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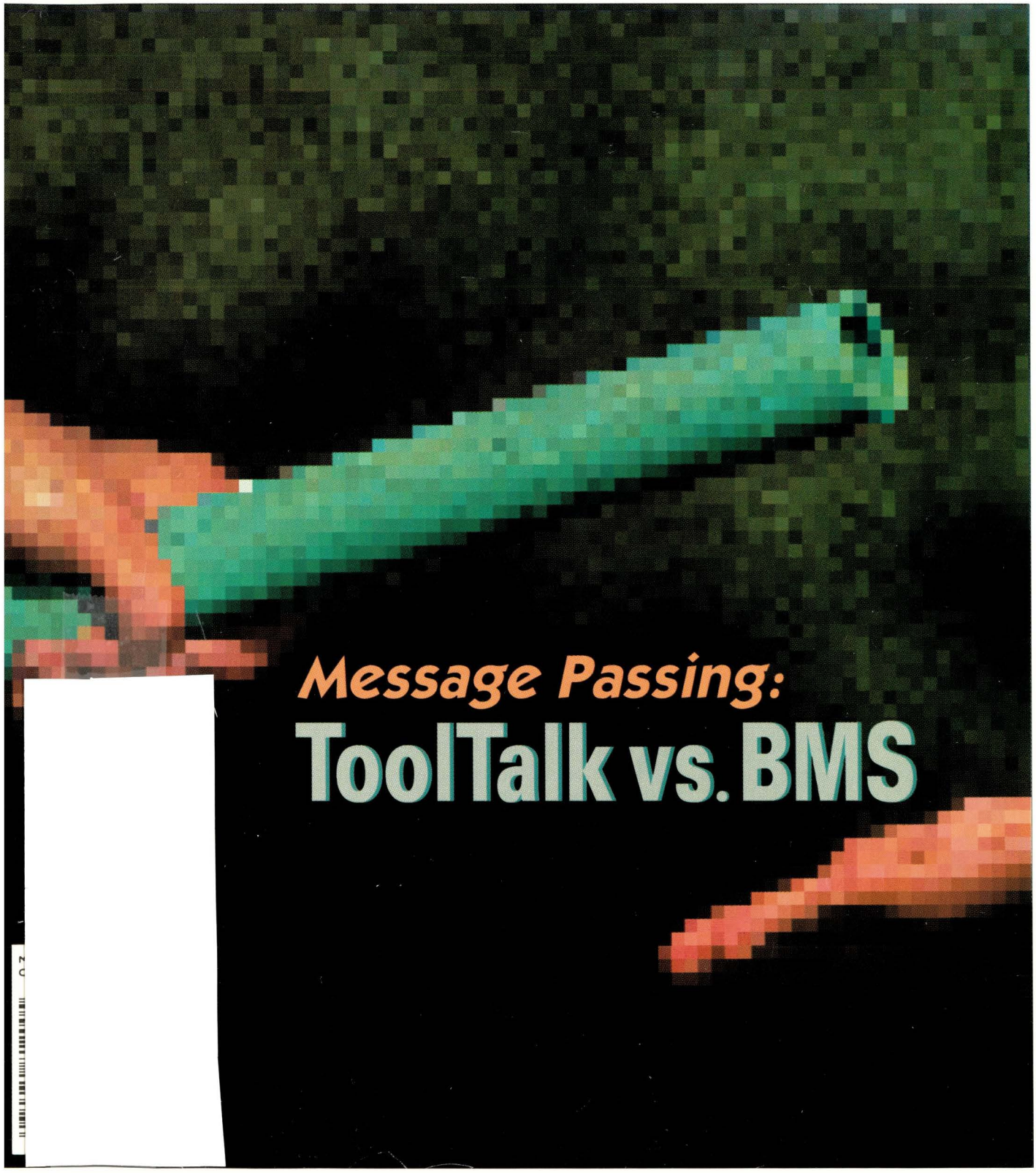

Message Passing: ToolTalk vs. BMS

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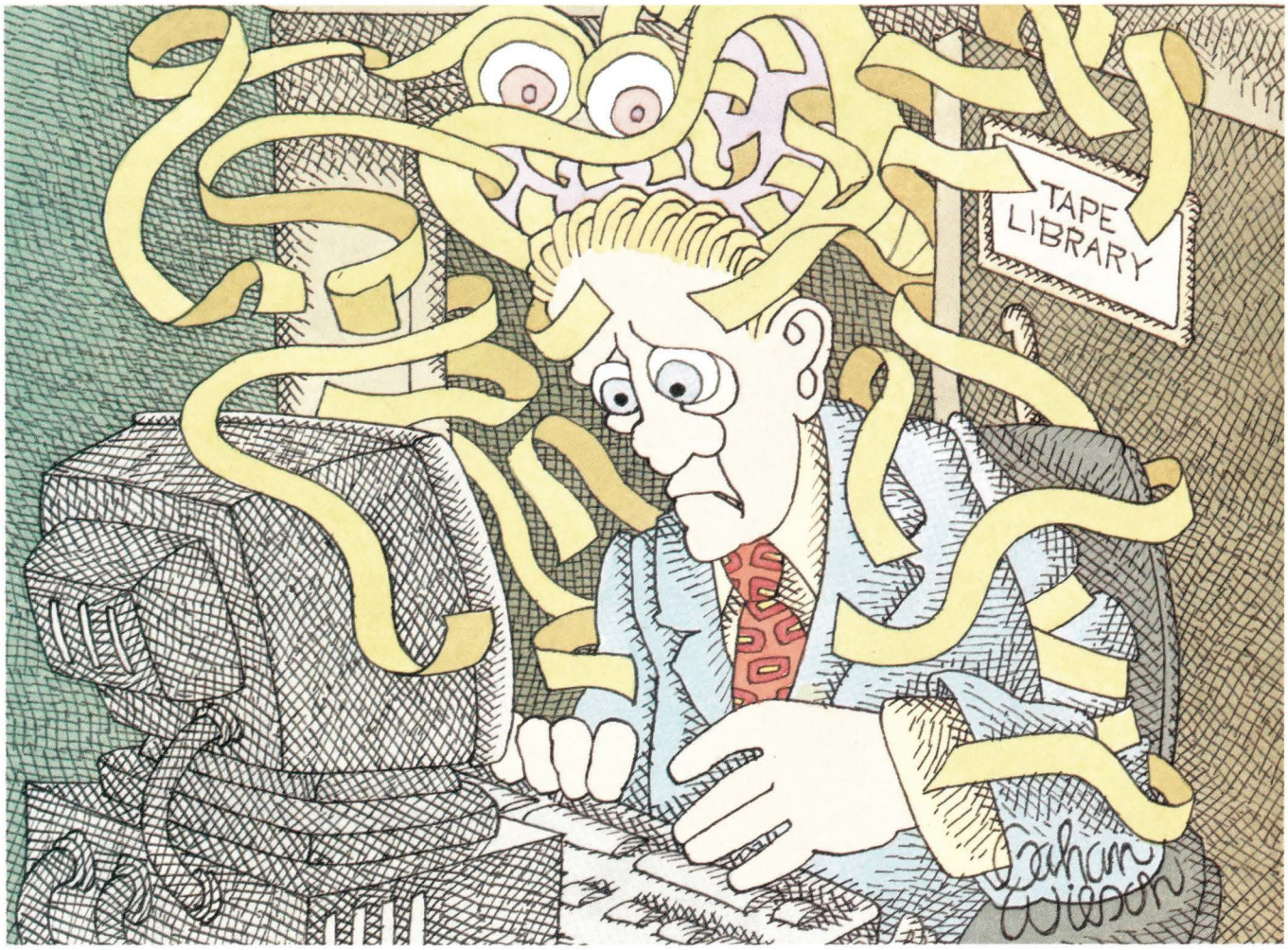

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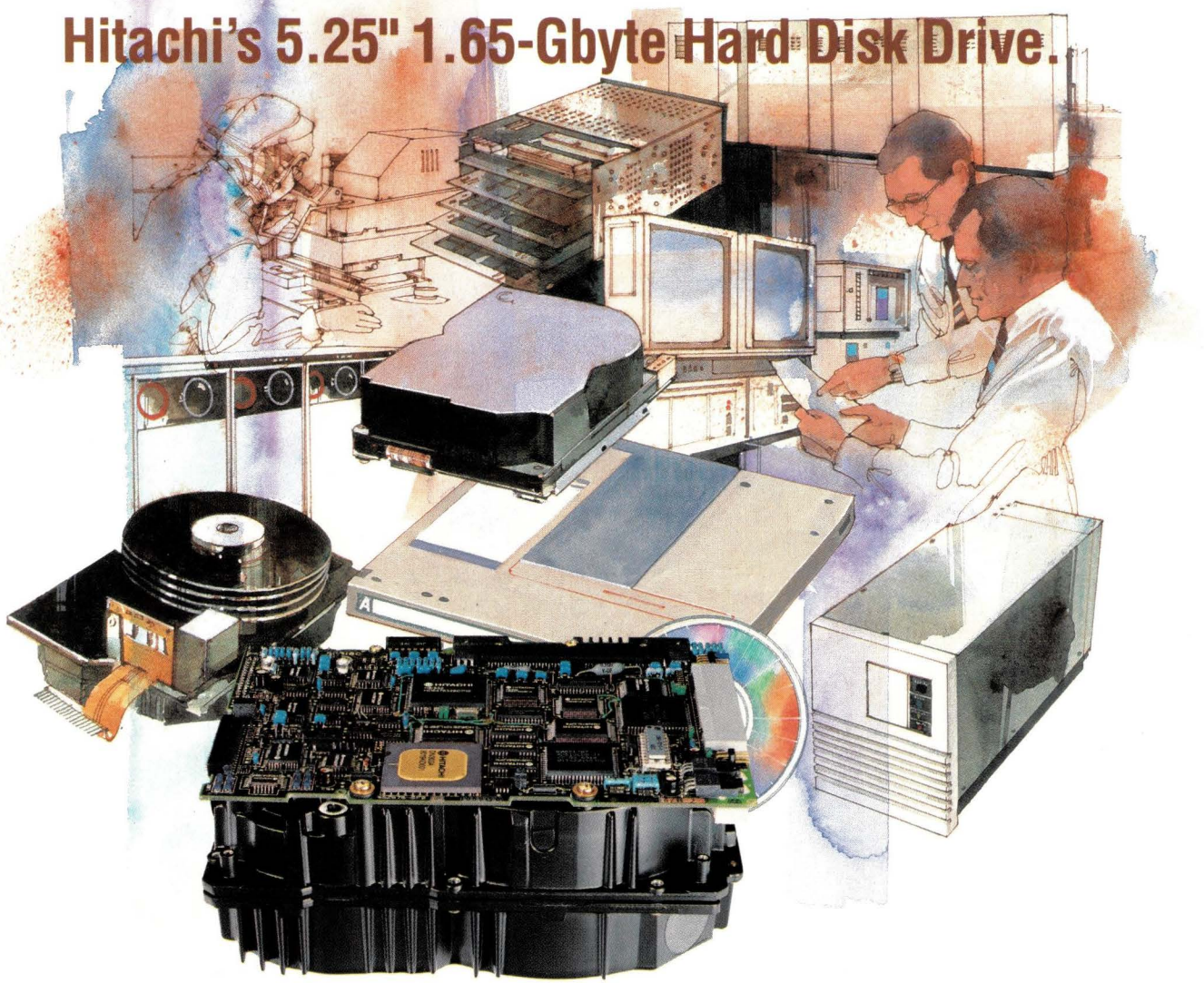

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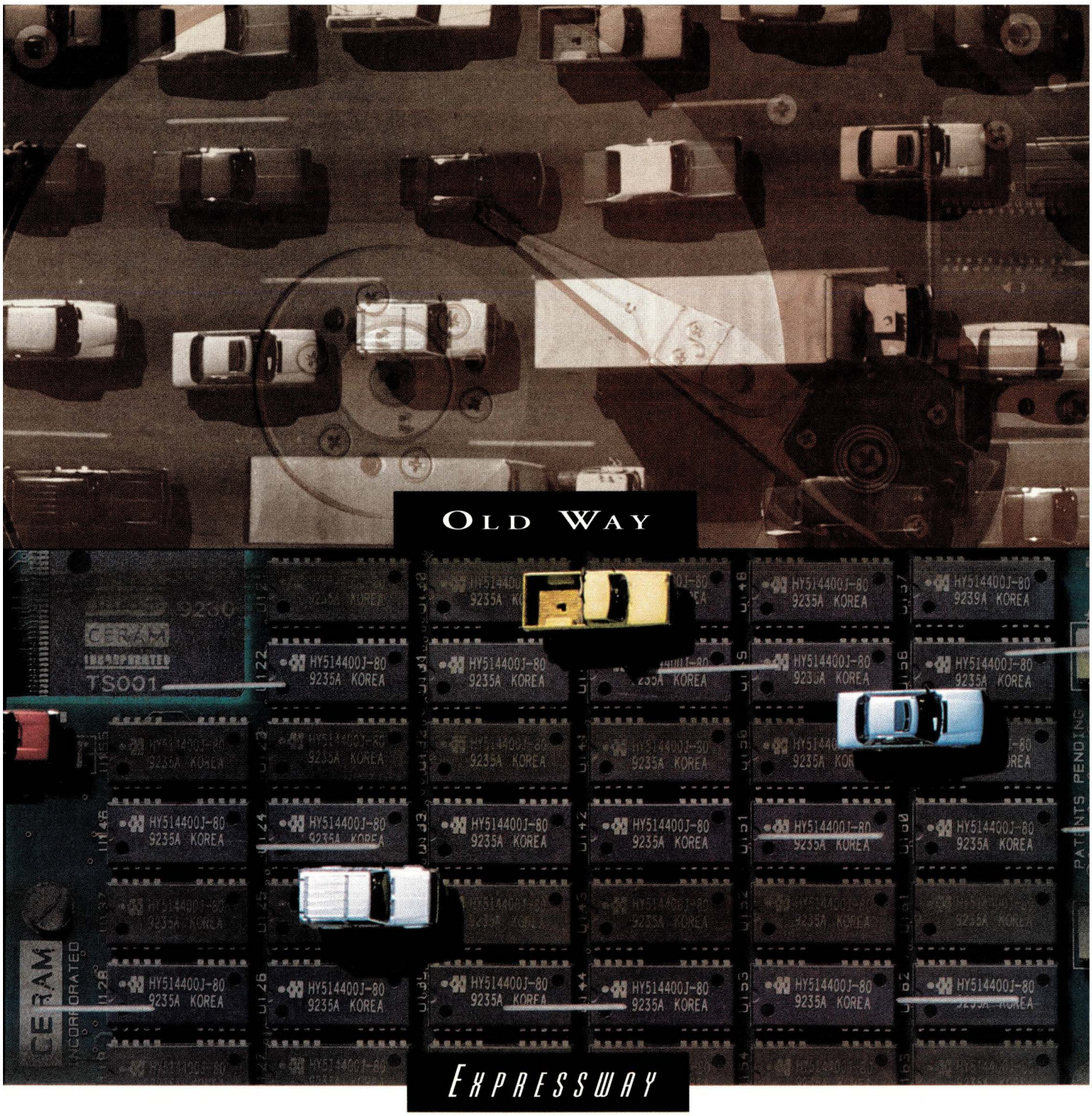

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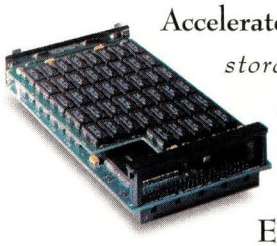

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SUNEXPERT
serves the UNIX workstation environment, emphasizing Sun, SPARC and Sun-compatible systems.

SUNEXPERT Magazine (ISSN 1053–9239) is published monthly by Computer Publishing Group, 1330 Beacon St., Brookline, MA 02146-3202. Telephone (617) 739-7001. Second-class Postage Rates paid at Boston, MA, and at additional mailing offices. This publication is free to qualified subscribers as determined by the publisher. Subscription rates are $60 per year in the United States, and $95 (surface mail) and $150 (air mail) outside the United States. Subscription requests can be sent to: Circulation Department, *SUNEXPERT* Magazine, 1330 Beacon St., Brookline, MA 02146-3202 or electronically mailed to circ@expert.com.

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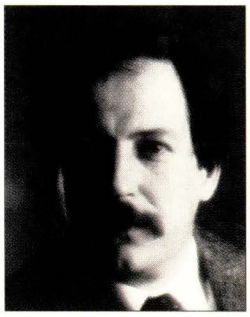
Editorial

Why HP Belongs in *SunExpert*

Hewlett-Packard has ported a substantial number of its key systems and application software to the SPARC platform. Among them is HP's SoftBench programming environment/application-development framework.



SoftBench competes head-to-head with two of Sun's most strategic products: its SPARCworks programming environment (with associated compilers) and its ToolTalk message-broadcast mechanism. It competes to a lesser extent with DEC's FUSE, Atherton Technology's Software Backplane and a new class of open APIs (such as CenterLine Software's CodeCenter API). Currently, many CASE software vendors, as well as a number of other ISVs, are reworking applications to take advantage of ToolTalk, SoftBench's Broadcast Message Server (BMS) or both. It's interesting to note that, until quite recently, when asked whether they were integrating their tools with ToolTalk, SoftBench or both, a large number of Sun's CASE vendors responded, "What is ToolTalk?"

More and more industry watchers believe that the CASE/software development market will standardize around both ToolTalk and SoftBench's BMS as the integration mechanisms of choice. (This is why *SunExpert* is running this month's debate-format features on ToolTalk and BMS, authored by SunSoft and HP, in our special report on software development.)

Even though ToolTalk and BMS achieve the same function–namely, tool and, to some degree, application integration–they go about it using different message-passing techniques. Another key difference between the products is that Sun is bundling ToolTalk for free as part of its Distributed Objects Everywhere (DOE) framework. DOE soon will be integrated into Sun's Solaris operating environment. HP is selling BMS as part of SoftBench but has not yet announced plans to bundle SoftBench with HP-UX or any other operating system.

Clearly, this debate addresses broader issues of UNIX software development: interoperability, portability and, in the near future, total application integration.

Doug Pryor

SUNEXPERT Magazine
Serving the UNIX Workstation Network
MARCH 1993 VOL. 4 NO. 3

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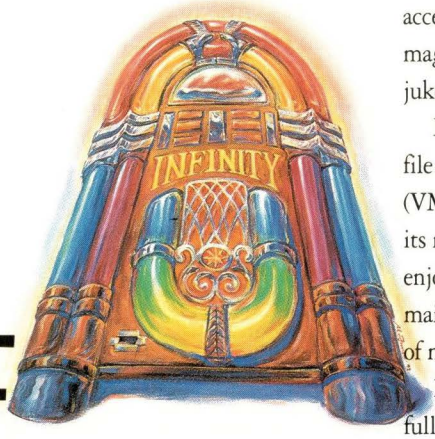

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NEWS

A Real Robotics Cliffhanger

It was a hell of a way to start the year. Literally. On January 2, the SPARC-based robot Dante was hanging by a cable over a volcano in Antarctica. However, robotics researchers have already termed Dante's cliffhanger a success. Critics, on the other hand, are saying that Dante may have been doomed by its own complexity.

Dante is a six-legged robot that was meant to be a prototype for the kind of robots that might eventually go into many different hostile environments, including those of other worlds. Designed by the Field Robotics Center at Carnegie Mellon University in Pittsburgh, the device was funded by NASA, which wants to be able to field similar mobile robots on the surface of Mars.

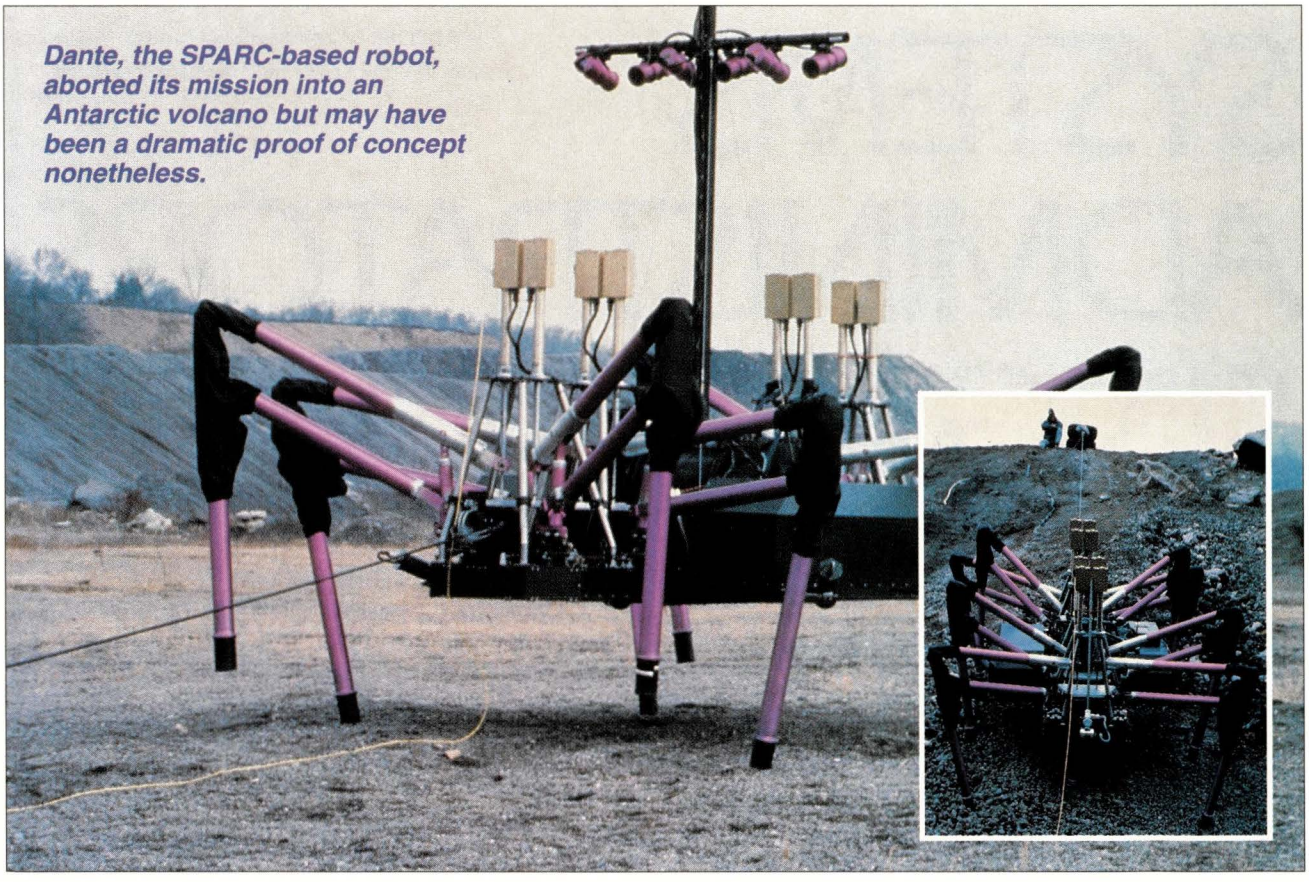
Dante, though, was meant to go into a live volcano, Mount Erebus in Antarctica, just after Christmas of 1992. In a blaze of publicity that included articles in *The Wall Street Journal* and *The New York Times*, the machine was sent rappelling into the volcano. Unfortunately, shortly after it began its descent, a cable connecting the robot to its controlling computer was damaged. The mission came to a halt.

Still, researchers are calling Dante a success. "Dante...is a proof of concept," says David Pahnos, assistant director of Field Robotics Research at Carnegie Mellon. "We were demonstrating new laser vision, new computer architectures, new stereo vision... and all of that worked." It was only the most mundane aspect of the device, its cable, that failed.

However, some researchers are saying that Dante was doomed because of its design philosophy. "As I understand it," says Joseph L. Jones, a software developer for IS Robotics Inc., Cambridge, MA, "much of the processing was done at the rim of the crater...and the mobile platform was connected to the computer from there. That made them extremely vulnerable to the kind of malfunction that eventually befell them."

Indeed, if Dante is stuck in a volcano, so, too, is it at the center of a debate in modern robotics research. It represents what might be called the traditional path of robotics, one linked to the artificial intelligence community, in which the robot's brain attempts to understand as much of its world as possible. There are, however, schools of self-declared robotics heretics who say that robots should be more like insects, with very limited brains performing only a few behaviors.

Jones and IS Robotics, for example, reflect work going on at MIT's Mobile Robotics Laboratory. This group, which is headed up by Rodney Brooks (who is also a co-founder of IS



Dante, the SPARC-based robot, aborted its mission into an Antarctic volcano but may have been a dramatic proof of concept nonetheless.

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Robotics), is developing very small, "insect-like" robots that use very simple mechanisms but still manage to perform very complex tasks. The Mobile Robotics Lab has fielded machines that can navigate crowded rooms and cross rugged terrains.

"In mobile robots," says Jones, "you can make a case for a new paradigm [of development]...and that's local information." Under this approach, the robot does not attempt to make sense of or model its world; rather, it pragmatically deals with only those situations that directly affect it. For example, if the robot encounters an obstacle on its way across a room, it doesn't attempt to discover whether that obstacle is a person or a table leg but simply seeks a way around it.

"It's effective in cases where you don't know exactly what's going on," says Jones. "The sensors on the robot are noisy; they may give you conflicting data and you don't have the information you need to proceed...but that's what real life is like."

Moreover, the robot is given a number of different behaviors, all of which attempt to execute at any one time but which are then subject to the control of a higher processor. To avoid obstacles, for example, the robot might automatically attempt to avoid anything in its path. On the other hand, it would also need to dock with a electrical socket to recharge its batteries. Most of the time, the avoidance response would be appropriate, but, says Jones, "obviously avoidance can't win out over recharging."

So, in cases of conflict, "you build an arbitration system...to decide who gets control." To promote these sorts of ideas, IS Robotics is selling two models of robots into the research community.

However, traditional robots like Dante still have defenders. Even Jones calls it "a superb technical achievement" and suspects that in industrial settings such devices may be the way to go. Pahnos, meanwhile, suggests that in the long run the two techniques won't be competitors.

But no matter who's right in the robotics philosophy business, the story has a happy ending for Dante. After spending a hair-raising few hours over certain doom, the robot was hauled back to safety. As of press time, it was packed up and flying back to the United States.–*mjt*

A Race to the Start

Solaris 2.1 may be well out of the starting blocks, but many of the compilers and programming-environment tools that developers need to do their 2.1 work have yet to leave the gate. And by most accounts–with the exceptions of SunPro and Cygnus Support (the GNU C/C++ people)–vendors won't be ready to ship their wares before the second or third quarter.

Although Solaris 2.0 has been available to early-release customers for more than a year now, few of the leading developer tools were successfully ported to 2.0, let alone marketed by their vendors. "Version 2.0 never made it as a release," says Bob Cramer, vice president of marketing for CenterLine Software Inc., the Cambridge, MA-based programming-environment company. "We brought [CodeCenter and ObjectCenter environments] to alpha states for 2.0, but we couldn't stabilize the products. We decided to wait for 2.1." CenterLine expects to hit its second-quarter target for Solaris 2.1 versions of CodeCenter and ObjectCenter, as well as for its standalone CenterLine-C compiler, Cramer says.

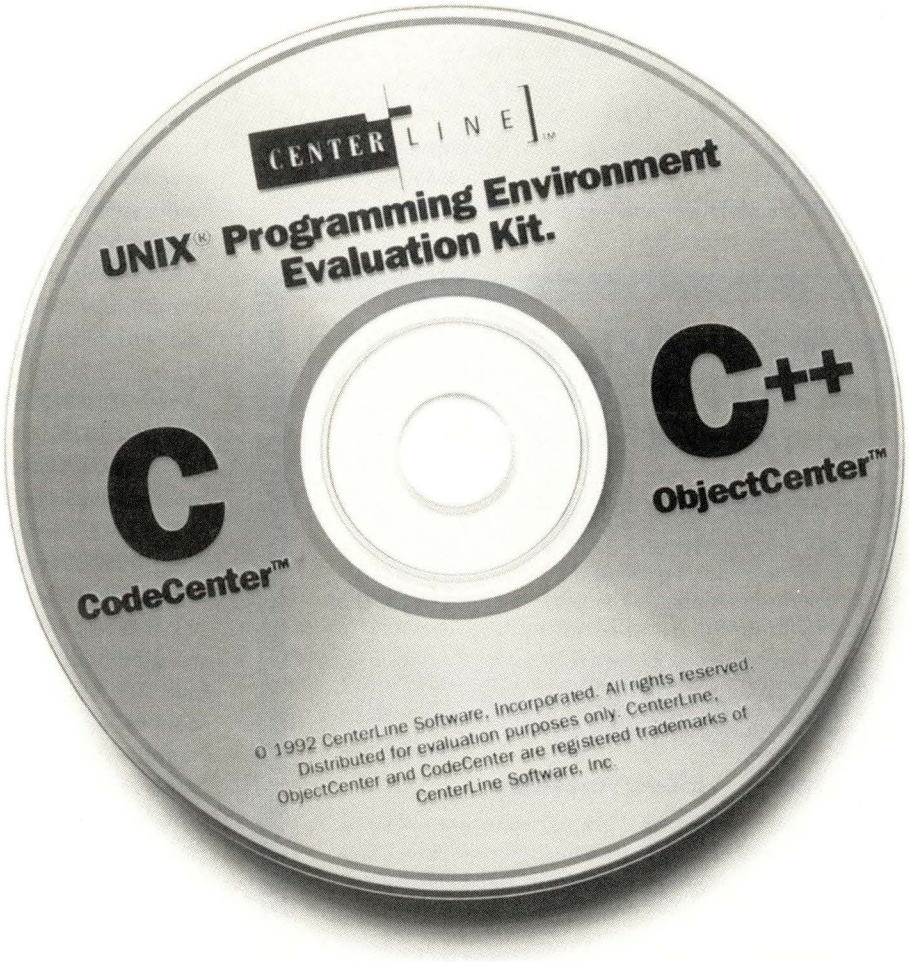
Oasys Inc., the Lexington, MA, vendor of the Green Hills C, C++, FORTRAN and Pascal compilers, ported its products to Solaris 2.0. "But there weren't a lot of 2.0 users," points out Ann Bischoff, director of marketing for the company. Oasys was in the beta test phase for the Solaris 2.1 version of all of its compilers in late January/early February. Bischoff says she expects Oasys will have its 2.1 version of its cross-compilers for embedded development ready by this month or next. And Oasys expected to finish its 2.1 port of its MULTI X Window System debugging environment by late January or early February, according to Bischoff.

Framingham, MA-based compiler vendor Liant Software is putting the finishing touches on the Solaris 2.1 versions of its C, PL/1, COBOL, FORTRAN and C++ products, says Charles McComas, director of research and development for the LPI business unit. First customer ship for all of the products should happen sometime in the second quarter, he says. By then, Liant should also be finished with its Solaris 2.1 version of its Codewatch debugging environment, McComas says. The only potential stumbling block for Codewatch, says McComas, is the lack of versions of Motif that fully support 2.1. Codewatch is based on Motif.

"People are only now getting ready to make the move to Solaris," claims Teddy Rosenberg, vice president of marketing for Menlo Park, CA-based programming-environment vendor Lucid Inc. "They want to know *when* we'll be there, not necessarily that we are *already* there." Rosenberg says Lucid decided against porting its Energize environment to Solaris 2.0 because there was no customer demand. She expects Lucid to have completed its 2.1 ports of its C and C++ compilers by the second quarter, and its 2.1 version of Energize by some time in the third quarter.

Micro Focus Inc., Palo Alto, CA, only recently completed its Solaris 1.0 port of its various development tools, including COBOL compilers, Dialog System client/server screen environment and Operating System Extension (OSX) run-time environment. The company has had older versions of its Sun-based development products on the market for five years, says Kevin Moultrup, OEM sales manager. Micro Focus obtained its copy of Solaris 2.1 for SPARC in late January and is expected to release products based on 2.1 sometime in the third quarter, according to Moultrup.

For developers for whom Q2 or Q3 might as well be the year 2000, there are at least two 2.1 developer tool solutions on the market today. SunPro, to no one's surprise, has a full suite of compilers and development tools available for 2.1. These include the complete SPARCworks tool set, the SPARCworks Professional C and C++ environments and the various SPARC-compilers (C, C++, FORTRAN,



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COBOL, Ada).

For customers looking to do things on the cheap–meaning, in this case, "buying" free software, plus a $3,000 annual support contract–2.1 versions of the GNU C and C++ development environments are available through Cygnus Support, Mountain View, CA. Customers can order the products directly from Cygnus, obtain them via anonymous ftp or access them through their latest CDware disks, says Cygnus President Michael Tiemann. Cygnus offers a full source code version of its compilers and debuggers and binaries for its compilers on the existing CDware disk.

Even more interesting than when the various compilers and programming environments for Solaris for SPARC will be ready is the question of when the ones for Solaris on Intel will make their debut. Of course, SunPro has its ProWorks development environment on the market already for Solaris on X86 customers. But Cygnus won't be joining SunPro as an early-to-market leader on the Intel front. "Our strategy is to become the dominant SPARC tool supplier and then port to X86." Tiemann says.

At press time, most of the other tool vendors claimed to have no concrete plans to port to Solaris on X86.–*mjf*

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X Terminals and Motif... from Sun?

Motif and X terminals are two technologies that Sun Microsystems Inc. was expected to ignore–for at least as long as its beloved CEO is around. (Scott McNealy is often quoted as having said Sun will support Motif over his dead body.) But a couple of recent Sun announcements have hinted, if not outright stated, that Sun's belated support of these two industry standards may not be too long in coming.

SunSelect, the Chelmsford, MA, PC products subsidiary of Sun, unveiled Version 3.1 of its SunPC software, which includes a number of enhancements, not the least of which is support for Motif. Granted, a SunSelect press release announcing the new version allowed "the M-word" a single, well-buried mention, but it was there nonetheless. Other new SunPC-related announcements include NetWare server access, inclusion of a simplified licensing mechanism and price cuts of up to 50% for SunPC software and up to 20% for SunPC hardware acceleration products.

Sun Microsystems Computer Corp. couldn't quite bring itself to pen the words "X terminal," but it did announce an agreement with Xylogics Inc., Burlington, MA, under which SMCC will OEM the Annex Three communications server from the company. SMCC is positioning the Network Terminal Server, which allows up to 64 terminals or other serial devices to be connected anywhere on a network that includes at least one SPARCstation/SPARCserver, between its SPARCstation LX and

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SPARCstation 10 products. The Network Terminal Server began shipping last month and is available from SMCC or SunExpress for $6,990.–*mjf*

100-MB/s SBus

A 100-MB/s SBus interface has been introduced by LSI Logic Corp. The L64864 SBus DMA controller, priced at $79 per 100, is a single-chip 64- or 32-bit interface for peripheral subsystems. With controllers like this, the SBus could be made competitive with such buses as VME.

The low speed of peripheral interfaces has been one of the most frequently cited weaknesses of the SBus. "SBus has a lot of bandwidth," says Lit Lam, SBus product marketing manager at LSI. "But the bottleneck is in the connection to the peripherals...you don't have the bandwidth on the peripheral side." For that reason, many systems integrators have turned to VME, but Sun itself has largely abandoned VME. In late 1992, for example, the company introduced a line of servers that lacked a VME bus entirely. "They think of it as dinosaur technology," says Walter Snell, director of sales and marketing at Themis Computer, Pleasanton, CA. "They want to get away from it." Themis sells, among other things, SPARC-based VME boards and says that it can happily profit in the VME market, which is too small for Sun to enter comfortably.

There is therefore a demand for much higher speed SBus interfaces. LSI's 64864 is one of the first of these. The company expects the product to be used in high-performance SPARC-based workstations. It also expects it to be used as an add-on performance booster on existing Sun workstations. The company says that the controller might be used as a low-cost, high-performance solution for SCSI-2 peripherals, including servers, FDDI LANS and so on.

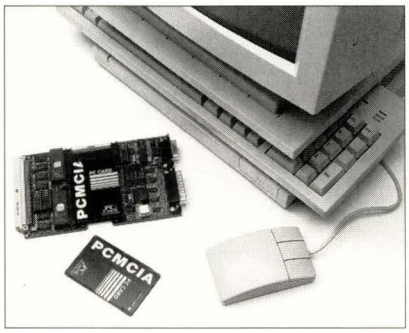
The L64864 chip can be configured for either a single 32-bit DMA channel, or two 16-bit DMA channels and one standard 8-bit channel, by setting an external mode pin. When functioning as a 64-bit or 32-bit master bus for SBus peripheral subsystems, it can initiate burst sizes up to 64 bits.–*mjt*

Latest Flash: Terminals Play Cards

The latest trend in terminals seems to be PCMCIA cards. Suppliers of both X Window System and alphanumeric terminals are poised to introduce terminals that support the credit-card-size Flash EEPROM cards that were originally developed in the laptop and palmtop computer markets.

On the X terminal side, Network Computing Devices Inc., Mountain View, CA, has introduced a new Ethernet-Serial-PCMCIA (ESP) network interface board that fits into existing NCD terminals. The ESP board supports one Ethernet port, two serial ports and a socket for a PCMCIA card. The company envisions users loading and updating their X Window software via PCMCIA cards. This is considerably easier than physically removing chips from the machine each time there is an upgrade.

An Ethernet-Serial-PCMCIA network board fits into existing Network Computing Devices Inc. X terminals.



However, the company says that, in the longer run, NCD customers will be able to exploit the large variety of PCMCIA cards expected to come from the PC market. NCD is anticipating PCMCIA modems, LAN adapters, ISDN devices and so on. In the interim, the ESP board is priced at $250, and the first PCMCIA card to go into it is $500.

Meanwhile, Link Technologies Inc., Fremont, CA, is already shipping a line of alphanumeric terminals called MAXit, each of which has two PCMCIA slots in its rear. Link, a subsidiary of Wyse Technology Inc., markets terminals to OEMs, and the MAXits are designed to be rapidly modified for customers' special requirements. The company says that the PCMCIA bus lends itself to such specialization in that the vendor or end user can quickly add or subtract different functions.

Currently, the company is showing only character terminal MAXits. However, it says that Alphawindow terminals are available should anyone want them. An X Window MAXit is also reportedly in the works.–*mjt*

Cypress to Lay Off 400; Settles AMD Suit

Not all of the SPARC processor vendors have happy news to relay. Chip maker Cypress Semiconductor Corp. will lay off "about 400" people and shift 75% of its assembly and test operation to Bangkok, Thailand. Moreover, the company's San Jose, CA, facility will be scaled down to an R&D process development facility, while wafer fabrication will be shifted to a Minnesota site.

The company says that these actions will "return Cypress to the performance levels our investors expect."

In addition, Cypress said that it had settled for $4.25 million an outstanding suit with Advanced Micro Devices, in which AMD alleged Cypress had infringed on an AMD patent for the "macrocell" technique used in Cypress' programmable logic devices. But Cypress still faces other potential legal expenses: Texas Instruments Inc. is charging that Cypress has infringed on one of its packaging methods. Cypress is also in discussions with AT&T regarding a "potential agreement" on several of that company's patents.

Cypress said it is establishing reserve funds for the settlement of those potential costs and that the total costs of restructuring and litigation would amount to $37.2 million in the fourth quarter of 1992.–*mjt*

New and Networthy

Hub, bridge and router companies, not to mention networking software vendors and the telecommunications granddaddy itself, AT&T, have made a slew of product introductions of late.

• *AT&T*, New York, and *Novell Inc.*, Provo, UT, have announced that they will jointly develop and market prod-

ucts that link computer networks with business telephones. The first such product will be the Telephony Server NetWare Loadable Module (NLM), software that will link Novell's NetWare with AT&T's Definity Communications Systems. It will allow customers to use such common telephone features as auto-dialing and conference calling in combination with information stored on networked computers. That will be followed by a suite of application programming interfaces for third parties to integrate the products into network applications. Both NLM and the APIs are supposed to be available in the second half of 1993.

• ***FTP Software Inc.***, North Andover, MA, has shipped Version 2.0 of its flagship product, PC/TCP for DOS and Windows. FTP says it has enhanced the speed and flexibility of the basic transport, added an automatic installation program and created PCTCPNET, a Windows front end for Interdrive, which is FTP Software's implementation of NFS.

• ***InterCon Systems Corp.***, Herndon, VA, has signed an agreement with ICE Engineering of Witmore Lake, MI, allowing InterCon to add a UUCP-based network communications software product to its current line of connectivity software for the Mac. The new product, called UUCP/Connect, allows users to convert a Mac into a UUCP host or client that can connect with other UUCP hosts using a dial-up connection or a direct link. UUCP Connect is available immediately in bundles for 10, 25, 50 and 100 users.

• ***Cayman Systems Inc.***, Cambridge, MA, has introduced the Gatorbox EX, a dual Ethernet port router that links AppleTalk work groups with Ethernet backbone networks. Cayman is positioning the EX as a solution for large Mac sites that are migrating from LocalTalk to Ethernet and need a fast way to let Ethernet-based Mac users communicate with Mac- and UNIX-based users on different Ethernet networks.

• ***Cabletron Systems Inc.***, Rochester, NH, has begun shipping what it is calling the industry's first interface to support FDDI routing for AppleTalk networks. The F6069 Desktop Network Interface (DNI) card provides routing capabilities through Cabletron's support for the AppleTalk Update-based Routing Protocol (AURP), a recent enhancement to AppleTalk that allows data to be routed between different networking technologies. The F6069 connects Mac II and Quadra systems on LocalTalk, Ethernet, Token Ring or FDDI networks to other FDDI networks. The card is manageable through any SNMP-compliant platform.

• ***Wellfleet Communications***, the Bedford, MA, bridge/router vendor, introduced a high-speed serial interface module that provides links to T3, E3 and SONET OC-1, and supports high-speed services such as frame relay, SMDS and ATM. The High-Speed Serial Interface (HSSI) link is user-configurable at line speeds of up to 52 Mb/s. Wellfleet simultaneously announced that it has extended its protocol support to include OSI. Now, the company's routers support both Intermediate System-to-Intermediate System (IS-IS) for OSI-based commu-

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–mjf and mjt

This Just In...

• All you thirty-somethings (and non-thirty-somethings): You've got 19 days left (i.e., until March 19) to cash in on the latest *Sun Microsystems Computer Corp.* promotion. Depending on how many SPARCstation 10 Model 30 full systems you order, SMCC is throwing in for free all kinds of peripherals, memory and even full systems. If you buy one Model 30, you get a free CD-ROM drive; buy three and you get a free SPARCprinter and three 424-MB internal disk expansion units. If you buy five Model 30s, SMCC is offering a free Model 30 with a 19-inch color monitor, 32 MB of memory and a 424-MB internal drive. And if you buy 10, you get two free Model 30s and a SPARCprinter. Maximum order size is 100 SS10 Model 30s.

• The newest kid on the SPARCalike block is *Apogee Systems Inc.*, Tallahassee, FL. Apogee has announced a 50-MHz workstation called the Orbiter II+. The system comes with a 19-inch color monitor, 32 MB of memory, a GX graphics accelerator and a 424-MB hard disk and lists for $11,295. The company is claiming a 20% improvement in both integer and floating-point performance over a SPARCstation 2, and a 26% improvement in FP and 3% improvement in integer performance when compared with the SPARCclassic and LX products.

• *Novell Inc.* announced it has selected *HyperDesk Corp.*'s Distributed Object Management System (HD-DOMS) to "provide an object-based interface to services and resources within the NetWare environment." Novell is licensing HD-DOMS from HyperDesk and bundling it as NetWare Loadable Modules (NLMs) with NetWare 3.X and future releases. How the move will affect UNIX, via Novell's recent bid to buy UNIX System Laboratories, is uncertain. Novell has said HD-DOMS will support DOS, Windows, NetWare and UNIX clients.

• *National Information Systems Inc.*, San Jose, CA, has introduced a Motif and Open Look GUI tool kit, called the Accent ToolKit. The company says the product is the first Motif API that supports both Open Look and Motif without requiring users to rewrite applications. The tool kit features both Motif 1.1 and OpenWindows 3.0 support in the same package.

• Plant-floor-manufacturing software vendor *Promis Systems Corp.* is porting its PROMIS software to the SPARC platform. PROMIS is one of the most popular plant-floor packages and previously was only available on Digital Equipment Corp. VAX systems.

• DBMS-vendor *Oracle Corp.*, Redwood Shores, CA, and *Sun Microsystems Inc.* have announced a strategic alliance. The two will cooperate in development and marketing of products and services for the pharmaceutical industry. The companies claim to expect as much as $200 million in revenues from the partnership by 1997.

• Aster*x, the integrated office automation software package from *Applix*, Westboro, MA, seems to have survived an attempt to oust it from a lucrative eight-year contract with the Pentagon. Aster*x is part of GTE Government Service's bid on the lucrative Joint Staff Automation for the Nineties (JSAN). GTE won the contract, but losing bidders protested the award. However, according to Applix, the Government Board of Contract Appeals confirmed GTE's (and Applix's) possession of the contract.

Correction

In the chart entitled "New SPARCserver 600 MP Upgrade Prices," (*SunExpert*, January, Page 8) the sixth item in the chart should have read: SPARCsystem 470, SPARCserver 490, Sun-3/470 board upgrade to 64-MB SPARCserver 600MP (with SuperSPARC and SuperCache) with a list price of $26,495.

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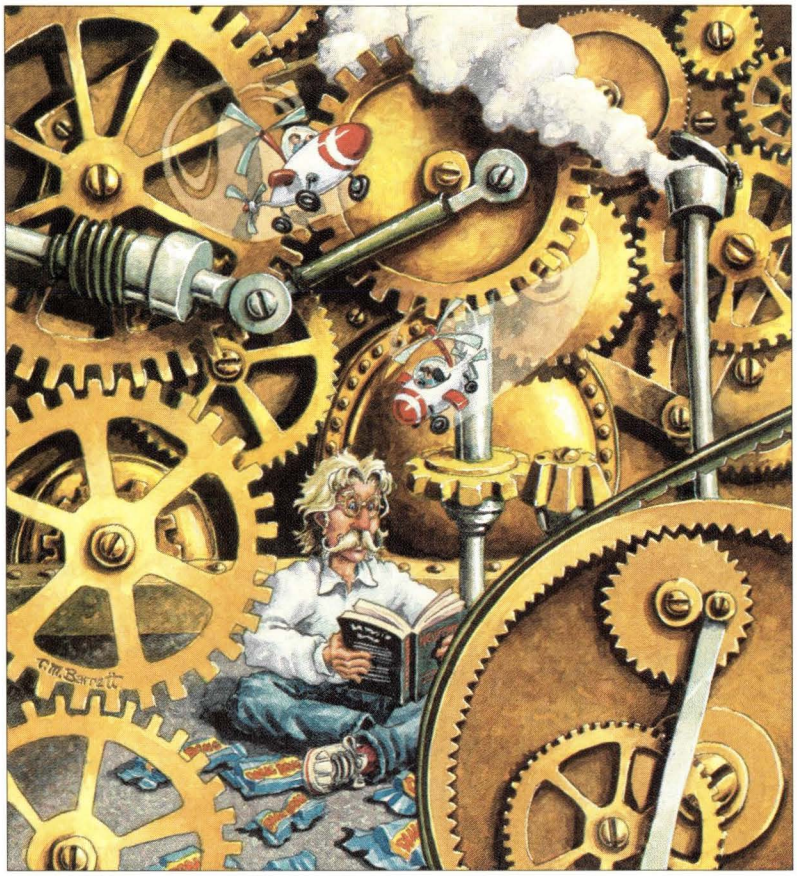

TOM BARRETT

Cyber and Steam: The Compleat Victorian

by MICHAEL O'BRIEN

"The sky above the port was the color of television, tuned to a dead channel."
–William Gibson, *Neuromancer*

"It doesn't matter."
–What you say when confronted with too much information you can't use.

"It doesn't matter."
–What the British Royal Navy said to Charles Babbage when he pleaded for just a little more money to finish a much more capable engine than the one he'd proposed.

Q: Questions? I'm not going to ask any questions. I know better than that. I see Mr. Protocol sitting there surrounded by wheels, cogs, drive belts and any number of chattering gears, and not a computer in sight. I know better than to ask any questions.

A: How many times do I have to explain to you that your job isn't to *like* it. Your job is to *ask questions* about it, so that people will get sucked into reading this column and we all get to eat around here, not to mention laying in all those Ding-Dongs for Old Squirrelbrain over...ah. Yes, well, excuse me.

The environment in which you see our gallant Mr. Protocol this month is, for a change, on the same level of reality as he is himself, which is to say, virtual. This, however, is definitely a retrograde version of reality. In several recent columns, we have examined a few of the possibilities that the growth of the Internet sets before us, in terms of possible futures. This month, we are going to examine some visions of the future held by those whose points of view are complementary to our own. We'll be looking at the work of several writers who have great visionary ability, but no technical background.

At this point, most technical types note that alarms have begun to sound, as their bogometers suddenly go off the scale. We all remember such wonderful TV series as "20,000 Leagues Under the Sea," where technical content was thin enough to qualify for a sauce in a California cuisine

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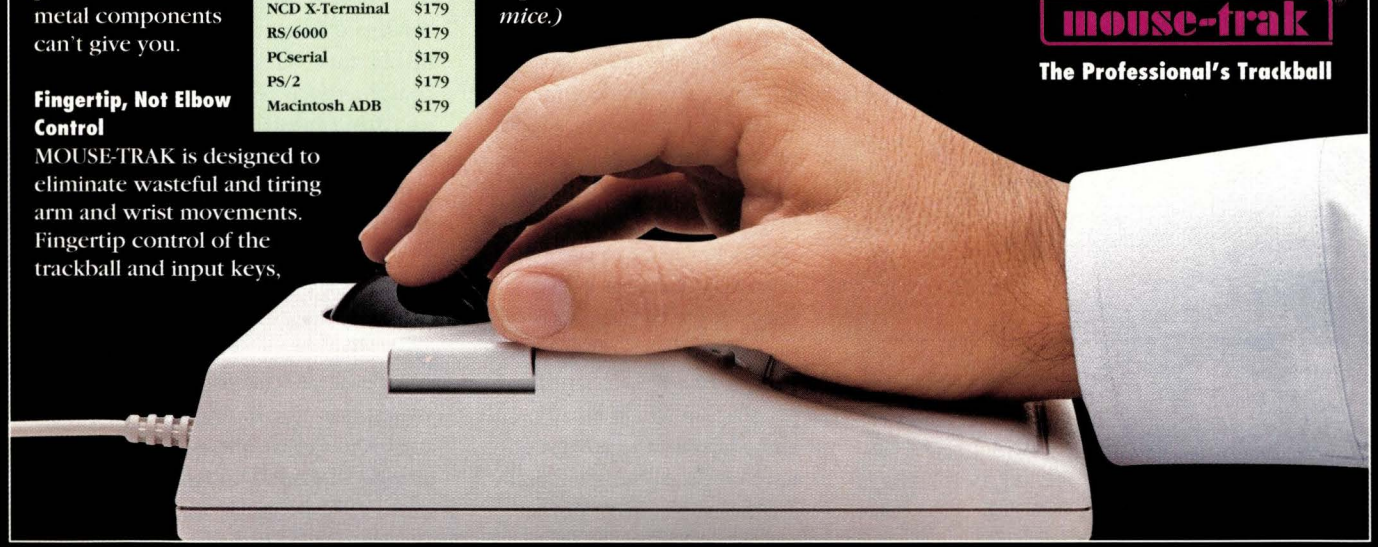

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restaurant, and where the level of technical sophistication of any device was related directly to its explosive power when mishandled.

So get over it. The writers with which Mr. Protocol is here concerned are among those whose abilities lie not in the technical, but in the literary and social. Their modus operandi is to track technology only loosely, but to pay particular attention to the pressures that society applies to technology.

The usual approach in technical prognostication is to concentrate on the changes that technology forces upon society. Small-town provincialism and isolation crumble before mass media and telecommunications; businesses expand into worldwide entities thanks to rapid long-distance travel; privacy is eroded by computerized databases, etc. However, predictions based solely upon this effect have an awful habit of turning out spectacularly wrong. *Popular Mechanics*, for example, has consistently and insistently provided cover illustrations of the happy breadwinner heading off to work in his own personal flyer. The ornithopter has given way to the autogyro and then to the fan-levitation family of expensive failures, but we see no such tendency in real life. The dream of universal flight has given way to the reality of the unfortunate consequences of systems failure. When daddy's car goes blooey, it coasts to a stop, but when daddy's autogyro goes blooey, the neighbors are as like as not converted to fajitas in a "Death From the Skies" scenario that is truly terrifying when multiplied by 200 million or so personal flyers. On top of that, we have the natural consequence of the hot rod fan-lev with the outboard turbo that can do 0 to 200 mph in 2.3 seconds flat. I think not.

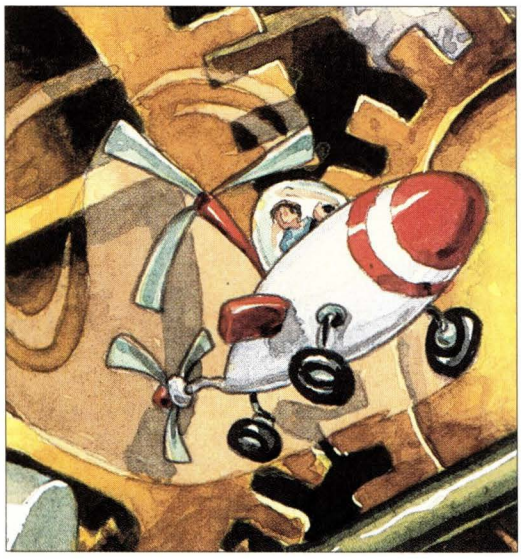
This serves as an example of the usually unexamined impact of society upon technology. What Mr. Protocol is here to take a look at are several stories by people who typically work both sides of the street. Their science comes straight out of *Science News*, but they are keen observers of the human condition.

So who are they? Mr. Protocol is glad you asked.

The first writer we'll be looking at is William Gibson. This will come as no surprise to some; his 1984 novel *Neuromancer* started an entire literary movement which, thank heavens, is finally showing signs of slowing down.

Mr. Protocol does not mean to devalue Mr. Gibson's work. Certainly his writing has generated enough interest in certain quarters to qualify as a religion. To such people, the dystopic vision served up by Mr. Gibson in his work acts as a high-technology vision of romance and adventure that carries all the appeal (and the same sort of appeal) as the works of Raymond Chandler or the film noir of the '30s.

Mr. Gibson has based his work on a single observation, which, if he never writes another word, is still sufficient to earn him a permanent place in science fiction history. Until the publication of *Neuromancer*, visions of the future, even those that give a prominent place to computer science, all seem to derive from Hugo Gernsback's original vision of the future as a shining temple of scientific progress, in which bread mold and cracked concrete not only have no place, but are literally inconceivable. Most of the people in *Neuromancer* consider themselves lucky to find even moldy bread to eat. Mr. Gibson's primary contribution is the realization that advanced technology and computer networking will not substantially change the world view of those who have become alienated. To the contrary, a tightly linked worldwide information web cannot help but create a class of "have-nots" whose alienation will be so severe that the skinheads of today offer only a glimpse of what is to come.

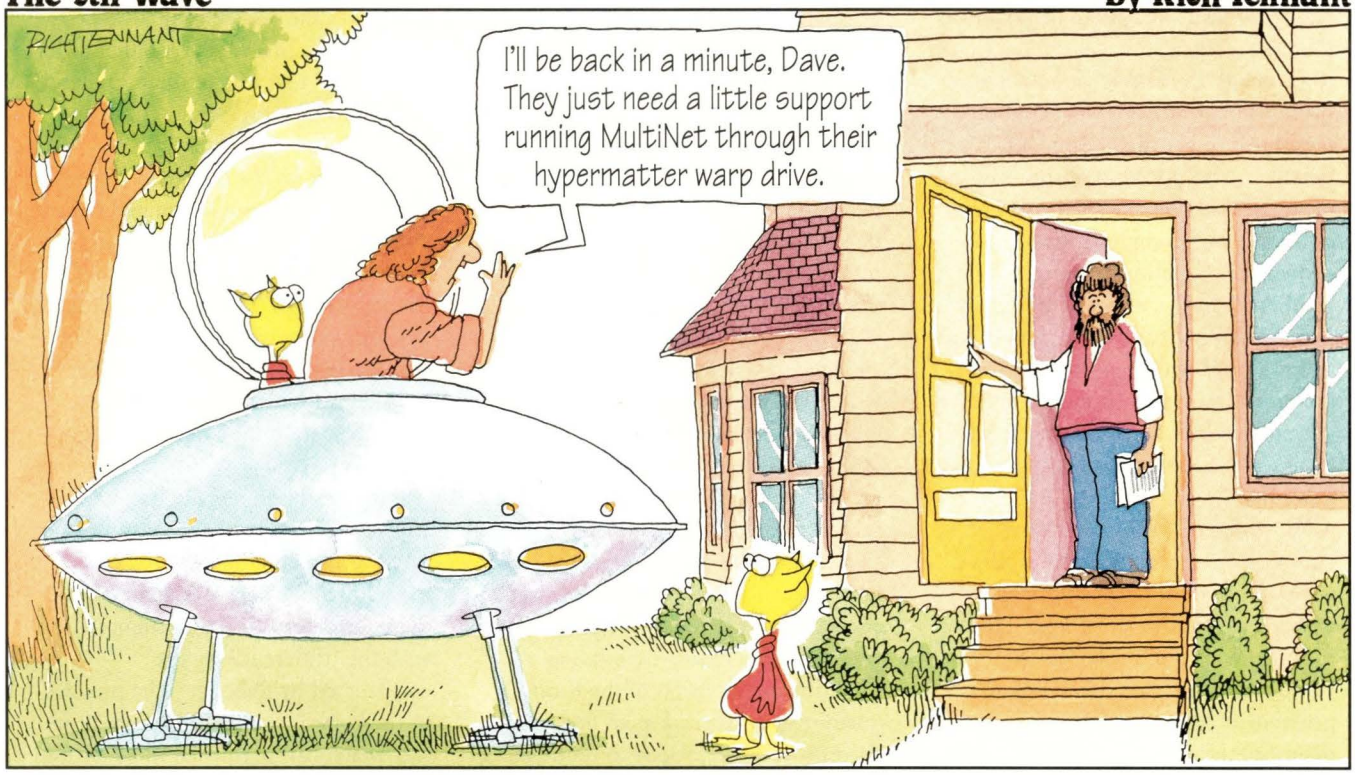


To this, Mr. Gibson adds a concept that is brilliant in its simplicity, one made paradoxically easier by Mr. Gibson's own ignorance of the nuances of computer technology. His is the notion of "jacking in," of connecting one's brain directly to the world computer network via a dimly envisioned device called a "deck," which seems to look something like a cross between a PC keyboard and a musical synthesizer. (Mr. Protocol was assisted in attaining this vision by taking a close look at today's synthesizers. Almost all of them are computerized, and almost all of those provide such unmusical options as "FORMAT DISK" in their menus.)

The experience of the characters in *Neuromancer* in navigating the world network is one that has literally inspired thousands of computer scientists, hackers, observers and enthusiasts. Mr. Gibson refers to it only as a "consensual hallucination," but those who inhabit this alternate world of data space seem to have given their consensus to a reality that can kill its inhabitants. Running afoul of computer security software ("black ice," from Intrusion Countermeasures Electronics) does not result in detection, arrest and conviction; it results in detection, assault and sudden death. The simple notion of filtering the connection between deck and brain such that one's own personal deck cannot fry one's own personal brain is never even referred to. It is part of the assumption that to inhabit data space at all is to expose oneself to all of the dangers therein. This lends the entire world of "cyberspace" a rather piratical air, where data thieves suddenly become highly mobile raiders risking their lives in the finest Errol Flynn tradition.

The notion of a complete sensory

The 5th Wave **By Rich Tennant**



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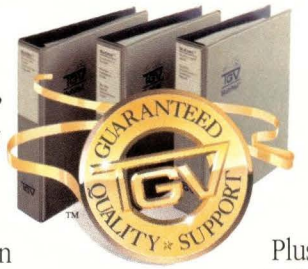

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reality, as "real" and more dangerous than everyday reality, is so romantic as to be nearly irresistible, at least among those who are tired of whacking on keyboards to get their computers to behave. Certainly Mr. Gibson's vision of the network as a cityscape where even the most complex software systems are visualized as simple geometric shapes, and where security penetration is visualized as something as simple as breaking through a wall, are much more palatable than our own current symbolic conceptions of such things as tortured exercises in machine grammar.

The problem with such visions, of course, is that they are oversimplified to the point of unbelievability by we who know what we are doing. The problem with the "problem," Mr. Protocol feels, is that this is not a problem at all. The deletion of extraneous information is one of the most powerful tools of abstraction that we possess. If it were necessary to represent each book we discuss by its entire contents instead of its title, for instance, we would never be able to discuss books at all. If we were actually able to visualize the Internet as a cityscape, for example, and to give it a spatial geography, and to give the organizations on it an architectural representation as opposed to a simple domain name, we would all probably live easier lives. In fact, for those like Mr. Protocol, who had actually seen a good percentage of the machine rooms on the original Arpanet, the Arpanet did have a visual representation, because Telnet and FTP were being pointed at real places, not indistinguishable abstractions. Given the impossibility of actually visualizing the millions of machines on the net, generating a consensual hallucination actually sounds like a pretty good second option.

William Gibson, however, is not the first person to have an interesting and original idea about what the Worldnet would be like. In Mr. Protocol's humble opinion, that honor belongs to John Brunner, whose novel *The Shockwave Rider*, now several decades old, still stands up as excellent reading and a good vision. In Mr. Brunner's vision, the world computer network is taken as a given and used in much the same way as the electric power grid. Its use is closely tied with the existence of many hundreds of channels of television, some commercial, some paid and some guerrilla. Governmental decisions are commonly made by Delphi conferencing, whose results are binding.

Mr. Brunner's vision of the future qualifies as neither utopian nor dystopian. Power is seen to reside in the hands of those who are able to move information about; the most common form of governmental malfeasance is seen as the concealment of information. Although the philosophies expounded in this book seem to hold a whiff of the '60s about them, it is still a refreshing breath of fresh air among the miserably misinformed and underinformed literature generally available. In fact, it acts as a valuable counterbalance to the nightmare world proffered in *Neuromancer*, recognizing as it does the existence of checks and balances even in an out-of-kilter society.

Perhaps the strangest vision is at the same time the most revealing. Rather than taking contemporary American society and extrapolating the ubiquitous presence of the net to the most dominant feature of society, it instead postulates the existence of advanced computer technology in a rather different society–that of Victorian England, in the heyday of the Industrial Revolution.

This book is *The Difference Engine* by (surprise!) William Gibson and Bruce Sterling. Mr. Gibson's first book spawned an entire (and largely unfortunate) wave in literature (and lifestyle, at least among wannabes) known as "cyberpunk." *The Difference Engine* postulates what the authors rather coyly refer to in interviews as "steampunk."

In the world of *The Difference Engine*, Charles Babbage's was far from the mostly vain effort we think of today. The book's title is artistic rather than accurate, as it has nothing to do with the "difference engine" constructed by Babbage. The premise of the book is that Babbage's work on the Analytical Engine led to an entire industry of nonelectronic computers, of general power and capability comparable with those of the (our) 1960s, at least. The world thus painted is peculiar, to say the least. The authors have done considerable research into the period, and in some sense this is unfortunate for modern readers, as those unfamiliar with the period are confronted with many events that are obviously of Significance, but which are incomprehensible in the absence of knowledge about how those same events or personages figured in the history of our world.

This archness aside, the carefully thought-out view of the computerized Victorian age is fascinating indeed. The all-mechanical governmental computers are the size of large buildings, installed perforce in even larger buildings built to contain them. Dust, oil and grease are the main enemies of the government's efforts at tracking information, and an entire cadre of dedicated government clerks work, not in tweed suits and anonymous office buildings, but in Victorian versions of clean room garb, feeding punched cards to the steam-driven behemoths that incarnate government policy.

In everyday life, perhaps the most obvious use of the Babbage engines is

in entertainment. In our world, the cinema grew out of the magic lantern shows that served not only as entertainment in their own right, but often formed part of the program in vaudeville shows. The earliest moving pictures were booked as vaudeville acts.

> Mr. Gibson's first book spawned an entire wave in literature known as 'cyberpunk.'

In the world of *The Difference Engine*, the entertainment takes the part of a gigantic pin-screen driven by a Babbage engine in the basement. Would-be impresarios bring decks of cards for the engine which drive the pin-screen to produce a form of animated picture, similar to a silent movie. This wildly improbable assemblage is described in loving detail, becoming almost believable.

Against this backdrop, Messrs. Gibson and Sterling describe a world with all of the problems of early industrial England multiplied to the breaking point. Luddites and anarchists attempt to smash the State, and the infamous "yellow fog" comes close to killing the entire city out of hand. Both of these phenomena were all too real in our own world, but in this world, the Engines have so greased the gears of government that it has created conditions far worse than historical England ever managed to produce on its own.

It is this recurring vision of computers providing both great power and nightmare consequences that seems to invade all of the literature which is based on premises which we would regard as anywhere near correct. Mr. Protocol thinks that "alienation" is at best overused to describe the phenomenon. In his darker moments, he prefers the term coined by Gilberto Hernandez, "human diastrophism."

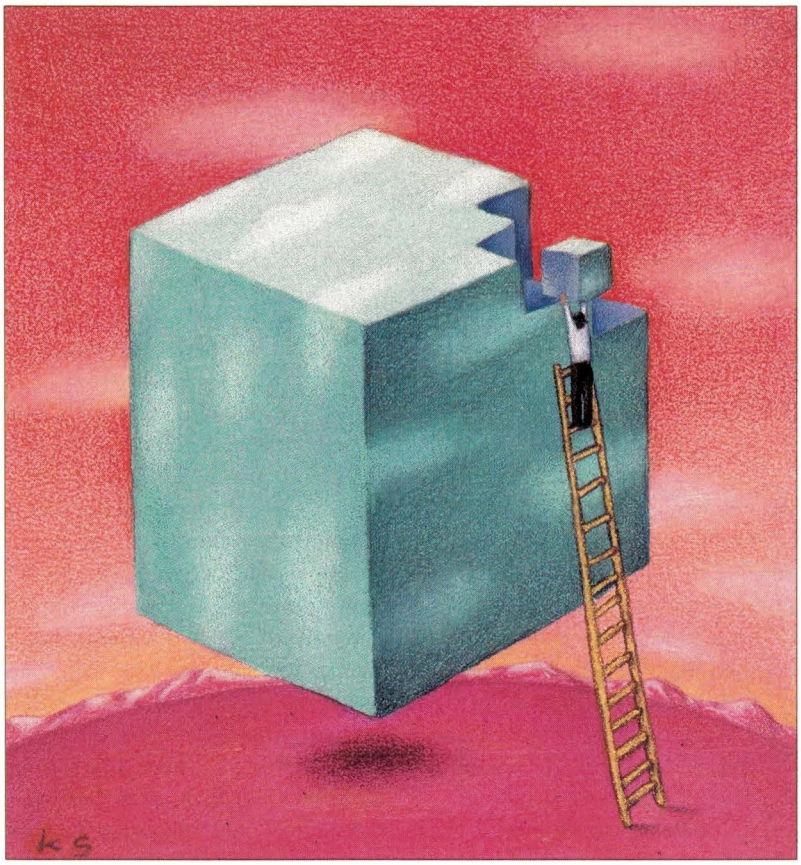
Mr. Protocol does not believe that this is in reality an inevitable consequence of the deployment of a generally accessible worldwide computer network, but he does believe that it is a likely one. He is not of the same sanguine opinion as those who created the notable Community Memory Project in Berkeley, nor does he now share the dream that put the People's Computer Company on the map. Simply throwing an information resource at a community does not mean that that community will use, or benefit from, that resource. The efforts mentioned were brilliant failures even in communities noted for the high percentage of their population that is educated and willing to try new things. Too many barriers of education, culture and human communication remain. The real power in information does not, today, lie with the availability of the information itself. It lies with those who at least purport to interpret that information, to make it digestible, trivially available, and entertaining, and who stand to make more than a few bucks doing so.

"Human diastrophism," indeed. Mr. Protocol thinks you should consider what the Worldnet means to your Peruvian nanny. ⊸

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 at an aerospace research corporation.

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



KEITH GRAVES

Making Programs

by PETER COLLINSON,
Hillside Systems

At the start of computing, early programmers instructed their computers using numbers, sometimes called machine code. Machine code is placed in the memory of the machine. Each instruction is passed one by one into the instruction-decoding logic controlling how the hardware works. Actually, dealing in raw numbers may seem to be in the dim and distant past, but it isn't really. I can remember toggling octal values into the PDP-11 to start the bootstrap and burst UNIX into life.

Writing programs by hand-crafting numbers proved to be difficult, and along came some salvation in the form of assemblers. An assembler is a program that takes text as its input and generates machine code as its output. It allows the programmer to give a mnemonic name to each instruction. It is better to write than machine code and easier to read. The early assemblers directly translated from a textual representation of the instructions into the machine code that ran on the machine.

These early machines had a small number of registers. Registers are complicated bits of hardware and were expensive to make. Each machine code instruction contained an op-code saying what the instruction was to do; a few bits perhaps selecting a machine register; and a memory location. The assemblers allowed you to say things like "load the content of location 679 into register 1." It was quickly realized that plumbing absolute numbers into the program was not a good idea because it made things hard to change and hard to read. After all, just what did the number in location 679 represent?

Assemblers developed the ability for users to define their own names for locations in memory. These names could be related to the job in hand. Also, you could insert new locations easily. You didn't have to worry about their address. The assembler would do that for you. You could name variables and you could name parts of the program by supplying labels for jump instructions. Better, you could name subroutines so you could begin to split your programs into separate modules.

Hold on a minute. All this stuff sounds easy and logical. But there is a large technical leap between the simple translating assembler and the more complex assembler that deals with named locations. Remember that there were no disk operating systems. Even simple translation was a complicated process. First, you loaded the assembler into the machine. The assembler read in your program that you had placed on punched tape (or cards). The assembler output punched a tape (or cards) that could be loaded into the

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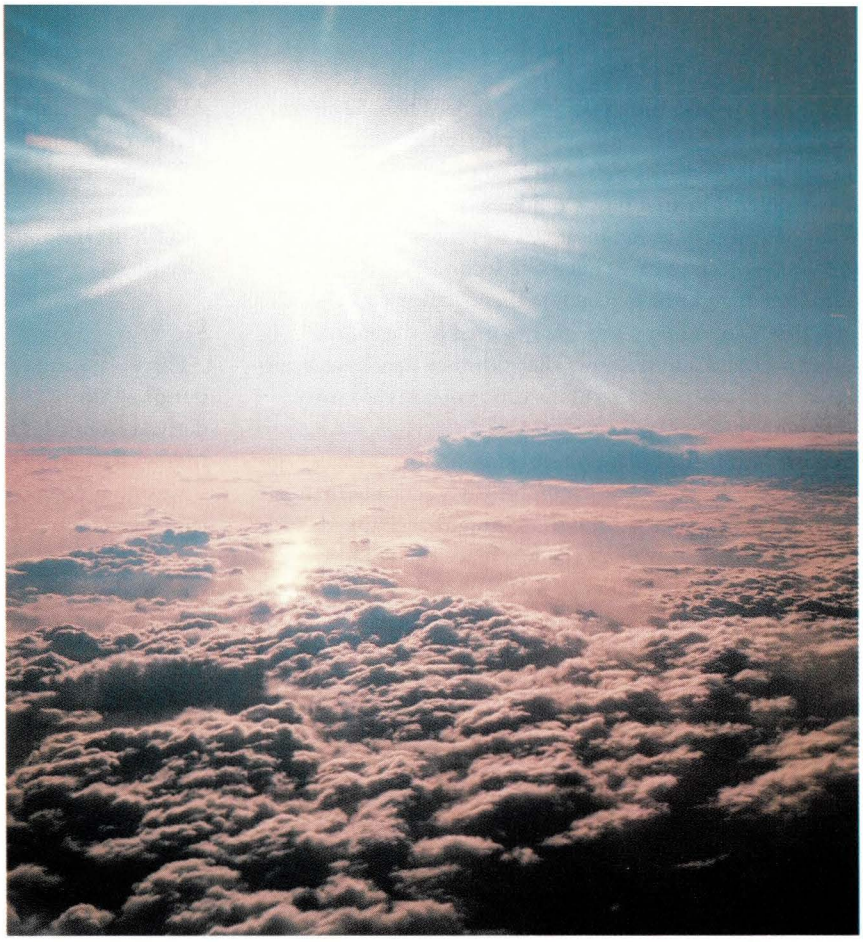

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machine in turn and run as your program. When we spoke of "one-pass" assemblers, it had real physical meaning.

The addition of names meant that you might need a two-pass assembler. The first pass would check the names, verify instruction formats, assign locations to variable data and output some intermediate code. The second pass would use that intermediate form to generate the machine code. The second pass knows that all the names used in the source program are valid and it knows the addresses they have been assigned in memory. As a result, it can generate the correct instruction values.

The next step is the invention of "high-level languages," so-called because they were more complex syntactically than assembler. Rather than writing something that mapped directly onto the hardware of the machine, you could write in statements that were closer to the algebra that you learned in school. It was easier to write

```
a = b + c
```

than

```
lda     b
add     c
sta     a
```

It was seen to be possible to get the machine to generate the full instruction sequence. The program that did this was called a "compiler" because it generated several machine code statements for each line that you supplied.

There was another payoff. If I gave you my program, you could get your machine to generate something that would run on your computer:

```
mov     b,r1
add     c,r1
mov     r1,a
```

Program portability was born.

We now hit a period of huge growth in computing. Machines acquired viable storage media. Operating systems began to emerge, managing the data storage and the machine. It became easier to run a compiler to create the object file. It became easier to automate the various passes that you needed to take the source and make the binary. It became harder to write portable programs because they interfaced to operating systems, and these interfaces were different.

There was an immense explosion in language design. It seemed to be the focus of computer science in the late '60s and early '70s. A credible computer scientist had to have written a compiler for something. Of course, I was no different from anyone else. I was there.

On the whole, languages were formally defined so that they were unambiguous. They could be parsed into elements and their syntax recognized by the compiler. Many errors could be eliminated by ensuring that the program was specified using a known set of unambiguous rules.

Languages dealt with very similar ideas; on the whole, if you learned one then you could transfer to another. Languages tended to try to hide the machine from the programmer. If you consider BASIC, FORTRAN, ALGOL and COBOL, none provided access to the real address of a variable.

C

The C language and the UNIX operating system sprang out of all this. C was derived from B, which was in turn derived from BCPL. BCPL was a language invented by Martin Richards from Cambridge in the United Kingdom. It was notable because it was designed to be portable. The language compiled into pseudocode for an "imaginary" stack machine. To get BCPL working on your system, all you needed to do was to write some code that translated a set of relatively simple operations into machine code that would run on your machine. This was not too difficult, and BCPL became widespread in academic circles in the United Kingdom, at least.

BCPL admitted that computers used addresses and allowed you to use them directly. It allowed you to deal with pointers to objects, so for the first time in my experience as a user of high-level languages, you could create complex data structures that used real pointers. Previously, you had to use array indexes as "pointers."

BCPL was typeless. It assumed that the machine consisted of boxes, and those boxes could contain an integer, a pointer, the address of a routine, etc., etc. It assumed that if you added one to a pointer, then it would point at the next box. This worked fine on word-oriented machines but created severe problems on byte machines like the PDP-11.

For me, however, BCPL had shown the way. Writing in assembler was all well and good, but it was tedious. By now, assemblers had become complicated. In some attempt to take the drudgery out of program creation, they had picked up the idea of macro replacement. You could write your program in a self-specified set of higher level statements, and the assembler would replace the text you wrote by with the text from a macro definition. Many complex systems were written like this. However, macros were generally personal, could not be checked syntactically and were limited. A high-level language was better.

C is (or was) the best high-level assembler that has been designed. The compiler for the PDP-11 was tuned so that you could generate excellent machine code from your high-level language statements. The language had some constructs that mapped directly onto the addressing modes of the PDP-11, and

```
c = *ptr++;
```

could be done in an instruction.

The language had picked up the idea of structures from PL/1 and Pascal. A structure is a pattern of data; it tells the compiler that a certain chunk of memory is to be laid out in a particular way. The language separates the definition of the structure from the act of making an instance of the structure.

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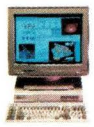

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You can create pointers to structures, and arithmetic on these pointers works sensibly. Adding one to a pointer moves the pointer to the next instance of the structure in memory (not just the next box). You can load a structure pointer with a physical machine address and control hardware by setting values into registers whose type is defined by the structure. C changed the idea that the machine should be hidden and opened up the machine for the programmer.

Compiling C

C was also interesting because it was designed to run on UNIX. UNIX at that time only supported small programs. Of course, some would say these were reasonably sized and everything else that has followed is too big. The program that took your source and made an executable program, cc, was not actually the compiler. Instead it was a program that coordinated the activities of a number of other phases of the compilation process. UNIX made it easy to write such a program.

Also, UNIX made file handling very easy. You didn't worry about creating temporary files. You steamed on and just did it. This was certainly not true of other operating systems, where disk space seemed to be a jealously guarded resource. In UNIX, you behaved as if disk space were limitless and simply created files. It was fast and effortless to do so. Files grew without you having to worry about saying first how big they were going to be. They just grew and were infinite in size. Well, nothing is infinite. It's just that infinity is relative. Infinity here means "big enough."

If it's easy to create and use files, you can afford to use them to communicate between the programs that are the phases of the compiler. It's easier to break the compilation process down into manageable sections.

The compiler has several sections. First, your program is passed through the C preprocessor. This is mandatory now but didn't used to be. On the compiler for UNIX Version 6, the first character of the file had to be "#" to force the source to be passed through the C preprocessor. This was dropped in later systems because the pre-processor was so heavily used.

The preprocessor added macro processing to make the source code more readable; you can insert readable text strings in place of numeric constants. Complex expressions can be reduced to readable function calls that are expanded in-line for efficiency. An important feature is the ability to insert the contents of files; these "include" files mean that programs can share definitions. This code sharing has become an important feature of modern-day programming: It gives us the ability to share data definitions, but we don't need the source code that implements them. We link that in ready-compiled from a library at the end of the compilation process.

The output from the preprocessor is passed into the first phase of the compiler. Its job is to check syntax and definitions. It creates an internal representation of the code, generally a tree structure. This is passed in the second phase to generate the instructions needed to run the program on the machine. Traditionally, this code is output as assembler

source for input into a simple assembler, usually called as.

The assembler source can be passed through a code optimizer. The code optimizer is a text recognition program. It scans the assembler source looking for patterns and replacing them with new code that is hopefully more efficient than the compiler was able to generate. The reason for this is that the compiler will generate code for each simple expression that it finds; it is hard for it to see paths through the code. For example, a compiler may generate a jump to a jump to a jump. The optimizer can spot this and make the first jump go to the final destination. Incidentally, many modern compilers do their own internal optimization in the code-generation phase; take a peek at Sun's manual page for cc.

The as program takes whatever it is given and translates it into an "object file." This might be the end of the story if the program is completely self-contained in a single module. This is a rare case. C was designed with the idea that programs could easily be split into separate modules. The complete program is created by linking all the object files together using a link editor, usually called ld.

Linking and Loading

The compiler, the assembler and the link loader will conspire to make the program consist of three parts: the text, data and bss segments. The text segment contains the machine code instructions that the compiler creates from the code of the program. The instructions will never modify themselves–the code segment is capable of being shared by several processes and so must remain constant.

The data segment contains any preinitialized variables and any constant strings that the programmer may have defined. The bss segment contains any uninitialized variables. This segment is not present on the file containing the load image of the program; instead it exists as a size in the file header. A corresponding area of memory is allocated to the process and set to zero when the exec system call starts the program executing. The name bss stands for "block started by symbol" and is a hangover from early IBM machines.

When these segments are linked together and run as a UNIX process, they will be loaded as if the process was a program running on the raw machine. So, for example, the same compiler, assembler and link loader are used to generate the running kernel–which *is* a program running on the raw machine.

Each module of the program will contribute something to each of the three segments. The linker's job is to build up the three segments from the object modules. It assigns addresses so that the machine code in the text segment refers to the correct addresses in the data and bss segments.

Each module will undoubtedly refer to a routine or some global data in another module. It's a feature of C that the names the programmer assigns to global objects are passed down through the compiler and assembler to end in the object module in a symbol table. Originally, this was very unusual.

When one module calls a routine in another, the name will be flagged as undefined in the first module. The assembler is happy with this; it knows that the loader will fail if any

symbols are undefined when the loader runs out of modules.

The notion of having undefined symbols allows us to have libraries of precompiled object files that can be loaded with our program. When the linker has finished with the modules from our program, it will find that there are several undefined symbols, like `printf` perhaps. The `cc` program instructs the linker to look through an archive file, `libc.a`. This is several separate object files joined together using some recognizable glue, so each file can be seen as distinct within the archive.

The loader scans the archive looking for a file containing one of the symbols that are undefined. It finds `printf` is defined in a file (probably `printf.o`) and loads that file into the object file that it is building. This file will add some more undefined symbols into the link loading process, say `_doprint`. The loader continues to scan for the undefined symbols and will pull in any files that define symbols in the undefined list. It stops when the undefined list no longer exists, or the library is exhausted. In the first case, we have a runnable program. In the second, we have an error. The serial nature of the search for undefined names means that the ordering of files in the archive is crucial. It also means that you have to be careful about what routines you place in what library modules.

Actually, I have just described the original process. A number of things have changed since that mechanism was defined. First, the number of files in the standard library has grown, and serial searching of the library is too slow. The `ranlib` program helps with this. This generates an index that is placed as the first file in the archive. The loader knows about the index and uses it to speed up the searching process.

Second, libraries have multiplied and the amount of code that we want to load into programs has grown. It's grown to a point where people began to worry about the size of the programs being generated. The basic problem is that every program contains its own copy of the library routines. We didn't worry about this when the routines were small, but as the libraries grew there were increasing calls for some mechanism where all the running programs on machine could point to one instance of the library code. This is what we now mean by shared libraries.

Shared Libraries

UNIX has always shared code segments. If two instances of the same program are running, then the processes share the code segment. These days that code segment is actually a file mapped into memory using the memory management hardware. The hardware splits the code up into pages pointed to by registers. The registers can contain page addresses in memory or can hold disk addresses. A page fault happens when the executing program hits a page that is not physically present in memory. The operating system arranges to bring the relevant page into memory, and the program continues to run.

In order to make shared libraries work in a clean way, we want to dynamically link a routine into our address space at run time. We want to do it like this so that the linkage mech-

anism is position-independent; it would be inconvenient to have some mechanism that said the `printf` code must reside at some fixed point in every program.

The Sun implementation starts with the `ld` program, which permits the object module to have references to routines that are stored in a sharable dynamic library, say, `libc.so.1.7`. These references are indirect calls via linkage tables.

The program start-up code invokes the dynamic link editor `ld.so`. This code is mapped into the processes' address space and given the address of a structure that refers to the modules that are needed by the process. The modules are mapped into memory, and the primary entry points are entered into the linkage tables. This done, the program starts executing. The linkage tables are not filled until they are needed; this stops unnecessary work being done. The linkage procedure is made a little more speedy by the storage of data in a cache built when the system reboots by the `ldconfig` program.

The shared library routine might need to reference some data areas that are potentially writable. This is handled by placing the necessary data definitions in a matching library say, `libc.sa.1.7`. Parts from this archive are linked statically into the program by `ld`.

We have many programs with parts of shared library files mapped into their address space. How do we update the library? We can simply replace the file and restart the processes. This is safe if none of the external interfaces to the routines have altered. This is hard to guarantee. The Sun system uses version numbering on the libraries, and `ld` records the version number in the executable image. When `ld.so` runs, it checks the available libraries against the stored version number looking for a matching major number (1 in the examples above) and the highest compatible minor number (7 in the examples above). Incompatibilities can result in a warning error message being printed.

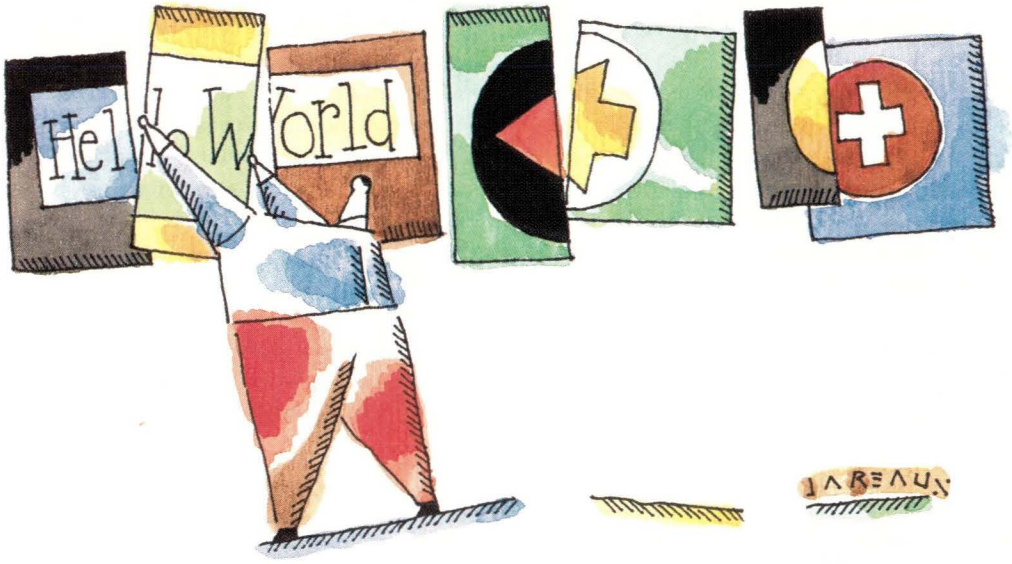
We have certainly gained memory from the use of shared libraries. What have we lost? Programs no longer stand alone. It is now much harder to move programs from machine to machine as binaries. You run the risk that some hidden library routine has altered the way it works. When you link all the routines into the program statically, you freeze the code so it should always work. On the positive side, it means that binary programs can benefit from improvements and bug fixes in library routines.

Thanks

Thanks to Ningping Fan from the University of Pittsburgh for the email that sparked this article. Thanks also to the AnswerBook for providing reading on shared libraries; see Chapter 1 of the book *Programming Utilities and Libraries.*

Peter Collinson runs his own UNIX consultancy, dedicated to earning enough money to allow him to pursue his own interests; doing whatever, whenever, where ever... He writes, teaches, consults and programs using SunOS running on a SPARCstation 1+. Email: `pc@expert.com`.

I/Opener



ROBIN JAREAUX

by **RICHARD MORIN**,
Technical Editor

The Tool Command Language

Last month's column looked at the Windowing Korn Shell (WKSH), USL's approach to generating script-based window applications. This month, we look at a freeware approach to the same problem.

John Ousterhout has developed a Windowing Shell (`wish`) with many of the same capabilities as WKSH and a few nifty additional features. Just as `ksh` is the basis for WKSH, John's Tool Command Language (Tcl) and Toolkit (Tk) libraries form the basis for `wish`. Bear with me on a short explanation of the libraries; I promise to get back to `wish` before long.

Tcl Basics

John describes Tcl as an "embeddable command language." Using the Tcl library, you can build a command language into a C application. The base language includes control flow constructs, subroutines, variable handling and so forth. The library handles the overhead, letting your application code respond to its specialized commands. The resulting program thus contains a specialized language interpreter.

Because most applications are not designed around a command language parser, I prefer to think of Tcl as an "extensible shell" or perhaps an "application backplane." This emphasizes the fact that Tcl is not very suitable for hacking into an existing application. Instead of having an all-powerful main program, Tcl applications define service routines, then start up a demand-driven executive. Window programmers will find this very familiar.

Tcl service routines are quite a bit like the C functions that WKSH allows to be linked in at run time. That is, they look like main programs that have been munged into functions. Some of the fine points differ, however. Most obviously, Tcl service routines cannot be loaded at run time. I would like to see John copy this feature from WKSH, as it might encourage the development of useful libraries.

In any event, a service routine parses its command, then performs its task. For uniformity, service routines always return text strings. If no results need to be returned, the string will be empty. Service routines can invoke other service routines by sending command strings to the Tcl executive.

This may seem a bit baroque and more than a little inefficient. It has some very strong advantages, however. It gives the service routines a consistent interface; they can be called equally well by the user or by another service routine. It also allows them to take full advantage of the interpreter.

Let's say an application needs a lot of run-time flexibility. When it starts up, it can preload a few default bits of Tcl code. At run time, these definitions can be modified, changing the way the application does its job. We'll get to another significant advantage below.

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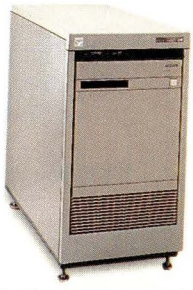

Tk Basics

Tk is a Tcl-based X11 toolkit. The user interface is modeled after Motif, but the programming interface and internal structure are totally different. The Tk library is mostly a collection of Tcl service routines. They get linked into Tcl as commands and may be invoked in the usual manner. The application programmer sees them as an extension to the Tcl language.

Tk commands set up, adjust and otherwise interact with X11 widgets. When a widget is activated (for instance, by a mouse click), it sends the interpreter a string containing one or more Tcl commands. These get passed off to Tcl, Tk or application service routines for handling.

Although Tk is not particularly object-oriented, it has many of the characteristics that make object-oriented libraries pleasant to use. The Tk commands are very abstract, relying on defaults whenever possible. These defaults may be overridden in a variety of ways, allowing great flexibility. In the simple case, however, Tk does reasonable things on its own.

Tk's `pack` command is a good example of this approach. Used without options, `pack` puts each widget into the top of the remaining unallocated space. This produces a descending vertical stack. Using the `top`, `bottom`, `left` and `right` options, a programmer can modify this placement. Filling options can be used to put stretch widgets or place empty space around them.

Using `pack`, it is quite simple to create a nested set of windows. Each window's options control its internal arrangement, and `pack` tries to ensure that all of the constraints are met. This is not too dissimilar from the technique used in WKSH, or for that matter, `grap`. The use of constraint-based techniques simplifies all of these languages.

wish Basics

If you don't need any application-specific service routines, you don't need to bother with building an application. Just hand the commands to the Tcl and Tk code and be done with it. `wish` lets you do this. Like any other shell, `wish` can be run interactively or in batch mode (running a script). In Tk terms, `wish` is a completely generic application.

Consequently, the `wish` code is really simple. It parses the command line, initializes Tk and Tcl, adds a few sample commands, and drops into the main loop of Tk. The whole thing takes less than 500 lines of C.

In many ways, `wish` is a window hacker's dream. The C code is small enough that it is trivial to understand, so additions and modifications should be very easy to install. New commands can be added in either C or Tcl, depending on what is needed. If the extension needs to run really fast or use low-level OS features, a bit of C code is appropriate. Otherwise, Tcl code will be shorter, simpler and quicker to debug.

send-ing Commands

The Tk `send` command allows Tk-based applications to interchange arbitrary Tcl commands. This allows sets of applications to interoperate in some really powerful ways. It can also get programmers into a lot of trouble, if they're not careful.

Let's say my spreadsheet needs a plotting window. It invokes a plotting application, telling it which variables to plot, etc. Whenever the spreadsheet modifies the plotted data, it `send`s a command to the plotter, telling it to wake up.

The plotter could get the new data as part of the command. More deviously, it might `send` commands back to the spreadsheet, asking for the updated values. There is no reason for the plotter to be passive, either. It could allow the user to fudge plotted data points, then `send` the new values back to the spreadsheet.

Getting more radical, a program (or programmer) can `send` new definitions to a running program. Let's say the plotter needs the spreadsheet to perform a particular function during each recalculation. Using `send`, it could insert the needed code into the spreadsheet. Similarly, a debugger could use this technique to add tracing code.

I'm only hand-waving, you understand, but the capabilities are all implicit in the Tk system. Moreover,

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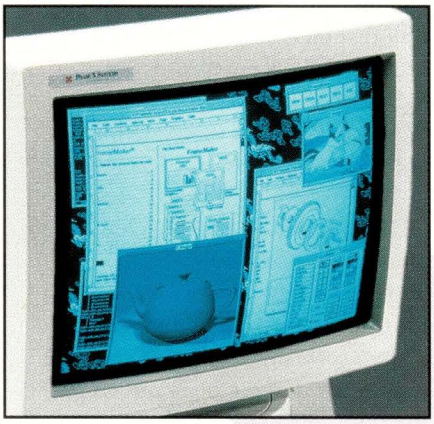

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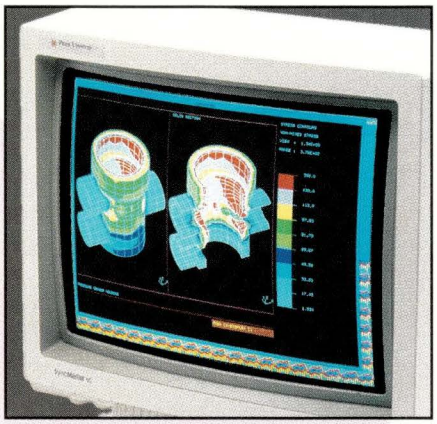

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Circle No. 38 on Inquiry Card

John Ousterhout is quite serious about getting them used. He feels that the move to larger and larger monolithic applications is misguided. If simple programs and shell scripts can cooperate in sophisticated ways, perhaps we can use suites of small programs to do big jobs in flexible ways.

This shouldn't sound too unfamiliar to UNIX types. The UNIX philosophy is built on such notions. Unfortunately, traditional UNIX values haven't fared very well in the Wonderful World of Windowing and Widgets. I'm hoping that ideas like `send` will help us to regain a bit of the simplicity we have abandoned.

I also hope some de facto standards will arise soon on how such scripts should be written. Like most general techniques, `send` is a very sharp knife. By `send`ing the wrong commands to another program, a program can cause some very peculiar results.

More generally, software engineering could be a real issue. If two programs get modified independently, their ability to interact smoothly could go away. If there aren't clear ways for programs to structure their interaction, the suite of programs could have some bitter disputes.

Some Tcl Code

Last month, we looked at a five-line WKSH script that put up a "hello, world" widget. This month, we'll do it in three lines, using `wish`:

```
#!/usr/local/wish -f
label .l text "hello, world"
pack append . .l {}
```

The first line forces the script to be interpreted by `wish`. The second line starts up a `label` widget with the desired `text` string. Finally, we ask `wish` to `pack` up a window including the label.

Tcl's widget naming system should feel quite familiar to UNIX types. The top level of the window has the name ".". The label's name (`.l`) indicates that it is just within the window. If the label lived inside a `frame` "`.f`", its name would be "`.f.l`". I like this kind of regularity and suspect it greatly eases widget referencing tasks.

Resources

If you have Internet access, it's very easy to get copies of Tcl and related packages. The current Tcl and Tk distributions reside in directory `/tcl` on `allspice.berkeley.edu`. The Barkley Tcl Archive (`/tcl` on `barkley.berkeley.edu`) contains a wealth of contributed packages.

Alternatively, you can pick up one of the commercial freeware distributions that includes Tcl. The Sun User Group, (617) 232-0514, 1992.2 disk contains a copy of Tk, as does Prime Time Freeware, (408) 738-4832, Issue 2-1. While we're on the subject, there are some other new disks that might contain Tcl, and certainly contain other interesting freeware.

InfoMagic, (609) 683-5501, has a disk that includes 386BSD and NET/2. O'Reilly and Associates, (707) 829-0515, has some X-related CD-ROMs coming out soon. Sterling Software, (402) 291-8300, is redoing its NetGems disk. Walnut Creek CDROM, (800) 786-9907, has a range of freeware disks. Finally, Yggdrasil, (510) 526-7531, has a Linux distribution on CD-ROM.

More generally, if you are interested in freeware that can be found on the Internet, take a look at (shameless hype alert) my other column, "The Internet Notebook," in *UNIX Review*. The April column ("Tcl, Tk and Friends") fills in a few areas left alone in this column.

John Ousterhout's upcoming book (*An Introduction to Tcl and Tk*, John K. Ousterhout, Addison-Wesley, 1993) should be both easy to read and definitive. (An early draft of part of the book is available on `allspice.berkeley.edu`.) Finally, if you have Usenet access, consider subscribing to `comp.lang.tcl`. ⊸

Richard Morin produces Prime Time Freeware, a semi-annual CD-ROM collection of redistributable, UNIX-related source code. Between releases, he consults, writes and teaches on UNIX topics. He may be reached at Canta Forda Computer Laboratory, P.O. Box 1488, Pacifica, CA 94044 or by email at `rdm@cfcl.com`.

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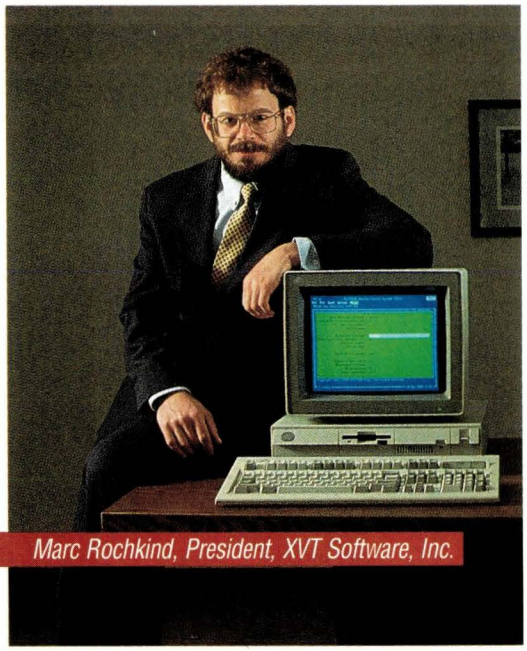

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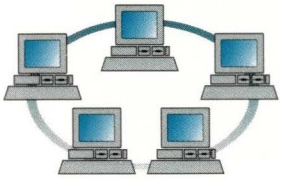

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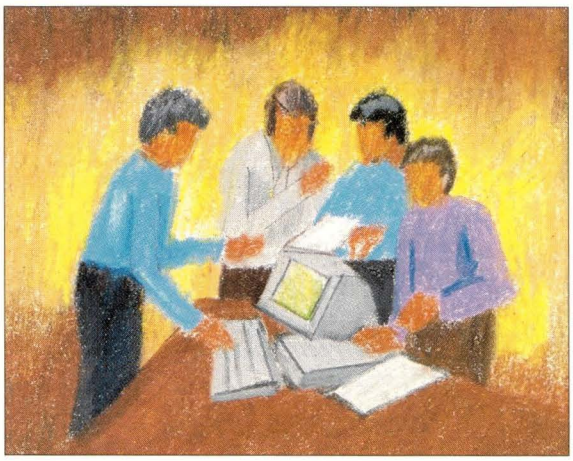
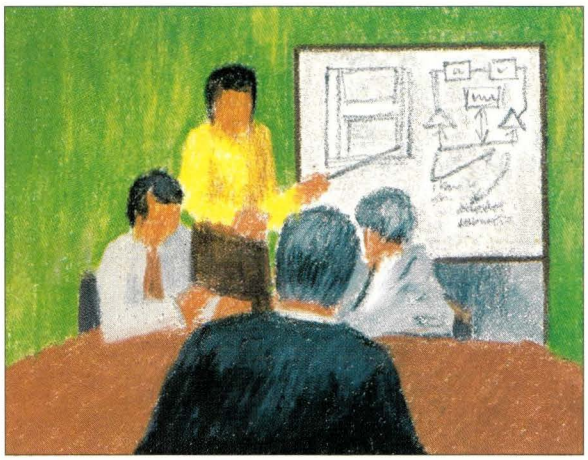




JOHN W. KELLEY JR.

JTC1 and ANSI

by PETER H. SALUS

Though I began this series of columns nearly three years ago by discussing the various standards organizations, I still get a large number of requests for information about them. At the same time, I am reluctant to merely reprint a column. And though John Hill of Unisys posted a long description of JTC1 on the net some months ago, just what JTC1 is and how it relates to other things is far from understood.

Joint Technical Committee 1 is "joint" between the IEC and ISO. IEC is the International Electrotechnical Commission, and up until 1988, equipment standards were developed by IEC. Standards for media and programming languages were developed by ISO–the International Standardization Organization.

In the middle 1980s, thanks largely to the efforts of Ed Lohse, late of Burroughs Corp., activities to rationalize the situation were started in earnest. JTC1 was the result. JTC1 is the first and only joint ISO-IEC committee.

ISO committee procedures are Byzantine; IEC is similarly involved. The situation was sufficiently complex that separate procedures were developed and approved for JTC1. This document is known as the JTC1 Directives. (The JTC1 Directives can be obtained from the JTC1 secretariat, ANSI.)

The current organization and program of work of JTC1 is as follows. JTC1 has two kinds of member bodies: national bodies, of which there are 42–24 primary and 18 observer; and internal, 14 internal to ISO and IEC and 19 external (like ECMA–the European Computer Manufacturers Association). ANSI is the U.S. national member body; AFNOR is the French; DIN is the German; JIS is the Japanese; etc.

There is no such thing as "organizational" or corporate membership. Similarly, there are no individual members. ANSI, however, accredits organizations and committees to develop standards for it. Membership in some of these is organizational, such as X3. In some it is individual, such as the Institute of Electrical and Electronics Engineers (IEEE).

For the most part, the work of JTC1 itself is managerial in nature. JTC1 focuses on matters like project initiation, subgroup establishment and document approval.

The technical work of JTC1 is really accomplished by its subgroups. Broadly speaking, there are three types of JTC1 subgroup. These are special working groups (SWG), study groups (SG) and subcommittees (SC).

SWGs are typically established to perform some specific task and are often nontechnical in nature. Examples include the SWG-P, which deals with

ISO/IEC JTC1 Subcommittees

SC1 (Vocabulary): Collects and coordinates terminology usage by all groups within JTC1.

SC2 (Character Sets and Information Coding): Standards for the bit- and byte-coded representation of elements of various identified types of information, for interchange mainly at the application level.

SC6 (Telecommunications and Information Exchange): Standards for telecommunications and OSI, (systems functions, procedures and parameters, as well as the conditions for their use) for the four OSI layers that support the transport service–in cooperation with CCITT.

SC7 (Software Engineering): Defines standardized tools for development software.

SC11 (Flexible Magnetic Media for Digital Data Interchange): Development of standards for diskettes and cartridges.

SC14 (Representation of Data Elements): Codifies data elements so that their common definitions can be used to exchange data.

SC15 (Labeling and File Structure): Standardization of file allocation and directory information used for all types of recorded media.

SC17 (Identification Cards and Related Devices): Standards for cards such as credit and debit cards including the physical, electrical and magnetic properties.

SC18 (Text and Office Systems): Standardization of functionality that simplifies text editing and other office-related subjects.

SC21 (OSI Information Retrieval, Transfer and Management): Development of standards for the upper layers of the Open Systems Interconnection (OSI) model. Also included are database management systems, information resource management systems (IRDS), and open distributed processing standards (ODP).

SC22 (Languages and Application Environments): Programming language and operating environment standards.

SC23 (Optical Digital Data Disks): Development of optical media standards including unrecorded (raw) media as well as recording onto and reading from those media. Both write once read many (WORM) and rewritable media are included.

SC26 (Microprocessor Systems): Development of standards used in microprocessor systems including basic hardware, bus and allied interfaces.

SC27 (Security Techniques): Development of standards for security, such as encryption and verification.

SC28 (Office Equipment): Standardization of equipment commonly used in office settings. This includes printers and the quality of their output.

SC29 (Coded Representation of Picture, Audio and Multimedia/Hypermedia Information): Standardization of complex (i.e., more difficult than characters) data representation. Data compression without the loss of information is also handled here.

JTC1 procedures, and SWG-FS, which deals with functional standards (often called international standardized profiles, or ISPs). Technical Report (TR) 10000 describes procedures for the development of Open Systems Interconnection (OSI) ISPs. SWG-FS is currently revising TR10000 to incorporate procedures for managing the development of ISPs for open systems environments.

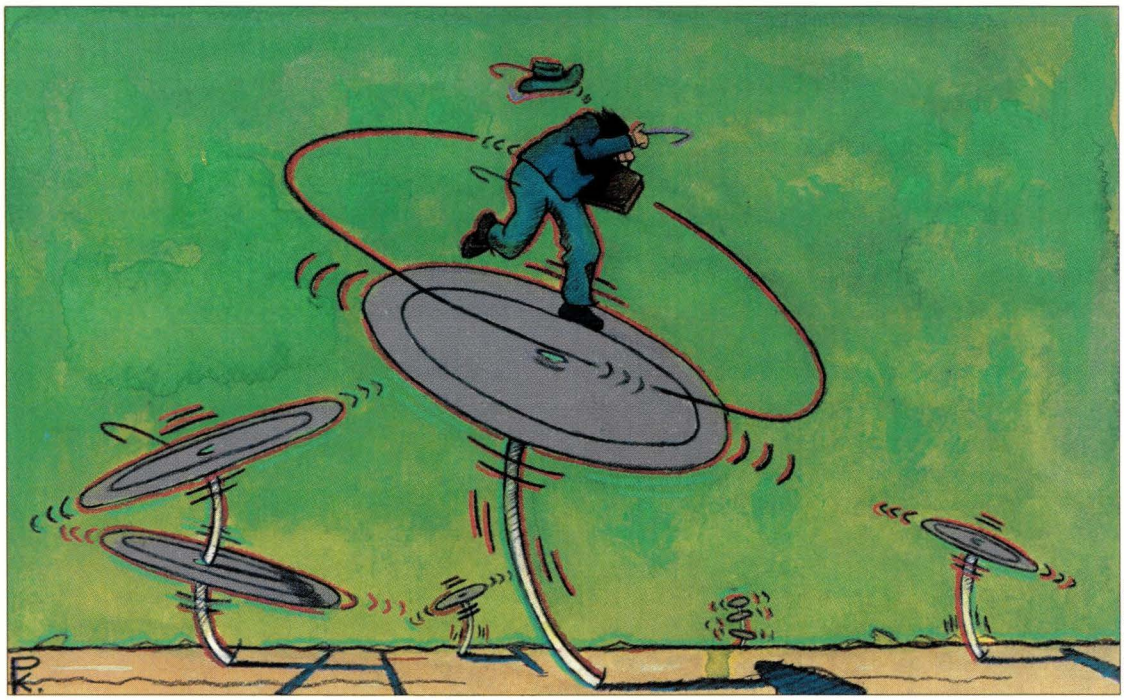
There have been two special study groups established by JTC1. Each was given a specific charter and assigned specific deliverables. Neither exists today since they completed their assignments. The two study groups were MSG-1 (management study group) and TSG-1 (technical study group). TSG-1 focused on interfaces for application portability.

The most enduring subgroup type is the subcommittee (SC). SCs tend to be organized around functional topics. An SC typically focuses on a single technical subject area. The detailed standards development work of an SC takes place within the working groups (WG) within an SC.

One way to better grasp the activities of JTC1 is to group the SCs (see "ISO/IEC JTC1 Subcommittees"). There are four convenient groupings: application elements, systems, equipment and media, and systems support.

The scope of JTC1 is extensive. Virtually all standards used in modern information technology systems receive their worldwide endorsement through JTC1. ⊸

Peter H. Salus is currently working on books on internationalization and computer communication. He has attended P1003, P1224 and ISO meetings. He can be reached at `peter@uunet.uu.net`.



PETER KALABOKIS

Tuning Disk and File Systems

by S. LEE HENRY

You're on the set of "Honey, I Shrunk the Sysadmin." Suddenly, the reducer beam catches you, and, without having a chance to properly shut down the system, you are thrust inside the disk of your SPARCserver 690. Dazed, but curious, you glance down at the rapidly spinning magnetic platters. You estimate their movement to be about 3,600 revolutions per minute and almost slip off the arm on which you are perched. It moved! Caught you by surprise. You realize that it just slid over to the left and is now hovering over a different track than it was just a moment ago. Someone is reading your files? Maybe the system is simply writing out its buffers? You're not sure.

The disk head appears to be almost touching the surface, but the ride is smooth, as if the head were floating on the thinnest cushion of air. Another swerve, this time to the right. You find yourself wishing you'd been inserted into a less active disk. You're beginning to feel a little nauseated.

To keep your mind off your stomach, you begin to ponder disk geometry. The thought of concentric tracks on multiple platters is almost mesmerizing. You recall your class in solid geometry and imagine a hollow cylinder intersecting the disk platters and joining corresponding tracks on all platters. Yes! You imagine the sectors lying end-to-end on the track below you. Sectors, you think, the smallest addressable unit on a disk. Suddenly, you're swerving several tracks to the left. Seek time. It didn't take very long, but you notice that it took longer to reach the new track than it did before. Little wonder seek time is reported as three statistics–minimum, average and maximum. Slowly, you begin to see the magnetization on the surface below you. Yikes. Looks like an endless stream of bar code whizzing by at about 35 mph. You can sense some requested data lying up ahead and wonder if you'll get it all this time or have to wait for it to come around again. You hope that rotational delay will be minimal; you can sense the system's hunger for this data.

Processes are waiting. Someone just hit a carriage return and is waiting for a file to display. You try to estimate the

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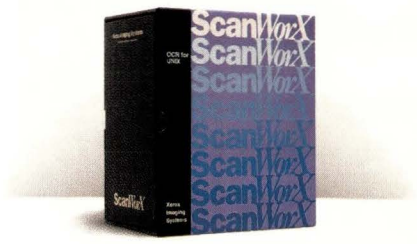

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transfer rate of this disk. Must be close to 6 MB/s of raw data. That's not bad. Your VCR, analog beast that it is, can't move information that fast. But with all the file system overhead, you think, your processes won't be getting useful data at this rate. Processes are still waiting. You wonder if you should have bought that 10-MB/s fast SCSI-2 disk that Corey from Andataco called you about last month. Swoosh! Off again to another track. Seems you're picking up pieces of the same file from many different locations. Wonder if you'll survive the 4 million miles or so of this frenzy predicted by your mean time between failure (MTBF). Swoosh. Swoosh. How much fragmentation is there on this disk, anyway? Maybe those log files you've been keeping in `/var` and analyzing through `cron` every afternoon are filling up the spaces left between other files. On the other hand, there are probably a number of data requests all going on at the same time, and this poor head is bouncing around like a host at a cocktail party trying to satisfy everyone.

You look again at the spinning surface, a little nervously this time. Your file systems are down there. Judging from the number of cylinders and sectors, this might be your system disk. Hold yourself steady. If you bounce, you might cause a head crash right in the middle of your root file system! What else did you put on this disk? Swap space and `/usr`. Any applications? How long would it take you to rebuild them? Don't bounce. Please don't bounce.

You wonder about all the space used up by the disk formatting and all the overhead of your file systems. These platters look so large to you now. You're a little surprised there is so little free space left. It's been a long time since you did any cleanup, you think guiltily. Old log files and core dumps might be eating up some of the space and causing you to be tossed around like this.

Swoosh! Suddenly, a rush of cool air. Someone is shoving papers in your face and you realize you've dozed off in a team meeting. Everyone is looking at you, waiting for your report about the new disks you're supposed to be adding to one of the file servers. Ah, you sigh, there is still time to tune your file systems. You haven't even formatted the disks yet.

Disk Hardware

Wow. You've seen this picture before and heard all this terminology, but never before thought so deeply about how well your file systems performed given the decisions that you made about partitioning disks and running the `newfs` command. You've always known that disks were divided into things called tracks and cylinders but never really cared much about them. Now, still feeling a little lightheaded, you just can't seem to get basic disk geometry, illustrated in Figure 1, out of your mind.

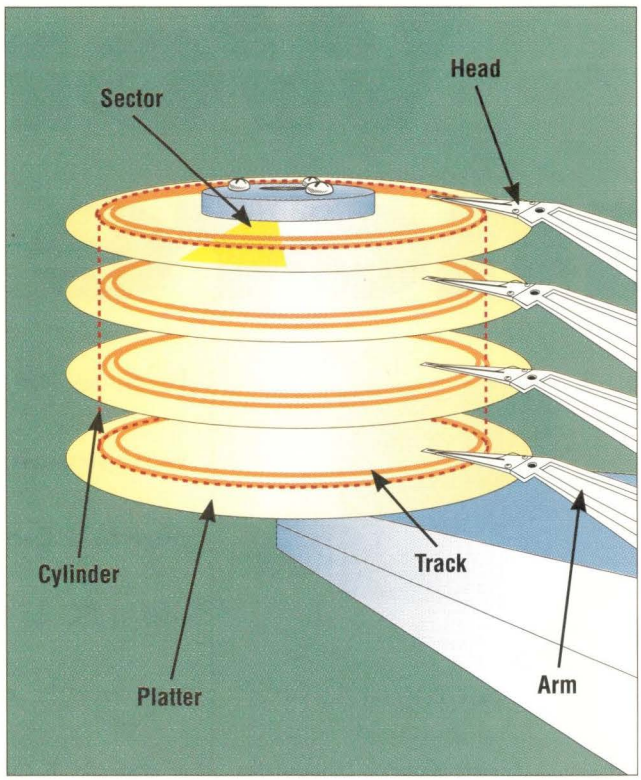


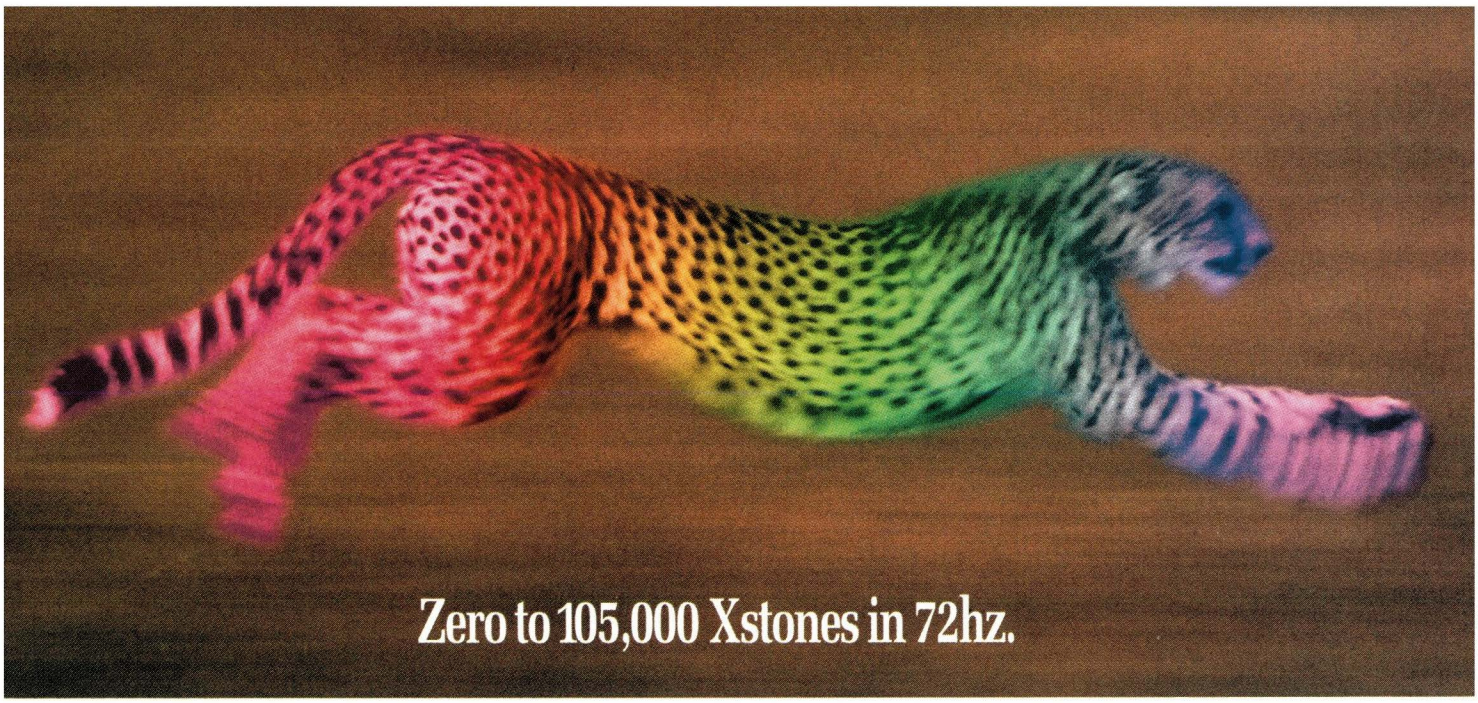
Figure 1. Disk geometry

You want to set your new disks up as well as possible. After all, you rationalize, you've spent a lot of your budget over the last couple of years upgrading your storage, and disks are expensive. Besides that, they house all the data and applications that your users need. Without that data, the system is of no use to anyone. And, recalling your mind trip into the internals of a hard disk, disks are usually the slowest part of a system and, thus, play a major role in determining overall performance.

You glance through your `/etc/format.dat` file for an entry corresponding to your new disk. If you don't find one, you'll have to get back on the phone and get this information from Corey, who sold it to you. You'll need accurate information about the disk to utilize its capacity as well as possible. Still, you realize that you have several goals. Good use of the disk space is only one consideration. You also want good performance, even if you have to trade some disk space for it. And you want reliability.

Figure 2. Using iostat to report terminal and disk activity, as well as CPU utilization

```
$ iostat 10
             tty                 sd0               sd1                cpu
    tin     tout    bps    tps   msps    bps    tps   msps    us    ni    sy    id
      1        8      8      1    0.0      4      1    0.0     2     0     2    97
      0        3      0      0    0.0     13      2    0.0     6     0     5    89
      1        7     27      4    0.0      0      0    0.0     0     0     1    99
      2       13      6      1    0.0      3      0    0.0     1     0     2    97
```



Finally, an X terminal with claws.

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Circle No. 43 on Inquiry Card

```
# df
Filesystem             kbytes    used   avail capacity  Mounted on
/dev/sd1a               19095    7314    9872    43%    /
/dev/sd1g              145999  125884    5516    96%    /usr
/dev/sd1h              192151  135663   37273    78%    /home
/dev/sd0f                4831    3966     382    91%    /opt
/dev/sd0a               16303   10778    3895    73%    /root5
/dev/sd0g              168528  150868     808    99%    /usr5

# df -i
Filesystem            iused   ifree  %iused  Mounted on
/dev/sd1a               999    9753      9%   /
/dev/sd1g              9942   62634     14%   /usr
/dev/sd1h              4564   92204      5%   /home
/dev/sd0f                33    2399      1%   /opt
/dev/sd0a              1767    6745     21%   /root5
/dev/sd0g             11807   73313     14%   /usr5
```

Figure 3. Using df to find usage

Balancing the Load Across Disks

Now that you find yourself with a fresh opportunity to set up some file systems, you want to do it right. Partitioning the disks will be a piece of cake, but you'd like to balance the load as much as possible to get the best overall performance across the disks. One way to start planning for balancing your load is to use the `iostat` command (see Figure 2) with a sampling interval to produce a report on disk I/O activity.

Figure 4. Calculating KB per inode

The Shell Script

```
#! /bin/sh
df | grep -v File | sort > /tmp/df.$$
df -i | grep -v File | sort > /tmp/dfi.$$
join -j1 1 -j2 1 -o 1.1 1.2 1.3 2.2 2.3 2.5 /tmp/df.$$ /tmp/dfi.$$ > /tmp/join.$$
cat /tmp/join.$$ | awk -f avginodes
```

The awk *Script*

```
# avginodes - calculate average space per inode in each file system
#
{    AVG = $3 / $4
     print $1, AVG " Kbytes/inode in " $6
     print "\t " $2 / ($4 + $5) " expected"
}
```

The Results

```
# avg
/dev/sd0a 6.0996 Kbytes/inode in /root5
     1.9153 expected
/dev/sd0f 120.182 Kbytes/inode in /opt
     1.98643 expected
/dev/sd0g 12.7778 Kbytes/inode in /usr5
     1.97989 expected
/dev/sd1a 7.32565 Kbytes/inode in /
     1.77595 expected
/dev/sd1g 12.6618 Kbytes/inode in /usr
     2.01167 expected
/dev/sd1h 29.7246 Kbytes/inode in /home
     1.98569 expected
```

The Shell Script

```
#!/bin/sh
# compare - line up space used and inodes used from df
#
df | grep -v File | sort > /tmp/tmp0.$$
df -i | grep -v File | sort > /tmp/tmp1.$$
echo "FileSys %Space %Inodes"
join -j1 1 -j2 1 -o 1.1 1.5 2.4 /tmp/tmp0.$$ /tmp/tmp1.$$
```

The Results

```
# compare
FileSys    %Space   %Inodes
/dev/sd0a     74%       21%
/dev/sd0f     91%        1%
/dev/sd0g     99%       14%
/dev/sd1a     42%        9%
/dev/sd1g     96%       14%
/dev/sd1h     78%        5%
```

Figure 5. Calculating space/inode ratio

The bps column shows how many KB are being transferred per second over these intervals. This, at least, should tell you how well your current disks are balanced. You can also use this information to restructure your file systems later if the balance changes. You decide to take a look at the disks on your SPARCstation2.

You also need to think about how many file systems you want per disk. You'd probably make the best use of disk space by having one or two large partitions per disk. On the other hand, smaller file systems will perform better. You also need to decide if you want to keep all your system partitions–`root`, `swap`, and `/usr`–on the same disk, and home directories and applications on another. Having a system disk would, after all, enable you to replace or reload file systems on the second disk more easily.

File System Parameters

Once you've partitioned your new disks, you are ready to set up your file systems. Browsing through the man page for `newfs`, you are astounded at the number of parameters that you can set. Many of them look familiar. You can set the block size, # cylinders/group, rotational delay and fragment size along with a number of other parameters. You decide to get as much information as you can from the manufacturer, examine the defaults, and maybe experiment with maximum contiguous blocks like the example in the man page of `tunefs`. You also note that the `tunefs` command will allow you to change some of the file system parameters on the fly. If you unmount a file system, for example, you can change the ratio between space and inodes. This might help correct for an imbalance and allow you to better use the disk. You're concerned that if you have more than enough inodes for a given amount of space (this is usually the case), you will run out of disk space sooner than you should. If you have too few inodes, you will not be able to create new files even when plenty of space is available.

The default value for disk space per inode is 2,048 bytes. In other words, your average file is expected to be about 2 KB long. You think for most file systems, this value is inappropriately small. You decide to evaluate your system by using the commands and scripts shown in Figures 3 and 4.

First, you run a simple `df` command to show how much space is used and available. The avail column omits free space withheld from users. You remember when you first noticed that this number seemed too low and began to understand the discrepancy.

With a `-i` option, the `df` command reports on inodes, the structures that contain information about files.

Combining the output of these two commands, you reason, can produce a report that calculates the ratio of space to inodes for existing files and for the file system as a whole. So, you write a shell script and an `awk` script to help compute the ratios.

You can see by the output of this procedure that the file systems are set up with the default ratio of 2 KB per inode. The actual ratio shows that your files are much larger and, therefore, too much space is reserved for inodes. A simple comparison of the capacity column from the `df` command and the %iused column from the `df -i` command shows the same thing with slightly less precision (see Figure 5). You

Figure 6. Calculating capacity

The `awk` Script

```
# sumparts
{
DISK = substr($1,6,3)
DK = substr($1,8,1)
if (DK == PRIOR_DK)
     SPACE = SPACE + $2
else if (NR > 1) {
     print PRIOR_DISK, SPACE, "Kbytes"
     print " ", SPACE * 1.024, "Kbytes"
     SPACE = $2
}
PRIOR_DK = DK
PRIOR_DISK = DISK
}
```

The Results

```
# df | sort | awk -f sumparts
sd0 173359 Kbytes
     177520 Kbytes
sd1 357245 Kbytes
     365819 Kbytes
```

write another script so that you can line these values up conveniently.

Another parameter you think about altering is minimum free space. You've always gone with the default of 10% and known that this cushion of unusable disk space improved file system performance. You're inclined to think that 10% of disks as large as 1 or 2 GB is simply too much space to put aside; hundreds of MB may be more disk than you want to sacrifice.

You think about all the space already unusable and how large those platters looked when you were perched over them. Even on the SPARCstation2 on your desk, the space lost to formatting and building file systems is considerable. And wait! You wonder if the size of your new disk was

> Thankfully, there is `tunefs` to allow you to change some of the parameters later on.

reported to you in GB as you think of them (2 to the 30th power or 1,073,741,824) or as a simple power of ten (1 billion). The difference is almost 74 MB per GB! Corey was careful to specify the disk size after formatting. You decide to build an `awk` script that adds up the space on local disks and calculates the difference between the two ways of reporting MB. Even on your small disks, you see a difference (see Figure 6).

You collapse into your chair. It's been a hard afternoon. There's a lot more to setting up disks and file systems than you thought. Thankfully, there is `tunefs` to allow you to change some of the parameters later on. And, you can always back up a file system, rebuild and reload it. Gee. You should call Corey back and talk in more detail about disks. Wait. What's that now? The boss is talking about shooting a video in the office? Quickly, you make a dash for the door. ⊸

S. Lee Henry is on the Board of Directors of The Sun User Group and is a system administrator for a large network of Suns in the federal government. Her email address is `slee@expert.com`.

It's In the Mail

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THE SUN ENQUIRER

Volume XXII No.19 Special Edition One Dollar

8MM TAPE DRIVE TELLS ALL!

Built-In Display Reveals The Most Intricate Details Of Backup.

After delivering the keynote address at a recent trade show, the TTi 8501 granted The Sun Enquirer an exclusive backstage interview.

Sun Enquirer: We hear your built-in display is the greatest thing since transistors replaced tubes!

8501: Well, I wouldn't go that far. But DP managers sure love it. It tells you if there's enough unused tape in a cartridge to complete your backup. It lets you know if the tape is in good condition. And it even reminds you when it's time to install a cleaning cartridge.

Sun Enquirer: That's terrific! But fill us in on some basics. What's your speed and capacity?

8501: I can hold five gigs on a standard 8mm cartridge and my sustained data transfer is up to 500 kilobytes per second.

Sun Enquirer: How about your average seek time?

8501: In high-speed search mode I can find any file on a tape that contains 5,000 megabytes in about 60 seconds.

Sun Enquirer: That's fast! But I think our readers would really like to know if you're still doing work with some of the top CPUs in the business?

8501: You better believe it! I'm compatible with all kinds of SCSI-based systems. Not to drop names, but some of my best friends are VAXes, Sun SPARCstations and servers, IBM PCs and RS/6000s, HP/Apollos, and Macs.

Sun Enquirer: Boy, you really do get around! Is it hard to get along with so many different hosts?

8501: Not really. You see, the engineers at TTi designed me with 12 little switches on my back panel. By changing the settings I can speak almost any language.

Sun Enquirer: That must really come in handy in a multi-host environment. Do those switches do anything else?

8501: Of course! Besides setting the emulation, they change my SCSI address and let the user choose options like fast file search, short file mark enable and more!

Sun Enquirer: I suppose those switches also help you get along with 2.3 gigabyte 8mm drives?

8501: You got it. I can read tapes that were written by 2.3 gigabyte drives and write tapes in EXB-8200 mode, so they can be read by any 2.3 gigabyte drive.

Sun Enquirer: Mr. 8501, thank you for talking with us today. If folks want to learn more about you, what should they do?

8501: Either call (714) 693-1133 or drop me a line at TTi. I take all my calls and I always answer my mail. Well, gotta' go, but I hope I'll be talkin' to you soon!

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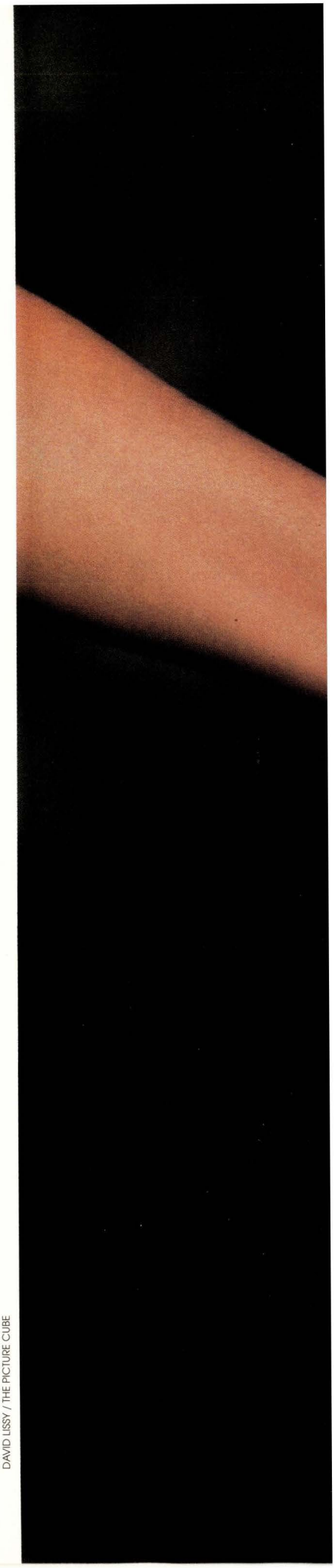
Circle No. 45 on Inquiry Card

The Message Is the Medium

There are a lot of similarities between SunSoft's ToolTalk and Hewlett-Packard Co.'s Broadcast Message Server (BMS) message-passing technologies. Both are a collection of specs, services and application programming interfaces (APIs) that enable software developers (and users) to interchange tools, applications and other data seamlessly. Once these technologies take hold, according to SunSoft and HP, gone will be the days when developers are required to write customized links between individual tools and applications so that they can share information. Instead, ToolTalk- and BMS-aware applications will automatically notify one another of changes, updates and other pertinent information.

Both ToolTalk and BMS run on multiple platforms, including Sun Microsystems Inc. hardware. Both accommodate standard network protocols and transport mechanisms, such as TCP/IP, Sockets, ONC, NFS and RPC. And because SunSoft and HP were among the winners of the bid to provide the Object Management Group's Common Object Request Broker Architecture (CORBA) standard–technology upon which both ToolTalk and BMS are grounded–the two message-passing systems are evolving, to a large extent, in parallel.

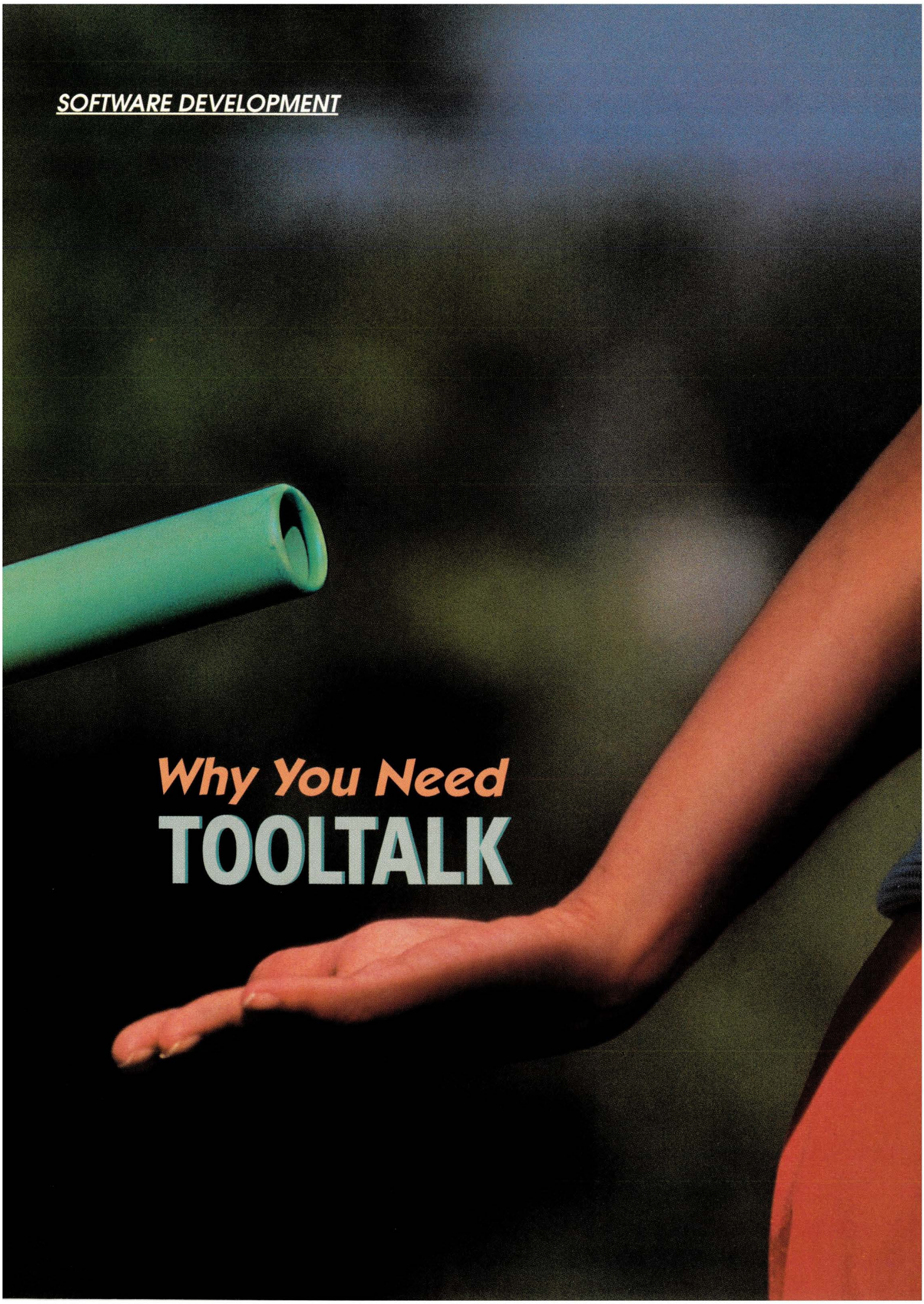
At the same time, there are plenty of ToolTalk-BMS differences. What stands out first and foremost is the difference in packaging and positioning of the two technologies.



DAVID LISSY / THE PICTURE CUBE

While SunSoft is bundling ToolTalk with its Solaris operating environment and offering the various ToolTalk message sets as public-domain software, HP is taking the tack of making BMS a part of its SoftBench application-integration framework and selling a "code-construction" license of the C-language version of SoftBench for Sun for $2,300. (The BMS binary is available as a standalone product for $495 per seat.)

To be fair, and in order to make an apples-to-apples pricing and functionality comparison, you would need to pit SoftBench against ToolTalk plus the SPARCworks (or ProWorks for X86) development environment plus products that eventually emerge from Project Distributed Objects Everywhere (DOE), Sun's object-oriented system strategy. Here, however, the focus is on the communications mechanisms. In the features that follow, SunSoft and HP explain their respective technologies, offer some hints for developers and present some of their future directions for ToolTalk and BMS.–*Mary Jo Foley*


SOFTWARE DEVELOPMENT
Why You Need
TOOLTALK

Released by SunSoft in 1991, the ToolTalk service is architected to be completely distributed and network-aware. Applications can use ToolTalk in two ways: They can employ it directly, calling functions from the ToolTalk API library to create, send and receive messages; or they can use a "service" built on top of the ToolTalk service, thereby making the ToolTalk service a communication backbone. In both cases, the ToolTalk service runs on top of the ONC+/RPC product.

With ToolTalk, location is entirely transparent to the developer as well as the user. The ToolTalk service determines which applications receive the information sent by another by looking for those applications that have asked for the type of information sent, regardless of whether the receiving application resides on the local system or across the network. As the number of users increases, the number of ToolTalk software servers increases to support scalable distributed performance. ToolTalk also integrates applications for single users on single systems.

Any ToolTalk-enabled application can be replaced by any other tool or application that supports the same ToolTalk message protocol. ToolTalk message-compliant applications describe the functions they need another application to perform and do not need explicit links to a specific application. Applications perform the tasks they do best and ask other applications to perform tasks for which they lack functionality. When ToolTalk protocols are observed, cooperating applications can be modified or rewritten without affecting one another. ToolTalk messages are easily added to existing applications to send, receive and use shared information.

---

by Astrid Julienne and Larry Russell, SunSoft

DAVID LISSY / THE PICTURE CUBE

ToolTalk also offers complete support for both procedural and object-oriented messaging, allowing ToolTalk messages to leverage the functionality of the procedural applications that dominate current usage, while enabling a smooth migration path to tomorrow's object-oriented environments.

SunSoft's vision of an object-oriented environment is outlined within its Project DOE (Distributed Objects Everywhere), SunSoft's distributed object paradigm. Project DOE includes an evolutionary growth path for current applications, with continuing support for the ToolTalk messaging service. All current ToolTalk functionality will continue to be supported, with the migration occurring in a completely transparent manner to users and developers. This will preserve current application integration functionality, while providing access to the additional capabilities of distributed object solutions in the future.

ToolTalk Availability

SunSoft's position is that application integration technologies such as ToolTalk should be standard system software. It therefore ships ToolTalk bundled with Solaris 2.X for SPARC and X86, encouraging its widespread availability and adoption. As a standard feature of the Solaris operating environment, all Solaris users have ToolTalk installed and available on their systems at no extra charge.

In addition to integrating applications across Solaris-based systems, ToolTalk can also integrate applications running across multivendor distributed networks. The ToolTalk service is currently available for more than 75% of the world's UNIX workstations, including systems from Cray Research Inc., Digital Equipment Corp., Hewlett-Packard Co., IBM Corp., Intergraph and Silicon Graphics Inc., as well as Sun Microsystems Computer Corp. and SPARC-compatible vendors.

ToolTalk binaries for HP 9000/7xx HP-UX, DECstation Ultrix 4.2, and IBM RS/6000 AIX RISC systems are available through SunSoft authorized distributors worldwide, including Pencom Software of Austin, TX. End-user companies can obtain an unlimited usage site license for ToolTalk binaries on DEC, HP or IBM RISC workstations for $1,500 per architecture. In other words, a site with 1,000 HP workstations can obtain ToolTalk for $1.50 per seat. ToolTalk for Silicon Graphics' Iris 4D systems is available from SGI, and ToolTalk for Cray and Intergraph systems is distributed through these vendors' respective distribution channels.

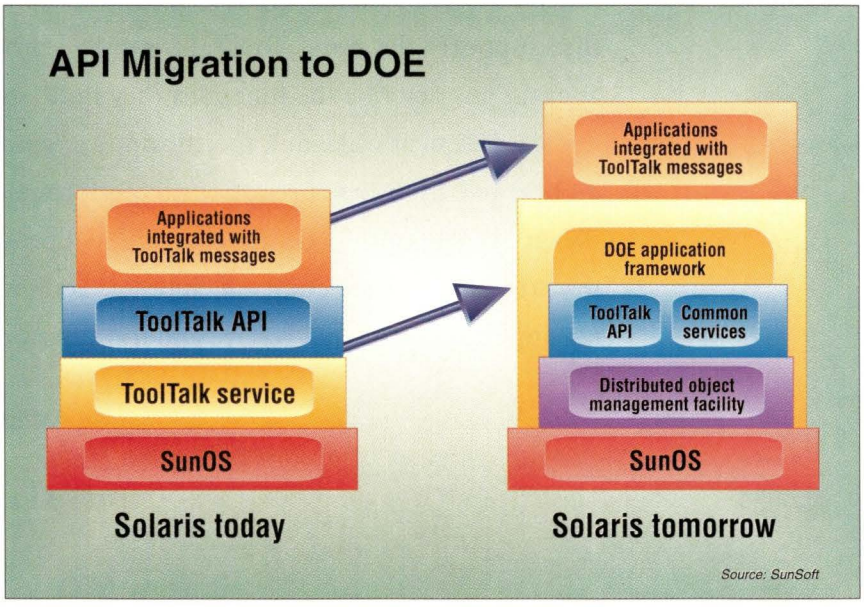
Standard Message Sets

Developers in different organizations need standard messages to ensure that the applications they develop will automatically integrate with the applications developed by others. Users access a vast array of purchased and internally developed applications to do their work, making an integrated set of tools in one horizontal or vertical market segment insufficient to accomplish the tasks necessary. Users want and need freedom of choice and do not want to be restricted to any narrow set of tools. Standard ToolTalk message sets enable this freedom of choice across all applications.

SunSoft has done extensive work with leading software suppliers and end users to define standard message sets. These message sets are open specifications in the public domain and are free for anyone to use without royalty or license fees. Copies of these standard message set specifications and information on developing ToolTalk-message-compliant applications can be obtained from SunSoft.

Separating messages into related sets helps developers to adopt the most appropriate messages for their applications. Software vendors can choose to adopt some or all message sets, depending upon the functional integration their customers require (or they can forego the message sets altogether and add ToolTalk to apps on a case-by-case basis). Their applications will be able to interoperate with any other application that has also adopted a particular message set. Existing ToolTalk message sets include:

- *The Desktop Services Message Set.* To achieve basic desktop integration, applications need to support interapplication control messages. With the Desktop Services Message Set, an application can manage the state of files, windowing and processing for itself or for any other application. This kind of functionality enables the development of smart desktops and integrated smart tool sets. Groups of appli-



Over time, the underlying ToolTalk implementation that users and developers do not see will be swapped out and replaced by the DOMF and other services.

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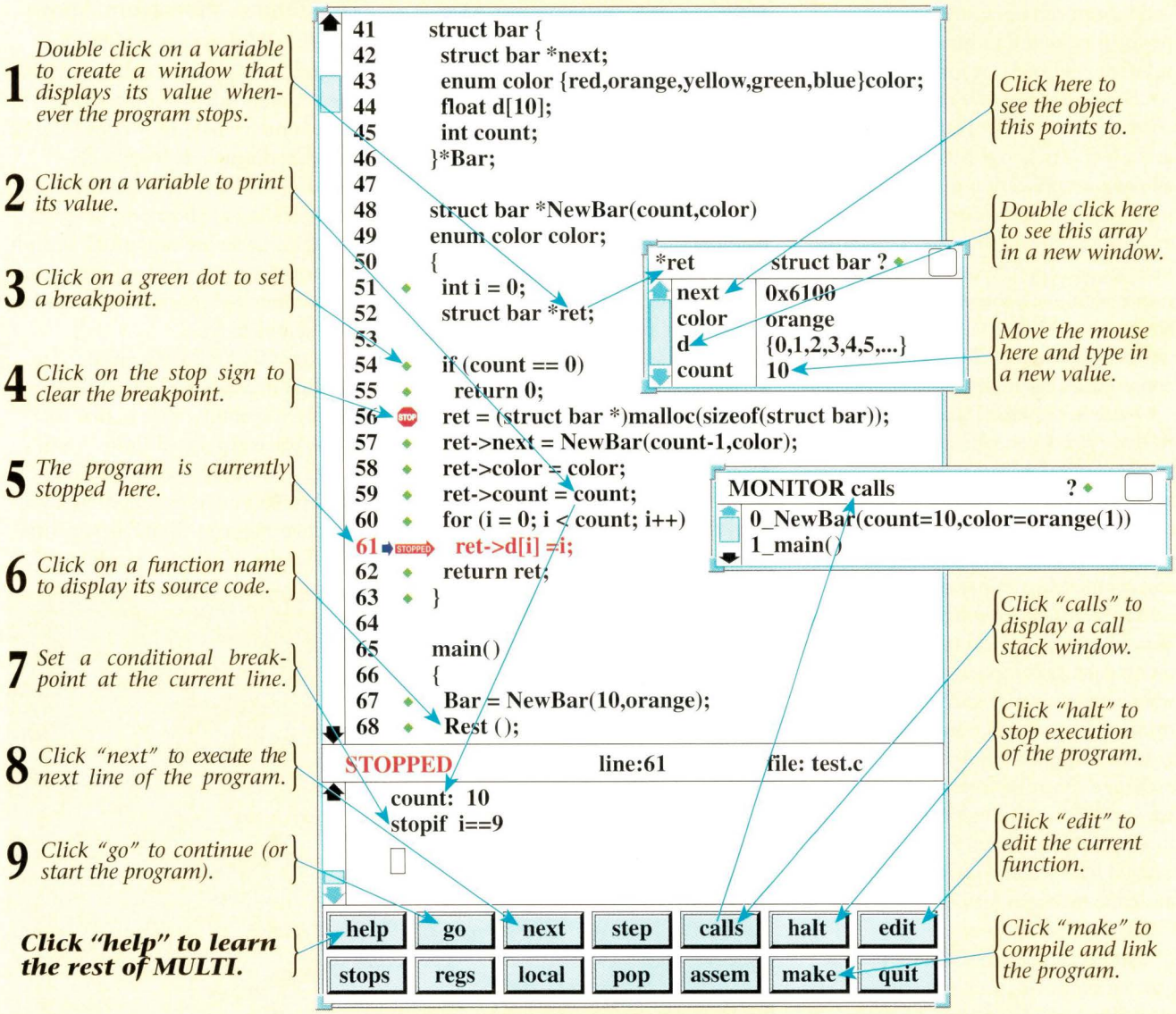

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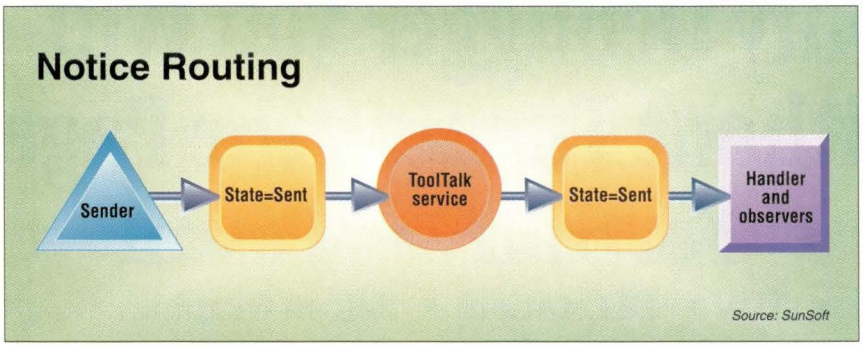


HANNA DYER

A notice, one class of ToolTalk messages, is a way for a process to announce an event. Processes that receive a notice need not return any results.

cations can call upon one another to perform tasks and to interact as one solution environment for the end user.

• ***Document and Media Exchange Message Set.*** The ToolTalk Document and Media Exchange Message Set allows any application to incorporate text, graphics, audio and video generated by another application. Using this message set, applications can communicate with one another in a transparent manner, both locally and over networks, regardless of data formats or compression technology.

• ***Data Access and Manipulation Message Set.*** Users who access databases and manipulate information in spreadsheets and decision support applications require integration. This message set makes data integration seamless and completely transparent to users.

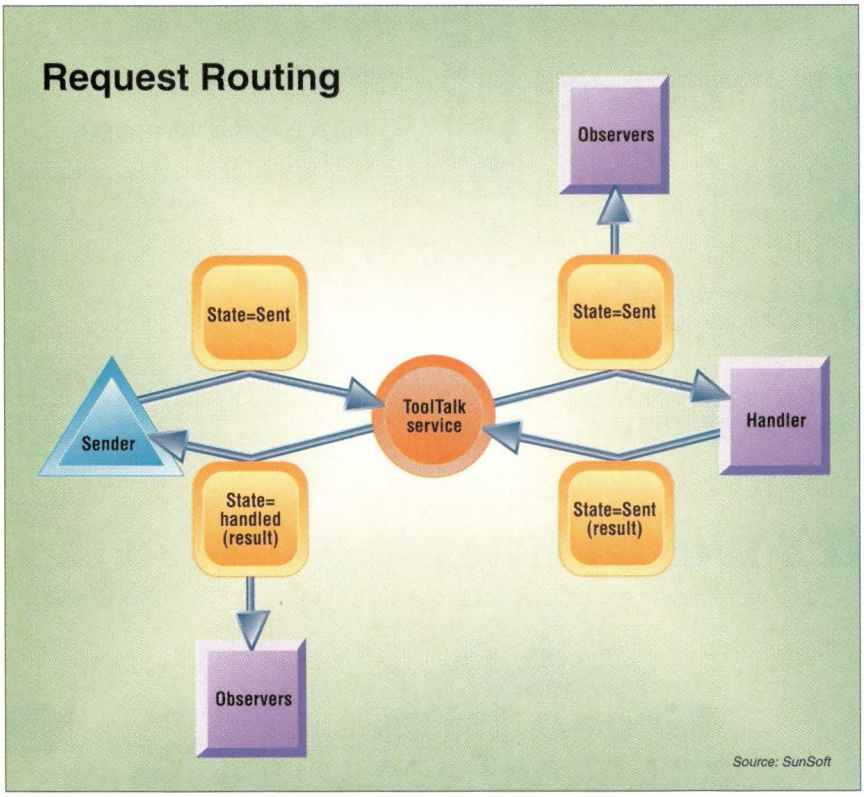
• ***CASE Interoperability Message Sets.*** In certain vertical market segments such as computer-aided software engineering (CASE) and electronic design automation (EDA), groups of applications need to exchange control information to operate in concert. Through the CASE Interoperability Alliance, SunSoft has worked with leading software vendors to define messages for this specialized CASE functionality.

SunSoft, DEC and SGI have proposed a vendor-neutral CASE-tool-integration messaging standard that enables software developers to integrate their CASE tools across heterogeneous CASE environments. This 180-page document has been submitted for consideration as a base standard to the ANSI X3H6 CASE tool standards committee and specifies sets of messages for debugging, browsing, analysis and design, editing, builds and version management. These standard definitions allow developers to have a wider choice of fully integrated tools running on their preferred platform. More than a dozen leading CASE tool vendors, including Cadre Technologies Inc., CaseWare Inc., CenterLine Software Inc., Frame Technology Corp., Interactive Development Environments Inc., Interleaf Inc., SoftTool Corp. and SunPro, have endorsed this vendor-neutral approach.

ToolTalk: A View from Above

The ToolTalk service enables any independent application to communicate with any other without either application having direct knowledge of the other through delivery of an agreed-upon set of messages between interoperating applications. Several messaging styles are supported, including messaging to a particular process, to any interested process, to an object or to an object type.

Any tool that follows a given ToolTalk message has universal plug-and-play capability; that is, that tool can be placed (plugged) into a computing environment and perform (play) those functions supported by a particular message. ToolTalk supports several styles of message passing



HANNA DYER

A request, another class of ToolTalk messages, is a call for an action. With the results of the action recorded in the message, the message is returned to the sender as a reply.

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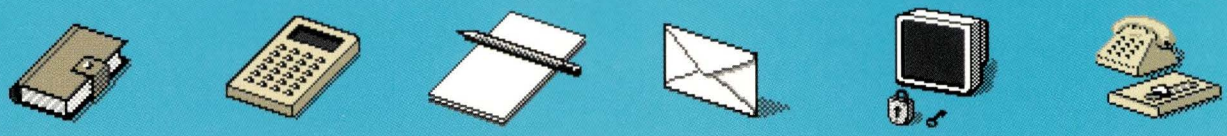
Now Sun users can have a Motif environment without giving up these.



IXI CALENDAR: a combined group calendar, time manager and diary. To schedule an appointment with a colleague just drag and drop their icon into Calendar.

IXI CALC: provides all the usual functions, accessed via either the keyboard or mouse (use drag and drop to move numbers to or from other software or the desktop).

IXI EDIT: replaces unfriendly UNIX editors such as "vi" to provide text editing with cut and paste, multiple open windows, and multi-level undo.

IXI MAIL: lets you receive, read and send e-mail. Sending a mail message has never been easier – simply write your reply with 'edit', then drop onto the mail icon.

IXI LOCK: locks the keyboard and screen while you're away from your desk. You can also set a time-out delay that locks automatically when your screen is not being used.

IXI DIAL: provides frequently used telephone numbers with a click of the mouse. To make a call, simply drag and drop the number you want onto the dialler icon.

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Sample Code for a ToolTalk Protocol from a Standard ToolTalk Message Set

```
ptype Acme_AudioPlayer {
    start "audiotool -tooltalk";
    per_session 5;
    handle:
        /*
         * Optional extra arguments for these requests:
         *                    in        requestID     requestID
         */
    session Display(          in        audio         contents      ) => start;
}
ptype Acme_AudioComposer {
    start "audiotool -tooltalk";
    per_session 5;
    handle:
        /*
         * Optional extra arguments for these requests:
         *                    in        requestID     requestID
         */
        session Compose(      out       audio         contents,
                              out       string        newMediaType  ) => start;
    observe:
        /*
         * These are notices which this tool *sends* (as opposed to
         * receives), so we document them here but hide them from the
         * types compiler.
         *
         * Optional extra arguments for this notice:
         *                    in        contents
         *
        session Buffer_Saved( in        string        bufferID      );
         */
};
ptype CasaDePublishing_UWriteIt {
    start "uwrite -tooltalk";
    per_session 1;
    handle:
        /*
         * Optional extra arguments for these requests:
         *                    in        requestID     requestID
         */
        session Display(      in        udoc          contents      ) => start;
        session Edit(         inout     udoc          contents,
                              out       string        newMediaType  ) => start;
        session Compose(      out       udoc          contents,
                              out       string        newMediaType  ) => start;
         /*
         * Optional extra arguments for this request:
         *                    in        <mediatype>   contents
         *
        session Buffer_Saved( in        string        bufferID      );
         */
};
```

Source: SunSoft

between applications, and it provides network-transparent multicast of both ToolTalk procedural and object-oriented messaging.

The ToolTalk service supports two basic kinds of scoping: file scoping and session scoping. File scoping limits the recipients of a message to those processes interested in a particular piece of information that is represented as a file. It also integrates multiple applications that can run on behalf of different users across the network whose applications are working on the same information. Session scoping limits the recipients of a message to those processes that run on behalf of a single user. In addition, the ToolTalk service supports file-in-session scoping, a combination of the two basic kinds of scoping. An additional feature of the ToolTalk service allows you to specify that you want the message to be delivered to either or both the specified file scope and specified session scope.

The ToolTalk service delivers event messages, called notices, and requests to any interested process anywhere on the network. An event is an announcement that something has happened, a news bulletin. When a tool informs interested processes that an event has occurred, it sends a ToolTalk notice. The sending tool does not require that any tool pay attention to the notice, and no reply is expected.

An operation, on the other hand, is an inquiry or a request for an action. When a tool makes an inquiry or requests that an operation be performed, it sends a ToolTalk request. The requesting tool expects a result to be returned and expects to be informed about the status of the request.

Once you have determined how your application will interact with other tools, you can determine the specific messages needed to accomplish the required tasks. The ToolTalk service uses message patterns–information stating explicitly how messages should appear–to determine message recipients. The attributes in your message pattern specify the type of messages you want to receive and, to some extent, the number of messages you receive. After receiving a message, the ToolTalk service compares this message pattern to all current message patterns in the application within the scope of the file or session. Once a match is made, the message is delivered to the application associated with the message pattern.

Some vendors talk about encapsulation as if it magically supports sophisticated application integration without extra effort.

Networking and 'Encapsulation'

With ToolTalk, networking distribution is transparent. The ToolTalk service hides the networking details, such as location issues, while providing easy global access.

Additionally, the ToolTalk service is entirely transparent to end users. ToolTalk messages described in your application can automatically invoke an application from any location on the network. This autostart function ensures that a message is delivered even if an application is not currently running. If there is less urgency, another option is to have notices queue up, until the application is started directly. The ToolTalk service maintains an instance of the ToolTalk server for each user. It automatically starts ToolTalk servers for new users, allowing the system to scale for distributed performance.

The ToolTalk capabilities are provided to an application through a C API library. This API is the same for any ToolTalk application anywhere on the network on any platform. Because the ToolTalk binaries run on platforms from multiple vendors, a ToolTalk application running on one platform is able to communicate with ToolTalk applications running on another platform.

The ToolTalk service requires an RPC. ONC+/RPC is preferred if application vendors wish their application to operate across multiple vendors' platforms.

One technology that ToolTalk does not insist upon is encapsulation. Some vendors talk about encapsulation as if it magically supports sophisticated application integration without extra effort. Unfortunately, encapsulation simply externalizes the message logic and requires extra coding to monitor the I/O stream of an application. Encapsulation degrades integration performance and increases the complexity of the coding effort. It is always preferable to install messages directly into the applications source code, and encapsulation should only be considered for unsupported, non-GUI-based utilities.

In the limited number of circumstances where encapsulation cannot be avoided, the Solaris environment provides a solution. Solaris encapsulation uses ToolTalk messaging, ANSI C for coding and OpenWindows DevGuide for building a GUI ($495 per seat). HP's Encapsulator product uses BMS messaging and the nonstandard Encapsulator Description Language for coding and building the GUI (at $5,460 per seat). To achieve the same objective, the Solaris encapsulation approach does not require a developer to learn a new, nonstandard language or to work with a nonstandard GUI-builder.

Designing Developers

Before integrating ToolTalk capabilities into an application, you need to be clear about how the tools will work together and what operations are to be performed. Automated encapsulation schemes that take the developer out of the decision process tend to provide very limited benefits to end users. Instead, by following a few standard design guidelines, developers will be

able to create ToolTalk-aware applications that will successfully interact with any other application that supports the ToolTalk message protocol.

Developers must always make requests anonymous. They need to let tools be started as needed, thus providing the user with more flexibility and more efficient use of resources. Developers must ensure that apps reply to a request only when the requested operation has been completed. This way, because ToolTalk messaging is entirely asynchronous, neither a tool (nor its session) will be blocked because it has one or more outstanding requests.

Developers should make protocols stateless, whenever possible. When a protocol is stateless, the messages in it avoid dependency on any previous messages or on some state in the assumed recipient. It is good to declare one process type (called a ptype) for each role (that is, the kinds of tasks) a tool can play. When you declare only one ptype per role in your protocol, you provide users with the flexibility to interchange tools as their needs require.

In short, there are five simple steps developers need take to add ToolTalk code to two existing applications so they can interoperate. First, you modify the Makefiles for each of the applications. Next, modify the source file for Application A. Then, modify the header file for Application A. Next, modify the source file for Application B. And finally, create a new file to declare the ToolTalk ptype for Application B.

The Five-Fold Path

Here are the steps in more depth:

Step 1: The first modification you need to make in order for the two applications to interoperate is to change both of their Makefiles to use the ToolTalk libraries. To do this, add the `-ltt` option as follows:

```
LOCAL_LIBRARIES = -ltt $(XAWLIB) $(XMULIB) $(XTOOLLIB) $(XLIB)
```

Step 2: Next add code to Application A's source file to set the ToolTalk session, to specify what operations it wants performed, and to receive and process ToolTalk messages. Then add code to Application A's header file that tells it about the ToolTalk header file and also about the new ToolTalk commands in its source file.

Step 3: Application A must be able to receive ToolTalk messages and respond in a specified manner when certain types of messages are received. Application A will send a message to tell Application B what operation it wants performed. It also wants Application B to send a reply when the request has been completed or to notify it if the operation should fail. Add this code to the actual code within Application A that performs these specified tasks.

Step 4: Add code to Application B's source file that tells it where to find the ToolTalk header file; how to handle a ToolTalk message when it receives one; how to process an error caused by a ToolTalk message; and how to join the ToolTalk session.

Step 5: The ToolTalk types mechanism is designed to help the ToolTalk service route messages. However, you must first define a process type (ptype), and then compile the ptype with the ToolTalk type compiler, `tt_type_comp`.

The ptype file contains information on what requests an application is interested in handling, what events an application is interested in being notified about, and what requests and/or events can cause the application to be started. When a tool declares a ptype, the message patterns listed in it are automatically registered; the ToolTalk service then matches messages it receives to these registered patterns. These static message patterns remain in effect until the tool closes communication with the ToolTalk service.

Ptype files are text files that contain the specific syntax of the messages your application is interested in. After you have created the ptype file, you need to install the ptype using the ToolTalk type compiler. The type compiler verifies the ptype syntax, checks for conflicts with existing definitions, and merges the ptypes into the ToolTalk user database.

Before you can participate in ToolTalk sessions, you must initialize and register your process with the ToolTalk service. To initialize and register your process with the initial ToolTalk session, your application needs to obtain a process identifier (procid) and a matching file descriptor (fd).

You can either register in the ToolTalk session in which the application was started (the initial session), or locate another session and register there. To register in a session other than the initial session, your program must find the name of the other session, set the new session as the default, and register with the ToolTalk service.

After you have initialized the ToolTalk service and joined a session, you can join files and additional user sessions. When your process is ready to quit, you must unregister your message patterns and leave your ToolTalk session before your application exits.

ToolTalk Futures

ToolTalk is an integral part of SunSoft's Project DOE. Today, ToolTalk enables the integration of procedural and object (i.e., "large-grained") applications through multicast messaging. Over time, Sun's vision is that DOE technology will allow developers to create new kinds of finer-grained apps constructed via the "plug-and-play" model using distributed-object components.

SunSoft plans to move the ToolTalk messaging API into the DOE application framework. In the longer term, Sun expects to swap out underlying ToolTalk technology that is invisible to developers and end users and replace it with the Distributed Object Management Facility (a CORBA implementation) and common services. The ToolTalk API will remain intact as part of future versions of Solaris. ⊸

Astrid Julienne is a technical writer in the ToolTalk documentation group at SunSoft. **Larry Russell** is the ToolTalk product manager.

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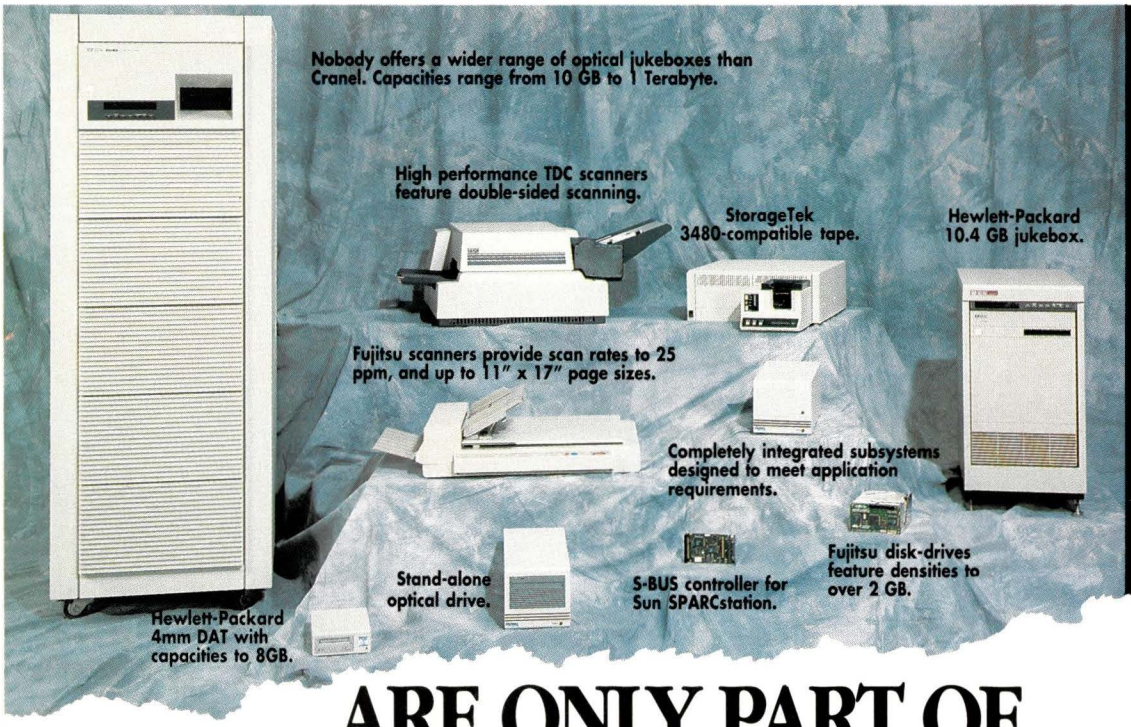

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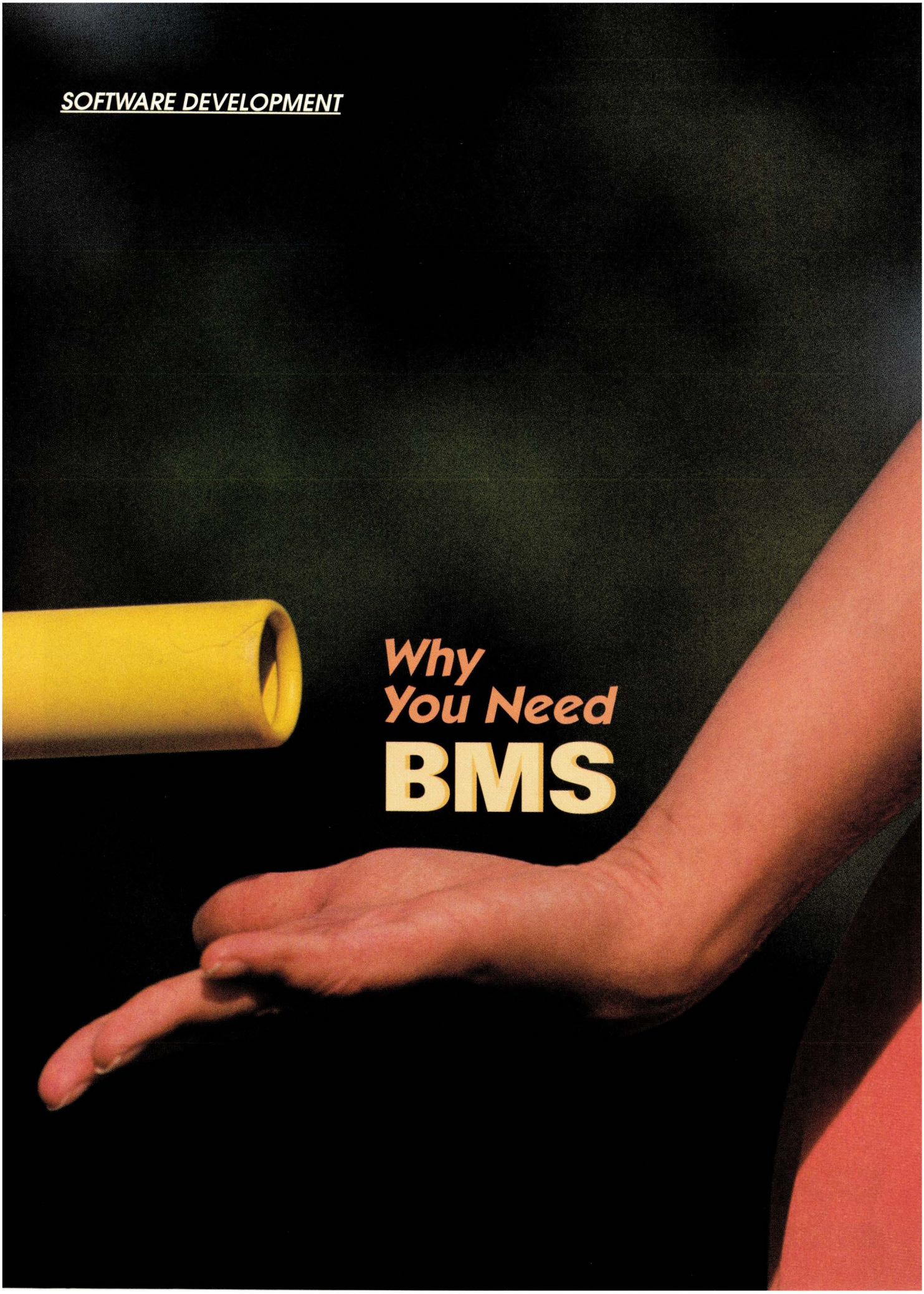


Why You Need BMS

The Broadcast Message Server (BMS) is the central point of communication among multiple client programs within the SoftBench Framework. It is responsible for routing messages between client programs, filtering messages, invoking client programs when needed, and recording the custom environment for each individual using the Framework.

The SoftBench Framework is a set of software services that allows tools and tasks to be tied together into an open, integrated, heterogeneous distributed environment. The Framework allows tools that were created as standalone applications to be encapsulated, or plugged in, without source code modification. These encapsulated tools can then communicate with each other to become a part of a user's task, or overall process. The SoftBench Framework allows tasks to be created by the user, quickly and easily. As each user's needs change, the tasks can evolve to meet these needs.

The SoftBench Framework services can be separated into three distinct yet related categories: messaging, subprocess control and remote data access. Each of these services can be used independently of the others, yet they work best in concert. The BMS facilitates tool communication in a client/server architecture. The subprocess control (SPC) service allows previously standalone applications to be executed under the control of a Framework client, or the Framework itself, again in a client/server model. The application can be executed locally or remotely via the Subprocess Control Daemon (SPCD). SPC is also used by the BMS to activate tools. The remote data access feature allows client programs to reference remote data via NFS. This feature provides a consistent mechanism to handle references to remote file system data within a message.

by BRIAN FROMME, Hewlett-Packard Co.

The SoftBench Connection

Developed in 1988, Hewlett-Packard Co.'s SoftBench Framework addresses application integration issues by providing a control integration mechanism based on smart messaging–a k a BMS. The SoftBench Framework provides services that are essential to creating an open, integrated, distributed environment, such as graphical user interface and communication services that are accessed and shared by all applications in the Framework-based environment.

Today, more than 60 commercially available software tools have been integrated with the SoftBench Framework. In addition, CASE Communique, a cooperative forum of more than 100 independent software vendors, environment builders and end users, is chartered with creating industrywide standards for control integration based on the SoftBench Framework.

The SoftBench Framework is available on multiple hardware platforms, including the HP Apollo 9000 workstations, IBM Corp. RISC System/6000 workstations, Digital Equipment Corp. Ultrix systems, MIPS Computer Systems Inc. systems, Sun Microsystems Inc. SPARCstations and Sequent Computer Systems Inc. systems. Much of this broad platform availability has been accomplished by licensing the SoftBench Framework to hardware vendors, such as IBM and Control Data Corp., and to software vendors such as Siemens Nixdorf Information Systems Inc., Informix Software Inc. and Objectivity Inc. The European Computer Manufacturers Association (ECMA) adopted a reference model originally developed by HP and influenced, to a great extent, by SoftBench, to describe those services that a framework must provide to be beneficial.

In order to run on so many platforms, the Framework must be highly portable. The BMS and SPCD are what make it so. The BMS is implemented on standard networking services, such as Ethernet and TCP/IP. It was easily ported to the many UNIX platforms mentioned earlier. This means that applications running on these systems can be encapsulated and communicate transparently across the network with other client programs running on different operating systems. The SPCD also allows applications to be executed on non-UNIX systems–such as HP's MPE/ix systems, IBM's MVS systems and DEC's VMS systems–without the need for porting the entire SoftBench Framework. This feature allows the SoftBench Framework to encapsulate tools regardless of whether the tool is on the same host computer as the Framework.

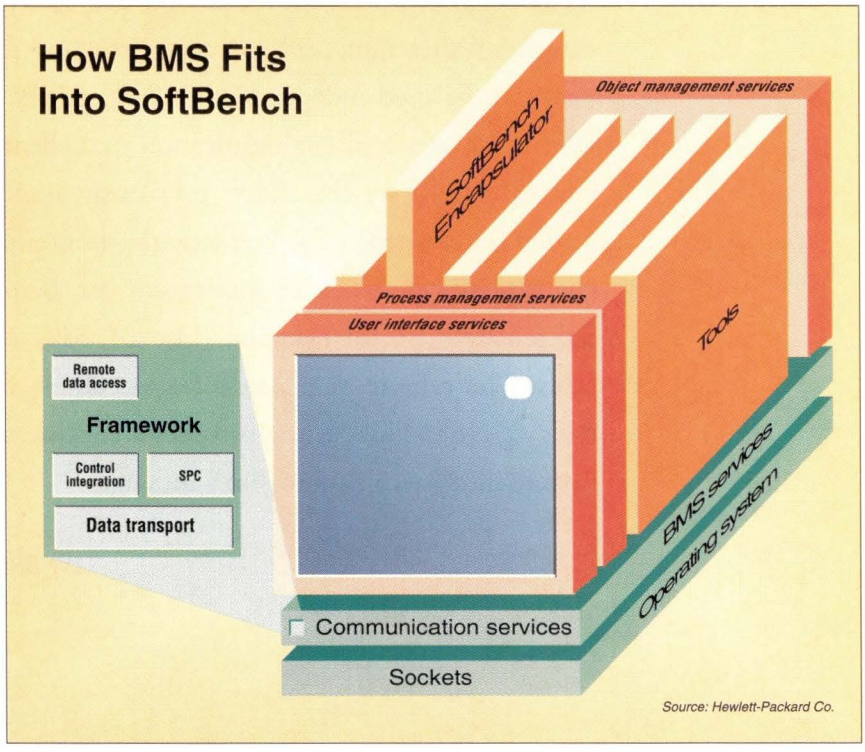
Within the ECMA model, the SPC and BMS are implemented on network services such as Ethernet and TCP/IP.

The Ins and Outs of BMS

A message is the unit of communication between client programs in the Framework. Messages are used to convey control information. The term "control integration" is used to describe this form of tool communication. The control information passed in a message typically takes one of two forms, notifications of some activity and requests for some other client program to take some action.

A notification is used to convey a client program's most recent activity. Notifications can be delivered via the BMS to any number of client programs. A request message is used to ask some other client program to take a certain action. The sender of a request need not know which client program will actually handle the request. This characteristic is the heart of the BMS open system model. The actual tool that handles a request can be replaced with another tool without the need to inform the requesting client program of that change in the environment. In fact, the requesting client program need not even be restarted when such a tool replacement is made. Responses to requests are actually a special form of a notification and are used to notify client programs that a requested event has been completed. Responses contain status information that denotes if the event was successful.

The BMS performs smart message routing to any number of client programs. It is responsible for forwarding any message sent from a client program, whether a notification or request, to any other client programs that have registered an interest in this message. This is done via ARPA/Sockets, a standard, portable and distributed network transport mechanism. Therefore, the BMS and any of



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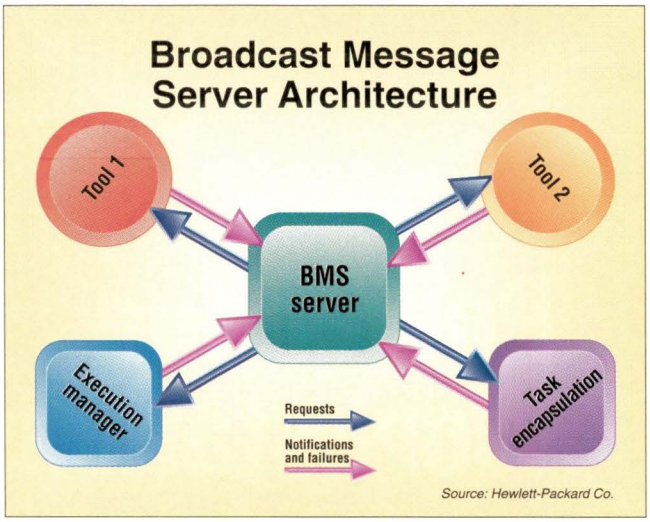

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The BMS forwards any message from a client program to other clients with registered interest in the message.

its client programs can be distributed across a heterogeneous network. The BMS also performs message filtering. Only those client programs that register an interest in a message will receive that message. All other programs are simply left alone. A key feature of message passing is guaranteed response. When a request message is sent, the requesting client program often needs to receive a reply that indicates the action was attempted. The BMS will ensure that such a reply is generated if the client program cannot execute or is prematurely terminated.

The BMS maintains the tool environment automatically via the Execution Management facility. The Execution Manager is responsible for invoking client programs when a request message is sent and there is not an appropriate client program already running to handle that request. This means that the user need not be concerned with whether or not a client program has been started in the correct place in the network to handle a desired task.

The Execution Manager uses an activator to describe how to start the appropriate client program somewhere in the network. The activator is a string that looks much like the command line that the user would enter to invoke the client program, but the activator also contains macro expansion capabilities that allow the Execution Manager to start the client program with data supplied from the corresponding request message.

For example, a user may be in the editor about to make an enhancement to a piece of software, but the file must first be checked out of a source code management system. The user doesn't know whether or not the source code management client program has been invoked yet and may not know exactly where in the network it should be invoked. With the Execution Manager, the user need not ever know this information. The check-out request is made from the editor, and the Execution Manager determines that the source code management client program has not yet been invoked. So, the request message is queued while the source code management client program is invoked via SPC on the appropriate node in the network. When that client program announces to the BMS that it is ready to accept messages, the Execution Manager will resend the queued request message, which is then forwarded to that client program.

Multiple access methods assure that integrators can choose the method that best suits an application.

Encapsulating with Encapsulator

Encapsulation is performed by using the SoftBench Encapsulator product. The Encapsulator is the API to the SoftBench Framework services, as well as the device that provides remote data access, subprocess control and user interface services for client programs. Encapsulator enables developers to unobtrusively add or encapsulate custom, third-party or UNIX program applications without source code modification. All client programs then have access to the SoftBench Framework services.

Without capabilities like those provided by the Encapsulator, every program that is integrated into the environment must be rewritten to make use of Framework services. Not only is this impractical, but, in most cases, for end users to access the source code of a third-party tool is simply impossible.

Another advantage to the Encapsulator is flexibility. The Encapsulator provides multiple access methods for writing integration software. These methods are called direct library access, unobtrusive access and shell access. Direct library access is used when calls to an archived or shared library are added to an application. Unobtrusive access is used when an application has some form of programmatic interface, either textual, through Sockets, remote procedure calls or through some other text-passing mechanism. In this case, no source code modifications to the application are necessary; only access to the binary program is required. Shell access is provided so that shell scripts can be written to access the BMS. Shell access is also used by programs, such as `emacs`, that have the ability to execute a process. Multiple access methods assure that integrators can choose the method that best suits an application.

Encapsulations can be written in many programming languages: C, C++, EDL (Encapsulator Description Language) and UNIX shell scripts. With the C library access, other programming languages that have the ability to call C library procedures can be used, too.

The Encapsulator is second-genera-

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tion integration technology. Developed in 1988, the Encapsulator continues to be enhanced to allow easy integration for a growing set of applications. The Encapsulator provides the interface to the SoftBench Framework services based on an object-oriented methodology, called the Simple User Model.

The Simple User Model (SUM) is an object-oriented approach to providing the services in the SoftBench Framework to a software integrator. Client programs can interact with a BMS component, controlled application component, remote data component, and Motif user interface component. In this model, client programs become event-driven programs, waiting to service interesting events that occur on the various interfaces: BMS, SPC, Motif and others defined by the programmer.

SUM defines three Framework objects: the Message Object, the Subprocess Object and the Display Object. The Message Object is the interface to the BMS. By instantiation, a connection can be made with a BMS on a particular machine, by host name. By passing information to a Message Object, data can be delivered to the BMS and therefore to other client programs. The integrator need not deal with the low-level network transport mechanism, i.e., Sockets. This is all handled by the Message Object.

The Subprocess Object is used to create a new process and execute an application within that process, on any named host accessible via an SPCD. A connection with that subprocess is made so that data can be passed, collected and parsed via pattern matching. Pattern matching in the Subprocess Object allows an client program to define textual events on an application.

A developer can integrate encapsulated tools to automate a task by using the Encapsulator to compose programs in C, C++, or, as is the case here, EDL. The steps in the program are color keyed to the task diagram.

This means that the client program can determine what the application has done in response to a command. Thus, errors can be caught, and response data from a command can be collected and used in other interfaces, such as being placed in the user interface or written as part of a BMS message.

The Display Object provides consistent access to Motif user interface objects as well as several special SoftBench Framework objects so that a client program can easily manipulate information on an X display. One special SoftBench Framework Display Object, the Terminal Object, allows interaction with a curses-based, or terminal-oriented subprocess.

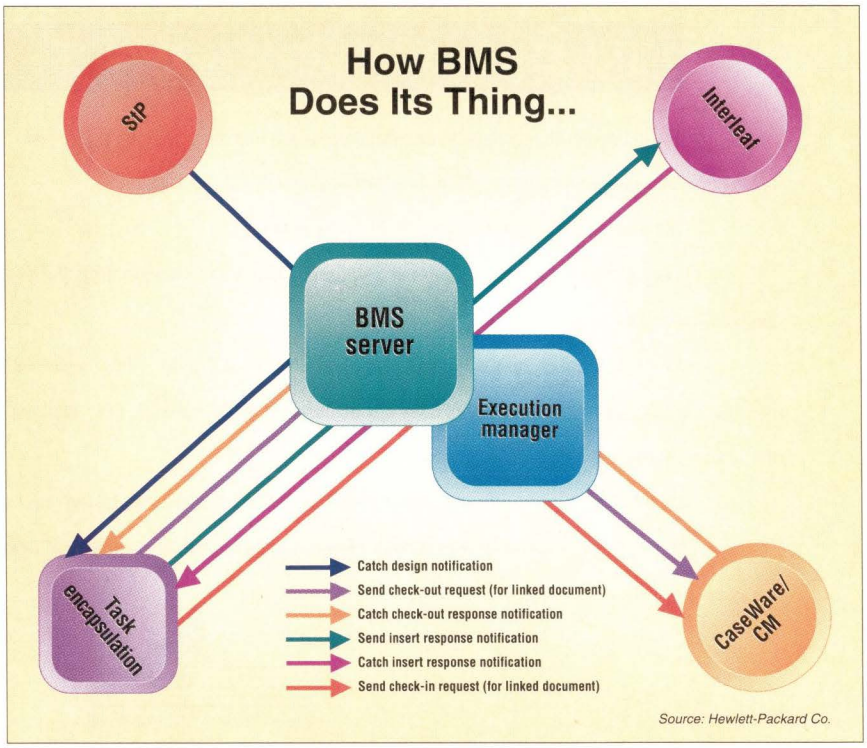
A Real-World Example

So you know how to access the SoftBench Framework functionality. Now you want to build a real application environment that allows your customer to easily automate tasks. Here's an example of one that works today.

We will take three encapsulated software development tools: Interactive Development Environment Inc.'s Software through Pictures (StP), Interleaf Inc.'s Interleaf, and CaseWare Inc.'s CaseWare/CM (see "How BMS Does Its Thing..." and "...Using Encapsulation Description Language"). StP provides structured analysis and design capabilities. Interleaf is a WYSIWYG documentation publishing system. CaseWare/CM is a configuration management system for managing large software systems. Each of these applications has already been encapsulated by its respective independent software vendors (ISV), so we don't have to worry about building the interfaces to each application's functionality. What we do want to do is automate a task that our company does every day and we will leverage the integration via the BMS to do that.

Our task consists of keeping a software design and its corresponding user documentation up to date with each other. When a design change is made, we want to automatically modify the user documentation and keep both the design and the document under control of the configuration management system. To do this, we will write a task encapsulation that will listen for a `DESIGN` notification message from StP, send a `CHECK-OUT` request to CaseWare/CM, then send an `INSERT` request message to Interleaf, and finally send a `CHECK-IN` request message back to CaseWare/CM.

The BMS will take care of automati-

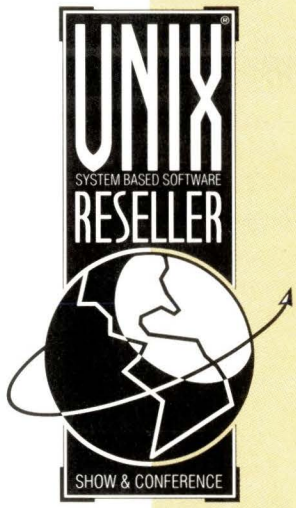


HANNA DYER

...Using Encapsulation Description Language

```
/*****************************************************************************
 *
 * File: task.edl
 * Description: A practical example of how to create a real software
 * development task using real ISV encapsulations.
 *
 *****************************************************************************/

/* These lines create the event that catches the StP message we care about.
 * This handles step (1) which is initiated by the user in StP. */
event catchme; string id;
event stp = make_event(Message, make_message_pattern(Notify, "STP", "DESIGN"),
                       catch_design_message());
add_event(stp);

function catch_design_message() {
   /* This function requests to CHECK-OUT the document and catch the reply.
    * This handles step (2) and (3), the first portion of our automation. */
   id = make_message_id();
   set_context_file(message_file());

   catchme = make_event(Message,
                       make_message_pattern(Notify, "CM", "CHECK-OUT",
                                            NULL, NULL, NULL, id),
                       catch_checkout_message());
   add_event(catchme);
   send_message(Request, "CM", "CHECK-OUT", id);
}

function catch_checkout_message()
{
   /* This function requests to add the design to the document.
    * This handles step (4) and (5), the second portion of our automation. */
   id = make_message_id();
   remove_event(catchme);
   catchme = make_event(Message,
                       make_message_pattern(Notify, "DOC", "INSERT",
                                            NULL, NULL, NULL, id),
                       catch_insertion_message());
   add_event(catchme);
   send_message(Request, "DOC", "INSERT", id);
}

function catch_insertion_message()
{
   /* This function request that the document be returned to the CM package.
    * This handles step (5) and completes our automated task. */
   remove_event(catchme);
   set_context_file(message_file());
   send_message(Request, "CM", "CHECK-IN");
}

start();
```

Source: Hewlett-Packard Co.



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cally invoking each tool that is requested to take an action via the Execution Manager and queue each request until the application is ready to accept messages. The BMS will also handle forwarding each message to the appropriate application, without the need for each application to be aware of the others. The task encapsulation facility will handle the linking of the message events to fully automate this task.

The code that implements this task can be written using the Encapsulator product in C, C++ or EDL. We wrote this EDL program in about 20 minutes, and there is no need to modify the BMS environment to use this program to automate the task. We simply add the program to the BMS configuration file to inform it of the new task encapsulation and then we run it.

The World, According to HP

HP plans to extend the Framework to include repository and object management services. These extensions coincide with another emerging standards effort–that of the Object Management Group (OMG). The Distributed Object Management Facility (DOMF) portion of OMG's CORBA was initially intended to provide point-to-point integration of distributed objects. The SoftBench Framework provides broadcast message integration of distributed applications. Consequently, the SoftBench Framework can be utilized to support encapsulation of existing applications for interoperation through the DOMF. This would allow applications that are not object-based to present an object interface to the DOMF. Thus, encapsulated applications would need not be rewritten to coexist in the DOMF world.

Ultimately, HP is working toward using BMS as the basis for the communication facility within the DOMF.

Brian Fromme is a program manager in Hewlett-Packard Co.'s Software Engineering Systems Division in Fort Collins, CO. He is the original designer and patent holder for the SoftBench Encapsulator.

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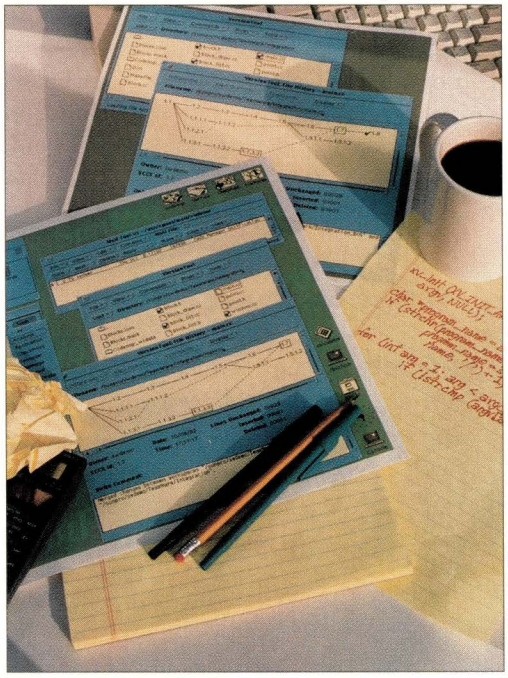
Checking Out SCM

Nine developers out of 10 would probably tell you that software configuration management (SCM) is no fun. Most would skip the process entirely, if not for pesky managers forcing them to keep better track of source files and versions of applications under development.

Gradually, however, programmers are beginning to accept the method behind the SCM madness. SCCS (Source Code Control System) and RCS (Revision Control System), the UNIX SCM utilities, just aren't powerful enough anymore for serious software developers. Programming is no longer a solitary function. In more and more companies, programming teams of tens and hundreds juggle code in ways SCCS and RCS can't handle. Accordingly, in-house-developed SCM systems are giving way to third-party-developed ones–currently from more than 50 vendors, according to Glenn Johnson, president of market researcher SCM Consulting in San Francisco.



JOHN W. KELLEY, JR.

Software configuration management's days of getting no respect are over.

by MARY JO FOLEY, Senior Editor

"In the past, SCM products were aimed at developers *or* managers. But it never worked when developers were forced to use SCM and the managers were forced to use change management software," a subset of SCM, Johnson explains. "Today, all of the top products try to appeal to both the developer and manager camps."

SCM today encompasses four key operations, according to an IEEE standard definition (IEEE-CM-87):

- Identification, for identifying components and their types;
- Control, for controlling releases of a product and changes to it throughout its life;
- Status accounting, for recording and reporting the status of components and change requests;
- Audit and review, for validating the completeness and consistency of a product.

Some SCM systems also include other capabilities such as manufacture, for managing the building of a product; process management, for carrying out an organization's policies and lifecycle model; and team work (also known as check-in/check-out), for controlling the work and interaction among multiple users. In short, SCM is the foundation for a software development environment.

Beating a Bad Rap

For a class of software at the crux of the development process, SCM has suffered from a bad rap in almost every market segment other than military/defense–where the requirements for reusable code make SCM an absolute must. Sun Microsystems Inc.'s original SCM product, Network Software Environment (NSE), didn't help matters. The product was too large and too complex for many users, Sun acknowledges. "NSE wasn't a very successful product, even though, by some estimates, we had the biggest installed base, with hundreds of seats," admits Paul Henderson, director of marketing for SunPro. Late last year, SunPro introduced NSE's successor, TeamWare, which Sun is marketing as more of a version-control system than a full-blown SCM one.

Sun is just one of many vendors, several of them rather unlikely, to specialize in SPARC-based SCM. Last summer, IBM Corp. began shipping for Sun (and Hewlett-Packard Co.) platforms a version of its SCM client software, called IBM Configuration Management Version Control (CMVC) Client. To use the client software, Sun users install it on a SPARC-based workstation connected to an IBM RISC System/6000 POWERserver running IBM AIX CMVC Server/6000 software.

The Marconi Systems Technology division of GEC Plessey Naval Systems Inc., for another, offers a Sun-based SCM system, called Expertware/CMF, which Marconi is OEMing from Expertware Inc. Expertware's Configuration Management Facility runs on both UNIX and Digital Equipment Corp. VAX/VMS systems.

Other top SCM vendors include Atria Software Inc., CaseWare Inc., Intersolv Inc., Softool Corp., Software Maintenance and Development Systems Inc. (SMDS) and TeamOne Systems Inc. Also, some CASE tool vendors include rudimentary SCM tools/modules in their products.

In the SCM market, not too surprisingly, multiplatform support seems to be a key selling point. For example, Honeywell Corp.'s Commercial Flight Systems/Minneapolis Operation selected TeamOne's TeamNet as the SCM system of choice because it ran on Sun and HP workstations, says Willy Velarde, senior productivity engineer. Until two years ago, "we didn't have any way to manage our files' versioning," Velarde says. "We had islands of automation, using RCS and SCCS. But we were looking for a tool that would leverage our Sun and HP workstations. We wanted something that

Think Before You Buy

Software configuration management systems don't come cheap. And few, if any, customers can afford to put a lot of time and effort into buying and trying an SCM system, only to end up having it sit unused in a closet somewhere. Potential customers could avoid a lot of headaches if they asked a few questions before they put down any money, says SCM Consulting President Glenn Johnson. Here are some points to ponder:

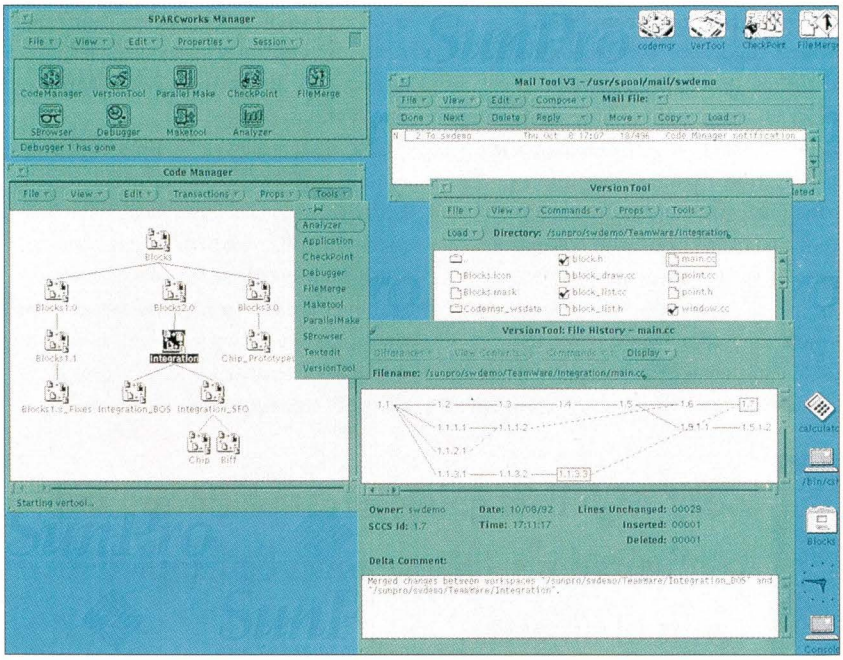
- What kind of communications capabilities are accommodated by the product (TCP/IP, NFS, etc.)?
- How can you customize the product? Do you use existing shell commands or proprietary macros?
- How is the product structured? Who is the target audience–developers, managers or both?
- Which GUIs are supported by the product? (And do you really need a version with a full-blown GUI?)
- What kind of reporting capabilities are supported by the product?
- What is the product's storage structure, in terms of size, distributed or not, etc.?
- Is there a make tool included as part of the product and/or can the product work with industry-standard make tools?
- What kinds of databases/repositories are supported by the product? Are there facilities for exchanging information that is stored in different DBMS/repositories?
- What kind of automation of processes/policies does the product provide?
- Who is the vendor and what kind of service/support is it set up to provide?–*mjf*

was easy to use and that was distributed."

After evaluating a number of tools, the group installed 40 concurrent Sun TeamNet licenses for a six-month pilot study. The Honeywell hardware and software engineers design air-data inertial-reference units, the on-board systems that help an aircraft determine and maintain its location. "We discovered the [TeamNet] GUI was very rich–too much so for the hardware engineers," Velarde says. As a result, Honeywell opted to run two different TeamNet versions on its Suns: one using a VT-100 interface for the hardware engineers, and another, full Open Look-based one for the software engineers. The group is currently installing TeamNet on another 40 of its 120 Suns and 10 of its 300 PCs (running PC-NFS). At press time, Commercial Flight Systems was beginning to implement TeamNet on some of its 120 HP workstations, as well.

TeamNet supports configuration management, change management and version control for any file types, according to the company. An audit trail is automatically maintained, and real-time status reports may be generated. The system incorporates a POSIX-compliant file management system, a SQL subset for the query interface, an X Window System/Open Look-based user interface and NFS for distributed file management. This month, TeamOne plans to beef up two areas in which TeamNet has been weak, by opening up its proprietary object database and adding work flow (i.e., policy) automation to the product. "Customers will be able to access our object-oriented database API through a C-callable-level language," explains Patrick McGill, TeamOne vice president of marketing.

"TeamNet is a layer between the tools within UNIX," McGill says. "That's why we don't need to go through the encapsulation and integration processes that other companies do. We're coupled closely with the operating system." Another differentiator between TeamNet and other SCM systems, he says, is that "TeamNet supports an underlying peer-to-peer, not just client/server, architecture. That's why we're a more truly distributed SCM system. We really work in high-performance, networked environments, where there are large amounts of data in very concurrent usage. Developers don't need to change their tools, data or the way they work."



SunPro's TeamWare consists of four tools: CodeManager, for graphical project integration and release management; VersionTool, for inspecting and managing multiple versions of source files; CheckPoint, for capturing project source file configurations for later retrieval; and SunPro's own ParallelMake, for accelerating project builds.

Bells and Whistles

The extent to which these features distinguish TeamNet from TeamWare or from any of the other SCM systems is debatable, since nearly all SCM vendors claim similar capabilities.

For example, Softool lists component management, complete change and version management, access management, auditing, application management, stage management, production management, release and baseline management and multiplatform availability among the capabilities offered by its flagship product, CCC/Manager. Like TeamOne, Softool stresses its product's distributed-computing support and independence from platform, methodology and operating system.

Cincinnati Bell Information Systems' Maitland, FL-based technical planning and development department ratifies Softool's claims. "CCC/Manager is very flexible. It gives you a lot of leeway. It doesn't tie you to a single set of processes and procedures," says systems analyst Don Dam. Technical planning and development is using the Softool product for several projects, including Project 2000, which is its mobile wireless and cellular phone billing system, and within its platform development center, where code reusability is a priority, Dam says. Both projects employ multiple Sun workstations.

CCC/Manager is truly multiplatform, supporting everything from mainframes to PCs running Windows and OS/2, he adds. While Cincinnati Bell would like to see more integration between CCC/Manager and other CASE tools, such as Cadre Technologies' TeamWork and Intellicorp Inc.'s ProKappa, the company is content with Softool's initiatives in this area, Dam says. "The lack of integration of some sort of a problem-tracking system [with CCC/ Manager] was a problem initially," Dam says, noting that Softool in December remedied this shortcoming by introducing CCC/Pro.

Another market veteran, SMDS, supports the major SCM bells and whistles required by customers. SMDS' SCM product, Aide-de-Camp, handles the full range of change and configuration management chores across platforms–and is an object-oriented system, to boot, the company claims. "We don't just provide binary or image control," points out director of marketing Mary Cole. "We also do information management, acting like an on-line dictionary or encyclopedia.

'Today, with data going across platforms and configurations, change must be handled in terms of objects.'

"File-by-file delta technology," for reconciling differences among software versions, "because it's linear, is obsolete," Cole says. "Today, with data going across platforms and configurations, change must be handled in terms of objects."

CogniSeis Development Corp., a Houston geophysical software developer, has used Aide-de-Camp for nearly two years. It uses 30 or so Sun systems–SPARCstation IPXs, 1s, 2s, 10s and pair of 690MP servers–for development work. CogniSeis also employs a few RS/6000s, HP-UX systems, DEC VAX/VMS machines, Silicon Graphics Inc. workstations and a Cray Research and Convex Computer system, says David Judson, vice president of system development.

"We used to have a home-brewed [SCM] system running on our VAX," Judson says. "When we decided to move to UNIX and a multiplatform environment, we needed something else." CogniSeis opted for Aide-de-Camp, but ended up "reimplementing" the system so that it would look almost like the VAX-based SCM system the company had grown up with. "We worked it so we could check code in and out and do builds just like we did on the VAX," Judson says. At the time that CogniSeis was doing its implementation, Aide-de-Camp didn't have a GUI front end (which the technical end users at CogniSeis didn't need anyway, Judson says); SMDS added X-ADC, with its Motif look and feel, last year.

CaseWare, likewise, claims all the latest and greatest SCM features. CaseWare says its CaseWare/CM (formerly Amplify Control) "gives a software engineering team complete control over source code development and maintenance activities." According to company literature, "The system is designed to support medium to large-scale UNIX development teams running in a heterogeneous, distributed computing environment." CaseWare says that CaseWare/CM is a multiplatform, OS-, methodology- and file-system-independent product. The latest version, 3.0, synchronizes source code, object code, design specifications, technical and user documentation and other project-related data, the company says. It allows users to choose among a Motif GUI, command-line interface and a UNIX shell interface. CaseWare also offers a problem-tracking module to users who want this feature.

Carving a Niche

This is not to imply that all SCM packages are created equal. Vendors *do* distinguish themselves in positioning and/or in the SCM file-management model they support. Standalone CM tools operate on one of four paradigms, according to an article entitled "The State of Automated Configuration Management," which appeared in the 1992 Software Engineering Institute's *SEI Technical Review*. Just about all SCM systems are founded on the check-in/check-out model. Other models that vendors use to complement this are change set, transaction and composition.

On the positioning front, Intersolv touts its PVCS Series of SCM products as the best choice for users developing across heterogeneous LANs. PVCS runs on DOS, OS/2, Solaris/SunOS, AIX, SCO UNIX and Interactive UNIX platforms. The company claims more than 10,000 companies and 100,000 developers as customers. Version 5.0 of the product offers "member" (code, data files, documentation, object modules and other binary files) storage; access control; parallel development; and a reporting facility. Users can opt for the PVCS Developer's Toolkit, an API that lets customers invoke PVCS functions from their in-house systems; and/or PVCS Production Gateway, a DOS/OS-2-based link between the mainframe-based library management tools and PVCS on the LAN.

Atria Software–a company formed by a number of the developers of the Apollo Domain Software Engineering Environment (DSEE), the No. 1 SCM platform to date–is positioning its product, ClearCase, as the rightful successor to DSEE. "We do version control with a key distinction," says director of marketing Adam Zais. "We version everything, not just the ASCII source and directories. We're also different from SCCS and RCS and the companies whose products are based on them, like TeamOne and Softool." Atria is slowly distancing itself from the SCM label and is moving toward calling ClearCase a development environment, Zais says, because it complements the compiler/editor/debugger programming environments on the market today.

Zais says that ClearCase offers the primary benefits that made DSEE so popular, namely, rule-based configurations (configuration threads), transparent access to any version of versioned files, binary sharing and build audits. He says that the product also provides a number of long-standing DSEE-user wish-list items, such as portability, heterogeneous platform support, makefile compatibility, no need to declare dependencies and configuration management for all activities, not just building.

After two quarters of sales (ending December 1992), Atria claims to have 80 customers and more than 2,000

users. One customer, Motorola Inc.'s Land Mobile Products Sector, Shared Systems Division, based in Schaumburg, IL, is developing software for wireless communications systems. It has been using ClearCase since it was a pre-alpha version, a mere gleam in Atria's eye, says software engineer Mark Zanella. Prior to the fall of 1991, "we were using SCCS, which comes with the kernel on our 100 or so SPARCstation 2s," he says. "We built our own [SCM] tools on top of SCCS."

The Shared Systems Division was ecstatic over ClearCase's functionality and "how it could be implemented across our network," Zanella says. Among the features that impressed the division is ClearMake, the Atria build tool that supports standard and Sun `make`. ClearMake users share derived objects; and pre- and post-operation event triggers for process management.

The SCM vendor most anxious to differentiate itself by creating a new SCM niche is none other than SunPro. With its TeamWare system, SunPro is attacking what it claims is a problem for a huge pool of users. They need more than SCCS and RCS, SunPro says, but less than full-fledged SCM systems. According to SunPro, 80% of Solaris developers currently use SCCS, RCS or nothing to handle basic code management, while the remaining 20% use SCM systems. These systems are "costly and difficult to implement," in SunPro's words.

The SPARC-based version of TeamWare began shipping in volume in January; the Intel X86 TeamWare version is slated for mid-1993 availability. SunPro is pitching TeamWare first and foremost as a natural extension to its SPARCworks and ProWorks (for Solaris on X86) development environments. The product can run without SPARCworks or ProWorks, but SunPro anticipates that most customers will use the system in concert with the total Sun development environment, says director of marketing Henderson.

TeamWare consists of four new tools: CodeManager, for graphical project integration and release management; VersionTool, for visually inspecting and managing multiple versions of source files; CheckPoint, for capturing project source file configurations for later retrieval; and SunPro's own ParallelMake, for accelerating project builds. TeamWare also uses the SPARCworks and ProWorks Manager and FileMerge tools, whenever TeamWare runs with the complete SunPro development environment. TeamWare is based on the same "copy-modify-merge" paradigm upon which its predecessor, NSE, operated.

At press time, SunPro claimed more than 550 developers were beta-testing TeamWare, most of them affiliated with Sun Microsystems Computer Corp. and SunSoft. SunSoft used TeamWare as the code-management system for Solaris 2.1. One large beta customer outside of Sun is the Chicago-based systems integrator Andersen Consulting. Andersen is using TeamWare to develop a number of large-scale engineering applications for a petrochemical firm outside of Chicago. The development effort involves more than 22 Andersen team members, is expected to take three years and should result in about 300,000 lines of shared C++ source code.

Before Andersen introduced TeamWare into the petrochemical firm's development environment, "they were using bare-bones SCCS or nothing at all," says Larry Podmolik, an Andersen technical manager. Andersen is creating quite a development environment for its client, combining TeamWare with Rational's Rational Rose, CenterLine Software Inc.'s ObjectCenter, Parc Place Systems Inc.'s OI Library, SunPro's SPARCworks and Andersen's own Foundation CASE framework. "All of these tools will be integrated into TeamWare, except for Foundation and Rose, which both have their own repositories," Podmolik explains. TeamWare will be responsible for managing the software coding, testing and documentation.

Andersen isn't thrilled with the copy-modify-merge paradigm upon which TeamWare is grounded, Podmolik says. "Because we work on a contracting basis, we wanted single-threaded access to individual pieces of code," he explains. He also points out that SunPro's product lacks dependency-checking capabilities at the file level, so Andersen ended up writing a dependency analysis itself.

"TeamWare's not right for every environment," Podmolik acknowledges, "but its training curve isn't very high and it's fairly scalable." As more managers and engineers draw similar conclusions about their own choices, SCM is likely to be seen as less of a pain and more of a necessity. ⊸

Companies Mentioned in this Article

Atria Software Inc.
24 Prime Park Way
Natick, MA 01760
Circle 141

CaseWare Inc.
108 Pacifica, 2nd Floor
Irvine, CA 92718
Circle 142

Expertware
3235 Kifer Road, Suite 220
Santa Clara, CA 95051
Circle 143

IBM Corp.
1133 Westchester Ave.
White Plains, NY 10604
Circle 144

Intersolv
3200 Tower Oaks Blvd.
Rockville, MD 20852
Circle 145

Softool Corp.
340 South Kellogg Ave.
Goleta, CA 93117
Circle 146

Software Maintenance and Development Systems Inc.
P.O. Box 555
Concord, MA 01742
Circle 147

SunPro
2550 Garcia Ave.
Mountain View, CA 94043
Circle 148

TeamOne Systems Inc.
710 Lakeway Drive
Sunnyvale, CA 94086
Circle 149

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.

Turbo Boost for Optical

Could your optical storage devices stand a 200% to 500% increase in performance? U.S. Design has announced the first member of its Turbo Mass family of products. The primary function of this product is to boost performance of both standalone and jukebox versions of optical storage. Strategies for read caching, write caching, platter caching and drive caching as well as striping and other methods are used to accelerate optical devices. These methods allow Turbo Mass to boost either data-transfer rates, individual command-response times or net I/O transaction rates in an application-sensitive manner.

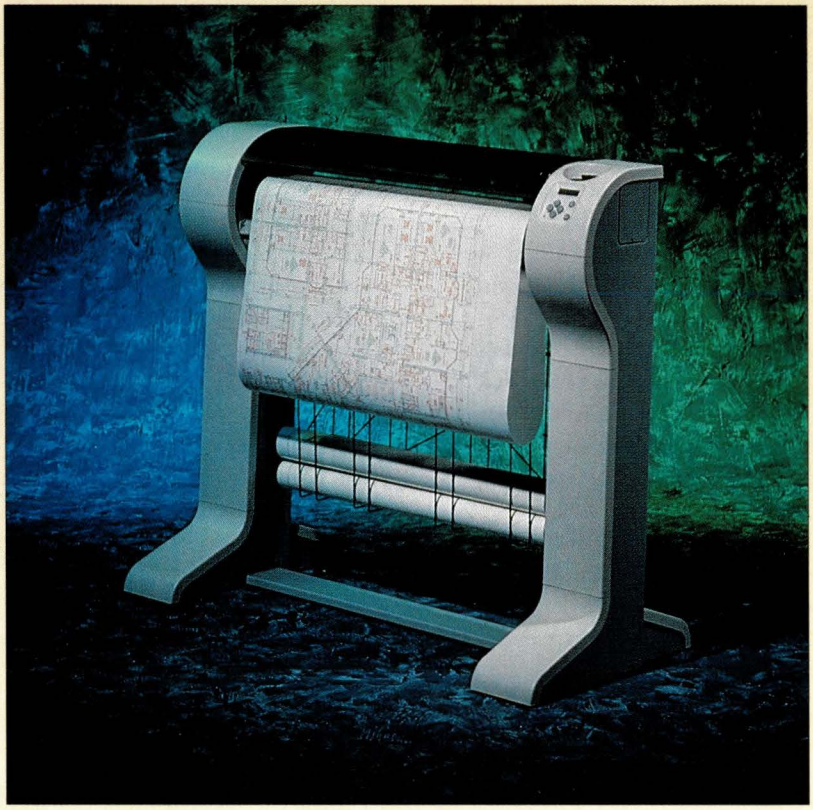
Turbo Mass operates as a SCSI-to-SCSI unit, supporting three 10-MB/s SCSI ports: one for initiator service, one for optical storage and one for cache devices. The product interfaces to any SCSI optical device, so all existing SCSI drives can benefit. It operates transparently to the host operating system so all existing software continues to run without change, including system-level software. Other features included are hot-swap options, a built-in UPS, local and remote console operation and more.

U.S. Design Corp.
9075 Guilford Road
Columbia, MD 21046
Circle 101

Contemporary Tape

Contemporary Cybernetics has added two half-height 8mm tape drives to its line of tape-backup devices. The CY-8205 stores between 2.5 and 12.5 GB at speeds of up to 1.3 MB/s; the CY-8505 stores between 5 and 25 GB at speeds of up to 2.5 MB/s. The high capacity and speeds are explained by use of built-in data compression. For compatibility with other sites, the data compression is switch-selectable so users can read and write tapes without data compression. Multiple levels of error correction code and the constant monitoring of data compression ensure data integrity.

These models are plug-compatible with such systems as Digital Equipment Corp., Data General Corp., Hewlett-Packard Co., IBM Corp., Apple Computer Inc., NCR Corp., NeXT Inc., Silicon Graphics Inc., Sun,



E-Size Pen Plotter

CalComp has introduced an E-size pen plotter that produces multicolor drawings on both cut-sheet and roll-feed media. Called the Classic, the product can output cut-sheet media in widths ranging from A- to E-size. In roll-feed mode, it can deal with E-size media and, with an adapter, D-size media in 120-foot rolls. It has an eight-pen turret, and the user can mix and match liquid ink, liquid ball and fiber-tip pens for printing on bond, polyester film, translucent or vellum.

CalComp says the new product can plot at speeds of up to 42 inches per second. Addressable resolution is .0005 inches, single-pen repeatability is .004 inches, and accuracy is 0.1% of the move. Classic is compatible with Sun workstations. Pricing begins at $6,995.

CalComp
Computer Graphics Group
2411 West La Palma Ave.
Anaheim, CA 92801
Circle 100

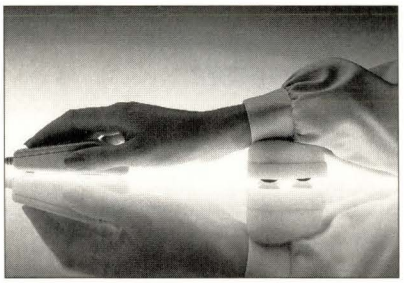
Unisys Corp. and more. Drives can be internally mounted or purchased as desktop models. Contemporary's Advanced SCSI Processor allows two drives to work together to maximize backup speed and capacity with a variety of recording models.

Contact the vendor for pricing, which is dependent on configuration.

Contemporary Cybernetics Group
11846 Rock Landing
Newport News, VA 23606
Circle 102

Hot Set o' Wheels

A wheeled platform that supports your arm while you use a mouse is



being sold as the latest response to carpal tunnel syndrome and other nasty cumulative trauma disorders.

The Mouse Shadow is an "ergonomically correct" product that allows you to move a mouse, and your hand, while giving your arm a place to rest. This is said to reduce the "repetitive wrist motion...that can cause the median nerve to rub against a narrow space in the underside of the wrist..."

With a suggested retail price of $19.95, Mouse Shadow is considerably cheaper than surgery and/or physical therapy. The wheels are described as geoplast rubberized balls. It also has a cushion across the arm rest which is made of Volara, a material that the company says is nontoxic and resistant to hot water and detergents.

ShadowTech International Inc.
2207 NW 37th St.
Lawton, OK 73505
Circle 103

Focus on Workstations

In Focus Systems has entered the workstation market with the 7500WS, the first portable LCD color projection panel for workstation users. Weighing in at 7.5 pounds, the 7600WS has a resolution of 1,024 by 768 and a 24,000-color palette.

In Focus claims the projection panel will be ideal for applications such as CAD, GIS and scientific imaging. Primary applications are software training, software and hardware sales demonstrations and interactive workgroups. The 7500WS is priced at $8,995.

In Focus Systems Inc.
7770 S.W. Mohawk St.
Tualatin, OR 97062
Circle 104

Security on the Network

Security Dynamics has announced Version 1.1 of its ACE/Server network security products. ACE/Server is a software-based security server that centrally authenticates a user's identity and allows only authorized users to gain access to a protected network. The new version offers security administrators the option of running a backup ACE/Server that would process authentication requests and maintain an audit trail of all security-related activities if the master server were to malfunction or cease operation.

ACE/Server is used with SDI's SecurID Card, a credit card-size token that displays a randomly generated, unpredictable access code that automatically changes every 60 seconds. It effectively protects and controls internal and external access to network resources regardless of whether a gateway, remote dial-up or direct connection is used.

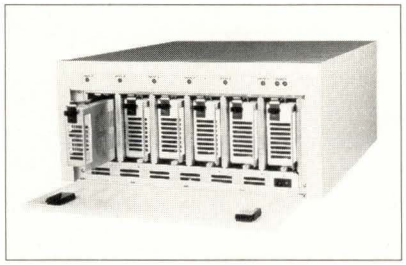
Supporting TCP/IP, the ACE/Server operates in SunOS, DEC Ultrix, IBM RS/6000 and HP/UX environments. The starter kit, which supports up to 16 users, is priced at $4,950.

Security Dynamics Inc.
One Alewife Center
Cambridge, MA 02140
Circle 105

RAID Enclosure

A new enclosure for RAID and other SCSI applications has been brought to market by Sigma Information Systems. The SA-H288 incorporates all of the advanced features necessary for supporting up to six 3½-inch disk drives and an array controller in a package suitable for use in rack-mount, desktop or floor-mounted configurations.

The chassis features dual-redundant hot-pluggable power supplies, hot-pluggable disk drive canisters and



automatic drive power sequencing. Individual SCSI/IN and SCSI/OUT connections for each drive canister are available for applications requiring array rank expansion or an external array controller. A front door is provided for access to the drives and the on/off switch. A display area that contains drive activity and power supply status indicators is visible above drives. List price is $2,769.

Sigma Information Systems
5775 Polaris Ave.
Las Vegas, NV 89118
Circle 106

Homemade CD-ROMs

Philips' new CD-ROM recorder and CD-Gen software from CD-ROM Strategies allows you to make a single CD-ROM in 35 minutes. 650 MB of data, or 300,000 pages of text, can be stored on a single disk, making this a great option for daily network backup, converting microfiche to electronic media and distributing large databases and other needs.

The Philips recorder works on a wide range of platforms, including PC, Mac and UNIX. Price is $14,995.

dataDisc International
Route 3, Box 1108
Gainesville, VA 22065
Circle 107

Tripling Tape Trick from Dynamic

Dynamic Computer Products has a user-installable data compression and LCD display upgrade kit on the market for use with any existing 8mm Exabyte drive.

The Model 5TXXDC/DP triples both capacity and transfer rate of the drive. It operates through a SCSI inter-

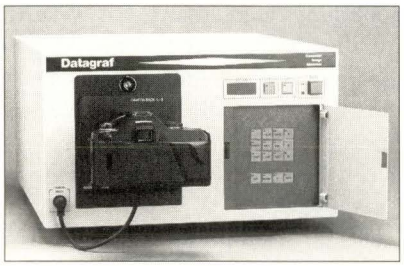
face. A front-panel selection of compression and tape status is provided.

This upgrade option sells for $960 including a one-year warranty.

Dynamic Computer Products
63 Commercial Ave.
Garden City, NY 11530
Circle 108

Creative Improvement

For anyone who needs to study, analyze, present or publish documents, or archive hard copy of a generated



image, Datagraf introduces a product for you. The Image Recorder 300 Series is a family of film recorders designed to consistently produce the highest quality images directly from computer and workstation displays. The imaging source is a high-resolution, 7-inch, flat-faced CRT. The output resolution is host-dependent and designed to accommodate pixel resolutions up to 1,600 by 1,280.

The CIR is completely software independent. A passive hardware interface is used to display the computer's video image on the internal CRT, resulting in exposure times less than 20 seconds for a complete 35mm image. Four film formats, ranging from 35mm to 8 by 10 inches, are supported. Pricing ranges from $6,000 to $12,000.

Datagraf Inc.
P.O. Box 1446
Wheeling, IL 60090
Circle 109

Portable Workstation from RDI

RDI has added a new member to its family of portable workstation products. The new BriteLite LX offers greater memory and disk capacity. A new Colorplus Active Matrix LCD display provides a palette of 256K colors (64 levels of gray scale) for more accurate color illustrations and image rendering.

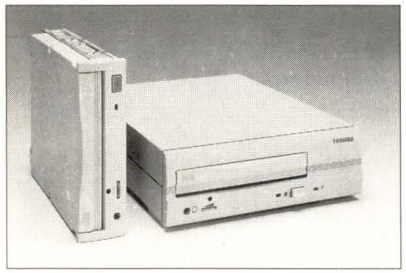
The power behind this model is the new 50-MHz SPARCengine from Sun. Improved memory architecture allows the BriteLite LX to be configured with 16 to 96 MB of memory. The internal hard disk supplies 450 MB of storage. For disk-intensive applications, the 3½-inch form factor offers an improvement in the BriteLite's I/O performance.

RDI's use of actual Sun motherboards and an unmodified Solaris 2.1 operating environment ensure 100% Sun compatibility. Pricing is $15,995.

RDI Computer Corp.
6696 Mesa Ridge Road, Building A
San Diego, CA 92121
Circle 110

CD-ROM Improves Again

Toshiba has introduced the XM-3401 Series CD-ROM disk drives.



These double-speed drives feature 2.2 times the rotational speed to provide a 330-KB/s data transfer rate and a 200-msec random access time. Standard features include a SCSI-2 interface and fully integrated audio with continuous volume control. Mean time between failure rate is 50,000 hours.

These drives are available in four models. The XM-3401B internal drive, the TXM-3401E external drive, the TXM-3401P for laptop and notebook computers, and the TXM-3401A4 for applications with fast access to multiple CDs.

XM3401B lists at $695; TXM-3401E at $895; TXM-3401P at $925; TSM-3401A4 at $3,575.

Toshiba America
Information Systems Inc.
Disk Product Division
9740 Irvine Blvd.
Irvine, CA 92718
Circle 111

Optima Strikes Again

Optima Technology has come out with its latest development in high-performance external SCSI hard disk subsystems, the MiniPak 1600. The MiniPak is designed to provide high-end workstation users with an easy way to expand their storage capacity and is supported on workstations from Sun, Hewlett-Packard Co., IBM Corp., Digital Equipment Corp., Data General Corp. and other UNIX vendors.

The drive features 1.6 GB of formatted capacity, 3½-inch half-height form factor in a Fast SCSI-2 hard disk drive, a burst transfer rate of 10 MB/s and a seek time of 9.5 msec. Features include an auxiliary power supply outlet and a modular design that allows for vertical or horizontal setup. Retail price is $4,295.

Optima Technology Corp.
17526 Von Karman
Irvine, CA 92714
Circle 112

Canon Bubble Jet Engine Ready to Go

Canon USA's Computer Peripheral Products Division has introduced a high-quality Bubble Jet printer engine, the BJP-C80, designed specifically for OEMs targeting desktop publishing, graphic arts, CAD/CAM, etc. OEMs integrate a controller with the BJP-C80 through a proprietary interface to provide value-added features to targeted market segments, or it can be incorporated into a host-based system.

The BJP-C80 prints at 360 dpi and uses disposable, snap-in ink cartridges. List price will vary according to OEM.

Canon USA Inc.
One Canon Plaza
Lake Success, NY 11042-1113
Circle 113

Low-Cost X Terminal

The FX17CT, a new member of the color X terminal family from HDS, has hit the market at a price of $2,299. This model features a 17-inch Trinitron display, and 1,152-by-900 and 1,280-by-1,024 resolution. Like other members of the ViewStation FX Series, the new model is designed around an Intel Corp. i960CA RISC CPU. Included in the base configuration are 4 MB of RAM; configurations up to 68 MB are possible. The FX17CT comes with twisted-pair Ethernet, serial and parallel ports, a mouse and keyboard.

This terminal includes HDSware V2.0, a new software environment that includes HDS' X server, local Open Look and Motif window managers, local VT320 emulation, PPP, SNMP, a local host chooser, and a new graphical setup mode made for ease of use. The unit is available two weeks after receipt of order.

Human Designed Systems Inc.
421 Feheley Drive
King of Prussia, PA 19406
Circle 114

SBus Communications Subsystem

An SBus communications subsystem that allows a SPARCstation to support up to 32 asynchronous serial devices has been announced.

The S-Bus Connect, from Metacomp, supports the additional serial devices with full modem control, operating at 38.4 Kb/s, full-duplex with continuous operation. The company says the product can be used to fit SPARCstations into a variety of connectivity applications, including multiuser server, data collection and processing and so on.

The product consists of an SBus host adapter board and a 16- by 16-inch chassis. The enclosure then provides 32 asynchronous parts, two parallel printer ports and space for two 5¼-inch SCSI peripherals. The adapter board resides in the SPARCstation and provides the link to the subsystem chassis. Pricing begins at $3,295.

Metacomp Inc.
108908 Via Frontera
San Diego, CA 92127
Circle 115

Solaris Supercomputer

A supercomputer-class machine based on the SPARC and running Solaris has been introduced by Meiko. The product, called the CS-2, is an array of SuperSPARC-based nodes that can, depending on the configurations, provide multiple teraflops of performance. The CS-2's operating system, meanwhile, is Solaris. The machine also comes with assorted software tools for software development in a parallel and multiprocessing environment.

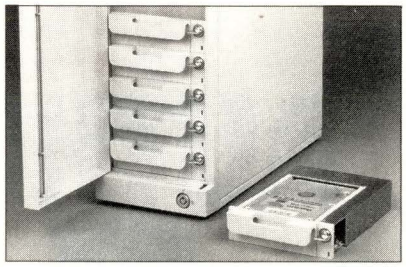
There are two kinds of processing elements available, both based on the SuperSPARC. One is a computing element; the other is a vector processor that offers peak speeds of 200 64-bit MFLOPS. These elements can be mixed or matched, depending on the

end user's needs. An entry-level system starts at $500,000.

Meiko World Inc.
Reservoir Place
1601 Trapelo Road
Waltham, MA 02154
Circle 116

Low-Cost RAID Device

A device that combines solid-state disk, cache and RAID technology into a single unit has been introduced by



Vermont Research. Called RAIDstar, the product supports SCSI or SCSI 2 Fast and Wide to provide RAID performance at levels 0, 3 and 5. An entry-level system consists of 1.8 GB of disk, 8 MB of cache memory and a power supply. A RAIDstar can be expanded up to 45 GB of disk and 20 MB of cache or 320 MB of solid-state disk. Pricing begins at $24,080. VRC also offers a RAIDstar retrofit kit that allows users to configure their own disks to fit the RAIDstar. With it, the RAIDstar will support as many as 35 5¼- or 3½-inch SCSI or SCSI II/Fast drives. The user can either send the disk drives to VRC for retrofit, or VRC will do the conversion at the customer's site. Pricing begins at $200 for factory conversion and $300 for on-site.

Vermont Research Corp.
Precision Park
North Springfield, VT 05150
Circle 117

Optical Deserves a Look

Alphatronix has improved on its optical storage offerings with the Inspire II. This new drive claims access speeds faster than any other currently available and will be priced 40% lower than the original. The drive's average seek time is 23 msec; access time is 14 msec.

High speeds are made possible through a new, ultralight, asymmetric split head. Data transfer and throughput are speeded through full read and write caching. A new DSP-based minimum trajectory seek method minimizes the number of seeks required.

The new drives are targeted toward users requiring large amounts of storage or portability, extended durability or security and are expected to rival removable and portable hard drives. List price starts at $4,495.

Alphatronix Inc.
2300 Englert Drive, Suite C
P.O. Box 13687
Research Triangle Park, NC 27709
Circle 118

Slate Upgrade

BBN Systems is shipping an upgrade of its famed BBN/Slate integrated software package.

Slate is an office-productivity tool that provides document creation and transfer between multiple users. In Release 2.0 of the product, Slate will include an Open Look and Motif GUI, the ability to create forms with read-only fields in the text, new page-layout facilities, and several other features.

Slate sells for $995 per license, though users of the previous release will receive free upgrades to 2.0.

BBN Systems and Technologies
10 Moulton St.
Cambridge, MA 02138.
Circle 119

Correction

Regrettably, *SunExpert* omitted ANDATACO from the January listing of tape vendors. ANDATACO sells a varity of tape products including 4mm and 8mm drives. Its desktop, 3½-inch 4mm DAT subsystems range in capacity from 2 to 8 GB and its 8mm subsystems and stackloaders, including a library system, provide 2.5 to 200 GB (with compression) of storage. Media, cables, tape-management software, warranty service, maintenance and on-site installation are available. For more information, contact:

ANDATACO
9550 Waples ST.
San Diego, CA 92121
Circle 120

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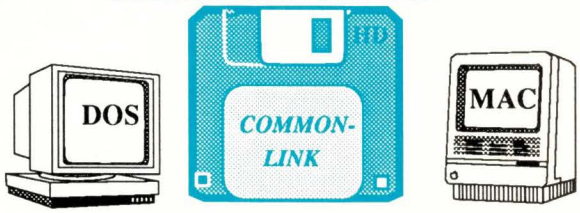

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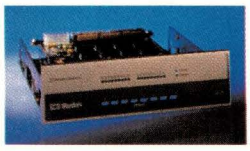

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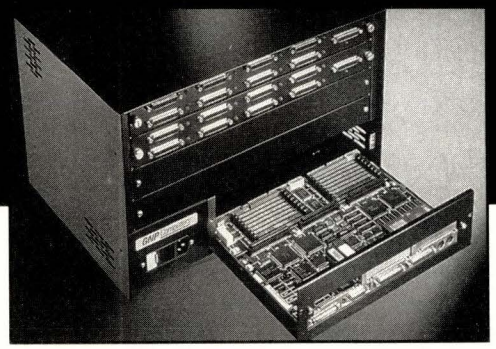

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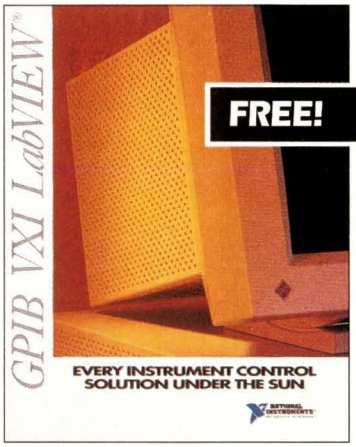

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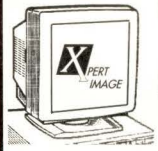

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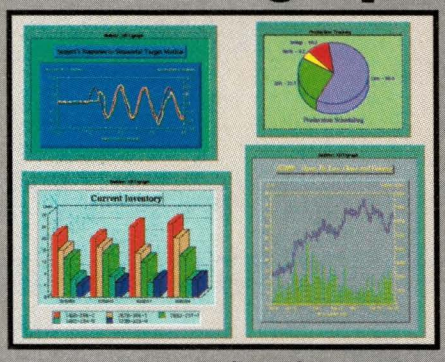

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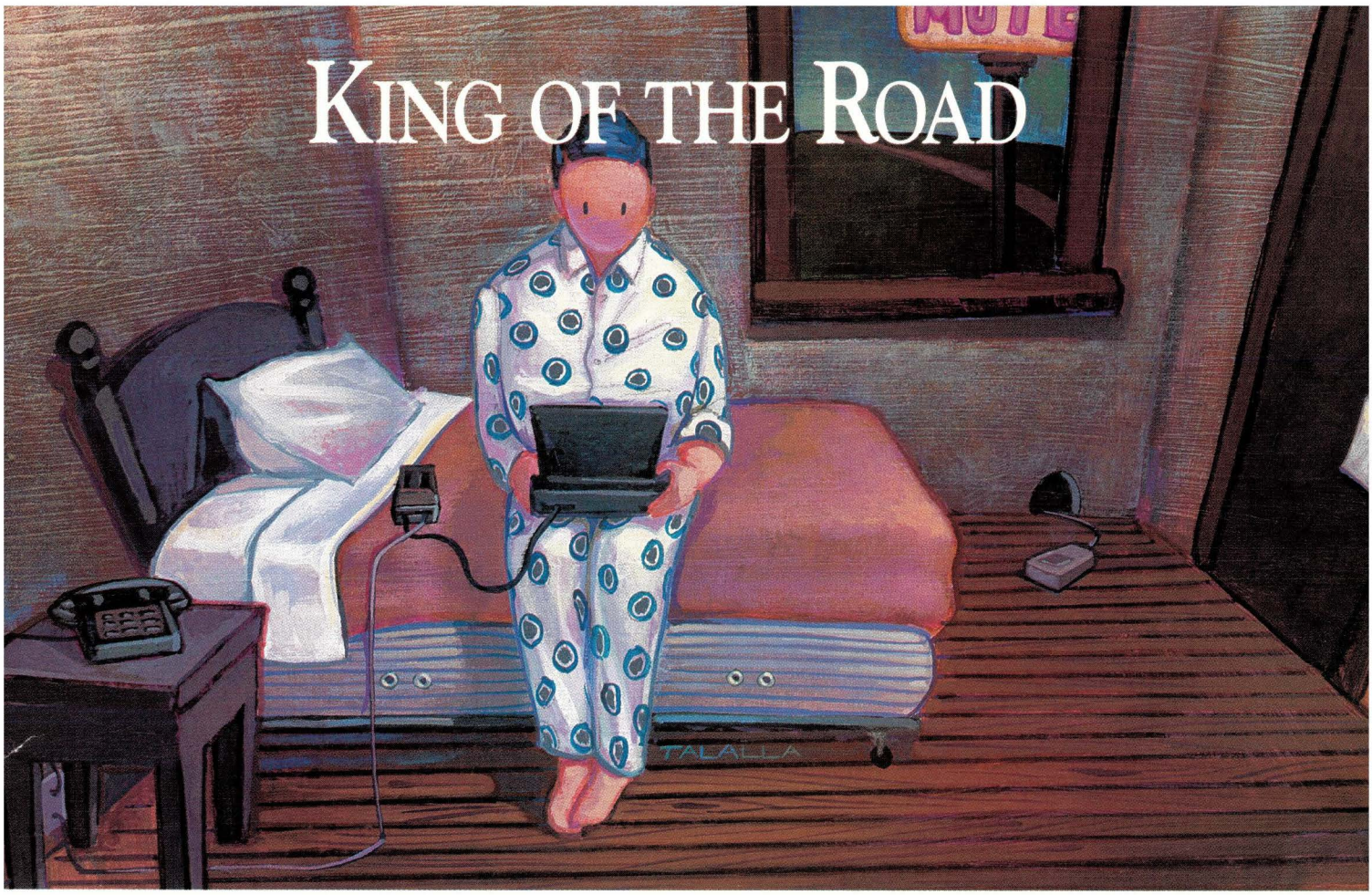

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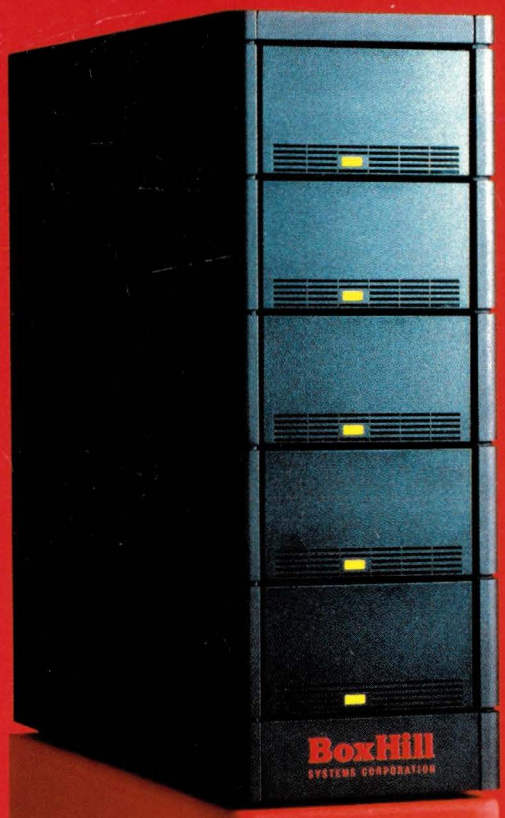

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