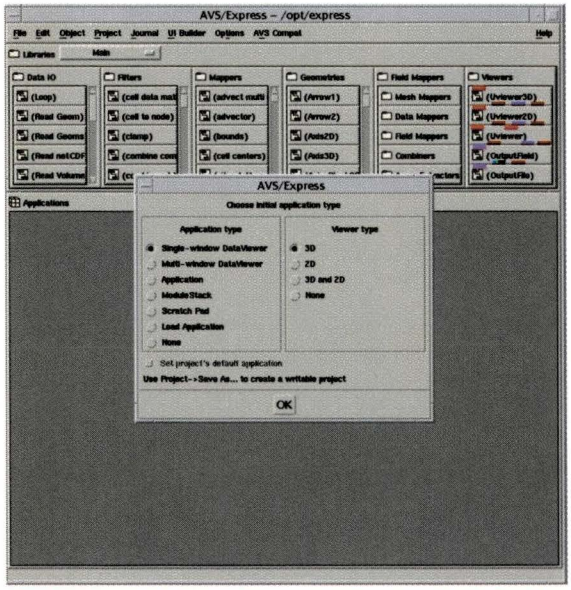
What's New in 3.0?

The on-line documentation has improved as well. The integrated, context-sensitive, hypertext help system provides point-and-click access to object documentation for any object in the AVS/ Express libraries. AVS has used Ridgefield, CT-based Bristol Technology Inc.'s HyperHelp for UNIX/ Motif, so on-line help is identical in the UNIX and Windows versions. And yes, that is Motif. AVS/Express has abandoned the unique AVS interface in favor of a Motif interface, which not only makes the learning curve for new users less steep but also makes the interface more intuitive, in my opinion.

The Network Editor now includes an Object Editor, which presents a view of objects in addition to the view presented in the Network Editor workspace. From here you can control object declarations, module parameters, methods and source code. Network Editor configuration has also improved, with a dialog box that allows you to turn on and off various kits, database interfaces and renderers. The Object Manager has also been updated with new operators, statements and base types, as well as performance improvements.

Two new tools are now available. The Add Module tool guides the creation of AVS/Express modules, greatly simplifying the task, and the Data Import tool assists in creating modules to read specific file formats. The Graphics Display Kit has received some performance improvements, while the Data Visualization and Annotation and Graphing Kits have been expanded. There are now image read and write modules for TIFF, GIF, JPEG, PBM, BMP, SGI RGB and Sun Raster file formats, and polar charts are also implemented.

Completely new is a GIS Library, which includes modules, readers, mappings and macros to facilitate the import and manipulation of geographic information system com-



Application and viewer types are chosen at initialization.

ponents, and a FORTRAN interface.

New features for the Developer Edition include Database Kit extensions (which now fully support Oracle, Sybase, Informix and Open Database), and OLE 2.0 support, with the capability to build OCXs as well as the ability for AVS/Express to be used as an OLE Automation Server.

Easy-to-Use Design

Despite the great tutorials and documentation, AVS/Express is a complex system for sophisticated data modeling–don't expect to master it in a day. However, with its drag-and-drop and build-on-the-fly design, you can build an AVS/Express application in minutes with no experience. The key is the Network Editor.

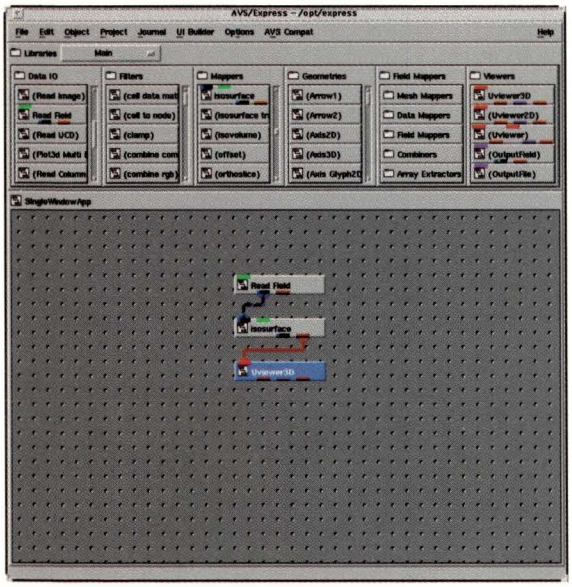
When started, AVS/Express prompts you for the application and viewer type you want–either single- or multi-window data viewer, application, module stack, scratch pad and 2D or 3D viewer. Once an application type is chosen, the Network Editor window is appropriately initialized; one or more DataViewer windows may be created, and the V Command Processor starts in the shell from which you started AVS/Express, or in a new command shell for Windows.

The Network Editor is used to create objects and applications, while the data viewers render data and provide access to editor panels and module stack controls. The V Command Processor provides a programmatic interface to the Object Manager, using the V programming language and APIs for C, C++ and FORTRAN.

The Network Editor is divided into two main sections: a library pane, which provides point-and-click access to library object templates; and an application workspace in which objects and applications are built. Building an application can be as simple as dragging templates from the libraries into the workspace and connecting their ports together. As you place objects in the workspace and connect them, AVS/Express executes the application. For instance, any user interface that an object may have immediately becomes accessible in the Module Editor when the object enters the workspace.

For example, to build a simple application that renders an isosurface of selected data, simply create a new 3D data viewer application. An instance of the Uviewer3D object, which is the object that renders three-dimensional data, is automatically placed in the workspace. To read data from a file, instance a `Read_Field` object from the Data I/O library. To map the isosurface, instance an isosurface mapping object from the Mappers library. The output of the `Read_Field` object is connected to the input of the isosurface mapper, whose output is connected to the input of Uviewer3D. The Module Editor lets you specify a file for the `Read_Field` object, and the viewer window displays the output of Uviewer3D.

Object information and subobjects are easily accessed in the Network Editor, and the data viewer allows you to interact with rendered data. The Module Editor gives you access to object parameters of all objects in an application. The one oddity of the Network Editor is that there are no scrollbars in the workspace. Real applications can quickly grow quite large, so that its network does not fit within the workspace window. You can zoom in and out on the network and even slide the entire network around the workspace, but you can't scroll the window.



The Network Editor provides a visual representation of the application, as seen with this isosurface rendering network.

Hardware Rendering

AVS/Express supports the following hardware renderers:

Platform	Hardware Renderer
HP	PEX, OpenGL (Freedom Series 9000 only)
SGI	OpenGL
IBM	OpenGL
SunOS 4.1.x	XGL
SunOS 5.x	XGL (3D), XIL (2D)
Digital UNIX	OpenGL
PC	OpenGL

According to AVS, future releases of AVS/Express will support Sun Microsystems' OpenGL implementation for Creator3D.

Hard to Outgrow

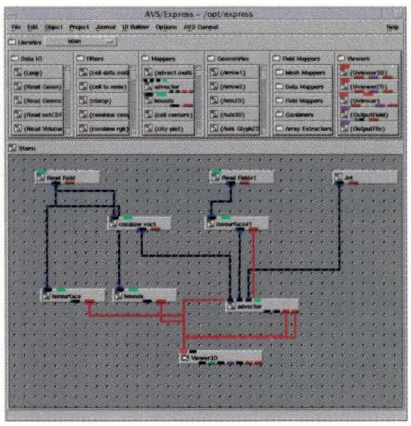
Despite large sets of libraries from which many applications can be quickly built, the real power of AVS/Express lies in its extensibility. If you don't like the drag-and-drop GUI of the Network Editor, you can use the V Command Processor to define objects and applications in the V language, from which you may also access the C, C++ and FORTRAN APIs. Knowledge of the V language will also allow you to edit and extend saved applications quickly.

The Object Editor lets you edit any of the properties and methods of defined objects and modules, and customized modules are easily built with the Add Module tool. In addition, the AVS/Express C, C++ and FORTRAN APIs allow applications to call user code, and allow user code to manipulate objects in AVS/Express. Module methods may be C, C++ or FORTRAN routines, while C, C++ or FORTRAN programs may call the

AVS/Express Object Manager to perform any operation that can be performed with the Network Editor or V language.

Five kits are provided to aid in building applications: User Interface, Data Visualization, Annotation and Graphing, Graphics Display and Database (the last three are in the Developer Edition only). The User Interface Kit helps in building GUIs for your applications. For example, adding widgets–menus, buttons, etc.–to a GUI is as simple as dragging the User Interface library objects into the Network Editor workspace. The Data Visualization Kit contains objects to manipulate and transform numeric gridded data, and includes the Image Processing Kit.

The Annotation and Graphing Kit provides a plethora of tools for adding presentation-quality text and graphs to viewers. The Graphics Display Kit makes up the renderer and provides a high-level API to rendering objects, such as views, cameras, lights and textures. The Database Kit defines a set of objects that allow the access and manipulation of data in relational databases, and provides logon validation, selective extraction and presentation of data, table data modification, commit and rollback of transactions and miscellaneous SQL operations.



Objects are connected in the workspace to build applications.

AVS/Express is a data modeler, renderer, programming library and application development environment–in short, everything you would need for data visualization in most contexts.

Impressive Performance

The performance of this product was impressive, both on the Ultra and the NT box. However, the Ultra clearly outperformed the NT. Rendering manipulations, such as rotation and scaling, on the Ultra were smooth, effortless and extremely fast (proportional, of course, to the amount of data). The NT box, on the other hand, struggled with even the simplest visuals, such as the hydrogen isosurface, with jerky motion and flashing redraws. All our rendering speed tests showed the Ultra to be 10 times faster than the NT box. No doubt performance would be improved with more sophisticated display hardware.

More troubling were a number of GUI anomalies we ran into on the NT platform. It was common, for example, for certain elements such as list boxes not to display upon window creation, forcing a window redraw. This is an NT anomaly, however, and not attributable to AVS/Express.

The performance difference between the two platforms was not so evident when it came to compilation. Both machines were able to load and compile complex applications quickly and without exhausting system resources. In compilation, the NT box was about 25% slower on average than the Ultra.

In Summary

AVS has been on my list of all-time great UNIX products (an exclusive but admittedly subjective category) for some years, and this latest release of AVS/Express certainly justifies its place there. Technical and scientific users tend to be the most skeptical, nonloyal, penny-pinching users in this industry, which makes them the best end-user evaluators I know. This makes the success of AVS that much more impressive, since its users don't pick products based on fad.

Many of AVS' weak points have been addressed in this release, and a number of useful functions have been added, increasing its usefulness not only in traditional application domains but extending its usability into new fields.

The power and complexity of the application is completely hidden under an easy-to-use interface that both novice and advanced users will appreciate–despite the lack of scrollbars in the workspace. Its easy installation and well-behaved execution will please administrators as well.

AVS/Express is a data modeler, renderer, programming library and application development environment–in short, everything you would need for data visualization in most contexts. If all you want to do is visualize raw data, then the Visualization Edition is for you. If you need to build sophisticated stand-alone applications, perhaps integrating simulation or modeling code, with customized interfaces and relational database access, then the Developer Edition fits the bill.

Pricing for AVS/Express 3.0 Visualization Edition starts at $6,000 for UNIX-based systems and at $2,995 for Windows 95 and NT systems. AVS/Express 3.0 Developer Edition is priced at $25,000 for the first UNIX-based system and $6,000 for each additional purchase, and at $18,000 for the first Windows-based system, with follow-on systems priced at $4,000 each. ⊸

AVS/Express 3.0

Company
Advanced Visual Systems Inc.
300 Fifth Ave.
Waltham, MA 02154

Phone
(617) 890-4300

Fax
(617) 890-8287

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Lack of scroll bars.

Circle 150

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 the magazine.

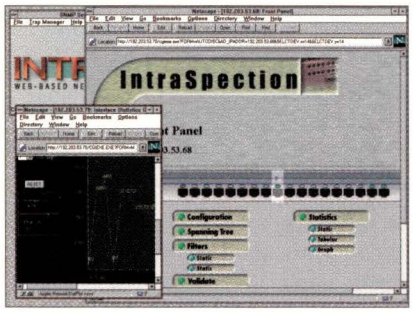
Free Network Management Program

Asanté Technologies, maker of SNMP-based network hubs, has introduced a free browser-based network management program with support for all SNMP devices.

The program, called IntraSpection, uses Java applets to deliver real-time network status information, statistical graphs and tables, and problem reports, Asanté says. The Map Manager reportedly builds and displays a map of the network, incorporating changes and deletions as needed.

IntraSpection is compliant with SNMP, MIB II, Standard Repeater MIB and Standard Bridge MIB. Login verification is provided, and users can also choose to encrypt data traffic with Secure Sockets Layer (SSL).

IntraSpection is customized for Asanté network devices. However, Asanté offers Personality Modules for network devices from other vendors,



including 3Com Corp., Bay Networks Inc., Cabletron Systems Inc. and Cisco Systems Inc. The Personality Modules provide more detailed management of vendor products, the company says. In addition, systems administrators can write their own Personality Modules, which can be programmed in HTML.

The basic IntraSpection product, which runs on a Windows NT server, is downloadable for free from the Asanté Web site. Documentation, service and support is available for $295. Personality Modules, priced at $99 each, come bundled in a Vendor Pack for $795.

Asanté Technologies Inc.
821 Fox Lane
San Jose, CA 95131
Circle 101

LibraryXpress Expansion Module Out

Overland Data has unveiled the second component of its innovative LibraryXpress technology with the release of its global control module, LXG. LXG allows users to modularly expand a 400-GB base unit to create a single logical tape library with more than 3 TB of capacity and throughput of up to 172 GB/hour, Overland says.

LXG is said to serve as a single point of control to an attached host system

Tape Libraries Based on AIT Drives

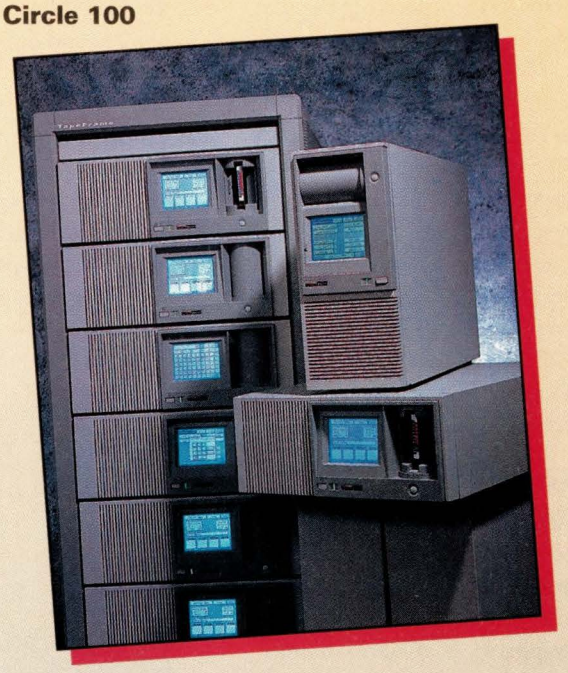
A new line of automated tape libraries, the Spectra 10000S, from Spectra Logic, is said to offer up to 2.6 TB of compressed data at transfer rates of up to 112 GB/hr. The library, which is designed for high-capacity data centers, is better suited to the task than competing Digital Linear Tape (DLT) and 8mm tape libraries, the company says.

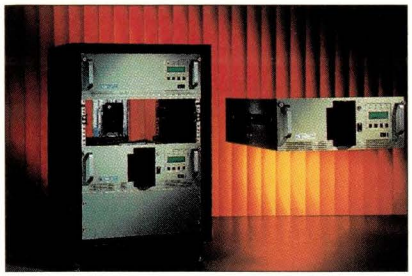
The Spectra 10000S is based on the Sony Advanced Intelligent Tape drive, which is an 8mm helical scan technology. The AIT drive lasts up to 200,000 hours and does not require much cleaning. The drive head is rated at 30,000 tape motion hours, and the AIT media life is rated at 20,000 passes, Spectra says.

The Spectra 10000S line consists of the 10000S/40, which manages 40 AIT cartridges for 2.6 TB of compressed capacity (1 TB native); and the 10000S/20, which supports 20 cartridges and 1.3 TB compressed capacity (500 GB native). Both models can house up to four drives, or up to 12 MB/s of native (uncompressed) throughput.

The Spectra 10000S line can be maintained via a Windows-like GUI, with a touch-screen overlay. The unit can come with a 7-inch rack-mount, desktop or tower enclosure, secure exit/entry port and an optional bar-code reader, the company says. Support is also provided for industry-standard backup packages. Pricing ranges from $19,370 to $41,370, depending on the number of drives, cartridges and other options.

Spectra Logic
1700 North 55th St.
Boulder, CO 80301
Circle 100





for multiple LibraryXpress Base (LXB) modules. Users can reportedly configure two to nine LXBs, each consisting of one or two DLT 2000XT, DLT 4000 or DLT 7000 drives and a 10-cartridge capacity.

The LXG's XpressChannel allows any cartridge to access any drive in the system. Network administrators can continually fine-tune LibraryXpress expansion by balancing the ratio of tape drives and cartridges. LibraryXpress is based on Overland's SmartScale Storage architecture, which offers a full range of scalability.

By managing all communications with the host, Overland says, the LXG presents LibraryXpress to the host data management software as a single massive tape library, regardless of the number of modules and tape drives under its control. The LXG insulates the host software from having to manage the details of internal library robotics and the pass-through operations.

As a result, users can reportedly create custom, flexible multimode LXB installations incorporating popular storage management software applications. The LXG can set library configuration parameters either via a front screen control or via host software, allowing virtually unlimited flexibility in configuring the LibraryXpress to achieve specific data management goals, the company says.

The LXG is priced at $5,000.

Overland Data Inc.
8975 Balboa Ave.
San Diego, CA 92123
Circle 102

Fibre Channel Storage Box Bows

Box Hill Systems has launched its full-speed, Fibre Channel storage system, the Fibre Box. The unit is a hot-swappable, dual Fibre Channel Arbitrated Loop (FC-AL) storage system offering up to 72 GB of storage space per enclosure, using eight 9-GB Fibre Channel drives, Box Hill says. Storage capacity for up to 1,125 GB is said to be obtainable by "daisy-chaining" enclosures for a total of 125 drives per dual FC-AL system.

The product is being targeted at applications such as mission-critical database applications, multimedia imaging programs and Internet and Web server programs, the company says. The Fibre Box is capable of data transfer rates of 200 MB/s and transmission distances from 30m to 10km.

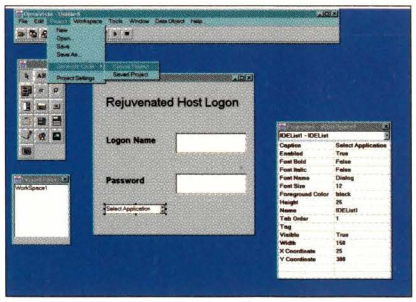
The enclosure features hot-swapping of all active components including drives, power supplies and fans. System status indicators are located on a front panel, along with ID switches and an optional security key-lock bar. Multiple RAID levels are supported, including 1, 0+1 and 5. Pricing for the Fibre Box works out to be less than $1 per megabyte, Box Hill says.

Box Hill Systems Corp.
161 Avenue of the Americas
New York, NY 10013
Circle 103

Java without Java

OpenConnect Systems, known for its OC://WebConnect Enterprise Access Server, has announced an integrated development environment (IDE) called OpenVista. This is a cross-platform IDE that is said to enable the design, development and distribution of Java applets and applications for simplified legacy host and enterprise information access.

OpenVista enables on-the-fly development of 3270, 5250 and VT220 front-end Java applets, without any prior knowledge of Java or programming, the company says. While the developer is dragging, dropping and customizing the application using simple tools and icons, OpenConnect says, OpenVista is automatically generating Java classes and code. This allows users to create simplified user screens and environments, or to automate processes normally associated with logging on, finding, accessing, manipulating and viewing information located within traditional legacy data applications and repositories.



OpenVista is designed to be open and extensible and, as a result, developers can plug in other Java objects and use them as integrated tools of OpenVista. On completion, the Java applet is uploaded to the OC://WebConnect Server, where it is then accessed or downloaded by anyone with authorization to use that application.

Pricing is based on concurrent users. For 1,000 users it is $88 per user.

OpenConnect Systems Inc.
2711 LBJ Freeway
Dallas, TX 75234
Circle 104

Library of Geometric Functions Unveiled

A toolkit of advanced geometry functions for developers writing graphics software applications is available from Building Block Software. The CAD/CAM Developer's Kit/Advanced Geometry includes more than 150 advanced geometry C functions. Building Block says these types of functions are increasingly important in Web page authoring tools, where users need to be able to create arbitrarily shaped clickable hot spots.

CCDK/Advanced Geometry is said to allow users to create boundary offsets; union, difference and common area Booleans; and area fills (spiral and crosshatch).

The C functions can reportedly handle open and closed boundaries of any length, and can also work with closed areas with islands. Other complexities handled by the functions include coincident boundaries, split regions and multiple regions, the company says. Functions for sorting random lists of segments into sequences forming regions and open contours are also provided.

CCDK/Advanced Geometry works with several compilers, including bun-

dled UNIX compilers, as well as a host of Windows-based compilers. The toolkit can be licensed for $4,995.

Building Block Software Inc.
49 Waltham St.
Lexington, MA 02173
Circle 105

High-Speed RAID Subsystem Out

Conley has announced a RAID subsystem, the SR-50 Multi-Host RAID Storage Subsystem, designed for high availability and fast performance.

Conley says that the SR-50 eliminates single points of failure by using redundant features such as a mirrored cache, dual active controllers and auto-failover of host data paths. Also, the SR-50 features hot-swappable parts, which can be replaced without bringing down the system.

High-speed performance is achieved with the dual active controllers, up to 256 MB of nonvolatile, mirrored data cache, as well as Ultra-SCSI disk drive channels, the company says. An optional Fibre Channel Arbitrated Loop (FC-AL) interface is said to allow hosts to connect at 100 MB/s, as opposed to 40 MB/s with Ultra-SCSI. For even faster performance, Conley suggests users connect multiple data paths between hosts.

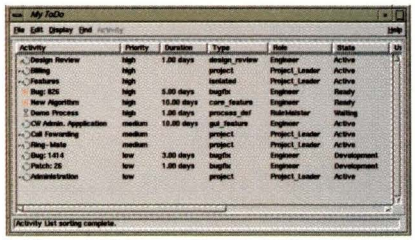
Each SR-50 subsystem supports up to 30 disks, providing up to 260 GB of storage. Up to seven hosts can be supported. A single array can support RAID levels 0, 1, 0+1, 3 and 5, allowing administrators to fine-tune the array, Conley says. The SR-50 runs under Sun, Hewlett-Packard Co., IBM Corp. and Digital Equipment Corp. UNIX systems, as well as Intel Corp. Pentium-based Microsoft Corp. Windows NT systems. Prices start at $40,000.

Conley Corp.
420 Lexington Ave.
New York, NY 10017
Circle 106

Process Management Tool Bows

Pure Atria has announced a process management tool, ClearGuide 1.0. The product fully integrates the configuration management functionality found in Atria's ClearCase 3.0 product, including build management and bug fix tracking, the company says.

ClearGuide is said to offer process modeling options that enable development teams to customize their software development process by adding or removing steps as needed.



In addition, ClearGuide comes with a default process from which users can work. Atria says that the process is customizable throughout the software development lifecycle, and not just at configuration time.

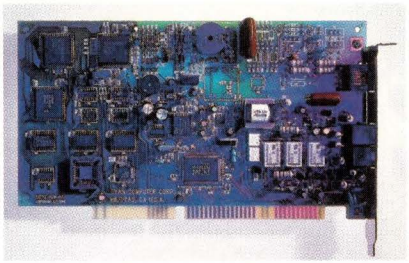
ClearGuide reportedly assigns activities and roles to specific members of the development team with what Atria calls an "Activity Breakdown Hierarchy." From this, each team member is given a daily to-do list, with assigned priorities and deadlines. Updates to the list are made automatically, the company says.

ClearGuide 1.0 is available for SunOS, Solaris, HP-UX and SGI IRIX. For existing ClearCase customers, ClearGuide costs $2,700 per concurrent user license. Pricing is $7,000 for the full package, including ClearCase.

Pure Atria Software Inc.
1309 S. Mary Ave.
Sunnyvale, CA 94087
Circle 107

Tylan Unwraps V.34/ISDN Combo Modem

Tyan Computer has introduced what it claims is the industry's first combination V.34 bis and 128-Kb/s ISDN modem, called the Netscaliber. Tyan says its target customers will be analog modem users who plan to move to ISDN in the near future.



Netscaliber can run in two modes independently or at the same time, allowing users to simultaneously connect to analog or digital sites, Tyan says. Also, users do not have to concern themselves with whether a site is analog or digital–Netscaliber handles those questions, according to the company.

Netscaliber supports the Hayes-compatible AT commands, thus it is compatible with most communications packages, such as Quarterdeck Corp.'s Procomm. Pricing for OEM quantities is set at $140 per unit.

Tyan Computer Corp.
1753 S. Main St.
Milpitas, CA 95035
Circle 108

Zitel Offers Scalable Storage for Open Systems

Zitel, a longtime player in the mainframe storage market, has released its CASD-II product specifically for open systems. Called CASD-II/Enterprise, the storage unit is a scalable product that can support heterogeneous UNIX environments, the company says.

CASD-II/Enterprise features a modular architecture that does not experience a performance loss when more disk space is added, as do competing fixed-bus storage architectures, Zitel says.

Each CASD-II/Enterprise is an integrated, self-contained unit, with a host/disk controller that supports a Dual Port/Dual Host Fast SCSI interface. This is said to allow users to support multiple hosts with dual path configurations in HI-RAS, clustered and heterogeneous environments. For high-availability environments, CASD-II features an ultra-redundant N+1 "Plus" power system, which includes an additional battery charger, power supply and another battery. This helps to protect data in cache memory (nonvolatile RAM).

For storing files with high read and write requirements–logs, system, transactions, temporary database files, for example–CASD-II features a solid state disk (SSD) configuration option, which can provide a further performance boost. By setting the SSD option, users reportedly allocate up to two areas of cache into high-speed SSD configurations, optimizing performance on small and medium-size files.

The CASD-II/Enterprise system is compatible with all major UNIX systems. Pricing starts at $16,500 for an entry-level system.

Zitel Corp.
47211 Bayside Pkwy.
Fremont, CA 94538
Circle 109

Ink-Jet Plotters Aimed at Graphics Industries

A new line of wide-format ink-jet plotters, the TechJET 5500 series, has been unveiled by CalComp. The company says the plotters are ideal for the CAD and graphic design industries.

The TechJET 5500 series can output monochrome drawings at up to 720-by-720 dpi, and full-color drawings at 360-by-360 dpi, while a D-size monochrome drawing can be output in less than 2 minutes, the company says.

TechJET 5500 plotters come standard with PostScript Level 2, an Ethernet interface and 16 MB of memory (upgradable to 72 MB). CalComp ensures compatibility with most computer systems, including UNIX.

Also, standard drivers are provided for AutoCAD running under Windows platforms. Supported data formats include CALS G4, HP-GL, HP-GL2, HP-RTL, and CalComp 907/PCI and CCRF-IL.

Users can choose to output in either roll-feed or cut-sheet media. According to CalComp, the TechJET can print on a variety of media, including bond paper, vellum, clear and matte film, poster paper, photo presentation paper and backlit film.

The TechJET D-size Model 5524 costs $5,895, and the E-size Model 5536 costs $6,595.

CalComp
2411 W. La Palma Ave.
P.O. Box 3250
Anaheim, CA 92803
Circle 110

Start-up Releases Productivity Tool

Intrinsa, a Palo Alto, CA-based start-up, has announced its flagship product, Prefix, a developer productivity tool based on the company's patented Software Component Simulation (SCS) technology.

Prefix is designed to help developers identify problems, or bugs, in the early stages of a development project, and bring products to market faster, Intrinsa says.

Built around a language-independent engine, Prefix is said to automatically identify defects at compile time. To do this, Prefix does not need to actually run compiled software, the company says. Prefix can automatically generate a model for a function it is simulating; supply models for operating and windowing systems; and suppress error messages by error type, error code, file and function, Intrinsa says.

Prefix runs on Solaris 2.4 and HP-

UX 10.1 and above, and analyzes code generated by those systems' native C compilers. Plans for Prefix products for C++, Java and Visual Basic, on both UNIX and Windows platforms, are in the works.

Pricing for a 10-user license, simulation engine and operating system models is $40,000.

Intrinsa Corp.
101 University Ave.
Palo Alto, CA 94301
Circle 111

Flow Manufacturing Software Unveiled

American Software, maker of supply-chain management and financial control systems, has introduced software that supports flow manufacturing.

Flow manufacturing, the company says, is an innovative manufacturing process that allows users to dynamically link production and customer demand, remove non-value-added activities from production, and achieve reductions in cycle time.

The product, which is also called Flow Manufacturing, incorporates mixed-model planning, mixed-model line design, flow-based costing and kanban support.

Users can reportedly integrate Flow Manufacturing with standard Enterprise Resource Planning (ERP) systems. Other features include backflushing and guided event sequencing.

The product helps in designing production floor layouts, line balancing, flex fence demand smoothing, and the automatic calculations of events such as process cycle efficiencies, American Software says.

Flow Manufacturing is available for SunOS, Solaris, HP-UX, IBM AIX and AS/400. Pricing is $200,000.

American Software
470 E. Paces Ferry Road
Atlanta, GA 30305
Circle 112

High-Availability Data Access Server Out

A Web-enhanced data access server has been announced by Falcon Systems. Called the FastfilePro-HA, the server represents an effort by the company to upgrade its entire line of data access servers for use as Web servers.

Falcon says the FastfilePro-HA provides 99.9% availability, which is achieved by a so-called passive-processing unit that monitors the system's heartbeat. When the processing unit detects CPU failure, it takes over the operations, generally within 15 to 30 seconds, the company says.

Falcon says its FastfilePro-HA system is less expensive than other HA systems because of its Journaling Automation System (JAS) and the AerREAL operating system. The JAS reportedly maintains disk integrity by keeping a real-time journaled record of all file operations on the disk.

Upgrades, Enhancements, Additions...

■ Apple Computer has released Version 3.0 of its Macintosh Application Environment, or MAE, the emulation software that lets users run Macintosh applications on their UNIX desktop. Apple says the MAE 3.0 addresses user concerns with respect to performance, remote display and Mac/UNIX integration, including file-sharing security, independent volumes and NFS/file system improvements. Also, MAE 3.0 supports floating licenses and the latest Mac OS, System 7.5.3. MAE 3.0 costs $599, with upgrades priced at $199. MAE 3.0 is available through large Apple distributors. **Apple Computer Inc.**, One Infinite Loop, Cupertino, CA 95014. **Circle 113**

■ ICL has announced that support for the Eiffel language is being added to its Dais Object Request Broker (ORB) product. ICL is collaborating with Interactive Software Engineering (ISE) and Tower Technology, two leading Eiffel vendors. The three companies will develop a joint proposal and submit it to the Object Management Group for approval. **ICL Inc.**, 11490 Commerce Park Drive, Reston, VA 20191. **Circle 114**

■ Imperial Software Technology's X-Designer, a GUI builder for Motif, can now generate Java code, as well as code for X/Motif and Windows. This is said to allow developers to use a single GUI-tool for Java, Motif and Windows applications, thereby "future-proofing" Motif applications. The Java Edition enhancement is available to existing X-Designer clients as part of the standard support package. X-Designer runs on SunOS, Solaris, HP-UX, SGI IRIX, IBM AIX and Digital UNIX. It costs $3,500 for the first developer's license. **Imperial Software Technology,** 120 Hawthorne Ave., Ste. 101, Palo Alto, CA 94301. **Circle 115**

■ Blueberry Software's Filtrix product, a file format conversion product that runs under UNIX, Windows and DOS, now supports the import of 24 different formats, and can export to 15 different file formats. Filtrix 3.4 supports word processing formats including Word, WordPerfect, Applix, FrameMaker, Interleaf and IslandWrite. Under UNIX, it is available for SunOS, Solaris, HP-UX, IBM AIX and Digital UNIX. A single-user license costs $695. **Blueberry Software,** 260 Petaluma Ave., Sebastopol, CA 95472. **Circle 116**

■ MicroSim has released Version 7.1 of its Electronic Design Automation (EDA) software. New features include updated vendor libraries, a trace browser, unlimited Undo/Redo functionality, a packaging wizard and DFX file export. EDA 7.1 is available on Sun Solaris and Windows platforms. Pricing ranges from $995 to $13,500. **MicroSim Corp.**, 20 Fairbanks, Irvine, CA 92718. **Circle 117**

■ SystemWatch, from SCH Technologies, has added support for the DEC Alpha to its list of supported platforms (SunOS, Solaris, IBM AIX and HP-UX). SystemWatch is said to perform such tasks as managing disk space, memory, swap space, CPU utilization, host availability, system processes and logs. SystemWatch costs $695, with one year of maintenance. **SCH Technologies,** 895 Central Ave., Cincinnati, OH 45202. **Circle 118**

AerREAL is said to be responsible for making file volumes recoverable in the event of a failure. Together, these features reduce the need for expensive mirrored servers, RAID devices and costly HA software, the company says.

An additional HTTP module provides read-only access of Web files on the server, while providing LADDIS benchmark speeds of 1,276 operations per second. Falcon says that for additional speed, users can opt for a Fibre Channel networking option, which gives transmission speeds of up to 1,062 MB/s.

The FastfilePro-HA server comes with large storage capabilities, of up to one petabyte (1,024 terabytes), across 128 disk volumes. Users also have the option to have their servers configured with RAID levels 0,1, 0+1, 3, 5 and JBOD.

Pricing for a 100-MHz Pentium system with 32 MB of RAM, 38 GB of storage, monitor, keyboard, redundant power, FDDI interface and all necessary software, including the operating system, is $84,968.

Falcon Systems Inc.
1417 N. Market Blvd.
Sacramento, CA 95834
Circle 119

Optimize LAN/WAN Traffic with Ecopad

French IT firm Synchronix has announced Ecopad, which is said to optimize data transmission over both local- and wide-area networks.

Ecopad transmits data differently from traditional UNIX systems, where, for each character entered into a keyboard by the user, a representative signal must make a round trip between the server and the display, Synchronix says. Ecopad handles data locally, and thus eliminates so-called "echo" frames, immediately displaying typed characters. Ecopad reportedly attempts to remember frequently used screen displays so that display data can be processed locally. Successive screen images still make the trip between the server and the display.

Synchronix says that using Ecopad can improve network efficiency by two to five times, thus enabling the network to handle more simultaneous users. Display speed is increased three to eight times. Analysis of data flow reductions is done using an integrated statistics module, the company says.

Ecopad runs independently of network protocol, the company says. As such, it can run over X.25, Frame Relay, ATM, cellular phones, ISDN, LANs and the Internet. Ecopad comprises two parts: the server module, running on the server or on a communications unit; and the client software on PCs running MS-DOS, Windows NT and 95, and on most UNIX platforms, including SunOS, Solaris, IBM AIX, HP-UX, SCO and Digital UNIX. Pricing starts at $50 to $60 per single-user license.

Synchronix
C/O French Technology Press Office
401 N. Michigan Ave., Ste. 1760
Chicago, IL 60611
Circle 120

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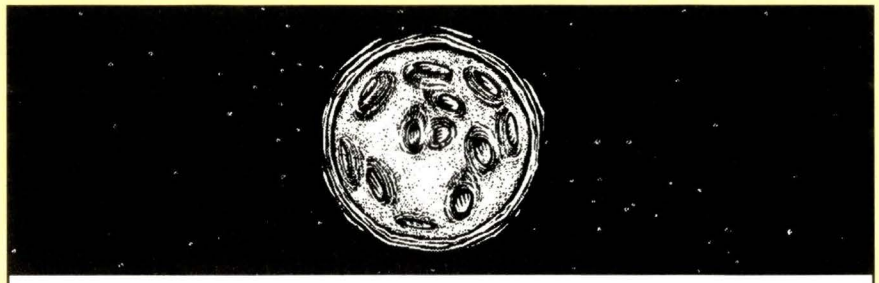

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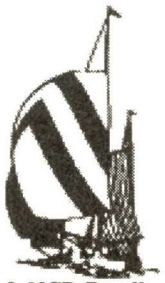

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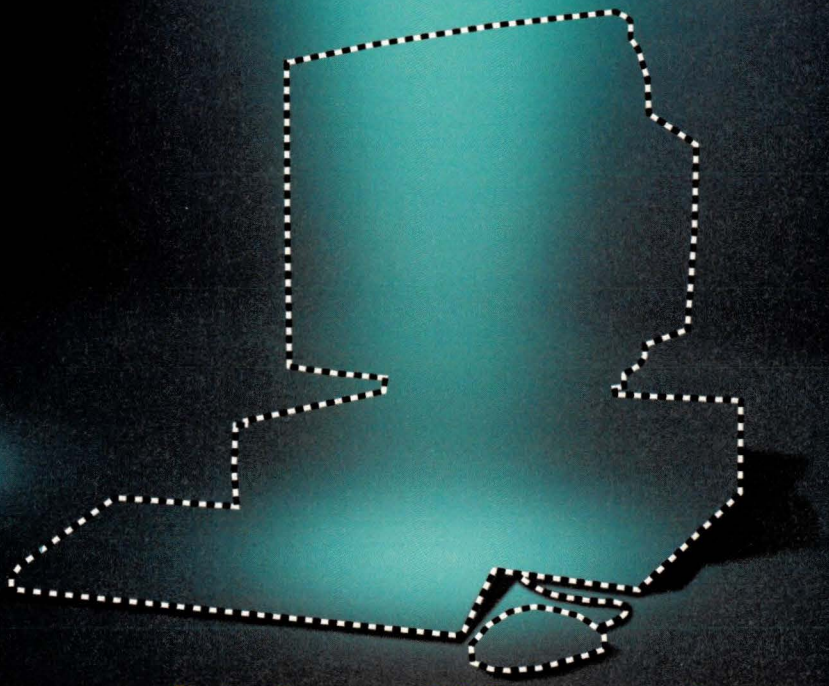

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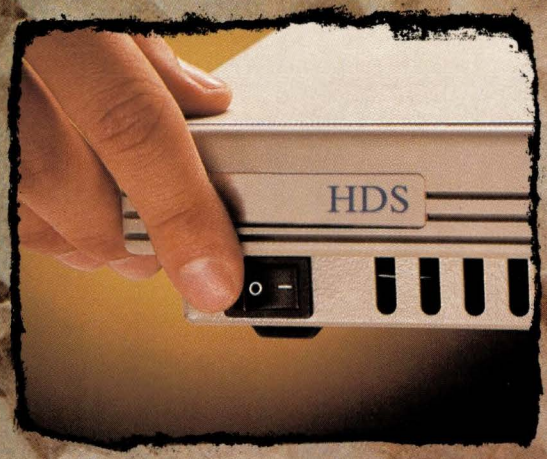

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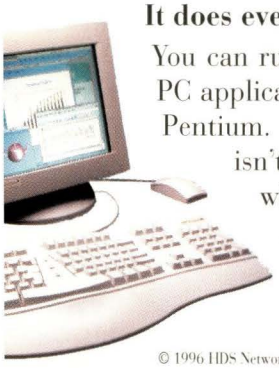

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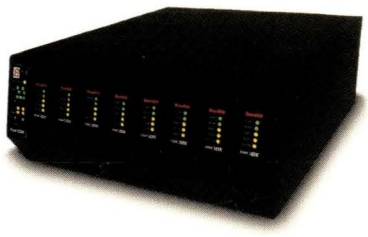

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