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DECEMBER 1992 Vol. 3 No. 12 $5.50

ews: SPARC LX and Classic

Reviews: Three Terminal Servers

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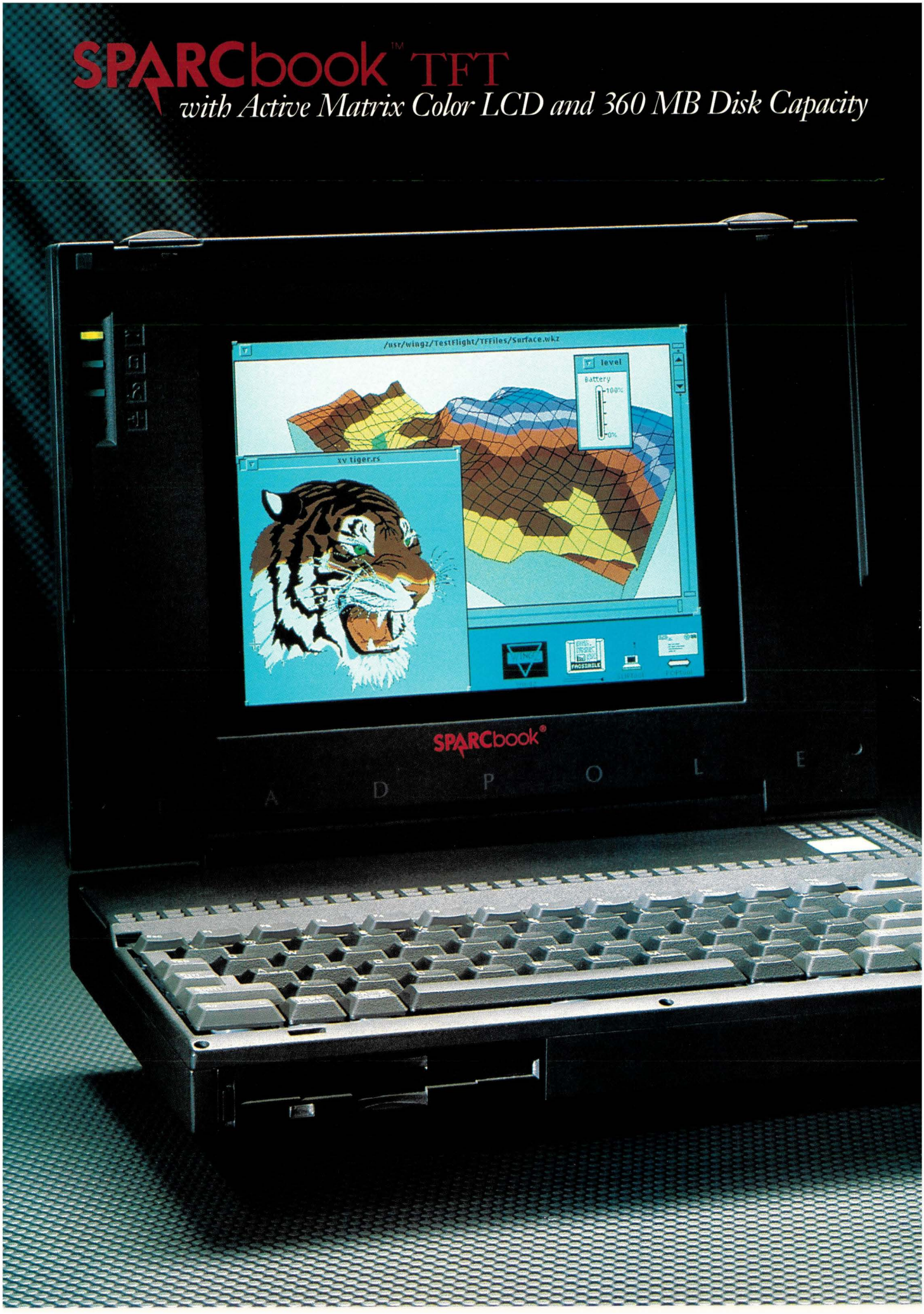
with Active Matrix Color LCD and 360 MB Disk Capacity



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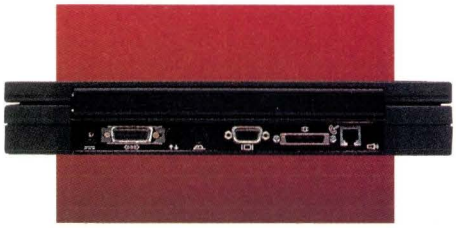

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SUNEXPERT Magazine
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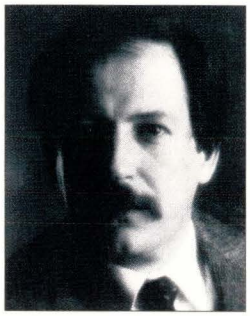
Editorial

Welcome to the Club

The SPARC shopping club, that is. Have we got a deal–toot, toot–for you today. What would you pay for a 50-MHz, 59-MIPS CPU? No, not $8,000. Try 16 MB of memory? Not $7,000. How about a 207-MB, 10-MB/s SCSI disk? Not even $6,000. Throw in a 1,024-by-768 15-inch monitor. Would you pay $5,000? You say you want Ethernet? OK, $4,750, but we're not done yet. Remember folks, this is not a clone. It's the real thing. Comes in a box with a purple company logo. A classic with an 8-bit audio port and SBus expansion possibilities. If you're on the line, you get the street price of just $4,295. That's right, under $4,300. And for a 12-pack, the price is just $3,995.



Most of this month's News section is devoted to hardware, including Sun's November product blitz–the SPARCclassic and SPARCstation LX for the desktop, and the SPARCcenter 2000, a mainframe-class multiprocessor once known as Dragon. The Classic, according to Sun, will unseat some high-end PCs, while the $7,995 LX, with its GXplus graphics accelerator and 424-MB disk drive, will find a home as an entry-level graphics workstation. Sun hopes the SPARCcenter will attract MIS-oriented accounts, as well as compute-intensive technical users. The blitz is a high-low combination aimed squarely at commercial computing. All of the new boxes run yet another release of Solaris. In fact, the Classic and LX ship with 2.1, the same OS that will be required for Model 52 and 54 SPARC 10s. We'll have more on Solaris 2.X next month. Meanwhile, you'll need the disks on the Classic and LX just to keep a local OS. (Is that a cost-effective use of the net?)

An interesting feature of the SPARCcenter 2000 is the absence of a feature. Venerable VME is gone. All expansion must be SCSI or SBus. So, check out our cover story. It's a nitty-gritty explanation of the many issues involved in picking an expansion chassis.

Doug Pryor

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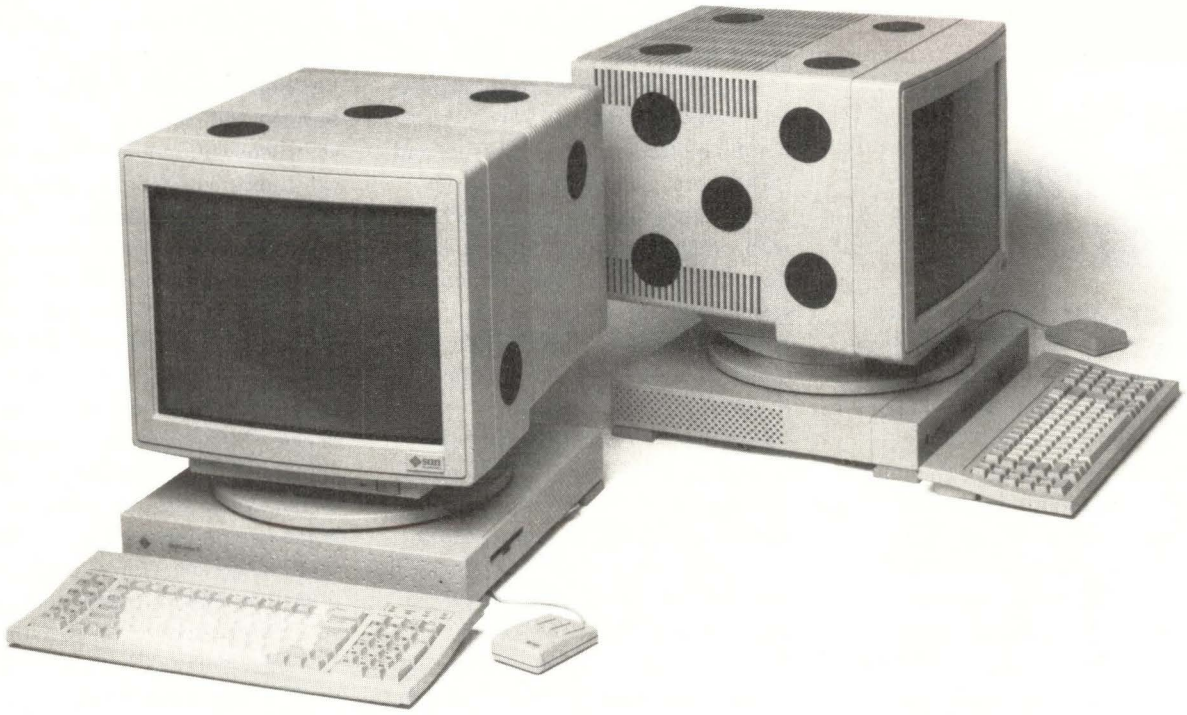

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NEWS

The Real (Low-End) Thing

Move over, Mac. Step aside, Coke. The real thing–at least in the workstation market–is the SPARCclassic, according to its proud parent, Sun Microsystems Computer Corp.

The Classic, which begins shipping in volume this month, is "the first color workstation priced less than a PC–fully configured," claims SMCC. (Several SPARC-compatible/clone vendors have serious problems with Sun's claim to be "first" in this market, however.) With a nondiscountable base price of $4,495, the Classic has been clocked in SMCC's labs using the SunPro SPARCworks compiler at 59 MIPs and 26.3 SPECint92, says Jeff McFadden, director of desktop product marketing. Built around the 50-MHz Texas Instruments Inc. microSPARC, the system features 10-MB/s SCSI; a 207-MB disk; a 15-inch, 1,024-by-768 monitor; a built-in Ethernet port; and 8-bit audio.

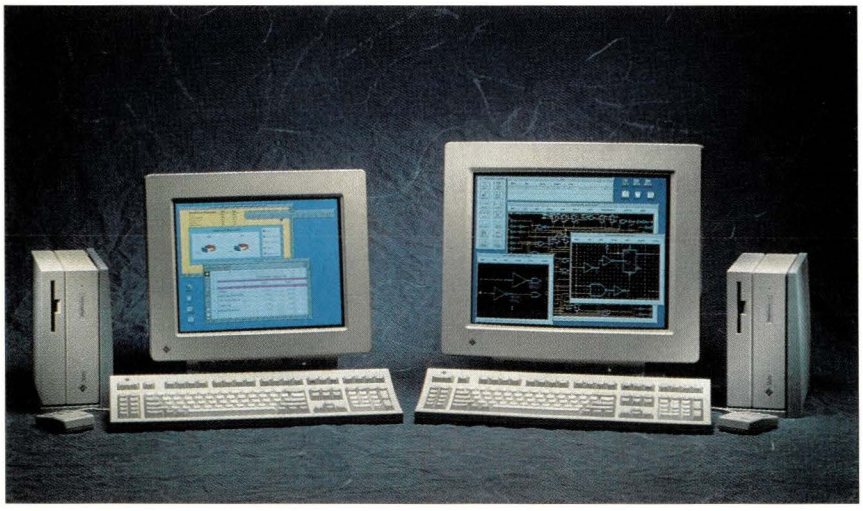
At the same November 10 unveiling, SMCC also launched its SPARCstation LX, which, like the Classic, has at its heart the microSPARC processor. Sun's new entry-level accelerated graphics machine sports the same MIPS, SPECint92 and floating-point (SPECfp92 of 21) ratings as the Classic. It ships with a GXplus accelerator; a 424-MB disk; a 16-inch, 1,152-by-900 monitor; built-in Ethernet and ISDN ports; and 16-bit, CD-quality audio. The system lists for $7,995, with volume discounts available. Sun claims that the LX is "the first accelerated graphics workstation under $8,000." (Again, the SPARCalike vendors have a bone to pick with Sun over its use of the word "first.")

Both the Classic and LX sport two SBus slots and can be expanded to feature up to 96 MB of memory, 1.05 GB of internal disk and up to 22 GB of total disk capacity. Both systems will ship with Solaris 2.1, the same OS required by the SPARCstation 10 Models 52 and 54. Rumor has it that the machines *will* run with Solaris 1.X, but very slowly, at best.

SMCC isn't billing either the Classic or the LX as a replacement system for other SPARCstation models in its product lineup. For users unable or unwilling to make the jump to Solaris 2.X right now, the existing SPARCstations are viable options. But the price and performance of the new systems point to Sun's phasing out of its ELC, IPC and IPX. SMCC decided not to slash prices on these models for now but plans instead to take the ELC, IPC and IPX off its price list by May 1993, says McFadden.

Sun is hoping to unseat some of the high-end PC leaders with the Classic, and some of the low-end graphics workstation ones with the LX. Desktop publishing, CAD and other business and "specialist" applications are where workstations like the Classic can compete realistically against top-of-the-line PCs, McFadden says. In what seems like a contradiction–based on numerous reports of Sun's intentions to enter the X-terminal market by the second quarter of 1993–SMCC also sees the Classic as a competitor to color X terminals, McFadden says. Where SMCC *doesn't* see itself competing is in the low-end/midrange PC market, where office-automation and home-computing applications rule the roost, he explains. Interestingly, prior to the November launch, quite a number of SMCC customers were thinking and talking of the Classic as "a nice little home computer."–*mjf*

The SPARCclassic and SPARCstation LX aren't being billed as replacements for other SPARCstation models, but are likely to succeed the ELC, IPC and IPX over time.



Meanwhile, Over at the Mainframe...

While one hand of Sun Microsystems Computer Corp. was showing SPARCclassic as its low-end offering, the other was displaying SPARCcenter, a new and expandable server that can support up to 20 SuperSPARC processors. The resulting system is a mainframe-like device that Sun says will sell into commercial, MIS-oriented accounts, as well as to compute-intensive technical users.

The SPARCcenter 2000 is a tower unit hardly larger than the existing SPARCserver 600MP. Under the hood, however, all bets are off. An entry-level system, which would cost about $95,000, consists of a single system board (with two CPUs), 4.2 GB of disk space and 64 MB of memory. Users can expand the system, however, by simply sliding in additional system boards–up to the total of 20 CPUs–at a cost of $18,000 per board and $10,000 per SPARC. Moreover, when fully configured, the machine would support 40 SBus slots, up to 1 terabyte

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of disk and 5 GB of main memory.

What makes all this possible is the operating system–the multiprocessor-oriented Solaris 2.X SMP/MT–and the XDBus. The latter is a CPU-to-memory link from Xerox PARC. Not a bus in the classic computist-sense, the XDBus is effectively a tiny packet-switching communications network that links the CPU to memory, CPU to CPU, and system board to system board.

Because the systems are so new, benchmark information remains sketchy. However, Sun already has some firm SPECmark numbers. In terms of integer performance, the four-processor version of the machine offers 4,199 SPECint92, and with eight processors it offers 7,389 SPECint92. In terms of floating-point performance, meanwhile, the four-processor version offers 5,605 SPECfp92 and for the eight-processor machine, 10,096 SPECfp92.

Significantly, there is no VME bus in the system. System expansion comes via the SBus slots, or it does not come at all. This does not really signal a change of direction for Sun, since the company has been backing away from VME since the late 1980s, but it does bring the company a step closer to being out of VME entirely. Company spokespeople say that while Sun will continue to support its existing VME products, like the 600MPs, it will introduce no more new VME-based products.

Sun says the SPARCcenters will be sold to commercial accounts that wish to slowly migrate away from mainframes to smaller, less-expensive systems. To this end, the company says that it has designed them to be attractive to MIS–they are, for instance, said to be "fault resistant." Perhaps more importantly, though, Sun has also moved to change itself–modifying, for example, its service and support programs to meet the needs of commercial computing environments that cannot survive long periods of downtime. *–mjt*

Here Come the 10s

Contrary to the word on the street (and a handful of published reports), Sun Microsystems Computer Corp. stands in good stead with its SPARCstation 10s. The first model, the 30, began shipping on time and in volume in September. Due to processor yield problems, the Model 41 was shipping only in limited volume this fall, but Sun is promising volume deliveries this month. The multiprocessing Models 52 and 54 are right on target, according to Jeff McFadden, director of desktop product marketing, with the 52 due out in January and the 54 during second-quarter 1993. And by and large, users seem content with the system delivery, performance and support they are receiving from SMCC.

"Once they started coming," says Richard Elling, manager of network support for engineering administration at Auburn University, of the 35 Model 30s the university had ordered, "they came fast and furious. But, of course, we would always like them to ship the next day." At press time, Elling had received 31 of the Model 30s but had yet to receive the Model 41 or 54 that the university has requested. The 30s, which are running CAD/CAM/CAE software and related development tools, "are much easier to work on than every other Sun, except perhaps the ELC," claims Elling.

What else do users like about the 10s? "Performance, performance, performance," responds Jeff Sundin, a software engineer with the Sun VAR CTR Business Systems Inc., Portland, OR. For customers with applications like Sundin's–solids modeling, database and CAD–speed is of the essence.

Steve Mowbray, computer systems manager for the University of Manchester's physics department, points out another priority for SS10 customers: solid I/O performance. The department is using the 10s to replace IPXes to analyze various scientific data. While noting that he's not overjoyed with SMCC's delivery speeds for the two Model 41s he has on order, he adds that the Model 30, of which he has taken delivery, was "easy to install, fits seamlessly into the SunOS 4.1.1 environment, [provides] good CPU performance and fast SCSI."

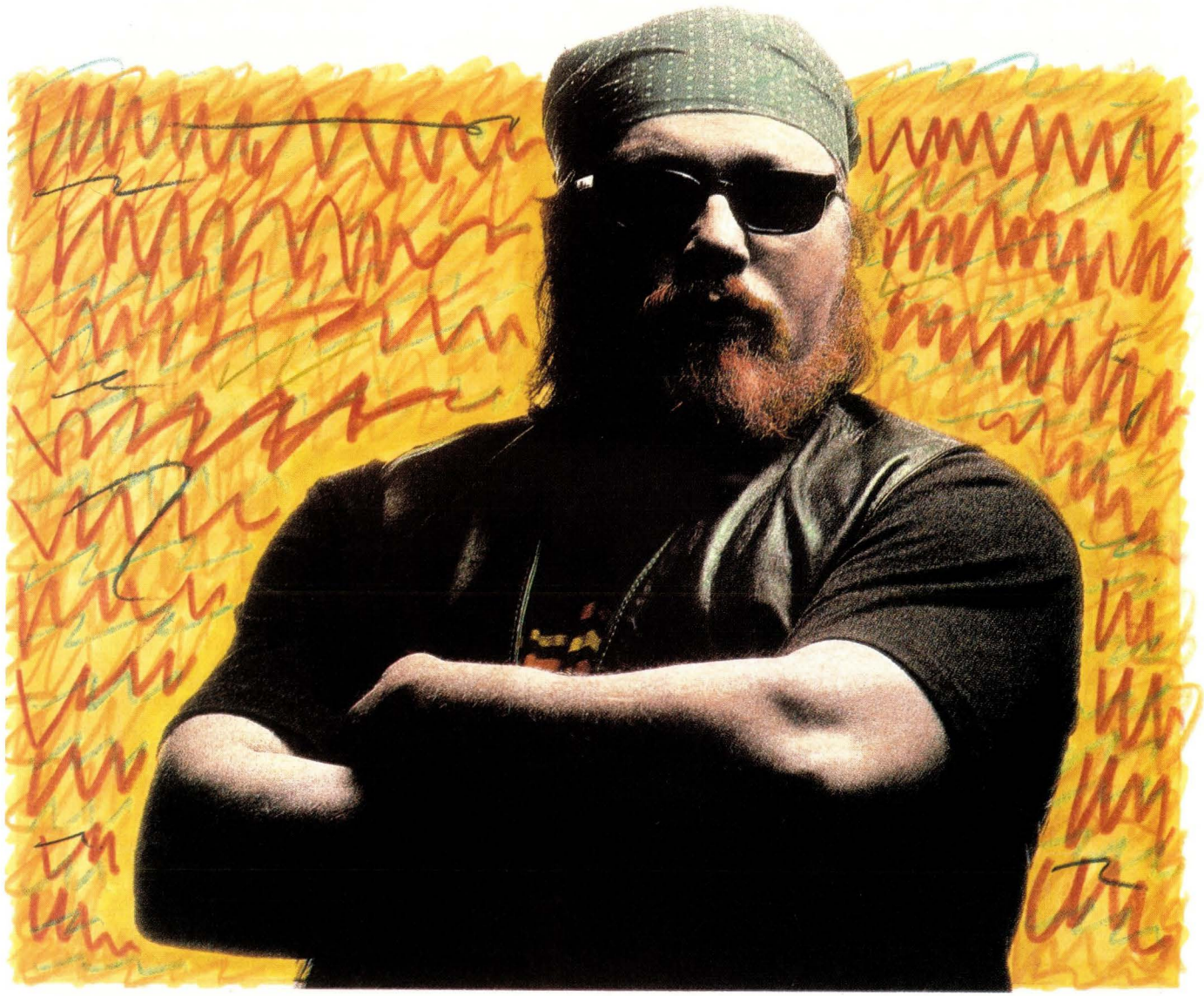
A couple of 10 customers make note of some fairly minor yet annoying cabling problems they've encountered with the systems. One user says he wishes that Sun had included an RS-232 cable with the 10 so that he would have been able to access both a and b serial ports. Another user at Purdue University calls the thicknet port on the Model 30 "a kludge." CTR's Sundin claims "there are too many 'optional' cables–i.e., serial splitter, AUI/speaker cable, parallel cable–for a machine that includes so many standard items." Sundin also points out that the internal hard disks that ship with the SS10s use a completely different mounting scheme than do the other SPARCstations, and that this difference "will make third-party disk integration tricky."

But the biggest problem in the SS10 realm remains the elusive Model 41. SMCC knew this summer that the 41 would be late due to difficulties on Texas Instruments Inc.'s part in turning out 40-MHz SuperSPARC chips in volume. To compensate–and to make use of a substantial quantity of 33-MHz SuperSPARCs that TI *was* able to produce–SMCC developed a previously unannounced SS10 Model 20 machine and made it available up until September 30 to Model 41 customers as an interim solution. SMCC then knocked a couple of thousand dollars off of the price of the 41 upgrade for the Model 20 customers. Some 41 customers who opted not to take shipment of the 20, pleading that they didn't understand the monetary benefits of the deal, say they feel cheated. And even some 30 customers, who later learned of the 20-to-41 upgrade, say they wish they had known about this option, claiming that it might have inspired them to buy Model 41s instead of 30s.*–mjf*

E&S Gives Graphics to Sun Desktop

Graphics gurus and picture partisans may finally be able to forgive Sun Microsystems Inc.–thanks to a new product from Evans & Sutherland Computer Corp. in Salt Lake City.

Relations between the graphics community and Sun have never been good–and they've been downright strained since Sun's well-publicized departure from the high-end imaging market, not to mention ill-timed and



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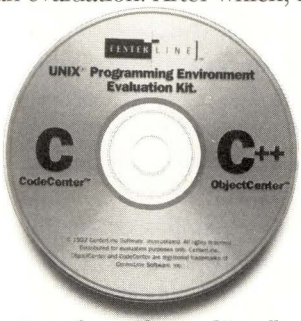

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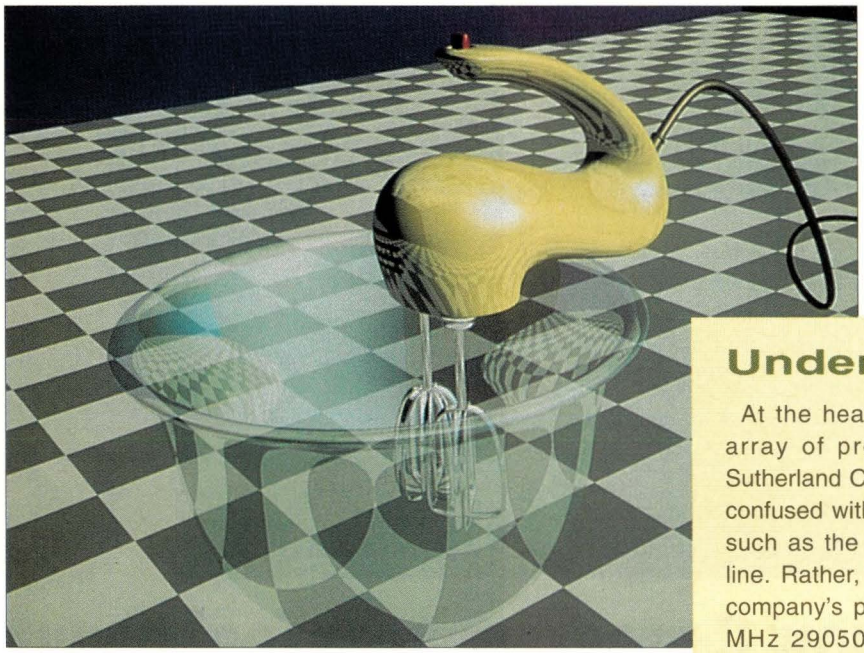
impolitic public statements by high-placed Sun officers to the effect that graphics specialists would be better off working on video games.

Now, however, there's a detente in the making. This October, Sun and E&S showed the Freedom Series of 3D graphics accelerators for SPARC and other Solaris platforms. The two products in the line, the Freedom 1000 and 3000, effectively bring the graphics performance of E&S's famed graphics engines to the SPARCstation. The two companies are saying that with this introduction, Sun will finally be able to compete directly with Silicon Graphics Inc. in graphics-oriented accounts.

The machines are the product of E&S but were developed with input from Sun and will be marketed with Sun–all of which is in keeping SMCC's Open Graphics scheme, whereby Sun encourages but does not develop a graphics and imaging products. The Freedom products thus offer significant advantages for both Sun and E&S. Sun gets a graphics capacity, which it needed badly, and E&S gets a toehold in the standards-based workstation world at a time when sales of its own dedicated graphics systems are increasingly threatened by high-performance but generic systems.–*mjt*



The Freedom's high-end features, such as advanced lighting, shading algorithms and transparency can be used to portray the 3D nature of objects–like this hand mixer.

The two machines are tower units that attach to a SPARCstation via an SBus connector. The 1000, the smaller of the two systems, ranges in price according to model from $25,500 to $32,500 and offers performance of 500K to 1 million vectors per second. In terms of polygons per second, the product offers between 500 and 1 million. It has a resolution of up to 1,280 by 1,024.

The Freedom 3000, meanwhile, achieves its highest performance with the SPARCstation 10. In that configuration, it offers 1 million to 3 million vectors and polygons per second, depending on the model. It has a resolution of up to 1,536 by 1,280.

DOE Takes Shape

SunSoft's Distributed Objects Everywhere (DOE), which upon completion will be Sun Microsystems Inc.'s distributed object-oriented computing environment, has been shrouded in secrecy to date. Outside of SunSoft (and maybe even within it), no one seems to know exactly when DOE will come together and what shape it will take.

A couple of months ago, however, interested parties received their first glimpse of what some of the components that will go into DOE will look like. Three object-oriented database management system (ODBMS) vendors–Object Design Inc., Objectivity Inc. and Versant Object Technology Corp.–revealed some specification and product specifics in regard to how their respective technologies figure in the DOE scenario.

Object Design, Burlington, MA, is developing an engine that will supply the basic object storage capability for DOE. The engine, called the Persistent Storage Manager Engine (PSME),

Under the Hood

At the heart of both Freedom machines is an array of processing elements that Evans & Sutherland Computer Corp. calls "DSPs," not to be confused with commercial digital signal processors such as the Texas Instruments Inc. TMS320CX0 line. Rather, these are modules that combine the company's proprietary graphics silicon and a 40-MHz 29050 processor from Advanced Micro Devices Inc., Milpitas, CA. Buyers can start with relatively few DSP modules and upgrade to, in the case of the Freedom 3000, 16.

The choice of the AMD 29K could be significant in its own right. The SPARC has never pretended to be a graphics or imaging machine. But until very recently, the merchant part most often chosen to run as SPARC's graphics coprocessor was the Intel Corp. i860. As little as three years ago, Sun itself offered i860-based image processors as attachments to its workstations. A number of independent companies, Du Pont Pixel Systems for instance, still do.

Now, however, the AMD part seems to be emerging as the first real rival to the i860 in that role. This may be partly because of the 29K's successes as a graphics processor for Apple Computer Inc. graphics and printing peripherals. As a result of its embedded application wins, the 29000 currently ranks as the No. 1-selling RISC chip family.–*mjt*

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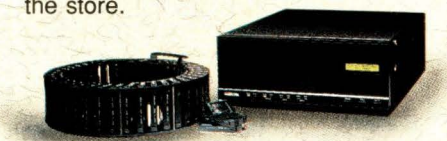

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will provide a "limited subset of the functionality" found in Object Design's ObjectStore database, according to ODI. Object Design will license PSME to SunSoft; SunSoft, in turn, will provide an "open interface" to the PSME, "allowing customers to easily upgrade to a full-featured object-oriented database, when required," ODI says. In July, ODI struck a similar deal with NeXT Inc., whereby NeXT will replace its NeXTstep file system with PSME, says William Blundon, ODI's vice president of marketing.

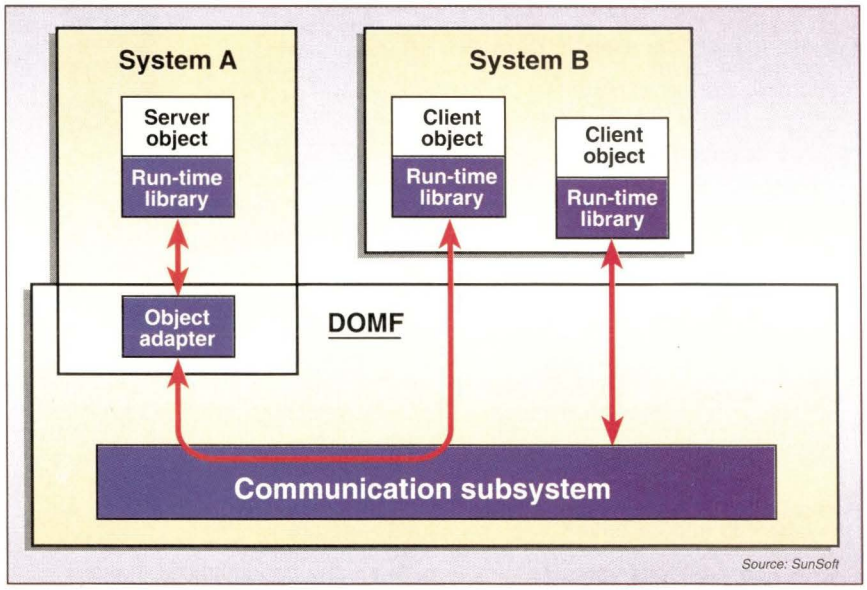
ODI expects to ship PSME to SunSoft sometime this month, Blundon adds. SunSoft then will have the right to transfer the PSME technology to Hewlett-Packard Co., Sun's partner in the development of the Distributed Object Management Facility (DOMF), a key piece of the Object Management Group's Common Object Request Broker Architecture (CORBA) technology.

Objectivity, Menlo Park, CA, is developing an interface between its Objectivity/DB database and DOMF. According to Director of Marketing Craig Woods, the interface will allow DOE applications direct access to objects in Objectivity/DB via the CORBA protocol. "Objectivity has announced the first ODBMS support for the Sun DOMF," Woods says. "For users who wish full database capability, including concurrency, recovery, transactions, distribution, heterogeneity and large data, Sun expects users to replace the simple persistence system (PSME) with a full ODBMS system."

Objectivity and SunSoft are also working to jointly develop and publish an open specification to provide other ODBMS vendors with a standard interface between DOMF and their respective ODBMSs. The spec should be completed sometime in mid-1993, Woods says.

Versant, also of Menlo Park, is working with SunSoft to develop an open application programming interface (API) to various ODBMSs that are part of DOE. The interface will be based on the work of the Object Database Management Group (ODMG), a year-old body formed by commercial ODBMS vendors to create standard object-oriented access methods in collaboration with the OMG. Versant will build an implementation of the ODMG interface, using the OMG's standard Interface Definition Language (IDL) and will integrate the result into the DOE environment, explains Executive Vice President David Gilmour. Developers will be able to embed language- and ODBMS-independent calls into their applications, providing transparent access, manipulation and control of an ODBMS and the objects stored within

The Distributed Object Management Facility (DOMF)–a set of run-time services for managing the execution and interaction of objects–is at the heart of DOE.



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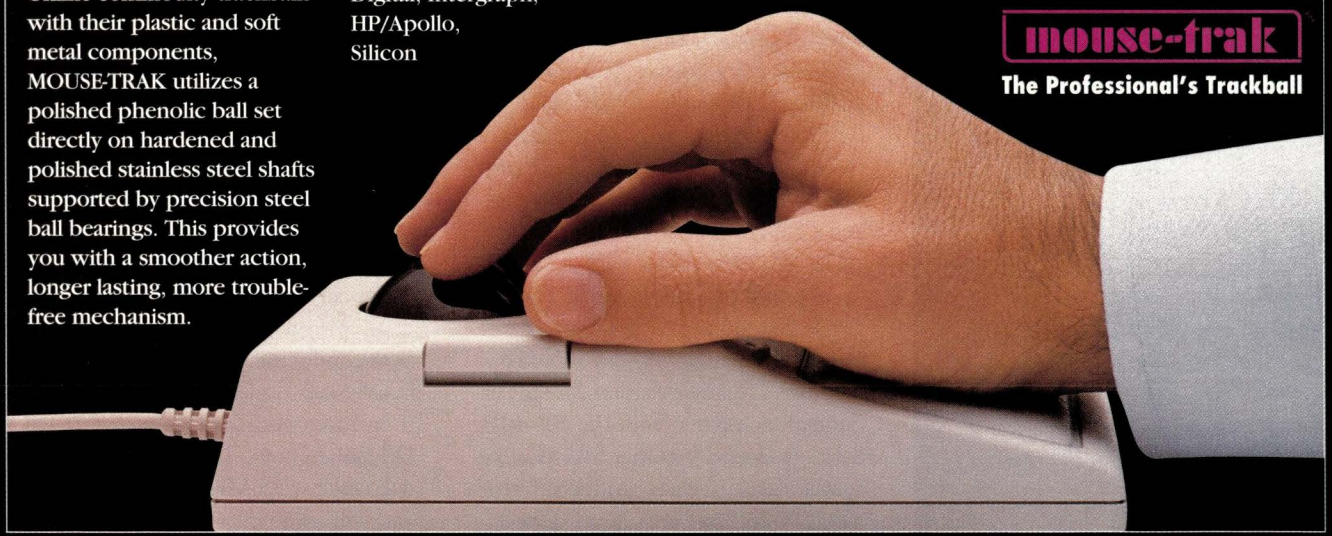

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it, he says. The interface will be made available to other ODBMS vendors through the ODMG during the first quarter of next year, Versant claims.

Object Design's Blundon says he believes the DOE environment could be available to developers as early as mid-1993. Others are not quite as optimistic. But, in the end, "DOE will be invisible," explains Versant's Gilmour. "It will be an integrated part of Solaris. Users won't know it's there. They'll just see more integration among applications and data."–*mjf*

There's Still Life at 40 MHz

While Sun Microsystems Inc. rushes to bring its SuperSPARC- and microSPARC-based systems to market, a number of the SPARC compatible/clone (a k a, SPARCalike) vendors are finding the 40-MHz, SPARCstation 2-compatible realm is still a viable one.

Elitegroup Computer Systems Inc., Fremont, CA, is manufacturing a SPARCstation 2-compatible with a Sun-manufactured motherboard and GX graphics accelerator. And, rather than going the cut-rate price route, Elitegroup is nearly matching Sun's SS2 price, selling its VS-2000 system for $15,000.

The Taipei, Taiwan-based parent company is one of the major manufacturers of PC motherboards in the world. "We're not trying to compete with Sun," maintains Darwin Chang, director of marketing. "We're trying to grow the marketplace." Elitegroup's position is that other SPARCalike vendors have done damage to the market, through cutthroat pricing, use of poor-quality components and peripherals and tampering with host ID numbers.

The VS-2000 comes with a 21-inch (as opposed to Sun's 19-inch) Hitachi flat-screen monitor. Elitegroup is bundling with its system a 535-MB hard drive (made by either Maxtor or Fujitsu), compared with the 200-MB drives packaged by other SPARCalike companies with their products. Other VS-2000 features include a Logitech mouse, Type-4 SPARC keyboard, Sony 1.44-MB floppy drive and Sun GX accelerator. In addition to offering a complete, prepackaged system,

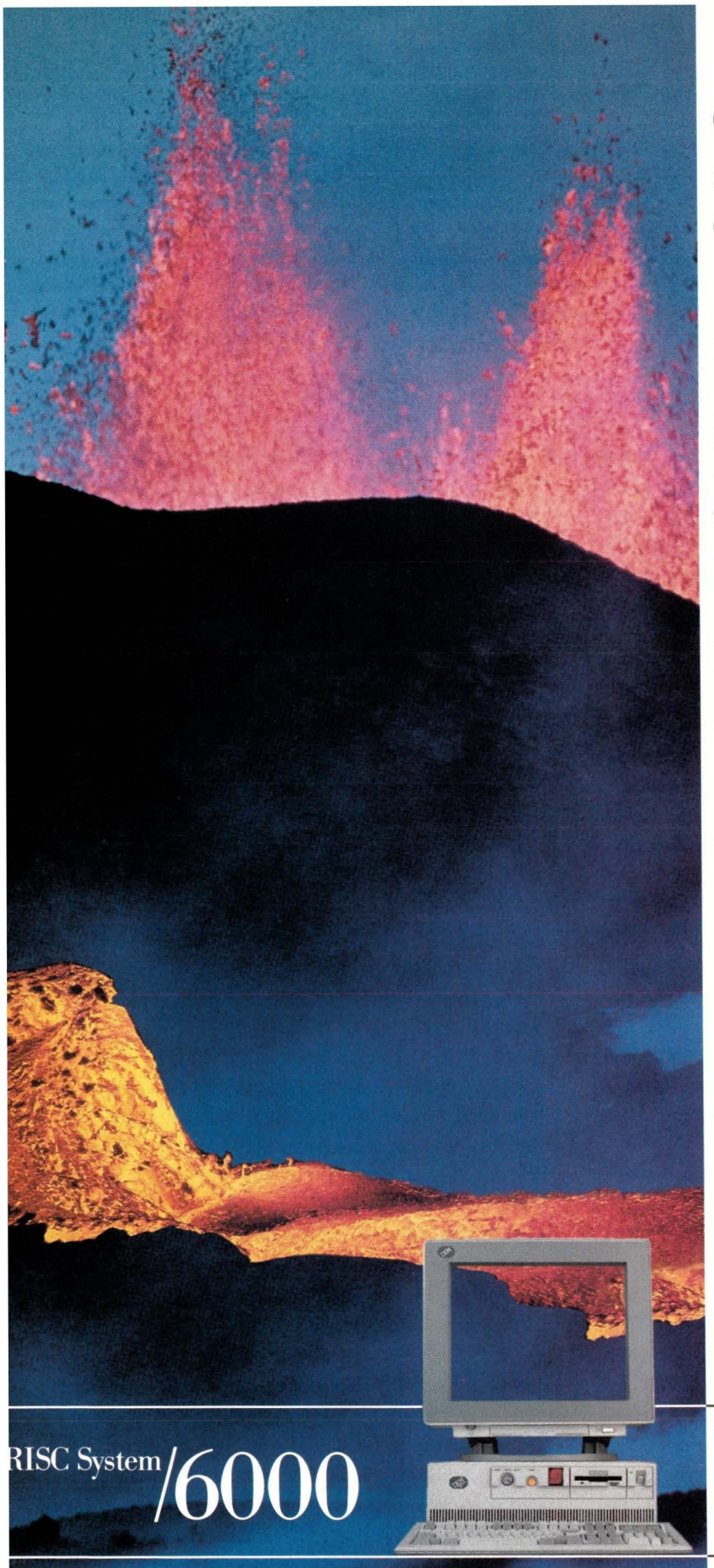
The VS-2000 from Elitegroup Computer Systems Inc. is one of several new 40-MHz SPARCalikes.

Elitegroup is offering the VM-40 (SPARCstation 2) motherboard and its VG-VX (Sun's GX) accelerator card as standalone products. The motherboard lists for $3,000 and the accelerator for $1,600.

Startup Stealth Computer Systems of Thousand Oaks, CA, has been shipping since June the StealthStation and StealthServer II, a pair of 40-MHz systems. Both ship with a choice of 17- or 21-inch flat-screen color monitors; three open SBus slots; up to 2.4 GB of internal disk and 21 GB of external disk; and optional GX accelerator. With a campaign of "Out of Nowhere: The System You've Been Waiting For," the company is going head-to-head with Sun and other SPARCalike vendors. Pricing ranges from $7,495 for a base configuration to $15,695 for a fully loaded system with 32 MB of main memory, a 1.2-GB disk drive and 21-inch monitor.

Stealth is presided over by Mike Hildenberg, the former vice president of marketing, sales and service for Sony Corp.'s workstation division. At press time, Hildenberg said Stealth was putting the finishing touches on the StealthStation III, a low-cost 40-MHz SPARCalike "with slightly better MBus performance." Stealth expected to ship the $4,995 system in November.

The company is in the throes of developing a number of Cypress Semiconductor Inc. hyperSPARC-based SPARCalikes, which it expects to introduce during first-quarter 1993, Hildenberg says. The StealthStation XI will clock at 55 MHz, 50 SPECint92 and will come in at a base price of $10,000. The dual-processor StealthStation XII will fly, he says, with a SPECint92 rating of 97. Base price will be $15,000.–*mjf*



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This Just In...

• The first national *SunNet Manager Users Group* has been formed by network integrator DeskTalk Systems Inc., with the first meeting having taken place at InterOp Fall. The group is intended to help users and developers to "figure out how to put the various network management applications together," in the words of DeskTalk President David Kaufman. For more information, contact DeskTalk at (310) 323-5998, ext. 510, or SnMUG@desktalk.com.

• Yet another CASE integration standard is in the making. *SunSoft, Digital Equipment Corp.* and *Silicon Graphics Inc.* have created a CASE tool integration standard that they are proposing to ANSI that will enable developers to integrate and deploy their CASE tools across different CASE environments. The submission, "The CASE Interoperability Message Sets: Release 1.0," specifies a common set of definitions for messages that can be shared among CASE tools, including messages for debugging, browsing, analysis and design, editing and version management. Because the stan-

Also on the SPARCalike Beat...

Hyundai Electronics America's Axil Workstation and Hyundai Workstation divisions have introduced two product families consisting of five new SPARC workstations and servers. The AxilStation-230 and AxilStation-250 are the first of Axil's line of "differentiated, value-added SPARC-compatibles aimed primarily at the commercial market," according to the San Jose, CA-based company. The three Hyundai Workstation systems are the first of the division's clones.

The 230 and 250 are based on SuperSPARC; the 230 supports a single CPU only; and the 250 can be upgraded to support multiprocessing. Pricing ranges from $15,995 for the AxilStation-230 to $16,995 for the AxilStation-250. Both feature a built-in fax/modem interface, rather than an ISDN one such as Sun provides with its SS10. The clones include the HWS-S210, a $13,000 SS2-compatible; the HWS-S310 (Model 3.0), a $16,995 SS10 Model 30-compatible; and the HWS-S310 (Model 4.1), a SS10 Model 41-compatible.

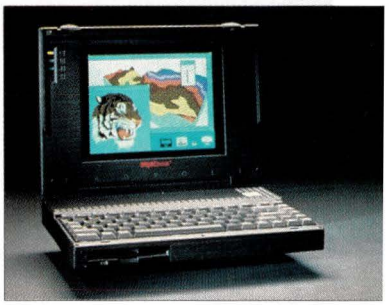
On the personnel front, Axil has added Sun's former director of channels strategy USA, Daniel Shaver, to its ranks. Shaver is Axil's first vice president of sales and marketing.

SBus board vendor **Integrix Inc.** launched its first full-fledged workstation, called the Integrix SS2 Basic System, at UNIX Expo in September. The monitorless system lists for $2,995. It features three SBus slots, up to 128 MB of internal memory, Ethernet and SCSI-2 ports, a three-button mouse and Type 5 keyboard. The Newbury Park, CA, vendor is targeting OEMs, VARs and resellers with its entire range of boards and systems.

Beleaguered **Opus Systems** has thrown in the SPARCalike system towel but will continue to sell its SPARCard PC board. Opus sold its workstation business to Digital Systems Research, an Arlington, VA, federal systems integrator and consultant. DSR will be manufacturing the former Personal Mainframe workstations at its facility in San Diego. During the transition phase, Apex Computer, Redmond, WA, will be handling customer support calls for Personal Mainframe.

Laptop vendor **RDI Computer Corp.**, San Diego, CA, announced that it has received "significant" additional financial backing from its "strategic partner" TriGem Computer Inc.

Notebook vendor **Tadpole Technology Inc.**, Austin, TX, is making an active matrix TFT color display available as an option with its SPARCbook. TFT provides faster screen refresh and a wider viewing angle than passive LCD, making for image quality closer to that of desktop workstations than portables. Tadpole also has extended disk options, allowing users to opt for up to 360 MB of hard disk storage. In conjunction with Codar Technology Inc., Longmont, CO, Tadpole has introduced the Lynx ruggedized SPARCbook. The ruggedized version is a 15-pound system with a durable aluminum case. And Tadpole will support Morning Star Technologies' Point-to-Point Protocol (PPP) on the SPARCbook as an option when it issues its next release of Solaris for the SPARCbook. Morning Star is based in Columbus, OH.



Tatung Science & Technology Inc. released specs and pricing for its SuperCOMPstation 7/30. The system, which is slated to ship this month, is based on a 36-MHz SuperSPARC. It sports many of the same features as the SS10 Model 30, with a few exceptions. Whereas the SS10 offers two MBus slots, the Super COMPstation features just one. The Tatung system doesn't come with an ISDN port, but it does offer as part of its standard package an SBus GX board. (For the SS10s, GX is an add-on option.) List price is $16,290. The 33-MHz, SS10 Model 20-compatible, the Super COMPstation 7/20, was to have shipped in November, for a list price of $14,990.

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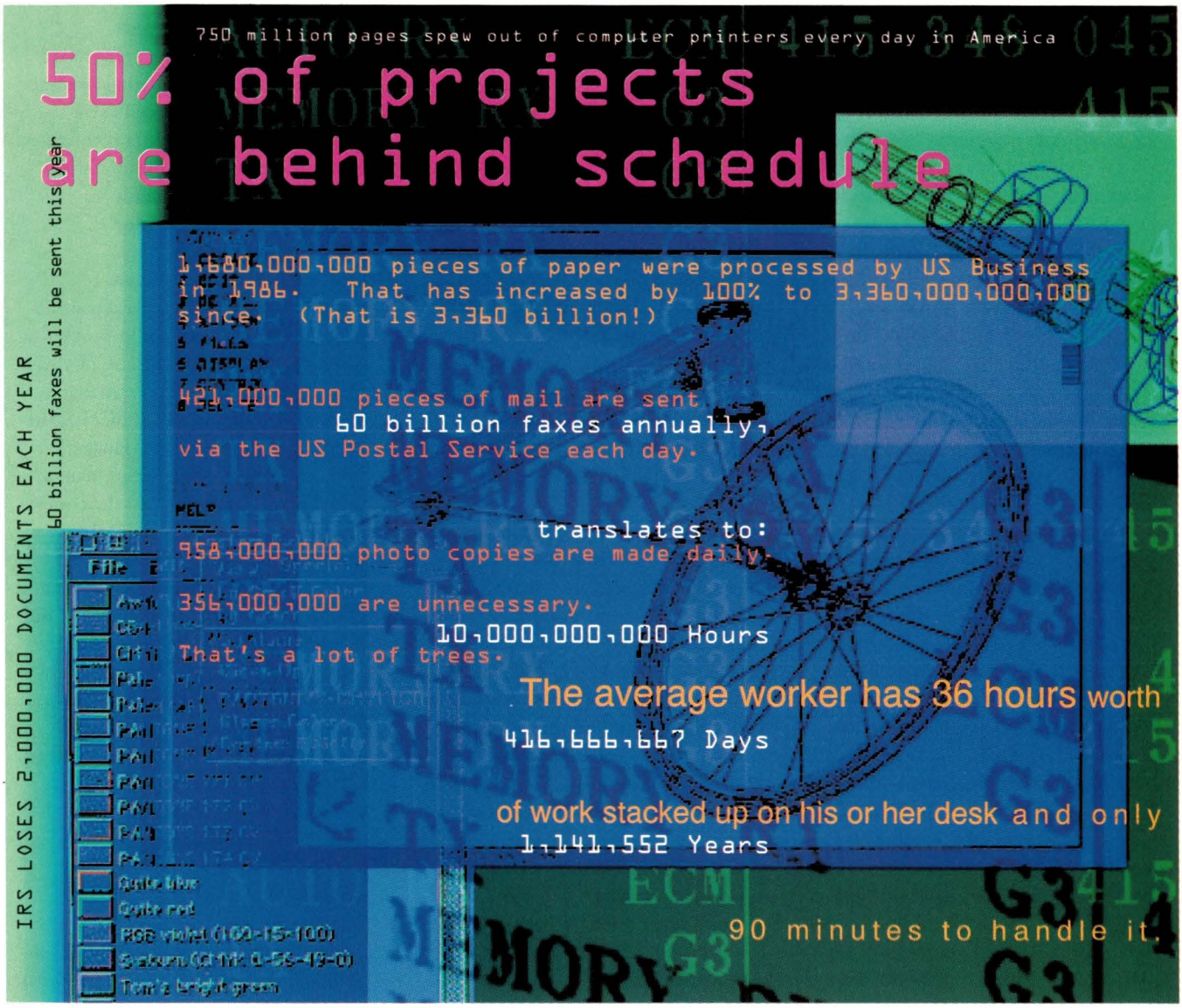

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dard is transport-independent, it allows developers to work with other tool integration standards of their own choosing, such as ToolTalk, SoftBench's Broadcast Message Server and/or DEC's Fuse. "Until now," says Steve Martino, SunSoft's director of DOE product marketing "we've had a phone without a way to call people." More than 12 CASE tool vendors have endorsed the effort.

• Check out two new books on the Internet. Addison-Wesley Publishing Co.'s ***Internet System Handbook***, edited by Dan Lynch and Marshall Rose, is a collection of chapters authored by "specialists and pioneers in each aspect of the Internet's underlying technology." Part I is an introduction to and review of the Internet's geographic and technological evolution. Part II is devoted to the net's underlying technologies, including the core protocols, routing and major applications. Part III discusses the Internet infrastructure, and Part IV focuses on changes in the Internet architecture made necessary by growth and new technologies. O'Reilly and Associates' ***The Whole Internet User's Guide and Catalog***, by Ed Krol, is an introduction to the Internet for new users. The Resource Catalog lists many of the resources available to net users–ranging from the Bryn Mawr Classical Reviews to the University of Stuttgart's on-line cookbook. The book offers a little net history, an explanation of how the net works, a chapter on addressing and "general background on what you're allowed to do." Both books are available through technical bookstores and directly from the publishers.

• ***SunSoft*** has rolled out a full-text search-and-retrieval application called SearchIt. The application allows users to locate on-line business data, such as reports, proposals and correspondence stored anywhere on the corporate network. SearchIt also enables users to manage and manipulate this information via its DeskSet-based interface. Because it is based on ONC/NFS, SearchIt makes searches across multivendor systems possible. Like AnswerBook, SearchIt is based on Fulcrum Technologies' Ful/Text engine. Pricing for a single-user license, shrink-wrapped package for Solaris 1.0 is $295.

• A different DBMS: ***Automated Technology Associates***, Indianapolis, IN, has unleashed its Entity Relation Database (ERDB) on software developers and systems integrators. The database offers "100 to 1,000 times the performance of relational database management systems," the company claims, and is tailor-made for factory floor, telecommunications, distributed control systems and other "primary operations" support systems. ERDB also offers hooks to conventional RDBMSs for planning and analysis via an SQL interface. The product runs on SunOS, VMS, Ultrix, HP-UX, SCO UNIX and the Stratus operating environments. Licenses begin at $10,000.

• Hauppauge, NY-based systems integrator ***ERI*** is offering customers a direct FrameMaker-to-Sybase link. The link is built upon the Crossroad application development system from Crossroad Systems Inc. The link is designed to save corporate users time in formatting and reformatting documents. ERI also has expanded the capabilities of its OutLook open imaging environment to include viewing capabilities on PCs and Macintosh systems. PC and Mac users can now query, view and edit documents residing on OutLook's UNIX-based servers via a portion of Informix's Wingz, coupled with PC/TCP.

• Network-management vendor ***Remedy Corp.*** of Mountain View, CA, has created an application that provides managers and users with "user-definable dashboards," thereby simplifying the tasks of and requirements for network managers. The application is called Health Profiler, and it "distills the messiness of the plethora of MIB variables into the visual essentials," according to Remedy CEO Larry Garlick. The product works with many existing network management applications. It runs on top of SunNet Manager; OpenView support will follow in 1993. A single-user license of the real-time view builder and display tool is $4,000; the history module and report writer list for $4,000, and additional user licenses for $2,500 each.

• Cincinnati, OH-based software distributor ***SCH Inc.*** is shipping an integrated network system and application management system called OS/Eye*Node, a product developed by systems integrator Digital Analysis Corp. The package's Motif GUI allows managers to maintain consistent interfaces for the product's various modules, which include Domain*View, Map*Editor, Node*View and Data*View. OS/Eye*Node is distributed, SNMP-based and open enough to accommodate future standards and protocols, including OSI and DME. SCH also is making available its UNIX management environment, called SCH:SAM (System Administration Manager). The product, which is "more than a UNIX shell," according to the company, integrates several utilities–print management, batch job scheduler, tape backup system and a customization toolkit–via a consistent front end.

• ***UniSQL Inc.***'s multiple heterogeneous DBMS, UniSQSL/M, is now available to early-release customers, a few months after the Austin, TX-based company originally planned to ship the product. (UniSQL says it was waiting for the market to catch up with its technology.) The package allows SPARC users to "unify the schemas of existing multivendor databases to form a single, homogeneous database for application development." UniSQL/M integrates with existing UniSQL products, including the UniSQL/X DBMS and UniSQL/4GE application development tools. Version 1.0 supports Ingres and UniSQL/X. Support for Oracle and Sybase, as well as DB2, IMS and RMS, will follow. A single-user license begins at $3,995.

• ***SunConnect*** has joined hands with a group of systems and networking vendors to form the APPI Forum. The Forum is chartered to develop a standard advanced peer-to-peer internetworking solution that will provide TCP/IP capabilities in the SNA space. The result will offer users a choice that competes head-to-head with IBM Corp.'s APPN solution. Other members of the Forum include Alcatel, British Telecom, Cabletron

Systems, Cascade Communications, Cisco Systems, Digital Equipment Corp., Hewlett-Packard Co., Infonet, McData, Netrix, Proteon and SynOptics. The group is hoping to submit a full APPI spec to the Internet Engineering Task Force by mid-1993.

Other Open Systems News

Digital Equipment Corp.

Raytheon Co. has signed a license with DEC enabling Raytheon to produce military versions of DEC's Alpha architecture. Raytheon's adaptations will go into systems that meet military specifications and provide a range of real-time processing functions.

Another Alpha-related announcement comes from Nth Graphics Ltd. Austin, TX-based Nth Graphics has agreed to port its Portable GL graphics software library to DEC's forthcoming Alpha workstations running DEC OSF/1. NPGL software mimics the Iris GL V4.0 graphics software programming environment from Silicon Graphics Inc. The NPGL software will allow graphics-intensive programs written for SGI systems to be ported quickly to Alpha workstations.

DEC has made available SQL Access Server for Rdb/VMS, a product for software vendors developing clients that implement the SQL Access Group standards for multivendor database interoperability. SQL Access Server for Rdb/VMS is the first in a series of SQL Access-compliant database products under development by Digital.

DEC is gunning to develop a complete object-oriented software development environment and has developed enhancements to established products and new services to fulfill its mission. DECdesign Version 2.0 now includes support for new design techniques that integrate this graphical design and analysis tool into the object-oriented environment. DEC Object/DB Version 1.0, a port of the Objectivity/DB database, is now available from DEC. The next release of DEC C++ for UNIX-based systems, when announced later this year, will support DEC OSF/1, as well as OpenVMS and Ultrix.

IBM Corp.

Top-end models for both the deskside and rack-mounted versions of its RISC System/6000 were introduced by Big Blue. The deskside workstation/server Model 580 and rack-mounted POWERserver 980 incorporate IBM's fastest clock rate (62.5 MHz) processor. Both systems also use the 80-MB/s Micro Channel I/O bus and faster I/O controller announced earlier this year on the Model 970. IBM added to the machines SCSI-2 technology, the second-generation small computer systems interface. Storage capacity, pricing and other details weren't available at press time.

IBM also unveiled the first five components of its DCE-based product line, called the AIX DCE Product Family. AIX DCE Base/6000 includes a time service; thread service; the DCE remote procedure call (based on the Hewlett-Packard Co./Apollo NCS RPC); and clients for security, service and cell directory. AIX DCE Security Server/6000 provides authorization tools and authentication based on the Kerberos system. AIX DCE Cell Directory Server/6000 provides a local naming service that works in conjunction with the global naming done by the X.500 server. AIX DCE Enhanced Distributed File System/6000 is an implementation of the Open Software Foundation's distributed file system for remote file access. AIX DCE X.500 Directory Server/6000 provides global naming services based on X.500. The first three products will be available in December; the latter two in June 1993. In a separate, but related, announcement, IBM launched AIX CICS/6000. Slated for June 1993 availability, AIX CICS/6000 is a fully compatible version of IBM's Customer Information Control System transaction monitor for OLTP. ➙


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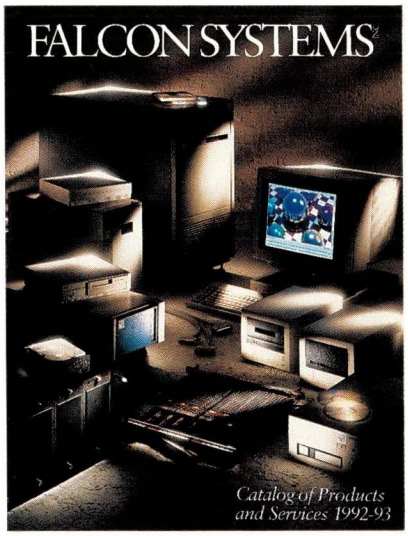

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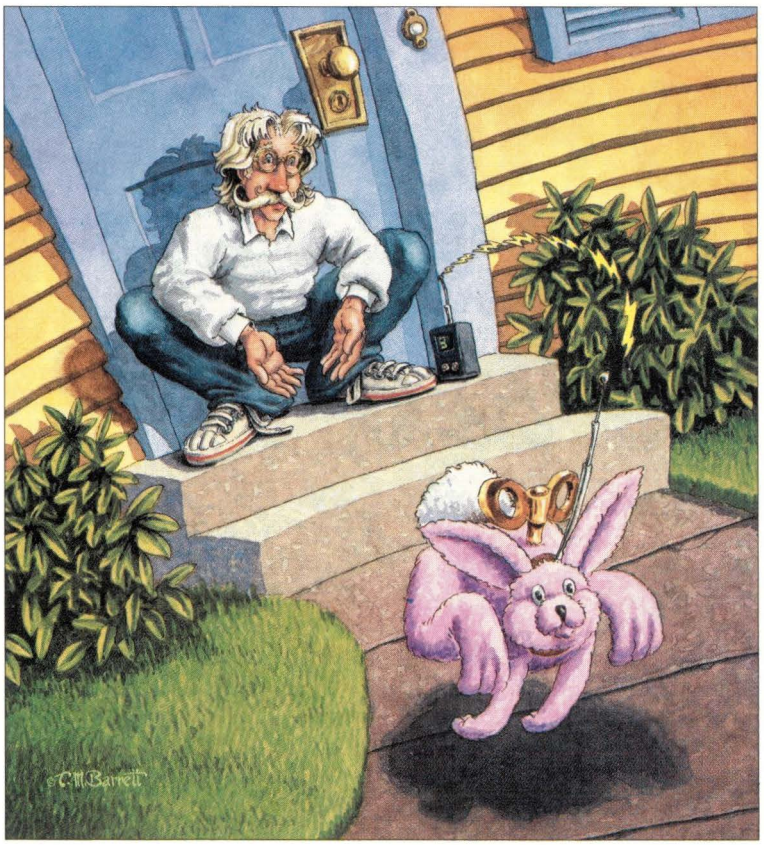


TOM BARRETT

by MICHAEL O'BRIEN

How Wide is Round?

"Hop hop hop hop hop hop hop!
We are going to the shop!"
–Walt Kelly

"Choose your routes carefully. You'll be in them for the next 2,000 hops."
–Signpost erected by a network pioneer

"HONK!"
–Beulah, when time is up

Q: How does `traceroute` work? Why should I care? Why am I here?

A: Well, let's take the last question first. From my point of view, you're here because I pay you a substantial sum to be a stooge. So enough of the philosophical stuff or your cut of the George P. Wheeler Memorial Ding-Dong Fund is history. Got it?

Now, it turns out that your first question is at least moderately interesting, since it's about the only navigational tool we have on the Internet. Mr. Protocol begs you to cease your squawks of alarm: He is speaking, as is his wont, at a very low level.

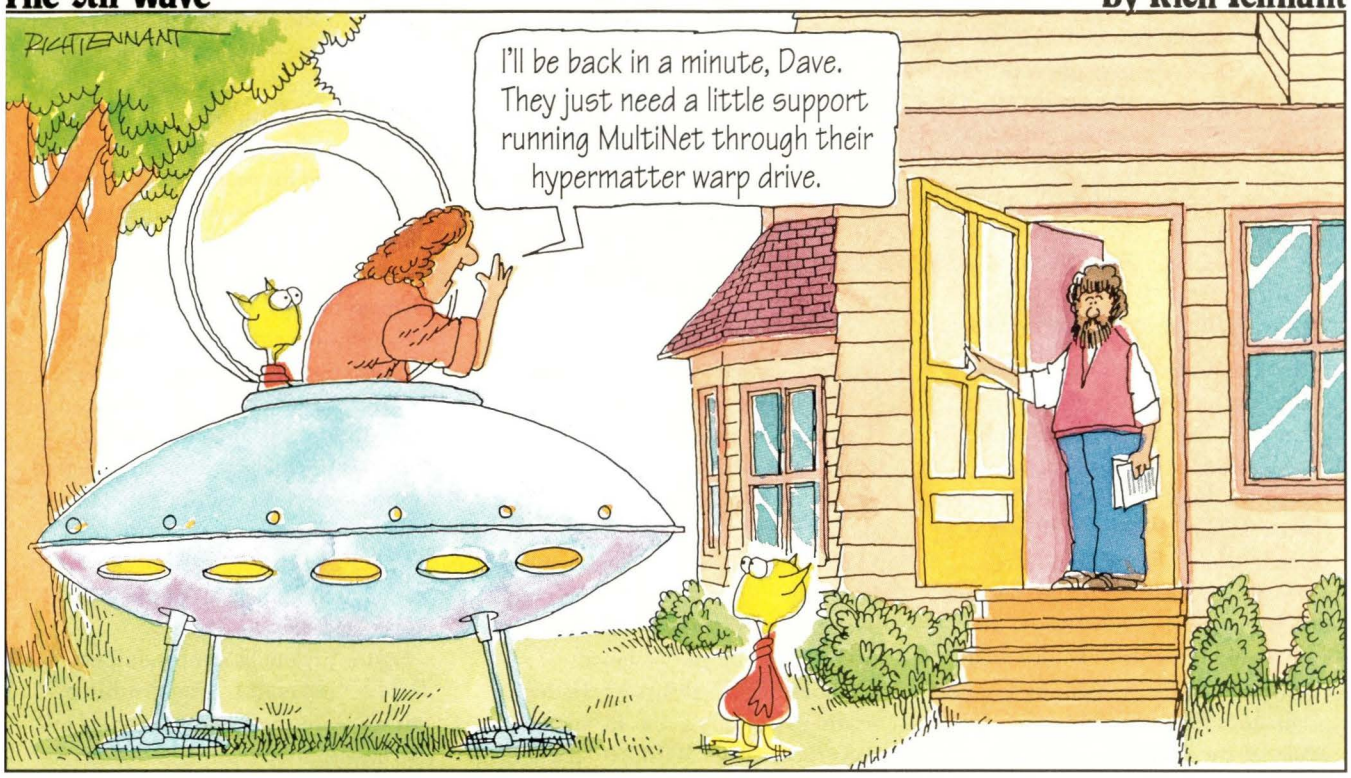
`traceroute` is a tool that allows you to discover the route traveled by packets en route from your machine to any other machine on the Internet. It can't be guaranteed, of course, that all packets will travel by the same route, but you will at least have a pretty good indication as to what is going on.

The `traceroute` program, which was written by Van Jacobson, takes as its argument the name of an Internet host. Its output is a series of lines that list each node along the path through which the packet was routed on its way to the destination.

Mr. Protocol wishes to point out that if you stop to think about it, this is a remarkable achievement. Considering the propensity of network managers to keep network information inside the network, the success of `traceroute` in exporting information is to be marveled at.

The reason for this success, of course,

The 5th Wave **By Rich Tennant**



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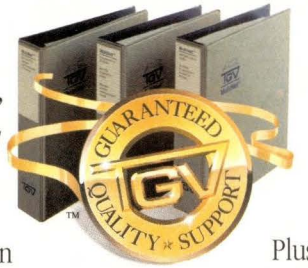

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```
traceroute to bbn.com (128.89.0.122), 30 hops max, 38-byte packets
 1   our-gateway1 (130.221.192.1) 0 ms 0 ms 0 ms
 2   our-gateway2 (130.221.120.2) 0 ms 20 ms 0 ms
 3   our-external-gateway (130.221.96.2) 20 ms 0 ms 0 ms
 4   ln-gw.isi.edu (128.9.16.1) 20 ms 20 ms 0 ms
 5   128.9.16.7 (128.9.16.7) 160 ms 160 ms 160 ms
 6   bbn-blk.twb.net (28.50.0.0) 240 ms 240 ms 260 ms
 7   BBN.COM (128.89.0.122) 200 ms 200 ms 180 ms
```

Figure 1. Route to host bbn.com

is that the network managers have no choice in the matter. If they pass packets at all, `traceroute` must work. It does its work by using a feature of ICMP, the Internet Control Message Protocol. This is a type of IP packet, separate from TCP or UDP, that is normally used to send useful information between machines that are exchanging IP packets. For example, ICMP REDIRECT is sent back to the originator of a packet and tells it that while an attempt will be made to deliver the packet, future packets to the same destination should be sent to a different gateway. ICMP SOURCE QUENCH is a control message amounting to, roughly, "SHADDAP!" It is used to cause a machine to slow the rate at which it is generating packets for a particular destination.

`traceroute` works by sending a type of packet called ICMP ECHO. If a host receives an ICMP ECHO packet addressed to it, it must return that packet to the sender by swapping the origin and destination addresses and shipping it back out. This is part of the IP protocol spec, and any host that does not do this is in violation of the spec.

`traceroute` sends a carefully constructed ECHO packet. One of the fields in every IP packet is the Time to Live field, also known as the TTL field. This field is used to prevent routing loops from clogging the Internet. If a packet hasn't gotten to its destination by the the time specified in the TTL field, it is dropped. Otherwise, packets "stuck" in circular routes would circulate forever. Formally, this is specified as a time. However, the correlation between real time and the amount of work that should be done to deliver a packet is hazy at best, given the range in speeds encountered on the Internet (from 1,200-baud SLIP connections to 45-Mb/s T3). Therefore, in practice, the TTL field is universally used as a "hop count," specifying how many routers a packet should traverse before being dropped. Ordinarily, this field is filled in automatically with a "sensible" number. These days, 64 is the suggested value (to be found in the "Assigned Numbers RFC"–always interesting reading). `traceroute`, however, constructs its ICMP ECHO packet "by hand" and injects it into the "raw packet" interface (which is why `traceroute` has to run as root). It actually sends a series of ICMP ECHO packets, starting with a TTL value of 1.

The host will send this packet, presumably, to the nearest gateway, which will decrement the TTL field. Since the field is now zero, the packet has timed out and will be dropped. However, the gateway, following the IP spec, will generate another type of ICMP message to the originating host (the one running `traceroute`), informing it of the timeout. This ICMP packet will show the gateway as the sender, so the originating host now knows where the packet was when it timed out. No big surprise here–after all, it sent the packet to the gateway in the first place–but now, having made arrangements to see the reply, `traceroute` will construct a new ECHO packet, this one with a TTL value of 2. This packet will time out, not at the gateway, but at the next hop along the road. Now the originating host knows to whom the gateway sent the packet.

Continuing along in this fashion, `traceroute` will send out repeated ECHO packets, each one with a TTL value one greater than the previous one, waiting each time for the timeout notification. Eventually, instead of a timeout notification, it will get an ECHO REPLY packet from the destination, and knowledge of the route is now complete.

Figure 1 contains sample output from `traceroute`. The first three entries represent gateways internal to the organization owning the originating host; these have been changed. The rest of the entries represent the hosts traversed on the way to the destination host. Each echo packet is actually sent three times. The readings in milliseconds after each entry give the time required to receive the timeout notification and therefore give some notion of network delays. An asterisk in this position indicates that no reply of any sort was received. Note that sometimes the intermediate gateways are known only by network address. This means that the gateway's hostname could not be discovered via the domain name system.

Figures 2 and 3 give routes to other locations, for comparison. Note that the originating host is in Southern California, yet it takes fewer hops to

Figure 2. Route to host nic.cerf.net

```
traceroute to nic.cerf.net (192.102.249.3), 30 hops max, 38-byte packets
 1   our-gateway1 (130.221.192.1) 20 ms 0 ms 0 ms
 2   our-gateway2 (130.221.120.2) 0 ms 20 ms 0 ms
 3   our-external-gateway (130.221.96.2) 20 ms 0 ms 20 ms
 4   ln-gw.isi.edu (128.9.16.1) 20 ms 0 ms 20 ms
 5   ucla-isi-gw.ln.net (130.152.64.2) 20 ms 20 ms 0 ms
 6   cerfnet.ucla.edu (128.97.130.10) 20 ms 40 ms 300 ms
 7   sdsc-ucla.cerf.net (134.24.101.100) 40 ms 20 ms 40 ms
 8   134.24.99.2 (134.24.99.2) 20 ms 20 ms 40 ms
 9   nic.cerf.net (192.102.249.3) 40 ms 40 ms 40 ms
```

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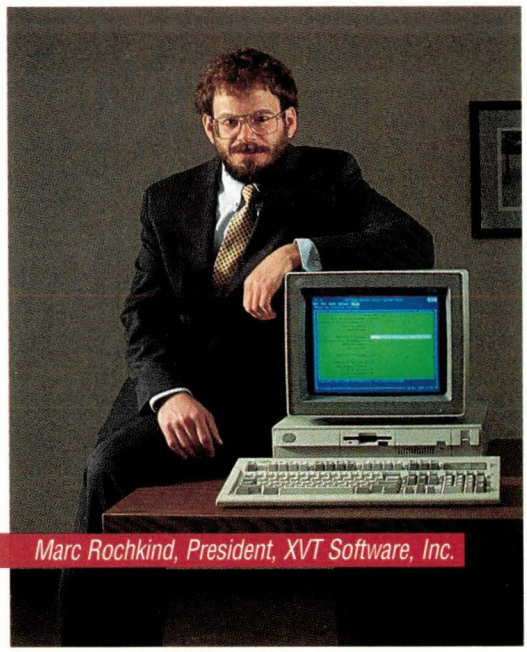
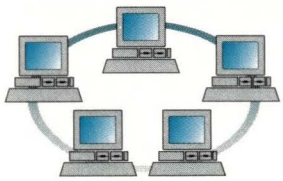


Marc Rochkind, President, XVT Software, Inc.



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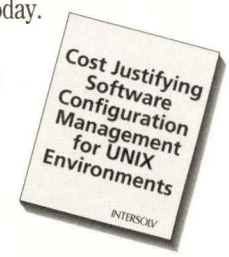

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move to BBN, in Massachusetts (Figure 1), than it does to move to Cerfnet headquarters in San Diego (Figure 2). This is because there seems to be a gateway attached directly to BBN, in something called twb.net. One guess might be that this represents the Terrestrial Wideband Net. Figure 3 shows that the route to Berkeley, traversing as it does the T3 backbone, requires far more hops than either of the other two.

The lesson here is that connectivity is both hierarchical and nonobvious. The number of hops would seem from our examples to be completely unrelated to the geographical distance involved. In fact, this is not true. There is a correlation, if only a rough one. Our examples are thrown off by the fact that ISI seems to have a direct connection of some sort to BBN. In fact, a jump from Sweden to Japan can take more than 30 hops. We can conclude that the number of hops is correlated to the number of organizations traversed, and to the extent that this corresponds to geography, the hop count will increase with distance.

What does all this mean? Mr. Protocol is glad you asked.

In fact, the Internet is more than a collection of machines. It is the connections between the machines. Therefore the size of the Internet must include not only the number of hosts, but the largest path from one "side" to another. If we take each possible pair of hosts and find the routes between them, then the longest route in this collection could be taken as the "diameter" of the Internet. The Internet is as big as the biggest hop count.

How big is this? We don't really know. It changes all the time, as organizations rewire their internal architectures and refurbish their connections to the "outside world."

This is the current subject of an interesting debate. Presuming that Mr. Protocol has any following whatsoever, those lucky souls will remember prior discussions in this column regarding the current effort to redefine the Internet Protocol, given the current squeeze on address space. Those responsible for this effort know that, given the current size of the Internet, the choices they make now will be in force well into the next century, and that significant pockets of the Internet will not upgrade at all, necessitating some provisions for backward compatibility, or at least for "backward" gateway translation.

Most of the "packet wars" are being fought over the twin issues of routing and addressing, which shouldn't be surprising, given that that is what started the whole business in the first place. However, some attention is being paid to the question of the new version of the TTL field. How big should it be? What is the future diameter of the Internet?

This is a wonderfully loaded question, so Mr. Protocol will of course dive right in.

The problem in terms of the TTL field is that it is difficult to say, offhand, whether it should continue to be a hop count, or whether it should in fact represent a true time to live. On the one hand, not all hops are equal. In the case of the T3 backbone, for example, there are all sorts of internal hops, as can be seen from the gateway names beginning "t3-" in Figure 3. These handoffs occur at very high speed and should probably not be as "expensive" as a real gateway handoff, for example. Some wags have started referring to such an internal handoff as a "hippety." On the other hand, to give a packet a true time to live requires that gateways have some notion of how long a handoff takes. Over the lifetime of a packet, this could lead to gross misestimation.

One other possibility is to give each packet a time stamp. This has the distinct advantage that the gateway need no longer mess with the packet as it goes through. Decrementing the hop count means having to fix up the checksum, which is a relatively expensive operation. A time stamp doesn't have to be changed, merely compared with the current time.

This, however, requires that the entire Internet be synchronized to a common time. This led to a discussion that Mr. Protocol was proud to witness. The argument moved, and Mr. Protocol is not making this up, to the realm of special relativity. The problem is

Figure 3. Route to okeeffe.cs.berkeley.edu

```
traceroute to okeeffe.berkeley.edu (128.32.130.3), 30 hops max, 38 byte packets
 1  our-gateway1 (130.221.192.1) 0 ms 0 ms 0 ms
 2  our-gateway2 (130.221.120.2) 0 ms 0 ms 0 ms
 3  our-external-gateway (130.221.96.2) 0 ms 0 ms 20 ms
 4  ln-gw.isi.edu (128.9.16.1) 40 ms 0 ms 0 ms
 5  ucla-isi-gw.ln.net (130.152.64.2) 20 ms 0 ms 20 ms
 6  cerfnet.ucla.edu (128.97.130.10) 20 ms 20 ms 20 ms
 7  sdsc-ucla.cerf.net (134.24.101.100) 40 ms 20 ms 20 ms
 8  134.24.99.254 (134.24.99.254) 40 ms 20 ms 40 ms
 9  enss.sdsc.edu (132.249.32.22) 20 ms 20 ms 40 ms
10  t3-1.cnss17.t3.nsf.net (140.222.17.2) 20 ms 20 ms 40 ms
11  t3-3.cnss16.t3.nsf.net (140.222.16.4) 40 ms 40 ms 40 ms
12  t3-2.cnss8.t3.nsf.net (140.222.8.3) 40 ms 40 ms 60 ms
13  t3-0.cnss9.t3.nsf.net (140.222.9.1) 60 ms 40 ms 40 ms
14  t3-0.enss128.t3.nsf.net (140.222.128.1) 40 ms 40 ms 60 ms
15  SU-A.BARRNET.NET (192.31.48.200) 40 ms 60 ms 60 ms
16  SU-C4.BARRNET.NET (131.119.254.104) 60 ms 60 ms 40 ms
17  UCB-C1.BARRNET.NET (131.119.2.2) 60 ms 60 ms 60 ms
18  inr-108-dmz.Berkeley.EDU (192.31.161.22) 60 ms 40 ms 40 ms
19  inr-60-fddi.Berkeley.EDU (128.32.155.60) 40 ms 60 ms 40 ms
20  inr-35.Berkeley.EDU (128.32.168.35) 60 ms 40 ms 40 ms
21  csgw.Berkeley.EDU (128.32.133.254) 40 ms 100 ms 60 ms
22  okeeffe.CS.Berkeley.EDU (128.32.130.3) 40 ms 80 ms 80 ms
```

that the rotating surface of the earth constitutes an accelerated frame of reference, which makes the entire issue of global synchronization problematic.

Calculations can be done, of course (Global Positioning System satellites do them all the time), but it is a nontrivial problem. In fact it would take some work to decide just how bad the synchronization errors would be. Hmm, let's see, the speed of light in fiber is roughly 50% of the speed of light in free space, so the transit time around the world would be on the order of a third of a second...

What? Hello? Oh, very well. But just remember, when we're squirting packets between Earth and Mars, transit times will become very important.

The other alternative is to use a hop count, as before. In this case it becomes important to determine the maximum hop count that will be encountered. The chief problem of this approach is evident: It requires social prognostication as well as technical sophistication. How many organizational boundaries will there be? What will, in the end, count as a "hop"? Everything? Nonbackbone hops only?

Mr. Protocol is of the opinion that the hierarchical future of the Internet is only now beginning to be appreciated. The local/mid-level/backbone division of the net will only increase with time. Mr. P. is on record as having guesstimated that the average household will have no fewer than three levels of networking before a packet even gets out of the house. The first level represents packets exchanged between processors within a given device, the second represents the exchange of packets between devices in a system (the stereo system, for example), and the third level represents the housewide net. It figures that this division will continue, at least somewhat. The current telephone system is hierarchical in this way, though of course the architecture is invisible to the end user, as it should be.

This would argue that the difference between a "hippety" and a "hop" is not merely facetious. Ideally, hop counts would themselves be hierarchical, indicating expected lifetimes at each network level. This may in the end prove too complicated. However, it would also provide some new functionality, as it would be possible to mark packets as "local only," merely by setting the hop count above a certain level to zero. This feature might seem useless, until we remember that there will be charges for the use of networks outside the house. Restricting packets from using high-charge, long-distance networks might eventually be a desirable feature, though perhaps this would be best accomplished via an IP option. If this feature were commonly used, though, option processing might prove to be too expensive. On the other hand, this might come under the heading of policy-based routing, which is definitely on the horizon as long as networks persist in having acceptable-use policies.

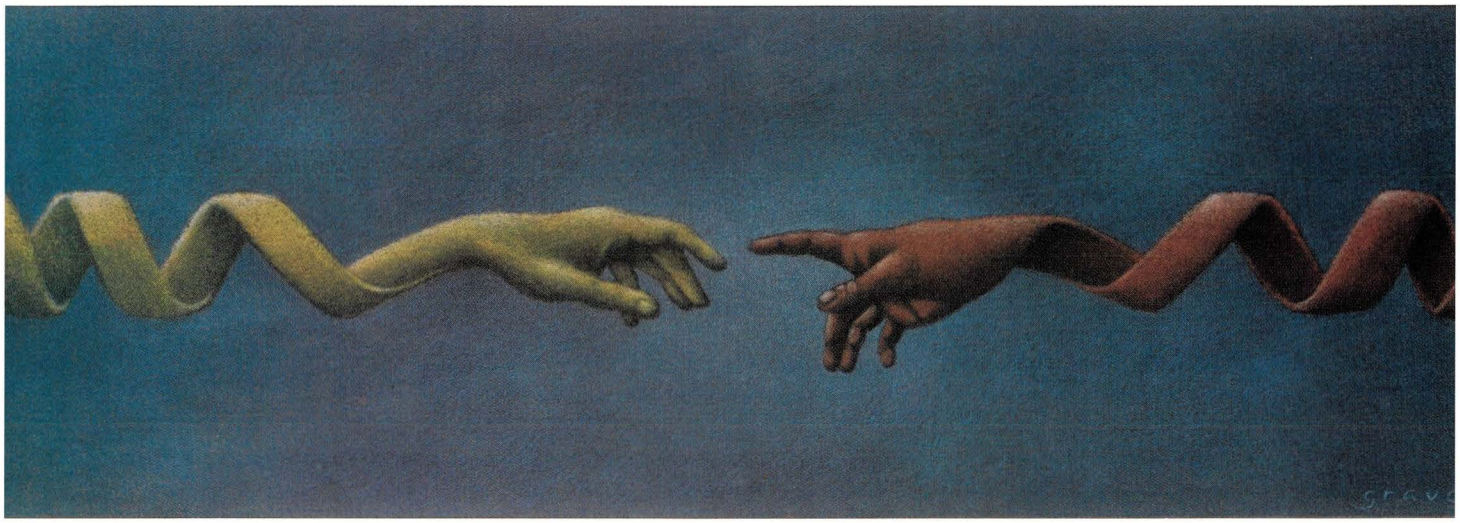
The end result is that there are those who believe that the network, no matter how large it grows, won't possibly have more than 100 hops end-to-end, because there won't be more organizational boundaries than that. Others believe that hop counts in the tens of thousands are possible.

Who's right? Mr. Protocol wishes he knew. Somebody had better know, though, because the packet format to handle all this must come off the drawing boards and into service soon. ⊸

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

Accessing Other Machines

by **PETER COLLINSON**, Hillside Systems

If you look around an average UNIX system, you will find several ways of reaching out from your machine and touching another. One basic need is to ship files between machines. A second is to run remote commands. A further need is to have the ability to log in from one host to another. The standard utilities that are provided offer a mix of these capabilities.

There are three main groups of commands. The UUCP suite permits file copying between machines; UUCP stands for "UNIX to UNIX copy." UUCP was the first widely used set of networking software. It was originally designed to run on serial lines slung between terminal ports on machines. It gained popularity when modems became widespread. UUCP implementations now exist for most machines and operating systems.

The next set of available commands all start with the letter "r." The `rcp` command performs a remote file copy; `rsh` executes a command on another host and `rlogin` is used for remote login. There are also "r" versions of the `dump` and `restore` programs that are used to dump (and restore) a local machine to a remote tape. The original "r" commands were invented at Berkeley and were "a quick hack," an afternoon's expedience. However, they have found their way onto most networked UNIX machines. In general, these commands are restricted to UNIX systems, although you will find other implementations. They are mostly used for connections on the local-area network but can be used over the Internet. This is a testament to having the same protocol running everywhere.

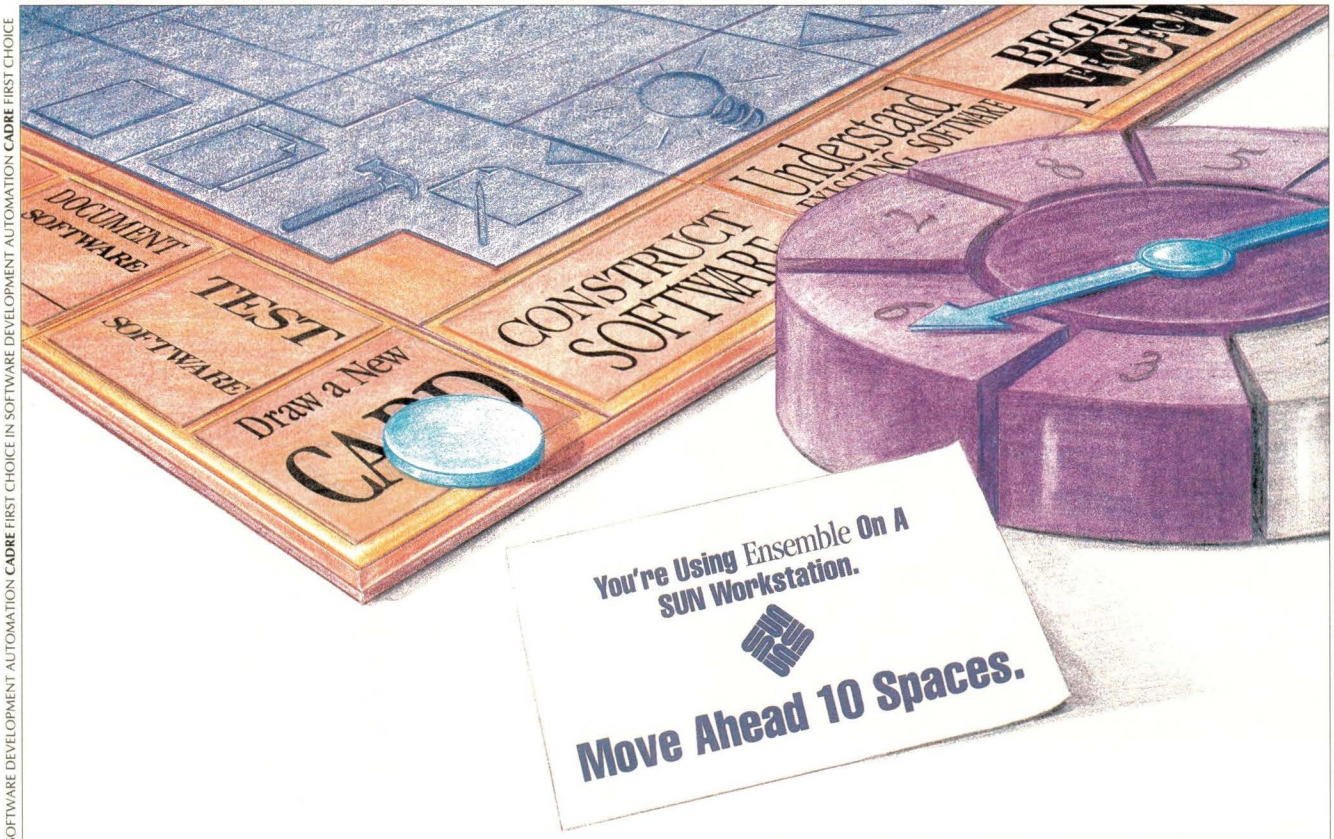
The remaining commands are designed for use on longer haul connections, like the Internet, but of course, can be used locally too. They were also designed to be machine- and operating system-independent, so that the services can be provided ubiquitously. The `ftp` command allows interactive access to a remote machine solely for the purpose of transferring files. Remote login is done using `telnet`.

This article concentrates on the middle set of commands, the "r" commands, to illustrate how they work and the problems that arise when using networking to provide intermachine communication.

Networking

While there may seem to be a wide range of commands and systems, the model of networking that they use is remarkably consistent. The model is largely independent of the actual technology being used to communicate. When we connect two or more machines together, the same types of problems pop up.

First, we need some way of saying which machine we would like to reach–this is normally called the *address* of the



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machine. Being humans, we like to refer to machines by name rather than by number. We name our dogs, cats, boats, so why not our computers? It's usual for the protocol or the hardware to use numbers to address remote systems. We try to provide a directory service to translate from the name that we want to use into the number used by the underlying layers. Some systems use a file, `/etc/hosts`, to list names and addresses. The software to access this file is quick and dirty, doing a fast scan when needed.

Using a file doesn't scale. It's not impossible to keep all the names and addresses on the Internet in a file. It's just impossible to keep all *correct* names and addresses in a file. The update job is beyond human abilities. An automatic system is needed and exists; it's called `named`. This supports the Domain Name Service (DNS); it makes your machine part of a distributed database of names and machine addresses. You maintain your local addresses and access other people's up-to-date information when you want to address their machines.

OK. We can put something out on the network that is guaranteed to reach another machine. What problems are there then? At a low level, we have the related problems of flow control and data reliability. If my speedy machine is transmitting to your sluggish one, eventually your machine cannot take data fast enough. It will need some way to tell my machine to stop sending data for a short time until buffers become free.

One way for you to deal with this overrun problem is simply to throw away inbound data when you run out of space to keep it. However, this makes the connection unreliable. Applications running on your machine won't know whether they have got all the data that I have sent. Also, it's entirely possible that I don't know that you have thrown away some of the data.

For some applications, we might not care if data is lost. If my machine is regularly updating something on your machine, then one lost message might not matter, another is coming. For other applications, we do care. If we are transferring a file, we need to know that the file has come across reliably. If bits are missing, we will get a little cross.

Networking software begins to tackle these problems by splitting the data into manageable chunks called *packets*. We arrange things so that when we send a packet, the other end will either get it intact or not see it. Sometimes the hardware takes care of this; sometimes code layers in the communications protocol will cope. If the application demands that we send a single message, then we can possibly send the message in one packet. This is often called communication by *datagrams*.

Datagrams are not reliable, in the sense that they might not get to the other end. Datagrams will contain addressing information and on a complex network can take different routes between machines. As a result, they might appear at the other end in a different order from that in which they were sent. If an application chooses to use datagrams to communicate with another machine, then it is its problem to cope with the difficulties raised by these limitations.

If we want to provide a reliable connection between


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machines, then we will use datagrams to create a *virtual circuit.* This is a temporary connection between machines built from protocol. Both ends know that the connection exists and will maintain some state information about the connection: I have just sent packet number 5; or I am expecting packet 92 and have just got 93; or I have just been asked to retransmit the last packet I sent.

If we create a virtual circuit, some of the bandwidth of the network is used to communicate this state information. There are often timeouts running so we can detect whether the other end of the connection has died or perhaps a packet has gone astray. The protocols deal with flow control in a number of ways, using packet acknowledgments or go-ahead messages. As a benefit, we will have confidence in the transmitted data. We will know that the data we have just sent has reached the other end intact and in the correct order.

As far as the application is concerned, someone else is worrying about data integrity. It can simply open the connection, throw some data down the hole and close things down, in the knowledge that the data has reached the other end intact. This satisfies the needs of many applications.

We have a model of communications that permits us to address remote machines by name. Our model recognizes that the network is inherently unreliable and does something about it if needed. On the Internet and also on local ether, we use Internet Protocol (IP) packets to communicate. On this is built a simple datagram protocol–User Datagram Protocol (UDP) and a reliable virtual circuit protocol–Transmission Control Protocol (TCP).

Remote Login

Since networking began, people have wanted to log in from one machine to another; this saves hardware–you only need one terminal–and desk space. The `rlogin` program permits this. Let's go though a login session and see what happens. A user types something like `rlogin remote`. First, the name of the remote machine is translated into a network address using direct translation from `/etc/hosts`, or more dynamically using the Domain Name Service. Then `rlogin` makes a TCP call to `remote`. All being well, the connection pops up in a user level process, `rlogind`, on the remote machine.

Here is the first of the problems: Data from the user's keyboard does not appear on the remote machine as a series of characters from a serial line. It appears as the inbound half of a bidirectional network connection. The `rlogind` daemon needs to pass inbound information into shells and commands that the user will run; it needs to collect the output from these commands and send them via the network to the user on the remote machine.

We could envisage a scenario where `rlogind` forked to a user shell and ran commands. The commands would inherit the network connections as file descriptors; we can arrange for network connections to operate with normal read/write system calls. Things would work happily for many commands that deal with streams of data (this is what `rsh` does, see below).

The trouble is that many commands that users need to run are interactive and have strong ideas about the nature of

heir input and output device–it must be a terminal. Perhaps hey need to alter the flow characteristics of the terminal, vhether the terminal should send a line or a single character. 'erhaps they need to turn echoing on and off. These ›rograms get confused if they try to take these actions using .octl calls but the calls fail. The calls will fail when the file lescriptor referring to the standard output is not a terminal ›ut is a network connection. We need something that will ›e like a terminal for these interactive connections to talk to. This is the *pseudo-terminal.*

The pseudo-terminal is a special device driver sitting in the ternel. It acts rather like a tunnel through the kernel, but a unnel that alters the nature of the messages that pass hrough. One end behaves like a terminal to any process ısing it; the other end deals in streams of data like a UNIX ile or network interface. If you pump data into the write ıalf of the stream end, it appears as read data for the termi-ıal. When the process writes to the terminal half, the data ıppears at the stream end as information to be read.

The two ends are conventionally related in name. For example, /dev/ttypa is the terminal end of the connec-ion while /dev/ptypa is the stream end. When rlogind gets a remote request from another machine, it looks for a ree pseudo-terminal. It starts the login program using the erminal end as the standard input, standard output and tandard error channels. From now on, the user logs in as ıormal and all the programs that are run are convinced that hey are talking to a terminal. The rlogind daemon hangs ıround shipping data between the stream end of the pseudo-erminal and the rlogin running on the caller's machine.

By now, the original rlogin program has forked into two ıalves. One takes data from the network and sends to the screen; one takes data from the keyboard and sends it to the emote machine via the network.

We can now put the whole story together. We imagine that he user is editing a file on the remote machine using an nteractive editor and see what happens when the user types ı character on the keyboard. The character enters the local ıachine and is read by the listening half of the rlogin ›rogram. The character is encapsulated in TCP and sent ›ver the network to the remote machine where rlogind eceives it. The character is now passed into the stream end ›f the pseudo-terminal and is read by the editor from the corresponding terminal end.

If the editor decides to echo the character, it will send it ›ack the way it has just come. Sending it by the pseudo-erminal to rlogind, from rlogind to network, from the ıetwork to output half of the rlogin program. Finally, the echoed character appears on the user's screen. This process is shown in Figure 1.

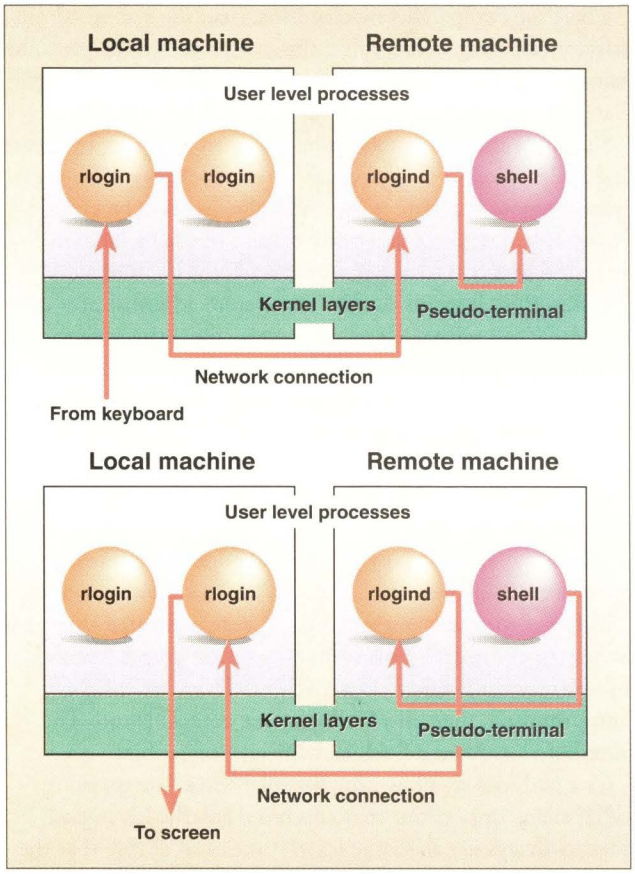

Figure 1. Processes involved in character input and output for rlogin

Security

Having got the basic mechanism in place, let's worry a little about security. Since the standard login sequence is being invoked, users are asked for their password to validate the connection to the machine. This may seem reasonably secure since it is no different from logging in from a terminal. It seems so normal that people do this without thinking; after all, using rlogin *looks* the same.

However, networking technology is remarkably insecure. It's easy to sit on an Ethernet and grab all the packets traveling between two points. Also, network debugging software exists to track particular connections in the protocols. The normal login sequence turns echo off so that someone looking over your shoulder cannot see what you are typing. However, this precaution is useless because your password is traveling as plain text and is visible to the network snooper.

You have some protection if your network is composed of workstations, because workstations generally prevent raw access to the network. Packet tracing is only permitted to superusers. However, all bets are off if you connect PCs on your workstation network. Anyone can snoop from a PC.

Security is always a compromise between safety and convenience, in computing systems and life. Usually, it's convenient to be able to log in remotely, and we will take the risk of password discovery. However, too many people are not aware that the risk exists.

If you regularly log in to a remote machine, it quickly becomes inconvenient and tedious to be forced to type your password every time. The designers of rlogin knew (or found) this and decided to permit "fast" access. The rlogind daemon knows the address of the machine that is calling since it needs to send data back there. It can look up the name from the address to determine the machine that originated the call. By adding the remote machine name to a file, we authorize remote access without a password.

There are two parallel mechanisms, first, the system administrator can create a file, `/etc/hosts.equiv`, that gives the names of all the machines that are cooperating. Users must have the same login name on all machines in the group.

Second, a user can establish his/her own mapping by creating a file called `.rhosts` on the home directory. This can give a remote machine from which the user will be permitted to log in with no password; it can optionally be used to permit free access to a user with a different login name.

Again, this all seems sound. The system administrator can control access with the `hosts.equiv` file; otherwise the user must log in to the machine to create the local `.rhosts` file. Once the files are in place, then the problems of password visibility disappear since users no longer type them on every connection.

Other problems raise their head. First, there is the problem of litter: Once a machine name is in your `.rhosts` file it tends to stay there. Many people will enter the name of a remote machine into the `.rhosts` file as a matter of course and forget to take it out again when access through that path is no longer needed. This is the way to build up a network of insecure connections to a machine. If one machine is compromised, then all your logins are accessible too. The Internet worm had a field day with `.rhosts` files.

It's a bad idea to allow nonpassword access for anything other than connections that you use regularly. It's a good idea to always use the same login routes and ensure that the `.rhosts` files permit only the connections that you use. I also think that it's a bad idea to allow nonpassword access on a wide-area network.

Second, there is the bigger problem of a machine popping up on the network and pretending to be a trusted host. Since the address in the host is configured in by software, any address can be loaded. So it's possible to lie about who you are and be believed. In general, this can only happen if the trusted host is down.

Some systems have insisted that the hardware Ethernet address of a remote machine be installed in a file before it will believe that the remote machine is who it says it is. This has not really caught on, largely because it's inconvenient to maintain distributed databases of Ethernet addresses and the solution doesn't scale.

These problems are beginning to be solved with the introduction of security systems like Kerberos; encryption is helping the software to believe that other software systems can be trusted.

Remote Execution

The authentication system that is used by `rlogin` is adopted from the `rcmd()` routine. It is this routine that forms the basis of the remote execution program `rsh` and, in turn, the remote copy program `rcp`. The ability to remotely execute a single command on a remote machine considerably enhances the ability of a single user to take advantage of the CPU cycles that may be unused on a multimachine network.

Using `rsh` is simplicity itself, assuming that the `/etc/hosts.equiv` file is set up or the `.rhosts` file is in place. To list your home directory on another machine called `remote`, you can say:

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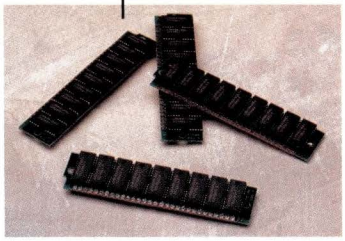

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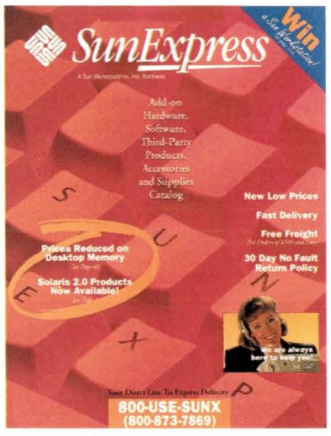

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```
$ rsh remote ls.
```

If the authentication fails, the command will fail, with the `Permission denied` error message. Otherwise, the remote machine runs the `ls` command. The standard input, the standard output and the standard error channels of the remote command are connected "conventionally," so

```
% rsh remote cmd >opfile
```

will print any error messages coming out on the standard error channel to the screen while diverting normal output to the file. As a result, it behaves exactly like the command is being run locally. Unfortunately, the `rsh` command doesn't appear to return program status, so there is something lacking in its transparency. However, you can run any command that doesn't require special interaction with a terminal.

The operation of the `rsh` command is simple to understand. First, it must be run by root or be setuid to root because it uses a privileged port number in the underlying protocol to communicate to the remote machine. It connects to a copy of `rshd` on the remote machine, again using a TCP virtual circuit. The `rshd` will refuse connections unless the port number is privileged, since it believes that the remote process is being run by root to get hold of the privileged port. This security check works on a network of cooperating UNIX systems but fails when an unscrupulous user gets hold of a PC and can emit requests on any port.

The intention is that an external machine requires privilege to invoke `rshd`, because in turn, the daemon is using privilege to set up a user. On a set of cooperating UNIX machines, this all works nicely. It's hard for one user to pretend to be another.

Once the connection to the remote `rshd` is opened, the local machine sends identification information so that the remote end can establish the user and check their `.rhosts` file for valid access. The local machine sends the command to be executed. The daemon will then change to the user's home directory, become the user and execute the command using the user's normal login shell. While the command is run, the daemon will pass data from the network into the command and will transmit any data that the command sends to its standard output and error channels back to the remote machine. When the command is done, the copy of `rshd` terminates.

The `rcp` command uses this mechanism to validate users and also to move data. The command generates calls to itself on the remote machine; the calls arrange to send data down the existing TCP connection between the machines. Clever stuff. ⊸

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+. He is the Usenix Standards Liaison. Email: `pc@expert.com`.

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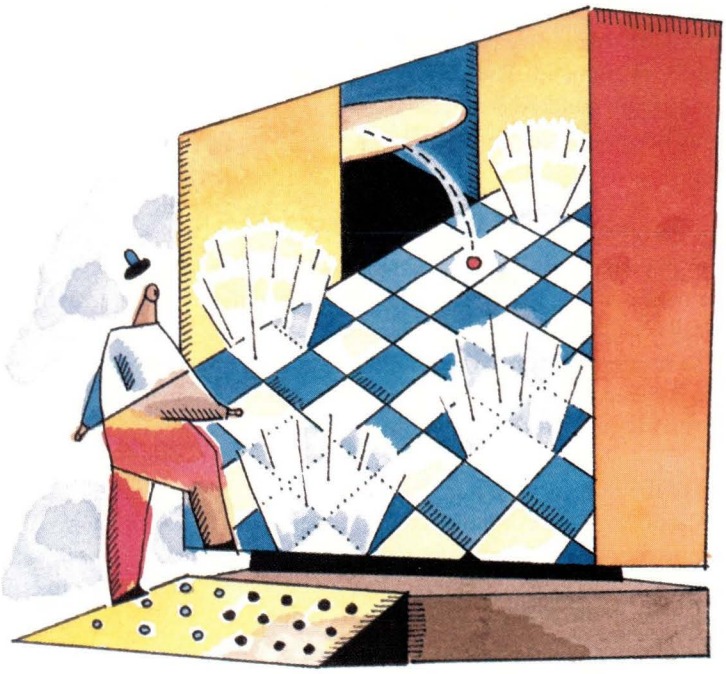


ROBIN JAREAUX

A Guide to Workstation Hardware (Part 3)

by **RICHARD MORIN**,
Technical Editor

It's still quiet on the USL front, so let's do some more looking at hardware issues. This month's column is a naive exposition of virtual memory, using the notion of a "Magic Checkerboard." I will also bring in some of the performance numbers on RAM and disks, to lend a quantitative flavor to things. Bear in mind, however, that while the numbers keep changing, the basic principles do not.

The Magic Checkerboard

Visualize your computer's address space as a (large) checkerboard. Each square stands for a page of memory, which may be resident in RAM (red) or sitting out on the disk (black). Each time your program references a memory location, it "lands" in one of the squares.

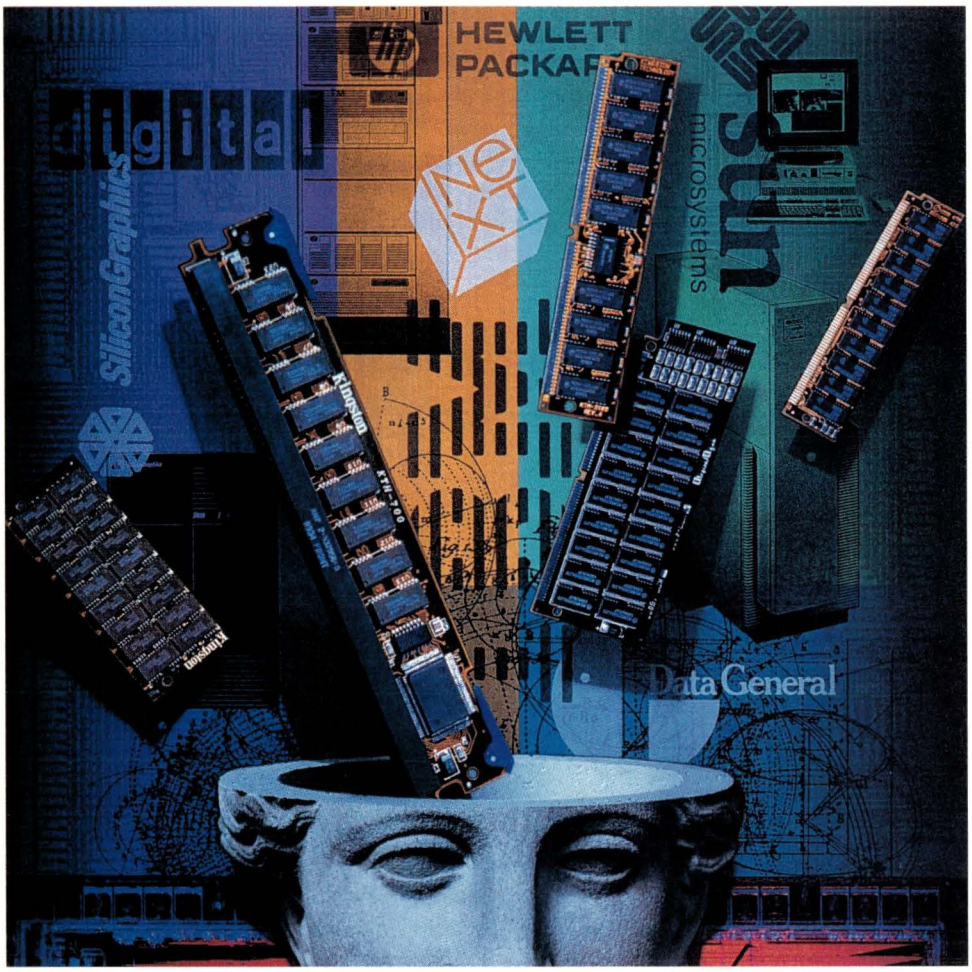
If the square is black, you must pay to make it red. If it is already red, you get a free ride for this turn. To keep the game interesting, only a certain number of squares can be red at any time. If you make one square red, another one must go black. The strategy is very simple: Stay on the red squares. Hit too many black squares, and you'll end up paying more than you can afford.

The analogy is not all that far-fetched. If a page is already in memory, an access takes about a tenth of a microsecond. If not, the page must be brought in from disk, taking at least 15 milliseconds (15,000 microseconds). Divide the two numbers and you get a cost ratio of 150,000 to one. In financial terms, if a RAM reference costs a penny, a disk reference costs $1,500. This explains why system designers work so hard on caching algorithms.

On a multitasking system, this cost is largely hidden. The computer doesn't waste time waiting for your I/O to complete. Instead, it executes processes that aren't waiting for resources. Your program's elapsed time goes up, but the CPU time does not (much). For this discussion, however, let's keep things simple. The computer is only running one task (yours), and we want it to finish as soon as possible.

If you have 8 MB of RAM and your kernel takes up 2 MB, user processes get a total of 6 MB for all their code and data needs. If your program fits within the available (total minus system) RAM, the question of virtual memory is largely irrelevant. Pages are brought in until your program has what it needs. They remain in RAM from then on, because nothing is pushing them out.

If, on the other hand, your program needs more memory than is available, the system has to push one of your pages out to disk before it can bring another one in to RAM. This costs *another* 15 milliseconds, doubling the cost ratio. Page over the net (e.g., on a diskless node), and the cost of bringing in a block gets even more expensive.



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Pretty serious stuff, if you do it very often.

Locality of Reference

Most well-written C programs do not hop around memory willy-nilly. A few hot spots (e.g., loops) in the executing code account for most of the CPU (and hence memory) activity. This increases the "locality of reference" (keeping memory accesses bunched together) and minimizes paging of executing code.

Data activity is still a problem, however. If a program walks through its arrays sequentially, each page gets a large number of references before it is returned to disk. If the needs of the algorithm (or programming clumsiness) cause the program to make long jumps through its arrays, pages go in and out of RAM like mad. The following nonsense program demonstrates this, by walking through a very large array:

```
#define S 3000 /* #define FAST /**/

int i,j,k,m[S][S];
main() {
    for (i=0;i<S;i++)
        for (j=0;j<S;j++)
#ifdef FAST
        k += m[i][j];
#else
        k += m[j][i];
#endif
}
```

With FAST defined, my ELC takes 20 seconds to run this program. Otherwise, it takes 173 seconds. Swapping two subscripts produces more than a factor of eight difference in run time. This is clearly an extreme example, but it *is* relevant. Subscripting order can have a very strong effect on paging activity. If you have a program that chomps through massive arrays, try running it under the C-shell's built-in `time` command. The test runs I made looked something like:

```
% time fast
12.7u   5.7s 0:20 ... 9pf+0w
% time slow
21.8u 103.5s 2:53 ... 3023pf+0w
```

After running the command, `time` prints out several values (see `csh(1)` and `time(1)` man pages for details). The first value (12.7u) is the "user time." This is the number of CPU seconds the command itself spent on the task. The second value (5.7s) is the "system time." The operating system spent this time doing things for the command. The third value (0:20) is the elapsed time in minutes and seconds, as you would get by using a stopwatch.

The last value (9pf+0w) shows page faults and swaps. In this example, the page faults tell the whole story. The fast version has nine page faults, compared with 3,023 for the slow version. By cleaning up subscript use on a thrashing program, you may be able to improve things by a similar ratio.

Tree structures and other linked lists can be even more troublesome. There is no reasonable way to store trees in memory. They sprawl, and pointers for closely related nodes may go anywhere in the address space of the machine. Every time you follow a pointer to a child node, you are risking an access to a whole new page.

If the nodes are small, the problem is reduced somewhat. At least some related nodes will fit on the same pages and may be accessed economically. Some programs take advantage of this by keeping big chunks of data outside of the list itself. This allows them to traverse the list economically, accessing big chunks only when they are needed.

In the Lisp language, the program itself is arranged as a tree. On a coarser scale, the many levels of subroutines used in structured languages produce a kind of tree-structured code. If these programs are not loaded carefully, their execution can cause repeated references to large numbers of pages. In any case, their locality of reference tends to be poor.

So What?

Good question. As a system administrator, you have very little to say about how local programmers design their code, let alone what vendors do in theirs. You can and should point out programs that page a lot, because

If you're paging too much, and you can't fix the code, add more memory!

improvement may well be possible. Other than that, however, you must live with the problem.

This is not to say, however, that there is nothing you can do. If you're paging too much, and you can't fix the code, add more memory! By adding more red squares to the checkerboard, you increase the chance that your programs will land on one of them. Besides, memory is really cheap these days. I recently bought a 16-MB memory module for my ELC. It cost less than $500, including tax.

One caution. Sun's VM system uses RAM as a cache. Process memory limits are based on the (disk) swap space. It's pretty silly actually. Put in 128 MB so that you can avoid swapping entirely, and you won't get any use out of it unless you allocate 128 MB of swap. In any case, adding RAM without increasing your swap space is a big loss. Live with it.

If you have a relatively small number of memory-intensive jobs, consider putting large amounts of memory on just a few machines. Encourage your users to put the hogs onto the memory-heavy machines. Telling them should be enough; nobody wants their programs to run slowly.

More generally, you can insist that programs be given enough memory to run efficiently. Virtual memory isn't free, and the costs go up sharply as the ratio of virtual to physical memory increases. If half of your programs'

memory fits in RAM, you're doing fine. Push it down to a third, and you'll start thrashing a bit. Less than that, and you're probably asking for trouble.

The `ps`, `pstat` and `vmstat` programs give useful, if complex, rundowns on how the system is doing. Look over the relevant manual pages, then try them out in various ways. After a bit of practice, you'll find ways in which they can help you to monitor the system. Mike Loukides' book *System Performance Tuning* (O'Reilly, 1991, ISBN 0-937175-60-9) gives extended coverage of these and other tools.

Bitch, Bitch, Batch...

One way of reducing instantaneous memory requirements is to use run queues (batches) for memory-intensive jobs. The `batch(1)` command is present on most versions of UNIX. It only supports a single job queue, so it won't handle complex scheduling requirements. On the other hand, it's very easy to use:

```
% batch
at> foo
at> bar
at> <EOT>
job 7570 at Tue Oct ...
%
```

By putting all your memory hogs into a batch, you keep them from competing for limited RAM resources. Each one gets all that the system has available and runs more efficiently. Some related commands, `at` and `cron`, will let your users schedule large production jobs for times when not much else is happening. Just remember the bad news about workstations: Even when you go in at night, they're still slow.

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`.

JOHN W. KELLEY JR.

Standards and FTP

by PETER H. SALUS

About 10 times each month, someone enquires why she or he can't access standard xyz electronically. I usually respond that it's because ANSI, IEEE, ISO or the ITU don't allow the standards to be put on to a server, and I supply several of the reasons that these august bodies have given in the past.

Well, boys and girls, once upon a time in 1991, Carl Malamud proposed to the International Telecommunication Union that the 19,000 (yes, nineteen thousand) pages of the "Blue Book" [the massive 1988 CCITT standards] be scanned in and posted to the Internet for ftp accessibility.

In August of 1991 Malamud flew to Geneva and met with the Secretary General of the ITU as well as with several folks at ISO. The upshot was that "Bruno" was permitted as an experiment. The result was that it was shot down as "failed" in only three months, the ITU and ISO viewing the Internet as a toy for academic techies and realizing that making things available would cut into their lucrative sales and printing contracts.

To get the whole story, run out and buy Malamud's new book, *Exploring the Internet,* for $26.95 (Prentice Hall, 1992; ISBN 0-13-296898-3). It is subtitled "a technical travelogue," and that's what it is. Malamud seems to have circled the world thrice in under a year, visiting lots of folks, eating in a number of restaurants I wish I could get to, and recounting conversations and naming names where the bureaucracy of international telecommunications is concerned.

It is a wonderful book, but the tale of Bruno and its slaughter at the hands of ISO and ITU may be the funniest and saddest in the book.

We can learn from a "Dr. Zakharov"– head of the ISO computer group–that "People don't need to read the standards" (Page 10). In fact, Dr. Zakharov seems to believe that ISO standards are unreadable and that people shouldn't try to read them.

Dr. Zakharov appears to believe that what every standard needs is the appropriate guru to digest it, and provide baby food to the technical community. This should then be redigested by another guru to supply third- or fourth-generation generalities to the public. (I guess the good doctor would support this column.)

We can learn from Walter Richter at ITU that the Internet doesn't reach the right sort of people. We can learn just what sort of big business printing is for the ITU (seven offset presses, four Xerox 5090s, "and a dozen or so

other large copiers...The ITU's own facility generated only a fraction of the total output. Swiss printers had a long and cozy relationship with the ITU bureaucracy" (Page 127)).

The Bruno experiment clearly threatened this high-gloss paper empire.

In its first four weeks, Bruno had been cloned by 21 servers on four continents. More than 500 hosts in 27 countries had retrieved over 65,000 files at rates up to 35 packets per second. Larry Eicher, the Secretary-General of ISO, put it quite bluntly to Malamud: 25% of ISO revenues came from sales. How would this revenue be replaced? Further, how would Malamud convince the national groups (like ANSI, DIN, etc.) to give up their sales revenue?

Another interesting point made by Malamud has to do with the copyrighting of standards. I presume that readers of this column know that IEEE, ANSI, ISO, etc., all indicate that the standards themselves are copyrighted. The substance of what Malamud remarks is that there may not be a sustainable basis for the various bodies to assert copyright protection.

His reasoning is that all standards "start out as public-domain working documents," which go through many public revisions; they are not "original and not previously published."

Furthermore, many jurisdictions don't permit the copyrighting of government or official documents. While I don't think it has ever come up, I would think that standards organizations are "official" and (in most countries) "governmental." Finally, copyright law appears to involve representation, so it is a matter for the courts to decide whether pieces of paper and arrays of bits are the same representation. (I think this may mean that the diagrams in standards are copyrightable, but the text isn't.)

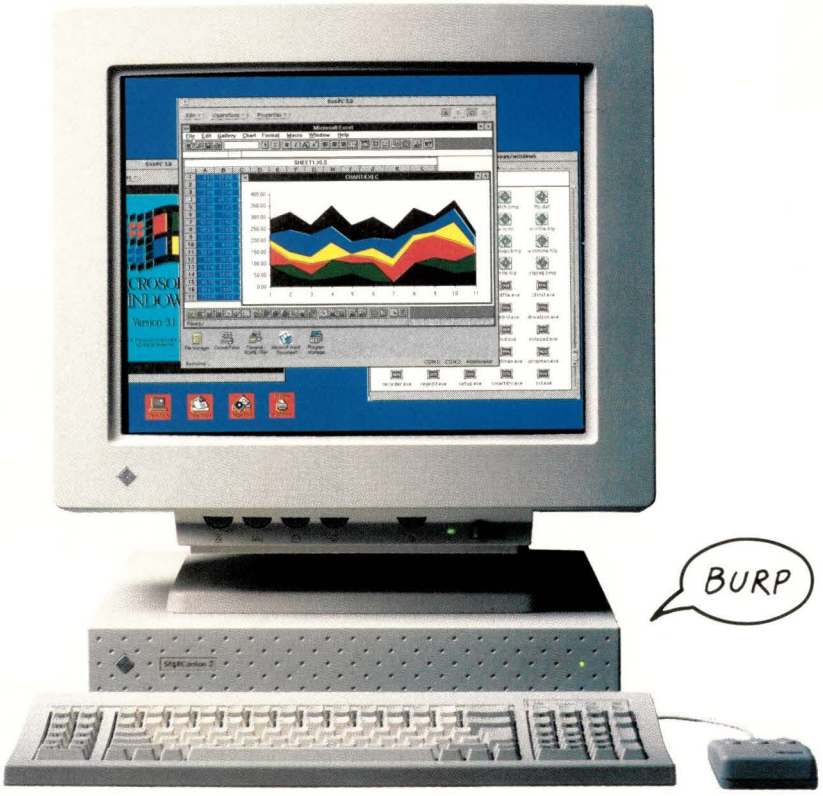
Malamud's book is entertaining, informative and lots of other things. I love his anecdotal style. This is not a high-tech volume on the Internet. But it is a great tour. And it will explain why the international standards bodies don't want standards to be readily available; why they genuinely fear the Internet and the wonder that John Quarterman calls "The Matrix"; and just why OSI is less than a success, despite the support of many governments and PTTs.

I admit that I don't think I've ever met Carl Malamud, but his columns are usually very fine, and his two recent books, *Stacks* and *Exploring the Internet*, are really excellent. *Exploring the Internet* deserves becoming Prentice Hall's greatest hit since K&R.

Correction

Due to a lack of standards on my part, I spelled Baldrige wrong in my September column.

Peter H. Salus is the executive director of the Sun User Group. He has attended both ISO and P1003/P1201 meetings and expects remission of time in purgatory as a result. Email: peter@sug.org.



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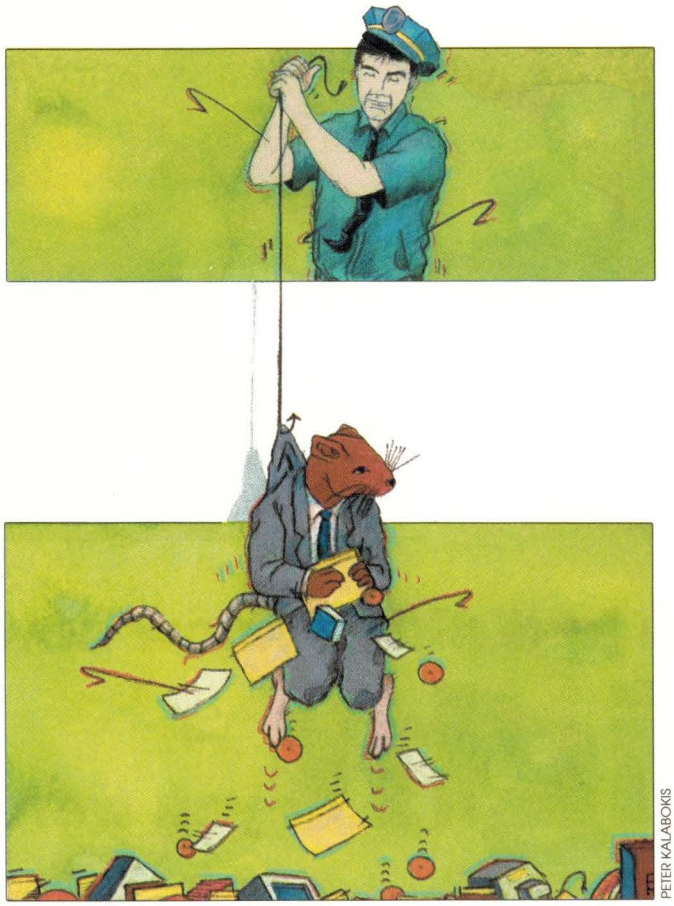

Space Police

by S. LEE HENRY

Electronic pack rats–that's what they are. All those users who never throw away a file and fill "your" disks with data that needs to be maintained and backed up. With few exceptions, no one cleans up after himself on a regular basis. As a result, disk space is constantly on every systems administrator's mind.

Space cadets to the rescue! By setting up your file systems to enforce quotas, you might gently make your users accountable for the space that they occupy.

File System Quotas

The disk quota option of SunOS has a couple of quirks but is basically easy to administer. Further, simple scripts can be built that facilitate configuring the quotas and watch for users who are getting close to the limits that you set. This gives you the ability to deal with the politics of who owns the resources and whether you, as the space policeman, can enforce limits on how much your users retain long before they get "bitten."

Disk quotas are set up to limit one or both of 1) disk space and 2) the number of inodes (file descriptors) used. For exported file systems, quotas are established on the server. Only superusers can set quotas and look at other people's usage. Quotas are set up by file system and require kernel support through the QUOTA and UFS options.

```
options  QUOTA # disk quotas for local disks
options  UFS   # filesystem code for local disks
```

The quotas file itself is kept at the base of the particular file system. For home directories, this file will be something like `/home/quotas` or `/home/wizard/quotas`, depending on how you've set up your accounts.

The `/etc/fstab` and `/etc/mtab` files reflect the use of

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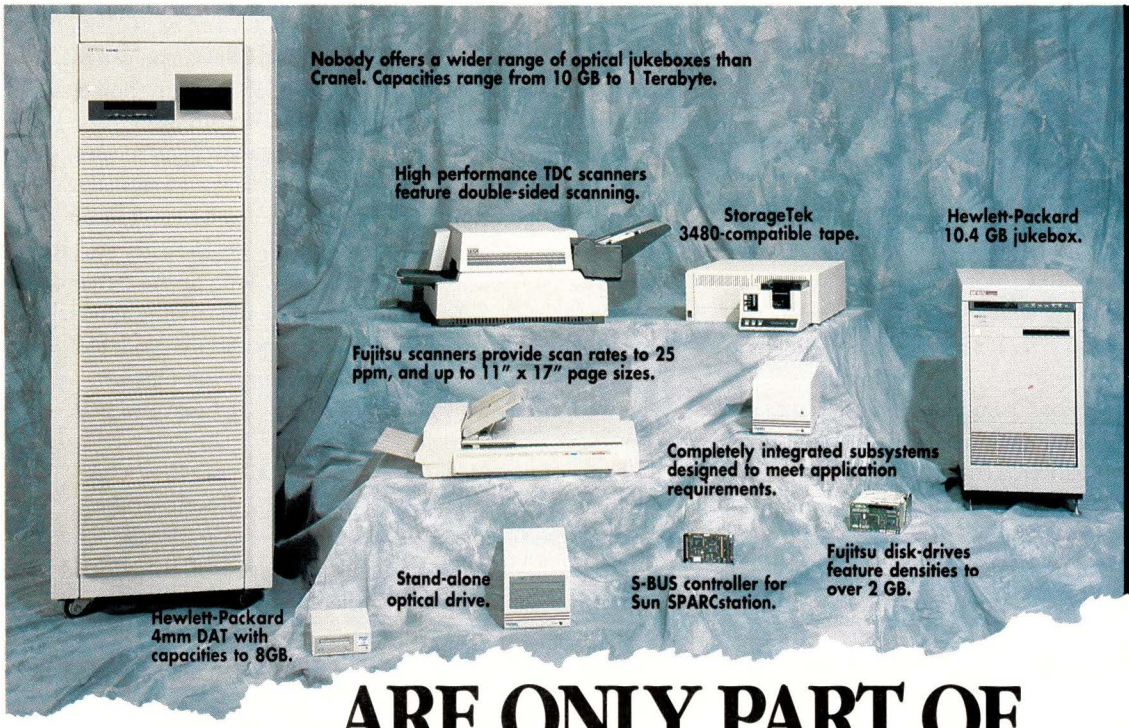

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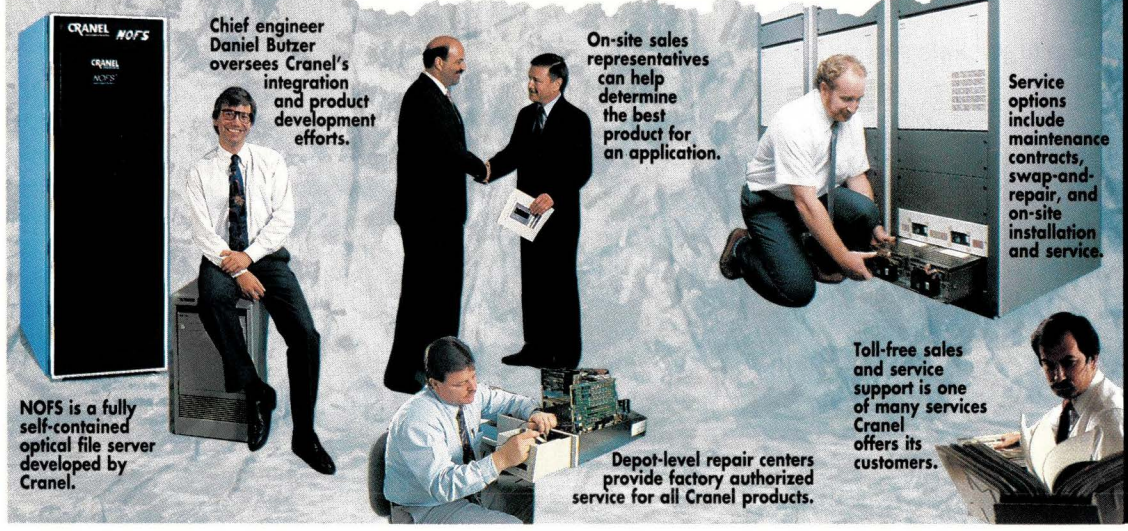

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```
fs /home blocks (soft = 40000, hard = 50000) inodes (soft = 0, hard = 0)
fs /usr blocks (soft = 8000, hard = 10000) inodes (soft = 100, hard = 100)
```

Listing 1. Showing individual disk quotas with edquota

quotas on both local and remote file systems as shown below:

```
/etc/fstab:
/dev/sd0a       /       4.2 rw 1 1
/dev/sd0g       /home   4.2 rw,quota 1 6
/dev/sd3h       /usr    4.2 rw,quota 1 2
/dev/fd0        /pcfs   pcfs rw,noauto 0 0
/etc/mtab:
/dev/sd0a       /       4.2 rw,dev=0700 1 1
/dev/sd3h       /usr    4.2 rw,quota,dev=071f 1 2
/dev/sd0g       /home   4.2 rw,quota,dev=0706 1 6
```

The `quotaon` and `quotaoff` commands will start and stop quotas. You do need to create the quotas file before using `quotaon`; `quotaon` doesn't create it for you and will complain if it doesn't exist. This is one of the command's "quirks" but is not much of a problem.

```
touch /home/quotas quotaon /home
```

To set individual disk quotas, use the `edquota` command.

```
/usr/etc/edquota slee
```

See Listing 1 for the output. Unless the EDITOR environment variable is set, `edquota` puts you into vi, where you can modify the values for space and inodes.

By default, both the space (blocks) and inodes values are set to zero. This indicates that no quotas will be applied. From the quotas expressed in the lines above, you can see that I am free to create as many files as I want in /home, as long as I do not use more than 40 MB of storage.

Allocating both soft and hard limits allows you to warn the user that he has used up more space than he is entitled to while giving him time to clean up his act. The soft limits denote the value at which the user will begin to get warnings and the clock begins to "tick" on how long he has to remove some files. The hard limit denotes the usage value at which he no longer will be able to create files and may lose files that he edits. Make sure that the cushion you provide between these two values is reasonable and that you give your user time to react.

Timeout values can be specified for file systems by the `edquota -t` command. To change the default for the system, modify the value indicated in the header file `/usr/include/usf/quota.h`. Changes will be reflected when you compile a new kernel.

```
#define  DQ_FTIMELIMIT   (7 * 24*60*60)
         /* 1 week */
#define  DQ_BTIMELIMIT   (7 * 24*60*60)
         /* 1 week */
```

To use the `edquota -t` command, you should first shut off quotas for the particular file system and remove the old

Listing 2a. Using repquota to generate a report

```
                    Block limits                File limits
User            used    soft    hard     timeleft    used  soft  hard   timeleft
slee    +-  37869   30000   40000  NOT STARTED    1049     0     0
fred    --   1784   30000   40000                   39     0     0
onowa   --    290   30000   40000                   18     0     0
vail    --     15   30000   40000                   12     0     0
melodie --    889   30000   40000                   93     0     0
shayla  --    110   30000   40000                   21     0     0
charita --     11   30000   40000                    8     0     0
```

Listing 2b. The -v option reports on individual usage

```
wizard#quota -v fred
Disk quotas for fred (uid 222):
Filesystem  usage    quota   limit   timeleft    files    quota   limit    timeleft
/usr           1     8000   10000                   1      100     100
/home       1784    30000   40000                  39        0       0
```

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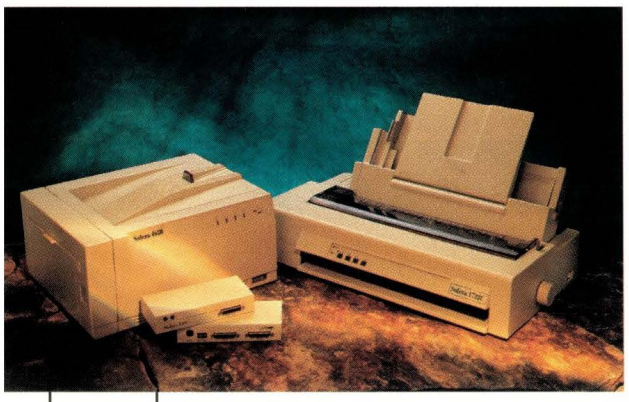

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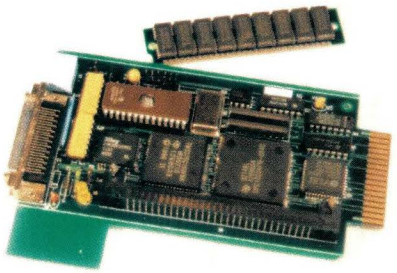

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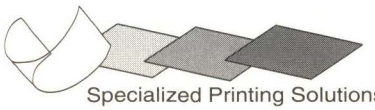

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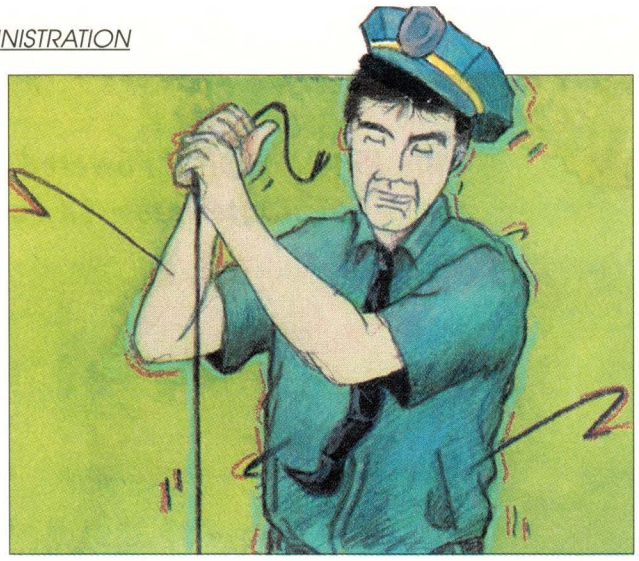

quotas file.

```
quotaoff /home
cat /dev/null > /home/quotas
edquota -t
quotaon /home
edquota slee
quotacheck /home
repquota /home
```

If all your users are going to be given the same quotas, you can simplify the setup by setting up a single or "model" user and then copying the quotas for other users with the `edquota -p <model> <user>` command. If I want to set up Vail's quotas the same as mine, I use:

```
edquota -p slee vail
```

The beauty of this method is that you can set up quotas via a simple script or using your favorite shell interactively:

```
wizard# foreach user (vail fred onowa melodie
shayla charita)
? edquota -p slee $user
? end
```

Don't forget to run the `quotacheck` command for a consistency check after setting them up.

You can do this same thing on a larger scale (e.g., across all servers) by copying the quotas file after you've set up quotas for your model and then using a loop like that shown above to set up quotas for all users on each of those servers.

Reporting Quotas

To generate a report on quotas, use the `repquota <file system>` command. A sample of the output of this command appears in Listing 2a. Clearly, I'm the only electronic pack rat on my system! On the network overall, I don't stick out so much.

The `quota -v <user>` command, Listing 2b, displays a quota report for an individual.

The second "quirk" that I've found in dealing with quotas is that the `repquota` and `quota -v <user>` commands do not always agree. Sometimes the `repquota` command will say "NOT STARTED" when the `quota -v <user>` command indicates how much time is still left.

Watching Out for Your Users

Something that I've found very useful is to run the `repquota` command each night through an `awk` filter that looks for quotas over 90% (see Listing 3). If you examine this report each morning, you can warn users who are getting close (probably long before they would notice). It reminds them that you're on their side. I've included the simple `awk` script that does this for you.

Listing 3. An awk filter to look for quotas over 90%

```
# over90: print disk space and file usage over 90% of quota
# BEGIN {
 print "Space Usage Over 90% of Quota"
 print "---------------"}
{
if (NR > 2) {
PCT = $3 / $4
PCT2 = PCT * 100
if (PCT2 > 90) {
 DEC = index(PCT2,".")
 PERCENT = substr(PCT2,1,DEC-1)
 print $1 "\t" PERCENT "%"
 }}
}

Space Usage Over 90% of Quota
---------------
slee  126%
```

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The command

```
repquota /home | awk -f over90 | lpr
```

will run this report and send it to your printer. Put this in root's crontab file and run it each morning before folks start working. The following entry in `/var/spool/cron/ crontabs/root` would run the quota report each morning at 6:15:

```
15 6 * * * /usr/etc/repquota /home | awk -f
/usr/local/bin/over90 | lpr
```

Calculations inside the `awk` script start with the second line of the `repquota` output in order to jump over the column labels. Subsequent to that, all we're doing in this script is calculating the percentage of the soft limit for disk space used and printing it out as a percentage. The output of this command is shown below the script itself. For simplicity, this script only looks at disk usage. Clearly you can add calculations for checking the number of files quota as well.

For those of you thinking about the move to Solaris 2.0, you'll be happy to know that quotas have not changed.

Solaris 2.0

For those of you thinking about the move to Solaris 2.0, you'll be happy to know that quotas have not changed. The noteworthy exception to this statement is that you will no longer have to concern yourself with whether or not your kernel has been built to support quotas; the dynamically configured kernel takes care of this for you. ➸

S. Lee Henry is on the board of directors of the Sun User Group and is a systems administrator for a large network of Suns in the federal government. She also runs The Next Page Inc., a consulting firm specializing in software documentation.

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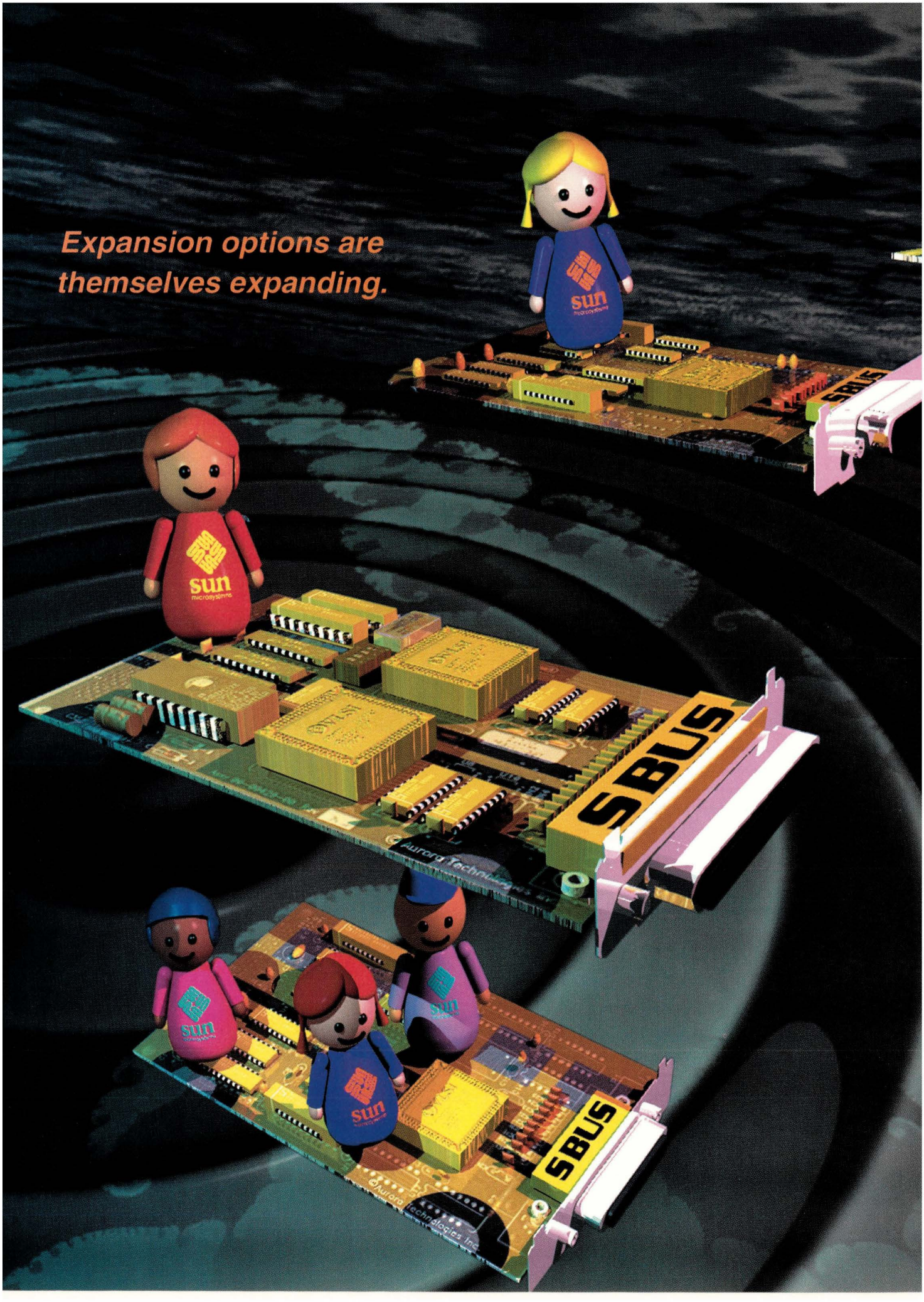
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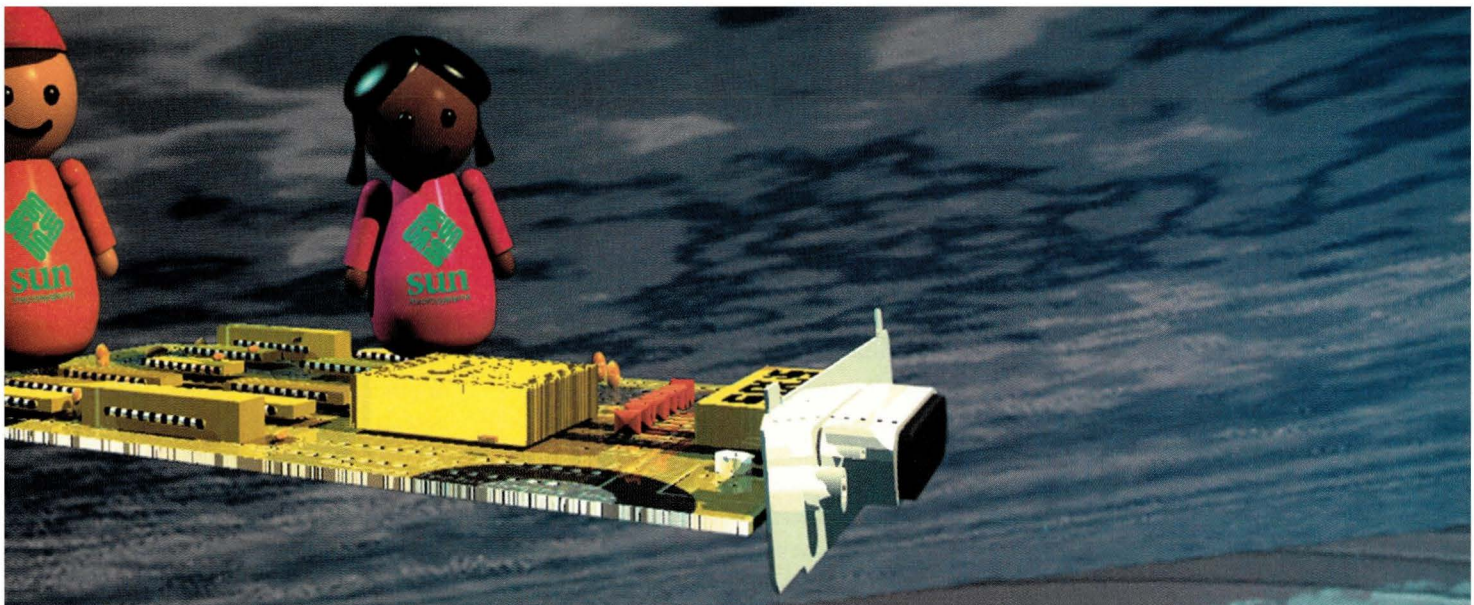


COLIN CHEER/VORTEX STUDIOS

SBUS

SBus Expansion Options

by **JAMES D. LYLE**, Troubador Technologies

Many computer users have been trained to expect a large number of expansion slots in their machines. For example, systems based on VME, Multibus, STD and similar interfaces are often found in card cages that can accept a dozen or more cards. The five slots in the original IBM PC design proved woefully inadequate. Today most of its descendants have at least eight slots, and even that is barely enough in many cases.

This is why potential customers are often surprised that SBus-based machines typically have only two, three or four slots. If there are hundreds of SBus options available, they wonder, then how can even four slots possibly be enough?

For most customers, though, two or three or four SBus slots are enough. There are several reasons for this. First, many SBus-based workstations have migrated the standard devices to the motherboard itself. This includes the Ethernet, SCSI, serial and parallel interfaces. This often also includes the frame buffer or graphics accelerator, and even ISDN and CD-quality audio interfaces. When on the motherboard, these devices don't consume any of the available slots; they all remain free.

Also, modern high-integration technologies allow for better use of those slots that are available. For example, adding memory to a system once meant adding a card and consuming a slot. Today, single in-line memory modules (SIMMs) are used instead. More devices and functions can be crammed onto a card, too. There are dual coprocessor cards, for example, Ethernet and SCSI interfaces, multiple serial and parallel interfaces, and so on. One SBus card will often suffice where previously two or three might have been required.

Still, some users do need more SBus slots. SBus host manufacturers can't simply add slots, though, because the SBus specification strictly limits certain electrical characteristics, such as capacitance. This drives the cost and size of SBus cards down, while improving performance. Unfortunately, it also limits the number of slots. If specification-compliant, any SBus with a 25-MHz clock rate probably has no more than three slots. If the clock rate is 20 MHz or less, then four slots are possible (and with extreme care, perhaps five or six).

SBus host manufacturers can add bus interfaces, however. Consider the SPARCserver 600 MP series, which can be expanded through its VME and MBus interfaces, in addition to the four SBus slots it provides. Consider also Performance Technologies SBus/System Model PT-SYS5000, which offers up to eight total SBus slots. To accomplish this it uses multiple SBus interfaces, as shown in Figure 1. This approach has advantages besides an increase in the number of SBus slots; it also increases the total I/O bandwidth available.

Boarding the Bus

It is also possible to add slots to a machine already in the customer's hands. This is done with a bus bridge or expansion chassis. This is a product that connects another bus through one slot on the existing bus. In the case of a true bus bridge, the added bus can be of virtually any type. For example, a VME bus interface (and hence VME expansion devices) can be connected in this way. In fact, several vendors do offer such SBus-to-VME bridges. Since the interfaces at each end can be very different, bus bridges usually must provide some kind of electrical isolation and translation facilities.

An expansion chassis typically refers to more of a bus extension than a true bridge, because the same kind of bus is at each end. It is usually simpler, and an expansion chassis may only need to provide electrical isolation (signal buffering), although resynchronization or other functions are sometimes also necessary.

A diagram of an SBus expansion chassis is shown in Figure 2. Its components include the expansion chassis itself, an adapter card and the cable that connects the two. Extra SBus cards are plugged into the remote bus in the expansion chassis, and transfers to or from them are routed through the adapter card that is plugged into the host bus. Note that while an expansion chassis might provide *n* slots in the remote bus, it also consumes a slot in the host bus. Therefore the total number of additional slots it provides is *n-1*.

There are a number of SBus expansion chassis products available. A summary of these and their primary characteristics is shown in Table 1. Not surprisingly, there are many similarities between these products; after all, they are designed to perform the same basic purpose. Ultimately, the differences are more interesting, though, because they spring from the unique approaches taken to add value and solve the technical challenges involved. Exactly which product is best for a given application depends on the customer's particular needs and how they are affected by the choices and trade-offs the vendors made.

For example, note that there is significant variation in the cable lengths that each product affords. The longer the cable, the greater the flexibility, in most cases. If the cable is too short, then the expansion chassis probably must be positioned directly below or above the workstation. A short cable may be problematic for some nondesktop machines, too, which aren't in typical pizza box enclosures. This includes the SPARCserver 600 MP series, for instance, which is in a deskside VME enclosure. Longer cables offer no such difficulties, though.

Figure 1. A multi-SBus architecture not only increases the number of SBus slots, it also increases the total I/O bandwidth available.

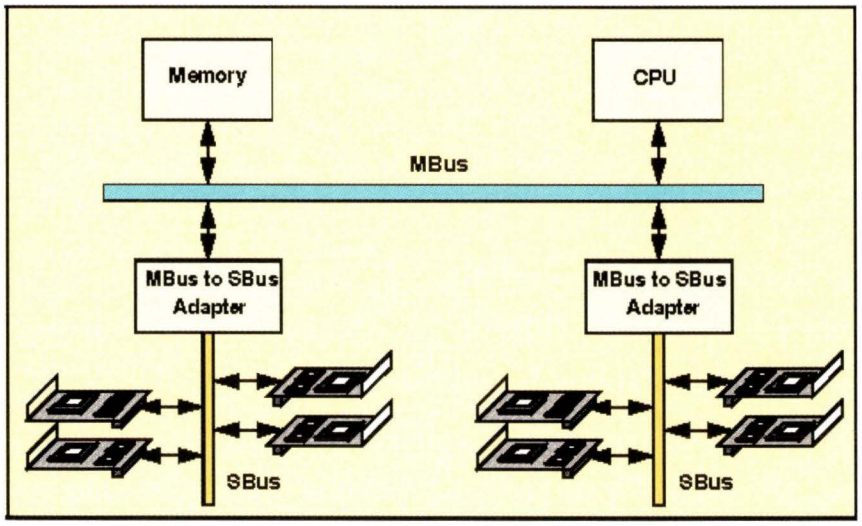
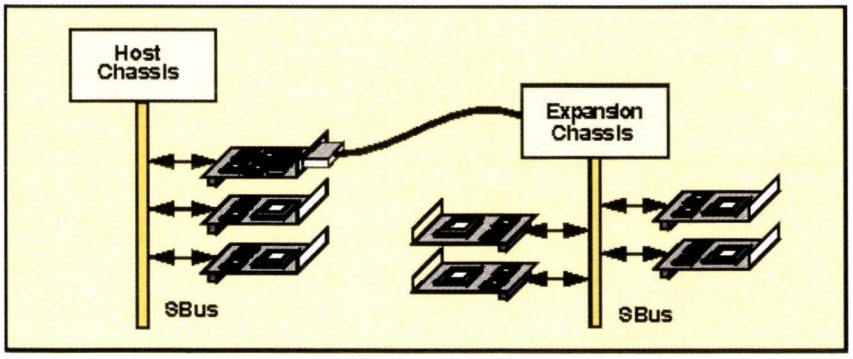


Figure 2. Expansion chassis components include the expansion chassis itself, an adapter card and the cable that connects the two.

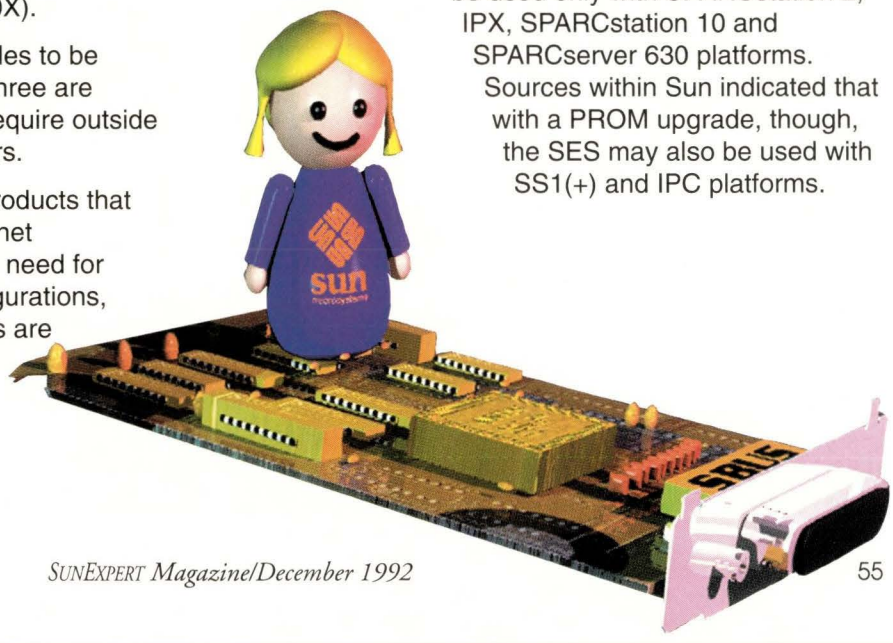


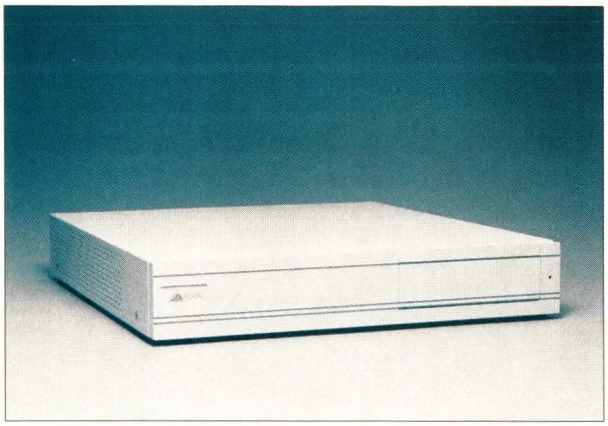
Summary of SBus Expansion Products

	Aurora Technologies Inc. SBox	Integrix Inc. SEC150	Artecon SB-3000XD (SB-6000X)[1]	Sun Microsystems Inc. SES	Texas Microsystems Inc. 9100
List Price	$1,995	$1,950	$1,995	$2,495	$2,595
Warranty	1 year	1 year	1 year	90 days	1 year
Number of slots[3]	4[2]	6[4]	3 [6[5]]	3	44
DVMA (master) support?	no	yes	yes	yes	yes
Space for SCSI devices?	two 3½-inch bays[6]	two 3½-inch bays	two 3½-inch bays[7]	two 3½-inch bays	four bays[8]
Compatible with SS1(+), IPC?	yes	yes	yes	no[9]	yes
Cable length	100 feet	1 foot	12 to 30 inches	6 feet (2 meters)	18 inches

Notes:

1. Artecon's SB-3000XD and SB-6000X are now second-generation products. The previous models had fewer features and a more restrictive cable length of only six inches.
2. Aurora offers a "Dual SBox" configuration that has eight slots and lists for $3,599.
3. An expansion chassis adds the number of slots indicated but also consumes one slot in the host. Therefore the net gain ranges from two slots (for Su's SES and Artecon's SB-3000XD and SB-3100XD) to five slots (for the Integrix SEC150 and Artecon's SB-6000X and SB-6100X).
4. Of these six slots, three allow cables to be attached to the cards. The other three are reserved for devices that do not require outside connections, such as coprocessors.
5. Artecon offers variants of these products that provide on-board SCSI and Ethernet controllers. This can eliminate the need for such an SBus card in some configurations, thus saving a slot. These products are designated SB-3100XD and SB-6100X and list for $2,395.
6. Requires optional mounting kit. One of the device bays can accept a 5¼-inch device and has external access so that it may be used for a floppy, tape or CD-ROM drive, for example.
7. Not available on the SB-6000X and SB-6100X.
8. Two 3½-inch bays and two 5¼-inch bays. The latter have external access.
9. The SES can only be used in a host whose Open Boot Prom revision is 2.0 or higher, which is not typical of most SPARCstation 1, 1+ and IPC platforms (and equivalents). According to the documentation Sun provides, the SES may be used only with SPARCstation 2, IPX, SPARCstation 10 and SPARCserver 630 platforms. Sources within Sun indicated that with a PROM upgrade, though, the SES may also be used with SS1(+) and IPC platforms.





SBus expansion chassis, like this SBox from Aurora Technologies Inc., come in several different forms. All, however, allow a workstation to support more than the maximum four SBus slots allowed by SPARCstations and compatibles.

Why then don't all these products offer long cables? Long cables are more difficult because they are more susceptible to electrical noise, ground loops and offsets, and so on. Also, a finite amount of time is required to send a signal down a cable and then get the result. If long enough, this propagation delay can degrade overall performance or disallow certain kinds of SBus transfers that have especially strict timing requirements.

Aurora Technologies Inc.'s SBox buffers all the signals using differential drivers (which are largely immune to noise and tolerant of ground offsets). It also resynchronizes critical signals to guarantee required timing constraints. This allows cable lengths of 100 feet or more when needed (although due to the delays introduced by longer cables, performance is maximized when the cable length is kept as short as possible). According to Aurora's marketing director, Brian Skidmore, this approach required additional expense and difficulty, but the result is a more robust and reliable design. The length also makes it easier to place the expansion chassis where it is needed, such as on the manufacturing floor or in the wiring closet. An added benefit of the design is the ability to turn the expansion chassis on and off independently. This allows SBus cards to be removed or installed without turning off power to the host.

A Master Plan

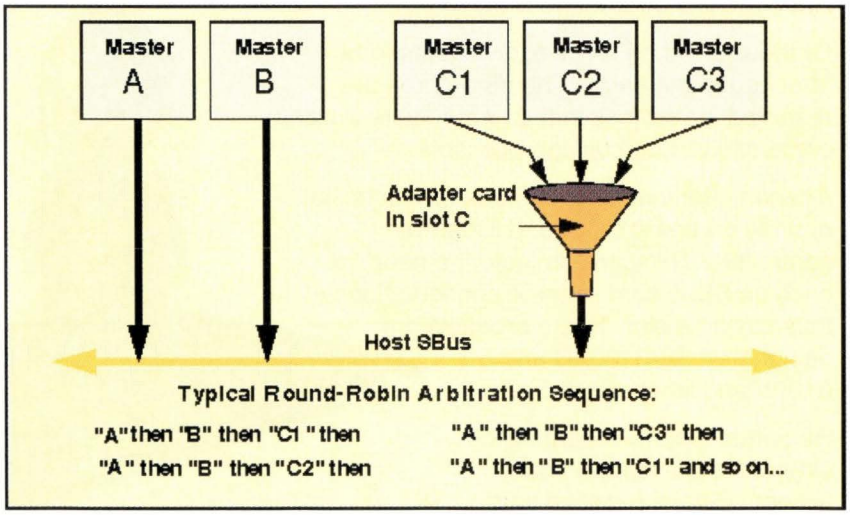
There is a cost associated with this approach, though; the delays and resynchronization penalties do not allow SBus master devices (those that can initiate transfers) in the remote bus. This product is only useful for SBus slave devices (those that only respond to transfers). Still, this may not be as severe a restriction as it first seems, because of issues related to the effective use of SBus master devices in any expansion chassis. More on this later.

Integrix Inc.'s SEC150 can support SBus master devices only if the cable delay is minimized. This is why this product limits its cable's length to only one foot. Texas Microsystems Inc. uses a pipelined approach that reduces its product's sensitivity to propagation delay and allows the cable to stretch to 18 inches. Artecon's SB-3100XD and SB-6100X use a similar mechanism.

Sun Microsystems Inc.'s SBus Expansion Subsystem (SES) takes a very different approach. This product is more like a true bus bridge than the others. In this case, the remote SBus is not really an extension to the host bus; it is more like an independent bus in its own right. According to Robert Gianni, Sun's engineering manager, Hardware Interface Technologies, peer-to-peer transfers (those between one SBus card and another) on the remote bus require the host bus only for virtual address translation. Once that is done, the transfer on the remote side completes in parallel with other activity on the host side. Also, the remote bus always operates at the maximum SBus clock rate (25 MHz), even if the host's SBus clock rate is lower. Both of these features improve the product's performance.

The SES packetizes transfers; it encodes them before sending them through the cable and then decodes them at the other side. This mechanism allows the independent bus activity described above, and it also manages the delay and resynchronization that a long cable requires while still allowing the SES to support both master and slave devices in the remote bus. This allows the SES to use a cable up to two meters long.

Figure 3. Devices in a remote chassis have inherently lower priorities (priority dilution) than local devices. Remote requests are "funneled" through a single slot and must share that slot's place in the arbitration sequence. In this case, remote masters get one access for every three of the local master.



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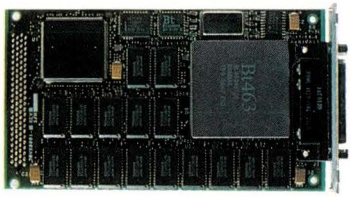

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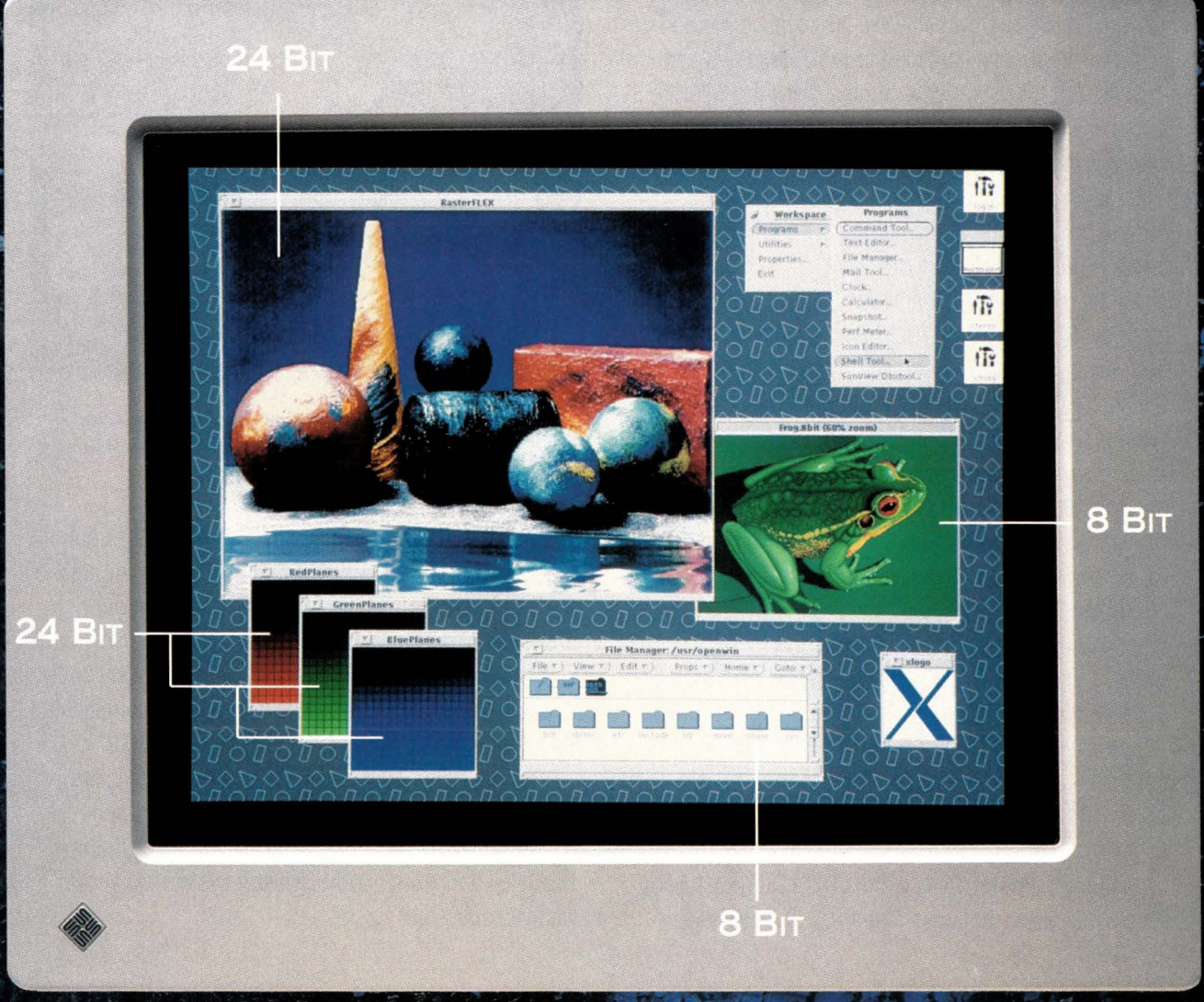


Circle No. 49 on Inquiry Card

Like Aurora's SBox, the SES' long cable has its drawbacks. All of these products add to the time and overhead required to complete a transfer. This increases latency and reduces bandwidth, but usually the effect is small (the difference is only a few percentage points in most cases). Packetizing transfers exacerbates the problem, though. The effect is still small for burst transfers (which send or receive multiple words per transfer) but might be pronounced for nonburst transfers. When asked to comment, Sun's Gianni acknowledged that "if an SBus card does not make use of burst transfers, it will perform better in the host."

This could be significant. Many existing SBus slave devices don't make use of burst transfers (Sun's GX and CG3 frame buffers are two examples). There are two principal reasons for this. First, it complicates the design and is only possible with 32-bit-wide interfaces (while slaves are often 8- or 16-bit devices). Second, some SBus hosts cannot initiate burst transfers at all. Those that do often can't do it cleanly. There is no SPARC instruction to generate a 16-byte burst (the most common type), for example, and system- or processor-specific mechanisms must be used.

With the exception of Aurora's SBox, all of these products allow SBus master devices in the remote bus in some cases. Restrictions and exceptions are common, though; check with the vendor to find out which devices and which configurations do not work with each expansion product. Even in those cases where the restrictions are not specific, there are still architectural issues that affect how well SBus masters will work in a bus-bridge or expansion chassis. Among these are such factors as priority dilution and retry blocking.

As mentioned before, SBus masters can initiate transfers while slaves cannot. This capability is often referred to as Direct Memory Access (DMA), or in this case Direct Virtual Memory Access (DVMA; SBus masters use virtual addresses). To perform such an operation, the master must first request access to the bus and

The Mux Option

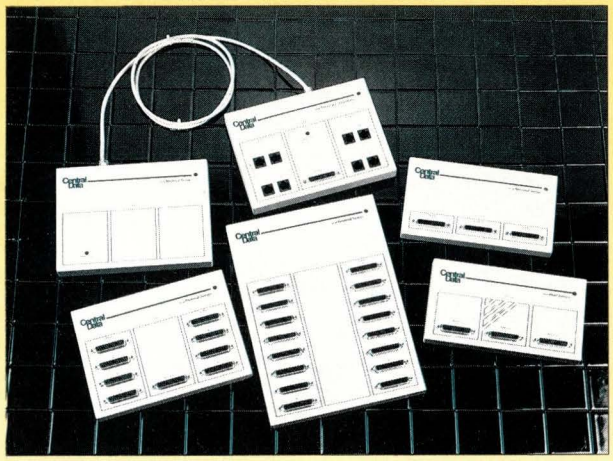
SBus expansion chassis, such as those mentioned in this article, are probably the best-known method of providing additional hardware to SPARCstations and their ilk. But there are other routes. Since the SPARCstation's introduction, a number of companies have explored the possibilities inherent in the machine's ports.

The SCSI port, for example, is a popular method. Among the vendors in this market is Central Data, which offers a line of products it calls scsiTerminal Servers. These plug into the SCSI port of a SPARCstation or other system and provide additional parallel and serial ports–up to 393 serial ports and 49 parallel ports in its Series 2000 model, which the company describes as a "workgroup" model. More common, though, are its smaller systems, such as the ST-1002+, which offers one parallel and two serial ports, and the ST-1008+, which offers one parallel and eight serial ports, and the ST-1016, which has 16 serial ports. Central Data also offers a still smaller product, the scsiPrint Server, or SP-1003, which adds three parallel ports to UNIX systems via the SCSI. All of these devices can be expanded with additional ports.

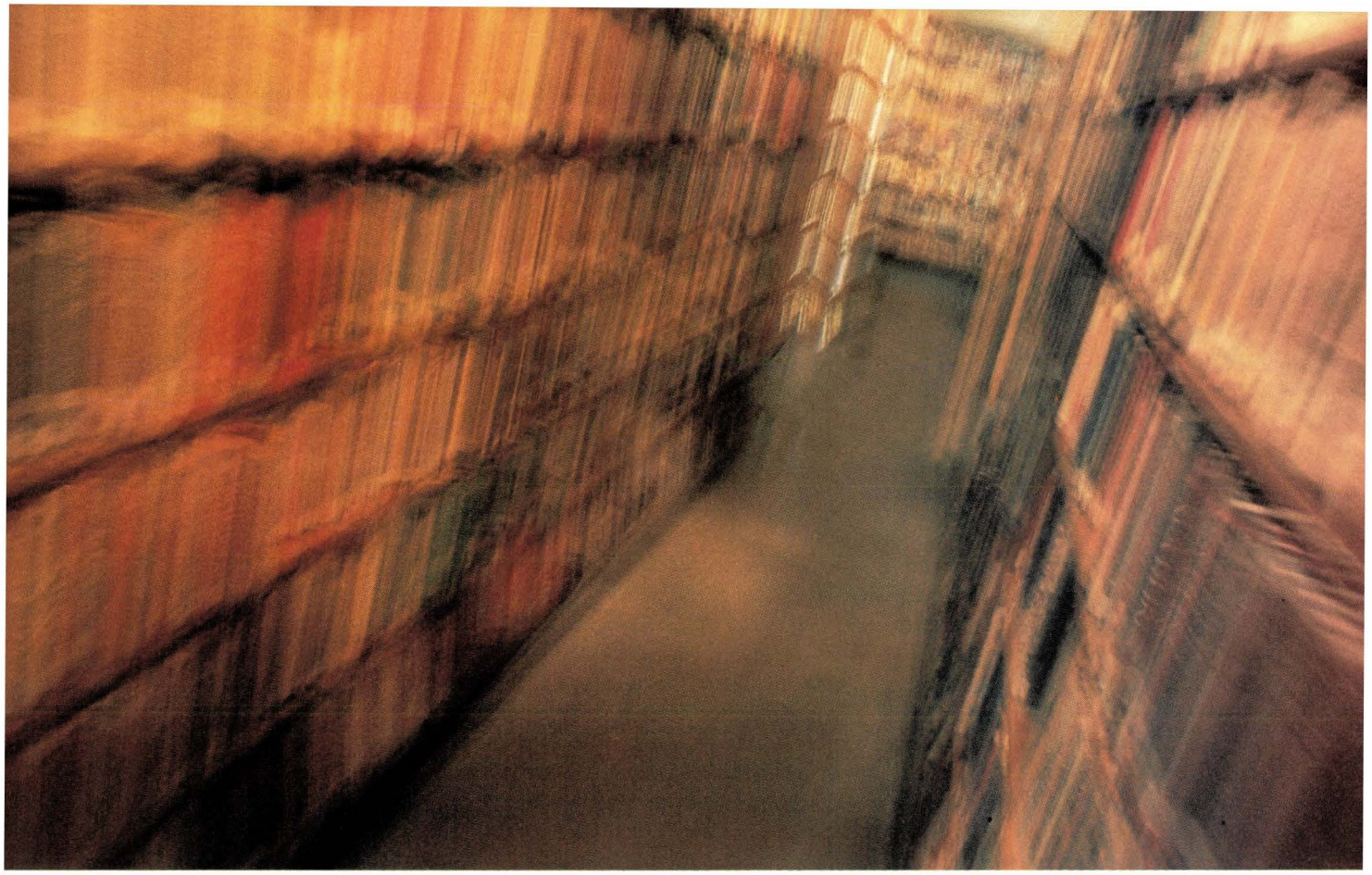
Pricing on the ST-1002+ is $695. The ST-1008+ is $995. The ST-1016 is $1,495. The SP-1003 Printer Server is $795. And, finally, the Series 200 machines are $1,490.

Another multiport device is the VPX-128 from Tucson-based Vector Technologies. The VPX, too, provides additional ports and connections, but where the Central Data route is through the SCSI, the VPX goes through the Sun Microsystem Inc.'s RS-232-C. The product gives one parallel and seven serial ports to the workstation's serial port. "We are the only one we know of doing it this way," says Frank Olivieri, the company's manager, sales and marketing. Pricing is $1,195.

There are other players in the game, of course, and other ports through which to ship. Now that Sun is supporting ISDN, for example, it will be interesting to see when and if integrators attempt system expansion via that route.–*mjt*



The SBus is not the only path to system expansion. These Central Data SCSI terminal servers, for example, provide expansion via the SCSI port.



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then wait until access is granted (by the SBus controller).

Each SBus slot has only a single request/grant signal pair, so logically each slot contains only a single master. If multiple master devices are needed, either on an expansion card or in an expansion chassis, then they must "funnel" their requests through the single request/grant pair (shown conceptually in Figure 3). This dilutes the effective priority of these masters and can reduce the bus bandwidth available to them.

Roadblocks

Sharing the request/grant pair of signals has another important side-effect. SBus controllers and slaves may generate "rerun" acknowledgments if they are not ready to perform an operation the master requests. If this happens, the master is required to retry the same operation again; as soon as possible and without any intervening transfers. Look again at Figure 3. If any one of the remote masters receives such an acknowledgment, then all remote transfers (and all remote masters) cannot proceed until the operation that caused the rerun acknowledgment is retried and successfully completed. Under certain circumstances (such as a miss in an address translation table or a "split" transfer), this may take some time.

This was not an important issue previously, because most SBus masters typically performed transfers only to and from the host system's memory, and historically the host memory slave has not generated rerun acknowledgments. Both of these factors are changing, though. Peer-to-peer transfers are increasingly common, and most new hosts (especially those that combine MBus and SBus) do generate rerun acknowledgments.

Some of these products do not guarantee the proper behavior when a rerun acknowledgment is received (this is not an issue with Aurora's SBox because it doesn't allow SBus masters). Again, check with the manufacturer for details.Without this guarantee, correct operation in any host that relies upon it cannot be assured. In such a case, the problem is eliminated if only one SBus master is used in a remote slot (this also eliminates priority dilution and therefore should be considered whenever possible).

Factors such as priority dilution and retry blocking all increase the latency with which an SBus master must contend. Some masters, such as Ethernet cards, are sensitive to latency and may not work in an expansion chassis. Others will work, but at reduced performance levels. Similar issues reduce the effectiveness of SBus masters in any bridge environment, including the SBus-to-MBus interfaces found in most of today's newer hosts.

In such cases, SBus slaves sometimes offer better performance than SBus masters. DVMA makes great sense where CPU resources are scarce and must be carefully conserved. Processor power has grown much more rapidly than I/O bandwidth in recent years, though, and so it makes sense to use that power to improve I/O efficiency and lower its cost. Sun has followed this strategy in the graphics arena for some time and is replacing some of its SBus master cards with equivalents that are slave-only devices. The SBE/S combination Ethernet/SCSI card is one example.

Just as there are issues that affect how well SBus masters will work in an expansion chassis or bus bridge environment, there are also issues that primarily affect slaves. The most important of these is the fundamental limit in physical address space, used to access the slave. SBus slots have either 25 or 28 physical address bits, depending on the host. This corresponds to an address space of 32 or 256 MB per slot. An SBus slave plugged into this slot has this entire space available. In an expansion chassis, all slaves must share the same space, though, and this reduces the amount available to each.

In a host that drives all 28 address bits, this isn't much of a problem. The address space is easily sub-decoded into up to eight separate spaces (slots), each of which is at least 32 MB deep (the minimum SBus requirement). Many hosts only drive 25 bits, though. The SPARCstation 1+, IPC, SPARCstation 2 and their clones all fall into this category. With these hosts, it is not possible to provide each remote slot with the minimum space requirements. Each may only get a fraction of what it otherwise would.

Fortunately, this predicament can be managed in most cases. Few SBus

Companies Mentioned in this Article

Aurora Technologies Inc.
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slaves actually require an address space at least 32 MB deep. In fact, many require only a few KB at most. So the address space can be sub-decoded into several spaces, each of which is sized to match the requirements of that particular slave.

There are many ways to accomplish this. Aurora's SBox is configured manually, via jumper settings. Integrix, Sun and Texas Microsystems use a fully automatic mechanism that makes use of the information contained within an SBus card's ID PROM. Artecon also offers a GUI utility called SBus Tool that allows the configuration to be fine-tuned manually.

The products listed in Table 1 add between two and five slots (net) to an SBus system. What if even this isn't enough? Expansion chassis can be used together in parallel; each of the host SBus slots can contain the adapter card for a separate expansion chassis. In this way, systems can be easily configured with a dozen or more slots! In some cases it is even possible to use expansion chassis serially (in a daisy-chain fashion), although special care is often required.

Hopefully, those who use SBus-based machines will never run into a slot limitation. If they do, though, there are several ways they can stretch the limit. More highly integrated cards (with more devices on each), are an option. So are some of the newer hosts with more slots available. Or an expansion chassis or bus bridge can be used to add slots to a machine that the user already has. If the latter approach is taken, there are many products and alternatives to choose from. This article has offered a brief look at some of them, and at some of the relevant issues that affect their use. ➸

James D. Lyle is a hardware development engineer, consultant and vice-chair of the IEEE P1496 SBus working group. An original member of Sun Microsystems Inc.'s SBus Technical Support Group, he is the author of *SBus: Information, Applications, and Experience* (published by Springer-Verlag). He can be reached at jlyle@netcom.com.

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Serve, Server, Servest

by **BARRY SHEIN,** Technical Editor

This month, we review three terminal/communications servers. I use a running table format for handy reference, highlighting the features I found worth contrasting as we go. The three products are the Xylogics Inc. Annex-3, Chase Research Inc.'s Iolan-TC8 and Livingston Enterprises Inc.'s PortMaster2 (and Dialnet software). For many customers, these three products are very similar: They can be used to hook up serial (RS-232) devices to hosts over a LAN. All three products can do this, but many features differentiate these products, including extras such as printer support and tools for aiding network administration.

General Administration

All of these products are actually small computers (sometimes multiple-processor computers) dedicated to a single task. They all have fairly sophisticated command interfaces to which you can attach for administrative control (see Table 1) of their software. A remote interface means that you can telnet or rlogin over your LAN to the box to perform various administrative chores such as modifying port parameters or monitoring activity. The other choice is a local interface port dedicated to administrative control.

Remote interfaces are both a blessing and a curse. They are a blessing because they allow a network administrator to manage many of these boxes on a network without leaving his or her seat. They are a curse because remote capabilities are a potential security problem. The Annex, PortMaster and Iolan all allow you to set a password that must be entered before the administrative command interface can be accessed. The PortMaster supplies OpenLook and Sunview monitoring and administrative interfaces, as well as a "dumb" terminal interface.

When all else fails, or if new software is to be loaded, you will need to reboot a server. All three systems allow you to reboot the box via the remote administrative interface. You can also, through the same administrative interface, dump the memory of the Annex for inspection by you or someone from the vendor as an aid to diagnosing problems.

Resetting modems and other pesky devices is often accomplished remotely only via toggling certain control lines such as DTR. The Annex allows you to toggle these through the standard administrative interface, remotely.

Sometimes a security issue arises (see Table 2) and it is important to be able to find out who is connected, send

Table 1. General Administration

	Annex-3	PortMaster	Iolan
Remote Interface	yes	yes	yes
Local Interface	yes	yes	yes
Password Protect	yes	yes	yes
Reboot	yes	yes	yes
Toggle Modem Control Lines	yes	no	no
Who is Connected	yes	yes	yes
Text Messages to Ports	yes	no	yes
Finger Server	yes	no	no
Error Logging to Server	yes	yes	no
Syslogd Support	yes	yes	no
TOD Client	yes	no	no
Message of the Day	yes	yes	1 line

messages to a port or even tap a port to monitor activity (e.g., a port that is not logging in but has been connected for a while might well be someone guessing passwords). In order to know who is on, the ports have to be set up to require usernames and passwords before using them, when this feature is enabled all these servers let you inquire who is on each port. You can also use `finger` to an Annex to inquire who is on each port (if known), and what host or hosts the port is accessing across the LAN. To enhance security and integrity, the Annex lets you send error logs to a remote server, either through their own `erpcd` protocol or via UNIX's standard `syslogd` protocol.

Having to set and check the time on servers on a large network can be a chore if it has to be done manually. The Annex will, optionally (a software setting), keep itself synchronized with a host on your network. All the servers allow you to set a message of the day, a one- or more line banner message seen by users upon connection.

The Command Line Interpreter (CLI) is the interface through which a user of the server accesses its features. Among the desirable features are the ability to set various terminal parameters (such as flow control) and to manage multiple connections across the LAN, similar to job control in UNIX.

Customizability is a further plus: Can you set up menus of host names for the user to choose from or otherwise prompt with local information? The Annex allows this.

Finally, for this section, sometimes the best way to deal with the CLI is to be able to suppress it entirely and dedicate particular ports to particular functions.

Security SLIPs

Security on networks is a never-ending concern these days, as each new feature that was supposed to make our lives easier becomes another potential hole into our network. One simple defense is the ability to set one or more local passwords on dial-in or direct serial ports to prevent anyone unauthorized from getting past your modems and into the network at all, thus preventing them from getting to host prompts and guessing for easy accounts to crack, etc. The Annex could set these for all combinations, the PortMaster only for ports configured for SLIP.

By dedicating ports, mentioned earlier, to particular hosts, you can also limit what a person can do on the network. Completely dedicated ports should be transparent and look the same as a direct-connect modem.

The ability to monitor and log connections (connection security) helps spot trouble early in otherwise open networks. For example, could all those odd connections to that little one-user workstation on someone's desk off-hours suggest that perhaps there's a guest account without a password? A little analysis of such logs with tools like `awk` or `perl` can locate oddities, but first you need the raw data.

Port security goes in the other direction; for example, who can connect outbound to modems (and run up phone bills)? Is there password protection? Can you shut this off entirely or limit it to specific hosts or users?

If you send error or security messages, can they be encrypted just in case your channel has been compromised?

Port-Able Servers

This next section (see Table 3) focuses on more fine-tuned features of a port server (outbound connections to modems, etc.). Can all ports be used? Can certain ports be used, chosen by the network administrator?

Camp-on is a term coined by the Annex folks; this function allows someone to wait in line–without having to manually retry over and over–for a free port when this is a limited resource and they're all busy.

Being able to name rotaries eases use of ports; for example, if only a certain group of ports can be used for outgoing modem dialing, can the server give the entire group a name (e.g., "dialouts") rather than force the users to maintain cryptic crib sheets? This is particularly important if you change which ports are dedicated to certain services with any frequency.

Annex-3

Company
Xylogics Inc.

Address
53 Third Ave.
Burlington, MA 01803

Phone
(800) 225-3317
(617) 272-8140

Fax
(617) 273-5392

Best Feature
Very mature, sophisticated product.

Worst Feature
Earlier models lacked proper modem control, which is fixed in the Annex-3.

Price
$3,995, 8-port

Circle 140

Most people who buy these servers want at least serial communications, terminals, dial-ins, etc., even if they support printers and other features. Expandability can be more economical than buying a new box to add a few ports, but at some up-front cost for the initial configuration.

Not all terminal servers can properly support modems. By "properly" I mean at least the following two features: hardware flow control and hangup on carrier loss or host disconnect (when appropriate). If the server allows per-port password protection but cannot properly detect that the phone has been hung up (and close the session) then someone is going to eventually get a free ride and come into an active session. It's just a matter of time and (bad) luck. Without hardware flow control, some software is miserable to use, either because screen updates get scrambled or, if you are forced to use software flow control, certain characters cannot be typed as commands.

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Table 2

	Annex-3	PortMaster	Iolan
Command Line Interpreter			
Multiple Connections	yes	no	yes
Customizable	yes	no	no
Suppressible	yes	yes	yes
Security			
Local Password	yes	yes	yes
Dedicated Ports	yes	yes	yes
Connection Security	yes	yes	yes
Port Security	yes	no	yes
Encryption	yes	no	no

Autobauding is a feature that UNIX has generally been weak on. This is the ability to match the serial port to the speed of the modem or terminal by looking for an initial character (typically a carriage return) and guessing (correctly) the line speed it was typed at. The Annex has general support for this, the PortMaster will cycle between three preset speeds per port.

There are many other parameters one can set on a serial line, such as parity, number of data bits to actually send along, stop bits, idle timers, which flow control to use, if any, which break characters to recognize, what to use as an attention character to get back to the CLI, even the prompt, newline, telnet escape, output toggle and other comfort features. All the servers we reviewed had a reasonably rich set of these features.

We'll get to more details of serial printers later, but let's note here whether they are supported at all.

There are two commonly used TCP/IP remote login protocols (Telnet and rlogin), each with their proponents. LAT is found in DEC networks and is a semiproprietary protocol used typically with VMS systems. SLIP, CSLIP and PPP are actually peer-to-peer TCP/IP protocols that make the remote host a full-fledged member of your network using the serial port (SLIP is an acronym for Serial Link Internet Protocol) as its LAN connection. CSLIP is compressed SLIP, a modification that squeezes more out of the line by not retransmitting certain information which is redundant on such a simple connection. PPP is yet another improvement on SLIP and is an acronym for Point-to-Point Protocol. The Annex comes standard with the all the noted protocols; the PortMaster has another product, Dialnet, which adds SLIP.

Wiring Ins and Outs

A PBX connector uses standard telephone company 25-pair (or 50-pair) connectors to wire between devices, thus eliminating most of the wires that have to be slung across your room. In many cases, modem racks can take these connectors directly, eliminating the entire milking machine look from your glass house. You can also buy a cable, called an octopus, that goes between these 25-pair single PBX connectors and a fan-out of more traditional D-type serial connectors (9-pin or 25-pin or custom). Finally, there's the good old rat's nest, one cable for each connection, typically with a D-type connector on each end. The Annex supports only PBX on its end, so connections must be PBX to octopus or PBX to PBX. The other two servers were DB25-only so you need one cable per port.

Parallel connectors for printers are very standard. Unfortunately, there are two major standards: Centronics (ubiquitous in the PC market) and Dataproducts (common in minicomputer and mainframe shops).

Now that you have your printer wired to the server, how are you going to talk to it? There are at least three common choices: LPD, which is based on Berkeley protocols; Direct, which makes the printer look as much like it is attached to a serial port directly on a host as possible; and UNIX System V's LP. By "pseudo" in Table 3, I mean that the vendor provides a program for another host to simulate this feature.

People want to enter host names, not numbers. This requires that the software in the server be able to translate between host names and the numbers required to actually assemble packets. There are a few choices for setting up these mappings: A static table would be set up by a network administrator manually and loaded when the server boots (or saved in its own memory). IEN116 is an old but simple and effective name server protocol (the name refers to the standards document that specifies the protocol, Internet Engineering Note #116). IEN116 is easy to set up on most any UNIX host that already has general TCP/IP proto-

PortMaster2 (and Dialnet Software)

Company
Livingston Enterprises Inc.
6920 Koll Center Parkway, #220
Pleasanton, CA 94566

Phone
(510) 426-0770

Fax
(510) 426-8951

Best Feature
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Worst Feature
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Price
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(software is free of charge)

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1 *Double click on a variable to create a window that displays its value whenever the program stops.*

2 *Click on a variable to print its value.*

3 *Click on a green dot to set a breakpoint.*

4 *Click on the stop sign to clear the breakpoint.*

5 *The program is currently stopped here.*

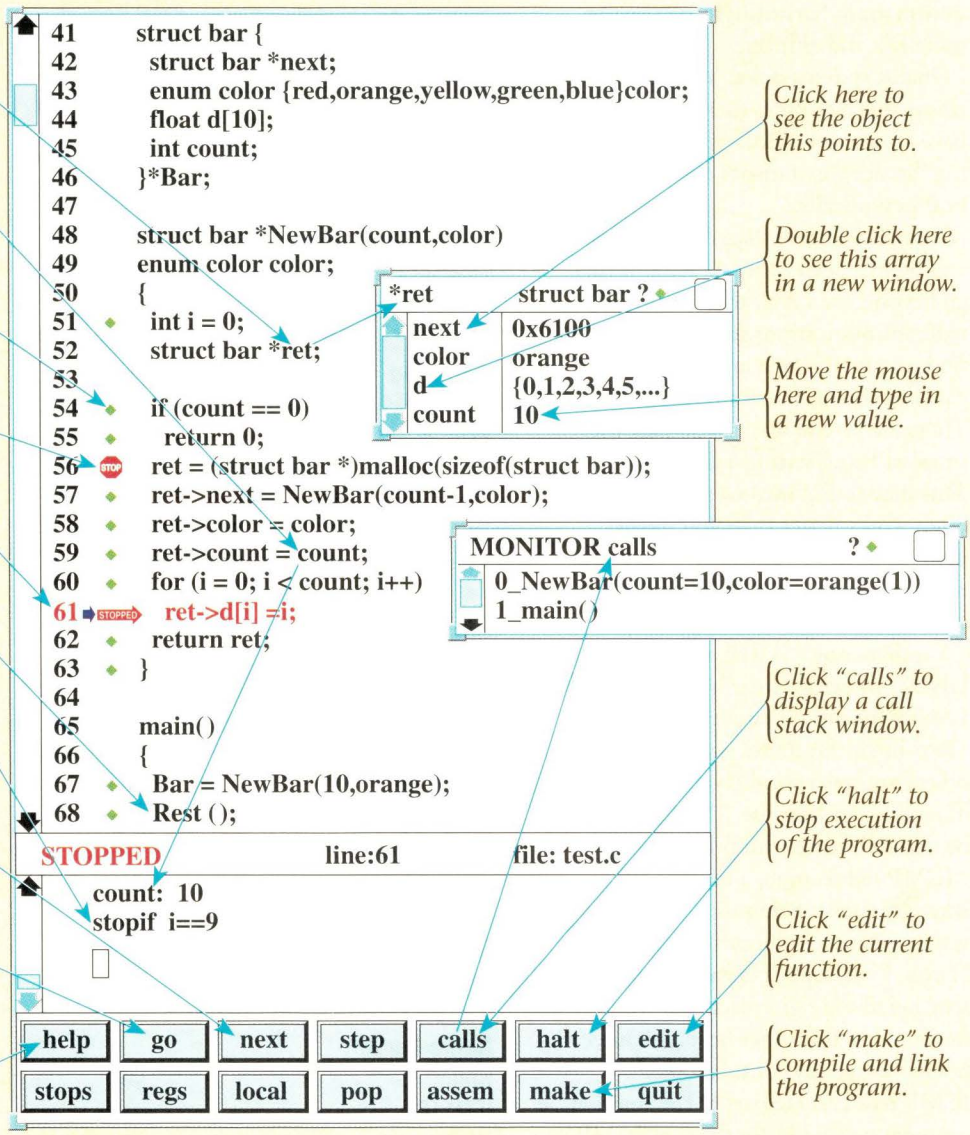
6 *Click on a function name to display its source code.*

7 *Set a conditional breakpoint at the current line.*

8 *Click "next" to execute the next line of the program.*

9 *Click "go" to continue (or start the program).*

Click "help" to learn the rest of MULTI.



Click here to see the object this points to.

Double click here to see this array in a new window.

Move the mouse here and type in a new value.

Click "calls" to display a call stack window.

Click "halt" to stop execution of the program.

Click "edit" to edit the current function.

Click "make" to compile and link the program.

It's worth learning MULTI to fix one bug.

Also, embedded development for: 68xxx, 386/486, SPARC, R2000/R3000/R4000, 88000/88110, Gmicro, V810

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Tel: (617) 862-2002 • FAX: (617) 863-2633

cols. The Annex comes with sources for an IEN116 server to put on your host (or hosts) and instructions for installation.

Many modern Internet sites already run something called DNS, the Domain Naming System. Unlike IEN116, DNS can be used across the entire Internet, if desired, and discovers mappings between host names and addresses by querying a series of servers (possibly worldwide) for local information. Surprisingly, it's usually quite fast and efficient.

Finally, systems based on BSD (or reasonable facsimiles thereof) often have a protocol called `rwho` running that broadcasts statistics about each host periodically.

If you have more than one network and people need to access systems that go beyond the LAN, then your terminal/communications server needs to find a route through an appropriate gateway that will forward its packets. There are several ways to do this, the simplest being setting a fixed route. This may sound inconvenient, but it often works better than you might imagine because you can set one fixed route to a very smart host (such as a router box) as the default gateway.

Another choice is RIP, a Berkeley UNIX protocol primarily designed for LANs with multiple independent legs. Hosts broadcast routes periodically and others squirrel away this information into tables for later use. The Annex can be told to listen to this information.

ICMP redirects are a mechanism whereby a host, being used as a gateway (perhaps involuntarily), can say, "Look, I will send this packet you just sent me to the right place, but from now on, use this other host (or router box) as a gateway for this route." ICMP redirects are part of the Internet protocol standards. By the way, ICMP is an acronym for Internet Control Message Protocol. The Annex guide mentioned this feature explicitly.

Finally, many medium to large networks use subnetting, a method where a mask is used to make more bits available to specify subnets under one Internet network. If you need to get across your subnets and the box you bought doesn't understand them, you will probably be dissatisfied.

Telnet-to-LAT (see Table 4) translation is a handy feature of the Annex, if you need it. LAT is basically a LAN-only protocol and doesn't know about routers and gateways. Telnet to LAT encapsulates LAT traffic into telnet packets that are big-network capable and sends them on their way.

Network Management

SNMP is an acronym for Simple Network Management Protocol. This is basically a standard that allows products from other vendors query network hosts and devices about their existence, status, etc. The set of messages supported are called a MIB (Management Information Base). Both the Annex

Table 3

	Annex-3	PortMaster	Iolan
Port Server			
All Ports	yes	yes	yes
Per Port	yes	yes	yes
Camp-on	yes	no	yes
Named Rotaries	yes	yes	yes
Serial Communications			
Min/Max Number of Lines	8/64	10/30*	8/16*
Modem Support	yes	yes	yes
Max Port Speed	38.4K	115K	115K
Autobaud	yes	yes	no
General Parameters	yes	yes	yes
Printer Support	yes	yes	yes
Interactive Protocols			
Telnet	yes	yes	yes
Rlogin	yes	yes	yes
LAT	yes	no	no
SLIP	yes	yes	yes
CSLIP	yes	yes	no
PPP	yes	yes	no
Parallel Communications			
Centronics	yes	yes	no
Dataproducts	yes	no	no
Printers			
LPD	yes	pseudo	pseudo
Direct	yes	yes	yes
SysV LP	yes	pseudo	pseudo
Name Server			
Static	yes	yes	yes
IEN116	yes	no	no
DNS	yes	yes	yes
RWHO	yes	no	no
NIS (YP)	no	yes	yes
Routing			
Fixed	yes	yes	yes
RIP	yes	yes	no
ICMP Redirect	yes	yes	yes
Subnets	yes	yes	yes

*Different models, not expansion.

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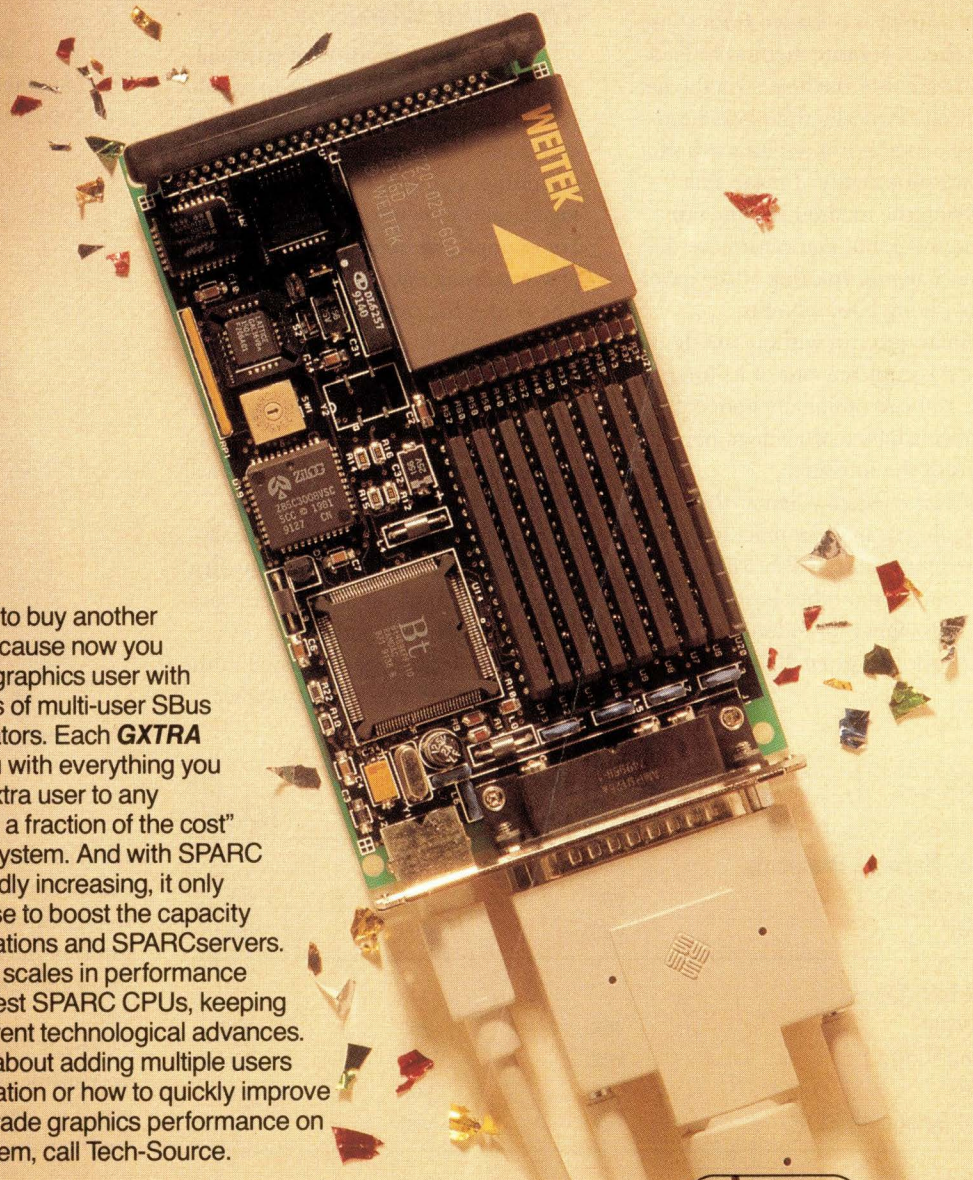

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and Iolan support SNMP.

OK, so how do we plug it in? All the boxes we looked at support at least Ethernet. In addition, the Annex supports token ring. SLIP we have already described, but the issue here is whether the box can use SLIP as its primary network attachment out to hosts, such as across a high-speed leased line.

The PortMaster, uniquely, can use SLIP across more than one serial line simultaneously, spreading the traffic.

There are two choices for getting software into these boxes: The vendor solders it in, or it is loaded from somewhere else. A favorite method of loading software into the box is via the network itself. Typically this is via a proprietary or semi-proprietary method. By "semi-proprietary" I mean that underlying the method is some standard protocol, but you must have the vendors' daemon running at the other end answering boot requests.

The Iolan can run without any boot software, completely out of its internal ROM. You can optionally boot software from a host to download newer versions of the software.

Broadcast refers to whether the box, upon failing to make contact with its preferred boot host, will broadcast on the network for another host to boot from. This allows for redundancy on the network and generally hassle-free service.

SLIP is really just another network interface, but it's nice to know if a particular terminal/communications server can boot over such an interface.

TFTP, Trivial File Transfer Protocol, is another Internet standard and is also used heavily by Sun's diskless clients to boot across a network, so it may already be set up and ready to go in your shop.

The final category, Boot Server, checks whether one of these boxes can boot a kindred box across the network, without use of any intervening hosts.

The Final Word

There are many features of terminal and communications servers in which you might be interested that we haven't examined. A review like this could extend for many pages. Some interesting features were unique to one box. For example, the Iolan can be set to display menus in any of several languages. The Annex has rack-mount options and various types of built-in diagnostic support. The PortMaster (using the vendor's Dialnet software) can be set up to act as a dial-out IP router. A user trying to connect to a host it knows about will cause it to build a SLIP connection across the phone network dynamically.

Manuals varied quite a bit in quality. The Annex's manuals are the most professional and well-organized of the batch. One feature sorely missed in the other two manual sets was an index.

Table 4

	Annex-3	PortMaster	Iolan
Other Network Protocols			
Telnet to LAT	yes	no	no
SNMP	yes	yes	yes
LAN Interfaces			
Ethernet	yes	yes	yes
Token Ring	yes	no	no
SLIP	yes	yes	yes
Load Balancing SLIP	no	yes	no
Boot			
Proprietary	yes	yes	yes
ROM	soon	yes	yes
Broadcast	yes	yes	yes
SLIP	yes	yes	no
TFTP	yes	yes	yes
Boot Server	yes	no	no

Iolan

Company
Chase Research
545 Marriott Drive, Suite 100
Nashville, TN 37210

Phone
(615) 872-0770

Fax
(615) 872-0771

Best Feature
Inexpensive, good international features.

Worst Feature
Smaller feature list but well-focused as a terminal server.

Price
$1,795, 8-port;
$2,495, 16-port

Circle 142

Perhaps that was more important to a reviewer than to a customer. All manuals had the necessary information and stepped you through setup and configuration reasonably well.

Overall, I would say all these boxes are capable and well worth considering. The Annex-3 is clearly the most "industrial-strength" and mature product of the three we reviewed, both in look and features. This is not surprising when you note that Annex was one of the first terminal servers of this kind on the market, going back to at least 1986. The other two, PortMaster and Iolan, are low-cost and do what they claim to do.

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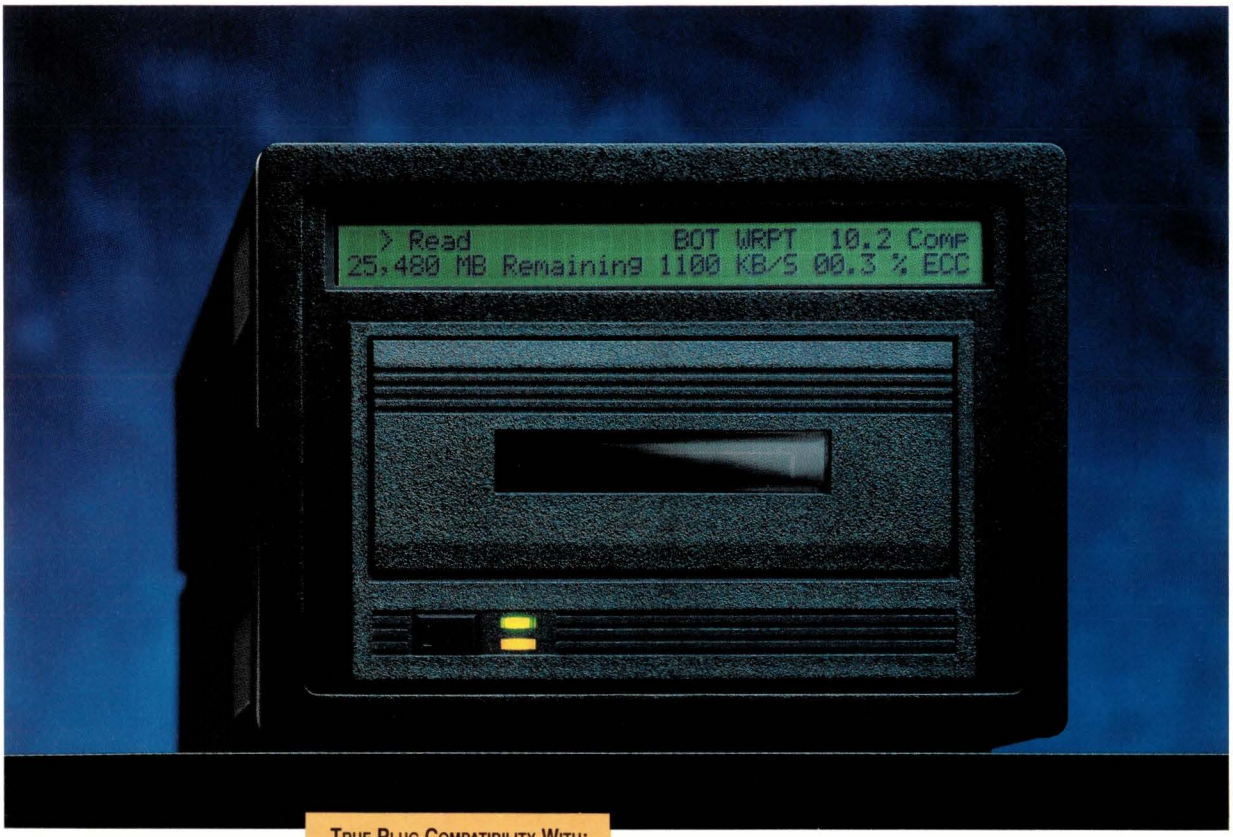

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Wanted:
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Archie can tell you where and how to find it.

by JOSEPH ILACQUA, JR.

Databases, spreadsheets, editors, compilers, typesetters, system-administration tools and countless other types of software wait for you at a nearby ftp site. The catch? You have to find the package to do the job at hand. Who ya gonna call? "archie!"

```
death% /usr/etc/ping archie.sura.net
PING nic.sura.net: 56 data bytes
64 bytes from 128.167.254.179: icmp_seq=0. time=22. ms
64 bytes from 128.167.254.179: icmp_seq=1. time=18. ms
64 bytes from 128.167.254.179: icmp_seq=2. time=18. ms
64 bytes from 128.167.254.179: icmp_seq=3. time=21. ms
64 bytes from 128.167.254.179: icmp_seq=4. time=24. ms
^C
--archie.sura.net PING Statistics--
5 packets transmitted, 5 packets received, 0% packet loss
round-trip (ms) min/avg/max = 18/20/24

death% /usr/etc/ping archie.ans.net
PING nis.ans.net: 56 data bytes
64 bytes from 147.225.1.2: icmp_seq=0. time=114. ms
64 bytes from 147.225.1.2: icmp_seq=1. time=144. ms
64 bytes from 147.225.1.2: icmp_seq=2. time=173. ms
64 bytes from 147.225.1.2: icmp_seq=3. time=147. ms
64 bytes from 147.225.1.2: icmp_seq=4. time=130. ms
^C
--archie.ans.net PING Statistics--
5 packets transmitted, 5 packets received, 0% packet loss
round-trip (ms) min/avg/max = 114/141/173
```

Figure 1. Using ping to find shortest route

Choosing an Archie Server

Archie is a pair of databases: One indexes the contents of a vast number of anonymous ftp sites throughout the Internet, and a second, smaller database contains descriptions of various freely available software packages. The archie server runs on a number of hosts and can be accessed through several different interfaces.

Archie servers can be found on the following Internet hosts:

`archie.ans.net`	The United States (ANSNET)
`archie.rutgers.edu`	The United States (JVNCNET)
`archie.sura.net`	The United States (SURANET)
`archie.mcgill.ca`	Canada
`archie.funet.fi`	Finland
`archie.au`	Australia
`archie.doc.ic.ac.uk`	Great Britain

When choosing an archie server, you should choose the server "closest" to you–the closest in a network sense, not geographic. For example, despite the fact that I am in Brookline, MA, `archie.ans.net` is in New York, and `archie.rutgers.edu` is in New Jersey, `archie.sura.net` in Maryland is "closest" to me. This is best checked with `ping` (see Figure 1).

Compare the average round-trip times to the sites you are interested in and choose the shortest. Twenty milliseconds versus 141 milliseconds makes the choice in the above example easy. This method may also be used when choosing any kind of Internet service, for example, choosing between two ftp sites.

Searching in the Archie Database

No matter which of the following clients you choose to use to search the archie database, the basic search mechanism is the same.

The first archie server database contains descriptions of software packages. This database is maintained by humans, and is not, by any means, all-inclusive. None of the archie clients can access this database; it is only accessible through the telnet interface. The second, a database of ftp sites, contains a list of filenames and directory names. It has stored the host on which the file is found, the pathname to the file on that host and the output of an `ls -l` on that file. This database is automatically maintained and, while it may get out of date, it tends to reflect reality. When you search in the ftp sites database, you search only the filenames, not the host names.

There are four types of searches you can perform on the archie databases. The easiest search method to use is a "sub-string search." The string you give archie will match any filename that contains the string in any combination of upper and lower case. Thus if you asked archie to find "sam," it would match "samples" and "The Samurai."

A slight variation on sub-string search is the "case-sensitive sub-string search." In this search, the case of the string matters. Case sensitivity is useful if, for example, you wish to search for "TeX," but don't want to see files that contain "text" or "Texas."

For those who are experienced in using UNIX regular expressions, like those used by `grep(1)` and `ed(1)`, there is a search method that uses them. Regular expressions give special meanings to a number of characters, which can cause trouble for the uninitiated. UNIX regular expressions are covered in the man page for `ed(1)`; see `man ed` on your system.

Finally there is the "exact match," which is just that. The search will return only filenames that exactly match your search string.

No matter which search method you choose, the output will take the form:

```
Host hostname
  Location: pathname
    FILETYPE ls -l output
```

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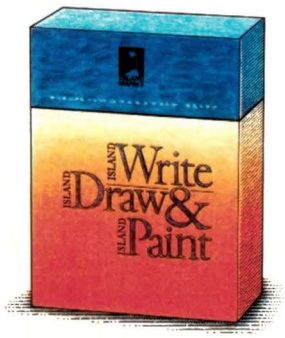

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Circle No. 25 on Inquiry Card

A partial output of a search for files beginning with the string "archie" returns the results seen in Figure 2.

```
Host ab20.larc.nasa.gov

    Location: /usenet/comp.sources.amiga/volume89/util
        FILE -rw-rw-r--    5015 Mar 15 1989 archie.1.Z
        FILE -r--r--r--    4979 Jul 11 1989 archie18.1.Z
    Location: /usenet/comp.sources.misc/volume26
        DIRECTORY drwxrwxr-x 512 Nov 24 05:01 archie

Host aix1.segi.ulg.ac.be

    Location: /pub/docs/tcpip/ftpsites
        FILE -rw-r--r--    12899 Unk 0 15:59 archie
(55 additional entries were deleted; it's a big database.)
```

Figure 2. Searching for "archie"

Accessing an Archie Server

The simplest, but perhaps least rewarding way to use archie is with `telnet` (see Figure 3). You telnet to the archie server and log in as `archie`. There is no password.

At the `archie` prompt, you use the command `prog` to search the ftp site database. The software package descriptions are searched with the command `whatis`. The default search type is a regular expression search, but `set search sub` will give you a sub-string search, `set search subcase` a case-sensitive sub-string search and `set search exact` an exact match search. The following would search for any entry on "archie" in the ftp site database:

```
archie> set search sub
archie> prog archie
# matches / % database searched: 9 / 20%
```

When the search is finished, the archie server will blast you with a list of the matches in the database. If, before you begin your search, you issue the commands:

```
archie> set pager
archie> set term your-terminal-type
```

where "your-terminal-type" is the name of the `termcap(5)` entry for your terminal, archie will stop at the end of each full screen of output until you type a SPACE. If you wish to save a copy of the search results, you must do the following:

```
archie> set mailto
your@internet.address
archie> mail
```

This will instruct the archie server to send a copy of the search results to you via electronic mail.

The problems with telneting to an archie server are twofold. First, to use the result of your search effectively, you have to mail it to yourself, then return to your local system and view it there. Second, most archie servers are overloaded and limit the number of logins at any given moment. Sometimes you will not be allowed to log in to the server–usually just when you need an answer in a hurry.

Next up is the archie C language client from Brendan Kehoe (`bren-dan@cs.widener.edu`). The program can be obtained via anonymous ftp from `ftp.cs.widener.edu` in the directory `/pub/archie`, your favorite `comp.sources.unix` ftp archive, or almost any of the archie servers. The current version, 1.3, has just been posted to `comp.sources.misc`.

Installation is simple. You edit a Makefile to choose a default archie server and to select compilation options you might need, and type `make`.

This interface is also simple. You run `archie search-string`, where `search-string` is just that. The default search is exact match, and you can select the different search types with the following options:

-s	sub-strings search
-r	UNIX regular expression search
-c	case-sensitive sub-string search
-e	exact match

So, to find all of the files containing the string `spam` in upper or lower case and to save the results to a file, you would use `archie -s spam > filename`. The file can then

Figure 3. Logging in using telnet

```
death% telnet archie.sura.net
Trying...
Connected to archie.sura.net.
Escape character is '^]'.

SunOS UNIX (nic.sura.net)

login: archie
Last login: Wed Jan 15 19:05:01 from Menudo.UH.EDU
SunOS Release 4.1.1 (CTHULHU) #1: Wed May 29 11:30:09 EDT 1991
       Welcome to the ARCHIE server at SURAnet

Please report any problem to archie-admin@sura.net. We encourage
people to use client software to connect rather than actually
logging in. client software is available on ftp.sura.net in
/pub/archie/clients. If you need futher instructions type help at
the archie> prompt.
archie>
```

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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be viewed at your leisure.

This version can also be compiled on VMS and MS-DOS machines with TCP/IP networking.

There is a `perl` version of the archie client for Khun Fung (`clipper@csd.uwo.ca`) that is very similar to the C version. The current version is 3.8 and is available via anonymous ftp from `ftp.cs.widener.edu` in the directory `/pub/archie` or for one of the archie server machines.

Before you can install this client, you must have `perl` installed. (You should get `perl`; it's the greatest thing since nethack.) You simply edit the program to define a default archie server, install several `perl` libraries and you are off.

The flags are a bit different with a default of sub-strings search:

- `case` make the search case-sensitive,
- `nocase` make the search case-insensitive,
- `exact` exact match,
- `reg` regular expression search.

But the usage is the same, `archie search-string`. The only real advantage of the `perl` version is that it lets you redefine how the data returned by the server is presented. However, if you are a `perl` programmer, this software can give you a nice set of library routines to use in your own programs.

The coolest archie client is xarchie (see Figure 4), from George Ferguson (`ferguson@cs.rochester.edu`). xarchie is at Version 1.3 and can be found at `cs.rochester.edu` in `/pub`, on `ftp.cs.widener.edu` in the directory `/pub/archie`, and on `export.lcs.mit.edu` in `/contrib`. As the name implies, xarchie requires the X Window System to compile and run. It requires X11R4 or X11R5 to install. I recommend you install X11R5 to take advantage of the wide variety of software available to you for the X Window System.

If you have X11R4 or X11R5, installation involves typing `xmkmf` followed by `make`. The default archie server is controlled by an X resources file installed in `/usr/lib/X11` on most systems.

With xarchie, you select search types through a pull-down menu. There is a field to enter the search string, and the query is started with the click of a button. The search results are displayed in three scrolling windows. The first contains the host names, the second the pathname(s) to the file(s), and the third the file(s). A host, a path and a filename can all be selected by clicking. Once a file is selected, it can be automatically retrieved via ftp, by clicking the "Ftp" button. The results of the search can also be saved to a file with another click of a button.

Finally, for those who believe that the one true window system is GNU Emacs, there is an Emacs Lisp client,

The only real advantage of the `perl` version is that it lets you redefine how the data returned by the server is presented.

Brendan Kehoe (`brendan@cs.widener.edu`). This is also available from `ftp.cs.widener.edu` in the directory `/pub/archie` and various archie servers. The Emacs client is not a true client and requires that the C version be installed on your system.

Installation is as follows: Copy the Lisp file, `archie.el`, into your Emacs Lisp directory, traditionally `/usr/local/emacs/lisp`; change directory to the Emacs Lisp directory; and issue the one-line command

```
emacs -batch -l archie.el -f
  batch-byte-compile archie.el.
```

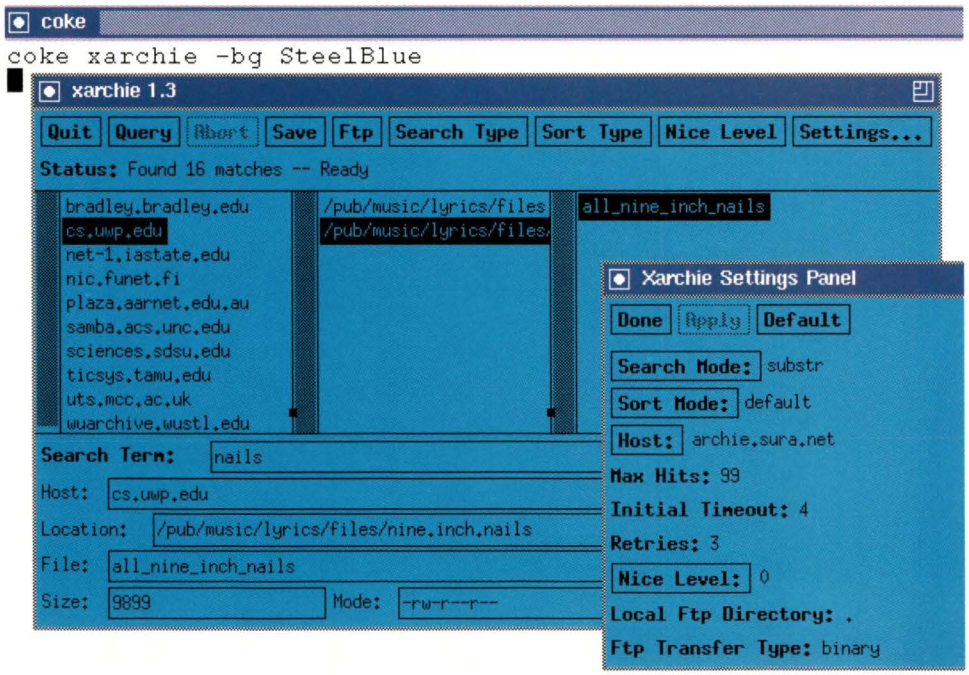
You will then want to add:

```
(autoload 'archie "archie" nil t)
(autoload 'archie-sez "archie" nil t)
```

to `/usr/local/emacs/lisp/default.el` or to your personal `.emacs` file.

The Emacs Lisp version provides two interfaces, `M-x archie`, which returns the search results in a buffer called

Figure 4. xarchie requires X11R4 or R5.



archie, and `M-x archie-sez`, which places the search results in the buffer you are currently editing. Both prompt for a search string. The default search type is exact match. To use a different search type, prefix the command with M-1 (`M-1-M-x archie` and `M-1-M-x archie-sez`) and you will be prompted for one of `-c`, `-r`, `-s`, or `-e`, which have the same meaning as with the C version above.

"But wait," you say, "I'm not on the Internet, so all of this is of no use to me..." Good news: You are wrong. All of you poor souls without direct access to the Internet can search archie by sending electronic mail to a mail server at `archie@cs.mcgill.ca`. The following are the basic commands, one or more of which should be contained in the body or the subject of the message:

help	Send you a detailed help message.
prog "search-string"	Perform a regular expression search for "search-string."
path "email.address"	Use a different return mail address than the one found in your mail message. Useful if your mailer is broken.

"So what," you say. "Now I have a list of files I might want but cannot get. I don't have access to ftp." Fear not, there is hope. A mail server at `ftpmail@decwrl.dec.com` can provide ftp requests via electronic mail. Send a message to the server containing only "help" in the message body for complete details on how to use this service. This service can be slow, and you should use it wisely because large files may be mailed even though you email neighbors, running up phone bills and annoying administrators. But it is a very useful tool.

Archie was written at McGill University by Alan Emtage and Peter Deutsch and is the subject of a paper given at the Winter '92 Usenix conference. For more on the operation of archie, questions can be sent to `archie-l@cs.mcgill.ca`.

Joseph Ilacqua, Jr. (Spike) has never used any UNIX system with less than 4 MB of memory. He is systems administrator of The World, a public-access UNIX facility based in Brookline, MA.

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 at the end of the magazine.

The Legacy of Lakota

A portable shell language that helps turn aging "legacy" software into unified applications has been introduced. Called Lakota, the language is a product of Software Maintenance and Development Systems and is meant to "glue" together older software that companies and users might have developed, and which they now long to bind into a single application. To this end, developers can write in Lakota, which is portable across multiple operating systems and which supports modern programming concepts, such as named procedures, inheritance and black structured code.

Lakota can be purchased as either a portable shell language or as a shell language with an embedded kernel. It is currently supported on some 20 different environments, including Sun Solaris, DEC Ultrix and VAX VMS, AIX and Hewlett-Packard Co.'s HP/UX. Pricing is based on the number of users. In volume, the price for the shell is $99 per user, while rights to the internal use of the kernel are $3,000.

Software Maintenance and Development Systems Inc.
P.O. Box 555
Concord, MA 01742
Circle 108

Magic Mushroom!

A photo-retouching and image-processing system that runs on the Sun workstation has been introduced by ISTR. Called the Magic Inkwell PhotoEditor, the product is software with an optional hardware assist that can modify, mix, match, blend and otherwise manipulate photographs. The company says the product's main advantage is that it can not only compress images, but can then work on those images in compressed form–thus allowing it to work quickly on jobs that would otherwise be too complex to process.

The PhotoEditor is software, but the company says that it works best with a RAM disk. The company will sell the software by itself, or with the RAM disk, or as part of a complete Mariner SPARCalike-based system from Tatung Science and Technology. The software by itself is $8,000. With the hardware, pricing ranges from $37,000 to $88,000.

ISTR Inc.
812 Main St.
Buffalo, NY 14202
Circle 107

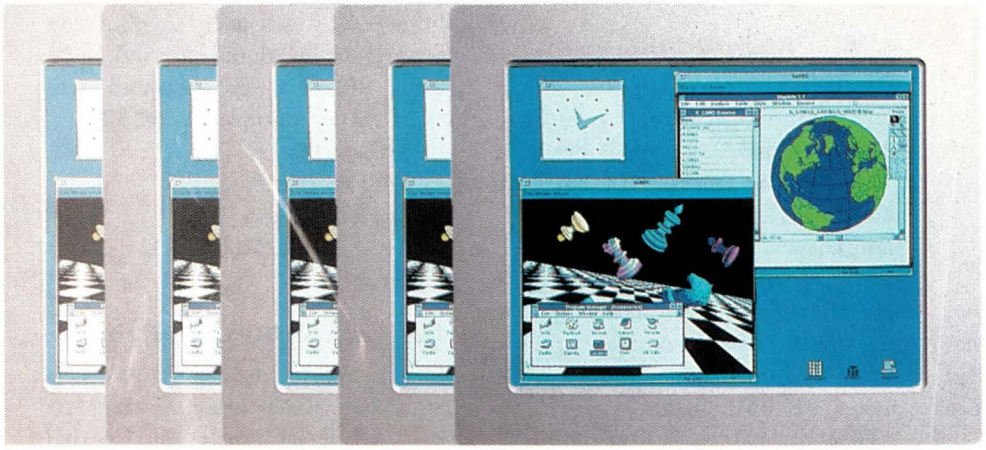
Novel Parallelism

A new parallel processing system designed to run off a UNIX host via Ethernet has been announced. The CNAPS computer, a product of Adaptive Solutions, is designed for pattern recognition, signal processing and other applications that may benefit from parallel processing. To this end, the system comes with either 128, 256 or 512 individual CNAPS processors. Each processor is a complete digital processor with multiplier, adder/accumulator, shifter-logic unit and 4 KB of RAM.

The company says the machine is particularly well optimized for pattern-recognition problems, experiments in machine learning, the modeling of neural networks, image processing, speech recognition and so on. Adaptive Solutions notes that a single CNAPS chip can perform a 32-point discrete Fourier Transform with 16-bit precision in 5.4 microseconds. A C compiler is available. Pricing on the CNAPS system ranges from $50,000 to $110,000, depending on configuration.

Adaptive Solutions Inc.
1400 NW Compton Drive
Suite 340
Beaverton, OR 97006
Circle 109

Zippity-Do-DOS



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Insignia Solutions Inc., 6 Campanelli Drive, Andover, MA 01810

Circle No. 22 on Inquiry Card

GIS Joins RDBMS

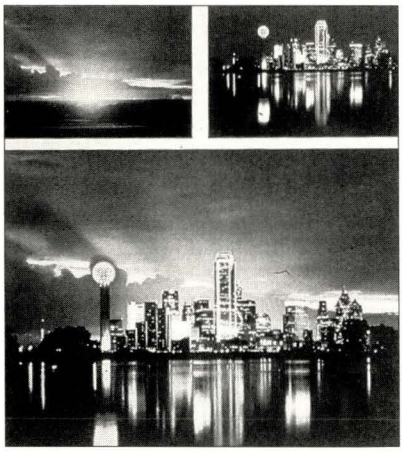
GeoVision Systems has announced a product that links a geographic information system with leading relational database management systems. Called Vision*2.0, the product allows users to create intelligent maps that display data derived from their existing investments in RDBMS products. A company might, for example, choose to display customer data combined with a map of the area in which its products where shipped.

To this end, Vision consists of two layers of software. The first is a GIS system of GeoVision's own design. The second is an interface that takes the Geographical Query Language and translates it into SQL and uses that to query the customer's DBMS. Currently, Vision supports Oracle and Ingres, with other databases accessible via customization. Pricing ranges from $2,000 to $20,000.

GeoVision Systems Inc.
5251 DTC Parkway, Suite 200
Englewood, CO 80111
Circle 110

Photo Retouching on SPARC

Software that allows a SPARCstation to act as a photo retouching system has been introduced by Mentalix. Called Pixel!FX Version 2.0, the product is a



suite of several packages, originally developed for general image-management tasks, but now optimized for photo prepress. The company says that with Pixel!FX, a workstation can perform the same functions as, for example, a Macintosh running Adobe Photoshop, but with greater power and speed.

The five components may be purchased separately or together. They are Pixel!SCAN, at $795, which serves as an interface to number of scanners; Pixel!View, at $195, which enables users to format and display image data and supports and converts a number of import and export file formats; Pixel!EDIT, at $995, which includes a number of image editing and photo retouching tools; Pixel!PRINT, at $395, which provides an interface to a number of output devices; and, finally, Pixel!OCR, at $895, which converts scanned copy to text. The entire package can also be purchased for $1,595.

Mentalix Inc.
1700 Alma Drive, Suite 110
Plano, Texas 75075
Circle 111

VME Chassis for SPARCstations

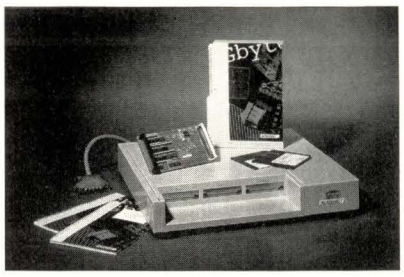
An expansion chassis that gives VME slots to SBus-based systems has been introduced by Dawn VME Products. A pizza box-style enclosure, the expansion chassis links to the SBus via an SBus-to-VME connector that occupies one SBus slot in the workstation. The expansion chassis can then support either three or five (depending on the model) 6U VME boards.

There are four models of the product. Three offer three slots a piece and power of 150 watts, 200 watts and 160 watts, though power supply options range up to 350 watts. There is also a five-slot option. The three-slot models measure 16 by 16 by 3½ inches, while the five-slot model has the same dimensions but is 5.1 inches tall. Pricing begins at $3,500.

Dawn VME Products Inc.
47073 Warm Springs Blvd.
Fremont, CA 94539
Circle 112

SBus Expander with Bundles

Artecon has introduced an SBus expansion box that comes bundled with Ethernet and SCSI controllers. Called the SB-6100X, the product offers six accessible slots and also comes with a SCSI controller and both



thick and thin Ethernet controllers built directly into the product's SBus expansion motherboard. In addition, Artecon says that the SBus cards that fit into the chassis can be either master or slave devices.

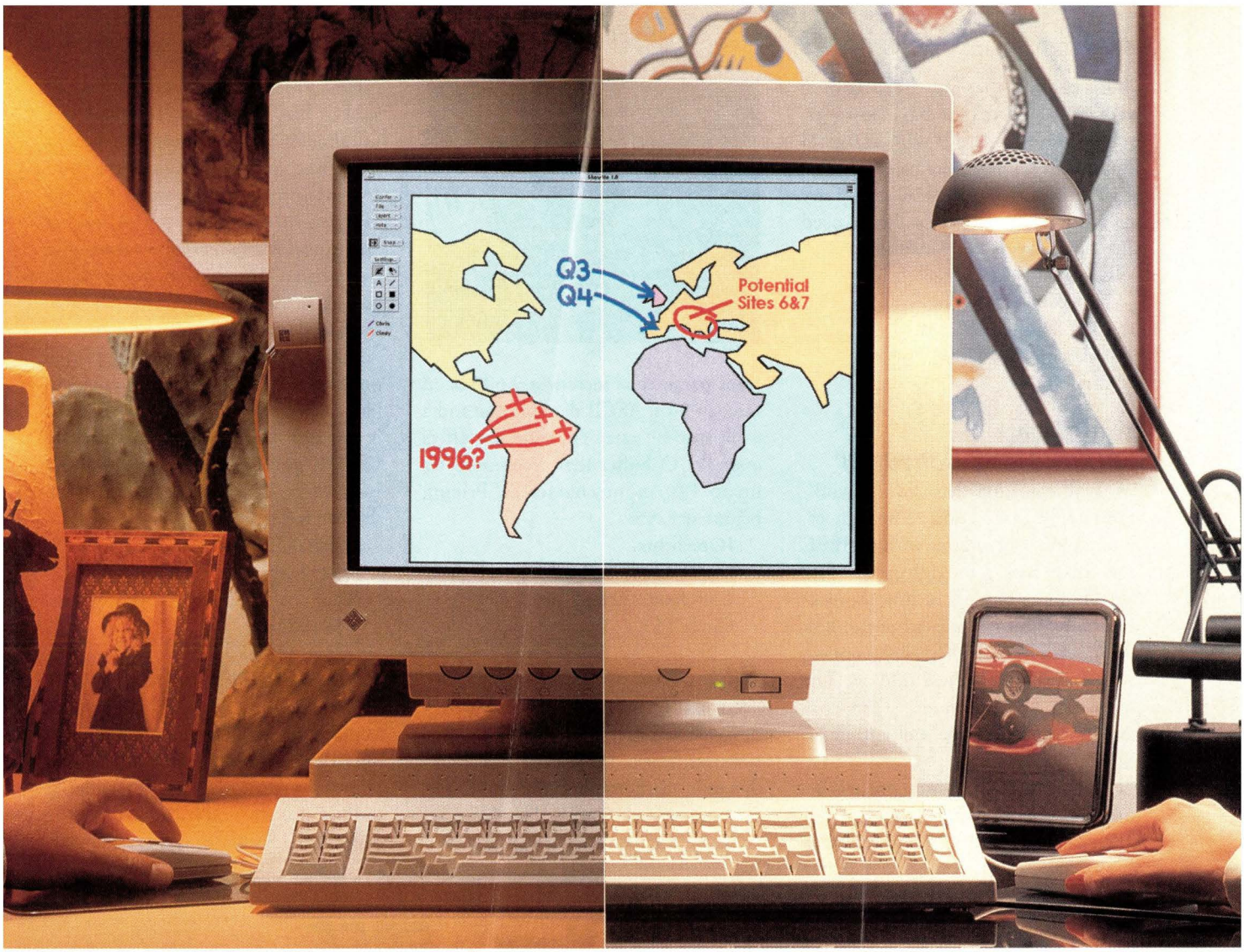
There are three different models of the product. The first of these is the SB-3100XD, which offers three master/slave slots, SCSI and Ethernet controllers, and room for two disk or tape devices for $2,395. The second is the SB-6000X, which offers six SBus slots for $1,995. The third is the SB-6100X, which offers six SBus slots and SCSI and Ethernet controllers for $2,395.

Artecon Inc.
2460 Impala Drive
Box 9000, Dept. 5500
Carlsbad, CA 92008-7236
Circle 113

VME-to-Futurebus Bridge

In the world of Sun systems, it is SBus that attracts headlines. But Sun has VME-based servers. And, beyond VME, there is Futurebus, the connector that is being widely proposed as the successor to VME. Sun does not have Futurebus-based products, but Sun users can already exploit Futurebus devices with a new bridge that links VME to Futurebus. Cable and Computer Technology has announced the FBB-001, a bridge product that gives inventive Sun customers a toehold in the Futurebus world, and which could someday provide a means to migrate there entirely.

The FBB-001 consists of cable (up to six feet long) with a 6U VME card on one end and a 12SU Futurebus+ card on the other. These cards fit into their respective systems and provide transparent movement of data between them. VME system users have access to everything attached to the Futurebus chassis.



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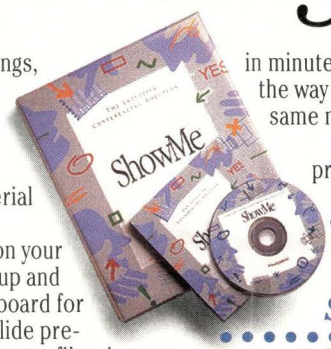

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SunSolutions

SunSolutions, Sun Technology Enterprises, Inc. 2550 Garcia Avenue, MS: MTV02-208, Mountain View, CA 94043 USA. Fax: (415) 962-9421

Circle No. 42 on Inquiry Card

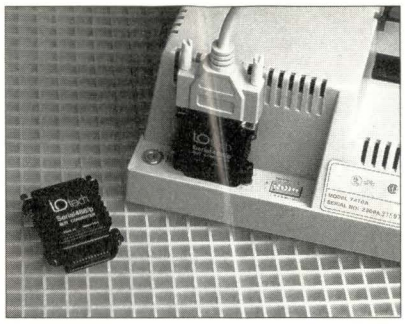
The product has not been shown with Sun systems. It has, however, been demonstrated with Digital Equipment Corp. Alpha-based systems with the Futurebus. The company says, however, that it could be used with Sun systems fairly easily.

Cable and Computer Technology Inc.
1555 South Sinclair St.
Anaheim, CA 92806
Circle 114

Miniature Serial-to-488 Converter

A small converter that allows a workstation with a serial port to link directly to a plotter or printer with an IEEE 488 interface has debuted. The Serial488/p, a product of IOtech, measures only 2 by 2.3 inches but can link a workstation to an IEEE 488 connector either directly or via cabling. The product draws its power from the serial port itself and thus does not require an external power supply.

The Serial488/p comes preconfigured and doesn't require a user to flip DIP switches. Its RS-232 communications parameters include a 9,600 baud rate, an 8-bit ASCII data-bit rate and a 1-bit stop-bit rate. The unit also offers a serial I/O buffer that accommodates up to 120 input characters. Pricing begins at $295.



IOtech Inc.
25971 Cannon Road
Cleveland, OH 44146
Circle 115

New Debugging Tool

Virtual Technologies has released a new debugging tool that supports runtime verification of pointer usage and dynamic memory allocation in C and C++ programs. Called The Sentinel Library, the product traps memory errors, traces stack and reports the source file, function name and line number of the offending statements. Moreover, Sentinel provides the same sort of information concerning the allocation of memory and, where applicable, where memory was freed or overwritten. In addition, the product assists in determining the cause of memory leaks.

The Sentinel is currently supported on the Sun SPARCstation and compatibles running Solaris 1.0.1 and above. It is also available on the Hewlett-Packard Co. HP 9000 running HP-UX 8.0 and Intel Corp. UNIX systems. Pricing on the Sun is $395.

Virtual Technologies Inc.
46030 Manekin Plaza, Suite 160
Dulles, VA 20166
Circle 116

PC X under Solaris

X Technology, a supplier of X Window System server software, now has its products on two additional operating systems. One of these is Solaris 2.0 on Intel processors, the other is the VxWorks real-time operat-

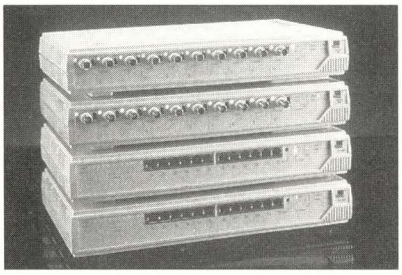
ing system from Wind River.

X Technology's server is TIX-020. It provides server functions for X Window applications and supports a variety of PC display adapters based on Texas Instruments Inc.'s TMS34020 chip. The company says that with TIX-020, up to 90% of X server functions can be implemented on the display, thus freeing the host workstation from graphics and windows management tasks. Pricing was unavailable at press time.

X Technology Corp.
784 Turnpike St.
Canton, MA 02021
Circle 117

3Com Stacks Hubs

3Com has introduced a family of stackable fixed-port hub systems offering chassis-like features. Called the LinkBuilder FMS family, these products allow users to mix coaxial, fiber and twisted-pair in a single-repeater format. The company says that the products are targeted at remote branch offices and workgroups within large organizations where users need chassis-based hubs but cannot easily afford them. LinkBuilder FMS can provide any combination of four twisted-pair, coaxial or fiber hubs to create a stack of up to 52 ports without adding logical repeaters.



The product family consists of three hubs, a management module and transceiver modules. The LinkBuilder hubs are the TP Hub, offering 12 RJ-45 10Base-T ports; the Coaxial Hub with 10 BNC ports for thin Ethernet coaxial cable; and Fiber Hub, with 12 ST or SMA fiber-optic ports. The Management Module provides full SNMP (through MIB II), Telnet and SLIP management. The Transceiver Modules, finally, offer AUI, BNC, ST or SMA connections.

The twisted-pair and coaxial hubs are available at $1,295 and $2,195, respectively, while pricing on the fiber hub was not available as of press time. The management module is $1,295.

3Com Corp.
5400 Bayfront Plaza
P.O. Box 58145
Santa Clara, CA 95052-8145
Circle 118

EDT's SBus Interface

An SBus-to-MIL-STD 1553B serial interface has been introduced by EDT. The S53B-1 is a single SBus card that provides a 1-Mb/s serial MIL-STD 1553B interface. Meant for situations demanding reliability in extreme environments, the product initializes as a single remote terminal. After initialization, the application program can con-

figure the card as necessary.

The product comes standard with a SunOS loadable device driver–which can be obtained in source code form for an additional charge. It also comes with an FCodes PROM for identification and initialization. Pricing begins at $2,750.

EDT Inc.
1100 NW Compton, Suite 306
Beaverton, OR 97006
Circle 119

Remote Your Sun Screen

A fiber-optic cable product that allows you to separate your workstation from its display by as much as 500 feet has been introduced by Lightwave Communications. The VDE/200 allows 1,280-by-768-pixel images to be sent to a remote high-resolution display. The product does not access or affect the operating system of the workstation but rather takes video

and keyboard/mouse signals from the output ports and transmits them along a fiber-optic cable. As far as either the processor or the display is concerned, the distance between them is the standard fractional inches rather than feet.

The product is currently available for Sun workstations, as well as those from Silicon Graphics Inc. The base price on a 160-MHz video-only system is $2,990. A single-fiber, 120-MHz monochrome or composite color system is $995.

Lightwave Communications Inc.
84 Research Drive
Milford, CT 06460
Circle 120

Engine Set for Takeoff

SPARCstation 10 performance at SPARCstation 2 pricing sound good? Pinnacle Data Systems has released its MBUSengine/System-III, which it claims will boost performance. Together with a removable processor card, the

Upgrades, Enhancements, Additions...

• SunPro has ported its ProWorks line of software development tools to Solaris for X86. ProWorks is an integrated development environment for C, C++ and FORTRAN. **SunPro**, 2550 Garcia Ave., Mountain View, CA 94043-1100. **Circle 121**.

• FastPath 5, the LocalTalk-to-Ethernet gateway from Shiva, has decreased in price by 29%. The new price will be $1,999, down from $2,795. **Shiva Corp.**, One Cambridge Center, Cambridge, MA 02142. **Circle 122**.

• Xylogics has added support for the Point-to-Point Protocol (PPP) to its Annex family of communications and terminal servers. PPP is an alternative to SLIP and provides improved support for remote terminals over standard telephone lines. **Xylogics Inc.**, 53 Third Ave., Burlington, MA 01803. **Circle 123**.

• There has been a new release of CustomerQ from Quintus. CustomerQ combines 4GL-like qualities with an easy-to-use interface to give corporations and other organizations improved control of customer information. Version 2.0 of the product features improved links to standard SQL-based databases, improved email and fax facilities, and user-customizable tools. **Quintus Corp.**, 2100 Geng Road, Suite 101, Palo Alto, CA 94303. **Circle 124**.

• Cayman Systems has updated the software to its LocalTalk-to-Ethernet router, the Gatorbox, and the GatorStar GX, which combines a router with a 24-port LocalTalk repeater. Release 2.2 of the software includes improved support for SNMP, new port-node mapping features for the GaterStar, and automatic problem isolation for the GaterStar. Cayman Systems Inc., University Park at MIT, 26 Landsdowne St., Cambridge, MA 02139. **Circle 125**.

• Figaro+, the PHIGS+ programming library from Liant, has been made callable from C++. Liant says this will allow programmers to develop C++ applications that can exploit Figaro+ 3.0 graphics routines. Figaro is an implementation of PHIGS+. **Liant Software Corp.**, 9920 Pacific Heights, Suite 200, San Diego, CA 92121. **Circle 126**.

• Datacube has increased the processor power of its MaxTD Target/Development Image Processing System. The new version of the product will feature the company's recently developed Virtual Surface Image Memory (VSIM), which provides multiple 40-MHz image pipelines, virtual memory, and on-chip ALU, Crosspoint, LUT and statistics. **Datacube Inc.**, 300 Rosewood Drive, Danvers, MA 01923. **Circle 127**.

• The CASEworks/RT real-time development environment from Multiprocessor Toolsmiths Inc. has been ported to the Sky Computer SKYbolt family of application accelerators. The SKYbolts are i860-based VME boards that can provide 1.28 GFLOPS, or up to 10 GFLOPS when used in combination. **Sky Computer Inc.**, 27 Industrial Ave., Chelmsford, MA 01824. **Circle 128**.

• Clearpoint has enhanced its Constellation Series of Ethernet-based internetworking products. The enhancements include expansion modules that give the company's Little Dipper networking platform up to 16 Ethernet LAN ports and three WAN ports. The company is also showing new software that provides expanded WAN interoperability and network management control. **Clearpoint Research Corp.**, 35 Parkwood Drive, Hopkinton, MA 01748. **Circle 129**.

•The MicroLaser line of printers from TI now has a series of LAN interface options. TI has introduced a series of plug-and-play interfaces including a thinnet Ethernet, a thicknet Ethernet and a Novell NetWare LAN connection. **Texas Instruments Inc.**, Information Technology Group, P.O. Box 202230, ITG-015, Austin, TX 78720-2230. **Circle 130**.

System-III motherboard or MBUS-engine uses Sun's open MBus standard for processor-to-system interface.

Pinnacle claims MBus processors, along with the hyperSPARC chip set, will allow the board to run at 28.5 SPECmarks and 32 MIPS and will allow two processors per motherboard under Solaris 2.0. The MBUSengine offers on-board color graphics at GX-type performance and includes two available SBus expansion slots for compatibility with virtually any SPARC SBus card. The board runs Solaris and all SPARCware applications.

The package may be sold as a single-board unit for any SPARCstation upgrade or as a complete SPARC-compatible System-III for under $8,000, complete with one-year warranty.

Pinnacle Data Systems
1350 West Fifth Ave.
Columbus, OH 43212
Circle 131

Rimfire Introduction

Ciprico has announced its series of high-performance disk arrays. The industry's first 8 + 1 SCSI-2-to-SCSI-2 disk array, the Rimfire 6710, uses RAID-3 implementation with 3½-inch disks and provides data transfer rates of 20 MB/s.

The 8 + 1 configuration provides eight data disks plus one redundant disk. User data requests continue to be serviced in the event of single drive failure while the disk is "hot swapped." Data is automatically regenerated on the replacement disk by the disk array controller. This model also allows for replacement of failed disks with non-matched disks.

Ciprico offers the 6710 in a desktop enclosure that is also rack mountable. Pricing begins at $31,650 for 8.4 GB of usable capacity.

Ciprico Inc.
2800 Campus Drive
Plymouth, MN 55441
Circle 132

Visible Improvements

Visible Systems unveiled its latest release of the Visible Analyst Workbench I-CASE tool. Version 5.0 offers CASE solutions for PC/MS-DOS, MS Windows and Novell Inc. NetWare network environments. The product is an integrated tool set with both forward- and reverse-engineering capabilities and generates SQL database schemas, COBOL source code and C source code from designs developed in the system.

This new version contains many new windows capabilities and features including pop up and pull down menus, and clipboard-based data exchange with external applications. Internally, the VAW allows models and repository entries to dynamically reflect changes made during model or repository editing. Other Windows features supported include device drivers, color sets and fonts.

New functional enhancements include multipage document support, ease-of-use enhancements, model navi-

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S. Henry Sacks

S. Henry Sacks
Publisher

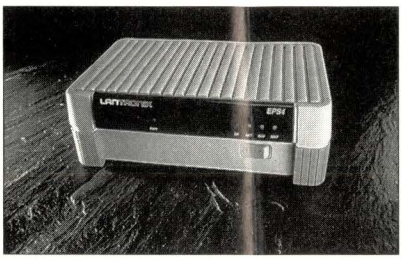
gation improvements, control bar support, repository data access and text editing enhancements.

Configurations start at $1,895.

Visible Systems Corp.
The Bay Colony Corporate Center
950 Winter St.
Waltham, MA 02154
Circle 133

Sweet 16 from Lantronix

Lantronix has announced the release of 16 terminal/print server models, including the ETS8 and ETS16, for connecting eight or 16 serial terminals,



printers, modems or peripherals to an Ethernet network. The EPS4 and EPS12, which have four or 12 serial lines plus one Centronics/Data-products-compatible parallel port, were also released. Each type is available with or without flash PROMs. All are compatible with TCP/IP and DEC's LAT.

Support for SLIP and SNMP has been added to cover more management information bases including MIB II, character MIB, RS-232-like MIB and more. Ease of use has been improved with a setup menu, and security has been improved with a dial-back software option. Warranties have been extended to five years.

Prices begin at $995 for a five-line unit with four serial ports and one parallel port.

Lantronix
26072 Merit Circle, Suite 113
Laguna Hills, CA 92653
Circle 134

Pascal-2 for Sun

TauMetric has come up with a Sun SPARC version of Oregon Pascal-2. Pascal-2 offers programmers a powerful solution for designing, testing, maintaining and improving software written in Pascal. Oregon Pascal-2 is an ISO and ANSI Standard Pascal-compliant implementation, featuring separate compilation of modules, a dynamic string library, flexible file handling and an intelligent, highly optimizing compiler.

A full-functioned source-level debugger is included with the Pascal-2 development system. Utilities bundled in the package include a profiler (used to spot program bottlenecks), cross-reference generators for procedure and variable references, an automatic source code formatter and a macro package to simplify the calling of assembly language routines from Pascal.

Pricing starts at $1,800.

TauMetric Corp.
8765 Fletcher Parkway, Suite 301
La Mesa, CA 91942
Circle 135

Nine-Port HUB

A nine-port Ethernet 10BaseT hub has debuted for $375. The Micro*Hub LE, from MiLAN Technology, offers eight 10BaseT ports on the front panel for connection to workstations or PCs, and one port on the back panel for connection to an Ethernet network. The back-panel port is switch-selectable between 10BaseT, thinnet or thicknet.

For systems-administration purposes, the product has 10 LEDs on the front panel that display the status of the ports. Should there be a fault or excessive collisions, the Micro*Hub LE automatically segments the affected ports. The product comes with a five-year warranty.

MiLAN Technology
894 Ross Drive, Suite 105
Sunnyvale, CA 94089
Circle 136

Simplified Software

Interactive Development Environments is adding Object-Oriented Structured Design/C++ (OOSD/C++) to its Software through Pictures family of CASE products. C++ developers can now reuse validated design diagrams, then automatically generate compilable code and publish documentation. The product's graphical editor lets users draw diagrams of C++ software components in concise OOSD nota-

tion. The Reuse Browser increases quality and productivity by making it easier to reuse software components stored in multiple libraries. An accompanying code generator for C++ produces compilable code for all program objects.

Initially, OOSD/C++ is integrated with the ObjectCenter programming environment and with FrameMaker and Interleaf publishing systems. A mouse click lets users navigate between a design object and its corresponding code in ObjectCenter.

OOSD/C++ is available with one year of maintenance and support and a four-day class for $10,000 per seat.

Interactive Development Environments
595 Market St., 10th Floor
San Francisco, CA 94105
Circle 137

See-N-Say

Communique!, InSoft's new version of multimedia business conferencing software, integrates real-time video technology with fully interactive, easy-to-use conferencing tools such as a shared whiteboard, audio, text and graphics. On-line meetings are interactively initiated by chosen participants who are viewed as icons on the monitor. Meetings can be saved and reviewed or continued at a later date.

Audio compression and a silence sensor lets users choose how much information will be sent over the network, and a mute setting allows users to blank out private conversations. Communique! is available on all Sun and SPARC-compatible workstations and servers running Solaris 1.0 or above and OpenWindows 3.0. List price for a single-user version with Parallax XVideo support is $1,295.

InSoft Inc.
Executive Park West I, Suite 307
4718 Old Gettysburg Road
Mechanicsburg, PA 17055
Circle 138

Practically Infinite Data Management

R Squared has added two products to its Infinity Data Management System product line. According to the company, the IFS 700T and IFS 9000T represent the highest capacity mass storage available, using low-cost media to provide 700 gigabtyes to 8.7 terabytes of NFS-mountable virtual storage.

The Infinity IFS 700 T and 9000T combine the performance and features of the Metrum Information Storage tape-drive subsystem, the RSP-2150, with Infinity software to provide a mass-storage option in a system that takes up less than 20 square feet.

The RSP-2150 can store 14.5 gigabytes on one ST-120 data cartridge, which sells for $20, and includes sustained data-transfer rates of 2 MB/s, which means 1 gigabyte of disk can be backed up in 8.3 seconds.

IFS 700T and 9000T are designed for data aquisition and analysis, imaging, CAD/CAM/CAE and other applications in distributed-processing environments. Pricing for the 700T is 38 cents per MB on-line for 700 GB; the 9000T is prices at 82 cents per MB on-line for 9 terabytes.

R Squared
11211 E. Arapahoe Road
Suite 200
Englewood, CO 80112
Circle 139

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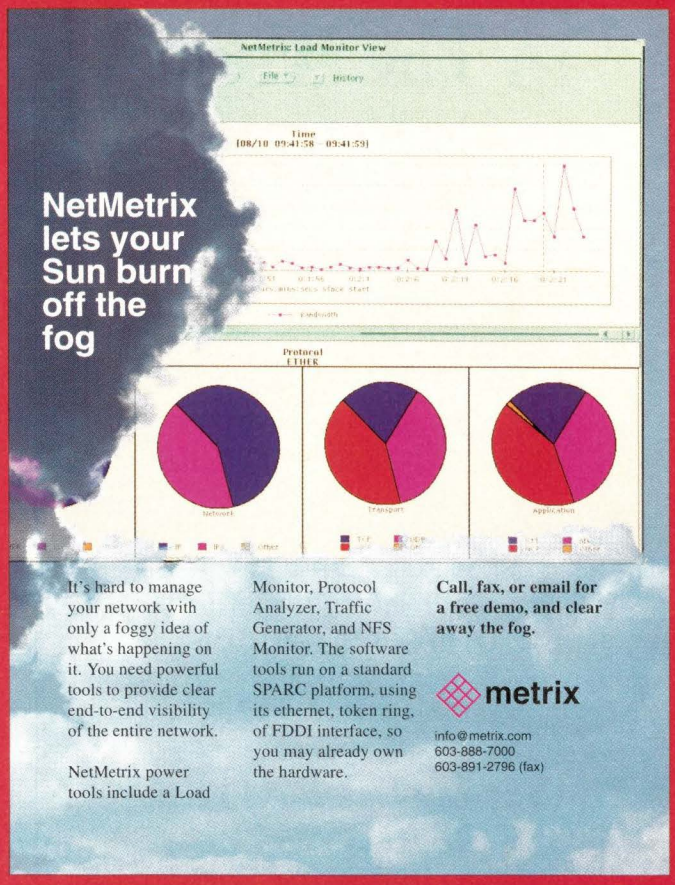

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Maxtor						
213Meg	15ms	64K	1yr	3600rpm	$499	$629
340Meg	13ms	64K	1yr	3600rpm	$699	$829
1027Meg	13ms	256K	2yr	3600rpm	n/a	$1769
1470Meg	13ms	256K	2yr	3600rpm	n/a	$2049
MICROPOLIS						
660Meg	15ms	256K	5yr	3600rpm	n/a	$1399
1050Meg	10ms	256K	5yr	5400rpm	$1959	$2089
1340Meg	14ms	256K	5yr	3600rpm	n/a	$1979
1400Meg	11ms	256K	5yr	5400rpm	n/a	$2429
1740Meg	14ms	256K	5yr	3600rpm	n/a	$2529
2050Meg	11ms	256K	5yr	5400rpm	n/a	$3669
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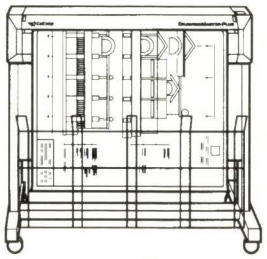

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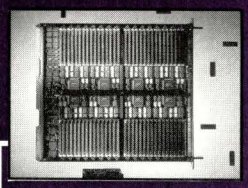

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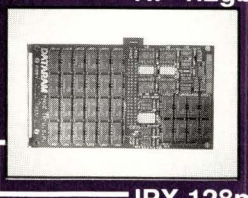

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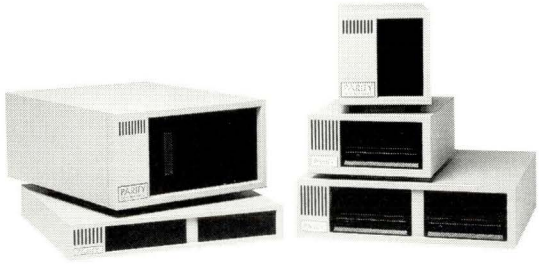

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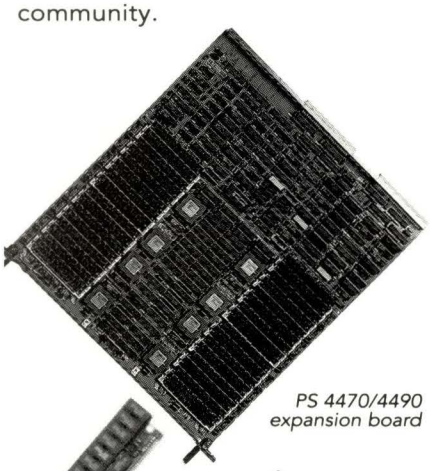

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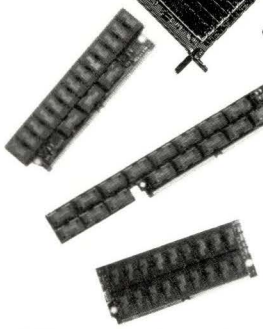

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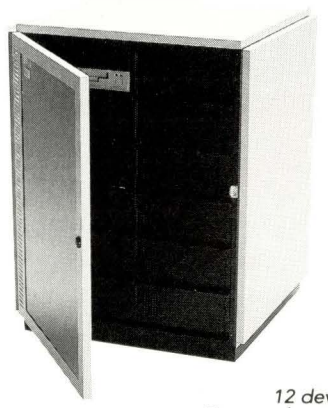

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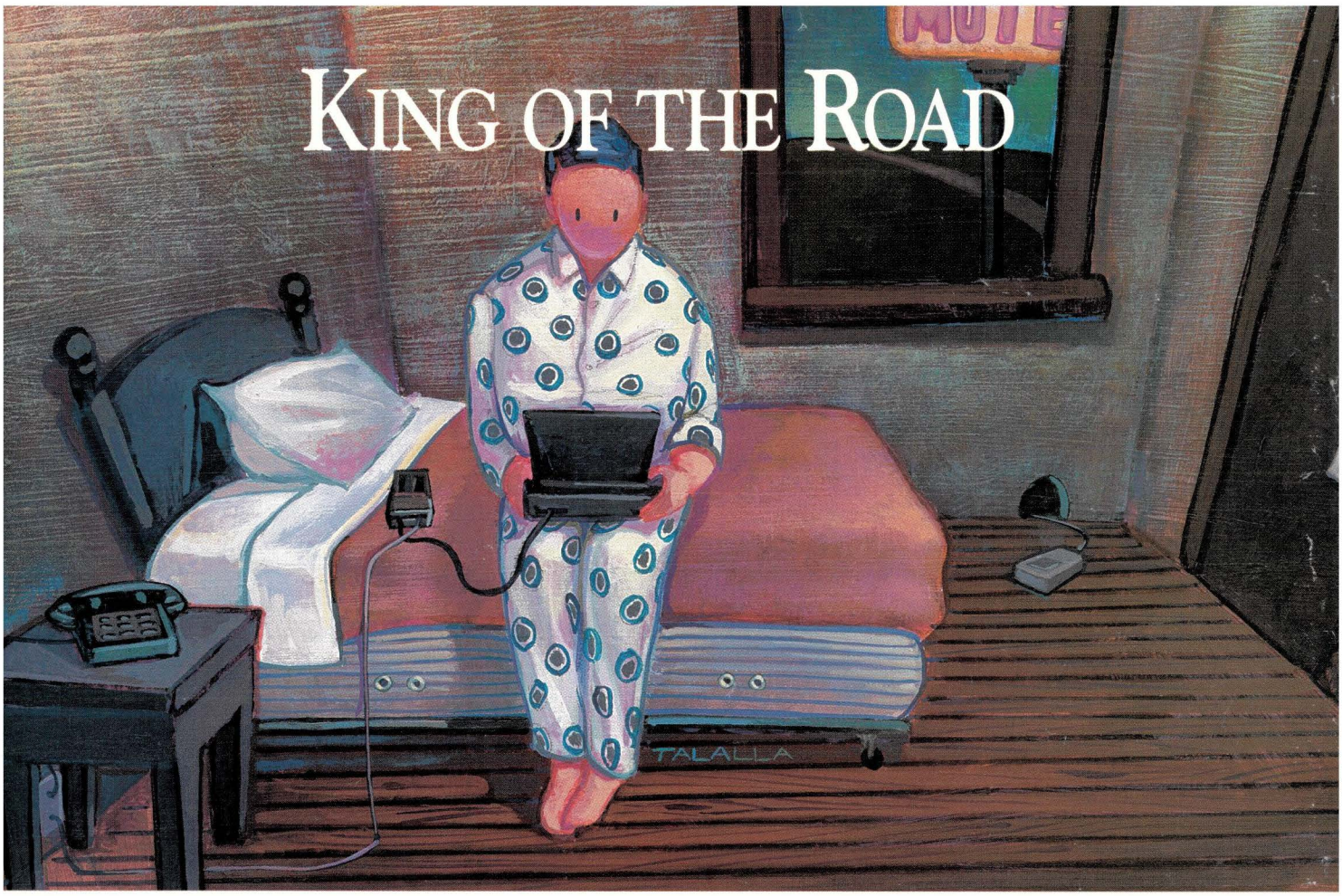

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